STATE OF CALIFORNIA
NATURAL RESOURCES AGENCY
DEPARTMENT OF FISH AND WILDLIFE

REPORT TO THE FISH AND GAME COMMISSION

A STATUS REVIEW OF THE **TRICOLORED BLACKBIRD** (*Agelaius tricolor*) IN CALIFORNIA

CHARLTON H. BONHAM, DIRECTOR
CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE

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EXECUTIVE SUMMARY

On August 19, 2015, the California Fish and Game Commission (Commission) received "A Petition to List the Tricolored Blackbird (*Agelaius tricolor*) as Endangered under the California Endangered Species Act and Request for Emergency Action to Protect the Species", as submitted by the Center for Biological Diversity. At its public meeting on December 10, 2015, in San Diego, California, the Commission considered the Petition, the California Department of Fish and Wildlife's (Department) petition evaluation and recommendation, and comments received. The Commission determined that sufficient information existed to indicate the petitioned action may be warranted and accepted the Petition for consideration. Upon publication of the Commission's notice of its findings, the Tricolored Blackbird was designated a candidate species on January 8, 2016.

This report contains the results of the Department's status review, including independent peer review of the report by scientists with expertise relevant to the Tricolored Blackbird. Additionally, it provides the Commission with the most current, scientifically-based information available on the status of the Tricolored Blackbird in California and serves as the basis for the Department's recommendation to the Commission.

The Tricolored Blackbird is designated as a Priority 1 Species of Special Concern by the Department and as a Bird of Conservation Concern by the U.S. Fish and Wildlife Service (USFWS). The species was previously petitioned for listing as endangered under the California Endangered Species Act (CESA) in 1991, 2004, and 2014. At its December 3, 2014 meeting in Van Nuys, California, the Commission voted to take emergency action to list the Tricolored Blackbird as an endangered species under CESA; the emergency regulation expired by operation of law in June 2015. The USFWS received petitions to list the Tricolored Blackbird as endangered under the federal Endangered Species Act in 2004 and 2015. The recent petition is currently under review by the USFWS. The Tricolored Blackbird is a covered species under several Habitat Conservation Plans and Natural Community Conservation Plans.

Species Description, Biology, and Ecology—Like other blackbirds in the family Icteridae, the Tricolored Blackbird is a medium-sized songbird with a slender, pointed bill and a relatively long tail. Tricolored Blackbirds are sexually dimorphic, with the breeding male plumage entirely black except for the bright red lesser wing coverts forming a conspicuous red patch ("shoulder" or "epaulets") on the wing and white median coverts forming a distinct border to the red. The female is mostly dark brown dorsally and heavily streaked in brown ventrally.

The Tricolored Blackbird is nearly endemic to the state of California. The species can be found throughout much of the lowlands west of the Sierra Nevada, extending west across the Central Valley to the coast from Sonoma County south to Santa Barbara County. The largest breeding colonies and the large majority of the breeding population occur in the Central Valley. The species is also found in the lowlands west of the deserts in southern California, extending south into northwestern Baja California. Small numbers of birds extend the range to the north into Oregon and Washington.

The Tricolored Blackbird forms by far the largest breeding colony aggregations of any extant North American landbird. Breeding colonies are seldom smaller than 100 nests, and in the past colonies have been composed of up to 300,000 breeding birds. Breeding within a colony is often highly synchronized, with all females in a colony typically initiating nest building within a few days. Nest density and territory size can vary among colonies with individual nests in the densest colonies built within one foot (0.3 m) or less of each other. Food resources for both the breeding adults and for the provisioning of young are mostly obtained from sites away from the colony location. Nestlings require animal matter (primarily insects) for the first nine days after hatching, and insect-rich foraging areas are required for successful reproduction. Adults will frequently travel up to 3 miles (4.8 km) from the colony location, and in some cases much further, to obtain insects for their young. Hence, the required foraging habitat for successful breeding has a much greater spatial extent than the nesting vegetation.

Tricolored Blackbirds often occupy and breed at two or more sites during the breeding season, a phenomenon known as itinerant breeding. Itinerant breeding is a rare trait among birds, and occurs exclusively in species that move between breeding attempts to locate or follow locally abundant food sources. Flocks of Tricolored Blackbirds roam widely within the breeding range in the weeks before breeding begins and between breeding attempts. In the Central Valley, there is a general pattern of a first nesting attempt in the San Joaquin Valley, with second nesting attempts often occurring to the north in the Sacramento Valley.

For successful breeding, Tricolored Blackbirds require three resources: 1) secure nesting substrate, 2) a source of water, and 3) foraging habitat that provides sufficient food resources. Historically, the nesting substrate (i.e., the vegetation in which nests are constructed) occurred primarily in freshwater wetlands dominated by cattails and tules. As the extent of freshwater wetlands decreased, Tricolored Blackbirds began using novel, nonnative vegetation types as nesting substrate. Other than wetlands, the primary nesting substrates used currently are Himalayan blackberry, thistles, stinging nettle, and agricultural grain fields. Foraging habitats during the breeding season include grasslands, low-density shrublands (e.g., alkali scrub), pastures, dry seasonal pools, and certain agricultural crops including alfalfa and rice, which provide for high production of insect prey for breeding Tricolored Blackbirds.

Status and Trends—The range of the Tricolored Blackbird has changed little since at least the mid-1930s. However, the distribution of the species within the range has shifted, and the species appears to be experiencing a range retraction in southern California and Baja California. In southern California, Tricolored Blackbirds no longer occur in most of the coastal portion of their former range, and 60–80% of the southern California population generally nests in a single region in western Riverside County. An apparent early nesting season shift in distribution from the Sacramento Valley to the southern San Joaquin Valley occurred at the end of the 20th century when Tricolored Blackbirds were discovered breeding in grain fields. This discovery corresponded to an increase in the number of dairies and the associated expansion of grain crops grown for silage in the San Joaquin Valley. Since the 1990s, the largest breeding colonies in the early nesting season have occurred on grain crops on or adjacent to dairies.

Early attempts to assess the Tricolored Blackbird population in the 1930s and 1970s suggested that the population size had declined by about 50% over 35 years. The most intensive efforts to estimate rangewide population abundance have occurred since 1994, with three statewide surveys conducted between 1994 and 2000, and an additional four statewide surveys conducted between 2008 and 2017. Although there has been limited effort to quantify uncertainty in the population estimates from any single statewide survey, the long-term trend shows a decline of 75%–90% over a 23-year period. The observed rates of decline of -5.8% to -10.5% per year indicates that the species has been in severe decline over the last two decades.

An Integrated Population Model (IPM) has recently been developed to jointly analyze banding, fecundity, and population data, which allows for evaluation of changes in population size and the demographic rates (e.g., survival or reproduction) responsible for the change. Data from more than 64,000 Tricolored Blackbirds banded from 2007 to 2016, fecundity data from 10 sites in 1992–2016, and population abundance data from eBird were used in development of the IPM. Over a 10-year period from 2007 to 2016, the Tricolored Blackbird population was estimated to have declined by 34% (95% credible interval = 71% decline to 7.5% growth). The estimated rate of population decline had a mean of -6.0% per year, indicating that the Tricolored Blackbird population has been in steep decline over the last 10 years. Results of the IPM indicated that adult female survival and fecundity were positively correlated with population growth rate. Because adult female survival is already relatively high and on par with other blackbird species, results from the IPM suggest that improvements in fecundity may be the best approach to increasing the Tricolored Blackbird population.

In the 1930s, the largest Tricolored Blackbird breeding colony consisted of more than 300,000 breeding birds. The average Tricolored Blackbird colony size declined significantly from 1935 to 1975, with the average colony size declining by more than 60%. During years when statewide surveys were conducted between 1994 and 2017, the size of the largest colony declined from more than 100,000 birds to less than 20,000 birds. The trend in size of the largest colonies follows a pattern similar to that of the total numbers of birds estimated during statewide surveys.

Christmas Bird Count (CBC) data were used to evaluate population changes in California during the nonbreeding season. CBC data analyses indicate a long-term decline in the Tricolored Blackbird population from 1974 to 2015, and a shorter term decline from 1995 to 2015.

Trends in the Tricolored Blackbird population from a variety of data sources and analyses are in agreement that the species has been in steep decline over the last several decades. Coupled with the earlier declines between the 1930s and 1970s, the recent declines have resulted in a population that is a small fraction of its historical abundance.

Threats—The Department has identified the following factors as potential threats to the continued existence of the Tricolored Blackbird in California: colonial breeding and small population size; habitat loss; overexploitation, including the harvest of breeding colonies; predation; contaminants; extreme weather events; and drought, water availability, and climate change. Although they have negative effects on Tricolored Blackbirds, the following are not considered threats to the continued existence of the species at this time: interspecific competition, brood parasitism, disease, and invasive species.

Highly social and colonial breeding species are vulnerable to population declines, with an increased risk at small population sizes. In conjunction with a declining population abundance, the primary threats to the Tricolored Blackbird are habitat loss, especially loss of foraging habitat; low rates of reproductive success, in part due to losses of colonies to harvest on agricultural fields and to infrequent but intense predation events; and climate change, including increases in frequency and intensity of droughts. Although less certain in the level of impact on the Tricolored Blackbird, contaminants (primarily neonicotinoid insecticides) are an additional potentially important threat.

About 95% of the wetlands that occurred historically in the Central Valley have been lost. The loss of nesting substrates of all types continues, with specific nesting locations being lost in most years. Wetlands continue to be lost as lands are converted to agriculture, urban uses, or water availability limits the ability to maintain habitat through the breeding season. Nonnative vegetation types that are used for nesting are often considered undesirable and are frequently removed. Despite these ongoing losses, there appears to be suitable nesting substrate in some areas that goes unused in many years; therefore, nesting substrate availability does not appear to limit the Tricolored Blackbird population in these areas. However, there are other regions within the Tricolored Blackbird range where large areas of apparently suitable foraging habitat have little or no available nesting substrate.

The extent of foraging habitat required for successful breeding is much greater than the extent of nesting substrate, and once lost, large landscapes with suitable habitat are difficult to replace. Loss of foraging habitat has likely led to the extirpation of colonies from most of the coastal lowlands in southern California. Widespread habitat loss due to urban expansion and agricultural conversions to vineyards and orchards has removed known breeding locations and caused the extirpation of breeding colonies from large regions of the state. In recent years, the rate at which grasslands and compatible crops (e.g., alfalfa) have been converted to orchards has accelerated. Large-scale losses are projected to continue into the future as agricultural practices evolve, cities continue to expand, and a changing climate makes large areas unsuitable for grassland communities.

A large portion of the Tricolored Blackbird population nests annually on agricultural grain fields, mostly in grain grown for silage on dairies. In many cases the entire reproductive effort of silage colonies has been lost when the nesting substrate is harvested while the young or eggs are still in the nest. Efforts to protect colonies have had mixed success, with many colonies protected but with large colonies being lost in most years. The availability of well-funded colony protection programs, the emergency listing of the species prior to the 2015 breeding season, the continued protection under CESA as a candidate for listing, and the resulting response to colony harvest incidents by Department law enforcement resulted in an increased incentive for landowners to participate in colony protection programs. As a result, participation in colony protection programs has been very high in recent years. Without long-term secured funding and the incentives provided by protection under CESA, the future success of these programs is uncertain.

Although infrequent, predation has at times had large impacts on colonies, even leading to complete nesting failure. Because predation at Tricolored Blackbird colonies typically occurs on eggs, nestlings, and fledglings, predation can have a substantial effect on reproductive success when large colonies are affected.

Drought reduces water supply reliability and has far-reaching impacts on most habitat types in California. The recent multi-year drought resulted in reductions in surface water in the Central Valley, which likely reduced availability of wetlands for nesting. Several of the upland nesting substrates used by Tricolored Blackbirds are also reduced or eliminated in dry years. Extreme or prolonged drought negatively affects grasshopper and other insect prey populations through desiccation of eggs or through decreased biomass of primary producer food sources (e.g., grasses and forbs). Climate change is projected to bring longer and more severe droughts to California in the future.

The average temperature is expected to rise by approximately 2.7°F (1.5°C) by 2050, and the average number of extremely hot days (at least 105°F [41°C]) per year in Sacramento is expected to increase fivefold (up to 20 days) by the middle of the century. Rising temperatures may directly affect annual Tricolored Blackbird productivity by truncating the breeding season or causing colony failure. Two important Tricolored Blackbird communities, grassland and freshwater marsh, are projected to be among the natural communities most affected by climate change in California. The extent of freshwater marsh in California is projected to decrease by 71%–97% by year 2100 due to increasing temperatures, and the extent of grasslands are projected to decrease by 16%–48%.

Neonicotinoid insecticides have been implicated in the decline of invertebrate communities and, in a few cases, the decline of insectivorous birds. Several studies have revealed a negative relationship between insect populations and neonicotinoid use, and at higher concentrations they can have lethal and sublethal impacts to vertebrates. This relatively new group of insecticides may have caused declines of non-target insect species within the breeding range of the Tricolored Blackbird, resulting in a declining prey base, but no data have been collected that can directly support this. Studies to date have relied on observational data to find correlations between neonicotinoids and potential effects. There is a need for mechanistic research to investigate exposure rates of Tricolored Blackbirds to neonicotinoids, effect of exposure on body condition and fitness, and investigations into potential insect-based food-web impacts.

A number of recommended management actions are described in this report. These actions could be undertaken whether or not the Tricolored Blackbird is listed under CESA, by the Department as well as by other public agencies, non-governmental organizations, and private landowners in some cases. These include actions to address: habitat protection, restoration, and enhancement; breeding colony protection; monitoring and research; and education and outreach.

Recommendation—The Department provides this status review report, including its recommendation, to the Commission in an advisory capacity based on the best scientific information available. In addition to evaluating whether the petitioned action to list as endangered is warranted, the Department also considered whether listing as threatened under CESA is warranted. In consideration of the scientific information contained herein, the Department has determined that listing the Tricolored Blackbird as threatened under CESA is warranted at this time.

REGULATORY FRAMEWORK

Petition Evaluation Process

A petition to list the Tricolored Blackbird (*Agelaius tricolor*) as endangered under the California Endangered Species Act (CESA) was submitted to the Fish and Game Commission (Commission) on August 19, 2015 by the Center for Biological Diversity. Commission staff transmitted the petition to the Department of Fish and Wildlife (Department) pursuant to Fish and Game Code section 2073 on August 20, 2015, and published a formal notice of receipt of the petition on September 4, 2015 (Cal. Reg. Notice Register 2015, No. 36-Z, p. 1514). The Department's charge and focus in its advisory capacity to the Commission is scientific. A petition to list or delist a species under the CESA must include "information regarding the population trend, range, distribution, abundance, and life history of a species, the factors affecting the ability of the population to survive and reproduce, the degree and immediacy of the threat, the impact of existing management efforts, suggestions for future management, and the availability and sources of information. The petition shall also include information regarding the kind of habitat necessary for species survival, a detailed distribution map, and any other factors that the petitioner deems relevant" (Fish & G. Code, § 2072.3).

On October 2, 2015, the Department provided the Commission with its evaluation of the petition, "Evaluation of the Petition from the Center for Biological Diversity to List Tricolored Blackbird (*Agelaius tricolor*) as Endangered Under the California Endangered Species Act," to assist the Commission in making a determination as to whether the petitioned action may be warranted based on the sufficiency of scientific information (Fish & G. Code, §§ 2073.5 & 2074.2; Cal. Code Regs., tit. 14, § 670.1, subds. (d) & (e)). Focusing on the information available to the Department relating to each of the relevant categories, the Department recommended to the Commission that the petition be accepted.

At its scheduled public meeting on December 10, 2015, in San Diego, California, the Commission considered the petition, the Department's petition evaluation and recommendation, and comments received. The Commission found that sufficient information existed to indicate the petitioned action may be warranted and accepted the petition for consideration. Upon publication of the Commission's notice of its findings, the Tricolored Blackbird was designated a candidate species on January 8, 2016 (Cal. Reg. Notice Register 2016, No. 2-Z, p. 57).

Status Review Overview

The Commission's action designating the Tricolored Blackbird as a candidate species triggered the Department's process for conducting a status review to inform the Commission's decision on whether to list the species. At its scheduled public meeting on December 8, 2016, in San Diego, California, the Commission granted the Department a six-month extension to complete the status review and facilitate external peer review.

This status review report is not intended to be an exhaustive review of all published scientific literature relevant to the Tricolored Blackbird; rather, it is intended to summarize the key points from the best scientific information available relevant to the status of the species. The final report represents the Department's evaluation of the current and potential future status of the species and is informed by independent peer review of a draft report by scientists with expertise relevant to Tricolored Blackbird. It is intended to provide the Commission with the most current information on the Tricolored Blackbird and to serve as the basis for the Department's recommendation to the Commission on whether the petitioned action is warranted. The status review report also identifies habitat that may be essential to the continued existence of the species and provides management recommendations for recovery of the species (Fish & G. Code, § 2074.6). Receipt of this report is to be placed on the agenda for the next available meeting of the Commission after delivery. At that time, the report will be made available to the public for a 30-day public comment period prior to the Commission taking any action on the petition.

Existing Regulatory Status

California Endangered Species Act

The Tricolored Blackbird was the subject of three previous CESA listing petitions. In 1991, the Yolo chapter of the National Audubon Society submitted a petition to the Commission to list the species as endangered. After reviewing the document and other available information, the Department determined that the petitioned action might be warranted and recommended to the Commission that it accept and consider the petition. In March 1992, the Commission voted to accept the petition and designated the Tricolored Blackbird as a candidate for listing. During the 1992 breeding season, researchers discovered that the abundance of the species (number of individuals) was much greater than previously thought, and the Yolo Audubon Society withdrew the petition based on the new abundance data. The Commission allowed the petition to be withdrawn, but urged the Department to work with interested persons and groups to develop conservation measures for the Tricolored Blackbird. The species was again petitioned to be listed under CESA in 2004 (Cal. Reg. Notice Register 2004, No. 18-Z, p. 568). The petition evaluation report by the Department (Gustafson and Steele 2004) stated there was sufficient information to indicate the petitioned action may be warranted; however, the Commission voted to reject the petition (Fish and Game Commission meeting, Feb. 3, 2005). On October 8, 2014, the Center for Biological Diversity submitted a petition to list the Tricolored Blackbird as endangered (Cal. Reg. Notice Register 2014, No. 44-Z, p. 1861). The Commission referred the petition to the Department for an initial evaluation on October 15, 2014. At its December 3, 2014 meeting in Van Nuys, California, the Commission voted to take emergency action to add Tricolored Blackbird to the list of endangered species pursuant to Fish and Game Code section 2076.5, with the related regulation as approved by the Office of Administrative Law taking effect for an initial term of six months beginning on December 29, 2014 (Cal. Reg. Notice Register 2015, No. 2-Z, p. 91). At its meeting in Mammoth Lakes on June 11, 2015, the Commission voted to reject the 2014 petition and on June 30, 2015 the emergency regulation adopted in December 2014 expired by operation of law.

Federal Endangered Species Act

The Tricolored Blackbird also has a history of consideration for listing under the federal Endangered Species Act (ESA). In 1988, the United States Fish and Wildlife Service (USFWS) contracted for a compilation of all historical information on the distribution and abundance of the Tricolored Blackbird, resulting in the work of Beedy et al. (1991). In 1991, the USFWS identified the Tricolored Blackbird as a category 2 candidate for listing. However, in 1996, the USFWS eliminated category 2 species from the list of candidate species. In 2004, the USFWS received a petition to list the Tricolored Blackbird as a threatened or endangered species from the Center for Biological Diversity. In 2006, the USFWS issued a 90-day finding in response to the petition that listing the Tricolored Blackbird was not warranted (50 CFR Part 17, Dec 5, 2006). On February 3, 2015, the Center for Biological Diversity submitted a petition to the USFWS to list the Tricolored Blackbird as an endangered species under the ESA and to designate critical habitat concurrent with listing. The petition is currently under review by the USFWS (50 CFR Part 17, Sept 18, 2015).

California Species of Special Concern and USFWS Birds of Conservation Concern

The Tricolored Blackbird is listed as a Priority 1 Species of Special Concern (SSC) by the Department. The Department's SSC designation is administrative and is intended to alert biologists, land managers, and others to a species' declining or at-risk status, to encourage additional management of these species to ensure population viability, and to preclude the need for listing under CESA. SSCs are defined as species, subspecies, or distinct populations of animals native to California that currently satisfy one or more of the following criteria: extirpated from the state in the recent past; listed under ESA as threatened or endangered, but not under CESA; meets the state definition of threatened or endangered but has not been formally listed; experiencing, or formerly experienced, serious (noncyclical) population declines or range retractions (that have not been reversed), which if continued or resumed could qualify the species for threatened or endangered status under CESA; has naturally small populations or range size and exhibits high susceptibility to risk from any factor that, if realized, could lead to declines that would qualify it for threatened or endangered status (Shuford and Gardali 2008). In 2008, the USFWS updated its Birds of Conservation Concern report, identifying "species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act of 1973" (USFWS 2008). The Tricolored Blackbird was included on two Bird Conservation Region lists (Coastal California and Great Basin), the USFWS Region 8 (California and Nevada) list, and the national list. Neither the state nor the federal species of concern designations provides the species with formal regulatory status as does the CESA or ESA; however, negative impacts to SSC are generally considered potentially significant under the California Environmental Quality Act, and therefore mitigation for impacts may be provided (see Existing Management section).

Migratory Bird Treaty Act

The Tricolored Blackbird is included on the list of species protected under the Migratory Bird Treaty Act (MBTA). It is unlawful to take, possess, transport, sell, or purchase any bird listed in the Act, or its nest or eggs, without a permit issued by the USFWS.

A recent reinterpretation (December 22, 2017) of the MBTA by the U.S. Department of the Interior solicitor regarding implementation of the law suggests that incidental take will no longer be prohibited. Rather, the solicitor argued that the "MBTA's prohibition on pursuing, hunting, taking, capturing, killing, or attempting to do the same applies only to direct and affirmative purposeful actions that reduce migratory birds, their eggs, or their nests, by killing or capturing, to human control." The effect of this interpretation on the conservation of Tricolored Blackbirds is not clear.

California Fish and Game Code

The Fish and Game Code includes certain protections for birds, including nongame birds. Sections applicable to the Tricolored Blackbird include the following:

> Section 3503 – It is unlawful to take, possess, or needlessly destroy the nest or eggs of any bird, except as otherwise provided by this code or any regulation made pursuant thereto.
>
> Section 3513 – It is unlawful to take or possess any migratory nongame bird as designated in the Migratory Bird Treaty Act or any part of such migratory nongame bird except as provided by rules and regulations adopted by the Secretary of the Interior under provisions of the Migratory Treaty Act.
>
> Section 3800(a) – All birds occurring naturally in California that are not resident game birds, migratory game birds, or fully protected birds are nongame birds. It is unlawful to take any nongame bird except as provided in this code or in accordance with regulations of the commission.

The Fish and Game Code defines take as hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill (Fish & G. Code, § 86).

BIOLOGY AND ECOLOGY

Species Description

The Tricolored Blackbird was first collected by Thomas Nuttall in 1836 near Santa Barbara, California (Nuttall 1840, Baird et al. 1874). A male specimen was sent to John James Audubon who described it as a unique form of blackbird in his well-known *Ornithological Biography* (Audubon 1839).

The Tricolored Blackbird is sexually dimorphic, with the breeding male plumage entirely black except for the bright red lesser wing coverts forming a conspicuous red patch ("shoulder" or "epaulets") on the wing and white median coverts forming a distinct border to the red. The black body plumage is glossed bluish when viewed in sunlight. The female is mostly dark brown dorsally and heavily streaked ventrally with dark brown streaks merging to form a largely solid dark brown belly. The head of the female is indistinctly patterned with a whitish supercilium, malar, chin, and throat (Beedy et al. 2017).

Although similar in appearance to the related Red-winged Blackbird (*A. phoeniceus*), several features can be used to distinguish the two species in breeding plumage (described by Nuttall 1840, Cooper 1870, Baird et al. 1874). The black plumage of the Tricolored Blackbird male has a soft bluish luster that is lacking in the Red-winged Blackbird. The lesser wing coverts (the red "shoulder") on the breeding male Tricolored Blackbird are a much deeper red (described as crimson, carmine, or the color of venous blood) compared to the brighter red with a tinge of orange (vermilion or scarlet) in the Red-winged Blackbird. The median coverts in the Tricolored Blackbird are white (pale-yellowish when fresh) and create a stark contrast between the black and red feathers on the wing, whereas in the Red-winged Blackbird they are generally yellowish (or black in the subspecies that breeds in much of the Central Valley). The bill of the Tricolored Blackbird averages thinner and can appear more sharply pointed. In flight, the wings of the Tricolored Blackbird appear to have a more pointed shape (vs. rounded in the Red-winged Blackbird) due to differences in length of the primary flight feathers. Female Tricolored Blackbirds have darker plumage than most female Red-winged Blackbirds, although this difference is less pronounced in the Central Valley where the subspecies of Red-winged Blackbird is relatively dark (Beedy et al. 2017).

Taxonomy

The Tricolored Blackbird is a member of the avian family Icteridae, which is restricted to the Americas in the Western Hemisphere and includes blackbirds, orioles, cowbirds, grackles, and meadowlarks (Skutch 1996). The blackbirds are medium-sized songbirds with slender, pointed bills and relatively long tails. There are about 100 species in the family, most of which occur in the tropics. Following recent taxonomic changes that removed several South American species from the genus *Agelaius*, there are currently five species in the genus worldwide (Remsen 2017). The only other species that occurs on the North America mainland is the much more widespread and diverse Red-winged Blackbird. The other three species in the genus occur in the Greater Antilles: *A. assimilis* (the Red-shouldered Blackbird of western Cuba), *A. humeralis* (the Tawny-shouldered Blackbird of Hispaniola and Cuba), and *A. xanthomus* (the Yellow-shouldered Blackbird of Puerto Rico) (Beedy et al. 2017). There are no recognized subspecies of Tricolored Blackbird (AOU 1957).

Geographic Range and Distribution

The Tricolored Blackbird is nearly endemic to the state of California, with small numbers of birds extending the species' range into neighboring states of Oregon, Washington, and Nevada, and into Baja California.

Breeding Range

The majority of the Tricolored Blackbird's breeding range is composed of two disjunct regions of California and Baja California, separated by the Transverse Ranges of southern California (Figure 1). The larger of the two areas includes the lowlands west of the Sierra Nevada, extending west across the

Central Valley to the coast from Sonoma County south to Santa Barbara County. The second area includes the lowlands west of the deserts in southern California, extending south into northwestern Baja California. Throughout this report, references to the southern California portion of the species' range are to this area south of the Transverse Ranges, unless otherwise stated.

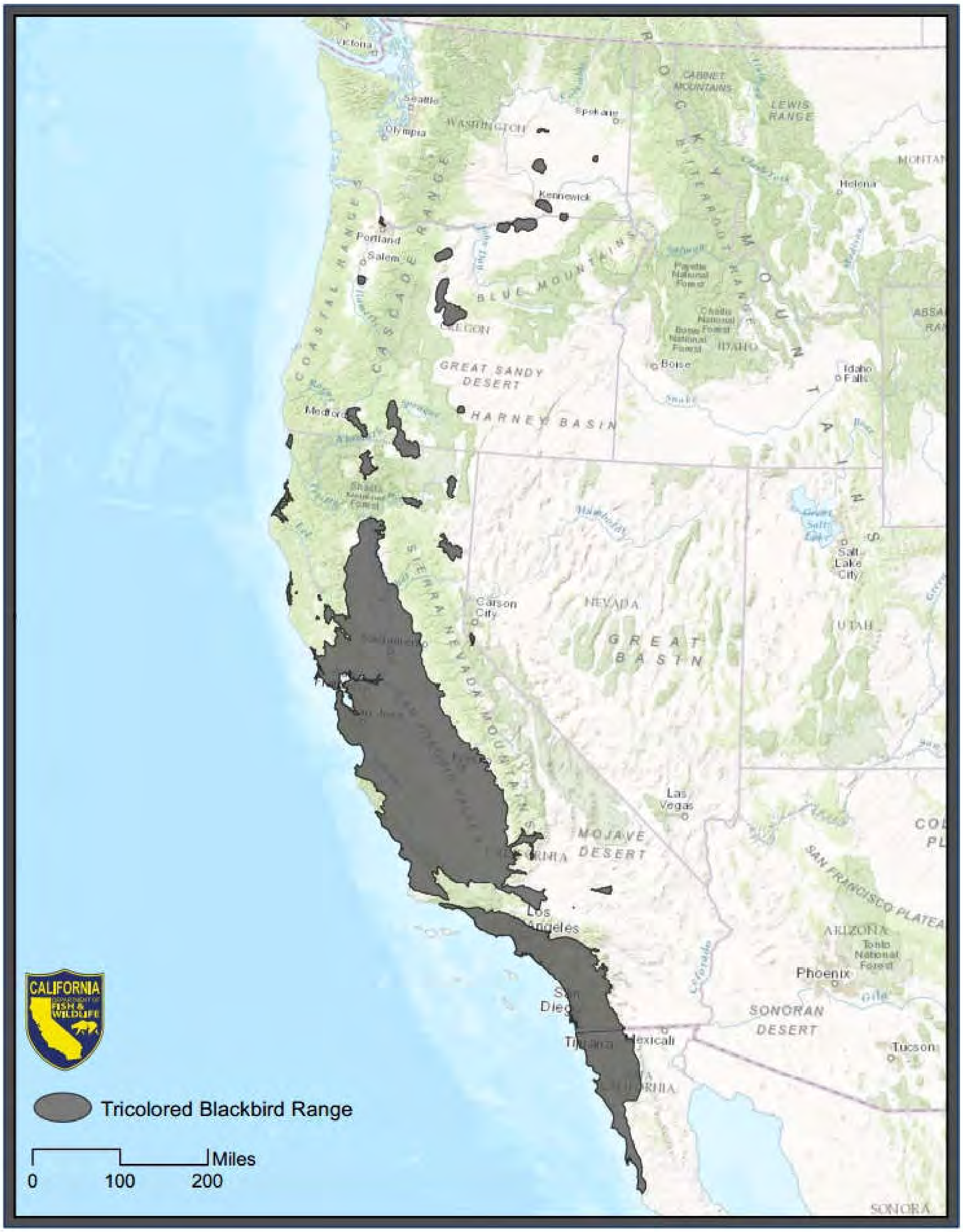


Figure 1. Global range of the Tricolored Blackbird.

Small numbers of birds extend the range to the north in isolated low-lying areas on the northern California coast and to isolated areas in northeastern California, Oregon, and eastern Washington. Similarly, the range extends east from the southern Central Valley to small areas in the Mojave Desert. The species is currently known to occupy a single area in Douglas County, Nevada (Skutch 1996, Ammon and Woods 2008, Beedy et al. 2017).

Winter Range

In winter, Tricolored Blackbirds mostly withdraw from the portion of their breeding range north of the Central Valley (northeastern California, Oregon, and Washington) and from Nevada to the lowlands of central and coastal California (Wahl et al. 2005, Ammon and Woods 2008, Beedy et al. 2017), although a small number of birds are occasionally documented throughout the northern breeding range during winter (Gilligan et al. 1994, Spencer 2003, eBird Dataset 2016). The species can be found in most of the remainder of its range year-round, with shifts in distribution as described below.

Distribution of Breeding Colonies

Within the breeding range, the largest breeding colonies and the large majority of the breeding population occur in the Central Valley of California (Figure 2b). In all California statewide surveys (breeding season surveys conducted on a mostly triennial schedule since 1994), most (≥90% in all years but 1997) of the observed birds were detected in the Central Valley counties during the early breeding season (Hamilton et al. 1995, Beedy and Hamilton 1997, Hamilton 2000, Kelsey 2008, Kyle and Kelsey 2011, Meese 2014a).

Although the overall distribution and breeding locations vary from year to year, Tricolored Blackbirds at the species level exhibit some fidelity to traditional use areas. These areas likely provide all of the critical resources needed by breeding colonies, while the specific nesting sites used in the area can change from year to year (Beedy et al. 1991). In the Central Valley, there are distinct regions that frequently support multiple colonies and a large proportion of the breeding population. In the southern San Joaquin Valley, the largest colonies are typically detected in an area centered at the junction of Kern, Kings, and Tulare counties (Figure 2), although the numbers in Kings and Tulare counties have declined in recent years (Meese 2017). In the northern San Joaquin Valley, Merced County regularly supports multiple large colonies. Further north in the Central Valley and Sierra Nevada foothills, breeding colonies are regularly distributed more broadly from Sacramento County north through the Sacramento Valley to Butte, Colusa, and Glenn counties. In southern California, breeding colonies are located mainly in the western portions of Riverside and San Bernardino Counties, south through the interior of San Diego County (Figure 2; Feenstra 2009). Colonies are patchily distributed throughout the rest of the species' range in California, particularly in the Coast Ranges and on the coastal slope.

The limited range of the species in Oregon, Washington, and Nevada is believed to be maintained by irregular occurrences of relatively small numbers of birds (Gilligan et al. 1994, Spencer 2003, Wahl et al. 2005, Ammon and Woods 2008). These states have historically supported less than 1% of the species' global population (Beedy et al. 1991). Although previously more widespread, breeding in Baja California now appears to occur at only a few isolated locations (Erickson et al. 2007, Erickson and de la Cueva

a) b)

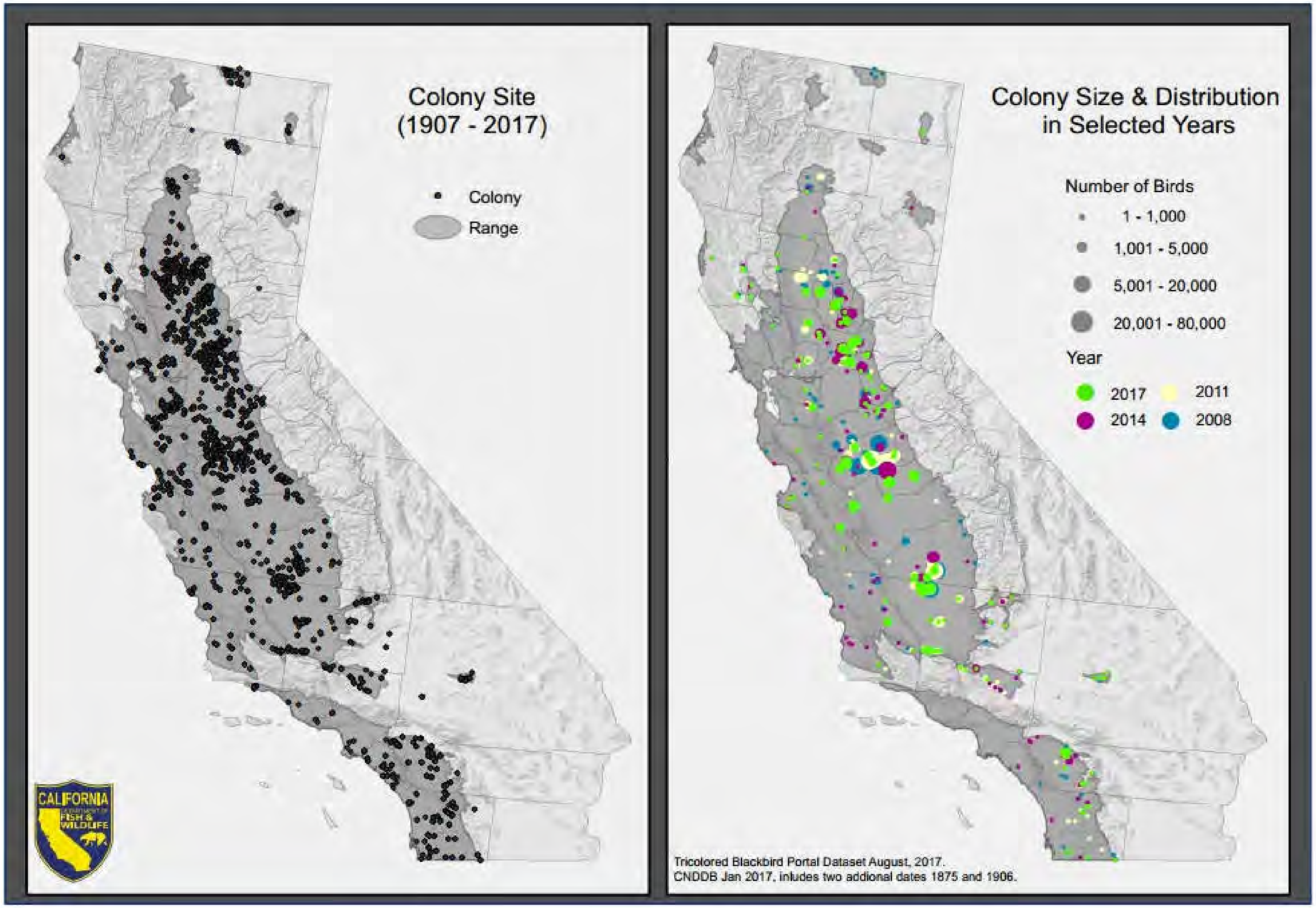


Figure 2. Distribution of known breeding colony locations in California. a) All known breeding locations 1907-2017. b) Distribution and size of breeding colonies in selected years. Recent statewide survey years were selected for mapping the distribution and size of breeding colonies due to the more thorough searches conducted in those years; the map includes colonies from throughout the breeding season (i.e., it is not limited to the April survey period when the population is concentrated in the southern half of the state).

2008, Feenstra 2013, Erickson et al. 2016). Currently, no more than about 1% of the species' population is believed to breed outside of California.

Breeding colonies typically occur in valleys or low-lying areas with nesting habitat and extensive grassland, certain agricultural crops, or other suitable foraging habitat. However, the elevation of colony locations varies greatly across the range. The majority of birds breed below an elevation of about 300 feet (91 m) in the Central Valley. In the central Sierra foothills, colonies occur up to 1,720 feet (524 m), although most have been detected near the valley floor at or below about 300 feet elevation (Airola et al. 2015a). In the southern Sierra Nevada they breed up to 2,500 (762 m) feet near Lake Isabella in eastern Kern County (eBird Dataset 2016). In southern California, most colonies occur below about 1,500 feet (457 m), although colonies at more inland locations are at higher elevations, with a small colony in San Diego County occurring at about 4,400 feet (1,341 m). Further inland, such as in the Mojave Desert and to the northeast in the Modoc Plateau, colonies occur at elevations up to several thousand feet. Grinnell and Miller (1944) included a record of 4,400 feet on the "South Fork of the Pit River" in Modoc County. The single known breeding location in Nevada is at 4,730 feet (1,442 m) elevation (Ammon and Woods 2008).

Winter Distribution

Although Tricolored Blackbirds can be found throughout much of the California breeding range year-round, most birds withdraw from the southern San Joaquin Valley and the northern Sacramento Valley in the winter (Grinnell and Miller 1944, Beedy et al. 2017). Band recoveries and observational studies have documented movement of birds away from these portions of the range toward the central part of the valley surrounding and including the Sacramento-San Joaquin Delta region (Neff 1942, DeHaven and Neff 1973, DeHaven et al. 1975a). Birds are generally concentrated in this region, the northern San Joaquin Valley in Merced County, and in coastal areas north and south of the San Francisco Bay area in winter (Orians 1961a, Payne 1969, Stallcup 2004) (Figure 3). Evidence from banded birds recovered outside the Central Valley is limited, but birds from throughout the northern range are thought to follow the general pattern of winter movement to central and coastal California (DeHaven et al. 1975a, Beedy 2008). Although a relatively large portion of the population winters in this region, wintering flocks have been detected at widely scattered locations throughout the species' range north of the Transverse Ranges (DeHaven et al. 1975a).

South of the Transverse Ranges, birds from Santa Barbara County south to Baja California appear to occupy the region year-round (Unitt 2004, Beedy 2008), although distribution in the southern portion of the range is patchy in all seasons. Recoveries of birds banded in southern California have revealed movements over much shorter distances compared to birds from the Central Valley (Neff 1942, DeHaven and Neff 1973).

Genetics and Population Structure

Hamilton (2004a) documented differences in apparent patterns of movement between Central Valley and southern California populations of Tricolored Blackbirds, and suggested that a lack of gene flow may have led to genetically distinct populations. While banding studies indicate extensive movement of

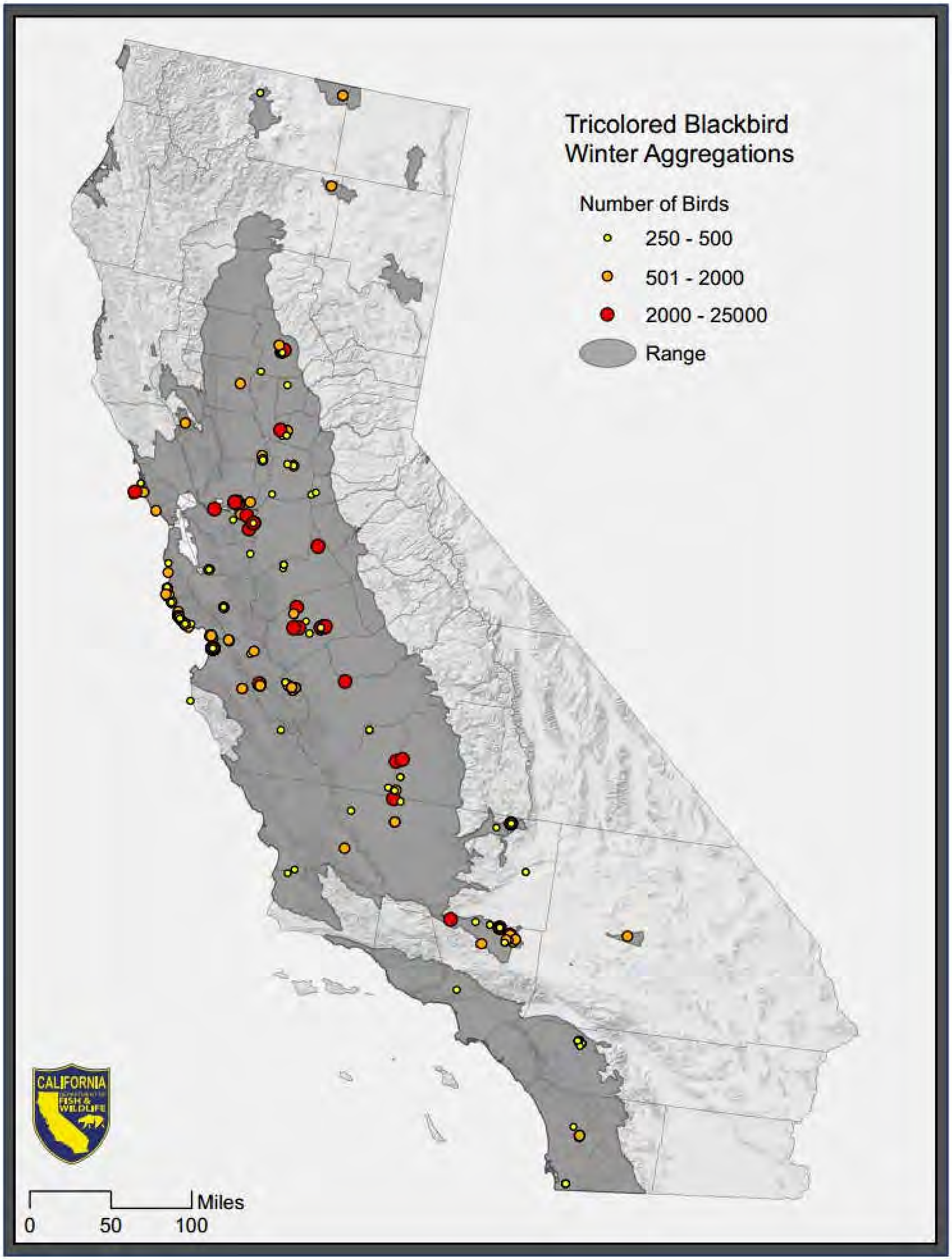


Figure 3. Winter season aggregations of Tricolored Blackbirds. Data is from eBird and was selected to represent November through January distribution for groups of at least 250 birds.

Tricolored Blackbirds throughout the entire length of the Central Valley (DeHaven et al. 1975a), DeHaven and Neff (1973) reported on recoveries of banded birds from the Central Valley and southern

California and suggested that little or no exchange occurs between populations north and south of the Transverse Ranges. The observation of a single banded bird in the Mojave Desert of northern Los Angeles County was the first datum documenting movement of the species from the Central Valley to the desert (Feenstra 2009), although there is a report from the late 1800s documenting a flock of Tricolored Blackbirds moving in the opposite direction (Belding 1890). In 2014 and 2016, the second and third Tricolored Blackbirds that had been banded in the Central Valley were photographed in San Bernardino County, providing further evidence of movement from the valley to the Mojave Desert (Meese 2014b, Aug 2017 email from R. Meese to N. Clipperton; unreferenced). No movement across the Transverse Ranges (i.e., between the Central Valley/Mojave Desert and the southern California portion of the species' range) has been documented based on banding data.

A microsatellite and mitochondrial DNA analysis (Berg et al. 2010) on the Tricolored Blackbird did not find evidence of substantial genetic differentiation between the Central Valley and a southern population composed of birds from the Mojave Desert and southern California. The birds sampled in the southern population had higher allelic diversity, suggesting that the southern population may be an important reservoir of genetic variation for the species. There was statistically significant evidence of inbreeding (F_{IS}) in both putative populations, and F_{IS} was about 33% greater in southern than in central California. A greater percentage of birds appeared to move from southern to Central California than vice versa. The historical effective population size (Ne) was estimated to be three to eight times greater in southern California than in central California, and reductions in Ne appeared to be considerably greater in southern California (Berg et al. 2010). A caveat to these results is that samples were obtained at only two colonies south of the Transverse Ranges and at two colonies in the desert, sample sizes were small at some colony locations, and the study used a relatively small number of genetic markers. In addition, it may be inappropriate to combine birds from the Mojave Desert with birds from south of the Transverse Ranges to represent a single southern population, as was done in Berg et al. (2010). This is especially true if the birds in the Mojave Desert are connected through gene flow with birds in the Central Valley. Researchers at UCLA are currently conducting a study with more advanced genomic techniques to characterize genetic variation, population structure, and spatial and temporal patterns of movement throughout the range of the Tricolored Blackbird (Feb 2017 email from K. Barr to N. Clipperton; unreferenced).

Movements

Most Tricolored Blackbirds are resident in California, with seasonal movements leading to shifts in distribution within the state over the course of a year. Grinnell and Miller (1944) wrote that the Tricolored Blackbird is "resident within State [California], but partly migratory within the Sacramento-San Joaquin drainage system; all populations are in some degree nomadic and in fall and winter normally leave the immediate vicinity of the nesting colonies." Banding studies (Neff 1942, DeHaven and Neff 1973, DeHaven et al. 1975a) and observations of unbanded birds (Payne 1969) demonstrated that most Tricolored Blackbirds reside throughout the Central Valley from March through September, and then move into the Sacramento-San Joaquin Delta and northern San Joaquin Valley (primarily Merced County) and coastal locations during winter. More extensive migratory movements are made by small numbers of birds that breed north of the Central Valley as far north as Washington (Wahl et al. 2005);

most of these migratory individuals apparently return to California in winter. In southern California south of the Transverse Ranges, birds seem to undergo much more localized seasonal movements compared to those from the Central Valley (Neff 1942, DeHaven and Neff 1973).

Itinerant Breeding

Individual Tricolored Blackbirds often occupy and breed at two or more sites during the breeding season, a phenomenon known as itinerant breeding (Hamilton 1998). Itinerant breeding is a very rare trait among birds, and occurs exclusively in species that move between breeding attempts to locate or follow locally abundant food sources (Jaeger et al. 1986). Although early observers suspected that Tricolored Blackbirds nested more than once in a season at multiple locations (e.g., Neff 1937), the movements of Tricolored Blackbirds have been described as "sheerly and illogically erratic" (Neff 1942), "wanderings" (Payne 1969), and "highly nomadic" (Beedy et al. 1991). Recoveries of banded Tricolored Blackbirds documented interannual breeding at widely separated locations, but within-year movements during the breeding season were not documented prior to the 1990s (Neff 1942, DeHaven and Neff 1973). The movements of Tricolored Blackbirds continue to be somewhat unpredictable from year to year, but Hamilton et al. (1995) suggested, based on a large-scale shift in the distribution of the population between early and late-season nesting attempts, that most of the adults in the Central Valley breed more than once and often at different locations. This itinerant breeding follows a pattern of initial breeding in the south, mostly San Joaquin Valley and southern foothills to Sacramento County, with a shift north for a second breeding attempt, primarily in the Sacramento Valley and adjacent foothills. The timing and degree to which this shift occurs vary from year to year (Hamilton 1998). The timing of breeding in Sacramento County was intermediate to that of the San Joaquin and Sacramento Valleys, with initiation of breeding in Sacramento County approximately 10 days later than in the San Joaquin Valley, but over a month before most breeding in the northern Sacramento Valley (Figure 4). On the Central California Coast in Monterey County, 25% of radio-tagged birds moved between study colonies during a breeding season, suggesting itinerant breeding on a smaller scale (Wilson et al. 2016).

The following discussion of seasonal movements is largely from Beedy and Hamilton (1997) and Beedy et al. (2017).

<u>Spring Movements from Wintering Areas</u>

The species vacates wintering areas concentrated around the Sacramento-San Joaquin River Delta and along coastal California in mid-February. Birds arrive at breeding locations and establish colonies in Sacramento County and throughout the San Joaquin Valley from early March to early April (DeHaven et al. 1975a). Colonies at foothill locations adjacent to the San Joaquin and Sacramento valleys may be established by late March, but many are not established until May. In southern California and Baja California, the species typically nests in April and May but may nest anytime throughout March–June.

Flocks of Tricolored Blackbirds roam widely within the breeding range in the weeks before breeding begins and between breeding attempts. These flocks prospect the landscape for abundant insect food resources near which breeding colonies are established (Payne 1969). Similar behaviors have been documented in nomadic flocking species of semiarid habitats in Asia, Africa, and Australia, where colonial breeding occurs opportunistically in areas of high prey abundance (Payne 1969).

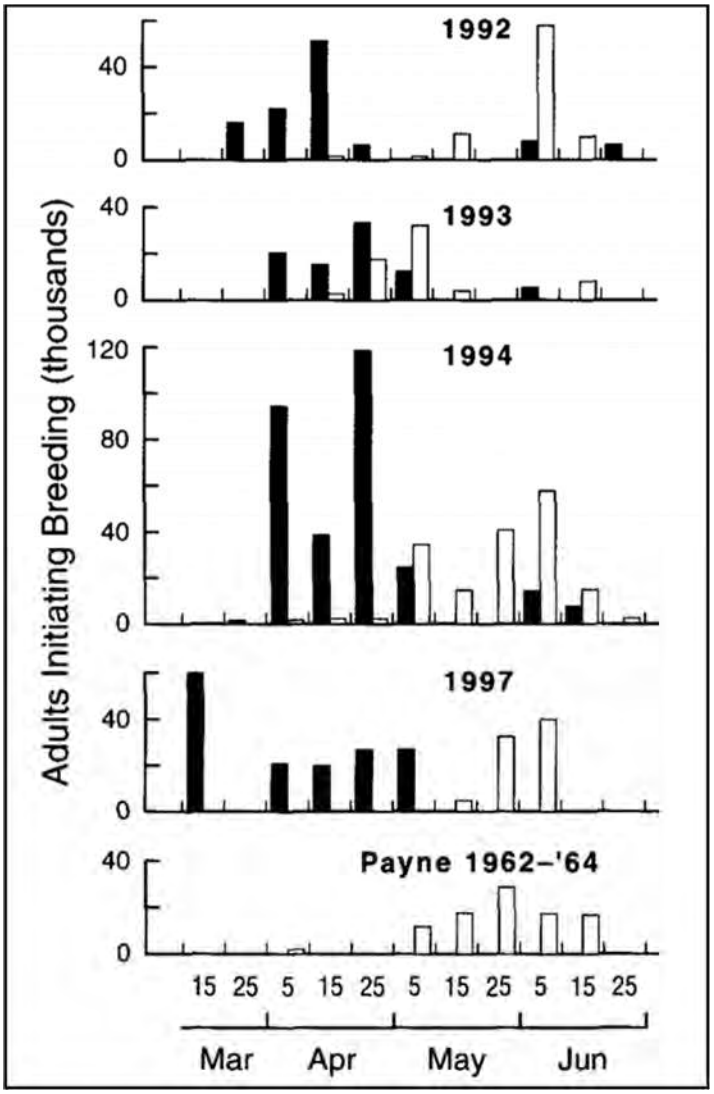


Figure 4. Number of Tricolored Blackbirds initiating breeding during 10-day intervals in the San Joaquin Valley (plus Sacramento County) and in the Sacramento Valley. Black bars represent San Joaquin Valley plus Sacramento County. White bars represent the northern Sacramento Valley. Figure from Hamilton et al. (1998).

<u>Breeding Season Movements</u>

During the breeding season, Central Valley birds often move north to the Sacramento Valley after first nesting efforts (March–April) in the San Joaquin Valley and Sacramento County, with small numbers apparently moving further north to northeastern California and southern Oregon (Beedy and Hamilton 1997, Hamilton 1998). On the floor of the Sacramento Valley north of Sacramento County, the largest colonies are typically not settled until May or early June. Recent banding results suggest a degree of colony cohesion, where many birds at a colony may move and breed together again in a new location, but banding results also suggest a high degree of mixing between breeding attempts. Although later nesting is typical in northern portions of the range, small colonies may form throughout the breeding season anywhere in the geographic distribution (Hamilton 1998). Radio telemetry studies have shown that birds move from one breeding colony location to another while both are active, due presumably to reproductive failures at the first colony, but data linking movements to breeding failure are lacking (Wilson et al. 2016). Apparent shifts in location following nest failure have been observed in other portions of the range, including southern California (WRC-MSHCP 2016) and the San Joaquin Valley (Weintraub et al. 2016).

<u>Post-breeding Movements</u>

Most Central Valley birds occur in the Sacramento Valley at the end of the breeding season and remain there until mid-September or later, apparently attracted to ripening and recently harvested rice (DeHaven et al. 1975a). From mid-September through mid-November, most move south into the Sacramento-San Joaquin Delta, Merced County, and coastal locations.

<u>Winter Movements</u>

In winter, numbers decline in the Sacramento Valley and increase in the Sacramento-San Joaquin Delta and northern San Joaquin Valley (Neff 1942, Orians 1961a, Payne 1969, DeHaven et al. 1975a). Large foraging flocks have traditionally occurred in pasturelands in southern Solano County by late October and often joined large flocks of several blackbird species to roost on islands in the eastern part of Suisun Marsh. Wintering flocks formerly numbering more than 10,000 birds assembled near dairies on the Point Reyes Peninsula, Marin County, by mid-October in the 1980s, but these numbers have been reduced to 3,000 or less in recent years (eBird Dataset 2016). Highly variable numbers of birds also winter in the central and southern San Joaquin Valley, with flocks of hundreds or thousands seen in most years in the general area where large colonies occur in the early spring (Kern and Tulare counties; eBird Dataset 2016). Winter flocks consist at times of only Tricolored Blackbirds, either mixed-sex or single-sex, and at other times Tricolored Blackbirds occur in mixed-species blackbird flocks. Birds from one large winter roost in Sacramento County foraged over an area 32 km in diameter (Neff 1937). Winter distribution and movements are not well understood.

Home Range and Territoriality

Unlike most species of songbirds that defend a territory in which they nest and acquire most of their necessary resources, the Tricolored Blackbird breeds in dense colonies in which adult males defend only a small area surrounding the nest site, and this only until nests are established and eggs are laid (Lack and Emlen 1939, Payne 1969). Nest density and male territory size can vary among colonies with individual nests in the densest colonies built within one foot (0.3 m) or less of each other (Hosea 1986, Beedy et al. 1991). In some cases two nests may even share interwoven strands of nest material (Lack and Emlen 1939). Male territories have been measured from 1.8 m^2 to 3.25 m^2 (Lack and Emlen 1939, Orians 1961b) and nest densities have been observed at up to six nests per square meter (Beedy et al. 2017). The greatest nesting density reported occurred in a rare nesting substrate, giant cane (*Arundo* sp.), with 2,500 adults nesting in an area 42 x 13 feet (13 x 4 m) (equivalent to 4.5 birds per square foot) (DeHaven et al. 1975b).

The small territories in dense breeding colonies cannot supply sufficient food for the adults and for the growing young, therefore most foraging occurs away from the colony site. While breeding, most foraging occurs within 2–3 miles (3.2–4.8 km) of colony sites (Orians 1961b, Hamilton et al. 1992), although longer foraging flights have been documented (up to 8 miles [13 km] or more). Typically, only a portion of the landscape surround a breeding colony is suitable for foraging and the range used by individual birds in colonies is variable depending on the extent and quality of the foraging landscape.

Colonial Breeding and Social Behavior

> "To one in search of something utterly different I can heartily recommend an hour, or a day, in a Tricolor swamp… *Agelaius tricolor* is intensely gregarious, more so than perhaps any other American bird. Every major act of its life is performed in close association with its fellows… the very day of its nesting is agreed upon in concert. In continuous procession the individuals of a colony repair to a field agreed upon in quest of building material; and when the babies are clamoring the loudest for food, the deploying foragers join their nearest fellows and return to the swamps by platoons and volleys, rather than as individuals." – Dawson (1923).

Coloniality in birds is typically defined as the breeding by a contiguous group of individuals at a more or less centralized place from which colony residents regularly depart from to search for food. This breeding strategy is most common among seabirds, in which more than 95% of species nest colonially (Danchin and Wagner 1997), but it is uncommon among North American landbirds.

The Tricolored Blackbird forms by far the largest breeding colony aggregations of any extant North American landbird (Neff 1937, Lack and Emlen 1939, Orians 1961a, Skutch 1996). Bent (1958) found that the Tricolored Blackbird "nests in enormous, most densely populated colonies, the nests being placed more closely together than in any other colonies of marsh-nesting blackbirds." Grinnell and Miller (1944) stated, "one essential would seem to be provision at the site of the colony for a large number of individuals. Nests apparently must be close together and pairs usually [must be] in excess of 50 in order to meet the instinctive requirements of the species." Breeding colonies are seldom smaller than 100 nests, and in the past have been as large as 100,000 to 200,000 nests (Neff 1937, Orians 1961a). Each male breeds, on average, with two females resulting in a skewed sex ratio at many breeding colonies (Lack and Emlen 1939, Orians 1961b, Payne 1969, Hamilton 1998, Beedy et al. 2017). Although Payne (1969) observed breeding colonies consisting of as little as four nests, of the 21 colonies monitored, no colonies containing less than 100 nests were successful in fledging young.

While the great concentration of birds in a small area is the most conspicuous feature of Tricolored Blackbird colonies, the degree of synchrony among members of the colony is no less unique (Orians 1960). Breeding within a colony is often highly synchronized, with all females in a colony typically initiating nest building within a few days (Orians 1961b, Payne 1969). A flock of Tricolored Blackbirds can appear in an area in which it has been absent for months and begin nesting within days or even hours

(Orians 1961b). Food resources for both the breeding adults and for the provisioning of young are mostly obtained from sites away from the colony location. Insect-rich foraging areas appear to be identified and used by all or large portions of the breeding adults in a colony until the prey base is exhausted, at which time new areas are identified and breeding birds collectively shift to new foraging sites.

<u>Occurrence dynamics</u>—Tricolored Blackbird breeding colonies frequently shift locations from year to year, though sites used each year often occur in the same traditionally used areas. In some cases Tricolored Blackbirds exhibit high inter-annual site fidelity, perhaps driven by the continued availability of essential resources, including suitable nesting substrate, water, and foraging habitat (Beedy and Hamilton 1997). Of 72 occupied colony locations between 1992 and 1994, only 19 (26%) were active in all three years and an additional 11 (15%) were active in at least two years (Hamilton et al. 1995). In the central Sierra Nevada foothills, 58% (11 of 19) of occupied breeding colony sites in 2015 were also occupied in 2014 (Airola et al. 2015b). Of 44 sites surveyed during a three-year period in the central foothills, only eight (18%) were active in all three years and seven (16%) were active in two of three years (Airola et al. 2016). Of four colony locations monitored for three consecutive years in coastal Monterey County, all four were occupied in one year and only two were occupied in the other years (Wilson et al. 2016). From 2006 to 2011, annual occupancy rates varied across nesting substrate types, with wetland, thistle, and Himalayan blackberry (*Rubus armeniacus*) locations having similar rates of about 40% (Holyoak et al. 2014). Occupancy rates were lower for triticale and other grain sites and higher for nettle colony sites. Although any given site may be unoccupied in some years, birds often return to sites over longer time periods and some sites are used in almost every year. Hosea (1986) reported a colony location that had been occupied for more than 30 years in Sacramento County, and was able to locate several active colonies by visiting locations reported in the literature decades earlier. The result of these complex occupancy dynamics is an extremely variable rate of site fidelity over the short-term, but fidelity to breeding locations and general breeding areas are high over the longer term.

Beedy et al. (1991) compiled all available information on breeding colony locations and identified 696 historical breeding locations, although many of these lacked specific locality information. As of the 2016 breeding season, the number of known historical and current breeding colony locations had grown to 1,272, including all records since 1907 (Figure 2a). The large majority of these historical locations are not used in any given year, and many no longer meet the habitat requirements of the species and so have been abandoned as nesting sites. During recent thorough statewide surveys conducted between 2008 and 2014 the number of occupied breeding locations has averaged about 140 (Kelsey 2008, Kyle and Kelsey 2011, Meese 2014a). New locations are discovered each year, while other sites cease to be used. This turnover of breeding locations likely reflects shifting habitat conditions across the range and results in complex occupancy dynamics described above. Most sites are used repeatedly over the course of many years as long as local habitat conditions do not change.

Fluctuations in colony site selection and colony size have been attributed to a response of Tricolored Blackbirds to changes in local insect abundance within and across years (Orians 1961b, Payne 1969, DeHaven et al. 1975b). Their colonial breeding behavior requires that the foraging landscape surrounding the nest site provide abundant insect food sources. The colonial nesting, compressed breeding cycle, and social structure of Tricolored Blackbirds are well suited for rapid exploitation of unpredictable resources when they become temporarily very abundant. Initiation of nesting may also be triggered by an abundant food source (Payne 1969).

Colony size has been shown to have a positive relationship with nest success in a wide variety of colonial species. In many cases, large Tricolored Blackbird breeding colonies have been observed to exhibit higher nest survival or reproductive success than smaller colonies (Orians 1961a, Payne 1969, Hamilton et al. 1992, Meese 2013, Weintraub et al. 2016), and in some years a few large colonies have been responsible for the majority of the reproductive output for the year (Hamilton 1993). However, there are many examples when a positive correlation between colony size and reproductive success was not observed, and a wide variation in reproductive success has been observed in both small and large colonies (Payne 1969, Meese 2013, Weintraub et al. 2016). It is possible that changes in environmental factors lead to density dependent reproductive success in some situations, while success may be density independent in other cases. The relationship between colony size and reproductive success is discussed in more detail in the Reproduction and Survival section.

Adaptive advantages of colonial breeding may be conferred by decreasing risk of predation or increasing foraging efficiency (Ward and Zahavi 1973, Beauchamp 1999), both of which could lead to increased success in production of young. The following mechanisms have been proposed as advantages to colonial breeding:

1. Predator avoidance
2. Joint anti-predator responses
3. Predator satiation
4. Social food-finding
5. Information sharing

Predator avoidance—Colonial breeding birds frequently occupy sites that are inaccessible to predators (Ward and Zahavi 1973), or in some cases that are naturally free of some groups of predators (e.g., seabirds nesting on isolated islands). Tricolored Blackbirds typically select breeding locations that provide a degree of protection from predators, either by selecting inaccessible sites (e.g., wetlands surrounded by or inundated by relatively deep water) or protective nesting substrates (e.g., dense, thorny, or spinous vegetation) that limit access by predators. Wetland sites may primarily limit access to terrestrial predators, whereas some dense or armored substrates may also limit access by predatory birds. In the case of a nomadic species like the Tricolored Blackbird, which does not necessarily use the same breeding location each year due to annual shifts in substrate suitability, social behavior may enhance the ability to locate these suitable locations.

Anti-predator responses—Social mobbing of predators or other aggressive behaviors are common among colonial nesting birds. However, Tricolored Blackbirds do not exhibit strong defensive responses against their predators. Unlike Red-winged Blackbirds that will fiercely defend territories from potential predators that approach the nest, Tricolored Blackbirds provide little in the way of defense to eggs or nestlings (Skutch 1996). For example, when a hawk is sighted the adults in a colony may stop vocalizing and settle low within the nesting substrate, with the entire colony sometimes going silent (Orians and Christman 1968, Payne 1969). Adults may hover in the vicinity of a predator as nestlings are taken, but no pursuit of the predator is offered. Complete reproductive failure in colonies of thousands of birds can result from the efforts of relatively few predators (Beedy et al. 2017). Tricolored Blackbirds do not benefit from social anti-predator responses.

Predator satiation—The massive quantity of readily available prey in the form of eggs or nestlings at a Tricolored Blackbird breeding colony may reduce the chance of loss of any one nest by satiating territorial predators (e.g., raptors). Payne (1969) observed a single pair of Northern Harriers preying on a Tricolored Blackbird colony of 10,000 nests, with no negative impact on the large majority of the colony. Satiation of predators may be less likely in species that hunt in groups, such as many species of wading birds. In recent decades, Black-crowned Night-Herons, Cattle Egrets, and White-faced Ibis have caused complete failure of large breeding colonies (Meese 2012, 2016, Beedy et al. 2017). Predator satiation may provide a benefit to Tricolored Blackbird colonies, depending on the number and type of predators.

Food-finding and information sharing—Roosting and colonial birds may benefit from social behavior to more efficiently locate patches of concentrated food resources, and colony sites may serve as information centers where locations of good feeding sites can be shared among individuals (Ward and Zahavi 1973, Emlen and DeLong 1975, Brown 1988). Under this scenario, larger colonies may be more successful because there is a larger pool of information on the whereabouts of productive feeding places within the foraging area being exploited by the colony (Ward and Zahavi 1973). This increased foraging efficiency, along with the highly synchronized nesting and the compressed length of a nesting cycle in Tricolored Blackbirds, may increase the chance that temporarily abundant prey will remain available to the young in a colony for the duration of the breeding cycle. Coloniality may result from situations when suitable breeding sites are limited among areas of high food availability (Danchin and Wagner 1997).

Because of occasional destruction of entire Tricolored Blackbird breeding colonies by predators and observations of prey-following by adults, Orians (1961a) and Payne (1969) suggested that colonial nesting by Tricolored Blackbirds is more likely related to location and exploitation of a locally abundant food supply than to a strategy of predator avoidance or response. However, the choice of flooded or dense and armored vegetation for breeding suggests that suitable nesting locations provide some protection from predators, and predator satiation may be a successful strategy for confronting territorial predators. These benefits of colonial breeding are not necessarily mutually exclusive. Because predation at colonies and the ability of adults to locate and acquire food primarily effects the survival of eggs and young, these mechanisms may collectively serve to increase productivity.

Habitat Associations and Use

For successful breeding, Tricolored Blackbirds require three resources: 1) secure nesting substrate, 2) a source of water, and 3) foraging habitat that provides sufficient food resources.

Nesting Substrate

The nesting substrate for Tricolored Blackbird breeding colonies is defined as the vegetation in which nests are constructed. In most cases the nesting substrate is either flooded by water, as in wetland colony sites, or is composed of thorny or spiny vegetation that is impenetrable to many predators (Beedy and Hamilton 1997). In some cases, Tricolored Blackbird colonies occur in upland nesting substrates that lack these protective characteristics (e.g., silage grain, weedy mustard fields); in these cases the nesting substrate is usually extremely dense and therefore may provide similar protection.

The majority of Tricolored Blackbird breeding colonies have occurred in one of five nesting substrate types: 1) wetland vegetation (either cattail [*Typha* sp.] or bulrush [*Schoenoplectus* sp.]), 2) Himalayan blackberry, 3) thistle, usually milk thistle (*Silybum marianum*) or bull thistle (*Cirsium vulgare*), 4) stinging nettle (*Urtica* sp.), or 5) agricultural grain fields, especially triticale, a wheat-rye hybrid grain grown as silage for dairy cattle (Table 1). Several additional nesting substrates have been used to a lesser degree (less than 6% of colonies in total), with the more common being mustard (*Brassica* sp.), willows (*Salix* sp.), mallow (*Malva* sp.), wild rose (*Rosa* sp.), tamarisk (*Tamarix* sp.), and giant cane (*Arundo* sp.) (Beedy et al. 1991, Beedy and Hamilton 1997, Graves et al. 2013, Beedy et al. 2017, Tricolored Blackbird Portal 2017).

Table 1. Number of colonies in major nesting substrate types. Includes all colonies with known substrate type, 1907–2016.

Nesting substrate type	Number of colonies	Percent colonies
Wetland	621	52.4%
Himalayan blackberry	235	19.8%
Thistle	114	9.6%
Triticale or other grain	73	6.2%
Stinging Nettle	63	5.3%
All other	80	6.7%

The primary nesting substrates used by Tricolored Blackbirds have different distributions across the breeding range in California (Figure 5) (Cook and Toft 2005). Wetland sites with cattail or bulrush substrate are fairly evenly distributed across the range (Graves et al. 2013). Himalayan blackberry sites are mostly restricted to Merced County and north through the Sierra foothills to the Sacramento Valley. Triticale and other agricultural grain sites are found mainly in the southern San Joaquin Valley and Merced County, with a few additional sites in southern California. In recent years stinging nettle sites have mainly occurred in the southern San Joaquin Valley portion of Kern County including the surrounding foothill grasslands, although historically they were also common at the extreme northern portion of the California range in Siskiyou and Shasta counties. Thistle sites have been located throughout much of the range in California, and have been the primary nesting substrates used in the southern Sierra Nevada foothills (Airola et al. 2016). Thistle sites are typically only available to breeding Tricolored Blackbirds in years with weather patterns that support abundant thistle growth.

a) b)

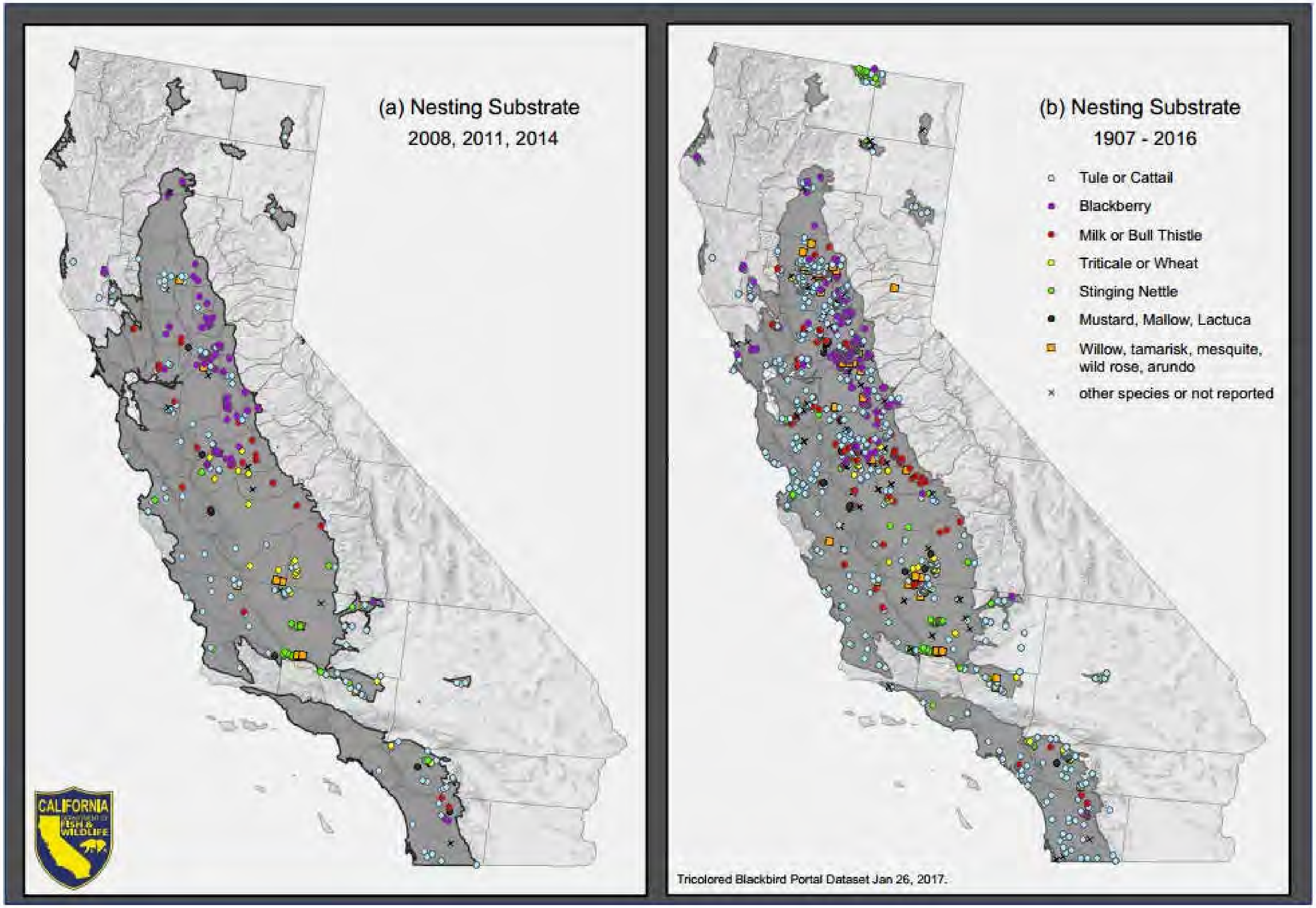


Figure 5. Distribution of nesting substrates used by Tricolored Blackbirds. a) Occupied breeding locations during 2008, 2011, and 2014. b) All known breeding locations 1907-2016.

Historically, most breeding colonies were in freshwater marshes dominated by cattails and tules (Beedy 2008). In the 1930s, 93% of breeding colonies were in freshwater marsh vegetation with the remaining colonies in willows, blackberries, thistles, and nettles (Neff 1937). The proportion of colonies in freshwater marshes had decreased to about 70% by the 1970s as Tricolored Blackbirds began using novel, nonnative vegetation types, especially Himalayan blackberry and thistles (DeHaven et al. 1975b). By 2008, the proportion of colonies established in freshwater marsh during the statewide survey had declined to 35% (Kelsey et al. 2008).

Tricolored Blackbirds are known to have bred in blackberry bushes from the early 1900s (Booth 1926, Neff 1934, 1937), but this was a very infrequent occurrence and the species of blackberry is not known. Sacramento County has a long history of breeding by Tricolored Blackbirds, with colonies in the 1930s found entirely in wetland substrates and colonies in the 1970s still mainly located in wetlands (Neff 1937, DeHaven et al. 1975b). In the 1980s and 1990s, an increasing percentage of breeding colonies were reported in nonnative Himalayan blackberry (Hosea 1986, Beedy and Hamilton 1997). Over 55,000 breeding Tricolored Blackbirds were located in Sacramento County in 1993, with the large majority of these in Himalayan blackberry and a small number in wetland substrates (Hamilton 1993). Himalayan blackberry is currently the dominant nesting substrate throughout the northern and central Sierra Nevada foothills. From 2014 to 2016, 65–80% of foothill colonies have occurred in Himalayan blackberry annually (Airola et al. 2016). Between 1994 and 2004, a large shift from cattail marsh colonies to Himalayan blackberry colonies occurred in the rice-growing region of Sacramento Valley (Hamilton 2004b). In 1994, Hamilton et al. (1995) found very few Tricolored Blackbird colonies using Himalayan blackberry in the Sacramento Valley, but by 2004 Himalayan blackberry was a commonly used nesting substrate adjacent to rice fields (Hamilton 2004b). This was in part due to the loss of specific cattail marsh sites, but was also likely due in part to an increase in distribution of Himalayan blackberry. Specific cattail marsh sites where 90,000 Tricolored Blackbirds nested in 1994 were either not maintained or were destroyed by 2004 (Hamilton 2004b).

Tricolored Blackbirds were discovered breeding in grain fields in the San Joaquin Valley in 1991 and 1992 (Hamilton et al. 1992). Prior to this, nesting in large cultivated grain fields was unknown and little work on the status of the species in the southern San Joaquin Valley had been conducted (Beedy et al. 1991, Hamilton et al. 1992). The only previous report of nesting in a cultivated grain field was from 1944, when a colony was observed in mustard-infested barley (Bent 1958). The discovery of breeding on grain fields in the 1990s corresponded to an increase in planting of triticale, which in the San Joaquin Valley is grown primarily as a silage crop for dairy cattle (colonies on agricultural grain fields associated with dairies are often referred to as “silage colonies”). This wheat-rye hybrid grain may be attractive to breeding Tricolored Blackbirds due to its robust structure that is well suited to support nests and it dense growth that is relatively impenetrable to terrestrial predators. Many of the recent grain colonies have occurred in weed-infested (usually mustard or mallow) triticale, although colonies also occur in pure stands of triticale and in other types of cultivated grains. Relatively little triticale had been planted for silage in the San Joaquin Valley by 1994, but by 2005 the planted acreage had grown to about 75,000 acres (304 km^2) (Aksland and Wright 2005). Of the nesting substrates used by Tricolored Blackbirds, triticale and other grain fields are unique in that they are available in abundance each year in the San Joaquin Valley, and in recent years, many of the largest colonies have occurred on grain fields. Fifty percent of the breeding Tricolored Blackbirds detected in California during the 2008 statewide survey were observed nesting in triticale fields (Kelsey 2008).

During the April 2011 statewide survey, the majority of colonies (54%) in the San Joaquin Valley and Tulare Basin were located on agricultural grain crops, with an additional 22% in milk thistle. Conversely, 70% of colonies in the Sacramento Valley and Sierra Nevada foothills were in Himalayan blackberry. The majority of colonies in southern California, on the central coast, and in extreme northern California continued to occur in wetland habitats. Statewide, wetlands continued to support more colonies than any other substrate type (37%), although these wetland colonies supported only 5% of the total population reported in the statewide survey (Kyle and Kelsey 2011).

The areal extent of nesting substrate used by breeding Tricolored Blackbird colonies has ranged from a few square meters to more than 200 acres (81 ha) (Tricolored Blackbird Portal 2017). The smallest colonies have occurred in a variety of nesting substrate types, including cattail or bulrush marsh, Himalayan blackberry, and willows. The largest colonies of 100 acres (40 ha) or more have been located in triticale in recent years, although historically very large colonies occurred in wetland habitats (Neff 1937). The large majority of colonies occupy less than 10 acres (4 ha) of nesting substrate, with many being smaller than 1 acre (0.4 ha). DeHaven et al. (1975b) found that the area occupied by nests in all substrates types averaged less than 2 acres (0.8 ha) per colony, and the largest colonies observed from 1968 to 1972 occupied only 10 acres.

Nest densities vary widely across nesting substrates. DeHaven et al. (1975b) observed densities up to 66,670 nests per acre (100,000 breeding adults per acre) in Himalayan blackberry colonies, with the average density in blackberry colonies closer to 16,000 nests per acre. Densities in other common nesting substrates (cattails, bulrush, thistle, and willows) had densities of up to 13,340–20,000 nests per acres (20,000–30,000 breeding adults per acre), with average densities ranging from 3,300 to 4,800 nests per acre (DeHaven et al. 1975b).

Water

Breeding Tricolored Blackbirds require an open, accessible water source in the vicinity of the breeding location. Adults use the water for drinking and bathing, and will sometimes submerge insect prey items before provisioning young. Females will also submerge nesting material in water to, presumably, make it more pliable for use in nest construction (Beedy et al. 2017). The requirement for open water can be met by any of a number of sources, including wetlands, streams, ponds, reservoirs, and agricultural canals or ditches. Water must be available within a few hundred meters of the nesting substrate (Hamilton 1995). The loss of local water sources during the nesting cycle has caused entire colonies of birds to abandon their nests (Beedy et al. 1991).

Foraging Habitat

The Tricolored Blackbird breeds in dense colonies with the individual territories that are defended by each male consisting of a very small area. These dense congregations of large numbers of birds likely exert large pressures on the foraging landscape surrounding the nesting location. Unlike most other songbirds, Tricolored Blackbirds forage almost exclusively away from the small nesting territory, and colonies require suitable foraging habitat with abundant insect prey within a few miles of the colony site. Because provisioning success and the resulting rate of nestling starvation have been shown to influence reproductive success, the availability of high quality foraging habitat is at least as important to Tricolored Blackbird breeding as is the availability of suitable nesting substrate (Hamilton et al. 1992). The proximity to highly abundant insect food supplies is an important factor in the selection of breeding sites by Tricolored Blackbirds (Neff 1937, Orians 1961b, Payne 1969), and their nomadic and colonial behavior may have evolved as a strategy for maximizing the ability to locate and exploit unpredictable and temporarily abundant insect food sources. The required foraging habitat for successful breeding has a much greater spatial extent than nesting substrate. Although data are not available to define the minimum extent of foraging habitat, it has been reported that colonies with less than 200–300 acres (81–121 ha) of foraging habitat do not persist and that several thousand acres are usually necessary to maintain most large colonies (Hamilton 2004a).

Primary foraging habitats during the breeding season include grasslands, low-density shrublands (e.g., alkali scrub), pastures, dry seasonal pools, and certain agricultural crops including alfalfa and rice, which provide for high production of insect prey for breeding Tricolored Blackbirds. The landscape variables that best predict Tricolored Blackbird colony occurrence during the early breeding season are proportion of grassland and proportion of alfalfa. The likelihood of breeding colony occurrence increases when landscape composition reaches thresholds of 30% and 80% grassland cover and 15% alfalfa cover within 3 miles (4.8 km) of a colony location (NAS 2017). Relative size of breeding colonies also increases above approximately 15% alfalfa cover (Figure 6; NAS 2017). Adults will also sometimes exhibit aerial foraging above wetland colonies when aquatic insects are hatching (Beedy et al. 2017). Adult birds also frequently feed at cattle feedlots and dairies where they have access to abundant grain sources. Among grassland foraging habitats, Hamilton et al. (1995) reported that ungrazed grasslands were preferred over heavily grazed grasslands by foraging Tricolored Blackbirds, but this conclusion has not been reported in later studies of grassland foraging birds (Meese 2013, Airola et al. 2015a, 2016). Tricolored Blackbirds breeding in agricultural landscapes do not use most row crops, vineyards, or orchards (Hamilton et al. 1992, Hamilton 2004a). During the 2000 statewide survey, Hamilton (2000) found that over 90% of observed Tricolored Blackbird foraging activity occurred on private property.

In Sacramento County, Hamilton et al. (1992) reported that 96% of all foraging by breeding Tricolored Blackbirds occurred in grasslands. Large portions of eastern Sacramento County and the Sierra Nevada foothill region to the north and south are still dominated by annual grasslands, intermixed with agricultural lands, woodlands, and shrublands (Airola et al. 2015a). In 2014, Tricolored Blackbirds nesting in this region from Placer County in the north to Stanislaus County in the south continued to rely heavily on grasslands, with 70% of foraging observations occurring in grasslands (Airola et al. 2015a).

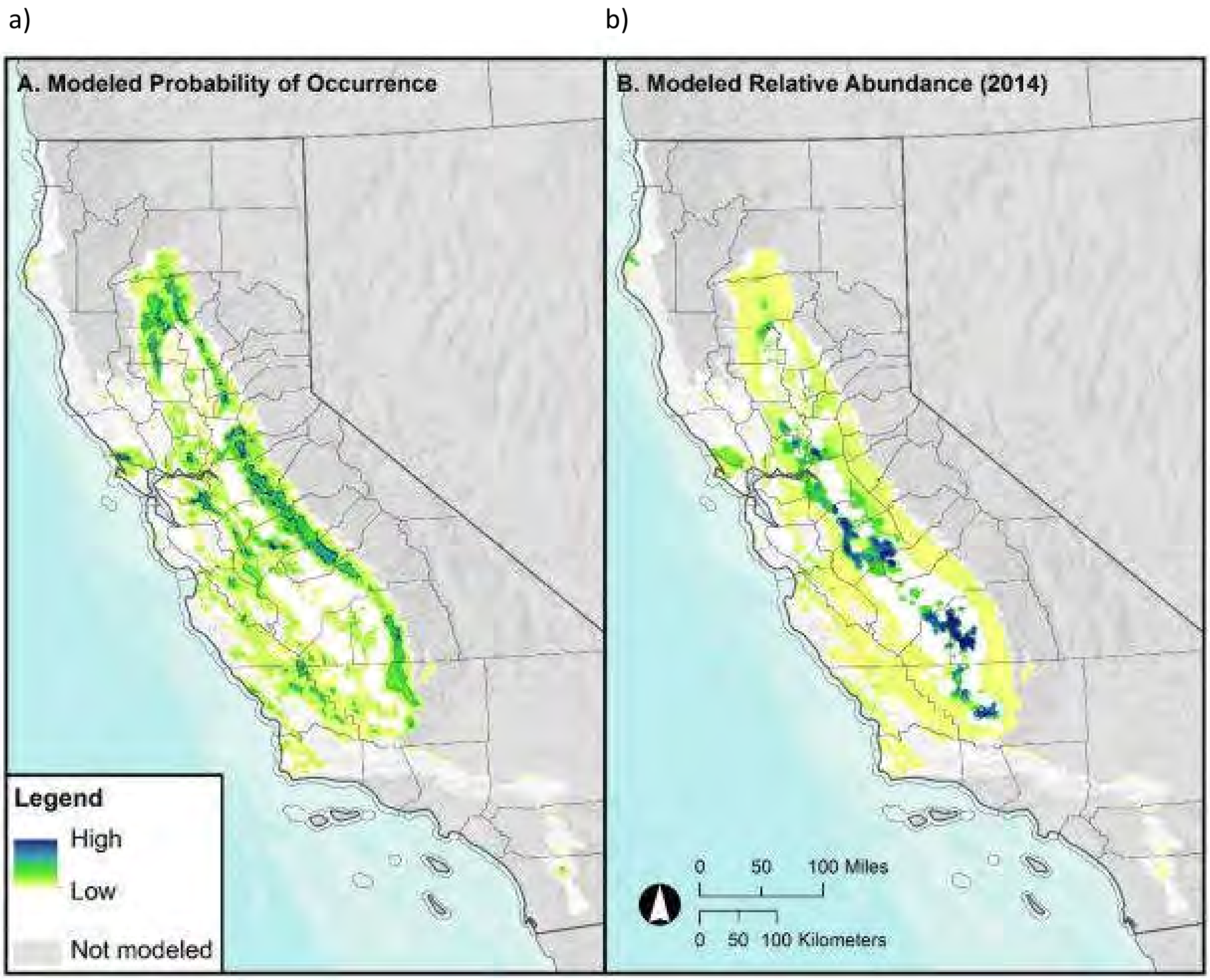


Figure 6. Predicted probability of Tricolored Blackbird breeding colony (a) occurrence and (b) relative abundance in 2014, based on foraging habitat and other covariate relationships determined in presence-absence and relative abundance models. The occurrence of colonies was best predicted by year, proportion grassland cover, and proportion alfalfa. The relative abundance at colonies was best predicted by proportion of alfalfa and number of dairies. Models focused on foraging landscape and did not consider nesting substrate. Figure from NAS (2017).

In many parts of the Central Valley and southern California where Tricolored Blackbird colonies occur on agricultural grain fields, alfalfa is often the most important foraging habitat for acquisition of insect prey (Cook and Toft 2005, Meese 2009a), and colonies in other nesting substrates in the Central Valley also frequently use alfalfa (Meese 2013). For colonies in the Mojave Desert area of San Bernardino County, alfalfa may be the only source of insects for provisioning young, except during rare occasions when the surrounding desert provides abundant insect prey. In some cases, alfalfa can be extremely productive and large colonies of up to 15,000 nesting birds have depended on less than 200 acres (81 ha) of alfalfa to meet most of their insect prey needs (Meese 2006).

Mailliard (1900) described the distinctive flight of Tricolored Blackbirds in the process of feeding nestlings as a "stream composed of birds going toward the tules with their bills full of bugs and of equal numbers returning to the fields for fresh supplies." Both prey abundance and proximity to the colony site likely influence the reproductive success of a colony. When abundant insect prey are available adjacent to colony locations, adults will make only very short foraging flights to acquire prey, and shorter foraging distances may reduce the amount of time eggs and nestlings are exposed. For example, a colony in the nestling stage failed during a period of hot weather when adults needed to travel 3 miles (4.8 km) to forage (WRC-MSHCP 2017). In at least some cases, adults foraging near the colony site bring few prey items to their young, while adults foraging more distant return with many more prey items (Orians 1980, *cited in* Skutch 1996). This may be a mechanism to conserve energy by making fewer long-distance flights and shows the value of foraging habitats in close proximity to colony sites; however, the possibility that proximate food sources had been exhausted during observations cannot be ruled out. Most foraging occurs within about 3 miles (4.8 km) of the colony location, although Hamilton et al. (1992) reported maximum foraging flight distances by breeding birds of up to 8 miles (13 km). In the Central Valley from 2006 to 2011, Meese (2013) observed adult Tricolored Blackbirds foraging up to 5.6 miles (9 km) from the colony location.

Several authors have suggested that regional insect abundance plays a role in breeding colony site selection, and that a super-abundant insect population may stimulate nesting behavior (Lack 1954, Orians 1961b, Orians and Collier 1963, Payne 1969). This could explain the variation in general distribution of colonies between years (DeHaven et al. 1975a). The highly synchronized and colonial breeding system may have adapted to exploit an unpredictable environment where locations of nesting substrate and abundant insect food resources changed unpredictably from year to year (Orians and Collier 1963). Although Meese (2013) demonstrated that colony reproductive success was correlated with local availability of insect prey (usually within 3–5 miles of the nesting location), the role that insect abundance in foraging habitats has on colony site selection has not been investigated.

Diet and Food Habits

For most of the year, the majority of food items taken by Tricolored Blackbirds consist of plant material, especially seeds. However, during the breeding season, adult females require large amounts of high-protein insect prey for egg production and nestlings require a protein-rich diet for growth and development (Crase and DeHaven 1977). Nestlings are fed almost exclusively animal matter for the first nine days after hatching, at which point parents begin to introduce plant matter into the diet (Hamilton et al. 1995). Colonies consisting of many thousands of adult birds and growing nestlings require an immense amount of insect prey during short windows of time. The availability of insect prey in the foraging landscape likely influences the establishment of breeding colonies, and an abundant prey base is essential for successful breeding.

Nestlings have been provisioned with a wide variety of prey items, including grasshoppers and crickets (order Orthoptera), beetles, weevils, and water beetle larvae (order Coleoptera), moths and butterflies (including caterpillars; order Lepidoptera), and to a lesser degree spiders, flies, tadpoles, snails, and emergent dragonflies, damselflies, and midges (Payne 1969, Crase and DeHaven 1977, Skorupa et al. 1980). At three breeding colonies in Merced County where adults often foraged for prey in alfalfa and grain fields, animal matter made up 91% of food volume for nestlings and fledglings, with moth larvae, beetles, and weevils the primary food items (Skorupa et al. 1980). In foothill grasslands, grasshoppers have often been the primary prey item fed to nestlings (Payne 1969, Airola et al. 2015a). In a diet study that included colonies from several regions of the Central Valley located among a variety of foraging substrates, animal matter made up more than 86% of the total volume of nestling food (Crase and DeHaven 1977). Ground beetles were the predominant food item when averaging across all colonies, followed by water beetle larvae, grasshoppers and crickets, and weevils. Colonies differed significantly in the primary food items provided to nestlings, with differences in foraging substrate responsible in some cases. For example, colonies with water beetle larvae as the predominant food source were located in rice-growing areas, and the greatest percent of grasshoppers were fed to nestlings at colonies bordered by grassland (Crase and DeHaven 1977).

Early observers noted that nestling and fledgling Tricolored Blackbirds were frequently fed grasshoppers, leading to descriptions of the species as a grasshopper-follower (Belding 1890, Bendire 1895, Mailliard 1914, Orians 1961b). Payne (1969) observed breeding adult Tricolored Blackbirds at colonies in the Sacramento Valley foraging primarily in grasslands and providing nestlings with a diet composed of 47% grasshoppers; crickets, beetles, and spiders were also acquired in grasslands and fed to young in smaller amounts. Payne (1969) suggested that the movements of Tricolored Blackbirds during the breeding season paralleled the nomadic movements of rangeland grasshoppers in California and compared the Tricolored Blackbird with “locust bird” species of Asia and Africa. Grasshoppers continue to provide a valuable food source to Tricolored Blackbird colonies, especially when adjacent to grasslands and pastures (Airola 2015a), but Tricolored Blackbirds have been shown to be more flexible in breeding season diet, as long as an abundant insect source is available.

In the spring and summer, the proportion of animal material consumed by adult Tricolored Blackbirds in the rice-growing region of the Sacramento Valley was 28% and 39%, respectively, with primary prey items including ground beetles, water beetle larvae, and orthopterans (Crase and DeHaven 1978). At four breeding colonies in agricultural areas of Merced County, animal matter made up 56% of food volume for adult females and 28% for adult males (Skorupa et al. 1980). The most consumed animal foods were beetles and weevils, moth larvae, and flies; the predominant plant foods consisted of oats (*Avena* sp.) and filaree (*Erodium* sp.), and to a lesser degree chickweed (*Stellaria* sp.) and pigweed (*Amaranthus* sp.). In the nonbreeding season, Tricolored Blackbirds are more strictly granivorous, although a variety of plant and animal matter is taken opportunistically. One study in the rice-growing region of the Sacramento Valley revealed that about 90% of the fall and winter diet consisted of plant material, primarily seeds of rice, other grains, and weed seeds (Crase and DeHaven 1978).

Reproduction and Survival

Breeding Phenology and Behavior

Breeding typically extends from mid-March through early August (Beedy et al. 2017). Autumnal breeding has been observed in the Central Valley (September–November; Orians 1960, Payne 1969) and in Marin County (July–September; Stallcup 2004), although not since 1964 and 2003 in the Central Valley and Marin County, respectively. From initiation of nest building to independence of fledged young, the nesting cycle of the Tricolored Blackbird is about 10 days shorter than that of the Red-winged Blackbird, mostly due to rapid progression through the nest building and egg laying stages (Payne 1969). The condensed length of the nesting cycle may be a function of the synchronized colonial nesting and an adaptation to take advantage of unpredictable periods of abundant and temporary insect food sources (Payne 1969, Skutch 1996).

Nest building and incubation are performed exclusively by the female, but the male takes an active role in feeding the young (Lack and Emlen 1939, Orians 1960). Although female Tricolored Blackbirds breed in their first year, most males may defer breeding until they are at least two years old (Payne 1969). This contributes to a skewed sex ratio at many breeding colonies, with each male breeding on average with two females (Lack and Emlen 1939, Orians 1961b, Payne 1969). Although colonies with even sex ratios or with more skewed sex ratios (each male breeding with more than two females) have been observed (Hamilton et al. 1995), for monitoring purposes it is often assumed that each nest in a colony represents 1.5 breeding birds.

After fledging, Tricolored Blackbirds often leave the vicinity of the nest and congregate in groups of young birds from many different nests. These fledgling groups will often congregate near the edge of the nesting substrate nearest the foraging grounds being used by the adults, where they are fed when adults return to the colony site (Payne 1969). A group of fledgling Tricolored Blackbirds has been referred to as a crèche (Hamilton 1998, Beedy et al. 2017). The formation of crèches generally occurs among birds that breed in large colonies and whose eggs all hatch at about the same time (examples of other crèche-forming species include terns and penguins). Supervision of unrelated offspring by a small number of adult guardians is usually considered a characteristic of crèches, although it is unclear whether this is the case in Tricolored Blackbirds. A single large colony of Tricolored Blackbirds can produce many crèches, and a single crèche may include several thousand fledglings. Crèches can persist for up to one to two weeks, and have been observed as far as 3 miles (4.8 km) from a colony site (Payne 1969, Hamilton et al. 1995).

Reproductive Success

Successful breeding (i.e., production of any fledglings) was found to be positively correlated with colony size by Payne (1969); all colonies (n=7) that produced no fledglings contained 200 or fewer nests, while only one of seven successful colonies was smaller than 400 nests. Hamilton (1993) observed that the largest colonies in a single year of observation produced the highest estimates of reproductive success. Meese (2013) documented a weak positive correlation between reproductive success and colony size over a six-year period ($r = 0.53$, $r^2 = 0.28$). In wetland and silage colonies in the southern San Joaquin Valley, Weintraub et al. (2016) found reproductive success to vary with colony size, with more young fledged per nest in the largest and the smallest colonies, while intermediate sized colonies (1,000–5,000 birds) fledged fewer young.

Reproductive success, defined here as the average number of young fledged per nest, has been the generally accepted method for estimating productivity of Tricolored Blackbird colonies since the early 1990s (Hamilton et al. 1995, Meese 2013, Holyoak et al. 2014, Airola et al. 2015a). Reproductive success has been estimated in one of two ways: visual estimation of the number of fledglings or nest sampling via walking transects through active colonies. When estimating reproductive success by visual counts of fledglings, colonies are visited at several-day intervals (often four days but in practice this has been variable) after fledglings have left the nests. The sum of fledgling counts on all site visits and the estimated number of nests in the colony are used to estimate the number of fledglings produced per nest. The fledglings observed at each visit are assumed to represent unique birds, which leads to some uncertainty in reproductive success estimates obtained using this method. When estimating reproductive success by nest transects, it has been common practice to count the number of young per nest during the portion of the nest cycle when nestlings are 7–9 days old, with a minimum target sample of 25 nests (Hamilton et al. 1995, Cook and Toft 2005, Meese 2013). Entering colonies when nestlings are less than seven days old inflates the reproductive success estimate by underestimating nestling mortality and entering colonies when greater than 9 days of age causes the nestlings to jump from the nests prematurely. As a result, reproductive success estimates obtained by the transect method represent the maximum number of young fledged per nest because several days may remain before nestlings fledge (Hamilton 2004b). Therefore, the two methods of estimating reproductive success measure two somewhat different indices of productivity.

Many Tricolored Blackbird colonies in the Central Valley exhibited relatively low reproductive success from 2006 to 2011. Meese (2013) estimated reproductive success at 47 colonies, representing most of the largest colonies each year, during this six-year period ranging in size from 800 to 138,000 breeding birds. Reproductive success was estimated using both the nest transect and the fledgling count methods. About half of the monitored colonies were in wetlands (n = 23), with the rest in thistle (n = 11), triticale (n = 9), and Himalayan blackberry (n = 4). The average reproductive success across all sites and years was 0.62. Colonies that were destroyed by harvest of the grain nesting substrate were not included in the study results. Low productivity during this time resulted in very few young Tricolored Blackbirds being produced in the southern San Joaquin Valley where a large portion of the population's first annual breeding attempts occur (Figure 7). Incidental observations in 2012 and 2013 suggested that the trend of low reproductive success continued.

Meese (2013) linked reproductive success at Central Valley colonies to relative abundance of insect prey at foraging sites, suggesting that many Tricolored Blackbird colonies may have been food-limited. High levels of predation plus destruction of colonies to harvest during this time also contributed to the low overall production of fledglings (Meese 2011, 2012). Parents reduce the size of broods at many colonies after the hatching of eggs (Hamilton et al. 1995). Often the majority of eggs in a clutch (usually three or four) will hatch but each nest typically fledges a reduced number of young, either due to parents not feeding all nestlings which leads to starvation, or by the active removal of nestlings from the nest by females (Payne 1969, Hamilton et al. 1995). This is likely because of a shortage of food supplies. When abundant food is available each nest produces more fledglings (Meese 2013), and although rare, as many as four young have been raised from some nests at productive colonies (Hamilton et al. 1995).

Few estimates of colony reproductive success are available after 2011, but observations of large numbers of fledglings at several colonies suggest that the species has had relatively high success at some colonies in recent years. In 2015, the estimated reproductive success at five colonies on agricultural grain fields averaged 0.6–1.9 fledglings produced per nest (Aug 2015 presentation from

NRCS to Tricolored Blackbird Working Group; unreferenced). In 2016, eight of nine known colonies on agricultural grain fields fledged at least some young, although efforts to estimate reproductive success were limited. Only one colony in silage was both accessible and uniform in nest density to allow for nest transects and resulted in an estimated reproductive success of 0.44 (Frazer 2016). At four colonies in Himalayan blackberry, cattail, and milk thistle that ranged in size from 5,000 to 12,000 birds, reproductive success estimates ranged from 0.4 to 0.67 (Meese 2016). In 2017, all known silage colonies at seven locations fledged at least some young. Some of these experienced very low reproductive success, but at least two had high success and produced several thousand fledglings. Several additional colonies in other nesting substrates were reported to have high (although unquantified) reproductive success in 2017, with four wetland colonies in the San Joaquin and Sacramento valleys producing at least several thousand young (Colibri 2017, Meese 2017). As in other years, many other colonies were observed to have low success. These limited quantitative estimates and additional qualitative assessments are difficult to compare directly to previous work due to the high variability in reproductive success across colonies and the inconsistent methods used to evaluate reproductive success.

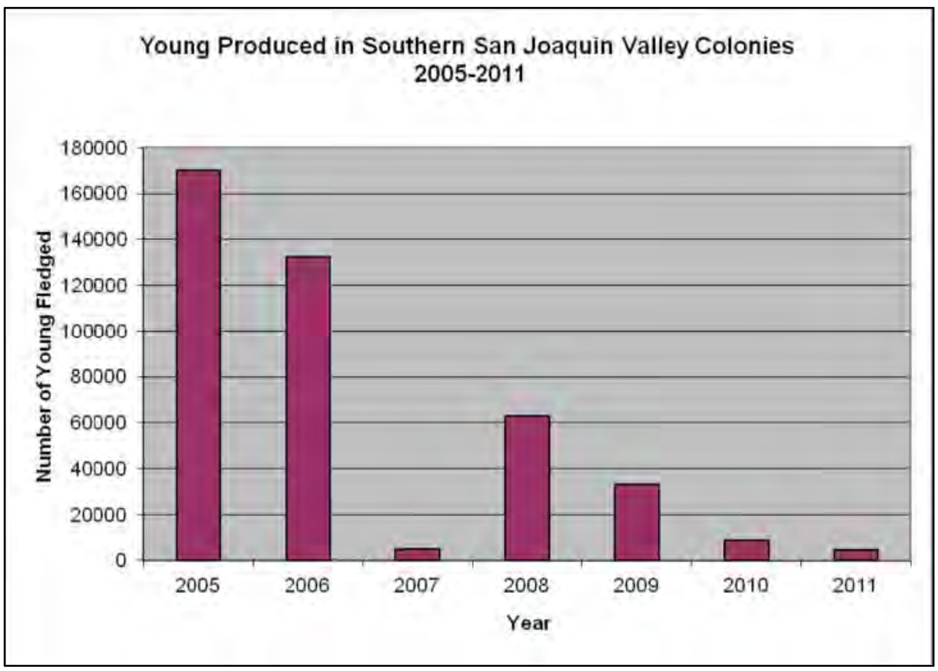


Figure 7. Number of young produced in Southern San Joaquin Valley colonies (Kern and Tulare counties) from 2005 to 2011. Figure from Meese (2011).

At times, reproductive output has been observed to vary across substrate types (Hamilton et al. 1992, Hamilton 2000, Holyoak et al. 2014). Holyoak et al. (2014) fitted statistical models to occupancy rates in the most common nesting habitat types in recent years (2006–2011) and considered data on abundance, reproductive success, and frequency of use for each nesting habitat type to determine the net reproductive output of different nesting habitats over time. Occupancy rates and other factors that influence reproductive output varied across habitat types, resulting in variation in the importance of habitats to Tricolored Blackbird productivity. Four nesting habitat types had sufficient sample size to make strong inferences about average reproductive output, including Himalayan blackberry, nettles, wetlands, and grain fields. Himalayan blackberry and nettle colonies exhibited higher than average reproductive output. High overall reproductive output for nettle colonies is a little unexpected given that there are very few colonies, which are of average size, in this nesting substrate. However, high rates of occupancy and reproductive success result in high overall reproductive output for nettle colonies. Himalayan blackberry colonies exhibit average occupancy rates and size, but high reproductive success and the large number of colonies in this nesting substrate (the second most frequent colony type after wetlands) lead to high overall reproductive output. Grain field colonies exhibit average overall reproductive output, despite having low occupancy rates, low reproductive success, and a small number of colonies on grain fields each year; the very large size of grain field colonies increases the overall reproductive output. Of the four nesting habitat types assessed, wetlands remain the most common nesting habitat used by breeding Tricolored Blackbird colonies in recent years. Despite this, average levels of occupancy, reproductive success, and size of marsh colonies have led to the lowest overall contribution to reproductive output among the four nesting habitat types.

Between 1992 and 2003, average estimated reproductive success was significantly higher in nonnative Himalayan blackberry (RS = 2.0) than in native emergent cattail and bulrush marshes (RS = 0.5; Cook and Toft 2005). Excluding colonies that were lost to harvest, colonies on silage grain fields had an intermediate reproductive success (RS = 1.0). These rates of success on Himalayan blackberry and silage colonies over an 11-year period have rarely been reported at any individual colonies in more recent years. From 2006 to 2011, Meese (2013) observed a similar pattern of higher success in silage colonies compared to wetlands, although with lower overall values of reproductive success (unharvested triticale RS = 0.73; wetland RS = 0.31). However, in an intensive study of 12 colonies in the southern San Joaquin Valley, Weintraub et al. (2016) found no difference in reproductive success between colonies in agricultural silage fields and in wetlands. The reproductive success observed by Meese (2013) in Himalayan blackberry colonies was much lower (RS = 0.44) than that reported by Cook and Toft (2005), although only four Himalayan blackberry colonies were included in the 47 sampled colonies. In 2014, Airola et al. (2015a) estimated the average reproductive success at four Himalayan blackberry colonies in Sacramento County as 0.84 fledglings per nest, less than half that reported by Cook and Toft (2005) for the 1992–2003 time period. Although the methods used were slightly different, the estimate by Airola et al. (2015a) is within the range of reproductive success estimates observed in all nesting substrate types by Meese (2013) during six years of low reproductive success (average RS = 0.62; range 0.01–1.44), but the range of values observed by Airola et al. was much narrower (0.66–0.90). Although there has been much variation observed in reproductive success among substrate types, assessments that compiled data over multiple years are consistent in finding that Himalayan blackberry colonies experience relatively high success, while silage colonies are intermediate and wetland colonies have relatively low reproductive success, on average (Cook and Toft 2005, Meese 2013, Holyoak et al. 2014).

As a colonial breeding bird, Tricolored Blackbirds may benefit from occasional bouts of high productivity that recruit large numbers of birds into the population. Although reproductive success at many colonies has been relatively low in most years, estimates have been highly variable and in some years highly productive colonies have been observed. High rates of reproductive success at a few large colonies can produce large numbers of fledglings. For example, three colonies representing 50,000 nests accounted for the production of an estimated 100,000 fledglings in 1993, while many smaller colonies produced no or few fledglings in the same year (Hamilton 1993). Meese (2013) observed high variability in reproductive success in both triticale and milk thistle colonies from 2006 to 2011 (range 0.01–1.44). The relatively high reproductive success at a small number of colonies was demonstrated to be a function of a high insect abundance in nearby foraging areas (Meese 2013). Low reproductive success has been implicated in Tricolored Blackbird population declines over the last two decades (Cook and Toft 2005, Meese 2013). Occasional high rates of reproductive success at a few large colonies may be a successful strategy for long-term population viability, but the degree to which infrequent bouts of high success can compensate for the low reproductive success that may be persistent and widespread across most colonies is unknown. Trends in the population size indicate that reproduction and survival rates have been insufficient over the last two decades to maintain the population (see Status and Trends section).

Survival

There are no published studies on the annual survival rate of Tricolored Blackbirds, but banding studies have shown that individuals can live up to 13 years (Neff 1942, DeHaven and Neff 1973). Meese (2014b) used recapture data to estimate the average annual adult survivorship of Tricolored Blackbirds as 60%. Estimates of annual survival rates for other temperate blackbirds have ranged from 42% to 60%, with rates for the closely-related Red-winged Blackbird ranging from 42% to 54% (Fankhauser 1971, Searcy and Yasukawa 1981).

An ongoing study has developed an Integrated Population Model (IPM) to jointly analyze banding, fecundity, and population data (from eBird). Banding data was analyzed in a Cormack-Jolly-Seber framework within the IPM, and preliminary results indicate that adult survival is higher in females than in males; however, there are far fewer banded males in the data than females, thus higher uncertainty around these estimates. The estimated average annual survival over the last 10 years was 0.68 for females and 0.53 for males (Robinson et al. 2018). The Integrated Population Model is discussed further in the Population Trend section.

STATUS AND TRENDS IN CALIFORNIA

Range

Nuttall (1840) observed the Tricolored Blackbird along the coast of California in the 1830s and, without offering any supporting evidence, suggested that the Tricolored Blackbird range extended into Oregon and Mexico. In the mid-1800s, Cooper (1870) reported the species to be common on the southern California coast from Santa Barbara to San Diego, with the range to the north passing “more into the interior, extending up as far as Klamath Lake and southern Oregon.” Bendire (1895) reported the range as “[s]outhwestern Oregon, south through California, west of the Sierra Nevada, to northern Lower [Baja] California.” Bendire knew of no reports of the species north of Klamath Lake in southwestern Oregon, and thought it to be uncommon there. The range of the species was confirmed to include northern Baja California in the late 1800s, with A. W. Anthony reporting them “[r]ather common along the northwest coast, breeding in all fresh-water marshes” (Bendire 1895).

Following a period of years with no reported sightings of Tricolored Blackbird in Oregon, Neff (1933) reported a number of observations of the species from 1931 to 1933, all within 30 miles (48 km) of Klamath Falls, and consisting collectively of fewer than 60 birds. Richardson (1961) reported up to several hundred Tricolored Blackbirds near Medford, Oregon in 1957 and documented breeding colonies of 1,500 and 1,800 birds in the region in 1958 and 1960, respectively. Inconsistent observations during the 1800s and early 1900s at the northern extent of the species range may represent shifts in distribution over time or are perhaps more likely the result of limited survey coverage. The species has continued to breed in small numbers in the vicinity of Klamath Falls to the present time, and small numbers of birds continue to occur near Medford during the breeding season. Small breeding colonies (30 or fewer birds) were observed in three northern Oregon counties (Multnomah, Umatilla, and Wheeler) in the 1980s (Beedy et al. 1991). Since the 1990s, several hundreds of birds have occurred regularly in central Oregon near the town of Prineville in Crook County, and breeding has been confirmed in the area. In recent decades, the species has been documented in several other isolated locations in western Oregon and eastern Washington, almost always in very low numbers but occasionally numbering in the hundreds of birds (Gilligan et al. 1994, Spencer 2003, eBird Dataset 2016). The degree to which these records represent recent range expansion to isolated areas, irregular use of the region, or increased survey coverage is unclear, but it appears that small numbers of birds may have recently expanded the species' range to at least some isolated areas in the north (Gilligan et al. 1994, Wahl et al. 2005).

Ammon and Woods (2008) describe the recent discovery and status of breeding Tricolored Blackbirds at a single location in western Nevada (Douglas County), and report that there was no confirmed breeding in Nevada prior to 1996. However, Wheelock (1904) described the distribution of the species in the early 1900s, and reported that in the vicinity of Lake Tahoe, "these birds stray across the crest, but not in the numbers in which they are found westward." The species was also reported to have bred in the vicinity of Lake Tahoe in the early 1900s (Dawson 1923) and Hosea (1986) reported a breeding colony in Carson City, Nevada in 1980.

In the early 1900s, the Tricolored Blackbird occurred in northwestern Baja California south to about the 30th parallel north (Grinnell 1928). This is consistent with recent breeding records from the southern extreme of the species range near El Rosario (Erickson et al. 2007, Feenstra 2013), although since at least 2016 there has been a retraction from the southernmost portion of the range.

The above historic accounts from the periphery of the range are largely consistent with the current range of the species, and overall, the range of the Tricolored Blackbird has changed little since at least the mid-1930s (Beedy et al. 2017). However, the species appears to be experiencing a range retraction in the southern California portion of the range and in Baja California, as discussed below.

Distribution

There are no descriptions of the distribution of the Tricolored Blackbird before the widespread conversion of native habitats across much of its range in California. However, accounts by early naturalists in California provide several records of the Tricolored Blackbird in the 1800s and early 1900s that document the local abundance, and to some extent, the distribution of the species prior to any systematic study of the species across its range.

The early anecdotal reports from the 1800s and early 1900s, although typically not quantitative, informed the historical distribution of birds and demonstrated the occurrence of large numbers regionally. Most early observations of large numbers of birds were from the Central Valley and southern California, and only small numbers of birds have occurred north of the Central Valley, both historically and in recent years. Therefore, this report discusses changes in distribution for the Central Valley and for southern California, which have supported the majority of the population and for which adequate information is available to assess long-term changes in distribution.

Central Valley

In 1852, Heermann reported frequent encounters with winter flocks of Tricolored Blackbirds in the Suisun Valley that numbered "so many thousands as to darken the sky for some distance by their masses" (Baird et al. 1874). The Tricolored Blackbird was known to be an abundant breeder in the interior valleys of California in the late 1800s (Bendire 1895). Belding (1890) observed "an immense colony" near Stockton in 1879. Ray (1906) noted the species breeding at various points on an automobile trip down the San Joaquin Valley from Stockton to Porterville in 1905. Linton (1908) observed a breeding colony at Buena Vista Lake at the southern edge of the Central Valley in 1907. Lamb and Howell (1913) reported seeing "hordes" of Tricolored Blackbirds at Buena Vista Lake in 1912. Dawson (1923) reported the species as "locally abundant in the Great Interior [Central] Valley."

Neff (1937) was the first to attempt to document the rangewide status and distribution of Tricolored Blackbirds. Over a six-year period from 1931 to 1936, Neff located breeding colonies throughout the Central Valley and at a few additional locations in California and southern Oregon; however, Neff's surveys focused on the Sacramento Valley in most years. Based on his somewhat geographically limited efforts, Neff (1937) reported nesting birds in 26 California counties over the six-year study. During this period, the rice-growing areas of the Sacramento Valley appear to have been the heart of the Tricolored Blackbird's distribution, although this may be due to survey efforts being focused there and the limited effort applied further south in the San Joaquin Valley.

Bent (1958) reported that the center of abundance for the species seemed to be in the San Joaquin Valley. Orians and Christman (1968) reported that the largest colonies occurred in the rice-growing districts of the Central Valley (mainly the Sacramento Valley and northern San Joaquin Valley). Neither of these reports were based on systematic surveys of the valley and have limited utility in documenting species distribution, other than that the majority of the population continued to occur in the Central Valley.

The distribution of colonies encountered over a five-year period by DeHaven et al. (1975b) was similar to that observed 35 years earlier by Neff (1937). DeHaven et al. (1975b) reported that 78% of colonies located between 1968 and 1972 were in the Central Valley. Most colonies and breeding birds were found in the Sacramento and northern San Joaquin Valleys, including Butte, Colusa, Glenn, Yolo, Sacramento, Merced, and Stanislaus counties. In the 1980s, the largest colonies and the majority of the known population continued to breed in the Sacramento and northern San Joaquin valleys (Hosea 1986, Beedy et al. 1991), although survey effort remained limited in the southern San Joaquin Valley.

An apparent early nesting season shift in distribution from the Sacramento Valley to the southern San Joaquin Valley occurred at the end of the 20th century. Although breeding had been documented in the San Joaquin Valley since the 1800s, this region had not been the focus of intense monitoring efforts prior to the 1990s. DeHaven et al. (1975b) reported that areas with suitable nesting substrates were scarce in the arid southern San Joaquin Valley in the 1970s. As described above, loss of native wetland breeding habitat had resulted in a shift to novel nonnative vegetation types beginning by the 1970s, and the distribution shift away from the Sacramento Valley is presumably in part due to these changes in nesting substrate availability. In the early 1990s, Tricolored Blackbirds were discovered breeding in grain fields in the San Joaquin Valley (Hamilton et al. 1992, Hamilton 1993). This discovery corresponded to an increase in the number of dairies and the associated expansion of triticale in the San Joaquin Valley as dairies began growing this new crop for silage. By 1994, most of the largest colonies and 40% of known breeding birds in the early part of the breeding season were found in the southern San Joaquin Valley associated with dairies and cattle feedlots (Hamilton et al. 1995). Relatively little triticale had been planted for silage in the San Joaquin Valley by 1994, but by 2005 the planted acreage had grown to about 75,000 acres (304 km^2) (Aksland and Wright 2005).

The shift in distribution to the San Joaquin Valley during the early breeding season has persisted, with very large proportions of the population nesting in a few large “mega-colonies” on or adjacent to dairies in the San Joaquin Valley (Kelsey 2008). In 1994, 68% of the estimated population in the early nesting season occurred in the San Joaquin Valley; this increased to 86% and 89% by 2008 and 2011, respectively (Hamilton et al. 1995, Kelsey 2008, Kyle and Kelsey 2011). In 2011, the 10 largest colonies were in the San Joaquin Valley during the early season survey (Kyle and Kelsey 2011). Breeding sites on triticale and other silage crops are also generally near other important habitat features, including irrigated pasture, grassland, or alfalfa crops for foraging, and available open water. The degree to which the apparent shift from the Sacramento Valley to the southern San Joaquin Valley is due to the loss of nesting habitat, the availability of a novel nesting substrate (i.e., triticale) and foraging habitat (i.e., alfalfa), or an increase in survey effort in the San Joaquin Valley is unknown (DeHaven 2000). Nevertheless, there has been a consistent use of the region by a majority of the Tricolored Blackbird population since the mid-1990s (Figure 8). The proportion of the population breeding in the San Joaquin Valley during the early part of the breeding season dropped to about 52% in 2014. This drop was in part due to increases in the number of birds in the Sacramento Valley, including the Sierra Nevada foothills, and southern California, but was primarily the result of a large rangewide decline, with most of the decline in number of birds occurring in the San Joaquin Valley (see the Regional Shifts in Abundance section). In 2017, the proportion of birds nesting in the San Joaquin Valley in the early breeding season returned to almost 70% (Meese 2017).

The grasslands and pastures of southeastern Sacramento County have seen consistent use by breeding Tricolored Blackbirds for at least the last 80 years (Neff 1937, DeHaven et al. 1975b, Hosea 1986, Beedy et al. 1991, Cook and Toft 2005, Airola et al. 2016), even as the dominant nesting substrate in the region has shifted from native wetlands to Himalayan blackberry (see Nesting Substrate section). DeHaven et al. (1975b) described the pasturelands of southern Sacramento County as the most consistently used area during a five-year study. Until recently, little emphasis has been placed on monitoring Tricolored Blackbird colonies in the Sierra Nevada foothills and grasslands/pasturelands of the eastern Central Valley relative to population centers in the Central Valley and in southern California. Observations of colonies from this region during statewide surveys have usually been lumped with the Central Valley for reporting purposes. Starting in 2014, these grasslands in the low elevation foothills have received focused monitoring as a distinct breeding area (Airola et al. 2015a, 2015b, 2016), with regular use reported for not only Sacramento County, but also from Butte County in the north to Stanislaus County in the south. In 2016, precipitation patterns supported growth of milk thistle patches across extensive areas in the foothills further south as far as Fresno County, resulting in breeding by more than 22,000 birds that had not been observed in the region in the two previous years (Airola et al. 2016). When milk thistle is available for nesting by Tricolored Blackbirds, this nonnative plant may extend the distribution of the species into the southern Sierra Nevada foothills.

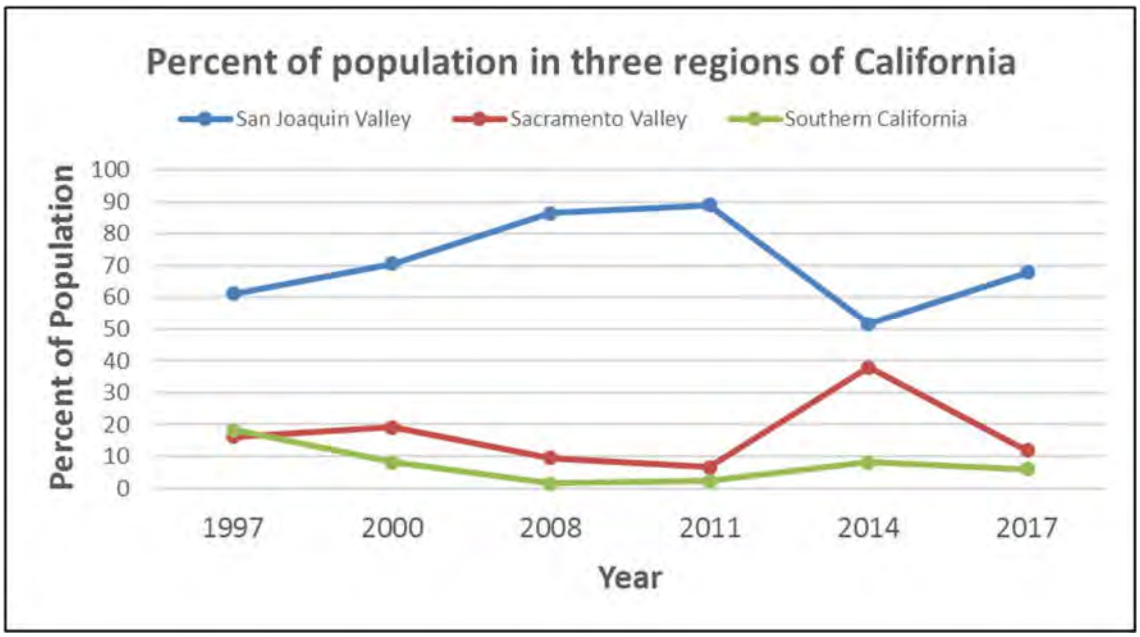


Figure 8. Percent of the Tricolored Blackbird population in three regions of the state during statewide surveys. Regions are defined as in Kelsey (2008): Southern California includes the Mojave Desert and the region south of the Transverse Ranges. Sierra Nevada foothill colonies are lumped with either the Sacramento Valley or the San Joaquin Valley, depending on latitude.

Distributional shifts may have occurred within the Central Valley, and some areas of the valley that once supported large numbers of birds now support few or no breeding colonies, while other areas appear to have become much more important. Changes in distribution may be due in part to shifting of birds to new areas, but may also be due to a declining population and associated loss from some areas. Despite these changes, the Central Valley and surrounding foothills as a whole have supported the majority of the Tricolored Blackbird population both historically and in recent years. Additional information on use of the Central Valley is presented in the Regional Shifts in Abundance section.

Southern California and Baja California

The first Tricolored Blackbird specimen was collected by Nuttall near Santa Barbara in 1836 (Baird et al. 1874, Bent 1958). Although he did not observe breeding colonies, Nuttall reported that the Tricolored Blackbird was very common around Santa Barbara and Monterey in the month of April (Nuttall 1840). In the mid-1800s, Cooper (1870) found the Tricolored Blackbird to be the most abundant species near San Diego and Los Angeles, and they were not rare near Santa Barbara. In the late 1800s, the species was described as an abundant winter resident in Los Angeles and Orange counties, occurring in very large flocks, with several colonies known to breed in tule marshes up to 1,500 feet (457 m) in elevation (Bendire 1895). Grinnell (1898) reported the species to occur in "considerable numbers" throughout the lowlands of the Pacific slope of Los Angeles County, and Willett (1912) considered the species a common resident throughout the lowlands of coastal southern California. Dawson (1923) reported the species as "locally abundant…in the San Diegan district."

There is evidence that the Tricolored Blackbird had experienced declines in a large portion of its range in southern California, even by the 1930s. In a revision of his former description of the species' status in coastal southern California, Willett (1933) described the species as a "formerly common resident…Now rare throughout former range in southern California, excepting in some sections of San Diego County." Grinnell and Miller (1944) described the status of the Tricolored Blackbird as "common to abundant locally" but noted a general decrease in southern California.

In 1980, the Tricolored Blackbird was characterized as a fairly common resident in the southern California coastal district that bred locally in all coastal counties (Garrett and Dunn 1981). The species no longer occurs at many historical sites in coastal southern California. Small numbers of breeding birds were documented at a few locations in coastal Santa Barbara County through the 1970s, with the last known colony of 200 birds in 1979 (Lehman 1994, Tricolored Blackbird Portal 2017). The last known colony in Ventura County, of 53 birds, occurred in 1994. About 200 birds persisted as breeders in the portion of Los Angeles County south of the Transverse Ranges through the 1990s, with the last known breeding attempt in 1999 (Allen et al. 2016, Tricolored Blackbird Portal 2017). Several hundred breeding birds occupied multiple sites in Orange County through the 1990s, but only a single colony of 14 birds has been observed breeding in the county in two years since 2000. The highly urbanized coastal portion of San Diego County, which supported thousands of breeding birds through at least the 1970s, has supported less than a thousand breeding birds at only three locations since 2000 (Tricolored Blackbird Portal 2017). Very few Tricolored Blackbirds now breed in the coastal lowlands of southern California where they were once abundant (Garrett et al. 2012).

Approximately 60–80% of the southern California population (south of the Transverse Ranges) nests in the San Jacinto Valley of western Riverside County in most years (Cook 2010). This area supports the Department's San Jacinto Wildlife Area and one of the last remaining agricultural communities in southern California. The numerous dairies in the valley along with the wetlands and grasslands of the Wildlife Area constitute the last stronghold for breeding Tricolored Blackbirds in southern California. Currently, nearly all farmland in the valley is slated for large scale residential and commercial development.

The status of the Tricolored Blackbird population in Baja California has followed a similar pattern to that for southern California. In the late 1800s, the species was described as "rather common along the northwest coast [of Baja California], breeding in all fresh water marshes" (Bryant 1889). Grinnell (1928) described the species as a "Fairly common resident locally in the northwestern section of the territory, north from about 30 degrees." In the 1980s, the species was described as a "local resident in northwestern Baja California south to El Rosario" (Wilbur 1987). A search of the entire Baja California range turned up a single breeding colony of 80 birds in 2007 (Erickson et al. 2007) and four breeding colonies totaling 240 birds in 2008 (Erickson and de la Cueva 2008). A follow-up survey several years later located three breeding colonies supporting an estimated total of 240–340 birds (Feenstra 2013). In recent years, most breeding in Baja California has occurred in the north within about 70 miles (113 km) of the U.S. border. Breeding continued at a disjunct area at the historical southern extent of the species' range (about 100 miles [160 km] farther south than the next nearest breeding location) near El Rosario through at least 2013 (Erickson and de la Cueva 2008, Feenstra 2013). By 2016 all known breeding colonies occurred within about 12 miles (19 km) of the U.S. border (Erickson et al. 2016). In 2017, the only known breeding colonies occurred within 5 miles (8 km) of the U.S. border and eight nonbreeding Tricolored Blackbirds were observed at a historic breeding site about 70 miles (113 km) south of the U.S. border. No birds were observed south of this point, leaving the southernmost 100 miles (160 km) of the species range in Baja California apparently unoccupied (April 2017 email from R. Erickson to N. Clipperton; unreferenced).

Where previously abundant and widespread south of the Transverse Ranges, the distribution of breeding colonies is now mostly restricted to inland sites in western Riverside and San Bernardino counties, and in the interior of San Diego County (Feenstra 2009). This represents a long-term decline in southern California and Baja California, with remnant colonies disappearing in recent decades throughout much of the southern range (Figure 9), including much of coastal southern California and the majority of the historical range in Baja California (Erickson et al. 2016). This may represent a permanent breeding range retraction from portions of the range where the species was previously abundant, and is likely the result of ongoing urban development and declines in population numbers.

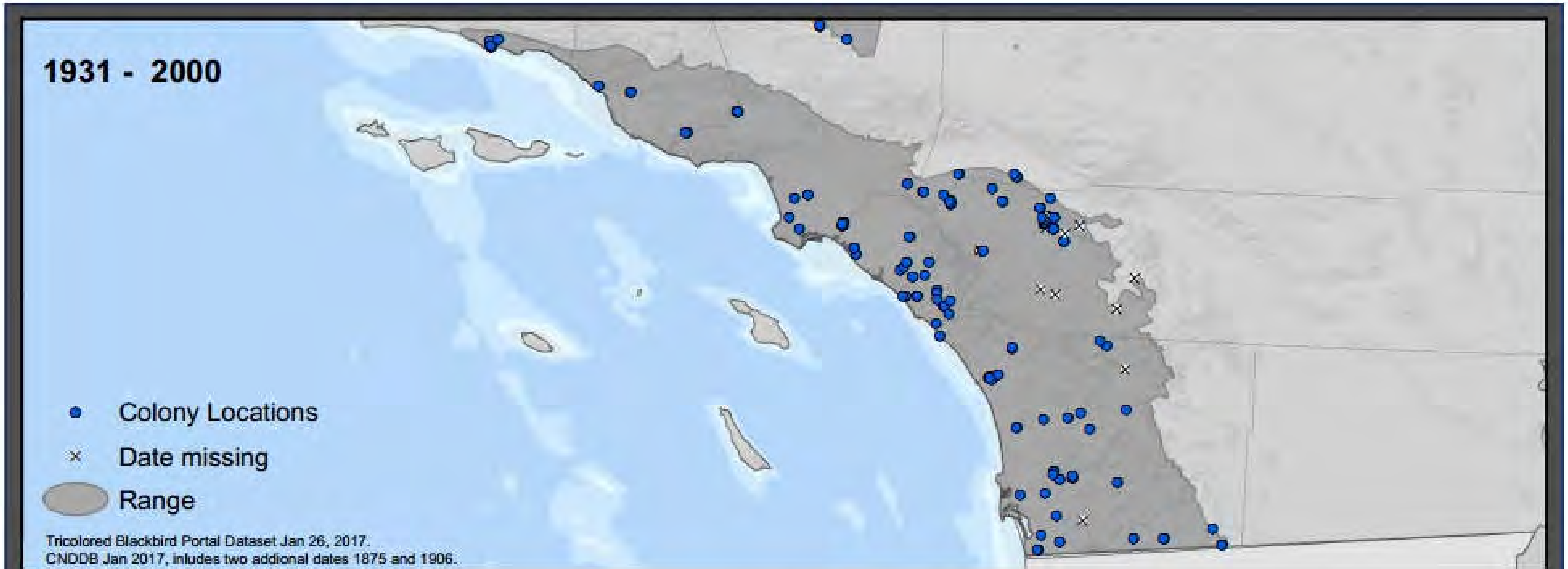
Allen et al. (2016) reported that nesting commenced late in the 20th century in the Mojave Desert portion of northern Los Angeles County, and attributed this to manmade reservoirs and other impoundments, but breeding by small numbers of birds was known for the area since at least the 1970s (DeHaven et al. 1975b, Beedy et al. 1991). The species was known to occur in the Mojave Desert since at least 1890, but breeding was not documented (Belding 1890). The region has not supported more than a few thousand breeding birds in any year.

Population Trend

Breeding Population

Assessments of the rangewide population abundance of the Tricolored Blackbird prior to the 1990s are restricted to published literature describing research by a limited number of individuals in the 1930s (Neff 1937) and an additional rangewide assessment using similar methods in the 1970s (DeHaven et al.

a)



b)

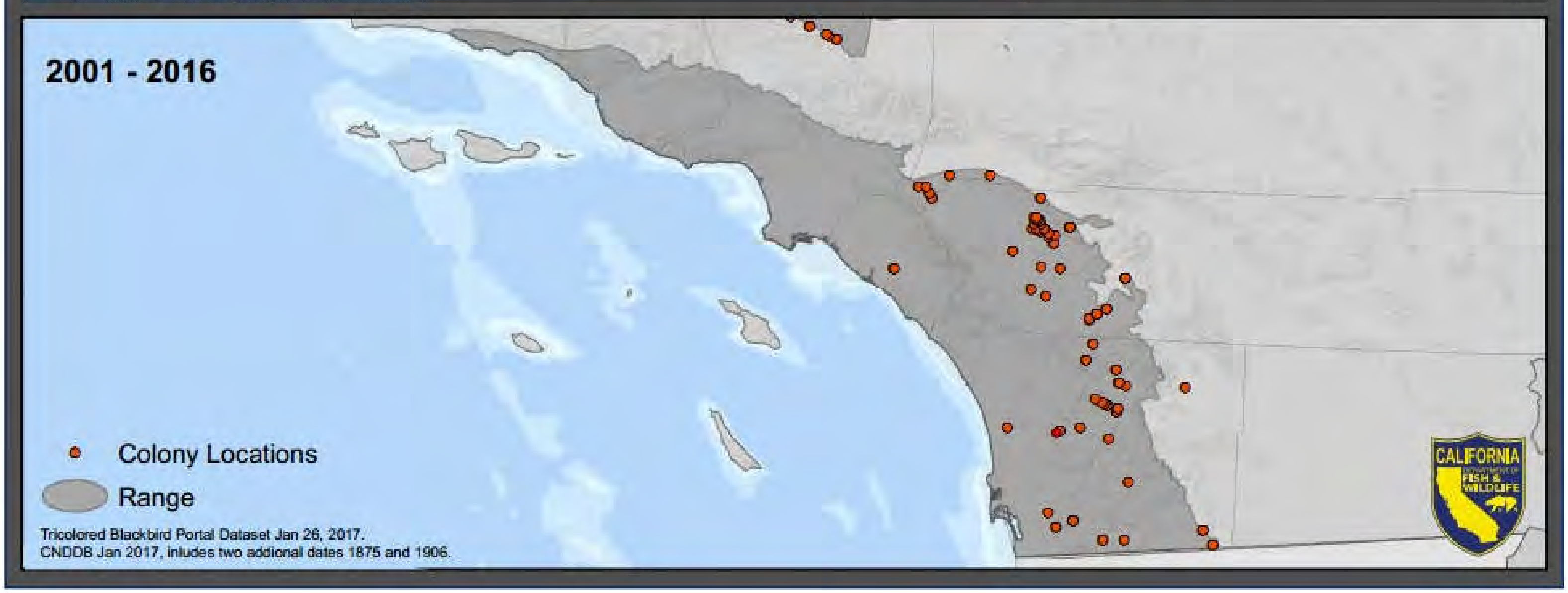


Figure 9. Distribution of active breeding colonies in southern California south of the Transverse Ranges. a) 1931–2000. b) 2001–2016.

1975b). An additional recent published study used all available breeding colony data collected over more than 100 years (1907–2009) to evaluate changes in average colony size (Graves et al. 2013). The most intensive efforts to estimate rangewide population abundance have occurred since 1994, with results presented in reports prepared by academic researchers, Audubon California biologists, and in contractor reports prepared for the USFWS and the Department. These represent the best available information for assessing trends in the rangewide population over the last two decades. The North American Breeding Bird Survey (BBS) provides one of the primary sources of data for evaluating relative abundance and population trends for North American landbirds (Hudson et al. 2017). Unfortunately, a species that breeds in large colonies and shifts in location on the landscape from year to year is not expected to be well-represented in BBS data. The data for Tricolored Blackbird have been identified to have deficiencies (Sauer et al. 2017a) and therefore are not a good source of information on abundance or population trends.

Over a period of six years (1931–1936), Neff (1937) surveyed Tricolored Blackbird colonies across California. Neff located several breeding colonies of more than 100,000 nests in the Sacramento Valley, with the largest composed of greater than 200,000 nests (corresponding to approximately 300,000 adult Tricolored Blackbirds). Breeding colonies were located throughout the Central Valley and in a few additional locations in California and southern Oregon; however, Neff's surveys focused on the Sacramento Valley in most years. An effort to cover the entire known range of the species was attempted by Neff in only one year (1932). Most areas outside the Sacramento Valley were covered only incidentally as "cooperators drove up or down the State in the performance of routine duties," and in the regions of the state that were most thoroughly surveyed, it was impossible to make complete surveys of all possible locations (Neff 1937). Neff concluded that obtaining an estimate of the statewide population was not possible. Working alone in 1934, Neff observed an estimated 491,250 nests (about 737,000 breeding birds), almost all of which were in the Sacramento Valley. The presence of birds in the San Joaquin Valley and southern California was noted in the same year, but no effort was made to estimate numbers. Several authors have cited Neff (1937) in statements about the Tricolored Blackbird population in the 1930s, sometimes suggesting that the population numbered in the millions (e.g., Beedy et al. 1991, Hamilton et al. 1995, Kyle and Kelsey 2011). Neff himself did not attempt to extrapolate his results to a region-wide estimate, although the roughly 737,000 breeding birds observed in a single year is likely an underestimate of the population at the time.

No attempts were made to describe the Tricolored Blackbird distribution or abundance during the 1940s, 1950s, or most of the 1960s. From 1969 to 1972, DeHaven et al. (1975b) attempted to survey the entire range of the Tricolored Blackbird to document the distribution of the species and to compare estimates of abundance to those provided by Neff (1937). The surveys were carried out by a few individuals surveying vast areas by road, and in most areas were limited to one or two drives through each county where Tricolored Blackbirds were known to occur in California and southern Oregon. Still, the search effort was at least as extensive as that carried out by Neff in the 1930s, and included the benefit of improved transportation and an increased number of roads. In many counties the survey consisted of driving county roads with little knowledge of historical colony sites, but this was an improvement over much of the effort of the 1930s, when counties were considered covered if visited incidental to other activities. Despite a greater search effort, all measures of abundance indicated a decline: the number of active colonies detected per year declined from 43 to 41; nonbreeding birds encountered declined from >50,000 in a single year to <15,000 over four years; maximum colony size declined from hundreds of thousands to tens of thousands of birds; and number of birds observed per year within the study period declined from about 375,000 per year to about 133,000 per year (DeHaven et al. 1975b). Although no population estimate was provided, the authors suggested that the Tricolored Blackbird population declined by more than 50% in 35 years. Like Neff three decades before, DeHaven et al. (1975b) were unable to cover the entire range of the species thoroughly, including large portions of the southern San Joaquin Valley.

Following more than a decade with no survey to assess the statewide population, Beedy et al. (1991) compiled all historical records of Tricolored Blackbird breeding colonies and conducted limited field surveys from 1986 to 1990 to evaluate long-term population trends. Bill Hamilton and others (Hamilton et al. 1992, Hamilton 1993) conducted ecological investigations in 1992 and 1993 that included documentation of colony locations and sizes, the discovery of large breeding colonies on grain fields in the San Joaquin Valley, and the initial observations that suggested Tricolored Blackbirds are itinerant breeders (Hamilton et al. 1995). Based on the increased understanding of the species' biology and distribution, a new approach to estimating the statewide population of Tricolored Blackbirds was proposed by Ted Beedy and Bill Hamilton (Hamilton 1998, Meese 2015a). The discovery of itinerant breeding with broad movements between nesting attempts made it clear that a survey of the statewide population should occur during a narrow window in order to maximize the likelihood of detecting nesting colonies and to avoid double-counting birds (Hamilton et al. 1995, Beedy and Hamilton 1997). A survey conducted in a minor portion of the range or carried out over a long time period would either miss breeding colonies or double count birds over multiple breeding attempts. An improved understanding of colony occupancy dynamics suggested a need for early season colony-detection efforts to locate active colonies (Hamilton et al. 1995), while also considering the compiled information on all historical breeding locations in order to visit as many potential breeding locations as possible.

The new approach to surveying the statewide population was first implemented during the 1994 breeding season. The survey was conducted on a single day in the early part of the season (April 23). The choice of a survey date is an effort to select a time period when most birds have initiated a first nesting attempt and can be detected and counted at breeding colony sites, but before the first breeding cycle is completed and birds have moved to the north (usually) for the second breeding attempt. The goal of the survey was to conduct as complete a population census as possible by visiting as many known breeding locations (historical and recent) as possible, documenting occupancy status, and estimating colony size at all occupied locations. This was also the first survey to be largely volunteer-based and to enlist a large number of observers over a narrow time period. Compared to the surveys of the 1930s and 1970s, these surveys employed many more surveyors to more thoroughly cover as much of the state and known colonies as possible. The discovery of breeding by a large proportion of the population on silage fields near dairies had recently been documented (Hamilton et al. 1992, 1995), and therefore unlike previous statewide survey efforts, the 1994 survey focused heavily on the San Joaquin Valley.

After the establishment of the new approach to conduct a statewide survey, attempts to census the population were carried out in 13 years between 1994 and 2017. Despite a consistent approach in many of the early years of this time period, methods varied considerably for many of these surveys. The years 1994, 1997, and 2000 produced a set of three triennial surveys that were considered to have been comparable in effort by the survey organizers (Beedy and Hamilton 1997, Hamilton 2000, Cook and Toft 2005). After a period of years with surveys that followed inconsistent and variable approaches, another set of four triennial surveys were conducted using similar methods in 2008, 2011, 2014, and 2017 (Kelsey 2008, Kyle and Kelsey 2011, Meese 2014a, Meese 2017). The effort and results of these seven surveys are summarized in Table 2. Although the other six survey years (1995, 1996, 1999, 2001, 2004, and 2005) are not discussed further here, they are briefly summarized in Table 3 and in a larger discussion of Tricolored Blackbird surveys included in Appendix 1.

Due to small changes in methods over time and the inherent difficulties in estimating population abundance of a colonial, itinerant breeding bird species, there are several potential sources of uncertainty in the population estimates from statewide surveys. Attempts to quantify this uncertainty have been limited and inconsistent across survey years. Traditional survey sampling designs would likely produce biased estimates of population size due to the colonial breeding and the unpredictable distribution of Tricolored Blackbird colonies from year to year, and new approaches to surveying the population are being explored. Comments on the approach used to estimate the size of the population during recent statewide surveys, along with a discussion of uncertainty, are provided in Appendix 2.

Table 2. Comparison of survey effort and results for seven statewide surveys.

Year	Duration	Number of observers	Number of counties surveyed (occupied)	Number of sites surveyed (breeding sites)	Occupied breeding locations	Estimated number of birds
1994	1 day (3 days)[1]	60[2]	– (32)	–	100	369,400
1997	1 day (3 days)[1]	55[2]	– (33)	–	71[3]	232,960
2000	4 days	81[2]	33 (25)	231 (181)	72	162,000
2008	3 days	155	38 (32)	361 (284)	135	395,000
2011	3 days	100	38 (29)	608	138	259,000
2014	3 days	143	41 (37)	802	143	145,000
2017	3 days	181	44 (37)	884	168	177,700

[1] Observations of birds not associated with colonies from one day before and after the survey day were accepted, effectively expanding the survey window to three days.
[2] Number includes participants who submitted written reports. A larger number of volunteers may have searched for birds.
[3] As reported by Hamilton (2000).
"—" = data not reported

The statewide survey efforts in 1994, 1997, and 2000 followed similar methods to locate and survey as many colonies as possible. Although the duration of the survey and the survey effort varied across these years, the organizers of the surveys reported these three surveys had used the most consistent methods to date and could be compared to assess the population trend (Beedy and Hamilton 1997, Hamilton 2000). However, inconsistencies in effort still occurred with the 1994 survey conducting only a limited survey of southern California, and the 2000 survey using more observers to visit more sites than the other two survey years. Therefore there was a general increase in survey effort and geographic coverage each year. Despite this, Hamilton (2000) reported that the San Joaquin Valley, with its potentially large silage colonies, was not surveyed completely. However, he concluded that "…the method of the Census and the survey, to reinvestigate all known breeding places and to search for new ones, has become an increasingly complete assessment of Tricolored Blackbird distribution and abundance. The 2000 Census probably located a greater proportion of the entire population than did censuses in previous years." The estimated number of birds declined 56% from 369,400 birds in 1994 to about 162,000 birds in 2000 (Hamilton 2000, Cook and Toft 2005). In addition to the results of the surveys showing declines in the 1990s, Hamilton (2000) stated that personal observations over long intervals by many regional experts had also suggested declines during this time period.

Table 3. Brief descriptions of 13 surveys that attempted to estimate the size of all or a portion of the Tricolored Blackbird population between 1994 and 2017.

Survey year	Description of survey	Sources
1994	The first year a statewide survey was conducted in a narrow time period, was informed by knowledge of historical breeding locations and by pre-survey colony detection work, and enlisted the help of a large number of volunteers.	Hamilton et al. (1995) Beedy and Hamilton (1997)
1995 and 1996	Limited pre-survey effort. Incomplete county coverage. Large colonies may have been overlooked. Results are not considered representative of the total population.	Beedy and Hamilton (1997)
1997	Used the same coverage, methods, and personnel as did the 1994 survey. Participation was greater than in 1994.	Beedy and Hamilton (1997)
1999	Participation in the survey was low. Results considered an underestimate of population size by the survey organizer.	Hamilton et al. (1999, 2000) Hamilton (2000)
2000	Used the same methods applied in 1994 and 1997, although a greater number of observers were used to visit more locations. Training was provided to participants. Surveys from 1994, 1997, and 2000 were considered comparable.	Hamilton (2000)
2001	Followed a very different approach compared to standardized methods used since 1994. A limited number of sites were visited and estimates were compiled from observations made throughout the breeding season.	Humple and Churchwell (2002)
2004	Not intended to provide an estimate of the statewide population size that was comparable to previous surveys. Surveys limited to colony sites that had historically supported more than 2,000 birds. Focused on sites in the Central Valley.	Green and Edson (2004)
2005	No report was produced and no record is available describing the survey effort.	Meese (2015a)
2008	Used similar methods as in the 2000 survey, although estimates not adjusted using nest density. Also, county coordinators were used for the first time to ensure each county was well surveyed by volunteers. Maps with all survey locations were provided for the first time, and a website improved communication and data management. Number of survey participants and number of sites surveyed greatly increased relative to earlier surveys.	Kelsey (2008)
2011	Methods followed those used in 2008, although county coordinators were not used to lead surveys in individual counties.	Kyle and Kelsey (2011)
2014	Used the same methods as in 2008 and 2011, and again used county coordinators to ensure each county was thoroughly covered. The number of counties and number of sites visited exceeded all other surveys to date.	Meese (2014a)
2017	Used the same methods as in 2008–2014, with the addition of a mobile map application that assisted in location of sites. The number of survey participants and the number of counties and sites visited exceeded all other surveys to date. Surveys conducted 2008–2017 are considered comparable, although interpretation must account for increase in effort over time.	Meese (2017)

As during the early set of survey years, the survey effort increased each year from 2008 to 2017. More counties were surveyed in 2014 than on any previous survey and the number of observers participating on the 2014 survey (n = 143) was exceeded on only one previous survey (n = 155 in 2008). There was a large increase in the number of sites visited in each survey year between 2008 and 2014, and the number of colony sites visited in 2017 exceeded that of any other survey (Figure 10). The 2017 survey was the most extensive survey conducted to date based on all available metrics of effort (Table 2). The number of birds estimated on statewide surveys declined 63% from 395,000 birds in 2008 to an all-time low of about 145,000 birds in 2014 (Kelsey 2008, Meese 2014a) (Table 2). From 2014 to 2017, the estimated number of birds increased 22% to about 177,700. The number of birds observed in 2017 represents a 55% decline in the population over the nine years since 2008. The observed decline occurred despite large increases in the number of confirmed colony locations surveyed in each successive survey.

Although the conclusion following each of the two groups of survey years (1994–2000 and 2008–2017) was that a population decline had occurred, differences in survey methods and effort make it difficult to combine the two groups of surveys to make longer-term conclusions (Meese 2015a). Does the estimated number of birds in 2008 represent an increase in population size following the decline of the 1990s, or do increased survey effort and other changes to survey methodology preclude comparison of results from the two survey periods? In addition to differences in duration of the survey, geographic scope, and effort shown in Table 2, there were important differences in methods used between the two groups of surveys (see Appendix 1). Methods unique to the earlier 1994–2000 surveys include: 1) birds counted at colonies before the survey were included in the results if the colony remained active after the survey period (although not counted on the survey day); 2) birds observed and counted at colonies after the survey were included if nest phenology led to a conclusion that the colony was active on the survey date (although not observed); and 3) visual colony size estimates were often adjusted using observed nest densities, as determined by walking transects through colony sites after the survey, which resulted in final colony size estimates that in some cases differed substantially from those reported by survey participants (Hamilton et al. 1995). Unfortunately, the overall impact (both the magnitude and direction) of these methodological differences on the population estimates is unknown, and therefore a direct comparison of results from the two time periods is not appropriate. However, Hamilton et al. (1995) reported that the adjustment of estimates using nest densities at large colonies resulted in less than a 15% change in any colony size estimate. At a minimum, the large step change in survey effort between the two time periods must be taken into account if the data are to be used to inform a longer-term population trend.

As shown in Table 2, the individual metrics of survey effort were not consistently reported across survey years. The number of sites surveyed has been used to describe survey effort in recent years (Meese 2014a, 2015, 2017), but this number is not known for the surveys conducted in the 1990s. The number of counties surveyed was also not reported for surveys conducted in the 1990s. The number of participants and the number of occupied breeding locations were reported for all survey years. It is not known whether an increase in effort as measured by any of these metrics results in a proportional increase in the number of birds observed, but Graves et al. (2013) reported that total counts of breeding

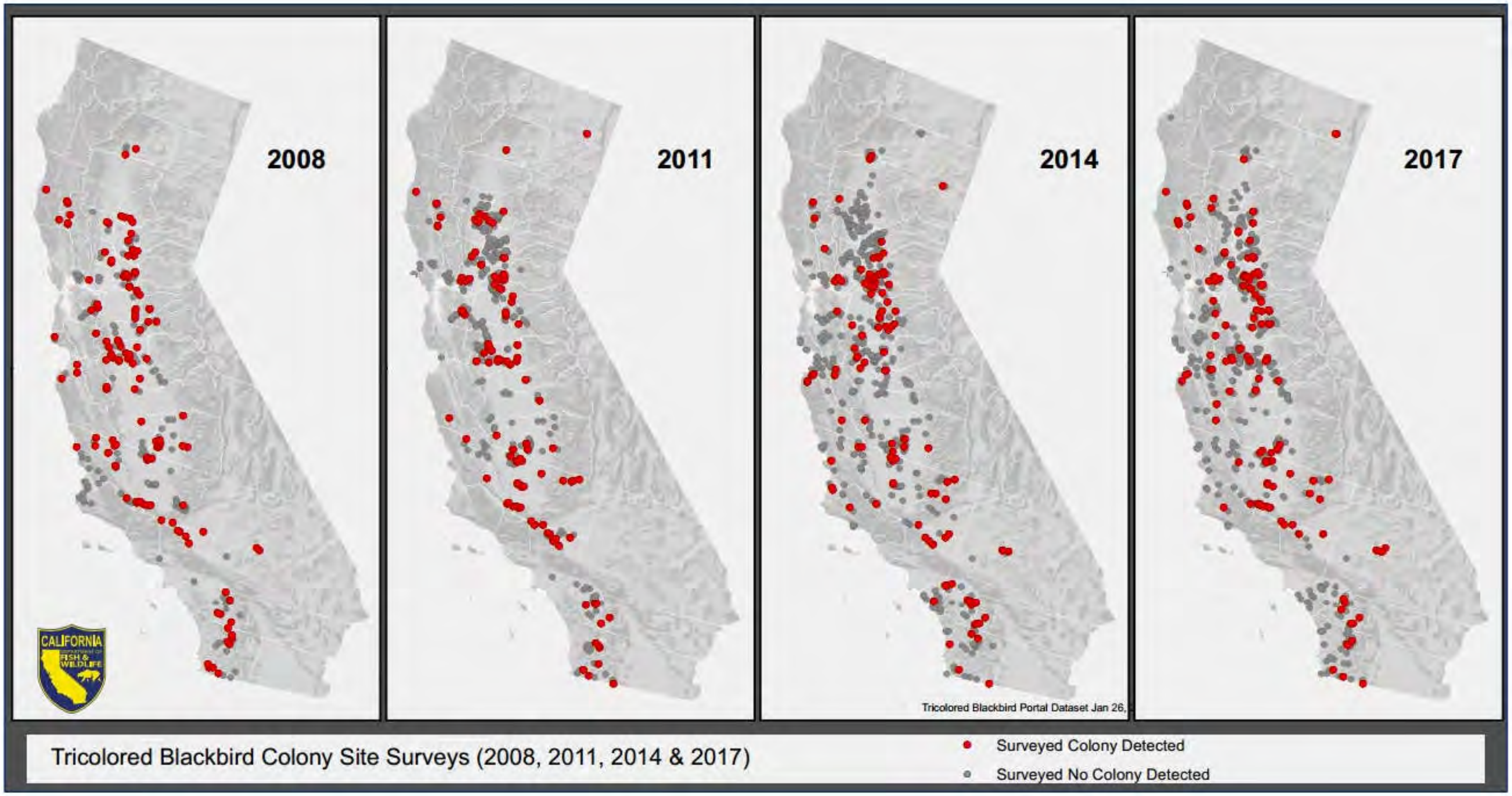


Figure 10. Locations surveyed during statewide surveys conducted since 2008. Red circles indicate occupied breeding locations. Gray circles indicate surveyed locations that were not occupied.

birds are correlated with the number of sites sampled. The number of sites sampled is also related to the proportion of the landscape searched by survey participants (Figure 10) and therefore might be the most appropriate metric of effort with which to standardize survey results.

In order to make use of as many survey years as possible to evaluate population trend over time, survey results were adjusted for effort when available (Figure 11a-c). Viewed as a whole, when adjusting for survey effort the results suggest a consistent pattern in the Tricolored Blackbird population since 1994. Regardless of the metric used to adjust population estimates for survey effort, the trend shows a long-term decline over the 23-year period with a partial recovery between 2000 and 2008[1]. Depending on the metric used to correct for effort, either 2014 or 2017 represents the all-time low for effort-adjusted number of birds observed.

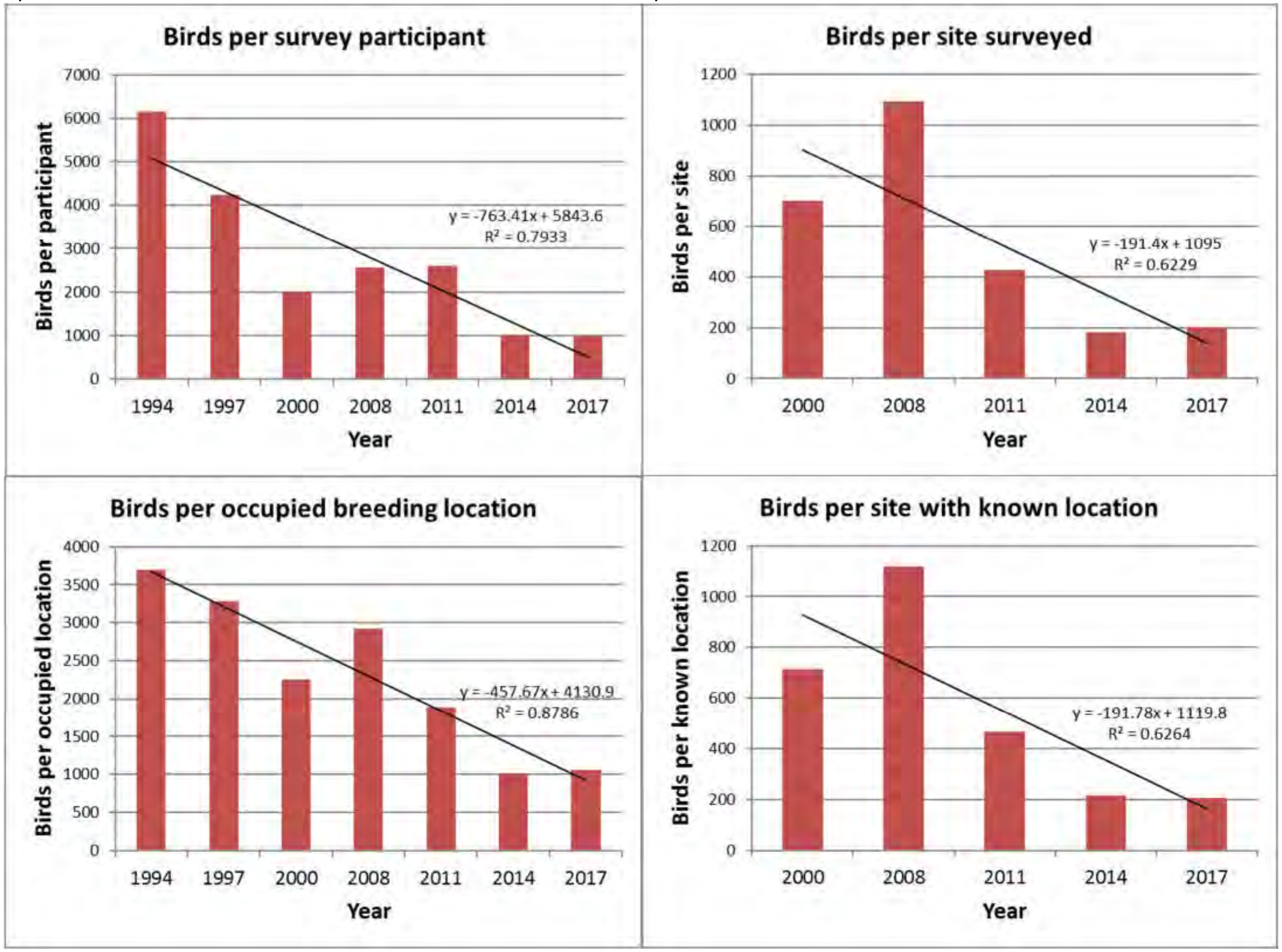
As the number of locations visited has increased with each successive statewide survey, so too has the number of locations with some uncertainty regarding the exact location. These are historical breeding locations for which the exact coordinates were often not reported, and therefore the level of confidence is recorded as "uncertain" in the Tricolored Blackbird Portal database (2017). As a result, surveyors have visited an increasing number of locations that have not necessarily supported Tricolored Blackbird breeding in the past (Table 4). This is not wasted effort, as the visits to uncertain locations increase the size of the landscape area searched for colonies during the survey (Figure 10), and the locations are likely near historical colony sites. Nevertheless, for the 2017 survey, participants were directed to focus on sites with known coordinates, resulting in a large decline in the number of "uncertain" sites surveyed. To be conservative in interpreting changes in survey effort over time, the uncertain locations were removed from the count of sites visited during the 2000, 2008, 2011, 2014, and 2017 surveys to adjust the effort for those survey years (Table 4). The adjusted number of sites surveyed each year continues to show an increase in survey effort over time. A graph prepared using the revised number of sites surveyed (Figure 11d) revealed little effect on the pattern of birds observed per site shown in Figure 11b.

Table 4. Number of sites surveyed during recent statewide surveys, adjusted to remove uncertain locations.

Survey year	Number of sites surveyed	Number of uncertain sites	Revised number of sites surveyed
2000	231	4	227
2008	361	8	353
2011	608	54	554
2014	802	127	675
2017	884	25	859

[1] One peer reviewer questioned whether an increase in population size occurred between 2000 and 2008. Based on participation in surveys of the southern San Joaquin Valley from the early 1990s to 2005, and again in 2008, the reviewer made the following statement: "The changes [declines] were remarkable. I surveyed the whole of the breeding range of Tulare, Kings, Fresno, and Kern in 2004 and again in 2008, and could not believe the magnitude of change that had occurred in those years."

a) b)



c) d)

Figure 11. Number of birds observed per statewide survey conducted since 1994, corrected for level of survey effort.
a) Birds per participant: 90% decline over 23 years (**-9.6% per year**). b) Birds per site: 85% decline over 17 years (**-10.5% per year**).
c) Birds per occupied location: 75% decline over 23 years (**-5.8% per year**). d) Birds per known location: 83% decline over 17 years (**-9.8% per year**).

The linear regression trendlines for each of the effort-corrected survey results indicate that the Tricolored Blackbird population has declined by 75%–90% in the last 23 years (Figure 11). The observed rates of decline of 5.8% to 10.5% per year indicate that this species has been in severe decline over the last two decades. These rates of decline are in the range of the steepest declines observed across all North American landbird species based on Breeding Bird Survey data (Sauer et al. 2017b). Results of the most recent 2017 statewide survey suggest that the Tricolored Blackbird population decline may have slowed or reversed since 2014, but the population remains at or near its smallest size ever recorded. Coupled with the earlier declines between the 1930s and 1970s, the recent declines have resulted in a population that is a small fraction of its historical abundance.

Colony Size

In recent statewide survey years, the size of the largest colonies (including the single largest colony and the average of the several largest colonies per year) has been reported as an alternative metric to total counts of birds for tracking trends over time. Use of the size of large colonies to evaluate trends is only appropriate if the survey effort is sufficient to detect most of the largest colonies. Although the survey effort required to detect most of the largest colonies is unknown, Graves et al. (2013) reported that average colony size observed, based on colony data from 1907 to 2009, was not strongly correlated to the total number of sites sampled annually, suggesting that survey effort may have generally been sufficient to detect the largest colonies. Larger colonies may be more likely to be detected and therefore survey effort may have less effect on size of largest colonies observed compared to total counts of birds.

Neff (1937) located several breeding colonies of more than 100,000 nests in the Sacramento Valley, with the largest composed of greater than 200,000 nests (about 300,000 adult birds). Orians (1961a) reported that, in 1959 and 1960, there were four Tricolored Blackbird colonies larger than 100,000 adults; three were in the rice-growing area in Colusa and Yolo counties and one was in Sacramento County. The largest reported colonies in the 1970s were in Colusa and Yolo counties and comprised about 30,000 adults (DeHaven et al. 1975b, Beedy and Hayworth 1992). All but one of the colonies observed by DeHaven et al. (1975b) that were larger than 20,000 birds were located in the Sacramento Valley. In the 1980s, the largest reported colony was in the northern San Joaquin Valley at Kesterson Reservoir (Merced County) in 1986, with an estimated 47,000 adults (Beedy and Hayworth 1992).

After the discovery of Tricolored Blackbird breeding colonies on grain fields in the San Joaquin Valley in the early 1990s (Hamilton et al. 1995), the size of the largest colonies in several subsequent years once again grew to more than 100,000 birds (so-called “mega-colonies”). Beedy and Hamilton (1997) reported that 1994 and 1997 were the only two survey years to date with sufficient survey effort to detect “virtually all large colonies.” In 1994, Hamilton et al. (1995) found that the largest colony, at San Luis National Wildlife Refuge, numbered about 105,000 adult Tricolored Blackbirds. In 1997, Beedy and Hamilton (1997) reported the largest colony to contain about 80,000 adults. The documentation of large colonies during this time period is likely due in part to the formation of mega-colonies on grain fields, but may also be a result of increased survey effort in the San Joaquin Valley.

Colonies of at least 80,000 breeding birds continued to occur through 2010 (Meese 2009a, Meese 2010). From 2008 to 2017, maximum colony size declined from 80,000 to fewer than 20,000 birds (Kelsey 2008, Kyle and Kelsey 2011, Meese 2017). In 2014, only a single colony consisted of more than 20,000 birds and only three colonies consisted of 10,000 birds or more (Meese 2014a). The proportion of birds observed in the 10 largest colonies during the years 2008, 2011, 2014, and 2017 was 77% (306,000), 81% (208,800), 64% (93,000), and 55% (98,050) of the statewide population estimate for those years, respectively. This reflects a downward trend in the sizes of the largest colonies, without a large increase in the number of occupied breeding locations (Figure 12). The trend in the largest colonies from 1994 to 2017 is similar to those in Figure 11 for effort-corrected statewide survey results: a long-term decline over the 23-year period with a partial recovery between 2000 and 2008.

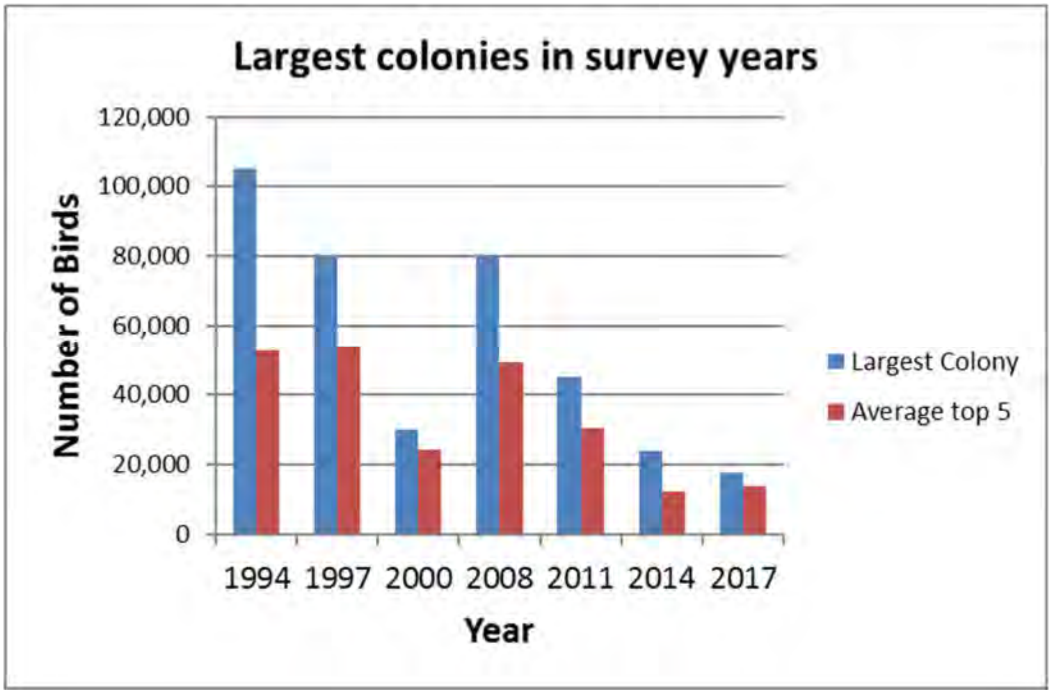


Figure 12. Size of the largest and average of the five largest colonies observed during statewide surveys conducted since 1994.

Graves et al. (2013) performed an evaluation of trends in the average size of Tricolored Blackbird colonies over a more than 100-year period (1907–2009) using data compiled from a variety of sources. Average colony size, rather than total abundance, was used as the metric to evaluate trends to account for the effects of variable sampling effort across years. Graves et al. (2013) found a significant decline in the average colony size from 1935 to 1975, with the average colony size declining by more than 60%. This corresponds to the period over which DeHaven et al. (1975b) concluded that the population size had declined by about 50%. Despite large amounts of data on colony sizes from the 1980s onward, no significant decline was detected in average colony size from 1980 to 2009. This finding is counter to reports of population declines for portions of the 1980–2009 period (e.g., Beedy et al. 1991, Hamilton 2000). However, the statistical evaluation conducted by Graves et al. (2013) used data only through 2009, so it does not include much of the time period during which the recent population decline was observed (2008–2014). In addition, it is unlikely that survey effort was sufficient in all years since 1907 to detect most of the largest Tricolored Blackbird colonies, which may have influenced the estimates of average colony size.

The degree to which size of the largest or average colonies correlates to total population size in any given year is unknown. However, during statewide survey years since 1994, the sizes of the largest colonies follow a pattern similar to that of the total numbers of birds observed. Given that in many years the majority of the birds occur in a small number of the largest colonies and the number of occupied colonies per year has not increased dramatically with increased survey effort (Table 2), it is likely that short-term declines in colony size often reflect real changes in the population size. Over longer periods, the correlation between colony size and population might be expected to break down due to shifts in breeding distribution and selection of novel nesting substrates. For example, when the population began using agricultural grain crops in the early 1990s and experienced an apparent shift in early breeding season distribution to the San Joaquin Valley, very large colonies were reported for the first time in many years. These changes in nesting substrate availability and distribution could have influenced the size of the largest colonies (and average colony size) by concentrating the population at a small number of breeding locations without necessarily reflecting a change in population size. In fact, Graves et al. (2013) reported that colonies in triticale and other grain crops were 40 times larger than colonies in other habitats during the last 20 years. This may explain in part why they did not find a reduction in average colony size from 1980 to 2009, a time when breeding surveys revealed declines in total number of birds observed.

Winter Population

The Christmas Bird Count (CBC) is a volunteer-based survey conducted each winter at designated 15-mile (24 km) diameter circles across North America. CBC data consist of counts of all birds encountered during a single day at each circle for which a count is conducted. There are more than 2,400 count circles across North America, some of which have been run since the early 1900s (Soykan et al. 2016). The number of count circles increased dramatically through the 1950s and 1960s, especially in the western region of the U.S. (Niven et al. 2004), and long-term trend assessments have often used a start date in the late 1960s to avoid any influence of increased survey coverage on apparent trends (Butcher et al. 2006). This is also the time period when the Breeding Bird Survey was initiated, which allows for comparisons between breeding and wintering populations (Butcher et al. 2006). Counts are not necessarily conducted for every circle each year, and some circles are run more consistently than others. The number of volunteer observers and the duration of the count can vary from year to year, and yearly differences in effort can have substantial influence on the results of the counts. Therefore, the number of party-hours is often used as a measure of effort to standardize count results. Count circle locations are also not randomly selected, so data cannot be extrapolated to provide population estimates across the range of a species, but if corrected for effort can provide an index that can inform population change in areas covered by count circles.

Soykan et al. (2016) used a hierarchical model to evaluate population change from 1966 to 2013 for several hundred species sampled by the CBC, including Tricolored Blackbird. The analysis assessed change in each U.S. state and in each Bird Conservation Region (BCR; a map of BCRs is available at http://nabci-us.org/resources/bird-conservation-regions-map/), with the Coastal California BCR being the primary BCR in which Tricolored Blackbird occurs. Trends for Tricolored Blackbird were non-significant at both the California and the BCR scales. Hierarchical models are more efficient than linear regression approaches when assessing population change for a large number of species across multiple geographic scales, and can control for variation in survey effort among circles and across years. However, the use of large spatial scales for analysis may introduce variability in the quality of information that may not be accounted for in the models. Although the Coastal California BCR captures the majority of the Tricolored Blackbird range in California, it is neither geologically nor biologically uniform. Also, the addition of count circles over time has not been evenly distributed across the BCR or the state. Due to the variability in habitat and species distribution at these broad scales, any apparent population trend, or lack thereof, can be an artifact of the years in which count circles were added or removed, or the years in which particular circles were surveyed across a heterogeneous landscape. A finer-scale approach that considers the impacts of this variability on a single species is warranted.

In California, count circles increased through the 1960s as has been documented in other areas, but the number of circles continued to increase through the early 1990s. The number of circles in California detecting Tricolored Blackbird doubled from 1974 (25 circles) to 1986 (50 circles) and the number of circles with Tricolored Blackbird detections did not stabilize until the 1990s. Since 1992 the number of circles with Tricolored Blackbird detections has been fairly stable and has fluctuated between 54 and 66. Because of the continued increase in the number of count circles through the 1990s, and the inconsistent running of counts at some circles over time, the sampling intensity has varied across the range of the Tricolored Blackbird in California. Based on the number of count circles surveyed in California over time, and by establishing criteria for consistency of effort, the Department assessed trends based on CBC data for two time periods: 1974–2015 and 1995–2015. These two periods capture a longer-term extending back to the 1970s when the breeding-season surveys of DeHaven et al. (1975b) were conducted, and a shorter term covering the time since the first statewide surveys of the 1990s and when CBC data quality was highest and most consistent. The distribution of count circles that met a set of criteria and that were therefore included in the analyses provides fairly good coverage of the core of the winter distribution of the species (Figure 13; Appendix 3). Population trends were estimated from the slope of the regression of the log-transformed counts on year (see Butcher et al. 1990). Results of the CBC data analyses indicate declines in the Tricolored Blackbird population over both the longer term 1974–2015 period and the shorter term 1995–2015 period (Appendix 3).

Improvement in bird identification skills by volunteer observers has been apparent within the past 20 years, and poses a significant challenge in the interpretation of trends based on CBC data. This may be especially true for species with potential identification problems and for flocking species such as the Tricolored Blackbird (Butcher et al. 1990). As a result, counts that are adjusted by party-hour may be positively biased in recent years, which would tend to result in a positive bias in observed trends.

A number of historical winter observations of large numbers of Tricolored Blackbirds corroborate the observed decline in CBC data. For example, wintering flocks numbering 12,000–14,000 once assembled near dairies on the Point Reyes Peninsula, Marin County, which was one of the most reliable locations to

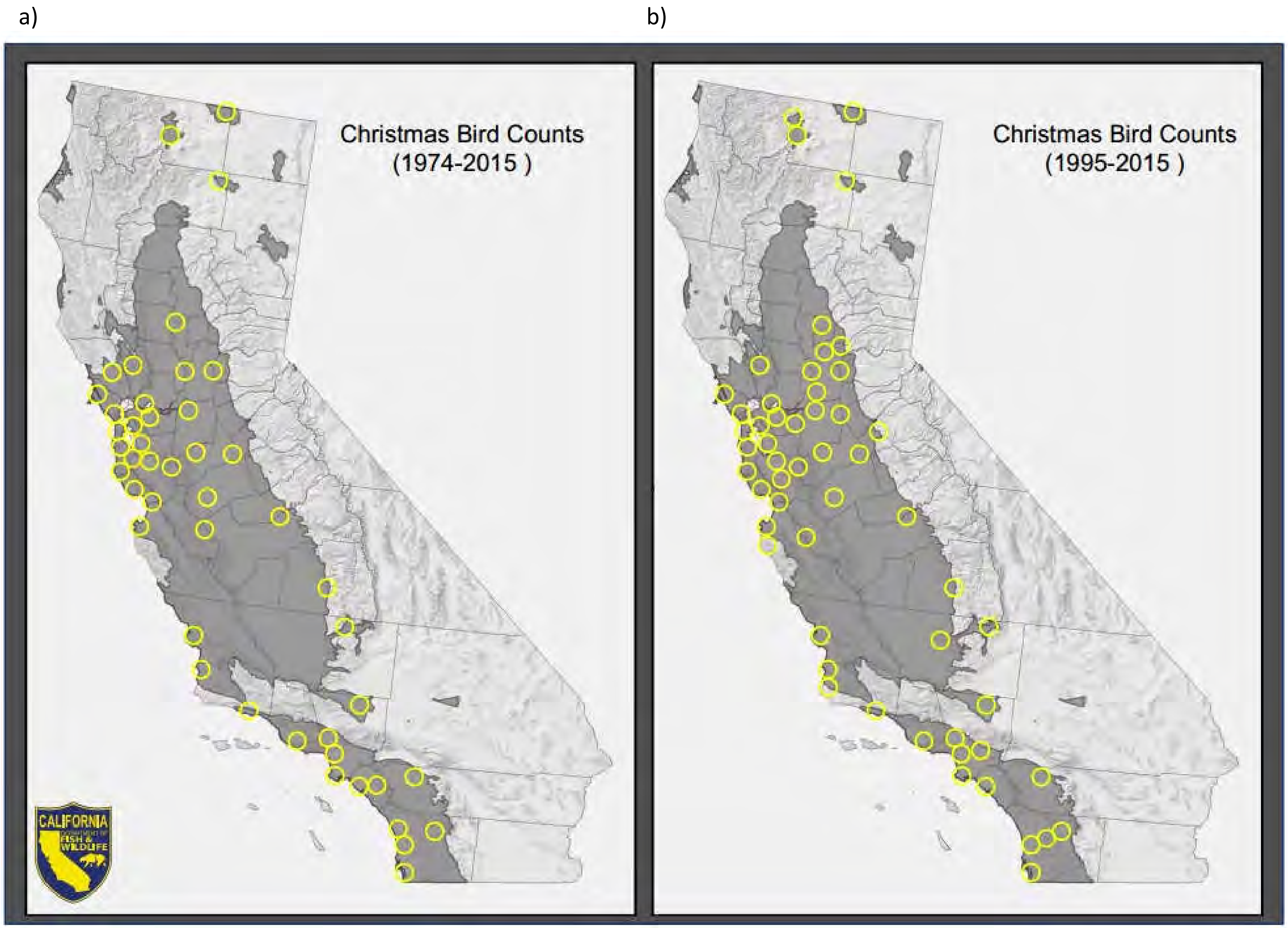


Figure 13. Christmas Bird Count Circles used for winter population trend analysis. a) Circles for which data were analyzed over a long-term period (1974–2015). b) Circles for which data were analyzed for a shorter-term analysis during which better data was available. See Appendix 3 for details of the analyses.

observe large numbers of wintering Tricolored Blackbirds. In recent years, these flocks have been in the range of 2,000–3,000 birds (eBird Dataset 2016, Beedy et al. 2017). There have been no known habitat changes in this region over the time period with declining bird numbers.

Integrated Population Model

An ongoing study has developed an Integrated Population Model (IPM) to jointly analyze banding, fecundity, and population data, which allows for evaluation of changes in population size and the demographic parameters responsible for the change. Data from more than 64,000 Tricolored Blackbirds banded from 2007 to 2016, fecundity data from 10 sites in 1992–2016, and population abundance data from eBird were used in development of the IPM (Robinson et al. 2018).

Over a 10-year period from 2007 to 2016, trends using eBird population data alone suggested a 52% decline, which is similar to the magnitude of decline observed in statewide breeding surveys conducted from 2008 to 2017 (55% decline). Incorporation of survival and fecundity data in the IPM resulted in an estimated population decline of 34% over 10 years (95% credible interval = 71% decline to 7.5% growth). The growth rate of the population was negative with a mean of -6.0% per year, although the credible interval slightly overlapped zero (CI = -14%–1.6% per year). This is highly suggestive of a decline, as 94% of the IPM iterations resulted in an estimated growth rate below zero (Robinson et al. 2018). The estimated rate of decline indicates that the Tricolored Blackbird population has been in steep decline over the last 10 years, and is consistent with rates observed in the statewide survey data over the last 23 years.

Results of the IPM indicated that adult female survival and fecundity were positively correlated with population growth rate, and the years of highest population abundance followed intervals when fecundity and female survival were highest. Because adult female survival is already relatively high and on par with other blackbird species, there may not be room to improve it via conservation measures. Therefore, the results of the IPM suggest that improvements in fecundity may be the best approach to increase the Tricolored Blackbird population (Robinson et al. 2018).

Regional Shifts in Abundance

Because of the Tricolored Blackbird's large-scale seasonal movements and the potential for large interannual shifts in breeding distribution, year-to-year changes in regional abundance are common. Tricolored Blackbird surveys have regularly revealed large annual changes in local abundance that would not be expected due to productivity or mortality rates alone (Hamilton 1998). During statewide surveys, large declines in one region are often coupled with large increases in other regions, and therefore caution is warranted when interpreting year-to-year changes in local abundance. That said, persistent long-term changes in distribution and regional abundance likely represent shifts in regional habitat suitability or population size.

Central Valley

Based on incidental observations on the regional abundance of Tricolored Blackbirds in the 1800s and early 1900s, the Central Valley was described as the center of abundance for the species. The first systematic attempt to assess the species' rangewide distribution and abundance confirmed this, with most birds observed in the Sacramento Valley (Neff 1937). Additional observations and study of breeding colonies occurred through the 1960s before a second attempt at quantifying rangewide abundance in the early 1970s, with the majority of birds again found in the Sacramento Valley and northern San Joaquin Valley (DeHaven et al. 1975b).

Within the Central Valley, shifts in regional abundance over relatively short time periods have been a regular occurrence. Over a period of five years in the 1930s, Neff (1937) observed regular shifts in the annual centers of abundance between the rice-growing regions of the Sacramento Valley (Butte and Glenn counties) and regions to the south in Sacramento and Merced counties. DeHaven et al. (1975b) noted substantial yearly variation in centers of breeding abundance, even in their limited study area consisting of the Sacramento and northern San Joaquin valleys. For example, they observed 57,000 Tricolored Blackbirds nesting in Colusa County in 1969, but only 2,000 the following year. This pattern was mirrored in Yolo County where the number of breeding birds observed declined from 25,000 to 5,000. At the same time, other counties in the Sacramento Valley experienced increases in the number of breeding birds, with Glenn County increasing from 2,000 to 18,500 birds, and Yuba County increasing from 1,000 to 5,250 birds. A larger region comprising the major rice-growing region of the Sacramento Valley (Butte, Colusa, Glenn, Yolo, and Yuba counties) also varied considerably in the proportion of the known population it supported, with the proportion of known breeding birds in the region ranging from 29% to 59% during a four-year study period (DeHaven et al. 1975b). In the year when the smallest proportion of birds were located in this rice-growing region, the largest known congregation of birds occurred to the south in the pasturelands of southeastern Sacramento County. These regional shifts in abundance demonstrate the species' ability to undergo large interannual shifts in breeding distribution, likely in response to an unpredictable food supply, the availability of nesting substrates, or other habitat components.

In addition to short-term shifts in regional abundance, the Central Valley has experienced longer-term changes, with some regions of the valley experiencing long-term declines in number of breeding colonies or breeding birds. For example, Kings County supported tens of thousands of breeding birds per year through the 1990s, with 65,000 birds breeding in the county in 1992. In recent years, the county has hosted only a few hundred to a few thousand breeding birds. Glenn County, which once supported hundreds of thousands of birds per year and continued to support at least 10,000 birds into the 1990s, has not hosted more than 1,400 birds in any year since 2000 (eBird Dataset 2016, Meese 2017). San Joaquin County regularly supported up to about 10,000 birds per year through the 1990s, but has hosted only a few small colonies since then, with the largest recent colony of 1,800 birds in 2015. As described above, the Tricolored Blackbird appears to have experienced a population increase in the 1990s in the San Joaquin Valley as a whole, with a corresponding decrease in the Sacramento Valley. Following this increase, the population in the San Joaquin Valley experienced a severe decline of 78% from 2008 to 2014 (Meese 2015a). This is a time period during which the species declined by 63%

rangewide, and the majority of this decrease was due to declines in the San Joaquin Valley. The total number of birds lost from the San Joaquin Valley portion of the range during this period (~267,000 birds) exceeded the rangewide decline (250,000 birds), with a small portion of the loss compensated by increases in the breeding population elsewhere (Figure 14) (Meese 2015a). The number of birds breeding in the San Joaquin Valley rebounded somewhat by 2017, but declines in this region remain the primary contributor to rangewide population declines since 2008.

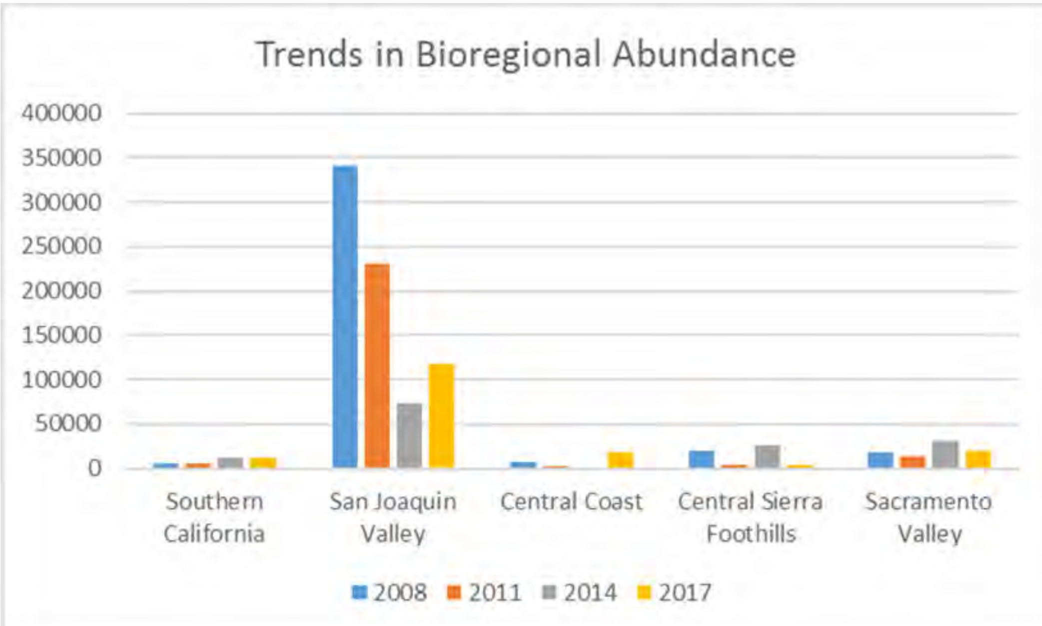


Figure 14. Number of Tricolored Blackbirds observed in regions of the state during statewide surveys conducted since 2008. Figure from Meese (2017).

Southern California and Baja California

As described above under Distribution, the Tricolored Blackbird was once abundant on the coastal slope of the southern California portion of the range, from Santa Barbara County to San Diego and into Baja California. Although the early reports of species abundance were not quantitative, they serve as a comparison to numbers of birds in the region in recent decades. Neff (1937) provided the first quantitative estimates for southern California, although San Diego and Santa Barbara counties were the only counties his collaborators spent a significant amount of time surveying; thousands of birds were documented in both of these counties. DeHaven et al. (1975b) reported colonies of up to 10,000 birds in southern California (Riverside County), with thousands of birds documented in all counties south of the Transverse Ranges, except Orange County.

The first statewide survey to include all counties in southern California was conducted in 1997 (Beedy and Hamilton 1997). That year, more than 40,000 Tricolored Blackbirds bred in the southern California portion of the range, with more than 90% occurring in western Riverside County (Feenstra 2009, Cook 2010). Since this time, the largest proportion of the southern California breeding population has continued to occur in western Riverside County (Cook 2010). The 2005 statewide survey located about

12,500 breeding birds south of the Transverse Ranges. A thorough search of historical breeding locations in southern California in 2008, 2009, and 2011 revealed a population south of the Transverse Ranges of consistently less than 5,000 breeding birds (Figure 15) (Kelsey 2008, Feenstra 2009, Kyle and Kelsey 2011). By 2009 the coastal slope portion of the region had declined to only 750 Tricolored Blackbirds breeding at a single site in San Diego County (Feenstra 2009). The 2014 survey located a slightly larger population in southern California of about 6,400 breeding birds (Meese 2014a). In 2017, the number of birds observed increased again to about 8,800, although the large majority of these (>80%) were located in the San Jacinto Valley region of western Riverside County. San Diego was the only other county with breeding birds in 2017, with seven small colonies totaling fewer than 700 birds. Most breeding colonies of the Tricolored Blackbird in Southern California have tended to be small in recent years, averaging a few hundred birds (Feenstra 2009). The exception has been the larger colonies consisting of thousands of birds in recent years that have nested at the San Jacinto Wildlife Area or the dairies nearby (Cook 2016, WRC-MSHCP 2017).

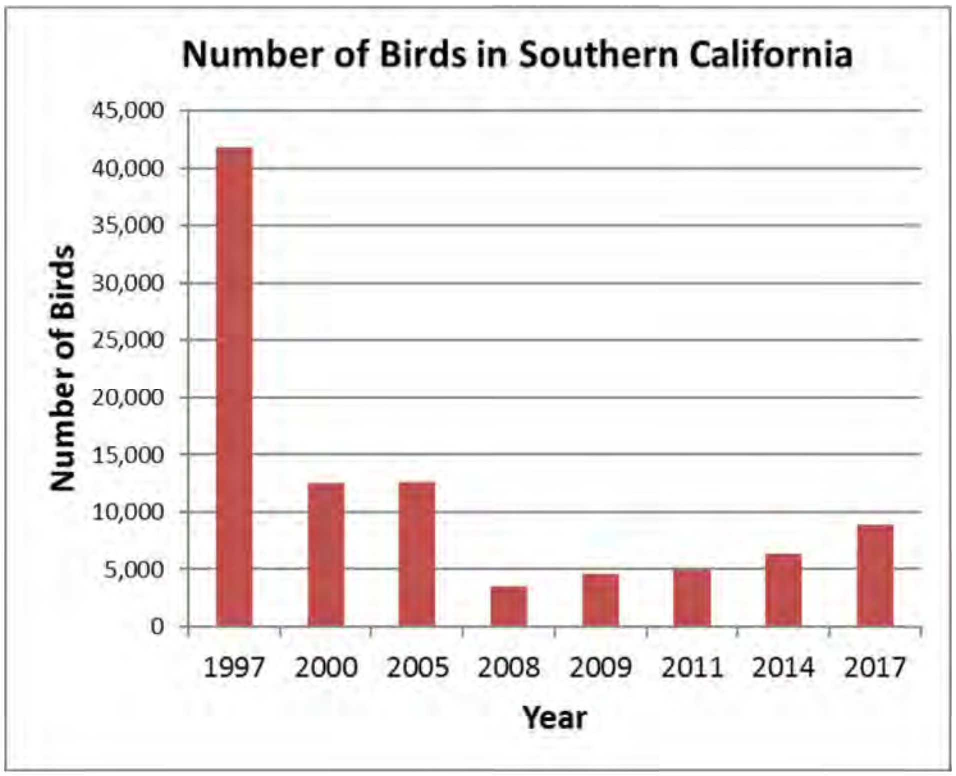


Figure 15. Estimated numbers of Tricolored Blackbirds in southern California (south of the Transverse Ranges) since the first thorough survey of the region in 1997.

In the last decade the breeding population in the Mojave Desert portion of the range in San Bernardino and northern Los Angeles counties appears to have grown somewhat, from just over 1,000 breeding birds located during surveys in 2008–2011, to more than 5,000 breeding birds in 2014, the majority of which were at a single breeding location (Meese 2014a). It is unclear whether the Mojave Desert birds are more closely associated with the southern California population or to the birds in the Central Valley, although observations of three banded birds since 2009 and observations of a flying flock in the 1800s have documented birds moving between the desert and the Central Valley. Ongoing genomic studies will address the population structure and patterns of movement throughout California.

Originally considered common in northwestern Baja California, numbers appear to have declined by the late 1900s. Recent surveys have shown that the northwestern Baja California population has declined to only several hundred individuals (Erickson et al. 2007, Erickson and de la Cueva 2008, Feenstra 2013, Erickson et al. 2016, Meese 2017).

In summary, the Tricolored Blackbird, once described as the most abundant bird species in southern California, had declined dramatically by the time statewide surveys were established in the 1990s. Tens of thousands of breeding birds continued to occupy the region during the first complete survey of 1997. The most recent intensive searches of the southern California portion of the range located only thousands of breeding birds at a small number of locations. Following the first comprehensive survey of southern California counties in 1997, the Tricolored Blackbird population declined by nearly 90%, to lows of fewer than 5,000 birds from 2008 to 2011. The southern California population (as defined in the 2014 survey report to include the Mojave Desert) increased somewhat by 2014, but most of the increase can be attributed to birds at a single location in the Mojave Desert. This decline coincides with the disappearance of the species from much of the southern California portion of the range and is mirrored by declines in abundance and distribution in the Baja California portion of the species' range. If recent trends continue, the species may decline to extirpation in the southern portion of its range in the near future.

Northern and Central Coasts

Small numbers of birds bred annually during the late nesting season (July–September; thought to represent second breeding attempts by birds that previously nested elsewhere) in western Marin County until 2003 (Stallcup 2004). There has been no documented breeding in Marin County since then.

EXISTING MANAGEMENT

Land Ownership within the California Range

There is a paucity of public lands in the Central Valley, with the region that regularly supports more than 90% of the breeding population composed primarily of privately-owned lands (Figure 16). The total area in the range of the Tricolored Blackbird in California is more than 34 million acres (137,600 km^2). Privately-owned lands compose 84% of this area, with state and federal lands totaling about 12%. Much of the area under federal ownership is composed of forested areas that are not suitable for the species. The USFWS National Wildlife Refuges and Department Wildlife Areas comprise about 250,000 acres (1,012 km^2) and 254,000 acres (1,028 km^2), respectively (1.5% of the range, combined).

Of the 1,045 historical breeding locations with known coordinates in the Tricolored Blackbird Portal database (as of January 2017), 191 (18%) have been located on public lands. A minority of breeding colonies continue to occur on public lands each year. For example, during the 2011 statewide survey, colonies were found on a county park, a Department Ecological Reserve in San Diego County and an

Ecological Reserve in Kern County, and on three National Wildlife Refuges in the Central Valley (Kyle and Kelsey 2011). These colonies totaled 66,325 breeding birds (about 25% of the estimated statewide population in that year), the large majority of which were from a single colony on a USFWS National Wildlife Refuge.

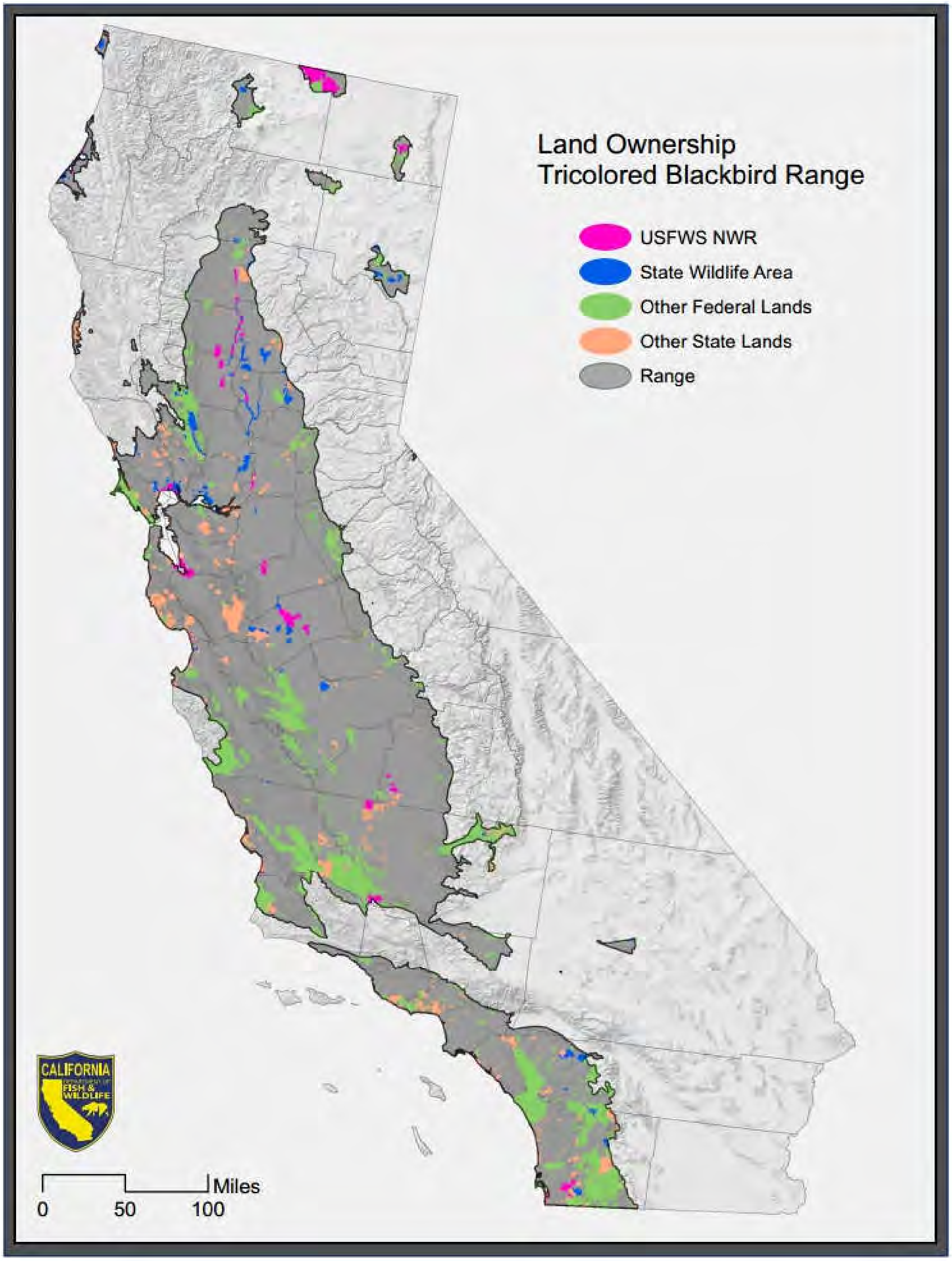


Figure 16. Land ownership in the range of the Tricolored Blackbird in California.

Habitat Conservation Plans

Habitat Conservation Plans (HCPs) provide the basis for regulatory compliance with the ESA by nonfederal entities. HCPs provide a mechanism to authorize incidental take of federally threatened and endangered species under section 10(a) of the ESA, while also describing how negative impacts to covered species will be minimized or mitigated in the plan area. An HCP must minimize and mitigate the impacts of take to the maximum extent practicable. HCPs can accommodate a range of projects that vary greatly in size and scope, and are a mechanism by which long-term landscape-level plans can receive take permits under the ESA.

There are five approved (permits issued) HCPs in California that include the Tricolored Blackbird as a covered species and two additional HCPs that are in the planning stage (Figure 17; Table 5).

The goals, objectives, and conservation measures for Tricolored Blackbird included in approved HCPs are summarized below.

Natomas Basin HCP

The Natomas Basin Habitat Conservation Plan (NBHCP) covers 53,342 acres (216 km^2) in the northwestern part of Sacramento County and southern Sutter County. The City of Sacramento and County of Sutter are participants. The 50-year term expires June 2053.

Tricolored Blackbirds nest and forage in the Natomas Basin. At the time of the planning effort, one active nesting colony was known from the eastern edge of the plan area (Betts Kismat-Silva Reserve) and three recent colony occurrences are located in the Sutter County portion of the area. Based on habitat preferences of Tricolored Blackbirds, the Natomas Basin supported about 1,998 acres (8 km^2) of potential nesting habitat and 41,310 acres (167 km^2) of potential foraging habitat (NBHCP 2003). A total of 449 acres (182 ha) (22%) of potential nesting habitat will be lost to urban development under the plan. A loss of 15,311 acres (62 km^2) (37%) of potential foraging habitat will result from the planned development (USFWS June 24, 2003).

Under the plan, 2,138 acres (865 ha) of managed marsh habitat will be preserved in a reserve system. Wetland reserves are intended to focus on the needs of giant garter snake (*Thamnophis gigas*) while also benefitting other covered species, but as described in the Habitat Loss section, many managed wetlands are unsuitable for Tricolored Blackbird colonies. The managed marsh reserves will provide potential nesting habitat for Tricolored Blackbirds in close proximity to foraging habitat, which is expected to maintain suitable nesting opportunities for this species. Additionally, 4,375 acres (1,770 ha) of rice and 2,188 acres (885 ha) of upland habitats will be protected in the reserve system. Generally, acquisition of upland habitat is prioritized first for the conservation of Swainson's Hawk (*Buteo swainsoni*) then secondarily for other upland-associated covered species including Tricolored Blackbird (USFWS June 24, 2003).

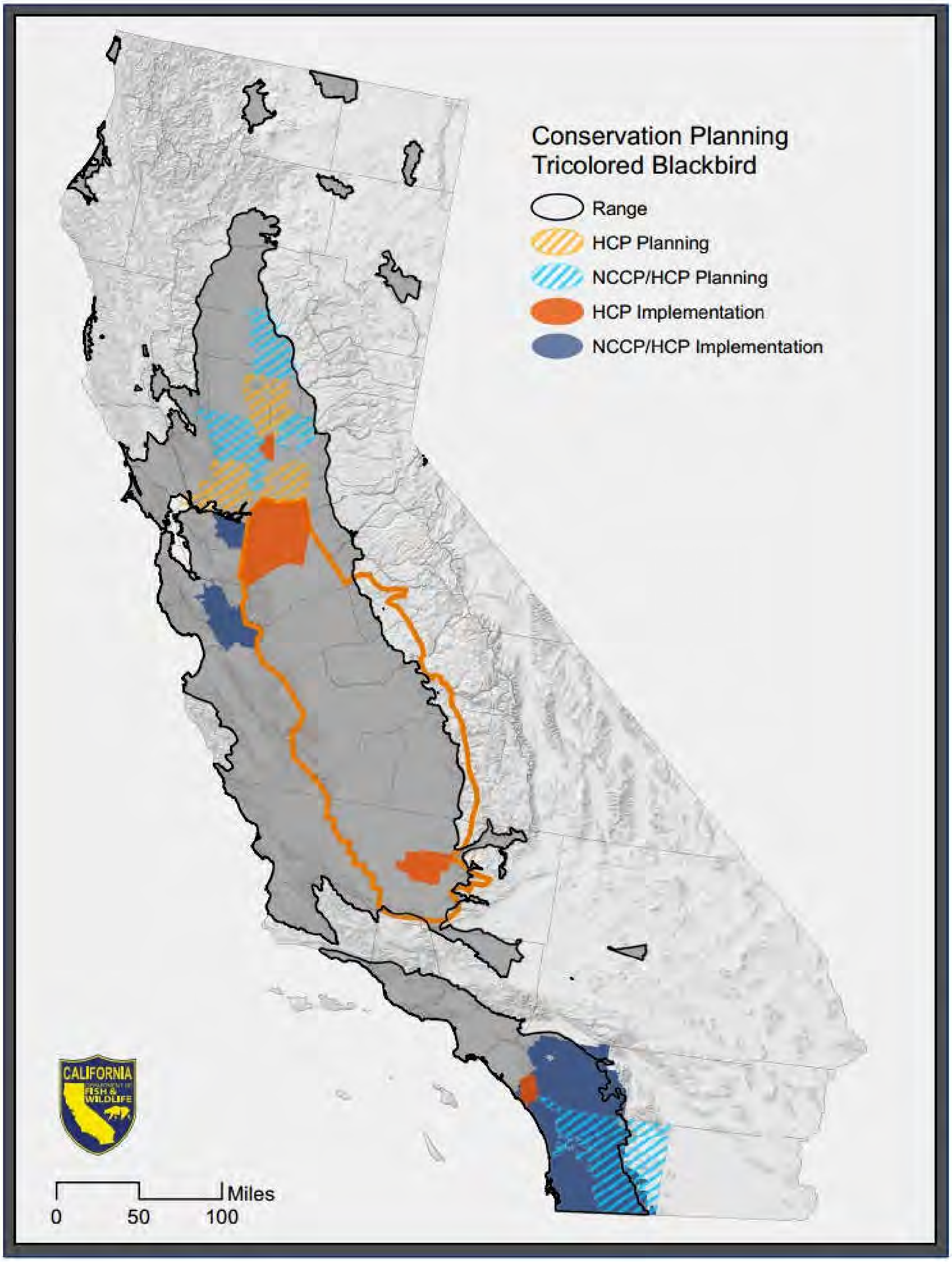


Figure 17. Locations of HCPs and NCCPs for which Tricolored Blackbird is a covered species in California. Solid orange and blue represent approved plans. Lighter hatching colors are plans that are in the planning stage and have not been approved.

Table 5. Current and Planned HCPs/NCCPs in California that include Tricolored Blackbird as a covered species.

Plan title	Counties	Plan acreage	Date permit issued	Term
Natomas Basin (HCP)	Sacramento, Sutter	53,342	June 2003	50 years
San Joaquin County Multi-species Conservation Plan (HCP)	San Joaquin	896,000	May 2001	50 years
PG&E San Joaquin Valley Operations & Maintenance (HCP)	Portions of nine counties: San Joaquin, Stanislaus, Merced, Fresno, Kings, Kern, Mariposa, Madera, Tulare	276,350	December 2007	30 years
Kern Water Bank (HCP)	Kern	19,900	October 1997	75 years
Orange County Southern Subregion (HCP)	Orange	132,000	January 2007	75 years
South Sacramento (HCP)	Sacramento	317,656	Planning stage	TBD
Solano Multi-species (HCP)	Solano, Yolo (edge)	580,000	Planning stage	TBD
East Contra Costa County (NCCP)	Contra Costa	175,435	July 2007	30 years
Santa Clara Valley Habitat Plan (NCCP)	Santa Clara	460,205	July 2013	50 years
Western Riverside County Multiple Species Habitat Conservation Plan (NCCP)	Riverside	1,300,000	June 2004	75 years
San Diego County Multiple Species Conservation Program (NCCP)	San Diego	511,878	August 1998	50 years
San Diego Gas & Electric Subregional (NCCP)	San Diego, Orange, Riverside	Linear projects[1]	December 1995	55 years
San Diego County Water Authority (NCCP)	San Diego, Riverside	Linear projects[1]	December 2011	55 years
Butte Regional Conservation Plan (NCCP)	Butte	564,270	Planning stage	TBD
Yuba-Sutter Regional Conservation Plan (NCCP)	Yuba, Sutter	468,552	Planning stage	TBD
Placer County Conservation Plan Phase I (NCCP)	Placer	201,000	Planning stage	TBD
Yolo Habitat Conservancy (NCCP)	Yolo	653,663	Planning stage	TBD
San Diego East County Multiple Species Conservation Plan (NCCP)	San Diego	1,600,000	Planning stage	TBD
San Diego North County Multiple Species Conservation Plan (NCCP)	San Diego	311,800	Planning stage	TBD

[1] These NCCPs cover discrete linear or energy projects but have larger plan areas that overlap with other NCCPs.
Primary Sources:
USFWS endangered species page for Tricolored Blackbird under conservation plans:
https://ecos.fws.gov/ecp0/profile/speciesProfile?spcode=B06P#conservationPlans
Summary of Natural Community Conservation Plans (NCCPs) September 2016
https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=15329&inline

San Joaquin County Multi-Species Conservation Plan HCP

The San Joaquin County Multi-Species Conservation Plan HCP (SJMSCP) spans 896,000 acres (3,626 km^2) in San Joaquin County. Participating entities include seven cities and the County of San Joaquin. The 50-year term expires May 2051.

The SJMSCP identified 9,374 acres (3,794 ha) of "occupied" habitat for the Tricolored Blackbird in the plan area and an additional 47,193 acres (191 km^2) of potential habitat including foraging and wintering areas. It is expected that 1,614 acres (653 ha) of Tricolored Blackbird habitat will be lost under full build-out. Mitigating impacts to covered species will largely be accomplished through the protection of habitat through the creation and management of preserves. Tricolored Blackbirds are associated with five planned preserves.

Pacific Gas & Electric San Joaquin Valley Operations & Maintenance HCP

The PG&E San Joaquin Valley Operations & Maintenance HCP (PG&E HCP) plan area includes 276,350 acres (1,118 km^2) in portions of nine counties in the San Joaquin Valley, as follows: San Joaquin, Stanislaus, Merced, Fresno, Kings, Kern, Mariposa, Madera, and Tulare. The 30-year term expires in 2037.

Tricolored Blackbirds occupied approximately 1,443 acres (584 ha) of existing PG&E right-of-way in the plan area (52 occurrences in CNDDB as of 2007).

Over the 30-year permit term, the PG&E HCP estimated that covered activities would directly disturb approximately 120 acres (49 ha) of suitable nesting or foraging habitat, with most of this disturbance occurring in foraging habitat. Less than 3 acres (1.2 ha) of nesting habitat is expected to be permanently lost. Covered activities that may cause disturbance to birds will affect 1,020 acres (413 ha) of suitable Tricolored Blackbird habitat. These impacts are expected to be individually small and widely dispersed. Permanent loss of suitable foraging or nesting habitat will be compensated at a 3:1 ratio and temporary disturbance to suitable habitat will be compensated at a 0.5:1 ratio. Overall, PG&E will provide approximately 69 acres (28 ha) of Tricolored Blackbird compensation (USFWS 2007a).

Kern Water Bank HCP

The Kern Water Bank HCP covers 19,900 acres (81 km^2) of central Kern County. The 75-year term expires in 2072. Planning documents list no known Tricolored Blackbird colonies from the Kern Water Bank area; however, it was acknowledged that the species might move into the HCP area in the future. Impacts were described as "negligible; high mobility of the species [nonbreeding birds] allows easy escape from project-related impacts" (Kern Water Bank Authority 1997). Monitoring has revealed several breeding colonies totaling several thousand birds in the area since the plan was approved (Tricolored Blackbird Portal 2017). Most recently, a monitoring effort conducted in 2011 documented five small colonies numbering about 400 individuals within the plan area and a large colony numbering several thousand individuals that settled but then abandoned (Hardt 2011).

Orange County Southern Subregion HCP

The Orange County Southern Subregion HCP comprises 132,000 acres (534 km^2) in the plan area, including the Cleveland National Forest (40,000 acres [162 km^2]). Excluding certain urbanized areas and the National Forest property, the planning area totals 86,000 acres (348 km^2) within southern Orange County. The County of Orange and Rancho Mission Viejo are signatory to the implementing agreement. The 75-year term expires in 2082.

Six general Tricolored Blackbird breeding locations have been documented in the planning area historically. Not all sites have been used consistently or recently and only a single colony of 14 birds has occurred in the area since the plan was approved. A total of 18,759 acres (7,591 ha) of potential foraging habitat was identified in the planning area. One of the known historic breeding sites will be directly impacted by the proposed covered activities and an estimated 3,769 acres (1,525 ha) of foraging habitat will be developed or otherwise made unsuitable for Tricolored Blackbirds (USFWS 2007b).

The plan conserves four of the breeding colony sites within a planned habitat reserve. Adequate foraging habitat within a 4-mile (6 km) radius of these sites also would be conserved. Planners assumed that "at least 1,000 acres [405 ha] of foraging habitat within 4 miles of a nest site would be more than adequate to sustain the relatively small nesting colonies that occur in the study area" (Dudek and Associates 2006).

Natural Community Conservation Plans

Like HCPs, Natural Community Conservation Plans (NCCPs) are long-term landscape-level conservation plans. Under California state law, the Natural Community Conservation Planning Act (Fish & G. Code, §§ 2800-2835) provides a mechanism to obtain authorization for incidental take of CESA-listed and other species. An NCCP provides for the protection of habitat, natural communities, and species diversity on a landscape or ecosystem level, while allowing compatible and appropriate economic activity. An NCCP is broader in its objectives than the take authorization provided under the California and Federal ESAs, and may require conservation measures that go beyond mitigation of impacts to meet the recovery needs of covered species. All approved NCCPs are also HCPs and so provide authorization for take of federally-listed species through section 10 of the ESA.

There are six approved NCCPs in California that include the Tricolored Blackbird as a covered species and six additional NCCPs that are in the planning stage (Figure 17; Table 5). The goals, objectives, and conservation measures for Tricolored Blackbird included in approved NCCPs are summarized below.

East Contra Costa County NCCP

The East Contra Costa County NCCP (ECCC) spans 174,018 acres (704 km^2) in eastern Contra Costa County. The signatories to the implementing agreement include four cities and the County of Contra Costa. The 30-year term will expire August 2037.

During the project planning phase, Tricolored Blackbirds were described as sporadic in the plan area; two breeding colonies were noted and several additional small colonies were detected during fieldwork for the county bird atlas project (ECCC 2006). The Contra Costa County Bird Atlas project found the Tricolored Blackbird to be a "fairly common permanent but highly local resident of freshwater marshes and weedy fields, particularly in East County but also locally elsewhere." (Glover 2009). The largest colony detected numbered several hundred pairs.

Under the agreement, up to 204 acres (83 ha) of core habitat and 9,621 acres (3,893 ha) of primary foraging habitat may be impacted as a result of covered activities. A planned preserve system will protect 126–164 acres (51–66 ha) of suitable core habitat and 16,747–20,138 acres (6,777–8,150 ha) of primary foraging habitat. The preserve system will also protect at least seven of 13 ponds, all of which may provide potential breeding habitat. Additional pond and wetland creation (an estimated 85 acres [34 ha] of perennial wetland plus an estimated 16 acres [6 ha] of pond habitat) will be created or restored. Conservation easements will be acquired on 250–400 acres (101–162 ha) of cropland or pasture; landowners will be required to enhance habitat for Tricolored Blackbird and other covered species (CDFG 2007). Two recent land acquisitions with value for Tricolored Blackbirds have occurred, totaling 895 acres (362 ha) (ECCHC 2011, ECCHC 2013). No progress towards pond creation was reported in the latest available annual report of activities (ECCHC 2016).

Santa Clara Valley Habitat Plan NCCP

The Santa Clara Valley Habitat Plan NCCP (SCVHP) includes the three cities and the County of Santa Clara. The permit covering Tricolored Blackbird encompasses 460,205 acres (1,862 km^2). The term of the permit is for 50 years and will expire July 2063.

Tricolored Blackbirds are relatively uncommon in Santa Clara County. Breeding colonies are few and fairly small. During the Santa Clara County Breeding Bird Atlas project, Tricolored Blackbirds were confirmed breeding in 19 survey blocks. In total, hundreds to several thousand individuals were documented (Bousman 2007).

Conservation goals for Tricolored Blackbirds include protection of at least four sites that support, historically supported, or could support nesting colonies. Each protected site will have at least 2 acres (0.8 ha) of breeding marsh habitat and will have at least 200 acres (81 ha) of foraging habitat within 2 miles (3.2 km) (ICF 2012). Impacts to this species are limited to loss of habitat. Acquisitions will focus on the four breeding sites and at least 22,840 acres (9,243 ha) of modeled habitat, as well as the creation of new wetlands that may provide breeding habitat for the species (CDFW 2013).

Western Riverside County Multiple Species Habitat Conservation Plan NCCP

The Western Riverside County Multiple Species Habitat Conservation Plan NCCP (WRC-MSHCP) covers approximately 1,300,000 acres (5,261 km^2) in western Riverside County. All unincorporated county land west of the crest of the San Jacinto Mountains, as well as 14 cities are included in the plan area. The 75-year term will expire 2079.

Tricolored Blackbirds were described as "widely scattered" throughout the lowlands of Riverside County and few current or historical breeding locations were documented within the planning area (Dudek and

Associates 2003). A total of 480 acres (194 ha) of primary habitat (potential marsh breeding habitat) and 259,695 acres (1,051 km^2) of secondary habitat (potential foraging habitat) was identified as occurring within the planning area. A loss of 60 acres (12.5%) of primary habitat and 193,180 acres (74%) of secondary habitat was projected under the plan. Secondary habitat losses are primarily agricultural land and grassland (Dudek and Associates 2003). Mitigation identified in the plan includes the protection of 420 acres (170 ha) of suitable primary habitat (marsh) and protection of 66,510 acres (269 km^2) of secondary habitat (playa and vernal pool, grasslands, agriculture land, and riparian scrub, woodland, and forest).

Several breeding colonies have occurred in the area each year since plan approval, although not necessarily within protected conservation areas. Most colonies have numbered in the hundreds of birds, with the total number breeding in western Riverside County ranging from about 1,300 to 5,000 since 2010 (WRC-MSHCP 2013, 2017). The largest colonies have frequently occurred on private grain fields and in some years have been lost to harvest (WRCRCA 2015). In other years, the majority of birds have nested on the San Jacinto Wildlife Area.

According to recent biological monitoring reports, three of the five Core Areas identified for Tricolored Blackbird conservation purposes do not provide suitable or sufficient breeding habitat for the species (WRC-MSHCP 2013). Other sites were recommended as additional Core Areas based on recent Tricolored Blackbird activity. Further, a recommendation was made that the plan “be modified to recognize loss of foraging habitat in the vicinity of breeding sites as a significant threat to the survival of the species” (WRC-MSHCP 2011, 2013, WRCRCA 2015).

San Diego County Multiple Species Conservation Program

The San Diego County Multiple Species Conservation Program NCCP (SDCMSCP) covers approximately 511,878 acres (2,071 km^2) in San Diego County. SDCMSCP participants include the County of San Diego and several cities. The 50-year term expires 2048.

Under the plan, 23% of breeding habitat (1,400 acres [567 ha]) may be lost to development or other impacts. The Plan identified the following rationale for including Tricolored Blackbirds as a covered species: “…77% of potential habitat, including 59% of mapped localities, will be conserved. Breeding colonies move from season to season, and with a goal of no net loss of wetlands, most of the suitable breeding sites will continue to be available… Foraging habitat near the known nesting colonies will be conserved at 70–100%” (Ogden Environmental 1998).

San Diego Gas & Electric Company Subregional NCCP

The San Diego Gas & Electric Company (SDG&E) Subregional NCCP covers discrete linear or energy projects but has a larger plan area that overlaps with other NCCPs. The plan area traverses 2,000,000 acres (8,094 km^2) of SDG&E service territory in San Diego, Orange, and Riverside counties. Its 55-year term will expire December 2050.

In total, the SDG&E plan will result in a combined permanent loss of no greater than 400 acres (162 ha) with 50 miles (80 km) of electric transmission and/or new gas transmission lines. Impacts to Tricolored Blackbirds were considered to be generally very small and minimized or mitigated when potential impacts occur to the species' habitats (SDG&E 1995).

San Diego County Water Authority NCCP

The San Diego County Water Authority NCCP covers discrete linear projects but has a larger plan area that overlaps with other NCCPs. The plan area traverses 992,000 acres (4,014 km^2) in western San Diego and southwestern Riverside counties. Covered Activities will occur within 1,000 feet (305 m) on either side of the pipelines or facilities, or approximately 64,600 acres (261 km^2) along the pipeline rights-of-way, and other facilities. The 55-year term of the agreement will expire December 2066.

One Tricolored Blackbird colony was documented near a water authority reservoir during the planning process; no colonies were noted within the planned impact zone (CNDDB in SDCWA and RECON 2010). Approximately 16 acres (6 ha) of potential Tricolored Blackbird breeding habitat could be impacted by permitted activities. Twenty-one acres (8.5 ha) of potentially suitable breeding habitat in the existing preserve area may be used to mitigate impacts to Tricolored Blackbird. Suitable foraging habitat is conserved in the 1,186 acre (480 ha) San Miguel Habitat Management Area within the San Diego National Wildlife Refuge (Merkel and Associates 1997 in SDCWA and RECON 2010); however, no nesting has been documented there.

Conservation Plan for the Tricolored Blackbird

Following the 1991 petition to list the Tricolored Blackbird under CESA, a multi-stakeholder working group was formed to plan for and implement conservation actions. This resulted in the first of many statewide surveys, the first silage buyout to protect a breeding colony, and ongoing research. However, the working group made limited progress in developing comprehensive conservation measures for the Tricolored Blackbird and eventually dissolved in the mid-1990s. In 1997, a status update and management guidelines for the Tricolored Blackbird was completed (Beedy and Hamilton 1997). The species was again petitioned to be listed under CESA in 2004. After this petition was rejected by the Fish and Game Commission, a new multi-stakeholder Tricolored Blackbird Working Group was formed in 2005 and the group released a conservation plan in 2007 detailing the conservation and management, research and monitoring, data management, and education and outreach goals for the species (TBWG 2007). Working group members, including the Department, signed a Memorandum of Understanding agreeing to implement the actions in the conservation plan. Most of the goals and objectives in the plan are still relevant today and portions of the plan are currently being updated by the Tricolored Blackbird Working Group. Progress toward meeting objectives by the Department, USFWS, and partners on the working group has focused on protecting large breeding colonies threatened by harvest of agricultural grain fields and increasing knowledge through monitoring and research. New information is being used to update goals and objectives in the conservation plan.

Protection of Agriculture Colonies from Losses to Harvest

As described above, a large portion of the Tricolored Blackbird population has nested annually on agricultural grain fields since the 1990s, mostly in grain grown for silage on dairies. Although dairies often provide nesting substrate (the grain grown to feed cattle), a water source (e.g., drainage ditches or wastewater ponds), and food for adult birds (stored grains), colonies located on or adjacent to dairies often have low productivity. Where foraging habitat is available in the form of insect-rich alfalfa fields, grasslands, or other productive land cover types, these so-called silage colonies can be relatively productive (Meese 2013). However, in many cases the entire reproductive effort of silage colonies has been lost when the nesting substrate is harvested while the young or eggs are still in the nest (Cook and Toft 2005, Meese 2009b). The timing of grain harvest typically coincides with the Tricolored Blackbird breeding season, resulting in the destruction of nests, eggs, and nestlings, and mortality of some adult Tricolored Blackbirds. The Tricolored Blackbird colonies that form on agricultural grain fields early in the breeding season are often the largest colonies formed each year, and the complete destruction of these colonies due to harvest can be especially damaging to annual blackbird productivity (Arthur 2015).

The protection of large colonies that occur on agricultural grain fields has been the primary conservation action implemented for Tricolored Blackbird since the species was discovered breeding in this substrate type in the early 1990s. Shortly after the discovery of grain colonies in the San Joaquin Valley, the USFWS intervened to encourage harvest delays and protect the largest known breeding colony (Hamilton 1993). In 1994, a crop was bought to protect a 28,000-bird colony (Kelsey 2008). Hamilton et al. (1995) calculated that interventions in 1992, 1993, and 1994 may have been responsible “for the presence of over 75,000 adult Tricolored Blackbirds in 1995 [which had been nestlings in the three previous years], about 25% of the known population.” In 1999, the Department and USFWS protected a colony that was composed of one-third of the known population at the time, which otherwise would have been destroyed by routine harvesting activities (Hamilton et al. 1999). In 2004, silage purchases by the Department and USFWS protected portions of three colonies that consisted of more than 100,000 adult Tricolored Blackbirds. In the 1990s and early 2000s, it was common to target only the largest colonies for protection and to protect only a portion of the field occupied by a colony (the most densely occupied area) due to funding limitations. In 2006, the two largest known colonies, totaling more than 200,000 breeding birds, were protected through silage buyouts (Meese 2006). Meese (2009b) estimated that payments to landowners for harvest delays resulted in the protection of 364,000 nests and about 396,000 Tricolored Blackbird fledglings in the five years from 2005 to 2009. Despite these efforts to protect birds breeding on agricultural fields, losses to harvest have continued to occur in almost all years, and in several years the majority of silage colonies have been lost (Figure 18). The Harvest of Breeding Colonies section details some of the losses.

The Natural Resources Conservation Service (NRCS) established a fund in 2012 that was used for three breeding seasons to protect colonies on agricultural lands and to enhance habitat for the Tricolored Blackbird. Landowner participation in the program varied from year to year, with many thousands of nests protected each year while many colonies continued to be lost to harvest. For example, in 2012 only 3 of 8 colonies on silage fields were protected and in 2013 only 6 of 11 were protected (Aug 2013 presentation from NRCS to Tricolored Blackbird Working Group; unreferenced).

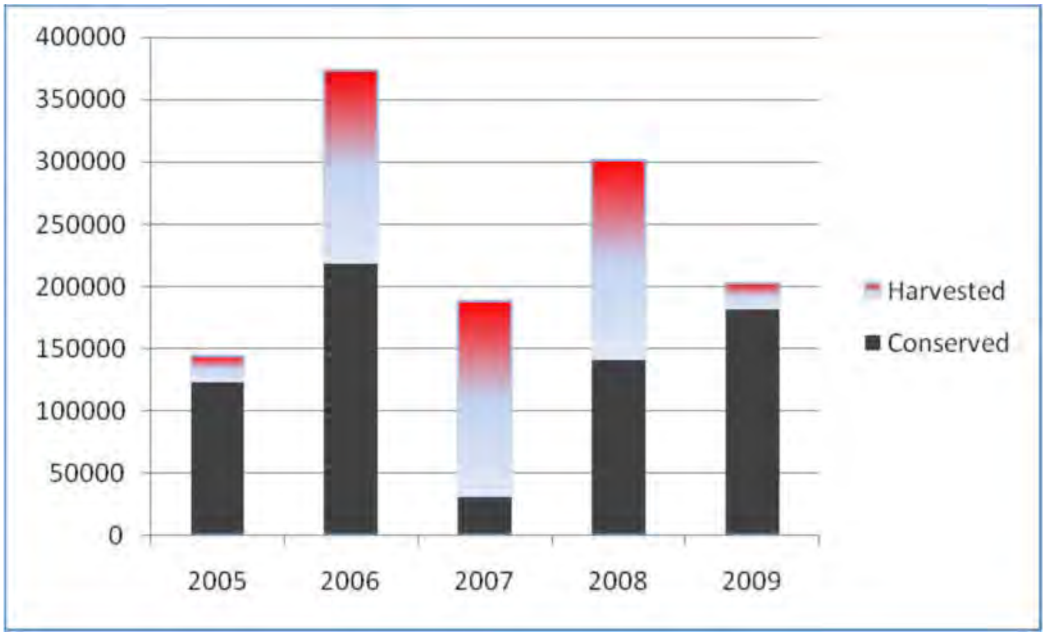


Figure 18. Number of Breeding Birds in Harvested and Conserved Silage Colonies 2005–2009. Figure from Meese (2009b).

Regional Conservation Partnership Program

In 2015, the NRCS awarded a Regional Conservation Partnership Program (RCPP) grant to a group of conservation and dairy organizations (Arthur 2015). The grant provided five years of funding to protect, restore, and enhance Tricolored Blackbird habitat on agricultural lands, with the primary objective being to prevent loss of breeding colonies to harvest. During the first year of implementation in the 2016 breeding season, the program succeeded in enrolling all landowners with Tricolored Blackbird colonies identified on their property, and 100% of known agricultural colonies representing more than 60,000 breeding birds were protected through delay of harvest. In 2017, a single colony, which was large by today's standards (estimated at up to 12,500 breeding birds), was lost to harvest at a location that had not been enrolled in the NRCS program (Colibri 2017).

Because a large proportion of the Tricolored Blackbird population nests on silage grain fields in the spring, successful reproduction in the early nesting season has depended to a large degree on the willingness of farmers to delay harvest and potentially lose portions of their crops (Cook and Toft 2005). Programs that compensate farmers for these losses have had variable success, but have been very successful in the two most recent breeding seasons. The recent success has resulted from: 1) consistent and adequate funding sources for locating and monitoring colonies, conducting outreach efforts to farmers, and compensating landowners for the cost associated with harvest delays; 2) a coordinated effort by members of the Tricolored Blackbird Working Group to develop and implement colony protection programs; and 3) the protections provided by CESA and law enforcement activities conducted by the Department since 2015, which have incentivized participation in colony protection programs. The protection of all known colonies on agricultural fields in the 2016 breeding season is encouraging progress, but given the multiple requirements for success, the future of colony protection programs and therefore the success of a large proportion of the annual breeding effort, is uncertain. Without the programs, which to date have been funded by the state and federal governments, colonies associated with silage fields will likely return to being population sinks (Cook and Toft 2005). See the section on Harvest of Breeding Colonies below for further discussion of this ongoing threat to the species.

Habitat Restoration and Enhancement

USFWS National Wildlife Refuges

The USFWS manages several National Wildlife Refuges (NWR) in the breeding range of the Tricolored Blackbird. In northeastern California, the Lower Klamath and Tule Lake NWRs have supported breeding colonies at several locations, although colony size has been relatively small as is typical for this portion of the range. The Sacramento National Wildlife Refuge Complex in the Sacramento Valley, the San Luis National Wildlife Refuge Complex in the northern San Joaquin Valley, and Kern and Pixley NWRs in the southern San Joaquin Valley have all supported breeding Tricolored Blackbird colonies.

The Sacramento National Wildlife Refuge Complex has actively managed selected wetlands to maintain suitable Tricolored Blackbird habitat for some time, and they have been frequently successful in attracting large breeding colonies to Delevan NWR. Recent restoration at Colusa NWR has resulted in a return of breeding birds after many years of absence. Portions of the Merced NWR have been managed to provide breeding substrate for Tricolored Blackbirds in recent years, and the refuge has been successful in attracting multiple colonies of several thousand breeding birds. The Kern NWR has supported suitable habitat, and for many years hosted breeding colonies. Despite continued efforts to provide flooded spring wetlands, in recent years use of the refuge by breeding colonies has been limited, although a colony of 3,000 birds nested on the refuge in 2017. The Pixley NWR has not supported breeding colonies in recent years, but the USFWS is implementing management to attract breeding birds.

NRCS Easements and Incentive Programs

Through a combination of easements on privately owned lands and 3-year incentive programs, the NRCS has enrolled about 500 acres (202 ha) of land (as of January 2017) in programs that will provide wetland habitat for Tricolored Blackbird nesting. These programs focus on providing dense cattail habitat using water management practices compatible with Tricolored Blackbird nesting. The majority of current NRCS habitat projects are in the Grasslands District of Merced County, with a smaller acreage in the southern San Joaquin Valley in Kern and Tulare Counties. Existing habitat projects have proven successful, with Tricolored Blackbirds breeding on three NRCS easement properties in 2016 (report to the Tricolored Blackbird Working Group, January 31, 2017; unreferenced).

One wetland restoration site in Tulare County, Atwell Island, has been particularly successful. This is a site owned by the Bureau of Land Management and managed for Tricolored Blackbird nesting habitat under a conservation easement held by NRCS. The Atwell Island location has hosted Tricolored Blackbird breeding colonies in most years since 2013, ranging in size from 250 to more than 10,000 birds (Tricolored Blackbird Portal 2017). This site is located in the southern San Joaquin Valley within 10 miles

(16 km) of several grain colony locations, and can serve as a model for other restoration efforts. However, like many restoration sites, no source of funding has been identified to provide long-term management or a consistent water supply for the benefit of Tricolored Blackbird.

California Department of Fish and Wildlife Lands

On many of the Department wildlife areas and ecological reserves located in the breeding range of the Tricolored Blackbird, management practices include spring or permanent wetland habitats that can support suitable nesting substrate for breeding colonies. In some cases, these wetlands have been managed specifically for Tricolored Blackbirds by setting back wetland succession through burning or mechanical methods, and in other cases the wetlands are typically managed for a broader suite of species. Use of Department wildlife areas and ecological reserves by breeding colonies includes (Tricolored Blackbird Portal 2017):

<u>Northeastern California</u> – The Honey Lake Wildlife Area has supported breeding colonies at two wetland locations. The number of breeding birds has been small, with the most recent observation of 200 breeding birds in 1996.

<u>Sacramento Valley</u> – Four wildlife areas in the Sacramento Valley have supported breeding colonies. Three of these wildlife areas are in Butte County (Oroville, Gray Lodge, and Upper Butte Basin), each of which has supported colonies at a single location, with the most recent observations including 1,600 birds on a wetland at Gray Lodge Wildlife Area in 2011 and 2,000 birds in willows at Oroville Wildlife Area in 2015. Oroville Wildlife Area also regularly supports foraging birds in the post-breeding season (B. Stone pers. comm.). The Yolo Bypass Wildlife Area in Yolo County has hosted small breeding colonies at three separate locations in wetlands and button willow shrubs.

<u>San Joaquin Valley</u> – Four wildlife areas in the San Joaquin Valley have supported breeding colonies. Three of these are in Merced County, with North Grasslands Wildlife Area supporting three colony locations in milk thistle and mustard, Los Banos Wildlife Area supporting five colony locations in wetlands, and O’Neill Forebay Wildlife Area supporting four colony locations in Himalayan blackberry. The most recent use includes a 9,000 bird colony on a wetland at Los Banos Wildlife Area in 2008 and a 3,500 bird colony in Himalayan blackberry at O’Neill Forebay Wildlife Area in 2005. The fourth wildlife area in the San Joaquin Valley, Mendota Wildlife Area, is located in Fresno County. This wildlife area has supported breeding colonies at three separate wetland locations, with the last reported breeding by 1,000 birds in 1995.

<u>Southern California</u> – The Rancho Jamul Ecological Reserve in San Diego County has hosted a small breeding colony on a wetland in most years since 2007. This colony is usually fewer than 200 breeding birds. In Riverside County, the San Jacinto Wildlife Area has supported breeding colonies at 12 different locations. Most of the colonies have occurred in wetland habitats, with a few locations in other vegetation types including stinging nettle, thistles, and mallow. This wildlife area is located in the most important region for breeding Tricolored Blackbirds in southern California. The wildlife area regularly hosts several thousand breeding birds, with a single location supporting 10,000 birds

in 2005. During the 2017 statewide survey, 6,300 birds were observed at a single location on the wildlife area.

The Department has also worked with private landowners to create nesting habitat using a variety of incentive programs. The goals of the programs have included management of water to create spring wetland habitat with emergent cattail vegetation. Several of these projects were successful in attracting Tricolored Blackbird colonies, with colonies of up to several thousand birds breeding on private wetlands created through these programs from at least 2005 through 2011. Funding has been limited in recent years, resulting in declining participation and the loss of most of the wetland nesting habitat created under the incentive programs. Tricolored Blackbird wetland nesting habitat was provided only as long as funds were available, which may ultimately be the case with habitat provided under current short-term incentive programs, such as those implemented by NRCS.

California Environmental Quality Act

The California Environmental Quality Act (CEQA; Public Resources Code Section 21000 et seq.) requires state and local agencies to publicly disclose, analyze, and potentially mitigate environmental impacts from projects over which they have discretionary approval power. In particular, CEQA requires that actions that may substantially reduce the habitat, decrease the number, or restrict the range of any species that can be considered rare, threatened, or endangered must be identified, disclosed, considered, and mitigated or justified (Cal. Code Regs., tit. 14, §§ 15065(a)(1), 15380).

The environmental review process required by CEQA can be costly and time consuming, and compliance is not always thorough. Agencies may also make the determination that projects are exempt (i.e., they do not need to go through the impact analysis, public disclosure, and mitigation process). Mitigation is required if a project is not CEQA-exempt and impacts would be potentially “significant.” Mitigation must reduce negative impacts to below a level of significance or minimize unavoidable significant impacts, where feasible. The CEQA process generally incentivizes agencies and project applicants to implement mitigation, thereby avoiding significant impacts.

Due to its SSC designation, negative impacts to Tricolored Blackbirds are generally considered potentially significant if agencies determine on a project-specific basis that the species meets the CEQA criteria for rare, threatened, or endangered. However, agencies are not required to make this determination for Tricolored Blackbirds and other species that are not listed under CESA or ESA.

FACTORS AFFECTING ABILITY TO SURVIVE AND REPRODUCE

Colonial Breeding and Small Population Size

Social species might experience increased risk of population declines and extinction, and obligate colonial nesting birds may be especially vulnerable. In these species, there is generally a positive relationship between individual fitness (i.e., reproduction or survival) and population size or density, a concept which is broadly referred to as the Allee effect (Stephens and Sutherland 1999). In modern times, three colonial and highly social bird species have gone extinct in North America north of Mexico, including the Passenger Pigeon (*Ectopistes migratorius*), the Carolina Parakeet (*Conuropsis carolinensis*), and the Great Auk (*Pinguinus impennis*) (Cook and Toft 2005). The Passenger Pigeon declined to extinction as a result of its highly social and nomadic breeding, combined with multiple population pressures including loss of foraging habitat and commercial hunting (Bucher 1992, Stephens and Sutherland 1999). In addition to the well-known effect of market hunting in the decline of the Passenger Pigeon, habitat alteration and a lack of social facilitation in food finding due to reduced population size have been implicated in the extinction of the species (Bucher 1992). The species seemed to have an inability to survive and reproduce at low population numbers. The Tricolored Blackbird is similar to the Passenger Pigeon in that they are both highly social, colonial breeders with nomadic tendencies that likely evolved for locating highly localized and abundant food sources and other breeding requirements. The Tricolored Blackbird has experienced, or continues to experience, many of the population pressures that led to extinction of the Passenger Pigeon. However, unlike the Passenger Pigeon, the Tricolored Blackbird has responded to the wide-scale loss of native nesting and foraging habitat by using a variety of novel upland and agricultural vegetation types. As habitat provided by these vegetation types continues to decline, a key question is whether the colonially breeding Tricolored Blackbird can maintain a viable population at some reduced population abundance that is comprised of only small colonies or concentrates the majority of the population into very few colonies. That is, what is the population size and distribution necessary in order to support a well-distributed breeding population with colonies that are productive and resilient to the dynamic breeding and foraging landscape within their range?

The degree of sociality of a species might reflect the degree to which it experiences Allee effects. Highly social species may require a minimum group size for successful reproduction, or may experience reduced reproduction or survival at low population densities (Stephens and Sutherland 1999). As described in the section on Biology and Ecology, Tricolored Blackbirds may benefit from social and colonial behaviors by reducing mortality due to predation during the nesting cycle and by facilitating food finding and information sharing. Smaller groups of birds would likely retain the ability to locate and use secure nesting substrates, but small colonies might lose the potential benefits of predator satiation and of social food finding and information sharing. The location and exploitation of abundant food sources could affect small groups of birds both in the selection of productive breeding locations and in acquiring sufficient prey with which to provision young after a site is selected.

Some bird species are known to nest in colonies when conditions are suitable, but can also nest in smaller groups or as single pairs. For example, the White-winged Dove (*Zenaida asiatica*) once nested in extremely large colonies in Mexico. In 1978, 22 breeding colonies contained a collective population size of more than eight million birds (Sanchez Johnson et al. 2009). Individual birds were shown to have very high site fidelity to breeding areas, sometimes returning to nest in the same tree across years (Schwertner et al. 2002). Habitat changes driven by urbanization and intensification of agricultural practices caused the loss and fragmentation of nesting habitat, and now the White-winged Dove nests singly or in smaller colonies at more dispersed locations in Mexico and appears to have adapted to use urban areas (Schwertner et al. 2002, Sanchez Johnson et al. 2009). Unlike the Tricolored Blackbird, the White-winged Dove does not appear to have a high degree of sociality in seasonal movements, breeding site selection, and food-finding (Schwertner et al. 2002), which may allow it to occur and breed in smaller numbers.

Although the Tricolored Blackbird has been observed to nest in very small colonies (as few as 4 nests), the species has not been observed to nest as single pairs. Very small colonies (<100 birds) are quite rare, and although nesting success varies greatly across colonies of all sizes, there is evidence that small colonies are not as successful as larger colonies (Payne 1969), and that larger colonies produce more young per female (Hamilton 1993, Meese 2013, Weintraub et al. 2016). Reductions in population size may make the Tricolored Blackbird more vulnerable to additional declines due to inherent natural history factors, but the degree to which a small population would limit the species' ability to survive and reproduce is not known.

The fact that half or more of the total Tricolored Blackbird population will often occur in a small number of large colonies in silage fields during the first nesting attempt makes the species vulnerable to losses of productivity (Cook and Toft 2005, Meese 2012, Beedy et al. 2017). In 2011, 65% of the total known population was located at only six colony sites in Merced, Kern, and Tulare counties (Kyle and Kelsey 2011). This concentration of large portions of the population makes the species vulnerable to a number of potential threats, especially colony destruction through harvest, predation, or extreme weather events (Weintraub et al. 2016).

Habitat Loss

Loss of Nesting Habitat

The conversion of wetland nesting habitat to agricultural and urban uses has been implicated in the long-term decline of the species. Neff (1937) observed, "[t]he destruction of [Tricolored Blackbird] nesting habitats by man is of most importance," and cited reclamation and drainage as key factors in the loss of many favorable sites, along with "dredging or cleaning of reservoirs, marshes, and canals in order to destroy the growths of cattails and tules." Only about 15% of the four million acres (16,187 km^2) of wetlands that existed in the Central Valley in the 1850s remained when Neff conducted his work in the 1930s, and about 40% of those remaining wetlands were lost between 1939 and the 1980s (Frayer et al. 1989). Of the freshwater emergent wetlands most likely to be used by breeding Tricolored Blackbirds in the Central Valley, 50% were lost between 1939 and the 1980s, with an average loss of 5,200 acres (2,104 ha) per year (Frayer et al. 1989). These losses were primarily due to conversion of wetlands to agriculture.

DeHaven et al. (1975b) found no nesting substrate at several locations in Los Angeles, Kern, Sacramento, and Yolo counties where earlier researchers had studied the species. Subsequent investigators have continued to document habitat loss at known prior breeding colony locations through the present. For example, Beedy et al. (1991) found that 9.3% (n = 17) of the 183 known colony locations used in the 1980s were extirpated by 1990 through permanent removal of nesting habitat. Hamilton et al. (1999) observed the removal of a wetland that had supported a productive breeding colony in 1998. DeHaven (2000) noted the loss of several breeding colonies in Sacramento County to urban development and the expansion of vineyards. Humple and Churchwell (2002) reported on the draining of a wetland and the removal of Himalayan blackberry that had previously supported breeding colonies. Hamilton (2004b) documented the loss or destruction of cattail nesting substrates that had supported up to 90,000 breeding birds between 1994 and 2004. During the 2017 statewide survey, local experts and survey participants were asked to score the suitability of nesting substrate for all sites visited. Of the 636 sites for which scores were reported during the survey or during pre-survey site visits, 70 sites (11%) were scored as permanently unsuitable, usually due to development or conversion to permanent crops like orchards or vineyards (Table 6). An additional 80 sites had no nesting substrate present during the survey and 101 sites had vegetation present, but were considered unsuitable by the survey participant. Based on this habitat assessment, about 60% of known historical breeding sites supported suitable nesting substrate during the 2017 season.

Table 6. Nesting substrate suitability for 636 sites scored before and during the 2017 statewide survey.

Score	Number of sites (percent of total)	Notes on suitability scores
Suitable	385 (60%)	Nesting substrate present and considered suitable for nesting.
Unsuitable	101 (16%)	Nesting substrate present but appears to be unsuitable for nesting (e.g., it is immature, too short, lacks sufficient foliage, too sparse, or has recently been burned).
Substrate absent	80 (13%)	Nesting substrate absent because it has been removed or died (e.g., former grain field planted to alfalfa, milk thistle stand or Himalayan blackberry that has been mowed, wetland that has dried up).
Permanently unsuitable	70 (11%)	Nesting substrate is absent and cannot be replaced (e.g., has been converted to urban development, orchard, or vineyard).

Following a low point in the extent of wetlands in the 1980s, aggressive restoration actions resulted in an increase of 65,000 acres (263 km^2) of managed wetlands between 1990 and 2005 (CVJV 2006). The majority of the wetlands in the Central Valley are managed lands that are maintained by application of water, and many areas undergo occasional land recontouring or vegetation control to maintain desired conditions. As of 2006, there were about 205,000 acres (830 km^2) of managed wetlands in the Central Valley (CVJV 2006). Most managed wetlands (~90%) are flooded primarily in the fall and winter for wintering waterfowl (i.e., seasonal wetlands) and are unlikely to provide suitable nesting substrate for Tricolored Blackbirds. A small proportion are managed as semi-permanent or permanent wetlands that hold water during the spring and summer (Iglecia and Kelsey 2012) and are often managed to support brood habitat for waterfowl. The small proportion of semi-permanent and permanent wetlands may provide suitable nesting substrate for breeding Tricolored Blackbirds, depending on management practices.

The availability of novel, nonnative upland nesting substrates may have lessened the impact of the decline in Central Valley wetlands to the Tricolored Blackbird population (Cook and Toft 2005). However, these nonnative vegetation types are often considered undesirable and are frequently removed. Himalayan blackberry habitat with a history of use by breeding colonies has been removed on many occasions by burning, treatment with herbicide, or mechanical removal (Meese 2011, Airola et al. 2015a, 2015b). Milk thistle colonies have been destroyed when landowners have removed or sprayed the invasive weed while Tricolored Blackbirds are actively nesting (Airola et al. 2016). In 2015 and 2016, large colonies in mustard were destroyed by grazing cattle, and vegetation has been sprayed with herbicide to prevent reestablishment (Meese 2016). The active removal of Himalayan blackberry and other weeds utilized by breeding Tricolored Blackbirds has been widespread but is generally localized in any given year, and therefore may not have a large overall effect on the population. However, there are cases where removal of nesting substrate has resulted in permanently unsuitable conditions, such as the loss of the largest colony sites and about two-thirds of the breeding population in Sacramento County between 1994 and 2002 (Cook and Toft 2005). Many of these losses were in the southwest portion of the county, which experienced urbanization and agricultural intensification (Tricolored Blackbird Portal 2017), and reductions or degradation of foraging habitat likely contributed to these large-scale declines. The number of birds breeding in Sacramento County appears to have rebounded since this decline in the 1990s and early 2000s, at least in part due to a shift in distribution to areas with adequate foraging habitat and Himalayan blackberry nesting substrate. However, in the central Sierra Nevada foothills that include many colonies in Sacramento County, 32% of colonies active in 2014 occurred in areas zoned for development or that were proposed for rezoning for development (Airola et al. 2015a). In 2017, a group of Himalayan blackberry sites that had supported 13,000 breeding Tricolored Blackbirds were removed or degraded by aggregate mining activities (Oct 2017 email from D. Airola to N. Clipperton; unreferenced). The Department is unaware of any available information to evaluate distribution or trends of these nonnative nesting substrates across the range of the Tricolored Blackbird in California.

Although the loss of wetlands in California's Central Valley is well documented and there are many examples of nesting substrate being removed or degraded at historical Tricolored Blackbird colony locations, there also appears to be suitable nesting substrate in some areas that goes unused in many years. In some areas, nesting substrates are abundant (e.g., silage grain fields in parts of the San Joaquin Valley, Himalayan blackberry in parts of the central Sierra Nevada foothills), and only a fraction of available substrates is used each year; therefore, Tricolored Blackbirds do not seem to be nest substrate-limited in these areas. However, there are other regions where large areas of apparently suitable foraging habitat have no available nesting substrate, or where nesting substrate is only available during years when rainfall patterns support vigorous growth of upland nesting substrates (Airola et al. 2016). Most managed wetlands in the Central Valley are not suitable as nesting substrate for the Tricolored Blackbird, but wetlands remain the substrate type most frequently used by breeding colonies, and upland nesting substrates provide additional habitat. The dynamic occupancy patterns at breeding locations from year to year and the need for abundant insect prey in surrounding foraging habitat makes it difficult to reach conclusions about nesting substrate suitability based on occupancy in a single year. It is likely that loss of nesting substrate has caused local declines and shifts in distribution, but the overall effect on the population is difficult to assess, especially without considering other breeding requirements. Losses of nesting substrate at historically large or productive colony locations, or in areas surrounded by high quality foraging habitat, would have the largest impact on the population.

Loss of Foraging Habitat

The extent of foraging habitat required for successful breeding is much greater than the extent of nesting substrate. The abundance of insect prey in foraging habitat has been linked to reproductive success, and Tricolored Blackbirds may choose breeding locations in part based on the local prey populations. Because insect populations are variable and unpredictable from year to year, the Tricolored Blackbird population likely requires much more foraging habitat on the landscape than is used in any given year, and once lost, large landscapes with suitable habitat are difficult to replace. For these reasons, loss of foraging habitat is likely as important, or more so, than the documented losses of nesting substrate to the long-term viability of Tricolored Blackbirds.

The loss of foraging habitat has been suggested as a likely cause of decline in southern California (Hamilton et al. 1995, Cook 2010). The extirpation of colonies from most of the coastal lowlands in southern California, despite the presence of more numerous marsh habitats relative to inland areas, suggests that foraging habitat sufficient to support breeding colonies is the population's limiting factor (Unitt 2004). Loss of habitat, particularly foraging habitat, has been suggested as the greatest threat to the survival of the species in southern California. In western Riverside County, where the majority of the southern California population occurs, large residential and commercial developments are planned for much of the San Jacinto Valley. This will likely result in substantial loss of dairy lands and the alfalfa fields used by Tricolored Blackbirds that nest both on and off the San Jacinto Wildlife Area (R. Cook pers. comm.).

Hamilton et al. (1992) reported on the pervasive loss of foraging habitat near breeding colony sites due to expansion of cultivated agriculture and the conversion of existing agriculture to incompatible crops in the Central Valley, and considered this the primary threat to population abundance. DeHaven (2000) observed widespread habitat loss due to urban expansion and agricultural conversions to vineyards and orchards relative to the 1970s when he and others conducted Tricolored Blackbird research across the state, and suggested that habitat loss was a primary driver of continued population declines. Conversion of pastures and crops suitable for foraging by Tricolored Blackbirds was observed in Placer, Sacramento, Stanislaus, and Tulare counties. DeHaven (2000) noted especially extensive losses in Sacramento County, where urban development and expansion of vineyards had removed thousands of acres of high-quality habitat. More than 5,000 acres (20 km^2) of habitat had been converted to vineyards in just a two-year period from 1996 to 1998, resulting in the loss of known breeding colony locations.

Grasslands have been identified as one of the most vulnerable habitats across North America, and many grassland species have experienced steep population declines in recent decades (NABCI 2016). A great deal of effort has been expended on conserving the grasslands in the central part of North America from the Great Plains to northern Mexico (Knopf and Skagen 2012). The grasslands of California have not received the same level of conservation attention, although losses of grasslands in California have been extensive.

Soulard and Wilson (2015) used Landsat (satellite) data to analyze land-use and land-cover change in the Central Valley from 2000 to 2010, and compared this to changes in the valley since 1973. The largest land-cover trend from 2000 to 2010 occurred in grassland/shrubland habitats. During this 10-year period, an estimated 79,200 acres (321 km^2) of grasslands and shrublands were lost, representing a 5% decrease in the Central Valley over 10 years. Over the longer period from 1973 to 2010, grasslands and shrublands declined by 22% (a loss of 476,900 acres [1,930 km^2]), due mainly to conversions to more intensive agriculture and urban development. Although many of the grassland losses were due to agricultural intensification, losses of agriculture to urban development resulted in relatively little net change in area of agriculture in the Central Valley from 1973 to 2010.

Cameron et al. (2014) analyzed time series land cover data from the California Farmlands Mapping and Monitoring Program collected between 1984 and 2008 to evaluate rangeland habitat (grassland, shrubland, and woodland) conversion in California. The area evaluated covers much of the breeding range of the Tricolored Blackbird except for southern California. About 483,000 acres (1,955 km^2) of rangelands were converted during this 20+ year period, with urban and rural development and conversion to more intensive agricultural uses accounting for most (~90%) of the rangeland loss. Agricultural intensification was primarily due to increases in vineyards and orchards, but smaller amounts of other agricultural crops that may provide foraging habitat for Tricolored Blackbirds were also responsible for grassland loss. The San Joaquin Valley region, which in recent decades has been the center of abundance for breeding Tricolored Blackbirds during the early nesting season, experienced the largest amount of rangeland conversion (Figure 19).

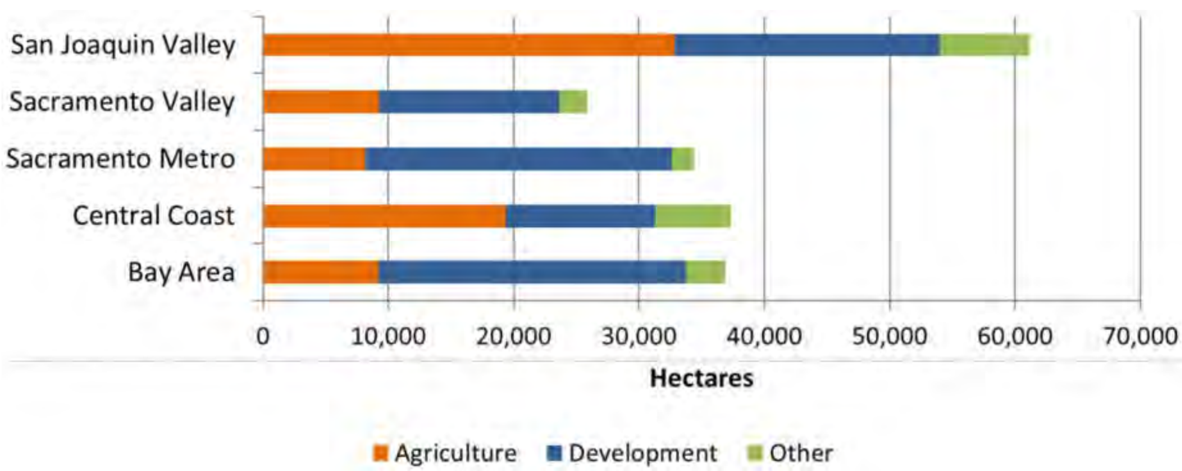


Figure 19. Regional conversion of rangelands in California by type, 1984–2008. Figure from Cameron et al. (2014).

Land cover types suitable for Tricolored Blackbird foraging in the Central Valley continue to be converted to incompatible land cover types such as orchards, vineyards, and urban development as agricultural practices evolve and cities continue to expand. Due to the continued expansion of nut trees and vineyards that replace grasslands, shrublands, or agricultural crops that provide insects required for breeding (e.g., alfalfa), regions that were previously occupied by thousands of birds have now become permanently unsuitable for breeding because of insufficient foraging habitat (Meese 2016). For example, the acreage of pistachio orchards in the Central Valley has grown exponentially in recent years and the acreage of almonds continues to increase (Figures 20 and 21). The five leading pistachio producing counties in California have also supported a large proportion of the Tricolored Blackbird breeding population in recent years (Kern, Tulare, Kings, Fresno, and Madera counties), with Kern County alone supporting 42% of pistachio production in 2012 (Geisseler and Horwath 2016). These regions of habitat loss in the San Joaquin Valley have also experienced the largest regional declines in the Tricolored Blackbird breeding population. In the central Sierran foothills, many colony sites and the surrounding foraging landscape are zoned for development, and several development projects that may affect Tricolored Blackbird habitat have moved forward in recent years (Airola et al. 2015a, 2016). Statewide, the proportion of grasslands within 3 miles (4.8 km) of occupied breeding colony locations declined significantly from 2008 to 2014 (from about 30% to 25%; NAS 2017).

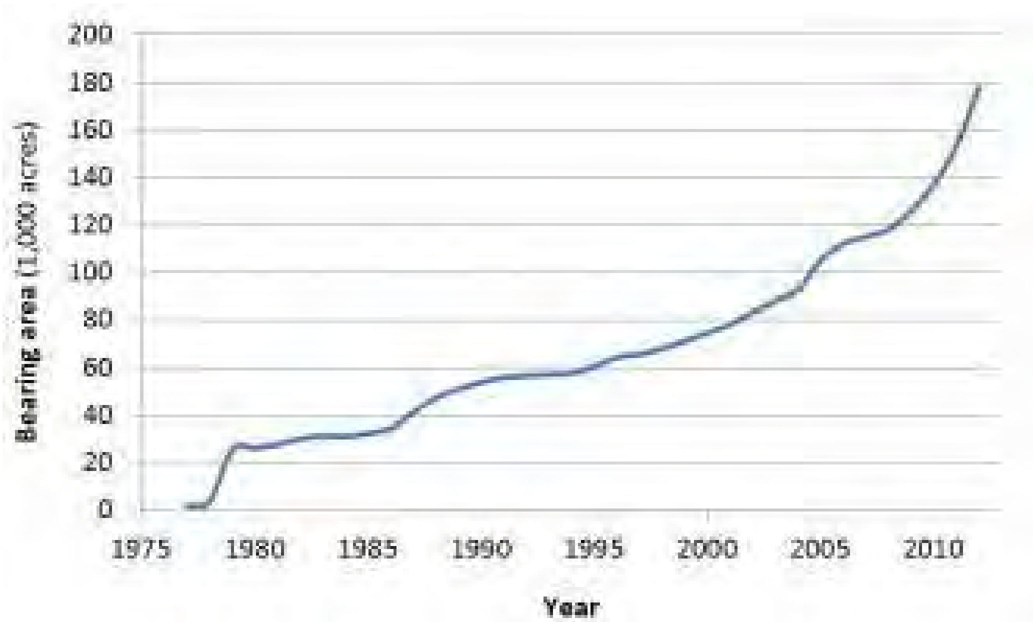


Figure 20. Increase in acreage of pistachio trees in California 1977–2012. Figure from Geisseler and Horwath (2016).

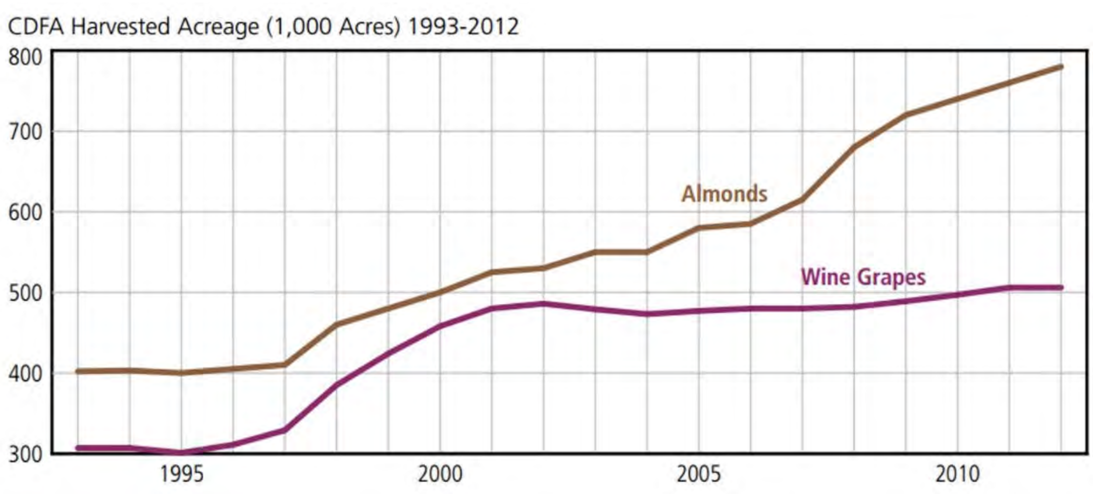


Figure 21. Acreage of wine grapes and almonds in California from 1993 to 2012. Figure from DWR (2015).

The California Rangeland Trust has conserved more than 300,000 acres (1,214 km^2) of rangeland in 24 California counties through conservation easements (https://www.rangelandtrust.org/ranch/). Although data are not available on the distribution of conserved lands within the range of the Tricolored Blackbird, some of the conserved ranches are in counties that receive regular use by breeding Tricolored Blackbirds, including Kern, Merced, Madera, and Placer counties. Many of the easements are in the Coast Ranges, where Tricolored Blackbird colonies are typically small, but a large number of easements also occur in the central and southern Sierra Nevada foothills. Data on the proximity of conserved rangelands to Tricolored Blackbird breeding colony locations is not available, but these easements may provide protection of important foraging habitat for birds that breed in the foothills and grasslands on the periphery of the Central Valley.

Multiple studies using a variety of data sources have consistently shown large losses of rangeland and suitable crop foraging habitat over the last several decades. Conversion of suitable foraging habitat continues and has accelerated in portions of the Tricolored Blackbird's range. Although large acreages of rangeland habitat have been conserved through conservation easements, these have not necessarily focused on areas of highest value to Tricolored Blackbird and are small relative to the extent of grassland in the state and the observed rate of loss over the past several decades. Future development in California is projected to be concentrated in several core areas of the Tricolored Blackbird range, including the Central Valley, the foothills of the Sierra Nevada, and on both sides of the Transverse Ranges in southern California (Jongsomjit et al. 2013; Figure 22), which would further reduce or degrade the available foraging landscape for breeding colonies. Loss of suitable rangeland foraging habitat is projected to continue into the future (see Drought, Water Availability, and Climate Change section). The proportion of grasslands in the landscape surrounding potential breeding sites has been shown to be the most important land cover type in predicting the occurrence of breeding Tricolored Blackbirds, and the proportion of alfalfa in the foraging landscape is highly correlated with colony size during the early nesting season (NAS 2017). Combined with regular loss of nesting substrate, the ongoing loss of foraging habitat makes it less likely that these essential breeding habitat requirements will co-occur on the landscape, with the result being a reduced number of locations suitable for successful breeding and foraging by Tricolored Blackbird colonies.

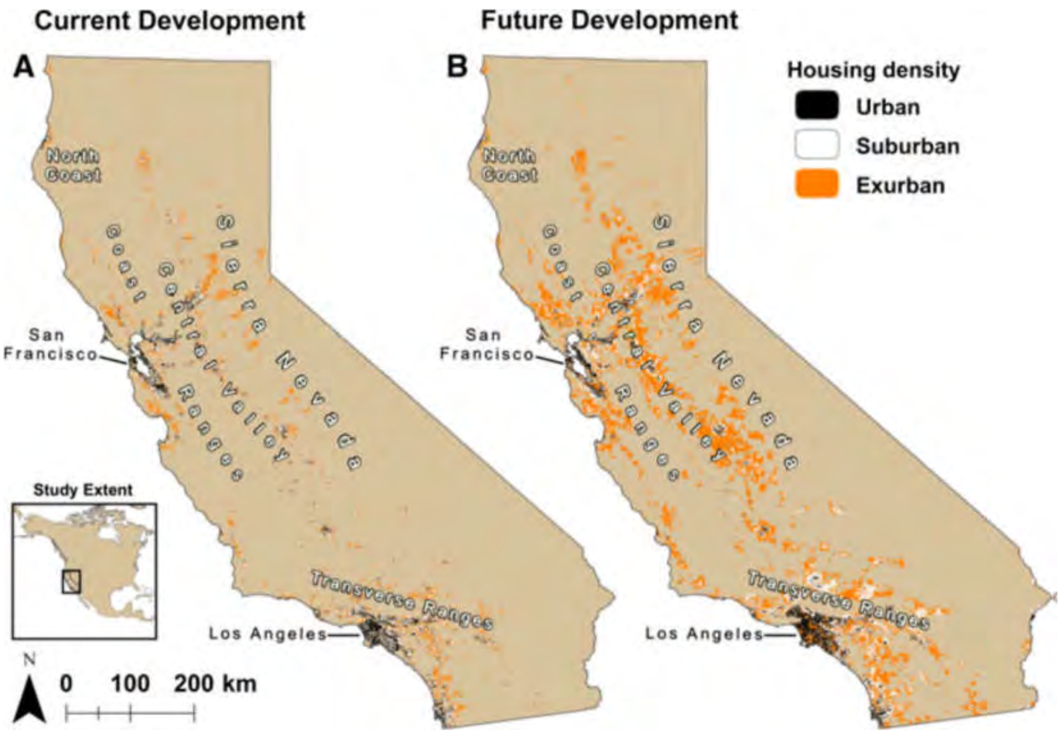


Figure 22. Current and future housing densities projected by the U.S. EPA. a) Current development. b) Future development. Figure from Jongsomjit et al. (2013).

Overexploitation

Market Hunting and Depredation Killing

Neff (1937, 1942) reported hundreds of thousands of blackbirds sold on the Sacramento market, many of which were Tricolored Blackbirds. Market hunting of blackbirds in the Central Valley became a thriving business in about 1928 or 1929 and continued through the mid-1930s. Tricolored Blackbirds banded for research activities throughout the 1930s were often recovered by market hunters with whom Neff collaborated (1942).

McCabe (1932) described the deliberate strychnine poisoning of 30,000 breeding Tricolored Blackbirds as part of an agricultural experiment. In the early 1930s active poisoning and shooting programs were enacted to control populations of blackbirds (McCabe 1932, Neff 1937). Tricolored Blackbirds and other blackbird species were killed by poisoned baits used as a means of blackbird control in rice fields in the Sacramento Valley, and numerous blackbirds were shot by farmers or by hired bird herders in attempts to drive the flocks away from rice and other crops (Neff 1942). During the period from 1935 to 1940 blackbird depredations in rice fields were of lesser intensity, and control operations by means of poisoned baits were almost entirely discontinued (Neff 1942).

Because the Tricolored Blackbird forages in mixed-species flocks with the European Starling and other species of blackbirds in the nonbreeding season, and because these flocks forage at feedlots and on ripening rice, the Tricolored Blackbird may be exposed to avicides intended to control nuisance and depredating flocks of blackbirds. The number of Tricolored Blackbirds killed by avicides is unknown.

A depredation order under the federal Migratory Bird Treaty Act allows for the control of several species of blackbirds and corvids in agricultural situations without a permit from the USFWS (when birds are causing serious depredation of agricultural or horticultural crops or to livestock feed; 50 CFR 21.43). In 1988, the USFWS modified the long-standing depredation order to remove the Tricolored Blackbird and prohibit killing the species without a federal permit (Beedy et al. 1991). Although Tricolored Blackbird is no longer covered by the depredation order, it is possible that misidentification of Tricolored Blackbirds when they occur in mixed flocks in the fall and winter leads to unintentional mortality of the species. Landowners are required to report on activities and on the number of birds captured or killed under the depredation order, including non-target species such as the Tricolored Blackbird (50 CFR 21.43, Nov 5, 2014). Based on reports provided to the USFWS, annual reporting appears to be inconsistent and the number of birds killed under the depredation order may be underreported. The number of Tricolored Blackbirds killed annually is unknown and therefore the killing of blackbirds to protect ripening rice in the Sacramento Valley is a known but unquantified source of Tricolored Blackbird mortality. The U.S. Department of the Interior solicitor recently argued that interpreting the MBTA to prohibit incidental take is incorrect (see the Existing Regulatory Status section). If the taking of Tricolored Blackbirds during otherwise lawful activities such as the shooting of birds covered under a USFWS depredation order is no longer considered a violation of MBTA, this could result in increased mortality due to shooting or other forms of control.

There has been limited documentation of the shooting of Tricolored Blackbirds in the Sacramento Valley. Two birds that had previously been banded were reported to have been shot by a rice farmer in Butte County in 2009 (Meese 2009a). These birds were reported because they were banded and it seems likely that additional, unbanded birds were also shot.

Historical killing of blackbirds to protect crops and for the food market may have contributed to a long-term decline of the species, but the intentional killing of Tricolored Blackbirds has declined since the 1930s. The effect of mortality due to shooting or poisoning on annual Tricolored Blackbird survival rates is currently unknown.

Harvest of Breeding Colonies

The Tricolored Blackbird colonies that form on agricultural grain fields early in the breeding season are often the largest colonies formed each year, and the complete destruction of these colonies due to harvest can be especially damaging to annual blackbird productivity (Arthur 2015). Normal harvesting activities typically coincide with the breeding season and the harvest of fields that contain nesting colonies results in nest destruction and the loss of eggs or nestlings. The cutting of grain has also killed adult Tricolored Blackbirds but most adults appear to survive harvest operations.

Shortly after the discovery of grain colonies in the San Joaquin Valley, Hamilton et al. (1992) observed the loss of a 15,000-bird colony to harvest. As early as 1993, the USFWS intervened to encourage harvest delays and protect the largest known breeding colony (Hamilton 1993). Since then, colony protection through crop purchase or delayed harvest has been the primary conservation action implemented for the species (see Existing Management section), with mixed success. Despite annual attempts to locate and protect large colonies since the early 1990s, losses to harvest have occurred in most years (Figure 18), with 2010 and 2016 being the only years with no known losses to harvest. For context, a brief list of some of the known large losses follows. Two large colonies representing more than 60,000 breeding birds were lost due to harvest in 1994 (Hamilton et al. 1995). The two largest breeding colonies in 1995 were destroyed during harvest of the grain nesting substrate (Beedy and Hamilton 1997). At least one colony of 14,000 birds was harvested in 1999 and four colonies were lost to harvest operations in 2000 (Hamilton et al. 1999, Hamilton 2000). Two colonies totaling approximately 80,000 breeding birds were lost to harvest operations in 2003 (Cook and Toft 2005). Especially large losses occurred in 2004, 2006, 2007, and 2008, when the largest colonies or the majority of grain colonies were lost (Meese 2009b). In 2008, several of the largest known colonies were destroyed, with six colonies being cut that hosted 140,000 breeding birds (Meese 2008). At least three colonies were lost to harvest in 2011, including the largest known colony, which supported 17% of the total known population (Kyle and Kelsey 2011, Meese 2011). The largest colony in southern California in 2013, which contained most of the southern California population, suffered complete reproductive failure when the field was cut (WRC-MSHCP 2014). At least two colonies in grain fields were destroyed in 2014 during the harvest of nesting substrate and at least three colonies were partially or totally destroyed due to harvest in 2015 (Meese 2014a, 2015b). After a breeding season with no known harvest losses in 2016, a large colony (estimated at up to 12,500 birds) was mostly lost in 2017 when the grain nesting substrate was cut in preparation for harvest (Colibri 2017).

No colonies are known to have been destroyed by harvest in 2010; a settlement on a dairy in Merced County was lost when the grain was harvested, but the harvest occurred during nest building before eggs were laid (Meese 2010). Beginning in 2016, a new partnership was created through a grant from NRCS, with Audubon California, dairy trade organizations, and agencies working together to conduct outreach to dairy owners and to detect and protect breeding colonies. The program succeeded in enrolling all landowners with Tricolored Blackbird colonies identified on their property in 2016, and 100% of known agricultural colonies were protected through delay of harvest. In 2017, most colonies on grain fields at dairies were again protected, but at least one large colony in Madera County was destroyed when the grain was cut (Colibri 2017).

The value of protecting colonies that breed on silage fields has been questioned because adult birds are not necessarily killed by harvesting operations and Tricolored Blackbirds are known to breed more than once in a season. DeHaven (2000) and Hamilton (2004a, 2004b) suggested that habitat losses might be more important in population declines than nesting mortality, and resources spent protecting colonies on silage fields might be better spent protecting or restoring habitat. However, clutch size has been observed to decline in second nesting attempts (Beedy et al. 2017). The only study to evaluate reproductive success over the course of a breeding season, which was carried out on silage and wetland colonies in the San Joaquin Valley, showed that reproductive success declined as the season progressed (Weintraub et al. 2016). The elimination of a first breeding attempt may cause breeding colonies to miss the period of peak prey abundance, thereby reducing seasonal reproductive success, as has been observed in other species (Martin 1987). Colony destruction through harvest typically occurs well after females have laid eggs and often after eggs have hatched, so the lost energetic input to a failed breeding attempt and the delay before a second attempt likely reduce total annual productivity, even if birds attempt to nest a second time (Meese 2008). Most adult Tricolored Blackbirds appear to nest at least twice during the breeding season, and destruction of colonies late in the nesting cycle could eliminate one of these attempts. In addition to the loss of eggs and nestlings, adult birds are known to have been killed when colonies are harvested. Because nest survival and reproductive success rates were similar in silage and wetland colonies in the San Joaquin Valley, Weintraub et al. (2016) suggested that payments to farmers who delay harvest is a viable conservation action for increasing productivity.

The Tricolored Blackbird was shown to have experienced low reproductive success from at least 2006 to 2011 (Meese 2013). Reproductive success appears to have always been quite variable across colonies in any given year, and occasional success at large colonies may be important in maintaining the population over time (see Reproduction and Survival section). A number of factors have been shown to influence reproductive success, including predation and shortage of food, but reproductive failures caused by harvest at breeding Tricolored Blackbird colonies on agricultural fields of the San Joaquin Valley may have contributed to population declines through loss of much of the annual reproductive potential of the species in several years.

In summary, the direct killing of Tricolored Blackbirds was once a large source of adult mortality, but the number of birds killed declined dramatically after blackbird depredations in rice fields declined in the 1930s. Killing of Tricolored Blackbirds that may be depredating crops during the post-breeding period is likely a continuing source of mortality, but the limited available data do not indicate this to be a large source of mortality; additional data would be required to determine the degree to which this factor effects the population. Destruction of colonies in agricultural fields has been occurring since Tricolored Blackbirds were discovered nesting in this substrate type in the early 1990s. In recent years (2015–2017), the protections provided to the Tricolored Blackbird as a candidate under CESA, the availability of funds to implement colony protection programs, law enforcement actions conducted by the Department, and a coordinated effort by agencies, the dairy and farming industries, and nonprofit groups, have led to a dramatic decline in this source of mortality. These protections, and a resulting increase in productivity, may have contributed to population stability observed between 2014 and 2017. However, losses of large colonies to grain harvest have continued. The future success of breeding colonies on agricultural crops will depend on the availability of funds to continue programs that locate and monitor breeding colonies on grain fields early in the nesting season and compensate farmers for delaying harvest. If the recent reinterpretation of the MBTA by the U.S. Department of the Interior solicitor removes the prohibition on incidental take, protection under CESA may be necessary in order to ensure continued participation in colony protection programs.

Predation

A large number of predators have been observed preying on Tricolored Blackbirds (Table 7), including their eggs or nestlings. Most observations of predation have occurred at breeding colonies when the birds are congregated in dense groups, and most predation has occurred on the eggs, nestlings, or fledglings of Tricolored Blackbirds.

Table 7. Predators of Tricolored Blackbirds.

Taxonomic Group	Predators	Sources
Birds	Black-crowned Night-Heron (*Nycticorax nycticorax*), Cattle Egret (*Bubulcus ibis*), White-faced Ibis (*Plegadis chihi*), Great Blue Heron (*Ardea herodias*), Cooper's Hawk (*Accipiter cooperii*), Swainson's Hawk (*Buteo swainsoni*), Red-tailed Hawk (*Buteo jamaicensis*), Peregrine Falcon (*Falco peregrinus*), Prairie Falcon (*Falco mexicanus*), Merlin (*Falco columbarius*), Northern Harrier (*Circus hudsonius*), Barn Owl (*Tyto alba*), Burrowing Owl (*Athene cunicularia*), Short-eared Owl (*Asio flammeus*), Yellow-billed Magpie (*Pica nuttalli*), American Crow (*Corvus brachyrhynchos*), Common Raven (*Corvus corax*), Great-tailed Grackle (*Quiscalus mexicanus*)	Mailliard (1900), Neff (1937), Payne (1969), Hamilton et al. (1995), Beedy and Hamilton (1997), Hamilton (2000), Kelsey (2008), Meese (2010), Meese (2012), Airola et al. (2015a), Meese (2016), Beedy et al. (2017)
Mammals	coyote (*Canis latrans*), wolf (*Canis lupus*), gray fox (*Urocyon cinereoargenteus*), raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), long-tailed weasel (*Mustela frenata*), feral domestic cat (*Felis catus*), mink (*Mustela vison*)	Evermann (1919), Neff (1937), Payne (1969), Hamilton et al. (1995), Beedy and Hamilton (1997), Wilson et al. (2016), Beedy et al. (2017)
Snakes	gopher snake (*Pituophis catenifer*), king snake (*Lampropeltis* sp.), garter snake (*Thamnophis* sp.), and possibly western rattlesnake (*Crotalus oreganus*)	Neff (1937), Payne (1969), Hamilton et al. (1995)

Small areas of native vegetation may be especially vulnerable to predation, especially if they are near sites at which predator populations are artificially high due to the availability of augmented food sources from human activities. In the early 1990s, Hamilton and others found that many breeding colonies in emergent wetland nesting substrates suffered partial or complete destruction by predation (primarily by Black-crowned Night-Herons; Hamilton et al. 1992, 1995, Hamilton 1993), resulting in consistently lower reproductive success in wetlands compared to other nesting substrates. Beedy and Hamilton (1997) reported that more recently, Black-crowned Night-Herons eliminated all or most nests at several freshwater marsh breeding colonies. Hamilton (2000) later reported that wetland colonies with no Black-crowned Night-Heron predation were highly successful. DeHaven (2000) reported that he also observed high rates of colony failure due to predation in the 1970s, a time when the majority of the population still bred in wetland substrates. Whether recent rates of loss to predation are similar to historical rates of loss is unknown.

In recent decades, complete nesting failures have been caused by novel predators on agricultural grain fields, and the increasing concentration of birds in mega-colonies may have increased their susceptibility to nest predation (Kelsey 2008). Cattle Egrets from a single rookery caused complete or near-complete failure of large breeding colonies in Tulare County from 2006 to 2011 (Meese 2012). White-faced Ibis prey on the eggs of the Tricolored Blackbird, and in 2016 caused the complete failure of a large breeding colony on a silage field in Tulare County (Meese 2016, Beedy et al. 2017).

Kelsey (2008) reported a steady increase in population sizes of several avian predators in California, including Black-crowned Night-Heron, Cattle Egret, American Crow, and Common Raven. However, the most recent Breeding Bird Survey data show an increase for only one of these species, the Common Raven, and the data for Cattle Egret have important deficiencies that preclude trend assessment (Sauer et al. 2017a). White-faced Ibis have experienced a large population increase in California since the 1980s (Shuford et al. 1996), but BBS data are inadequate for trend assessment (Sauer et al. 2017a).

Although many species have been documented as predators of Tricolored Blackbirds, most have not had severe effects on the population or on the breeding success at nesting colonies. However, a few species have caused the complete failure of entire breeding colonies through heavy predation on eggs and nestlings. In recent decades, the predators that have destroyed entire colonies have usually been wading birds that hunt in large groups (i.e., Black-crowned Night-Heron, Cattle Egret, and White-faced Ibis). These species have had significant negative impacts on the overall productivity rate of Tricolored Blackbirds in several years over the last three decades (Hamilton et al. 1995, Cook and Toft 2005, Meese 2012). A few other species, including Common Raven, raccoon, and coyote have had large effects on breeding success, but these predators have typically not caused complete colony failure or have had less widespread effects.

Interspecific Competition

Red-winged Blackbirds and, less frequently, Yellow-headed Blackbirds, will often nest in the same locations as Tricolored Blackbird colonies, although they may occupy the less-dense portions of a marsh. Where territorial conflicts occur, Tricolored Blackbirds ignore the territorial displays of these other species and overwhelm them with their sheer numbers, displacing them to the fringes of the substrate or pushing them out entirely (Payne 1969). There is no evidence that competition with these species is limiting the Tricolored Blackbird population (Hamilton et al. 1995).

Beedy et al. (2017) reported that Great-tailed Grackles may be aggressive toward nesting Tricolored Blackbirds but did not consider the impacts severe. White-faced Ibis may destroy Tricolored Blackbird nests when in the process of constructing their own nests in the same wetland or grain field, causing large-scale nest failure, but this occurs infrequently (Weintraub et al. 2016). The Marsh Wren (*Cistothorus palustris*) may destroy eggs in Tricolored Blackbird nests that are in proximity to its own nest (Beedy et al. 2017). Competition with other species does not appear to be a large factor in the survival or reproduction of the Tricolored Blackbird.

Brood Parasitism

The Brown-headed Cowbird (*Molothrus ater*) is known to rarely parasitize nests of Tricolored Blackbirds (Hamilton et al. 1995, Beedy et al. 2017), but brood parasitism is not a major threat to the species.

Disease

Beedy et al. (2017) stated that no diseases have been reported for the Tricolored Blackbird but that in some years many nestlings have mites. Avian pox is prevalent in Tricolored Blackbirds in the Sacramento

Valley, and much less so in the San Joaquin Valley (Beedy et al. 2017). West Nile virus (WNV) has been detected in dead Tricolored Blackbirds, as well as in many other species of blackbirds, orioles, and grackles nationwide (www.cdc.gov/westnile/resources/pdfs/Bird%20Species%201999-2012.pdf). Adult Tricolored Blackbirds tested positive for WNV antibodies in 2009 but did not show symptoms of the disease and were assigned a relatively low risk score (Wheeler et al. 2009, Beedy et al. 2017). Although the highly social nature of the species could place the Tricolored Blackbird at greater risk to disease transmission, the impact of disease and parasites on the species is unknown but is not thought to be a major threat to the species.

Contaminants

Feeding in agricultural environments creates numerous opportunities for exposure to contaminants. Mortality of Tricolored Blackbird eggs and nestlings due to chemical contaminants has been suggested in a number of cases. Hosea (1986) reported that two colonies in Colusa and Sacramento counties near rice fields were over-sprayed during aerial application of herbicides resulting in the poisoning of almost all of the nestlings. Beedy and Hayworth (1992) described the effects of possible selenium toxicosis on a Tricolored Blackbird colony by comparing the reproductive success of a colony at Kesterson Reservoir in Merced County, which had a history of selenium contamination, with the success at four other colonies. Nesting failures were documented and deformities in Tricolored Blackbird nestlings were observed at the colony at Kesterson, and livers from dead nestlings collected at Kesterson had elevated levels of selenium. The area was cleaned up and the use of selenium-laden agricultural drain water to maintain the wetlands at Kesterson was discontinued. There have been no apparent selenium impacts on Tricolored Blackbird nesting success since. Hamilton et al. (1995) reported evidence of chemical-induced egg mortality from mosquito abatement operations in Kern County.

In 1995, Hamilton et al. concluded that, “Despite the limited evidence that Tricolored Blackbirds are suffering some mortality as a result of patterns of chemical use in agricultural areas, poisons do not appear to be inducing a serious population problem for Tricolored Blackbirds.” Hamilton (2000) knew of no evidence that toxic contaminants had adversely affected the Tricolored Blackbird since the early 1990s.

Feeding in residential areas can also expose birds to contaminants. In 2012, several adults at a colony in Riverside County were found dead. Seventeen dead Tricolored Blackbirds were tested and found positive for strychnine. The likely source was misapplied gopher poison that was applied on the ground rather than in a gopher burrow as required by the label (Jan 2018 email from K. Rogers to N. Clipperton; unreferenced). A similar case of suspected strychnine poisoning occurred in Sacramento County in 2012.

Neonicotinoid Insecticides

A relatively new class of insecticides, neonicotinoids, has been implicated in the decline of invertebrate communities and, in a few cases, the decline of insectivorous birds. The application of neonicotinoids has increased dramatically in California, especially since the early to mid-2000s (https://water.usgs.gov/nawqa/pnsp/usage/maps/). Neonicotinoids are relatively stable, and are water soluble so can be incorporated into the tissues of plants. They are commonly applied to crops as seed treatments, with the insecticide taken up systemically by the growing plant (Godfray et al. 2014). In the two decades since their introduction, neonicotinoid insecticides have become the most widely used insecticides in the world (Goulson 2013). They are highly effective at killing insects and have relatively low mammal and bird toxicity. However, at higher concentrations they can have lethal and sublethal impacts to vertebrates (Mineau and Palmer 2013).

Acute toxicity of neonicotinoids has been assessed for only a few bird species, with wide variation in results. Bobwhite and Mallard are the species typically used in acute toxicity testing for regulatory purposes, but where smaller species have been tested, including songbirds, the body weight-corrected dosage resulting in mortality is much lower (Mineau and Palmer 2013). A potential acute impact mechanism for species that are partly granivorous, like the Tricolored Blackbird, is sublethal or lethal effects through the ingestion of neonicotinoid-coated seeds. Ingestion of only a few neonicotinoid-coated seeds (a single seed in the case of corn) might be sufficient to kill a songbird, but there has been little work conducted on the availability and consumption of treated seeds by vertebrates (Goulson 2013, Mineau and Palmer 2013). Although not limited to neonicotinoids, a study that evaluated the effect of multiple potential factors found that acute toxicity of pesticides was the strongest correlate to declines of grassland bird species in the U.S., followed by habitat loss caused by agricultural intensification (Mineau and Whiteside 2013). No data are available on the acute toxicity of any neonicotinoid insecticide specifically to Tricolored Blackbirds, but seeds treated with imidacloprid, a widely used neonicotinoid insecticide, caused ataxia and retching in captive Red-winged Blackbirds and Brown-headed Cowbirds (Avery et al. 1993). These effects were transitory and birds learned to avoid consumption of treated seeds when alternative grains were available. Neonicotinoids may also have chronic toxicity effects (exposure over longer time periods) on reproductive success, but chronic effects are even less studied than acute effects (Mineau and Palmer 2013).

Neonicotinoids may also indirectly affect Tricolored Blackbirds through suppression of insect prey populations. They have been shown to have adverse effects on a number of non-target invertebrate species, with most studies focusing on bees (Hopwood et al. 2012, Godfray et al. 2014). In California, long-term observational data have revealed declines in the number of butterfly species and declines in abundance for many butterfly species in the Central Valley, both of which were negatively associated with annual application rates of neonicotinoid insecticides (Forister et al. 2016). Imidacloprid was shown to have a negative association with a wide variety of insectivorous bird populations in the Netherlands, suggesting that the pesticide may have led to food deprivation in birds (Hallmann et al. 2014). The evidence linking imidacloprid concentrations to bird population declines was circumstantial, but the authors ruled out confounding effects from other land use changes and showed that the timing of observed declines in bird populations corresponds to the introduction of neonicotinoid insecticides (Goulson 2014, Hallmann et al. 2014).

Depending on environmental conditions, neonicotinoids can persist and accumulate in soils and in waterways, and levels measured in soils, waterways, and field margin plants have sometimes overlapped substantially with concentrations sufficient to control pests in crops (Goulson 2013). Neonicotinoids degrade through photolysis when exposed to sunlight and so would not be expected to occur at high levels in clear water (Goulson 2013). However, Starner and Goh (2012) detected imidacloprid in 89% of water samples taken from rivers, creeks, and drains in agricultural regions of California, with 19% of samples exceeding the US Environmental Protection Agency guideline concentration of 1.05 μg/L; this suggests that the insecticide moves off of treatment areas and may impact non-target aquatic insects. Little is known about the uptake of neonicotinoids from soil and water by non-target plants, and the downstream effect on non-target invertebrates (Goulson 2013).

Several studies have revealed a negative relationship between insect populations and neonicotinoid use. These results, along with the large increase in application of neonicotinoids, suggest a potential mechanism leading to observed reductions in reproductive success in Tricolored Blackbirds (Meese 2013). It is possible that this relatively new group of insecticides has resulted in declines of non-target insect species within the breeding range of the Tricolored Blackbird resulting in a declining prey base, but no data have been collected that can directly support this. It is also possible that acute effects resulting from ingestion of neonicotinoid-coated seeds has had a negative impact on the population, but the number of Tricolored Blackbirds suffering sublethal or lethal effects due to exposure to neonicotinoids is unknown. In addition to Tricolored Blackbirds, population declines in insectivorous birds have been documented across North America, with specific examples from California's Central Valley (Nebel et al. 2010, Airola et al. 2014). Neonicotinoids may be playing a role in driving these declines, but more study is needed. There is a need for mechanistic research to complement results from observational data; these should include testing exposure rates of Tricolored Blackbirds to neonicotinoids, effect of exposure on body condition and fitness (direct effects), and investigations into potential insect-based food-web impacts (indirect effects).

Invasive Species

With the exception of occasional impacts due to nonnative predators (e.g., Cattle Egret, Great-tailed Grackle), invasive species have not been reported to have a large negative impact on the ability of the Tricolored Blackbird to survive and reproduce. The availability of many nonnative plant species as nesting substrates have allowed the Tricolored Blackbird to breed in locations that would otherwise be unavailable. Invasive species are not considered a major threat to the species, and in large parts of the species' range invasive plants may be considered a benefit. The birds nest in several non-native plants (e.g., Himalayan blackberry, milk thistle, mustard, and mallow), some of which are considered to be invasive. Some nonnative plants in weedy fields, such as curly dock (*Rumex crispus*), can provide a food source (Cook 2016).

Extreme Weather Events

Hamilton et al. (1995) stated that high mortality of Tricolored Blackbird nestlings can result from severe or prolonged storms and that some observed reproductive failure may be the result of chilling of adult and nestling birds. Also, some adult female mortality at nests appears to have been induced by cold and rainy weather (Hamilton et al. 1995). Heavy winds or precipitation (rain or hail) have been documented to knock down nesting substrates and to knock nests out of the vegetation, often in triticale or other grain colonies but also in milk thistle colonies (Meese 2010, 2016), eliminating the reproductive effort for all or a part of breeding colonies. Weintraub et al. (2016) observed the blowdown of triticale fields at two colonies, resulting in the loss of thousands of nests. Extremely high temperatures have also been documented to cause colony failure (WRC-MSHCP 2017). Weather events may have widespread impacts on reproductive success in some years, but impacts are usually isolated and the overall effect on the population's ability to reproduce is limited in most years. However, this depends on the size of the colonies affected, the nesting stage at which colonies are impacted, and the severity and distribution of storms (Airola et al. 2016). In some years, weather has likely reduced the annual recruitment due to widespread and severe impacts.

Drought, Water Availability, and Climate Change

Drought reduces water supply reliability and has far-reaching impacts on most habitat types in California (DWR 2014, 2015a). Several significant statewide droughts have occurred in California over the last century (1928–1934, 1976–1977, 1987–1992, and 2007–2009) (DWR 2015a), and California recently experienced the three driest consecutive years of statewide precipitation in the historical record between 2012 and 2014. The winter of 2015 produced a record low statewide mountain snowpack of only 5% of average.

Drought effects on availability of nesting substrate

Tricolored Blackbirds have adapted to use a variety of novel vegetation types as nesting substrate, but wetlands continue to support the largest number of breeding colonies each year. Because of the need for wetlands that are flooded during the spring and summer breeding season, the various approaches to wetland management, and the dependence on water deliveries to maintain wetland habitats in most of the Tricolored Blackbird's range, assessing the availability of suitable wetland nesting substrate in a given year is difficult. A recent method applied reflectance to satellite imagery to identify areas of open surface water in the Central Valley (Reiter et al. 2015). Although not an ideal approach to quantifying and assessing distribution of wetlands, the method would identify wetlands with large amounts of open water. In addition, identification of open water on the landscape during the Tricolored Blackbird breeding season is likely a good proxy for the availability of water for wetland management. Reiter et al. (2015) showed that open surface water declined across the Central Valley between 2000 and 2011. Drought had a significant negative effect on open surface water in the late summer and early fall. Cumulative years of drought resulted in a noticeable reduction in surface water. Although not a direct measure of Tricolored Blackbird breeding habitat, declines in surface water during the drought likely resulted in reduced availability of wetlands with sufficient water to provide high quality nesting substrates.

Although more resilient to dry conditions than wetland vegetation, plants species that provide upland nesting substrate for Tricolored Blackbird colonies also experience negative effects due to drought. After several years of dry conditions during California's most recent drought, many Himalayan blackberry copses that have historically supported Tricolored Blackbird colonies were observed to be dry and mostly barren of leaves. In a few cases, extremely dry blackberry bushes continued to be used by breeding colonies, but many were unoccupied. Milk thistle, which provides high-quality nesting substrate across much of the Tricolored Blackbird range when annual precipitation patterns support vigorous growth, was largely absent from historically used areas until California experienced an average water year in the winter of 2015–2016 (Airola et al. 2016). The wetter weather created nesting substrate in areas that had not been used by Tricolored Blackbirds in several years, and breeding colonies once again occupied these areas.

Drought effects on prey populations

The availability of large insect prey is an important factor in Tricolored Blackbird reproductive success, and may influence colony site selection. Large landscapes with suitable foraging habitat are strong drivers of colony site occupancy and abundance (NAS 2017).

Insect abundance is strongly related to biomass of herbaceous vegetation, including important Tricolored Blackbird prey items like grasshoppers in grasslands (Falcone 2010). Climate, especially drought, is thought to play a key role in abundance of grasshoppers and other insect species in grasslands (Vose et al. 2016). The response of insect populations can differ depending on drought severity. For example, non-severe drought and warm temperatures can have a positive effect on grasshopper populations through increased survival and faster population growth (Kemp and Cigliano 1994). However, extreme or prolonged drought can negatively affect grasshopper populations through desiccation of eggs or through decreased biomass of primary producer food sources (i.e., grasses and forbs) (Vose et al. 2016). Reductions in precipitation not only lead to reductions in the abundance of insects in grasslands, but may also make insect prey less accessible through changes in behavior (e.g., moving underground) (Barnett and Facey 2016). Severe droughts likely have strong negative effects on grasshoppers and insect prey in general (Kemp and Cigliano 1994, Vose et al. 2016).

The established impacts of precipitation on insect populations in grasslands, especially grasshoppers, suggests a mechanism for drought impacts on Tricolored Blackbird productivity. Research is needed that measures grasshopper and other prey abundance relative to precipitation and primary productivity around occupied Tricolored Blackbird colonies, and evaluates the effect on Tricolored Blackbird reproductive success.

Climate Change

Average annual temperatures have been rising in California in recent decades, and climate models are in broad agreement that temperatures in California will rise significantly over the next century (DWR 2015b). The average temperature is expected to rise by approximately 2.7°F (1.5°C) by 2050, and depending on the emissions scenario, average temperatures could increase by 4.1–8.6°F (2.3–4.8°C) by the year 2100 (Moser et al. 2012). Summer temperatures will rise more than winter temperatures, and the increases will be greater in inland California. As a result, the average number of extremely hot days (at least 105°F [41°C]) per year in Sacramento is expected to increase fivefold (up to 20 days) by the middle of the century, and may increase to as many as 50 days per year by 2100 (Moser et al. 2012). Tricolored Blackbirds have been observed to cease initiation of breeding when temperatures exceeded 90°F (32°C), although care of existing nests continued in temperatures over 100°F (38°C) (Hamilton et al. 1995). Extremely high temperatures have also caused colony failure. Rising temperatures may directly affect annual Tricolored Blackbird productivity by truncating or interrupting the breeding season, although more work is needed on the effect of temperature on initiation and success of nesting attempts. Tricolored Blackbirds have begun nesting earlier in the year, perhaps in response to climate change (e.g., see Tottrup et al. 2010, Mazerolle et al. 2011). Between 1939 and 2009, the mean date of first breeding date has shifted to occur about 22 days earlier (M. Holyoak pers. comm.).

Along with projected negative impacts to Tricolored Blackbird foraging habitat due to housing and agricultural development discussed above, the areas of California with the largest climate-projected effects on a variety of bird species are largely concentrated within the Tricolored Blackbird range in the Central Valley (Jongsomjit et al. 2013). A suite of analyses integrating the effects of climate change and land use changes in California's rangelands concluded that grassland habitat loss in California could reach 37% by the year 2100 (Byrd et al. 2015). Thorne et al. (2016) estimated the vulnerability of California's natural communities to climate change by examining how a range of climate change scenarios would change the spatial distribution of those communities. Two important Tricolored Blackbird communities, grassland and freshwater marsh, were projected to be among the most affected natural communities in California, with freshwater marsh being one of only four communities receiving the highest vulnerability rank. Under multiple emission scenarios, the regions modeled as being most highly stressed by future climate change include much of the Tricolored Blackbird's core range in the Central Valley and surrounding foothills (Figure 23). The extent of freshwater marsh was projected to decrease by 71%–97% by year 2100. Of the area currently occupied by grassland in California, 16%–48% is expected to no longer be suitable, depending on the climate change scenario (Figure 24). The current level of emissions is on track with the higher-impact scenarios (Thorne et al. 2016).

The recent severe drought in California was at least partially due to, and made more severe by, climate change (Diffenbaugh et al. 2015). Climate change is projected to bring longer and more severe droughts to California in the future (Diffenbaugh et al. 2015, Williams et al. 2015), exacerbating the impacts to Tricolored Blackbird habitat described above. The Central Valley may be particularly vulnerable to warming-driven drought increases in the future (Williams et al. 2015), and water deliveries are projected to be reduced by 5.6% from 2013 to 2033 due to climate change effects on reliability (DWR 2014). Climate change effects on water supplies and stream flows are expected to increase competition among urban and agricultural water users and environmental needs (Moser et al. 2012). This competition may lead to decreases in available wetland nesting substrate provided by private and public land managers. Declines in the availability of water for agriculture may also reduce prey populations provided by high quality crops like alfalfa and rice.

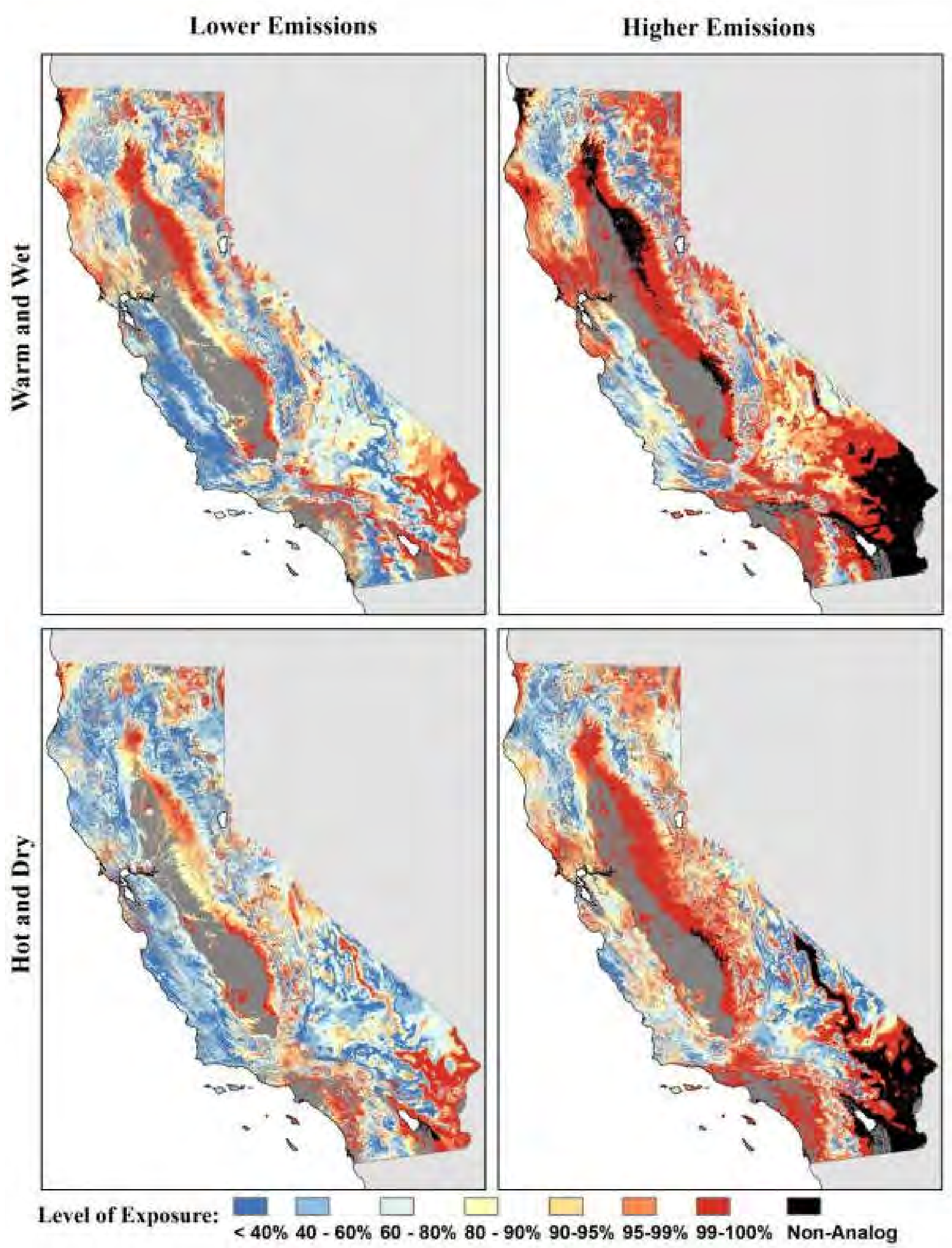


Figure 23. Mapped climate exposure in 2100 under four climate projections. Areas considered to be highly stressed are in the 95-99%, 99-100% and Non-Analog categories. Grey areas on the map represent urban and agricultural areas and were not evaluated. Figure from Thorne et al. (2016).

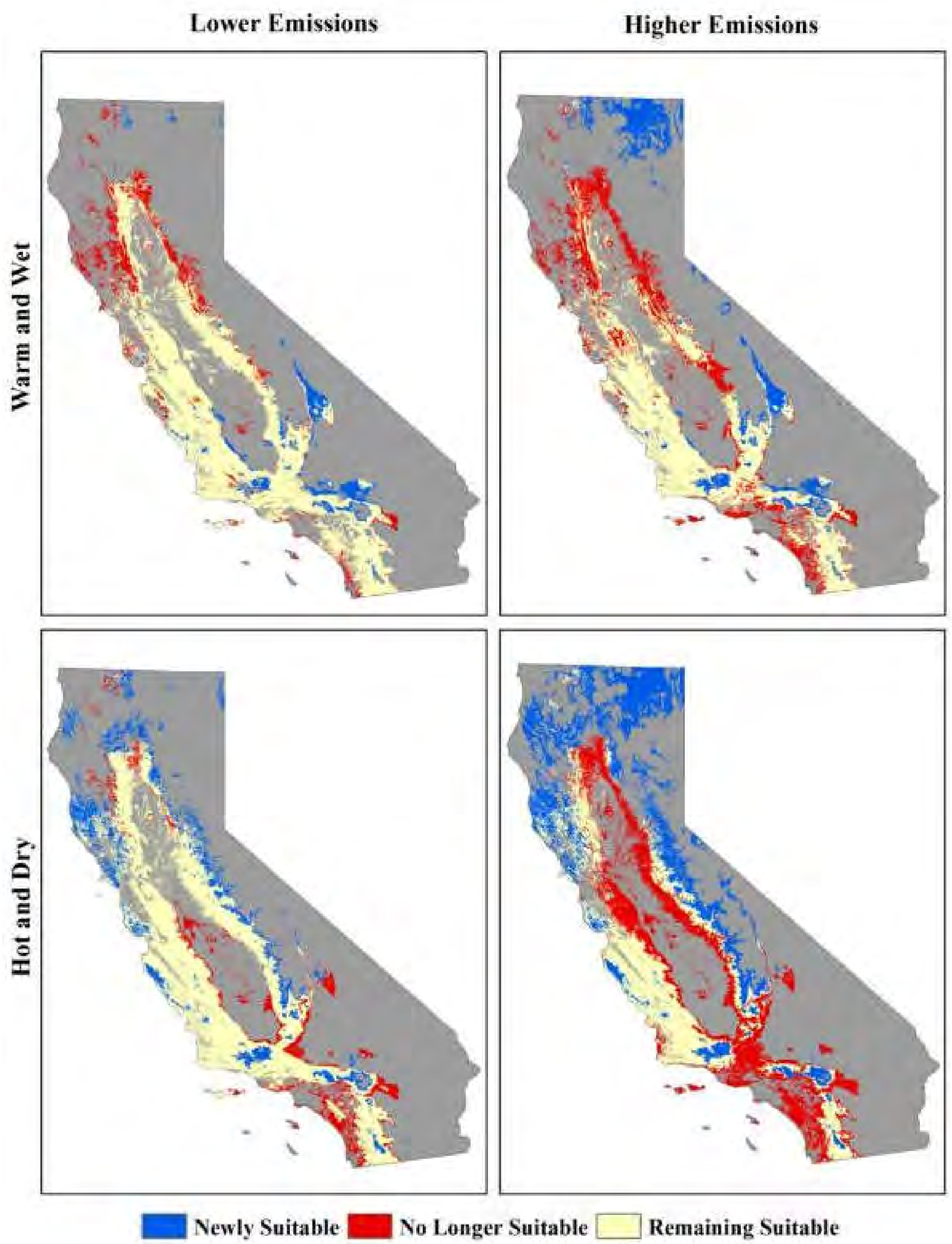


Figure 24. Projected climatically suitable range for grassland for the time period 2070–2099 under four climate projections. Figure from Thorne et al. (2016).

SUMMARY OF LISTING FACTORS

CESA's implementing regulations identify key factors that are relevant to the Department's analyses and the Fish and Game Commission's decision on whether to list species as threatened or endangered. Specifically, a "species shall be listed as endangered or threatened…if the Commission determines that its continued existence is in serious danger or is threatened by any one or any combination of the following factors: (1) present or threatened modification or destruction of its habitat; (2) overexploitation; (3) predation; (4) competition; (5) disease; or (6) other natural occurrences or human-related activities." (Cal. Code Regs., Tit. 14, § 670.1).

This section provides summaries of information from the foregoing sections of this status review, arranged under each of the factors to be considered by the Commission in making a determination as to whether listing is warranted.

Present or Threatened Modification or Destruction of Habitat

Of the estimated four million acres (16,187 km2) of wetlands that existed in the Central Valley in the 1850s that could have been available to Tricolored Blackbirds as nesting substrate, only about 5% remain. Most of the loss of wetlands occurred in the late 1800s and early 1900s, but there was a continued decline of 50% between 1939 and the 1980s, with an average loss of 5,200 acres (2,104 ha) per year. Restoration actions beginning in the 1980s have resulted in an increase of 65,000 acres (263 km2) of managed wetlands between 1990 and 2005. Although many of these managed wetlands may provide nesting habitat for Tricolored Blackbird, the majority are managed as seasonal wetlands for wintering waterfowl and are not suitable. Wetlands remain the most frequently-used nesting substrate, but as the extent of wetlands declined, Tricolored Blackbirds began using novel, nonnative vegetation types and agricultural grain fields.

The loss of nesting substrates of all types continues, with specific nesting locations being lost in most years. Wetlands continue to be lost as lands are converted to agriculture or urban uses, or water availability limits the ability to maintain habitat through the breeding season. Nonnative vegetation types are often considered undesirable and are frequently removed. Despite these ongoing losses, there appears to be suitable nesting substrate in some areas that goes unused in many years; therefore, Tricolored Blackbirds do not seem to be nest substrate-limited in these areas. However, there are other regions within the Tricolored Blackbird range where large areas of apparently suitable foraging habitat have little or no available nesting substrate. It is likely that loss of nesting substrate has caused local declines and shifts in distribution, but the overall effect on the population is difficult to assess, especially without considering the availability of foraging habitat, insect prey, and other breeding requirements.

The extent of foraging habitat required for successful breeding is much greater than the extent of nesting substrate, and once lost, large landscapes with suitable habitat are difficult to replace. Loss of foraging habitat has likely led to the extirpation of colonies from most of the coastal lowlands in southern California. Widespread habitat loss due to urban expansion and agricultural conversions to vineyards and orchards has removed known breeding locations and caused the extirpation of breeding colonies from large regions of the state. From 1973 to 2010, grasslands and shrublands in the Central Valley declined by an estimated 22% (a loss of 476,900 acres [1,930 km2]), due mainly to conversions to more intensive agriculture and urban development. The San Joaquin Valley region, which in recent decades has been the center of abundance for breeding Tricolored Blackbirds during the early nesting season, has experienced the largest amount of rangeland conversion, primarily to vineyards, orchards, and urban development. This region, which has experienced that largest Tricolored Blackbird population decline in the last 10 years, has abundant nesting substrate available in the form of triticale and other grain crops; the loss of foraging habitat has likely contributed to the population decline. In recent years, the rate at which grasslands and compatible crops (e.g., alfalfa) have been converted to orchards has accelerated. Large-scale losses are projected to continue into the future as agricultural practices evolve, cities continue to expand, and a changing climate makes large areas unsuitable for grassland communities.

Several HCPs and NCCPs cover Tricolored Blackbird in California, but only a small portion of the species' range is covered by approved conservation plans. In the Central Valley portion of the range, all approved plans are HCPs, which provide mitigation for habitat losses, but overall result in net decreases in the extent of nesting and foraging habitat. Much of the Central Valley, including the major breeding areas in Merced County and the southern San Joaquin Valley, are not covered by conservation plans. The southern California portion of the range is more thoroughly covered by NCCPs, with the Riverside and San Diego county portions of the range well-covered. Some of these plans are the earliest approved NCCPs in California, and were established under previous versions of the NCCP Act. As such, these plans provide little detail on how Tricolored Blackbird will be conserved. Recently approved NCCPs (e.g., East Contra Costa County, Santa Clara Valley) consider the full range of breeding needs for the species and provide meaningful conservation actions, but these plan areas are on the periphery of the species breeding range and have supported only few small colonies historically. The Western Riverside County NCCP includes perhaps the most important remaining area in southern California for Tricolored Blackbirds. The plan protects core Tricolored Blackbird areas and supports several thousand breeding birds each year, representing the majority of the breeding birds in southern California. However, large residential and commercial developments are planned for much of the San Jacinto Valley in western Riverside County. This will likely result in substantial loss of dairy lands and the alfalfa fields used by Tricolored Blackbirds that nest both on and off the San Jacinto Wildlife Area.

Easements have been acquired on a large acreage of rangeland in California, but acquisitions have not been directed by the needs of the Tricolored Blackbird. Many of the easements are in the Coast Ranges, where Tricolored Blackbird colonies are typically small, but others are in the Sierra Nevada foothills and may provide foraging habitat for breeding Tricolored Blackbirds, depending on location. The most important breeding areas for the species, including southern California, the San Joaquin Valley, and the central Sierra Nevada foothills, continue to lose large amounts of foraging habitat, and these losses are projected to continue into the future.

The state and federal governments have had some successes restoring and managing wetland nesting substrates on public and private lands, but many efforts have been temporary and funding shortages have resulted in loss of most of the wetland nesting habitat created on private lands under incentive programs. No source of funding has been identified to provide long-term management or a consistent water supply for the benefit of Tricolored Blackbird.

Without a focused effort to identify and protect the most important landscapes for the Tricolored Blackbird, the species will continue to lose nesting and foraging habitat, and will become increasingly dependent on nonnative upland nesting substrates, including grain fields. If the loss of foraging habitats continue at projected rates, the species will continue to disappear from portions of the current range.

Overexploitation

A large portion of the Tricolored Blackbird population has nested annually on agricultural grain fields since the 1990s, mostly in grain grown for silage on dairies. In many cases the entire reproductive effort of silage colonies has been lost when the nesting substrate is harvested while the young or eggs are still in the nest. Since the early 1990s, a number of programs, primary funded by the federal government, have been implemented to protect nesting colonies on dairy silage fields and other grain crops. These efforts have had mixed success, with many colonies protected but with large colonies being lost in most years. In the two most recent breeding seasons, participation in colony protection programs has been very high, and most colonies have been protected. The recent success has resulted from the availability of consistent and sufficient funding sources for colony protection programs, a commitment by members of the Tricolored Blackbird Working Group to conduct outreach efforts, and the protections provided by CESA and law enforcement activities conducted by the Department since 2015, which have incentivized participation in colony protection programs.

The Tricolored Blackbird colonies that form on agricultural grain fields early in the breeding season are often the largest colonies formed each year. Reproductive success is variable across colonies but has often been low over the past decade, and increases in reproductive success may be the best approach to increase the Tricolored Blackbird population size. The destruction of grain colonies has contributed to declines in reproductive success, but other factors, including the recent drought, have likely also contributed. Following increases in precipitation in recent years, breeding conditions have improved and Tricolored Blackbirds appear to have experienced increased reproductive success. The success of the silage colony protection programs in the two most recent breeding seasons has likely allowed the large colonies in the San Joaquin Valley to contribute to increased rates of recruitment. This may be in part responsible for an apparent stabilization of the population size between 2014 and 2017.

The commitment of the working group members to continue conducting outreach to landowners and implementing colony protection programs is not in doubt, but funding to support colony protection programs has not been identified beyond the 2018 breeding season. The emergency listing of the species prior to the 2015 breeding season, the continued protection under CESA as a candidate for listing, and the resulting response to colony harvest incidents by Department law enforcement resulted in an increased incentive for landowners to participate in colony protection programs. Without long-term secured funding and the incentives provided by protection under CESA, the future success of these programs is uncertain. In the absence of successful protection programs, colonies associated with silage fields will likely become population sinks again.

Predation

Predation at Tricolored Blackbird colonies is a natural occurrence that has been documented since the early 1900s. Although infrequent, predation has at times had large impacts on colonies, even leading to complete nesting failure. Although a healthy population should be able to withstand natural levels of predation, breeding colonies should continue to be monitored for impacts due to predation, especially due to nonnative predators or unusually high predator populations.

Reproductive success at Tricolored Blackbird colonies has been low in many years since at least 2006, and increases in reproductive success may be the best approach to increasing the Tricolored Blackbird population. Because predation at Tricolored Blackbird colonies typically occurs on eggs, nestlings, and fledglings, predation can have a large effect on reproductive success. When predation has large effects or causes complete nesting failure at large colonies, it may negatively impact the annual reproductive output of the Tricolored Blackbird population.

Competition

The Department does not consider competition to be a significant threat to the continued existence of the Tricolored Blackbird in California.

Disease

The Department does not consider disease to be a significant threat to the continued existence of the Tricolored Blackbird in California.

Other Natural Events or Human-Related Activities

Contaminants—In the two decades since their introduction, neonicotinoid insecticides have become the most widely used insecticides in the world, including in California. They are highly effective at killing insects and have relatively low mammal and bird toxicity. However, at higher concentrations they can have lethal and sublethal impacts to vertebrates. Neonicotinoids have been implicated in the decline of invertebrate communities and, in a few cases, the decline of insectivorous birds. Ingestion of only a few neonicotinoid-coated seeds (a single seed in the case of corn) might be sufficient to kill a songbird, but there has been little work conducted on the availability and consumption of treated seeds by vertebrates, and no data are available on the acute toxicity of any neonicotinoid insecticide specifically to Tricolored Blackbirds. Neonicotinoids may also have chronic toxicity effects (exposure over longer time periods) on reproductive success, but chronic effects are even less studied than acute effects.

Neonicotinoids have been shown to have adverse effects on a number of non-target invertebrate species, and may indirectly affect Tricolored Blackbirds through suppression of insect prey populations. In the Netherlands, neonicotinoids were shown to have a negative association with insectivorous bird populations, likely due to insect food deprivation. Neonicotinoids were detected in 89% of water samples taken from rivers, creeks, and drains in agricultural regions of California, with 19% of samples exceeding the US Environmental Protection Agency guideline concentration. Long-term observational data have revealed declines in the number of butterfly species and declines in abundance for many butterfly species in the Central Valley, both of which were negatively associated with annual application rates of neonicotinoid insecticides. Studies to date have relied on observational data to find correlations between neonicotinoids and potential effects. There is a need for mechanistic research to investigate exposure rates of Tricolored Blackbirds to neonicotinoids, effect of exposure on body condition and fitness (direct effects), and investigations into potential insect-based food-web impacts (indirect effects).

Drought and Climate Change—Drought reduces water supply reliability and has far-reaching impacts on most habitat types in California. The maintenance of wetland habitats in most of the Tricolored Blackbird's range depends on water deliveries. Recent droughts have resulted in reductions in surface water in the Central Valley, which likely resulted in reduced availability of wetlands for nesting. Several of the upland nesting substrates used by Tricolored Blackbirds are also reduced or eliminated in dry years. Drought also effects the abundance of grasshoppers and other insect species that are important to nesting Tricolored Blackbirds. Extreme or prolonged drought negatively affects grasshopper and other insect prey populations through desiccation of eggs or through decreased biomass of primary producer food sources (e.g., grasses and forbs). Climate change is projected to bring longer and more severe droughts to California in the future, exacerbating the impacts to Tricolored Blackbird habitat and prey availability.

The average temperature in California is expected to rise by approximately 2.7°F (1.5°C) by 2050, and depending on the emissions scenario, average temperatures could increase by 4.1–8.6°F (2.3–4.8°C) by the year 2100. The average number of extremely hot days (at least 105°F [41°C]) per year in Sacramento is expected to increase fivefold (up to 20 days) by the middle of the century, and may increase to as many as 50 days per year by 2100. Rising temperatures may directly affect annual Tricolored Blackbird productivity by truncating or interrupting the breeding season, although more work is needed on the effect of temperature on initiation and success of nesting attempts.

The areas of California with the largest climate-projected effects on a variety of bird species are largely concentrated within the Tricolored Blackbird range in the Central Valley. Two important Tricolored Blackbird communities, grassland and freshwater marsh, are projected to be among the natural communities most affected by climate change in California. Depending on the climate projection used, the extent of freshwater marsh in California is projected to decrease by 71%–97% by year 2100. The extent of grasslands is projected to decrease by 16%–48%. The current level of emissions is on track with the higher-impact scenarios.

PROTECTION AFFORDED BY LISTING

It is the policy of the State to conserve, protect, restore and enhance any endangered or threatened species and its habitat (Fish & G. Code, § 2052). The conservation, protection, and enhancement of listed species and their habitat is of statewide concern (Fish & G. Code, § 2051(c)). CESA defines "take" as hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill (Fish & G. Code, § 86). The Fish and Game Code provides the Department with related authority to allow "take" of species listed as threatened or endangered under certain circumstances through incidental take permits, memoranda of understandings, natural community conservation plans, or other plans or agreements approved by or entered into by the Department (Fish & G. Code, §§ 2081, 2081.1, 2086, 2087, and 2835).

If the Tricolored Blackbird is listed under CESA, impacts of take caused by activities authorized through incidental take permits must be minimized and fully mitigated according to state standards. These standards typically include protection of the land in perpetuity with an easement, development and implementation of a species-specific adaptive management plan, and funding through an endowment to pay for long-term monitoring and maintenance to ensure the mitigation land meets performance criteria. Obtaining an incidental take permit is voluntary. The Department cannot force compliance; however, any person violating the take prohibition may be punishable under state law.

Additional protection of Tricolored Blackbird following listing would be expected to occur through state and local agency environmental review under CEQA. CEQA requires that affected public agencies analyze and disclose project-related environmental effects, including potentially significant impacts on rare, threatened, and endangered species. In common practice, potential impacts to listed species are examined more closely in CEQA documents than potential impacts to unlisted species. Where significant impacts are identified under CEQA, the Department expects that project-specific avoidance, minimization, and mitigation measures will benefit the species. State listing, in this respect, and consultation with the Department during state and local agency environmental review under CEQA, would be expected to benefit the Tricolored Blackbird in terms of reducing impacts from individual projects, which might otherwise occur absent listing.

For some species, CESA listing may prompt increased interagency coordination and the likelihood that state and federal land and resource management agencies will allocate funds toward protection and recovery actions. In the case of the Tricolored Blackbird, the Tricolored Blackbird Working Group signatory agencies already meet and coordinate regularly, but a state listing could result in increased availability of conservation funds.

LISTING RECOMMENDATION

CESA directs the Department to prepare this report regarding the status of the Tricolored Blackbird in California based upon the best scientific information available. CESA also directs the Department based on its analysis to indicate in the status report whether the petitioned action is warranted (Fish & G. Code, § 2074.6; Cal. Code Regs., tit. 14, § 670.1, subd. (f)). In addition to evaluating whether the petitioned action (i.e., listing as endangered) was warranted, the Department considered whether listing as threatened under CESA was warranted.

Under CESA, an endangered species is defined as “a native species or subspecies…which is in serious danger of becoming extinct throughout all, or a significant portion, of its range due to one or more causes, including loss of habitat, change in habitat, overexploitation, predation, competition, or disease” (Fish and G. Code, § 2062). A threatened species is defined as “a native species or subspecies…that, although not presently threatened with extinction, is likely to become an endangered species in the foreseeable future in the absence of the special protection and management efforts required by [CESA]" (Fish and G. Code, § 2067).

The Department includes and makes its recommendation in its status report as submitted to the Commission in an advisory capacity based on the best available science. In consideration of the scientific information contained herein, the Department has determined that listing the Tricolored Blackbird as threatened under CESA is warranted at this time.

MANAGEMENT RECOMMENDATIONS

The Department evaluated existing management recommendations and identified the following, listed in no particular order, as necessary to achieve conservation of the Tricolored Blackbird. The *Conservation Plan for the Tricolored Blackbird* (TBWG 2007) identifies goals, objectives, and tasks required to maintain a viable Tricolored Blackbird population throughout the current range of the species. The Department continues to support implementation of the conservation plan as revised by the Tricolored Blackbird Working Group. The goals, objectives, and tasks identified in the plan are not repeated in their entirety here, but many of the management recommendations listed below are related to, or based on, activities identified in the plan.

Habitat Protection, Restoration, and Enhancement

Land ownership patterns across the range of the Tricolored Blackbird, coupled with the diverse nesting and foraging habitats used by the species, necessitate cooperative efforts among government, industry, and the public in order to conserve the species.

Management of habitat must consider the large landscapes utilized by breeding colonies and the integral relationship between nesting colony sites and associated upland foraging areas (Hamilton 1993). Land management plans that do not specifically consider the landscape needs of Tricolored Blackbirds will not necessarily result in the protection or creation of suitable breeding habitat.

1. Determine the best areas for conservation, building off the recent research on habitat suitability conducted by the National Audubon Society (NAS 2017). It is difficult to predict the distribution of widespread species, and even more difficult when the distribution within the range is not stable, as with the dynamic colony site use of Tricolored Blackbirds. Breeding locations that should be prioritized for protection include those that are regularly occupied, those that support large colonies, those that support high reproductive success, and those with a secure foraging landscape (Meese and Beedy 2015).
2. Identify areas in the Tricolored Blackbird range with consistently high quality foraging landscapes, but that lack suitable nesting substrate. Consider conservation actions to enhance, create, or restore nesting substrate in areas with high probability of use by breeding Tricolored Blackbirds.
3. Secure funding and implement the highest priority nesting substrate protection, enhancement and restoration projects and foraging habitat protection projects.

4. Create a system for tracking habitat protection and restoration projects, including appropriate measures of success. Work with the Tricolored Blackbird Working Group to encourage reporting of habitat projects from all stakeholders.

Breeding Colony Protection

In addition to the long-term goal of providing suitable alternative habitat away from silage fields on public and private land, the near-term priority must continue to be placed on identifying and conserving the colonies nesting in silage on private property each year. In addition, the infrequent but large impacts to some colonies due to predation should be monitored and addressed if necessary.

5. Fully fund and implement a silage colony protection program. Continue work in the Tricolored Blackbird Working Group's agriculture subcommittee to plan for and implement a silage colony response plan, with participation from a diverse set of stakeholders including members of the dairy industry.
6. Identify locations that regularly support large and productive Tricolored Blackbird breeding colonies, with secure foraging landscape. Prioritize these locations for protection through acquisition or conservation easement.
7. Assess the effectiveness of provision of alternate nesting habitat (e.g., fresh emergent wetlands) to draw birds away from nesting in dairy silage fields (Beedy et al. 2017).
8. Monitor the effects of predation on colony reproductive success. Where persistent large negative impacts occur, especially due to nonnative or unusually large predator populations, evaluate potential actions to reduce the impacts.

Monitoring and Research

9. Determine the factors that influence nest site selection and especially whether relative insect abundance may affect site occupancy (Airola et al. 2016).
10. Determine the amount, type, and distribution of foraging habitat needed to support viable breeding colonies of various sizes. How does type, proximity to colony site, and diversity of foraging habitats influence the extent of foraging habitat required and the rate of reproductive success?
11. Determine the environmental factors that result in abundant large insect prey populations in grassland habitats and in commonly used agricultural crops, and their variability in time and space. Investigate prey selection by breeding birds.
12. Conduct mechanistic research to complement results from observational data that have shown correlations between neonicotinoid pesticides and declines in songbirds; these should include testing exposure rates of Tricolored Blackbirds to neonicotinoids, effect of exposure on body condition and fitness, and investigations into potential insect-based food web effects.
13. Estimate rates of within season and interannual movements and genetic exchange between populations breeding in different regions, especially between southern California and the Central Valley (Beedy et al. 2017). There is also a general need for evaluation of distribution and

habitats used throughout the year to understand when and where threats are encountered, and to plan conservation actions across the full life cycle.

14. Quantify annual adult survivorship and investigate factors that affect survival, including the magnitude of post-breeding mortality caused by shooting to reduce crop depredation and other nonbreeding season sources of mortality.
15. Create a standardized method to measure productivity in Tricolored Blackbird breeding colonies. Current methods that utilize nest transects or counts of fledglings might not be comparable, and nest transects can be difficult to implement and may negatively affect breeding birds.
16. Examine degree of colony cohesion between first and subsequent breeding attempts, and between breeding seasons (Beedy et al. 2017).
17. Develop and implement a statistically valid, standardized protocol for the long-term, statewide monitoring of Tricolored Blackbird abundance, including population estimate confidence.

Education and Outreach

18. Raise awareness of Tricolored Blackbird nesting behavior and conservation options on ranch and farmlands, stressing the importance of protecting large silage nesting colonies. Build off recent efforts by the Tricolored Blackbird Working Group and the dairy and rice industries.
19. Conduct outreach and coordination with landowners whose grazing lands in the foothills support breeding colonies (Airola et al. 2015b).
20. Provide land managers with habitat management guidance for creation and management of Tricolored Blackbird habitat. Continue work recently undertaken by the Tricolored Blackbird Working Group’s habitat subcommittee.

ECONOMIC CONSIDERATIONS

The Department is charged in an advisory capacity in the present context to provide a written report and a related recommendation to the Commission based on the best scientific information available regarding the status of Tricolored Blackbird in California. The topic areas and related factors the Department is required to address as part of that effort are biological and not economic, therefore the Department is not required to prepare an analysis of economic impacts (See Fish & G. Code, § 2074.6; Cal. Code Regs., tit. 14, § 670.1, subd. (f)).

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Appendix 1
Tricolored Blackbird surveys, 1986–2017

This Appendix briefly describes each effort to survey the Tricolored Blackbird population since 1986. As discussed in the body of the report, the survey approach varied across survey years, with two groups of years (1994, 1997, 2000; and 2008, 2011, 2014, 2017) following relatively consistent approaches and resulting in comparable results. Although surveys in these two groups of years followed similar approaches, there were several differences in methods and in survey effort that preclude direct comparisons of results across these two groups of survey years. Where possible, results have been adjusted for survey effort when discussed in the report.

1986-1990

Beedy et al. (1991) compiled all historical records of Tricolored Blackbird breeding colonies from published and unpublished sources to evaluate the long-term population trends and current status of the species for the USFWS. They also conducted intensive observations at seven colonies in four counties during 1987 and 1988 and made additional irregular observations in seven counties between 1986 and 1990. They concluded that the population had continued to decline since the 1970s (DeHaven et al. 1975b) to an average of 51,600 breeding birds at known colonies in the 1980s. In response to the report by Beedy et al. (1991), a more thorough survey was organized by the Department in 1992, with survey locations informed by ongoing research on the species by Bill Hamilton and others (see below). Results revealed the population to be much larger, indicating that an ad hoc compilation of observation records combined with a limited survey effort over multiple years does not provide an accurate measure of overall population size. Like previous efforts (Neff 1937, DeHaven et al. 1975b), the surveys by Beedy et al. (1991) included only sporadic surveys in the southern San Joaquin Valley.

1992-1993

Basic ecological investigations were conducted that included documentation of colony locations and sizes, discovery of large breeding colonies on grain fields in the San Joaquin Valley, and initial observations that suggested Tricolored Blackbirds are itinerant breeders, but efforts were not extensive enough to provide estimates of the statewide population (Hamilton et al. 1992, Hamilton 1993, Beedy and Hamilton 1997).

1994

Itinerant breeding had recently been documented in Tricolored Blackbirds and this was the first statewide survey conducted over a narrow time period to avoid double-counting birds that shift location between breeding attempts (Hamilton et al. 1995). The documentation of all historical colony sites (Beedy et al. 1991) and recent colony sites (Hamilton et al. 1992, Hamilton 1993) was used to inform a rangewide survey that attempted to visit all known Tricolored Blackbird breeding locations in 1994. The survey was largely volunteer-based and was carried out on a single day (April 23) early in the nesting season to detect as many birds as possible in colonies during their first breeding attempt of the year. The goals of the survey were to document occupancy status and to estimate the size of all active

colonies. Volunteers were asked to visit all known colony locations, estimate numbers at occupied sites, and to drive public roads near known breeding locations to identify previously undocumented colonies (Beedy and Hamilton 1997).

All colonies larger than 10,000 birds were revisited by Hamilton et al. (1995) to verify and sometimes refine estimates. At selected colony sites, the estimates of colony sizes provided by survey volunteers were adjusted using estimated nest densities. This was achieved by running transects through the nesting substrate when nests were active to obtain an estimate of average nest density and the proportion of observed nests that appeared active. More extensive transects were then run after breeding was completed to refine the estimate of nest density. This refined estimate was corrected for the proportion of active nests and multiplied by the total occupied area to obtain an estimate of the number of active nests in the colony. This number was then multiplied by 1.5 to account for an assumed male to female ratio of 1:2. The intent of this approach was to estimate the number of birds that ultimately nested in a breeding colony, but it might not have accurately represented the number of birds present during the survey period. For example, the approach would dismiss large groups of birds that may have been present during colony settlement that ultimately did not breed at a site (i.e., the method fails to account for the presence of any non-breeding adults). This is inconsistent with the goal of the statewide survey to estimate the total number of birds in the population. The approach also violates the condition that observations should be made during a narrow survey window to avoid double-counting birds.

Tricolored Blackbirds were observed in 32 California counties. One hundred active breeding colonies were observed in 28 counties. Ten previously occupied counties were not surveyed. The estimated number of birds observed was 369,400 (+/- 15%) (Beedy and Hamilton 1997). The assumed +/- 15% range in the estimate was based on a small sample of breeding colonies where visual estimates of colony size and estimates based on nest density varied by no more than 15% (Hamilton et al. 1995, Hamilton 1998).

Hamilton et al. (1995) felt that the survey effort in 1994 was “minimal” and that a larger number of birds would have been observed if a more substantial survey had been organized. The survey effort in the southern California portion of the range was especially limited. A single observer made two trips to southern California to search for colonies during the breeding season and organizers considered this portion of the range to be under-surveyed.

1995-1996

Volunteer surveys were conducted on a single day. Surveys were not informed by pre-survey monitoring as in the 1994 survey, and results did not include rangewide follow-up surveys. Some counties were surveyed incompletely, or not at all, and large breeding colonies may have been overlooked. Beedy and Hamilton (1997) concluded that the results of these surveys should not be considered total population estimates for Tricolored Blackbirds.

1997

The 1997 survey used the same coverage, methods, and personnel as did the 1994 survey (Beedy and Hamilton 1997). Participation was greater than in 1994 and most historically occupied counties received at least some coverage (Beedy and Hamilton 1997). The survey in the southern California portion of the range was much more thorough than that conducted in 1994 (Hamilton et al. 1995). The volunteer survey was conducted on April 26.

Breeding and nonbreeding birds were observed in 33 California counties, plus additional birds in one county in Oregon and in Baja California. Seventy-one active breeding colonies were observed (Hamilton 2000). The estimated number of birds observed was 232,960 (+/- 15%) (Beedy and Hamilton 1997).

Despite the 1994 survey being described as a minimal effort that overlooked some unknown number of birds (Hamilton et al. 1995), Beedy and Hamilton (1997) reported that 1994 and 1997 were the only two survey years to date with sufficient survey effort to detect “virtually all large colonies.” The observed number of birds declined by 37%, with the greatest declines occurring in the core of the species’ distribution in Sacramento, Fresno, Kern, and Merced counties (Beedy and Hamilton 1997).

1999

The organizers of the one-day survey in 1999 (Hamilton et al. 1999, 2000) attempted to follow the same methods as those used in 1994 and 1997, but participation in the survey was low and the total count of about 95,000 birds was considered an underestimate by Hamilton (2000). Much of the population began breeding later than in previous years and many colonies were not detected until after the survey date (Hamilton et al. 1999).

2000

As with the 1994 and 1997 surveys, the 2000 survey attempted to locate all breeding colonies and estimate the number of birds in each colony. The 2000 survey used the same methods used in these two previous surveys, although a greater number of observers participated and visited more locations. A workshop was also held before the 2000 survey to train participants in colony size estimation. Unlike the previous survey years that focused on a single day, the 2000 survey was conducted over four days, from April 21-24. Hamilton (2000) suggested that this differed little from the 1994 and 1997 surveys because records in those years were accepted from one day before and after the survey date, effectively accepting reports over a three-day period, and the addition of a fourth day in 2000 only accounted for an additional 1,750 birds observed. As in 1994 and 1997, survey locations were informed by pre-survey colony detection and monitoring.

Breeding and nonbreeding birds were observed in 25 California counties. Seventy-two active breeding colonies were observed (Hamilton 2000).

Although Hamilton concluded that the 2000 survey located a greater proportion of the entire population than did censuses in previous years, he still felt that the San Joaquin Valley, with its potentially large silage colonies, was not surveyed completely (Hamilton 2000). Nevertheless, he concluded that the

Tricolored Blackbird population had declined during the 1990s, from an estimated 370,000 birds in 1994 to 162,000 birds in 2000.

2001

The survey conducted in 2001 followed a very different approach compared to standardized methods used in the 1990s to survey the statewide population. Only 48 sites were surveyed and sites were visited throughout the breeding season rather than being restricted to a narrow survey window of a few days (Humple and Churchwell 2002). As had been demonstrated in the 1990s, a season-long approach to detecting and surveying colonies may result in double-counting of birds that move between locations. Conversely, the limited number of sites visited likely underrepresented the breeding population. The effect of these inconsistencies in methodology and effort on survey results is unclear, and results cannot be compared to those of other survey years.

2004

The four-day survey conducted in 2004 was not intended to produce an estimate of the statewide population size comparable to previous surveys. The survey was limited to colony sites that had historically supported more than 2,000 birds and focused on those located in the Central Valley (Green and Edson 2004). Participation was low with only 29 volunteers conducting surveys. Based on well-documented occupancy dynamics of Tricolored Blackbird, this approach is likely to miss large breeding colonies. No training was provided to participants prior to the survey.

2005

There was no report produced describing the 2005 survey and its results, and the only record available to the Department is a spreadsheet listing occupied sites with estimates of colony size at each location. There is no record of the survey methods used nor the effort expended in conducting the survey.

The number of birds observed was reported as about 258,000 birds at 121 occupied sites (Meese 2015).

2008

The survey methods used to obtain the population estimate in 2008 were similar to those used in statewide surveys conducted in the previous survey years of 1994, 1997, and 2000 (Kelsey 2008). However, the methods differed in a number of ways that likely affected the estimated number of birds and precluded a direct comparison of the earlier surveys with results from 2008:

1. The volunteer survey was conducted on a single day in 1994 and 1997 and over four days in 2000, compared to three days in 2008. However, in 1994 and 1997, birds that were observed one day before and after the survey day but not associated with a colony were included in the estimate, effectively expanding the survey to three days for incidental observations.
2. Despite the narrow survey windows established in each of the survey years, no survey has practiced strict adherence to the requirement that all observations occur during the survey window. For example, in the earlier survey years (1994-2000), birds seen at colonies before the survey date were included in the estimate if those colonies remained active after the survey window but were not observed during the survey dates. Also, breeding birds found after the

date of the surveys were included if nest phenology suggested a colony must have been active during the survey dates. Since 2008, there has been a greater emphasis on adhering to the survey dates, but exceptions have been made on a case-by-case basis each year if observations suggest that birds were missed during the survey window (July 2017 email from B. Meese to N. Clipperton; unreferenced).

3. In the earlier survey years, when multiple observations were available at colonies throughout the breeding effort, the number of birds at a colony was recorded based on the maximum number of nests, which ignored any changes in colony size over time, as opposed to using the number of birds observed only during the survey window. However, Hamilton et al. (1995) stated that the difference between maximum and minimum observations were not great at any large colony. In recent years, when multiple observations at a location during the survey window resulted in multiple estimates, the average has typically been reported as the number of birds for the location.
4. In the earlier survey years, the estimates of colony sizes provided by survey volunteers were sometimes adjusted using estimated nest densities, as described above under the 1994 survey. This adjustment has not been employed in surveys conducted since 2008. The proportion of colonies with estimates adjusted using this approach varied across survey years 1994, 1997, and 2000 and was not always reported.

These methodological differences between survey years may have had both positive and negative effects on the overall estimate, and the magnitude and direction of effect on the estimates are not known. Therefore, caution is warranted in making comparisons between the earlier group of surveys and those conducted since 2008.

The 2008 survey also included several enhancements relative to the earlier surveys:

1. County coordinators were used for the first time to ensure that each surveyed county was well-surveyed by local volunteers.
2. Maps with all survey locations were provided for the first time, and a website was developed prior to the survey that was available for downloading all survey materials and uploading survey data (Tricolored Blackbird Portal; http://tricolor.ice.ucdavis.edu/). The availability of the portal for distribution of materials allowed participants to be better informed about colony locations and likely contributed to the increase in number of sites surveyed.
3. The number of survey participants and the number of sites surveyed greatly increased relative to earlier surveys (Kelsey 2008). The result was a more complete survey and more reliable data collection and reporting.

In addition to these enhancements to the survey, several new colony locations in the San Joaquin Valley had been discovered in 2006 and 2007 through targeted searches. By surveying at dairies throughout the San Joaquin Valley (rather than relying on previously known colony locations), Meese (2006, 2007) located several colonies in new locations on grain fields that numbered in the tens of thousands of birds. The effect of these new procedures and increased effort on the proportion of the Tricolored Blackbird population observed is unknown, but a larger proportion of the population was likely observed in surveys conducted since 2008 compared to previous surveys. As was first implemented in 2000, training sessions were also provided to survey volunteers. The 2008 survey was conducted from April 25-27.

A total of 155 volunteers participated in the 2008 survey and visited 361 historical and new locations in 38 counties (Kelsey 2008). The total estimate for number of birds observed was 394,858. Many of the larger colonies were visited by Tricolored Blackbird experts, which is consistent with earlier statewide surveys. Kelsey (2008) reported that some portion of the increase in observed number of birds since the 2000 survey may have been attributable to increased survey effort, but did not think that the increase was entirely due to the increased effort.

2011

The survey methods followed in 2011 were largely the same as those used during the 2008 survey (Kyle and Kelsey 2011), although a different approach to coordinating the survey was used. Rather than establishing county coordinators to ensure complete coverage of each surveyed county, the 2011 survey was organized by a statewide coordinator using online resources. Volunteers were asked to sign up for survey areas using the online portal and a statewide coordinator tracked survey coverage. The survey was conducted over three days, from April 15-17.

A total of 100 volunteers participated in the 2011 survey and visited 608 historical and new locations in 38 counties (Kyle and Kelsey 2011). The total estimate for number of birds observed was 259,322.

2014

The 2014 survey followed the methods used in 2008 and 2011. As in the 2008 survey, county coordinators were again used to ensure thorough coverage of each county (Meese 2014). The survey was conducted over three days, from April 18-20.

A total of 143 volunteers participated in the 2014 survey and visited 802 historical and new locations in 41 counties (Meese 2014). Based on number of volunteers, counties covered, and number of sites visited, this was the most complete statewide completed to date. The total estimate for the number of birds observed was 145,135.

2017

The 2017 survey followed the methods used in 2008-2014. The survey was conducted over three days, from April 7-9 (Meese 2017). For 2017, additional survey forms were used to collect additional information on weather conditions, survey effort, site occupancy, and the suitability of nesting habitat at each surveyed location. Maps of survey locations were also updated and included online maps that could be used to navigate to sites in the field using a smartphone app.

A total of 181 volunteers participated in the 2017 survey and visited 884 historical and new locations in 44 counties (Meese 2017). Based on number of volunteers, counties covered, and the number of sites visited, the 2017 survey was even more thorough than the 2014 survey. The total estimate for the number of birds observed was 177,656.

Appendix 2
Observations on the Tricolored Blackbird statewide survey methods and sources of uncertainty

Methods of estimating population abundance and the approach used in statewide surveys

In surveys designed to estimate the number of individuals in a population, abundance data may be collected through a sampling approach that focuses on a representative subset of locations, or through a census that aims at a complete count of all birds within a survey boundary (Gregory et al. 2004). Many different approaches have been developed to sample data from a population in a defined area of interest, with the underlying goal to provide an estimate of the full population size and some measure of estimation error. Species that are spatially highly-clumped, or rare and occurring within a restricted range or at a limited number of sites, are often not amenable to sampling approaches because of the difficulty in designing an approach that results in a sample representative of the full population (i.e., an unbiased sample). These species may be more amenable to censuses, especially when highly conspicuous like the Tricolored Blackbird (Gregory et al. 2004).

Conducting a census of colonial species requires that breeding locations first be identified. For species with high site fidelity to traditional breeding locations (e.g., seabirds, some herons) it can be fairly straightforward to identify breeding sites and monitor the population of interest. Due to the dynamic occupancy patterns of Tricolored Blackbird breeding colony locations and the large geographic scale where statewide surveys are conducted, it is not possible to ensure every breeding colony is located and counted in any given year. Because of these difficulties, the approach for statewide surveys to date (since 1994) has been to conduct early season colony detection work to identify active colonies, then to combine these with all historical colony sites to attempt a comprehensive search of known breeding locations over a short (usually 3-day) survey window.

Some unknown portion of the Tricolored Blackbird population is not located and counted during each survey, and therefore the results of statewide surveys might be best described as an index of abundance that can be compared over time to evaluate population trends. Indices are based on the idea that a fixed amount of searching effort will always locate a fixed proportion of the population; therefore, changes in the index should be directly proportional to changes in the population size (Gregory et al. 2004). The dynamic inter-annual occupancy patterns of the Tricolored Blackbird can complicate efforts to meet this assumption, but the somewhat predictable distribution in the early breeding season, paired with pre-survey efforts to locate large breeding colonies may help to address this issue. As described in the body of this report, the recent approach to statewide surveys has been an ever-increasing effort across survey years to visit as many of the known historical breeding locations as possible, which themselves increase as additional breeding locations are discovered by survey participants and as birds shift to establish new breeding locations on the landscape. An ever-increasing survey effort is not a sustainable approach to monitoring the species, and it violates the assumption of a constant search effort in indices of abundance (an increasing effort over time may allow for documentation of a negative population trend, but may confound interpretation of any observed increase in population numbers).

Recent work to establish a survey design based on a random stratified sample has provided a method to estimate the number of birds that would result from a full census without the required effort to visit all known colony sites (Meese et al. 2015). The approach followed in sample surveys conducted in 2015 and 2016 was to attempt a complete census of five counties where the majority of the population occurs each April, and to survey the remaining counties based on a stratified sample, with bioregion and nesting substrate as sampling strata. The intent of this new survey design was to provide a method whereby the population could be monitored annually during years when a full triennial survey is not conducted, with a smaller force of volunteer surveyors. The data from these sample surveys are currently being analyzed and will likely result in revisions to the sampling approach. Results may also inform revisions to the triennial survey. Potential modifications to statewide surveys may include 1) removal of sites that are no longer suitable for Tricolored Blackbird nesting, 2) removal of sites that have not been occupied by Tricolored Blackbirds within a certain number of years, assuming sites have been surveyed on a regular basis, 3) removal of entire regions of the state where the species has declined or disappeared, or 4) increased opportunities to conduct multiple observations per colony site for estimation of detection probability and estimation error, or other modifications. Ultimately, the triennial attempts at a full census might be replaced with an annual or longer-duration sample survey.

Sources of uncertainty in Tricolored Blackbird population estimates

Geographic coverage

As shown in Figure 9 (distribution of colony sites visited 2008-2017) in the body of this report, survey locations visited during statewide surveys have been well distributed throughout the California range of the Tricolored Blackbird. As the survey effort has increased with each successive survey, the portion of the range surveyed has filled in as volunteers have visited more locations within the range. The addition of survey locations also results in an increased area searched as volunteers drive from one survey location to the next. In some years, birds at the geographic fringe of the range may have been excluded from the survey effort, but these areas have never supported large numbers of birds during the early breeding season and so this is unlikely to have a large effect on the overall estimate or index. For example, in statewide surveys in which Siskiyou County was included, it has held only 0-0.2% of the total estimate of birds observed. In some portions of the range (e.g., the Sierra foothills), there are areas with low road density and private property with no access and therefore some unknown number of colonies are likely missed each year. For example, Airola et al. (2016) estimated that only 36% of the available habitat was surveyed in a study of the Sierra Nevada foothills that utilized public roads (with a range of 26% to 44% depending on region of the foothills). This is a consistent omission in each survey year so it might not have a large impact on trend detection.

Detectability of colonies

Small breeding colonies are likely missed during each survey, especially in areas where small colonies might occur distant from any known colony site, and therefore are not located within the focused search area. Because Tricolored Blackbird colonies are extremely conspicuous leading up to and throughout most of the nesting cycle, most large colonies that would contribute substantially to the overall statewide estimate are likely to be observed during the 3-day search window, unless they occur at a large distance from public roads (Kelsey 2008). Given the concentration of birds in relatively few large colonies and within a few well-known and well-surveyed portions of their range, especially the San Joaquin Valley, Kelsey (2008) concluded that "it is unlikely that large numbers of Tricolored Blackbirds go undetected during the statewide surveys." Additionally, in areas of the state where most of the population breeds early in the nesting season (e.g., San Joaquin Valley), extensive pre-survey scouting occurs in an attempt to locate colonies, both for survey purposes and to initiate colony protection efforts where colonies occur on agricultural fields. Even if a colony site is not visible from a road, large colonies can be detected and identified by the species' diagnostic feeding flights as they move between the colony location and foraging habitat. The density of roads may limit observation of a portion of the landscape and some unknown proportion of colonies goes undetected each year; this is a limitation common to all survey years.

Julie Yee (Statistician with the USGS) used data from the 2008 statewide survey, which was the first statewide survey to consistently record colony absence information and contained incidentally collected double-observer data for certain colony sites, to evaluate colony detection rate. The per-visit detection probability (i.e., the likelihood that an occupied colony location will be detected) was 0.94, which is quite high (Nov 2016 email from J. Yee to N. Clipperton; unreferenced).

Timing of survey and nesting phenology

The number of birds present and visible at a colony location can vary dramatically across the nesting cycle. During settlement, many more birds may be present at a site than ultimately remain to breed, and the high level of activity can make estimation difficult. However, these birds are part of the adult population and should be included in survey estimates, although this may not have been the case in 1994-2000 when estimates were adjusted using nest densities. During incubation, females may be unaccompanied by males at the colony site and may remain on their nests hidden from view. At this stage the counts of birds at a colony may result in underestimates (Hamilton et al. 1995). Visual estimates of colony size are probably best made during the nestling/fledgling provisioning stage when both parents are visible and are making regular trips to and from the colony site (Hamilton et al. 1995).

The statewide surveys have regularly been conducted in the early part of the nesting season to capture the first breeding attempts of most of the population. The timing of nesting can vary annually, so there is no way to plan survey dates for a time when most colonies are at a certain stage of the nesting cycle. Tricolored Blackbirds have begun nesting earlier in the year, perhaps in response to climate change (e.g., see Tottrup et al. 2010, Mazerolle et al. 2011). Between 1939 and 2009, the mean date of first breeding date has shifted to occur about 22 days earlier (M. Holyoak pers. comm.), and the survey period for statewide surveys has been shifted to accommodate this in an attempt to sample the population during similar times in the nesting cycle.

Colony size estimation

Estimation of colony size may be the largest source of uncertainty in the number of birds estimated on statewide surveys. Hamilton et al. (1995) suggested that observer variability was a substantial source of error in population estimates, but felt that colony size estimates were accurate to within 15% based on efforts to verify colony size using nest densities. For this reason, results from the 1994 and 1997 surveys were provided with an error range of +/- 15%.

In each of the four most recent survey years (2008, 2011, 2014, and 2017), several steps have been followed to reduce the amount of observer-based error. Volunteers were provided with training in Tricolored Blackbird identification, estimation of colony size, use of maps and online tools, and a standard survey protocol. Many of the participants, especially those coordinating county efforts, have been knowledgeable observers with experience participating in multiple survey years, and the same survey participants are enlisted from year to year when possible. As with surveys from previous years, most of the largest colonies have been revisited by experienced observers to verify colony size estimates.

Since 2008, volunteers have been asked to provide a best estimate of colony sizes, plus a range incorporating the minimum and maximum number of birds that could be present at a site. This request may be interpreted differently by different observers. For example, some observers may provide a large range to be certain that the minimum and maximum numbers capture the true size of the colony, whereas others may treat the range as a measure of their ability to accurately count the observed birds. However, it does provide some sense of how certain an observer is in their ability to accurately estimate the size of a colony. Observers show a natural tendency to overestimate small flocks and underestimate large flocks, although the extent to which different observers do this varies greatly (Gregory et al. 2004) and the effect on the overall population estimate from multiple colonies is unclear. The range provided by observers to capture the minimum and maximum estimates has averaged about +/-25% [range for 2008, 2011, and 2014 surveys of -29% to +33%] of the best estimates across all colony sites. Unfortunately, data have not been collected in a way that allows for statistical estimates of error around the annual indices of abundance, but the similar survey protocols and extensive and increasing survey effort have provided information sufficient for detecting a long-term population decline. Ongoing efforts to revise the statistical sampling scheme for monitoring the Tricolored Blackbird population will incorporate methods to produce error estimates (Meese et al. 2015).

Appendix 3
Analysis of Christmas Bird Count Data

Because the number of Christmas Bird Count (CBC) circles is known to have increased dramatically through the 1950s and 1960s, especially in the western region of the U.S. (Niven et al. 2004), data were evaluated to determine an appropriate year to use as a start date for trend analysis. The first CBC to detect Tricolored Blackbird in California was conducted in Marysville in count year 12 (i.e., the winter of 1911–1912). CBC circles in California were sparse and were conducted inconsistently for several decades before the number of circles detecting Tricolored Blackbird began to increase in the 1950s and 1960s. The year 1974 was selected as the start year for a trend analysis using CBC data for the following reasons:

1. Following a period of rapid increases in the number of CBC circles in California through the 1960s, 1974 was the first year when Tricolored Blackbirds were detected on more than 25 circles. Annual increases in the number of party hours spent searching for birds also began to level off in the mid-1970s. The number of circles with Tricolored Blackbird detections in California continued to increase through the 1970s and 1980s, with detection of the species on 35 circles by 1978, 40 circles by 1981, and 50 by 1986.
2. DeHaven et al. (1975b) assessed the population status of the Tricolored Blackbird in the early 1970s, so selection of 1974 as a start date for CBC analysis allows for trend assessment since that important benchmark.
3. Graves et al. (2013) used data collected between 1935 and 1975 to evaluate trends in average colony size during a period when the Tricolored Blackbird population was reported to have declined by about 50% (Neff 1937, DeHaven et al. 1975b), and observed a negative trend. They selected data from 1980 to 2009 to evaluate more recent trends without finding evidence of a continued decline in average colony size. The use of data starting in the mid-1970s for a CBC data analysis allows for comparison of winter population trend to the results for average colony size from Graves et al. (2013).

CBCs circles are not run consistently every year. To ensure that apparent trends were not artifacts of the years when certain circles were run, data from CBC circles were included only if the circle met the following criteria:

1. Tricolored Blackbird was detected on the circle in more than 50% of survey years from 1974 to 2015 (at least 22 of 42 years).
2. The first detection of Tricolored Blackbird on a circle occurred no later than 1985. As mentioned above, new CBC circles continued to be added over the years; this criterion was implemented to limit the effect that an increasing set of circles might have on long-term trends.

Based on these criteria, 46 CBC circles were selected to assess winter population trend from 1974 to 2015 (Figure A3.1). The circles provide decent coverage of the winter distribution of the Tricolored

a) b)

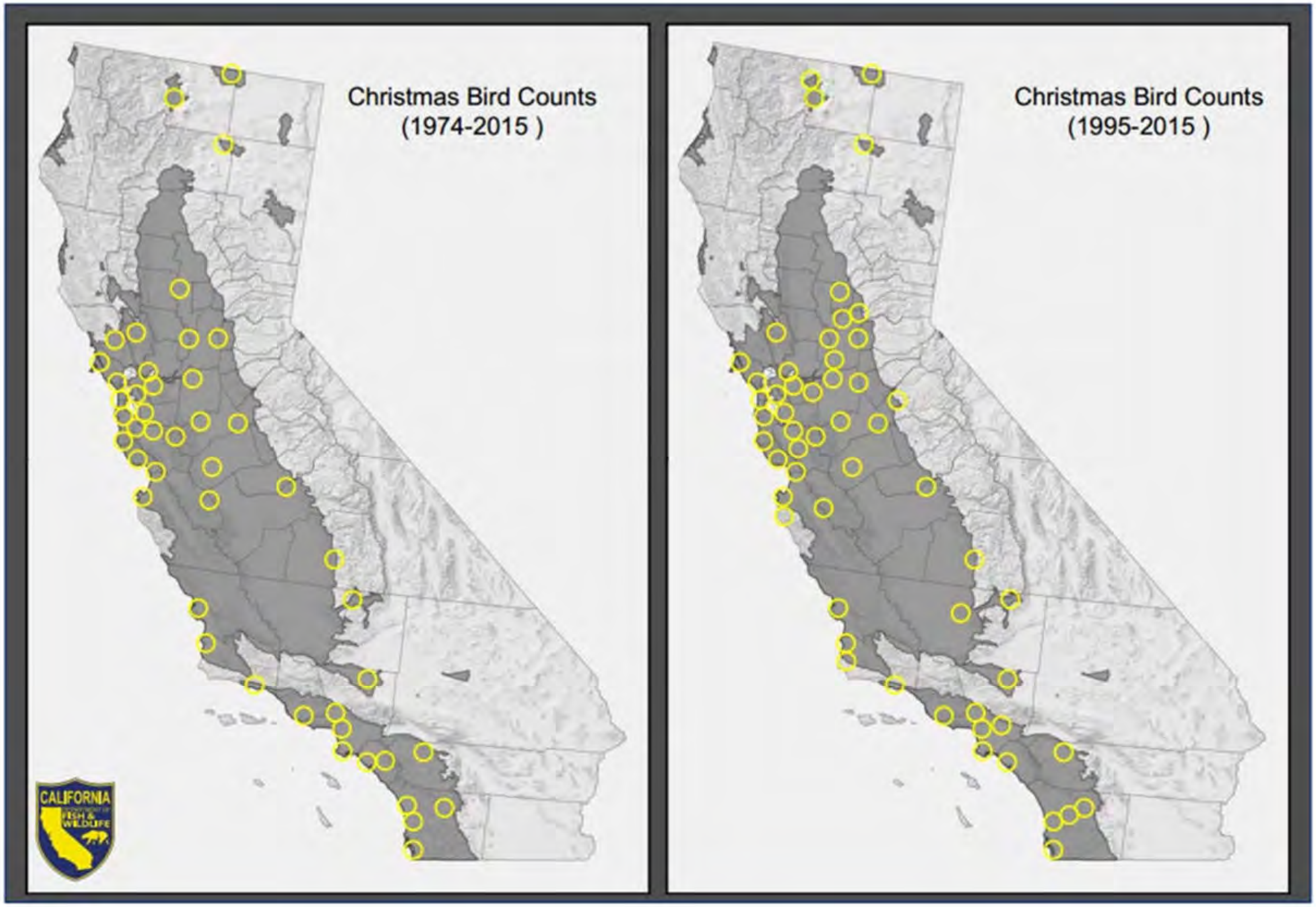

Figure A3.1. Christmas Bird Count circles used for trend assessment. a) Circles for which data were analyzed over a long-term period (1974–2015). b) Circles for which data were analyzed for a shorter-term period (1995–2015) during which more data were available.

Blackbird on the central California coast, the Delta and adjacent portions of the Central Valley, and of southern California. Coverage of the southern San Joaquin Valley is limited.

Although some CBC circles are run in all or most years, annual survey coverage of established circles continues to vary. However, the number of circles run each year has been much more consistent since the early 1990s. For example, from 1992 to 2015 the number of circles with detections of Tricolored Blackbird ranged from 54 to 66. A separate analysis was conducted using data from years 1995–2015. This allowed for use of a larger number of circles for trend evaluation and a more consistent set of data from year to year. This is also the time period for which the best data are available from Tricolored Blackbird breeding season surveys. Data from circles were included for analysis of trends over this narrower time period only if Tricolored Blackbird was detected on the circle in at least 13 of the 21 survey years. The resulting 55 CBC circles provided somewhat improved coverage of the northern San Joaquin and southern Sacramento valleys compared to the 1974–2015 analysis (Figure A3.1).

Because of the variable number of observers and time spent surveying CBC circles each year, it is common practice to evaluate effort-corrected data (birds detected/party hour). Although results are highly variable from year to year, data from the 46 circles evaluated for the 1974–2015 period showed a clear decline (Figure A3.2). The graph in Figure A3.2 only includes circles for which at least one Tricolored Blackbird was detected because data on survey effort (party hours) were unavailable for counts that were conducted but observed zero Tricolored Blackbirds. Therefore, the value for average birds per party hour are likely inflated for years that included circles with many non-detections. This likely results in a trend that is biased upward (positive) in recent years, as the number of circles with zero Tricolored Blackbirds has been increasing over the last two decades (Table A3.1).

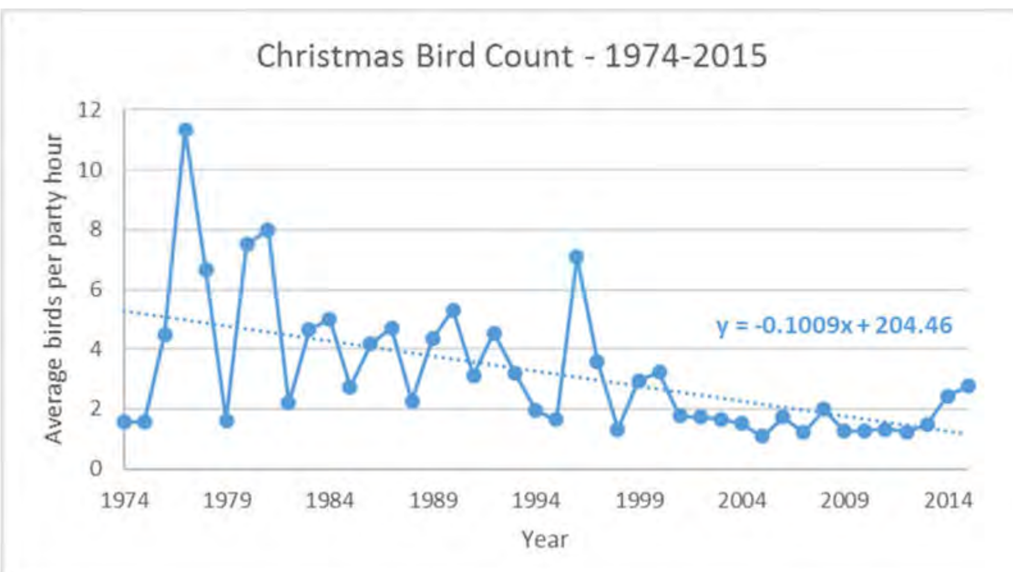

Figure A3.2. Effort-corrected numbers of Tricolored Blackbirds observed on Christmas Bird Counts conducted from survey year 74 (winter 1973–1974) to survey year 115 (winter 2014–2015).

Table A3.1. Number of circles with no Tricolored Blackbirds detected over the last 25 years.

Survey years	Average annual number of circles with zero TRBL (percent)[1]
1991–1995	3.2 (7%)
1996–2000	5 (11%)
2001–2005	7 (15%)
2006–2010	10.6 (23%)
2011–2015	13.4 (29%)

[1] Percent of the total 46 circles included in the analysis.

Population trends were estimated from the slope of the regression of the log-transformed counts on year. Because of the need for log-transformation to obtain normally distributed data, only circles with at least one Tricolored Blackbird detection were included. Whether all circles in each year were treated as independent samples (Figure A3.3) or were averaged for a single annual value of birds/hour (Figure A3.4), the 1974–2015 data show a negative trend in number of birds observed (i.e., the slope is not zero; p-values <0.001).

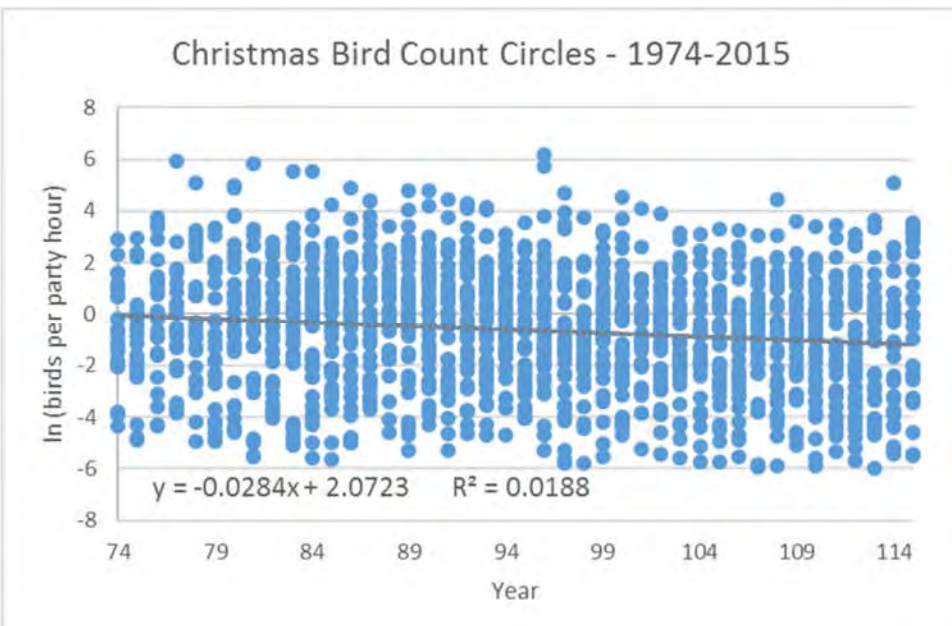

Figure A3.3. Christmas Bird Count data for all circles with Tricolored Blackbird detections (of the 46 circles selected for the analysis) from 1974 to 2015, with least squares line.

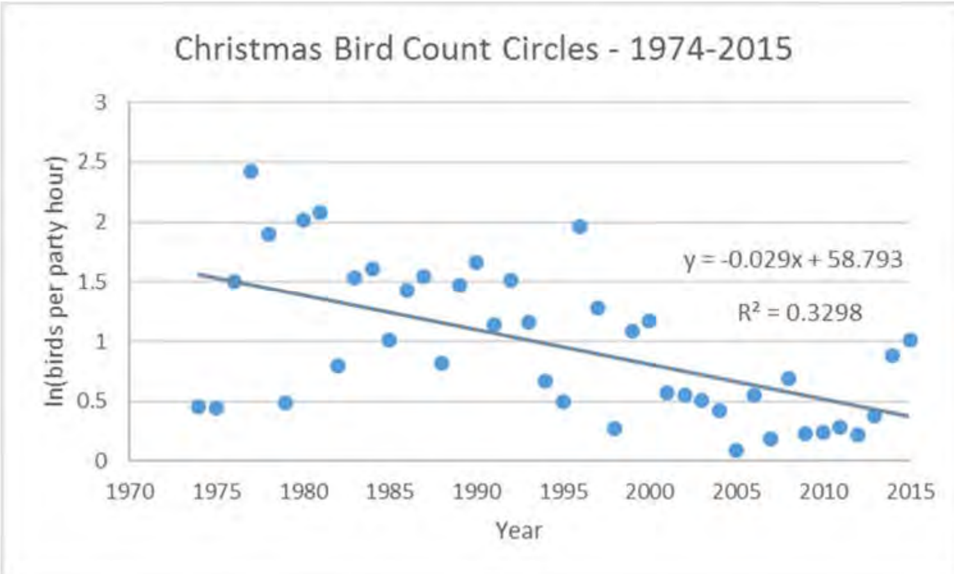

Figure A3.4. Christmas Bird Count data with circles averaged for a single value per year.

Data from the 55 circles evaluated for the 1995–2015 period show a decline, but this is primarily due to a large number of birds detected in 1996 (Figure A3.5). Since 1997, there is no apparent strong trend in the data, but rather a consistent low number of birds (<5 birds/party hour) observed in most years. This is a large contrast to the peaks in numbers seen 1977–1996. As with the analysis of data from 1974 to 2015, the graph in Figure A3.5 only includes circles for which at least one Tricolored Blackbird was detected. Therefore, the values for average birds per party hour are likely inflated for years that included circles with many non-detections, and this would have a larger effect in the most recent years (Table A3.1).

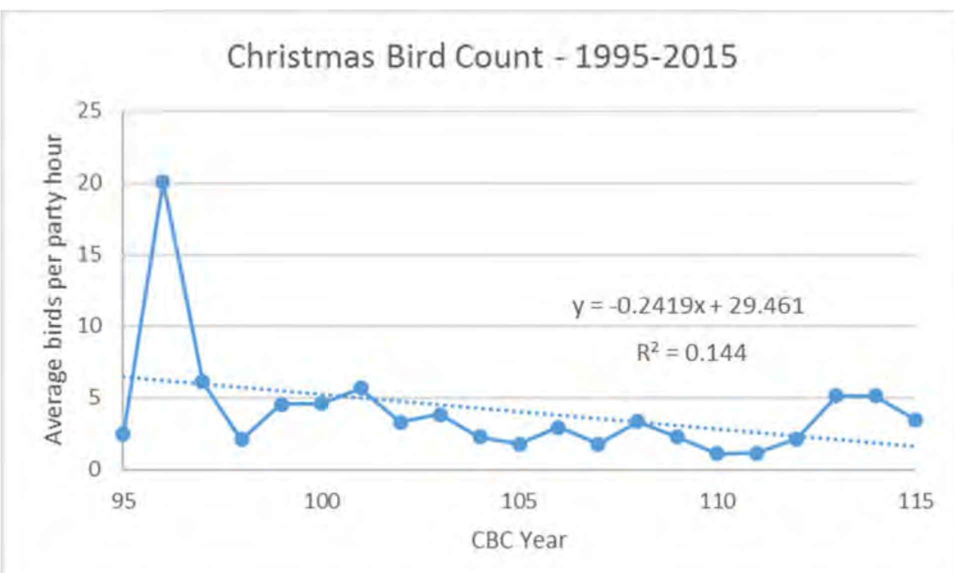

Figure A3.5. Effort-corrected numbers of Tricolored Blackbirds observed on Christmas Bird Counts conducted from survey year 95 (winter 1994–1995) to survey year 115 (winter 2014–2015).

For the shorter 1995–2015 time period, the requirement that Tricolored Blackbird be seen on a circle in at least 13 years for data from the circle to be considered had the unintended consequence of eliminating circles with previous detections of Tricolored Blackbird, but that in recent years have had none. For example, the Oceanside-Vista-Carlsbad circle had only two Tricolored Blackbirds detected in a single year since 2001, Orange County (northeastern) had only 12 birds seen in a single year since 2006, Palo Alto had birds seen in only two years since 2004, and Peace Valley (which recorded the largest number of Tricolored Blackbirds ever found on a CBC circle in 1977) had no birds detected since 2001. None of these circles were included in the analysis, which may have biased the observed trend to the positive. Additional count circles, although included in the analysis because they had at least 13 years of detections during 1995–2015, also saw declines to zero birds in recent years. These include the Los Angeles circle that had no Tricolored Blackbird sightings since 2011; Oakland, which had no Tricolored Blackbirds in 2015 and no more than seven birds since 2008; Orange County (coastal), with no birds detected since 2008; and San Fernando Valley, with only four birds seen in one year since 2008. Due to a lack of data, the effort at these circles where no birds were observed is not included in estimates of birds/party hour, which may obscure any negative trend in recent years.

Appendix 4
Public and tribal notice and summary of comments received

The Department of Fish and Wildlife and the Fish and Game Commission requested any information pertaining to the status of the Tricolored Blackbird in California that might help inform a decision on whether to list the species as threatened or endangered.

The Fish and Game Commission published a Notice of Findings regarding the candidacy and status review of the Tricolored Blackbird in the California Regulatory Notice Register on January 8, 2016 (Cal. Reg. Notice Register 2016, No. 2-Z, p. 57).

On February 26, 2016, the Department distributed the attached notice of the Tricolored Blackbird's candidacy and a request for information and comments to approximately 120 persons or offices of state and federal agencies, counties, industry, and non-governmental organizations. The Department also mailed a notice to approximately 110 tribes on February 29, 2016. The complete mailing list is on file with the Department. The Department released the attached announcement to news media on March 2, 2016.

Summary of Comments Received

In addition to a large number of form emails expressing general support or opposition for listing of the Tricolored Blackbird, the Department received letters or emails from eight individuals and organizations. These communications provided information on the life history of the Tricolored Blackbird, population and colony size trends, banding recovery and other data, threats, relevant literature, and descriptions of recent conservation efforts.

All communications are on files with the Department.

PUBLIC NOTICE

February 26, 2016

TO WHOM IT MAY CONCERN:

NOTICE IS HEREBY GIVEN that the California Department of Fish and Wildlife has initiated a status review of the Tricolored Blackbird (*Agelaius tricolor*) pursuant to Fish and Game Code section 2074.6, and is providing this notice pursuant to Fish and Game Code section 2074.4 to solicit data and comments on the petitioned action from interested and affected parties.

The Department has initiated this status review following related action by the Fish and Game Commission. Having provided notice, the Tricolored Blackbird is now a candidate species under the California Endangered Species Act (Cal. Reg. Notice Reg. 2013, No. 52-Z, pp. 2085-2092; see also Fish & G. Code, §§ 2074.2, 2085).

The Department has 12 months to review the petition, evaluate the available information, and report back to the Commission whether or not the petitioned action is warranted (Fish & G. Code, § 2074.6). The Department's recommendation must be based on the best scientific information available to the Department.

Therefore, **NOTICE IS FURTHER GIVEN** that anyone with data or comments on the taxonomic status, ecology, biology, life history, management recommendations, distribution, abundance, threats, habitat that may be essential for the species, or other factors related to the status of the above species, is hereby requested to provide such data or comments to the Department.

Comments may be submitted via email to: wildlifemgt@wildlife.ca.gov. If submitting by email, please include "Tricolored Blackbird" in the subject heading. Comments may also be submitted by surface mail. If submitting by mail, please submit two hard copies or include comments in a digital/electronic format and send to:

California Department of Fish and Wildlife
Nongame Wildlife Program
Attn: Neil Clipperton
1812 9th Street
Sacramento, California 95811

Responses and information received by **June 1, 2016** will be evaluated for possible incorporation in the Department's final report to the Fish and Game Commission. The Department's written report will indicate, based on the best scientific information available, whether the Department concludes that the petitioned action is warranted or not warranted. Receipt of the report will be placed on the agenda for the next available meeting of the Commission after delivery. The report will be made available to the public at that time. Following receipt of the Department's report, the Commission will allow a 30-day public comment period prior to taking any action on the Department's recommendation.

If you have any questions, please contact Neil Clipperton at (916) 445-9753 or the Department via email at wildlifemgt@wildlife.ca.gov or at the address above.

As a candidate species, the Tricolored Blackbird receives the same legal protection afforded to an endangered or threatened species (Fish & G. Code, § 2085). Research on Tricolored Blackbird requires appropriate permits issued pursuant to Fish and Game Code Section 2081(a). Interested researchers should contact Esther Burkett at Esther.Burkett@wildlife.ca.gov for more information.

NOTICE TO TRIBES

February 29, 2016

TO TRIBAL REPRESENTATIVES:

NOTICE IS HEREBY GIVEN that the California Department of Fish and Wildlife has initiated a status review of the Tricolored Blackbird (*Agelaius tricolor*) pursuant to Fish and Game Code section 2074.6, and is providing this notice pursuant to Fish and Game Code section 2074.4 to solicit data and comments on the petitioned action from interested and affected parties.

The Department has initiated this status review following related action by the Fish and Game Commission. Having provided notice, the Tricolored Blackbird is now a candidate species under the California Endangered Species Act (Cal. Reg. Notice Reg. 2013, No. 52-Z, pp. 2085-2092; see also Fish & G. Code, §§ 2074.2, 2085).

The Department has 12 months to review the petition, evaluate the available information, and report back to the Commission whether or not the petitioned action is warranted (Fish & G. Code, § 2074.6). The Department's recommendation must be based on the best scientific information available to the Department.

Therefore, **NOTICE IS FURTHER GIVEN** that anyone with data or comments on the taxonomic status, ecology, biology, life history, management recommendations, distribution, abundance, threats, habitat that may be essential for the species, or other factors related to the status of the above species, is hereby requested to provide such data or comments to the Department.

Comments may be submitted via email to: wildlifemgt@wildlife.ca.gov. If submitting by email, please include "Tricolored Blackbird" in the subject heading. Comments may also be submitted by surface mail. If submitting by mail, please submit two hard copies or include comments in a digital/electronic format and send to:

California Department of Fish and Wildlife
Nongame Wildlife Program
Attn: Neil Clipperton
1812 9th Street
Sacramento, California 95811

Responses and information received by **June 1, 2016** will be evaluated for possible incorporation in the Department's final report to the Fish and Game Commission. The Department's written report will indicate, based on the best scientific information available, whether the Department concludes that the petitioned action is warranted or not warranted. Receipt of the report will be placed on the agenda for the next available meeting of the Commission after delivery. The report will be made available to the public at that time. Following receipt of the Department's report, the Commission will allow a 30-day public comment period prior to taking any action on the Department's recommendation.

If you have any questions, please contact Neil Clipperton at (916) 445-9753 or the Department via email at wildlifemgt@wildlife.ca.gov or at the address above. If you would like to initiate consultation with the Department concerning the status review for Tricolored Blackbird, please contact the Department's Tribal Liaison, Steven Ingram, at steven.ingram@wildlife.ca.gov.

As a candidate species, the Tricolored Blackbird receives the same legal protection afforded to an endangered or threatened species (Fish & G. Code, § 2085). Research on Tricolored Blackbird requires appropriate permits issued pursuant to Fish and Game Code Section 2081(a). Interested researchers should contact Esther Burkett at Esther.Burkett@wildlife.ca.gov for more information.

California Department of Fish and Wildlife News Release

March 2, 2016

Media Contacts:
Neil Clipperton, CDFW Wildlife Branch, (916) 445-9753
Kyle Orr, CDFW Communications, (916) 322-8958

CDFW Seeks Public Comment Related to Tricolored Blackbird

The California Department of Fish and Wildlife (CDFW) is seeking public comment on a proposal to list the Tricolored Blackbird as a threatened or endangered species.

The Tricolored Blackbird (Agelaius tricolor) is native to California, occurring mainly in the lowlands of California west of the Sierra Nevada. Small populations can also be found to the south into Baja California and to the north in southernmost Oregon and the Modoc Plateau of northeastern California. Most Tricolored Blackbirds breed in California's Central Valley, and nest in a variety of habitats including wetlands, blackberries and nettles. In recent years, some of the largest colonies have occurred in grain fields in the San Joaquin Valley, often associated with dairies or feedlots.

Loss of habitat, destruction of breeding colonies and predation have been identified as factors negatively impacting the Tricolored Blackbird; however, climate change, contaminants, shooting mortality, extreme weather events and other factors may also negatively affect its populations.

In August 2015, the Center for Biological Diversity submitted a petition to the California Fish and Game Commission to formally list the Tricolored Blackbird as a threatened or endangered species. The Commission published findings of its decision to advance the species to candidacy on Dec. 29, 2015, triggering a 12-month period during which CDFW will conduct a status review to inform the Commission's decision on whether to list the species.

As part of the status review process, CDFW is soliciting public comment regarding the species' ecology, biology, life history, distribution, abundance, threats and habitat that may be essential for the species, as well as recommendations for management of the species. Comments, data and other information can be submitted by email to wildlifemgt@wildlife.ca.gov. If submitting comments by email, please include "Tricolored Blackbird" in the subject heading.

Comments may also be submitted by regular mail to:

California Department of Fish and Wildlife
Nongame Wildlife Program
Attn: Neil Clipperton
1812 Ninth St.
Sacramento, CA 95811

All comments received by June 1, 2016 will be evaluated prior to submission of the CDFW report to the Commission. Receipt of the report will be placed on the agenda for the next available meeting of the Commission after delivery and the report will be made available to the public at that time. Following the receipt of the CDFW report, the Commission will allow a 30-day public comment period prior to taking any action on the petition.

CDFW's petition evaluation report for Tricolored Blackbird can be found at www.dfg.ca.gov/wildlife/nongame/publications/.

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Appendix 5
External peer review solicitation letters

The Department solicited the assistance of the following persons to review and provide comments on the draft Tricolored Blackbird status review report, dated October 13, 2017:

Robert Meese, Ph.D.
University of California, Davis

Edward C. Beedy, Ph.D.
Beedy Environmental Consulting

Marcel Holyoak, Ph.D.
University of California, Davis

Robert H. Doster, Ph.D.
U.S. Fish and Wildlife Service

Rosamonde R. Cook, Ph.D.
Western Riverside County Multiple Species Habitat Conservation Plan

Erica Fleishman, Ph.D.
Colorado State University

Steve Beissinger, Ph.D.
University of California, Berkeley

State of California – Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
Wildlife Branch
1812 Ninth Street
Sacramento, CA 95814
www.wildlife.ca.gov

EDMUND G. BROWN JR., Governor
CHARLTON H. BONHAM, Director

October 13, 2017

Robert Meese, Ph.D.
University of California, Davis
[redacted]

RE: TRICOLORED BLACKBIRD (*AGELAIUS TRICOLOR*);
DEPARTMENT OF FISH AND WILDLIFE, PEER REVIEW STATUS REPORT

Dear Dr. Meese:

Thank you for agreeing to serve as a scientific peer reviewer for the Department of Fish and Wildlife's (Department) Draft Status Review of the Tricolored Blackbird (*Agelaius tricolor*). A copy of this report, dated October 13, 2017, is enclosed for your use in that review. The Department seeks your expert analysis regarding the scientific validity of the report and its assessment of the status of Tricolored Blackbird in California. **The Department would appreciate receiving your peer review input on or before November 10, 2017**.

The Department seeks your review as part of formal proceedings pending before the California Fish and Game Commission (Commission) under the California Endangered Species Act (CESA). As you may know, the Commission, as a constitutionally established entity distinct from the Department, exercises exclusive statutory authority under CESA to add species to the state lists of endangered and threatened species (Fish & G. Code, § 2070). The Department serves in an advisory capacity during listing proceedings, charged by the Fish and Game Code to use the best scientific information available to make related recommendations to the Commission (Fish & G. Code, § 2074.6).

The Commission first received the petition to list Tricolored Blackbird as endangered on August 19, 2015. (Cal. Reg. Notice Register 2015, No. 36-Z, p. 1514). The Commission published notice of its acceptance of the petition for further consideration and formal designation of the species as a candidate species on January 8, 2016. (Cal. Reg. Notice Register 2016, No. 2-Z, p. 57).

The draft report forwarded to you today reflects the Department's effort to identify and analyze the scientific information available regarding the status of Tricolored Blackbird in California. At this time, the Department believes the available science indicates that listing the species as threatened under CESA is warranted. An endangered species is defined as "a native species or subspecies...which is in serious danger of becoming extinct throughout all, or a significant portion, of its range due to one or more causes, including loss of habitat, change in habitat, overexploitation, predation, competition, or disease" (Fish and G. Code, § 2062). A threatened species is defined as "a native species or subspecies...that, although not presently threatened with extinction, is likely to become an endangered species in the foreseeable future in the absence of the special protection and management efforts required by [CESA]" (Fish and G. Code, § 2067). We underscore, however, that scientific peer review plays a critical role in the Department's effort to develop and finalize its recommendation to the Commission as required by the Fish and Game Code.

Because of the importance of your effort, we ask you to focus your review on the scientific information available regarding the status of Tricolored Blackbird in California. As with our own effort to date, your peer review of the science and analysis regarding each of the listing factors prescribed in CESA (Cal. Code Regs., Tit. 14, § 670.1(i)(1)(A)) (i.e., present or threatened habitat modification, overexploitation, predation, competition, disease, and other natural occurrences or human-related activities that could affect the species) is particularly important.

Please note that the Department releases this peer review report to you solely as part of the peer review process, and it is not yet public.

For ease of review, I invite you to use "track changes" in Microsoft Word, or provide comments in list form by page number, section header, and paragraph. Please submit your comments electronically to Neil Clipperton at Neil.Clipperton@wildlife.ca.gov, or at the address in the letterhead above. If you have any questions, you may reach Neil Clipperton by telephone at (916) 445-9753.

If there is anything the Department can do to facilitate your review, please let me know. Thank you again for your contribution to the status review effort and the important input it provides during the Commission's related proceedings.

Sincerely,

Kari Lewis, Chief
Wildlife Branch

Enclosure

ec: Department of Fish and Wildlife

Scott Gardner, Acting Nongame Program Manager
Wildlife Branch
Scott.Gardner@wildlife.ca.gov

Neil Clipperton, Senior Environmental Scientist (Specialist)
Wildlife Branch
Neil.Clipperton@wildlife.ca.gov

State of California – Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
Wildlife Branch
1812 Ninth Street
Sacramento, CA 95814
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EDMUND G. BROWN JR., Governor
CHARLTON H. BONHAM, Director

October 13, 2017

Edward C. Beedy, Ph.D.
Beedy Environmental Consulting
[redacted]

RE: TRICOLORED BLACKBIRD (*AGELAIUS TRICOLOR*);
DEPARTMENT OF FISH AND WILDLIFE, PEER REVIEW STATUS REPORT

Dear Dr. Beedy:

Thank you for agreeing to serve as a scientific peer reviewer for the Department of Fish and Wildlife's (Department) Draft Status Review of the Tricolored Blackbird (*Agelaius tricolor*). A copy of this report, dated October 13, 2017, is enclosed for your use in that review. The Department seeks your expert analysis regarding the scientific validity of the report and its assessment of the status of Tricolored Blackbird in California. **The Department would appreciate receiving your peer review input on or before November 10, 2017**.

The Department seeks your review as part of formal proceedings pending before the California Fish and Game Commission (Commission) under the California Endangered Species Act (CESA). As you may know, the Commission, as a constitutionally established entity distinct from the Department, exercises exclusive statutory authority under CESA to add species to the state lists of endangered and threatened species (Fish & G. Code, § 2070). The Department serves in an advisory capacity during listing proceedings, charged by the Fish and Game Code to use the best scientific information available to make related recommendations to the Commission (Fish & G. Code, § 2074.6).

The Commission first received the petition to list Tricolored Blackbird as endangered on August 19, 2015. (Cal. Reg. Notice Register 2015, No. 36-Z, p. 1514). The Commission published notice of its acceptance of the petition for further consideration and formal designation of the species as a candidate species on January 8, 2016. (Cal. Reg. Notice Register 2016, No. 2-Z, p. 57).

The draft report forwarded to you today reflects the Department's effort to identify and analyze the scientific information available regarding the status of Tricolored Blackbird in California. At this time, the Department believes the available science indicates that listing the species as threatened under CESA is warranted. An endangered species is defined as "a native species or subspecies...which is in serious danger of becoming extinct throughout all, or a significant portion, of its range due to one or more causes, including loss of habitat, change in habitat, overexploitation, predation, competition, or disease" (Fish and G. Code, § 2062). A threatened species is defined as "a native species or subspecies...that, although not presently threatened with extinction, is likely to become an endangered species in the foreseeable future in the absence of the special protection and management efforts required by [CESA]" (Fish and G. Code, § 2067). We underscore, however, that scientific peer review plays a critical role in the Department's effort to develop and finalize its recommendation to the Commission as required by the Fish and Game Code.

Because of the importance of your effort, we ask you to focus your review on the scientific information available regarding the status of Tricolored Blackbird in California. As with our own effort to date, your peer review of the science and analysis regarding each of the listing factors prescribed in CESA (Cal. Code Regs., Tit. 14, § 670.1(i)(1)(A)) (i.e., present or threatened habitat modification, overexploitation, predation, competition, disease, and other natural occurrences or human-related activities that could affect the species) is particularly important.

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If there is anything the Department can do to facilitate your review, please let me know. Thank you again for your contribution to the status review effort and the important input it provides during the Commission's related proceedings.

Sincerely,

Kari Lewis, Chief
Wildlife Branch

Enclosure

ec: Department of Fish and Wildlife

Scott Gardner, Acting Nongame Program Manager
Wildlife Branch
Scott.Gardner@wildlife.ca.gov

Neil Clipperton, Senior Environmental Scientist (Specialist)
Wildlife Branch
Neil.Clipperton@wildlife.ca.gov

October 13, 2017

Marcel Holyoak, Ph.D.
University of California, Davis
[redacted]

RE: TRICOLORED BLACKBIRD (*AGELAIUS TRICOLOR*);
DEPARTMENT OF FISH AND WILDLIFE, PEER REVIEW STATUS REPORT

Dear Dr. Holyoak:

Thank you for agreeing to serve as a scientific peer reviewer for the Department of Fish and Wildlife's (Department) Draft Status Review of the Tricolored Blackbird (*Agelaius tricolor*). A copy of this report, dated October 13, 2017, is enclosed for your use in that review. The Department seeks your expert analysis regarding the scientific validity of the report and its assessment of the status of Tricolored Blackbird in California. **The Department would appreciate receiving your peer review input on or before November 10, 2017**.

The Department seeks your review as part of formal proceedings pending before the California Fish and Game Commission (Commission) under the California Endangered Species Act (CESA). As you may know, the Commission, as a constitutionally established entity distinct from the Department, exercises exclusive statutory authority under CESA to add species to the state lists of endangered and threatened species (Fish & G. Code, § 2070). The Department serves in an advisory capacity during listing proceedings, charged by the Fish and Game Code to use the best scientific information available to make related recommendations to the Commission (Fish & G. Code, § 2074.6).

The Commission first received the petition to list Tricolored Blackbird as endangered on August 19, 2015. (Cal. Reg. Notice Register 2015, No. 36-Z, p. 1514). The Commission published notice of its acceptance of the petition for further consideration and formal designation of the species as a candidate species on January 8, 2016. (Cal. Reg. Notice Register 2016, No. 2-Z, p. 57).

The draft report forwarded to you today reflects the Department's effort to identify and analyze the scientific information available regarding the status of Tricolored Blackbird in California. At this time, the Department believes the available science indicates that listing the species as threatened under CESA is warranted. An endangered species is defined as "a native species or subspecies...which is in serious danger of becoming extinct throughout all, or a significant portion, of its range due to one or more causes, including loss of habitat, change in habitat, overexploitation, predation, competition, or disease" (Fish and G. Code, § 2062). A threatened species is defined as "a native species or subspecies...that, although not presently threatened with extinction, is likely to become an endangered species in the foreseeable future in the absence of the special protection and management efforts required by [CESA]" (Fish and G. Code, § 2067). We underscore, however, that scientific peer review plays a critical role in the Department's effort to develop and finalize its recommendation to the Commission as required by the Fish and Game Code.

Because of the importance of your effort, we ask you to focus your review on the scientific information available regarding the status of Tricolored Blackbird in California. As with our own effort to date, your peer review of the science and analysis regarding each of the listing factors prescribed in CESA (Cal. Code Regs., Tit. 14, § 670.1(i)(1)(A)) (i.e., present or threatened habitat modification, overexploitation, predation, competition, disease, and other natural occurrences or human-related activities that could affect the species) is particularly important.

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If there is anything the Department can do to facilitate your review, please let me know. Thank you again for your contribution to the status review effort and the important input it provides during the Commission's related proceedings.

Sincerely,

Kari Lewis, Chief
Wildlife Branch

Enclosure

ec: Department of Fish and Wildlife

Scott Gardner, Acting Nongame Program Manager
Wildlife Branch
Scott.Gardner@wildlife.ca.gov

Neil Clipperton, Senior Environmental Scientist (Specialist)
Wildlife Branch
Neil.Clipperton@wildlife.ca.gov

State of California – Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
Wildlife Branch
1812 Ninth Street
Sacramento, CA 95814
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EDMUND G. BROWN JR., Governor
CHARLTON H. BONHAM, Director

October 13, 2017

Robert H. Doster, Ph.D.
U.S. Fish and Wildlife Service
Pacific Southwest Regional Office, Migratory Birds
[redacted]

RE: TRICOLORED BLACKBIRD (*AGELAIUS TRICOLOR*);
DEPARTMENT OF FISH AND WILDLIFE, PEER REVIEW STATUS REPORT

Dear Dr. Doster:

Thank you for agreeing to serve as a scientific peer reviewer for the Department of Fish and Wildlife's (Department) Draft Status Review of the Tricolored Blackbird (*Agelaius tricolor*). A copy of this report, dated October 13, 2017, is enclosed for your use in that review. The Department seeks your expert analysis regarding the scientific validity of the report and its assessment of the status of Tricolored Blackbird in California. **The Department would appreciate receiving your peer review input on or before November 10, 2017.**

The Department seeks your review as part of formal proceedings pending before the California Fish and Game Commission (Commission) under the California Endangered Species Act (CESA). As you may know, the Commission, as a constitutionally established entity distinct from the Department, exercises exclusive statutory authority under CESA to add species to the state lists of endangered and threatened species (Fish & G. Code, § 2070). The Department serves in an advisory capacity during listing proceedings, charged by the Fish and Game Code to use the best scientific information available to make related recommendations to the Commission (Fish & G. Code, § 2074.6).

The Commission first received the petition to list Tricolored Blackbird as endangered on August 19, 2015. (Cal. Reg. Notice Register 2015, No. 36-Z, p. 1514). The Commission published notice of its acceptance of the petition for further consideration and formal designation of the species as a candidate species on January 8, 2016. (Cal. Reg. Notice Register 2016, No. 2-Z, p. 57).

The draft report forwarded to you today reflects the Department's effort to identify and analyze the scientific information available regarding the status of Tricolored Blackbird in California. At this time, the Department believes the available science indicates that listing the species as threatened under CESA is warranted. An endangered species is defined as "a native species or subspecies...which is in serious danger of becoming extinct throughout all, or a significant portion, of its range due to one or more causes, including loss of habitat, change in habitat, overexploitation, predation, competition, or disease" (Fish and G. Code, § 2062). A threatened species is defined as "a native species or subspecies...that, although not presently threatened with extinction, is likely to become an endangered species in the foreseeable future in the absence of the special protection and management efforts required by [CESA]" (Fish and G. Code, § 2067). We underscore, however, that scientific peer review plays a critical role in

the Department's effort to develop and finalize its recommendation to the Commission as required by the Fish and Game Code.

Because of the importance of your effort, we ask you to focus your review on the scientific information available regarding the status of Tricolored Blackbird in California. As with our own effort to date, your peer review of the science and analysis regarding each of the listing factors prescribed in CESA (Cal. Code Regs., Tit. 14, § 670.1(i)(1)(A)) (i.e., present or threatened habitat modification, overexploitation, predation, competition, disease, and other natural occurrences or human-related activities that could affect the species) is particularly important.

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If there is anything the Department can do to facilitate your review, please let me know. Thank you again for your contribution to the status review effort and the important input it provides during the Commission's related proceedings.

Sincerely,

Kari Lewis, Chief
Wildlife Branch

Enclosure

ec: Department of Fish and Wildlife

Scott Gardner, Acting Nongame Program Manager
Wildlife Branch
Scott.Gardner@wildlife.ca.gov

Neil Clipperton, Senior Environmental Scientist (Specialist)
Wildlife Branch
Neil.Clipperton@wildlife.ca.gov

State of California – Natural Resources Agency
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EDMUND G. BROWN JR., Governor
CHARLTON H. BONHAM, Director

October 13, 2017

Rosamonde R. Cook, Ph.D.
Western Riverside County Multiple Species Habitat Conservation Plan
[redacted]

RE: TRICOLORED BLACKBIRD (*AGELAIUS TRICOLOR*);
DEPARTMENT OF FISH AND WILDLIFE, PEER REVIEW STATUS REPORT

Dear Dr. Cook:

Thank you for agreeing to serve as a scientific peer reviewer for the Department of Fish and Wildlife's (Department) Draft Status Review of the Tricolored Blackbird (*Agelaius tricolor*). A copy of this report, dated October 13, 2017, is enclosed for your use in that review. The Department seeks your expert analysis regarding the scientific validity of the report and its assessment of the status of Tricolored Blackbird in California. **The Department would appreciate receiving your peer review input on or before November 10, 2017.**

The Department seeks your review as part of formal proceedings pending before the California Fish and Game Commission (Commission) under the California Endangered Species Act (CESA). As you may know, the Commission, as a constitutionally established entity distinct from the Department, exercises exclusive statutory authority under CESA to add species to the state lists of endangered and threatened species (Fish & G. Code, § 2070). The Department serves in an advisory capacity during listing proceedings, charged by the Fish and Game Code to use the best scientific information available to make related recommendations to the Commission (Fish & G. Code, § 2074.6).

The Commission first received the petition to list Tricolored Blackbird as endangered on August 19, 2015. (Cal. Reg. Notice Register 2015, No. 36-Z, p. 1514). The Commission published notice of its acceptance of the petition for further consideration and formal designation of the species as a candidate species on January 8, 2016. (Cal. Reg. Notice Register 2016, No. 2-Z, p. 57).

The draft report forwarded to you today reflects the Department's effort to identify and analyze the scientific information available regarding the status of Tricolored Blackbird in California. At this time, the Department believes the available science indicates that listing the species as threatened under CESA is warranted. An endangered species is defined as "a native species or subspecies...which is in serious danger of becoming extinct throughout all, or a significant portion, of its range due to one or more causes, including loss of habitat, change in habitat, overexploitation, predation, competition, or disease" (Fish and G. Code, § 2062). A threatened species is defined as "a native species or subspecies...that, although not presently threatened with extinction, is likely to become an endangered species in the foreseeable future in the absence of the special protection and management efforts required by [CESA]" (Fish and G. Code, § 2067). We underscore, however, that scientific peer review plays a critical role in the Department's effort to develop and finalize its recommendation to the Commission as required by the Fish and Game Code.

Because of the importance of your effort, we ask you to focus your review on the scientific information available regarding the status of Tricolored Blackbird in California. As with our own effort to date, your peer review of the science and analysis regarding each of the listing factors prescribed in CESA (Cal. Code Regs., Tit. 14, § 670.1(i)(1)(A)) (i.e., present or threatened habitat modification, overexploitation, predation, competition, disease, and other natural occurrences or human-related activities that could affect the species) is particularly important.

Please note that the Department releases this peer review report to you solely as part of the peer review process, and it is not yet public.

For ease of review, I invite you to use "track changes" in Microsoft Word, or provide comments in list form by page number, section header, and paragraph. Please submit your comments electronically to Neil Clipperton at Neil.Clipperton@wildlife.ca.gov, or at the address in the letterhead above. If you have any questions, you may reach Neil Clipperton by telephone at (916) 445-9753.

If there is anything the Department can do to facilitate your review, please let me know. Thank you again for your contribution to the status review effort and the important input it provides during the Commission's related proceedings.

Sincerely,

Kari Lewis, Chief
Wildlife Branch

Enclosure

ec: Department of Fish and Wildlife

Scott Gardner, Acting Nongame Program Manager
Wildlife Branch
Scott.Gardner@wildlife.ca.gov

Neil Clipperton, Senior Environmental Scientist (Specialist)
Wildlife Branch
Neil.Clipperton@wildlife.ca.gov

State of California – Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
Wildlife Branch
1812 Ninth Street
Sacramento, CA 95814
www.wildlife.ca.gov

October 13, 2017

Erica Fleishman, Ph.D.
Director, Center for Environmental Management of Military Lands
Professor, Department of Fish, Wildlife and Conservation Biology
[redacted]

RE: TRICOLORED BLACKBIRD (*AGELAIUS TRICOLOR*);
DEPARTMENT OF FISH AND WILDLIFE, PEER REVIEW STATUS REPORT

Dear Dr. Fleishman:

Thank you for agreeing to serve as a scientific peer reviewer for the Department of Fish and Wildlife's (Department) Draft Status Review of the Tricolored Blackbird (*Agelaius tricolor*). A copy of this report, dated October 13, 2017, is enclosed for your use in that review. The Department seeks your expert analysis regarding the scientific validity of the report and its assessment of the status of Tricolored Blackbird in California. **The Department would appreciate receiving your peer review input on or before November 10, 2017**.

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1812 Ninth Street
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EDMUND G. BROWN JR., Governor
CHARLTON H. BONHAM, Director

October 13, 2017

Steve Beissinger, Ph.D.
University of California, Berkeley
Department of Environmental Science, Policy & Management
Division of Ecosystem Sciences
[redacted]

RE: TRICOLORED BLACKBIRD (*AGELAIUS TRICOLOR*);
DEPARTMENT OF FISH AND WILDLIFE, PEER REVIEW STATUS REPORT

Dear Dr. Beissinger:

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Scott.Gardner@wildlife.ca.gov

Neil Clipperton, Senior Environmental Scientist (Specialist)
Wildlife Branch
Neil.Clipperton@wildlife.ca.gov

Appendix 6
External peer review comments

External peer review comments to the October 2017 draft of the status review are presented in the order they were received. Comments were received from six of the seven reviewers that were solicited.

Robert Meese, Ph.D. – October 25, 2017

Edward C. Beedy, Ph.D. – November 10, 2017

Marcel Holyoak, Ph.D. – November 15, 2017

Robert H. Doster, Ph.D. – November 17, 2017

Rosamonde R. Cook, Ph.D. – November 22, 2017

Erica Fleishman, Ph.D. – November 27, 2017

From: Meese, Robert [redacted]
Sent: Wednesday, October 25, 2017 3:09 PM
To: Clipperton, Neil@Wildlife
Subject: RE: Draft Tricolored Blackbird Status Review - peer review

Dear Neil,

Attached is my review of the draft Status Report on the Tricolored Blackbird. I have used track changes to make my comments and suggested editorial changes.

I am most impressed with this document and believe that it provides a comprehensive, authoritative, credible, and scientifically justified overview of the biology of the tricolored blackbird and of the threats to its existence. I am glad both as a University of California scientist as well as a California taxpayer to see the Department produce such a thorough and well-written report.

As you will see I have made relatively few comments and only a handful of suggested editorial revisions and this reflects my view that this is a very polished and mature document.

I thank you for allowing me to serve as a reviewer and would be happy to answer any questions that you may have about my review.

Regards,

Bob

Robert J. Meese, Ph.D.
Information Center for the Environment
Department of Environmental Science & Policy University of California One Shields Avenue Davis, CA 95616

STATE OF CALIFORNIA
NATURAL RESOURCES AGENCY
DEPARTMENT OF FISH AND WILDLIFE

REPORT TO THE FISH AND GAME COMMISSION
A STATUS REVIEW OF THE
TRICOLORED BLACKBIRD
(*Agelaius tricolor*) IN CALIFORNIA

CHARLTON H. BONHAM, DIRECTOR
CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE

Draft – October 13, 2017

Table of Contents

EXECUTIVE SUMMARY

[Note to reviewers: The executive summary will be prepared after peer review.]

REGULATORY FRAMEWORK

Petition Evaluation Process

A petition to list the Tricolored Blackbird (*Agelaius tricolor*) as endangered under the California Endangered Species Act (CESA) was submitted to the Fish and Game Commission (Commission) on August 19, 2015 by the Center for Biological Diversity. Commission staff transmitted the petition to the Department of Fish and Wildlife (Department) pursuant to Fish and Game Code section 2073 on August 20, 2015, and published a formal notice of receipt of the petition on September 4, 2015 (Cal. Reg. Notice Register 2015, No. 36-Z, p. 1514). The Department's charge and focus in its advisory capacity to the Commission is scientific. A petition to list or delist a species under the CESA must include "information regarding the population trend, range, distribution, abundance, and life history of a species, the factors affecting the ability of the population to survive and reproduce, the degree and immediacy of the threat, the impact of existing management efforts, suggestions for future management, and the availability and sources of information. The petition shall also include information regarding the kind of habitat necessary for species survival, a detailed distribution map, and any other factors that the petitioner deems relevant" (Fish & G. Code, § 2072.3).

On October 2, 2015, the Department provided the Commission with its evaluation of the petition, "Evaluation of the Petition from the Center for Biological Diversity to List Tricolored Blackbird (*Agelaius tricolor*) as Endangered Under the California Endangered Species Act," to assist the Commission in making a determination as to whether the petitioned action may be warranted based on the sufficiency of scientific information (Fish & G. Code, §§ 2073.5 & 2074.2; Cal. Code Regs., tit. 14, § 670.1, subds. (d) & (e)). Focusing on the information available to the Department relating to each of the relevant categories, the Department recommended to the Commission that the petition be accepted.

At its scheduled public meeting on December 10, 2015, in San Diego, California, the Commission considered the petition, the Department's petition evaluation and recommendation, and comments received. The Commission found that sufficient information existed to indicate the petitioned action may be warranted and accepted the petition for consideration. Upon publication of the Commission's notice of its findings, the Tricolored Blackbird was designated a candidate species on January 8, 2016 (Cal. Reg. Notice Register 2016, No. 2-Z, p. 57).

Status Review Overview

The Commission's action designating the Tricolored Blackbird as a candidate species triggered the Department's process for conducting a status review to inform the Commission's decision on whether to list the species. At its scheduled public meeting on December 8, 2016, in San Diego, California, the

Commission granted the Department a six-month extension to complete the status review and facilitate external peer review.

This status review report is not intended to be an exhaustive review of all published scientific literature relevant to the Tricolored Blackbird; rather, it is intended to summarize the key points from the best scientific information available relevant to the status of the species. The final report represents the Department's evaluation of the current and future conservation status of the species and is informed by independent peer review of a draft report by scientists with expertise relevant to Tricolored Blackbird. It is intended to provide the Commission with the most current information on the Tricolored Blackbird and to serve as the basis for the Department's recommendation to the Commission on whether the petitioned action is warranted. The status review report also presents identification of habitat that may be essential to the continued existence of the species and provides management recommendations for recovery of the species (Fish & G. Code, § 2074.6). Receipt of this report is to be placed on the agenda for the next available meeting of the Commission after delivery. At that time, the report will be made available to the public for a 30-day public comment period prior to the Commission taking any action on the petition.

Existing Regulatory Status

California Endangered Species Act

The Tricolored Blackbird was the subject of three previous CESA listing petitions. In 1991, the Yolo chapter of the National Audubon Society submitted a petition to the Commission to list the species as endangered. After reviewing the document and other available information, the Department determined that the petitioned action might be warranted and recommended to the Commission that it accept and consider the petition. In March 1992, the Commission voted to accept the petition and designated the Tricolored Blackbird as a candidate for listing. Researchers working during the 1992 breeding season discovered that the population was much larger than previously thought and the Yolo Audubon Society withdrew the petition based on the new population data. The Commission allowed the petition to be withdrawn, but urged the Department to work with interested persons and groups to develop conservation measures for the Tricolored Blackbird. The species was again petitioned to be listed under CESA in 2004 (Cal. Reg. Notice Register 2004, No. 18-Z, p. 568). The petition evaluation report by the Department (Gustafson and Steele 2004) stated there was sufficient information to indicate the petitioned action may be warranted; however, the Commission voted to reject the petition (Fish and Game Commission meeting, Feb. 3, 2005). On October 8, 2014, the Center for Biological Diversity submitted a petition to list the Tricolored Blackbird as endangered (Cal. Reg. Notice Register 2014, No. 44-Z, p. 1861). The Commission referred the petition to the Department for an initial evaluation on October 15, 2014. At its December 3, 2014 meeting in Van Nuys, California, the Commission voted to take emergency action to add Tricolored Blackbird to the list of endangered species pursuant to Fish and Game Code section 2076.5, with the related regulation as approved by the Office of Administrative Law taking effect for an initial term of six months beginning on December 29, 2014 (Cal. Reg. Notice Register 2015, No. 2-Z, p. 91). At its meeting in Mammoth Lakes on June 11, 2015,

the Commission voted to reject the 2014 petition and on June 30, 2015 the emergency regulation adopted in December 2014 expired by operation of law.

Federal Endangered Species Act

The Tricolored Blackbird also has a listing history under the federal Endangered Species Act (ESA). In 1988, the United States Fish and Wildlife Service (USFWS) contracted for a compilation of all historical information on distribution and abundance of the Tricolored Blackbird, resulting in the work of Beedy et al. (1991). In 1991, the USFWS identified the Tricolored Blackbird as a category 2 candidate for federal listing. However, in 1996, the USFWS eliminated category 2 species from the list of candidate species. In 2004, the USFWS received a petition to list the Tricolored Blackbird as a threatened or endangered species from the Center for Biological Diversity. In 2006, the USFWS issued a 90-day finding in response to the petition that listing the Tricolored Blackbird was not warranted (50 CFR Part 17, Dec 5, 2006). On February 3, 2015, the Center for Biological Diversity submitted a petition to the USFWS to list the Tricolored Blackbird as an endangered species under the federal endangered species act and to designate critical habitat concurrent with listing. The petition is currently under review by the USFWS (50 CFR Part 17, Sept 18, 2015).

California Species of Special Concern and USFWS Birds of Conservation Concern

The Tricolored Blackbird is listed as a Priority 1 Species of Special Concern (SSC) by the Department. The Department's SSC designation is administrative and is intended to alert biologists, land managers, and others to a species' declining or at-risk status, to encourage additional management considerations for these species to ensure population viability, and to preclude the need for listing under CESA. SSCs are defined as species, subspecies, or distinct populations of animals native to California that currently satisfy one or more of the following criteria: extirpated from the state in the recent past; listed under ESA as threatened or endangered, but not under CESA; meets the state definition of threatened or endangered but has not been formally listed; experiencing, or formerly experienced, serious (noncyclical) population declines or range retractions (that have not been reversed), which if continued or resumed could qualify for threatened or endangered status under CESA; has naturally small populations and/or range size and exhibits high susceptibility to risk from any factor that, if realized, could lead to declines that would qualify it for threatened or endangered status (Shuford and Gardali 2008). In 2008, the USFWS updated its Birds of Conservation Concern report, identifying "species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act of 1973" (USFWS 2008). The Tricolored Blackbird was included on two Bird Conservation Region lists (Coastal California and Great Basin), the USFWS Region 8 list (California and Nevada) and the National list. Neither of these "species of concern" designations provides the species with formal regulatory status like the ESA or CESA; however, impacts to SSC are generally considered potentially significant under CEQA, and therefore mitigation for impacts may be provided (see Existing Management section).

Migratory Bird Treaty Act

The Tricolored Blackbird is included on the list of species protected under the Migratory Bird Treaty Act (MBTA). The MBTA makes it unlawful to take, possess, transport, sell, or purchase any bird listed in the Act, or its nest or eggs, without a permit issued by the USFWS.

California Fish and Game Code

The Fish and Game Code includes certain protections for birds, including nongame birds. Sections applicable to the Tricolored Blackbird include the following:

> Section 3503 – It is unlawful to take, possess, or needlessly destroy the nest or eggs of any bird, except as otherwise provided by this code or any regulation made pursuant thereto.
>
> Section 3513 – It is unlawful to take or possess any migratory nongame bird as designated in the Migratory Bird Treaty Act or any part of such migratory nongame bird except as provided by rules and regulations adopted by the Secretary of the Interior under provisions of the Migratory Treaty Act.
>
> Section 3800(a) – All birds occurring naturally in California that are not resident game birds, migratory game birds, or fully protected birds are nongame birds. It is unlawful to take any nongame bird except as provided in this code or in accordance with regulations of the commission.

BIOLOGY AND ECOLOGY

Species Description

The Tricolored Blackbird was first collected by Nuttall in 1836 near Santa Barbara, CA (Nuttall 1840, Baird et al. 1874). A male specimen was sent to John James Audubon who described it as a unique form of blackbird in his well-known *Ornithological Biography* (Audubon 1839).

The Tricolored Blackbird is sexually dimorphic, with the male plumage entirely black except for the bright red lesser wing coverts forming a conspicuous red patch on the wing ("shoulder" or "epaulets") and white median coverts forming a distinct border to the red. The black body plumage is glossed bluish when viewed in sunlight. The female is mostly dark brown dorsally and heavily streaked ventrally with dark brown streaks merging to form a largely solid dark brown belly (Beedy et al. 2017). The head of the female is indistinctly patterned with a whitish supercilium, malar, chin, and throat.

Although similar in appearance to the related Red-winged Blackbird (*A. phoeniceus*), several features can be used to distinguish the two species (described by Nuttall 1840, Cooper 1870, Baird et al. 1874). The black plumage of the Tricolored Blackbird male has a soft bluish luster that is lacking in the Red-winged Blackbird. The lesser wing coverts (the red "shoulder") on the male Tricolored Blackbird are a much deeper red (described as crimson, carmine, or the color of venous blood) compared to the brighter red color (vermilion or scarlet) in the Red-winged Blackbird. The median coverts in the Tricolored Blackbird are white (pale-yellowish when fresh) and create a stark contrast between the black

Commented [B1]: The lesser wing coverts in red-wings are conspicuously orange-red, rather than scarlet.

and red feathers on the wing, whereas in the Red-winged Blackbird they are generally yellowish (or black in the subspecies that breeds in much of the Central Valley). The bill of the Tricolored Blackbird averages thinner and can appear more sharply pointed. In flight, the wings of the Tricolored Blackbird appear to have a more pointed shape (vs. rounded in the Red-winged Blackbird) due to differences in length of the primary flight feathers. Female Tricolored Blackbirds have darker plumage than most female Red-winged Blackbirds, although this difference is less pronounced in the Central Valley where the subspecies of Red-winged Blackbird is relatively dark (Beedy et al. 2017).

Commented [B2]: This description is accurate for breeding birds, but in autumn and winter, after the birds molt, the plumage is quite different and males are conspicuously scaly in appearance due to the presence of buff feather tips.

Taxonomy

The Tricolored Blackbird is a species in the avian family Icteridae, which is restricted to the Americas in the Western Hemisphere and includes blackbirds, orioles, cowbirds, grackles, and meadowlarks (Skutch 1996). There are about 100 species in the family, most of which occur in the tropics. Following recent taxonomic changes that removed several South American species from the genus *Agelaius*, there are currently five species in the genus worldwide (Remsen 2017). In addition to the Tricolored Blackbird, the only other species that occurs on the North America mainland is the much more widespread and diverse Red-winged Blackbird. The other three species in the genus occur in the Greater Antilles: *A. assimilis* (the Red-shouldered Blackbird of western Cuba), *A. humeralis* (the Tawny-shouldered Blackbird of Hispaniola and Cuba), and *A. xanthomus* (the Yellow-shouldered Blackbird of Puerto Rico) (Beedy et al. 2017). There are no recognized subspecies of Tricolored Blackbird (AOU 1957).

Geographic Range and Distribution

The Tricolored Blackbird is nearly endemic to the state of California, with small numbers of birds extending the species' range into neighboring states of Oregon, Washington, Nevada, and Baja California.

Breeding Range

The majority of the Tricolored Blackbird's breeding range is composed of two disjunct regions of California and Baja California, separated by the Transverse Ranges of southern California (Figure 1). The larger of the two areas occupies the lowlands west of the Sierra Nevada, extending west across the Central Valley to the coast from Sonoma County south to Santa Barbara County. The second area is composed of the lowlands west of the deserts in southern California, extending south into northwestern Baja California. Small numbers of birds extend the range to the north in isolated low-lying areas on the northern California coast and to isolated areas in northeastern California, Oregon, and eastern Washington. Similarly, the range extends east from the southern Central Valley to small areas in the Mojave Desert, and to a single area in Douglas County, Nevada (Skutch 1996, Ammon and Woods 2008, Beedy et al. 2017).

Winter Range

In the winter the Tricolored Blackbird mostly withdraws from the portion of its breeding range north of the Central Valley (northeastern CA, Oregon, and Washington) and from Nevada to the lowlands of

central and coastal California (Wahl et al. 2005, Ammon and Woods 2008, Beedy et al. 2017), although a small number of birds are occasionally documented throughout the northern breeding range during winter months (Gilligan et al. 1994, Spencer 2003, eBird Dataset 2016). The species can be found in most of the remainder of its range year-round, with shifts in distribution as described below.

Distribution of Breeding Colonies

Within the breeding range, the largest breeding colonies and the large majority of the breeding population occur in the Central Valley of California (Figure 2b). In all California statewide surveys conducted since 1994, most (≥90% in all years but 1997) of the population has occurred in the Central Valley counties during the early breeding season (Hamilton et al. 1995, Beedy and Hamilton 1997, Hamilton 2000, Kelsey 2008, Kyle and Kelsey 2011, Meese 2014a).

Although the overall distribution and breeding locations vary from year to year, Tricolored Blackbirds exhibit some fidelity to traditional use areas. These areas likely provide all of the critical resources needed by breeding colonies, while the specific nesting sites used in the area can change from year to year (Beedy et al. 1991). In the Central Valley, there are distinct regions that frequently support multiple colonies and a large proportion of the breeding population. In the southern San Joaquin Valley, the largest colonies are typically found annually in an area centered at the junction of Kern, Kings, and Tulare counties (Figure 2). In the northern San Joaquin Valley, Merced County regularly supports multiple large colonies. Further north in the Central Valley and Sierra Nevada foothills, breeding colonies are regularly distributed more broadly from Sacramento County north through the Sacramento Valley to Butte, Glenn, and Colusa counties. In southern California, breeding colonies are located mainly in the western portions of Riverside and San Bernardino Counties, south through the interior of San Diego County (Figure 2; Feenstra 2009). Colonies are patchily distributed throughout the rest of the species' range in California, particularly in the Coast Ranges and on the coastal slope.

The limited range of the species in Oregon, Washington, and Nevada is maintained by irregular occurrences of relatively small numbers of birds (Gilligan et al. 1994, Spencer 2003, Wahl et al. 2005, Ammon and Woods 2008). These neighboring states have historically supported less than 1% of the species' population (Beedy et al. 1991). Although previously more widespread, breeding in Baja California now occurs at only a few isolated locations (Erickson et al. 2007, Erickson and de la Cueva 2008, Feenstra 2013, Erickson et al. 2016). Currently, no more than about 1% of the species' population breeds outside of California.

Breeding colonies typically occur in valleys or low-lying areas with suitable nesting habitat and extensive grassland, agriculture, or other suitable foraging habitat. However, the elevation of colony locations varies greatly across the range. The majority of ~~the population~~ birds breed~~s~~ below an elevation of about 300 feet in the Central Valley. In the central Sierra foothills, colonies occur up to 1,720 feet, although most occur near the valley floor at or below about 300 feet elevation (Airola et al. 2015a). In the southern California portion of the range, most colonies occur below about 1,500 feet, although colonies at more inland locations are at higher elevations. Further inland, such as in the Mojave Desert and to the northeast in the Modoc Plateau, colonies occur at elevations up to several thousand feet. Grinnell and

Commented [B3]: The new BNA account updates this to show the species as resident in Washington, Oregon, and far northern California due to more recent information which confirms the presence of birds during the winter months.

Commented [B4]: This is the first use of the term "statewide survey" and it ought to be defined here, as many readers will not be familiar with the term nor with what it means, how long these have been conducted, etc.

Commented [B5]: The species has recently been nearly extirpated from Kings County and has undergone a steep and linear decline in Tulare County due to large-scale and permanent habitat losses, primarily to nut trees but to other types of agriculture that exclude the birds.

Commented [B6]: This is true according to the statewide survey results, but it's likely that the species has always been relatively abundant in San Benito County and adjacent regions. The results of the 2017 Statewide Survey strongly suggest a failure to adequately survey and document the occurrence of breeding birds here prior to 2017. I've been aware of this but until 2017 been unable to identify and recruit a local expert.

Commented [B7]: There are very few agricultural crops that can support foraging by tricolors, so the general term "agriculture" is misleading here, as ag-lands are generally totally unsuited to the species and tend to prevent its occurrence.

Commented [B8]: The Central Valley does not extend up to 300 feet, does it? It seems that the blue oaks and other trees begin below this.

Miller (1944) included a record of 4,400 feet on the "South Fork of the Pit River" in Modoc County. The single breeding location in Nevada is at 4,730 feet elevation (Ammon and Woods 2008).

Commented [B9]: And Mendenhall in San Diego County is at 4,439'.

Winter Distribution

Although Tricolored Blackbirds can be found throughout much of the California breeding range year-round, most birds withdraw from the southern San Joaquin Valley and the northern Sacramento Valley in the winter (Grinnell and Miller 1944, Beedy et al. 2017). Band recoveries and observational studies have documented movement of birds away from these portions of the range toward the central part of the valley surrounding and including the Sacramento-San Joaquin Delta region (Neff 1942, DeHaven and Neff 1973, DeHaven et al. 1975b). There is a general concentration of birds in this region during the winter, as well as in the northern San Joaquin Valley in Merced County and coastal areas north and south of the San Francisco Bay area (Orians 1961a, Payne 1969, Stallcup 2004) (Figure 3). Evidence from banded birds recovered outside the Central Valley is limited, but birds from throughout the northern range are thought to follow the general pattern of winter movement to central and coastal California (DeHaven et al. 1975b, Beedy 2008). Although a relatively large portion of the population winters in this region, wintering flocks can be found at widely scattered points throughout the species' range north of the Transverse Ranges (DeHaven et al. 1975b).

South of the Transverse Ranges, birds from Santa Barbara County south to Baja California appear to occupy the region year-round (Unitt 2004, Beedy 2008), although distribution in the southern portion of the range is patchy in all seasons. Recoveries of birds banded in southern California have revealed much more localized movements compared to those from the Central Valley (Neff 1942, DeHaven and Neff 1973).

Commented [B10]: But there are those 4 banded birds observed in southern California that were banded in the Central Valley, so there is some movement of birds across the Transverse Ranges from the CV into southern California, and this may be bi-directional, with birds from southern California returning to the Central Valley, although this has yet to be documented.

Genetics and Population Structure

Hamilton (2004) documented behavioral differences between Central Valley and southern populations of the Tricolored Blackbird, and suggested that a lack of gene flow may have led to genetically distinct populations. While banding studies indicate extensive movement of the Tricolored Blackbird population throughout the entire length of the Central Valley (DeHaven et al. 1975b), DeHaven and Neff (1973) reported on recoveries of banded birds from the Central Valley and southern California and suggested that little or no interchange occurs between populations north and south of the Transverse Ranges. The observation of a single banded bird in the Mojave Desert of northern Los Angeles County was the first data documenting movement of the species from the Central Valley to the desert (Feenstra 2009), although there is a report from the late 1800s documenting a flock of Tricolored Blackbirds moving in the opposite direction (Belding 1890). In 2014 and 2016, the second and third Tricolored Blackbirds that had been banded in the Central Valley were photographed in San Bernardino County, providing further confirmation of movement from the valley to the Mojave Desert (Meese 2014b, Aug 2017 email from R. Meese to N. Clipperton; unreferenced).

A single genetic study on the Tricolored Blackbird did not find evidence of significant population structuring between the Central Valley and a southern population composed of birds from the Mojave Desert and southern California. The birds sampled in the southern population were found to exhibit

higher allelic diversity, suggesting that the southern population may be an important reservoir of genetic variation for the species (Berg et al. 2010). In assessing population structure, it may be inappropriate to combine birds from the Mojave Desert with birds from south of the Transverse Ranges to represent a single southern population, especially if the Mojave Desert birds are linked to the Central Valley. In addition, samples were obtained at only two colonies south of the Transverse Ranges and at two colonies in the desert, sample sizes were small at some sites, and the study used a relatively small number of genetic markers. Researchers at UCLA are currently conducting a study using more advanced genomic techniques to characterize genetic variation, population structure, and spatial and temporal patterns of movement throughout the range of the Tricolored Blackbird (Feb 2017 email from K. Barr to N. Clipperton; unreferenced).

Movements

Most Tricolored Blackbird are resident in the state of California, with seasonal movements leading to shifts in distribution within the state over the course of a year. Grinnell and Miller (1944) wrote that the Tricolored Blackbird is “resident within State [California], but partly migratory within the Sacramento-San Joaquin drainage system; all populations are in some degree nomadic and in fall and winter normally leave the immediate vicinity of the nesting colonies.” Banding studies (Neff 1942, DeHaven and Neff 1973, DeHaven et al. 1975b) and observations of unbanded birds (Payne 1969) demonstrated that most Tricolored Blackbirds reside throughout the Central Valley March through September, and then move into the Sacramento-San Joaquin Delta and northern San Joaquin Valley (primarily Merced County) and coastal locations during winter. More extensive migratory movements are made by small numbers of birds that breed north of the Central Valley as far north as the state of Washington (Wahl et al. 2005); these migratory individuals apparently mostly return to California in the winter. In southern California south of the Transverse Ranges, birds seem to undergo much more localized seasonal movements compared to those from the Central Valley (Neff 1942, DeHaven and Neff 1973).

Itinerant Breeding

Individual Tricolored Blackbirds often occupy and breed at two or more sites during the breeding season, a phenomenon known as itinerant breeding (Hamilton 1998). Itinerant breeding is a very rare trait among birds, and occurs exclusively in species that move between breeding attempts to locate or follow locally abundant food sources (Jaeger et al. 1986). Although early observers suspected that Tricolored Blackbirds nested more than once in a season at multiple locations (e.g., Neff 1937), the movements of Tricolored Blackbirds have been described as “sheerly and illogically erratic” (Neff 1942), “wanderings” (Payne 1969), and highly nomadic (Beedy et al. 1991). Recoveries of banded Tricolored Blackbirds provided documentation of interannual breeding at widely separated locations, but within-year movements during a single breeding season were not documented prior to the 1990s (Neff 1942, DeHaven and Neff 1973). The movements of Tricolored Blackbirds continue to be somewhat unpredictable from year to year, but Hamilton et al. (1995) demonstrated that most of the adults in the Central Valley breed more than once and often at different locations. This itinerant breeding follows a pattern of initial breeding in the south, mostly San Joaquin Valley and southern foothills to Sacramento County, with a shift north for a second breeding attempt, primarily in the Sacramento Valley and

adjacent foothills. The timing and degree to which this shift occurs vary from year to year (Hamilton 1998). The timing of breeding in Sacramento County was intermediate to that of the San Joaquin and Sacramento Valleys, with initiation of breeding in Sacramento County 10 days later than in the San Joaquin Valley, but over a month before most breeding in the northern Sacramento Valley (Figure 4). On the Central California Coast in Monterey County, 25% of radio-tagged birds moved between study colonies during a breeding season, suggesting itinerant breeding on a smaller scale (Wilson et al. 2016).

Commented [B11]: This section is well written and especially for acknowledging the fact that "most" of the birds the breed first in the San Joaquin Valley are believed to breed again in the Sacramento Valley. Some have assumed that all of them do this, but there's no evidence to support this and much to support the statement that most do.

The following discussion of seasonal movements is largely from Beedy and Hamilton (1997) and Beedy et al. (2017).

Spring Movements from Wintering Areas

The species vacates wintering areas concentrated around the Sacramento-San Joaquin River Delta and along coastal California in mid-February. Birds arrive at breeding locations and establish colonies in Sacramento County and throughout the San Joaquin Valley from early March to early April (DeHaven et al. 1975b). Colonies at foothill locations adjacent to the San Joaquin and Sacramento valleys may be ~~settled~~ established by late March, but many are not ~~settled~~ established until May. In southern California and Baja California, the species may nest anytime throughout April and May.

Flocks of Tricolored Blackbirds roam widely within the breeding range in the weeks before breeding begins and between breeding attempts. Breeding season wanderings may serve to locate areas of abundant insect food resources near which breeding colonies are established (Payne 1969). Similar behaviors have been documented in nomadic flocking species of semiarid habitats in Asia, Africa, and Australia, where colonial breeding occurs opportunistically in areas of high prey abundance (Payne 1969).

Breeding Season Movements

During the breeding season, Central Valley birds often move north to the Sacramento Valley after first nesting efforts (March–April) in the San Joaquin Valley and Sacramento County, with small numbers moving further north to northeastern California and southern Oregon (Beedy and Hamilton 1997, Hamilton 1998). On the floor of the Sacramento Valley north of Sacramento County, the largest colonies are typically not settled until May or early June. Recent banding results suggest a degree of colony cohesion, where many birds at a colony may move and breed together again in a new location, but banding results also suggest a high degree of mixing between breeding attempts. Although later nesting is typical in northern portions of the range, small colonies may form throughout the breeding season anywhere in the geographic distribution (Hamilton 1998). Radio telemetry studies have shown that birds move from one breeding colony to another while both are active, due presumably to reproductive failures at the first colony, but the causes of these movements remain undocumented (Wilson et al. 2016).

Commented [B12]: This has yet to be demonstrated, it is an assumption at this point. Marked birds are needed to say with certainty if these birds move all the way up from the San Joaquin Valley.

Post-breeding Movements

Most Central Valley birds occur in the Sacramento Valley at the end of the breeding season and remain until mid-September, apparently attracted to ripening and recently harvested rice (DeHaven et al. 1975b). In mid-~~September~~ November most move south into the Sacramento-San Joaquin Delta, Merced County, and coastal locations.

Commented [B13]: As I understand it, the rice harvest continues well into October in the northern portion of the "rice belt" and there are thus still large numbers of birds well up into the Sacramento Valley until late October in most years, and the huge influx of birds in the Delta is observed from late October to Nov. 15 in most years.

Winter Movements

In winter, numbers decline in the Sacramento Valley and increase in the Sacramento-San Joaquin Delta and northern San Joaquin Valley (Neff 1942, Orians 1961a, Payne 1969, DeHaven et al. 1975b). Large foraging flocks have traditionally occurred in pasturelands in southern Solano County by late October and may join large flocks of several blackbird species to roost on islands in the eastern part of Suisun Marsh. Wintering flocks formerly numbering more than 10,000 birds assembled near dairies on the Point Reyes Peninsula, Marin County, by mid-October, but these numbers have been reduced in recent years. Highly variable numbers of birds also winter in the central and southern San Joaquin Valley, with flocks of hundreds or thousands seen in most years in the general area where large colonies ~~breed~~ occur in the early spring (Kern and Tulare counties; eBird Dataset 2016). Winter flocks consist at times of only Tricolored Blackbirds, either mixed-sex or single-sex, and at other times Tricolored Blackbirds occur in mixed-species blackbird flocks. Birds from one large winter roost in Sacramento County foraged over an area 32 km in diameter (Neff 1937). Winter distribution and movements need further study.

Home Range and Territoriality

Unlike most species of songbirds that defend a territory in which they nest and acquire most of their necessary resources, the Tricolored Blackbird breeds in dense colonies in which adult males defend only a small area surrounding the nest site, and this only until nests are established and eggs are laid (Lack and Emlen 1939, Payne 1969). Nest density and male territory size can vary among colonies with individual nests in the densest colonies built within a foot or less of each other (Hosea 1986, Beedy et al. 1991). In some cases two nests may even share interwoven strands of nest material (Lack and Emlen 1939). Male territories have been measured from 1.8 m^2 to 3.25 m^2 (Lack and Emlen 1939, Orians 1961) and nest densities have been observed at up to six nests per square meter (Beedy et al. 2017). The greatest nesting density reported occurred in a rare nesting substrate, giant cane (*Arundo* sp.), with 2,500 adults nesting in an area 42 x 13 feet (equivalent to 4.5 birds per square foot) (DeHaven et al. 1975a).

The small territories in dense breeding colonies cannot supply sufficient food for the adults and for the growing young, therefore most foraging occurs away from the colony site. While breeding, most foraging occurs within 2–3 miles of colony sites (Orians 1961, Hamilton et al. 1992), although longer foraging flights have been documented (up to 8 miles or more). Typically, only a portion of the landscape surround a breeding colony is suitable for foraging and the range used by individual birds in colonies is variable depending on the extent and quality of the foraging landscape.

Colonial Breeding and Social Behavior

> "To one in search of something utterly different I can heartily recommend an hour, or a day, in a Tricolor swamp… *Agelaius tricolor* is intensely gregarious, more so than perhaps any other American bird. Every major act of its life is performed in close association with its fellows… the very day of its nesting is agreed upon in concert. In continuous procession the individuals of a colony repair to a field agreed upon in quest of building material; and when the babies are clamoring the loudest for food, the deploying foragers join their nearest fellows and return to the swamps by platoons and volleys, rather than as individuals." – Dawson (1923).

Coloniality in birds is typically defined as the breeding by a number of individuals at a more or less centralized place from which colony residents regularly depart from to search for food. This breeding strategy is most common among seabirds, in which more than 95% of species nest colonially (Danchin and Wagner 1997), and is ~~relatively~~ quite uncommon among North American landbirds.

The Tricolored Blackbird forms by far the largest breeding colony aggregations of any North American landbird (Neff 1937, Lack and Emlen 1939, Orians 1961, Skutch 1996). Bent (1958) found that the Tricolored Blackbird "nests in enormous, most densely populated colonies, the nests being placed more closely together than in any other colonies of marsh-nesting blackbirds." Grinnell and Miller (1944) stated, "one essential would seem to be provision at the site of the colony for a large number of individuals. Nests apparently must be close together and pairs usually [must be] in excess of 50 in order to meet the instinctive requirements of the species." Breeding colonies are seldom smaller than 100 nests, and in the past have been as large as 100,000 to 200,000 nests (Neff 1937, Orians 1961). Each male breeds, on average, with two females resulting in a skewed sex ratio at many breeding colonies (Lack and Emlen 1939, Orians 1961, Payne 1969, Hamilton 1998, Beedy and Hamilton 1999). Although Payne (1969) observed breeding colonies consisting of as little as four nests, of the 21 colonies monitored, no colonies containing less than 100 nests were successful in fledging young.

While the great concentration of birds in a small area is the most conspicuous feature of Tricolored Blackbird colonies, the degree of synchrony among members of the colony is no less unique (Orians 1960). Breeding within a colony is often highly synchronized, with all females in a colony typically initiating nest building within a few days (Orians 1961, Payne 1969). A flock of Tricolored Blackbirds can appear in an area in which it has been absent for months and begin nesting within days (Orians 1961). Food resources for both the breeding adults and for the provisioning of young are mostly obtained from sites away from the colony location. Insect-rich foraging areas appear to be identified and utilized by all or large portions of the breeding adults in a colony until the prey base is exhausted, at which time new areas are identified and breeding birds collectively shift to new foraging sites.

Commented [B14]: I've seen them show up and begin nesting within hours. I do not consider this unusual for second nesting attempts, I consider it to be the norm.

Occupancy dynamics—Tricolored Blackbird breeding colonies frequently shift locations from year to year, though sites used each year often occur in the same traditionally used areas. In some cases Tricolored Blackbirds exhibit high inter-annual site fidelity, perhaps driven by the continued availability of essential resources, including suitable nesting substrate, water, and foraging habitat (Beedy and

Hamilton 1997). Of 72 occupied colony locations between 1992 and 1994, only 19 (26%) were active in all three years and an additional 11 (15%) were active in at least two years (Hamilton et al. 1995). In the central Sierra Nevada foothills, 58% (11 of 19) of occupied breeding colony sites in 2015 were also occupied in 2014 (Airola et al. 2015b). Of 44 sites surveyed during a three year period in the central foothills, only eight (18%) were active in all three years and seven (16%) were active in two of three years (Airola et al. 2016). Of four colony locations monitored for three consecutive years in coastal Monterey County, all four were occupied in one year and only two were occupied in the other years (Wilson et al. 2016). Annual occupancy rates vary across nesting substrate types, with wetland, thistle, and Himalayan blackberry locations having similar rates of about 40% (Holyoak et al. 2014). Occupancy rates are lower for triticale and other grain sites and higher for nettle colony sites. Although any given site may be unoccupied in some years, birds often return to sites over longer time periods and some sites are used in almost every year. Hosea (1986) reported on a colony that had been occupied for more than 30 years in Sacramento County, and was able to locate several active colonies by visiting locations reported in the literature decades earlier. The result of these complex occupancy dynamics is an extremely variable rate of site fidelity over the short-term, but fidelity to breeding locations and general breeding areas are high over the longer term.

Commented [B15]: The record holder, as far as I am aware, is the Conaway Ranch in Yolo County, which is mentioned by name in Neff's 1937 article. It was active this year, so that's 80 years.

Beedy et al. (1991) compiled all available information on breeding colony locations and identified 696 historical breeding colony locations. As of the 2016 breeding season, the number of known historical and current breeding colony locations had grown to 1,272, including all records since 1907 (Figure 2a). The large majority of these historical locations are not used in any given year, and many no longer meet the habitat requirements of the species and so are no longer considered suitable nesting sites. During recent thorough statewide surveys conducted between 2008 and 2014 the number of occupied breeding locations has averaged about 140 (Kelsey 2008, Kyle and Kelsey 2011, Meese 2014). New locations are discovered each year, while other sites cease to be used. This turnover of breeding locations likely reflects shifting habitat conditions across the range and results in complex occupancy dynamics described above. Most sites, once established, are used repeatedly over the course of many years.

Commented [B16]: But these were described only, they were not identified down to specific lat/long values so the precise locations were not identified.

Fluctuations in colony site selection and colony size have been attributed to a response of Tricolored Blackbirds to changes in local insect abundance within and across years (Orians 1961, Payne 1969, DeHaven et al. 1975a). Their colonial breeding behavior requires that the foraging landscape surrounding the nest site provide abundant insect food sources. The colonial nesting, compressed breeding cycle, and social structure of Tricolored Blackbirds are well suited for rapid exploitation of unpredictable resources when they become temporarily very abundant. Initiation of nesting may also be triggered by an abundant food source (Payne 1969).

In some cases, large breeding colonies have been observed to exhibit higher reproductive success than smaller colonies (Orians 1961, Payne 1969, Hamilton et al. 1992, Meese 2013), and in some years a few large colonies have been responsible for the majority of the reproductive output for the year (Hamilton 1993). However, there are many examples when a positive correlation between colony size and reproductive success was not observed, and a wide variation in reproductive success has been observed in both small and large colonies (Payne 1969, Meese 2013).

Adaptive advantages of colonial breeding may be conferred by decreasing risk of predation or increasing foraging efficiency (Ward and Zahavi 1973, Beauchamp 1999), both of which could lead to increased success in production of young. The following mechanisms have been proposed as advantages to colonial breeding:

1. Predator avoidance
2. Joint anti-predator responses
3. Predator satiation
4. Social food-finding
5. Information sharing

Predator avoidance—Colonial breeding birds frequently select sites that are inaccessible to predators (Ward and Zahavi 1973), or in some cases that are naturally free of some groups of predators (e.g., seabirds nesting on isolated islands). Tricolored Blackbirds typically select breeding locations that provide a degree of protection from predators, either by selecting inaccessible sites (e.g., wetlands surrounded by or inundated by relatively deep water) or protective nesting substrates (e.g., dense, thorny, or spinous vegetation) that limit access to predators. Wetland sites may primarily limit access to terrestrial predators, whereas some dense or armored substrates may also limit access by predatory birds. In the case of a nomadic species like the Tricolored Blackbird, which does not necessarily use the same breeding location each year due to annual shifts in substrate suitability, social behavior may enhance the ability to locate these suitable locations.

Anti-predator responses—Social mobbing of predators or other aggressive behaviors is a common trait among colonial nesting birds. However, Tricolored Blackbirds do not exhibit strong defensive responses against ~~to the presence of a~~ their predators. Unlike Red-winged Blackbirds that will fiercely defend territories from potential predators that approach the nest, Tricolored Blackbirds provide little in the way of defense to eggs or nestlings (Skutch 1996). For example, when a hawk is sighted the adults in a colony may stop vocalizing and settle low within the nesting substrate, with the entire colony sometimes going silent (Orians and Christman 1968, Payne 1969). Adults may hover in the vicinity of a predator as nestlings are taken, but no pursuit of the predator is offered. Complete reproductive failure in colonies of thousands of birds can result from the efforts of relatively few predators (Beedy and Hamilton 1999). Tricolored Blackbirds do not benefit from social anti-predator responses.

Commented [B17]: The birds do have strong, predator-specific responses, but these are not directed at the predators. Harriers make them fly up and get noisy, and peregrines make them dive down and remain silent.

Predator satiation—The massive quantity of readily available prey in the form of eggs or nestlings at a Tricolored Blackbird breeding colony may reduce the chance of loss of any one nest by satiating territorial predators (e.g., raptors). Payne (1969) observed a single pair of Northern Harriers preying on a Tricolored Blackbird colony of 10,000 nests, with no impact on the large majority of the colony. Satiation of predators may be less likely in species that hunt in groups, such as many species of wading birds. In recent decades, Cattle Egrets and White-faced Ibis have caused complete failure of large breeding colonies (Meese 2012, 2016). Predator satiation may provide a benefit to breeding Tricolored Blackbirds, depending on the number and type of predators.

Food-finding and information sharing—Roosting and colonial birds may take advantage of social behavior to more efficiently locate patches of concentrated food resources, and colony sites may serve as information centers where locations of good feeding sites can be shared among individuals (Ward and Zahavi 1973, Emlen and DeLong 1975, Brown 1988). Under this scenario, larger colonies may be more successful because there is a larger pool of information on the whereabouts of good feeding places within the foraging area being exploited by the colony (Ward and Zahavi 1973). This increased foraging efficiency, along with the highly synchronized nesting and the compressed length of a nesting cycle in Tricolored Blackbirds, may ensure that temporarily abundant prey will remain available to the young in a colony for the duration of the breeding cycle. Coloniality may result from situations when suitable breeding sites are limited among areas of high food availability (Danchin and Wagner 1997).

Because of occasional destruction of entire Tricolored Blackbird breeding colonies by predators and observations of prey-following by adults, Orians (1961) and Payne (1969) suggested that colonial nesting by Tricolored Blackbirds is more likely related to location and exploitation of a locally abundant food supply than to a strategy of predator avoidance or response. However, the choice of flooded or dense and armored vegetation for breeding suggests that suitable nesting locations provide some protection from predators, and predator satiation may be a successful strategy for confronting territorial predators.

Habitat that May be Essential for the Species' Continued Existence in California

For breeding, Tricolored Blackbirds require three critical resources: 1) secure nesting substrate, 2) a source of water, and 3) suitable foraging habitat.

Nesting Substrate

The nesting substrate for Tricolored Blackbird breeding colonies is defined as the vegetation in which nests are constructed. In most cases the nesting substrate is either flooded by water, as in wetland colony sites, or is composed of thorny or spiny vegetation that is impenetrable to many predators (Beedy and Hamilton 1997). In some cases, Tricolored Blackbird colonies occur in upland nesting substrates that lack these protective characteristics (e.g., silage grain, weedy mustard fields); in these cases the nesting substrate is usually extremely dense and therefore may provide similar protection.

The majority of Tricolored Blackbird breeding colonies have occurred in one of five nesting substrate types: 1) wetlands (either cattail [*Typha* sp.] or bulrush [*Schoenoplectus* sp.] vegetation), 2) Himalayan blackberry (*Rubus armeniacus*), 3) thistle, usually milk thistle (*Silybum marianum*) or bull thistle (*Cirsium vulgare*), 4) stinging nettle (*Urtica* sp.), or 5) agricultural grain fields, especially triticale, a wheat-rye hybrid grain grown as silage for dairy cattle. Several additional nesting substrates have been used to a lesser degree (less than 5% of colonies in total), with the more common being mustard (*Brassica* sp.), willows (*Salix* sp.), mallow (*Malva* sp.), wild rose (*Rosa* sp.), tamarisk (*Tamarix* sp.), and giant reed (*Arundo* sp.) (Beedy et al. 1991, Beedy and Hamilton 1997, Beedy et al. 2017, Tricolored Blackbird Portal 2017).

Commented [B18]: But far more often than not, birds nesting in triticale do not build their nests in the triticale itself but rather in islands of weeds, typically mallow and mustard, that occur surrounded by a sea of triticale. The seabird analogy may be especially appropriate in these situations.

The primary nesting substrates used by Tricolored Blackbirds have different distributions across the breeding range in California (Figure 5). Wetland sites with cattail or bulrush substrate are fairly evenly

distributed across the range. Himalayan blackberry sites are mostly restricted to Merced County and north through the Sierra foothills to the Sacramento Valley. Triticale and other agricultural grain sites are found mainly in the southern San Joaquin Valley and Merced County, with a few additional sites in southern California. In recent years stinging nettle sites have mainly occurred in the southern San Joaquin Valley portion of Kern County including the surrounding foothill grasslands, although historically they were also common at the extreme northern portion of the California range in Siskiyou and Shasta counties. Thistle sites have been located throughout much of the range in California, and has been the primary nesting substrate used in the southern Sierra Nevada foothills (Airola et al. 2016). Thistle sites are typically only available to breeding Tricolored Blackbirds in years with weather patterns that support abundant thistle growth.

Historically, most breeding colonies were in freshwater marshes dominated by cattails and tules (Beedy 2008). In the 1930s, 93% of breeding colonies were in freshwater marsh vegetation with the remaining colonies in willows, blackberries, thistles, and nettles (Neff 1937). The proportion of colonies in freshwater marshes had decreased to about 70% by the 1970s as Tricolored Blackbirds began using novel, nonnative vegetation types, especially Himalayan blackberry and thistles (DeHaven et al. 1975a). By 2008, the proportion of colonies established in freshwater marsh during the statewide survey had declined to 35% (Kelsey et al. 2008).

Tricolored Blackbirds are known to have bred in blackberry bushes from the early 1900s (Booth 1926, Neff 1934, 1937), but this was a very infrequent occurrence. Sacramento County has a long history of breeding by Tricolored Blackbirds, with colonies in the 1930s found entirely in wetland substrates and colonies in the 1970s still mainly located in wetlands (Neff 1937, DeHaven et al. 1975a). In the 1980s and 1990s, an increasing percentage of breeding colonies were reported in nonnative Himalayan blackberry (Hosea 1986, Beedy and Hamilton 1997). Over 55,000 breeding Tricolored Blackbirds were located in Sacramento County in 1993, with the large majority of these in Himalayan blackberry and a small number in wetland substrates (Hamilton 1993). Himalayan blackberry is currently the dominant nesting substrate throughout the northern and central Sierra Nevada foothills. From 2014 to 2016, 65–80% of foothill colonies have occurred in Himalayan blackberry annually (Airola et al. 2016). Between 1994 and 2004, a large shift from cattail marsh colonies to Himalayan blackberry colonies occurred in the rice-growing region of Sacramento Valley (Hamilton 2004a). This was in part due to the loss or destruction of specific cattail marsh sites, but was also likely due in part to an increase in distribution of Himalayan blackberry.

Tricolored Blackbirds were discovered breeding in grain fields in the San Joaquin Valley in 1991 and 1992 (Hamilton et al. 1992). Prior to this, nesting in large cultivated grain fields was unknown and little work on the status of the species in the southern San Joaquin Valley had been conducted (Beedy et al. 1991, Hamilton et al. 1992). The only previous report of nesting in a cultivated grain field was from 1944, when a colony was observed in mustard-infested barley (Bent 1958). The discovery of breeding on grain fields in the 1990s corresponded to an increase in planting of triticale. This wheat-rye hybrid grain may be attractive to breeding Tricolored Blackbirds due to its robust structure that is well suited to support nests and it dense growth that is relatively impenetrable to terrestrial predators. Relatively little triticale had been planted for silage in the San Joaquin Valley by 1994, but by 2005 the planted acreage had

grown to about 75,000 acres (Aksland and Wright 2005). Of the nesting substrates used by Tricolored Blackbirds, triticale and other grain fields are unique in that they are available in abundance each year in the San Joaquin Valley, and in recent years, many of the largest colonies have occurred on grain fields. Fifty percent of the breeding Tricolored Blackbirds detected in California during the 2008 statewide survey were observed nesting in triticale fields (Kelsey 2008).

During the April 2011 statewide survey, the majority of colonies (54%) in the San Joaquin Valley and Tulare Basin were located on agricultural grain crops, with an additional 22% in milk thistle. Conversely, 70% of colonies in the Sacramento Valley and Sierra Nevada foothills were in Himalayan blackberry. The majority of colonies in southern California, on the central coast, and in extreme northern California continued to occur in wetland habitats. Statewide, wetlands continued to support more colonies than any other substrate type (37%), although these wetland colonies supported only 5% of the population (Kyle and Kelsey 2011).

The areal extent of nesting substrate used by breeding Tricolored Blackbird colonies has ranged from a few square meters to more than 200 acres (Tricolored Blackbird Portal 2017). The smallest colonies have occurred in a variety of nesting substrate types, including cattail or bulrush marsh, Himalayan blackberry, and willows. The largest colonies of 100 acres or more have been located in triticale in recent years, although historically very large colonies occurred in wetland habitats (Neff 1937). The large majority of colonies occupy less than 10 acres of nesting substrate, with many being smaller than one acre. DeHaven et al. (1975a) found that the area occupied by nests in all substrates types averaged less than two acres per colony, and the largest colonies observed from 1968 to 1972 occupied only 10 acres.

Nest densities vary widely across nesting substrates. DeHaven et al. (1975a) observed densities up to 66,670 nests per acre~~s~~ (100,000 breeding adults per acre) in Himalayan blackberry colonies, with the average density in blackberry colonies closer to 16,000 nests per acre. Densities in other common nesting substrates (cattails, bulrush, thistle, and willows) had densities of up to 13,340–20,000 nests per acres (20,000–30,000 breeding adults per acre), with average densities ranging from 3,300 to 4,800 nests per acre (DeHaven et al. 1975a).

Commented [B19]: Please check to confirm these numbers. I'd thought that my measurements were similar to Rich's, and mine are in the range of 850-1,250 nests/acre, with an all-time maximum of 3,500 nests/acre in a triticale field infested with mallow.

Water

Breeding Tricolored Blackbirds require an open, accessible water source in the vicinity of the breeding location. Adults use the water for drinking and bathing, and will sometimes submerge insect prey items before provisioning young. The requirement for open water can be met by any of a number of sources, including wetlands, streams, ponds, reservoirs, and agricultural canals or ditches. Water must be available within a few hundred meters of the nesting substrate (Hamilton 1995). The loss of local water sources during the nesting cycle has caused entire colonies to abandon their nests (Beedy et al. 1991).

Foraging Habitat

The Tricolored Blackbird breeds in dense colonies with the individual territories that are defended by each male consisting of a very small area. These dense congregations of large numbers of birds exert large pressures on the foraging landscape surrounding the nesting location. Unlike most other landbirds,

Tricolored Blackbirds forage almost exclusively away from the nesting territory, and colonies require suitable foraging habitat with abundant insect prey within a few miles of the colony site. Because provisioning success and the resulting rate of nestling starvation have been shown to influence reproductive success, the availability of high quality foraging habitat is as important to Tricolored Blackbird breeding as is the availability of suitable nesting substrate (Hamilton et al. 1992). The proximity to highly abundant insect food supplies may be a factor in the selection of breeding sites by Tricolored Blackbirds (Neff 1937, Orians 1961, Payne 1969), and their nomadic and colonial behavior may have evolved as a strategy for maximizing the ability to locate and exploit unpredictable and temporarily abundant insect food sources. The required foraging habitat for successful breeding has a much greater spatial extent than nesting substrate. Although data are not available to define the minimum extent of foraging habitat, it has been reported that colonies with less than 200–300 acres of foraging habitat do not persist and access to several thousand acres is necessary to maintain most large colonies (Hamilton 2004b).

Commented [B20]: This is a tough one as many colonies are dependent upon very small, very rich foraging habitats, and therefore the amount of foraging habitat needed is a function of its productivity, and the more insects available per unit of area, the smaller this area needs to be. I've seen even large colonies of 10-15,000 colonies that appeared to get by on 160 acres of shrublands + alfalfa. Foothill colonies need lots of foraging habitat as insects are not concentrated in open rangelands, but some colonies are close to concentrated food sources and the sizes of these areas can be remarkably small.

Primary foraging habitats during the breeding season include grasslands, shrublands, pastures, dry seasonal pools, and certain agricultural crops including alfalfa and rice, which provide for high production of insect prey for breeding Tricolored Blackbirds. Grasslands and alfalfa have been shown to be important in predicting presence of breeding Tricolored Blackbird colonies, with probability of colony occurrence increasing with increasing proportion of these land cover types within 3 miles (NAS 2017). Adults will also sometimes exhibit aerial foraging above wetland colonies when aquatic insects are hatching (Beedy et al. 2017). Adult birds also frequently feed at cattle feedlots and dairies where they have access to abundant grain sources. Among grassland foraging habitats, Hamilton et al. (1995) reported that ungrazed grasslands were preferred over heavily grazed grasslands by foraging Tricolored Blackbirds, but this conclusion has not been reported in later studies of grassland foraging birds (Meese 2013, Airola et al. 2015a, 2016). Tricolored Blackbirds breeding in agricultural landscapes make little use of most row crops, vineyards, or orchards (Hamilton et al. 1992). During the 2000 statewide survey, Hamilton (2000) found that over 90% of observed Tricolored Blackbird foraging activity occurred on private property.

In Sacramento County, Hamilton et al. (1992) reported that 96% of all foraging by breeding Tricolored Blackbirds occurred in grasslands. This reliance on grasslands by Sacramento County and foothill breeding birds has persisted. In 2014, 90% of birds breeding in the central Sierra Nevada foothills, including Sacramento County, foraged in grasslands and pasture (Airola et al. 2015a).

Mailliard (1900) described the distinctive flight of Tricolored Blackbirds in the process of feeding nestlings as a "stream composed of birds going toward the tules with their bills full of bugs and of equal numbers returning to the fields for fresh supplies." Both prey abundance and proximity to the colony site likely influence the reproductive success of a colony. In at least some cases, adults foraging near the colony site bring few prey items to their young, while adults foraging more distant return with many more prey items (Orians 1980, *cited in* Skutch 1996). This may be a mechanism to conserve energy by making fewer long-distance flights and shows the value of foraging habitats in close proximity to colony sites; however, the possibility that proximate food sources had been exhausted during observations cannot be ruled out. When abundant insect prey are available adjacent to colony locations, adults will

make only very short foraging flights to acquire prey. Most foraging occurs within about 3 miles of the colony location, although Hamilton et al. (1992) reported maximum foraging flight distances by breeding birds of up to 8 miles. In the Central Valley from 2006 to 2011, Meese (2013) observed adult Tricolored Blackbirds foraging up to 5.6 miles from the colony location.

Several authors have suggested that regional insect abundance plays a role in breeding colony site selection, and that a super-abundant insect population may stimulate nesting behavior (Lack 1954, Orians 1961b, Orians and Collier 1963, Collier 1968, Payne 1969). This could explain the variation in general distribution of colonies between years (DeHaven et al. 1975b). The highly synchronized and colonial breeding system may have adapted to exploit an unpredictable environment where locations of nesting substrate and abundant insect food resources changed unpredictably from year to year (Orians and Collier 1963). Although Meese (2013) demonstrated that colony reproductive success depends on local availability of insect prey (usually within 3-5 miles of the nesting location), the role that insect abundance in foraging habitats has on colony site selection has not been investigated.

Commented [B21]: You may want to include the arboreal foraging that is seen along the coast and has been documented at Santa Lucia Preserve (Wilson et al. 2017). The birds eat oak moth caterpillars in the boughs of branches and do so almost exclusively during "breakout years."

Diet and Food Habits

For most of the year, the majority of food items taken by Tricolored Blackbirds consist of plant material, especially seeds. However, during the breeding season, adult females require large amounts of high-protein insect prey for egg production and nestlings require a protein-rich diet for growth and development (Crase and DeHaven 1977). Nestlings are fed almost exclusively animal matter for the first nine days after hatching, at which point parents begin to introduce plant matter into the diet (Hamilton et al. 1995). Colonies consisting of many thousands of adult birds and growing nestlings require an immense amount of insect prey during short windows of time. The availability of insect prey in the foraging landscape likely influences the establishment of breeding colonies, and an abundant prey base is essential for successful breeding.

Commented [B22]: OK, but you haven't linked protein (actually essential amino acids) to their higher concentration in animal foods. Also, essential fatty acids are just as important and deserve to be mentioned here.

Nestlings have been provisioned with a wide variety of prey items, including grasshoppers and crickets (order Orthoptera), beetles, weevils, and water beetle larvae (order Coleoptera), moths and butterflies (including caterpillars; order Lepidoptera), and to a lesser degree spiders, flies, tadpoles, snails, and emergent dragonflies, damselflies, and midges (Payne 1969, Crase and DeHaven 1977, Skorupa et al. 1980). At three breeding colonies in Merced County where adults often foraged for prey in alfalfa and grain fields, animal matter made up 91% of food volume for nestlings and fledglings, with moth larvae, beetles, and weevils the primary food items (Skorupa et al. 1980). In foothill grasslands, grasshoppers have often been the primary prey item fed to nestlings (Payne 1969, Airola et al. 2015a). In a diet study that included colonies from several regions of the Central Valley located among a variety of foraging substrates, animal matter made up more than 86% of the total volume of nestling food (Crase and DeHaven 1977). Ground beetles were the predominant food item when averaging across all colonies, followed by water beetle larvae, grasshoppers and crickets, and weevils. Colonies differed significantly in the primary food items provided to nestlings, with differences in foraging substrate responsible in some cases. For example, colonies with water beetle larvae as the predominant food source were located in rice-growing areas, and the greatest percent of grasshoppers were fed to nestlings at colonies bordered by grassland (Crase and DeHaven 1977).

Early observers noted that nestling and fledgling Tricolored Blackbirds were frequently fed grasshoppers, leading to descriptions of the species as a grasshopper-follower (Belding 1890, Bendire 1895, Mailliard 1914, Orians 1961). Payne (1969) observed breeding adult Tricolored Blackbirds at colonies in the Sacramento Valley foraging primarily in grasslands and providing nestlings with a diet composed of 47% grasshoppers; crickets, beetles, and spiders were also acquired in grasslands and fed to young in smaller amounts. Payne (1969) suggested that the movements of Tricolored Blackbirds during the breeding season paralleled the nomadic movements of rangeland grasshoppers in California and compared the Tricolored Blackbird with "locust bird" species of Asia and Africa. Grasshoppers continue to provide a valuable food source to Tricolored Blackbird colonies, especially when adjacent to grasslands and pastures (Airola 2015a), but Tricolored Blackbirds have been shown to be more flexible in breeding season diet, as long as an abundant insect source is available.

In the spring and summer, the proportion of animal material consumed by adult Tricolored Blackbirds in the rice-growing region of the Sacramento Valley was 28% and 39%, respectively, with primary prey items including ground beetles, water beetle larvae, and orthopterans (Crase and DeHaven 1978). At four breeding colonies in agricultural areas of Merced County, animal matter made up 56% of food volume for adult females and 28% for adult males (Skorupa et al. 1980). The most consumed animal foods were beetles and weevils, moth larvae, and flies; the predominant plant foods consisted of oats (*Avena* sp.) and filaree (*Erodium* sp.), and to a lesser degree chickweed (*Stellaria* sp.) and pigweed (*Amaranthus* sp.). In the nonbreeding season, Tricolored Blackbirds are more strictly granivorous, although a variety of plant and animal matter is taken opportunistically. One study in the rice-growing region of the Sacramento Valley revealed that about 90% of the fall and winter diet consisted of plant material, primarily seeds of rice, other grains, and weed seeds (Crase and DeHaven 1978).

Reproduction and Survival

Breeding typically extends from mid-March through early August (Beedy et al. 2017). Autumnal breeding has been observed in the Central Valley (September–November; Orians 1960, Payne 1969) and in Marin County (July–September; Stallcup 2004), although not since 1964 and 2003 in the Central Valley and Marin County, respectively. From initiation of nest building to independence of fledged young, the nesting cycle of the Tricolored Blackbird is about 10 days shorter than that of the Red-winged Blackbird, mostly due to rapid progression through the nest building and egg laying stages (Payne 1969). The condensed length of the nesting cycle may be a function of the synchronized colonial nesting and an adaptation to take advantage of unpredictable periods of abundant and temporary insect food sources (Payne 1969, Skutch 1996).

Nest building and incubation are performed exclusively by the female, but the male takes an active role in feeding the young (Lack and Emlen 1939, Orians 1960). Although female Tricolored Blackbirds breed in their first year, most males may defer breeding until they are at least two years old (Payne 1969). This contributes to a skewed sex ratio at many breeding colonies, with each male breeding on average with two females (Lack and Emlen 1939, Orians 1961, Payne 1969). Although colonies with even sex ratios or with more skewed sex ratios (each male breeding with more than two females) have been observed

(Hamilton et al. 1995), for monitoring purposes it is often assumed that each nest in a colony represents 1.5 breeding birds.

Successful breeding (i.e., production of any fledglings) was found to be positively correlated with colony size by Payne (1969); all colonies (n=7) that produced no fledglings contained 200 or fewer nests, while only one of seven successful colonies was smaller than 400 nests. Hamilton (1993) observed that the largest colonies in a single year of observation produced the highest estimates of reproductive success. Meese (2013) ~~demonstrated~~ documented a weak positive correlation between reproductive success and colony size over a six-year period ($r = 0.53$, $r^2 = 0.28$).

Reproductive success, defined here as the number of young fledged per nest, has been the generally accepted method for estimating productivity of Tricolored Blackbird colonies (Hamilton et al. 1995, Meese 2013, Holyoak et al. 2014, Airola et al. 2015a). Reproductive success has been estimated in one of two ways: visual estimation of the number of fledglings or nest sampling via walking transects through active colonies. When estimating reproductive success by visual counts of fledglings, colonies are visited at several-day intervals (often four days but in practice this has been variable), and fledglings observed at each visit are assumed to represent unique birds. The total number of fledglings observed on all site visits and the estimated number of nests based on the number of breeding birds are used to estimate the number of fledglings produced per nest. When estimating reproductive success by nest transects, it has been common practice to count the number of young per nest during the portion of the nest cycle when nestlings are 7–9 days old (Hamilton et al. 1995, Meese 2013). Entering colonies when nestlings are less than seven days old inflates the reproductive success estimate by underestimating nestling mortality and entering colonies when greater than 9 days of age causes the nestlings to jump from the nests prematurely. As a result, reproductive success estimates obtained by the transect method represent the maximum number of young fledged per nest. Therefore, the two methods of estimating reproductive success measure two somewhat different indices of productivity.

In 1992, reproductive success was relatively high at three colonies on wetlands and agricultural crops in the San Joaquin Valley (average RS = 2.7) and at Himalayan blackberry colonies in Sacramento County (average RS = 2.2) (Hamilton et al. 1992). Average reproductive success on wetlands in the Sacramento Valley was lower that year at 0.6 young per nest. Similar values of reproductive success were observed in 1994 (Hamilton et al. 1995). In 2000, reproductive success improved in the Sacramento Valley with three large colonies that did not experience heavy predation averaging 1.4 young per nest (Hamilton 2000), although the average reproductive success across all locations and substrate types was lower at 0.9 in 2000.

Many Tricolored Blackbird colonies in the Central Valley exhibited relatively low reproductive success from 2006 to 2011. Meese (2013) estimated reproductive success at 47 colonies, representing most of the largest colonies each year, during this six-year period ranging in size from 800 to 138,000 breeding birds. About half of the monitored colonies were in wetlands (n = 23), with the rest in thistle (n = 11), triticale (n = 9), and Himalayan blackberry (n = 4). The average reproductive success across all sites and years was 0.62. Reproductive success did not vary significantly across substrate type, although colonies that were destroyed by harvest of the grain nesting substrate were not included in the study results.

Low productivity during this time resulted in very few young Tricolored Blackbirds being produced in the southern San Joaquin Valley where a large portion of the population's first annual breeding attempts occur (Figure 6). Incidental observations in 2012 and 2013 suggested that the trend of low reproductive success continued. Meese (2013) linked reproductive success at Central Valley colonies to relative abundance of insect prey at foraging sites, suggesting that many Tricolored Blackbird colonies may have been food-limited. High levels of predation plus destruction of colonies to harvest during this time also contributed to the low overall production of fledglings (Meese 2011, 2012).

Although limited research has been conducted to estimate reproductive success at colonies since 2011, observations of large numbers of fledglings at multiple colonies suggest that the species has had at least some success in recent years. In 2015, the estimated reproductive success at five colonies on agricultural grain fields averaged 0.6–1.9 fledglings produced per nest (Aug 2015 presentation from NRCS to Tricolored Blackbird Working Group; unreferenced). In 2016, eight of nine known colonies on agricultural grain fields fledged at least some young, although efforts to estimate reproductive success were limited. Only one colony in silage was both accessible and uniform in nest density to allow for nest transects and resulted in an estimated reproductive success of 0.44 (Frazer 2016). At four colonies in Himalayan blackberry, cattail, and milk thistle that ranged in size from 5,000 to 12,000 birds, reproductive success estimates ranged from 0.4 to 0.67 (Meese 2016). In 2017, all known silage colonies at seven locations fledged at least some young. Some of these experienced very low reproductive success, but at least two had high success and produced several thousand fledglings. Several additional colonies in other nesting substrates were reported to have high (although unquantified) reproductive success in 2017, with four wetland colonies in the San Joaquin and Sacramento valleys producing at least several thousand young (Colibri 2017, Meese 2017). As in other years, many other colonies were observed to have low success. These limited quantitative estimates and additional qualitative assessments are difficult to compare directly to previous work due to the high variability in reproductive success across colonies and the inconsistent methods used to evaluate reproductive success.

Parents reduce the size of broods at ~~many~~ most colonies after the hatching of eggs (Hamilton et al. 1995). Often the majority of eggs in a clutch (usually three or four) will hatch but each nest typically fledges a reduced number of young, either due to parents not feeding all nestlings which leads to starvation, or by the active removal of nestlings from the nest by ~~parents~~ females (Payne 1969, Hamilton et al. 1995). This is likely because of a shortage of food supplies. When abundant food is available each nest produces more fledglings (Meese 2013), and as many as four young are raised per nest at productive colonies (Hamilton et al. 1995).

Commented [B23]: Impossible, this must be a misinterpretation. No colony every studied has had 100% egg hatch and RS. Has to be an error. And I have never seen a single nest that has fledged 4 young. I doubt that anyone has, for it does not happen except perhaps in extremely rare instances even in very insect-rich landscapes.

In many years, overall reproductive success at many or most colonies has been relatively low, but estimates have also been highly variable across colonies. Of 21 colonies observed by Payne (1969) from nest building through termination of the breeding effort, including both successful and unsuccessful colonies, only about 40% of nests produced fledglings. High rates of reproductive success at a few large colonies can produce large numbers of fledglings. For example, three colonies representing 50,000 nests accounted for the production of an estimated 100,000 fledglings in 1993, while many smaller colonies produced no or few fledglings in the same year (Hamilton 1993). Meese (2013) observed high variability in reproductive success in both triticale and milk thistle colonies from 2006 to 2011 (range 0.01–1.44).

The relatively high reproductive success at a small number of colonies was demonstrated to be a function of a high insect abundance in nearby foraging areas (Meese 2013). Low reproductive success has been implicated in Tricolored Blackbird population declines over the last two decades (Cook and Toft 2005, Meese 2013). Occasional high rates of reproductive success at a few large colonies may be a successful strategy for long-term population viability, but the degree to which infrequent bouts of high success can compensate for the low reproductive success that may be persistent and widespread across most colonies is unknown.

Reproductive output has been observed to vary across substrate types (Hamilton et al. 1992, Hamilton 2000, Holyoak et al. 2014). Holyoak et al. (2014) modeled occupancy rates in the most common nesting habitat types in recent years (2006–2011) and considered data on abundance, reproductive success, and frequency of use for each nesting habitat type to determine the net reproductive output of different nesting habitats over time. Occupancy rates and other factors that influence reproductive output varied across habitat types, resulting in variation in the importance of habitats to Tricolored Blackbird productivity. Four nesting habitat types had sufficient sample size to make strong ~~conclusions~~ inferences about average reproductive output, including Himalayan blackberry, nettles, wetlands, and grain fields. Himalayan blackberry and nettle colonies exhibited higher than average reproductive output. High overall reproductive output for nettle colonies is a little unexpected given that there are very few colonies, which are of average size, in this nesting substrate. However, high rates of occupancy and reproductive success result in high overall reproductive output for nettle colonies. Himalayan blackberry colonies exhibit average occupancy rates and size, but high reproductive success and the large number of colonies in this nesting substrate (the second most frequent colony type after wetlands) lead to high overall reproductive output. Grain field colonies exhibit average overall reproductive output, despite having low occupancy rates, low reproductive success, and a small number of colonies on grain fields each year; the very large size of grain field colonies increases the overall reproductive output. Of the four nesting habitat types assessed, wetlands remain the most common nesting habitat used by breeding Tricolored Blackbird colonies in recent years. Despite this, average levels of occupancy, reproductive success, and size of marsh colonies have led to the lowest overall contribution to reproductive output among the four nesting habitat types.

Commented [B24]: I don't think that we modeled this. We used actual values if I remember correctly.

Between 1992 and 2003, estimated reproductive success was significantly higher in nonnative Himalayan blackberry (RS = 2.0) than in native emergent cattail and bulrush marshes (RS = 0.5; Cook and Toft 2005). Excluding colonies that were lost to harvest, colonies on silage grain fields had an intermediate reproductive success (RS = 1.0). Meese (2013) did not observe this pattern from 2006 to 2011, when overall reproductive success was much lower and differences in reproductive success between substrates were not significant (unharvested triticale RS = 0.73; Himalayan blackberry RS = 0.44; wetland RS = 0.31), although only four Himalayan blackberry colonies were included in the sampled colonies. In 2014, Airola et al. (2015a) estimated the average reproductive success at four Himalayan blackberry colonies in Sacramento County as 0.84 fledglings per nest. Although the methods used were slightly different, this estimate is within the range of reproductive success estimates observed in all nesting substrate types by Meese (2013) during six years of low reproductive success

Commented [B25]: You probably ought to mention that Liz Cook's definition of RS differed from Bill and mine's, she set the bar at 5 days old, while all others have said 7-9, so of course her estimates of RS are greater.

(average RS = 0.62; range 0.01–1.44), but the range of values observed by Airola et al. was much narrower (0.66–0.90).

After fledging, Tricolored Blackbirds often leave the vicinity of the nest and congregate in groups of young birds from many different nests. These fledgling groups will often congregate near the edge of the nesting substrate nearest the foraging grounds being used by the adults, where they are fed when adults return to the colony site (Payne 1969). A group of fledgling Tricolored Blackbirds has been referred to as a crèche (Hamilton 1998, Beedy et al. 2017). The formation of crèches generally occurs among birds that breed in large colonies and whose eggs all hatch at about the same time (examples of other crèche-forming species include terns and penguins). Supervision of unrelated offspring by a small number of adult guardians is usually considered a characteristic of crèches, although it is unclear whether this is the case in Tricolored Blackbirds. A single large colony of Tricolored Blackbirds can produce many crèches, and a single crèche may include several thousand fledglings. Crèches can persist for up to one to two weeks, and have been observed as far as three miles from a colony site (Payne 1969, Hamilton et al. 1995).

There are no published studies on the annual survival rate of Tricolored Blackbirds, but banding studies have shown that individuals can live up to 13 years (Neff 1942, DeHaven and Neff 1973). Meese (2014b) used recapture data to estimate the average annual adult survivorship of Tricolored Blackbirds as 60%. Estimates of annual survival rates for other temperate blackbirds have ranged from 42% to 60%, with rates for the closely-related Red-winged Blackbird ranging from 42% to 54% (Fankhauser 1971, Searcy and Yasukawa 1981).

[Note to reviewers: Results of recent analyses of banding data by Cornell University provide revised estimates of apparent annual survival that differ from that reported here (adult female survival rate ~0.5-0.9, depending on year). Results have not been finalized and will be incorporated after further discussion with Cornell to verify preliminary results.]

STATUS AND TRENDS IN CALIFORNIA

Range

Nuttall (1840) observed the Tricolored Blackbird along the coast of California in the 1830s and, without offering any supporting evidence, suggested that the Tricolored Blackbird range extended into Oregon and Mexico. In the mid-1800s, Cooper (1870) reported the species to be common on the southern California coast from Santa Barbara to San Diego, with the range to the north passing “more into the interior, extending up as far as Klamath Lake and southern Oregon.” Bendire (1895) reported the range as “[s]outhwestern Oregon, south through California, west of the Sierra Nevada, to northern Lower [Baja] California.” Bendire knew of no reports of the species north of Klamath Lake in southwestern Oregon, and thought it to be uncommon there. The range of the species was confirmed to include northern Baja California in the late 1800s, with A. W. Anthony reporting them “[r]ather common along the northwest coast, breeding in all fresh-water marshes” (Bendire 1895).

Following a period of years with no reported sightings of Tricolored Blackbird in Oregon, Neff (1933) reported a number of observations of the species from 1931 to 1933, all within 30 miles of Klamath Falls, and consisting collectively of fewer than 60 birds. Richardson (1961) reported up to several hundred Tricolored Blackbirds near Medford, Oregon in 1957 and documented breeding colonies of 1,500 and 1,800 birds in the region in 1958 and 1960, respectively. Inconsistent observations during the 1800s and early 1900s at the northern extent of the species range may represent shifts in distribution over time or are perhaps the result of limited survey coverage. The species has continued to breed in small numbers in the vicinity of Klamath Falls to the present time, and small numbers of birds continue to occur near Medford during the breeding season. Small breeding colonies (30 or fewer birds) were observed in three northern Oregon counties (Multnomah, Umatilla, and Wheeler) in the 1980s (Beedy et al. 1991). Since the 1990s, several hundreds of birds have occurred regularly in central Oregon near the town of Prineville in Crook County, and breeding has been confirmed in the area. In recent decades, the species has been documented in several other isolated locations in western Oregon and eastern Washington, almost always in very low numbers but occasionally numbering in the hundreds of birds (Gilligan et al. 1994, Spencer 2003, eBird Dataset 2016). The degree to which these records represent recent range expansion to isolated areas, irregular use of the region, or increased survey coverage is unclear, but it appears that small numbers of birds may have recently expanded the species' range to at least some isolated areas in the north (Gilligan et al. 1994, Wahl et al. 2005).

Ammon and Woods (2008) describe the recent discovery and status of breeding Tricolored Blackbirds at a single location in western Nevada, and report that there was no confirmed breeding in Nevada prior to 1996. However, Wheelock (1904) described the distribution of the species in the early 1900s, and reported that in the vicinity of Lake Tahoe, "these birds stray across the crest, but not in the numbers in which they are found westward." The species was also reported to have bred at Lake Tahoe in the early 1900s (Dawson 1923) and Hosea (1986) reported a breeding colony in Carson City, Nevada in 1980.

In the early 1900s, the Tricolored Blackbird occurred in northwestern Baja California south to about the 30th parallel north (Grinnell 1928). This is consistent with recent breeding records from the southern extreme of the species range near El Rosario (Erickson et al. 2007, Feenstra 2013).

The above historic accounts from the periphery of the range are largely consistent with the current range of the species, and overall, the range of the Tricolored Blackbird has changed little since at least the mid-1930s (Beedy et al. 2017). However, the species appears to be experiencing a range retraction in the southern California portion of the range and in Baja California, as discussed below.

Distribution

There are no descriptions of the distribution of the Tricolored Blackbird before the widespread conversion of native habitats across much of its range in California. However, accounts by early naturalists in California provide several records of the Tricolored Blackbird in the 1800s and early 1900s that document the local abundance, and to some extent, the distribution of the species prior to any systematic study of the species across its range.

The early anecdotal reports from the 1800s and early 1900s, although typically not quantitative, informed the historical distribution of birds and demonstrated the occurrence of large numbers regionally. Most early observations of large numbers of birds were from the Central Valley and southern California, and only small numbers of birds have occurred north of the Central Valley, both historically and in recent years. Therefore, this report discusses changes in distribution for the Central Valley and for southern California, which have supported the majority of the population and for which adequate information is available to assess long-term changes in distribution.

Central Valley

In 1852, Heermann reported frequent encounters with winter flocks of Tricolored Blackbirds in the Suisun Valley that numbered “so many thousands as to darken the sky for some distance by their masses” (Baird et al. 1874). The Tricolored Blackbird was known to be an abundant breeder in the interior valleys of California in the late 1800s (Bendire 1895). Belding (1890) observed “an immense colony” near Stockton in 1879. Ray (1906) noted the species breeding at various points on an automobile trip down the San Joaquin Valley from Stockton to Porterville in 1905. Linton (1908) observed a breeding colony at Buena Vista Lake at the southern edge of the Central Valley in 1907. Lamb and Howell (1913) reported seeing “hordes” of Tricolored Blackbirds at Buena Vista Lake in 1912. Dawson (1923) reported the species as “locally abundant in the Great Interior [Central] Valley.”

Neff (1937) was the first to attempt to document the rangewide status and distribution of Tricolored Blackbirds. Over a six-year period from 1931 to 1936, Neff located breeding colonies throughout the Central Valley and at a few additional locations in California and southern Oregon; however, Neff’s surveys focused on the Sacramento Valley in most years. Based on his somewhat geographically limited efforts, Neff (1937) reported nesting birds in 26 California counties over the six-year study. During this period, the rice-growing areas of the Sacramento Valley appear to have been the heart of the Tricolored Blackbird’s distribution, although it is not clear whether this was due to survey efforts being focused there and the limited effort applied further south in the San Joaquin Valley.

Bent (1958) reported that the center of abundance for the species seemed to be in the San Joaquin Valley. Orians and Christman (1968) reported that the largest colonies occurred in the rice-growing districts of the Central Valley (mainly the Sacramento Valley and northern San Joaquin Valley). Neither of these reports were based on systematic surveys of the valley and have limited utility in documenting species distribution, other than that the majority of the population continued to occur in the Central Valley.

The distribution of colonies encountered over a five-year period by DeHaven et al. (1975a) was similar to that observed 35 years earlier by Neff (1937). DeHaven et al. (1975a) reported that 78% of colonies located between 1968 and 1972 were in the Central Valley. Most colonies and breeding birds were found in the Sacramento and northern San Joaquin Valleys, including Butte, Colusa, Glenn, Yolo, Sacramento, Merced, and Stanislaus counties. In the 1980s, the largest colonies and the majority of the known population continued to breed in the Sacramento and northern San Joaquin valleys (Hosea 1986, Beedy et al. 1991).

An apparent early nesting season shift in distribution from the Sacramento Valley to the southern San Joaquin Valley occurred at the end of the 20th century. Although breeding had been documented in the San Joaquin Valley since the 1800s, this region had not been the focus of intense monitoring efforts prior to the 1990s. DeHaven et al. (1975a) reported that areas with suitable nesting substrates were scarce in the arid southern San Joaquin Valley in the 1970s. As described above, loss of native wetland breeding habitat had resulted in a shift to novel nonnative vegetation types beginning by the 1970s, and the distribution shift away from the Sacramento Valley is presumably in part due to these changes in nesting substrate availability. In the early 1990s, Tricolored Blackbirds were discovered breeding in grain fields in the San Joaquin Valley (Hamilton et al. 1992, Hamilton 1993). This discovery corresponded to an increase in the number of dairies and the associated expansion of triticale in the San Joaquin Valley as dairies began growing this new crop for silage. By 1994, most of the largest colonies and 40% of known breeding birds in the early part of the breeding season were found in the southern San Joaquin Valley associated with dairies and cattle feedlots (Hamilton et al. 1995). Relatively little triticale had been planted for silage in the San Joaquin Valley by 1994, but by 2005 the planted acreage had grown to about 75,000 acres (Aksland and Wright 2005).

The shift in distribution to the San Joaquin Valley during the early breeding season has persisted, with very large proportions of the population nesting in a few large “mega-colonies” adjacent to dairies in the San Joaquin Valley (Kelsey 2008). In 1994, 68% of the estimated population in the early nesting season occurred in the San Joaquin Valley; this increased to 86% and 89% by 2008 and 2011, respectively (Hamilton et al. 1995, Kelsey 2008, Kyle and Kelsey 2011). In 2011, the 10 largest colonies were in the San Joaquin Valley during the early season survey (Kyle and Kelsey 2011). Breeding sites on triticale and other silage crops are also generally near other important habitat features, including irrigated pasture, grassland, or alfalfa crops for foraging, and available open water. The degree to which the apparent shift from the Sacramento Valley to the southern San Joaquin Valley is due to the loss of nesting habitat, the availability of a novel nesting substrate, or an increase in survey effort in the San Joaquin Valley is unknown (DeHaven 2000). Nevertheless, there has been a consistent use of the region by a majority of the Tricolored Blackbird population since the mid-1990s (Figure 7). The proportion of the population breeding in the San Joaquin Valley during the early part of the breeding season dropped to about 52% in 2014. This drop was in part due to increases in the number of birds in the Sacramento Valley, including the Sierra Nevada foothills, and southern California, but was primarily the result of a large rangewide decline, with most of the decline in number of birds occurring in the San Joaquin Valley (see the Regional Shifts in Abundance section). In 2017, the proportion of birds nesting in the San Joaquin Valley in the early breeding season returned to almost 70% (Meese 2017).

The grasslands and pastures of southeastern Sacramento County have seen consistent use by breeding Tricolored Blackbirds for at least the last 80 years (Neff 1937, DeHaven et al. 1975a, Hosea 1986, Beedy et al. 1991, Cook and Toft 2005, Airola et al. 2016), even as the dominant nesting substrate in the region has shifted from native wetlands to Himalayan blackberry (see Nesting Substrate section). DeHaven et al. (1975a) described the pasturelands of southern Sacramento County as the most consistently used area during a five-year study. Until recently, little emphasis has been placed on monitoring Tricolored Blackbird colonies in the Sierra Nevada foothills and grasslands/pasturelands of the eastern Central

Valley relative to population centers in the Central Valley and in southern California. Observations of colonies from this region during statewide surveys have usually been lumped with the Central Valley for reporting purposes. Starting in 2014, these grasslands in the low elevation foothills have received focused monitoring as a distinct breeding area (Airola et al. 2015a, 2015b, 2016), with regular use reported for not only Sacramento County, but also from Butte County in the north to Stanislaus County in the south. In 2016, precipitation patterns supported growth of milk thistle patches across extensive areas in the foothills further south as far as Fresno County, resulting in breeding by more than 22,000 birds that had not been observed in the region in the two previous years (Airola et al. 2016). When milk thistle is available for nesting by Tricolored Blackbirds, this nonnative plant may ~~extent~~ extend the distribution of the species into the southern Sierra Nevada foothills.

Although shifts may have occurred within the Central Valley and some areas of the valley that once supported large numbers of birds now support few or no breeding colonies, while other areas appear to have become much more important, the Central Valley and surrounding foothills as a whole have supported the majority of the Tricolored Blackbird population both historically and in recent years. Additional information on use of the Central Valley is presented in the Regional Shifts in Abundance section.

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Southern California and Baja California

The first Tricolored Blackbird specimen was collected by Nuttall near Santa Barbara in 1836 (Baird et al. 1874, Bent 1958). Although he did not observe breeding colonies, Nuttall reported that the Tricolored Blackbird was very common around Santa Barbara and Monterey in the month of April (Nuttall 1840). In the mid-1800s, Cooper (1870) found the Tricolored Blackbird to be the most abundant species near San Diego and Los Angeles, and they were not rare near Santa Barbara. In the late 1800s, the species was described as an abundant winter resident in Los Angeles and Orange counties, occurring in very large flocks, with several colonies known to breed in tule marshes up to 1,500 feet in elevation (Bendire 1895). Grinnell (1898) reported the species to occur in “considerable numbers” throughout the lowlands of the Pacific slope of Los Angeles County, and Willett (1912) considered the species a common resident throughout the lowlands of coastal southern California. Dawson (1923) reported the species as “locally abundant…in the San Diegan district.”

There is evidence that the Tricolored Blackbird had experienced declines in a large portion of its range in southern California, even by the 1930s. In a revision of his former description of the species’ status in coastal southern California, Willett (1933) described the species as a “formerly common resident…Now rare throughout former range in southern California, excepting in some sections of San Diego County.” Grinnell and Miller (1944) described the status of the Tricolored Blackbird as “common to abundant locally” but noted a general decrease in southern California.

In 1980, the Tricolored Blackbird was characterized as a fairly common resident in the southern California coastal district that bred locally in all coastal counties (Garrett and Dunn 1981). The species no longer occurs at many historical sites in coastal southern California. Small numbers of breeding birds were documented at a few locations in coastal Santa Barbara County through the 1970s, with the last

known colony of 200 birds in 1979 (Lehman 1994, Tricolored Blackbird Portal 2017). The last known colony in Ventura County, of 53 birds, occurred in 1994. About 200 birds persisted as breeders in the portion of Los Angeles County south of the Transverse Ranges through the 1990s, with the last known breeding attempt in 1999 (Allen et al. 2016, Tricolored Blackbird Portal 2017). Several hundred breeding birds occupied multiple sites in Orange County through the 1990s, but only a single colony of 14 birds has been observed breeding in the county in two years since 2000. The highly urbanized coastal portion of San Diego County, which supported thousands of breeding birds through at least the 1970s, has supported less than a thousand breeding birds at only three locations since 2000 (Tricolored Blackbird Portal 2017). Very few Tricolored Blackbirds now breed in the coastal lowlands of southern California where they were once abundant (Garrett et al. 2012).

The status of the Tricolored Blackbird population in Baja California has followed a similar pattern to that for southern California. In the late 1800s, the species was described as “rather common along the northwest coast [of Baja California], breeding in all fresh water marshes” (Bryant 1889). Grinnell (1928) described the species as a “Fairly common resident locally in the northwestern section of the territory, north from about 30 degrees.” In the 1980s, the species was described as a “local resident in northwestern Baja California south to El Rosario” (Wilbur 1987). A search of the entire Baja California range turned up a single breeding colony of 80 birds in 2007 (Erickson et al. 2007) and four breeding colonies totaling 240 birds in 2008 (Erickson and de la Cueva 2008). A follow-up survey several years later located three breeding colonies supporting an estimated 240–340 birds (Feenstra 2013). In recent years, most breeding in Baja California has occurred in the north within about 70 miles of the U.S. border. Breeding continued at a disjunct area at the historical southern extent of the species’ range (about 100 miles farther south than the next nearest breeding location) near El Rosario through at least 2013 (Erickson and de la Cueva 2008, Feenstra 2013). By 2016 all known breeding colonies occurred within about 12 miles of the U.S. border (Erickson et al. 2016). In 2017, the only known breeding colonies occurred within five miles of the U.S. border and eight nonbreeding Tricolored Blackbirds were observed at a historic breeding site about 70 miles south of the U.S. border. No birds were observed south of this point, leaving the southernmost 100 miles of the species range in Baja California apparently unoccupied (April 2017 email from R. Erickson to N. Clipperton; unreferenced).

Where previously abundant and widespread south of the Transverse Ranges, the distribution of breeding colonies is now mostly restricted to inland sites in western Riverside and San Bernardino counties, and in the interior of San Diego County (Feenstra 2009). This represents a long-term decline in southern California, with remnant colonies disappearing in recent decades throughout much of the southern range (Figure 8). This may represent a permanent breeding range retraction from portions of the range where the species was previously abundant, and is likely the result of ongoing urban development and declines in population numbers. The small numbers of birds that have occasionally bred at the extreme southern limit of the species’ range in Baja California, separated by 100 miles from the next most southern breeding colony locations in recent years, were not observed in 2017. The majority of the historical range in Baja California has been unoccupied in recent years (Erickson et al. 2016).

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Allen et al. (2016) reported that nesting commenced late in the 20th century in the Mojave Desert portion of northern Los Angeles County, and attributed this to manmade reservoirs and other impoundments, but breeding by small numbers of birds was known for the area since at least the 1970s (DeHaven et al. 1975a, Beedy et al. 1991). The species was known to occur in the Mojave Desert since at least 1890, but breeding was not documented (Belding 1890). The region has not supported more than a few thousand breeding birds in any year.

Population Trend

Breeding Population

Assessments of the rangewide population abundance of the Tricolored Blackbird prior to the 1990s are limited to published literature describing research by a limited number of individuals in the 1930s (Neff 1937) and an additional rangewide assessment using similar methods in the 1970s (DeHaven et al. 1975a). An additional recent published study used all available breeding colony data collected over more than 100 years (1907–2009) to evaluate changes in average colony size (Graves et al. 2013). The most intensive efforts to estimate rangewide population abundance have occurred since 1994, with results presented in reports prepared by academic researchers, Audubon California biologists, and in reports prepared for the USFWS and the Department. These represent the best available information for assessing trends in the rangewide population over the last two decades.

Over a period of six years (1931–1936), Neff (1937) surveyed Tricolored Blackbird colonies across California. Neff located several breeding colonies of more than 100,000 nests in the Sacramento Valley, with the largest composed of greater than 200,000 nests (corresponding to approximately 300,000 adult Tricolored Blackbirds). Breeding colonies were located throughout the Central Valley and in a few additional locations in California and southern Oregon; however, Neff's surveys focused on the Sacramento Valley in most years. An effort to cover the entire known range of the species was attempted by Neff in only one year (1932). Most areas outside the Sacramento Valley were covered only incidentally as "cooperators drove up or down the State in the performance of routine duties," and in the regions of the state that were most thoroughly surveyed, it was impossible to make complete surveys of all possible locations (Neff 1937). Neff concluded that obtaining an estimate of the statewide population was not possible. Working alone in 1934, Neff observed an estimated 491,250 nests (about 737,000 breeding birds), almost all of which were in the Sacramento Valley. The presence of birds in the San Joaquin Valley and southern California was noted in the same year, but no effort was made to estimate numbers. Several authors have cited Neff (1937) in statements about the Tricolored Blackbird population in the 1930s, sometimes suggesting that the population numbered in the millions (e.g., Beedy et al. 1991, Hamilton et al. 1995, Kyle and Kelsey 2011). Neff himself did not attempt to extrapolate his results to a region-wide estimate, although the roughly 737,000 breeding birds observed in a single year is likely an underestimate of the population at the time.

No attempts were made to describe the Tricolored Blackbird distribution or abundance during the 1940s, 1950s, or 1960s. From 1969 to 1972, DeHaven et al. (1975a) attempted to survey the entire range of the Tricolored Blackbird to document the distribution of the species and to compare estimates of abundance to those provided by Neff (1937). The surveys were carried out by a few individuals surveying vast areas by road, and in most areas were limited to one or two drives through each county where Tricolored Blackbirds were known to occur in California and southern Oregon. Still, the search effort was at least as extensive as that carried out by Neff in the 1930s, and included the benefit of improved transportation and an increased number of roads. In many counties the survey consisted of driving county roads with little knowledge of historical colony sites, but this was an improvement over much of the effort of the 1930s, when counties were considered covered if visited incidental to other activities. Despite a greater search effort, all measures of abundance indicated a decline: the number of active colonies detected per year declined from 43 to 41; nonbreeding birds encountered declined from >50,000 in a single year to <15,000 over four years; maximum colony size declined from hundreds of thousands to tens of thousands of birds; and number of birds observed per year within the study period declined from about 375,000 per year to about 133,000 per year (DeHaven et al. 1975a). Although no population estimate was provided, the authors suggested that the Tricolored Blackbird population declined by more than 50% in 35 years. Like Neff three decades before, DeHaven et al. (1975a) were unable to thoroughly cover the entire range of the species, including large portions of the southern San Joaquin Valley.

Following more than a decade with no survey to assess the statewide population, Beedy et al. (1991) compiled all historical records of Tricolored Blackbird breeding colonies and conducted limited field surveys from 1986 to 1990 to evaluate long-term population trends. Bill Hamilton and others (Hamilton et al. 1992, Hamilton 1993) conducted ecological investigations in 1992 and 1993 that included documentation of colony locations and sizes, the discovery of large breeding colonies on grain fields in the San Joaquin Valley, and the initial observations that suggested Tricolored Blackbirds are itinerant breeders (Hamilton et al. 1995). Based on the increased understanding of the species' biology and distribution, a new approach to estimating the statewide population of Tricolored Blackbirds was proposed by Ted Beedy and Bill Hamilton (Hamilton 1998, Meese 2015a). The discovery of itinerant breeding with broad movements between nesting attempts made it clear that a survey of the statewide population should occur during a narrow window in order to maximize the likelihood of detecting nesting colonies and to avoid double-counting birds (Hamilton et al. 1995, Beedy and Hamilton 1997). A survey conducted in a minor portion of the range or carried out over a long time period would either miss breeding colonies or double count birds over multiple breeding attempts. An improved understanding of colony occupancy dynamics suggested a need for early season colony-detection efforts to locate active colonies (Hamilton et al. 1995), while also considering the compiled information on all historical breeding locations in order to visit as many potential breeding locations as possible.

The new approach to surveying the statewide population was first implemented during the 1994 breeding season. The survey was conducted on a single day in the early part of the season (April 23). The choice of a survey date is an effort to select a time period when most birds have initiated a first nesting attempt and can be detected and counted at breeding colony sites, but before the first breeding cycle is completed and birds have moved to the north (usually) for the second breeding attempt. The goals of the survey were to visit as many known breeding locations as possible, document occupancy status, and estimate colony size at all occupied locations. This was also the first survey to be largely volunteer-based and to enlist a large number of observers over a narrow time period. Compared to the surveys of the 1930s and 1970s, these surveys employed many more surveyors to more thoroughly cover as much of the state and known colonies as possible. The discovery of breeding by a large proportion of the population on silage fields near dairies had recently been documented (Hamilton et al. 1992, 1995), and therefore unlike previous statewide survey efforts, the 1994 survey focused heavily on the San Joaquin Valley.

After the establishment of the new approach to conduct a statewide census, attempts to survey the population were carried out in 13 years between 1994 and 2017. Despite a consistent approach in many of the early years of this time period, methods varied considerably for many of these surveys. The years 1994, 1997, and 2000 produced a set of three triennial surveys that were considered to have been comparable in effort by the survey organizers (Beedy and Hamilton 1997, Hamilton 2000). After a period of years with surveys that followed inconsistent and variable approaches, another set of four triennial surveys were conducted using similar methods in 2008, 2011, 2014, and 2017 (Kelsey 2008, Kyle and Kelsey 2011, Meese 2014a, Meese 2017). The effort and results of these seven surveys are summarized in Table 1. Although the other six survey years (1995, 1996, 1999, 2001, 2004, and 2005) are not discussed further here, they are briefly summarized in Table 2 and in a larger discussion of Tricolored Blackbird surveys included in Appendix 1.

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Table 1. Comparison of survey effort and results for seven statewide surveys.

Year	Duration	Participants	Counties surveyed (occupied)	Number of sites surveyed (breeding sites)	Occupied breeding locations	Birds observed
1994	1 day (3 days)[1]	60[2]	– (32)	–	100	369,400
1997	1 day (3 days)[1]	55[2]	– (33)	–	71[3]	232,960
2000	4 days	81[2]	33 (25)	231 (181)	72	162,000
2008	3 days	155	38 (32)	361 (284)	135	395,000
2011	3 days	100	38 (29)	608	138	259,000
2014	3 days	143	41 (37)	802	143	145,000
2017	3 days	181	44 (37)	884	168	177,656

[1] Observations of birds not associated with colonies from one day before and after the survey day were accepted, effectively expanding the survey window to three days.
[2] Number includes participants who submitted written reports. A larger number of volunteers may have searched for birds.
[3] As reported by Hamilton (2000).
"—" = data not reported

Commented [B29]: This is more appropriately called number birds estimated, as the true number of birds observed can never be known.

The statewide survey efforts in 1994, 1997, and 2000 followed similar methods to locate and survey as many colonies as possible. Although the duration of the survey and the survey effort varied across these years, the organizers of the surveys reported these three surveys had used the most consistent methods to date and could be compared to assess the population trend (Beedy and Hamilton 1997, Hamilton 2000). However, inconsistencies in effort still occurred with the 1994 survey conducting only a limited survey of southern California, and the 2000 survey using more observers to visit more sites than the other two survey years. Hamilton (2000), however, concluded that "…the method of the Census and the survey, to reinvestigate all known breeding places and to search for new ones, has become an increasingly complete assessment of Tricolored Blackbird distribution and abundance. The 2000 Census probably located a greater proportion of the entire population than did censuses in previous years." The number of birds observed declined 56% from 369,400 birds in 1994 to about 162,000 birds in 2000 (Hamilton 2000, Cook and Toft 2005). In addition to the results of the surveys showing declines in the 1990s, Hamilton (2000) stated that personal observations over long intervals by many regional experts had also suggested declines during this time period.

Table 2. Description and summary of effort for 13 surveys that attempted to estimate the size of the statewide Tricolored Blackbird population between 1994 and 2017.

Survey year	Summary of effort and results	Sources
1994	The first year a statewide survey was conducted in a narrow time period, was informed by knowledge of historical breeding locations and by pre-survey colony detection work, and enlisted the help of a large number of volunteers.	Hamilton et al. (1995) Beedy and Hamilton (1997)
1995 and 1996	Limited pre-survey effort. Incomplete county coverage. Large colonies may have been overlooked. Results are not considered representative of the total population.	Beedy and Hamilton (1997)
1997	Used the same coverage, methods, and personnel as did the 1994 survey. Participation was greater than in 1994. Surveys from 1994, 1997, and 2000 are considered comparable.	Beedy and Hamilton (1997)
1999	Participation in the survey was low. Results considered an underestimate of population size by the survey organizer.	Hamilton et al. (1999, 2000) Hamilton (2000)
2000	Used the same methods applied in 1994 and 1997, although a greater number of observers were used to visit more locations. Training was provided to participants. Surveys from 1994, 1997, and 2000 are considered comparable.	Hamilton (2000)
2001	Followed a very different approach compared to standardized methods used since 1994. A limited number of sites were visited and estimates were compiled from observations made throughout the breeding season.	Humple and Churchwell (2002)
2004	Not intended to provide an estimate of the statewide population size that was comparable to previous surveys. Surveys limited to colony sites that had historically supported more than 2,000 birds. Focused on sites in the Central Valley.	Green and Edson (2004)
2005	No report was produced and no record is available describing the survey effort.	Meese (2015a)
2008	Used similar methods as in the 2000 survey, although estimates not adjusted using nest density. Also, county coordinators were used for the first time to ensure each county was well surveyed by volunteers. Maps with all survey locations were provided for the first time, and a website improved communication and data management. Number of survey participants and number of sites surveyed greatly increased relative to earlier surveys.	Kelsey (2008)
2011	Methods followed those used in 2008, although county coordinators were not used to lead surveys in individual counties. Surveys from 2008, 2011, 2014, and 2017 are considered comparable.	Kyle and Kelsey (2011)
2014	Used the same methods as in 2008 and 2011, and again used county coordinators to ensure each county was thoroughly covered. The number of counties and number of sites visited exceeded all other surveys to date. Surveys conducted 2008–2017 are considered comparable.	Meese (2014a)
2017	Used the same methods as in 2008–2014. The number of survey participants and the number of counties and sites visited exceeded all other surveys to date. Surveys conducted 2008–2017 are considered comparable.	Meese (2017)

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As during the early set of survey years, the survey effort increased each year from 2008 to 2017. More counties were surveyed in 2014 than on any previous survey and the number of observers participating on the 2014 survey (n = 143) was exceeded on only one previous survey (n = 155 in 2008). There was a large increase in the number of sites visited in each survey year between 2008 and 2014, and the number of colony sites visited in 2017 exceeded that of any other survey (Figure 9). The 2017 survey was the most extensive survey conducted to date based on all available metrics of effort (Table 1). The number of birds observed on statewide surveys declined 63% from 395,000 birds in 2008 to an all-time low of about 145,000 birds in 2014 (Kelsey 2008, Meese 2014a) (Table 1). From 2014 to 2017, the number of birds observed increased 22% to 177,656. The number of birds observed in 2017 represents a 55% decline in the population over the nine years since 2008 despite huge increases in the numbers of confirmed colony locations surveyed and vastly improved data management provided by the Tricolored Blackbird Portal.

Although the conclusion following each of the two groups of survey years (1994–2000 and 2008–2017) was that a population decline had occurred, differences in survey methods and effort make it difficult to combine the two groups of surveys to make longer-term conclusions (Meese 2015a). Does the estimated number of birds in 2008 represent an increase in population size following the decline of the 1990s, or do increased survey effort and other changes to survey methodology preclude comparison of results from the two survey periods? In addition to differences in duration of the survey, geographic scope, and effort shown in Table 1, there were important differences in methods used between the two groups of surveys (see Appendix 1). Methods unique to the earlier 1994–2000 surveys include: 1) Birds counted at colonies before the survey were included in the results if the colony remained active after the survey period (although not counted on the survey day), 2) Birds observed and counted at colonies after the survey were included if nest phenology led to a conclusion that the colony was active on the survey date (although not observed), and 3) Visual colony size estimates were often adjusted using observed nest densities, as determined by walking transects through colony sites after the survey; this resulted in final colony size estimates that in some cases differed significantly from those reported by survey participants (Hamilton et al. 1995). Unfortunately, the impact (both the magnitude and direction) of these methodological differences on the overall population estimates is unknown, and therefore a direct comparison of results from the two time periods is not appropriate. At a minimum, the large step change in survey effort between the two time periods must be taken into account if the data are to be used to inform a longer-term population trend.

As shown in Table 1, the individual metrics of survey effort were not consistently reported across survey years. The number of sites surveyed has been used to describe survey effort in recent years (Meese 2014a, 2015, 2017), but this number is not known for the surveys conducted in the 1990s. The number of counties surveyed was also not reported for surveys conducted in the 1990s. The number of participants and the number of occupied breeding locations were reported for all survey years. It is not known whether an increase in effort as measured by any of these metrics results in a proportional increase in the number of birds observed, but Graves et al. (2013) reported that total counts of breeding birds are correlated with the number of sites sampled. The number of sites sampled is also related to the proportion of the landscape searched by survey participants (Figure 9) and therefore might be the most appropriate metric of effort with which to standardize survey results.

In order to make use of as many survey years as possible to evaluate population trend over time, survey results were adjusted for effort when available (Figure 10a-c). Viewed as a whole, when adjusting for survey effort the results suggest a consistent pattern in the Tricolored Blackbird population since 1994. Regardless of the metric used to adjust population estimates for survey effort, the trend shows a long-term decline over the 23-year period with a partial recovery between 2000 and 2008. Depending on the metric used to correct for effort, either 2014 or 2017 represents the all-time low for effort-adjusted number of birds observed.

As the number of locations visited has increased with each successive statewide survey, so too has the number of locations with some uncertainty regarding the exact location. These are historical breeding locations for which the exact coordinates were often not reported, and therefore the level of confidence is recorded as "uncertain" in the Tricolored Blackbird Portal database (2017). As a result, surveyors have visited an increasing number of locations that have not necessarily supported Tricolored Blackbird breeding in the past (Table 3). This is not wasted effort, as the visits to uncertain locations increase the size of the landscape area searched for colonies during the survey (Figure 9), and the locations are likely near historical colony sites. Nevertheless, for the 2017 survey, participants were directed to focus on sites with known coordinates, resulting in a large decline in the number of "uncertain" sites surveyed. To be conservative in interpreting changes in survey effort over time, the uncertain locations were removed from the count of sites visited during the 2000, 2008, 2011, 2014, and 2017 surveys to adjust the effort for those survey years (Table 3). The adjusted number of sites surveyed each year continues to show an increase in survey effort over time. A graph prepared using the revised number of sites surveyed (Figure 10d) revealed little effect on the pattern of birds observed per site shown in Figure 10b.

Table 3. Number of sites surveyed during recent statewide surveys, adjusted to remove uncertain locations.

Survey year	Number of sites surveyed	Number of uncertain sites	Revised number of sites surveyed
2000	231	4	227
2008	361	8	353
2011	608	54	554
2014	802	127	675
2017	884	25	859

The linear regression trendlines for each of the effort-corrected survey results indicate that the Tricolored Blackbird population has declined by 75%–90% in the last 23 years (Figure 10). The observed rates of decline of -5.8% to -10.5% per year indicate that this species has been in severe decline over the last two decades. These rates of decline are in the range of the steepest declines observed across all North American landbird species based on Breeding Bird Survey data (Sauer et al. 2017a). Results of the most recent 2017 statewide survey suggest that the Tricolored Blackbird population decline may have slowed or reversed since 2014, but the population remains at or near its smallest size ever recorded. Coupled with the earlier declines between the 1930s and 1970s, the recent declines have resulted in a population that is a small fraction of its historical ~~abundance~~size.

There are several potential sources of uncertainty in the population estimates from statewide surveys. Attempts to quantify this uncertainty have been limited and inconsistent across years. Comments on the approach used to estimate the size of the population during recent statewide surveys, along with a discussion of uncertainty, are provided in Appendix 2.

Colony Size

In recent statewide survey years, the size of the largest colonies (including the single largest colony and the average of the several largest colonies per year) have been reported as an alternative metric to total counts of birds for tracking trends over time. Use of the size of large colonies to evaluate trends is only appropriate if the survey effort is sufficient to detect most of the largest colonies. Although the survey effort required to detect most of the largest colonies is unknown, Graves et al. (2013) reported that average colony size observed, based on colony data from 1907 to 2009, was not strongly correlated to the total number of sites sampled annually, suggesting that sampling may generally be sufficient to detect the largest colonies. Larger colonies may be more likely to be detected and therefore survey effort may have less effect on size of largest colonies observed compared to total counts of birds.

Commented [B31]: The term "sampling" in this context does not or should not imply statistically valid sampling for even several decades ago the locations of the largest colonies were often known only because so many, including landowners and curious citizens, knew of them and they were reported in a variety of ways. Thus, the intensive surveys of the past 30 years or so uncovered yet more large colonies, as would be expected, but historically even relatively modest surveys turned up large numbers of birds for they tended to be conducted in areas widely known to have supported large numbers of birds (there was not a lot of searching involved).

Neff (1937) located several breeding colonies of more than 100,000 nests in the Sacramento Valley, with the largest composed of greater than 200,000 nests (about 300,000 adult birds). Orians (1961a) reported that, in 1959 and 1960, there were four Tricolored Blackbird colonies larger than 100,000 adults; three were in the rice-growing area in Colusa and Yolo counties and one was in Sacramento County. The largest reported colonies in the 1970s were in Colusa and Yolo counties and comprised about 30,000 adults (DeHaven et al. 1975a, Beedy and Hayworth 1992). All but one of the colonies observed by DeHaven et al. (1975a) that were larger than 20,000 birds were located in the Sacramento Valley. In the 1980s, the largest reported colony was in the northern San Joaquin Valley at Kesterson Reservoir (Merced County) in 1986, with an estimated 47,000 adults (Beedy and Hayworth 1992).

The occurrence of Tricolored Blackbird breeding colonies on grain fields in the San Joaquin Valley was discovered in the early 1990s (Hamilton et al. 1995), and the size of the largest colonies in several subsequent years once again grew to more than 100,000 birds, so-called "mega-colonies." Beedy and Hamilton (1997) reported that 1994 and 1997 were the only two survey years to date with sufficient survey effort to detect "virtually all large colonies." In 1994, Hamilton et al. (1995) found that the largest colony, at San Luis National Wildlife Refuge, numbered about 105,000 adult Tricolored Blackbirds. In 1997, Beedy and Hamilton (1997) reported the largest colony to contain about 80,000 adults. The documentation of large colonies during this time period is likely due in part to the formation of mega-colonies on grain fields, but may also be a result of increased survey effort in the San Joaquin Valley.

Commented [B32]: Another possibility is that colonies at National Wildlife Refuges will not be missed due to the presence of paid staff who provide "eyes on the ground", and this extends all the way down to maintenance staff, who are in the field, in most cases, far more than are the wildlife biologists. The current maintenance staff at both San Luis and Sacramento NWRs are very well acquainted with tricolored blackbirds and know to report them ASAP should they show up in large numbers to breed. I think that it is likely that all NWRs in California are similar, although Kern, San Luis, and Sacramento may have the most history with efforts to detect and monitor the species.

Colonies of at least 80,000 breeding birds continued to occur through 2010 (Meese 2009a, Meese 2010). From 2008 to 2017, maximum colony size declined from 80,000 to fewer than 20,000 birds (Kelsey 2008, Kyle and Kelsey 2011, Meese 2017). In 2014, only a single colony consisted of more than 20,000 birds and only three colonies consisted of 10,000 birds or more (Meese 2014a). The proportion of birds observed in the 10 largest colonies during the years 2008, 2011, 2014, and 2017 was 77% (306,000), 81% (208,800), 64% (93,000), and 55% (98,050) of the statewide population estimate for those years, respectively. This reflects a downward trend in the sizes of the largest colonies, without a large increase in the number of occupied breeding locations (Figure 11). The trend in the largest colonies from 1994 to 2017 is similar to those in Figure 10 for effort-corrected statewide survey results: a long-term decline over the 23-year period with a partial recovery between 2000 and 2008.

Graves et al. (2013) performed an evaluation of trends in the average size of Tricolored Blackbird colonies over a more than 100-year period (1907–2009) using data compiled from a variety of sources. Average colony size, rather than total abundance, was used as the metric to evaluate trends to account for the effects of variable sampling effort across years. Graves et al. (2013) found a significant decline in the average colony size from 1935 to 1975, with the average colony size declining by more than 60%. This corresponds to the period over which DeHaven et al. (1975) concluded that the population size had declined by about 50%. Despite large amounts of data on colony sizes from the 1980s onward, no significant decline was detected in average colony size from 1980 to 2009. This finding is counter to reports of declines for portions of the 1980–2009 period (e.g., Beedy et al. 1991, Hamilton 2000, Meese 2014a, Meese 2015a). However, the statistical evaluation conducted by Graves et al. (2013) used data only through 2009, so it does not include much of the time period during which the recent population decline was observed (2008–2014). In addition, it is unlikely that ~~sampling~~ survey effort was sufficient in all years to detect most of the largest Tricolored Blackbird colonies, which may have influenced the estimates of average colony size.

The degree to which size of the largest or average colonies are correlated to total population size in any given year is unknown. However, during statewide survey years since 1994, the sizes of the largest colonies follow a pattern similar to that of the total numbers of birds observed. Given that in many years the majority of the ~~population~~ birds occurs in a small number of the largest colonies and the number of occupied colonies per year has not increased dramatically with increased survey effort (Table 1), it is likely that short-term declines in colony size often reflect real changes in the population size. Over longer periods, the correlation between colony size and population might be expected to break down due to shifts in breeding distribution and selection of novel nesting substrates. For example, when the population began using agricultural grain crops in the early 1990s and experienced an apparent shift in early breeding season distribution to the San Joaquin Valley, very large colonies were reported for the first time in many years. These changes in nesting substrate availability and distribution could have influenced the size of the largest colonies (and average colony size) by concentrating the population at a small number of breeding locations without necessarily reflecting a change in population size. In fact, Graves et al. (2013) reported that colonies in triticale and other grain crops were 40 times larger than colonies in other habitats during the last 20 years. This may explain in part why they did not find a reduction in average colony size from 1980 to 2009, a time when breeding surveys revealed declines in total number of birds observed.

Winter Population

The Christmas Bird Count (CBC) is a volunteer-based survey conducted each winter at designated 15-mile diameter circles across North America. CBC data consist of counts of all bird species encountered during a single day at each circle for which a count is conducted. There are more than 2,400 count circles across North America, some of which have been run since the early 1900s (Soykan et al. 2016). The number of count circles increased dramatically through the 1950s and 1960s, especially in the western region of the U.S. (Niven et al. 2004), and long-term trend assessments have often used a start date in the late 1960s to avoid any influence of increased survey coverage on apparent trends (Butcher et al. 2006). This is also the time period when the Breeding Bird Survey was initiated, which allows for comparisons between breeding and wintering populations (Niven et al. 2004). Counts are not necessarily conducted for every circle each year, and some circles are run more consistently than others. The number of volunteer observers and the duration of the count can vary from year to year, and yearly differences in effort can significantly influence the results of the counts. Therefore, the number of party-hours is often used as a measure of effort to standardize count results. Count circle locations are also not randomly selected, so data cannot be extrapolated to provide population estimates across the range of a species, but if corrected for effort can provide an index that can inform population change in areas covered by count circles.

Soykan et al. (2016) used a hierarchical model to evaluate population change from 1966 to 2013 for several hundred species sampled by the CBC, including Tricolored Blackbird. The analysis assessed change in each U.S. state and in each Bird Conservation Region (BCR; a map of BCRs is available at http://nabci-us.org/resources/bird-conservation-regions-map/), with the Coastal California BCR being the primary BCR in which Tricolored Blackbird occurs. Trends for Tricolored Blackbird were non-significant at both the California and the BCR scales. Hierarchical models are more efficient than linear regression approaches when assessing population change for a large number of species across multiple geographic scales, and can control for variation in survey effort among circles and across years. However, the use of large spatial scales for analysis may introduce variability in the quality of information that may not accounted for in the models. Although the Coastal California BCR captures the majority of the Tricolored Blackbird range in California, it is neither geologically nor biologically uniform. Also, the addition of count circles over time has not been evenly distributed across the BCR or the state. Due to the variability in habitat and species distribution at these broad scales, any apparent population trend, or lack thereof, can be an artifact of the years in which count circles were added or removed, or the years in which particular circles were surveyed across a heterogeneous landscape. A finer-scale approach that considers the impacts of this variability on a single species is warranted.

In California, count circles increased through the 1960s as has been documented in other areas, but the number of circles continued to increase through the early 1990s. The number of circles in California detecting Tricolored Blackbird doubled from 1974 (25 circles) to 1986 (50 circles) and the number of circles with Tricolored Blackbird detections did not stabilize until the 1990s. Since 1992 the number of circles with Tricolored Blackbird detections has been fairly stable and has fluctuated between 54 and 66. Because of the continued increase in the number of count circles through the 1990s, and the inconsistent running of counts at some circles over time, the sampling intensity has varied across the range of the Tricolored Blackbird in California. Based on the number of count circles surveyed in California over time, and by establishing criteria for consistency of effort, the Department assessed trends based on CBC data for two time periods: 1974–2015 and 1995–2015. These two periods capture a longer term extending back to the 1970s when the breeding-season surveys of DeHaven et al. (1975a) were conducted, and a shorter term covering the time since the first statewide surveys of the 1990s and when CBC data quality was highest and most consistent. The distribution of count circles that met a set of criteria and that were therefore included in the analyses provides fairly good coverage of the core of the winter distribution of the species (Figure 12; Appendix 3). Population trends were estimated from the slope of the regression of the log-transformed counts on year (see Butcher et al. 1990). Results of the CBC data analyses indicate declines in the Tricolored Blackbird population over both the longer term 1974–2015 period and the shorter term 1995–2015 period (Appendix 3).

Improvement in bird identification skills by volunteer observers has been apparent within the past 20 years, and poses a significant challenge in the interpretation of trends based on CBC data. This may be especially true for species with potential identification problems and for flocking species such as the Tricolored Blackbird (Butcher et al. 1990). As a result, counts that are adjusted by party-hour may be positively biased in recent years, which would tend to result in a positive bias in observed trends.

A number of historical winter observations of large numbers of Tricolored Blackbirds corroborate the observed decline in CBC data. Wintering flocks numbering 12,000–14,000 once assembled near dairies on the Point Reyes Peninsula, Marin County, which was one of the most reliable locations to observe large numbers of wintering Tricolored Blackbirds. In recent years, these flocks have been in the range of 2,000–3,000 birds (eBird Dataset 2016, Beedy et al. 2017).

Commented [B33]: It would probably be a good idea to state that there have been no known nor observed habitat changes here over several decades, so these could not account for the decline. My own efforts last winter showed far fewer than the numbers quoted here, as did the email I received from Jules Evens, who goes out every November and reported that the number dropped from ca. 15,000 a decade ago to several hundred the past few years.

Regional Shifts in Abundance

Because of the Tricolored Blackbird's nomadic tendency and the potential for large interannual shifts in breeding distribution, year-to-year changes in regional abundance are common. Tricolored Blackbird surveys have regularly revealed large annual changes in local abundance that would not be expected due to productivity or mortality rates alone (Hamilton 1998). During statewide surveys, large declines in one region are often coupled with large increases in other regions, and therefore caution is warranted when interpreting year-to-year changes in local abundance. That said, persistent long-term changes in distribution and regional abundance likely represent shifts in regional habitat suitability or population ~~abundance~~size.

Central Valley

Following incidental observations on the regional abundance of Tricolored Blackbirds in the 1800s and early 1900s, the Central Valley was described as the center of abundance for the species. The first systematic attempt to assess the species' rangewide distribution and population confirmed this, with most birds observed in the Sacramento Valley (Neff 1937). Additional observations and study of breeding colonies occurred through the 1960s before a second attempt at quantifying rangewide abundance in the early 1970s, with the majority of birds again found in the Sacramento Valley and northern San Joaquin Valley (DeHaven et al. 1975a).

Within the Central Valley, shifts in regional abundance over relatively short time periods have been a regular occurrence. Over a period of five years in the 1930s, Neff (1937) observed regular shifts in the annual centers of abundance between the rice-growing regions of the Sacramento Valley (Butte and Glenn counties) and regions to the south in Sacramento and Merced counties. DeHaven et al. (1975a) noted substantial yearly variation in centers of breeding abundance, even in their limited study area consisting of the Sacramento and northern San Joaquin valleys. For example, they observed 57,000 Tricolored Blackbirds nesting in Colusa County in 1969, but only 2,000 the following year. This pattern was mirrored in Yolo County where the number of breeding birds observed declined from 25,000 to 5,000. At the same time, other counties in the Sacramento Valley experienced increases in the number of breeding birds, with Glenn County increasing from 2,000 to 18,500 birds, and Yuba County increasing from 1,000 to 5,250 birds. A larger region comprising the major rice-growing region of the Sacramento Valley (Butte, Colusa, Glenn, Yolo, and Yuba counties) also varied considerably in the proportion of the known population it supported, with the proportion of known breeding birds in the region ranging from 29% to 59% during a four-year study period (DeHaven et al. 1975a). In the year when the smallest proportion of birds were located in this rice-growing region, the largest known congregation of birds occurred to the south in the pasturelands of southeastern Sacramento County. These regional shifts in abundance demonstrate the species' ability to undergo large interannual shifts in breeding distribution, likely in response to an unpredictable food supply or to the availability of attractive nesting substrates or to other habitat components.

In addition to short-term shifts in regional abundance, the Central Valley has experienced longer-term changes, with some regions of the valley experiencing long-term declines in number of breeding colonies or breeding birds. For example, Kings County supported tens of thousands of breeding birds per year through the 1990s, with 65,000 birds breeding in the county in 1992. In recent years, the county has hosted only a few hundred to a few thousand breeding birds. Glenn County, which once supported hundreds of thousands of birds per year and continued to support at least 10,000 birds into the 1990s, has not hosted more than 1,400 birds in any year since 2000 (statewide survey results). San Joaquin County regularly supported up to about 10,000 birds per year through the 1990s, but has hosted only a few small colonies since then, with the largest recent colony of 1,800 birds in 2015. As described above, the Tricolored Blackbird appears to have experienced a population increase from the 1990s through the 2000s in the San Joaquin Valley as a whole, with a corresponding decrease in the Sacramento Valley. Following this increase, the population in the San Joaquin Valley experienced a severe decline of 78% from 2008 to 2014 (Meese 2015a). This is a time period during which the species declined by 63% rangewide, and the majority of this decrease was due to declines in the San Joaquin Valley. The total number of birds lost from the San Joaquin Valley portion of the range during this period (~267,000 birds) exceeded the rangewide decline (250,000 birds), with a small portion of the loss compensated by increases in the breeding population elsewhere (Figure 13) (Meese 2015a). The number of birds breeding in the San Joaquin Valley rebounded somewhat by 2017, but declines in this region remain the primary contributor to range-wide population declines since 2008.

Southern California and Baja California

As described above under Distribution, the Tricolored Blackbird was once abundant on the coastal slope of the southern California portion of the range, from Santa Barbara County to San Diego and into Baja California. Although the early reports of species abundance were not quantitative, they serve as a comparison to numbers of birds in the region in recent decades. Neff (1937) provided the first quantitative estimates for southern California, although San Diego and Santa Barbara counties were the only counties his collaborators spent a significant amount of time surveying; thousands of birds were documented in both of these counties. DeHaven et al. (1975a) reported colonies of up to 10,000 birds in southern California (Riverside County), with thousands of birds documented in all counties south of the Transverse Ranges, except Orange County.

The first statewide survey to include all counties in southern California was conducted in 1997 (Beedy and Hamilton 1997). That year, more than 40,000 Tricolored Blackbirds bred in the southern California portion of the range, with more than 90% occurring in western Riverside County (Feenstra 2009, Cook 2010). Since this time, the largest proportion of the southern California breeding population has continued to occur in western Riverside County (Cook 2010). The 2005 statewide survey located about 12,500 breeding birds south of the Transverse Ranges. A thorough search of historical breeding locations in southern California in 2008, 2009, and 2011 revealed a population south of the Transverse Ranges of consistently less than 5,000 breeding birds (Figure 14) (Kelsey 2008, Feenstra 2009, Kyle and Kelsey 2011). By 2009 the coastal slope portion of the region had declined to only 750 Tricolored Blackbirds breeding at a single site in San Diego County (Feenstra 2009). The 2014 survey located a slightly larger population consisting of about 6,400 breeding birds (Meese 2014a). In 2017, the number of birds observed increased again to about 8,800, although the large majority of these (>90%) were again located in one small region of western Riverside County. San Diego was the only other county with breeding birds in 2017, with seven small colonies totaling fewer than 700 birds. Most breeding colonies of the Tricolored Blackbird in Southern California have tended to be small in recent years, averaging a few hundred birds (Feenstra 2009).

In the last decade the breeding population in the Mojave Desert portion of the range in San Bernardino and northern Los Angeles counties appears to have grown somewhat, from just over 1,000 breeding birds located during surveys in 2008–2011, to more than 5,000 breeding birds in 2014 (Meese 2014a). It is unclear whether the Mojave Desert birds are more closely associated with the southern California population or to the birds in the Central Valley, although observations of three banded birds since 2009 and observations of a flying flock in the 1800s have documented birds moving between the desert and the Central Valley. Ongoing genomic studies will address the population structure and patterns of movement throughout California.

Originally considered common in northwestern Baja California, numbers appear to have declined by the late 1900s. Recent surveys have shown that the northwestern Baja California population has declined to only several hundred individuals (Erickson et al. 2007, Erickson and de la Cueva 2008, Feenstra 2013, Erickson et al. 2016, Meese 2017).

Summary—The Tricolored Blackbird, once described as the most abundant bird species in southern California, had declined dramatically by the time statewide surveys were established in the 1990s. Tens of thousands of breeding birds continued to occupy the region during the first complete survey of 1997. The most recent intensive searches of the southern California portion of the range located only thousands of breeding birds at a small number of locations. Following the first comprehensive survey of southern California counties in 1997, the Tricolored Blackbird population declined by nearly 90%, to lows of fewer than 5,000 birds from 2008 to 2011. The southern California population rebounded somewhat by 2014, but most of the increase can be attributed to birds in the Mojave Desert. This decline coincides with the disappearance of the species from much of the southern California portion of the range and is mirrored by declines in abundance and distribution in the Baja California portion of the species' range. If recent trends continue, the species may decline to extirpation in the southern portion of its range in the near future.

Northern and Central Coasts

Small numbers of birds bred annually during the late nesting season (July–September; thought to represent second breeding attempts by birds that previously nested elsewhere) in western Marin County until 2003 (Stallcup 2004). There has been no documented breeding in Marin County since then.

EXISTING MANAGEMENT

Land Ownership within the California Range

There is a paucity of public lands in the Central Valley, with the region that regularly supports more than 90% of the breeding population composed primarily of privately-owned lands (Figure 15). The total area in the range of the Tricolored Blackbird in California is more than 34 million acres. Privately-owned lands compose 84% of this area, with state and federal lands totaling about 12%. Much of the area under federal ownership is composed of forested areas that are not suitable for the species. The USFWS National Wildlife Refuges and Department Wildlife Areas comprise about 250,000 and 254,000 acres, respectively (1.5% of the range, combined).

Of the 1,045 historical breeding locations with known coordinates in the Tricolored Blackbird Portal database (as of January 2017), 191 (18%) have been located on public lands. A minority of breeding colonies continue to occur on public lands each year. For example, during the 2011 statewide survey, colonies were found on a county park, a Department Ecological Reserve in San Diego County and an Ecological Reserve in Kern County, and on three National Wildlife Refuges in the Central Valley (Kyle and Kelsey 2011). These colonies totaled 66,325 breeding birds (about 25% of the estimated statewide population in that year), the large majority of which were from a single colony on a USFWS National Wildlife Refuge.

Habitat Conservation Plans

Habitat Conservation Plans (HCPs) are long-term landscape level plans that provide the basis for regulatory compliance with the ESA by nonfederal entities. HCPs provide a mechanism to authorize incidental take of federally threatened and endangered species under section 10(a) of the ESA, while also describing how impacts to covered species will be minimized or mitigated in the plan area. An HCP must minimize and mitigate the impacts of take to the maximum extent practicable.

There are five approved HCPs in California that include the Tricolored Blackbird as a covered species and two additional HCPs that are in the planning stage (Figure 16; Table 4):

Approved HCPs:

- Natomas Basin
- San Joaquin County Multi-species Conservation Plan
- PG&E San Joaquin Valley Operations & Maintenance
- Kern Water Bank
- Orange County Southern Subregion

Planning Stage:

- South Sacramento
- Solano Multi-Species

Table 4. Current and Planned HCPs/NCCPs in California that include Tricolored Blackbird as a covered species.

Plan title	Counties	Plan acreage	Date permit issued	Term
Natomas Basin HCP	Sacramento, Sutter	53,342	June 2003	50 years
San Joaquin County Multi-species Conservation Plan HCP	San Joaquin	896,000	May 2001	50 years
PG&E San Joaquin Valley Operations & Maintenance HCP	Portions of nine counties: San Joaquin, Stanislaus, Merced, Fresno, Kings, Kern, Mariposa, Madera, Tulare	276,350	December 2007	30 years
Kern Water Bank HCP	Kern	19,900	October 1997	75 years
Orange County Southern Subregion HCP	Orange	132,000	January 2007	75 years
South Sacramento HCP	Sacramento	317,656	Planning stage	TBD
Solano Multi-species HCP	Solano, Yolo (edge)	580,000	Planning stage	TBD
East Contra Costa County (NCCP)	Contra Costa	175,435	July 2007	30 years
Santa Clara Valley Habitat Plan (NCCP)	Santa Clara	460,205	July 2013	50 years
Western Riverside County Multiple Species Habitat Conservation Plan (NCCP)	Riverside	1,300,000	June 2004	75 years
San Diego County Multiple Species Conservation Program (NCCP)	San Diego	511,878	August 1998	50 years
San Diego Gas & Electric Subregional (NCCP)	San Diego, Orange, Riverside	Linear projects[1]	December 1995	55 years
San Diego County Water Authority (NCCP)	San Diego, Riverside	Linear projects[1]	December 2011	55 years
Butte Regional Conservation Plan (NCCP)	Butte	564,270	Planning stage	TBD
Yuba-Sutter Regional Conservation Plan (NCCP)	Yuba, Sutter	468,552	Planning stage	TBD
Placer County Conservation Plan Phase I (NCCP)	Placer	201,000	Planning stage	TBD
Yolo Habitat Conservancy (NCCP)	Yolo	653,663	Planning stage	TBD
San Diego East County Multiple Species Conservation Plan (NCCP)	San Diego	1,600,000	Planning stage	TBD
San Diego North County Multiple Species Conservation Plan (NCCP)	San Diego	311,800	Planning stage	TBD

[1] These NCCPs cover discrete linear or energy projects but have larger plan areas that overlap with other NCCPs.
Primary Sources:
USFWS endangered species page for Tricolored Blackbird under conservation plans:
https://ecos.fws.gov/ecp0/profile/speciesProfile?spcode=B06P#conservationPlans
Summary of Natural Community Conservation Plans (NCCPs) September 2016
https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=15329&inline

The goals, objectives, and conservation measures for Tricolored Blackbird included in approved HCPs are summarized below.

Natomas Basin HCP

The Natomas Basin Habitat Conservation Plan (NBHCP) covers 53,342 acres in the northwestern part of Sacramento County and southern Sutter County. The City of Sacramento and County of Sutter are participants. The 50-year term expires June 2053.

Tricolored Blackbirds nest and forage in the Natomas Basin. At the time of the planning effort, one active nesting colony was known from the eastern edge of the Natomas Basin (Betts Kismat-Silva Reserve) and nine documented occurrences were noted for Sutter County. Based on habitat preferences of Tricolored Blackbirds, the Natomas Basin supported about 1,998 acres of potential nesting habitat and 41,310 acres of potential foraging habitat (NBHCP 2003).

A total of 449 acres of potential nesting habitat will be converted to urban development as a result of implementing the proposed action. A loss of 15,311 acres of potential foraging habitat (non-rice crops = 6,517 acres, grassland = 560 acres, pasture = 147 acres, and rice = 8,087 acres) will result from the planned development (USFWS June 24, 2003).

Under the plan, 2,137.5 acres of managed marsh habitat will be preserved in a reserve system. Wetland reserves are intended to benefit wetland-associated Covered Species such as Tricolored Blackbirds. The managed marsh reserves will provide potential nesting habitat for Tricolored Blackbirds in close proximity to foraging habitat, which is expected to increase suitable nesting opportunities for this species. Additionally, 4,375 acres of rice and 2,187.5 acres of upland habitats will be added to the reserve system. Generally, acquisition of upland habitat is prioritized first for the conservation of Swainson's Hawk (*Buteo swainsoni*) then secondarily for other upland-associated Covered Species including Tricolored Blackbird (USFWS June 24, 2003).

Take minimization measures include pre-construction surveys for Tricolored Blackbirds, avoidance of actively nesting colonies/minimization of disturbance during the nesting season, establishment of a physical protective barrier 500 feet from the active nesting sites, and a "reasonable" buffer for foraging lands on reserve lands. The NBHCP includes measures to avoid, minimize, and mitigate take of the giant garter snake (*Thamnophis gigas*) with timing restrictions, pre-construction site dewatering, and vegetation control management. Because the Tricolored Blackbird shares some habitat similarities with the snake, these measures may also benefit the blackbird (NBHCP 2003).

Monitoring Covered Species is provided for in the plan. The USFWS commented on monitoring the Tricolored Blackbirds nesting colony in the final EIR/EIS (USFWS April 2003): "…the success of this population will be monitored annually and the reserve acquisition program of the NBHCP could be modified if it is determined that foraging habitat is a limiting factor for the colony. This colony is located well outside of the City's Permit Area, and this colony may forage upon unincorporated lands within Sacramento County. If, through the annual monitoring, it is determined that additional foraging habitat is required, the NBHCP would allow for modification of both acquisition programs and habitat

management/restoration to provide enhanced foraging. The long-term success of the NBHCP will rely not on establishing a rigid Operating Conservation Program based on limited information, but rather will result from a flexible program that responds to new information collected through monitoring as well as evolving scientific data as applicable to the Covered Species."

San Joaquin County Multi-Species Conservation Plan HCP

The San Joaquin County Multi-Species Conservation Plan HCP (SJMSCP) spans 896,000 acres in San Joaquin County. Participating entities include the Cities of Escalon, Lathrop, Lodi, Manteca, Ripon, Stockton, and Tracy and the County of San Joaquin. The 50-year term expires May 2051.

The SJMSCP identified 9,374 acres of "occupied" habitat for the Tricolored Blackbird in the plan area and an additional 47,193 acres of potential habitat including foraging and wintering areas. It is expected that 1,614 acres of Tricolored Blackbird habitat will be converted under full build-out.

The SJMSCP conservation strategy relies on minimizing, avoiding, and mitigating impacts for Covered Species including the Tricolored Blackbird. Mitigating impacts to Covered Species will largely be accomplished through the creation, enhancement and management of Preserves. Tricolored Blackbirds are associated with five planned Preserves: Primary Zone of the Delta (Large and Small Water's Edge Preserve), Vernal Pool Zone (Vernal Pool Grassland Preserve), Central Zone (Row and Field Crop/Riparian Preserve), Central Zone (Wetlands Preserve), Central/Southwest Transition Zone (Use Central Zone Row and Field Crop/Riparian Preserve). Tricolored Blackbirds are considered indicators of Preserve health and will be monitored at the species-level, accordingly.

Incidental take minimization measures include a setback of 500 feet from nesting areas during the nesting season for the period encompassing nest building and continuing until fledglings leave nests. This setback applies whenever construction or other ground-disturbing activities must begin during the nesting season in the presence of nests that are known to be occupied. Setbacks shall be marked by brightly-colored temporary fencing.

Pacific Gas & Electric San Joaquin Valley Operations & Maintenance HCP

The PG&E San Joaquin Valley Operations & Maintenance HCP (PG&E HCP) plan area includes 276,350 acres in portions of nine counties in the San Joaquin Valley, as follows: San Joaquin, Stanislaus, Merced, Fresno, Kings, Kern, Mariposa, Madera, and Tulare. The 30-year term expires in 2037.

The following discussion is derived from USFWS 2007:

> Tricolored Blackbirds occupied approximately 1,443 acres of existing PG&E right-of-way in the plan area (52 occurrences in CNDDB as of 2007).
>
> As part of the planning process, PG&E will establish a map book for the Tricolored Blackbird by, prior to initiation of any covered activities, determining where PG&E facility lines occur within 100 meters of CNDDB-documented occurrences of breeding colonies. Active nesting birds will be avoided. If an active breeding colony could be disrupted by the covered activity, an exclusion

zone of at least 350 feet around the colony will be established. This exclusion zone will be established in the field based on site conditions, the covered activity, and professional judgment by a qualified PG&E biologist, and will be greater than the minimum distance. Work will not occur in this exclusion zone during April 1–July 31.

The PG&E HCP estimated that covered activities would directly disturb approximately 4 acres of suitable nesting or foraging habitat each year (120 acres of temporary disturbance over 30 years), with most of this disturbance occurring in foraging habitat. Less than 0.1 acre per year of blackbird nesting habitat is expected to be permanently lost each year (less than 3 acres of nesting habitat permanently lost over 30 years). Other covered activities that may disturb Tricolored Blackbirds (e.g., off-road travel and tree trimming that do not disturb ground surfaces) will affect 34 acres of suitable Tricolored Blackbird habitat each year (1,020 acres over the 30-year permit term). These impacts are expected to be individually small, widely dispersed and, therefore, likely to be insignificant and discountable.

Permanent loss of suitable foraging or nesting habitat will be compensated at a 3:1 ratio and temporary disturbance to suitable habitat will be compensated at a 0.5:1 ratio. The HCP estimates PG&E will provide 0.37 acres of Tricolored Blackbird compensation in the North San Joaquin Valley, 0.91 acres of compensation in the Central San Joaquin Valley, and 0.57 acres of compensation in the South San Joaquin Valley annually. Overall, PG&E will provide approximately 2.3 acres of Tricolored Blackbird compensation annually (approximately 69 acres over 30 years).

Kern Water Bank HCP

The Kern Water Bank HCP covers 19,900 acres of central Kern County. The 75-year term expires in 2072. Planning documents list no known Tricolored Blackbird colonies from the Kern Water Bank area; however, it was acknowledged that the species might move into the HCP area in the future. Impacts were described as "negligible; high mobility of the species allows easy escape from project-related impacts" (Kern Water Bank Authority 1997). A monitoring effort conducted in 2011 documented five small colonies numbering ~400 individuals in nettles under mesquite within the plan area. A large colony numbering several thousand individuals settled in an historic site along the Kern River channel but the colony was abandoned; they may have joined a successful colony in Basin 6 on city property of approximately 10,000 individuals that successfully fledged young. The author did not identify whether the earlier failed effort or the successful colony was located within the plan area (Hardt 2011).

Orange County Southern Subregion HCP

The Orange County Southern Subregion HCP comprises 132,000 acres in the study area, including the Cleveland National Forest (40,000 acres). Excluding certain urbanized areas and the National Forest property, the planning area totals 86,000 acres within southern Orange County. The County of Orange and Rancho Mission Viejo are signatory to the implementing agreement. The 75-year term expires in 2082.

Six general Tricolored Blackbird breeding locations have been documented in the planning area historically and include: Middle Chiquita Canyon, Coto de Caza, Radio Tower Road, Verdugo Canyon in San Juan Creek, lower Gabino Canyon, and Trampas Canyon settling ponds. Not all sites have been used consistently or recently. A total of 18,759 acres of potential foraging habitat was identified in the planning area. One of the known historic breeding sites, Trampas Canyon, will be directly impacted by the proposed covered activities and an estimated 3,769 acres of foraging habitat will be developed or otherwise made unsuitable for Tricolored Blackbirds (USFWS 2007).

The plan conserves four of the breeding colony sites within a planned habitat reserve: Middle Chiquita Canyon, Verdugo Canyon, Radio Tower Road, and Lower Gabino Canyon. Adequate foraging habitat within a four-mile radius of these sites also would be conserved. Planners assumed that "at least 1,000 acres of foraging habitat within four miles of a nest site would be more than adequate to sustain the relatively small nesting colonies that occur in the study area" (Dudek and Associates 2006). Adequate foraging habitat will also be conserved at the Cota de Caza site. A total of 8,015 acres of foraging habitat for Tricolored Blackbirds in the planning area, including the four historic nest site locations, will be cooperatively managed within the habitat reserve. Additional open space habitats exist within County Parks (1,694 acres) which will be managed with overall conservation goals of the HCP (USFWS 2007).

Management actions to benefit Tricolored Blackbirds will focus on nonnative predators, grazing, minimizing pesticide use near colonies, and managing human disturbance near colonies (Dudek and Associates 2006).

South Sacramento HCP

The South Sacramento HCP is currently in the planning stage. The proposed study area encompasses 317,656 acres in Sacramento County. Anticipated partners include the County of Sacramento and the Cities of Rancho Cordova and Galt.

Solano Multi-Species HCP

Solano Multi-Species HCP is currently in the planning stage. The proposed study area includes 577,000 acres in Solano County and an additional 8,000 acres in Yolo County. Participants in this effort include the Cities of Dixon, Fairfield, Rio Vista, Suisun City, Vacaville, and Vallejo.

Natural Community Conservation Plans

Like HCPs, Natural Community Conservation Plans (NCCPs) are long-term landscape-level conservation plans. Under California state law, the Natural Community Conservation Planning Act (Fish & G. Code, §§ 2800-2835) provides a mechanism to obtain authorization for incidental take of CESA-listed and other species. An NCCP provides for the protection of habitat, natural communities, and species diversity on a landscape or ecosystem level, while allowing compatible and appropriate economic activity. An NCCP is broader in its objectives than the take authorization provided under the California and Federal ESAs, and may require conservation measures that go beyond mitigation of impacts to meet the recovery needs of

covered species. All approved NCCPs are also HCPs and so provide authorization for take of federally-listed species through section 10 of the ESA.

There are six approved NCCPs in California that include the Tricolored Blackbird as a covered species and six additional NCCPs that are in the planning stage (Figure 16; Table 4):

Approved NCCPs:

- East Contra Costa County
- Santa Clara Valley Habitat Plan
- Western Riverside County Multiple Species Habitat Conservation Plan
- San Diego County Multiple Species Conservation Program
- San Diego Gas & Electric Subregional
- San Diego County Water Authority

Planning Stage:

- Butte Regional Conservation Plan
- Yuba-Sutter Regional Conservation Plan
- Placer County Conservation Plan Phase I
- Yolo Natural Heritage Program
- San Diego East County Multiple Species Conservation Plan
- San Diego North County Multiple Species Conservation Plan

The goals, objectives, and conservation measures for Tricolored Blackbird included in approved NCCPs are summarized below.

East Contra Costa County NCCP

The East Contra Costa County NCCP (ECCC) spans 174,018 acres in eastern Contra Costa County. The following local governments are signatory to the implementing agreement: cities of Brentwood, Clayton, Oakley, and Pittsburg, and the County of Contra Costa. The city of Antioch is not part of the agreement. The 30-year term will expire August 2037.

The ECCC is located within the Bay Delta and Central Coast Province (CDFW 2015). Six natural communities are found in the study area: streams/riparian woodland, wetland, grassland, oak woodland, chaparral/scrub, and agricultural lands.

During the project planning phase, Tricolored Blackbirds were described as sporadic in the plan area; two breeding colonies were noted on the northern border of Los Vaqueros Watershed and several additional small colonies were detected during fieldwork for the county bird atlas project (ECCC 2006). The Contra Costa County Bird Atlas project found the Tricolored Blackbird to be a “fairly common permanent but highly local resident of freshwater marshes and weedy fields, particularly in East County but also locally elsewhere. Most breeding birds were present in the vicinity of… Byron” (Glover 2009). The largest colony detected numbered several hundred pairs. The Atlas confirmed breeding in six blocks,

found five additional blocks with possible nesting and an additional possible nesting colony just south of the county border (Glover 2009).

ECCC development guidelines require avoidance of occupied Tricolored Blackbird nests during the breeding season. Under the agreement, impacts of up to 204 acres of core habitat and 9,621 acres of primary foraging habitat may be permitted as a result of covered activities. A planned preserve system will protect 126–164 acres of suitable core habitat and 16,747–20,138 acres of primary foraging habitat under the initial urban development area or maximum urban development area, respectively. The preserve system will also protect at least seven of 13 ponds, all of which may provide potential breeding habitat. Additional pond and wetland creation (an estimated 85 acres of perennial wetland plus an estimated 16 acres of pond habitat) will be created or restored. Managed habitat is predicted to be of higher quality than what had existed prior to the agreement. Conservation easements will be acquired on 250–400 acres of cropland or pasture; landowners will be required to enhance habitat for Tricolored Blackbird and other covered species (CDFG 2007).

Annual progress reports prepared under the ECCC documented two recent land acquisitions with value for Tricolored Blackbirds. Vaquero Farms North, a 575-acre property adjacent to the Los Vaqueros Reservoir Watershed lands was purchased in 2010. It is situated entirely west of Vasco Road, with primary access from Vasco Road (ECCHC 2011). Vaquero Farms Central, a 320-acre property bounded by two existing Preserve System properties, Vaquero Farms North and Vaquero Farms South, was purchased in 2012 (ECCHC 2013). No progress towards pond creation was reported in the latest available annual report of activities (ECCHC 2016).

Santa Clara Valley Habitat Plan NCCP

The Santa Clara Valley Habitat Plan NCCP (SCVHP) includes the cities of Gilroy, Morgan Hill, and San Jose (excluding Alviso and the Baylands) and the County of Santa Clara. The study area encompasses 519,506 acres; the permits areas, however, differ from the study area. Two permits were issued under the plan, one solely for Burrowing Owl (48,464 acres) and another for all other covered species. The "all other covered species" permit, including Tricolored Blackbird, totals 460,205 acres and excludes Henry Coe State Park and a portion of Pacheco State Park. The term of the permit is for 50 years and will expire July 2063.

The SCVHP is found within the Bay Delta and Central Coast Province (CDFW 2015). Natural communities within the planning area include grassland (including serpentine grasslands), chaparral and scrub, coastal scrub, conifer woodland, oak savannah, oak woodland, riparian woodland scrub, mixed evergreen forest, wetlands, aquatic, rock outcrop, irrigated, and agriculture.

Tricolored Blackbirds appear to be relatively uncommon in Santa Clara County. Breeding colonies are few and fairly small. During the Santa Clara County Breeding Bird Atlas project, Tricolored Blackbirds were found in 29 blocks with breeding confirmed in 19 blocks. Hundreds to several thousand individuals were documented. Confirmed breeding occurred in Santa Clara Valley, Diablo Range, Calaveras Reservoir, San Felipe Lake, Coyote Reservoir, small pond on Coyote Ranch numbering fewer than 100

individuals, Horse Valley stock pond, in the upper Smith Creek watershed (Bousman 2007). These data and CNDDB records were assessed under the SCVHP.

Conservation goals for Tricolored Blackbirds include protection for at least four sites that support, historically supported, or could support nesting colonies. Each protected site will have at least 2 acres of breeding (marsh) habitat and will have at least 200 acres of foraging habitat within 2 miles. These breeding sites will either be enhanced or restored breeding habitat in historically/currently occupied areas within the Reserve System or newly-created ponds suitable for breeding Tricolored Blackbirds (ICF 2012).

Take of, or impacts to, existing or historic breeding colonies is prohibited. Impacts to this species are limited to loss of habitat. Mitigation measures consist of pre-construction surveys, impact avoidance or minimization, and land acquisition. Acquisitions will focus on the following:

- Four historical breeding sites with adequate nearby foraging habitat referenced above;
- At least 22,840 acres of modeled Tricolored Blackbird habitat;
- Enhancement of acquired habitat specifically for Tricolored Blackbirds; and
- Creation of new ponds and wetlands that may provide breeding and foraging habitat for the species (CDFW 2013).

Western Riverside County Multiple Species Habitat Conservation Plan NCCP

The Western Riverside County Multiple Species Habitat Conservation Plan NCCP (WRC-MSHCP) covers approximately 1,300,000 acres in western Riverside County and is located wholly within the South Coast Province (CDFW 2015). All unincorporated county land west of the crest of the San Jacinto mountains to the Orange County line, as well as the cities of Temecula, Murrieta, Lake Elsinore, Canyon Lake, Norco, Corona, Riverside, Moreno Valley, Banning, Beaumont, Calimesa, Perris, Hemet, and San Jacinto are included in the plan area. The 75-year term will expire 2079.

Tricolored Blackbirds were described as “widely scattered” throughout the lowlands and foothills of Riverside County. Few current or historic breeding locations were documented within the planning area (Dudek and Associates 2003). Tricolored Blackbird potential habitat was assessed; a total of 480 acres of primary habitat and 259,695 acres of secondary habitat was identified as occurring within the planning area. Of these totals, a loss of 60 acres of primary habitat and 193,180 acres of secondary habitat was projected. Secondary habitat losses included approximately 102,000 acres of agricultural land and 88,000 acres of grassland (Dudek and Associates 2003). Mitigation identified in the plan includes the following actions:

- Include within the Conservation Area, 420 acres of suitable primary habitat (freshwater marsh, cismontane alkali marsh).
- Include within the Conservation Area the five identified Core Areas for Tricolored Blackbirds. The Core Areas include San Jacinto River floodplain (7,320 acres), Mystic Lake/San Jacinto Wildlife Area (17,470 acres), Collier Marsh and Lake Elsinore grasslands (1,810 acres), Alberhill (3,460 acres), and Vail Lake/Wilson Valley/eastern Temecula Creek (50,000 acres).

- Include within the Conservation Area, 66,510 acres of secondary habitat (playa and vernal pool, grasslands, agriculture land, and riparian scrub, woodland, and forest).
- Maintain (once every 5 years) the continued use of and successful reproduction within at least one of the identified Core Areas. Successful reproduction is defined as a nest that fledges at least one known young.
- Maintain, preserve, and if feasible, restore hydrological processes within the five Core Areas.
- Include within the Conservation Area a 100-meter buffer around any known nesting locations.

Although not considered a Tricolored Blackbird Core Area, a total of 9,670 acres within the Prado Basin/Santa Ana River area will be conserved within Criteria Area and Public/Quasi-Public designations. This area may support Tricolored Blackbirds in the future (Dudek & Associates 2003).

The most recent biological monitoring report for Tricolored Blackbirds (2013 breeding season) described the following results:

> Six breeding colonies were detected during targeted searches for Tricolored Blackbirds. These included the Potrero Unit of the San Jacinto Wildlife Area (~350 birds), San Timoteo Canyon (10 birds), Lake Riverside (~200 birds), Highway 371 in Tule Valley (45 birds), and Garner Valley (~150 birds). All counts sum to a total estimated population size of 2,755 birds. Mean and median colony sizes were 459 and 175, respectively. Biologists were unable to confirm reproductive success for the Garner Valley, Highway 371, or San Timoteo Canyon colonies. Tricolored Blackbirds successfully reproduced in Potrero and Tule Valley in 2013. Only one colony, Potrero, was located inside the existing Conservation Area; however, no colony was located within a designated Tricolored Blackbird Core Area. The largest colony (~2,000 birds) occupied a 40-acre field on private land in the San Jacinto Valley. It suffered complete reproductive failure when the field was cut; adults were incubating eggs at the time (WRCRCA 2015).

Biological monitors made management and monitoring recommendations to improve conservation conditions for the Tricolored Blackbird in the Plan area. According to recent biological monitoring reports (WRC-MSHCP 2013), three of the five Core Areas identified for Tricolored Blackbird conservation purposes (Alberhill, Collier Marsh/Lake Elsinore grasslands, and San Jacinto River floodplain) do not provide suitable or sufficient breeding habitat for the species. Other sites were recommended as additional Core Areas based on recent Tricolored Blackbird recent activity. Further, recommendations to change the Tricolored Blackbird species account in the Plan so that it "be modified to recognize loss of foraging habitat in the vicinity of breeding sites as a significant threat to the survival of the species, and that the stated management objectives be reconsidered as well. In particular, the prescription for managing '… this species in order to maintain (once every five years) the continued use of, and successful reproduction within at least one of the identified Core Areas' (Dudek & Associates 2003) is likely insufficient for a rapidly declining species that is dependent on patchy and unpredictable breeding habitats which are being rapidly lost throughout the Plan Area" (WRC-MSHCP 2011, 2013, WRCRCA

2015). Finally, the monitoring regime was deemed inadequate to provide conservation awareness for the Tricolored Blackbird. Monitoring should be conducted with surveys for breeding colonies every year rather than every five years and the survey period be extended to allow multiple visits to active sites before, during, and after nesting (WRC-MSHCP 2011).

San Diego County Multiple Species Conservation Program

The San Diego County Multiple Species Conservation Program NCCP (SDCMSCP) covers approximately 511,878 acres in San Diego County and is located wholly within the South Coast Province (CDFW 2015). SDCMSCP participants include the County of San Diego, Cities of Chula Vista, San Diego, La Mesa, and Poway; implementing agreements are in progress for Coronado, Del Mar, Santee, and El Cajon. Subarea plans have been or will be prepared for each participating entity. Imperial Beach, National City, and Lemon Grove are not developing subarea plans but reserve the right to do so at a later date. The 50-year term expires 2048.

A detailed status assessment of the Tricolored Blackbird within the planning area was not provided in the planning documents. The Plan did identify a rationale for including Tricolored Blackbirds as a covered species: "…77% of potential habitat [4,800 acres], including 59% of mapped localities, will be conserved. Breeding colonies move from season to season, and with a goal of no net loss of wetlands, most of the suitable breeding sites will continue to be available. This species forages in grasslands and agricultural fields near its breeding habitat. Foraging habitat near the known nesting colonies will be conserved at 70–100%. Additionally, foraging opportunities will continue to be provided and created in turfed areas such as golf courses and cemeteries. Jurisdictions will require surveys during the CEQA review process in suitable breeding habitat proposed to be impacted. Participating jurisdictions' guidelines and ordinances and state and federal wetland regulations will provide additional habitat protection resulting in no net loss of wetlands" (Ogden Environmental 1998).

Under the plan, 23% of breeding habitat (1,400 acres) has the potential for development or impacts.

Additionally, the following conditions were specified for Tricolored Blackbirds: "Project approvals must require avoidance of active nesting areas during the breeding season. Area-specific management directives must include measures to avoid impacts to breeding colonies and specific measures to protect against detrimental edge effects to this species. Area-specific management directives for preserve areas will include specific guidelines for managing and monitoring covered species and their habitats including best management practices. Edge effects may include (but not be limited to) trampling, dumping, vehicular traffic, competition with invasive species, parasitism by cowbirds, predation by domestic animals, noise, collecting, recreational activities, & other human intrusions" (Ogden Environmental 1998).

Annual reports are available online for the South County Subarea of the SDCMSCP (http://www.sandiegocounty.gov/content/sdc/parks/openspace/MSCP.html). These reports typically document habitat losses and gains associated with development projects and do not mention Tricolored Blackbirds specifically.

San Diego Gas & Electric Company Subregional NCCP

The San Diego Gas & Electric Company (SDG&E) Subregional NCCP covers discrete linear or energy projects but has a larger plan area that overlaps with other NCCPs. The plan area traverses 2,000,000 acres of SDG&E service territory in San Diego, Orange, and Riverside counties and is located wholly within the South Coast Province (CDFW 2015). Its 55-year term will expire December 2050. Although the term of the agreement is 55 years, SDG&E may, at its election, terminate the agreement after the 25th year and every 10 years thereafter.

In total, the SDG&E plan will result in a combined permanent loss of no greater than 400 acres with 50 miles of electric transmission and/or new gas transmission lines. This acreage figure includes an estimated permanent loss of 124 acres of habitat. The most common and most affected habitat types will likely be coastal sage scrub, chaparral, oak woodland, and grasslands (SDG&E 1995).

Impacts to Tricolored Blackbirds were considered to be generally very small and minimized or mitigated (in that order) when potential impacts occur to the species' habitats (SDG&E 1995). Tricolored Blackbird habitat was categorized under Mitigation Category III: beach, marsh, and wetland species. Mitigation measures taken for this category include:

- Construction in marsh areas, soft sand, or open water in most cases will be accomplished through the use of helicopters for the delivery of materials, poles, personnel, and platforms; and
- Roads should be avoided to the extent feasible.

In general, the following conditions apply: wildlife will not be killed unless to protect life and limb of staff, personnel training will be provided, and pre-activity surveys will be conducted (SDG&E 1995).

Planning documents available online did not include site-specific information on Tricolored Blackbird colony locations or foraging sites.

San Diego County Water Authority NCCP

The San Diego County Water Authority NCCP covers discrete linear projects but has a larger plan area that overlaps with other NCCPs. The plan area traverses 992,000 acres in western San Diego and southwestern Riverside counties and is located wholly within the South Coast Province (CDFW 2015). Nearly all Covered Activities will occur within the probable impact zone: 1,000 feet on either side of the pipelines or facilities, or approximately 64,600 acres along the existing pipeline rights-of-way, and other connected water conveyance, storage, and treatment facilities. The 55-year term of the agreement will expire December 2066.

One Tricolored Blackbird colony was documented near the Sweetwater Reservoir during the planning process; no colonies were noted within the planned impact zone (CNDDB in SDCWA and RECON 2010).

A total of 1,830 acres of wetland/riparian habitat exists within the probable impact zone; of this total, approximately 16 acres of potential Tricolored Blackbird breeding habitat could be impacted by

permitted activities. Twenty-one acres of potentially suitable breeding habitat in the existing preserve area may be used to mitigate impacts to Tricolored Blackbird. Suitable foraging habitat is conserved in the 1,186 acre San Miguel Habitat Management Area within the San Diego National Wildlife Refuge (Merkel and Associates 1997 in SDCWA and RECON 2010); however, no nesting has been documented there.

No direct take of breeding Tricolored Blackbirds or their nests is allowable; avoidance and/or minimization measures will be undertaken to conserve breeding colonies. Biological mitigation is habitat-based at approved ratios, which are based on the resource value of the impacted habitat. Mitigation for unavoidable impacts may include acquisition of additional preserve area lands, acquisition of credits in other conservation/wetland banks, or development of a biologically superior conservation alternative for the species at appropriate locations in the planning area.

Butte Regional Conservation Plan NCCP

The Butte Regional Conservation Plan NCCP is currently in the planning stage. The proposed study area encompasses 564,270 acres in Butte County. A planning agreement was completed in December 2007 and was signed by Butte County and the cities of Biggs, Chico, Gridley, and Oroville. An independent science advisors report was completed in 2007. Formal public review of draft planning documents closed June 8, 2016; however, public comments are still being accepted.

Yuba-Sutter Regional Conservation Plan NCCP

The Yuba-Sutter Regional Conservation Plan NCCP is currently in the planning stage. The proposed study area encompasses 468,552 acres in Yuba and Sutter counties. A planning agreement was completed in September 2012 and was signed by the counties of Butte and Yuba, the cities of Yuba City, Live Oak, and Wheatland. An independent science advisors report was completed in February 2006. Draft plan documents are in preparation.

Placer County Conservation Plan Phase I NCCP

The Placer County Conservation Plan Phase I NCCP is currently in the planning stage. The proposed study area (phase one of an anticipated three phases) encompasses 201,000 acres in western Placer County. A planning agreement was prepared October 2001 and was signed by the county of Placer. An independent science advisors report was completed January 2004. Draft plan documents are in preparation.

Yolo Habitat Conservation Plan/NCCP

Yolo Habitat Conservation Plan/NCCP (formerly Yolo Natural Heritage Program) is currently in the planning stage. The proposed study area encompasses 653,663 acres in Yolo County. A planning agreement was prepared February 2005 and signed by the Yolo Habitat Conservation Plan/Natural Communities Conservation Plan Joint Powers Agency. An independent science advisors report was completed March 2006. Draft plan documents are in preparation.

San Diego East County Multiple Species Conservation Plan NCCP

The San Diego East County Multiple Species Conservation Plan NCCP is currently in the planning stage. The proposed study area encompasses 1,600,000 acres in eastern San Diego County. The following communities are expected participants: Central Mountain, Cuyamaca, Descanso, Pine Valley, Desert/Borrego Springs, Julian, Mountain Empire, Boulevard, Jacumba, Lake Morena/Campo, Potrero, Tecate, Dulzura (in part), and Palomar/North Mountain. A planning agreement for San Diego East County and San Diego North County was prepared in 2008, amended May 2014, and signed by San Diego County. However, separate NCCPs will be prepared. An independent science advisors report, Part 1, was completed March 2006. Draft plan documents are in preparation.

San Diego North County Multiple Species Conservation Plan NCCP

The San Diego North County Multiple Species Conservation Plan NCCP is currently in the planning stage. The proposed study area encompasses 311,800 acres in northern San Diego County. The following communities are expected participants: Bonsall, De Luz, Fallbrook, Harmony Grove, Lilac, Pala, Pauma Valley, Rainbow, Rincon Springs, Twin Oaks Valley, Valley Center, and Ramona (in part). Excluded from the study area are Carlsbad, Encinitas, Escondido, Oceanside, San Marcos, Solana Beach, and Vista. A planning agreement for San Diego North County and San Diego East County was prepared in 2008, amended May 2014, and signed by San Diego County. However, separate NCCPs will be prepared. Independent science advisors reports were prepared in 2001 and 2002. Draft plan documents underwent public review in 2009 and are now under revision.

Conservation Plan for the Tricolored Blackbird

Following the 1991 petition to list the Tricolored Blackbird under CESA, a multi-stakeholder working group was formed to plan for and implement conservation actions. This resulted in the first of many statewide surveys, the first silage buyout to protect a breeding colony, and ongoing research. However, the working group made limited progress in developing comprehensive conservation measures for the Tricolored Blackbird and eventually dissolved in the mid-1990s. In 1997, a status update and management guidelines for the Tricolored Blackbird was completed (Beedy and Hamilton 1997). The species was again petitioned to be listed under CESA in 2004. After this petition was rejected by the Fish and Game Commission, a new multi-stakeholder Tricolored Blackbird Working Group was formed in 2005 and the group released a conservation plan in 2007 detailing the conservation and management, research and monitoring, data management, and education and outreach goals for the species (TBWG 2007). Working group members, including the Department, signed a Memorandum of Understanding agreeing to implement the actions in the conservation plan. Most of the goals and objectives in the plan are still relevant today and portions of the plan are currently being updated by the Tricolored Blackbird Working Group. Progress toward meeting objectives by the Department, USFWS, and partners on the working group has focused on protecting large breeding colonies that are threatened by harvest of agricultural grain fields and increasing knowledge through monitoring and research. New information is being used to update goals and objectives in the conservation plan.

Protection of Agriculture Colonies from Losses to Harvest

As described above, a large portion of the Tricolored Blackbird population has been nesting on agricultural grain fields since the 1990s, mostly adjacent to dairies. Although dairies often provide nesting substrate (weeds in the grain grown to feed cattle), a water source (e.g., drainage ditches or wastewater ponds), and food for adult birds (stored grains), colonies located adjacent to dairies have often suffered from low productivity. In many cases, the entire reproductive effort of these so-called silage colonies has been lost when the nesting substrate is harvested while the young or eggs are still in the nest (Meese 2013). The timing of grain harvest typically coincides with the Tricolored Blackbird breeding season, resulting in the destruction of nests, eggs, and nestlings, and occasionally mortality of adult Tricolored Blackbirds. The Tricolored Blackbird colonies that form on agricultural grain fields early in the breeding season are often the largest colonies formed each year, and the complete destruction of these colonies due to harvest can be especially damaging to annual blackbird productivity (Arthur 2015).

The protection of large colonies that occur on agricultural grain fields has been the primary conservation action implemented for Tricolored Blackbird since the species was discovered breeding in this substrate type in the early 1990s. Shortly after the discovery of grain colonies in the San Joaquin Valley, the USFWS intervened to encourage harvest delays and protect the largest known breeding colony (Hamilton 1993). In 1994, a crop was bought to protect a 28,000-bird colony (Kelsey 2008). Hamilton et al. (1995) calculated that interventions in 1992, 1993, and 1994 may have been responsible "for the presence of over 75,000 adult Tricolored Blackbirds in 1995 [which had been nestlings in the three previous years], about 25% of the known population." In 1999, the Department and USFWS protected a colony that was composed of one-third of the known population at the time, which otherwise would have been destroyed by routine harvesting activities (Hamilton et al. 1999). In 2004, silage purchases by the Department and USFWS protected three colonies totaling over 100,000 adult Tricolored Blackbirds. In 2006, the two largest known colonies, totaling more than 200,000 breeding birds, were protected through silage buyouts (Meese 2006). Meese (2009b) estimated that payments to landowners for harvest delays resulted in the protection of 364,000 nests and about 396,000 Tricolored Blackbird fledglings in the five years from 2005 to 2009. Despite these efforts to protect birds breeding on agricultural fields, losses to harvest have continued to occur in most years (Figure 17).

The Natural Resources Conservation Service (NRCS) established a fund in 2012 that was used for three breeding seasons to protect colonies on agricultural lands and to enhance habitat for the Tricolored Blackbird. Landowner participation in the program varied from year to year, with many thousands of nests protected each year while some colonies continued to be lost to harvest.

Regional Conservation Partnership Program

In 2015, the NRCS awarded a Regional Conservation Partnership Program (RCPP) grant to a group of conservation and dairy organizations (Arthur 2015). The grant provided five years of funding to protect, restore, and enhance Tricolored Blackbird habitat on agricultural lands, with the primary objective being to prevent loss of breeding colonies to harvest. During the first year of implementation in the 2016 breeding season, the program succeeded in enrolling all landowners with Tricolored Blackbird colonies

identified on their property, and 100% of known agricultural colonies representing more than 60,000 breeding birds were protected through delay of harvest. In 2017, a single large colony (estimated at up to 12,500 breeding birds) was lost to harvest at a location that was not enrolled in the NRCS program.

Despite efforts by landowners and the state and federal government to protect colonies, losses to harvest have continued. The protection of all known colonies on agricultural fields in the 2016 breeding season is encouraging progress, although ongoing success will require a stable funding source to compensate landowners that delay harvest. See the section on Harvest of Breeding Colonies below for a discussion of this ongoing threat to the species.

Commented [B34]: It seems to me that funding is required for far more than the compensation element, for example, who will find the birds on the ephemeral substrates? Who will report them, and to whom? In the absence of adequate funding, the entire effort to conserve "silage colonies" disappears, and even the documentation of losses will cease, so no one will even know what is happening on the ground.

Habitat Restoration and Enhancement

USFWS National Wildlife Refuges

The USFWS owns and manages several National Wildlife Refuges (NWR) in the breeding range of the Tricolored Blackbird. In northeastern California, the Lower Klamath and Tule Lake NWRs have supported breeding colonies at several locations, although colony size has been relatively small as is typical for this portion of the range. The Sacramento National Wildlife Refuge Complex in the Sacramento Valley, the San Luis National Wildlife Refuge Complex in the northern San Joaquin Valley, and Kern and Pixley NWRs in the southern San Joaquin Valley have all supported breeding Tricolored Blackbird colonies.

The Sacramento National Wildlife Refuge Complex has actively managed selected wetlands to maintain suitable Tricolored Blackbird habitat for some time, and they have been frequently successful in attracting large breeding colonies to Delevan NWR. Recent restoration at Colusa NWR has resulted in a return of breeding birds after many years of absence. Portions of the Merced NWR have been managed to provide breeding substrate for Tricolored Blackbirds in recent years, and the refuge has been successful in attracting multiple colonies of several thousand breeding birds. The Kern NWR has supported suitable habitat, and for many years hosted breeding colonies. Despite continued efforts to provide flooded spring wetlands, in recent years use of the refuge by breeding colonies has been limited, although a colony of 3,000 birds nested on the refuge in 2017. The Pixley NWR has not supported breeding colonies in recent years, but the USFWS is implementing management to attract breeding birds.

NRCS Easements and Incentive Programs

Through a combination of easements on privately owned lands and 3-year incentive programs, the NRCS has enrolled about 500 acres of land (as of January 2017) in programs that will provide habitat suitable for Tricolored Blackbird nesting. These programs focus on providing dense cattail habitat using water management practices compatible with Tricolored Blackbird nesting habitat. The majority of current NRCS habitat projects are in the Grasslands District of Merced County, with a smaller acreage in the southern San Joaquin Valley in Kern and Tulare Counties. Existing habitat projects have proven successful, with Tricolored Blackbirds breeding on three NRCS easement properties in 2016 (report to the Tricolored Blackbird Working Group, January 31, 2017; unreferenced).

California Department of Fish and Wildlife Lands

On many of the Department wildlife areas and ecological reserves located in the breeding range of the Tricolored Blackbird, management practices include spring or permanent wetland habitats that can support suitable nesting substrate for breeding colonies. In some cases, these wetlands have been managed specifically for Tricolored Blackbirds by setting back wetland succession through burning or mechanical methods, and in other cases the wetlands are typically managed for a broader suite of species. Use of Department wildlife areas and ecological reserves by breeding colonies includes (Tricolored Blackbird Portal 2017):

> <u>Northeastern California</u> – The Honey Lake Wildlife Area has supported breeding colonies at two wetland locations. The number of breeding birds has been small, with the most recent observation of 200 breeding birds in 1996.

> <u>Sacramento Valley</u> – Four wildlife areas in the Sacramento Valley have supported breeding colonies. Three of these wildlife areas are in Butte County (Oroville, Gray Lodge, and Upper Butte Basin), each of which has~~ve~~ supported colonies at a single location, with the most recent observations including 1,600 birds on a wetland at Gray Lodge Wildlife Area in 2011 and 2,000 birds in willows at Oroville Wildlife Area in 2015. Oroville Wildlife Area also regularly supports foraging birds in the post-breeding season (B. Stone, pers. comm.). The Yolo Bypass Wildlife Area in Yolo County has hosted small breeding colonies at three separate locations in wetlands and button willow shrubs.

> <u>San Joaquin Valley</u> – Four wildlife areas in the San Joaquin Valley have supported breeding colonies. Three of these are in Merced County, with North Grasslands Wildlife Area supporting three colony locations in milk thistle and mustard, Los Banos Wildlife Area supporting five colony locations in wetlands, and O'Neill Forebay Wildlife Area supporting four colony locations in Himalayan blackberry. The most recent use includes a 9,000 bird colony on a wetland at Los Banos Wildlife Area in 2008 and a 3,500 bird colony in Himalayan blackberry at O'Neill Forebay Wildlife Area in 2005. The fourth wildlife area in the San Joaquin Valley, Mendota Wildlife Area, is located in Fresno County. This wildlife area has supported breeding colonies at three separate wetland locations, with the last reported breeding by 1,000 birds in 1995.

> <u>Southern California</u> – The Rancho Jamul Ecological Reserve in San Diego County has hosted a small breeding colony on a wetland in most years since 2007. This colony is usually fewer than 200 breeding birds. In Riverside County, the San Jacinto Wildlife Area has supported breeding colonies at 12 different locations. Most of the colonies have occurred in wetland habitats, with a few locations in other vegetation types including stinging nettle, thistles, and mallow. This wildlife area is located in perhaps the most important region for breeding Tricolored Blackbirds south of the Transverse Ranges. The wildlife area regularly hosts several thousand breeding birds, with a single location supporting 10,000 birds in 2005. During the 2017 statewide survey, 6,300 birds were observed at a single location on the wildlife area.

The Department has also worked with private landowners to create nesting habitat using a variety of incentive programs. The goals of the programs have included management of water to create spring

wetland habitat with emergent cattail vegetation. Several of these projects were successful in attracting Tricolored Blackbird colonies, with colonies of up to several thousand birds breeding on private wetlands created through these programs from at least 2005 through 2011. Funding has been limited in recent years, resulting in declining participation and a reduction in available wetland habitat on private lands.

California Environmental Quality Act

The California Environmental Quality Act (CEQA; Public Resources Code Section 21000 et seq.) requires state and local agencies to publicly disclose, analyze, and potentially mitigate environmental impacts from projects over which they have discretionary approval power. In particular, CEQA requires that actions that may substantially reduce the habitat, decrease the number, or restrict the range of any species that can be considered rare, threatened, or endangered must be identified, disclosed, considered, and mitigated or justified (Cal. Code Regs., tit. 14, §§ 15065(a)(1), 15380).

The environmental review process required by CEQA can be costly and time consuming, and compliance is not always thorough. Agencies may also make the determination that projects are exempt (i.e., they do not need to go through the impact analysis, public disclosure, and mitigation process). Mitigation is required if a project is not CEQA-exempt and impacts would be potentially "significant." Mitigation must reduce impacts to below a level of significance or minimize unavoidable significant impacts, where feasible. The CEQA process generally incentivizes agencies and project applicants to implement mitigation, thereby avoiding significant impacts.

Due to its SSC designation, impacts to Tricolored Blackbirds are generally considered potentially significant if agencies determine on a project-specific basis that the species meets the CEQA criteria for rare, threatened, or endangered. However, agencies are not required to make this determination for Tricolored Blackbirds and other species that are not listed under CESA or ESA.

FACTORS AFFECTING ABILITY TO SURVIVE AND REPRODUCE

Small Population Size and Colonial Breeding

A key question is whether the colonially breeding Tricolored Blackbird can maintain a viable population at some reduced population abundance that supports only small colonies or concentrates the majority of the population into very few colonies. That is, what is the minimum number of individuals that can continue to support a well-distributed breeding population with colonies that are productive and resilient to the dynamic breeding and foraging landscape within their range? Another North American colonially breeding bird, the Passenger Pigeon (*Ectopistes migratorius*), declined to extinction as a result of multiple population pressures, and the species seemed to have an inability to survive and reproduce at low population numbers (Bucher 1992). In addition to the well-known effect of market hunting in the decline of the Passenger Pigeon, habitat alteration and a lack of social facilitation in food finding due to reduced population size have been implicated in the extinction of the species (Bucher 1992). The Tricolored Blackbird is similar to the Passenger Pigeon in that they are both highly social, colonial breeders with nomadic tendencies that likely evolved for locating highly localized and abundant food sources and other breeding habitat requirements. The Tricolored Blackbird has experienced, or continues to experience, many of the population pressures that led to extinction of the Passenger Pigeon; however, unlike the passenger pigeon, the Tricolored Blackbird has ~~adapted~~ responded to the wide-scale loss of wetland nesting substrate habitat by using a variety of upland vegetation types.

As described in the section on Biology and Ecology, Tricolored Blackbirds may benefit from social and colonial behaviors by reducing mortality due to predation during the nesting cycle and by facilitating food finding and information sharing. Smaller groups of birds would likely retain the ability to locate and use secure nesting substrates, but small colonies might lose the potential benefits of predator satiation and of social food finding and information sharing. The location~~g~~ and exploitation of abundant food sources could affect small groups of birds both in the selection of productive breeding locations and in acquiring sufficient prey with which to provision young after a site is selected.

Some bird species are known to nest in colonies when conditions are suitable, but can also nest in smaller groups or as single pairs. For example, the White-winged Dove (*Zenaida asiatica*) once nested in extremely large colonies in Mexico. In 1978, 22 breeding colonies contained a collective population size of more than eight million birds (Sanchez Johnson et al. 2009). Individual birds were shown to have very high site fidelity to breeding areas, sometimes returning to nest in the same tree across years (Schwertner et al. 1999). Habitat changes driven by urbanization and intensification of agricultural practices and urbanization caused the loss and fragmentation of nesting habitat and now the White-winged Dove nests singly or in smaller colonies at more dispersed locations in Mexico, and appears to have adapted to use urban areas (Schwertner et al. 1999, Sanchez Johnson et al. 2009).

Although the Tricolored Blackbird has been observed to nest in very small colonies (as few as 4 nests), the species has not been observed to nest as single pairs. Very small colonies (<100 birds) are quite rare, and although nesting success varies greatly across colonies of all sizes, there is some evidence that very small colonies are not as successful as larger colonies (Payne 1969, Weintraub et al. 2016), and that larger colonies produce more young per female (Hamilton 1993, Meese 2013). Reductions in population size may make the Tricolored Blackbird more vulnerable to additional declines due to inherent natural history factors, but the degree to which a small population would limit the species' ability to survive and reproduce is not known.

The fact that half or more of the total population will often occur in a small number of large colonies in silage fields during the first nesting attempt makes the species vulnerable~~ility~~ to losses of productivity (Meese 2012, Beedy et al. 2017). In 2011, 65% of the total known population was located at only six colony sites in Merced, Kern, and Tulare counties (Kyle and Kelsey 2011). This concentration of large portions of the population makes the species vulnerable to a number of potential threats, especially colony destruction through harvest, predation, or extreme weather events (Weintraub et al. 2016). The enhanced risk to the species due to colonial breeding may be realized primarily through exacerbation of other threats that can effect a large portion of the total population.

Habitat Loss

Loss of Nesting Habitat

The conversion of wetland nesting habitat to agricultural and urban uses has been implicated in the long-term decline of the species. Neff (1937) observed, "[t]he destruction of [Tricolored Blackbird] nesting habitats by man is of most importance," and cited reclamation and drainage as key factors in the loss of many favorable sites, along with "dredging or cleaning of reservoirs, marshes, and canals in order to destroy the growths of cattails and tules." Only about 15% of the four million acres of wetlands that existed in the Central Valley in the 1850s remained when Neff conducted his work in the 1930s, and about 40% of those remaining wetlands were lost between 1939 and the 1980s (Frayer et al. 1989). Of the freshwater emergent wetlands most likely to be used by breeding Tricolored Blackbirds in the Central Valley, 50% were lost between 1939 and the 1980s, with an average loss of 5,200 acres per year (Frayer et al. 1989). These losses were primarily due to conversion of wetlands to agriculture.

DeHaven et al. (1975a) found no nesting substrate at several locations in Los Angeles, Kern, Sacramento, and Yolo counties where earlier researchers had studied the species. Subsequent investigators have continued to document habitat loss at known breeding colony locations through the present. For example, Beedy et al. (1991) found that 9.3% (n = 17) of all colony locations used in the 1980s were extirpated through permanent removal of nesting habitat. Hamilton et al. (1999) observed the removal of a wetland that had supported a productive breeding colony in 1998. DeHaven (2000) noted the loss of several breeding colonies in Sacramento County to urban development and the expansion of vineyards. Humple and Churchwell (2002) reported on the draining of a wetland and the removal of Himalayan blackberry that had previously supported breeding colonies. Hamilton (2004a) documented the loss or destruction of cattail nesting substrates that had supported 90,000 breeding birds between 1994 and 2004. During the 2017 statewide survey, local experts and survey participants were asked to score the suitability of nesting substrate for all sites visited. Of the 636 sites for which scores were reported before or during the survey, 70 sites were scored as permanently unsuitable, usually due to development or conversion to permanent crops like orchards or vineyards (Table 5). An additional 80 sites had no nesting substrate present during the survey and 101 sites had vegetation present, but were considered unsuitable by the survey participant.

Table 5. Nesting substrate suitability for 636 sites scored before and during the 2017 statewide survey.

Score	Number of sites	Notes on suitability scores
Suitable	385	Nesting substrate present and considered suitable for nesting.
Unsuitable	101	Nesting substrate present but appears to be unsuitable for nesting (e.g., it is immature, too short, lacks sufficient foliage, too sparse, or has recently been burned).
Substrate absent	80	Nesting substrate absent because it has been removed or died (e.g., former grain field planted to alfalfa, milk thistle stand or Himalayan blackberry that has been mowed, wetland that has dried up).
Permanently unsuitable	70	Nesting substrate is absent and cannot be replaced (e.g., has been converted to urban development, orchard, or vineyard).

Following a low point in the extent of wetlands in the 1980s, aggressive restoration actions resulted in an increase of 65,000 acres of managed wetlands between 1990 and 2005 (CVJV 2006). The majority of the wetlands in the Central Valley are managed lands that are maintained by application of water, and many areas undergo occasional land recontouring or vegetation control to maintain desired conditions. As of 2006, there were about 205,000 acres of managed wetlands in the Central Valley (CVJV 2006). Most managed wetlands (~90%) are flooded primarily in the fall and winter for wintering waterfowl (i.e., seasonal wetlands), and a small proportion are managed as semi-permanent or permanent wetlands that hold water during the spring and summer (Iglecia and Kelsey 2012). Semi-permanent wetlands are often managed to support brood habitat for waterfowl; the small proportion of semi-permanent and permanent wetlands are those that can potentially be suitable as nesting substrate for breeding Tricolored Blackbirds.

Replacement of wetland breeding habitat with novel, nonnative upland nesting substrates may have lessened the impact of the decline in Central Valley wetlands to the Tricolored Blackbird population. However, these nonnative vegetation types are often considered undesirable and are frequently removed. Himalayan blackberry habitat with a history of use by breeding colonies has been removed by burning, treatment with herbicide, or mechanical removal (Airola et al. 2015a, 2015b). Milk thistle colonies have been destroyed when landowners have removed or sprayed the invasive weed while Tricolored Blackbirds are actively nesting (Airola et al. 2016). Blackberry control is generally localized and occurs on multi-year intervals, and therefore may not have a large overall effect on the population, although there are cases where removal of nesting substrate has resulted in permanently unsuitable conditions. In the central Sierra Nevada foothills where Tricolored Blackbird colonies frequently nest in Himalayan blackberry, 32% of colonies active in 2014 occurred in areas zoned for development or that were proposed for rezoning for development (Airola et al. 2015a). In 2017, a group of Himalayan blackberry sites that had supported 13,000 breeding Tricolored Blackbirds were removed or degraded by aggregate mining activities (Oct 2017 email from D. Airola to N. Clipperton; unreferenced). The Department is unaware of any available information to evaluate distribution or trends of these nonnative nesting substrates across the range of the Tricolored Blackbird in California.

Commented [B35]: I'm not sure that this is the correct term in this context, the wetlands weren't replaced, the birds lost their native nesting substrate and had 2 choices, don't breed or breed using novel nesting substrates, they chose the latter. But it's not replacement of one with the other.

Commented [B36]: The same can be said for mustard, as was seen in Merced County on the Cunningham ranch after the birds used 2 stands of them in 2016 for 2 colonies and then both stands were sprayed and destroyed prior to the 2017 breeding season. The active removal of weeds utilized by breeding birds is a widespread phenomenon. The birds that nest at Fahey South (2016 & 2017) are almost certainly the same birds that nested at Hulen Levee, which was a huge and very old stand of H. blackberries that was destroyed after I had a very cordial conversation with a local landowner/dairyman (in 2014?). And the grains + weeds along Henry Miller were converted to almonds after 2015. This is a common phenomenon, especially so in Merced County.

Although the loss of wetlands in California's Central Valley is well documented and there are many examples of nesting substrate being removed or degraded at historical Tricolored Blackbird colony locations, there also appears to be suitable nesting substrate in some areas that goes unused in many years. However, there are other regions where large areas of apparently suitable foraging habitat have no available nesting substrate, or where nesting substrate is only available during years when rainfall patterns support vigorous growth of upland nesting substrates (Airola et al. 2016). Most managed wetlands in the Central Valley are not suitable as nesting substrate for the Tricolored Blackbird, but wetlands remain the substrate type most frequently used by breeding colonies and upland nesting substrates provide additional habitat. The dynamic occupancy patterns at breeding locations from year to year and the need for abundant insect prey in surrounding foraging habitat makes it difficult to reach conclusions about nesting substrate suitability based on occupancy in a single year. It is likely that loss of nesting substrate has caused local declines and shifts in distribution, but the overall effect on the population is difficult to assess, especially without considering other breeding requirements. Losses of

nesting substrate at historically large or productive colony locations, or in areas surrounded by high quality foraging habitat, would have the largest impact on the population.

Loss of Foraging Habitat

The extent of foraging habitat required for successful breeding is much greater than the extent of nesting substrate. The abundance of insect prey in foraging habitat has been linked to reproductive success, and Tricolored Blackbirds may choose breeding locations in part based on the local prey populations. Because insect populations are variable and unpredictable from year to year, the Tricolored Blackbird population likely requires much more foraging habitat on the landscape than is used in any given year, and once lost, large landscapes with suitable habitat are difficult to replace. For these reasons, loss of foraging habitat is likely as important, or more so, than the documented losses of nesting substrate on the long-term viability of the Tricolored Blackbird population.

The loss of foraging habitat has been suggested as a likely cause of decline in southern California (Hamilton et al. 1995, Cook 2010). The extirpation of colonies from most of the coastal lowlands in southern California, despite the presence of more numerous marsh habitats relative to inland areas, suggests that foraging habitat sufficient to support breeding colonies is the population's limiting factor (Unitt 2004).

Hamilton et al. (1992) reported on the pervasive loss of foraging habitat near breeding colony sites due to expansion of cultivated agriculture and the conversion of existing agriculture to incompatible crops in the Central Valley, and considered this the primary threat to population abundance. DeHaven (2000) observed widespread habitat loss due to urban expansion and agricultural conversions to vineyards and orchards relative to the 1970s when he and others conducted Tricolored Blackbird research across the state, and suggested that habitat loss was a primary driver of continued population declines. Conversion of pastures and crops suitable for foraging by Tricolored Blackbirds was observed in Placer, Sacramento, Stanislaus, and Tulare counties. DeHaven (2000) noted especially extensive losses in Sacramento County, where urban development and expansion of vineyards had removed thousands of acres of high-quality habitat. More than 5,000 acres of habitat had been converted to vineyards in just a two-year period from 1996 to 1998, resulting in the loss of known breeding colony locations.

Grasslands have been identified as one of the most vulnerable habitats across North America, and many grassland species have experienced steep population declines in recent decades (NABCI 2016). A great deal of effort has been expended on conserving the grasslands in the central part of North America from the Great Plains to northern Mexico (Knopf and Skagen 2012). The grasslands of California have not received the same level of conservation attention, although losses of grasslands in California have been extensive.

Soulard and Wilson (2015) used Landsat satellite data to analyze land-use and land-cover change in the Central Valley from 2000 to 2010, and compared this to changes in the valley since 1973. The largest land-cover trend from 2000 to 2010 occurred in grassland/shrubland habitats. During this 10-year period, an estimated 79,200 acres of grasslands and shrublands were lost, representing a 5% decrease in the Central Valley over 10 years. Over the longer period from 1973 to 2010, grasslands and shrublands

declined by 22% (a loss of 476,900 acres), due mainly to conversions to more intensive agriculture and urban development. Although many of the grassland losses were due to agricultural intensification, losses of agriculture to urban development resulted in relatively little net change in area of agriculture in the Central Valley from 1973 to 2010.

Cameron et al. (2014) analyzed time series land cover data from the California Farmlands Mapping and Monitoring Program collected between 1984 and 2008 to evaluate rangeland habitat (grassland, shrubland, and woodland) conversion in California. The area evaluated covers much of the breeding range of the Tricolored Blackbird except for southern California. About 483,000 acres of rangelands were converted during this 20+ year period, with urban and rural development and conversion to more intensive agricultural uses accounting for most (~90%) of the rangeland loss. Agricultural intensification was primarily due to increases in vineyards and orchards, but smaller amounts of other agricultural crops that may provide foraging habitat for Tricolored Blackbird were also responsible for grassland loss. The San Joaquin Valley region, which in recent decades has been the center of abundance for breeding Tricolored Blackbirds during the early nesting season, experienced the largest amount of rangeland conversion (Figure 18).

Land cover types suitable for Tricolored Blackbird foraging in the Central Valley continue to be converted to incompatible land cover types such as orchards, vineyards, and urban development as agricultural practices evolve and cities continue to expand in the Central Valley. Due to the continued expansion of nut trees and vineyards that replace grasslands, shrublands, or agricultural crops that provide insects required for breeding (e.g., alfalfa), regions that were previously occupied by thousands of birds have now become permanently unsuitable for breeding (Meese 2016). For example, the acreage of pistachio orchards in the Central Valley has grown exponentially in recent years and the acreage of almonds continues to increase (Figures 19 and 20). The five leading pistachio producing counties in California have also supported a large proportion of the Tricolored Blackbird breeding population in recent years (Kern, Tulare, Kings, Fresno, and Madera counties), with Kern County alone supporting 42% of pistachio production in 2012 (Geisseler and Horwath 2016). In the central Sierran foothills, many colony sites and the surrounding foraging landscape are zoned for development, and several development projects that may affect Tricolored Blackbird habitat have moved forward in recent years (Airola et al. 2015a, 2016). Statewide, the proportion of grasslands within 3 miles of known breeding colony locations declined from 2008 to 2014 (NAS 2017).

The California Rangeland Trust has conserved more than 300,000 acres of rangeland in 24 California counties through conservation easements (https://www.rangelandtrust.org/ranch/). Although data are not available on the extent and distribution of conserved lands within the range of the Tricolored Blackbird, some of the conserved ranches are in counties that receive regular use by breeding Tricolored Blackbirds, including Kern, Merced, Madera, and Placer counties. Data on the proximity of conserved rangelands to Tricolored Blackbird breeding colonies is not available, but these easements may provide protection of important foraging habitat for birds that breed in the foothills and grasslands on the periphery of the Central Valley.

Large losses of rangeland and suitable crop foraging habitat have occurred over the last several decades, and conversion of these suitable foraging habitats continue throughout much of the Tricolored Blackbird's range. Although large acreages of rangeland habitat have been conserved through conservation easements, these have not necessarily focused on areas of highest value to Tricolored Blackbird and are small relative to the extent of grassland in the state and the observed rate of loss over the past several decades. Future development in California is projected to be concentrated in several core areas of the Tricolored Blackbird range, including the Central Valley, the foothills of the Sierra Nevada, and on both sides of the Transverse Ranges in southern California (Jongsomjit et al. 2013; Figure 21), which would further reduce or degrade the available foraging landscape for breeding colonies. Loss of suitable rangeland foraging habitat is projected to continue into the future (see Drought, Water Availability, and Climate Change section). The proportion of grasslands in the landscape surrounding potential breeding sites has been shown to be the most important land cover type in predicting the occurrence of breeding Tricolored Blackbirds, and the proportion of alfalfa is the most important determinant of colony size (NAS 2017). Combined with regular loss of nesting substrate, the ongoing loss of foraging habitat makes it less likely that these essential breeding habitat requirements will co-occur on the landscape, with the result being a reduced number of locations suitable for successful breeding by Tricolored Blackbird colonies.

Commented [B37]: This could just as easily be a spurious correlation, rather than a determinant. There is no alfalfa near huge colonies in the Sacramento Valley (Yolo and Colusa counties, primarily), and yet some of the largest colonies year after year are found here. The presence of alfalfa is due to the presence of dairies in the San Joaquin Valley and has near zero predictive ability in the Sacramento Valley.

Overexploitation

Market Hunting and Depredation Killing

Neff (1937, 1942) reported hundreds of thousands of blackbirds sold on the Sacramento market, many of which were Tricolored Blackbirds. Market hunting of blackbirds in the Central Valley became a thriving business in about 1928 or 1929 and continued through the mid-1930s. Tricolored Blackbirds banded for research activities throughout the 1930s were often recovered by market hunters with which Neff collaborated (1942).

McCabe (1932) described the deliberate strychnine poisoning of 30,000 breeding Tricolored Blackbirds as part of an agricultural experiment. In the early 1930s active poisoning and shooting programs were enacted to control populations of blackbirds (McCabe 1932, Neff 1937). Tricolored Blackbirds and other blackbird species were killed by poisoned baits used as a means of blackbird control in rice fields in the Sacramento Valley, and numerous blackbirds were shot by farmers or by hired bird herders in attempts to drive the flocks away from rice and other crops (Neff 1942). During the period from 1935 to 1940 blackbird depredations in rice fields were of lesser intensity, and control operations by means of poisoned baits were almost entirely discontinued (Neff 1942).

Because the Tricolored Blackbird forages in mixed-species flocks with the European Starling and other species of blackbirds in the nonbreeding season, and because these flocks forage at feedlots and on ripening rice, the Tricolored Blackbird may be exposed to avicides intended to control nuisance and depredating flocks of blackbirds.

Commented [B38]: This may be an enormous factor in Monterey County, where much of the state's lettuce, strawberries, and artichokes are grown and where avicides are used to control bird populations. This is a huge hole in our understanding of threats to the population, but we do know that the number of tricolored blackbirds along the entire Central Coast is approaching zero, and we have some reason to suspect avicides as heavily contributing to the decline here.

A depredation order under the federal Migratory Bird Treaty Act allows for the control of several species of blackbirds and corvids in agricultural situations without a permit from the USFWS (when birds are

causing serious injuries to agricultural or horticultural crops or to livestock feed; 50 CFR 21.43). In 1988, the USFWS modified the long-standing depredation order to remove the Tricolored Blackbird and prohibit killing the species without a federal permit (Beedy et al. 1991). Although Tricolored Blackbird is no longer covered by the depredation order, it is possible that misidentification of Tricolored Blackbirds when they occur in mixed flocks in the fall and winter leads to unintentional mortality of the species. Landowners are required to report on activities and on the number of birds captured or killed under the depredation order, including non-target species such as the Tricolored Blackbird (50 CFR 21.43, Nov 5, 2014). Based on reports provided to the USFWS, annual reporting appears to be inconsistent and the number of birds killed under the depredation order may be underreported. The number of Tricolored Blackbirds killed annually is unknown and therefore the killing of blackbirds to protect ripening rice in the Sacramento Valley is a known but unquantified source of Tricolored Blackbird mortality.

There has been limited documentation of the shooting of Tricolored Blackbirds in the Sacramento Valley. Two birds that had previously been banded were reported to have been shot by a rice farmer in Butte County (Meese 2009a). These birds were reported because they were banded and it seems likely that additional, unbanded birds were also shot.

Historical killing of blackbirds to protect crops and for the food market may have contributed to a long-term decline of the species, but the intentional killing of Tricolored Blackbirds has declined since the 1930s. The effect of mortality due to shooting or poisoning on annual Tricolored Blackbird survival rates is currently unknown.

Harvest of Breeding Colonies

The Tricolored Blackbird colonies that form on agricultural grain fields early in the breeding season are often the largest colonies formed each year, and the complete destruction of these colonies due to harvest can be especially damaging to annual blackbird productivity (Arthur 2015). Normal harvesting activities typically coincide with the breeding season and the harvest of fields that contain nesting colonies results in nest destruction and the loss of eggs or nestlings. The cutting of grain has also killed adult Tricolored Blackbirds but most adults appear to survive harvest operations.

Shortly after the discovery of grain colonies in the San Joaquin Valley, Hamilton et al. (1992) observed the loss of a 15,000-bird colony to harvest. As early as 1993, the USFWS intervened to encourage harvest delays and protect the largest known breeding colony (Hamilton 1993). Since then, colony protection through crop purchase or delayed harvest has been the primary conservation action implemented for the species (see Existing Management section), with mixed success. Despite annual attempts to locate and protect large colonies since the early 1990s, losses to harvest have occurred in most years (Figure 17), with 2010 and 2016 the only known exceptions. Two large colonies representing more than 60,000 breeding birds were lost due to harvest in 1994 (Hamilton et al. 1995). The two largest breeding colonies in 1995 were destroyed during harvest of the grain nesting substrate (Beedy and Hamilton 1997). At least one colony of 14,000 birds was harvested in 1999 and four colonies were lost to harvest operations in 2000 (Hamilton et al. 1999, Hamilton 2000). Colonies were destroyed in all years from 2005 to 2009, with especially large losses in 2006, 2007, and 2008 (Meese 2009b). In 2008,

Commented [B39]: This overstates it. These were the only years when losses to harvest were not documented. That is not the same as saying that none occurred. What happened that went undocumented, whether in San Joaquin Valley, San Benito County, or Riverside County?

several of the largest known colonies were destroyed, with six colonies representing 140,000 breeding birds being cut (Meese 2008). At least three colonies were lost to harvest in 2011, including the largest known colony, which supported 17% of the total known population (Kyle and Kelsey 2011, Meese 2011). At least two colonies in grain fields were destroyed in 2014 during the harvest of nesting substrate and at least three colonies were partially or totally destroyed due to harvest in 2015 (Meese 2014a, 2015b). After a breeding season with no known harvest losses in 2016, a large colony (estimated at up to 12,000 birds) was mostly lost in 2017 when the grain nesting substrate was cut in preparation for harvest (Colibri 2017).

Commented [B40]: ? This was not harvest? It was preparation for harvest? I don't understand how it was not harvest.

No colonies are known to have been destroyed by harvest in 2010; a settlement on a dairy in Merced County was lost when the grain was harvested, but the harvest occurred during nest building before eggs were laid (Meese 2010). Beginning in 2016, a new partnership was created through a grant from NRCS, with Audubon California, dairy trade organizations, and agencies working together to conduct outreach to dairy owners and to detect and protect breeding colonies. The program succeeded in enrolling all landowners with Tricolored Blackbird colonies identified on their property in 2016, and 100% of known agricultural colonies were protected through delay of harvest. In 2017, most colonies on grain fields at dairies were again protected, but at least one large colony was destroyed when the grain was cut.

It has been argued that protection of colonies breeding on silage fields should be reevaluated because adult birds are unlikely to be killed by harvesting operations and Tricolored Blackbirds are known to breed more than once in a season. DeHaven (2000) and Hamilton (2004a, 2004b) suggested that habitat losses might be more important in population declines than nesting mortality, and resources spent protecting colonies on silage fields might be better spent protecting or restoring habitat. However, second breeding attempts are often less productive than first breeding attempts due to the energetic and physiological costs of egg formation in females, incubation and brooding, and raising of young (Martin 1987, Meese 2008). Even if these costs did not reduce the relative productivity of second breeding attempts, the elimination of a first breeding attempt may cause breeding colonies to miss the period of peak prey abundance, thereby reducing seasonal reproductive success (Martin 1987). Colony destruction through harvest typically occurs well after females have laid eggs and often after eggs have hatched, so the lost energetic input to a failed breeding and the delay before a second attempt likely reduce total annual productivity, even if birds attempt to nest a second time (Meese 2008).

The Tricolored Blackbird was shown to have experienced low reproductive success from at least 2006 to 2011 (Meese 2013). Reproductive success appears to have always been quite variable across colonies in any given year, and occasional success at large colonies may be important in maintaining the population over time (see Reproduction and Survival section). A number of factors have been shown to influence reproductive success, including predation and shortage of food, but reproductive failures caused by harvest at breeding Tricolored Blackbird colonies on agricultural fields of the San Joaquin Valley may have contributed to population declines through loss of much of the annual reproductive potential of the species in several years.

Overexploitation summary—Although direct killing of Tricolored Blackbirds was once a large source of adult mortality, the number of birds killed declined dramatically after blackbird depredations in rice fields declined in the 1930s. Killing of Tricolored Blackbirds that may be depredating crops during the post-breeding period is likely a continuing source of mortality, but the available data do not indicate this to be a large source of mortality; additional data would be required to determine the degree to which this factor effects the population. Destruction of colonies in agricultural fields has been occurring since Tricolored Blackbirds were discovered nesting in this substrate type in the early 1990s. In recent years, the protections provided to the Tricolored Blackbird as a candidate under CESA, the availability of funds, and a coordinated effort by agencies, the dairy and farming industries, and nonprofit groups has led to a dramatic decline in this source of mortality, but losses of large colonies to grain harvest have continued. The future success of breeding colonies on agricultural crops will depend on the availability of funds to continue programs that locate breeding colonies on grain fields early in the nesting season and compensate farmers for delaying harvest.

Commented [B41]: I've been told by locals, including rice farmers themselves, that the killing of large numbers of blackbirds, including tricolors, continued through 2015, the last time I inquired of this. I know of no support for the assertion that depredations were reduced after the 1930s nor that the killing of blackbirds went way down after the 1930s. Further, absence of evidence is not evidence of absence, and there has never been funding provided to study the post-breeding ecology of tricolors, and most of what we know comes from DeHaven's work of several decades ago plus anecdotal information provided by local landowners.

Predation

A large number of predators have been observed preying on Tricolored Blackbirds (Table 6), including their eggs or nestlings. Most observations of predation have occurred at breeding colonies when the birds are congregated in dense groups, and most predation has occurred on the eggs, nestlings, or fledglings of Tricolored Blackbirds.

Table 6. Predators of Tricolored Blackbirds.

Taxonomic Group	Predators	Sources
Birds	Black-crowned Night-Heron (*Nycticorax nycticorax*), Cattle Egret (*Bubulcus ibis*), White-faced Ibis (*Plegadis chihi*), Great Blue Heron (*Ardea herodias*), Cooper's Hawk (*Accipiter cooperii*), Red-tailed hawk (*Buteo jamaicensis*), Swainson's Hawk (*Buteo swainsoni*), Peregrine Falcon (*Falco peregrinus*), Prairie Falcon (*Falco mexicanus*), Merlin (*Falco columbarius*), Northern Harrier (*Circus cyaneus*), Barn Owl (*Tyto alba*), Burrowing Owl (*Athene cunicularia*), Short-eared Owl (*Asio flammeus*), Yellow-billed Magpie (*Pica nuttalli*), American Crow (*Corvus brachyrhynchos*), Common Raven (*Corvus corax*), Great-tailed Grackle (*Quiscalus mexicanus*)	Mailliard (1900), Neff (1937), Payne (1969), Hamilton et al. (1995), Beedy and Hamilton (1997), Hamilton (2000), Kelsey (2008), Meese (2010), Meese (2012), Airola et al. (2015a), Meese (2016), Beedy et al. (2017)
Mammals	coyote (*Canis latrans*), wolf (*Canis lupus*), gray fox (*Urocyon cinereoargenteus*), raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), long-tailed weasel (*Mustela frenata*), feral domestic cat (*Felis catus*), river otter (*Lontra canadensis*), and ~~possibly~~ mink (*Mustela vison*)	Evermann (1919), Neff (1937), Payne (1969), Hamilton et al. (1995), Beedy and Hamilton (1997), Wilson et al. (2016), Beedy et al. (2017)
Snakes	gopher snake (*Pituophis catenifer*), king snake (*Lampropeltis* sp.), garter snake (*Thamnophis* sp.), and possibly western rattlesnake (*Crotalus oreganus*)	Neff (1937), Payne (1969), Hamilton et al. (1995)

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Small areas of native vegetation may be especially vulnerable to predation, especially if they are near sites at which predator populations are artificially high due to the availability of augmented food sources

from human activities. In the early 1990s, Hamilton and others found that many breeding colonies in emergent wetland nesting substrates suffered partial or complete destruction by predation (primarily by Black-crowned Night-Herons; Hamilton et al. 1992, 1995, Hamilton 1993), resulting in consistently lower reproductive success in wetlands compared to other nesting substrates. Beedy and Hamilton (1997) reported that more recently, Black-crowned Night-Herons eliminated all or most nests at several freshwater marsh breeding colonies. Hamilton (2000) later reported that wetland colonies with no Black-crowned Night-Heron predation were highly successful. DeHaven (2000) reported that he also observed high rates of colony failure due to predation in the 1970s, a time when the majority of the population still bred in wetland substrates. Whether recent rates of loss to predation are similar to historical rates of loss is unknown.

In recent decades, complete nesting failures have been caused by novel predators on agricultural grain fields and the increasing concentration of birds in mega-colonies may have increased their susceptibility to nest predation (Kelsey 2008). Cattle Egrets from a single rookery caused complete or near-complete failure of large breeding colonies in Tulare County from 2006 to 2011 (Meese 2012). White-faced Ibis prey on the eggs of the Tricolored Blackbird, and in 2016 caused the complete failure of a large breeding colony on a silage field in Tulare County (Meese 2016, Beedy et al. 2017).

Kelsey (2008) reported a steady increase in population sizes of several avian predators in California, including Black-crowned Night-Heron, Cattle Egret, American Crow, and Common Raven. However, the most recent breeding bird survey data show an increase for only one of these species, the Common Raven, and the data for Cattle Egret have important deficiencies that preclude trend assessment (Sauer et al. 2017b). White-faced Ibis have experienced a large population increase in California since the 1980s (Shuford et al. 1996), but BBS data are inadequate for trend assessment (Sauer et al. 2017b).

Although many species have been documented as predators of Tricolored Blackbirds, most have not had severe effects on the population or on the breeding success at nesting colonies. However, a few species have caused the complete failure of entire breeding colonies through heavy predation on eggs and nestlings. In recent decades, the predators that have destroyed entire colonies have usually been wading birds that hunt in large groups (i.e., Black-crowned Night-Heron, Cattle Egret, and White-faced Ibis). These species have had significant impacts on the overall productivity rate of Tricolored Blackbirds in several years over the last three decades (Hamilton et al. 1995, Cook and Toft 2005, Meese 2012). A few other species, including Common Raven, raccoon, and coyote have had large effects on breeding success, but these predators have typically not caused complete colony failure or have had less widespread effects.

Competition

Red-winged Blackbirds and, less frequently, Yellow-headed Blackbirds, will often nest in the same locations as Tricolored Blackbird colonies, although they may occupy the less-dense portions of a marsh. Where territorial conflicts occur, Tricolored Blackbirds ignore the territorial displays of these other species and overwhelm them with their sheer numbers, displacing them to the fringes of the substrate

or pushing them out entirely (Payne 1969). There is no evidence that competition with these species is limiting the Tricolored Blackbird population (Hamilton et al. 1995).

Beedy et al. (2017) reported that Great-tailed Grackles may be aggressive toward nesting Tricolored Blackbirds but did not consider the impacts severe. White-faced Ibis may destroy Tricolored Blackbird nests when in the process of constructing their own nests, but this occurs infrequently. The Marsh Wren (*Cistothorus palustris*) may destroy eggs in Tricolored Blackbird nests that are in proximity to its own nest (Beedy et al. 2017). Competition with other species does not appear to be a large factor in the survival or reproduction of the Tricolored Blackbird.

Brood Parasitism

The Brown-headed Cowbird (*Molothrus ater*) is known to rarely parasitize nests of Tricolored Blackbirds (Hamilton et al. 1995, Beedy et al. 2017), but brood parasitism is not a major threat to the species.

Disease

Beedy et al. (2017) stated that no diseases have been reported for the Tricolored Blackbird but that in some years many nestlings have mites. Avian pox is prevalent in Tricolored Blackbirds in the Sacramento Valley, and much less so in the San Joaquin Valley (Beedy et al. 2017). West Nile virus (WNV) has been detected in dead Tricolored Blackbirds, as well as in many other species of blackbirds, orioles, and grackles nationwide (www.cdc.gov/westnile/resources/pdfs/Bird%20Species%201999-2012.pdf). Adult Tricolored Blackbirds tested positive for WNV antibodies in 2009 but did not show symptoms of the disease and were assigned a relatively low risk score (Wheeler et al. 2009, Beedy et al. 2017). Although the highly social nature of the species could place the Tricolored Blackbird at greater risk to disease transmission, the impact of disease and parasites on the species is unknown but is not thought to be a major threat to the species.

Contaminants

Feeding in agricultural environments creates numerous opportunities for exposure to contaminants. Mortality of Tricolored Blackbird eggs and nestlings due to chemical contaminants has been suggested in a number of cases. Hosea (1986) reported that two colonies in Colusa and Sacramento counties near rice fields were over-sprayed during aerial application of herbicides resulting in the poisoning of almost all of the nestlings. Beedy and Hayworth (1992) described the effects of possible selenium toxicosis on a Tricolored Blackbird colony by comparing the reproductive success of a colony at Kesterson Reservoir in Merced County, which had a history of selenium contamination, with the success at four other colonies. Nesting failures were documented and deformities in Tricolored Blackbird nestlings were observed at the colony at Kesterson, and livers from dead nestlings collected at Kesterson had elevated levels of selenium. The area was cleaned up and the use of selenium-laden agricultural drain water to maintain the wetlands at Kesterson was discontinued. There have been no apparent selenium impacts on Tricolored Blackbird nesting success since. Hamilton et al. (1995) reported evidence of chemical-induced egg mortality from mosquito abatement operations in Kern County.

In 1995, Hamilton et al. concluded that, "Despite the limited evidence that Tricolored Blackbirds are suffering some mortality as a result of patterns of chemical use in agricultural areas, poisons do not appear to be inducing a serious population problem for Tricolored Blackbirds." Hamilton (2000) knew of no evidence that toxic contaminants had adversely affected the Tricolored Blackbird since the early 1990s.

Neonicotinoid Insecticides

A relatively new class of insecticides, neonicotinoids, has been implicated in the decline of invertebrate communities and, in a few cases, the decline of insectivorous birds. The application of neonicotinoids has increased dramatically in California, especially since the early to mid-2000s (https://water.usgs.gov/nawqa/pnsp/usage/maps/). Neonicotinoids are relatively stable, and are water soluble so can be incorporated into the tissues of plants. They are commonly applied to crops as seed treatments, with the insecticide taken up systemically by the growing plant (Godfray et al. 2014). In the two decades since their introduction, neonicotinoid insecticides have become the most widely used insecticides in the world (Goulson 2013). They are highly effective at killing insects and have relatively low mammal and bird toxicity. However, at higher concentrations they can have lethal and sublethal impacts to vertebrates (Mineau and Palmer 2013).

Acute toxicity of neonicotinoids has been assessed for only a few bird species, with wide variation in results. Bobwhite and Mallard are the species typically used in acute toxicity testing for regulatory purposes, but where smaller species have been tested, including songbirds, the body weight-corrected dosage resulting in mortality is much lower (Mineau and Palmer 2013). A potential acute impact mechanism for species that are partly granivorous, like the Tricolored Blackbird, is sublethal or lethal effects through the ingestion of neonicotinoid-coated seeds. Ingestion of only a few neonicotinoid-coated seeds (a single seed in the case of corn) might be sufficient to kill a songbird, but there has been little work conducted on the availability and consumption of treated seeds by vertebrates (Goulson 2013, Mineau and Palmer 2013). Although not limited to neonicotinoids, a study that evaluated the effect of multiple potential factors found that acute toxicity of pesticides was the strongest correlate to declines of grassland bird species in the U.S., followed by habitat loss caused by agricultural intensification (Mineau and Whiteside 2013). No data are available on the acute toxicity of any neonicotinoid insecticide specifically to Tricolored Blackbirds, but seeds treated with imidacloprid, a widely used neonicotinoid insecticide, caused ataxia and retching in captive Red-winged Blackbirds and Brown-headed Cowbirds (Avery et al. 1993). These effects were transitory and birds learned to avoid consumption of treated seeds when alternative grains were available. Neonicotinoids may also have chronic toxicity effects (exposure over longer time periods) on reproductive success, but chronic effects are even less studied than acute effects (Mineau and Palmer 2013).

Neonicotinoids may also indirectly affect Tricolored Blackbirds through suppression of insect prey populations. They have been shown to have adverse effects on a number of non-target invertebrate species, with most studies focusing on bees (Hopwood et al. 2012, Godfray et al. 2014). In California, long-term observational data have revealed declines in the number of butterfly species and declines in abundance for many butterfly species in the Central Valley, both of which were negatively associated

with annual application rates of neonicotinoid insecticides (Forister et al. 2016). Imidacloprid was shown to have a negative association with a wide variety of insectivorous bird populations in the Netherlands, suggesting that the pesticide may have led to food deprivation in birds (Hallmann et al. 2014). The evidence linking imidacloprid concentrations to bird population declines was circumstantial, but the authors ruled out confounding effects from other land use changes and showed that the timing of observed declines in bird populations corresponds to the introduction of neonicotinoid insecticides (Goulson 2014, Hallmann et al. 2014).

Depending on environmental conditions, neonicotinoids can persist and accumulate in soils and in waterways, and levels measured in soils, waterways, and field margin plants have sometimes overlapped substantially with concentrations that are sufficient to control pests in crops (Goulson 2013). Neonicotinoids degrade through photolysis when exposed to sunlight and so would not be expected to occur at high levels in clear water (Goulson 2013). However, Starner and Goh (2012) detected imidacloprid in 89% of water samples taken from rivers, creeks, and drains in agricultural regions of California, with 19% of samples exceeding the US Environmental Protection Agency guideline concentration of 1.05 µg/L; this suggests that the insecticide moves off of treatment areas and may impact non-target aquatic insects. Little is known about the uptake of neonicotinoids from soil and soil water by non-target plants, and the downstream effect on non-target invertebrates (Goulson 2013).

A study evaluating landscape effects on Tricolored Blackbird breeding colonies found that colonies are more likely to be located in areas that experience higher neonicotinoid insecticide application rates (NAS 2017). This is likely because most colonies and birds breed in the highly agriculturalized Central Valley. The neonicotinoid application rate was also shown to increase during the 2008–2014 study period, suggesting that breeding Tricolored Blackbirds may be exposed to increasing amounts of the insecticides. The effect of this exposure on breeding Tricolored Blackbirds is unknown.

Several studies have revealed a negative relationship between insect populations and neonicotinoid use. These results, along with the large increase in application of neonicotinoids, suggest a potential mechanism leading to observed reductions in reproductive success in Tricolored Blackbirds (Meese 2013). It is possible that this relatively new group of insecticides has resulted in declines of non-target insect species within the breeding range of the Tricolored Blackbird resulting in a declining prey base, but no data have been collected that can directly support this. It is also possible that acute effects resulting from ingestion of neonicotinoid-coated seeds has had an impact on the population, but the number of Tricolored Blackbirds suffering sublethal or lethal effects due to exposure to neonicotinoids is unknown. In addition to Tricolored Blackbirds, population declines in insectivorous birds have been documented across North America, with specific examples from California's Central Valley (Nebel et al. 2010, Airola et al. 2014). Neonicotinoids may be playing a role in driving these declines, but more study is needed. There is a need for mechanistic research to ~~compliment~~ complement results from observational data; these should include testing exposure rates of Tricolored Blackbirds to neonicotinoids, effect of exposure on body condition and fitness (direct effects), and investigations into potential insect-based food-web impacts (indirect effects).

Invasive Species

With the exception of occasional impacts due to nonnative predators (e.g., Cattle Egret, Great-tailed Grackle), invasive species have not been reported to have a large impact on the ability of the Tricolored Blackbird to survive and reproduce. The availability of many nonnative plant species as nesting substrates have allowed the Tricolored Blackbird to breed in locations that would otherwise be unavailable. Invasive species are not considered a major threat to the species, indeed in large parts of the species' range they may be considered a benefit, as the birds nest in several non-native plants (Himalayan blackberries, mustards, and mallows) that are widely considered to be invasive.

Weather Events

Hamilton et al. (1995) stated that high mortality of Tricolored Blackbird nestlings can result from severe or prolonged storms and that some observed reproductive failure may be the result of chilling of adult and nestling birds. Also, some adult female mortality at nests appears to have been induced by cold and rainy weather (Hamilton et al. 1995). Heavy winds or precipitation have been documented to knock down nesting substrates, often in triticale or other grain colonies, but also in milk thistle colonies (Meese 2010, 2016), eliminating the reproductive effort for all or a part of breeding colonies. Weather events may have widespread impacts on reproductive success in some years, but impacts are usually isolated and the overall effect on the population's ability to reproduce is limited in most years.

Commented [B43]: This really depends upon the sizes of the colonies affected, and destruction due to high winds are frequent and widespread. I think that the impacts due to strong storms involving precipitation are most often limited, but if you add these together with the impacts due to high winds where no precipitation is involved, there can be population-level impacts if especially large colonies are affected. Certainly not an every-year phenomenon, but

Drought, Water Availability, and Climate Change

Drought reduces water supply reliability and has far-reaching impacts on most habitat types in California (DWR 2014, 2015a). Several significant statewide droughts have occurred in California over the last century (1928–1934, 1976–1977, 1987–1992, and 2007–2009) (DWR 2015a), and California recently experienced the four driest consecutive years of statewide precipitation in the historical record between 2012 and 2014. The winter of 2015 produced a record low statewide mountain snowpack of only 5% of average.

Drought effects on availability of nesting substrate

Tricolored Blackbirds have adapted to use a variety of novel vegetation types as nesting substrate, but wetlands continue to support the largest number of breeding colonies each year. Because of the need for wetlands that are flooded during the spring and summer breeding season, the various approaches to wetland management, and the dependence on water deliveries to maintain wetland habitats in most of the Tricolored Blackbird's range, assessing the availability of suitable wetland nesting substrate in a given year is difficult. A recent method applied reflectance to satellite imagery in order to identify areas of open surface water in the Central Valley (Reiter et al. 2015). Although not an ideal approach to quantifying and assessing distribution of wetlands, the method would identify wetlands with large amounts of open water. In addition, identification of open water on the landscape during the Tricolored Blackbird breeding season is likely a good proxy for the availability of water for wetland management. Reiter et al. (2015) showed that open surface water declined across the Central Valley between 2000 and 2011. Drought had a significant negative effect on open surface water in the late summer and early

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fall. Cumulative years of drought resulted in a noticeable reduction in surface water. Although not a direct measure of Tricolored Blackbird breeding habitat, declines in surface water during the drought likely resulted in reduced availability of wetlands with sufficient water to provide high quality nesting substrates.

Although more resilient to dry conditions than wetland vegetation, plants species that provide upland nesting substrate for Tricolored Blackbird colonies also experience negative effects due to drought. After several years of dry conditions during California's most recent drought, many Himalayan blackberry copses that have historically supported Tricolored Blackbird colonies were observed to be dry and mostly barren of leaves. In a few cases, extremely dry blackberry bushes continued to be used by breeding colonies, but many were unoccupied. Milk thistle, which provides high-quality nesting substrate across much of the Tricolored Blackbird range when annual precipitation patterns support vigorous growth, was largely absent from historically used areas until California experienced an average water year in the winter of 2015–2016 (Airola et al. 2016). The wetter weather created nesting substrate in areas that had not been used by Tricolored Blackbirds in several years, and breeding colonies once again occupied these areas.

Drought effects on prey populations

The availability of large insect prey is an important factor in Tricolored Blackbird reproductive success, and may influence colony site selection. Large landscapes with suitable foraging habitat are strong drivers of colony site occupancy and abundance (NAS 2017).

Insect abundance is ~~highly~~ strongly related to biomass of herbaceous vegetation, including important Tricolored Blackbird prey items like grasshoppers in grasslands (Falcone 2010). Climate, especially drought, is thought to play a key role in abundance of grasshoppers and other insect species in grasslands (Vose et al. 2016). The response of insect populations can differ depending on drought severity. For example, non-severe drought and warm temperatures can have a positive effect on grasshopper populations through increased survival and faster population growth (Kemp and Cigliano 1994). However, extreme or prolonged drought can negatively affect grasshopper populations through desiccation of eggs or through decreased biomass of primary producer food sources (i.e., grasses and forbs) (Vose et al. 2016). Reductions in precipitation not only lead to reductions in the abundance of insects in grasslands, but may also make insect prey less accessible through changes in behavior (e.g., moving underground) (Barnett and Facey 2016). Severe droughts likely have strong negative effects on grasshoppers and insect prey biodiversity in general (Kemp and Cigliano 1994, Vose et al. 2016).

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The established impacts of precipitation on insect populations in grasslands, especially grasshoppers, suggests a mechanism for drought impacts on Tricolored Blackbird productivity. Research is needed that measures grasshopper and other prey abundance relative to precipitation and primary productivity around occupied Tricolored Blackbird colonies, and evaluates the effect on Tricolored Blackbird reproductive success.

Climate Change

Average annual temperatures have been rising in California in recent decades, and climate models are in broad agreement that temperatures in California will rise significantly over the next century (DWR 2015b). The average temperature is expected to rise by approximately 2.7°F by 2050, and depending on the emissions scenario, average temperatures could increase by 4.1–8.6°F by the year 2100 (Moser et al. 2012). Summer temperatures will rise more than winter temperatures, and the increases will be greater in inland California. As a result, the average number of extremely hot days (at least 105°F) per year in Sacramento is expected to increase fivefold (up to 20 days) by the middle of the century, and may increase to as many as 50 days per year by 2100 (Moser et al. 2012). Tricolored Blackbirds have been observed to cease initiation of breeding when temperatures rose above 90°F, although care of existing nests continued in temperatures over 100°F (Hamilton et al. 1995). Rising temperatures may directly affect annual Tricolored Blackbird productivity by truncating or interrupting the breeding season, although more work is needed on the effect of temperature on initiation and success of nesting attempts.

Along with projected impacts to Tricolored Blackbird foraging habitat due to housing development discussed above, the areas of California with the largest climate-projected effects on a variety of bird species are largely concentrated within the Tricolored Blackbird range in the Central Valley (Jongsomjit et al. 2013). A suite of analyses integrating the effects of climate change and land use changes in California's rangelands concluded that grassland habitat loss in California could reach 37% by the year 2100 (Byrd et al. 2015).

The recent severe drought in California was at least in part due to and made more severe by climate change (Diffenbaugh et al. 2015). Climate change is projected to bring longer and more severe droughts to California in the future (Diffenbaugh et al. 2015, Williams et al. 2015), exacerbating the impacts to Tricolored Blackbird habitat described above. The Central Valley may be particularly vulnerable to warming-driven drought increases in the future (Williams et al. 2015). Water deliveries are projected to be reduced by 5.6% from 2013 to 2033 due to climate change effects on reliability (DWR 2014). Climate change effects on water supplies and stream flows are expected to increase competition among urban and agricultural water users and environmental needs (Moser et al. 2012). This competition may lead to decreases in available wetland nesting substrate provided by private and public land managers. Declines in the availability of water for agriculture may also reduce prey populations provided by high quality crops like alfalfa and rice.

SUMMARY OF LISTING FACTORS

[Note to reviewers: This section will provide summaries of information in the status review, arranged under each of the factors that the Fish and Game Commission must consider in making a determination as to whether listing is warranted (Cal. Code Regs., Tit. 14, § 670.1). These summaries will be prepared after peer review.]

Present or Threatened Modification or Destruction of Habitat

Overexploitation

Predation

Competition

Disease

Other Natural Events or Human-Related Activities

PROTECTION AFFORDED BY LISTING

It is the policy of the State to conserve, protect, restore and enhance any endangered or threatened species and its habitat (Fish & G. Code, § 2052). The conservation, protection, and enhancement of listed species and their habitat is of statewide concern (Fish & G. Code, § 2051(c)). CESA defines "take" as hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill (Fish & G. Code, § 86). The Fish and Game Code provides the Department with related authority to allow "take" of species listed as threatened or endangered under certain circumstances through incidental take permits, memoranda of understandings, natural community conservation plans, or other plans or agreements approved by or entered into by the Department (Fish & G. Code, §§ 2081, 2081.1, 2086, 2087, and 2835).

If the Tricolored Blackbird is listed under CESA, impacts of take caused by activities authorized through incidental take permits must be minimized and fully mitigated according to state standards. These standards typically include protection of the land in perpetuity with an easement, development and implementation of a species-specific adaptive management plan, and funding through an endowment to pay for long-term monitoring and maintenance to ensure the mitigation land meets performance criteria. Obtaining an incidental take permit is voluntary. The Department cannot force compliance; however, any person violating the take prohibition may be punishable under state law.

Additional protection of Tricolored Blackbird following listing would be expected to occur through state and local agency environmental review under CEQA. CEQA requires that affected public agencies analyze and disclose project-related environmental effects, including potentially significant impacts on rare, threatened, and endangered species. In common practice, potential impacts to listed species are examined more closely in CEQA documents than potential impacts to unlisted species. Where significant impacts are identified under CEQA, the Department expects that project-specific avoidance, minimization, and mitigation measures will benefit the species. State listing, in this respect, and consultation with the Department during state and local agency environmental review under CEQA, would be expected to benefit the Tricolored Blackbird in terms of reducing impacts from individual projects, which might otherwise occur absent listing.

For some species, CESA listing may prompt increased interagency coordination and the likelihood that state and federal land and resource management agencies will allocate funds toward protection and recovery actions. In the case of the Tricolored Blackbird, the Tricolored Blackbird Working Group signatory agencies already meet and coordinate regularly, but a state listing could result in increased availability of conservation funds.

LISTING RECOMMENDATION

CESA directs the Department to prepare this report regarding the status of the Tricolored Blackbird in California based upon the best scientific information. CESA also directs the Department based on its analysis to indicate in the status report whether the petitioned action is warranted (Fish & G. Code, § 2074.6; Cal. Code Regs., tit. 14, § 670.1, subd. (f)). In addition to evaluating whether the petitioned action (i.e., listing as endangered) was warranted, the Department considered whether listing as threatened under CESA was warranted.

The Department includes and makes its recommendation in its status report as submitted to the Commission in an advisory capacity based on the best available science. In consideration of the scientific information contained herein, the Department has determined that listing the Tricolored Blackbird as threatened or endangered under CESA is [warranted/not warranted] at this time.

[Note to reviewers: The Department's recommendation will be finalized following peer review and completion of the status review report.]

MANAGEMENT RECOMMENDATIONS

The Department evaluated existing management recommendations and identified the following, listed in no particular order, as necessary to achieve conservation of the Tricolored Blackbird. The *Conservation Plan for the Tricolored Blackbird* (TBWG 2007) identifies goals, objectives, and tasks required to maintain a viable Tricolored Blackbird population throughout the current range of the species. The Department continues to support implementation of the conservation plan as revised by the Tricolored Blackbird Working Group. The goals, objectives, and tasks identified in the plan are not repeated in their entirety here, but many of the management recommendations listed below are related to, or based on, activities identified in the plan.

Habitat Protection, Restoration, and Enhancement

Land ownership patterns across the range of the Tricolored Blackbird, coupled with the diverse nesting and foraging habitats used by the species, necessitate cooperative efforts among government, industry, and the public in order to conserve the species.

Management of habitat must consider the large landscapes utilized by breeding colonies and the integral relationship between nesting colony sites and associated upland foraging areas (Hamilton

1993). Land management plans that do not specifically consider the landscape needs of Tricolored Blackbirds will not necessarily result in the protection or creation of suitable breeding habitat.

1. Determine the best areas for conservation, building off the recent research on habitat suitability conducted by the National Audubon Society (NAS 2017). It is difficult to predict the distribution of widespread species, and even more difficult when the distribution within the range is not stable, as with the dynamic colony site use of Tricolored Blackbirds. Breeding locations that should be prioritized for protection include those that are regularly occupied, those that support large colonies, those that support high reproductive success, and those with a secure foraging landscape (Meese and Beedy 2015).
2. Identify areas in the Tricolored Blackbird range with high quality foraging landscapes, but that lack suitable nesting substrate. Consider conservation actions to create or restore nesting substrate in areas with high probability of use by breeding Tricolored Blackbirds.
3. Secure funding and implement the highest priority nesting substrate protection, enhancement and restoration projects and foraging habitat protection projects.
4. Create a system for tracking habitat protection and restoration projects, including appropriate measures of success. Work with the Tricolored Blackbird Working Group to encourage reporting of habitat projects from all stakeholders.

Breeding Colony Protection

In addition to the long-term goal of providing suitable alternative habitat away from silage fields on public and private land, the near-term priority must continue to be placed on identifying and conserving the colonies nesting in silage on private property each year.

5. Fully fund and implement a silage colony protection program. Continue work in the Tricolored Blackbird Working Group's agriculture subcommittee to plan for and implement a silage colony response plan, with participation from a diverse set of stakeholders including members of the dairy industry.
6. Identify locations that regularly support large and productive Tricolored Blackbird breeding colonies, with secure foraging landscape. Prioritize these locations for protection through acquisition or conservation easement.
7. Assess the effectiveness of provision of alternate nesting habitat (e.g., fresh emergent wetlands) to draw birds away from nesting in dairy silage fields (Beedy et al. 2017).

Monitoring and Research

8. Determine the factors that influence nest site selection and especially ~~how~~ whether relative insect abundance may affect site occupancy (Airola et al. 2016).
9. Determine the amount, type, and distribution of foraging habitat needed to support viable breeding colonies of various sizes. How does type, proximity to colony site, and diversity of foraging habitats influence the extent of foraging habitat required and the rate of reproductive success?

10. Determine the environmental factors that result in abundant large insect prey populations in grassland habitats and in commonly used agricultural crops, and their variability in time and space.
11. Conduct mechanistic research to ~~compliment~~ complement results from observational data that have shown correlations between neonicotinoid pesticides and declines in songbirds; these should include testing exposure rates of Tricolored Blackbirds to neonicotinoids, effect of exposure on body condition and fitness, and investigations into potential insect-based food web effects.
12. Estimate rates of within season and interannual movements and genetic exchange between populations breeding in different regions, especially between southern California and the Central Valley (Beedy et al. 2017).
13. Quantify annual adult survivorship and investigate factors that affect survival, including the magnitude of post-breeding mortality caused by shooting to reduce crop depredation.
14. Investigate new methods to measure productivity in Tricolored Blackbird breeding colonies. Current methods that utilize nest transects or counts of fledglings might not be comparable, and nest transects can be difficult to implement and may negatively affect breeding birds.
15. Examine degree of colony cohesion between first and subsequent breeding attempts, and between breeding seasons (Beedy et al. 2017).
16. Develop and implement a statistically valid, standardized protocol for the long-term, statewide monitoring of Tricolored Blackbird abundance, including population estimate confidence.

Education and Outreach

17. Raise awareness of Tricolored Blackbird nesting behavior and conservation options on ranch and farmlands, stressing the importance of protecting large silage nesting colonies. Build off recent efforts by the Tricolored Blackbird Working Group and the dairy and rice industries~~y~~.
18. Conduct outreach and coordination with landowners whose grazing lands in the foothills support breeding colonies (Airola et al. 2015b).
19. Provide land managers with habitat management guidance for creation and management of Tricolored Blackbird habitat. Continue work recently undertaken by the Tricolored Blackbird Working Group's habitat subcommittee.

ECONOMIC CONSIDERATIONS

The Department is charged in an advisory capacity in the present context to provide a written report and a related recommendation to the Commission based on the best scientific information available regarding the status of Tricolored Blackbird in California. The topic areas and related factors the Department is required to address as part of that effort are biological and not economic, therefore the Department is not required to prepare an analysis of economic impacts (See Fish & G. Code, § 2074.6; Cal. Code Regs., tit. 14, § 670.1, subd. (f)).

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Appendix 1
Tricolored Blackbird surveys, 1986-2017

This Appendix briefly describes each effort to survey the Tricolored Blackbird population since 1986. As discussed in the body of the report, the survey approach varied across survey years, with two groups of years (1994, 1997, 2000; and 2008, 2011, 2014, 2017) following relatively consistent approaches and resulting in comparable results. Although surveys in these two groups of years followed similar approaches, there were several differences in methods and in survey effort that preclude direct comparisons of results across these two groups of survey years. Where possible, results have been adjusted for survey effort when discussed in the report.

1986-1990

Beedy et al. (1991) compiled all historical records of Tricolored Blackbird breeding colonies to evaluate the long-term population trends and current status of the species for the USFWS. They also conducted intensive observations at seven colonies in four counties during 1987 and 1988 and made additional irregular observations in seven counties between 1986 and 1990. They concluded that the population had continued to decline since the 1970s (DeHaven et al. 1975) to an average of 51,600 breeding birds at known colonies in the 1980s. In response to the report by Beedy et al. (1991), a more thorough survey was organized by the Department in 1992, with survey locations informed by ongoing research on the species by Bill Hamilton and others (see below). Results revealed the population to be much larger, indicating that an ad hoc compilation of observation records combined with a limited survey effort over multiple years does not provide an accurate measure of overall population size. Like previous efforts, the surveys by Beedy et al. (1991) included only sporadic surveys in the southern San Joaquin Valley.

1992-1993

Basic ecological investigations were conducted that included documentation of colony locations and sizes, discovery of large breeding colonies on grain fields in the San Joaquin Valley, and initial observations that suggested Tricolored Blackbirds are itinerant breeders, but efforts were not extensive enough to provide estimates of the statewide population (Hamilton et al. 1992, Hamilton 1993, Beedy and Hamilton 1997).

1994

Itinerant breeding had recently been documented in Tricolored Blackbirds and this was the first statewide survey conducted over a narrow time period to avoid double-counting birds that shift location between breeding attempts (Hamilton et al. 1995). The documentation of all historical colony sites (Beedy et al. 1991) and recent colony sites (Hamilton et al. 1992, Hamilton 1993) was used to inform a rangewide survey that attempted to visit all known Tricolored Blackbird breeding locations in 1994. The survey was largely volunteer-based and was carried out on a single day (April 23) early in the nesting season to detect as many birds as possible in colonies during their first breeding attempt of the year. The goals of the survey were to document occupancy status and to estimate the size of all active

colonies. Volunteers were asked to visit all known colony locations, estimate numbers at occupied sites, and to drive public roads near known breeding locations to identify previously undocumented colonies (Beedy and Hamilton 1997).

All colonies larger than 10,000 birds were revisited by Hamilton et al. (1995) to verify and sometimes refine estimates. At selected colony sites, the estimates of colony sizes provided by survey volunteers were adjusted using estimated nest densities. This was achieved by running transects through the nesting substrate when nests were active to obtain an estimate of average nest density and the proportion of observed nests that appeared active. More extensive transects were then run after breeding was completed to refine the estimate of nest density. This refined estimate was corrected for the proportion of active nests and multiplied by the total occupied area to obtain an estimate of the number of active nests in the colony. This number was then multiplied by 1.5 to account for an assumed male to female ratio of 1:2. The intent of this approach was to estimate the number of birds that ultimately nested in a breeding colony, but it might not have accurately represented the number of birds present during the survey period. For example, the approach would dismiss large groups of birds that may have been present during colony settlement that ultimately did not breed at a site (i.e., the method fails to account for the presence of any non-breeding adults). This is inconsistent with the goal of the statewide survey to estimate the total number of birds in the population. The approach also violates the condition that observations should be made during a narrow survey window to avoid double-counting birds.

Tricolored Blackbirds were observed in 32 California counties. One hundred active breeding colonies were observed in 28 counties. Ten previously occupied counties were not surveyed. The estimated number of birds observed was 369,400 (+/- 15%) (Beedy and Hamilton 1997). The assumed +/- 15% range in the estimate was based on a small sample of breeding colonies where visual estimates of colony size and estimates based on nest density varied by no more than 15% (Hamilton et al. 1995, Hamilton 1998).

Hamilton et al. (1995) felt that the survey effort in 1994 was “minimal” and that a larger number of birds would have been observed if a more substantial survey had been organized. The survey effort in the southern California portion of the range was especially limited. A single observer made two trips to southern California to search for colonies during the breeding season and organizers considered this portion of the range to be under-surveyed.

1995-1996

Volunteer surveys were conducted on a single day. Surveys were not informed by pre-survey monitoring as in the 1994 survey, and results did not include rangewide follow-up surveys. Some counties were surveyed incompletely, or not at all, and large breeding colonies may have been overlooked. Beedy and Hamilton (1997) concluded that the results of these surveys should not be considered total population estimates for Tricolored Blackbirds.

1997

The 1997 survey used the same coverage, methods, and personnel as did the 1994 survey (Beedy and Hamilton 1997). Participation was greater than in 1994 and most historically occupied counties received at least some coverage (Beedy and Hamilton 1997). The survey in the southern California portion of the range was much more thorough than that conducted in 1994. The volunteer survey was conducted on April 26.

Breeding and nonbreeding birds were observed in 33 California counties, plus additional birds in one county in Oregon and in Baja California. Seventy-one active breeding colonies were observed (Hamilton 2000). The estimated number of birds observed was 232,960 (+/- 15%) (Beedy and Hamilton 1997).

Despite the 1994 survey being described as a minimal effort that overlooked some unknown number of birds (Hamilton et al. 1995), Beedy and Hamilton (1997) reported that 1994 and 1997 were the only two survey years to date with sufficient survey effort to detect "virtually all large colonies." The observed number of birds declined by 37%, with the greatest declines occurring in the core of the species' distribution in Sacramento, Fresno, Kern, and Merced counties (Beedy and Hamilton 1997).

1999

The organizers of the one-day survey in 1999 (Hamilton et al. 1999, 2000) attempted to follow the same methods as those used in 1994 and 1997, but participation in the survey was low and the total count of about 95,000 birds was considered an underestimate by Hamilton (2000). Much of the population began breeding later than in previous years and many colonies were located after the survey that were not detected on the survey date (Hamilton et al. 1999).

2000

As with the 1994 and 1997 surveys, the 2000 survey attempted to locate all breeding colonies and estimate the number of birds in each colony. The 2000 survey used the same methods used in these two previous surveys, although a greater number of observers participated and visited more locations. A workshop was also held before the 2000 survey to train participants in colony size estimation. Unlike the previous survey years that focused on a single day, the 2000 survey was conducted over four days, from April 21-24. Hamilton (2000) suggested that this differed little from the 1994 and 1997 surveys because records in those years were accepted from one day before and after the survey date, effectively accepting reports over a three-day period, and the addition of a fourth day in 2000 only accounted for an additional 1,750 birds observed. As in 1994 and 1997, survey locations were informed by pre-survey colony detection and monitoring.

Breeding and nonbreeding birds were observed in 25 California counties. Seventy-two active breeding colonies were observed (Hamilton 2000).

Although Hamilton concluded that the 2000 survey located a greater proportion of the entire population than did censuses in previous years, he still felt that the San Joaquin Valley, with its potentially large silage colonies, was not surveyed completely (Hamilton 2000). Nevertheless, he concluded that the

Tricolored Blackbird population had declined during the 1990s, from an estimated 370,000 birds in 1994 to 162,000 birds in 2000.

2001

The survey conducted in 2001 followed a very different approach compared to standardized methods used in the 1990s to survey the statewide population. Only 48 sites were surveyed and sites were visited throughout the breeding season rather than being restricted to a narrow survey window of a few days (Humple and Churchwell 2002). As had been demonstrated in the 1990s, a season-long approach to detecting and surveying colonies may result in double-counting of birds that move between locations. Conversely, the limited number of sites visited likely underrepresented the breeding population. The effect of these inconsistencies in methodology and effort on survey results is unclear, and results cannot be compared to those of other survey years.

2004

The four-day survey conducted in 2004 was not intended to produce an estimate of the statewide population size comparable to previous surveys. The survey was limited to colony sites that had historically supported more than 2,000 birds and focused on those located in the Central Valley (Green and Edson 2004). Participation was low with only 29 volunteers conducting surveys. Based on well-documented occupancy dynamics of Tricolored Blackbird, this approach is likely to miss large breeding colonies. No training was provided to participants prior to the survey.

2005

There was no report produced describing the 2005 survey and its results, and the only record available to the Department is a spreadsheet listing occupied sites with estimates of colony size at each location. There is no record of the survey methods used nor the effort expended in conducting the survey.

The number of birds observed was reported as about 258,000 birds at 121 occupied sites (Meese 2015).

2008

The survey methods used to obtain the population estimate in 2008 were similar to those used in statewide surveys conducted in the previous survey years of 1994, 1997, and 2000 (Kelsey 2008). However, the methods differed in a number of ways that likely effected the estimated number of birds and precluded a direct comparison of the earlier surveys with results from 2008:

1. The volunteer survey was conducted on a single day in 1994 and 1997 and over four days in 2000, compared to three days in 2008. However, in 1994 and 1997, birds that were observed one day before and after the survey day but not associated with a colony were included in the estimate, effectively expanding the survey to three days for incidental observations.
2. Despite the narrow survey windows established in each of the survey years, no survey has practiced strict adherence to the requirement that all observations occur during the survey window. For example, in the earlier survey years (1994-2000), birds seen at colonies before the survey date were included in the estimate if those colonies remained active after the survey window but were not observed during the survey dates. Also, breeding birds found after the

date of the surveys were included if nest phenology suggested a colony must have been active during the survey dates. Since 2008, there has been a greater emphasis on adhering to the survey dates, but exceptions have been made on a case-by-case basis each year if observations suggest that birds were missed during the survey window (July 2017 email from B. Meese to N. Clipperton; unreferenced).

3. In the earlier survey years, when multiple observations were available at colonies throughout the breeding effort, the number of birds at a colony was recorded based on the maximum number of nests, which ignored any changes in colony size over time, as opposed to using the number of birds observed only during the survey window. However, Hamilton et al. (1995) stated that the difference between maximum and minimum observations were not great at any large colony. In recent years, when multiple observations at a location during the survey window resulted in multiple estimates, the average has typically been reported as the number of birds for the location.
4. In the earlier survey years, the estimates of colony sizes provided by survey volunteers were sometimes adjusted using estimated nest densities, as described above under the 1994 survey. This adjustment has not been employed in surveys conducted since 2008. The proportion of colonies with estimates adjusted using this approach varied across survey years 1994, 1997, and 2000 and was not always reported.

These methodological differences between survey years may have had both positive and negative effects on the overall estimate, and the magnitude and direction of effect on the estimates are not known. Therefore, caution is warranted in making comparisons between the earlier group of surveys and those conducted since 2008.

The 2008 survey also included several enhancements relative to the earlier surveys:

1. County coordinators were used for the first time to ensure that each surveyed county was well-surveyed by local volunteers.
2. Maps with all survey locations were provided for the first time, and a website was available for downloading all survey materials and uploading survey data (Tricolored Blackbird Portal; http://tricolor.ice.ucdavis.edu/).
3. The number of survey participants and the number of sites surveyed greatly increased relative to earlier surveys (Kelsey 2008). The result was a more complete survey and more reliable data collection and reporting.

~~3.~~4. The Tricolored Blackbird Portal was developed and came on-line prior to the 2008 Statewide Survey and was used to support efforts of county coordinators, distribute maps, protocols, and other information sources, and for on-line data entry of results. The Portal greatly enhanced data management and provided for the first time a centralized data repository for both location and observation records that was available to all those with Portal accounts.

The effect of these new procedures and increased effort on the proportion of the Tricolored Blackbird population observed is unknown, but a larger proportion of the population was likely observed compared to previous surveys. As was first implemented in 2000, training sessions were also provided to survey volunteers. The 2008 survey was conducted from April 25-27.

A total of 155 volunteers participated in the 2008 survey and visited 361 historical and new locations in 38 counties (Kelsey 2008). The total estimate for number of birds observed was 394,858. Many of the larger colonies were visited by Tricolored Blackbird experts, which is consistent with earlier statewide surveys. Kelsey (2008) reported that some portion of the increase in observed number of birds since the 2000 survey may have been attributable to increased survey effort, but did not think that the increase was entirely due to the increased effort.

2011

The survey methods followed in 2011 were largely the same as those used during the 2008 survey (Kyle and Kelsey 2011), although a different approach to coordinating the survey was used. Rather than establishing county coordinators to ensure complete coverage of each surveyed county, the 2011 survey was organized by a statewide coordinator using online resources. Volunteers were asked to sign up for survey areas using the online portal and a statewide coordinator tracked survey coverage. The survey was conducted over three days, from April 15-17.

A total of 100 volunteers participated in the 2011 survey and visited 608 historical and new locations in 38 counties (Kyle and Kelsey 2011). The total estimate for number of birds observed was 259,322.

2014

The 2014 survey followed the methods used in 2008 and 2011. As in the 2008 survey, county coordinators were again used to ensure thorough coverage of each county (Meese 2014). The survey was conducted over three days, from April 18-20.

A total of 143 volunteers participated in the 2014 survey and visited 802 historical and new locations in 41 counties (Meese 2014). Based on number of volunteers, counties covered, and number of sites visited, this was the most complete statewide completed to date. The total estimate for the number of birds observed was 145,135.

2017

The 2017 survey followed the methods used in 2008-2014. The survey was conducted over three days, from April 7-9 (Meese 2017). For 2017, additional survey forms were used to collect additional information on weather conditions, survey effort, site occupancy, and the suitability of nesting habitat at each surveyed location. Maps of survey locations were also updated and included online maps that could be used to navigate to sites in the field using a smartphone app.

A total of 181 volunteers participated in the 2017 survey and visited 884 historical and new locations in 44 counties (Meese 2017). Based on number of volunteers, counties covered, and the number of sites visited, the 2017 survey was even more thorough than the 2014 survey. The total estimate for the number of birds observed was 177,656.

Appendix 2
Comments on Tricolored Blackbird statewide survey methods

Methods of estimating population abundance and the approach used in statewide surveys

In surveys designed to estimate the number of individuals in a population, abundance data may be collected through a sampling approach that focuses on a representative subset of locations, or through a census that aims at a complete count of all birds within a survey boundary (Gregory et al. 2004). Many different approaches have been developed to sample data from a population in a defined area of interest, with the underlying goal to provide an estimate of the full population size and some measure of estimation error. Species that are spatially highly-clumped, or rare and occurring within a restricted range or at a limited number of sites, are often not amenable to sampling approaches because of the difficulty in designing an approach that results in a sample representative of the full population. These species may be more amenable to censuses, especially when highly conspicuous like the Tricolored Blackbird (Gregory et al. 2004).

Conducting a census of colonial species requires that breeding locations first be identified. For species with high site fidelity to traditional breeding locations (e.g., seabirds, some herons) it can be fairly straightforward to identify breeding sites and monitor the population of interest. Due to the dynamic occupancy patterns of Tricolored Blackbird breeding colony locations and the large geographic scale at which statewide surveys are conducted, it is not possible to ensure every breeding colony is located and counted in any given year. Because of these difficulties, the approach for statewide surveys to date (since 1994) has been to conduct early season colony detection work to identify active colonies, then to combine these with all historical colony sites to attempt a comprehensive search of known breeding locations over a short (usually 3-day) survey window.

Some unknown portion of the Tricolored Blackbird population is not located and counted during each survey, and therefore the results of statewide surveys might be best described as an index of abundance that can be compared over time to evaluate population trends. Indices are based on the idea that a fixed amount of searching effort will always locate a fixed proportion of the population; therefore, changes in the index should be directly proportional to changes in the population size (Gregory et al. 2004). The dynamic inter-annual occupancy patterns of the Tricolored Blackbird can complicate efforts to meet this assumption, but the somewhat predictable distribution in the early breeding season, paired with pre-survey efforts to locate large breeding colonies may help to address this issue. As described in the body of this report, the recent approach to statewide surveys has been an ever-increasing effort across survey years to visit as many of the known historical breeding locations as possible, which themselves increase as additional breeding locations are discovered by survey participants and as birds shift to establish new breeding locations on the landscape. An ever-increasing survey effort is not a sustainable approach to monitoring the species, and it violates the assumption of a constant search effort in indices of abundance (an increasing effort over time may allow for documentation of a negative population trend, but may confound interpretation of any observed increase in population numbers).

Recent work to establish a survey design based on a random stratified sample has provided a method to estimate the number of birds that would result from a full census without the required effort to visit all known colony sites (Meese et al. 2015). The approach followed in sample surveys conducted in 2015 and 2016 was to attempt a complete census of five counties where the majority of the population occurs each April, and to survey the remaining counties based on a stratified sample, with bioregion and nesting substrate as strata. The intent of this new survey design was to provide a method whereby the population could be monitored annually during years when a full triennial survey is not conducted, with a smaller force of volunteer surveyors. The data from these sample surveys are currently being analyzed and will likely result in revisions to the sampling approach. Results may also inform revisions to the triennial survey. Potential modifications to statewide surveys may include 1) removal of sites that are no longer suitable for Tricolored Blackbird nesting, 2) removal of sites that have not been occupied by Tricolored Blackbirds within a certain number of years, assuming sites have been surveyed on a regular basis, 3) removal of entire regions of the state where the species has declined or disappeared, or 4) increased opportunities to conduct multiple observations per colony site for estimation of detection probability and estimation error, or other modifications. Ultimately, the triennial attempts at a full census might be replaced with an annual or longer-duration sample survey.

Sources of uncertainty in Tricolored Blackbird population estimates

Geographic coverage

As shown in Figure 9 (distribution of colony sites visited 2008-2017) in the body of this report, survey locations visited during statewide surveys have been well distributed throughout the California range of the Tricolored Blackbird. As the survey effort has increased with each successive survey, the portion of the range surveyed has filled in as volunteers have visited more locations within the range. The addition of survey locations also results in an increased area searched as volunteers drive from one survey location to the next. In some years, birds at the geographic fringe of the range may have been excluded from the survey effort, but these areas have never supported large numbers of birds during the early breeding season and so this is unlikely to have a large effect on the overall estimate or index. For example, in statewide surveys in which Siskiyou County was included, it has held only 0-0.2% of the total estimate of birds observed. In some portions of the range (e.g., the Sierra foothills), there are areas with low road density and therefore some unknown number of colonies are likely missed each year. For example, Airola et al. (2016) estimated that only 36% of the available habitat was surveyed in a study of the Sierra Nevada foothills that utilized public roads (with a range of 26% to 44% depending on region of the foothills). This is a consistent omission in each survey year so it might not have a large impact on trend detection.

Detectability of colonies

Small breeding colonies are likely missed during each survey, especially in areas where small colonies might occur distant from any known colony site, and therefore are not located within the focused search area. Because Tricolored Blackbird colonies are extremely conspicuous leading up to and throughout most of the nesting cycle, most large colonies that would contribute substantially to the overall statewide estimate are likely to be observed during the 3-day search window, unless they occur at a large distance from public roads (Kelsey 2008). Given the concentration of birds in relatively few large colonies and within a few well-known and well-surveyed portions of their range, especially the San Joaquin Valley, Kelsey (2008) concluded that "it is unlikely that large numbers of Tricolored Blackbirds go undetected during the statewide surveys." Additionally, in areas of the state where most of the population breeds early in the nesting season (e.g., San Joaquin Valley), extensive pre-survey scouting occurs in an attempt to locate colonies, both for survey purposes and to initiate colony protection efforts where colonies occur on agricultural fields. Even if a colony site is not visible from a road, large colonies can be detected and identified by the species' diagnostic feeding flights as they move between the colony location and foraging habitat. The density of roads may limit observation of a portion of the landscape and some unknown proportion of colonies goes undetected each year; this is a limitation common to all survey years.

Julie Yee (Statistician with the USGS) used data from the 2008 statewide survey, which was the first statewide survey to consistently record colony absence information and contained incidentally collected double-observer data for certain colony sites, to evaluate colony detection rate. The per-visit detection probability (i.e., the likelihood that an occupied colony location will be detected) was 0.94, which is quite high (Nov 2016 email from J. Yee to N. Clipperton; unreferenced).

Commented [B1]: There is an additional method to consider that is species-specific and it was employed by me in 2006 and 2007 and resulted in the detection of many new colony locations and tens of thousands of new birds. I used dairy locations, plotted on maps, as surrogates for TRBL colony locations and surveyed known points, the dairies, for the presence of birds in April and early May both years (described in my annual final reports for these years). I found tens of thousands of birds in these 2 years and many new colony locations and conducted surveys in regions where none, as far as is known, had ever been conducted before. Also, the Portal had another effect that has been overlooked: it served as a clearinghouse for information and a coordination hub and provided a means for field workers to both provide and to seek information about the birds. The increase in communication and coordination due to the Portal has been immense, and this has led to far more thorough surveys and greatly enhanced data management.

Timing of survey and nesting phenology

The number of birds present and visible at a colony location can vary dramatically across the nesting cycle. During settlement, many more birds may be present at a site than ultimately remain to breed, and the high level of activity can make estimation difficult. However, these birds are part of the adult population and should be included in survey estimates, although this may not have been the case in 1994-2000 when estimates were adjusted using nest densities. During incubation, females may be unaccompanied by males at the colony site and may remain on their nests hidden from view. At this stage the counts of birds at a colony may result in underestimates (Hamilton et al. 1995). Visual estimates of colony size are probably best made during the nestling/fledgling provisioning stage when both parents are visible and are making regular trips to and from the colony site (Hamilton et al. 1995).

The statewide surveys have regularly been conducted in the early part of the nesting season to capture the first breeding attempts of most of the population. The timing of nesting can vary annually, so there is no way to plan survey dates for a time when most colonies are at a certain stage of the nesting cycle. Tricolored Blackbirds have begun nesting earlier in the year over the past decade, perhaps in response to climate change (e.g., see Tottrup et al. 2010, Mazerolle et al. 2011), and the survey period has been shifted to accommodate this in an attempt to sample the population during similar times in the nesting cycle.

Colony size estimation

Estimation of colony size may be the largest source of uncertainty in the number of birds estimated on statewide surveys. Hamilton et al. (1995) suggested that observer variability was a substantial source of error in population estimates, but felt that colony size estimates were accurate to within 15% based on efforts to verify colony size using nest densities. For this reason, results from the 1994 and 1997 surveys were provided with an error range of +/- 15%.

In each of the four most recent survey years (2008, 2011, 2014, and 2017), several steps have been followed to reduce the amount of observer-based error. Volunteers were provided with training in Tricolored Blackbird identification, estimation of colony size, use of maps and online tools, and a standard survey protocol. Many of the participants, especially those coordinating county efforts, have been knowledgeable observers with experience participating in multiple survey years, and the same survey participants are enlisted from year to year when possible. As with surveys from previous years, most of the largest colonies have been revisited by experienced observers to verify estimates.

Since 2008, volunteers have been asked to provide a best estimate of colony sizes, plus a range incorporating the minimum and maximum number of birds that could be present at a site. This request may be interpreted differently by different observers. For example, some observers may provide a large range to be certain that the minimum and maximum numbers capture the true size of the colony, whereas others may treat the range as a measure of their ability to accurately count the observed birds. However, it does provide some sense of how certain an observer is in their ability to accurately estimate the size of a colony. Observers show a natural tendency to overestimate small flocks and underestimate large flocks, although the extent to which different observers do this varies greatly (Gregory et al. 2004) and the effect on the overall population estimate from multiple colonies is unclear. The range provided by observers to capture the minimum and maximum estimates has averaged about +/-25% [range for 2008, 2011, and 2014 surveys of -29% to +33%] of the best estimates across all colony sites. Unfortunately, data have not been collected in a way that allows for statistical estimates of error around the annual indices of abundance, but the similar survey protocols and extensive and increasing survey effort have provided information sufficient for detecting a long-term population decline. Ongoing efforts to revise the statistical sampling scheme for monitoring the Tricolored Blackbird population will incorporate methods to produce error estimates (Meese et al. 2015).

From: Ted Beedy [redacted]
Sent: Friday, November 10, 2017 8:29 AM
To: Clipperton, Neil@Wildlife
Subject: RE: Draft Tricolored Blackbird Status Review - peer review

Hi Neil,

I finally finished my editing of your attached status review this morning, and I think you have done an extremely comprehensive, unbiased, and thorough job that really covers all the bases—congratulations on preparing a top-notch report! Per your request, I have made minor, redline editorial suggestions as well as >40 margin notes for you to consider in your final revisions. I personally think you have made a very strong case for listing this species as endangered and will look forward to seeing yours and the Department’s final decision on that.

Please feel free to call me at any time if you have questions or comments that you would like to discuss regarding my suggested edits.

Thanks,

Ted

STATE OF CALIFORNIA
NATURAL RESOURCES AGENCY
DEPARTMENT OF FISH AND WILDLIFE

REPORT TO THE FISH AND GAME COMMISSION
A STATUS REVIEW OF THE
TRICOLORED BLACKBIRD
(*Agelaius tricolor*) IN CALIFORNIA

Commented [TB1]: A TRBL photo would be nice to have on the cover, I have a large selection that you are welcome to use—check the BNA account for examples.

CHARLTON H. BONHAM, DIRECTOR

CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE

Draft – October 13, 2017

Table of Contents

EXECUTIVE SUMMARY

[Note to reviewers: The executive summary will be prepared after peer review.]

REGULATORY FRAMEWORK

Petition Evaluation Process

A petition to list the Tricolored Blackbird (*Agelaius tricolor*) as endangered under the California Endangered Species Act (CESA) was submitted to the Fish and Game Commission (Commission) on August 19, 2015 by the Center for Biological Diversity. Commission staff transmitted the petition to the Department of Fish and Wildlife (Department) pursuant to Fish and Game Code section 2073 on August 20, 2015, and published a formal notice of receipt of the petition on September 4, 2015 (Cal. Reg. Notice Register 2015, No. 36-Z, p. 1514). The Department's charge and focus in its advisory capacity to the Commission is scientific. A petition to list or delist a species under the CESA must include "information regarding the population trend, range, distribution, abundance, and life history of a species, the factors affecting the ability of the population to survive and reproduce, the degree and immediacy of the threat, the impact of existing management efforts, suggestions for future management, and the availability and sources of information. The petition shall also include information regarding the kind of habitat necessary for species survival, a detailed distribution map, and any other factors that the petitioner deems relevant" (Fish & G. Code, § 2072.3).

On October 2, 2015, the Department provided the Commission with its evaluation of the petition, "Evaluation of the Petition from the Center for Biological Diversity to List Tricolored Blackbird (*Agelaius tricolor*) as Endangered Under the California Endangered Species Act," to assist the Commission in making a determination as to whether the petitioned action may be warranted based on the sufficiency of scientific information (Fish & G. Code, §§ 2073.5 & 2074.2; Cal. Code Regs., tit. 14, § 670.1, subds. (d) & (e)). Focusing on the information available to the Department relating to each of the relevant categories, the Department recommended to the Commission that the petition be accepted.

At its scheduled public meeting on December 10, 2015, in San Diego, California, the Commission considered the petition, the Department's petition evaluation and recommendation, and comments received. The Commission found that sufficient information existed to indicate the petitioned action may be warranted and accepted the petition for consideration. Upon publication of the Commission's notice of its findings, the Tricolored Blackbird was designated a candidate species on January 8, 2016 (Cal. Reg. Notice Register 2016, No. 2-Z, p. 57).

Status Review Overview

The Commission's action designating the Tricolored Blackbird as a candidate species triggered the Department's process for conducting a status review to inform the Commission's decision on whether to list the species. At its scheduled public meeting on December 8, 2016, in San Diego, California, the

Commission granted the Department a six-month extension to complete the status review and facilitate external peer review.

This status review report is not intended to be an exhaustive review of all published scientific literature relevant to the Tricolored Blackbird; rather, it is intended to summarize the key points from the best scientific information available relevant to the status of the species. The final report represents the Department's evaluation of the current and future conservation status of the species and is informed by independent peer review of a draft report by scientists with expertise relevant to Tricolored Blackbird. It is intended to provide the Commission with the most current information on the Tricolored Blackbird and to serve as the basis for the Department's recommendation to the Commission on whether the petitioned action is warranted. The status review report also presents identification of habitat that may be essential to the continued existence of the species and provides management recommendations for recovery of the species (Fish & G. Code, § 2074.6). Receipt of this report is to be placed on the agenda for the next available meeting of the Commission after delivery. At that time, the report will be made available to the public for a 30-day public comment period prior to the Commission taking any action on the petition.

Existing Regulatory Status

California Endangered Species Act

The Tricolored Blackbird was the subject of three previous CESA listing petitions. In 1991, the Yolo chapter of the National Audubon Society submitted a petition to the Commission to list the species as endangered. After reviewing the document and other available information, the Department determined that the petitioned action might be warranted and recommended to the Commission that it accept and consider the petition. In March 1992, the Commission voted to accept the petition and designated the Tricolored Blackbird as a candidate for listing. Researchers working during the 1992 breeding season discovered that the population was much larger than previously thought and the Yolo Audubon Society withdrew the petition based on the new population data. The Commission allowed the petition to be withdrawn, but urged the Department to work with interested persons and groups to develop conservation measures for the Tricolored Blackbird. The species was again petitioned to be listed under CESA in 2004 (Cal. Reg. Notice Register 2004, No. 18-Z, p. 568). The petition evaluation report by the Department (Gustafson and Steele 2004) stated there was sufficient information to indicate the petitioned action may be warranted; however, the Commission voted to reject the petition (Fish and Game Commission meeting, Feb. 3, 2005). On October 8, 2014, the Center for Biological Diversity submitted a petition to list the Tricolored Blackbird as endangered (Cal. Reg. Notice Register 2014, No. 44-Z, p. 1861). The Commission referred the petition to the Department for an initial evaluation on October 15, 2014. At its December 3, 2014 meeting in Van Nuys, California, the Commission voted to take emergency action to add Tricolored Blackbird to the list of endangered species pursuant to Fish and Game Code section 2076.5, with the related regulation as approved by the Office of Administrative Law taking effect for an initial term of six months beginning on December 29, 2014 (Cal. Reg. Notice Register 2015, No. 2-Z, p. 91). At its meeting in Mammoth Lakes on June 11, 2015,

the Commission voted to reject the 2014 petition and on June 30, 2015 the emergency regulation adopted in December 2014 expired by operation of law.

Federal Endangered Species Act

The Tricolored Blackbird also has a listing history under the federal Endangered Species Act (ESA). In 1988, the United States Fish and Wildlife Service (USFWS) contracted for a compilation of all historical information on distribution and abundance of the Tricolored Blackbird, resulting in the work of Beedy et al. (1991). In 1991, the USFWS identified the Tricolored Blackbird as a category 2 candidate for federal listing. However, in 1996, the USFWS eliminated category 2 species from the list of candidate species. In 2004, the USFWS received a petition to list the Tricolored Blackbird as a threatened or endangered species from the Center for Biological Diversity. In 2006, the USFWS issued a 90-day finding in response to the petition that listing the Tricolored Blackbird was not warranted (50 CFR Part 17, Dec 5, 2006). On February 3, 2015, the Center for Biological Diversity submitted a petition to the USFWS to list the Tricolored Blackbird as an endangered species under the federal endangered species act and to designate critical habitat concurrent with listing. The petition is currently under review by the USFWS (50 CFR Part 17, Sept 18, 2015).

California Species of Special Concern and USFWS Birds of Conservation Concern

The Tricolored Blackbird is listed as a Priority 1 Species of Special Concern (SSC) by the Department. The Department's SSC designation is administrative and is intended to alert biologists, land managers, and others to a species' declining or at-risk status, to encourage additional management considerations for these species to ensure population viability, and to preclude the need for listing under CESA. SSCs are defined as species, subspecies, or distinct populations of animals native to California that currently satisfy one or more of the following criteria: extirpated from the state in the recent past; listed under ESA as threatened or endangered, but not under CESA; meets the state definition of threatened or endangered but has not been formally listed; experiencing, or formerly experienced, serious (noncyclical) population declines or range retractions (that have not been reversed), which if continued or resumed could qualify for threatened or endangered status under CESA; has naturally small populations and/or range size and exhibits high susceptibility to risk from any factor that, if realized, could lead to declines that would qualify it for threatened or endangered status (Shuford and Gardali 2008). In 2008, the USFWS updated its Birds of Conservation Concern report, identifying "species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act of 1973" (USFWS 2008). The Tricolored Blackbird was included on two Bird Conservation Region lists (Coastal California and Great Basin), the USFWS Region 8 list (California and Nevada) and the National list. Neither of these "species of concern" designations provides the species with formal regulatory status like the ESA or CESA; however, impacts to SSC are generally considered potentially significant under CEQA, and therefore mitigation for impacts may be provided (see Existing Management section).

Migratory Bird Treaty Act

The Tricolored Blackbird is included on the list of species protected under the Migratory Bird Treaty Act (MBTA). The MBTA makes it unlawful to take, possess, transport, sell, or purchase any bird listed in the Act, or its nest or eggs, without a permit issued by the USFWS.

California Fish and Game Code

The Fish and Game Code includes certain protections for birds, including nongame birds. Sections applicable to the Tricolored Blackbird include the following:

> Section 3503 – It is unlawful to take, possess, or needlessly destroy the nest or eggs of any bird, except as otherwise provided by this code or any regulation made pursuant thereto.
>
> Section 3513 – It is unlawful to take or possess any migratory nongame bird as designated in the Migratory Bird Treaty Act or any part of such migratory nongame bird except as provided by rules and regulations adopted by the Secretary of the Interior under provisions of the Migratory Treaty Act.
>
> Section 3800(a) – All birds occurring naturally in California that are not resident game birds, migratory game birds, or fully protected birds are nongame birds. It is unlawful to take any nongame bird except as provided in this code or in accordance with regulations of the commission.

BIOLOGY AND ECOLOGY

Species Description

The Tricolored Blackbird was first collected by Thomas Nuttall in 1836 near Santa Barbara, CA (Nuttall 1840, Baird et al. 1874). A male specimen was sent to John James Audubon who described it as a unique form of blackbird in his well-known *Ornithological Biography* (Audubon 1839).

Commented [TB2]: You give Audubon's first & middle names below, so probably should for Nuttall, as well.

The Tricolored Blackbird is sexually dimorphic, with the male plumage entirely black except for the bright red lesser wing coverts forming a conspicuous red patch on the wing ("shoulder" or "epaulets") and white median coverts forming a distinct border to the red. The black body plumage is glossed bluish when viewed in sunlight. The female is mostly dark brown dorsally and heavily streaked ventrally with dark brown streaks merging to form a largely solid dark brown belly ~~(Beedy et al. 2017)~~. The head of the female is indistinctly patterned with a whitish supercilium, malar, chin, and throat (Beedy et al. 2017).

Commented [TB3]: All of this information is in our BNA account, mostly written by Peter Pyle, so it seems the citation should come at the end of the paragraph.

Although similar in appearance to the related Red-winged Blackbird (*A. phoeniceus*), several features can be used to distinguish the two species (described by Nuttall 1840, Cooper 1870, Baird et al. 1874). The black plumage of the Tricolored Blackbird male has a soft bluish luster that is lacking in the Red-winged Blackbird. The lesser wing coverts (the red "shoulder") on the male Tricolored Blackbird are a much deeper red (described as crimson, carmine, or the color of venous blood) compared to the brighter red color (vermilion or scarlet) in the Red-winged Blackbird. The median coverts in the Tricolored Blackbird are white (pale-yellowish when fresh) and create a stark contrast between the black

and red feathers on the wing, whereas in the Red-winged Blackbird they are generally yellowish (or black in the subspecies that breeds in much of the Central Valley). The bill of the Tricolored Blackbird averages thinner and can appear more sharply pointed. In flight, the wings of the Tricolored Blackbird appear to have a more pointed shape (vs. rounded in the Red-winged Blackbird) due to differences in length of the primary flight feathers. Female Tricolored Blackbirds have darker plumage than most female Red-winged Blackbirds, although this difference is less pronounced in the Central Valley where the subspecies of Red-winged Blackbird is relatively dark (Beedy et al. 2017).

Taxonomy

The Tricolored Blackbird is a species in the avian family Icteridae, which is restricted to the Americas in the Western Hemisphere and includes blackbirds, orioles, cowbirds, grackles, and meadowlarks (Skutch 1996). There are about 100 species in the family, most of which occur in the tropics. Following recent taxonomic changes that removed several South American species from the genus *Agelaius*, there are currently five species in the genus worldwide (Remsen 2017). In addition to the Tricolored Blackbird, the only other species that occurs on the North America mainland is the much more widespread and diverse Red-winged Blackbird. The other three species in the genus occur in the Greater Antilles: *A. assimilis* (the Red-shouldered Blackbird of western Cuba), *A. humeralis* (the Tawny-shouldered Blackbird of Hispaniola and Cuba), and *A. xanthomus* (the Yellow-shouldered Blackbird of Puerto Rico) (Beedy et al. 2017). There are no recognized subspecies of Tricolored Blackbird (AOU 1957).

Geographic Range and Distribution

The Tricolored Blackbird is nearly endemic to the state of California, with small numbers of birds extending the species' range into neighboring states of Oregon, Washington, Nevada, and Baja California.

Breeding Range

The majority of the Tricolored Blackbird's breeding range is composed of two disjunct regions of California and Baja California, separated by the Transverse Ranges of southern California (Figure 1). The larger of the two areas occupies the lowlands west of the Sierra Nevada, extending west across the Central Valley to the coast from Sonoma County south to Santa Barbara County. The second area is composed of the lowlands west of the deserts in southern California, extending south into northwestern Baja California. Small numbers of birds extend the range to the north in isolated low-lying areas on the northern California coast and to isolated areas in northeastern California, Oregon, and eastern Washington. Similarly, the range extends east from the southern Central Valley to small areas in the Mojave Desert, and to a single area in Douglas County, Nevada (Skutch 1996, Ammon and Woods 2008, Beedy et al. 2017).

Winter Range

In the winter the Tricolored Blackbird mostly withdraws from the portion of its breeding range north of the Central Valley (northeastern CA, Oregon, and Washington) and from Nevada to the lowlands of

central and coastal California (Wahl et al. 2005, Ammon and Woods 2008, Beedy et al. 2017), although a small number of birds are occasionally documented throughout the northern breeding range during winter months (Gilligan et al. 1994, Spencer 2003, eBird Dataset 2016). The species can be found in most of the remainder of its range year-round, with shifts in distribution as described below.

Distribution of Breeding Colonies

Within the breeding range, the largest breeding colonies and the large majority of the breeding population occur in the Central Valley of California (Figure 2b). In all California statewide surveys conducted since 1994, most (≥90% in all years but 1997) of the population has occurred in the Central Valley counties during the early breeding season (Hamilton et al. 1995, Beedy and Hamilton 1997, Hamilton 2000, Kelsey 2008, Kyle and Kelsey 2011, Meese 2014a).

Commented [TB4]: Labeled as upper case "B" on the figure—minor point. Consider changing all a & b figures to either lower or upper case for consistency with text—I prefer lower case.

Although the overall distribution and breeding locations vary from year-to-year, Tricolored Blackbirds exhibit some fidelity to traditional use areas. These areas likely provide all of the critical resources needed by breeding colonies, while the specific nesting sites used in the area can change from year-to-year (Beedy et al. 1991). In the Central Valley, there are distinct regions that frequently support multiple colonies and a large proportion of the breeding population. In the southern San Joaquin Valley, the largest colonies are typically found annually in an area centered at the junction of Kern, Kings, and Tulare counties (Figure 2). In the northern San Joaquin Valley, Merced County regularly supports multiple large colonies. Further north in the Central Valley and Sierra Nevada foothills, breeding colonies are regularly distributed more broadly from Sacramento County north through the Sacramento Valley to Butte and Colusa counties. In southern California, breeding colonies are located mainly in the western portions of Riverside and San Bernardino Counties, south through the interior of San Diego County (Figure 2; Feenstra 2009). Colonies are patchily distributed throughout the rest of the species' range in California, particularly in the Coast Ranges and on the coastal slope.

The limited range of the species in Oregon, Washington, and Nevada is maintained by irregular occurrences of relatively small numbers of birds (Gilligan et al. 1994, Spencer 2003, Wahl et al. 2005, Ammon and Woods 2008). These neighboring states have historically supported less than 1% of the species' global population (Beedy et al. 1991). Although previously more widespread, breeding in Baja California now occurs at only a few isolated locations (Erickson et al. 2007, Erickson and de la Cueva 2008, Feenstra 2013, Erickson et al. 2016). Currently, no more than about 1% of the species' population breeds outside of California.

Breeding colonies typically occur in valleys or low-lying areas with suitable nesting habitat and extensive grassland, agriculture, or other suitable foraging habitat. However, the elevation of colony locations varies greatly across the range. The majority of the population breeds below an elevation of about 300 feet in the Central Valley. In the central Sierra foothills, colonies occur up to 1,720 feet, although most occur near the valley floor at or below about 300 feet elevation (Airola et al. 2015a). In the southern Sierra they breed up to 2,500 feet near Lake Isabella in eastern Kern County (eBird data). In the southern California portion of the range, most colonies occur below about 1,500 feet, although colonies at more inland locations are at higher elevations. Further inland, such as in the Mojave Desert and to the

Commented [TB5]: They breed regularly there, I did surveys for WIFL & TRBL for 11 years, and breeding colonies were present in almost every year, up to 5K birds.

northeast in the Modoc Plateau, colonies occur at elevations up to several thousand feet. Grinnell and Miller (1944) included a record of 4,400 feet on the "South Fork of the Pit River" in Modoc County. The single breeding location in Nevada is at 4,730 feet elevation (Ammon and Woods 2008).

Winter Distribution

Although Tricolored Blackbirds can be found throughout much of the California breeding range year-round, most birds withdraw from the southern San Joaquin Valley and the northern Sacramento Valley in the winter (Grinnell and Miller 1944, Beedy et al. 2017). Band recoveries and observational studies have documented movement of birds away from these portions of the range toward the central part of the valley surrounding and including the Sacramento-San Joaquin Delta region (Neff 1942, DeHaven and Neff 1973, DeHaven et al. 1975b). There is a general concentration of birds in this region during the winter, as well as in the northern San Joaquin Valley in Merced County and coastal areas north and south of the San Francisco Bay area (Orians 1961a, Payne 1969, Stallcup 2004) (Figure 3). Evidence from banded birds recovered outside the Central Valley is limited, but birds from throughout the northern range are thought to follow the general pattern of winter movement to central and coastal California (DeHaven et al. 1975b, Beedy 2008). Although a relatively large portion of the population winters in this region, wintering flocks can be found at widely scattered points throughout the species' range north of the Transverse Ranges (DeHaven et al. 1975b).

Commented [TB6]: Should this be DeHaven et al. 1975a since it is the first mention of DeHaven et al. 1975? I guess this would require quite a few citation changes, but typically the first mention is "a."

South of the Transverse Ranges, birds from Santa Barbara County south to Baja California appear to occupy the region year-round (Unitt 2004, Beedy 2008), although distribution in the southern portion of the range is patchy in all seasons. Recoveries of birds banded in southern California have revealed much more localized movements compared to those from the Central Valley (Neff 1942, DeHaven and Neff 1973).

Genetics and Population Structure

Hamilton (2004) documented behavioral differences between Central Valley and southern populations of the Tricolored Blackbird, and suggested that a lack of gene flow may have led to genetically distinct populations. While banding studies indicate extensive movement of the Tricolored Blackbird population throughout the entire length of the Central Valley (DeHaven et al. 1975b), DeHaven and Neff (1973) reported on recoveries of banded birds from the Central Valley and southern California and suggested that little or no interchange occurs between populations north and south of the Transverse Ranges. The observation of a single banded bird in the Mojave Desert of northern Los Angeles County was the first data documenting movement of the species from the Central Valley to the desert (Feenstra 2009), although there is a report from the late 1800s documenting a flock of Tricolored Blackbirds moving in the opposite direction (Belding 1890). In 2014 and 2016, the second and third Tricolored Blackbirds that had been banded in the Central Valley were photographed in San Bernardino County, providing further confirmation of movement from the valley to the Mojave Desert (Meese 2014b, Aug 2017 email from R. Meese to N. Clipperton; unreferenced).

Commented [TB7]: Mention what differences he observed

A single genetic study on the Tricolored Blackbird did not find evidence of significant population structuring between the Central Valley and a southern population composed of birds from the Mojave

Desert and southern California. The birds sampled in the southern population were found to exhibit higher allelic diversity, suggesting that the southern population may be an important reservoir of genetic variation for the species (Berg et al. 2010). In assessing population structure, it may be inappropriate to combine birds from the Mojave Desert with birds from south of the Transverse Ranges to represent a single southern population, especially if the Mojave Desert birds are linked to the Central Valley. In addition, samples were obtained at only two colonies south of the Transverse Ranges and at two colonies in the desert, sample sizes were small at some sites, and the study used a relatively small number of genetic markers. Researchers at UCLA are currently conducting a study using more advanced genomic techniques to characterize genetic variation, population structure, and spatial and temporal patterns of movement throughout the range of the Tricolored Blackbird (Feb 2017 email from K. Barr to N. Clipperton; unreferenced).

Movements

Most Tricolored Blackbird are resident in the state of California, with seasonal movements leading to shifts in distribution within the state over the course of a year. Grinnell and Miller (1944) wrote that the Tricolored Blackbird is "resident within State [California], but partly migratory within the Sacramento-San Joaquin drainage system; all populations are in some degree nomadic and in fall and winter normally leave the immediate vicinity of the nesting colonies." Banding studies (Neff 1942, DeHaven and Neff 1973, DeHaven et al. 1975b) and observations of unbanded birds (Payne 1969) demonstrated that most Tricolored Blackbirds reside throughout the Central Valley March through September, and then move into the Sacramento-San Joaquin Delta and northern San Joaquin Valley (primarily Merced County) and coastal locations during winter. More extensive migratory movements are made by small numbers of birds that breed north of the Central Valley as far north as the state of Washington (Wahl et al. 2005); these migratory individuals apparently mostly return to California in the winter. In southern California south of the Transverse Ranges, birds seem to undergo much more localized seasonal movements compared to those from the Central Valley (Neff 1942, DeHaven and Neff 1973).

Itinerant Breeding

Individual Tricolored Blackbirds often occupy and breed at two or more sites during the breeding season, a phenomenon known as itinerant breeding (Hamilton 1998). Itinerant breeding is a very rare trait among birds, and occurs exclusively in species that move between breeding attempts to locate or follow locally abundant food sources (Jaeger et al. 1986). Although early observers suspected that Tricolored Blackbirds nested more than once in a season at multiple locations (e.g., Neff 1937), the movements of Tricolored Blackbirds have been described as "sheerly and illogically erratic" (Neff 1942), "wanderings" (Payne 1969), and "highly nomadic" (Beedy et al. 1991). Recoveries of banded Tricolored Blackbirds provided documentation of interannual breeding at widely separated locations, but within-year movements during a single breeding season were not documented prior to the 1990s (Neff 1942, DeHaven and Neff 1973). The movements of Tricolored Blackbirds continue to be somewhat unpredictable from year-to-year, but Hamilton et al. (1995) demonstrated that most of the adults in the Central Valley breed more than once and often at different locations. This itinerant breeding follows a pattern of initial breeding in the south, mostly San Joaquin Valley and southern foothills to Sacramento

County, with a shift north for a second breeding attempt, primarily in the Sacramento Valley and adjacent foothills. The timing and degree to which this shift occurs vary from year-~~-~~to-~~-~~year (Hamilton 1998). The timing of breeding in Sacramento County was intermediate to that of the San Joaquin and Sacramento Valleys, with initiation of breeding in Sacramento County approximately 10 days later than in the San Joaquin Valley, but over a month before most breeding in the northern Sacramento Valley (Figure 4). On the Central California Coast in Monterey County, 25% of radio-tagged birds moved between study colonies during a breeding season, suggesting itinerant breeding on a smaller scale (Wilson et al. 2016).

Commented [TB8]: Based on Figure 4, this seems to be an average or approximate number of days and not an exact number.

The following discussion of seasonal movements is largely from Beedy and Hamilton (1997) and Beedy et al. (2017).

Spring Movements from Wintering Areas

The species vacates wintering areas concentrated around the Sacramento-San Joaquin River Delta and along coastal California in mid-February. Birds arrive at breeding locations and establish colonies in Sacramento County and throughout the San Joaquin Valley from early March to early April (DeHaven et al. 1975b). Colonies at foothill locations adjacent to the San Joaquin and Sacramento valleys may be settled by late March, but many are not settled until May. In southern California and Baja California, the species may nest anytime throughout April and May.

Flocks of Tricolored Blackbirds roam widely within the breeding range in the weeks before breeding begins and between breeding attempts. These flocks prospect the landscape for ~~Breeding season wanderings may serve to locate areas of~~ abundant insect food resources near which breeding colonies are established (Payne 1969). Similar behaviors have been documented in nomadic flocking species of semiarid habitats in Asia, Africa, and Australia, where colonial breeding occurs opportunistically in areas of high prey abundance (Payne 1969).

Breeding Season Movements

During the breeding season, Central Valley birds often move north to the Sacramento Valley after first nesting efforts (March–April) in the San Joaquin Valley and Sacramento County, with small numbers moving further north to northeastern California and southern Oregon (Beedy and Hamilton 1997, Hamilton 1998). On the floor of the Sacramento Valley north of Sacramento County, the largest colonies are typically not settled until May or early June. Recent banding results suggest a degree of colony cohesion, where many birds at a colony may move and breed together again in a new location, but banding results also suggest a high degree of mixing between breeding attempts. Although later nesting is typical in northern portions of the range, small colonies may form throughout the breeding season anywhere in the geographic distribution (Hamilton 1998). Radio telemetry studies have shown that birds move from one breeding colony to another while both are active, due presumably to reproductive failures at the first colony, but the causes of these movements remain undocumented (Wilson et al. 2016).

Post-breeding Movements

Most Central Valley birds occur in the Sacramento Valley at the end of the breeding season and remain there until mid-September, apparently attracted to ripening and recently harvested rice (DeHaven et al. 1975b). In mid-September most move south into the Sacramento-San Joaquin Delta, Merced County, and coastal locations.

Winter Movements

In winter, numbers decline in the Sacramento Valley and increase in the Sacramento-San Joaquin Delta and northern San Joaquin Valley (Neff 1942, Orians 1961a, Payne 1969, DeHaven et al. 1975b). Large foraging flocks have traditionally occurred in pasturelands in southern Solano County by late October and may join large flocks of several blackbird species to roost on islands in the eastern part of Suisun Marsh. Wintering flocks formerly numbering more than 10,000 birds assembled near dairies on the Point Reyes Peninsula, Marin County, by mid-October, but these numbers have been reduced in recent years. Highly variable numbers of birds also winter in the central and southern San Joaquin Valley, with flocks of hundreds or thousands seen in most years in the general area where large colonies breed in the early spring (Kern and Tulare counties; eBird Dataset 2016). Winter flocks consist at times of only Tricolored Blackbirds, either mixed-sex or single-sex, and at other times Tricolored Blackbirds occur in mixed-species blackbird flocks. Birds from one large winter roost in Sacramento County foraged over an area 32 km in diameter (Neff 1937). Winter distribution and movements need further study.

Home Range and Territoriality

Unlike most species of songbirds that defend a territory in which they nest and acquire most of their necessary resources, the Tricolored Blackbird breeds in dense colonies in which adult males defend only a small area surrounding the nest site, and this only until nests are established and eggs are laid (Lack and Emlen 1939, Payne 1969). Nest density and male territory size can vary among colonies with individual nests in the densest colonies built within a foot or less of each other (Hosea 1986, Beedy et al. 1991). In some cases two nests may even share interwoven strands of nest material (Lack and Emlen 1939). Male territories have been measured from 1.8 m^2 to 3.25 m^2 (Lack and Emlen 1939, Orians 1961) and nest densities have been observed at up to six nests per square meter (Beedy et al. 2017). The greatest nesting density reported occurred in a rare nesting substrate, giant cane (*Arundo* sp.), with 2,500 adults nesting in an area 42 x 13 feet (equivalent to 4.5 birds per square foot) (DeHaven et al. 1975a).

The small territories in dense breeding colonies cannot supply sufficient food for the adults and for the growing young, therefore most foraging occurs away from the colony site. While breeding, most foraging occurs within 2–3 miles of colony sites (Orians 1961, Hamilton et al. 1992), although longer foraging flights have been documented (up to 8 miles or more). Typically, only a portion of the landscape surround a breeding colony is suitable for foraging and the range used by individual birds in colonies is variable depending on the extent and quality of the foraging landscape.

Colonial Breeding and Social Behavior

> "To one in search of something utterly different I can heartily recommend an hour, or a day, in a Tricolor swamp… *Agelaius tricolor* is intensely gregarious, more so than perhaps any other American bird. Every major act of its life is performed in close association with its fellows… the very day of its nesting is agreed upon in concert. In continuous procession the individuals of a colony repair to a field agreed upon in quest of building material; and when the babies are clamoring the loudest for food, the deploying foragers join their nearest fellows and return to the swamps by platoons and volleys, rather than as individuals." – Dawson (1923).

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Coloniality in birds is typically defined as the breeding by a number of individuals at a more or less centralized place from which colony residents regularly depart from to search for food. This breeding strategy is most common among seabirds, in which more than 95% of species nest colonially (Danchin and Wagner 1997), ~~and~~ but it is relatively uncommon among North American landbirds.

The Tricolored Blackbird forms by far the largest breeding colony aggregations of any North American landbird (Neff 1937, Lack and Emlen 1939, Orians 1961, Skutch 1996). Bent (1958) found that the Tricolored Blackbird "nests in enormous, most densely populated colonies, the nests being placed more closely together than in any other colonies of marsh-nesting blackbirds." Grinnell and Miller (1944) stated, "one essential would seem to be provision at the site of the colony for a large number of individuals. Nests apparently must be close together and pairs usually [must be] in excess of 50 in order to meet the instinctive requirements of the species." Breeding colonies are seldom smaller than 100 nests, and in the past have been as large as 100,000 to 200,000 nests (Neff 1937, Orians 1961). Each male breeds, on average, with two females resulting in a skewed sex ratio at many breeding colonies (Lack and Emlen 1939, Orians 1961, Payne 1969, Hamilton 1998, Beedy ~~and Hamilton 1999~~et al. 2017). Although Payne (1969) observed breeding colonies consisting of as little as four nests, of the 21 colonies monitored, no colonies containing less than 100 nests were successful in fledging young.

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While the great concentration of birds in a small area is the most conspicuous feature of Tricolored Blackbird colonies, the degree of synchrony among members of the colony is no less unique (Orians 1960). Breeding within a colony is often highly synchronized, with all females in a colony typically initiating nest building within a few days (Orians 1961, Payne 1969). A flock of Tricolored Blackbirds can appear in an area in which it has been absent for months and begin nesting within days (Orians 1961). Food resources for both the breeding adults and for the provisioning of young are mostly obtained from sites away from the colony location. Insect-rich foraging areas appear to be identified and ~~utilized~~ used by all or large portions of the breeding adults in a colony until the prey base is exhausted, at which time new areas are identified and breeding birds collectively shift to new foraging sites.

Occupancy dynamics—Tricolored Blackbird breeding colonies frequently shift locations from year-to-year, though sites used each year often occur in the same traditionally used areas. In some cases Tricolored Blackbirds exhibit high inter-annual site fidelity, perhaps driven by the continued availability of essential resources, including suitable nesting substrate, water, and foraging habitat (Beedy and

Hamilton 1997). Of 72 occupied colony locations between 1992 and 1994, only 19 (26%) were active in all three years and an additional 11 (15%) were active in at least two years (Hamilton et al. 1995). In the central Sierra Nevada foothills, 58% (11 of 19) of occupied breeding colony sites in 2015 were also occupied in 2014 (Airola et al. 2015b). Of 44 sites surveyed during a three-year period in the central foothills, only eight (18%) were active in all three years and seven (16%) were active in two of three years (Airola et al. 2016). Of four colony locations monitored for three consecutive years in coastal Monterey County, all four were occupied in one year and only two were occupied in the other years (Wilson et al. 2016). Annual occupancy rates vary across nesting substrate types, with wetland, thistle, and Himalayan blackberry (*Rubus armeniacus*) locations having similar rates of about 40% (Holyoak et al. 2014). Occupancy rates are lower for triticale and other grain sites and higher for nettle colony sites. Although any given site may be unoccupied in some years, birds often return to sites over longer time periods and some sites are used in almost every year. Hosea (1986) reported ~~on~~ a colony that had been occupied for more than 30 years in Sacramento County, and was able to locate several active colonies by visiting locations reported in the literature decades earlier. The result of these complex occupancy dynamics is an extremely variable rate of site fidelity over the short-term, but fidelity to breeding locations and general breeding areas are high over the longer term.

Beedy et al. (1991) compiled all available information on breeding colony locations and identified 696 historical breeding colony locations. As of the 2016 breeding season, the number of known historical and current breeding colony locations had grown to 1,272, including all records since 1907 (Figure ~~2a~~2A). The large majority of these historical locations are not used in any given year, and many no longer meet the habitat requirements of the species and ~~so are no longer considered suitable~~are abandoned. During recent thorough statewide surveys conducted between 2008 and 2014 the number of occupied breeding locations has averaged about 140 (Kelsey 2008, Kyle and Kelsey 2011, Meese 2014). New locations are discovered each year, while other sites cease to be used. This turnover of breeding locations likely reflects shifting habitat conditions across the range and results in complex occupancy dynamics described above. Most sites, once established, are used repeatedly over the course of many years as long as local habitat conditions do not change.

Fluctuations in colony site selection and colony size have been attributed to a response of Tricolored Blackbirds to changes in local insect abundance within and across years (Orians 1961, Payne 1969, DeHaven et al. 1975a). Their colonial breeding behavior requires that the foraging landscape surrounding the nest site provide abundant insect food sources. The colonial nesting, compressed breeding cycle, and social structure of Tricolored Blackbirds are well suited for rapid exploitation of unpredictable resources when they become temporarily very abundant. Initiation of nesting may also be triggered by an abundant food source (Payne 1969).

In some cases, large breeding colonies have been observed to exhibit higher reproductive success than smaller colonies (Orians 1961, Payne 1969, Hamilton et al. 1992), and in some years a few large colonies have been responsible for the majority of the reproductive output for the year (Hamilton 1993). However, there are many examples when a positive correlation between colony size and reproductive success was not observed, and a wide variation in reproductive success has been observed in both small and large colonies (Payne 1969, Meese 2013).

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Adaptive advantages of colonial breeding may be conferred by decreasing risk of predation or increasing foraging efficiency (Ward and Zahavi 1973, Beauchamp 1999), both of which could lead to increased success in production of young. The following mechanisms have been proposed as advantages to colonial breeding:

1. Predator avoidance
2. Joint anti-predator responses
3. Predator satiation
4. Social food-finding
5. Information sharing

Predator avoidance—Colonial breeding birds frequently select sites that are inaccessible to predators (Ward and Zahavi 1973), or in some cases that are naturally free of predators (e.g., seabirds nesting on isolated islands). Tricolored Blackbirds typically select breeding locations that provide a degree of protection from predators, either by selecting inaccessible sites (e.g., wetlands surrounded by or inundated by relatively deep water) or protective nesting substrates (e.g., dense, thorny, or spinous vegetation) that limit access ~~to~~ by predators. Wetland sites may primarily limit access to terrestrial predators, whereas some dense or armored substrates may also limit access by predatory birds. In the case of a nomadic species like the Tricolored Blackbird, which does not necessarily use the same breeding location each year due to annual shifts in substrate suitability, social behavior may enhance the ability to locate these suitable locations.

Anti-predator responses—Social mobbing of predators or other aggressive behaviors is a common trait among colonial nesting birds. However, Tricolored Blackbirds do not exhibit strong defensive responses to the presence of a predator. Unlike Red-winged Blackbirds that will fiercely defend territories from potential predators that approach the nest, Tricolored Blackbirds provide little in the way of defense to eggs or nestlings (Skutch 1996). For example, when a hawk is sighted the adults in a colony may stop vocalizing and settle low within the nesting substrate, with the entire colony sometimes going silent (Orians and Christman 1968, Payne 1969). Adults may hover in the vicinity of a predator as nestlings are taken, but no pursuit of the predator is offered. Complete reproductive failure in colonies of thousands of birds can result from the efforts of relatively few predators (Beedy ~~and Hamilton 1999~~et al. 2017). Tricolored Blackbirds do not benefit from social anti-predator responses.

Predator satiation—The massive quantity of readily available prey in the form of eggs or nestlings at a Tricolored Blackbird breeding colony may reduce the chance of loss of any one nest by satiating territorial predators (e.g., raptors). Payne (1969) observed a single pair of Northern Harriers preying on a Tricolored Blackbird colony of 10,000 nests, with no impact on the large majority of the colony. Satiation of predators may be less likely in species that hunt in groups, such as many species of wading birds. In recent decades, Black-crowned Night-Herons Cattle Egrets and White-faced Ibis have caused complete failure of large breeding colonies (Beedy et al. 2017, Meese 2012, 2016). Predator satiation may provide a benefit to breeding Tricolored Blackbirds, depending on the number and type of predators.

Food-finding and information sharing—Roosting and colonial birds may take advantage of social behavior to more efficiently locate patches of concentrated food resources, and colony sites may serve as information centers where locations of good feeding sites can be shared among individuals (Ward and Zahavi 1973, Emlen and DeLong 1975, Brown 1988). Under this scenario, larger colonies may be more successful because there is a larger pool of information on the whereabouts of ~~good~~ productive feeding places within the foraging area being exploited by the colony (Ward and Zahavi 1973). This increased foraging efficiency, along with the highly synchronized nesting and the compressed length of a nesting cycle in Tricolored Blackbirds, may ensure that temporarily abundant prey will remain available to the young in a colony for the duration of the breeding cycle. Coloniality may result from situations when suitable breeding sites are limited among areas of high food availability (Danchin and Wagner 1997).

Because of occasional destruction of entire Tricolored Blackbird breeding colonies by predators and observations of prey-following by adults, Orians (1961) and Payne (1969) suggested that colonial nesting by Tricolored Blackbirds is more likely related to location and exploitation of a locally abundant food supply than to a strategy of predator avoidance or response. However, the choice of flooded or dense and armored vegetation for breeding suggests that suitable nesting locations provide some protection from predators, and predator satiation may be a successful strategy for confronting territorial predators.

Habitat that May be Essential for the Species' Continued Existence in California

For successful breeding, Tricolored Blackbirds require three critical resources: 1) secure nesting substrate, 2) a source of water, and 3) suitable foraging habitat.

Nesting Substrate

The nesting substrate for Tricolored Blackbird breeding colonies is defined as the vegetation in which nests are constructed. In most cases the nesting substrate is either flooded by water, as in wetland colony sites, or is composed of thorny or spiny vegetation that is impenetrable to many predators (Beedy and Hamilton 1997). In some cases, Tricolored Blackbird colonies occur in upland nesting substrates that lack these protective characteristics (e.g., silage grain, weedy mustard fields); in these cases the nesting substrate is usually extremely dense and therefore may provide similar protection.

The majority of Tricolored Blackbird breeding colonies have occurred in one of five nesting substrate types: 1) wetlands (either cattail [*Typha* sp.] or bulrush [*Schoenoplectus* sp.] vegetation), 2) Himalayan blackberry ~~(*Rubus armeniacus*)~~, 3) thistle, usually milk thistle (*Silybum marianum*) or bull thistle (*Cirsium vulgare*), 4) stinging nettle (*Urtica* sp.), or 5) agricultural grain fields, especially triticale, a wheat-rye hybrid grain grown as silage for dairy cattle. Several additional nesting substrates have been used to a lesser degree (less than 5% of colonies in total), with the more common being mustard (*Brassica* sp.), willows (*Salix* sp.), mallow (*Malva* sp.), wild rose (*Rosa* sp.), tamarisk (*Tamarix* sp.), and giant reed (*Arundo* sp.) (Beedy et al. 1991, Beedy and Hamilton 1997, Beedy et al. 2017, Tricolored Blackbird Portal 2017).

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The primary nesting substrates used by Tricolored Blackbirds have different distributions across the breeding range in California (Figure 5). Wetland sites with cattail or bulrush substrate are fairly evenly distributed across the range. Himalayan blackberry sites are mostly restricted to Merced County and north through the Sierra foothills to the Sacramento Valley. Triticale and other agricultural grain sites are found mainly in the southern San Joaquin Valley and Merced County, with a few additional sites in southern California. In recent years stinging nettle sites have mainly occurred in the southern San Joaquin Valley portion of Kern County including the surrounding foothill grasslands, although historically they were also common at the extreme northern portion of the California range in Siskiyou and Shasta counties. Thistle sites have been located throughout much of the range in California, and ~~has~~ have been the primary nesting substrate used in the southern Sierra Nevada foothills (Airola et al. 2016). Thistle sites are typically only available to breeding Tricolored Blackbirds in years with weather patterns that support abundant thistle growth.

Historically, most breeding colonies were in freshwater marshes dominated by cattails and tules (Beedy 2008). In the 1930s, 93% of breeding colonies were in freshwater marsh vegetation with the remaining colonies in willows, blackberries, thistles, and nettles (Neff 1937). The proportion of colonies in freshwater marshes had decreased to about 70% by the 1970s as Tricolored Blackbirds began using novel, nonnative vegetation types, especially Himalayan blackberry and thistles (DeHaven et al. 1975a). By 2008, the proportion of colonies established in freshwater marsh during the statewide survey had declined to 35% (Kelsey et al. 2008).

Tricolored Blackbirds are known to have bred in blackberry bushes from the early 1900s (Booth 1926, Neff 1934, 1937), but this was a very infrequent occurrence. Sacramento County has a long history of breeding by Tricolored Blackbirds, with colonies in the 1930s found entirely in wetland substrates and colonies in the 1970s still mainly located in wetlands (Neff 1937, DeHaven et al. 1975a). In the 1980s and 1990s, an increasing percentage of breeding colonies were reported in nonnative Himalayan blackberry (Hosea 1986, Beedy and Hamilton 1997). Over 55,000 breeding Tricolored Blackbirds were located in Sacramento County in 1993, with the large majority of these in Himalayan blackberry and a small number in wetland substrates (Hamilton 1993). Himalayan blackberry is currently the dominant nesting substrate throughout the northern and central Sierra Nevada foothills. From 2014 to 2016, 65–80% of foothill colonies have occurred in Himalayan blackberry annually (Airola et al. 2016). Between 1994 and 2004, a large shift from cattail marsh colonies to Himalayan blackberry colonies occurred in the rice-growing region of Sacramento Valley (Hamilton 2004a). This was in part due to the loss or destruction of specific cattail marsh sites, but was also likely due in part to an increase in distribution of Himalayan blackberry.

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Tricolored Blackbirds were discovered breeding in grain fields in the San Joaquin Valley in 1991 and 1992 (Hamilton et al. 1992). Prior to this, nesting in large cultivated grain fields was unknown and little work on the status of the species in the southern San Joaquin Valley had been conducted (Beedy et al. 1991, Hamilton et al. 1992). The only previous report of nesting in a cultivated grain field was from 1944, when a colony was observed in mustard-infested barley (Bent 1958). The discovery of breeding on grain fields in the 1990s corresponded to an increase in planting of triticale. This wheat-rye hybrid grain may be attractive to breeding Tricolored Blackbirds due to its robust structure that is well suited to support nests and it dense growth that is relatively impenetrable to terrestrial predators. Relatively little triticale had been planted for silage in the San Joaquin Valley by 1994, but by 2005 the planted acreage had grown to about 75,000 acres (Aksland and Wright 2005). Of the nesting substrates used by Tricolored Blackbirds, triticale and other grain fields are unique in that they are available in abundance each year in the San Joaquin Valley, and in recent years, many of the largest colonies have occurred on grain fields. Fifty percent of the breeding Tricolored Blackbirds detected in California during the 2008 statewide survey were observed nesting in triticale fields (Kelsey 2008).

During the April 2011 statewide survey, the majority of colonies (54%) in the San Joaquin Valley and Tulare Basin were located on agricultural grain crops, with an additional 22% in milk thistle. Conversely, 70% of colonies in the Sacramento Valley and Sierra Nevada foothills were in Himalayan blackberry. The majority of colonies in southern California, on the central coast, and in extreme northern California continued to occur in wetland habitats. Statewide, wetlands continued to support more colonies than any other substrate type (37%), although these wetland colonies supported only 5% of the total population reported in the statewide survey (Kyle and Kelsey 2011).

The areal extent of nesting substrate used by breeding Tricolored Blackbird colonies has ranged from a few square meters to more than 200 acres (Tricolored Blackbird Portal 2017). The smallest colonies have occurred in a variety of nesting substrate types, including cattail or bulrush marsh, Himalayan blackberry, and willows. The largest colonies of 100 acres or more have been located in triticale in recent years, although historically very large colonies occurred in wetland habitats (Neff 1937). The large majority of colonies occupy less than 10 acres of nesting substrate, with many being smaller than one acre. DeHaven et al. (1975a) found that the area occupied by nests in all substrates types averaged less than two acres per colony, and the largest colonies observed from 1968 to 1972 occupied only 10 acres.

Nest densities vary widely across nesting substrates. DeHaven et al. (1975a) observed densities up to 66,670 nests per acres (100,000 breeding adults per acre) in Himalayan blackberry colonies, with the average density in blackberry colonies closer to 16,000 nests per acre. Densities in other common nesting substrates (cattails, bulrush, thistle, and willows) had densities of up to 13,340–20,000 nests per acres (20,000–30,000 breeding adults per acre), with average densities ranging from 3,300 to 4,800 nests per acre (DeHaven et al. 1975a).

Water

Breeding Tricolored Blackbirds require an open, accessible water source in the vicinity of the breeding location. Adults use the water for drinking and bathing, and will sometimes submerge insect prey items before provisioning young. The requirement for open water can be met by any of a number of sources, including wetlands, streams, ponds, reservoirs, and agricultural canals or ditches. Water must be available within a few hundred meters of the nesting substrate (Hamilton 1995). The loss of local water sources during the nesting cycle has caused entire colonies to abandon their nests (Beedy et al. 1991).

Foraging Habitat

The Tricolored Blackbird breeds in dense colonies with the individual territories that are defended by each male consisting of a very small area. These dense congregations of large numbers of birds exert large pressures on the foraging landscape surrounding the nesting location. Unlike most other landbirds, Tricolored Blackbirds forage almost exclusively away from the nesting territory, and colonies require suitable foraging habitat with abundant insect prey within a few miles of the colony site. Because provisioning success and the resulting rate of nestling starvation have been shown to influence reproductive success, the availability of high quality foraging habitat is as important to Tricolored Blackbird breeding as is the availability of suitable nesting substrate (Hamilton et al. 1992). The proximity to highly abundant insect food supplies ~~may be~~ is an important ~~a~~ factor in the selection of breeding sites by Tricolored Blackbirds (Neff 1937, Orians 1961, Payne 1969), and their nomadic and colonial behavior may have evolved as a strategy for maximizing the ability to locate and exploit unpredictable and temporarily abundant insect food sources. The required foraging habitat for successful breeding has a much greater spatial extent than nesting substrate. Although data are not available to define the minimum extent of foraging habitat, it has been reported that colonies with less than 200–300 acres of foraging habitat do not persist and access to several thousand acres is necessary to maintain most large colonies (Hamilton 2004b).

Primary foraging habitats during the breeding season include grasslands, shrublands, pastures, dry seasonal pools, and certain agricultural crops including alfalfa and rice, which provide for high production of insect prey for breeding Tricolored Blackbirds. Grasslands and alfalfa have been shown to be important in predicting presence of breeding Tricolored Blackbird colonies, with probability of colony occurrence increasing with increasing proportion of these land cover types within 3 miles (NAS 2017). Adults will also sometimes exhibit aerial foraging above wetland colonies when aquatic insects are hatching (Beedy et al. 2017). Adult birds also frequently feed at cattle feedlots and dairies where they have access to abundant grain sources. Among grassland foraging habitats, Hamilton et al. (1995) reported that ungrazed grasslands were preferred over heavily grazed grasslands by foraging Tricolored Blackbirds, but this conclusion has not been reported in later studies of grassland foraging birds (Meese 2013, Airola et al. 2015a, 2016). Tricolored Blackbirds breeding in agricultural landscapes ~~make little~~do not use of most row crops, vineyards, or orchards (Hamilton et al. 1992). During the 2000 statewide survey, Hamilton (2000) found that over 90% of observed Tricolored Blackbird foraging activity occurred on private property.

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Commented [TB17]: I'd say they never use row crops, orchards, or vineyards!

In Sacramento County, Hamilton et al. (1992) reported that 96% of all foraging by breeding Tricolored Blackbirds occurred in grasslands. This reliance on grasslands by Sacramento County and foothill breeding birds has persisted. In 2014, 90% of birds breeding in the central Sierra Nevada foothills, including Sacramento County, foraged in grasslands and pasture (Airola et al. 2015a).

Mailliard (1900) described the distinctive flight of Tricolored Blackbirds in the process of feeding nestlings as a "stream composed of birds going toward the tules with their bills full of bugs and of equal numbers returning to the fields for fresh supplies." Both prey abundance and proximity to the colony site likely influence the reproductive success of a colony. In at least some cases, adults foraging near the colony site bring few prey items to their young, while adults foraging more distant return with many more prey items (Orians 1980, *cited in* Skutch 1996). This may be a mechanism to conserve energy by making fewer long-distance flights and shows the value of foraging habitats in close proximity to colony sites; however, the possibility that proximate food sources had been exhausted during observations cannot be ruled out. When abundant insect prey are available adjacent to colony locations, adults will make only very short foraging flights to acquire prey. Most foraging occurs within about 3 miles of the colony location, although Hamilton et al. (1992) reported maximum foraging flight distances by breeding birds of up to 8 miles. In the Central Valley from 2006 to 2011, Meese (2013) observed adult Tricolored Blackbirds foraging up to 5.6 miles from the colony location.

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Several authors have suggested that regional insect abundance plays a role in breeding colony site selection, and that a super-abundant insect population may stimulate nesting behavior (Lack 1954, Orians 1961b, Orians and Collier 1963, Collier 1968, Payne 1969). This could explain the variation in general distribution of colonies between years (DeHaven et al. 1975b). The highly synchronized and colonial breeding system may have adapted to exploit an unpredictable environment where locations of nesting substrate and abundant insect food resources changed unpredictably from year to year (Orians and Collier 1963). Although Meese (2013) demonstrated that colony reproductive success depends on local availability of insect prey (usually within 3-5 miles of the nesting location), the role that insect abundance in foraging habitats has on colony site selection has not been investigated.

Diet and Food Habits

For most of the year, the majority of food items taken by Tricolored Blackbirds consist of plant material, especially seeds. However, during the breeding season, adult females require large amounts of high-protein insect prey for egg production and nestlings require a protein-rich diet for growth and development (Crase and DeHaven 1977). Nestlings are fed almost exclusively animal matter for the first nine days after hatching, at which point parents begin to introduce plant matter into the diet (Hamilton et al. 1995). Colonies consisting of many thousands of adult birds and growing nestlings require an immense amount of insect prey during short windows of time. The availability of insect prey in the foraging landscape likely influences the establishment of breeding colonies, and an abundant prey base is essential for successful breeding.

Nestlings have been provisioned with a wide variety of prey items, including grasshoppers and crickets (order Orthoptera), beetles, weevils, and water beetle larvae (order Coleoptera), moths and butterflies (including caterpillars; order Lepidoptera), and to a lesser degree spiders, flies, tadpoles, snails, and emergent dragonflies, damselflies, and midges (Payne 1969, Crase and DeHaven 1977, Skorupa et al. 1980). At three breeding colonies in Merced County where adults often foraged for prey in alfalfa and grain fields, animal matter made up 91% of food volume for nestlings and fledglings, with moth larvae, beetles, and weevils the primary food items (Skorupa et al. 1980). In foothill grasslands, grasshoppers have often been the primary prey item fed to nestlings (Payne 1969, Airola et al. 2015a). In a diet study that included colonies from several regions of the Central Valley located among a variety of foraging substrates, animal matter made up more than 86% of the total volume of nestling food (Crase and DeHaven 1977). Ground beetles were the predominant food item when averaging across all colonies, followed by water beetle larvae, grasshoppers and crickets, and weevils. Colonies differed significantly in the primary food items provided to nestlings, with differences in foraging substrate responsible in some cases. For example, colonies with water beetle larvae as the predominant food source were located in rice-growing areas, and the greatest percent of grasshoppers were fed to nestlings at colonies bordered by grassland (Crase and DeHaven 1977).

Early observers noted that nestling and fledgling Tricolored Blackbirds were frequently fed grasshoppers, leading to descriptions of the species as a grasshopper-follower (Belding 1890, Bendire 1895, Mailliard 1914, Orians 1961). Payne (1969) observed breeding adult Tricolored Blackbirds at colonies in the Sacramento Valley foraging primarily in grasslands and providing nestlings with a diet composed of 47% grasshoppers; crickets, beetles, and spiders were also acquired in grasslands and fed to young in smaller amounts. Payne (1969) suggested that the movements of Tricolored Blackbirds during the breeding season paralleled the nomadic movements of rangeland grasshoppers in California and compared the Tricolored Blackbird with “locust bird” species of Asia and Africa. Grasshoppers continue to provide a valuable food source to Tricolored Blackbird colonies, especially when adjacent to grasslands and pastures (Airola 2015a), but Tricolored Blackbirds have been shown to be more flexible in breeding season diet, as long as an abundant insect source is available.

In the spring and summer, the proportion of animal material consumed by adult Tricolored Blackbirds in the rice-growing region of the Sacramento Valley was 28% and 39%, respectively, with primary prey items including ground beetles, water beetle larvae, and orthopterans (Crase and DeHaven 1978). At four breeding colonies in agricultural areas of Merced County, animal matter made up 56% of food volume for adult females and 28% for adult males (Skorupa et al. 1980). The most consumed animal foods were beetles and weevils, moth larvae, and flies; the predominant plant foods consisted of oats (*Avena* sp.) and filaree (*Erodium* sp.), and to a lesser degree chickweed (*Stellaria* sp.) and pigweed (*Amaranthus* sp.). In the nonbreeding season, Tricolored Blackbirds are more strictly granivorous, although a variety of plant and animal matter is taken opportunistically. One study in the rice-growing region of the Sacramento Valley revealed that about 90% of the fall and winter diet consisted of plant material, primarily seeds of rice, other grains, and weed seeds (Crase and DeHaven 1978).

Reproduction and Survival

Breeding typically extends from mid-March through early August (Beedy et al. 2017). Autumnal breeding has been observed in the Central Valley (September–November; Orians 1960, Payne 1969) and in Marin County (July–September; Stallcup 2004), although not since 1964 and 2003 in the Central Valley and Marin County, respectively. From initiation of nest building to independence of fledged young, the nesting cycle of the Tricolored Blackbird is about 10 days shorter than that of the Red-winged Blackbird, mostly due to rapid progression through the nest building and egg laying stages (Payne 1969). The condensed length of the nesting cycle may be a function of the synchronized colonial nesting and an adaptation to take advantage of unpredictable periods of abundant and temporary insect food sources (Payne 1969, Skutch 1996).

Nest building and incubation are performed exclusively by the female, but the male takes an active role in feeding the young (Lack and Emlen 1939, Orians 1960). Although female Tricolored Blackbirds breed in their first year, most males may defer breeding until they are at least two years old (Payne 1969). This contributes to a skewed sex ratio at many breeding colonies, with each male breeding on average with two females (Lack and Emlen 1939, Orians 1961, Payne 1969). Although colonies with even sex ratios or with more skewed sex ratios (each male breeding with more than two females) have been observed (Hamilton et al. 1995), for monitoring purposes it is often assumed that each nest in a colony represents 1.5 breeding birds.

Successful breeding (i.e., production of any fledglings) was found to be positively correlated with colony size by Payne (1969); all colonies (n=7) that produced no fledglings contained 200 or fewer nests, while only one of seven successful colonies was smaller than 400 nests. Hamilton (1993) observed that the largest colonies in a single year of observation produced the highest estimates of reproductive success. Meese (2013) demonstrated a weak positive correlation between reproductive success and colony size over a six-year period ($r = 0.53$, $r^2 = 0.28$).

Reproductive success, defined here as the number of young fledged per nest, has been the generally accepted method for estimating productivity of Tricolored Blackbird colonies (Hamilton et al. 1995, Meese 2013, Holyoak et al. 2014, Airola et al. 2015a). Reproductive success has been estimated in one of two ways: visual estimation of the number of fledglings or nest sampling via walking transects through active colonies. When estimating reproductive success by visual counts of fledglings, colonies are visited at several-day intervals (often four days but in practice this has been variable), and fledglings observed at each visit are assumed to represent unique birds. The total number of fledglings observed on all site visits and the estimated number of nests based on the number of breeding birds are used to estimate the number of fledglings produced per nest. When estimating reproductive success by nest transects, it has been common practice to count the number of young per nest during the portion of the nest cycle when nestlings are 7–9 days old (Hamilton et al. 1995, Meese 2013). Entering colonies when nestlings are less than seven days old inflates the reproductive success estimate by underestimating nestling mortality and entering colonies when greater than 9 days of age causes the nestlings to jump from the nests prematurely. As a result, reproductive success estimates obtained by the transect method represent the maximum number of young fledged per nest. Therefore, the two methods of estimating reproductive success measure two somewhat different indices of productivity.

In 1992, reproductive success was relatively high at three colonies on wetlands and agricultural crops in the San Joaquin Valley (average RS = 2.7) and at Himalayan blackberry colonies in Sacramento County (average RS = 2.2) (Hamilton et al. 1992). Average reproductive success on wetlands in the Sacramento Valley was lower that year at 0.6 young per nest. Similar values of reproductive success were observed in 1994 (Hamilton et al. 1995). In 2000, reproductive success improved in the Sacramento Valley with three large colonies that did not experience heavy predation averaging 1.4 young per nest (Hamilton 2000), although the average reproductive success across all locations and substrate types was lower at 0.9 in 2000.

Many Tricolored Blackbird colonies in the Central Valley exhibited relatively low reproductive success from 2006 to 2011. Meese (2013) estimated reproductive success at 47 colonies, representing most of the largest colonies each year, during this six-year period ranging in size from 800 to 138,000 breeding birds. About half of the monitored colonies were in wetlands (n = 23), with the rest in thistle (n = 11), triticale (n = 9), and Himalayan blackberry (n = 4). The average reproductive success across all sites and years was 0.62. Reproductive success did not vary significantly across substrate type, although colonies that were destroyed by harvest of the grain nesting substrate were not included in the study results. Low productivity during this time resulted in very few young Tricolored Blackbirds being produced in the southern San Joaquin Valley where a large portion of the population's first annual breeding attempts occur (Figure 6). Incidental observations in 2012 and 2013 suggested that the trend of low reproductive success continued. Meese (2013) linked reproductive success at Central Valley colonies to relative abundance of insect prey at foraging sites, suggesting that many Tricolored Blackbird colonies may have been food-limited. High levels of predation plus destruction of colonies to harvest during this time also contributed to the low overall production of fledglings (Meese 2011, 2012).

Commented [TB20]: Using which method?

Although limited research has been conducted to estimate reproductive success at colonies since 2011, observations of large numbers of fledglings at multiple colonies suggest that the species has had at least some success in recent years. In 2015, the estimated reproductive success at five colonies on agricultural grain fields averaged 0.6–1.9 fledglings produced per nest (Aug 2015 presentation from NRCS to Tricolored Blackbird Working Group; unreferenced). In 2016, eight of nine known colonies on agricultural grain fields fledged at least some young, although efforts to estimate reproductive success were limited. Only one colony in silage was both accessible and uniform in nest density to allow for nest transects and resulted in an estimated reproductive success of 0.44 (Frazer 2016). At four colonies in Himalayan blackberry, cattail, and milk thistle that ranged in size from 5,000 to 12,000 birds, reproductive success estimates ranged from 0.4 to 0.67 (Meese 2016). In 2017, all known silage colonies at seven locations fledged at least some young. Some of these experienced very low reproductive success, but at least two had high success and produced several thousand fledglings. Several additional colonies in other nesting substrates were reported to have high (although unquantified) reproductive success in 2017, with four wetland colonies in the San Joaquin and Sacramento valleys producing at least several thousand young (Colibri 2017, Meese 2017). As in other years, many other colonies were observed to have low success. These limited quantitative estimates and additional qualitative assessments are difficult to compare directly to previous work due to the high variability in reproductive success across colonies and the inconsistent methods used to evaluate reproductive success.

Parents reduce the size of broods at many colonies after the hatching of eggs (Hamilton et al. 1995). Often the majority of eggs in a clutch (usually three or four) will hatch but each nest typically fledges a reduced number of young, either due to parents not feeding all nestlings which leads to starvation, or by the active removal of nestlings from the nest by parents (Payne 1969, Hamilton et al. 1995). This is likely because of a shortage of food supplies. When abundant food is available each nest produces more fledglings (Meese 2013), and as many as four young are raised per nest at productive colonies (Hamilton et al. 1995).

In many years, overall reproductive success at many or most colonies has been relatively low, but estimates have also been highly variable across colonies. Of 21 colonies observed by Payne (1969) from nest building through termination of the breeding effort, including both successful and unsuccessful colonies, only about 40% of nests produced fledglings. High rates of reproductive success at a few large colonies can produce large numbers of fledglings. For example, three colonies representing 50,000 nests accounted for the production of an estimated 100,000 fledglings in 1993, while many smaller colonies produced no or few fledglings in the same year (Hamilton 1993). Meese (2013) observed high variability in reproductive success in both triticale and milk thistle colonies from 2006 to 2011 (range 0.01–1.44). The relatively high reproductive success at a small number of colonies was demonstrated to be a function of a high insect abundance in nearby foraging areas (Meese 2013). Low reproductive success has been implicated in Tricolored Blackbird population declines over the last two decades (Cook and Toft 2005, Meese 2013). Occasional high rates of reproductive success at a few large colonies may be a successful strategy for long-term population viability, but the degree to which infrequent bouts of high success can compensate for the low reproductive success that may be persistent and widespread across most colonies is unknown.

Reproductive output has been observed to vary across substrate types (Hamilton et al. 1992, Hamilton 2000, Holyoak et al. 2014). Holyoak et al. (2014) modeled occupancy rates in the most common nesting habitat types in recent years (2006–2011) and considered data on abundance, reproductive success, and frequency of use for each nesting habitat type to determine the net reproductive output of different nesting habitats over time. Occupancy rates and other factors that influence reproductive output varied across habitat types, resulting in variation in the importance of habitats to Tricolored Blackbird productivity. Four nesting habitat types had sufficient sample size to make strong conclusions about average reproductive output, including Himalayan blackberry, nettles, wetlands, and grain fields. Himalayan blackberry and nettle colonies exhibited higher than average reproductive output. High overall reproductive output for nettle colonies is a little unexpected given that there are very few colonies, which are of average size, in this nesting substrate. However, high rates of occupancy and reproductive success result in high overall reproductive output for nettle colonies. Himalayan blackberry colonies exhibit average occupancy rates and size, but high reproductive success and the large number of colonies in this nesting substrate (the second most frequent colony type after wetlands) lead to high overall reproductive output. Grain field colonies exhibit average overall reproductive output, despite having low occupancy rates, low reproductive success, and a small number of colonies on grain fields each year; the very large size of grain field colonies increases the overall reproductive output. Of the four nesting habitat types assessed, wetlands remain the most common nesting habitat used by breeding Tricolored Blackbird colonies in recent years. Despite this, average levels of occupancy, reproductive success, and size of marsh colonies have led to the lowest overall contribution to reproductive output among the four nesting habitat types.

Between 1992 and 2003, estimated reproductive success was significantly higher in nonnative Himalayan blackberry (RS = 2.0) than in native emergent cattail and bulrush marshes (RS = 0.5; Cook and Toft 2005). Excluding colonies that were lost to harvest, colonies on silage grain fields had an intermediate reproductive success (RS = 1.0). Meese (2013) did not observe this pattern from 2006 to

2011, when overall reproductive success was much lower and differences in reproductive success between substrates were not significant (unharvested triticale RS = 0.73; Himalayan blackberry RS = 0.44; wetland RS = 0.31), although only four Himalayan blackberry colonies were included in the sampled colonies. In 2014, Airola et al. (2015a) estimated the average reproductive success at four Himalayan blackberry colonies in Sacramento County as 0.84 fledglings per nest. Although the methods used were slightly different, this estimate is within the range of reproductive success estimates observed in all nesting substrate types by Meese (2013) during six years of low reproductive success (average RS = 0.62; range 0.01–1.44), but the range of values observed by Airola et al. was much narrower (0.66–0.90).

After fledging, Tricolored Blackbirds often leave the vicinity of the nest and congregate in groups of young birds from many different nests. These fledgling groups will often congregate near the edge of the nesting substrate nearest the foraging grounds being used by the adults, where they are fed when adults return to the colony site (Payne 1969). A group of fledgling Tricolored Blackbirds has been referred to as a crèche (Hamilton 1998, Beedy et al. 2017). The formation of crèches generally occurs among birds that breed in large colonies and whose eggs all hatch at about the same time (examples of other crèche-forming species include terns and penguins). Supervision of unrelated offspring by a small number of adult guardians is usually considered a characteristic of crèches, although it is unclear whether this is the case in Tricolored Blackbirds. A single large colony of Tricolored Blackbirds can produce many crèches, and a single crèche may include several thousand fledglings. Crèches can persist for up to one to two weeks, and have been observed as far as three miles from a colony site (Payne 1969, Hamilton et al. 1995).

There are no published studies on the annual survival rate of Tricolored Blackbirds, but banding studies have shown that individuals can live up to 13 years (Neff 1942, DeHaven and Neff 1973). Meese (2014b) used recapture data to estimate the average annual adult survivorship of Tricolored Blackbirds as 60%. Estimates of annual survival rates for other temperate blackbirds have ranged from 42% to 60%, with rates for the closely-related Red-winged Blackbird ranging from 42% to 54% (Fankhauser 1971, Searcy and Yasukawa 1981).

[Note to reviewers: Results of recent analyses of banding data by Cornell University provide revised estimates of apparent annual survival that differ from that reported here (adult female survival rate ~0.5-0.9, depending on year). Results have not been finalized and will be incorporated after further discussion with Cornell to verify preliminary results.]

STATUS AND TRENDS IN CALIFORNIA

Range

Nuttall (1840) observed the Tricolored Blackbird along the coast of California in the 1830s and, without offering any supporting evidence, suggested that the Tricolored Blackbird range extended into Oregon and Mexico. In the mid-1800s, Cooper (1870) reported the species to be common on the southern California coast from Santa Barbara to San Diego, with the range to the north passing “more into the interior, extending up as far as Klamath Lake and southern Oregon." Bendire (1895) reported the range as "[s]outhwestern Oregon, south through California, west of the Sierra Nevada, to northern Lower [Baja] California." Bendire knew of no reports of the species north of Klamath Lake in southwestern Oregon, and thought it to be uncommon there. The range of the species was confirmed to include northern Baja California in the late 1800s, with A. W. Anthony reporting them "[r]ather common along the northwest coast, breeding in all fresh-water marshes" (Bendire 1895).

Following a period of years with no reported sightings of Tricolored Blackbird in Oregon, Neff (1933) reported a number of observations of the species from 1931 to 1933, all within 30 miles of Klamath Falls, and consisting collectively of fewer than 60 birds. Richardson (1961) reported up to several hundred Tricolored Blackbirds near Medford, Oregon in 1957 and documented breeding colonies of 1,500 and 1,800 birds in the region in 1958 and 1960, respectively. Inconsistent observations during the 1800s and early 1900s at the northern extent of the species range may represent shifts in distribution over time or are perhaps the result of limited survey coverage. The species has continued to breed in small numbers in the vicinity of Klamath Falls to the present time, and small numbers of birds continue to occur near Medford during the breeding season. Small breeding colonies (30 or fewer birds) were observed in three northern Oregon counties (Multnomah, Umatilla, and Wheeler) in the 1980s (Beedy et al. 1991). Since the 1990s, several hundreds of birds have occurred regularly in central Oregon near the town of Prineville in Crook County, and breeding has been confirmed in the area. In recent decades, the species has been documented in several other isolated locations in western Oregon and eastern Washington, almost always in very low numbers but occasionally numbering in the hundreds of birds (Gilligan et al. 1994, Spencer 2003, eBird Dataset 2016). The degree to which these records represent recent range expansion to isolated areas, irregular use of the region, or increased survey coverage is unclear, but it appears that small numbers of birds may have recently expanded the species' range to at least some isolated areas in the north (Gilligan et al. 1994, Wahl et al. 2005).

Ammon and Woods (2008) describe the recent discovery and status of breeding Tricolored Blackbirds at a single location in western Nevada, and report that there was no confirmed breeding in Nevada prior to 1996. However, Wheelock (1904) described the distribution of the species in the early 1900s, and reported that in the vicinity of Lake Tahoe, "these birds stray across the crest, but not in the numbers in which they are found westward." The species was also reported to have bred at Lake Tahoe in the early 1900s (Dawson 1923) and Hosea (1986) reported a breeding colony in Carson City, Nevada in 1980.

In the early 1900s, the Tricolored Blackbird occurred in northwestern Baja California south to about the 30th parallel north (Grinnell 1928). This is consistent with recent breeding records from the southern extreme of the species range near El Rosario (Erickson et al. 2007, Feenstra 2013).

The above historic accounts from the periphery of the range are largely consistent with the current range of the species, and overall, the range of the Tricolored Blackbird has changed little since at least the mid-1930s (Beedy et al. 2017). However, the species appears to be experiencing a range retraction in the southern California portion of the range and in Baja California, as discussed below.

Commented [TB21]: I think the latter explanation is more likely.

Commented [TB22]: You might consider subheaders for different states.

Commented [TB23]: Give location, in Carson Sink?

Commented [TB24]: I really doubt this one, way beyond their range & much too high in elevation.

Distribution

There are no descriptions of the distribution of the Tricolored Blackbird before the widespread conversion of native habitats across much of its range in California. However, accounts by early naturalists in California provide several records of the Tricolored Blackbird in the 1800s and early 1900s that document the local abundance, and to some extent, the distribution of the species prior to any systematic study of the species across its range.

The early anecdotal reports from the 1800s and early 1900s, although typically not quantitative, informed the historical distribution of birds and demonstrated the occurrence of large numbers regionally. Most early observations of large numbers of birds were from the Central Valley and southern California, and only small numbers of birds have occurred north of the Central Valley, both historically and in recent years. Therefore, this report discusses changes in distribution for the Central Valley and for southern California, which have supported the majority of the population and for which adequate information is available to assess long-term changes in distribution.

Central Valley

In 1852, Heermann reported frequent encounters with winter flocks of Tricolored Blackbirds in the Suisun Valley that numbered “so many thousands as to darken the sky for some distance by their masses” (Baird et al. 1874). The Tricolored Blackbird was known to be an abundant breeder in the interior valleys of California in the late 1800s (Bendire 1895). Belding (1890) observed “an immense colony” near Stockton in 1879. Ray (1906) noted the species breeding at various points on an automobile trip down the San Joaquin Valley from Stockton to Porterville in 1905. Linton (1908) observed a breeding colony at Buena Vista Lake at the southern edge of the Central Valley in 1907. Lamb and Howell (1913) reported seeing “hordes” of Tricolored Blackbirds at Buena Vista Lake in 1912. Dawson (1923) reported the species as “locally abundant in the Great Interior [Central] Valley.”

Neff (1937) was the first to attempt to document the rangewide status and distribution of Tricolored Blackbirds. Over a six-year period from 1931 to 1936, Neff located breeding colonies throughout the Central Valley and at a few additional locations in California and southern Oregon; however, Neff’s surveys focused on the Sacramento Valley in most years. Based on his somewhat geographically limited efforts, Neff (1937) reported nesting birds in 26 California counties over the six-year study. During this period, the rice-growing areas of the Sacramento Valley appear to have been the heart of the Tricolored Blackbird’s distribution, although it is not clear whether this was due to survey efforts being focused there and the limited effort applied further south in the San Joaquin Valley.

Commented [TB25]: I suspect that this was the case, since his research was funded to look at rice depredation and this crop is not grown in the San Joaquin Valley. From what I could tell, he didn’t spend much time down there.

Bent (1958) reported that the center of abundance for the species seemed to be in the San Joaquin Valley. Orians and Christman (1968) reported that the largest colonies occurred in the rice-growing districts of the Central Valley (mainly the Sacramento Valley and northern San Joaquin Valley). Neither of these reports were based on systematic surveys of the valley and have limited utility in documenting species distribution, other than that the majority of the population continued to occur in the Central Valley.

The distribution of colonies encountered over a five-year period by DeHaven et al. (1975a) was similar to that observed 35 years earlier by Neff (1937). DeHaven et al. (1975a) reported that 78% of colonies located between 1968 and 1972 were in the Central Valley. Most colonies and breeding birds were found in the Sacramento and northern San Joaquin Valleys, including Butte, Colusa, Glenn, Yolo, Sacramento, Merced, and Stanislaus counties. In the 1980s, the largest colonies and the majority of the known population continued to breed in the Sacramento and northern San Joaquin valleys (Hosea 1986, Beedy et al. 1991).

Commented [TB26]: Yes, but at that time we didn't know about their use of silage fields.

An apparent early nesting season shift in distribution from the Sacramento Valley to the southern San Joaquin Valley occurred at the end of the 20th century. Although breeding had been documented in the San Joaquin Valley since the 1800s, this region had not been the focus of intense monitoring efforts prior to the 1990s. DeHaven et al. (1975a) reported that areas with suitable nesting substrates were scarce in the arid southern San Joaquin Valley in the 1970s. As described above, loss of native wetland breeding habitat had resulted in a shift to novel nonnative vegetation types beginning by the 1970s, and the distribution shift away from the Sacramento Valley is presumably in part due to these changes in nesting substrate availability. In the early 1990s, Tricolored Blackbirds were discovered breeding in grain fields in the San Joaquin Valley (Hamilton et al. 1992, Hamilton 1993). This discovery corresponded to an increase in the number of dairies and the associated expansion of triticale in the San Joaquin Valley as dairies began growing this new crop for silage. By 1994, most of the largest colonies and 40% of known breeding birds in the early part of the breeding season were found in the southern San Joaquin Valley associated with dairies and cattle feedlots (Hamilton et al. 1995). Relatively little triticale had been planted for silage in the San Joaquin Valley by 1994, but by 2005 the planted acreage had grown to about 75,000 acres (Aksland and Wright 2005).

The shift in distribution to the San Joaquin Valley during the early breeding season has persisted, with very large proportions of the population nesting in a few large "mega-colonies" adjacent to dairies in the San Joaquin Valley (Kelsey 2008). In 1994, 68% of the estimated population in the early nesting season occurred in the San Joaquin Valley; this increased to 86% and 89% by 2008 and 2011, respectively (Hamilton et al. 1995, Kelsey 2008, Kyle and Kelsey 2011). In 2011, the 10 largest colonies were in the San Joaquin Valley during the early season survey (Kyle and Kelsey 2011). Breeding sites on triticale and other silage crops are also generally near other important habitat features, including irrigated pasture, grassland, or alfalfa crops for foraging, and available open water. The degree to which the apparent shift from the Sacramento Valley to the southern San Joaquin Valley is due to the loss of nesting habitat, the availability of a novel nesting substrate, or an increase in survey effort in the San Joaquin Valley is unknown (DeHaven 2000). Nevertheless, there has been a consistent use of the region by a majority of the Tricolored Blackbird population since the mid-1990s (Figure 7). The proportion of the population breeding in the San Joaquin Valley during the early part of the breeding season dropped to about 52% in 2014. This drop was in part due to increases in the number of birds in the Sacramento Valley, including the Sierra Nevada foothills, and southern California, but was primarily the result of a large rangewide decline, with most of the decline in number of birds occurring in the San Joaquin Valley (see the Regional Shifts in Abundance section). In 2017, the proportion of birds nesting in the San Joaquin Valley in the early breeding season returned to almost 70% (Meese 2017).

The grasslands and pastures of southeastern Sacramento County have seen consistent use by breeding Tricolored Blackbirds for at least the last 80 years (Neff 1937, DeHaven et al. 1975a, Hosea 1986, Beedy et al. 1991, Cook and Toft 2005, Airola et al. 2016), even as the dominant nesting substrate in the region has shifted from native wetlands to Himalayan blackberry (see Nesting Substrate section). DeHaven et al. (1975a) described the pasturelands of southern Sacramento County as the most consistently used area during a five-year study. Until recently, little emphasis has been placed on monitoring Tricolored Blackbird colonies in the Sierra Nevada foothills and grasslands/pasturelands of the eastern Central Valley relative to population centers in the Central Valley and in southern California. Observations of colonies from this region during statewide surveys have usually been lumped with the Central Valley for reporting purposes. Starting in 2014, these grasslands in the low elevation foothills have received focused monitoring as a distinct breeding area (Airola et al. 2015a, 2015b, 2016), with regular use reported for not only Sacramento County, but also from Butte County in the north to Stanislaus County in the south. In 2016, precipitation patterns supported growth of milk thistle patches across extensive areas in the foothills further south as far as Fresno County, resulting in breeding by more than 22,000 birds that had not been observed in the region in the two previous years (Airola et al. 2016). When milk thistle is available for nesting by Tricolored Blackbirds, this nonnative plant may extent the distribution of the species into the southern Sierra Nevada foothills.

Although shifts may have occurred within the Central Valley and some areas of the valley that once supported large numbers of birds now support few or no breeding colonies, while other areas appear to have become much more important, the Central Valley and surrounding foothills as a whole have supported the majority of the Tricolored Blackbird population both historically and in recent years. Additional information on use of the Central Valley is presented in the Regional Shifts in Abundance section.

Southern California and Baja California

The first Tricolored Blackbird specimen was collected by Nuttall near Santa Barbara in 1836 (Baird et al. 1874, Bent 1958). Although he did not observe breeding colonies, Nuttall reported that the Tricolored Blackbird was very common around Santa Barbara and Monterey in the month of April (Nuttall 1840). In the mid-1800s, Cooper (1870) found the Tricolored Blackbird to be the most abundant species near San Diego and Los Angeles, and they were not rare near Santa Barbara. In the late 1800s, the species was described as an abundant winter resident in Los Angeles and Orange counties, occurring in very large flocks, with several colonies known to breed in tule marshes up to 1,500 feet in elevation (Bendire 1895). Grinnell (1898) reported the species to occur in "considerable numbers" throughout the lowlands of the Pacific slope of Los Angeles County, and Willett (1912) considered the species a common resident throughout the lowlands of coastal southern California. Dawson (1923) reported the species as "locally abundant…in the San Diegan district."

There is evidence that the Tricolored Blackbird had experienced declines in a large portion of its range in southern California, even by the 1930s. In a revision of his former description of the species' status in coastal southern California, Willett (1933) described the species as a "formerly common resident…Now rare throughout former range in southern California, excepting in some sections of San Diego County."

Grinnell and Miller (1944) described the status of the Tricolored Blackbird as "common to abundant locally" but noted a general decrease in southern California.

In 1980, the Tricolored Blackbird was characterized as a fairly common resident in the southern California coastal district that bred locally in all coastal counties (Garrett and Dunn 1981). The species no longer occurs at many historical sites in coastal southern California. Small numbers of breeding birds were documented at a few locations in coastal Santa Barbara County through the 1970s, with the last known colony of 200 birds in 1979 (Lehman 1994, Tricolored Blackbird Portal 2017). The last known colony in Ventura County, of 53 birds, occurred in 1994. About 200 birds persisted as breeders in the portion of Los Angeles County south of the Transverse Ranges through the 1990s, with the last known breeding attempt in 1999 (Allen et al. 2016, Tricolored Blackbird Portal 2017). Several hundred breeding birds occupied multiple sites in Orange County through the 1990s, but only a single colony of 14 birds has been observed breeding in the county in two years since 2000. The highly urbanized coastal portion of San Diego County, which supported thousands of breeding birds through at least the 1970s, has supported less than a thousand breeding birds at only three locations since 2000 (Tricolored Blackbird Portal 2017). Very few Tricolored Blackbirds now breed in the coastal lowlands of southern California where they were once abundant (Garrett et al. 2012).

The status of the Tricolored Blackbird population in Baja California has followed a similar pattern to that for southern California. In the late 1800s, the species was described as "rather common along the northwest coast [of Baja California], breeding in all fresh water marshes" (Bryant 1889). Grinnell (1928) described the species as a "Fairly common resident locally in the northwestern section of the territory, north from about 30 degrees." In the 1980s, the species was described as a "local resident in northwestern Baja California south to El Rosario" (Wilbur 1987). A search of the entire Baja California range turned up a single breeding colony of 80 birds in 2007 (Erickson et al. 2007) and four breeding colonies totaling 240 birds in 2008 (Erickson and de la Cueva 2008). A follow-up survey several years later located three breeding colonies supporting an estimated 240–340 birds (Feenstra 2013). In recent years, most breeding in Baja California has occurred in the north within about 70 miles of the U.S. border. Breeding continued at a disjunct area at the historical southern extent of the species' range (about 100 miles farther south than the next nearest breeding location) near El Rosario through at least 2013 (Erickson and de la Cueva 2008, Feenstra 2013). By 2016 all known breeding colonies occurred within about 12 miles of the U.S. border (Erickson et al. 2016). In 2017, the only known breeding colonies occurred within five miles of the U.S. border and eight nonbreeding Tricolored Blackbirds were observed at a historic breeding site about 70 miles south of the U.S. border. No birds were observed south of this point, leaving the southernmost 100 miles of the species range in Baja California apparently unoccupied (April 2017 email from R. Erickson to N. Clipperton; unreferenced).

Where previously abundant and widespread south of the Transverse Ranges, the distribution of breeding colonies is now mostly restricted to inland sites in western Riverside and San Bernardino counties, and in the interior of San Diego County (Feenstra 2009). This represents a long-term decline in southern California, with remnant colonies disappearing in recent decades throughout much of the southern range (Figure 8). This may represent a permanent breeding range retraction from portions of the range where the species was previously abundant, and is likely the result of ongoing urban development and declines in population numbers. The small numbers of birds that have occasionally bred at the extreme southern limit of the species' range in Baja California, separated by 100 miles from the next most southern breeding colony locations in recent years, were not observed in 2017. The majority of the historical range in Baja California has been unoccupied in recent years (Erickson et al. 2016).

Allen et al. (2016) reported that nesting commenced late in the 20th century in the Mojave Desert portion of northern Los Angeles County, and attributed this to manmade reservoirs and other impoundments, but breeding by small numbers of birds was known for the area since at least the 1970s (DeHaven et al. 1975a, Beedy et al. 1991). The species was known to occur in the Mojave Desert since at least 1890, but breeding was not documented (Belding 1890). The region has not supported more than a few thousand breeding birds in any year.

Population Trend

Breeding Population

Assessments of the rangewide population abundance of the Tricolored Blackbird prior to the 1990s are limited to published literature describing research by a limited number of individuals in the 1930s (Neff 1937) and an additional rangewide assessment using similar methods in the 1970s (DeHaven et al. 1975a). An additional recent published study used all available breeding colony data collected over more than 100 years (1907–2009) to evaluate changes in average colony size (Graves et al. 2013). The most intensive efforts to estimate rangewide population abundance have occurred since 1994, with results presented in reports prepared by academic researchers, Audubon California biologists, and in reports prepared for the USFWS and the Department. These represent the best available information for assessing trends in the rangewide population over the last two decades.

Over a period of six years (1931–1936), Neff (1937) surveyed Tricolored Blackbird colonies across California. Neff located several breeding colonies of more than 100,000 nests in the Sacramento Valley, with the largest composed of greater than 200,000 nests (corresponding to approximately 300,000 adult Tricolored Blackbirds). Breeding colonies were located throughout the Central Valley and in a few additional locations in California and southern Oregon; however, Neff's surveys focused on the Sacramento Valley in most years. An effort to cover the entire known range of the species was attempted by Neff in only one year (1932). Most areas outside the Sacramento Valley were covered only incidentally as "cooperators drove up or down the State in the performance of routine duties," and in the regions of the state that were most thoroughly surveyed, it was impossible to make complete surveys of all possible locations (Neff 1937). Neff concluded that obtaining an estimate of the statewide population was not possible. Working alone in 1934, Neff observed an estimated 491,250 nests (about 737,000 breeding birds), almost all of which were in the Sacramento Valley. The presence of birds in the San Joaquin Valley and southern California was noted in the same year, but no effort was made to estimate numbers. Several authors have cited Neff (1937) in statements about the Tricolored Blackbird population in the 1930s, sometimes suggesting that the population numbered in the millions (e.g., Beedy et al. 1991, Hamilton et al. 1995, Kyle and Kelsey 2011). Neff himself did not attempt to extrapolate his results to a region-wide estimate, although the roughly 737,000 breeding birds observed in a single year is likely an underestimate of the population at the time.

No attempts were made to describe the Tricolored Blackbird distribution or abundance during the 1940s, 1950s, or 1960s. From 1969 to 1972, DeHaven et al. (1975a) attempted to survey the entire range of the Tricolored Blackbird to document the distribution of the species and to compare estimates of abundance to those provided by Neff (1937). The surveys were carried out by a few individuals surveying vast areas by road, and in most areas were limited to one or two drives through each county where Tricolored Blackbirds were known to occur in California and southern Oregon. Still, the search effort was at least as extensive as that carried out by Neff in the 1930s, and included the benefit of improved transportation and an increased number of roads. In many counties the survey consisted of driving county roads with little knowledge of historical colony sites, but this was an improvement over much of the effort of the 1930s, when counties were considered covered if visited incidental to other activities. Despite a greater search effort, all measures of abundance indicated a decline: the number of active colonies detected per year declined from 43 to 41; nonbreeding birds encountered declined from >50,000 in a single year to <15,000 over four years; maximum colony size declined from hundreds of thousands to tens of thousands of birds; and number of birds observed per year within the study period declined from about 375,000 per year to about 133,000 per year (DeHaven et al. 1975a). Although no population estimate was provided, the authors suggested that the Tricolored Blackbird population declined by more than 50% in 35 years. Like Neff three decades before, DeHaven et al. (1975a) were unable to thoroughly cover the entire range of the species, including large portions of the southern San Joaquin Valley.

Commented [TB27]: Seems to contradict the statement that no attempts were made in the 1960s when they started in 1969.

Following more than a decade with no survey to assess the statewide population, Beedy et al. (1991) compiled all historical records of Tricolored Blackbird breeding colonies and conducted limited field surveys from 1986 to 1990 to evaluate long-term population trends. Bill Hamilton and others (Hamilton et al. 1992, Hamilton 1993) conducted ecological investigations in 1992 and 1993 that included documentation of colony locations and sizes, the discovery of large breeding colonies on grain fields in the San Joaquin Valley, and the initial observations that suggested Tricolored Blackbirds are itinerant breeders (Hamilton et al. 1995). Based on the increased understanding of the species' biology and distribution, a new approach to estimating the statewide population of Tricolored Blackbirds was proposed by Ted Beedy and Bill Hamilton (Hamilton 1998, Meese 2015a). The discovery of itinerant breeding with broad movements between nesting attempts made it clear that a survey of the statewide population should occur during a narrow window in order to maximize the likelihood of detecting nesting colonies and to avoid double-counting birds (Hamilton et al. 1995, Beedy and Hamilton 1997). A survey conducted in a minor portion of the range or carried out over a long time period would either miss breeding colonies or double count birds over multiple breeding attempts. An improved understanding of colony occupancy dynamics suggested a need for early season colony-detection efforts to locate active colonies (Hamilton et al. 1995), while also considering the compiled information on all historical breeding locations in order to visit as many potential breeding locations as possible.

The new approach to surveying the statewide population was first implemented during the 1994 breeding season. The survey was conducted on a single day in the early part of the season (April 23). The choice of a survey date is an effort to select a time period when most birds have initiated a first nesting attempt and can be detected and counted at breeding colony sites, but before the first breeding cycle is completed and birds have moved to the north (usually) for the second breeding attempt. The goals of the survey were to visit as many known breeding locations as possible, document occupancy status, and estimate colony size at all occupied locations. This was also the first survey to be largely volunteer-based and to enlist a large number of observers over a narrow time period. Compared to the surveys of the 1930s and 1970s, these surveys employed many more surveyors to more thoroughly cover as much of the state and known colonies as possible. The discovery of breeding by a large proportion of the population on silage fields near dairies had recently been documented (Hamilton et al. 1992, 1995), and therefore unlike previous statewide survey efforts, the 1994 survey focused heavily on the San Joaquin Valley.

After the establishment of the new approach to conduct a statewide census, attempts to survey the population were carried out in 13 years between 1994 and 2017. Despite a consistent approach in many of the early years of this time period, methods varied considerably for many of these surveys. The years 1994, 1997, and 2000 produced a set of three triennial surveys that were considered to have been comparable in effort by the survey organizers (Beedy and Hamilton 1997, Hamilton 2000). After a period of years with surveys that followed inconsistent and variable approaches, another set of four triennial surveys were conducted using similar methods in 2008, 2011, 2014, and 2017 (Kelsey 2008, Kyle and Kelsey 2011, Meese 2014a, Meese 2017). The effort and results of these seven surveys are summarized in Table 1. Although the other six survey years (1995, 1996, 1999, 2001, 2004, and 2005) are not discussed further here, they are briefly summarized in Table 2 and in a larger discussion of Tricolored Blackbird surveys included in Appendix 1.

Table 1. Comparison of survey effort and results for seven statewide surveys.

Year	Duration	Participants	Counties surveyed (occupied)	Number of sites surveyed (breeding sites)	Occupied breeding locations	Birds observed
1994	1 day (3 days)[1]	60[2]	– (32)	–	100	369,400
1997	1 day (3 days)[1]	55[2]	– (33)	–	71[3]	232,960
2000	4 days	81[2]	33 (25)	231 (181)	72	162,000
2008	3 days	155	38 (32)	361 (284)	135	395,000
2011	3 days	100	38 (29)	608	138	259,000
2014	3 days	143	41 (37)	802	143	145,000
2017	3 days	181	44 (37)	884	168	177,656

[1] Observations of birds not associated with colonies from one day before and after the survey day were accepted, effectively expanding the survey window to three days.
[2] Number includes participants who submitted written reports. A larger number of volunteers may have searched for birds.
[3] As reported by Hamilton (2000).
"—" = data not reported

The statewide survey efforts in 1994, 1997, and 2000 followed similar methods to locate and survey as many colonies as possible. Although the duration of the survey and the survey effort varied across these years, the organizers of the surveys reported these three surveys had used the most consistent methods to date and could be compared to assess the population trend (Beedy and Hamilton 1997, Hamilton 2000). However, inconsistencies in effort still occurred with the 1994 survey conducting only a limited survey of southern California, and the 2000 survey using more observers to visit more sites than the other two survey years. Hamilton (2000), however, concluded that "…the method of the Census and the survey, to reinvestigate all known breeding places and to search for new ones, has become an increasingly complete assessment of Tricolored Blackbird distribution and abundance. The 2000 Census probably located a greater proportion of the entire population than did censuses in previous years." The number of birds observed declined 56% from 369,400 birds in 1994 to about 162,000 birds in 2000 (Hamilton 2000, Cook and Toft 2005). In addition to the results of the surveys showing declines in the 1990s, Hamilton (2000) stated that personal observations over long intervals by many regional experts had also suggested declines during this time period.

Table 2. Description and summary of effort for 13 surveys that attempted to estimate the size of the statewide Tricolored Blackbird population between 1994 and 2017.

Survey year	Summary of effort and results	Sources
1994	The first year a statewide survey was conducted in a narrow time period, was informed by knowledge of historical breeding locations and by pre-survey colony detection work, and enlisted the help of a large number of volunteers.	Hamilton et al. (1995) Beedy and Hamilton (1997)
1995 and 1996	Limited pre-survey effort. Incomplete county coverage. Large colonies may have been overlooked. Results are not considered representative of the total population.	Beedy and Hamilton (1997)
1997	Used the same coverage, methods, and personnel as did the 1994 survey. Participation was greater than in 1994. Surveys from 1994, 1997, and 2000 are considered comparable.	Beedy and Hamilton (1997)
1999	Participation in the survey was low. Results considered an underestimate of population size by the survey organizer.	Hamilton et al. (1999, 2000) Hamilton (2000)
2000	Used the same methods applied in 1994 and 1997, although a greater number of observers were used to visit more locations. Training was provided to participants. Surveys from 1994, 1997, and 2000 are considered comparable.	Hamilton (2000)
2001	Followed a very different approach compared to standardized methods used since 1994. A limited number of sites were visited and estimates were compiled from observations made throughout the breeding season.	Humple and Churchwell (2002)
2004	Not intended to provide an estimate of the statewide population size that was comparable to previous surveys. Surveys limited to colony sites that had historically supported more than 2,000 birds. Focused on sites in the Central Valley.	Green and Edson (2004)
2005	No report was produced and no record is available describing the survey effort.	Meese (2015a)
2008	Used similar methods as in the 2000 survey, although estimates not adjusted using nest density. Also, county coordinators were used for the first time to ensure each county was well surveyed by volunteers. Maps with all survey locations were provided for the first time, and a website improved communication and data management. Number of survey participants and number of sites surveyed greatly increased relative to earlier surveys.	Kelsey (2008)
2011	Methods followed those used in 2008, although county coordinators were not used to lead surveys in individual counties. Surveys from 2008, 2011, 2014, and 2017 are considered comparable.	Kyle and Kelsey (2011)
2014	Used the same methods as in 2008 and 2011, and again used county coordinators to ensure each county was thoroughly covered. The number of counties and number of sites visited exceeded all other surveys to date. Surveys conducted 2008–2017 are considered comparable.	Meese (2014a)
2017	Used the same methods as in 2008–2014. The number of survey participants and the number of counties and sites visited exceeded all other surveys to date. Surveys conducted 2008–2017 are considered comparable.	Meese (2017)

As during the early set of survey years, the survey effort increased each year from 2008 to 2017. More counties were surveyed in 2014 than on any previous survey and the number of observers participating on the 2014 survey (n = 143) was exceeded on only one previous survey (n = 155 in 2008). There was a large increase in the number of sites visited in each survey year between 2008 and 2014, and the number of colony sites visited in 2017 exceeded that of any other survey (Figure 9). The 2017 survey was the most extensive survey conducted to date based on all available metrics of effort (Table 1). The number of birds observed on statewide surveys declined 63% from 395,000 birds in 2008 to an all-time low of about 145,000 birds in 2014 (Kelsey 2008, Meese 2014a) (Table 1). From 2014 to 2017, the number of birds observed increased 22% to 177,656. The number of birds observed in 2017 represents a 55% decline in the population over the nine years since 2008.

Although the conclusion following each of the two groups of survey years (1994–2000 and 2008–2017) was that a population decline had occurred, differences in survey methods and effort make it difficult to combine the two groups of surveys to make longer-term conclusions (Meese 2015a). Does the estimated number of birds in 2008 represent an increase in population size following the decline of the 1990s, or do increased survey effort and other changes to survey methodology preclude comparison of results from the two survey periods? In addition to differences in duration of the survey, geographic scope, and effort shown in Table 1, there were important differences in methods used between the two groups of surveys (see Appendix 1). Methods unique to the earlier 1994–2000 surveys include: 1) Birds counted at colonies before the survey were included in the results if the colony remained active after the survey period (although not counted on the survey day), 2) Birds observed and counted at colonies after the survey were included if nest phenology led to a conclusion that the colony was active on the survey date (although not observed), and 3) Visual colony size estimates were often adjusted using observed nest densities, as determined by walking transects through colony sites after the survey; this resulted in final colony size estimates that in some cases differed significantly from those reported by survey participants (Hamilton et al. 1995). Unfortunately, the impact (both the magnitude and direction) of these methodological differences on the overall population estimates is unknown, and therefore a direct comparison of results from the two time periods is not appropriate. At a minimum, the large step change in survey effort between the two time periods must be taken into account if the data are to be used to inform a longer-term population trend.

As shown in Table 1, the individual metrics of survey effort were not consistently reported across survey years. The number of sites surveyed has been used to describe survey effort in recent years (Meese 2014a, 2015, 2017), but this number is not known for the surveys conducted in the 1990s. The number of counties surveyed was also not reported for surveys conducted in the 1990s. The number of participants and the number of occupied breeding locations were reported for all survey years. It is not known whether an increase in effort as measured by any of these metrics results in a proportional increase in the number of birds observed, but Graves et al. (2013) reported that total counts of breeding birds are correlated with the number of sites sampled. The number of sites sampled is also related to the proportion of the landscape searched by survey participants (Figure 9) and therefore might be the most appropriate metric of effort with which to standardize survey results.

In order to make use of as many survey years as possible to evaluate population trend over time, survey results were adjusted for effort when available (Figure 10a-c). Viewed as a whole, when adjusting for survey effort the results suggest a consistent pattern in the Tricolored Blackbird population since 1994. Regardless of the metric used to adjust population estimates for survey effort, the trend shows a long-term decline over the 23-year period with a partial recovery between 2000 and 2008. Depending on the metric used to correct for effort, either 2014 or 2017 represents the all-time low for effort-adjusted number of birds observed.

As the number of locations visited has increased with each successive statewide survey, so too has the number of locations with some uncertainty regarding the exact location. These are historical breeding locations for which the exact coordinates were not reported, and therefore the level of confidence is recorded as “uncertain” in the Tricolored Blackbird Portal database (2017). As a result, surveyors have visited an increasing number of locations that have not necessarily supported Tricolored Blackbird breeding in the past (Table 3). This is not wasted effort, as the visits to uncertain locations increase the size of the landscape area searched for colonies during the survey (Figure 9), and the locations are likely near historical colony sites. Nevertheless, for the 2017 survey, participants were directed to focus on sites with known coordinates, resulting in a large decline in the number of “uncertain” sites surveyed. To be conservative in interpreting changes in survey effort over time, the uncertain locations were removed from the count of sites visited during the 2000, 2008, 2011, 2014, and 2017 surveys to adjust the effort for those survey years (Table 3). The adjusted number of sites surveyed each year continues to show an increase in survey effort over time. A graph prepared using the revised number of sites surveyed (Figure 10d) revealed little effect on the pattern of birds observed per site shown in Figure 10b.

Table 3. Number of sites surveyed during recent statewide surveys, adjusted to remove uncertain locations.

Survey year	Number of sites surveyed	Number of uncertain sites	Revised number of sites surveyed
2000	231	4	227
2008	361	8	353
2011	608	54	554
2014	802	127	675
2017	884	25	859

The linear regression trendlines for each of the effort-corrected survey results indicate that the Tricolored Blackbird population has declined by 75%–90% in the last 23 years (Figure 10). The observed rates of decline of -5.8% to -10.5% per year indicate that this species has been in severe decline over the last two decades. These rates of decline are in the range of the steepest declines observed across all North American landbird species based on Breeding Bird Survey data (Sauer et al. 2017a). Results of the most recent 2017 statewide survey suggest that the Tricolored Blackbird population decline may have slowed or reversed since 2014, but the population remains at or near its smallest size ever recorded. Coupled with the earlier declines between the 1930s and 1970s, the recent declines have resulted in a population that is a small fraction of its historical abundance.

There are several potential sources of uncertainty in the population estimates from statewide surveys. Attempts to quantify this uncertainty have been limited and inconsistent across years. Comments on the approach used to estimate the size of the population during recent statewide surveys, along with a discussion of uncertainty, are provided in Appendix 2.

Colony Size

In recent statewide survey years, the size of the largest colonies (including the single largest colony and the average of the several largest colonies per year) have been reported as an alternative metric to total counts of birds for tracking trends over time. Use of the size of large colonies to evaluate trends is only appropriate if the survey effort is sufficient to detect most of the largest colonies. Although the survey effort required to detect most of the largest colonies is unknown, Graves et al. (2013) reported that average colony size observed, based on colony data from 1907 to 2009, was not strongly correlated to the total number of sites sampled annually, suggesting that sampling may generally be sufficient to detect the largest colonies. Larger colonies may be more likely to be detected and therefore survey effort may have less effect on size of largest colonies observed compared to total counts of birds.

Neff (1937) located several breeding colonies of more than 100,000 nests in the Sacramento Valley, with the largest composed of greater than 200,000 nests (about 300,000 adult birds). Orians (1961a) reported that, in 1959 and 1960, there were four Tricolored Blackbird colonies larger than 100,000 adults; three were in the rice-growing area in Colusa and Yolo counties and one was in Sacramento County. The largest reported colonies in the 1970s were in Colusa and Yolo counties and comprised about 30,000 adults (DeHaven et al. 1975a, Beedy and Hayworth 1992). All but one of the colonies observed by DeHaven et al. (1975a) that were larger than 20,000 birds were located in the Sacramento Valley. In the 1980s, the largest reported colony was in the northern San Joaquin Valley at Kesterson Reservoir (Merced County) in 1986, with an estimated 47,000 adults (Beedy and Hayworth 1992).

The occurrence of Tricolored Blackbird breeding colonies on grain fields in the San Joaquin Valley was discovered in the early 1990s (Hamilton et al. 1995), and the size of the largest colonies in several subsequent years once again grew to more than 100,000 birds, so-called "mega-colonies." Beedy and Hamilton (1997) reported that 1994 and 1997 were the only two survey years to date with sufficient survey effort to detect "virtually all large colonies." In 1994, Hamilton et al. (1995) found that the largest colony, at San Luis National Wildlife Refuge, numbered about 105,000 adult Tricolored Blackbirds. In 1997, Beedy and Hamilton (1997) reported the largest colony to contain about 80,000 adults. The documentation of large colonies during this time period is likely due in part to the formation of mega-colonies on grain fields, but may also be a result of increased survey effort in the San Joaquin Valley.

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Colonies of at least 80,000 breeding birds continued to occur through 2010 (Meese 2009a, Meese 2010). From 2008 to 2017, maximum colony size declined from 80,000 to fewer than 20,000 birds (Kelsey 2008, Kyle and Kelsey 2011, Meese 2017). In 2014, only a single colony consisted of more than 20,000 birds and only three colonies consisted of 10,000 birds or more (Meese 2014a). The proportion of birds observed in the 10 largest colonies during the years 2008, 2011, 2014, and 2017 was 77% (306,000), 81% (208,800), 64% (93,000), and 55% (98,050) of the statewide population estimate for those years,

respectively. This reflects a downward trend in the sizes of the largest colonies, without a large increase in the number of occupied breeding locations (Figure 11). The trend in the largest colonies from 1994 to 2017 is similar to those in Figure 10 for effort-corrected statewide survey results: a long-term decline over the 23-year period with a partial recovery between 2000 and 2008.

Graves et al. (2013) performed an evaluation of trends in the average size of Tricolored Blackbird colonies over a more than 100-year period (1907–2009) using data compiled from a variety of sources. Average colony size, rather than total abundance, was used as the metric to evaluate trends to account for the effects of variable sampling effort across years. Graves et al. (2013) found a significant decline in the average colony size from 1935 to 1975, with the average colony size declining by more than 60%. This corresponds to the period over which DeHaven et al. (1975) concluded that the population size had declined by about 50%. Despite large amounts of data on colony sizes from the 1980s onward, no significant decline was detected in average colony size from 1980 to 2009. This finding is counter to reports of declines for portions of the 1980–2009 period (e.g., Beedy et al. 1991, Hamilton 2000, Meese 2014a, Meese 2015a). However, the statistical evaluation conducted by Graves et al. (2013) used data only through 2009, so it does not include much of the time period during which the recent population decline was observed (2008–2014). In addition, it is unlikely that sampling effort was sufficient in all years prior to 2009 to detect most of the largest Tricolored Blackbird colonies, which may have influenced the estimates of average colony size.

The degree to which size of the largest or average colonies are correlated to total population size in any given year is unknown. However, during statewide survey years since 1994, the sizes of the largest colonies follow a pattern similar to that of the total numbers of birds observed. Given that in many years the majority of the population occurs in a small number of the largest colonies and the number of occupied colonies per year has not increased dramatically with increased survey effort (Table 1), it is likely that short-term declines in colony size often reflect real changes in the population size. Over longer periods, the correlation between colony size and population might be expected to break down due to shifts in breeding distribution and selection of novel nesting substrates. For example, when the population began using agricultural grain crops in the early 1990s and experienced an apparent shift in early breeding season distribution to the San Joaquin Valley, very large colonies were reported for the first time in many years. These changes in nesting substrate availability and distribution could have influenced the size of the largest colonies (and average colony size) by concentrating the population at a small number of breeding locations without necessarily reflecting a change in population size. In fact, Graves et al. (2013) reported that colonies in triticale and other grain crops were 40 times larger than colonies in other habitats during the last 20 years. This may explain in part why they did not find a reduction in average colony size from 1980 to 2009, a time when breeding surveys revealed declines in total number of birds observed.

Winter Population

The Christmas Bird Count (CBC) is a volunteer-based survey conducted each winter at designated 15-mile diameter circles across North America. CBC data consist of counts of all bird species encountered during a single day at each circle for which a count is conducted. There are more than 2,400 count

circles across North America, some of which have been run since the early 1900s (Soykan et al. 2016). The number of count circles increased dramatically through the 1950s and 1960s, especially in the western region of the U.S. (Niven et al. 2004), and long-term trend assessments have often used a start date in the late 1960s to avoid any influence of increased survey coverage on apparent trends (Butcher et al. 2006). This is also the time period when the Breeding Bird Survey was initiated, which allows for comparisons between breeding and wintering populations (Niven et al. 2004). Counts are not necessarily conducted for every circle each year, and some circles are run more consistently than others. The number of volunteer observers and the duration of the count can vary from year to year, and yearly differences in effort can significantly influence the results of the counts. Therefore, the number of party-hours is often used as a measure of effort to standardize count results. Count circle locations are also not randomly selected, so data cannot be extrapolated to provide population estimates across the range of a species, but if corrected for effort can provide an index that can inform population change in areas covered by count circles.

Commented [TB29]: Mention that BBS data are not very indicative of species with clumped distributions such as TRBLs?

Soykan et al. (2016) used a hierarchical model to evaluate population change from 1966 to 2013 for several hundred species sampled by the CBC, including Tricolored Blackbird. The analysis assessed change in each U.S. state and in each Bird Conservation Region (BCR; a map of BCRs is available at http://nabci-us.org/resources/bird-conservation-regions-map/), with the Coastal California BCR being the primary BCR in which Tricolored Blackbird occurs. Trends for Tricolored Blackbird were non-significant at both the California and the BCR scales. Hierarchical models are more efficient than linear regression approaches when assessing population change for a large number of species across multiple geographic scales, and can control for variation in survey effort among circles and across years. However, the use of large spatial scales for analysis may introduce variability in the quality of information that may not accounted for in the models. Although the Coastal California BCR captures the majority of the Tricolored Blackbird range in California, it is neither geologically nor biologically uniform. Also, the addition of count circles over time has not been evenly distributed across the BCR or the state. Due to the variability in habitat and species distribution at these broad scales, any apparent population trend, or lack thereof, can be an artifact of the years in which count circles were added or removed, or the years in which particular circles were surveyed across a heterogeneous landscape. A finer-scale approach that considers the impacts of this variability on a single species is warranted.

In California, count circles increased through the 1960s as has been documented in other areas, but the number of circles continued to increase through the early 1990s. The number of circles in California detecting Tricolored Blackbird doubled from 1974 (25 circles) to 1986 (50 circles) and the number of circles with Tricolored Blackbird detections did not stabilize until the 1990s. Since 1992 the number of circles with Tricolored Blackbird detections has been fairly stable and has fluctuated between 54 and 66. Because of the continued increase in the number of count circles through the 1990s, and the inconsistent running of counts at some circles over time, the sampling intensity has varied across the range of the Tricolored Blackbird in California. Based on the number of count circles surveyed in California over time, and by establishing criteria for consistency of effort, the Department assessed trends based on CBC data for two time periods: 1974–2015 and 1995–2015. These two periods capture a longer-~~-~~term extending back to the 1970s when the breeding-season surveys of DeHaven et al. (1975a)

were conducted, and a shorter term covering the time since the first statewide surveys of the 1990s and when CBC data quality was highest and most consistent. The distribution of count circles that met a set of criteria and that were therefore included in the analyses provides fairly good coverage of the core of the winter distribution of the species (Figure 12; Appendix 3). Population trends were estimated from the slope of the regression of the log-transformed counts on year (see Butcher et al. 1990). Results of the CBC data analyses indicate declines in the Tricolored Blackbird population over both the longer term 1974–2015 period and the shorter term 1995–2015 period (Appendix 3).

Improvement in bird identification skills by volunteer observers has been apparent within the past 20 years, and poses a significant challenge in the interpretation of trends based on CBC data. This may be especially true for species with potential identification problems and for flocking species such as the Tricolored Blackbird (Butcher et al. 1990). As a result, counts that are adjusted by party-hour may be positively biased in recent years, which would tend to result in a positive bias in observed trends.

A number of historical winter observations of large numbers of Tricolored Blackbirds corroborate the observed decline in CBC data. Wintering flocks numbering 12,000–14,000 once assembled near dairies on the Point Reyes Peninsula, Marin County, which was one of the most reliable locations to observe large numbers of wintering Tricolored Blackbirds. In recent years, these flocks have been in the range of 2,000–3,000 birds (eBird Dataset 2016, Beedy et al. 2017).

Regional Shifts in Abundance

Because of the Tricolored Blackbird's nomadic tendency and the potential for large inter-annual shifts in breeding distribution, year-to-year changes in regional abundance are common. Tricolored Blackbird surveys have regularly revealed large annual changes in local abundance that would not be expected due to productivity or mortality rates alone (Hamilton 1998). During statewide surveys, large declines in one region are often coupled with large increases in other regions, and therefore caution is warranted when interpreting year-to-year changes in local abundance. That said, persistent long-term changes in distribution and regional abundance likely represent shifts in regional habitat suitability or population abundance.

Central Valley

~~Following~~ Based on incidental observations on the regional abundance of Tricolored Blackbirds in the 1800s and early 1900s, the Central Valley was described as the center of abundance for the species. The first systematic attempt to assess the species' rangewide distribution and population confirmed this, with most birds observed in the Sacramento Valley (Neff 1937). Additional observations and study of breeding colonies occurred through the 1960s before a second attempt at quantifying rangewide abundance in the early 1970s, with the majority of birds again found in the Sacramento Valley and northern San Joaquin Valley (DeHaven et al. 1975a).

Commented [TB30]: By whom?

Within the Central Valley, shifts in regional abundance over relatively short time periods have been a regular occurrence. Over a period of five years in the 1930s, Neff (1937) observed regular shifts in the annual centers of abundance between the rice-growing regions of the Sacramento Valley (Butte and

Glenn counties) and regions to the south in Sacramento and Merced counties. DeHaven et al. (1975a) noted substantial yearly variation in centers of breeding abundance, even in their limited study area consisting of the Sacramento and northern San Joaquin valleys. For example, they observed 57,000 Tricolored Blackbirds nesting in Colusa County in 1969, but only 2,000 the following year. This pattern was mirrored in Yolo County where the number of breeding birds observed declined from 25,000 to 5,000. At the same time, other counties in the Sacramento Valley experienced increases in the number of breeding birds, with Glenn County increasing from 2,000 to 18,500 birds, and Yuba County increasing from 1,000 to 5,250 birds. A larger region comprising the major rice-growing region of the Sacramento Valley (Butte, Colusa, Glenn, Yolo, and Yuba counties) also varied considerably in the proportion of the known population it supported, with the proportion of known breeding birds in the region ranging from 29% to 59% during a four-year study period (DeHaven et al. 1975a). In the year when the smallest proportion of birds were located in this rice-growing region, the largest known congregation of birds occurred to the south in the pasturelands of southeastern Sacramento County. These regional shifts in abundance demonstrate the species' ability to undergo large inter-annual shifts in breeding distribution, likely in response to an unpredictable food supply or other habitat components.

In addition to short-term shifts in regional abundance, the Central Valley has experienced longer-term changes, with some regions of the valley experiencing long-term declines in number of breeding colonies or breeding birds. For example, Kings County supported tens of thousands of breeding birds per year through the 1990s, with 65,000 birds breeding in the county in 1992. In recent years, the county has hosted only a few hundred to a few thousand breeding birds. Glenn County, which once supported hundreds of thousands of birds per year and continued to support at least 10,000 birds into the 1990s, has not hosted more than 1,400 birds in any year since 2000. San Joaquin County regularly supported up to about 10,000 birds per year through the 1990s, but has hosted only a few small colonies since then, with the largest recent colony of 1,800 birds in 2015. As described above, the Tricolored Blackbird appears to have experienced a population increase from the 1990s through the 2000s in the San Joaquin Valley as a whole, with a corresponding decrease in the Sacramento Valley. Following this increase, the population in the San Joaquin Valley experienced a severe decline of 78% from 2008 to 2014 (Meese 2015a). This is a time period during which the species declined by 63% rangewide, and the majority of this decrease was due to declines in the San Joaquin Valley. The total number of birds lost from the San Joaquin Valley portion of the range during this period (~267,000 birds) exceeded the range-wide decline (250,000 birds), with a small portion of the loss compensated by increases in the breeding population elsewhere (Figure 13) (Meese 2015a). The number of birds breeding in the San Joaquin Valley rebounded somewhat by 2017, but declines in this region remain the primary contributor to range-wide population declines since 2008.

Southern California and Baja California

As described above under Distribution, the Tricolored Blackbird was once abundant on the coastal slope of the southern California portion of the range, from Santa Barbara County to San Diego and into Baja California. Although the early reports of species abundance were not quantitative, they serve as a comparison to numbers of birds in the region in recent decades. Neff (1937) provided the first quantitative estimates for southern California, although San Diego and Santa Barbara counties were the

only counties his collaborators spent a significant amount of time surveying; thousands of birds were documented in both of these counties. DeHaven et al. (1975a) reported colonies of up to 10,000 birds in southern California (Riverside County), with thousands of birds documented in all counties south of the Transverse Ranges, except Orange County.

The first statewide survey to include all counties in southern California was conducted in 1997 (Beedy and Hamilton 1997). That year, more than 40,000 Tricolored Blackbirds bred in the southern California portion of the range, with more than 90% occurring in western Riverside County (Feenstra 2009, Cook 2010). Since this time, the largest proportion of the southern California breeding population has continued to occur in western Riverside County (Cook 2010). The 2005 statewide survey located about 12,500 breeding birds south of the Transverse Ranges. A thorough search of historical breeding locations in southern California in 2008, 2009, and 2011 revealed a population south of the Transverse Ranges of consistently less than 5,000 breeding birds (Figure 14) (Kelsey 2008, Feenstra 2009, Kyle and Kelsey 2011). By 2009 the coastal slope portion of the region had declined to only 750 Tricolored Blackbirds breeding at a single site in San Diego County (Feenstra 2009). The 2014 survey located a slightly larger population consisting of about 6,400 breeding birds (Meese 2014a). In 2017, the number of birds observed increased again to about 8,800, although the large majority of these (>90%) were again located in one small region of western Riverside County. San Diego was the only other county with breeding birds in 2017, with seven small colonies totaling fewer than 700 birds. Most breeding colonies of the Tricolored Blackbird in Southern California have tended to be small in recent years, averaging a few hundred birds (Feenstra 2009).

In the last decade the breeding population in the Mojave Desert portion of the range in San Bernardino and northern Los Angeles counties appears to have grown somewhat, from just over 1,000 breeding birds located during surveys in 2008–2011, to more than 5,000 breeding birds in 2014 (Meese 2014a). It is unclear whether the Mojave Desert birds are more closely associated with the southern California population or to the birds in the Central Valley, although observations of three banded birds since 2009 and observations of a flying flock in the 1800s have documented birds moving between the desert and the Central Valley. Ongoing genomic studies will address the population structure and patterns of movement throughout California.

Commented [TB31]: Based on one location, correct?

Originally considered common in northwestern Baja California, numbers appear to have declined by the late 1900s. Recent surveys have shown that the northwestern Baja California population has declined to only several hundred individuals (Erickson et al. 2007, Erickson and de la Cueva 2008, Feenstra 2013, Erickson et al. 2016, Meese 2017).

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Summary—The Tricolored Blackbird, once described as the most abundant species in southern California, had declined dramatically by the time statewide surveys were established in the 1990s. Tens of thousands of breeding birds continued to occupy the region during the first complete survey of 1997. The most recent intensive searches of the southern California portion of the range located only thousands of breeding birds at a small number of locations. Following the first comprehensive survey of southern California counties in 1997, the Tricolored Blackbird population declined by nearly 90%, to lows of fewer than 5,000 birds from 2008 to 2011. The southern California population rebounded

somewhat by 2014, but most of the increase can be attributed to birds in the Mojave Desert. This decline coincides with the disappearance of the species from much of the southern California portion of the range and is mirrored by declines in abundance and distribution in the Baja California portion of the species' range. If recent trends continue, the species may decline to extirpation in the southern portion of its range in the near future.

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Northern and Central Coasts

Small numbers of birds bred annually during the late nesting season (July–September; thought to represent second breeding attempts by birds that previously nested elsewhere) in western Marin County until 2003 (Stallcup 2004). There has been no documented breeding in Marin County since then.

EXISTING MANAGEMENT

Land Ownership within the California Range

There is a paucity of public lands in the Central Valley, with the region that regularly supports more than 90% of the breeding population composed primarily of privately-owned lands (Figure 15). The total area in the range of the Tricolored Blackbird in California is more than 34 million acres. Privately-owned lands compose 84% of this area, with state and federal lands totaling about 12%. Much of the area under federal ownership is composed of forested areas that are not suitable for the species. The USFWS National Wildlife Refuges and Department Wildlife Areas comprise about 250,000 and 254,000 acres, respectively (1.5% of the range, combined).

Of the 1,045 historical breeding locations with known coordinates in the Tricolored Blackbird Portal database (as of January 2017), 191 (18%) have been located on public lands. A minority of breeding colonies continue to occur on public lands each year. For example, during the 2011 statewide survey, colonies were found on a county park, a Department Ecological Reserve in San Diego County and an Ecological Reserve in Kern County, and on three National Wildlife Refuges in the Central Valley (Kyle and Kelsey 2011). These colonies totaled 66,325 breeding birds (about 25% of the estimated statewide population in that year), the large majority of which were from a single colony on a USFWS National Wildlife Refuge.

Habitat Conservation Plans

Habitat Conservation Plans (HCPs) are long-term landscape level plans that provide the basis for regulatory compliance with the ESA by nonfederal entities. HCPs provide a mechanism to authorize incidental take of federally threatened and endangered species under section 10(a) of the ESA, while also describing how impacts to covered species will be minimized or mitigated in the plan area. An HCP must minimize and mitigate the impacts of take to the maximum extent practicable.

There are five approved HCPs in California that include the Tricolored Blackbird as a covered species and two additional HCPs that are in the planning stage (Figure 16; Table 4):

Approved HCPs:

- Natomas Basin
- San Joaquin County Multi-species Conservation Plan
- PG&E San Joaquin Valley Operations & Maintenance
- Kern Water Bank
- Orange County Southern Subregion

Planning Stage:

- South Sacramento
- Solano Multi-Species

Table 4. Current and Planned HCPs/NCCPs in California that include Tricolored Blackbird as a covered species.

Plan title	Counties	Plan acreage	Date permit issued	Term
Natomas Basin HCP	Sacramento, Sutter	53,342	June 2003	50 years
San Joaquin County Multi-species Conservation Plan HCP	San Joaquin	896,000	May 2001	50 years
PG&E San Joaquin Valley Operations & Maintenance HCP	Portions of nine counties: San Joaquin, Stanislaus, Merced, Fresno, Kings, Kern, Mariposa, Madera, Tulare	276,350	December 2007	30 years
Kern Water Bank HCP	Kern	19,900	October 1997	75 years
Orange County Southern Subregion HCP	Orange	132,000	January 2007	75 years
South Sacramento HCP	Sacramento	317,656	Planning stage	TBD
Solano Multi-species HCP	Solano, Yolo (edge)	580,000	Planning stage	TBD
East Contra Costa County (NCCP)	Contra Costa	175,435	July 2007	30 years
Santa Clara Valley Habitat Plan (NCCP)	Santa Clara	460,205	July 2013	50 years
Western Riverside County Multiple Species Habitat Conservation Plan (NCCP)	Riverside	1,300,000	June 2004	75 years
San Diego County Multiple Species Conservation Program (NCCP)	San Diego	511,878	August 1998	50 years
San Diego Gas & Electric Subregional (NCCP)	San Diego, Orange, Riverside	Linear projects[1]	December 1995	55 years
San Diego County Water Authority (NCCP)	San Diego, Riverside	Linear projects[1]	December 2011	55 years
Butte Regional Conservation Plan (NCCP)	Butte	564,270	Planning stage	TBD
Yuba-Sutter Regional Conservation Plan (NCCP)	Yuba, Sutter	468,552	Planning stage	TBD
Placer County Conservation Plan Phase I (NCCP)	Placer	201,000	Planning stage	TBD
Yolo Habitat Conservancy (NCCP)	Yolo	653,663	Planning stage	TBD
San Diego East County Multiple Species Conservation Plan (NCCP)	San Diego	1,600,000	Planning stage	TBD
San Diego North County Multiple Species Conservation Plan (NCCP)	San Diego	311,800	Planning stage	TBD

[1] These NCCPs cover discrete linear or energy projects but have larger plan areas that overlap with other NCCPs.
Primary Sources:
USFWS endangered species page for Tricolored Blackbird under conservation plans:
https://ecos.fws.gov/ecp0/profile/speciesProfile?spcode=B06P#conservationPlans
Summary of Natural Community Conservation Plans (NCCPs) September 2016
https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=15329&inline

The goals, objectives, and conservation measures for Tricolored Blackbird included in approved HCPs are summarized below.

Natomas Basin HCP

The Natomas Basin Habitat Conservation Plan (NBHCP) covers 53,342 acres in the northwestern part of Sacramento County and southern Sutter County. The City of Sacramento and County of Sutter are participants. The 50-year term expires June 2053.

Tricolored Blackbirds nest and forage in the Natomas Basin. At the time of the planning effort, one active nesting colony was known from the eastern edge of the Natomas Basin (Betts Kismat-Silva Reserve) and nine documented occurrences were noted for Sutter County. Based on habitat preferences of Tricolored Blackbirds, the Natomas Basin supported about 1,998 acres of potential nesting habitat and 41,310 acres of potential foraging habitat (NBHCP 2003).

A total of 449 acres of potential nesting habitat will be converted to urban development as a result of implementing the proposed action. A loss of 15,311 acres of potential foraging habitat (non-rice crops = 6,517 acres, grassland = 560 acres, pasture = 147 acres, and rice = 8,087 acres) will result from the planned development (USFWS June 24, 2003).

Under the plan, 2,137.5 acres of managed marsh habitat will be preserved in a reserve system. Wetland reserves are intended to benefit wetland-associated Covered Species such as Tricolored Blackbirds. The managed marsh reserves will provide potential nesting habitat for Tricolored Blackbirds in close proximity to foraging habitat, which is expected to increase suitable nesting opportunities for this species. Additionally, 4,375 acres of rice and 2,187.5 acres of upland habitats will be added to the reserve system. Generally, acquisition of upland habitat is prioritized first for the conservation of Swainson's Hawk (*Buteo swainsoni*) then secondarily for other upland-associated Covered Species including Tricolored Blackbird (USFWS June 24, 2003).

Take minimization measures include pre-construction surveys for Tricolored Blackbirds, avoidance of actively nesting colonies/minimization of disturbance during the nesting season, establishment of a physical protective barrier 500 feet from the active nesting sites, and a "reasonable" buffer for foraging lands on reserve lands. The NBHCP includes measures to avoid, minimize, and mitigate take of the giant garter snake (*Thamnophis gigas*) with timing restrictions, pre-construction site dewatering, and vegetation control management. Because the Tricolored Blackbird shares some habitat similarities with the snake, these measures may also benefit the blackbird (NBHCP 2003).

Monitoring Covered Species is provided for in the plan. The USFWS commented on monitoring the Tricolored Blackbirds nesting colony in the final EIR/EIS (USFWS April 2003): "…the success of this population will be monitored annually and the reserve acquisition program of the NBHCP could be modified if it is determined that foraging habitat is a limiting factor for the colony. This colony is located well outside of the City's Permit Area, and this colony may forage upon unincorporated lands within Sacramento County. If, through the annual monitoring, it is determined that additional foraging habitat is required, the NBHCP would allow for modification of both acquisition programs and habitat

management/restoration to provide enhanced foraging. The long-term success of the NBHCP will rely not on establishing a rigid Operating Conservation Program based on limited information, but rather will result from a flexible program that responds to new information collected through monitoring as well as evolving scientific data as applicable to the Covered Species."

San Joaquin County Multi-Species Conservation Plan HCP

The San Joaquin County Multi-Species Conservation Plan HCP (SJMSCP) spans 896,000 acres in San Joaquin County. Participating entities include the Cities of Escalon, Lathrop, Lodi, Manteca, Ripon, Stockton, and Tracy and the County of San Joaquin. The 50-year term expires May 2051.

The SJMSCP identified 9,374 acres of "occupied" habitat for the Tricolored Blackbird in the plan area and an additional 47,193 acres of potential habitat including foraging and wintering areas. It is expected that 1,614 acres of Tricolored Blackbird habitat will be converted under full build-out.

The SJMSCP conservation strategy relies on minimizing, avoiding, and mitigating impacts for Covered Species including the Tricolored Blackbird. Mitigating impacts to Covered Species will largely be accomplished through the creation, enhancement and management of Preserves. Tricolored Blackbirds are associated with five planned Preserves: Primary Zone of the Delta (Large and Small Water's Edge Preserve), Vernal Pool Zone (Vernal Pool Grassland Preserve), Central Zone (Row and Field Crop/Riparian Preserve), Central Zone (Wetlands Preserve), Central/Southwest Transition Zone (Use Central Zone Row and Field Crop/Riparian Preserve). Tricolored Blackbirds are considered indicators of Preserve health and will be monitored at the species-level, accordingly.

Incidental take minimization measures include a setback of 500 feet from nesting areas during the nesting season for the period encompassing nest building and continuing until fledglings leave nests. This setback applies whenever construction or other ground-disturbing activities must begin during the nesting season in the presence of nests that are known to be occupied. Setbacks shall be marked by brightly-colored temporary fencing.

Pacific Gas & Electric San Joaquin Valley Operations & Maintenance HCP

The PG&E San Joaquin Valley Operations & Maintenance HCP (PG&E HCP) plan area includes 276,350 acres in portions of nine counties in the San Joaquin Valley, as follows: San Joaquin, Stanislaus, Merced, Fresno, Kings, Kern, Mariposa, Madera, and Tulare. The 30-year term expires in 2037.

The following discussion is derived from USFWS 2007:

> Tricolored Blackbirds occupied approximately 1,443 acres of existing PG&E right-of-way in the plan area (52 occurrences in CNDDB as of 2007).
>
> As part of the planning process, PG&E will establish a map book for the Tricolored Blackbird by, prior to initiation of any covered activities, determining where PG&E facility lines occur within 100 meters of CNDDB-documented occurrences of breeding colonies. Active nesting birds will be avoided. If an active breeding colony could be disrupted by the covered activity, an exclusion

zone of at least 350 feet around the colony will be established. This exclusion zone will be established in the field based on site conditions, the covered activity, and professional judgment by a qualified PG&E biologist, and will be greater than the minimum distance. Work will not occur in this exclusion zone during April 1–July 31.

The PG&E HCP estimated that covered activities would directly disturb approximately 4 acres of suitable nesting or foraging habitat each year (120 acres of temporary disturbance over 30 years), with most of this disturbance occurring in foraging habitat. Less than 0.1 acre per year of blackbird nesting habitat is expected to be permanently lost each year (less than 3 acres of nesting habitat permanently lost over 30 years). Other covered activities that may disturb Tricolored Blackbirds (e.g., off-road travel and tree trimming that do not disturb ground surfaces) will affect 34 acres of suitable Tricolored Blackbird habitat each year (1,020 acres over the 30-year permit term). These impacts are expected to be individually small, widely dispersed and, therefore, likely to be insignificant and discountable.

Permanent loss of suitable foraging or nesting habitat will be compensated at a 3:1 ratio and temporary disturbance to suitable habitat will be compensated at a 0.5:1 ratio. The HCP estimates PG&E will provide 0.37 acres of Tricolored Blackbird compensation in the North San Joaquin Valley, 0.91 acres of compensation in the Central San Joaquin Valley, and 0.57 acres of compensation in the South San Joaquin Valley annually. Overall, PG&E will provide approximately 2.3 acres of Tricolored Blackbird compensation annually (approximately 69 acres over 30 years).

Kern Water Bank HCP

The Kern Water Bank HCP covers 19,900 acres of central Kern County. The 75-year term expires in 2072. Planning documents list no known Tricolored Blackbird colonies from the Kern Water Bank area; however, it was acknowledged that the species might move into the HCP area in the future. Impacts were described as “negligible; high mobility of the species allows easy escape from project-related impacts” (Kern Water Bank Authority 1997). A monitoring effort conducted in 2011 documented five small colonies numbering ~400 individuals in nettles under mesquite within the plan area. A large colony numbering several thousand individuals settled in an historic site along the Kern River channel but the colony was abandoned; they may have joined a successful colony in Basin 6 on city property of approximately 10,000 individuals that successfully fledged young. The author did not identify whether the earlier failed effort or the successful colony was located within the plan area (Hardt 2011).

Orange County Southern Subregion HCP

The Orange County Southern Subregion HCP comprises 132,000 acres in the study area, including the Cleveland National Forest (40,000 acres). Excluding certain urbanized areas and the National Forest property, the planning area totals 86,000 acres within southern Orange County. The County of Orange and Rancho Mission Viejo are signatory to the implementing agreement. The 75-year term expires in 2082.

Six general Tricolored Blackbird breeding locations have been documented in the planning area historically and include: Middle Chiquita Canyon, Coto de Caza, Radio Tower Road, Verdugo Canyon in San Juan Creek, lower Gabino Canyon, and Trampas Canyon settling ponds. Not all sites have been used consistently or recently. A total of 18,759 acres of potential foraging habitat was identified in the planning area. One of the known historic breeding sites, Trampas Canyon, will be directly impacted by the proposed covered activities and an estimated 3,769 acres of foraging habitat will be developed or otherwise made unsuitable for Tricolored Blackbirds (USFWS 2007).

The plan conserves four of the breeding colony sites within a planned habitat reserve: Middle Chiquita Canyon, Verdugo Canyon, Radio Tower Road, and Lower Gabino Canyon. Adequate foraging habitat within a four-mile radius of these sites also would be conserved. Planners assumed that “at least 1,000 acres of foraging habitat within four miles of a nest site would be more than adequate to sustain the relatively small nesting colonies that occur in the study area” (Dudek and Associates 2006). Adequate foraging habitat will also be conserved at the Cota de Caza site. A total of 8,015 acres of foraging habitat for Tricolored Blackbirds in the planning area, including the four historic nest site locations, will be cooperatively managed within the habitat reserve. Additional open space habitats exist within County Parks (1,694 acres) which will be managed with overall conservation goals of the HCP (USFWS 2007).

Management actions to benefit Tricolored Blackbirds will focus on nonnative predators, grazing, minimizing pesticide use near colonies, and managing human disturbance near colonies (Dudek and Associates 2006).

South Sacramento HCP

The South Sacramento HCP is currently in the planning stage. The proposed study area encompasses 317,656 acres in Sacramento County. Anticipated partners include the County of Sacramento and the Cities of Rancho Cordova and Galt.

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Solano Multi-Species HCP

Solano Multi-Species HCP is currently in the planning stage. The proposed study area includes 577,000 acres in Solano County and an additional 8,000 acres in Yolo County. Participants in this effort include the Cities of Dixon, Fairfield, Rio Vista, Suisun City, Vacaville, and Vallejo.

Natural Community Conservation Plans

Like HCPs, Natural Community Conservation Plans (NCCPs) are long-term landscape-level conservation plans. Under California state law, the Natural Community Conservation Planning Act (Fish & G. Code, §§ 2800-2835) provides a mechanism to obtain authorization for incidental take of CESA-listed and other species. An NCCP provides for the protection of habitat, natural communities, and species diversity on a landscape or ecosystem level, while allowing compatible and appropriate economic activity. An NCCP is broader in its objectives than the take authorization provided under the California and Federal ESAs, and may require conservation measures that go beyond mitigation of impacts to meet the recovery needs of

covered species. All approved NCCPs are also HCPs and so provide authorization for take of federally-listed species through section 10 of the ESA.

There are six approved NCCPs in California that include the Tricolored Blackbird as a covered species and six additional NCCPs that are in the planning stage (Figure 16; Table 4):

Approved NCCPs:

- East Contra Costa County
- Santa Clara Valley Habitat Plan
- Western Riverside County Multiple Species Habitat Conservation Plan
- San Diego County Multiple Species Conservation Program
- San Diego Gas & Electric Subregional
- San Diego County Water Authority

Planning Stage:

- Butte Regional Conservation Plan
- Yuba-Sutter Regional Conservation Plan
- Placer County Conservation Plan Phase I
- Yolo Natural Heritage Program
- San Diego East County Multiple Species Conservation Plan
- San Diego North County Multiple Species Conservation Plan

The goals, objectives, and conservation measures for Tricolored Blackbird included in approved NCCPs are summarized below.

East Contra Costa County NCCP

The East Contra Costa County NCCP (ECCC) spans 174,018 acres in eastern Contra Costa County. The following local governments are signatory to the implementing agreement: cities of Brentwood, Clayton, Oakley, and Pittsburg, and the County of Contra Costa. The city of Antioch is not part of the agreement. The 30-year term will expire August 2037.

The ECCC is located within the Bay Delta and Central Coast Province (CDFW 2015). Six natural communities are found in the study area: streams/riparian woodland, wetland, grassland, oak woodland, chaparral/scrub, and agricultural lands.

During the project planning phase, Tricolored Blackbirds were described as sporadic in the plan area; two breeding colonies were noted on the northern border of Los Vaqueros Watershed and several additional small colonies were detected during fieldwork for the county bird atlas project (ECCC 2006). The Contra Costa County Bird Atlas project found the Tricolored Blackbird to be a "fairly common permanent but highly local resident of freshwater marshes and weedy fields, particularly in East County but also locally elsewhere. Most breeding birds were present in the vicinity of… Byron" (Glover 2009). The largest colony detected numbered several hundred pairs. The Atlas confirmed breeding in six blocks,

found five additional blocks with possible nesting and an additional possible nesting colony just south of the county border (Glover 2009).

ECCC development guidelines require avoidance of occupied Tricolored Blackbird nests during the breeding season. Under the agreement, impacts of up to 204 acres of core habitat and 9,621 acres of primary foraging habitat may be permitted as a result of covered activities. A planned preserve system will protect 126–164 acres of suitable core habitat and 16,747–20,138 acres of primary foraging habitat under the initial urban development area or maximum urban development area, respectively. The preserve system will also protect at least seven of 13 ponds, all of which may provide potential breeding habitat. Additional pond and wetland creation (an estimated 85 acres of perennial wetland plus an estimated 16 acres of pond habitat) will be created or restored. Managed habitat is predicted to be of higher quality than what had existed prior to the agreement. Conservation easements will be acquired on 250–400 acres of cropland or pasture; landowners will be required to enhance habitat for Tricolored Blackbird and other covered species (CDFG 2007).

Annual progress reports prepared under the ECCC documented two recent land acquisitions with value for Tricolored Blackbirds. Vaquero Farms North, a 575-acre property adjacent to the Los Vaqueros Reservoir Watershed lands was purchased in 2010. It is situated entirely west of Vasco Road, with primary access from Vasco Road (ECCHC 2011). Vaquero Farms Central, a 320-acre property bounded by two existing Preserve System properties, Vaquero Farms North and Vaquero Farms South, was purchased in 2012 (ECCHC 2013). No progress towards pond creation was reported in the latest available annual report of activities (ECCHC 2016).

Santa Clara Valley Habitat Plan NCCP

The Santa Clara Valley Habitat Plan NCCP (SCVHP) includes the cities of Gilroy, Morgan Hill, and San Jose (excluding Alviso and the Baylands) and the County of Santa Clara. The study area encompasses 519,506 acres; the permits areas, however, differ from the study area. Two permits were issued under the plan, one solely for Burrowing Owl (*Athene cunicularia*) (48,464 acres) and another for all other covered species. The "all other covered species" permit, including Tricolored Blackbird, totals 460,205 acres and excludes Henry Coe State Park and a portion of Pacheco State Park. The term of the permit is for 50 years and will expire July 2063.

The SCVHP is found within the Bay Delta and Central Coast Province (CDFW 2015). Natural communities within the planning area include grassland (including serpentine grasslands), chaparral and scrub, coastal scrub, conifer woodland, oak savannah, oak woodland, riparian woodland scrub, mixed evergreen forest, wetlands, aquatic, rock outcrop, irrigated, and agriculture.

Tricolored Blackbirds appear to be relatively uncommon in Santa Clara County. Breeding colonies are few and fairly small. During the Santa Clara County Breeding Bird Atlas project, Tricolored Blackbirds were found in 29 blocks with breeding confirmed in 19 blocks. Hundreds to several thousand individuals were documented. Confirmed breeding occurred in Santa Clara Valley, Diablo Range, Calaveras Reservoir, San Felipe Lake, Coyote Reservoir, small pond on Coyote Ranch numbering fewer than 100

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individuals, Horse Valley stock pond, in the upper Smith Creek watershed (Bousman 2007). These data and CNDDB records were assessed under the SCVHP.

Conservation goals for Tricolored Blackbirds include protection for at least four sites that support, historically supported, or could support nesting colonies. Each protected site will have at least 2 acres of breeding (marsh) habitat and will have at least 200 acres of foraging habitat within 2 miles. These breeding sites will either be enhanced or restored breeding habitat in historically/currently occupied areas within the Reserve System or newly-created ponds suitable for breeding Tricolored Blackbirds (ICF 2012).

Take of, or impacts to, existing or historic breeding colonies is prohibited. Impacts to this species are limited to loss of habitat. Mitigation measures consist of pre-construction surveys, impact avoidance or minimization, and land acquisition. Acquisitions will focus on the following:

- Four historical breeding sites with adequate nearby foraging habitat referenced above;
- At least 22,840 acres of modeled Tricolored Blackbird habitat;
- Enhancement of acquired habitat specifically for Tricolored Blackbirds; and
- Creation of new ponds and wetlands that may provide breeding and foraging habitat for the species (CDFW 2013).

Western Riverside County Multiple Species Habitat Conservation Plan NCCP

The Western Riverside County Multiple Species Habitat Conservation Plan NCCP (WRC-MSHCP) covers approximately 1,300,000 acres in western Riverside County and is located wholly within the South Coast Province (CDFW 2015). All unincorporated county land west of the crest of the San Jacinto mountains to the Orange County line, as well as the cities of Temecula, Murrieta, Lake Elsinore, Canyon Lake, Norco, Corona, Riverside, Moreno Valley, Banning, Beaumont, Calimesa, Perris, Hemet, and San Jacinto are included in the plan area. The 75-year term will expire 2079.

Tricolored Blackbirds were described as “widely scattered” throughout the lowlands and foothills of Riverside County. Few current or historic breeding locations were documented within the planning area (Dudek and Associates 2003). Tricolored Blackbird potential habitat was assessed; a total of 480 acres of primary habitat and 259,695 acres of secondary habitat was identified as occurring within the planning area. Of these totals, a loss of 60 acres of primary habitat and 193,180 acres of secondary habitat was projected. Secondary habitat losses included approximately 102,000 acres of agricultural land and 88,000 acres of grassland (Dudek and Associates 2003). Mitigation identified in the plan includes the following actions:

- Include within the Conservation Area, 420 acres of suitable primary habitat (freshwater marsh, cismontane alkali marsh).
- Include within the Conservation Area the five identified Core Areas for Tricolored Blackbirds. The Core Areas include San Jacinto River floodplain (7,320 acres), Mystic Lake/San Jacinto Wildlife Area (17,470 acres), Collier Marsh and Lake Elsinore grasslands (1,810 acres), Alberhill (3,460 acres), and Vail Lake/Wilson Valley/eastern Temecula Creek (50,000 acres).

- Include within the Conservation Area, 66,510 acres of secondary habitat (playa and vernal pool, grasslands, agriculture land, and riparian scrub, woodland, and forest).
- Maintain (once every 5 years) the continued use of and successful reproduction within at least one of the identified Core Areas. Successful reproduction is defined as a nest that fledges at least one known young.
- Maintain, preserve, and if feasible, restore hydrological processes within the five Core Areas.
- Include within the Conservation Area a 100-meter buffer around any known nesting locations.

Although not considered a Tricolored Blackbird Core Area, a total of 9,670 acres within the Prado Basin/Santa Ana River area will be conserved within Criteria Area and Public/Quasi-Public designations. This area may support Tricolored Blackbirds in the future (Dudek & Associates 2003).

The most recent biological monitoring report for Tricolored Blackbirds (2013 breeding season) described the following results:

> Six breeding colonies were detected during targeted searches for Tricolored Blackbirds. These included the Potrero Unit of the San Jacinto Wildlife Area (~350 birds), San Timoteo Canyon (10 birds), Lake Riverside (~200 birds), Highway 371 in Tule Valley (45 birds), and Garner Valley (~150 birds). All counts sum to a total estimated population size of 2,755 birds. Mean and median colony sizes were 459 and 175, respectively. Biologists were unable to confirm reproductive success for the Garner Valley, Highway 371, or San Timoteo Canyon colonies. Tricolored Blackbirds successfully reproduced in Potrero and Tule Valley in 2013. Only one colony, Potrero, was located inside the existing Conservation Area; however, no colony was located within a designated Tricolored Blackbird Core Area. The largest colony (~2,000 birds) occupied a 40-acre field on private land in the San Jacinto Valley. It suffered complete reproductive failure when the field was cut; adults were incubating eggs at the time (WRCRCA 2015).

Biological monitors made management and monitoring recommendations to improve conservation conditions for the Tricolored Blackbird in the Plan area. According to recent biological monitoring reports (WRC-MSHCP 2013), three of the five Core Areas identified for Tricolored Blackbird conservation purposes (Alberhill, Collier Marsh/Lake Elsinore grasslands, and San Jacinto River floodplain) do not provide suitable or sufficient breeding habitat for the species. Other sites were recommended as additional Core Areas based on recent Tricolored Blackbird recent activity. Further, recommendations to change the Tricolored Blackbird species account in the Plan so that it "be modified to recognize loss of foraging habitat in the vicinity of breeding sites as a significant threat to the survival of the species, and that the stated management objectives be reconsidered as well. In particular, the prescription for managing '… this species in order to maintain (once every five years) the continued use of, and successful reproduction within at least one of the identified Core Areas' (Dudek & Associates 2003) is likely insufficient for a rapidly declining species that is dependent on patchy and unpredictable breeding habitats which are being rapidly lost throughout the Plan Area" (WRC-MSHCP 2011, 2013, WRCRCA

2015). Finally, the monitoring regime was deemed inadequate to provide conservation awareness for the Tricolored Blackbird. Monitoring should be conducted with surveys for breeding colonies every year rather than every five years and the survey period be extended to allow multiple visits to active sites before, during, and after nesting (WRC-MSHCP 2011).

San Diego County Multiple Species Conservation Program

The San Diego County Multiple Species Conservation Program NCCP (SDCMSCP) covers approximately 511,878 acres in San Diego County and is located wholly within the South Coast Province (CDFW 2015). SDCMSCP participants include the County of San Diego, Cities of Chula Vista, San Diego, La Mesa, and Poway; implementing agreements are in progress for Coronado, Del Mar, Santee, and El Cajon. Subarea plans have been or will be prepared for each participating entity. Imperial Beach, National City, and Lemon Grove are not developing subarea plans but reserve the right to do so at a later date. The 50-year term expires 2048.

A detailed status assessment of the Tricolored Blackbird within the planning area was not provided in the planning documents. The Plan did identify a rationale for including Tricolored Blackbirds as a covered species: "…77% of potential habitat [4,800 acres], including 59% of mapped localities, will be conserved. Breeding colonies move from season to season, and with a goal of no net loss of wetlands, most of the suitable breeding sites will continue to be available. This species forages in grasslands and agricultural fields near its breeding habitat. Foraging habitat near the known nesting colonies will be conserved at 70–100%. Additionally, foraging opportunities will continue to be provided and created in turfed areas such as golf courses and cemeteries. Jurisdictions will require surveys during the CEQA review process in suitable breeding habitat proposed to be impacted. Participating jurisdictions' guidelines and ordinances and state and federal wetland regulations will provide additional habitat protection resulting in no net loss of wetlands" (Ogden Environmental 1998).

Under the plan, 23% of breeding habitat (1,400 acres) has the potential for development or impacts.

Additionally, the following conditions were specified for Tricolored Blackbirds: "Project approvals must require avoidance of active nesting areas during the breeding season. Area-specific management directives must include measures to avoid impacts to breeding colonies and specific measures to protect against detrimental edge effects to this species. Area-specific management directives for preserve areas will include specific guidelines for managing and monitoring covered species and their habitats including best management practices. Edge effects may include (but not be limited to) trampling, dumping, vehicular traffic, competition with invasive species, parasitism by cowbirds, predation by domestic animals, noise, collecting, recreational activities, & other human intrusions" (Ogden Environmental 1998).

Annual reports are available online for the South County Subarea of the SDCMSCP (http://www.sandiegocounty.gov/content/sdc/parks/openspace/MSCP.html). These reports typically document habitat losses and gains associated with development projects and do not mention Tricolored Blackbirds specifically.

San Diego Gas & Electric Company Subregional NCCP

The San Diego Gas & Electric Company (SDG&E) Subregional NCCP covers discrete linear or energy projects but has a larger plan area that overlaps with other NCCPs. The plan area traverses 2,000,000 acres of SDG&E service territory in San Diego, Orange, and Riverside counties and is located wholly within the South Coast Province (CDFW 2015). Its 55-year term will expire December 2050. Although the term of the agreement is 55 years, SDG&E may, at its election, terminate the agreement after the 25th year and every 10 years thereafter.

In total, the SDG&E plan will result in a combined permanent loss of no greater than 400 acres with 50 miles of electric transmission and/or new gas transmission lines. This acreage figure includes an estimated permanent loss of 124 acres of habitat. The most common and most affected habitat types will likely be coastal sage scrub, chaparral, oak woodland, and grasslands (SDG&E 1995).

Impacts to Tricolored Blackbirds were considered to be generally very small and minimized or mitigated (in that order) when potential impacts occur to the species' habitats (SDG&E 1995). Tricolored Blackbird habitat was categorized under Mitigation Category III: beach, marsh, and wetland species. Mitigation measures taken for this category include:

- Construction in marsh areas, soft sand, or open water in most cases will be accomplished through the use of helicopters for the delivery of materials, poles, personnel, and platforms; and
- Roads should be avoided to the extent feasible.

In general, the following conditions apply: wildlife will not be killed unless to protect life and limb of staff, personnel training will be provided, and pre-activity surveys will be conducted (SDG&E 1995).

Planning documents available online did not include site-specific information on Tricolored Blackbird colony locations or foraging sites.

San Diego County Water Authority NCCP

The San Diego County Water Authority NCCP covers discrete linear projects but has a larger plan area that overlaps with other NCCPs. The plan area traverses 992,000 acres in western San Diego and southwestern Riverside counties and is located wholly within the South Coast Province (CDFW 2015). Nearly all Covered Activities will occur within the probable impact zone: 1,000 feet on either side of the pipelines or facilities, or approximately 64,600 acres along the existing pipeline rights-of-way, and other connected water conveyance, storage, and treatment facilities. The 55-year term of the agreement will expire December 2066.

One Tricolored Blackbird colony was documented near the Sweetwater Reservoir during the planning process; no colonies were noted within the planned impact zone (CNDDB in SDCWA and RECON 2010).

A total of 1,830 acres of wetland/riparian habitat exists within the probable impact zone; of this total, approximately 16 acres of potential Tricolored Blackbird breeding habitat could be impacted by

permitted activities. Twenty-one acres of potentially suitable breeding habitat in the existing preserve area may be used to mitigate impacts to Tricolored Blackbird. Suitable foraging habitat is conserved in the 1,186 acre San Miguel Habitat Management Area within the San Diego National Wildlife Refuge (Merkel and Associates 1997 in SDCWA and RECON 2010); however, no nesting has been documented there.

No direct take of breeding Tricolored Blackbirds or their nests is allowable; avoidance and/or minimization measures will be undertaken to conserve breeding colonies. Biological mitigation is habitat-based at approved ratios, which are based on the resource value of the impacted habitat. Mitigation for unavoidable impacts may include acquisition of additional preserve area lands, acquisition of credits in other conservation/wetland banks, or development of a biologically superior conservation alternative for the species at appropriate locations in the planning area.

Butte Regional Conservation Plan NCCP

The Butte Regional Conservation Plan NCCP is currently in the planning stage. The proposed study area encompasses 564,270 acres in Butte County. A planning agreement was completed in December 2007 and was signed by Butte County and the cities of Biggs, Chico, Gridley, and Oroville. An independent science advisors report was completed in 2007. Formal public review of draft planning documents closed June 8, 2016; however, public comments are still being accepted.

Yuba-Sutter Regional Conservation Plan NCCP

The Yuba-Sutter Regional Conservation Plan NCCP is currently in the planning stage. The proposed study area encompasses 468,552 acres in Yuba and Sutter counties. A planning agreement was completed in September 2012 and was signed by the counties of Butte and Yuba, the cities of Yuba City, Live Oak, and Wheatland. An independent science advisors report was completed in February 2006. Draft plan documents are in preparation.

Placer County Conservation Plan Phase I NCCP

The Placer County Conservation Plan Phase I NCCP is currently in the planning stage. The proposed study area (phase one of an anticipated three phases) encompasses 201,000 acres in western Placer County. A planning agreement was prepared October 2001 and was signed by the county of Placer. An independent science advisors report was completed January 2004. Draft plan documents are in preparation.

Yolo Habitat Conservation Plan/NCCP

Yolo Habitat Conservation Plan/NCCP (formerly Yolo Natural Heritage Program) is currently in the planning stage. The proposed study area encompasses 653,663 acres in Yolo County. A planning agreement was prepared February 2005 and signed by the Yolo Habitat Conservation Plan/Natural Communities Conservation Plan Joint Powers Agency. An independent science advisors report was completed March 2006. Draft plan documents are in preparation.

San Diego East County Multiple Species Conservation Plan NCCP

The San Diego East County Multiple Species Conservation Plan NCCP is currently in the planning stage. The proposed study area encompasses 1,600,000 acres in eastern San Diego County. The following communities are expected participants: Central Mountain, Cuyamaca, Descanso, Pine Valley, Desert/Borrego Springs, Julian, Mountain Empire, Boulevard, Jacumba, Lake Morena/Campo, Potrero, Tecate, Dulzura (in part), and Palomar/North Mountain. A planning agreement for San Diego East County and San Diego North County was prepared in 2008, amended May 2014, and signed by San Diego County. However, separate NCCPs will be prepared. An independent science advisors report, Part 1, was completed March 2006. Draft plan documents are in preparation.

San Diego North County Multiple Species Conservation Plan NCCP

The San Diego North County Multiple Species Conservation Plan NCCP is currently in the planning stage. The proposed study area encompasses 311,800 acres in northern San Diego County. The following communities are expected participants: Bonsall, De Luz, Fallbrook, Harmony Grove, Lilac, Pala, Pauma Valley, Rainbow, Rincon Springs, Twin Oaks Valley, Valley Center, and Ramona (in part). Excluded from the study area are Carlsbad, Encinitas, Escondido, Oceanside, San Marcos, Solana Beach, and Vista. A planning agreement for San Diego North County and San Diego East County was prepared in 2008, amended May 2014, and signed by San Diego County. However, separate NCCPs will be prepared. Independent science advisors reports were prepared in 2001 and 2002. Draft plan documents underwent public review in 2009 and are now under revision.

Conservation Plan for the Tricolored Blackbird

Following the 1991 petition to list the Tricolored Blackbird under CESA, a multi-stakeholder working group was formed to plan for and implement conservation actions. This resulted in the first of many statewide surveys, the first silage buyout to protect a breeding colony, and ongoing research. However, the working group made limited progress in developing comprehensive conservation measures for the Tricolored Blackbird and eventually dissolved in the mid-1990s. In 1997, a status update and management guidelines for the Tricolored Blackbird was completed (Beedy and Hamilton 1997). The species was again petitioned to be listed under CESA in 2004. After this petition was rejected by the Fish and Game Commission, a new multi-stakeholder Tricolored Blackbird Working Group was formed in 2005 and the group released a conservation plan in 2007 detailing the conservation and management, research and monitoring, data management, and education and outreach goals for the species (TBWG 2007). Working group members, including the Department, signed a Memorandum of Understanding agreeing to implement the actions in the conservation plan. Most of the goals and objectives in the plan are still relevant today and portions of the plan are currently being updated by the Tricolored Blackbird Working Group. Progress toward meeting objectives by the Department, USFWS, and partners on the working group has focused on protecting large breeding colonies that are threatened by harvest of agricultural grain fields and increasing knowledge through monitoring and research. New information is being used to update goals and objectives in the conservation plan.

Protection of Agriculture Colonies from Losses to Harvest

As described above, a large portion of the Tricolored Blackbird population has been nesting on agricultural grain fields since the 1990s, mostly adjacent to dairies. Although dairies often provide nesting substrate (the grain grown to feed cattle), a water source (e.g., drainage ditches or wastewater ponds), and food for adult birds (stored grains), colonies located adjacent to dairies have often suffered from low productivity. In many cases, the entire reproductive effort of silage colonies has been lost when the nesting substrate is harvested while the young or eggs are still in the nest (Meese 2013). The timing of grain harvest typically coincides with the Tricolored Blackbird breeding season, resulting in the destruction of nests, eggs, and nestlings, and occasionally mortality of adult Tricolored Blackbirds. The Tricolored Blackbird colonies that form on agricultural grain fields early in the breeding season are often the largest colonies formed each year, and the complete destruction of these colonies due to harvest can be especially damaging to annual blackbird productivity (Arthur 2015).

The protection of large colonies that occur on agricultural grain fields has been the primary conservation action implemented for Tricolored Blackbird since the species was discovered breeding in this substrate type in the early 1990s. Shortly after the discovery of grain colonies in the San Joaquin Valley, the USFWS intervened to encourage harvest delays and protect the largest known breeding colony (Hamilton 1993). In 1994, a crop was bought to protect a 28,000-bird colony (Kelsey 2008). Hamilton et al. (1995) calculated that interventions in 1992, 1993, and 1994 may have been responsible “for the presence of over 75,000 adult Tricolored Blackbirds in 1995 [which had been nestlings in the three previous years], about 25% of the known population.” In 1999, the Department and USFWS protected a colony that was composed of one-third of the known population at the time, which otherwise would have been destroyed by routine harvesting activities (Hamilton et al. 1999). In 2004, silage purchases by the Department and USFWS protected three colonies totaling over 100,000 adult Tricolored Blackbirds. In 2006, the two largest known colonies, totaling more than 200,000 breeding birds, were protected through silage buyouts (Meese 2006). Meese (2009b) estimated that payments to landowners for harvest delays resulted in the protection of 364,000 nests and about 396,000 Tricolored Blackbird fledglings in the five years from 2005 to 2009. Despite these efforts to protect birds breeding on agricultural fields, losses to harvest have continued to occur in most years (Figure 17).

The Natural Resources Conservation Service (NRCS) established a fund in 2012 that was used for three breeding seasons to protect colonies on agricultural lands and to enhance habitat for the Tricolored Blackbird. Landowner participation in the program varied from year to year, with many thousands of nests protected each year while some colonies continued to be lost to harvest.

Regional Conservation Partnership Program

In 2015, the NRCS awarded a Regional Conservation Partnership Program (RCPP) grant to a group of conservation and dairy organizations (Arthur 2015). The grant provided five years of funding to protect, restore, and enhance Tricolored Blackbird habitat on agricultural lands, with the primary objective being to prevent loss of breeding colonies to harvest. During the first year of implementation in the 2016 breeding season, the program succeeded in enrolling all landowners with Tricolored Blackbird colonies

identified on their property, and 100% of known agricultural colonies representing more than 60,000 breeding birds were protected through delay of harvest. In 2017, a single large colony (estimated at up to 12,500 breeding birds) was lost to harvest at a location that was not enrolled in the NRCS program.

Despite efforts by landowners and the state and federal government to protect colonies, losses to harvest have continued. The protection of all known colonies on agricultural fields in the 2016 breeding season is encouraging progress, although ongoing success will require a stable funding source to compensate landowners that delay harvest. See the section on Harvest of Breeding Colonies below for a discussion of this ongoing threat to the species.

Habitat Restoration and Enhancement

USFWS National Wildlife Refuges

The USFWS owns and manages several National Wildlife Refuges (NWR) in the breeding range of the Tricolored Blackbird. In northeastern California, the Lower Klamath and Tule Lake NWRs have supported breeding colonies at several locations, although colony size has been relatively small as is typical for this portion of the range. The Sacramento National Wildlife Refuge Complex in the Sacramento Valley, the San Luis National Wildlife Refuge Complex in the northern San Joaquin Valley, and Kern and Pixley NWRs in the southern San Joaquin Valley have all supported breeding Tricolored Blackbird colonies.

The Sacramento National Wildlife Refuge Complex has actively managed selected wetlands to maintain suitable Tricolored Blackbird habitat for some time, and they have been frequently successful in attracting breeding colonies to Delevan NWR. Recent restoration at Colusa NWR has resulted in a return of breeding birds after many years of absence. Portions of the Merced NWR have been managed to provide breeding substrate for Tricolored Blackbirds in recent years, and the refuge has been successful in attracting multiple colonies of several thousand breeding birds. The Kern NWR has supported suitable habitat, and for many years hosted breeding colonies. Despite continued efforts to provide flooded spring wetlands, in recent years use of the refuge by breeding colonies has been limited, although a colony of 3,000 birds nested on the refuge in 2017. The Pixley NWR has not supported breeding colonies in recent years, but the USFWS is implementing management to attract breeding birds.

NRCS Easements and Incentive Programs

Through a combination of easements on privately owned lands and 3-year incentive programs, the NRCS has enrolled about 500 acres of land (as of January 2017) in programs that will provide habitat suitable for Tricolored Blackbird nesting. These programs focus on providing dense cattail habitat using water management practices compatible with Tricolored Blackbird nesting habitat. The majority of current NRCS habitat projects are in the Grasslands District of Merced County, with a smaller acreage in the southern San Joaquin Valley in Kern and Tulare Counties. Existing habitat projects have proven successful, with Tricolored Blackbirds breeding on three NRCS easement properties in 2016 (report to the Tricolored Blackbird Working Group, January 31, 2017; unreferenced).

California Department of Fish and Wildlife Lands

On many of the Department wildlife areas and ecological reserves located in the breeding range of the Tricolored Blackbird, management practices include spring or permanent wetland habitats that can support suitable nesting substrate for breeding colonies. In some cases, these wetlands have been managed specifically for Tricolored Blackbirds by setting back wetland succession through burning or mechanical methods, and in other cases the wetlands are typically managed for a broader suite of species. Use of Department wildlife areas and ecological reserves by breeding colonies includes (Tricolored Blackbird Portal 2017):

Northeastern California – The Honey Lake Wildlife Area has supported breeding colonies at two wetland locations. The number of breeding birds has been small, with the most recent observation of 200 breeding birds in 1996.

Sacramento Valley – Four wildlife areas in the Sacramento Valley have supported breeding colonies. Three of these wildlife areas are in Butte County (Oroville, Gray Lodge, and Upper Butte Basin), each of which have supported colonies at a single location, with the most recent observations including 1,600 birds on a wetland at Gray Lodge Wildlife Area in 2011 and 2,000 birds in willows at Oroville Wildlife Area in 2015. Oroville Wildlife Area also regularly supports foraging birds in the post-breeding season (B. Stone, pers. comm.). The Yolo Bypass Wildlife Area in Yolo County has hosted small breeding colonies at three separate locations in wetlands and button willow shrubs.

Commented [TB35]: I've never seen a breeding colony at Gray Lodge, which has always surprised me, what is the source of the 2011 observation?.

San Joaquin Valley – Four wildlife areas in the San Joaquin Valley have supported breeding colonies. Three of these are in Merced County, with North Grasslands Wildlife Area supporting three colony locations in milk thistle and mustard, Los Banos Wildlife Area supporting five colony locations in wetlands, and O'Neill Forebay Wildlife Area supporting four colony locations in Himalayan blackberry. The most recent use includes a 9,000 bird colony on a wetland at Los Banos Wildlife Area in 2008 and a 3,500 bird colony in Himalayan blackberry at O'Neill Forebay Wildlife Area in 2005. The fourth wildlife area in the San Joaquin Valley, Mendota Wildlife Area, is located in Fresno County. This wildlife area has supported breeding colonies at three separate wetland locations, with the last reported breeding by 1,000 birds in 1995.

Southern California – The Rancho Jamul Ecological Reserve in San Diego County has hosted a small breeding colony on a wetland in most years since 2007. This colony is usually fewer than 200 breeding birds. In Riverside County, the San Jacinto Wildlife Area has supported breeding colonies at 12 different locations. Most of the colonies have occurred in wetland habitats, with a few locations in other vegetation types including stinging nettle, thistles, and mallow. This wildlife area is located in perhaps the most important region for breeding Tricolored Blackbirds south of the Transverse Ranges. The wildlife area regularly hosts several thousand breeding birds, with a single location supporting 10,000 birds in 2005. During the 2017 statewide survey, 6,300 birds were observed at a single location on the wildlife area.

The Department has also worked with private landowners to create nesting habitat using a variety of incentive programs. The goals of the programs have included management of water to create spring

wetland habitat with emergent cattail vegetation. Several of these projects were successful in attracting Tricolored Blackbird colonies, with colonies of up to several thousand birds breeding on private wetlands created through these programs from at least 2005 through 2011. Funding has been limited in recent years, resulting in declining participation and a reduction in available wetland habitat on private lands.

California Environmental Quality Act

The California Environmental Quality Act (CEQA; Public Resources Code Section 21000 et seq.) requires state and local agencies to publicly disclose, analyze, and potentially mitigate environmental impacts from projects over which they have discretionary approval power. In particular, CEQA requires that actions that may substantially reduce the habitat, decrease the number, or restrict the range of any species that can be considered rare, threatened, or endangered must be identified, disclosed, considered, and mitigated or justified (Cal. Code Regs., tit. 14, §§ 15065(a)(1), 15380).

The environmental review process required by CEQA can be costly and time consuming, and compliance is not always thorough. Agencies may also make the determination that projects are exempt (i.e., they do not need to go through the impact analysis, public disclosure, and mitigation process). Mitigation is required if a project is not CEQA-exempt and impacts would be potentially “significant.” Mitigation must reduce impacts to below a level of significance or minimize unavoidable significant impacts, where feasible. The CEQA process generally incentivizes agencies and project applicants to implement mitigation, thereby avoiding significant impacts.

Due to its SSC designation, impacts to Tricolored Blackbirds are generally considered potentially significant if agencies determine on a project-specific basis that the species meets the CEQA criteria for rare, threatened, or endangered. However, agencies are not required to make this determination for Tricolored Blackbirds and other species that are not listed under CESA or ESA.

FACTORS AFFECTING ABILITY TO SURVIVE AND REPRODUCE

Small Population Size and Colonial Breeding

A key question is whether the colonially breeding Tricolored Blackbird can maintain a viable population at some reduced population abundance that supports only small colonies or concentrates the majority of the population into very few colonies. That is, what is the minimum number of individuals that can continue to support a well-distributed breeding population with colonies that are productive and resilient to the dynamic breeding and foraging landscape within their range? Another North American colonially breeding bird, the Passenger Pigeon (*Ectopistes migratorius*), declined to extinction as a result of multiple population pressures, and the species seemed to have an inability to survive and reproduce at low population numbers (Bucher 1992). In addition to the well-known effect of market hunting in the decline of the Passenger Pigeon, habitat alteration and a lack of social facilitation in food finding due to reduced population size have been implicated in the extinction of the species (Bucher 1992). The Tricolored Blackbird is similar to the Passenger Pigeon in that they are highly social, colonial breeders

Commented [TB36]: Could also mention Carolina Parakeet, also a colonial breeder.

with nomadic tendencies that likely evolved for locating highly abundant food sources and other breeding habitat requirements. Tricolored Blackbird has experienced, or continues to experience, many of the population pressures that led to extinction of the Passenger Pigeon; however, unlike the passenger pigeon, the Tricolored Blackbird has adapted to the wide-scale loss of wetland nesting substrate habitat by using a variety of upland vegetation types.

As described in the section on Biology and Ecology, Tricolored Blackbirds may benefit from social and colonial behaviors by reducing mortality due to predation during the nesting cycle and by facilitating food finding and information sharing. Smaller groups of birds would likely retain the ability to locate and use secure nesting substrates, but small colonies might lose the potential benefits of predator satiation and of social food finding and information sharing. The locating and exploitation of abundant food sources could affect small groups of birds both in the selection of productive breeding locations and in acquiring sufficient prey with which to provision young after a site is selected.

Some bird species are known to nest in colonies when conditions are suitable, but can also nest in smaller groups or as single pairs. For example, the White-winged Dove (*Zenaida asiatica*) once nested in extremely large colonies in Mexico. In 1978, 22 breeding colonies contained a collective population size of more than eight million birds (Sanchez Johnson et al. 2009). Individual birds were shown to have very high site fidelity to breeding areas, sometimes returning to nest in the same tree across years (Schwertner et al. 1999). Habitat changes driven by urbanization and intensification of agricultural practices and urbanization caused the loss and fragmentation of nesting habitat and now the White-winged Dove nests singly or in smaller colonies at more dispersed locations in Mexico, and appears to have adapted to use urban areas (Schwertner et al. 1999, Sanchez Johnson et al. 2009).

Although the Tricolored Blackbird has been observed to nest in very small colonies (as few as 4 nests), the species has not been observed to nest as single pairs. Very small colonies (<100 birds) are quite rare, and although nesting success varies greatly across colonies of all sizes, there is some evidence that very small colonies are not as successful as larger colonies (Payne 1969, Weintraub et al. 2016), and that larger colonies produce more young per female (Hamilton 1993, Meese 2013). Reductions in population size may make the Tricolored Blackbird more vulnerable to additional declines due to inherent natural history factors, but the degree to which a small population would limit the species' ability to survive and reproduce is not known.

The fact that half or more of the total population will often occur in a small number of large colonies in silage fields during the first nesting attempt makes the species vulnerability to losses of productivity (Meese 2012, Beedy et al. 2017). In 2011, 65% of the total known population was located at only six colony sites in Merced, Kern, and Tulare counties (Kyle and Kelsey 2011). This concentration of large portions of the population makes the species vulnerable to a number of potential threats, especially colony destruction through harvest, predation, or extreme weather events (Weintraub et al. 2016). The enhanced risk to the species due to colonial breeding may be realized primarily through exacerbation of other threats that can effect a large portion of the total population.

Habitat Loss

Loss of Nesting Habitat

The conversion of wetland nesting habitat to agricultural and urban uses has been implicated in the long-term decline of the species. Neff (1937) observed, "[t]he destruction of [Tricolored Blackbird] nesting habitats by man is of most importance," and cited reclamation and drainage as key factors in the loss of many favorable sites, along with "dredging or cleaning of reservoirs, marshes, and canals in order to destroy the growths of cattails and tules." Only about 15% of the four million acres of wetlands that existed in the Central Valley in the 1850s remained when Neff conducted his work in the 1930s, and about 40% of those remaining wetlands were lost between 1939 and the 1980s (Frayer et al. 1989). Of the freshwater emergent wetlands most likely to be used by breeding Tricolored Blackbirds in the Central Valley, 50% were lost between 1939 and the 1980s, with an average loss of 5,200 acres per year (Frayer et al. 1989). These losses were primarily due to conversion of wetlands to agriculture.

DeHaven et al. (1975a) found no nesting substrate at several locations in Los Angeles, Kern, Sacramento, and Yolo counties where earlier researchers had studied the species. Subsequent investigators have continued to document habitat loss at known breeding colony locations through the present. For example, Beedy et al. (1991) found that 9.3% (n = 17) of all colony locations used in the 1980s were extirpated through permanent removal of nesting habitat. Hamilton et al. (1999) observed the removal of a wetland that had supported a productive breeding colony in 1998. DeHaven (2000) noted the loss of several breeding colonies in Sacramento County to urban development and the expansion of vineyards. Humple and Churchwell (2002) reported on the draining of a wetland and the removal of Himalayan blackberry that had previously supported breeding colonies. Hamilton (2004a) documented the loss or destruction of cattail nesting substrates that had supported 90,000 breeding birds between 1994 and 2004. During the 2017 statewide survey, local experts and survey participants were asked to score the suitability of nesting substrate for all sites visited. Of the 636 sites for which scores were reported before or during the survey, 70 sites were scored as permanently unsuitable, usually due to development or conversion to permanent crops like orchards or vineyards (Table 5). An additional 80 sites had no nesting substrate present during the survey and 101 sites had vegetation present, but were considered unsuitable by the survey participant.

Commented [TB37]: Also true in San Joaquin County.

Table 5. Nesting substrate suitability for 636 sites scored before and during the 2017 statewide survey.

Score	Number of sites	Notes on suitability scores
Suitable	385	Nesting substrate present and considered suitable for nesting.
Unsuitable	101	Nesting substrate present but appears to be unsuitable for nesting (e.g., it is immature, too short, lacks sufficient foliage, too sparse, or has recently been burned).
Substrate absent	80	Nesting substrate absent because it has been removed or died (e.g., former grain field planted to alfalfa, milk thistle stand or Himalayan blackberry that has been mowed, wetland that has dried up).
Permanently unsuitable	70	Nesting substrate is absent and cannot be replaced (e.g., has been converted to urban development, orchard, or vineyard).

Following a low point in the extent of wetlands in the 1980s, aggressive restoration actions resulted in an increase of 65,000 acres of managed wetlands between 1990 and 2005 (CVJV 2006). The majority of the wetlands in the Central Valley are managed lands that are maintained by application of water, and many areas undergo occasional land re-contouring or vegetation control to maintain desired conditions. As of 2006, there were about 205,000 acres of managed wetlands in the Central Valley (CVJV 2006). Most managed wetlands (~90%) are flooded primarily in the fall and winter for wintering waterfowl (i.e., seasonal wetlands), and a small proportion are managed as semi-permanent or permanent wetlands that hold water during the spring and summer (Iglecia and Kelsey 2012). Semi-permanent wetlands are often managed to support brood habitat for waterfowl; the small proportion of semi-permanent and permanent wetlands are those that can potentially be suitable as nesting substrate for breeding Tricolored Blackbirds.

Replacement of wetland breeding habitat with novel, nonnative upland nesting substrates may have lessened the impact of the decline in Central Valley wetlands to the Tricolored Blackbird population. However, these nonnative vegetation types are often considered undesirable and are frequently removed. Himalayan blackberry habitat with a history of use by breeding colonies has been removed by burning, treatment with herbicide, or mechanical removal (Airola et al. 2015a, 2015b). Milk thistle colonies have been destroyed when landowners have removed or sprayed the invasive weed while Tricolored Blackbirds are actively nesting (Airola et al. 2016). Blackberry control is generally localized and occurs on multi-year intervals, and therefore may not have a large overall effect on the population, although there are cases where removal of nesting substrate has resulted in permanently unsuitable conditions. In the central Sierra Nevada foothills where Tricolored Blackbird colonies frequently nest in Himalayan blackberry, 32% of colonies active in 2014 occurred in areas zoned for development or that were proposed for rezoning for development (Airola et al. 2015a). In 2017, a group of Himalayan blackberry sites that had supported 13,000 breeding Tricolored Blackbirds were removed or degraded by aggregate mining activities (Oct 2017 email from D. Airola to N. Clipperton; unreferenced). The Department is unaware of any available information to evaluate distribution or trends of these nonnative nesting substrates across the range of the Tricolored Blackbird in California.

Although the loss of wetlands in California's Central Valley is well documented and there are many examples of nesting substrate being removed or degraded at historical Tricolored Blackbird colony locations, there also appears to be suitable nesting substrate in some areas that goes unused in many years. However, there are other regions where large areas of apparently suitable foraging habitat have no available nesting substrate, or where nesting substrate is only available during years when rainfall patterns support vigorous growth of upland nesting substrates (Airola et al. 2016). Most managed wetlands in the Central Valley are not suitable as nesting substrate for the Tricolored Blackbird, but wetlands remain the substrate type most frequently used by breeding colonies and upland nesting substrates provide additional habitat. The dynamic occupancy patterns at breeding locations from year-to--year and the need for abundant insect prey in surrounding foraging habitat makes it difficult to reach conclusions about nesting substrate suitability based on occupancy in a single year. It is likely that loss of nesting substrate has caused local declines and shifts in distribution, but the overall effect on the population is difficult to assess, especially without considering other breeding requirements. Losses of

nesting substrate at historically large or productive colony locations, or in areas surrounded by high quality foraging habitat, would have the largest impact on the population.

Loss of Foraging Habitat

The extent of foraging habitat required for successful breeding is much greater than the extent of nesting substrate. The abundance of insect prey in foraging habitat has been linked to reproductive success, and Tricolored Blackbirds may choose breeding locations in part based on the local prey populations. Because insect populations are variable and unpredictable from year to year, the Tricolored Blackbird population likely requires much more foraging habitat on the landscape than is used in any given year, and once lost, large landscapes with suitable habitat are difficult to replace. For these reasons, loss of foraging habitat is likely as important, or more so, than the documented losses of nesting substrate on the long-term viability of the Tricolored Blackbird population.

The loss of foraging habitat has been suggested as a likely cause of decline in southern California (Hamilton et al. 1995, Cook 2010). The extirpation of colonies from most of the coastal lowlands in southern California, despite the presence of more numerous marsh habitats relative to inland areas, suggests that foraging habitat sufficient to support breeding colonies is the population's limiting factor (Unitt 2004).

Hamilton et al. (1992) reported on the pervasive loss of foraging habitat near breeding colony sites due to expansion of cultivated agriculture and the conversion of existing agriculture to incompatible crops in the Central Valley, and considered this the primary threat to population abundance. DeHaven (2000) observed widespread habitat loss due to urban expansion and agricultural conversions to vineyards and orchards relative to the 1970s when he and others conducted Tricolored Blackbird research across the state, and suggested that habitat loss was a primary driver of continued population declines. Conversion of pastures and crops suitable for foraging by Tricolored Blackbirds was observed in Placer, Sacramento, Stanislaus, and Tulare counties. DeHaven (2000) noted especially extensive losses in Sacramento County, where urban development and expansion of vineyards had removed thousands of acres of high-quality habitat. More than 5,000 acres of habitat had been converted to vineyards in just a two-year period from 1996 to 1998, resulting in the loss of known breeding colony locations.

Grasslands have been identified as one of the most vulnerable habitats across North America, and many grassland species have experienced steep population declines in recent decades (NABCI 2016). A great deal of effort has been expended on conserving the grasslands in the central part of North America from the Great Plains to northern Mexico (Knopf and Skagen 2012). The grasslands of California have not received the same level of conservation attention, although losses of grasslands in California have been extensive.

Soulard and Wilson (2015) used Landsat satellite data to analyze land-use and land-cover change in the Central Valley from 2000 to 2010, and compared this to changes in the valley since 1973. The largest land-cover trend from 2000 to 2010 occurred in grassland/shrubland habitats. During this 10-year period, an estimated 79,200 acres of grasslands and shrublands were lost, representing a 5% decrease in the Central Valley over 10 years. Over the longer period from 1973 to 2010, grasslands and shrublands

declined by 22% (a loss of 476,900 acres), due mainly to conversions to more intensive agriculture and urban development. Although many of the grassland losses were due to agricultural intensification, losses of agriculture to urban development resulted in relatively little net change in area of agriculture in the Central Valley from 1973 to 2010.

Cameron et al. (2014) analyzed time series land cover data from the California Farmlands Mapping and Monitoring Program collected between 1984 and 2008 to evaluate rangeland habitat (grassland, shrubland, and woodland) conversion in California. The area evaluated covers much of the breeding range of the Tricolored Blackbird except for southern California. About 483,000 acres of rangelands were converted during this 20+ year period, with urban and rural development and conversion to more intensive agricultural uses accounting for most (~90%) of the rangeland loss. Agricultural intensification was primarily due to increases in vineyards and orchards, but smaller amounts of other agricultural crops that may provide foraging habitat for Tricolored Blackbird were also responsible for grassland loss. The San Joaquin Valley region, which in recent decades has been the center of abundance for breeding Tricolored Blackbirds during the early nesting season, experienced the largest amount of rangeland conversion (Figure 18).

Land cover types suitable for Tricolored Blackbird foraging in the Central Valley continue to be converted to incompatible land cover types such as orchards, vineyards, and urban development as agricultural practices evolve and cities continue to expand in the Central Valley. Due to the continued expansion of nut trees and vineyards that replace grasslands, shrublands, or agricultural crops that provide insects required for breeding (e.g., alfalfa), regions that were previously occupied by thousands of birds have now become permanently unsuitable for breeding (Meese 2016). For example, the acreage of pistachio orchards in the Central Valley has grown exponentially in recent years and the acreage of almonds continues to increase (Figures 19 and 20). The five leading pistachio producing counties in California have also supported a large proportion of the Tricolored Blackbird breeding population in recent years (Kern, Tulare, Kings, Fresno, and Madera counties), with Kern County alone supporting 42% of pistachio production in 2012 (Geisseler and Horwath 2016). In the central Sierran foothills, many colony sites and the surrounding foraging landscape are zoned for development, and several development projects that may affect Tricolored Blackbird habitat have moved forward in recent years (Airola et al. 2015a, 2016). Statewide, the proportion of grasslands within 3 miles of known breeding colony locations declined from 2008 to 2014 (NAS 2017).

Commented [TB38]: And foraging!

The California Rangeland Trust has conserved more than 300,000 acres of rangeland in 24 California counties through conservation easements (https://www.rangelandtrust.org/ranch/). Although data are not available on the extent and distribution of conserved lands within the range of the Tricolored Blackbird, some of the conserved ranches are in counties that receive regular use by breeding Tricolored Blackbirds, including Kern, Merced, Madera, and Placer counties. Data on the proximity of conserved rangelands to Tricolored Blackbird breeding colonies is not available, but these easements may provide protection of important foraging habitat for birds that breed in the foothills and grasslands on the periphery of the Central Valley.

Large losses of rangeland and suitable crop foraging habitat have occurred over the last several decades, and conversion of these suitable foraging habitats continue throughout much of the Tricolored Blackbird's range. Although large acreages of rangeland habitat have been conserved through conservation easements, these have not necessarily focused on areas of highest value to Tricolored Blackbird and are small relative to the extent of grassland in the state and the observed rate of loss over the past several decades. Future development in California is projected to be concentrated in several core areas of the Tricolored Blackbird range, including the Central Valley, the foothills of the Sierra Nevada, and on both sides of the Transverse Ranges in southern California (Jongsomjit et al. 2013; Figure 21), which would further reduce or degrade the available foraging landscape for breeding colonies. Loss of suitable rangeland foraging habitat is projected to continue into the future (see Drought, Water Availability, and Climate Change section). The proportion of grasslands in the landscape surrounding potential breeding sites has been shown to be the most important land cover type in predicting the occurrence of breeding Tricolored Blackbirds, and the proportion of alfalfa is the most important determinant of colony size (NAS 2017). Combined with regular loss of nesting substrate, the ongoing loss of foraging habitat makes it less likely that these essential breeding habitat requirements will co-occur on the landscape, with the result being a reduced number of locations suitable for successful breeding and foraging by Tricolored Blackbird colonies.

Overexploitation

Market Hunting and Depredation Killing

Neff (1937, 1942) reported hundreds of thousands of blackbirds sold on the Sacramento market, many of which were Tricolored Blackbirds. Market hunting of blackbirds in the Central Valley became a thriving business in about 1928 or 1929 and continued through the mid-1930s. Tricolored Blackbirds banded for research activities throughout the 1930s were often recovered by market hunters with ~~which~~ whom Neff collaborated (1942).

McCabe (1932) described the deliberate strychnine poisoning of 30,000 breeding Tricolored Blackbirds as part of an agricultural experiment. In the early 1930s active poisoning and shooting programs were enacted to control populations of blackbirds (McCabe 1932, Neff 1937). Tricolored Blackbirds and other blackbird species were killed by poisoned baits used as a means of blackbird control in rice fields in the Sacramento Valley, and numerous blackbirds were shot by farmers or by hired bird herders in attempts to drive the flocks away from rice and other crops (Neff 1942). During the period from 1935 to 1940 blackbird depredations in rice fields were of lesser intensity, and control operations by means of poisoned baits were almost entirely discontinued (Neff 1942).

Because the Tricolored Blackbird forages in mixed-species flocks with the European Starling and other species of blackbirds in the nonbreeding season, and because these flocks forage at feedlots and on ripening rice, the Tricolored Blackbird may be exposed to avicides intended to control nuisance and depredating flocks of blackbirds.

A depredation order under the federal Migratory Bird Treaty Act allows for the control of several species of blackbirds and corvids in agricultural situations without a permit from the USFWS (when birds are

causing serious ~~injuries to~~depredation of ~~-~~agricultural or horticultural crops or to livestock feed; 50 CFR 21.43). In 1988, the USFWS modified the long-standing depredation order to remove the Tricolored Blackbird and prohibit killing the species without a federal permit (Beedy et al. 1991). Although Tricolored Blackbird is no longer covered by the depredation order, it is possible that misidentification of Tricolored Blackbirds when they occur in mixed flocks in the fall and winter leads to unintentional mortality of the species. Landowners are required to report on activities and on the number of birds captured or killed under the depredation order, including non-target species such as the Tricolored Blackbird (50 CFR 21.43, Nov 5, 2014). Based on reports provided to the USFWS, annual reporting appears to be inconsistent and the number of birds killed under the depredation order may be underreported. The number of Tricolored Blackbirds killed annually is unknown and therefore the killing of blackbirds to protect ripening rice in the Sacramento Valley is a known but unquantified source of Tricolored Blackbird mortality.

There has been limited documentation of the shooting of Tricolored Blackbirds in the Sacramento Valley. Two birds that had previously been banded were reported to have been shot by a rice farmer in Butte County (Meese 2009a). These birds were reported because they were banded and it seems likely that additional, unbanded birds were also shot.

Historical killing of blackbirds to protect crops and for the food market may have contributed to a long-term decline of the species, but the intentional killing of Tricolored Blackbirds has declined since the 1930s. The effect of mortality due to shooting or poisoning on annual Tricolored Blackbird survival rates is currently unknown.

Harvest of Breeding Colonies

The Tricolored Blackbird colonies that form on agricultural grain fields early in the breeding season are often the largest colonies formed each year, and the complete destruction of these colonies due to harvest can be especially damaging to annual blackbird productivity (Arthur 2015). Normal harvesting activities typically coincide with the breeding season and the harvest of fields that contain nesting colonies results in nest destruction and the loss of eggs or nestlings. The cutting of grain has also killed adult Tricolored Blackbirds but most adults appear to survive harvest operations.

Shortly after the discovery of grain colonies in the San Joaquin Valley, Hamilton et al. (1992) observed the loss of a 15,000-bird colony to harvest. As early as 1993, the USFWS intervened to encourage harvest delays and protect the largest known breeding colony (Hamilton 1993). Since then, colony protection through crop purchase or delayed harvest has been the primary conservation action implemented for the species (see Existing Management section), with mixed success. Despite annual attempts to locate and protect large colonies since the early 1990s, losses to harvest have occurred in most years (Figure 17), with 2010 and 2016 the only known exceptions. Two large colonies representing more than 60,000 breeding birds were lost due to harvest in 1994 (Hamilton et al. 1995). The two largest breeding colonies in 1995 were destroyed during harvest of the grain nesting substrate (Beedy and Hamilton 1997). At least one colony of 14,000 birds was harvested in 1999 and four colonies were lost to harvest operations in 2000 (Hamilton et al. 1999, Hamilton 2000). Colonies were destroyed in all years from 2005 to 2009, with especially large losses in 2006, 2007, and 2008 (Meese 2009b). In 2008, several of the largest known colonies were destroyed, with six colonies representing 140,000 breeding birds being cut (Meese 2008). At least three colonies were lost to harvest in 2011, including the largest known colony, which supported 17% of the total known population (Kyle and Kelsey 2011, Meese 2011). At least two colonies in grain fields were destroyed in 2014 during the harvest of nesting substrate and at least three colonies were partially or totally destroyed due to harvest in 2015 (Meese 2014a, 2015b). After a breeding season with no known harvest losses in 2016, a large colony (estimated at up to 12,000 birds) was mostly lost in 2017 when the grain nesting substrate was cut in preparation for harvest (Colibri 2017).

No colonies are known to have been destroyed by harvest in 2010; a settlement on a dairy in Merced County was lost when the grain was harvested, but the harvest occurred during nest building before eggs were laid (Meese 2010). Beginning in 2016, a new partnership was created through a grant from NRCS, with Audubon California, dairy trade organizations, and agencies working together to conduct outreach to dairy owners and to detect and protect breeding colonies. The program succeeded in enrolling all landowners with Tricolored Blackbird colonies identified on their property in 2016, and 100% of known agricultural colonies were protected through delay of harvest. In 2017, most colonies on grain fields at dairies were again protected, but at least one large colony was destroyed when the grain was cut.

Commented [TB39]: Where, and what is the source?

It has been argued that protection of colonies breeding on silage fields should be reevaluated because adult birds are unlikely to be killed by harvesting operations and Tricolored Blackbirds are known to breed more than once in a season. DeHaven (2000) and Hamilton (2004a, 2004b) suggested that habitat losses might be more important in population declines than nesting mortality, and resources spent protecting colonies on silage fields might be better spent protecting or restoring habitat. However, second breeding attempts are often less productive than first breeding attempts due to the energetic and physiological costs of egg formation in females, incubation and brooding, and raising of young (Martin 1987, Meese 2008). Even if these costs did not reduce the relative productivity of second breeding attempts, the elimination of a first breeding attempt may cause breeding colonies to miss the period of peak prey abundance, thereby reducing seasonal reproductive success (Martin 1987). Colony destruction through harvest typically occurs well after females have laid eggs and often after eggs have hatched, so the lost energetic input to a failed breeding and the delay before a second attempt likely reduce total annual productivity, even if birds attempt to nest a second time (Meese 2008).

Commented [TB40]: Still, this is a major source of mortality including for adults.

The Tricolored Blackbird was shown to have experienced low reproductive success from at least 2006 to 2011 (Meese 2013). Reproductive success appears to have always been quite variable across colonies in any given year, and occasional success at large colonies may be important in maintaining the population over time (see Reproduction and Survival section). A number of factors have been shown to influence reproductive success, including predation and shortage of food, but reproductive failures caused by harvest at breeding Tricolored Blackbird colonies on agricultural fields of the San Joaquin Valley may have contributed to population declines through loss of much of the annual reproductive potential of the species in several years.

Overexploitation summary—Although direct killing of Tricolored Blackbirds was once a large source of adult mortality, the number of birds killed declined dramatically after blackbird depredations in rice fields declined in the 1930s. Killing of Tricolored Blackbirds that may be depredating crops during the post-breeding period is likely a continuing source of mortality, but the available data do not indicate this to be a large source of mortality; additional data would be required to determine the degree to which this factor effects the population. Destruction of colonies in agricultural fields has been occurring since Tricolored Blackbirds were discovered nesting in this substrate type in the early 1990s. In recent years, the protections provided to the Tricolored Blackbird as a candidate under CESA, the availability of funds, and a coordinated effort by agencies, the dairy and farming industries, and nonprofit groups has led to a dramatic decline in this source of mortality, but losses of large colonies to grain harvest have continued. The future success of breeding colonies on agricultural crops will depend on the availability of funds to continue programs that locate breeding colonies on grain fields early in the nesting season and compensate farmers for delaying harvest.

Predation

A large number of predators have been observed preying on Tricolored Blackbirds (Table 6), including their eggs or nestlings. Most observations of predation have occurred at breeding colonies when the birds are congregated in dense groups, and most predation has occurred on the eggs, nestlings, or fledglings of Tricolored Blackbirds.

Table 6. Predators of Tricolored Blackbirds.

Taxonomic Group	Predators	Sources
Birds	Black-crowned Night-Heron (*Nycticorax nycticorax*), Cattle Egret (*Bubulcus ibis*), White-faced Ibis (*Plegadis chihi*), Great Blue Heron (*Ardea herodias*), Cooper's Hawk (*Accipiter cooperii*), Swainson's Hawk (*Buteo swainsoni*), Peregrine Falcon (*Falco peregrinus*), Merlin (*Falco columbarius*), Northern Harrier (*Circus cyaneus*), Barn Owl (*Tyto alba*), Burrowing Owl (*Athene cunicularia*), Short-eared Owl (*Asio flammeus*), Yellow-billed Magpie (*Pica nuttalli*), American Crow (*Corvus brachyrhynchos*), Common Raven (*Corvus corax*), Great-tailed Grackle (*Quiscalus mexicanus*)	Mailliard (1900), Neff (1937), Payne (1969), Hamilton et al. (1995), Beedy and Hamilton (1997), Hamilton (2000), Kelsey (2008), Meese (2010), Meese (2012), Airola et al. (2015a), Meese (2016), Beedy et al. (2017)
Mammals	coyote (*Canis latrans*), wolf (*Canis lupus*), gray fox (*Urocyon cinereoargenteus*), raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), long-tailed weasel (*Mustela frenata*), feral domestic cat (*Felis catus*), and possibly mink (*Mustela vison*)	Evermann (1919), Neff (1937), Payne (1969), Hamilton et al. (1995), Beedy and Hamilton (1997), Wilson et al. (2016), Beedy et al. (2017)
Snakes	gopher snake (*Pituophis catenifer*), king snake (*Lampropeltis* sp.), garter snake (*Thamnophis* sp.), and possibly western rattlesnake (*Crotalus oreganus*)	Neff (1937), Payne (1969), Hamilton et al. (1995)

Small areas of native vegetation may be especially vulnerable to predation, especially if they are near sites at which predator populations are artificially high due to the availability of augmented food sources

from human activities. In the early 1990s, Hamilton and others found that many breeding colonies in emergent wetland nesting substrates suffered partial or complete destruction by predation (primarily by Black-crowned Night-Herons; Hamilton et al. 1992, 1995, Hamilton 1993), resulting in consistently lower reproductive success in wetlands compared to other nesting substrates. Beedy and Hamilton (1997) reported that more recently, Black-crowned Night-Herons eliminated all or most nests at several freshwater marsh breeding colonies. Hamilton (2000) later reported that wetland colonies with no Black-crowned Night-Heron predation were highly successful. DeHaven (2000) reported that he also observed high rates of colony failure due to predation in the 1970s, a time when the majority of the population still bred in wetland substrates. Whether recent rates of loss to predation are similar to historical rates of loss is unknown.

In recent decades, complete nesting failures have been caused by novel predators on agricultural grain fields and the increasing concentration of birds in mega-colonies may have increased their susceptibility to nest predation (Kelsey 2008). Cattle Egrets from a single rookery caused complete or near-complete failure of large breeding colonies in Tulare County from 2006 to 2011 (Meese 2012). White-faced Ibis prey on the eggs of the Tricolored Blackbird, and in 2016 caused the complete failure of a large breeding colony on a silage field in Tulare County (Meese 2016, Beedy et al. 2017).

Kelsey (2008) reported a steady increase in population sizes of several avian predators in California, including Black-crowned Night-Heron, Cattle Egret, American Crow, and Common Raven. However, the most recent breeding bird survey data show an increase for only one of these species, the Common Raven, and the data for Cattle Egret have important deficiencies that preclude trend assessment (Sauer et al. 2017b). White-faced Ibis have experienced a large population increase in California since the 1980s (Shuford et al. 1996), but BBS data are inadequate for trend assessment (Sauer et al. 2017b).

Although many species have been documented as predators of Tricolored Blackbirds, most have not had severe effects on the population or on the breeding success at nesting colonies. However, a few species have caused the complete failure of entire breeding colonies through heavy predation on eggs and nestlings. In recent decades, the predators that have destroyed entire colonies have usually been wading birds that hunt in large groups (i.e., Black-crowned Night-Heron, Cattle Egret, and White-faced Ibis). These species have had significant impacts on the overall productivity rate of Tricolored Blackbirds in several years over the last three decades (Hamilton et al. 1995, Cook and Toft 2005, Meese 2012). A few other species, including Common Raven, raccoon, and coyote have had large effects on breeding success, but these predators have typically not caused complete colony failure or have had less widespread effects.

Competition

Red-winged Blackbirds and, less frequently, Yellow-headed Blackbirds, will often nest in the same locations as Tricolored Blackbird colonies, although they may occupy the less-dense portions of a marsh. Where territorial conflicts occur, Tricolored Blackbirds ignore the territorial displays of these other species and overwhelm them with their sheer numbers, displacing them to the fringes of the substrate

or pushing them out entirely (Payne 1969). There is no evidence that competition with these species is limiting the Tricolored Blackbird population (Hamilton et al. 1995).

Beedy et al. (2017) reported that Great-tailed Grackles may be aggressive toward nesting Tricolored Blackbirds but did not consider the impacts severe. White-faced Ibis may destroy Tricolored Blackbird nests when in the process of constructing their own nests, but this occurs infrequently. The Marsh Wren (*Cistothorus palustris*) may destroy eggs in Tricolored Blackbird nests that are in proximity to its own nest (Beedy et al. 2017). Competition with other species does not appear to be a large factor in the survival or reproduction of the Tricolored Blackbird.

Brood Parasitism

The Brown-headed Cowbird (*Molothrus ater*) is known to rarely parasitize nests of Tricolored Blackbirds (Hamilton et al. 1995, Beedy et al. 2017), but brood parasitism is not a major threat to the species.

Disease

Beedy et al. (2017) stated that no diseases have been reported for the Tricolored Blackbird but that in some years many nestlings have mites. Avian pox is prevalent in Tricolored Blackbirds in the Sacramento Valley, and much less so in the San Joaquin Valley (Beedy et al. 2017). West Nile virus (WNV) has been detected in dead Tricolored Blackbirds, as well as in many other species of blackbirds, orioles, and grackles nationwide (www.cdc.gov/westnile/resources/pdfs/Bird%20Species%201999-2012.pdf). Adult Tricolored Blackbirds tested positive for WNV antibodies in 2009 but did not show symptoms of the disease and were assigned a relatively low risk score (Wheeler et al. 2009, Beedy et al. 2017). Although the highly social nature of the species could place the Tricolored Blackbird at greater risk to disease transmission, the impact of disease and parasites on the species is unknown but is not thought to be a major threat to the species.

Contaminants

Feeding in agricultural environments creates numerous opportunities for exposure to contaminants. Mortality of Tricolored Blackbird eggs and nestlings due to chemical contaminants has been suggested in a number of cases. Hosea (1986) reported that two colonies in Colusa and Sacramento counties near rice fields were over-sprayed during aerial application of herbicides resulting in the poisoning of almost all of the nestlings. Beedy and Hayworth (1992) described the effects of possible selenium toxicosis on a Tricolored Blackbird colony by comparing the reproductive success of a colony at Kesterson Reservoir in Merced County, which had a history of selenium contamination, with the success at four other colonies. Nesting failures were documented and deformities in Tricolored Blackbird nestlings were observed at the colony at Kesterson, and livers from dead nestlings collected at Kesterson had elevated levels of selenium. The area was cleaned up and the use of selenium-laden agricultural drain water to maintain the wetlands at Kesterson was discontinued. There have been no apparent selenium impacts on Tricolored Blackbird nesting success since. Hamilton et al. (1995) reported evidence of chemical-induced egg mortality from mosquito abatement operations in Kern County.

In 1995, Hamilton et al. concluded that, “Despite the limited evidence that Tricolored Blackbirds are suffering some mortality as a result of patterns of chemical use in agricultural areas, poisons do not appear to be inducing a serious population problem for Tricolored Blackbirds.” Hamilton (2000) knew of no evidence that toxic contaminants had adversely affected the Tricolored Blackbird since the early 1990s.

Neonicotinoid Insecticides

A relatively new class of insecticides, neonicotinoids, has been implicated in the decline of invertebrate communities and, in a few cases, the decline of insectivorous birds. The application of neonicotinoids has increased dramatically in California, especially since the early to mid-2000s (https://water.usgs.gov/nawqa/pnsp/usage/maps/). Neonicotinoids are relatively stable, and are water soluble so can be incorporated into the tissues of plants. They are commonly applied to crops as seed treatments, with the insecticide taken up systemically by the growing plant (Godfray et al. 2014). In the two decades since their introduction, neonicotinoid insecticides have become the most widely used insecticides in the world (Goulson 2013). They are highly effective at killing insects and have relatively low mammal and bird toxicity. However, at higher concentrations they can have lethal and sublethal impacts to vertebrates (Mineau and Palmer 2013).

Acute toxicity of neonicotinoids has been assessed for only a few bird species, with wide variation in results. Bobwhite and Mallard are the species typically used in acute toxicity testing for regulatory purposes, but where smaller species have been tested, including songbirds, the body weight-corrected dosage resulting in mortality is much lower (Mineau and Palmer 2013). A potential acute impact mechanism for species that are partly granivorous, like the Tricolored Blackbird, is sublethal or lethal effects through the ingestion of neonicotinoid-coated seeds. Ingestion of only a few neonicotinoid-coated seeds (a single seed in the case of corn) might be sufficient to kill a songbird, but there has been little work conducted on the availability and consumption of treated seeds by vertebrates (Goulson 2013, Mineau and Palmer 2013). Although not limited to neonicotinoids, a study that evaluated the effect of multiple potential factors found that acute toxicity of pesticides was the strongest correlate to declines of grassland bird species in the U.S., followed by habitat loss caused by agricultural intensification (Mineau and Whiteside 2013). No data are available on the acute toxicity of any neonicotinoid insecticide specifically to Tricolored Blackbirds, but seeds treated with imidacloprid, a widely used neonicotinoid insecticide, caused ataxia and retching in captive Red-winged Blackbirds and Brown-headed Cowbirds (Avery et al. 1993). These effects were transitory and birds learned to avoid consumption of treated seeds when alternative grains were available. Neonicotinoids may also have chronic toxicity effects (exposure over longer time periods) on reproductive success, but chronic effects are even less studied than acute effects (Mineau and Palmer 2013).

Neonicotinoids may also indirectly affect Tricolored Blackbirds through suppression of insect prey populations. They have been shown to have adverse effects on a number of non-target invertebrate species, with most studies focusing on bees (Hopwood et al. 2012, Godfray et al. 2014). In California, long-term observational data have revealed declines in the number of butterfly species and declines in abundance for many butterfly species in the Central Valley, both of which were negatively associated

with annual application rates of neonicotinoid insecticides (Forister et al. 2016). Imidacloprid was shown to have a negative association with a wide variety of insectivorous bird populations in the Netherlands, suggesting that the pesticide may have led to food deprivation in birds (Hallmann et al. 2014). The evidence linking imidacloprid concentrations to bird population declines was circumstantial, but the authors ruled out confounding effects from other land use changes and showed that the timing of observed declines in bird populations corresponds to the introduction of neonicotinoid insecticides (Goulson 2014, Hallmann et al. 2014).

Depending on environmental conditions, neonicotinoids can persist and accumulate in soils and in waterways, and levels measured in soils, waterways, and field margin plants have sometimes overlapped substantially with concentrations that are sufficient to control pests in crops (Goulson 2013). Neonicotinoids degrade through photolysis when exposed to sunlight and so would not be expected to occur at high levels in clear water (Goulson 2013). However, Starner and Goh (2012) detected imidacloprid in 89% of water samples taken from rivers, creeks, and drains in agricultural regions of California, with 19% of samples exceeding the US Environmental Protection Agency guideline concentration of 1.05 µg/L; this suggests that the insecticide moves off of treatment areas and may impact non-target aquatic insects. Little is known about the uptake of neonicotinoids from soil and soil water by non-target plants, and the downstream effect on non-target invertebrates (Goulson 2013).

A study evaluating landscape effects on Tricolored Blackbird breeding colonies found that colonies are more likely to be located in areas that experience higher neonicotinoid insecticide application rates (NAS 2017). This is likely because most colonies and birds breed in the highly agriculturalized Central Valley. The neonicotinoid application rate was also shown to increase during the 2008–2014 study period, suggesting that breeding Tricolored Blackbirds may be exposed to increasing amounts of the insecticides. The effect of this exposure on breeding Tricolored Blackbirds is unknown.

Several studies have revealed a negative relationship between insect populations and neonicotinoid use. These results, along with the large increase in application of neonicotinoids, suggest a potential mechanism leading to observed reductions in reproductive success in Tricolored Blackbirds (Meese 2013). It is possible that this relatively new group of insecticides has resulted in declines of non-target insect species within the breeding range of the Tricolored Blackbird resulting in a declining prey base, but no data have been collected that can directly support this. It is also possible that acute effects resulting from ingestion of neonicotinoid-coated seeds has had an impact on the population, but the number of Tricolored Blackbirds suffering sublethal or lethal effects due to exposure to neonicotinoids is unknown. In addition to Tricolored Blackbirds, population declines in insectivorous birds have been documented across North America, with specific examples from California's Central Valley (Nebel et al. 2010, Airola et al. 2014). Neonicotinoids may be playing a role in driving these declines, but more study is needed. There is a need for mechanistic research to compliment results from observational data; these should include testing exposure rates of Tricolored Blackbirds to neonicotinoids, effect of exposure on body condition and fitness (direct effects), and investigations into potential insect-based food-web impacts (indirect effects).

Invasive Species

With the exception of occasional impacts due to nonnative predators (e.g., Cattle Egret, Great-tailed Grackle), invasive species have not been reported to have a large impact on the ability of the Tricolored Blackbird to survive and reproduce. The availability of many nonnative plant species as nesting substrates have allowed the Tricolored Blackbird to breed in locations that would otherwise be unavailable. Invasive species are not considered a major threat to the species.

Commented [TB41]: Both species got here on their own, and were not introduced.

Commented [TB42]: Mention Himalayan blackberries?

Weather Events

Hamilton et al. (1995) stated that high mortality of Tricolored Blackbird nestlings can result from severe or prolonged storms and that some observed reproductive failure may be the result of chilling of adult and nestling birds. Also, some adult female mortality at nests appears to have been induced by cold and rainy weather (Hamilton et al. 1995). Heavy winds or precipitation have been documented to knock down nesting substrates, often in triticale or other grain colonies, but also in milk thistle colonies (Meese 2010, 2016), eliminating the reproductive effort for all or a part of breeding colonies. Weather events may have widespread impacts on reproductive success in some years, but impacts are usually isolated and the overall effect on the population's ability to reproduce is limited in most years.

Drought, Water Availability, and Climate Change

Drought reduces water supply reliability and has far-reaching impacts on most habitat types in California (DWR 2014, 2015a). Several significant statewide droughts have occurred in California over the last century (1928–1934, 1976–1977, 1987–1992, and 2007–2009) (DWR 2015a), and California recently experienced the four driest consecutive years of statewide precipitation in the historical record between 2012 and 2014. The winter of 2015 produced a record low statewide mountain snowpack of only 5% of average.

Drought effects on availability of nesting substrate

Tricolored Blackbirds have adapted to use a variety of novel vegetation types as nesting substrate, but wetlands continue to support the largest number of breeding colonies each year. Because of the need for wetlands that are flooded during the spring and summer breeding season, the various approaches to wetland management, and the dependence on water deliveries to maintain wetland habitats in most of the Tricolored Blackbird's range, assessing the availability of suitable wetland nesting substrate in a given year is difficult. A recent method applied reflectance to satellite imagery in order to identify areas of open surface water in the Central Valley (Reiter et al. 2015). Although not an ideal approach to quantifying and assessing distribution of wetlands, the method would identify wetlands with large amounts of open water. In addition, identification of open water on the landscape during the Tricolored Blackbird breeding season is likely a good proxy for the availability of water for wetland management. Reiter et al. (2015) showed that open surface water declined across the Central Valley between 2000 and 2011. Drought had a significant negative effect on open surface water in the late summer and early fall. Cumulative years of drought resulted in a noticeable reduction in surface water. Although not a direct measure of Tricolored Blackbird breeding habitat, declines in surface water during the drought

likely resulted in reduced availability of wetlands with sufficient water to provide high quality nesting substrates.

Although more resilient to dry conditions than wetland vegetation, plants species that provide upland nesting substrate for Tricolored Blackbird colonies also experience negative effects due to drought. After several years of dry conditions during California's most recent drought, many Himalayan blackberry copses that have historically supported Tricolored Blackbird colonies were observed to be dry and mostly barren of leaves. In a few cases, extremely dry blackberry bushes continued to be used by breeding colonies, but many were unoccupied. Milk thistle, which provides high-quality nesting substrate across much of the Tricolored Blackbird range when annual precipitation patterns support vigorous growth, was largely absent from historically used areas until California experienced an average water year in the winter of 2015–2016 (Airola et al. 2016). The wetter weather created nesting substrate in areas that had not been used by Tricolored Blackbirds in several years, and breeding colonies once again occupied these areas.

Drought effects on prey populations

The availability of large insect prey is an important factor in Tricolored Blackbird reproductive success, and may influence colony site selection. Large landscapes with suitable foraging habitat are strong drivers of colony site occupancy and abundance (NAS 2017).

Insect abundance is highly related to biomass of herbaceous vegetation, including important Tricolored Blackbird prey items like grasshoppers in grasslands (Falcone 2010). Climate, especially drought, is thought to play a key role in abundance of grasshoppers and other insect species in grasslands (Vose et al. 2016). The response of insect populations can differ depending on drought severity. For example, non-severe drought and warm temperatures can have a positive effect on grasshopper populations through increased survival and faster population growth (Kemp and Cigliano 1994). However, extreme or prolonged drought can negatively affect grasshopper populations through desiccation of eggs or through decreased biomass of primary producer food sources (i.e., grasses and forbs) (Vose et al. 2016). Reductions in precipitation not only lead to reductions in the abundance of insects in grasslands, but may also make insect prey less accessible through changes in behavior (e.g., moving underground) (Barnett and Facey 2016). Severe droughts likely have strong negative effects on grasshoppers and insect prey biodiversity in general (Kemp and Cigliano 1994, Vose et al. 2016).

The established impacts of precipitation on insect populations in grasslands, especially grasshoppers, suggests a mechanism for drought impacts on Tricolored Blackbird productivity. Research is needed that measures grasshopper and other prey abundance relative to precipitation and primary productivity around occupied Tricolored Blackbird colonies, and evaluates the effect on Tricolored Blackbird reproductive success.

Climate Change

Average annual temperatures have been rising in California in recent decades, and climate models are in broad agreement that temperatures in California will rise significantly over the next century (DWR

2015b). The average temperature is expected to rise by approximately 2.7°F by 2050, and depending on the emissions scenario, average temperatures could increase by 4.1–8.6°F by the year 2100 (Moser et al. 2012). Summer temperatures will rise more than winter temperatures, and the increases will be greater in inland California. As a result, the average number of extremely hot days (at least 105°F) per year in Sacramento is expected to increase fivefold (up to 20 days) by the middle of the century, and may increase to as many as 50 days per year by 2100 (Moser et al. 2012). Tricolored Blackbirds have been observed to cease initiation of breeding when temperatures rose above 90°F, although care of existing nests continued in temperatures over 100°F (Hamilton et al. 1995). Rising temperatures may directly affect annual Tricolored Blackbird productivity by truncating or interrupting the breeding season, although more work is needed on the effect of temperature on initiation and success of nesting attempts.

Along with projected impacts to Tricolored Blackbird foraging habitat due to housing and agricultural development discussed above, the areas of California with the largest climate-projected effects on a variety of bird species are largely concentrated within the Tricolored Blackbird range in the Central Valley (Jongsomjit et al. 2013). A suite of analyses integrating the effects of climate change and land use changes in California's rangelands concluded that grassland habitat loss in California could reach 37% by the year 2100 (Byrd et al. 2015).

The recent severe drought in California was at least in part due to and made more severe by climate change (Diffenbaugh et al. 2015). Climate change is projected to bring longer and more severe droughts to California in the future (Diffenbaugh et al. 2015, Williams et al. 2015), exacerbating the impacts to Tricolored Blackbird habitat described above. The Central Valley may be particularly vulnerable to warming-driven drought increases in the future (Williams et al. 2015). Water deliveries are projected to be reduced by 5.6% from 2013 to 2033 due to climate change effects on reliability (DWR 2014). Climate change effects on water supplies and stream flows are expected to increase competition among urban and agricultural water users and environmental needs (Moser et al. 2012). This competition may lead to decreases in available wetland nesting substrate provided by private and public land managers. Declines in the availability of water for agriculture may also reduce prey populations provided by high quality crops like alfalfa and rice.

SUMMARY OF LISTING FACTORS

[Note to reviewers: This section will provide summaries of information in the status review, arranged under each of the factors that the Fish and Game Commission must consider in making a determination as to whether listing is warranted (Cal. Code Regs., Tit. 14, § 670.1). These summaries will be prepared after peer review.]

Present or Threatened Modification or Destruction of Habitat

Overexploitation

Predation

Competition

Disease

Other Natural Events or Human-Related Activities

PROTECTION AFFORDED BY LISTING

It is the policy of the State to conserve, protect, restore and enhance any endangered or threatened species and its habitat (Fish & G. Code, § 2052). The conservation, protection, and enhancement of listed species and their habitat is of statewide concern (Fish & G. Code, § 2051(c)). CESA defines "take" as hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill (Fish & G. Code, § 86). The Fish and Game Code provides the Department with related authority to allow "take" of species listed as threatened or endangered under certain circumstances through incidental take permits, memoranda of understandings, natural community conservation plans, or other plans or agreements approved by or entered into by the Department (Fish & G. Code, §§ 2081, 2081.1, 2086, 2087, and 2835).

If the Tricolored Blackbird is listed under CESA, impacts of take caused by activities authorized through incidental take permits must be minimized and fully mitigated according to state standards. These standards typically include protection of the land in perpetuity with an easement, development and implementation of a species-specific adaptive management plan, and funding through an endowment to pay for long-term monitoring and maintenance to ensure the mitigation land meets performance criteria. Obtaining an incidental take permit is voluntary. The Department cannot force compliance; however, any person violating the take prohibition may be punishable under state law.

Additional protection of Tricolored Blackbird following listing would be expected to occur through state and local agency environmental review under CEQA. CEQA requires that affected public agencies analyze and disclose project-related environmental effects, including potentially significant impacts on rare, threatened, and endangered species. In common practice, potential impacts to listed species are examined more closely in CEQA documents than potential impacts to unlisted species. Where significant impacts are identified under CEQA, the Department expects that project-specific avoidance, minimization, and mitigation measures will benefit the species. State listing, in this respect, and consultation with the Department during state and local agency environmental review under CEQA, would be expected to benefit the Tricolored Blackbird in terms of reducing impacts from individual projects, which might otherwise occur absent listing.

For some species, CESA listing may prompt increased interagency coordination and the likelihood that state and federal land and resource management agencies will allocate funds toward protection and recovery actions. In the case of the Tricolored Blackbird, the Tricolored Blackbird Working Group signatory agencies already meet and coordinate regularly, but a state listing could result in increased availability of conservation funds.

LISTING RECOMMENDATION

CESA directs the Department to prepare this report regarding the status of the Tricolored Blackbird in California based upon the best scientific information. CESA also directs the Department based on its analysis to indicate in the status report whether the petitioned action is warranted (Fish & G. Code, § 2074.6; Cal. Code Regs., tit. 14, § 670.1, subd. (f)). In addition to evaluating whether the petitioned action (i.e., listing as endangered) was warranted, the Department considered whether listing as threatened under CESA was warranted.

The Department includes and makes its recommendation in its status report as submitted to the Commission in an advisory capacity based on the best available science. In consideration of the scientific information contained herein, the Department has determined that listing the Tricolored Blackbird as threatened or endangered under CESA is [warranted/not warranted] at this time.

[Note to reviewers: The Department's recommendation will be finalized following peer review and completion of the status review report.]

MANAGEMENT RECOMMENDATIONS

The Department evaluated existing management recommendations and identified the following, listed in no particular order, as necessary to achieve conservation of the Tricolored Blackbird. The *Conservation Plan for the Tricolored Blackbird* (TBWG 2007) identifies goals, objectives, and tasks required to maintain a viable Tricolored Blackbird population throughout the current range of the species. The Department continues to support implementation of the conservation plan as revised by the Tricolored Blackbird Working Group. The goals, objectives, and tasks identified in the plan are not repeated in their entirety here, but many of the management recommendations listed below are related to, or based on, activities identified in the plan.

Habitat Protection, Restoration, and Enhancement

Land ownership patterns across the range of the Tricolored Blackbird, coupled with the diverse nesting and foraging habitats used by the species, necessitate cooperative efforts among government, industry, and the public in order to conserve the species.

Management of habitat must consider the large landscapes utilized by breeding colonies and the integral relationship between nesting colony sites and associated upland foraging areas (Hamilton

1993). Land management plans that do not specifically consider the landscape needs of Tricolored Blackbirds will not necessarily result in the protection or creation of suitable breeding habitat.

1. Determine the best areas for conservation, building off the recent research on habitat suitability conducted by the National Audubon Society (NAS 2017). It is difficult to predict the distribution of widespread species, and even more difficult when the distribution within the range is not stable, as with the dynamic colony site use of Tricolored Blackbirds. Breeding locations that should be prioritized for protection include those that are regularly occupied, those that support large colonies, those that support high reproductive success, and those with a secure foraging landscape (Meese and Beedy 2015).
2. Identify areas in the Tricolored Blackbird range with high quality foraging landscapes, but that lack suitable nesting substrate. Consider conservation actions to create or restore nesting substrate in areas with high probability of use by breeding Tricolored Blackbirds.
3. Secure funding and implement the highest priority nesting substrate protection, enhancement and restoration projects and foraging habitat protection projects.
4. Create a system for tracking habitat protection and restoration projects, including appropriate measures of success. Work with the Tricolored Blackbird Working Group to encourage reporting of habitat projects from all stakeholders.

Breeding Colony Protection

In addition to the long-term goal of providing suitable alternative habitat away from silage fields on public and private land, the near-term priority must continue to be placed on identifying and conserving the colonies nesting in silage on private property each year.

5. Fully fund and implement a silage colony protection program. Continue work in the Tricolored Blackbird Working Group's agriculture subcommittee to plan for and implement a silage colony response plan, with participation from a diverse set of stakeholders including members of the dairy industry.
6. Identify locations that regularly support large and productive Tricolored Blackbird breeding colonies, with secure foraging landscape. Prioritize these locations for protection through acquisition or conservation easement.
7. Assess the effectiveness of provision of alternate nesting habitat (e.g., fresh emergent wetlands) to draw birds away from nesting in dairy silage fields (Beedy et al. 2017).

Monitoring and Research

8. Determine the factors that influence nest site selection and especially how relative insect abundance may affect site occupancy (Airola et al. 2016).
9. Determine the amount, type, and distribution of foraging habitat needed to support viable breeding colonies of various sizes. How does type, proximity to colony site, and diversity of foraging habitats influence the extent of foraging habitat required and the rate of reproductive success?

10. Determine the environmental factors that result in abundant large insect prey populations in grassland habitats and in commonly used agricultural crops, and their variability in time and space.
11. Conduct mechanistic research to compliment results from observational data that have shown correlations between neonicotinoid pesticides and declines in songbirds; these should include testing exposure rates of Tricolored Blackbirds to neonicotinoids, effect of exposure on body condition and fitness, and investigations into potential insect-based food web effects.
12. Estimate rates of within season and interannual movements and genetic exchange between populations breeding in different regions, especially between southern California and the Central Valley (Beedy et al. 2017).
13. Quantify annual adult survivorship and investigate factors that affect survival, including the magnitude of post-breeding mortality caused by shooting to reduce crop depredation.
14. Investigate new methods to measure productivity in Tricolored Blackbird breeding colonies. Current methods that utilize nest transects or counts of fledglings might not be comparable, and nest transects can be difficult to implement and may negatively affect breeding birds.
15. Examine degree of colony cohesion between first and subsequent breeding attempts, and between breeding seasons (Beedy et al. 2017).
16. Develop and implement a statistically valid, standardized protocol for the long-term, statewide monitoring of Tricolored Blackbird abundance, including population estimate confidence.

Commented [TB43]: I think better quantification of winter distribution and survival is a high research priority. Samantha & Cornell are working on a pilot study this year,and this should be mentioned here, in my opinion.

Education and Outreach

17. Raise awareness of Tricolored Blackbird nesting behavior and conservation options on ranch and farmlands, stressing the importance of protecting large silage nesting colonies. Build off recent efforts by the Tricolored Blackbird Working Group and the dairy industry.
18. Conduct outreach and coordination with landowners whose grazing lands in the foothills support breeding colonies (Airola et al. 2015b).
19. Provide land managers with habitat management guidance for creation and management of Tricolored Blackbird habitat. Continue work recently undertaken by the Tricolored Blackbird Working Group's habitat subcommittee.

ECONOMIC CONSIDERATIONS

The Department is charged in an advisory capacity in the present context to provide a written report and a related recommendation to the Commission based on the best scientific information available regarding the status of Tricolored Blackbird in California. The topic areas and related factors the Department is required to address as part of that effort are biological and not economic, therefore the Department is not required to prepare an analysis of economic impacts (See Fish & G. Code, § 2074.6; Cal. Code Regs., tit. 14, § 670.1, subd. (f)).

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Appendix 1
Tricolored Blackbird surveys, 1986-2017

This Appendix briefly describes each effort to survey the Tricolored Blackbird population since 1986. As discussed in the body of the report, the survey approach varied across survey years, with two groups of years (1994, 1997, 2000; and 2008, 2011, 2014, 2017) following relatively consistent approaches and resulting in comparable results. Although surveys in these two groups of years followed similar approaches, there were several differences in methods and in survey effort that preclude direct comparisons of results across these two groups of survey years. Where possible, results have been adjusted for survey effort when discussed in the report.

1986-1990

Beedy et al. (1991) compiled all historical records of Tricolored Blackbird breeding colonies from published and unpublished sources (we reviewed and summarized all the American Birds note books as well as personal field notes from many reliable observers) to evaluate the long-term population trends and current status of the species for the USFWS. They also conducted intensive observations at seven colonies in four counties during 1987 and 1988 and made additional irregular observations in seven counties between 1986 and 1990. They concluded that the population had continued to decline since the 1970s (DeHaven et al. 1975) to an average of 51,600 breeding birds at known colonies in the 1980s. In response to the report by Beedy et al. (1991), a more thorough survey was organized by the Department in 1992, with survey locations informed by ongoing research on the species by Bill Hamilton and others (see below). Results revealed the population to be much larger, indicating that an ad hoc compilation of observation records combined with a limited survey effort over multiple years does not provide an accurate measure of overall population size. Like previous efforts, the surveys by Beedy et al. (1991) included only sporadic surveys in the southern San Joaquin Valley.

Commented [TB1]: Perhaps cite Neff, DeHaven, etc. for previous efforts?

1992-1993

Basic ecological investigations were conducted that included documentation of colony locations and sizes, discovery of large breeding colonies on grain fields in the San Joaquin Valley, and initial observations that suggested Tricolored Blackbirds are itinerant breeders, but efforts were not extensive enough to provide estimates of the statewide population (Hamilton et al. 1992, Hamilton 1993, Beedy and Hamilton 1997).

1994

Itinerant breeding had recently been documented in Tricolored Blackbirds and this was the first statewide survey conducted over a narrow time period to avoid double-counting birds that shift location between breeding attempts (Hamilton et al. 1995). The documentation of all historical colony sites (Beedy et al. 1991) and recent colony sites (Hamilton et al. 1992, Hamilton 1993) was used to inform a rangewide survey that attempted to visit all known Tricolored Blackbird breeding locations in 1994. The survey was largely volunteer-based and was carried out on a single day (April 23) early in the nesting season to detect as many birds as possible in colonies during their first breeding attempt of the year.

The goals of the survey were to document occupancy status and to estimate the size of all active colonies. Volunteers were asked to visit all known colony locations, estimate numbers at occupied sites, and to drive public roads near known breeding locations to identify previously undocumented colonies (Beedy and Hamilton 1997).

All colonies larger than 10,000 birds were revisited by Hamilton et al. (1995) to verify and sometimes refine estimates. At selected colony sites, the estimates of colony sizes provided by survey volunteers were adjusted using estimated nest densities. This was achieved by running transects through the nesting substrate when nests were active to obtain an estimate of average nest density and the proportion of observed nests that appeared active. More extensive transects were then run after breeding was completed to refine the estimate of nest density. This refined estimate was corrected for the proportion of active nests and multiplied by the total occupied area to obtain an estimate of the number of active nests in the colony. This number was then multiplied by 1.5 to account for an assumed male to female ratio of 1:2. The intent of this approach was to estimate the number of birds that ultimately nested in a breeding colony, but it might not have accurately represented the number of birds present during the survey period. For example, the approach would dismiss large groups of birds that may have been present during colony settlement that ultimately did not breed at a site (i.e., the method fails to account for the presence of any non-breeding adults). This is inconsistent with the goal of the statewide survey to estimate the total number of birds in the population. The approach also violates the condition that observations should be made during a narrow survey window to avoid double-counting birds.

Tricolored Blackbirds were observed in 32 California counties. One hundred active breeding colonies were observed in 28 counties. Ten previously occupied counties were not surveyed. The estimated number of birds observed was 369,400 (+/- 15%) (Beedy and Hamilton 1997). The assumed +/- 15% range in the estimate was based on a small sample of breeding colonies where visual estimates of colony size and estimates based on nest density varied by no more than 15% (Hamilton et al. 1995, Hamilton 1998).

Hamilton et al. (1995) felt that the survey effort in 1994 was “minimal” and that a larger number of birds would have been observed if a more substantial survey had been organized. The survey effort in the southern California portion of the range was especially limited. A single observer made two trips to southern California to search for colonies during the breeding season and organizers considered this portion of the range to be under-surveyed.

1995-1996

Volunteer surveys were conducted on a single day. Surveys were not informed by pre-survey monitoring as in the 1994 survey, and results did not include rangewide follow-up surveys. Some counties were surveyed incompletely, or not at all, and large breeding colonies may have been overlooked. Beedy and Hamilton (1997) concluded that the results of these surveys should not be considered total population estimates for Tricolored Blackbirds.

1997

The 1997 survey used the same coverage, methods, and personnel as did the 1994 survey (Beedy and Hamilton 1997). Participation was greater than in 1994 and most historically occupied counties received at least some coverage (Beedy and Hamilton 1997). The survey in the southern California portion of the range was much more thorough than that conducted in 1994. The volunteer survey was conducted on April 26.

Commented [TB2]: Provide a citation, or the number of surveyors?

Breeding and nonbreeding birds were observed in 33 California counties, plus additional birds in one county in Oregon and in Baja California. Seventy-one active breeding colonies were observed (Hamilton 2000). The estimated number of birds observed was 232,960 (+/- 15%) (Beedy and Hamilton 1997).

Commented [TB3]: Why is this cited here instead of 2000?

Despite the 1994 survey being described as a minimal effort that overlooked some unknown number of birds (Hamilton et al. 1995), Beedy and Hamilton (1997) reported that 1994 and 1997 were the only two survey years to date with sufficient survey effort to detect "virtually all large colonies." The observed number of birds declined by 37%, with the greatest declines occurring in the core of the species' distribution in Sacramento, Fresno, Kern, and Merced counties (Beedy and Hamilton 1997).

1999

The organizers of the one-day survey in 1999 (Hamilton et al. 1999, 2000) attempted to follow the same methods as those used in 1994 and 1997, but participation in the survey was low and the total count of about 95,000 birds was considered an underestimate by Hamilton (2000). Much of the population began breeding later than in previous years and many colonies were located after the survey that were not detected on the survey date (Hamilton et al. 1999).

2000

As with the 1994 and 1997 surveys, the 2000 survey attempted to locate all breeding colonies and estimate the number of birds in each colony. The 2000 survey used the same methods used in these two previous surveys, although a greater number of observers participated and visited more locations. A workshop was also held before the 2000 survey to train participants in colony size estimation. Unlike the previous survey years that focused on a single day, the 2000 survey was conducted over four days, from April 21-24. Hamilton (2000) suggested that this differed little from the 1994 and 1997 surveys because records in those years were accepted from one day before and after the survey date, effectively accepting reports over a three-day period, and the addition of a fourth day in 2000 only accounted for an additional 1,750 birds observed. As in 1994 and 1997, survey locations were informed by pre-survey colony detection and monitoring.

Breeding and nonbreeding birds were observed in 25 California counties. Seventy-two active breeding colonies were observed (Hamilton 2000).

Although Hamilton concluded that the 2000 survey located a greater proportion of the entire population than did censuses in previous years, he still felt that the San Joaquin Valley, with its potentially large silage colonies, was not surveyed completely (Hamilton 2000). Nevertheless, he concluded that the

Tricolored Blackbird population had declined during the 1990s, from an estimated 370,000 birds in 1994 to 162,000 birds in 2000.

2001

The survey conducted in 2001 followed a very different approach compared to standardized methods used in the 1990s to survey the statewide population. Only 48 sites were surveyed and sites were visited throughout the breeding season rather than being restricted to a narrow survey window of a few days (Humple and Churchwell 2002). As had been demonstrated in the 1990s, a season-long approach to detecting and surveying colonies may result in double-counting of birds that move between locations. Conversely, the limited number of sites visited likely underrepresented the breeding population. The effect of these inconsistencies in methodology and effort on survey results is unclear, and results cannot be compared to those of other survey years.

2004

The four-day survey conducted in 2004 was not intended to produce an estimate of the statewide population size comparable to previous surveys. The survey was limited to colony sites that had historically supported more than 2,000 birds and focused on those located in the Central Valley (Green and Edson 2004). Participation was low with only 29 volunteers conducting surveys. Based on well-documented occupancy dynamics of Tricolored Blackbird, this approach is likely to miss large breeding colonies. No training was provided to participants prior to the survey.

2005

There was no report produced describing the 2005 survey and its results, and the only record available to the Department is a spreadsheet listing occupied sites with estimates of colony size at each location. There is no record of the survey methods used nor the effort expended in conducting the survey.

The number of birds observed was reported as about 258,000 birds at 121 occupied sites (Meese 2015).

2008

The survey methods used to obtain the population estimate in 2008 were similar to those used in statewide surveys conducted in the previous survey years of 1994, 1997, and 2000 (Kelsey 2008). However, the methods differed in a number of ways that likely ~~effected~~ affected the estimated number of birds and precluded a direct comparison of the earlier surveys with results from 2008:

1. The volunteer survey was conducted on a single day in 1994 and 1997 and over four days in 2000, compared to three days in 2008. However, in 1994 and 1997, birds that were observed one day before and after the survey day but not associated with a colony were included in the estimate, effectively expanding the survey to three days for incidental observations.
2. Despite the narrow survey windows established in each of the survey years, no survey has practiced strict adherence to the requirement that all observations occur during the survey window. For example, in the earlier survey years (1994-2000), birds seen at colonies before the survey date were included in the estimate if those colonies remained active after the survey window but were not observed during the survey dates. Also, breeding birds found after the

date of the surveys were included if nest phenology suggested a colony must have been active during the survey dates. Since 2008, there has been a greater emphasis on adhering to the survey dates, but exceptions have been made on a case-by-case basis each year if observations suggest that birds were missed during the survey window (July 2017 email from B. Meese to N. Clipperton; unreferenced).

3. In the earlier survey years, when multiple observations were available at colonies throughout the breeding effort, the number of birds at a colony was recorded based on the maximum number of nests, which ignored any changes in colony size over time, as opposed to using the number of birds observed only during the survey window. However, Hamilton et al. (1995) stated that the difference between maximum and minimum observations were not great at any large colony. In recent years, when multiple observations at a location during the survey window resulted in multiple estimates, the average has typically been reported as the number of birds for the location.
4. In the earlier survey years, the estimates of colony sizes provided by survey volunteers were sometimes adjusted using estimated nest densities, as described above under the 1994 survey. This adjustment has not been employed in surveys conducted since 2008. The proportion of colonies with estimates adjusted using this approach varied across survey years 1994, 1997, and 2000 and was not always reported.

Commented [TB4]: Not true, in my experience.

These methodological differences between survey years may have had both positive and negative effects on the overall estimate, and the magnitude and direction of effect on the estimates are not known. Therefore, caution is warranted in making comparisons between the earlier group of surveys and those conducted since 2008.

The 2008 survey also included several enhancements relative to the earlier surveys:

1. County coordinators were used for the first time to ensure that each surveyed county was well-surveyed by local volunteers.
2. Maps with all survey locations were provided for the first time, and a website was available for downloading all survey materials and uploading survey data (Tricolored Blackbird Portal; http://tricolor.ice.ucdavis.edu/).
3. The number of survey participants and the number of sites surveyed greatly increased relative to earlier surveys (Kelsey 2008). The result was a more complete survey and more reliable data collection and reporting.

The effect of these new procedures and increased effort on the proportion of the Tricolored Blackbird population observed is unknown, but a larger proportion of the population was likely observed compared to previous surveys. As was first implemented in 2000, training sessions were also provided to survey volunteers. The 2008 survey was conducted from April 25-27.

A total of 155 volunteers participated in the 2008 survey and visited 361 historical and new locations in 38 counties (Kelsey 2008). The total estimate for number of birds observed was 394,858. Many of the larger colonies were visited by Tricolored Blackbird experts, which is consistent with earlier statewide surveys. Kelsey (2008) reported that some portion of the increase in observed number of birds since the 2000 survey may have been attributable to increased survey effort, but did not think that the increase was entirely due to the increased effort.

2011

The survey methods followed in 2011 were largely the same as those used during the 2008 survey (Kyle and Kelsey 2011), although a different approach to coordinating the survey was used. Rather than establishing county coordinators to ensure complete coverage of each surveyed county, the 2011 survey was organized by a statewide coordinator using online resources. Volunteers were asked to sign up for survey areas using the online portal and a statewide coordinator tracked survey coverage. The survey was conducted over three days, from April 15-17.

A total of 100 volunteers participated in the 2011 survey and visited 608 historical and new locations in 38 counties (Kyle and Kelsey 2011). The total estimate for number of birds observed was 259,322.

2014

The 2014 survey followed the methods used in 2008 and 2011. As in the 2008 survey, county coordinators were again used to ensure thorough coverage of each county (Meese 2014). The survey was conducted over three days, from April 18-20.

A total of 143 volunteers participated in the 2014 survey and visited 802 historical and new locations in 41 counties (Meese 2014). Based on number of volunteers, counties covered, and number of sites visited, this was the most complete statewide completed to date. The total estimate for the number of birds observed was 145,135.

2017

The 2017 survey followed the methods used in 2008-2014. The survey was conducted over three days, from April 7-9 (Meese 2017). For 2017, additional survey forms were used to collect additional information on weather conditions, survey effort, site occupancy, and the suitability of nesting habitat at each surveyed location. Maps of survey locations were also updated and included online maps that could be used to navigate to sites in the field using a smartphone app.

A total of 181 volunteers participated in the 2017 survey and visited 884 historical and new locations in 44 counties (Meese 2017). Based on number of volunteers, counties covered, and the number of sites visited, the 2017 survey was even more thorough than the 2014 survey. The total estimate for the number of birds observed was 177,656.

Appendix 2
Comments on Tricolored Blackbird statewide survey methods

Methods of estimating population abundance and the approach used in statewide surveys

In surveys designed to estimate the number of individuals in a population, abundance data may be collected through a sampling approach that focuses on a representative subset of locations, or through a census that aims at a complete count of all birds within a survey boundary (Gregory et al. 2004). Many different approaches have been developed to sample data from a population in a defined area of interest, with the underlying goal to provide an estimate of the full population size and some measure of estimation error. Species that are spatially highly-clumped, or rare and occurring within a restricted range or at a limited number of sites, are often not amenable to sampling approaches because of the difficulty in designing an approach that results in a sample representative of the full population. These species may be more amenable to censuses, especially when highly conspicuous like the Tricolored Blackbird (Gregory et al. 2004).

Conducting a census of colonial species requires that breeding locations first be identified. For species with high site fidelity to traditional breeding locations (e.g., seabirds, some herons) it can be fairly straightforward to identify breeding sites and monitor the population of interest. Due to the dynamic occupancy patterns of Tricolored Blackbird breeding colony locations and the large geographic scale ~~at which~~where statewide surveys are conducted, it is not possible to ensure every breeding colony is located and counted in any given year. Because of these difficulties, the approach for statewide surveys to date (since 1994) has been to conduct early season colony detection work to identify active colonies, then to combine these with all historical colony sites to attempt a comprehensive search of known breeding locations over a short (usually 3-day) survey window.

Some unknown portion of the Tricolored Blackbird population is not located and counted during each survey, and therefore the results of statewide surveys might be best described as an index of abundance that can be compared over time to evaluate population trends. Indices are based on the idea that a fixed amount of searching effort will always locate a fixed proportion of the population; therefore, changes in the index should be directly proportional to changes in the population size (Gregory et al. 2004). The dynamic inter-annual occupancy patterns of the Tricolored Blackbird can complicate efforts to meet this assumption, but the somewhat predictable distribution in the early breeding season, paired with pre-survey efforts to locate large breeding colonies may help to address this issue. As described in the body of this report, the recent approach to statewide surveys has been an ever-increasing effort across survey years to visit as many of the known historical breeding locations as possible, which themselves increase as additional breeding locations are discovered by survey participants and as birds shift to establish new breeding locations on the landscape. An ever-increasing survey effort is not a sustainable approach to monitoring the species, and it violates the assumption of a constant search effort in indices of abundance (an increasing effort over time may allow for documentation of a negative population trend, but may confound interpretation of any observed increase in population numbers).

Recent work to establish a survey design based on a random stratified sample has provided a method to estimate the number of birds that would result from a full census without the required effort to visit all known colony sites (Meese et al. 2015). The approach followed in sample surveys conducted in 2015 and 2016 was to attempt a complete census of five counties where the majority of the population occurs each April, and to survey the remaining counties based on a stratified sample, with bioregion and nesting substrate as strata. The intent of this new survey design was to provide a method whereby the population could be monitored annually during years when a full triennial survey is not conducted, with a smaller force of volunteer surveyors. The data from these sample surveys are currently being analyzed and will likely result in revisions to the sampling approach. Results may also inform revisions to the triennial survey. Potential modifications to statewide surveys may include 1) removal of sites that are no longer suitable for Tricolored Blackbird nesting, 2) removal of sites that have not been occupied by Tricolored Blackbirds within a certain number of years, assuming sites have been surveyed on a regular basis, 3) removal of entire regions of the state where the species has declined or disappeared, or 4) increased opportunities to conduct multiple observations per colony site for estimation of detection probability and estimation error, or other modifications. Ultimately, the triennial attempts at a full census might be replaced with an annual or longer-duration sample survey.

Commented [TB1]: What do you mean by strata?

Commented [TB2]: Really? I've never seen any of the results from these surveys in either published or unpublished form….

Commented [TB3]: This has already been done, at least for the counties I survey.

Sources of uncertainty in Tricolored Blackbird population estimates

Geographic coverage

As shown in Figure 9 (distribution of colony sites visited 2008-2017) in the body of this report, survey locations visited during statewide surveys have been well distributed throughout the California range of the Tricolored Blackbird. As the survey effort has increased with each successive survey, the portion of the range surveyed has filled in as volunteers have visited more locations within the range. The addition of survey locations also results in an increased area searched as volunteers drive from one survey location to the next. In some years, birds at the geographic fringe of the range may have been excluded from the survey effort, but these areas have never supported large numbers of birds during the early breeding season and so this is unlikely to have a large effect on the overall estimate or index. For example, in statewide surveys ~~in which~~when Siskiyou County was included, it has held only 0-0.2% of the total estimate of birds observed. In some portions of the range (e.g., the Sierra foothills), there are areas with low road density and private property with no access and therefore some unknown number of colonies are likely missed each year. For example, Airola et al. (2016) estimated that only 36% of the available habitat was surveyed in a study of the Sierra Nevada foothills that utilized public roads (with a range of 26% to 44% depending on region of the foothills). This is a consistent omission in each survey year so it might not have a large impact on trend detection.

Detectability of colonies

Small breeding colonies are likely missed during each survey, especially in areas where small colonies might occur distant from any known colony site, and therefore are not located within the focused search area. Because Tricolored Blackbird colonies are extremely conspicuous leading up to and throughout most of the nesting cycle, most large colonies that would contribute substantially to the overall statewide estimate are likely to be observed during the 3-day search window, unless they occur at a large distance from public roads (Kelsey 2008). Given the concentration of birds in relatively few large colonies and within a few well-known and well-surveyed portions of their range, especially the San Joaquin Valley, Kelsey (2008) concluded that "it is unlikely that large numbers of Tricolored Blackbirds go undetected during the statewide surveys." Additionally, in areas of the state where most of the population breeds early in the nesting season (e.g., San Joaquin Valley), extensive pre-survey scouting occurs in an attempt to locate colonies, both for survey purposes and to initiate colony protection efforts where colonies occur on agricultural fields. Even if a colony site is not visible from a road, large colonies can be detected and identified by the species' diagnostic feeding flights as they move between the colony location and foraging habitat. The density of roads may limit observation of a portion of the landscape and some unknown proportion of colonies goes undetected each year; this is a limitation common to all survey years.

Julie Yee (Statistician with the USGS) used data from the 2008 statewide survey, which was the first statewide survey to consistently record colony absence information and contained incidentally collected double-observer data for certain colony sites, to evaluate colony detection rate. The per-visit detection probability (i.e., the likelihood that an occupied colony location will be detected) was 0.94, which is quite high (Nov 2016 email from J. Yee to N. Clipperton; unreferenced).

Timing of survey and nesting phenology

The number of birds present and visible at a colony location can vary dramatically across the nesting cycle. During settlement, many more birds may be present at a site than ultimately remain to breed, and the high level of activity can make estimation difficult. However, these birds are part of the adult population and should be included in survey estimates, although this may not have been the case in 1994-2000 when estimates were adjusted using nest densities. During incubation, females may be unaccompanied by males at the colony site and may remain on their nests hidden from view. At this stage the counts of birds at a colony may result in underestimates (Hamilton et al. 1995). Visual estimates of colony size are probably best made during the nestling/fledgling provisioning stage when both parents are visible and are making regular trips to and from the colony site (Hamilton et al. 1995).

The statewide surveys have regularly been conducted in the early part of the nesting season to capture the first breeding attempts of most of the population. The timing of nesting can vary annually, so there is no way to plan survey dates for a time when most colonies are at a certain stage of the nesting cycle. Tricolored Blackbirds have begun nesting earlier in the year over the past decade, perhaps in response to climate change (e.g., see Tottrup et al. 2010, Mazerolle et al. 2011), and the survey period has been shifted to accommodate this in an attempt to sample the population during similar times in the nesting cycle.

Colony size estimation

Estimation of colony size may be the largest source of uncertainty in the number of birds estimated on statewide surveys. Hamilton et al. (1995) suggested that observer variability was a substantial source of error in population estimates, but felt that colony size estimates were accurate to within 15% based on efforts to verify colony size using nest densities. For this reason, results from the 1994 and 1997 surveys were provided with an error range of +/- 15%.

In each of the four most recent survey years (2008, 2011, 2014, and 2017), several steps have been followed to reduce the amount of observer-based error. Volunteers were provided with training in Tricolored Blackbird identification, estimation of colony size, use of maps and online tools, and a standard survey protocol. Many of the participants, especially those coordinating county efforts, have been knowledgeable observers with experience participating in multiple survey years, and the same survey participants are enlisted from year-to-year when possible. As with surveys from previous years, most of the largest colonies have been revisited by experienced observers to verify population estimates.

Since 2008, volunteers have been asked to provide a best estimate of colony sizes, plus a range incorporating the minimum and maximum number of birds that could be present at a site. This request may be interpreted differently by different observers. For example, some observers may provide a large range to be certain that the minimum and maximum numbers capture the true size of the colony, whereas others may treat the range as a measure of their ability to accurately count the observed birds. However, it does provide some sense of how certain an observer is in their ability to accurately estimate the size of a colony. Observers show a natural tendency to overestimate small flocks and underestimate large flocks, although the extent to which different observers do this varies greatly (Gregory et al. 2004) and the effect on the overall population estimate from multiple colonies is unclear. The range provided by observers to capture the minimum and maximum estimates has averaged about +/-25% [range for 2008, 2011, and 2014 surveys of -29% to +33%] of the best estimates across all colony sites. Unfortunately, data have not been collected in a way that allows for statistical estimates of error around the annual indices of abundance, but the similar survey protocols and extensive and increasing survey effort have provided information sufficient for detecting a long-term population decline. Ongoing efforts to revise the statistical sampling scheme for monitoring the Tricolored Blackbird population will incorporate methods to produce error estimates (Meese et al. 2015).

Appendix 3
Analysis of Christmas Bird Count Data

Because the number of Christmas Bird Count (CBC) circles is known to have increased dramatically through the 1950s and 1960s, especially in the western region of the U.S. (Niven et al. 2004), data were evaluated to determine an appropriate year to use as a start date for trend analysis. The first CBC to detect Tricolored Blackbird in California was conducted in Marysville in count year 12 (i.e. the winter of 2011-2012). CBC circles in California were sparse and were conducted inconsistently for several decades before the number of circles detecting Tricolored Blackbird began to increase in the 1950s and 1960s. The year 1974 was selected as the start year for a trend analysis using CBC data for the following reasons:

Commented [TB1]: How could count year 12 have been in 2012? There must be a whole bunch of TRBLs on CBCs before then! This statement is inconsistent with what you report below…

1. Following a period of rapid increases in the number of CBC circles in California through the 1960s, 1974 was the first year when Tricolored Blackbirds were detected on more than 25 circles. Annual increases in the number of party hours spent searching for birds also began to level off in the mid-1970s. The number of circles with Tricolored Blackbird detections in California continued to increase through the 1970s and 1980s, with detection of the species on 35 circles by 1978, 40 circles by 1981, and 50 by 1986.
2. DeHaven et al. (1975a) assessed the population status of the Tricolored Blackbird in the early 1970s, so selection of 1974 as a start date for CBC analysis allows for trend assessment since that important benchmark.
3. Graves et al. (2013) used data collected between 1935 and 1975 to evaluate trends in average colony size during a period when the Tricolored Blackbird population was reported to have declined by about 50% (Neff 1937, DeHaven et al. 1975a), and observed a negative trend. They selected data from 1980 to 2009 to evaluate more recent trends without finding evidence of a continued decline in average colony size. The use of data starting in the mid-1970s for a CBC data analysis allows for comparison to these results.

Commented [TB2]: How could winter CBCs be used to estimate colony sizes?

CBCs circles are not run consistently every year. To ensure that apparent trends were not artifacts of the years when certain circles were run, data from CBC circles were included only if the circle met the following criteria:

1. Tricolored Blackbird was detected on the circle in more than 50% of survey years from 1974-2015 (at least 22 of 42 years).
2. The first detection of Tricolored Blackbird on a circle occurred no later than 1985. As mentioned above, new CBC circles continued to be added over the years; this criterion was implemented to limit the effect that an increasing set of circles might have on long-term trends.

Based on these criteria, 46 CBC circles were selected to assess winter population trend from 1974 to 2015 (Figure A3.1). The circles provide decent coverage of the winter distribution of the Tricolored

A) B)

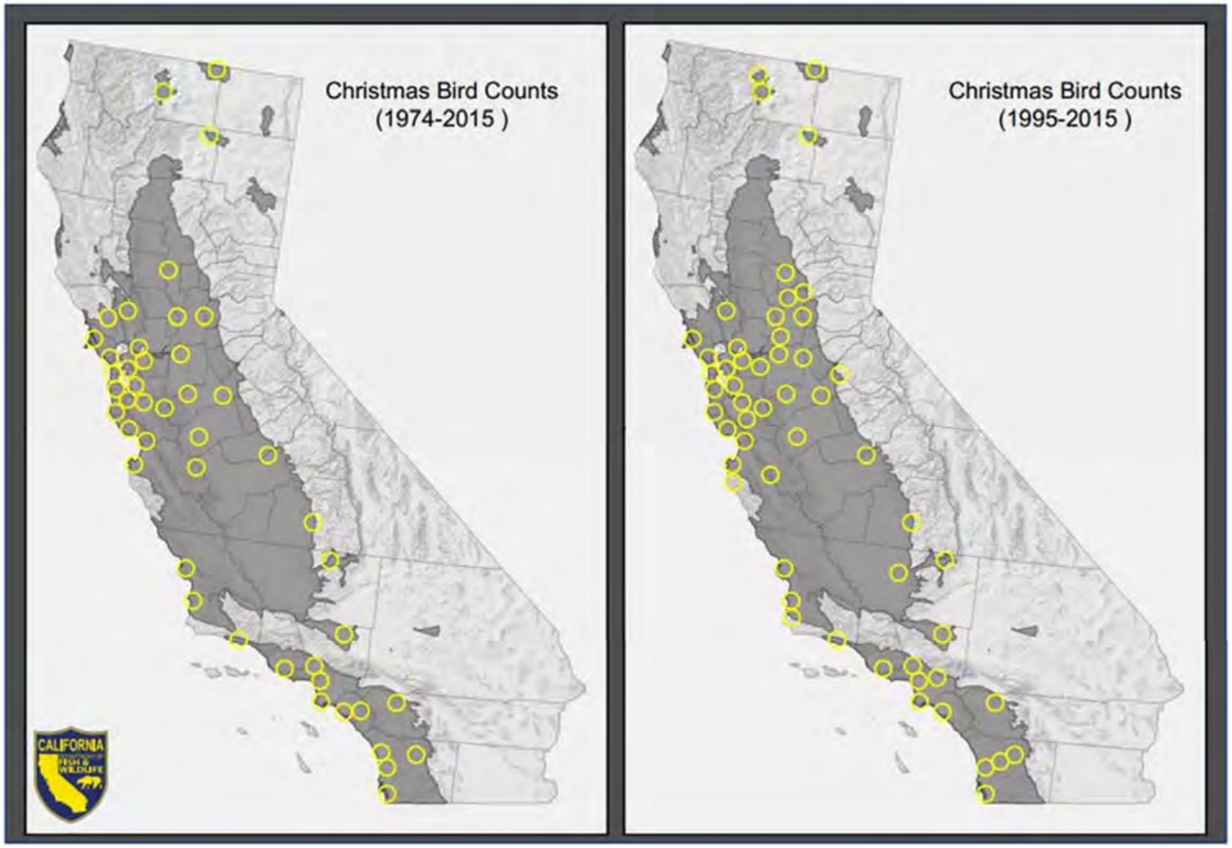

Figure A3.1. Christmas Bird Count circles used for trend assessment. A) Circles for which data were analyzed over a long-term period (1974-2015). B) Circles for which data were analyzed for a shorter-term period (1995-2015) during which more data were available.

Blackbird on the central California coast, the Delta and adjacent portions of the Central Valley, and of southern California. Coverage of the southern San Joaquin Valley is limited.

Although some CBC circles are run in all or most years, annual survey coverage of established circles continues to vary. However, the number of circles run each year has been much more consistent since the early 1990s. For example, from 1992 to 2015 the number of circles with detections of Tricolored Blackbird ranged from 54 to 66. A separate analysis was conducted using data from years 1995-2015. This allowed for use of a larger number of circles for trend evaluation and a more consistent set of data from year to year. This is also the time period for which the best data are available from Tricolored Blackbird breeding season surveys. Data from circles were included for analysis of trends over this narrower time period only if Tricolored Blackbird was detected on the circle in at least 13 of the 21 survey years. The resulting 55 CBC circles provided somewhat improved coverage of the northern San Joaquin and southern Sacramento valleys compared to the 1974-2015 analysis (Figure A3.1).

Because of the variable number of observers and time spent surveying CBC circles each year, it is common practice to evaluate effort-corrected data (birds detected/party hour). Although results are highly variable from year-to-year, data from the 46 circles evaluated for the 1974-2015 period showed a clear decline (Figure A3.2). The graph in Figure A3.2 only includes circles for which at least one Tricolored Blackbird was detected because data on survey effort (party hours) were unavailable for counts that were conducted but observed zero Tricolored Blackbirds. Therefore, the value for average birds per party hour are likely inflated for years that included circles with many non-detections. This likely results in a trend that is biased upward in recent years, as the number of circles with zero Tricolored Blackbirds has been increasing over the last two decades (Table A3.1).
[Note to reviewers: Data on party hours for circles that were run but no Tricolored Blackbird detected have been requested from Audubon. Figure A3.2 will be updated when data is received.]

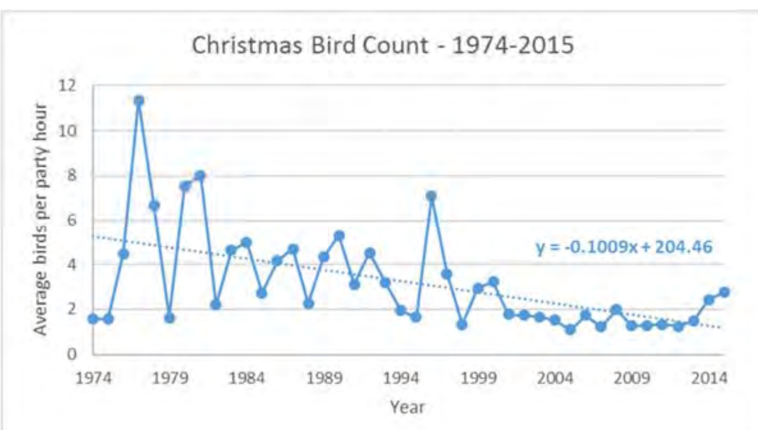

Figure A3.2. Effort-corrected numbers of Tricolored Blackbirds observed on Christmas Bird Counts conducted from survey year 74 (winter 1973-1974) to survey year 115 (winter 2014-2015).

Table A3.1. Number of circles with no Tricolored Blackbirds detected over the last 25 years.

Survey years	Average annual number of circles with zero TRBL (percent)[1]
1991-1995	3.2 (7%)
1996-2000	5 (11%)
2001-2005	7 (15%)
2006-2010	10.6 (23%)
2011-2015	13.4 (29%)

[1] Percent of the total 46 circles included in the analysis.

Population trends were estimated from the slope of the regression of the log-transformed counts on year. Because of the need for log-transformation to obtain normally distributed data, only circles with at least one Tricolored Blackbird detection were included. Whether all circles in each year were treated as independent samples (Figure A3.3) or were averaged for a single annual value of birds/hour (Figure A3.4), the 1974-2015 data show a negative trend in number of birds observed (i.e., the slope is not zero; p-values <0.001).

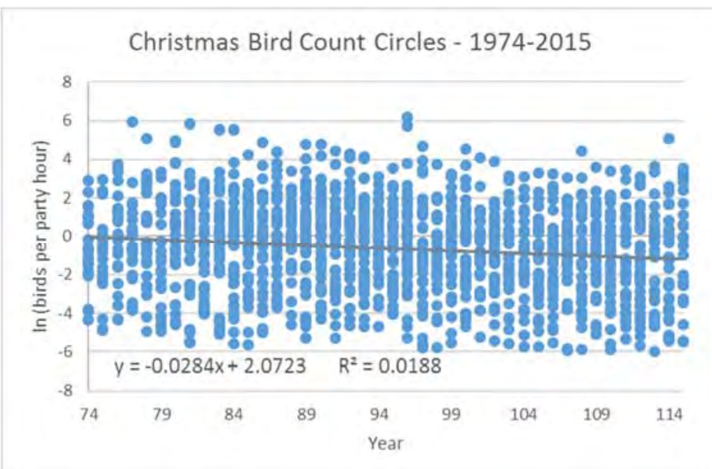

Figure A3.3. Christmas Bird Count data for all circles with Tricolored Blackbird detections (of the 46 circles selected for the analysis) from 1974 to 2015, with least squares line.

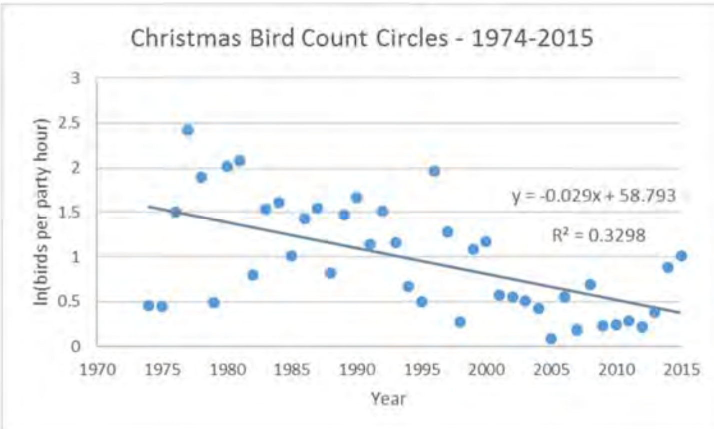

Figure A3.4. Christmas Bird Count data with circles averaged for a single value per year.

Data from the 55 circles evaluated for the 1995-2015 period show a decline, but this is primarily due to a large number of birds detected in 1996 (Figure A3.5). Since 1997, there is no apparent strong trend in the data, but rather a consistent low number of birds (<5 birds/party hour) observed in most years. This is a large contrast to the peaks in numbers seen 1977-1996. As with the analysis of data from 1974-2015, the graph in Figure A3.5 only includes circles for which at least one Tricolored Blackbird was detected. Therefore, the value for average birds per party hour are likely inflated for years that included circles with many non-detections, and this would have a larger effect in the most recent years (Table A3.1).

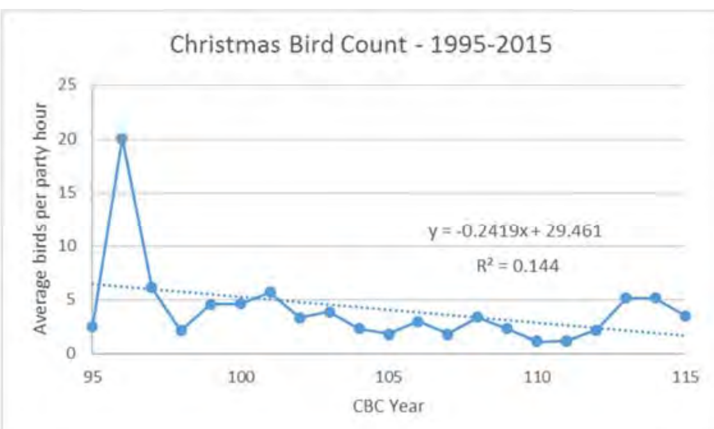

Figure A3.5. Effort-corrected numbers of Tricolored Blackbirds observed on Christmas Bird Counts conducted from survey year 95 (winter 1994-1995) to survey year 115 (winter 2014-2015).

For the shorter 1995-2015 time period, the requirement that Tricolored Blackbird be seen on a circle in at least 13 years for data from the circle to be considered had the unintended consequence of eliminating circles with previous detections of Tricolored Blackbird, but that in recent years have had none. For example, the Oceanside-Vista-Carlsbad circle had only two Tricolored Blackbirds detected in a single year since 2001, Orange County (northeastern) had only 12 birds seen in a single year since 2006, Palo Alto had birds seen in only two years since 2004, and Peace Valley (which recorded the largest number of Tricolored Blackbirds ever found on a CBC circle in 1977) had no birds detected since 2001. None of these circles were included in the analysis, which may have biased the observed trend to the positive. Additional count circles, although included in the analysis because they had at least 13 years of detections during 1995-2015, also saw declines to zero birds in recent years. These include the Los Angeles circle that had no Tricolored Blackbird sightings since 2011; Oakland, which had no Tricolored Blackbirds in 2015 and no more than seven birds since 2008; Orange County (coastal), with no birds detected since 2008; and San Fernando Valley, with only four birds seen in one year since 2008. Due to a lack of data, the effort at these circles where no birds were observed is not included in estimates of birds/party hour, which may also obscure any negative trend in recent years.

Commented [TB3]: I've done this count almost every year since the late 1990s, and I believe the drop in TRBLs is directly related to the dramatic expansion of nut orchards in former rangeland habitats. I went there last Sat for an Audubon field trip, and noted several thousand acres of new orchards around the Buttes from last year….

From: Marcel Holyoak <maholyoak@ucdavis.edu>
Sent: Wednesday, November 15, 2017 9:36 PM
To: Clipperton, Neil@Wildlife
Subject: RE: Draft Tricolored Blackbird Status Review - peer review

Dear Neil

I was actually working on my review of the listing status document when you emailed. I started it about 10 days ago but kept getting interrupted by other things.

The status review overall seems careful and precise, and so I did not have many substantial comments: mainly clarifications or suggestions for wording to better reflect the strength of evidence. The most substantial point I came up with was that Central Coast breeding early in the season was perhaps omitted (my comment on page number 42 using the page numbers on the report, referring to Santa Clara County). I also had an insight into climate change that is below and in the attached files.

I'm attaching two files with an analysis we did of the data in Graves et al. 2012 but never included in the paper. It shows and advancement of breeding date (earlier breeding) in more recent years. It is hard to know what this means for the species. Whether everything shifts to earlier in the season and there is no change in season length, or whether there is some negative effect on reproductive success or similar.

Cheers, Marcel

STATE OF CALIFORNIA
NATURAL RESOURCES AGENCY
DEPARTMENT OF FISH AND WILDLIFE

REPORT TO THE FISH AND GAME COMMISSION
A STATUS REVIEW OF THE
TRICOLORED BLACKBIRD
(*Agelaius tricolor*) IN CALIFORNIA

CHARLTON H. BONHAM, DIRECTOR
CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE
Draft – October 13, 2017

CONFIDENTIAL—CDFW EXTERNAL PEER REVIEW DRAFT—DO NOT CIRCULATE

Table of Contents

EXECUTIVE SUMMARY

[Note to reviewers: The executive summary will be prepared after peer review.]

REGULATORY FRAMEWORK

Petition Evaluation Process

A petition to list the Tricolored Blackbird (*Agelaius tricolor*) as endangered under the California Endangered Species Act (CESA) was submitted to the Fish and Game Commission (Commission) on August 19, 2015 by the Center for Biological Diversity. Commission staff transmitted the petition to the Department of Fish and Wildlife (Department) pursuant to Fish and Game Code section 2073 on August 20, 2015, and published a formal notice of receipt of the petition on September 4, 2015 (Cal. Reg. Notice Register 2015, No. 36-Z, p. 1514). The Department's charge and focus in its advisory capacity to the Commission is scientific. A petition to list or delist a species under the CESA must include "information regarding the population trend, range, distribution, abundance, and life history of a species, the factors affecting the ability of the population to survive and reproduce, the degree and immediacy of the threat, the impact of existing management efforts, suggestions for future management, and the availability and sources of information. The petition shall also include information regarding the kind of habitat necessary for species survival, a detailed distribution map, and any other factors that the petitioner deems relevant" (Fish & G. Code, § 2072.3).

On October 2, 2015, the Department provided the Commission with its evaluation of the petition, "Evaluation of the Petition from the Center for Biological Diversity to List Tricolored Blackbird (*Agelaius tricolor*) as Endangered Under the California Endangered Species Act," to assist the Commission in making a determination as to whether the petitioned action may be warranted based on the sufficiency of scientific information (Fish & G. Code, §§ 2073.5 & 2074.2; Cal. Code Regs., tit. 14, § 670.1, subds. (d) & (e)). Focusing on the information available to the Department relating to each of the relevant categories, the Department recommended to the Commission that the petition be accepted.

At its scheduled public meeting on December 10, 2015, in San Diego, California, the Commission considered the petition, the Department's petition evaluation and recommendation, and comments received. The Commission found that sufficient information existed to indicate the petitioned action may be warranted and accepted the petition for consideration. Upon publication of the Commission's notice of its findings, the Tricolored Blackbird was designated a candidate species on January 8, 2016 (Cal. Reg. Notice Register 2016, No. 2-Z, p. 57).

Status Review Overview

The Commission's action designating the Tricolored Blackbird as a candidate species triggered the Department's process for conducting a status review to inform the Commission's decision on whether to list the species. At its scheduled public meeting on December 8, 2016, in San Diego, California, the

Commission granted the Department a six-month extension to complete the status review and facilitate external peer review.

This status review report is not intended to be an exhaustive review of all published scientific literature relevant to the Tricolored Blackbird; rather, it is intended to summarize the key points from the best scientific information available relevant to the status of the species. The final report represents the Department's evaluation of the current and future conservation status of the species and is informed by independent peer review of a draft report by scientists with expertise relevant to Tricolored Blackbird. It is intended to provide the Commission with the most current information on the Tricolored Blackbird and to serve as the basis for the Department's recommendation to the Commission on whether the petitioned action is warranted. The status review report also presents identification of habitat that may be essential to the continued existence of the species and provides management recommendations for recovery of the species (Fish & G. Code, § 2074.6). Receipt of this report is to be placed on the agenda for the next available meeting of the Commission after delivery. At that time, the report will be made available to the public for a 30-day public comment period prior to the Commission taking any action on the petition.

Existing Regulatory Status

California Endangered Species Act

The Tricolored Blackbird was the subject of three previous CESA listing petitions. In 1991, the Yolo chapter of the National Audubon Society submitted a petition to the Commission to list the species as endangered. After reviewing the document and other available information, the Department determined that the petitioned action might be warranted and recommended to the Commission that it accept and consider the petition. In March 1992, the Commission voted to accept the petition and designated the Tricolored Blackbird as a candidate for listing. Researchers working during the 1992 breeding season discovered that the population was much larger than previously thought and the Yolo Audubon Society withdrew the petition based on the new population data. The Commission allowed the petition to be withdrawn, but urged the Department to work with interested persons and groups to develop conservation measures for the Tricolored Blackbird. The species was again petitioned to be listed under CESA in 2004 (Cal. Reg. Notice Register 2004, No. 18-Z, p. 568). The petition evaluation report by the Department (Gustafson and Steele 2004) stated there was sufficient information to indicate the petitioned action may be warranted; however, the Commission voted to reject the petition (Fish and Game Commission meeting, Feb. 3, 2005). On October 8, 2014, the Center for Biological Diversity submitted a petition to list the Tricolored Blackbird as endangered (Cal. Reg. Notice Register 2014, No. 44-Z, p. 1861). The Commission referred the petition to the Department for an initial evaluation on October 15, 2014. At its December 3, 2014 meeting in Van Nuys, California, the Commission voted to take emergency action to add Tricolored Blackbird to the list of endangered species pursuant to Fish and Game Code section 2076.5, with the related regulation as approved by the Office of Administrative Law taking effect for an initial term of six months beginning on December 29, 2014 (Cal. Reg. Notice Register 2015, No. 2-Z, p. 91). At its meeting in Mammoth Lakes on June 11, 2015,

the Commission voted to reject the 2014 petition and on June 30, 2015 the emergency regulation adopted in December 2014 expired by operation of law.

Federal Endangered Species Act

The Tricolored Blackbird also has a listing history under the federal Endangered Species Act (ESA). In 1988, the United States Fish and Wildlife Service (USFWS) contracted for a compilation of all historical information on distribution and abundance of the Tricolored Blackbird, resulting in the work of Beedy et al. (1991). In 1991, the USFWS identified the Tricolored Blackbird as a category 2 candidate for federal listing. However, in 1996, the USFWS eliminated category 2 species from the list of candidate species. In 2004, the USFWS received a petition to list the Tricolored Blackbird as a threatened or endangered species from the Center for Biological Diversity. In 2006, the USFWS issued a 90-day finding in response to the petition that listing the Tricolored Blackbird was not warranted (50 CFR Part 17, Dec 5, 2006). On February 3, 2015, the Center for Biological Diversity submitted a petition to the USFWS to list the Tricolored Blackbird as an endangered species under the federal endangered species act and to designate critical habitat concurrent with listing. The petition is currently under review by the USFWS (50 CFR Part 17, Sept 18, 2015).

California Species of Special Concern and USFWS Birds of Conservation Concern

The Tricolored Blackbird is listed as a Priority 1 Species of Special Concern (SSC) by the Department. The Department's SSC designation is administrative and is intended to alert biologists, land managers, and others to a species' declining or at-risk status, to encourage additional management considerations for these species to ensure population viability, and to preclude the need for listing under CESA. SSCs are defined as species, subspecies, or distinct populations of animals native to California that currently satisfy one or more of the following criteria: extirpated from the state in the recent past; listed under ESA as threatened or endangered, but not under CESA; meets the state definition of threatened or endangered but has not been formally listed; experiencing, or formerly experienced, serious (noncyclical) population declines or range retractions (that have not been reversed), which if continued or resumed could qualify for threatened or endangered status under CESA; has naturally small populations and/or range size and exhibits high susceptibility to risk from any factor that, if realized, could lead to declines that would qualify it for threatened or endangered status (Shuford and Gardali 2008). In 2008, the USFWS updated its Birds of Conservation Concern report, identifying "species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act of 1973" (USFWS 2008). The Tricolored Blackbird was included on two Bird Conservation Region lists (Coastal California and Great Basin), the USFWS Region 8 list (California and Nevada) and the National list. Neither of these "species of concern" designations provides the species with formal regulatory status like the ESA or CESA; however, impacts to SSC are generally considered potentially significant under CEQA, and therefore mitigation for impacts may be provided (see Existing Management section).

Migratory Bird Treaty Act

The Tricolored Blackbird is included on the list of species protected under the Migratory Bird Treaty Act (MBTA). The MBTA makes it unlawful to take, possess, transport, sell, or purchase any bird listed in the Act, or its nest or eggs, without a permit issued by the USFWS.

California Fish and Game Code

The Fish and Game Code includes certain protections for birds, including nongame birds. Sections applicable to the Tricolored Blackbird include the following:

> Section 3503 – It is unlawful to take, possess, or needlessly destroy the nest or eggs of any bird, except as otherwise provided by this code or any regulation made pursuant thereto.
>
> Section 3513 – It is unlawful to take or possess any migratory nongame bird as designated in the Migratory Bird Treaty Act or any part of such migratory nongame bird except as provided by rules and regulations adopted by the Secretary of the Interior under provisions of the Migratory Treaty Act.
>
> Section 3800(a) – All birds occurring naturally in California that are not resident game birds, migratory game birds, or fully protected birds are nongame birds. It is unlawful to take any nongame bird except as provided in this code or in accordance with regulations of the commission.

BIOLOGY AND ECOLOGY

Species Description

The Tricolored Blackbird was first collected by Nuttall in 1836 near Santa Barbara, CA (Nuttall 1840, Baird et al. 1874). A male specimen was sent to John James Audubon who described it as a unique form of blackbird in his well-known *Ornithological Biography* (Audubon 1839).

The Tricolored Blackbird is sexually dimorphic, with the male plumage entirely black except for the bright red lesser wing coverts forming a conspicuous red patch on the wing (“shoulder” or “epaulets”) and white median coverts forming a distinct border to the red. The black body plumage is glossed bluish when viewed in sunlight. The female is mostly dark brown dorsally and heavily streaked ventrally with dark brown streaks merging to form a largely solid dark brown belly (Beedy et al. 2017). The head of the female is indistinctly patterned with a whitish supercilium, malar, chin, and throat.

Although similar in appearance to the related Red-winged Blackbird (*A. phoeniceus*), several features can be used to distinguish the two species (described by Nuttall 1840, Cooper 1870, Baird et al. 1874). The black plumage of the Tricolored Blackbird male has a soft bluish luster that is lacking in the Red-winged Blackbird. The lesser wing coverts (the red “shoulder”) on the male Tricolored Blackbird are a much deeper red (described as crimson, carmine, or the color of venous blood) compared to the brighter red color (vermilion or scarlet) in the Red-winged Blackbird. The median coverts in the Tricolored Blackbird are white (pale-yellowish when fresh) and create a stark contrast between the black

and red feathers on the wing, whereas in the Red-winged Blackbird they are generally yellowish (or black in the subspecies that breeds in much of the Central Valley). The bill of the Tricolored Blackbird averages thinner and can appear more sharply pointed. In flight, the wings of the Tricolored Blackbird appear to have a more pointed shape (vs. rounded in the Red-winged Blackbird) due to differences in length of the primary flight feathers. Female Tricolored Blackbirds have darker plumage than most female Red-winged Blackbirds, although this difference is less pronounced in the Central Valley where the subspecies of Red-winged Blackbird is relatively dark (Beedy et al. 2017).

Taxonomy

The Tricolored Blackbird is a species in the avian family Icteridae, which is restricted to the Americas in the Western Hemisphere and includes blackbirds, orioles, cowbirds, grackles, and meadowlarks (Skutch 1996). There are about 100 species in the family, most of which occur in the tropics. Following recent taxonomic changes that removed several South American species from the genus *Agelaius*, there are currently five species in the genus worldwide (Remsen 2017). In addition to the Tricolored Blackbird, the only other species that occurs on the North America mainland is the much more widespread and diverse Red-winged Blackbird. The other three species in the genus occur in the Greater Antilles: *A. assimilis* (the Red-shouldered Blackbird of western Cuba), *A. humeralis* (the Tawny-shouldered Blackbird of Hispaniola and Cuba), and *A. xanthomus* (the Yellow-shouldered Blackbird of Puerto Rico) (Beedy et al. 2017). There are no recognized subspecies of Tricolored Blackbird (AOU 1957).

Geographic Range and Distribution

The Tricolored Blackbird is nearly endemic to the state of California, with small numbers of birds extending the species' range into neighboring states of Oregon, Washington, Nevada, and Baja California.

Breeding Range

The majority of the Tricolored Blackbird's breeding range is composed of two disjunct regions of California and Baja California, separated by the Transverse Ranges of southern California (Figure 1). The larger of the two areas occupies the lowlands west of the Sierra Nevada, extending west across the Central Valley to the coast from Sonoma County south to Santa Barbara County. The second area is composed of the lowlands west of the deserts in southern California, extending south into northwestern Baja California. Small numbers of birds extend the range to the north in isolated low-lying areas on the northern California coast and to isolated areas in northeastern California, Oregon, and eastern Washington. Similarly, the range extends east from the southern Central Valley to small areas in the Mojave Desert, and to a single area in Douglas County, Nevada (Skutch 1996, Ammon and Woods 2008, Beedy et al. 2017).

Winter Range

In the winter the Tricolored Blackbird mostly withdraws from the portion of its breeding range north of the Central Valley (northeastern CA, Oregon, and Washington) and from Nevada to the lowlands of

central and coastal California (Wahl et al. 2005, Ammon and Woods 2008, Beedy et al. 2017), although a small number of birds are occasionally documented throughout the northern breeding range during winter months (Gilligan et al. 1994, Spencer 2003, eBird Dataset 2016). The species can be found in most of the remainder of its range year-round, with shifts in distribution as described below.

Distribution of Breeding Colonies

Within the breeding range, the largest breeding colonies and the large majority of the breeding population occur in the Central Valley of California (Figure 2b). In all California statewide surveys conducted since 1994, most (≥90% in all years but 1997) of the population has occurred in the Central Valley counties during the early breeding season (Hamilton et al. 1995, Beedy and Hamilton 1997, Hamilton 2000, Kelsey 2008, Kyle and Kelsey 2011, Meese 2014a).

Although the overall distribution and breeding locations vary from year to year, Tricolored Blackbirds exhibit some fidelity to traditional use areas. These areas likely provide all of the critical resources needed by breeding colonies, while the specific nesting sites used in the area can change from year to year (Beedy et al. 1991). In the Central Valley, there are distinct regions that frequently support multiple colonies and a large proportion of the breeding population. In the southern San Joaquin Valley, the largest colonies are typically found annually in an area centered at the junction of Kern, Kings, and Tulare counties (Figure 2). In the northern San Joaquin Valley, Merced County regularly supports multiple large colonies. Further north in the Central Valley and Sierra Nevada foothills, breeding colonies are regularly distributed more broadly from Sacramento County north through the Sacramento Valley to Butte and Colusa counties. In southern California, breeding colonies are located mainly in the western portions of Riverside and San Bernardino Counties, south through the interior of San Diego County (Figure 2; Feenstra 2009). Colonies are patchily distributed throughout the rest of the species' range in California, particularly in the Coast Ranges and on the coastal slope.

The limited range of the species in Oregon, Washington, and Nevada is maintained by irregular occurrences of relatively small numbers of birds (Gilligan et al. 1994, Spencer 2003, Wahl et al. 2005, Ammon and Woods 2008). These neighboring states have historically supported less than 1% of the species' population (Beedy et al. 1991). Although previously more widespread, breeding in Baja California now occurs at only a few isolated locations (Erickson et al. 2007, Erickson and de la Cueva 2008, Feenstra 2013, Erickson et al. 2016). Currently, no more than about 1% of the species' population breeds outside of California.

Breeding colonies typically occur in valleys or low-lying areas with suitable nesting habitat and extensive grassland, agriculture, or other suitable foraging habitat. However, the elevation of colony locations varies greatly across the range. The majority of the population breeds below an elevation of about 300 feet in the Central Valley. In the central Sierra foothills, colonies occur up to 1,720 feet, although most occur near the valley floor at or below about 300 feet elevation (Airola et al. 2015a). In the southern California portion of the range, most colonies occur below about 1,500 feet, although colonies at more inland locations are at higher elevations. Further inland, such as in the Mojave Desert and to the northeast in the Modoc Plateau, colonies occur at elevations up to several thousand feet. Grinnell and

Miller (1944) included a record of 4,400 feet on the "South Fork of the Pit River" in Modoc County. The single breeding location in Nevada is at 4,730 feet elevation (Ammon and Woods 2008).

Winter Distribution

Although Tricolored Blackbirds can be found throughout much of the California breeding range year-round, most birds withdraw from the southern San Joaquin Valley and the northern Sacramento Valley in the winter (Grinnell and Miller 1944, Beedy et al. 2017). Band recoveries and observational studies have documented movement of birds away from these portions of the range toward the central part of the valley surrounding and including the Sacramento-San Joaquin Delta region (Neff 1942, DeHaven and Neff 1973, DeHaven et al. 1975b). There is a general concentration of birds in this region during the winter, as well as in the northern San Joaquin Valley in Merced County and coastal areas north and south of the San Francisco Bay area (Orians 1961a, Payne 1969, Stallcup 2004) (Figure 3). Evidence from banded birds recovered outside the Central Valley is limited, but birds from throughout the northern range are thought to follow the general pattern of winter movement to central and coastal California (DeHaven et al. 1975b, Beedy 2008). Although a relatively large portion of the population winters in this region, wintering flocks can be found at widely scattered points throughout the species' range north of the Transverse Ranges (DeHaven et al. 1975b).

South of the Transverse Ranges, birds from Santa Barbara County south to Baja California appear to occupy the region year-round (Unitt 2004, Beedy 2008), although distribution in the southern portion of the range is patchy in all seasons. Recoveries of birds banded in southern California have revealed much more localized movements compared to those from the Central Valley (Neff 1942, DeHaven and Neff 1973).

Genetics and Population Structure

Hamilton (2004) documented behavioral differences between Central Valley and southern populations of the Tricolored Blackbird, and suggested that a lack of gene flow may have led to genetically distinct populations. While banding studies indicate extensive movement of the Tricolored Blackbird population throughout the entire length of the Central Valley (DeHaven et al. 1975b), DeHaven and Neff (1973) reported on recoveries of banded birds from the Central Valley and southern California and suggested that little or no interchange occurs between populations north and south of the Transverse Ranges. The observation of a single banded bird in the Mojave Desert of northern Los Angeles County was the first data documenting movement of the species from the Central Valley to the desert (Feenstra 2009), although there is a report from the late 1800s documenting a flock of Tricolored Blackbirds moving in the opposite direction (Belding 1890). In 2014 and 2016, the second and third Tricolored Blackbirds that had been banded in the Central Valley were photographed in San Bernardino County, providing further confirmation of movement from the valley to the Mojave Desert (Meese 2014b, Aug 2017 email from R. Meese to N. Clipperton; unreferenced).

A single genetic study on the Tricolored Blackbird did not find evidence of significant population structuring between the Central Valley and a southern population composed of birds from the Mojave Desert and southern California. The birds sampled in the southern population were found to exhibit

higher allelic diversity, suggesting that the southern population may be an important reservoir of genetic variation for the species (Berg et al. 2010). In assessing population structure, it may be inappropriate to combine birds from the Mojave Desert with birds from south of the Transverse Ranges to represent a single southern population, especially if the Mojave Desert birds are linked to the Central Valley. In addition, samples were obtained at only two colonies south of the Transverse Ranges and at two colonies in the desert, sample sizes were small at some sites, and the study used a relatively small number of genetic markers. Researchers at UCLA are currently conducting a study using more advanced genomic techniques to characterize genetic variation, population structure, and spatial and temporal patterns of movement throughout the range of the Tricolored Blackbird (Feb 2017 email from K. Barr to N. Clipperton; unreferenced).

Movements

Most Tricolored Blackbird are resident in the state of California, with seasonal movements leading to shifts in distribution within the state over the course of a year. Grinnell and Miller (1944) wrote that the Tricolored Blackbird is "resident within State [California], but partly migratory within the Sacramento-San Joaquin drainage system; all populations are in some degree nomadic and in fall and winter normally leave the immediate vicinity of the nesting colonies." Banding studies (Neff 1942, DeHaven and Neff 1973, DeHaven et al. 1975b) and observations of unbanded birds (Payne 1969) demonstrated that most Tricolored Blackbirds reside throughout the Central Valley March through September, and then move into the Sacramento-San Joaquin Delta and northern San Joaquin Valley (primarily Merced County) and coastal locations during winter. More extensive migratory movements are made by small numbers of birds that breed north of the Central Valley as far north as the state of Washington (Wahl et al. 2005); these migratory individuals apparently mostly return to California in the winter. In southern California south of the Transverse Ranges, birds seem to undergo much more localized seasonal movements compared to those from the Central Valley (Neff 1942, DeHaven and Neff 1973).

Itinerant Breeding

Individual Tricolored Blackbirds often occupy and breed at two or more sites during the breeding season, a phenomenon known as itinerant breeding (Hamilton 1998). Itinerant breeding is a very rare trait among birds, and occurs exclusively in species that move between breeding attempts to locate or follow locally abundant food sources (Jaeger et al. 1986). Although early observers suspected that Tricolored Blackbirds nested more than once in a season at multiple locations (e.g., Neff 1937), the movements of Tricolored Blackbirds have been described as "sheerly and illogically erratic" (Neff 1942), "wanderings" (Payne 1969), and highly nomadic (Beedy et al. 1991). Recoveries of banded Tricolored Blackbirds provided documentation of interannual breeding at widely separated locations, but within-year movements during a single breeding season were not documented prior to the 1990s (Neff 1942, DeHaven and Neff 1973). The movements of Tricolored Blackbirds continue to be somewhat unpredictable from year to year, but Hamilton et al. (1995) demonstrated that most of the adults in the Central Valley breed more than once and often at different locations. This itinerant breeding follows a pattern of initial breeding in the south, mostly San Joaquin Valley and southern foothills to Sacramento County, with a shift north for a second breeding attempt, primarily in the Sacramento Valley and

Commented [MH1]: What is the extent of evidence here? Were the birds banded? Or were they guessing they were the same birds? Clarify the evidence.

adjacent foothills. The timing and degree to which this shift occurs vary from year to year (Hamilton 1998). The timing of breeding in Sacramento County was intermediate to that of the San Joaquin and Sacramento Valleys, with initiation of breeding in Sacramento County 10 days later than in the San Joaquin Valley, but over a month before most breeding in the northern Sacramento Valley (Figure 4). On the Central California Coast in Monterey County, 25% of radio-tagged birds moved between study colonies during a breeding season, suggesting itinerant breeding on a smaller scale (Wilson et al. 2016).

The following discussion of seasonal movements is largely from Beedy and Hamilton (1997) and Beedy et al. (2017).

Spring Movements from Wintering Areas

The species vacates wintering areas concentrated around the Sacramento-San Joaquin River Delta and along coastal California in mid-February. Birds arrive at breeding locations and establish colonies in Sacramento County and throughout the San Joaquin Valley from early March to early April (DeHaven et al. 1975b). Colonies at foothill locations adjacent to the San Joaquin and Sacramento valleys may be settled by late March, but many are not settled until May. In southern California and Baja California, the species may nest anytime throughout April and May.

Flocks of Tricolored Blackbirds roam widely within the breeding range in the weeks before breeding begins and between breeding attempts. Breeding season wanderings may serve to locate areas of abundant insect food resources near which breeding colonies are established (Payne 1969). Similar behaviors have been documented in nomadic flocking species of semiarid habitats in Asia, Africa, and Australia, where colonial breeding occurs opportunistically in areas of high prey abundance (Payne 1969).

Breeding Season Movements

During the breeding season, Central Valley birds often move north to the Sacramento Valley after first nesting efforts (March–April) in the San Joaquin Valley and Sacramento County, with small numbers moving further north to northeastern California and southern Oregon (Beedy and Hamilton 1997, Hamilton 1998). On the floor of the Sacramento Valley north of Sacramento County, the largest colonies are typically not settled until May or early June. Recent banding results suggest a degree of colony cohesion, where many birds at a colony may move and breed together again in a new location, but banding results also suggest a high degree of mixing between breeding attempts. Although later nesting is typical in northern portions of the range, small colonies may form throughout the breeding season anywhere in the geographic distribution (Hamilton 1998). Radio telemetry studies have shown that birds move from one breeding colony to another while both are active, due presumably to reproductive failures at the first colony, but the causes of these movements remain undocumented (Wilson et al. 2016).

Commented [MH2]: Identifying cause seems too strong an expectation. Perhaps "but data linking movements to breeding failure are lacking".

Post-breeding Movements

Most Central Valley birds occur in the Sacramento Valley at the end of the breeding season and remain until mid-September, apparently attracted to ripening and recently harvested rice (DeHaven et al. 1975b). In mid-September most move south into the Sacramento-San Joaquin Delta, Merced County, and coastal locations.

Winter Movements

In winter, numbers decline in the Sacramento Valley and increase in the Sacramento-San Joaquin Delta and northern San Joaquin Valley (Neff 1942, Orians 1961a, Payne 1969, DeHaven et al. 1975b). Large foraging flocks have traditionally occurred in pasturelands in southern Solano County by late October and may join large flocks of several blackbird species to roost on islands in the eastern part of Suisun Marsh. Wintering flocks formerly numbering more than 10,000 birds assembled near dairies on the Point Reyes Peninsula, Marin County, by mid-October, but these numbers have been reduced in recent years. Highly variable numbers of birds also winter in the central and southern San Joaquin Valley, with flocks of hundreds or thousands seen in most years in the general area where large colonies breed in the early spring (Kern and Tulare counties; eBird Dataset 2016). Winter flocks consist at times of only Tricolored Blackbirds, either mixed-sex or single-sex, and at other times Tricolored Blackbirds occur in mixed-species blackbird flocks. Birds from one large winter roost in Sacramento County foraged over an area 32 km in diameter (Neff 1937). Winter distribution and movements need further study.

Commented [MH3]: When? Reference?

Commented [MH4]: eBird dataset 2016?

Home Range and Territoriality

Unlike most species of songbirds that defend a territory in which they nest and acquire most of their necessary resources, the Tricolored Blackbird breeds in dense colonies in which adult males defend only a small area surrounding the nest site, and this only until nests are established and eggs are laid (Lack and Emlen 1939, Payne 1969). Nest density and male territory size can vary among colonies with individual nests in the densest colonies built within a foot or less of each other (Hosea 1986, Beedy et al. 1991). In some cases two nests may even share interwoven strands of nest material (Lack and Emlen 1939). Male territories have been measured from 1.8 m^2 to 3.25 m^2 (Lack and Emlen 1939, Orians 1961) and nest densities have been observed at up to six nests per square meter (Beedy et al. 2017). The greatest nesting density reported occurred in a rare nesting substrate, giant cane (*Arundo* sp.), with 2,500 adults nesting in an area 42 x 13 feet (equivalent to 4.5 birds per square foot) (DeHaven et al. 1975a).

The small territories in dense breeding colonies cannot supply sufficient food for the adults and for the growing young, therefore most foraging occurs away from the colony site. While breeding, most foraging occurs within 2–3 miles of colony sites (Orians 1961, Hamilton et al. 1992), although longer foraging flights have been documented (up to 8 miles or more). Typically, only a portion of the landscape surround a breeding colony is suitable for foraging and the range used by individual birds in colonies is variable depending on the extent and quality of the foraging landscape.

Colonial Breeding and Social Behavior

> "To one in search of something utterly different I can heartily recommend an hour, or a day, in a Tricolor swamp… *Agelaius tricolor* is intensely gregarious, more so than perhaps any other American bird. Every major act of its life is performed in close association with its fellows… the very day of its nesting is agreed upon in concert. In continuous procession the individuals of a colony repair to a field agreed upon in quest of building material; and when the babies are clamoring the loudest for food, the deploying foragers join their nearest fellows and return to the swamps by platoons and volleys, rather than as individuals." – Dawson (1923).

Coloniality in birds is typically defined as the breeding by a number of individuals at a more or less centralized place from which colony residents regularly depart from to search for food. This breeding strategy is most common among seabirds, in which more than 95% of species nest colonially (Danchin and Wagner 1997), and is relatively uncommon among North American landbirds.

The Tricolored Blackbird forms by far the largest breeding colony aggregations of any living North American landbird (Neff 1937, Lack and Emlen 1939, Orians 1961, Skutch 1996). Bent (1958) found that the Tricolored Blackbird "nests in enormous, most densely populated colonies, the nests being placed more closely together than in any other colonies of marsh-nesting blackbirds." Grinnell and Miller (1944) stated, "one essential would seem to be provision at the site of the colony for a large number of individuals. Nests apparently must be close together and pairs usually [must be] in excess of 50 in order to meet the instinctive requirements of the species." Breeding colonies are seldom smaller than 100 nests, and in the past have been as large as 100,000 to 200,000 nests (Neff 1937, Orians 1961). Each male breeds, on average, with two females resulting in a skewed sex ratio at many breeding colonies (Lack and Emlen 1939, Orians 1961, Payne 1969, Hamilton 1998, Beedy and Hamilton 1999). Although Payne (1969) observed breeding colonies consisting of as little as four nests, of the 21 colonies monitored, no colonies containing less than 100 nests were successful in fledging young.

Commented [MH5]: Passenger pigeons had larger colonies?

While the great concentration of birds in a small area is the most conspicuous feature of Tricolored Blackbird colonies, the degree of synchrony among members of the colony is no less unique (Orians 1960). Breeding within a colony is often highly synchronized, with all females in a colony typically initiating nest building within a few days (Orians 1961, Payne 1969). A flock of Tricolored Blackbirds can appear in an area in which it has been absent for months and begin nesting within days (Orians 1961). Food resources for both the breeding adults and for the provisioning of young are mostly obtained from sites away from the colony location. Insect-rich foraging areas appear to be identified and utilized by all or large portions of the breeding adults in a colony until the prey base is exhausted, at which time new areas are identified and breeding birds collectively shift to new foraging sites.

Occupancy dynamics—Tricolored Blackbird breeding colonies frequently shift locations from year to year, though sites used each year often occur in the same traditionally used areas. In some cases Tricolored Blackbirds exhibit high inter-annual site fidelity, perhaps driven by the continued availability of essential resources, including suitable nesting substrate, water, and foraging habitat (Beedy and

Hamilton 1997). Of 72 occupied colony locations between 1992 and 1994, only 19 (26%) were active in all three years and an additional 11 (15%) were active in at least two years (Hamilton et al. 1995). In the central Sierra Nevada foothills, 58% (11 of 19) of occupied breeding colony sites in 2015 were also occupied in 2014 (Airola et al. 2015b). Of 44 sites surveyed during a three year period in the central foothills, only eight (18%) were active in all three years and seven (16%) were active in two of three years (Airola et al. 2016). Of four colony locations monitored for three consecutive years in coastal Monterey County, all four were occupied in one year and only two were occupied in the other years (Wilson et al. 2016). Annual occupancy rates vary across nesting substrate types, with wetland, thistle, and Himalayan blackberry locations having similar rates of about 40% (Holyoak et al. 2014). Occupancy rates are lower for triticale and other grain sites and higher for nettle colony sites. Although any given site may be unoccupied in some years, birds often return to sites over longer time periods and some sites are used in almost every year. Hosea (1986) reported on a colony that had been occupied for more than 30 years in Sacramento County, and was able to locate several active colonies by visiting locations reported in the literature decades earlier. The result of these complex occupancy dynamics is an extremely variable rate of site fidelity over the short-term, but fidelity to breeding locations and general breeding areas are high over the longer term.

Commented [MH6]: One point here is that the role of year to year variation in weather conditions is unknown. The data from Holyoak et al. 2014 were longer term, so may be more representative.

Beedy et al. (1991) compiled all available information on breeding colony locations and identified 696 historical breeding colony locations. As of the 2016 breeding season, the number of known historical and current breeding colony locations had grown to 1,272, including all records since 1907 (Figure 2a). The large majority of these historical locations are not used in any given year, and many no longer meet the habitat requirements of the species and so are no longer considered suitable. During recent thorough statewide surveys conducted between 2008 and 2014 the number of occupied breeding locations has averaged about 140 (Kelsey 2008, Kyle and Kelsey 2011, Meese 2014). New locations are discovered each year, while other sites cease to be used. This turnover of breeding locations likely reflects shifting habitat conditions across the range and results in complex occupancy dynamics described above. Most sites, once established, are used repeatedly over the course of many years.

Fluctuations in colony site selection and colony size have been attributed to a response of Tricolored Blackbirds to changes in local insect abundance within and across years (Orians 1961, Payne 1969, DeHaven et al. 1975a). Their colonial breeding behavior requires that the foraging landscape surrounding the nest site provide abundant insect food sources. The colonial nesting, compressed breeding cycle, and social structure of Tricolored Blackbirds are well suited for rapid exploitation of unpredictable resources when they become temporarily very abundant. Initiation of nesting may also be triggered by an abundant food source (Payne 1969).

In some cases, large breeding colonies have been observed to exhibit higher reproductive success than smaller colonies (Orians 1961, Payne 1969, Hamilton et al. 1992), and in some years a few large colonies have been responsible for the majority of the reproductive output for the year (Hamilton 1993). However, there are many examples when a positive correlation between colony size and reproductive success was not observed, and a wide variation in reproductive success has been observed in both small and large colonies (Payne 1969, Meese 2013).

Commented [MH7]: This seems like a part of what might be expected. Some variation being density independent, and likely dependent on environment conditions. Positive correlations would likely occur during times when populations are growing, and negative correlations when they are declining.

Adaptive advantages of colonial breeding may be conferred by decreasing risk of predation or increasing foraging efficiency (Ward and Zahavi 1973, Beauchamp 1999), both of which could lead to increased success in production of young. The following mechanisms have been proposed as advantages to colonial breeding:

1. Predator avoidance
2. Joint anti-predator responses
3. Predator satiation
4. Social food-finding
5. Information sharing

Predator avoidance—Colonial breeding birds frequently select sites that are inaccessible to predators (Ward and Zahavi 1973), or in some cases that are naturally free of predators (e.g., seabirds nesting on isolated islands). Tricolored Blackbirds typically select breeding locations that provide a degree of protection from predators, either by selecting inaccessible sites (e.g., wetlands surrounded by or inundated by relatively deep water) or protective nesting substrates (e.g., dense, thorny, or spinous vegetation) that limit access to predators. Wetland sites may primarily limit access to terrestrial predators, whereas some dense or armored substrates may also limit access by predatory birds. In the case of a nomadic species like the Tricolored Blackbird, which does not necessarily use the same breeding location each year due to annual shifts in substrate suitability, social behavior may enhance the ability to locate these suitable locations.

Commented [MH8]: This all seems rather speculative. Social behavior may also attract predators. Also this seems like a feature of colonial nesting rather than nomadic species per se.

Anti-predator responses—Social mobbing of predators or other aggressive behaviors is a common trait among colonial nesting birds. However, Tricolored Blackbirds do not exhibit strong defensive responses to the presence of a predator. Unlike Red-winged Blackbirds that will fiercely defend territories from potential predators that approach the nest, Tricolored Blackbirds provide little in the way of defense to eggs or nestlings (Skutch 1996). For example, when a hawk is sighted the adults in a colony may stop vocalizing and settle low within the nesting substrate, with the entire colony sometimes going silent (Orians and Christman 1968, Payne 1969). Adults may hover in the vicinity of a predator as nestlings are taken, but no pursuit of the predator is offered. Complete reproductive failure in colonies of thousands of birds can result from the efforts of relatively few predators (Beedy and Hamilton 1999). Tricolored Blackbirds do not benefit from social anti-predator responses.

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Predator satiation—The massive quantity of readily available prey in the form of eggs or nestlings at a Tricolored Blackbird breeding colony may reduce the chance of loss of any one nest by satiating territorial predators (e.g., raptors). Payne (1969) observed a single pair of Northern Harriers preying on a Tricolored Blackbird colony of 10,000 nests, with no impact on the large majority of the colony. Satiation of predators may be less likely in species that hunt in groups, such as many species of wading birds. In recent decades, Cattle Egrets and White-faced Ibis have caused complete failure of large breeding colonies (Meese 2012, 2016). Predator satiation may provide a benefit to breeding Tricolored Blackbirds, depending on the number and type of predators.

Food-finding and information sharing—Roosting and colonial birds may take advantage of social behavior to more efficiently locate patches of concentrated food resources, and colony sites may serve as information centers where locations of good feeding sites can be shared among individuals (Ward and Zahavi 1973, Emlen and DeLong 1975, Brown 1988). Under this scenario, larger colonies may be more successful because there is a larger pool of information on the whereabouts of good feeding places within the foraging area being exploited by the colony (Ward and Zahavi 1973). This increased foraging efficiency, along with the highly synchronized nesting and the compressed length of a nesting cycle in Tricolored Blackbirds, may increase the chance ~~ensure~~ that temporarily abundant prey will remain available to the young in a colony for the duration of the breeding cycle. Coloniality may result from situations when suitable breeding sites are limited among areas of high food availability (Danchin and Wagner 1997).

Because of occasional destruction of entire Tricolored Blackbird breeding colonies by predators and observations of prey-following by adults, Orians (1961) and Payne (1969) suggested that colonial nesting by Tricolored Blackbirds is more likely related to location and exploitation of a locally abundant food supply than to a strategy of predator avoidance or response. However, the choice of flooded or dense and armored vegetation for breeding suggests that suitable nesting locations provide some protection from predators, and predator satiation may be a successful strategy for confronting territorial predators.

Habitat that May be Essential for the Species' Continued Existence in California

For breeding, Tricolored Blackbirds require three critical resources: 1) secure nesting substrate, 2) a source of water, and 3) suitable foraging habitat.

Nesting Substrate

The nesting substrate for Tricolored Blackbird breeding colonies is defined as the vegetation in which nests are constructed. In most cases the nesting substrate is either flooded by water, as in wetland colony sites, or is composed of thorny or spiny vegetation that is impenetrable to many predators (Beedy and Hamilton 1997). In some cases, Tricolored Blackbird colonies occur in upland nesting substrates that lack these protective characteristics (e.g., silage grain, weedy mustard fields); in these cases the nesting substrate is usually extremely dense and therefore may provide similar protection.

The majority of Tricolored Blackbird breeding colonies have occurred in one of five nesting substrate types: 1) wetland~~s~~ (either cattail [*Typha* sp.] or bulrush [*Schoenoplectus* sp.] vegetation), 2) Himalayan blackberry (*Rubus armeniacus*), 3) thistle, usually milk thistle (*Silybum marianum*) or bull thistle (*Cirsium vulgare*), 4) stinging nettle (*Urtica* sp.), or 5) agricultural grain fields, especially triticale, a wheat-rye hybrid grain grown as silage for dairy cattle. Several additional nesting substrates have been used to a lesser degree (less than 5% of colonies in total), with the more common being mustard (*Brassica* sp.), willows (*Salix* sp.), mallow (*Malva* sp.), wild rose (*Rosa* sp.), tamarisk (*Tamarix* sp.), and giant reed (*Arundo* sp.) (Beedy et al. 1991, Beedy and Hamilton 1997, Beedy et al. 2017, Tricolored Blackbird Portal 2017).

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Commented [MH11]: It seems worth pointing out that the different explanations are also not necessarily mutually exclusive.

Commented [MH12]: Foraging habitats with sufficient food? Suitable here presumably relates to food availability so its probably worth making its meaning clearer.

Commented [MH13]: Something else perhaps worth noting is that most of the habitat types used as substrates are abundant, and only a fraction of available substrates is used each year: therefore they don't seem to be next substrate limited.

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The primary nesting substrates used by Tricolored Blackbirds have different distributions across the breeding range in California (Figure 5). Wetland sites with cattail or bulrush substrate are fairly evenly distributed across the range. Himalayan blackberry sites are mostly restricted to Merced County and north through the Sierra foothills to the Sacramento Valley. Triticale and other agricultural grain sites are found mainly in the southern San Joaquin Valley and Merced County, with a few additional sites in southern California. In recent years stinging nettle sites have mainly occurred in the southern San Joaquin Valley portion of Kern County including the surrounding foothill grasslands, although historically they were also common at the extreme northern portion of the California range in Siskiyou and Shasta counties. Thistle sites have been located throughout much of the range in California, and has been the primary nesting substrate used in the southern Sierra Nevada foothills (Airola et al. 2016). Thistle sites are typically only available to breeding Tricolored Blackbirds in years with weather patterns that support abundant thistle growth.

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Historically, most breeding colonies were in freshwater marshes dominated by cattails and tules (Beedy 2008). In the 1930s, 93% of breeding colonies were in freshwater marsh vegetation with the remaining colonies in willows, blackberries, thistles, and nettles (Neff 1937). The proportion of colonies in freshwater marshes had decreased to about 70% by the 1970s as Tricolored Blackbirds began using novel, nonnative vegetation types, especially Himalayan blackberry and thistles (DeHaven et al. 1975a). By 2008, the proportion of colonies established in freshwater marsh during the statewide survey had declined to 35% (Kelsey et al. 2008).

Commented [MH16]: There is a statistical analysis of such patterns and more extensive data in Graves et al. 2012 figure 3. The comment also applies to the next paragraph. It makes sense to cite the formal statistical analysis.

Tricolored Blackbirds are known to have bred in blackberry bushes from the early 1900s (Booth 1926, Neff 1934, 1937), but this was a very infrequent occurrence. Sacramento County has a long history of breeding by Tricolored Blackbirds, with colonies in the 1930s found entirely in wetland substrates and colonies in the 1970s still mainly located in wetlands (Neff 1937, DeHaven et al. 1975a). In the 1980s and 1990s, an increasing percentage of breeding colonies were reported in nonnative Himalayan blackberry (Hosea 1986, Beedy and Hamilton 1997). Over 55,000 breeding Tricolored Blackbirds were located in Sacramento County in 1993, with the large majority of these in Himalayan blackberry and a small number in wetland substrates (Hamilton 1993). Himalayan blackberry is currently the dominant nesting substrate throughout the northern and central Sierra Nevada foothills. From 2014 to 2016, 65–80% of foothill colonies have occurred in Himalayan blackberry annually (Airola et al. 2016). Between 1994 and 2004, a large shift from cattail marsh colonies to Himalayan blackberry colonies occurred in the rice-growing region of Sacramento Valley (Hamilton 2004a). This was in part due to the loss or destruction of specific cattail marsh sites, but was also likely due in part to an increase in distribution of Himalayan blackberry.

Tricolored Blackbirds were discovered breeding in grain fields in the San Joaquin Valley in 1991 and 1992 (Hamilton et al. 1992). Prior to this, nesting in large cultivated grain fields was unknown and little work on the status of the species in the southern San Joaquin Valley had been conducted (Beedy et al. 1991, Hamilton et al. 1992). The only previous report of nesting in a cultivated grain field was from 1944, when a colony was observed in mustard-infested barley (Bent 1958). The discovery of breeding on grain fields in the 1990s corresponded to an increase in planting of triticale. This wheat-rye hybrid grain may be attractive to breeding Tricolored Blackbirds due to its robust structure that is well suited to support

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nests and it dense growth that is relatively impenetrable to terrestrial predators. Relatively little triticale had been planted for silage in the San Joaquin Valley by 1994, but by 2005 the planted acreage had grown to about 75,000 acres (Aksland and Wright 2005). Of the nesting substrates used by Tricolored Blackbirds, triticale and other grain fields are unique in that they are available in abundance each year in the San Joaquin Valley, and in recent years, many of the largest colonies have occurred on grain fields. Fifty percent of the breeding Tricolored Blackbirds detected in California during the 2008 statewide survey were observed nesting in triticale fields (Kelsey 2008).

During the April 2011 statewide survey, the majority of colonies (54%) in the San Joaquin Valley and Tulare Basin were located on agricultural grain crops, with an additional 22% in milk thistle. Conversely, 70% of colonies in the Sacramento Valley and Sierra Nevada foothills were in Himalayan blackberry. The majority of colonies in southern California, on the central coast, and in extreme northern California continued to occur in wetland habitats. Statewide, wetlands continued to support more colonies than any other substrate type (37%), although these wetland colonies supported only 5% of the population (Kyle and Kelsey 2011).

The areal extent of nesting substrate used by breeding Tricolored Blackbird colonies has ranged from a few square meters to more than 200 acres (Tricolored Blackbird Portal 2017). The smallest colonies have occurred in a variety of nesting substrate types, including cattail or bulrush marsh, Himalayan blackberry, and willows. The largest colonies of 100 acres or more have been located in triticale in recent years, although historically very large colonies occurred in wetland habitats (Neff 1937). The large majority of colonies occupy less than 10 acres of nesting substrate, with many being smaller than one acre. DeHaven et al. (1975a) found that the area occupied by nests in all substrates types averaged less than two acres per colony, and the largest colonies observed from 1968 to 1972 occupied only 10 acres.

Nest densities vary widely across nesting substrates. DeHaven et al. (1975a) observed densities up to 66,670 nests per acres (100,000 breeding adults per acre) in Himalayan blackberry colonies, with the average density in blackberry colonies closer to 16,000 nests per acre. Densities in other common nesting substrates (cattails, bulrush, thistle, and willows) had densities of up to 13,340–20,000 nests per acres (20,000–30,000 breeding adults per acre), with average densities ranging from 3,300 to 4,800 nests per acre (DeHaven et al. 1975a).

Water

Breeding Tricolored Blackbirds require an open, accessible water source in the vicinity of the breeding location. Adults use the water for drinking and bathing, and will sometimes submerge insect prey items before provisioning young. The requirement for open water can be met by any of a number of sources, including wetlands, streams, ponds, reservoirs, and agricultural canals or ditches. Water must be available within a few hundred meters of the nesting substrate (Hamilton 1995). The loss of local water sources during the nesting cycle has caused entire colonies of birds to abandon their nests (Beedy et al. 1991).

Foraging Habitat

The Tricolored Blackbird breeds in dense colonies with the individual territories that are defended by each male consisting of a very small area. These dense congregations of large numbers of birds likely exert large pressures on the foraging landscape surrounding the nesting location. Unlike most other landbirds, Tricolored Blackbirds forage almost exclusively away from the nesting territory, and colonies require suitable foraging habitat with abundant insect prey within a few miles of the colony site. Because provisioning success and the resulting rate of nestling starvation have been shown to influence reproductive success, the availability of high quality foraging habitat is as important to Tricolored Blackbird breeding as is the availability of suitable nesting substrate (Hamilton et al. 1992). The proximity to highly abundant insect food supplies may be a factor in the selection of breeding sites by Tricolored Blackbirds (Neff 1937, Orians 1961, Payne 1969), and their nomadic and colonial behavior may have evolved as a strategy for maximizing the ability to locate and exploit unpredictable and temporarily abundant insect food sources. The required foraging habitat for successful breeding has a much greater spatial extent than nesting substrate. Although data are not available to define the minimum extent of foraging habitat, it has been reported that colonies with less than 200–300 acres of foraging habitat do not persist and access to several thousand acres is necessary to maintain most large colonies (Hamilton 2004b).

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Commented [MH19]: Do we know this?

Commented [MH20]: I'd suggest foraging habitat is actually more important for reproductive success than nesting substrate; which fits with the comment above about not being substrate limited. What is left out of the sentence highlighted here is that nesting substrate may also affect rates of predation, so rather than availability of substrate it may also be choice of substrate.

Primary foraging habitats during the breeding season include grasslands, shrublands, pastures, dry seasonal pools, and certain agricultural crops including alfalfa and rice, which provide for high production of insect prey for breeding Tricolored Blackbirds. Grasslands and alfalfa have been shown to be important in predicting presence of breeding Tricolored Blackbird colonies, with probability of colony occurrence increasing with increasing proportion of these land cover types within 3 miles (NAS 2017). Adults will also sometimes exhibit aerial foraging above wetland colonies when aquatic insects are hatching (Beedy et al. 2017). Adult birds also frequently feed at cattle feedlots and dairies where they have access to abundant grain sources. Among grassland foraging habitats, Hamilton et al. (1995) reported that ungrazed grasslands were preferred over heavily grazed grasslands by foraging Tricolored Blackbirds, but this conclusion has not been reported in later studies of grassland foraging birds (Meese 2013, Airola et al. 2015a, 2016). Tricolored Blackbirds breeding in agricultural landscapes make little use of most row crops, vineyards, or orchards (Hamilton et al. 1992). During the 2000 statewide survey, Hamilton (2000) found that over 90% of observed Tricolored Blackbird foraging activity occurred on private property.

In Sacramento County, Hamilton et al. (1992) reported that 96% of all foraging by breeding Tricolored Blackbirds occurred in grasslands. This reliance on grasslands by Sacramento County and foothill breeding birds has persisted. In 2014, 90% of birds breeding in the central Sierra Nevada foothills, including Sacramento County, foraged in grasslands and pasture (Airola et al. 2015a).

Commented [MH21]: This would benefit from a bit more explanation rather than such a general statement.

Mailliard (1900) described the distinctive flight of Tricolored Blackbirds in the process of feeding nestlings as a "stream composed of birds going toward the tules with their bills full of bugs and of equal numbers returning to the fields for fresh supplies." Both prey abundance and proximity to the colony site likely influence the reproductive success of a colony. In at least some cases, adults foraging near the colony site bring few prey items to their young, while adults foraging more distant return with many more prey items (Orians 1980, *cited in* Skutch 1996). This may be a mechanism to conserve energy by making fewer long-distance flights and shows the value of foraging habitats in close proximity to colony sites; however, the possibility that proximate food sources had been exhausted during observations cannot be ruled out. When abundant insect prey are available adjacent to colony locations, adults will make only very short foraging flights to acquire prey. Most foraging occurs within about 3 miles of the colony location, although Hamilton et al. (1992) reported maximum foraging flight distances by breeding birds of up to 8 miles. In the Central Valley from 2006 to 2011, Meese (2013) observed adult Tricolored Blackbirds foraging up to 5.6 miles from the colony location.

Several authors have suggested that regional insect abundance plays a role in breeding colony site selection, and that a super-abundant insect population may stimulate nesting behavior (Lack 1954, Orians 1961b, Orians and Collier 1963, Collier 1968, Payne 1969). This could explain the variation in general distribution of colonies between years (DeHaven et al. 1975b). The highly synchronized and colonial breeding system may have adapted to exploit an unpredictable environment where locations of nesting substrate and abundant insect food resources changed unpredictably from year to year (Orians and Collier 1963). Although Meese (2013) demonstrated that colony reproductive success depends on local availability of insect prey (usually within 3-5 miles of the nesting location), the role that insect abundance in foraging habitats has on colony site selection has not been investigated.

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Diet and Food Habits

For most of the year, the majority of food items taken by Tricolored Blackbirds consist of plant material, especially seeds. However, during the breeding season, adult females require large amounts of high-protein insect prey for egg production and nestlings require a protein-rich diet for growth and development (Crase and DeHaven 1977). Nestlings are fed almost exclusively animal matter for the first nine days after hatching, at which point parents begin to introduce plant matter into the diet (Hamilton et al. 1995). Colonies consisting of many thousands of adult birds and growing nestlings require an immense amount of insect prey during short windows of time. The availability of insect prey in the foraging landscape likely influences the establishment of breeding colonies, and an abundant prey base is essential for successful breeding.

Nestlings have been provisioned with a wide variety of prey items, including grasshoppers and crickets (order Orthoptera), beetles, weevils, and water beetle larvae (order Coleoptera), moths and butterflies (including caterpillars; order Lepidoptera), and to a lesser degree spiders, flies, tadpoles, snails, and emergent dragonflies, damselflies, and midges (Payne 1969, Crase and DeHaven 1977, Skorupa et al. 1980). At three breeding colonies in Merced County where adults often foraged for prey in alfalfa and grain fields, animal matter made up 91% of food volume for nestlings and fledglings, with moth larvae, beetles, and weevils the primary food items (Skorupa et al. 1980). In foothill grasslands, grasshoppers have often been the primary prey item fed to nestlings (Payne 1969, Airola et al. 2015a). In a diet study that included colonies from several regions of the Central Valley located among a variety of foraging substrates, animal matter made up more than 86% of the total volume of nestling food (Crase and DeHaven 1977). Ground beetles were the predominant food item when averaging across all colonies, followed by water beetle larvae, grasshoppers and crickets, and weevils. Colonies differed significantly in the primary food items provided to nestlings, with differences in foraging substrate responsible in some cases. For example, colonies with water beetle larvae as the predominant food source were located in rice-growing areas, and the greatest percent of grasshoppers were fed to nestlings at colonies bordered by grassland (Crase and DeHaven 1977).

Early observers noted that nestling and fledgling Tricolored Blackbirds were frequently fed grasshoppers, leading to descriptions of the species as a grasshopper-follower (Belding 1890, Bendire 1895, Mailliard 1914, Orians 1961). Payne (1969) observed breeding adult Tricolored Blackbirds at colonies in the Sacramento Valley foraging primarily in grasslands and providing nestlings with a diet composed of 47% grasshoppers; crickets, beetles, and spiders were also acquired in grasslands and fed to young in smaller amounts. Payne (1969) suggested that the movements of Tricolored Blackbirds during the breeding season paralleled the nomadic movements of rangeland grasshoppers in California and compared the Tricolored Blackbird with “locust bird” species of Asia and Africa. Grasshoppers continue to provide a valuable food source to Tricolored Blackbird colonies, especially when adjacent to grasslands and pastures (Airola 2015a), but Tricolored Blackbirds have been shown to be more flexible in breeding season diet, as long as an abundant insect source is available.

In the spring and summer, the proportion of animal material consumed by adult Tricolored Blackbirds in the rice-growing region of the Sacramento Valley was 28% and 39%, respectively, with primary prey items including ground beetles, water beetle larvae, and orthopterans (Crase and DeHaven 1978). At four breeding colonies in agricultural areas of Merced County, animal matter made up 56% of food volume for adult females and 28% for adult males (Skorupa et al. 1980). The most consumed animal foods were beetles and weevils, moth larvae, and flies; the predominant plant foods consisted of oats (*Avena* sp.) and filaree (*Erodium* sp.), and to a lesser degree chickweed (*Stellaria* sp.) and pigweed (*Amaranthus* sp.). In the nonbreeding season, Tricolored Blackbirds are more strictly granivorous, although a variety of plant and animal matter is taken opportunistically. One study in the rice-growing region of the Sacramento Valley revealed that about 90% of the fall and winter diet consisted of plant material, primarily seeds of rice, other grains, and weed seeds (Crase and DeHaven 1978).

Reproduction and Survival

Breeding typically extends from mid-March through early August (Beedy et al. 2017). Autumnal breeding has been observed in the Central Valley (September–November; Orians 1960, Payne 1969) and in Marin County (July–September; Stallcup 2004), although not since 1964 and 2003 in the Central Valley and Marin County, respectively. From initiation of nest building to independence of fledged young, the nesting cycle of the Tricolored Blackbird is about 10 days shorter than that of the Red-winged Blackbird, mostly due to rapid progression through the nest building and egg laying stages (Payne 1969). The condensed length of the nesting cycle may be a function of the synchronized colonial nesting and an adaptation to take advantage of unpredictable periods of abundant and temporary insect food sources (Payne 1969, Skutch 1996).

Nest building and incubation are performed exclusively by the female, but the male takes an active role in feeding the young (Lack and Emlen 1939, Orians 1960). Although female Tricolored Blackbirds breed in their first year, most males may defer breeding until they are at least two years old (Payne 1969). This contributes to a skewed sex ratio at many breeding colonies, with each male breeding on average with two females (Lack and Emlen 1939, Orians 1961, Payne 1969). Although colonies with even sex ratios or with more skewed sex ratios (each male breeding with more than two females) have been observed (Hamilton et al. 1995), for monitoring purposes it is often assumed that each nest in a colony represents 1.5 breeding birds.

Successful breeding (i.e., production of any fledglings) was found to be positively correlated with colony size by Payne (1969); all colonies (n=7) that produced no fledglings contained 200 or fewer nests, while only one of seven successful colonies was smaller than 400 nests. Hamilton (1993) observed that the largest colonies in a single year of observation produced the highest estimates of reproductive success. Meese (2013) demonstrated a weak positive correlation between reproductive success and colony size over a six-year period ($r = 0.53$, $r^2 = 0.28$).

Reproductive success, defined here as the number of young fledged per nest, has been the generally accepted method for estimating productivity of Tricolored Blackbird colonies (Hamilton et al. 1995, Meese 2013, Holyoak et al. 2014, Airola et al. 2015a). Reproductive success has been estimated in one of two ways: visual estimation of the number of fledglings or nest sampling via walking transects through active colonies. When estimating reproductive success by visual counts of fledglings, colonies are visited at several-day intervals (often four days but in practice this has been variable), and fledglings observed at each visit are assumed to represent unique birds. The total number of fledglings observed on all site visits and the estimated number of nests based on the number of breeding birds are used to estimate the number of fledglings produced per nest. When estimating reproductive success by nest transects, it has been common practice to count the number of young per nest during the portion of the nest cycle when nestlings are 7–9 days old (Hamilton et al. 1995, Meese 2013). Entering colonies when nestlings are less than seven days old inflates the reproductive success estimate by underestimating nestling mortality and entering colonies when greater than 9 days of age causes the nestlings to jump from the nests prematurely. As a result, reproductive success estimates obtained by the transect method represent the maximum number of young fledged per nest. Therefore, the two methods of estimating reproductive success measure two somewhat different indices of productivity.

In 1992, reproductive success was relatively high at three colonies on wetlands and agricultural crops in the San Joaquin Valley (average RS = 2.7) and at Himalayan blackberry colonies in Sacramento County (average RS = 2.2) (Hamilton et al. 1992). Average reproductive success on wetlands in the Sacramento Valley was lower that year at 0.6 young per nest. Similar values of reproductive success were observed in 1994 (Hamilton et al. 1995). In 2000, reproductive success improved in the Sacramento Valley with three large colonies that did not experience heavy predation averaging 1.4 young per nest (Hamilton 2000), although the average reproductive success across all locations and substrate types was lower at 0.9 in 2000.

Many Tricolored Blackbird colonies in the Central Valley exhibited relatively low reproductive success from 2006 to 2011. Meese (2013) estimated reproductive success at 47 colonies, representing most of the largest colonies each year, during this six-year period ranging in size from 800 to 138,000 breeding birds. About half of the monitored colonies were in wetlands (n = 23), with the rest in thistle (n = 11), triticale (n = 9), and Himalayan blackberry (n = 4). The average reproductive success across all sites and years was 0.62. Reproductive success did not vary significantly across substrate type, although colonies that were destroyed by harvest of the grain nesting substrate were not included in the study results. Low productivity during this time resulted in very few young Tricolored Blackbirds being produced in the southern San Joaquin Valley where a large portion of the population's first annual breeding attempts occur (Figure 6). Incidental observations in 2012 and 2013 suggested that the trend of low reproductive success continued. Meese (2013) linked reproductive success at Central Valley colonies to relative abundance of insect prey at foraging sites, suggesting that many Tricolored Blackbird colonies may have been food-limited. High levels of predation plus destruction of colonies to harvest during this time also contributed to the low overall production of fledglings (Meese 2011, 2012).

Although limited research has been conducted to estimate reproductive success at colonies since 2011, observations of large numbers of fledglings at multiple colonies suggest that the species has had at least some success in recent years. In 2015, the estimated reproductive success at five colonies on agricultural grain fields averaged 0.6–1.9 fledglings produced per nest (Aug 2015 presentation from NRCS to Tricolored Blackbird Working Group; unreferenced). In 2016, eight of nine known colonies on agricultural grain fields fledged at least some young, although efforts to estimate reproductive success were limited. Only one colony in silage was both accessible and uniform in nest density to allow for nest transects and resulted in an estimated reproductive success of 0.44 (Frazer 2016). At four colonies in Himalayan blackberry, cattail, and milk thistle that ranged in size from 5,000 to 12,000 birds, reproductive success estimates ranged from 0.4 to 0.67 (Meese 2016). In 2017, all known silage colonies at seven locations fledged at least some young. Some of these experienced very low reproductive success, but at least two had high success and produced several thousand fledglings. Several additional colonies in other nesting substrates were reported to have high (although unquantified) reproductive success in 2017, with four wetland colonies in the San Joaquin and Sacramento valleys producing at least several thousand young (Colibri 2017, Meese 2017). As in other years, many other colonies were observed to have low success. These limited quantitative estimates and additional qualitative assessments are difficult to compare directly to previous work due to the high variability in reproductive success across colonies and the inconsistent methods used to evaluate reproductive success.

Parents reduce the size of broods at many colonies after the hatching of eggs (Hamilton et al. 1995). Often the majority of eggs in a clutch (usually three or four) will hatch but each nest typically fledges a reduced number of young, either due to parents not feeding all nestlings which leads to starvation, or by the active removal of nestlings from the nest by parents (Payne 1969, Hamilton et al. 1995). This is likely because of a shortage of food supplies. When abundant food is available each nest produces more fledglings (Meese 2013), and as many as four young are raised per nest at productive colonies (Hamilton et al. 1995).

In many years, overall reproductive success at many or most colonies has been relatively low, but estimates have also been highly variable across colonies. Of 21 colonies observed by Payne (1969) from nest building through termination of the breeding effort, including both successful and unsuccessful colonies, only about 40% of nests produced fledglings. High rates of reproductive success at a few large colonies can produce large numbers of fledglings. For example, three colonies representing 50,000 nests accounted for the production of an estimated 100,000 fledglings in 1993, while many smaller colonies produced no or few fledglings in the same year (Hamilton 1993). Meese (2013) observed high variability in reproductive success in both triticale and milk thistle colonies from 2006 to 2011 (range 0.01–1.44). The relatively high reproductive success at a small number of colonies was demonstrated to be a function of a high insect abundance in nearby foraging areas (Meese 2013). Low reproductive success has been implicated in Tricolored Blackbird population declines over the last two decades (Cook and Toft 2005, Meese 2013). Occasional high rates of reproductive success at a few large colonies may be a successful strategy for long-term population viability, but the degree to which infrequent bouts of high success can compensate for the low reproductive success that may be persistent and widespread across most colonies is unknown.

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Reproductive output has been observed to vary across substrate types (Hamilton et al. 1992, Hamilton 2000, Holyoak et al. 2014). Holyoak et al. (2014) modeled occupancy rates in the most common nesting habitat types in recent years (2006–2011) and considered data on abundance, reproductive success, and frequency of use for each nesting habitat type to determine the net reproductive output of different nesting habitats over time. Occupancy rates and other factors that influence reproductive output varied across habitat types, resulting in variation in the importance of habitats to Tricolored Blackbird productivity. Four nesting habitat types had sufficient sample size to make strong conclusions about average reproductive output, including Himalayan blackberry, nettles, wetlands, and grain fields. Himalayan blackberry and nettle colonies exhibited higher than average reproductive output. High overall reproductive output for nettle colonies is a little unexpected given that there are very few colonies, which are of average size, in this nesting substrate. However, high rates of occupancy and reproductive success result in high overall reproductive output for nettle colonies. Himalayan blackberry colonies exhibit average occupancy rates and size, but high reproductive success and the large number of colonies in this nesting substrate (the second most frequent colony type after wetlands) lead to high overall reproductive output. Grain field colonies exhibit average overall reproductive output, despite having low occupancy rates, low reproductive success, and a small number of colonies on grain fields each year; the very large size of grain field colonies increases the overall reproductive output. Of the four nesting habitat types assessed, wetlands remain the most common nesting habitat used by breeding Tricolored Blackbird colonies in recent years. Despite this, average levels of occupancy, reproductive success, and size of marsh colonies have led to the lowest overall contribution to reproductive output among the four nesting habitat types.

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Between 1992 and 2003, estimated reproductive success was significantly higher in nonnative Himalayan blackberry (RS = 2.0) than in native emergent cattail and bulrush marshes (RS = 0.5; Cook and Toft 2005). Excluding colonies that were lost to harvest, colonies on silage grain fields had an intermediate reproductive success (RS = 1.0). Meese (2013) did not observe this pattern from 2006 to

2011, when overall reproductive success was much lower and differences in reproductive success between substrates were not significant (unharvested triticale RS = 0.73; Himalayan blackberry RS = 0.44; wetland RS = 0.31), although only four Himalayan blackberry colonies were included in the sampled colonies. In 2014, Airola et al. (2015a) estimated the average reproductive success at four Himalayan blackberry colonies in Sacramento County as 0.84 fledglings per nest. Although the methods used were slightly different, this estimate is within the range of reproductive success estimates observed in all nesting substrate types by Meese (2013) during six years of low reproductive success (average RS = 0.62; range 0.01–1.44), but the range of values observed by Airola et al. was much narrower (0.66–0.90).

After fledging, Tricolored Blackbirds often leave the vicinity of the nest and congregate in groups of young birds from many different nests. These fledgling groups will often congregate near the edge of the nesting substrate nearest the foraging grounds being used by the adults, where they are fed when adults return to the colony site (Payne 1969). A group of fledgling Tricolored Blackbirds has been referred to as a crèche (Hamilton 1998, Beedy et al. 2017). The formation of crèches generally occurs among birds that breed in large colonies and whose eggs all hatch at about the same time (examples of other crèche-forming species include terns and penguins). Supervision of unrelated offspring by a small number of adult guardians is usually considered a characteristic of crèches, although it is unclear whether this is the case in Tricolored Blackbirds. A single large colony of Tricolored Blackbirds can produce many crèches, and a single crèche may include several thousand fledglings. Crèches can persist for up to one to two weeks, and have been observed as far as three miles from a colony site (Payne 1969, Hamilton et al. 1995).

There are no published studies on the annual survival rate of Tricolored Blackbirds, but banding studies have shown that individuals can live up to 13 years (Neff 1942, DeHaven and Neff 1973). Meese (2014b) used recapture data to estimate the average annual adult survivorship of Tricolored Blackbirds as 60%. Estimates of annual survival rates for other temperate blackbirds have ranged from 42% to 60%, with rates for the closely-related Red-winged Blackbird ranging from 42% to 54% (Fankhauser 1971, Searcy and Yasukawa 1981).

[Note to reviewers: Results of recent analyses of banding data by Cornell University provide revised estimates of apparent annual survival that differ from that reported here (adult female survival rate ~0.5-0.9, depending on year). Results have not been finalized and will be incorporated after further discussion with Cornell to verify preliminary results.]

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STATUS AND TRENDS IN CALIFORNIA

Range

Nuttall (1840) observed the Tricolored Blackbird along the coast of California in the 1830s and, without offering any supporting evidence, suggested that the Tricolored Blackbird range extended into Oregon and Mexico. In the mid-1800s, Cooper (1870) reported the species to be common on the southern California coast from Santa Barbara to San Diego, with the range to the north passing “more into the interior, extending up as far as Klamath Lake and southern Oregon." Bendire (1895) reported the range as "[s]outhwestern Oregon, south through California, west of the Sierra Nevada, to northern Lower [Baja] California." Bendire knew of no reports of the species north of Klamath Lake in southwestern Oregon, and thought it to be uncommon there. The range of the species was confirmed to include northern Baja California in the late 1800s, with A. W. Anthony reporting them "[r]ather common along the northwest coast, breeding in all fresh-water marshes" (Bendire 1895).

Following a period of years with no reported sightings of Tricolored Blackbird in Oregon, Neff (1933) reported a number of observations of the species from 1931 to 1933, all within 30 miles of Klamath Falls, and consisting collectively of fewer than 60 birds. Richardson (1961) reported up to several hundred Tricolored Blackbirds near Medford, Oregon in 1957 and documented breeding colonies of 1,500 and 1,800 birds in the region in 1958 and 1960, respectively. Inconsistent observations during the 1800s and early 1900s at the northern extent of the species range may represent shifts in distribution over time or are perhaps the result of limited survey coverage. The species has continued to breed in small numbers in the vicinity of Klamath Falls to the present time, and small numbers of birds continue to occur near Medford during the breeding season. Small breeding colonies (30 or fewer birds) were observed in three northern Oregon counties (Multnomah, Umatilla, and Wheeler) in the 1980s (Beedy et al. 1991). Since the 1990s, several hundreds of birds have occurred regularly in central Oregon near the town of Prineville in Crook County, and breeding has been confirmed in the area. In recent decades, the species has been documented in several other isolated locations in western Oregon and eastern Washington, almost always in very low numbers but occasionally numbering in the hundreds of birds (Gilligan et al. 1994, Spencer 2003, eBird Dataset 2016). The degree to which these records represent recent range expansion to isolated areas, irregular use of the region, or increased survey coverage is unclear, but it appears that small numbers of birds may have recently expanded the species' range to at least some isolated areas in the north (Gilligan et al. 1994, Wahl et al. 2005).

Ammon and Woods (2008) describe the recent discovery and status of breeding Tricolored Blackbirds at a single location in western Nevada, and report that there was no confirmed breeding in Nevada prior to 1996. However, Wheelock (1904) described the distribution of the species in the early 1900s, and reported that in the vicinity of Lake Tahoe, "these birds stray across the crest, but not in the numbers in which they are found westward." The species was also reported to have bred at Lake Tahoe in the early 1900s (Dawson 1923) and Hosea (1986) reported a breeding colony in Carson City, Nevada in 1980.

In the early 1900s, the Tricolored Blackbird occurred in northwestern Baja California south to about the 30th parallel north (Grinnell 1928). This is consistent with recent breeding records from the southern extreme of the species range near El Rosario (Erickson et al. 2007, Feenstra 2013).

The above historic accounts from the periphery of the range are largely consistent with the current range of the species, and overall, the range of the Tricolored Blackbird has changed little since at least the mid-1930s (Beedy et al. 2017). However, the species appears to be experiencing a range retraction in the southern California portion of the range and in Baja California, as discussed below.

Distribution

There are no descriptions of the distribution of the Tricolored Blackbird before the widespread conversion of native habitats across much of its range in California. However, accounts by early naturalists in California provide several records of the Tricolored Blackbird in the 1800s and early 1900s that document the local abundance, and to some extent, the distribution of the species prior to any systematic study of the species across its range.

The early anecdotal reports from the 1800s and early 1900s, although typically not quantitative, informed the historical distribution of birds and demonstrated the occurrence of large numbers regionally. Most early observations of large numbers of birds were from the Central Valley and southern California, and only small numbers of birds have occurred north of the Central Valley, both historically and in recent years. Therefore, this report discusses changes in distribution for the Central Valley and for southern California, which have supported the majority of the population and for which adequate information is available to assess long-term changes in distribution.

Central Valley

In 1852, Heermann reported frequent encounters with winter flocks of Tricolored Blackbirds in the Suisun Valley that numbered "so many thousands as to darken the sky for some distance by their masses" (Baird et al. 1874). The Tricolored Blackbird was known to be an abundant breeder in the interior valleys of California in the late 1800s (Bendire 1895). Belding (1890) observed "an immense colony" near Stockton in 1879. Ray (1906) noted the species breeding at various points on an automobile trip down the San Joaquin Valley from Stockton to Porterville in 1905. Linton (1908) observed a breeding colony at Buena Vista Lake at the southern edge of the Central Valley in 1907. Lamb and Howell (1913) reported seeing "hordes" of Tricolored Blackbirds at Buena Vista Lake in 1912. Dawson (1923) reported the species as "locally abundant in the Great Interior [Central] Valley."

Neff (1937) was the first to attempt to document the rangewide status and distribution of Tricolored Blackbirds. Over a six-year period from 1931 to 1936, Neff located breeding colonies throughout the Central Valley and at a few additional locations in California and southern Oregon; however, Neff's surveys focused on the Sacramento Valley in most years. Based on his somewhat geographically limited efforts, Neff (1937) reported nesting birds in 26 California counties over the six-year study. During this period, the rice-growing areas of the Sacramento Valley appear to have been the heart of the Tricolored Blackbird's distribution, although it is not clear whether this was due to survey efforts being focused there and the limited effort applied further south in the San Joaquin Valley.

Bent (1958) reported that the center of abundance for the species seemed to be in the San Joaquin Valley. Orians and Christman (1968) reported that the largest colonies occurred in the rice-growing districts of the Central Valley (mainly the Sacramento Valley and northern San Joaquin Valley). Neither of these reports were based on systematic surveys of the valley and have limited utility in documenting species distribution, other than that the majority of the population continued to occur in the Central Valley.

The distribution of colonies encountered over a five-year period by DeHaven et al. (1975a) was similar to that observed 35 years earlier by Neff (1937). DeHaven et al. (1975a) reported that 78% of colonies located between 1968 and 1972 were in the Central Valley. Most colonies and breeding birds were found in the Sacramento and northern San Joaquin Valleys, including Butte, Colusa, Glenn, Yolo, Sacramento, Merced, and Stanislaus counties. In the 1980s, the largest colonies and the majority of the known population continued to breed in the Sacramento and northern San Joaquin valleys (Hosea 1986, Beedy et al. 1991).

An apparent early nesting season shift in distribution from the Sacramento Valley to the southern San Joaquin Valley occurred at the end of the 20th century. Although breeding had been documented in the San Joaquin Valley since the 1800s, this region had not been the focus of intense monitoring efforts prior to the 1990s. DeHaven et al. (1975a) reported that areas with suitable nesting substrates were scarce in the arid southern San Joaquin Valley in the 1970s. As described above, loss of native wetland breeding habitat had resulted in a shift to novel nonnative vegetation types beginning by the 1970s, and the distribution shift away from the Sacramento Valley is presumably in part due to these changes in nesting substrate availability. In the early 1990s, Tricolored Blackbirds were discovered breeding in grain fields in the San Joaquin Valley (Hamilton et al. 1992, Hamilton 1993). This discovery corresponded to an increase in the number of dairies and the associated expansion of triticale in the San Joaquin Valley as dairies began growing this new crop for silage. By 1994, most of the largest colonies and 40% of known breeding birds in the early part of the breeding season were found in the southern San Joaquin Valley associated with dairies and cattle feedlots (Hamilton et al. 1995). Relatively little triticale had been planted for silage in the San Joaquin Valley by 1994, but by 2005 the planted acreage had grown to about 75,000 acres (Aksland and Wright 2005).

The shift in distribution to the San Joaquin Valley during the early breeding season has persisted, with very large proportions of the population nesting in a few large “mega-colonies” adjacent to dairies in the San Joaquin Valley (Kelsey 2008). In 1994, 68% of the estimated population in the early nesting season occurred in the San Joaquin Valley; this increased to 86% and 89% by 2008 and 2011, respectively (Hamilton et al. 1995, Kelsey 2008, Kyle and Kelsey 2011). In 2011, the 10 largest colonies were in the San Joaquin Valley during the early season survey (Kyle and Kelsey 2011). Breeding sites on triticale and other silage crops are also generally near other important habitat features, including irrigated pasture, grassland, or alfalfa crops for foraging, and available open water. The degree to which the apparent shift from the Sacramento Valley to the southern San Joaquin Valley is due to the loss of nesting habitat, the availability of a novel nesting substrate, or an increase in survey effort in the San Joaquin Valley is unknown (DeHaven 2000). Nevertheless, there has been a consistent use of the region by a majority of the Tricolored Blackbird population since the mid-1990s (Figure 7). The proportion of the population breeding in the San Joaquin Valley during the early part of the breeding season dropped to about 52% in 2014. This drop was in part due to increases in the number of birds in the Sacramento Valley, including the Sierra Nevada foothills, and southern California, but was primarily the result of a large rangewide decline, with most of the decline in number of birds occurring in the San Joaquin Valley (see the Regional Shifts in Abundance section). In 2017, the proportion of birds nesting in the San Joaquin Valley in the early breeding season returned to almost 70% (Meese 2017).

The grasslands and pastures of southeastern Sacramento County have seen consistent use by breeding Tricolored Blackbirds for at least the last 80 years (Neff 1937, DeHaven et al. 1975a, Hosea 1986, Beedy et al. 1991, Cook and Toft 2005, Airola et al. 2016), even as the dominant nesting substrate in the region has shifted from native wetlands to Himalayan blackberry (see Nesting Substrate section). DeHaven et al. (1975a) described the pasturelands of southern Sacramento County as the most consistently used area during a five-year study. Until recently, little emphasis has been placed on monitoring Tricolored Blackbird colonies in the Sierra Nevada foothills and grasslands/pasturelands of the eastern Central Valley relative to population centers in the Central Valley and in southern California. Observations of colonies from this region during statewide surveys have usually been lumped with the Central Valley for reporting purposes. Starting in 2014, these grasslands in the low elevation foothills have received focused monitoring as a distinct breeding area (Airola et al. 2015a, 2015b, 2016), with regular use reported for not only Sacramento County, but also from Butte County in the north to Stanislaus County in the south. In 2016, precipitation patterns supported growth of milk thistle patches across extensive areas in the foothills further south as far as Fresno County, resulting in breeding by more than 22,000 birds that had not been observed in the region in the two previous years (Airola et al. 2016). When milk thistle is available for nesting by Tricolored Blackbirds, this nonnative plant may extend~~t~~ the distribution of the species into the southern Sierra Nevada foothills.

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Although shifts may have occurred within the Central Valley and some areas of the valley that once supported large numbers of birds now support few or no breeding colonies, while other areas appear to have become much more important, the Central Valley and surrounding foothills as a whole have supported the majority of the Tricolored Blackbird population both historically and in recent years. Additional information on use of the Central Valley is presented in the Regional Shifts in Abundance section.

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Southern California and Baja California

The first Tricolored Blackbird specimen was collected by Nuttall near Santa Barbara in 1836 (Baird et al. 1874, Bent 1958). Although he did not observe breeding colonies, Nuttall reported that the Tricolored Blackbird was very common around Santa Barbara and Monterey in the month of April (Nuttall 1840). In the mid-1800s, Cooper (1870) found the Tricolored Blackbird to be the most abundant species near San Diego and Los Angeles, and they were not rare near Santa Barbara. In the late 1800s, the species was described as an abundant winter resident in Los Angeles and Orange counties, occurring in very large flocks, with several colonies known to breed in tule marshes up to 1,500 feet in elevation (Bendire 1895). Grinnell (1898) reported the species to occur in "considerable numbers" throughout the lowlands of the Pacific slope of Los Angeles County, and Willett (1912) considered the species a common resident throughout the lowlands of coastal southern California. Dawson (1923) reported the species as "locally abundant…in the San Diegan district."

There is evidence that the Tricolored Blackbird had experienced declines in a large portion of its range in southern California, even by the 1930s. In a revision of his former description of the species' status in coastal southern California, Willett (1933) described the species as a "formerly common resident…Now rare throughout former range in southern California, excepting in some sections of San Diego County."

Grinnell and Miller (1944) described the status of the Tricolored Blackbird as "common to abundant locally" but noted a general decrease in southern California.

In 1980, the Tricolored Blackbird was characterized as a fairly common resident in the southern California coastal district that bred locally in all coastal counties (Garrett and Dunn 1981). The species no longer occurs at many historical sites in coastal southern California. Small numbers of breeding birds were documented at a few locations in coastal Santa Barbara County through the 1970s, with the last known colony of 200 birds in 1979 (Lehman 1994, Tricolored Blackbird Portal 2017). The last known colony in Ventura County, of 53 birds, occurred in 1994. About 200 birds persisted as breeders in the portion of Los Angeles County south of the Transverse Ranges through the 1990s, with the last known breeding attempt in 1999 (Allen et al. 2016, Tricolored Blackbird Portal 2017). Several hundred breeding birds occupied multiple sites in Orange County through the 1990s, but only a single colony of 14 birds has been observed breeding in the county in two years since 2000. The highly urbanized coastal portion of San Diego County, which supported thousands of breeding birds through at least the 1970s, has supported less than a thousand breeding birds at only three locations since 2000 (Tricolored Blackbird Portal 2017). Very few Tricolored Blackbirds now breed in the coastal lowlands of southern California where they were once abundant (Garrett et al. 2012).

The status of the Tricolored Blackbird population in Baja California has followed a similar pattern to that for southern California. In the late 1800s, the species was described as "rather common along the northwest coast [of Baja California], breeding in all fresh water marshes" (Bryant 1889). Grinnell (1928) described the species as a "Fairly common resident locally in the northwestern section of the territory, north from about 30 degrees." In the 1980s, the species was described as a "local resident in northwestern Baja California south to El Rosario" (Wilbur 1987). A search of the entire Baja California range turned up a single breeding colony of 80 birds in 2007 (Erickson et al. 2007) and four breeding colonies totaling 240 birds in 2008 (Erickson and de la Cueva 2008). A follow-up survey several years later located three breeding colonies supporting an estimated 240–340 birds (Feenstra 2013). In recent years, most breeding in Baja California has occurred in the north within about 70 miles of the U.S. border. Breeding continued at a disjunct area at the historical southern extent of the species' range (about 100 miles farther south than the next nearest breeding location) near El Rosario through at least 2013 (Erickson and de la Cueva 2008, Feenstra 2013). By 2016 all known breeding colonies occurred within about 12 miles of the U.S. border (Erickson et al. 2016). In 2017, the only known breeding colonies occurred within five miles of the U.S. border and eight nonbreeding Tricolored Blackbirds were observed at a historic breeding site about 70 miles south of the U.S. border. No birds were observed south of this point, leaving the southernmost 100 miles of the species range in Baja California apparently unoccupied (April 2017 email from R. Erickson to N. Clipperton; unreferenced).

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Where previously abundant and widespread south of the Transverse Ranges, the distribution of breeding colonies is now mostly restricted to inland sites in western Riverside and San Bernardino counties, and in the interior of San Diego County (Feenstra 2009). This represents a long-term decline in southern California, with remnant colonies disappearing in recent decades throughout much of the southern range (Figure 8). This may represent a permanent breeding range retraction from portions of the range where the species was previously abundant, and is likely the result of ongoing urban development and declines in population numbers. The small numbers of birds that have occasionally bred at the extreme southern limit of the species' range in Baja California, separated by 100 miles from the next most southern breeding colony locations in recent years, were not observed in 2017. The majority of the historical range in Baja California has been unoccupied in recent years (Erickson et al. 2016).

Allen et al. (2016) reported that nesting commenced late in the 20th century in the Mojave Desert portion of northern Los Angeles County, and attributed this to manmade reservoirs and other impoundments, but breeding by small numbers of birds was known for the area since at least the 1970s (DeHaven et al. 1975a, Beedy et al. 1991). The species was known to occur in the Mojave Desert since at least 1890, but breeding was not documented (Belding 1890). The region has not supported more than a few thousand breeding birds in any year.

Population Trend

Breeding Population

Assessments of the rangewide population abundance of the Tricolored Blackbird prior to the 1990s are limited to published literature describing research by a limited number of individuals in the 1930s (Neff 1937) and an additional rangewide assessment using similar methods in the 1970s (DeHaven et al. 1975a). An additional recent published study used all available breeding colony data collected over more than 100 years (1907–2009) to evaluate changes in average colony size (Graves et al. 2013). The most intensive efforts to estimate rangewide population abundance have occurred since 1994, with results presented in reports prepared by academic researchers, Audubon California biologists, and in reports prepared for the USFWS and the Department. These represent the best available information for assessing trends in the rangewide population over the last two decades.

Over a period of six years (1931–1936), Neff (1937) surveyed Tricolored Blackbird colonies across California. Neff located several breeding colonies of more than 100,000 nests in the Sacramento Valley, with the largest composed of greater than 200,000 nests (corresponding to approximately 300,000 adult Tricolored Blackbirds). Breeding colonies were located throughout the Central Valley and in a few additional locations in California and southern Oregon; however, Neff's surveys focused on the Sacramento Valley in most years. An effort to cover the entire known range of the species was attempted by Neff in only one year (1932). Most areas outside the Sacramento Valley were covered only incidentally as "cooperators drove up or down the State in the performance of routine duties," and in the regions of the state that were most thoroughly surveyed, it was impossible to make complete surveys of all possible locations (Neff 1937). Neff concluded that obtaining an estimate of the statewide population was not possible. Working alone in 1934, Neff observed an estimated 491,250 nests (about 737,000 breeding birds), almost all of which were in the Sacramento Valley. The presence of birds in the San Joaquin Valley and southern California was noted in the same year, but no effort was made to estimate numbers. Several authors have cited Neff (1937) in statements about the Tricolored Blackbird population in the 1930s, sometimes suggesting that the population numbered in the millions (e.g., Beedy et al. 1991, Hamilton et al. 1995, Kyle and Kelsey 2011). Neff himself did not attempt to extrapolate his results to a region-wide estimate, although the roughly 737,000 breeding birds observed in a single year is likely an underestimate of the population at the time.

No attempts were made to describe the Tricolored Blackbird distribution or abundance during the 1940s, 1950s, or 1960s. From 1969 to 1972, DeHaven et al. (1975a) attempted to survey the entire range of the Tricolored Blackbird to document the distribution of the species and to compare estimates of abundance to those provided by Neff (1937). The surveys were carried out by a few individuals surveying vast areas by road, and in most areas were limited to one or two drives through each county where Tricolored Blackbirds were known to occur in California and southern Oregon. Still, the search effort was at least as extensive as that carried out by Neff in the 1930s, and included the benefit of improved transportation and an increased number of roads. In many counties the survey consisted of driving county roads with little knowledge of historical colony sites, but this was an improvement over much of the effort of the 1930s, when counties were considered covered if visited incidental to other activities. Despite a greater search effort, all measures of abundance indicated a decline: the number of active colonies detected per year declined from 43 to 41; nonbreeding birds encountered declined from >50,000 in a single year to <15,000 over four years; maximum colony size declined from hundreds of thousands to tens of thousands of birds; and number of birds observed per year within the study period declined from about 375,000 per year to about 133,000 per year (DeHaven et al. 1975a). Although no population estimate was provided, the authors suggested that the Tricolored Blackbird population declined by more than 50% in 35 years. Like Neff three decades before, DeHaven et al. (1975a) were unable to thoroughly cover the entire range of the species, including large portions of the southern San Joaquin Valley.

Following more than a decade with no survey to assess the statewide population, Beedy et al. (1991) compiled all historical records of Tricolored Blackbird breeding colonies and conducted limited field surveys from 1986 to 1990 to evaluate long-term population trends. Bill Hamilton and others (Hamilton et al. 1992, Hamilton 1993) conducted ecological investigations in 1992 and 1993 that included documentation of colony locations and sizes, the discovery of large breeding colonies on grain fields in the San Joaquin Valley, and the initial observations that suggested Tricolored Blackbirds are itinerant breeders (Hamilton et al. 1995). Based on the increased understanding of the species' biology and distribution, a new approach to estimating the statewide population of Tricolored Blackbirds was proposed by Ted Beedy and Bill Hamilton (Hamilton 1998, Meese 2015a). The discovery of itinerant breeding with broad movements between nesting attempts made it clear that a survey of the statewide population should occur during a narrow window in order to maximize the likelihood of detecting nesting colonies and to avoid double-counting birds (Hamilton et al. 1995, Beedy and Hamilton 1997). A survey conducted in a minor portion of the range or carried out over a long time period would either miss breeding colonies or double count birds over multiple breeding attempts. An improved understanding of colony occupancy dynamics suggested a need for early season colony-detection efforts to locate active colonies (Hamilton et al. 1995), while also considering the compiled information on all historical breeding locations in order to visit as many potential breeding locations as possible.

The new approach to surveying the statewide population was first implemented during the 1994 breeding season. The survey was conducted on a single day in the early part of the season (April 23). The choice of a survey date is an effort to select a time period when most birds have initiated a first nesting attempt and can be detected and counted at breeding colony sites, but before the first breeding cycle is completed and birds have moved to the north (usually) for the second breeding attempt. The goals of the survey were to visit as many known breeding locations as possible, document occupancy status, and estimate colony size at all occupied locations. This was also the first survey to be largely volunteer-based and to enlist a large number of observers over a narrow time period. Compared to the surveys of the 1930s and 1970s, these surveys employed many more surveyors to more thoroughly cover as much of the state and known colonies as possible. The discovery of breeding by a large proportion of the population on silage fields near dairies had recently been documented (Hamilton et al. 1992, 1995), and therefore unlike previous statewide survey efforts, the 1994 survey focused heavily on the San Joaquin Valley.

After the establishment of the new approach to conduct a statewide census, attempts to survey the population were carried out in 13 years between 1994 and 2017. Despite a consistent approach in many of the early years of this time period, methods varied considerably for many of these surveys. The years 1994, 1997, and 2000 produced a set of three triennial surveys that were considered to have been comparable in effort by the survey organizers (Beedy and Hamilton 1997, Hamilton 2000). After a period of years with surveys that followed inconsistent and variable approaches, another set of four triennial surveys were conducted using similar methods in 2008, 2011, 2014, and 2017 (Kelsey 2008, Kyle and Kelsey 2011, Meese 2014a, Meese 2017). The effort and results of these seven surveys are summarized in Table 1. Although the other six survey years (1995, 1996, 1999, 2001, 2004, and 2005) are not discussed further here, they are briefly summarized in Table 2 and in a larger discussion of Tricolored Blackbird surveys included in Appendix 1.

Table 1. Comparison of survey effort and results for seven statewide surveys.

Year	Duration	Participants	Counties surveyed (occupied)	Number of sites surveyed (breeding sites)	Occupied breeding locations	Birds observed
1994	1 day (3 days)[1]	60[2]	– (32)	–	100	369,400
1997	1 day (3 days)[1]	55[2]	– (33)	–	71[3]	232,960
2000	4 days	81[2]	33 (25)	231 (181)	72	162,000
2008	3 days	155	38 (32)	361 (284)	135	395,000
2011	3 days	100	38 (29)	608	138	259,000
2014	3 days	143	41 (37)	802	143	145,000
2017	3 days	181	44 (37)	884	168	177,656

[1] Observations of birds not associated with colonies from one day before and after the survey day were accepted, effectively expanding the survey window to three days.
[2] Number includes participants who submitted written reports. A larger number of volunteers may have searched for birds.
[3] As reported by Hamilton (2000).
"—" = data not reported

The statewide survey efforts in 1994, 1997, and 2000 followed similar methods to locate and survey as many colonies as possible. Although the duration of the survey and the survey effort varied across these years, the organizers of the surveys reported these three surveys had used the most consistent methods to date and could be compared to assess the population trend (Beedy and Hamilton 1997, Hamilton 2000). However, inconsistencies in effort still occurred with the 1994 survey conducting only a limited survey of southern California, and the 2000 survey using more observers to visit more sites than the other two survey years. Hamilton (2000), however, concluded that "…the method of the Census and the survey, to reinvestigate all known breeding places and to search for new ones, has become an increasingly complete assessment of Tricolored Blackbird distribution and abundance. The 2000 Census probably located a greater proportion of the entire population than did censuses in previous years." The number of birds observed declined 56% from 369,400 birds in 1994 to about 162,000 birds in 2000 (Hamilton 2000, Cook and Toft 2005). In addition to the results of the surveys showing declines in the 1990s, Hamilton (2000) stated that personal observations over long intervals by many regional experts had also suggested declines during this time period.

Table 2. Description and summary of effort for 13 surveys that attempted to estimate the size of the statewide Tricolored Blackbird population between 1994 and 2017.

Survey year	Summary of effort and results	Sources
1994	The first year a statewide survey was conducted in a narrow time period, was informed by knowledge of historical breeding locations and by pre-survey colony detection work, and enlisted the help of a large number of volunteers.	Hamilton et al. (1995) Beedy and Hamilton (1997)
1995 and 1996	Limited pre-survey effort. Incomplete county coverage. Large colonies may have been overlooked. Results are not considered representative of the total population.	Beedy and Hamilton (1997)
1997	Used the same coverage, methods, and personnel as did the 1994 survey. Participation was greater than in 1994. Surveys from 1994, 1997, and 2000 are considered comparable.	Beedy and Hamilton (1997)
1999	Participation in the survey was low. Results considered an underestimate of population size by the survey organizer.	Hamilton et al. (1999, 2000) Hamilton (2000)
2000	Used the same methods applied in 1994 and 1997, although a greater number of observers were used to visit more locations. Training was provided to participants. Surveys from 1994, 1997, and 2000 are considered comparable.	Hamilton (2000)
2001	Followed a very different approach compared to standardized methods used since 1994. A limited number of sites were visited and estimates were compiled from observations made throughout the breeding season.	Humple and Churchwell (2002)
2004	Not intended to provide an estimate of the statewide population size that was comparable to previous surveys. Surveys limited to colony sites that had historically supported more than 2,000 birds. Focused on sites in the Central Valley.	Green and Edson (2004)
2005	No report was produced and no record is available describing the survey effort.	Meese (2015a)
2008	Used similar methods as in the 2000 survey, although estimates not adjusted using nest density. Also, county coordinators were used for the first time to ensure each county was well surveyed by volunteers. Maps with all survey locations were provided for the first time, and a website improved communication and data management. Number of survey participants and number of sites surveyed greatly increased relative to earlier surveys.	Kelsey (2008)
2011	Methods followed those used in 2008, although county coordinators were not used to lead surveys in individual counties. Surveys from 2008, 2011, 2014, and 2017 are considered comparable.	Kyle and Kelsey (2011)
2014	Used the same methods as in 2008 and 2011, and again used county coordinators to ensure each county was thoroughly covered. The number of counties and number of sites visited exceeded all other surveys to date. Surveys conducted 2008–2017 are considered comparable.	Meese (2014a)
2017	Used the same methods as in 2008–2014. The number of survey participants and the number of counties and sites visited exceeded all other surveys to date. Surveys conducted 2008–2017 are considered comparable.	Meese (2017)

As during the early set of survey years, the survey effort increased each year from 2008 to 2017. More counties were surveyed in 2014 than on any previous survey and the number of observers participating on the 2014 survey (n = 143) was exceeded on only one previous survey (n = 155 in 2008). There was a large increase in the number of sites visited in each survey year between 2008 and 2014, and the number of colony sites visited in 2017 exceeded that of any other survey (Figure 9). The 2017 survey was the most extensive survey conducted to date based on all available metrics of effort (Table 1). The number of birds observed on statewide surveys declined 63% from 395,000 birds in 2008 to an all-time low of about 145,000 birds in 2014 (Kelsey 2008, Meese 2014a) (Table 1). From 2014 to 2017, the number of birds observed increased 22% to 177,656. The number of birds observed in 2017 represents a 55% decline in the population over the nine years since 2008.

Although the conclusion following each of the two groups of survey years (1994–2000 and 2008–2017) was that a population decline had occurred, differences in survey methods and effort make it difficult to combine the two groups of surveys to make longer-term conclusions (Meese 2015a). Does the estimated number of birds in 2008 represent an increase in population size following the decline of the 1990s, or do increased survey effort and other changes to survey methodology preclude comparison of results from the two survey periods? In addition to differences in duration of the survey, geographic scope, and effort shown in Table 1, there were important differences in methods used between the two groups of surveys (see Appendix 1). Methods unique to the earlier 1994–2000 surveys include: 1) ~~B~~birds counted at colonies before the survey were included in the results if the colony remained active after the survey period (although not counted on the survey day);~~,~~ 2) b~~B~~irds observed and counted at colonies after the survey were included if nest phenology led to a conclusion that the colony was active on the survey date (although not observed);~~,~~ and, 3) ~~V~~visual colony size estimates were often adjusted using observed nest densities, as determined by walking transects through colony sites after the survey,~~;~~ which~~this~~ resulted in final colony size estimates that in some cases differed significantly from those reported by survey participants (Hamilton et al. 1995). Unfortunately, the impact (both the magnitude and direction) of these methodological differences on the overall population estimates is unknown, and therefore a direct comparison of results from the two time periods is not appropriate. At a minimum, the large step change in survey effort between the two time periods must be taken into account if the data are to be used to inform a longer-term population trend.

As shown in Table 1, the individual metrics of survey effort were not consistently reported across survey years. The number of sites surveyed has been used to describe survey effort in recent years (Meese 2014a, 2015, 2017), but this number is not known for the surveys conducted in the 1990s. The number of counties surveyed was also not reported for surveys conducted in the 1990s. The number of participants and the number of occupied breeding locations were reported for all survey years. It is not known whether an increase in effort as measured by any of these metrics results in a proportional increase in the number of birds observed, but Graves et al. (2013) reported that total counts of breeding birds are correlated with the number of sites sampled. The number of sites sampled is also related to the proportion of the landscape searched by survey participants (Figure 9) and therefore might be the most appropriate metric of effort with which to standardize survey results.

In order to make use of as many survey years as possible to evaluate population trend over time, survey results were adjusted for effort when available (Figure 10a-c). Viewed as a whole, when adjusting for survey effort the results suggest a consistent pattern in the Tricolored Blackbird population since 1994. Regardless of the metric used to adjust population estimates for survey effort, the trend shows a long-term decline over the 23-year period with a partial recovery between 2000 and 2008. Depending on the metric used to correct for effort, either 2014 or 2017 represents the all-time low for effort-adjusted number of birds observed.

As the number of locations visited has increased with each successive statewide survey, so too has the number of locations with some uncertainty regarding the exact location. These are historical breeding locations for which the exact coordinates were not reported, and therefore the level of confidence is recorded as "uncertain" in the Tricolored Blackbird Portal database (2017). As a result, surveyors have visited an increasing number of locations that have not necessarily supported Tricolored Blackbird breeding in the past (Table 3). This is not wasted effort, as the visits to uncertain locations increase the size of the landscape area searched for colonies during the survey (Figure 9), and the locations are likely near historical colony sites. Nevertheless, for the 2017 survey, participants were directed to focus on sites with known coordinates, resulting in a large decline in the number of "uncertain" sites surveyed. To be conservative in interpreting changes in survey effort over time, the uncertain locations were removed from the count of sites visited during the 2000, 2008, 2011, 2014, and 2017 surveys to adjust the effort for those survey years (Table 3). The adjusted number of sites surveyed each year continues to show an increase in survey effort over time. A graph prepared using the revised number of sites surveyed (Figure 10d) revealed little effect on the pattern of birds observed per site shown in Figure 10b.

Table 3. Number of sites surveyed during recent statewide surveys, adjusted to remove uncertain locations.

Survey year	Number of sites surveyed	Number of uncertain sites	Revised number of sites surveyed
2000	231	4	227
2008	361	8	353
2011	608	54	554
2014	802	127	675
2017	884	25	859

The linear regression trendlines for each of the effort-corrected survey results indicate that the Tricolored Blackbird population has declined by 75%–90% in the last 23 years (Figure 10). The observed rates of decline of -5.8% to -10.5% per year indicate that this species has been in severe decline over the last two decades. These rates of decline are in the range of the steepest declines observed across all North American landbird species based on Breeding Bird Survey data (Sauer et al. 2017a). Results of the most recent 2017 statewide survey suggest that the Tricolored Blackbird population decline may have slowed or reversed since 2014, but the population remains at or near its smallest size ever recorded. Coupled with the earlier declines between the 1930s and 1970s, the recent declines have resulted in a population that is a small fraction of its historical abundance.

There are several potential sources of uncertainty in the population estimates from statewide surveys. Attempts to quantify this uncertainty have been limited and inconsistent across years. Comments on the approach used to estimate the size of the population during recent statewide surveys, along with a discussion of uncertainty, are provided in Appendix 2.

Colony Size

In recent statewide survey years, the size of the largest colonies (including the single largest colony and the average of the several largest colonies per year) have been reported as an alternative metric to total counts of birds for tracking trends over time. Use of the size of large colonies to evaluate trends is only appropriate if the survey effort is sufficient to detect most of the largest colonies. Although the survey effort required to detect most of the largest colonies is unknown, Graves et al. (2013) reported that average colony size observed, based on colony data from 1907 to 2009, was not strongly correlated to the total number of sites sampled annually, suggesting that sampling may generally be sufficient to detect the largest colonies. Larger colonies may be more likely to be detected and therefore survey effort may have less effect on size of largest colonies observed compared to total counts of birds.

Neff (1937) located several breeding colonies of more than 100,000 nests in the Sacramento Valley, with the largest composed of greater than 200,000 nests (about 300,000 adult birds). Orians (1961a) reported that, in 1959 and 1960, there were four Tricolored Blackbird colonies larger than 100,000 adults; three were in the rice-growing area in Colusa and Yolo counties and one was in Sacramento County. The largest reported colonies in the 1970s were in Colusa and Yolo counties and comprised about 30,000 adults (DeHaven et al. 1975a, Beedy and Hayworth 1992). All but one of the colonies observed by DeHaven et al. (1975a) that were larger than 20,000 birds were located in the Sacramento Valley. In the 1980s, the largest reported colony was in the northern San Joaquin Valley at Kesterson Reservoir (Merced County) in 1986, with an estimated 47,000 adults (Beedy and Hayworth 1992).

The occurrence of Tricolored Blackbird breeding colonies on grain fields in the San Joaquin Valley was discovered in the early 1990s (Hamilton et al. 1995), and the size of the largest colonies in several subsequent years once again grew to more than 100,000 birds, so-called “mega-colonies.” Beedy and Hamilton (1997) reported that 1994 and 1997 were the only two survey years to date with sufficient survey effort to detect “virtually all large colonies.” In 1994, Hamilton et al. (1995) found that the largest colony, at San Luis National Wildlife Refuge, numbered about 105,000 adult Tricolored Blackbirds. In 1997, Beedy and Hamilton (1997) reported the largest colony to contain about 80,000 adults. The documentation of large colonies during this time period is likely due in part to the formation of mega-colonies on grain fields, but may also be a result of increased survey effort in the San Joaquin Valley.

Colonies of at least 80,000 breeding birds continued to occur through 2010 (Meese 2009a, Meese 2010). From 2008 to 2017, maximum colony size declined from 80,000 to fewer than 20,000 birds (Kelsey 2008, Kyle and Kelsey 2011, Meese 2017). In 2014, only a single colony consisted of more than 20,000 birds and only three colonies consisted of 10,000 birds or more (Meese 2014a). The proportion of birds observed in the 10 largest colonies during the years 2008, 2011, 2014, and 2017 was 77% (306,000), 81% (208,800), 64% (93,000), and 55% (98,050) of the statewide population estimate for those years,

respectively. This reflects a downward trend in the sizes of the largest colonies, without a large increase in the number of occupied breeding locations (Figure 11). The trend in the largest colonies from 1994 to 2017 is similar to those in Figure 10 for effort-corrected statewide survey results: a long-term decline over the 23-year period with a partial recovery between 2000 and 2008.

Graves et al. (2013) performed an evaluation of trends in the average size of Tricolored Blackbird colonies over a more than 100-year period (1907–2009) using data compiled from a variety of sources. Average colony size, rather than total abundance, was used as the metric to evaluate trends to account for the effects of variable sampling effort across years. Graves et al. (2013) found a significant decline in the average colony size from 1935 to 1975, with the average colony size declining by more than 60%. This corresponds to the period over which DeHaven et al. (1975) concluded that the population size had declined by about 50%. Despite large amounts of data on colony sizes from the 1980s onward, no significant decline was detected in average colony size from 1980 to 2009. This finding is counter to reports of declines for portions of the 1980–2009 period (e.g., Beedy et al. 1991, Hamilton 2000, Meese 2014a, Meese 2015a). However, the statistical evaluation conducted by Graves et al. (2013) used data only through 2009, so it does not include much of the time period during which the recent population decline was observed (2008–2014). In addition, it is unlikely that sampling effort was sufficient in all years to detect most of the largest Tricolored Blackbird colonies, which may have influenced the estimates of average colony size.

Commented [MH29]: Breaking down the references a bit here helps. Beedy et al. 1991 and Hamilton 2004 obviously used only early data. It'd be worth looking at what Meese used.

The degree to which size of the largest or average colonies are correlated to total population size in any given year is unknown. However, during statewide survey years since 1994, the sizes of the largest colonies follow a pattern similar to that of the total numbers of birds observed. Given that in many years the majority of the population occurs in a small number of the largest colonies and the number of occupied colonies per year has not increased dramatically with increased survey effort (Table 1), it is likely that short-term declines in colony size often reflect real changes in the population size. Over longer periods, the correlation between colony size and population might be expected to break down due to shifts in breeding distribution and selection of novel nesting substrates. For example, when the population began using agricultural grain crops in the early 1990s and experienced an apparent shift in early breeding season distribution to the San Joaquin Valley, very large colonies were reported for the first time in many years. These changes in nesting substrate availability and distribution could have influenced the size of the largest colonies (and average colony size) by concentrating the population at a small number of breeding locations without necessarily reflecting a change in population size. In fact, Graves et al. (2013) reported that colonies in triticale and other grain crops were 40 times larger than colonies in other habitats during the last 20 years. This may explain in part why they did not find a reduction in average colony size from 1980 to 2009, a time when breeding surveys revealed declines in total number of birds observed.

Winter Population

The Christmas Bird Count (CBC) is a volunteer-based survey conducted each winter at designated 15-mile diameter circles across North America. CBC data consist of counts of all bird species encountered during a single day at each circle for which a count is conducted. There are more than 2,400 count

circles across North America, some of which have been run since the early 1900s (Soykan et al. 2016). The number of count circles increased dramatically through the 1950s and 1960s, especially in the western region of the U.S. (Niven et al. 2004), and long-term trend assessments have often used a start date in the late 1960s to avoid any influence of increased survey coverage on apparent trends (Butcher et al. 2006). This is also the time period when the Breeding Bird Survey was initiated, which allows for comparisons between breeding and wintering populations (Niven et al. 2004). Counts are not necessarily conducted for every circle each year, and some circles are run more consistently than others. The number of volunteer observers and the duration of the count can vary from year to year, and yearly differences in effort can significantly influence the results of the counts. Therefore, the number of party-hours is often used as a measure of effort to standardize count results. Count circle locations are also not randomly selected, so data cannot be extrapolated to provide population estimates across the range of a species, but if corrected for effort can provide an index that can inform population change in areas covered by count circles.

Soykan et al. (2016) used a hierarchical model to evaluate population change from 1966 to 2013 for several hundred species sampled by the CBC, including Tricolored Blackbird. The analysis assessed change in each U.S. state and in each Bird Conservation Region (BCR; a map of BCRs is available at http://nabci-us.org/resources/bird-conservation-regions-map/), with the Coastal California BCR being the primary BCR in which Tricolored Blackbird occurs. Trends for Tricolored Blackbird were non-significant at both the California and the BCR scales. Hierarchical models are more efficient than linear regression approaches when assessing population change for a large number of species across multiple geographic scales, and can control for variation in survey effort among circles and across years. However, the use of large spatial scales for analysis may introduce variability in the quality of information that may not accounted for in the models. Although the Coastal California BCR captures the majority of the Tricolored Blackbird range in California, it is neither geologically nor biologically uniform. Also, the addition of count circles over time has not been evenly distributed across the BCR or the state. Due to the variability in habitat and species distribution at these broad scales, any apparent population trend, or lack thereof, can be an artifact of the years in which count circles were added or removed, or the years in which particular circles were surveyed across a heterogeneous landscape. A finer-scale approach that considers the impacts of this variability on a single species is warranted.

In California, count circles increased through the 1960s as has been documented in other areas, but the number of circles continued to increase through the early 1990s. The number of circles in California detecting Tricolored Blackbird doubled from 1974 (25 circles) to 1986 (50 circles) and the number of circles with Tricolored Blackbird detections did not stabilize until the 1990s. Since 1992 the number of circles with Tricolored Blackbird detections has been fairly stable and has fluctuated between 54 and 66. Because of the continued increase in the number of count circles through the 1990s, and the inconsistent running of counts at some circles over time, the sampling intensity has varied across the range of the Tricolored Blackbird in California. Based on the number of count circles surveyed in California over time, and by establishing criteria for consistency of effort, the Department assessed trends based on CBC data for two time periods: 1974–2015 and 1995–2015. These two periods capture a longer term extending back to the 1970s when the breeding-season surveys of DeHaven et al. (1975a)

were conducted, and a shorter term covering the time since the first statewide surveys of the 1990s and when CBC data quality was highest and most consistent. The distribution of count circles that met a set of criteria and that were therefore included in the analyses provides fairly good coverage of the core of the winter distribution of the species (Figure 12; Appendix 3). Population trends were estimated from the slope of the regression of the log-transformed counts on year (see Butcher et al. 1990). Results of the CBC data analyses indicate declines in the Tricolored Blackbird population over both the longer term 1974–2015 period and the shorter term 1995–2015 period (Appendix 3).

Improvement in bird identification skills by volunteer observers has been apparent within the past 20 years, and poses a significant challenge in the interpretation of trends based on CBC data. This may be especially true for species with potential identification problems and for flocking species such as the Tricolored Blackbird (Butcher et al. 1990). As a result, counts that are adjusted by party-hour may be positively biased in recent years, which would tend to result in a positive bias in observed trends.

A number of historical winter observations of large numbers of Tricolored Blackbirds corroborate the observed decline in CBC data. Wintering flocks numbering 12,000–14,000 once assembled near dairies on the Point Reyes Peninsula, Marin County, which was one of the most reliable locations to observe large numbers of wintering Tricolored Blackbirds. In recent years, these flocks have been in the range of 2,000–3,000 birds (eBird Dataset 2016, Beedy et al. 2017).

Regional Shifts in Abundance

Because of the Tricolored Blackbird's nomadic tendency and the potential for large interannual shifts in breeding distribution, year-to-year changes in regional abundance are common. Tricolored Blackbird surveys have regularly revealed large annual changes in local abundance that would not be expected due to productivity or mortality rates alone (Hamilton 1998). During statewide surveys, large declines in one region are often coupled with large increases in other regions, and therefore caution is warranted when interpreting year-to-year changes in local abundance. That said, persistent long-term changes in distribution and regional abundance likely represent shifts in regional habitat suitability or population abundance.

Commented [MH30]: This wording is probably not appropriate. Itinerant breeding is not equivalent to nomadism, and the fact that some sites remained occupied for decades (or longer) suggests otherwise. I'd just say something like itinerant breeding or large-scale seasonal movements.

Central Valley

Following incidental observations on the regional abundance of Tricolored Blackbirds in the 1800s and early 1900s, the Central Valley was described as the center of abundance for the species. The first systematic attempt to assess the species' rangewide distribution and population confirmed this, with most birds observed in the Sacramento Valley (Neff 1937). Additional observations and study of breeding colonies occurred through the 1960s before a second attempt at quantifying rangewide abundance in the early 1970s, with the majority of birds again found in the Sacramento Valley and northern San Joaquin Valley (DeHaven et al. 1975a).

Within the Central Valley, shifts in regional abundance over relatively short time periods have been a regular occurrence. Over a period of five years in the 1930s, Neff (1937) observed regular shifts in the annual centers of abundance between the rice-growing regions of the Sacramento Valley (Butte and

Glenn counties) and regions to the south in Sacramento and Merced counties. DeHaven et al. (1975a) noted substantial yearly variation in centers of breeding abundance, even in their limited study area consisting of the Sacramento and northern San Joaquin valleys. For example, they observed 57,000 Tricolored Blackbirds nesting in Colusa County in 1969, but only 2,000 the following year. This pattern was mirrored in Yolo County where the number of breeding birds observed declined from 25,000 to 5,000. At the same time, other counties in the Sacramento Valley experienced increases in the number of breeding birds, with Glenn County increasing from 2,000 to 18,500 birds, and Yuba County increasing from 1,000 to 5,250 birds. A larger region comprising the major rice-growing region of the Sacramento Valley (Butte, Colusa, Glenn, Yolo, and Yuba counties) also varied considerably in the proportion of the known population it supported, with the proportion of known breeding birds in the region ranging from 29% to 59% during a four-year study period (DeHaven et al. 1975a). In the year when the smallest proportion of birds were located in this rice-growing region, the largest known congregation of birds occurred to the south in the pasturelands of southeastern Sacramento County. These regional shifts in abundance demonstrate the species' ability to undergo large interannual shifts in breeding distribution, likely in response to an unpredictable food supply or other habitat components.

In addition to short-term shifts in regional abundance, the Central Valley has experienced longer-term changes, with some regions of the valley experiencing long-term declines in number of breeding colonies or breeding birds. For example, Kings County supported tens of thousands of breeding birds per year through the 1990s, with 65,000 birds breeding in the county in 1992. In recent years, the county has hosted only a few hundred to a few thousand breeding birds. Glenn County, which once supported hundreds of thousands of birds per year and continued to support at least 10,000 birds into the 1990s, has not hosted more than 1,400 birds in any year since 2000. San Joaquin County regularly supported up to about 10,000 birds per year through the 1990s, but has hosted only a few small colonies since then, with the largest recent colony of 1,800 birds in 2015. As described above, the Tricolored Blackbird appears to have experienced a population increase from the 1990s through the 2000s in the San Joaquin Valley as a whole, with a corresponding decrease in the Sacramento Valley. Following this increase, the population in the San Joaquin Valley experienced a severe decline of 78% from 2008 to 2014 (Meese 2015a). This is a time period during which the species declined by 63% rangewide, and the majority of this decrease was due to declines in the San Joaquin Valley. The total number of birds lost from the San Joaquin Valley portion of the range during this period (~267,000 birds) exceeded the rangewide decline (250,000 birds), with a small portion of the loss compensated by increases in the breeding population elsewhere (Figure 13) (Meese 2015a). The number of birds breeding in the San Joaquin Valley rebounded somewhat by 2017, but declines in this region remain the primary contributor to range-wide population declines since 2008.

Southern California and Baja California

As described above under Distribution, the Tricolored Blackbird was once abundant on the coastal slope of the southern California portion of the range, from Santa Barbara County to San Diego and into Baja California. Although the early reports of species abundance were not quantitative, they serve as a comparison to numbers of birds in the region in recent decades. Neff (1937) provided the first quantitative estimates for southern California, although San Diego and Santa Barbara counties were the

only counties his collaborators spent a significant amount of time surveying; thousands of birds were documented in both of these counties. DeHaven et al. (1975a) reported colonies of up to 10,000 birds in southern California (Riverside County), with thousands of birds documented in all counties south of the Transverse Ranges, except Orange County.

The first statewide survey to include all counties in southern California was conducted in 1997 (Beedy and Hamilton 1997). That year, more than 40,000 Tricolored Blackbirds bred in the southern California portion of the range, with more than 90% occurring in western Riverside County (Feenstra 2009, Cook 2010). Since this time, the largest proportion of the southern California breeding population has continued to occur in western Riverside County (Cook 2010). The 2005 statewide survey located about 12,500 breeding birds south of the Transverse Ranges. A thorough search of historical breeding locations in southern California in 2008, 2009, and 2011 revealed a population south of the Transverse Ranges of consistently less than 5,000 breeding birds (Figure 14) (Kelsey 2008, Feenstra 2009, Kyle and Kelsey 2011). By 2009 the coastal slope portion of the region had declined to only 750 Tricolored Blackbirds breeding at a single site in San Diego County (Feenstra 2009). The 2014 survey located a slightly larger population consisting of about 6,400 breeding birds (Meese 2014a). In 2017, the number of birds observed increased again to about 8,800, although the large majority of these (>90%) were again located in one small region of western Riverside County. San Diego was the only other county with breeding birds in 2017, with seven small colonies totaling fewer than 700 birds. Most breeding colonies of the Tricolored Blackbird in Southern California have tended to be small in recent years, averaging a few hundred birds (Feenstra 2009).

In the last decade the breeding population in the Mojave Desert portion of the range in San Bernardino and northern Los Angeles counties appears to have grown somewhat, from just over 1,000 breeding birds located during surveys in 2008–2011, to more than 5,000 breeding birds in 2014 (Meese 2014a). It is unclear whether the Mojave Desert birds are more closely associated with the southern California population or to the birds in the Central Valley, although observations of three banded birds since 2009 and observations of a flying flock in the 1800s have documented birds moving between the desert and the Central Valley. Ongoing genomic studies will address the population structure and patterns of movement throughout California.

Originally considered common in northwestern Baja California, numbers appear to have declined by the late 1900s. Recent surveys have shown that the northwestern Baja California population has declined to only several hundred individuals (Erickson et al. 2007, Erickson and de la Cueva 2008, Feenstra 2013, Erickson et al. 2016, Meese 2017).

Summary—The Tricolored Blackbird, once described as the most abundant species in southern California, had declined dramatically by the time statewide surveys were established in the 1990s. Tens of thousands of breeding birds continued to occupy the region during the first complete survey of 1997. The most recent intensive searches of the southern California portion of the range located only thousands of breeding birds at a small number of locations. Following the first comprehensive survey of southern California counties in 1997, the Tricolored Blackbird population declined by nearly 90%, to lows of fewer than 5,000 birds from 2008 to 2011. The southern California population rebounded

somewhat by 2014, but most of the increase can be attributed to birds in the Mojave Desert. This decline coincides with the disappearance of the species from much of the southern California portion of the range and is mirrored by declines in abundance and distribution in the Baja California portion of the species' range. If recent trends continue, the species may decline to extirpation in the southern portion of its range in the near future.

Northern and Central Coasts

Commented [MH31]: Some of the populations in places like Santa Clara county breeding in late April presumably represent first attempts. Presumably the breeding survey reports have some information on such colonies.

Small numbers of birds bred annually during the late nesting season (July–September; thought to represent second breeding attempts by birds that previously nested elsewhere) in western Marin County until 2003 (Stallcup 2004). There has been no documented breeding in Marin County since then.

EXISTING MANAGEMENT

Land Ownership within the California Range

There is a paucity of public lands in the Central Valley, with the region that regularly supports more than 90% of the breeding population composed primarily of privately-owned lands (Figure 15). The total area in the range of the Tricolored Blackbird in California is more than 34 million acres. Privately-owned lands compose 84% of this area, with state and federal lands totaling about 12%. Much of the area under federal ownership is composed of forested areas that are not suitable for the species. The USFWS National Wildlife Refuges and Department Wildlife Areas comprise about 250,000 and 254,000 acres, respectively (1.5% of the range, combined).

Of the 1,045 historical breeding locations with known coordinates in the Tricolored Blackbird Portal database (as of January 2017), 191 (18%) have been located on public lands. A minority of breeding colonies continue to occur on public lands each year. For example, during the 2011 statewide survey, colonies were found on a county park, a Department Ecological Reserve in San Diego County and an Ecological Reserve in Kern County, and on three National Wildlife Refuges in the Central Valley (Kyle and Kelsey 2011). These colonies totaled 66,325 breeding birds (about 25% of the estimated statewide population in that year), the large majority of which were from a single colony on a USFWS National Wildlife Refuge.

Habitat Conservation Plans

Habitat Conservation Plans (HCPs) are long-term landscape ~~-~~level plans that provide the basis for regulatory compliance with the ESA by nonfederal entities. HCPs provide a mechanism to authorize incidental take of federally threatened and endangered species under section 10(a) of the ESA, while also describing how impacts to covered species will be minimized or mitigated in the plan area. An HCP must minimize and mitigate the impacts of take to the maximum extent practicable.

There are five approved HCPs in California that include the Tricolored Blackbird as a covered species and two additional HCPs that are in the planning stage (Figure 16; Table 4).~~:~~

Approved HCPs:

- Natomas Basin
- San Joaquin County Multi-species Conservation Plan
- PG&E San Joaquin Valley Operations & Maintenance
- Kern Water Bank
- Orange County Southern Subregion.

Planning Stage:

- South Sacramento
- Solano Multi-Species.

Table 4. Current and Planned HCPs/NCCPs in California that include Tricolored Blackbird as a covered species.

Plan title	Counties	Plan acreage	Date permit issued	Term
Natomas Basin HCP	Sacramento, Sutter	53,342	June 2003	50 years
San Joaquin County Multi-species Conservation Plan HCP	San Joaquin	896,000	May 2001	50 years
PG&E San Joaquin Valley Operations & Maintenance HCP	Portions of nine counties: San Joaquin, Stanislaus, Merced, Fresno, Kings, Kern, Mariposa, Madera, Tulare	276,350	December 2007	30 years
Kern Water Bank HCP	Kern	19,900	October 1997	75 years
Orange County Southern Subregion HCP	Orange	132,000	January 2007	75 years
South Sacramento HCP	Sacramento	317,656	Planning stage	TBD
Solano Multi-species HCP	Solano, Yolo (edge)	580,000	Planning stage	TBD
East Contra Costa County (NCCP)	Contra Costa	175,435	July 2007	30 years
Santa Clara Valley Habitat Plan (NCCP)	Santa Clara	460,205	July 2013	50 years
Western Riverside County Multiple Species Habitat Conservation Plan (NCCP)	Riverside	1,300,000	June 2004	75 years
San Diego County Multiple Species Conservation Program (NCCP)	San Diego	511,878	August 1998	50 years
San Diego Gas & Electric Subregional (NCCP)	San Diego, Orange, Riverside	Linear projects[1]	December 1995	55 years
San Diego County Water Authority (NCCP)	San Diego, Riverside	Linear projects[1]	December 2011	55 years
Butte Regional Conservation Plan (NCCP)	Butte	564,270	Planning stage	TBD
Yuba-Sutter Regional Conservation Plan (NCCP)	Yuba, Sutter	468,552	Planning stage	TBD
Placer County Conservation Plan Phase I (NCCP)	Placer	201,000	Planning stage	TBD
Yolo Habitat Conservancy (NCCP)	Yolo	653,663	Planning stage	TBD
San Diego East County Multiple Species Conservation Plan (NCCP)	San Diego	1,600,000	Planning stage	TBD
San Diego North County Multiple Species Conservation Plan (NCCP)	San Diego	311,800	Planning stage	TBD

[1] These NCCPs cover discrete linear or energy projects but have larger plan areas that overlap with other NCCPs.
Primary Sources:
USFWS endangered species page for Tricolored Blackbird under conservation plans:
https://ecos.fws.gov/ecp0/profile/speciesProfile?spcode=B06P#conservationPlans
Summary of Natural Community Conservation Plans (NCCPs) September 2016
https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=15329&inline

The goals, objectives, and conservation measures for Tricolored Blackbird included in approved HCPs are summarized below.

Natomas Basin HCP

The Natomas Basin Habitat Conservation Plan (NBHCP) covers 53,342 acres in the northwestern part of Sacramento County and southern Sutter County. The City of Sacramento and County of Sutter are participants. The 50-year term expires June 2053.

Tricolored Blackbirds nest and forage in the Natomas Basin. At the time of the planning effort, one active nesting colony was known from the eastern edge of the Natomas Basin (Betts Kismat-Silva Reserve) and nine documented occurrences were noted for Sutter County. Based on habitat preferences of Tricolored Blackbirds, the Natomas Basin supported about 1,998 acres of potential nesting habitat and 41,310 acres of potential foraging habitat (NBHCP 2003).

Commented [MH32]: Recent or old? The age of records seems relevant.

A total of 449 acres of potential nesting habitat will be converted to urban development as a result of implementing the proposed action. A loss of 15,311 acres of potential foraging habitat (non-rice crops = 6,517 acres, grassland = 560 acres, pasture = 147 acres, and rice = 8,087 acres) will result from the planned development (USFWS June 24, 2003).

Under the plan, 2,137.5 acres of managed marsh habitat will be preserved in a reserve system. Wetland reserves are intended to benefit wetland-associated Covered Species such as Tricolored Blackbirds. The managed marsh reserves will provide potential nesting habitat for Tricolored Blackbirds in close proximity to foraging habitat, which is expected to increase suitable nesting opportunities for this species. Additionally, 4,375 acres of rice and 2,187.5 acres of upland habitats will be added to the reserve system. Generally, acquisition of upland habitat is prioritized first for the conservation of Swainson's Hawk (*Buteo swainsoni*) then secondarily for other upland-associated Covered Species including Tricolored Blackbird (USFWS June 24, 2003).

Take minimization measures include pre-construction surveys for Tricolored Blackbirds, avoidance of actively nesting colonies/minimization of disturbance during the nesting season, establishment of a physical protective barrier 500 feet from the active nesting sites, and a "reasonable" buffer for foraging lands on reserve lands. The NBHCP includes measures to avoid, minimize, and mitigate take of the giant garter snake (*Thamnophis gigas*) with timing restrictions, pre-construction site dewatering, and vegetation control management. Because the Tricolored Blackbird shares some habitat similarities with the snake, these measures may also benefit the blackbird (NBHCP 2003).

Monitoring Covered Species is provided for in the plan. The USFWS commented on monitoring the Tricolored Blackbirds nesting colony in the final EIR/EIS (USFWS April 2003): "…the success of this population will be monitored annually and the reserve acquisition program of the NBHCP could be modified if it is determined that foraging habitat is a limiting factor for the colony. This colony is located well outside of the City's Permit Area, and this colony may forage upon unincorporated lands within Sacramento County. If, through the annual monitoring, it is determined that additional foraging habitat is required, the NBHCP would allow for modification of both acquisition programs and habitat

management/restoration to provide enhanced foraging. The long-term success of the NBHCP will rely not on establishing a rigid Operating Conservation Program based on limited information, but rather will result from a flexible program that responds to new information collected through monitoring as well as evolving scientific data as applicable to the Covered Species."

San Joaquin County Multi-Species Conservation Plan HCP

The San Joaquin County Multi-Species Conservation Plan HCP (SJMSCP) spans 896,000 acres in San Joaquin County. Participating entities include the Cities of Escalon, Lathrop, Lodi, Manteca, Ripon, Stockton, and Tracy and the County of San Joaquin. The 50-year term expires May 2051.

The SJMSCP identified 9,374 acres of "occupied" habitat for the Tricolored Blackbird in the plan area and an additional 47,193 acres of potential habitat including foraging and wintering areas. It is expected that 1,614 acres of Tricolored Blackbird habitat will be converted under full build-out.

The SJMSCP conservation strategy relies on minimizing, avoiding, and mitigating impacts for Covered Species including the Tricolored Blackbird. Mitigating impacts to Covered Species will largely be accomplished through the creation, enhancement and management of Preserves. Tricolored Blackbirds are associated with five planned Preserves: Primary Zone of the Delta (Large and Small Water's Edge Preserve), Vernal Pool Zone (Vernal Pool Grassland Preserve), Central Zone (Row and Field Crop/Riparian Preserve), Central Zone (Wetlands Preserve), Central/Southwest Transition Zone (Use Central Zone Row and Field Crop/Riparian Preserve). Tricolored Blackbirds are considered indicators of Preserve health and will be monitored at the species-level, accordingly.

Incidental take minimization measures include a setback of 500 feet from nesting areas during the nesting season for the period encompassing nest building and continuing until fledglings leave nests. This setback applies whenever construction or other ground-disturbing activities must begin during the nesting season in the presence of nests that are known to be occupied. Setbacks shall be marked by brightly-colored temporary fencing.

Pacific Gas & Electric San Joaquin Valley Operations & Maintenance HCP

The PG&E San Joaquin Valley Operations & Maintenance HCP (PG&E HCP) plan area includes 276,350 acres in portions of nine counties in the San Joaquin Valley, as follows: San Joaquin, Stanislaus, Merced, Fresno, Kings, Kern, Mariposa, Madera, and Tulare. The 30-year term expires in 2037.

The following discussion is derived from USFWS 2007:

> Tricolored Blackbirds occupied approximately 1,443 acres of existing PG&E right-of-way in the plan area (52 occurrences in CNDDB as of 2007).
>
> As part of the planning process, PG&E will establish a map book for the Tricolored Blackbird by, prior to initiation of any covered activities, determining where PG&E facility lines occur within 100 meters of CNDDB-documented occurrences of breeding colonies. Active nesting birds will be avoided. If an active breeding colony could be disrupted by the covered activity, an exclusion

zone of at least 350 feet around the colony will be established. This exclusion zone will be established in the field based on site conditions, the covered activity, and professional judgment by a qualified PG&E biologist, and will be greater than the minimum distance. Work will not occur in this exclusion zone during April 1–July 31.

The PG&E HCP estimated that covered activities would directly disturb approximately 4 acres of suitable nesting or foraging habitat each year (120 acres of temporary disturbance over 30 years), with most of this disturbance occurring in foraging habitat. Less than 0.1 acre per year of blackbird nesting habitat is expected to be permanently lost each year (less than 3 acres of nesting habitat permanently lost over 30 years). Other covered activities that may disturb Tricolored Blackbirds (e.g., off-road travel and tree trimming that do not disturb ground surfaces) will affect 34 acres of suitable Tricolored Blackbird habitat each year (1,020 acres over the 30-year permit term). These impacts are expected to be individually small, widely dispersed and, therefore, likely to be insignificant and discountable.

Permanent loss of suitable foraging or nesting habitat will be compensated at a 3:1 ratio and temporary disturbance to suitable habitat will be compensated at a 0.5:1 ratio. The HCP estimates PG&E will provide 0.37 acres of Tricolored Blackbird compensation in the North San Joaquin Valley, 0.91 acres of compensation in the Central San Joaquin Valley, and 0.57 acres of compensation in the South San Joaquin Valley annually. Overall, PG&E will provide approximately 2.3 acres of Tricolored Blackbird compensation annually (approximately 69 acres over 30 years).

Kern Water Bank HCP

The Kern Water Bank HCP covers 19,900 acres of central Kern County. The 75-year term expires in 2072. Planning documents list no known Tricolored Blackbird colonies from the Kern Water Bank area; however, it was acknowledged that the species might move into the HCP area in the future. Impacts were described as "negligible; high mobility of the species allows easy escape from project-related impacts" (Kern Water Bank Authority 1997). A monitoring effort conducted in 2011 documented five small colonies numbering ~400 individuals in nettles under mesquite within the plan area. A large colony numbering several thousand individuals settled in an historic site along the Kern River channel but the colony was abandoned; they may have joined a successful colony in Basin 6 on city property of approximately 10,000 individuals that successfully fledged young. The author did not identify whether the earlier failed effort or the successful colony was located within the plan area (Hardt 2011).

Commented [MH33]: Not really appropriate for nesting colonies, but I think you realized this in the way it is quoted. Perhaps worth spelling out more clearly

Orange County Southern Subregion HCP

The Orange County Southern Subregion HCP comprises 132,000 acres in the study area, including the Cleveland National Forest (40,000 acres). Excluding certain urbanized areas and the National Forest property, the planning area totals 86,000 acres within southern Orange County. The County of Orange and Rancho Mission Viejo are signatory to the implementing agreement. The 75-year term expires in 2082.

Six general Tricolored Blackbird breeding locations have been documented in the planning area historically and include: Middle Chiquita Canyon, Coto de Caza, Radio Tower Road, Verdugo Canyon in San Juan Creek, lower Gabino Canyon, and Trampas Canyon settling ponds. Not all sites have been used consistently or recently. A total of 18,759 acres of potential foraging habitat was identified in the planning area. One of the known historic breeding sites, Trampas Canyon, will be directly impacted by the proposed covered activities and an estimated 3,769 acres of foraging habitat will be developed or otherwise made unsuitable for Tricolored Blackbirds (USFWS 2007).

The plan conserves four of the breeding colony sites within a planned habitat reserve: Middle Chiquita Canyon, Verdugo Canyon, Radio Tower Road, and Lower Gabino Canyon. Adequate foraging habitat within a four-mile radius of these sites also would be conserved. Planners assumed that "at least 1,000 acres of foraging habitat within four miles of a nest site would be more than adequate to sustain the relatively small nesting colonies that occur in the study area" (Dudek and Associates 2006). Adequate foraging habitat will also be conserved at the Cota de Caza site. A total of 8,015 acres of foraging habitat for Tricolored Blackbirds in the planning area, including the four historic nest site locations, will be cooperatively managed within the habitat reserve. Additional open space habitats exist within County Parks (1,694 acres) which will be managed with overall conservation goals of the HCP (USFWS 2007).

Management actions to benefit Tricolored Blackbirds will focus on nonnative predators, grazing, minimizing pesticide use near colonies, and managing human disturbance near colonies (Dudek and Associates 2006).

South Sacramento HCP

The South Sacramento HCP is currently in the planning stage. The proposed study area encompasses 317,656 acres in Sacramento County. Anticipated partners include the County of Sacramento and the Cities of Rancho Cordova and Galt.

Solano Multi-Species HCP

Solano Multi-Species HCP is currently in the planning stage. The proposed study area includes 577,000 acres in Solano County and an additional 8,000 acres in Yolo County. Participants in this effort include the Cities of Dixon, Fairfield, Rio Vista, Suisun City, Vacaville, and Vallejo.

Natural Community Conservation Plans

Like HCPs, Natural Community Conservation Plans (NCCPs) are long-term landscape-level conservation plans. Under California state law, the Natural Community Conservation Planning Act (Fish & G. Code, §§ 2800-2835) provides a mechanism to obtain authorization for incidental take of CESA-listed and other species. An NCCP provides for the protection of habitat, natural communities, and species diversity on a landscape or ecosystem level, while allowing compatible and appropriate economic activity. An NCCP is broader in its objectives than the take authorization provided under the California and Federal ESAs, and may require conservation measures that go beyond mitigation of impacts to meet the recovery needs of

covered species. All approved NCCPs are also HCPs and so provide authorization for take of federally-listed species through section 10 of the ESA.

There are six approved NCCPs in California that include the Tricolored Blackbird as a covered species and six additional NCCPs that are in the planning stage (Figure 16; Table 4).~~:~~

Approved NCCPs:

- East Contra Costa County
- Santa Clara Valley Habitat Plan
- Western Riverside County Multiple Species Habitat Conservation Plan
- San Diego County Multiple Species Conservation Program
- San Diego Gas & Electric Subregional
- San Diego County Water Authority.

Planning Stage:

- Butte Regional Conservation Plan
- Yuba-Sutter Regional Conservation Plan
- Placer County Conservation Plan Phase I
- Yolo Natural Heritage Program
- San Diego East County Multiple Species Conservation Plan
- San Diego North County Multiple Species Conservation Plan.

The goals, objectives, and conservation measures for Tricolored Blackbird included in approved NCCPs are summarized below.

East Contra Costa County NCCP

The East Contra Costa County NCCP (ECCC) spans 174,018 acres in eastern Contra Costa County. The following local governments are signatory to the implementing agreement: cities of Brentwood, Clayton, Oakley, and Pittsburg, and the County of Contra Costa. The city of Antioch is not part of the agreement. The 30-year term will expire August 2037.

The ECCC is located within the Bay Delta and Central Coast Province (CDFW 2015). Six natural communities are found in the study area: streams/riparian woodland, wetland, grassland, oak woodland, chaparral/scrub, and agricultural lands.

During the project planning phase, Tricolored Blackbirds were described as sporadic in the plan area; two breeding colonies were noted on the northern border of Los Vaqueros Watershed and several additional small colonies were detected during fieldwork for the county bird atlas project (ECCC 2006). The Contra Costa County Bird Atlas project found the Tricolored Blackbird to be a "fairly common permanent but highly local resident of freshwater marshes and weedy fields, particularly in East County but also locally elsewhere. Most breeding birds were present in the vicinity of… Byron" (Glover 2009). The largest colony detected numbered several hundred pairs. The Atlas confirmed breeding in six blocks,

found five additional blocks with possible nesting and an additional possible nesting colony just south of the county border (Glover 2009).

ECCC development guidelines require avoidance of occupied Tricolored Blackbird nests during the breeding season. Under the agreement, impacts of up to 204 acres of core habitat and 9,621 acres of primary foraging habitat may be permitted as a result of covered activities. A planned preserve system will protect 126–164 acres of suitable core habitat and 16,747–20,138 acres of primary foraging habitat under the initial urban development area or maximum urban development area, respectively. The preserve system will also protect at least seven of 13 ponds, all of which may provide potential breeding habitat. Additional pond and wetland creation (an estimated 85 acres of perennial wetland plus an estimated 16 acres of pond habitat) will be created or restored. Managed habitat is predicted to be of higher quality than what had existed prior to the agreement. Conservation easements will be acquired on 250–400 acres of cropland or pasture; landowners will be required to enhance habitat for Tricolored Blackbird and other covered species (CDFG 2007).

Annual progress reports prepared under the ECCC documented two recent land acquisitions with value for Tricolored Blackbirds. Vaquero Farms North, a 575-acre property adjacent to the Los Vaqueros Reservoir Watershed lands was purchased in 2010. It is situated entirely west of Vasco Road, with primary access from Vasco Road (ECCHC 2011). Vaquero Farms Central, a 320-acre property bounded by two existing Preserve System properties, Vaquero Farms North and Vaquero Farms South, was purchased in 2012 (ECCHC 2013). No progress towards pond creation was reported in the latest available annual report of activities (ECCHC 2016).

Santa Clara Valley Habitat Plan NCCP

The Santa Clara Valley Habitat Plan NCCP (SCVHP) includes the cities of Gilroy, Morgan Hill, and San Jose (excluding Alviso and the Baylands) and the County of Santa Clara. The study area encompasses 519,506 acres; the permits areas, however, differ from the study area. Two permits were issued under the plan, one solely for Burrowing Owl (48,464 acres) and another for all other covered species. The “all other covered species” permit, including Tricolored Blackbird, totals 460,205 acres and excludes Henry Coe State Park and a portion of Pacheco State Park. The term of the permit is for 50 years and will expire July 2063.

The SCVHP is found within the Bay Delta and Central Coast Province (CDFW 2015). Natural communities within the planning area include grassland (including serpentine grasslands), chaparral and scrub, coastal scrub, conifer woodland, oak savannah, oak woodland, riparian woodland scrub, mixed evergreen forest, wetlands, aquatic, rock outcrop, irrigated, and agriculture.

Tricolored Blackbirds appear to be relatively uncommon in Santa Clara County. Breeding colonies are few and fairly small. During the Santa Clara County Breeding Bird Atlas project, Tricolored Blackbirds were found in 29 blocks with breeding confirmed in 19 blocks. Hundreds to several thousand individuals were documented. Confirmed breeding occurred in Santa Clara Valley, Diablo Range, Calaveras Reservoir, San Felipe Lake, Coyote Reservoir, small pond on Coyote Ranch numbering fewer than 100

individuals, Horse Valley stock pond, in the upper Smith Creek watershed (Bousman 2007). These data and CNDDB records were assessed under the SCVHP.

Conservation goals for Tricolored Blackbirds include protection for at least four sites that support, historically supported, or could support nesting colonies. Each protected site will have at least 2 acres of breeding (marsh) habitat and will have at least 200 acres of foraging habitat within 2 miles. These breeding sites will either be enhanced or restored breeding habitat in historically/currently occupied areas within the Reserve System or newly-created ponds suitable for breeding Tricolored Blackbirds (ICF 2012).

Take of, or impacts to, existing or historic breeding colonies is prohibited. Impacts to this species are limited to loss of habitat. Mitigation measures consist of pre-construction surveys, impact avoidance or minimization, and land acquisition. Acquisitions will focus on the following:

- Four historical breeding sites with adequate nearby foraging habitat referenced above;
- At least 22,840 acres of modeled Tricolored Blackbird habitat;
- Enhancement of acquired habitat specifically for Tricolored Blackbirds; and
- Creation of new ponds and wetlands that may provide breeding and foraging habitat for the species (CDFW 2013).

Western Riverside County Multiple Species Habitat Conservation Plan NCCP

The Western Riverside County Multiple Species Habitat Conservation Plan NCCP (WRC-MSHCP) covers approximately 1,300,000 acres in western Riverside County and is located wholly within the South Coast Province (CDFW 2015). All unincorporated county land west of the crest of the San Jacinto mountains to the Orange County line, as well as the cities of Temecula, Murrieta, Lake Elsinore, Canyon Lake, Norco, Corona, Riverside, Moreno Valley, Banning, Beaumont, Calimesa, Perris, Hemet, and San Jacinto are included in the plan area. The 75-year term will expire 2079.

Tricolored Blackbirds were described as “widely scattered” throughout the lowlands and foothills of Riverside County. Few current or historic breeding locations were documented within the planning area (Dudek and Associates 2003). Tricolored Blackbird potential habitat was assessed; a total of 480 acres of primary habitat and 259,695 acres of secondary habitat was identified as occurring within the planning area. Of these totals, a loss of 60 acres of primary habitat and 193,180 acres of secondary habitat was projected. Secondary habitat losses included approximately 102,000 acres of agricultural land and 88,000 acres of grassland (Dudek and Associates 2003). Mitigation identified in the plan includes the following actions:

- Include within the Conservation Area, 420 acres of suitable primary habitat (freshwater marsh, cismontane alkali marsh).
- Include within the Conservation Area the five identified Core Areas for Tricolored Blackbirds. The Core Areas include San Jacinto River floodplain (7,320 acres), Mystic Lake/San Jacinto Wildlife Area (17,470 acres), Collier Marsh and Lake Elsinore grasslands (1,810 acres), Alberhill (3,460 acres), and Vail Lake/Wilson Valley/eastern Temecula Creek (50,000 acres).

- Include within the Conservation Area, 66,510 acres of secondary habitat (playa and vernal pool, grasslands, agriculture land, and riparian scrub, woodland, and forest).
- Maintain (once every 5 years) the continued use of and successful reproduction within at least one of the identified Core Areas. Successful reproduction is defined as a nest that fledges at least one known young.
- Maintain, preserve, and if feasible, restore hydrological processes within the five Core Areas.
- Include within the Conservation Area a 100-meter buffer around any known nesting locations.

Although not considered a Tricolored Blackbird Core Area, a total of 9,670 acres within the Prado Basin/Santa Ana River area will be conserved within Criteria Area and Public/Quasi-Public designations. This area may support Tricolored Blackbirds in the future (Dudek & Associates 2003).

The most recent biological monitoring report for Tricolored Blackbirds (2013 breeding season) described the following results:

> Six breeding colonies were detected during targeted searches for Tricolored Blackbirds. These included the Potrero Unit of the San Jacinto Wildlife Area (~350 birds), San Timoteo Canyon (10 birds), Lake Riverside (~200 birds), Highway 371 in Tule Valley (45 birds), and Garner Valley (~150 birds). All counts sum to a total estimated population size of 2,755 birds. Mean and median colony sizes were 459 and 175, respectively. Biologists were unable to confirm reproductive success for the Garner Valley, Highway 371, or San Timoteo Canyon colonies. Tricolored Blackbirds successfully reproduced in Potrero and Tule Valley in 2013. Only one colony, Potrero, was located inside the existing Conservation Area; however, no colony was located within a designated Tricolored Blackbird Core Area. The largest colony (~2,000 birds) occupied a 40-acre field on private land in the San Jacinto Valley. It suffered complete reproductive failure when the field was cut; adults were incubating eggs at the time (WRCRCA 2015).

Biological monitors made management and monitoring recommendations to improve conservation conditions for the Tricolored Blackbird in the Plan area. According to recent biological monitoring reports (WRC-MSHCP 2013), three of the five Core Areas identified for Tricolored Blackbird conservation purposes (Alberhill, Collier Marsh/Lake Elsinore grasslands, and San Jacinto River floodplain) do not provide suitable or sufficient breeding habitat for the species. Other sites were recommended as additional Core Areas based on recent Tricolored Blackbird recent activity. Further, recommendations to change the Tricolored Blackbird species account in the Plan so that it "be modified to recognize loss of foraging habitat in the vicinity of breeding sites as a significant threat to the survival of the species, and that the stated management objectives be reconsidered as well. In particular, the prescription for managing '… this species in order to maintain (once every five years) the continued use of, and successful reproduction within at least one of the identified Core Areas' (Dudek & Associates 2003) is likely insufficient for a rapidly declining species that is dependent on patchy and unpredictable breeding habitats which are being rapidly lost throughout the Plan Area" (WRC-MSHCP 2011, 2013, WRCRCA

2015). Finally, the monitoring regime was deemed inadequate to provide conservation awareness for the Tricolored Blackbird. Monitoring should be conducted with surveys for breeding colonies every year rather than every five years and the survey period be extended to allow multiple visits to active sites before, during, and after nesting (WRC-MSHCP 2011).

San Diego County Multiple Species Conservation Program

The San Diego County Multiple Species Conservation Program NCCP (SDCMSCP) covers approximately 511,878 acres in San Diego County and is located wholly within the South Coast Province (CDFW 2015). SDCMSCP participants include the County of San Diego, Cities of Chula Vista, San Diego, La Mesa, and Poway; implementing agreements are in progress for Coronado, Del Mar, Santee, and El Cajon. Subarea plans have been or will be prepared for each participating entity. Imperial Beach, National City, and Lemon Grove are not developing subarea plans but reserve the right to do so at a later date. The 50-year term expires 2048.

A detailed status assessment of the Tricolored Blackbird within the planning area was not provided in the planning documents. The Plan did identify a rationale for including Tricolored Blackbirds as a covered species: "…77% of potential habitat [4,800 acres], including 59% of mapped localities, will be conserved. Breeding colonies move from season to season, and with a goal of no net loss of wetlands, most of the suitable breeding sites will continue to be available. This species forages in grasslands and agricultural fields near its breeding habitat. Foraging habitat near the known nesting colonies will be conserved at 70–100%. Additionally, foraging opportunities will continue to be provided and created in turfed areas such as golf courses and cemeteries. Jurisdictions will require surveys during the CEQA review process in suitable breeding habitat proposed to be impacted. Participating jurisdictions' guidelines and ordinances and state and federal wetland regulations will provide additional habitat protection resulting in no net loss of wetlands" (Ogden Environmental 1998).

Under the plan, 23% of breeding habitat (1,400 acres) has the potential for development or impacts.

Additionally, the following conditions were specified for Tricolored Blackbirds: "Project approvals must require avoidance of active nesting areas during the breeding season. Area-specific management directives must include measures to avoid impacts to breeding colonies and specific measures to protect against detrimental edge effects to this species. Area-specific management directives for preserve areas will include specific guidelines for managing and monitoring covered species and their habitats including best management practices. Edge effects may include (but not be limited to) trampling, dumping, vehicular traffic, competition with invasive species, parasitism by cowbirds, predation by domestic animals, noise, collecting, recreational activities, & other human intrusions" (Ogden Environmental 1998).

Annual reports are available online for the South County Subarea of the SDCMSCP (http://www.sandiegocounty.gov/content/sdc/parks/openspace/MSCP.html). These reports typically document habitat losses and gains associated with development projects and do not mention Tricolored Blackbirds specifically.

San Diego Gas & Electric Company Subregional NCCP

The San Diego Gas & Electric Company (SDG&E) Subregional NCCP covers discrete linear or energy projects but has a larger plan area that overlaps with other NCCPs. The plan area traverses 2,000,000 acres of SDG&E service territory in San Diego, Orange, and Riverside counties and is located wholly within the South Coast Province (CDFW 2015). Its 55-year term will expire December 2050. Although the term of the agreement is 55 years, SDG&E may, at its election, terminate the agreement after the 25th year and every 10 years thereafter.

In total, the SDG&E plan will result in a combined permanent loss of no greater than 400 acres with 50 miles of electric transmission and/or new gas transmission lines. This acreage figure includes an estimated permanent loss of 124 acres of habitat. The most common and most affected habitat types will likely be coastal sage scrub, chaparral, oak woodland, and grasslands (SDG&E 1995).

Impacts to Tricolored Blackbirds were considered to be generally very small and minimized or mitigated (in that order) when potential impacts occur to the species' habitats (SDG&E 1995). Tricolored Blackbird habitat was categorized under Mitigation Category III: beach, marsh, and wetland species. Mitigation measures taken for this category include:

- Construction in marsh areas, soft sand, or open water in most cases will be accomplished through the use of helicopters for the delivery of materials, poles, personnel, and platforms; and
- Roads should be avoided to the extent feasible.

In general, the following conditions apply: wildlife will not be killed unless to protect life and limb of staff, personnel training will be provided, and pre-activity surveys will be conducted (SDG&E 1995).

Planning documents available online did not include site-specific information on Tricolored Blackbird colony locations or foraging sites.

San Diego County Water Authority NCCP

The San Diego County Water Authority NCCP covers discrete linear projects but has a larger plan area that overlaps with other NCCPs. The plan area traverses 992,000 acres in western San Diego and southwestern Riverside counties and is located wholly within the South Coast Province (CDFW 2015). Nearly all Covered Activities will occur within the probable impact zone: 1,000 feet on either side of the pipelines or facilities, or approximately 64,600 acres along the existing pipeline rights-of-way, and other connected water conveyance, storage, and treatment facilities. The 55-year term of the agreement will expire December 2066.

One Tricolored Blackbird colony was documented near the Sweetwater Reservoir during the planning process; no colonies were noted within the planned impact zone (CNDDB in SDCWA and RECON 2010).

A total of 1,830 acres of wetland/riparian habitat exists within the probable impact zone; of this total, approximately 16 acres of potential Tricolored Blackbird breeding habitat could be impacted by

permitted activities. Twenty-one acres of potentially suitable breeding habitat in the existing preserve area may be used to mitigate impacts to Tricolored Blackbird. Suitable foraging habitat is conserved in the 1,186 acre San Miguel Habitat Management Area within the San Diego National Wildlife Refuge (Merkel and Associates 1997 in SDCWA and RECON 2010); however, no nesting has been documented there.

No direct take of breeding Tricolored Blackbirds or their nests is allowable; avoidance and/or minimization measures will be undertaken to conserve breeding colonies. Biological mitigation is habitat-based at approved ratios, which are based on the resource value of the impacted habitat. Mitigation for unavoidable impacts may include acquisition of additional preserve area lands, acquisition of credits in other conservation/wetland banks, or development of a biologically superior conservation alternative for the species at appropriate locations in the planning area.

Butte Regional Conservation Plan NCCP

The Butte Regional Conservation Plan NCCP is currently in the planning stage. The proposed study area encompasses 564,270 acres in Butte County. A planning agreement was completed in December 2007 and was signed by Butte County and the cities of Biggs, Chico, Gridley, and Oroville. An independent science advisors report was completed in 2007. Formal public review of draft planning documents closed June 8, 2016; however, public comments are still being accepted.

Yuba-Sutter Regional Conservation Plan NCCP

The Yuba-Sutter Regional Conservation Plan NCCP is currently in the planning stage. The proposed study area encompasses 468,552 acres in Yuba and Sutter counties. A planning agreement was completed in September 2012 and was signed by the counties of Butte and Yuba, the cities of Yuba City, Live Oak, and Wheatland. An independent science advisors report was completed in February 2006. Draft plan documents are in preparation.

Placer County Conservation Plan Phase I NCCP

The Placer County Conservation Plan Phase I NCCP is currently in the planning stage. The proposed study area (phase one of an anticipated three phases) encompasses 201,000 acres in western Placer County. A planning agreement was prepared October 2001 and was signed by the county of Placer. An independent science advisors report was completed January 2004. Draft plan documents are in preparation.

Yolo Habitat Conservation Plan/NCCP

Yolo Habitat Conservation Plan/NCCP (formerly Yolo Natural Heritage Program) is currently in the planning stage. The proposed study area encompasses 653,663 acres in Yolo County. A planning agreement was prepared February 2005 and signed by the Yolo Habitat Conservation Plan/Natural Communities Conservation Plan Joint Powers Agency. An independent science advisors report was completed March 2006. Draft plan documents are in preparation.

San Diego East County Multiple Species Conservation Plan NCCP

The San Diego East County Multiple Species Conservation Plan NCCP is currently in the planning stage. The proposed study area encompasses 1,600,000 acres in eastern San Diego County. The following communities are expected participants: Central Mountain, Cuyamaca, Descanso, Pine Valley, Desert/Borrego Springs, Julian, Mountain Empire, Boulevard, Jacumba, Lake Morena/Campo, Potrero, Tecate, Dulzura (in part), and Palomar/North Mountain. A planning agreement for San Diego East County and San Diego North County was prepared in 2008, amended May 2014, and signed by San Diego County. However, separate NCCPs will be prepared. An independent science advisors report, Part 1, was completed March 2006. Draft plan documents are in preparation.

San Diego North County Multiple Species Conservation Plan NCCP

The San Diego North County Multiple Species Conservation Plan NCCP is currently in the planning stage. The proposed study area encompasses 311,800 acres in northern San Diego County. The following communities are expected participants: Bonsall, De Luz, Fallbrook, Harmony Grove, Lilac, Pala, Pauma Valley, Rainbow, Rincon Springs, Twin Oaks Valley, Valley Center, and Ramona (in part). Excluded from the study area are Carlsbad, Encinitas, Escondido, Oceanside, San Marcos, Solana Beach, and Vista. A planning agreement for San Diego North County and San Diego East County was prepared in 2008, amended May 2014, and signed by San Diego County. However, separate NCCPs will be prepared. Independent science advisors reports were prepared in 2001 and 2002. Draft plan documents underwent public review in 2009 and are now under revision.

Conservation Plan for the Tricolored Blackbird

Following the 1991 petition to list the Tricolored Blackbird under CESA, a multi-stakeholder working group was formed to plan for and implement conservation actions. This resulted in the first of many statewide surveys, the first silage buyout to protect a breeding colony, and ongoing research. However, the working group made limited progress in developing comprehensive conservation measures for the Tricolored Blackbird and eventually dissolved in the mid-1990s. In 1997, a status update and management guidelines for the Tricolored Blackbird was completed (Beedy and Hamilton 1997). The species was again petitioned to be listed under CESA in 2004. After this petition was rejected by the Fish and Game Commission, a new multi-stakeholder Tricolored Blackbird Working Group was formed in 2005 and the group released a conservation plan in 2007 detailing the conservation and management, research and monitoring, data management, and education and outreach goals for the species (TBWG 2007). Working group members, including the Department, signed a Memorandum of Understanding agreeing to implement the actions in the conservation plan. Most of the goals and objectives in the plan are still relevant today and portions of the plan are currently being updated by the Tricolored Blackbird Working Group. Progress toward meeting objectives by the Department, USFWS, and partners on the working group has focused on protecting large breeding colonies that are threatened by harvest of agricultural grain fields and increasing knowledge through monitoring and research. New information is being used to update goals and objectives in the conservation plan.

Protection of Agriculture Colonies from Losses to Harvest

As described above, a large portion of the Tricolored Blackbird population has been nesting on agricultural grain fields since the 1990s, mostly adjacent to dairies. Although dairies often provide nesting substrate (the grain grown to feed cattle), a water source (e.g., drainage ditches or wastewater ponds), and food for adult birds (stored grains), colonies located adjacent to dairies have often suffered from low productivity. In many cases, the entire reproductive effort of silage colonies has been lost when the nesting substrate is harvested while the young or eggs are still in the nest (Meese 2013). The timing of grain harvest typically coincides with the Tricolored Blackbird breeding season, resulting in the destruction of nests, eggs, and nestlings, and occasionally mortality of adult Tricolored Blackbirds. The Tricolored Blackbird colonies that form on agricultural grain fields early in the breeding season are often the largest colonies formed each year, and the complete destruction of these colonies due to harvest can be especially damaging to annual blackbird productivity (Arthur 2015).

The protection of large colonies that occur on agricultural grain fields has been the primary conservation action implemented for Tricolored Blackbird since the species was discovered breeding in this substrate type in the early 1990s. Shortly after the discovery of grain colonies in the San Joaquin Valley, the USFWS intervened to encourage harvest delays and protect the largest known breeding colony (Hamilton 1993). In 1994, a crop was bought to protect a 28,000-bird colony (Kelsey 2008). Hamilton et al. (1995) calculated that interventions in 1992, 1993, and 1994 may have been responsible "for the presence of over 75,000 adult Tricolored Blackbirds in 1995 [which had been nestlings in the three previous years], about 25% of the known population." In 1999, the Department and USFWS protected a colony that was composed of one-third of the known population at the time, which otherwise would have been destroyed by routine harvesting activities (Hamilton et al. 1999). In 2004, silage purchases by the Department and USFWS protected three colonies totaling over 100,000 adult Tricolored Blackbirds. In 2006, the two largest known colonies, totaling more than 200,000 breeding birds, were protected through silage buyouts (Meese 2006). Meese (2009b) estimated that payments to landowners for harvest delays resulted in the protection of 364,000 nests and about 396,000 Tricolored Blackbird fledglings in the five years from 2005 to 2009. Despite these efforts to protect birds breeding on agricultural fields, losses to harvest have continued to occur in most years (Figure 17).

The Natural Resources Conservation Service (NRCS) established a fund in 2012 that was used for three breeding seasons to protect colonies on agricultural lands and to enhance habitat for the Tricolored Blackbird. Landowner participation in the program varied from year to year, with many thousands of nests protected each year while some colonies continued to be lost to harvest.

Regional Conservation Partnership Program

In 2015, the NRCS awarded a Regional Conservation Partnership Program (RCPP) grant to a group of conservation and dairy organizations (Arthur 2015). The grant provided five years of funding to protect, restore, and enhance Tricolored Blackbird habitat on agricultural lands, with the primary objective being to prevent loss of breeding colonies to harvest. During the first year of implementation in the 2016 breeding season, the program succeeded in enrolling all landowners with Tricolored Blackbird colonies

identified on their property, and 100% of known agricultural colonies representing more than 60,000 breeding birds were protected through delay of harvest. In 2017, a single large colony (estimated at up to 12,500 breeding birds) was lost to harvest at a location that was not enrolled in the NRCS program.

Despite efforts by landowners and the state and federal government to protect colonies, losses to harvest have continued. The protection of all known colonies on agricultural fields in the 2016 breeding season is encouraging progress, although ongoing success will require a stable funding source to compensate landowners that delay harvest. See the section on Harvest of Breeding Colonies below for a discussion of this ongoing threat to the species.

Habitat Restoration and Enhancement

USFWS National Wildlife Refuges

The USFWS owns and manages several National Wildlife Refuges (NWR) in the breeding range of the Tricolored Blackbird. In northeastern California, the Lower Klamath and Tule Lake NWRs have supported breeding colonies at several locations, although colony size has been relatively small as is typical for this portion of the range. The Sacramento National Wildlife Refuge Complex in the Sacramento Valley, the San Luis National Wildlife Refuge Complex in the northern San Joaquin Valley, and Kern and Pixley NWRs in the southern San Joaquin Valley have all supported breeding Tricolored Blackbird colonies.

The Sacramento National Wildlife Refuge Complex has actively managed selected wetlands to maintain suitable Tricolored Blackbird habitat for some time, and they have been frequently successful in attracting breeding colonies to Delevan NWR. Recent restoration at Colusa NWR has resulted in a return of breeding birds after many years of absence. Portions of the Merced NWR have been managed to provide breeding substrate for Tricolored Blackbirds in recent years, and the refuge has been successful in attracting multiple colonies of several thousand breeding birds. The Kern NWR has supported suitable habitat, and for many years hosted breeding colonies. Despite continued efforts to provide flooded spring wetlands, in recent years use of the refuge by breeding colonies has been limited, although a colony of 3,000 birds nested on the refuge in 2017. The Pixley NWR has not supported breeding colonies in recent years, but the USFWS is implementing management to attract breeding birds.

NRCS Easements and Incentive Programs

Through a combination of easements on privately owned lands and 3-year incentive programs, the NRCS has enrolled about 500 acres of land (as of January 2017) in programs that will provide habitat suitable for Tricolored Blackbird nesting. These programs focus on providing dense cattail habitat using water management practices compatible with Tricolored Blackbird nesting habitat. The majority of current NRCS habitat projects are in the Grasslands District of Merced County, with a smaller acreage in the southern San Joaquin Valley in Kern and Tulare Counties. Existing habitat projects have proven successful, with Tricolored Blackbirds breeding on three NRCS easement properties in 2016 (report to the Tricolored Blackbird Working Group, January 31, 2017; unreferenced).

California Department of Fish and Wildlife Lands

On many of the Department wildlife areas and ecological reserves located in the breeding range of the Tricolored Blackbird, management practices include spring or permanent wetland habitats that can support suitable nesting substrate for breeding colonies. In some cases, these wetlands have been managed specifically for Tricolored Blackbirds by setting back wetland succession through burning or mechanical methods, and in other cases the wetlands are typically managed for a broader suite of species. Use of Department wildlife areas and ecological reserves by breeding colonies includes (Tricolored Blackbird Portal 2017):

Northeastern California – The Honey Lake Wildlife Area has supported breeding colonies at two wetland locations. The number of breeding birds has been small, with the most recent observation of 200 breeding birds in 1996.

Sacramento Valley – Four wildlife areas in the Sacramento Valley have supported breeding colonies. Three of these wildlife areas are in Butte County (Oroville, Gray Lodge, and Upper Butte Basin), each of which have supported colonies at a single location, with the most recent observations including 1,600 birds on a wetland at Gray Lodge Wildlife Area in 2011 and 2,000 birds in willows at Oroville Wildlife Area in 2015. Oroville Wildlife Area also regularly supports foraging birds in the post-breeding season (B. Stone, pers. comm.). The Yolo Bypass Wildlife Area in Yolo County has hosted small breeding colonies at three separate locations in wetlands and button willow shrubs.

San Joaquin Valley – Four wildlife areas in the San Joaquin Valley have supported breeding colonies. Three of these are in Merced County, with North Grasslands Wildlife Area supporting three colony locations in milk thistle and mustard, Los Banos Wildlife Area supporting five colony locations in wetlands, and O'Neill Forebay Wildlife Area supporting four colony locations in Himalayan blackberry. The most recent use includes a 9,000 bird colony on a wetland at Los Banos Wildlife Area in 2008 and a 3,500 bird colony in Himalayan blackberry at O'Neill Forebay Wildlife Area in 2005. The fourth wildlife area in the San Joaquin Valley, Mendota Wildlife Area, is located in Fresno County. This wildlife area has supported breeding colonies at three separate wetland locations, with the last reported breeding by 1,000 birds in 1995.

Southern California – The Rancho Jamul Ecological Reserve in San Diego County has hosted a small breeding colony on a wetland in most years since 2007. This colony is usually fewer than 200 breeding birds. In Riverside County, the San Jacinto Wildlife Area has supported breeding colonies at 12 different locations. Most of the colonies have occurred in wetland habitats, with a few locations in other vegetation types including stinging nettle, thistles, and mallow. This wildlife area is located in perhaps the most important region for breeding Tricolored Blackbirds south of the Transverse Ranges. The wildlife area regularly hosts several thousand breeding birds, with a single location supporting 10,000 birds in 2005. During the 2017 statewide survey, 6,300 birds were observed at a single location on the wildlife area.

The Department has also worked with private landowners to create nesting habitat using a variety of incentive programs. The goals of the programs have included management of water to create spring

wetland habitat with emergent cattail vegetation. Several of these projects were successful in attracting Tricolored Blackbird colonies, with colonies of up to several thousand birds breeding on private wetlands created through these programs from at least 2005 through 2011. Funding has been limited in recent years, resulting in declining participation and a reduction in available wetland habitat on private lands.

California Environmental Quality Act

The California Environmental Quality Act (CEQA; Public Resources Code Section 21000 et seq.) requires state and local agencies to publicly disclose, analyze, and potentially mitigate environmental impacts from projects over which they have discretionary approval power. In particular, CEQA requires that actions that may substantially reduce the habitat, decrease the number, or restrict the range of any species that can be considered rare, threatened, or endangered must be identified, disclosed, considered, and mitigated or justified (Cal. Code Regs., tit. 14, §§ 15065(a)(1), 15380).

The environmental review process required by CEQA can be costly and time consuming, and compliance is not always thorough. Agencies may also make the determination that projects are exempt (i.e., they do not need to go through the impact analysis, public disclosure, and mitigation process). Mitigation is required if a project is not CEQA-exempt and impacts would be potentially “significant.” Mitigation must reduce impacts to below a level of significance or minimize unavoidable significant impacts, where feasible. The CEQA process generally incentivizes agencies and project applicants to implement mitigation, thereby avoiding significant impacts.

Due to its SSC designation, impacts to Tricolored Blackbirds are generally considered potentially significant if agencies determine on a project-specific basis that the species meets the CEQA criteria for rare, threatened, or endangered. However, agencies are not required to make this determination for Tricolored Blackbirds and other species that are not listed under CESA or ESA.

FACTORS AFFECTING ABILITY TO SURVIVE AND REPRODUCE

Small Population Size and Colonial Breeding

A key question is whether the colonially breeding Tricolored Blackbird can maintain a viable population at some reduced population abundance that supports only small colonies or concentrates the majority of the population into very few colonies. That is, what is the minimum number of individuals that can continue to support a well-distributed breeding population with colonies that are productive and resilient to the dynamic breeding and foraging landscape within their range? Another North American colonially breeding bird, the Passenger Pigeon (*Ectopistes migratorius*), declined to extinction as a result of multiple population pressures, and the species seemed to have an inability to survive and reproduce at low population numbers (Bucher 1992). In addition to the well-known effect of market hunting in the decline of the Passenger Pigeon, habitat alteration and a lack of social facilitation in food finding due to reduced population size have been implicated in the extinction of the species (Bucher 1992). The Tricolored Blackbird is similar to the Passenger Pigeon in that they are highly social, colonial breeders

with nomadic tendencies that likely evolved for locating highly abundant food sources and other breeding habitat requirements. Tricolored Blackbird has experienced, or continues to experience, many of the population pressures that led to extinction of the Passenger Pigeon; however, unlike the passenger pigeon, the Tricolored Blackbird has adapted to the wide-scale loss of wetland nesting substrate habitat by using a variety of upland vegetation types.

Commented [MH34]: It will also feed with other blackbird species, so the social facilitation effect may also be enhanced by this.

As described in the section on Biology and Ecology, Tricolored Blackbirds may benefit from social and colonial behaviors by reducing mortality due to predation during the nesting cycle and by facilitating food finding and information sharing. Smaller groups of birds would likely retain the ability to locate and use secure nesting substrates, but small colonies might lose the potential benefits of predator satiation and of social food finding and information sharing. The locating and exploitation of abundant food sources could affect small groups of birds both in the selection of productive breeding locations and in acquiring sufficient prey with which to provision young after a site is selected.

Some bird species are known to nest in colonies when conditions are suitable, but can also nest in smaller groups or as single pairs. For example, the White-winged Dove (*Zenaida asiatica*) once nested in extremely large colonies in Mexico. In 1978, 22 breeding colonies contained a collective population size of more than eight million birds (Sanchez Johnson et al. 2009). Individual birds were shown to have very high site fidelity to breeding areas, sometimes returning to nest in the same tree across years (Schwertner et al. 1999). Habitat changes driven by urbanization and intensification of agricultural practices and urbanization caused the loss and fragmentation of nesting habitat and now the White-winged Dove nests singly or in smaller colonies at more dispersed locations in Mexico, and appears to have adapted to use urban areas (Schwertner et al. 1999, Sanchez Johnson et al. 2009).

Although the Tricolored Blackbird has been observed to nest in very small colonies (as few as 4 nests), the species has not been observed to nest as single pairs. Very small colonies (<100 birds) are quite rare, and although nesting success varies greatly across colonies of all sizes, there is some evidence that very small colonies are not as successful as larger colonies (Payne 1969, Weintraub et al. 2016), and that larger colonies produce more young per female (Hamilton 1993, Meese 2013). Reductions in population size may make the Tricolored Blackbird more vulnerable to additional declines due to inherent natural history factors, but the degree to which a small population would limit the species' ability to survive and reproduce is not known.

The fact that half or more of the total population will often occur in a small number of large colonies in silage fields during the first nesting attempt makes the species vulnerable~~ility~~ to losses of productivity (Meese 2012, Beedy et al. 2017). In 2011, 65% of the total known population was located at only six colony sites in Merced, Kern, and Tulare counties (Kyle and Kelsey 2011). This concentration of large portions of the population makes the species vulnerable to a number of potential threats, especially colony destruction through harvest, predation, or extreme weather events (Weintraub et al. 2016). The enhanced risk to the species due to colonial breeding may be realized primarily through exacerbation of other threats that can effect a large portion of the total population.

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Habitat Loss

Loss of Nesting Habitat

The conversion of wetland nesting habitat to agricultural and urban uses has been implicated in the long-term decline of the species. Neff (1937) observed, "[t]he destruction of [Tricolored Blackbird] nesting habitats by man is of most importance," and cited reclamation and drainage as key factors in the loss of many favorable sites, along with "dredging or cleaning of reservoirs, marshes, and canals in order to destroy the growths of cattails and tules." Only about 15% of the four million acres of wetlands that existed in the Central Valley in the 1850s remained when Neff conducted his work in the 1930s, and about 40% of those remaining wetlands were lost between 1939 and the 1980s (Frayer et al. 1989). Of the freshwater emergent wetlands most likely to be used by breeding Tricolored Blackbirds in the Central Valley, 50% were lost between 1939 and the 1980s, with an average loss of 5,200 acres per year (Frayer et al. 1989). These losses were primarily due to conversion of wetlands to agriculture.

DeHaven et al. (1975a) found no nesting substrate at several locations in Los Angeles, Kern, Sacramento, and Yolo counties where earlier researchers had studied the species. Subsequent investigators have continued to document habitat loss at known prior breeding colony locations through the present. For example, Beedy et al. (1991) found that 9.3% (n = 17) of all colony locations used in the 1980s were extirpated through permanent removal of nesting habitat. Hamilton et al. (1999) observed the removal of a wetland that had supported a productive breeding colony in 1998. DeHaven (2000) noted the loss of several breeding colonies in Sacramento County to urban development and the expansion of vineyards. Humple and Churchwell (2002) reported on the draining of a wetland and the removal of Himalayan blackberry that had previously supported breeding colonies. Hamilton (2004a) documented the loss or destruction of cattail nesting substrates that had supported 90,000 breeding birds between 1994 and 2004. During the 2017 statewide survey, local experts and survey participants were asked to score the suitability of nesting substrate for all sites visited. Of the 636 sites for which scores were reported before or during the survey, 70 sites were scored as permanently unsuitable, usually due to development or conversion to permanent crops like orchards or vineyards (Table 5). An additional 80 sites had no nesting substrate present during the survey and 101 sites had vegetation present, but were considered unsuitable by the survey participant.

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Table 5. Nesting substrate suitability for 636 sites scored before and during the 2017 statewide survey.

Score	Number of sites	Notes on suitability scores
Suitable	385	Nesting substrate present and considered suitable for nesting.
Unsuitable	101	Nesting substrate present but appears to be unsuitable for nesting (e.g., it is immature, too short, lacks sufficient foliage, too sparse, or has recently been burned).
Substrate absent	80	Nesting substrate absent because it has been removed or died (e.g., former grain field planted to alfalfa, milk thistle stand or Himalayan blackberry that has been mowed, wetland that has dried up).
Permanently unsuitable	70	Nesting substrate is absent and cannot be replaced (e.g., has been converted to urban development, orchard, or vineyard).

Following a low point in the extent of wetlands in the 1980s, aggressive restoration actions resulted in an increase of 65,000 acres of managed wetlands between 1990 and 2005 (CVJV 2006). The majority of the wetlands in the Central Valley are managed lands that are maintained by application of water, and many areas undergo occasional land recontouring or vegetation control to maintain desired conditions. As of 2006, there were about 205,000 acres of managed wetlands in the Central Valley (CVJV 2006). Most managed wetlands (~90%) are flooded primarily in the fall and winter for wintering waterfowl (i.e., seasonal wetlands), and a small proportion are managed as semi-permanent or permanent wetlands that hold water during the spring and summer (Iglecia and Kelsey 2012). Semi-permanent wetlands are often managed to support brood habitat for waterfowl; the small proportion of semi-permanent and permanent wetlands are those that can potentially be suitable as nesting substrate for breeding Tricolored Blackbirds.

Replacement of wetland breeding habitat with novel, nonnative upland nesting substrates may have lessened the impact of the decline in Central Valley wetlands to the Tricolored Blackbird population. However, these nonnative vegetation types are often considered undesirable and are frequently removed. Himalayan blackberry habitat with a history of use by breeding colonies has been removed by burning, treatment with herbicide, or mechanical removal (Airola et al. 2015a, 2015b). Milk thistle colonies have been destroyed when landowners have removed or sprayed the invasive weed while Tricolored Blackbirds are actively nesting (Airola et al. 2016). Blackberry control is generally localized and occurs on multi-year intervals, and therefore may not have a large overall effect on the population, although there are cases where removal of nesting substrate has resulted in permanently unsuitable conditions. In the central Sierra Nevada foothills where Tricolored Blackbird colonies frequently nest in Himalayan blackberry, 32% of colonies active in 2014 occurred in areas zoned for development or that were proposed for rezoning for development (Airola et al. 2015a). In 2017, a group of Himalayan blackberry sites that had supported 13,000 breeding Tricolored Blackbirds were removed or degraded by aggregate mining activities (Oct 2017 email from D. Airola to N. Clipperton; unreferenced). The Department is unaware of any available information to evaluate distribution or trends of these nonnative nesting substrates across the range of the Tricolored Blackbird in California.

Although the loss of wetlands in California's Central Valley is well documented and there are many examples of nesting substrate being removed or degraded at historical Tricolored Blackbird colony locations, there also appears to be suitable nesting substrate in some areas that goes unused in many years. However, there are other regions where large areas of apparently suitable foraging habitat have no available nesting substrate, or where nesting substrate is only available during years when rainfall patterns support vigorous growth of upland nesting substrates (Airola et al. 2016). Most managed wetlands in the Central Valley are not suitable as nesting substrate for the Tricolored Blackbird, but wetlands remain the substrate type most frequently used by breeding colonies and upland nesting substrates provide additional habitat. The dynamic occupancy patterns at breeding locations from year to year and the need for abundant insect prey in surrounding foraging habitat makes it difficult to reach conclusions about nesting substrate suitability based on occupancy in a single year. It is likely that loss of nesting substrate has caused local declines and shifts in distribution, but the overall effect on the population is difficult to assess, especially without considering other breeding requirements. Losses of

nesting substrate at historically large or productive colony locations, or in areas surrounded by high quality foraging habitat, would have the largest impact on the population.

Loss of Foraging Habitat

The extent of foraging habitat required for successful breeding is much greater than the extent of nesting substrate. The abundance of insect prey in foraging habitat has been linked to reproductive success, and Tricolored Blackbirds may choose breeding locations in part based on the local prey populations. Because insect populations are variable and unpredictable from year to year, the Tricolored Blackbird population likely requires much more foraging habitat on the landscape than is used in any given year, and once lost, large landscapes with suitable habitat are difficult to replace. For these reasons, loss of foraging habitat is likely as important, or more so, than the documented losses of nesting substrate on the long-term viability of the Tricolored Blackbird population.

The loss of foraging habitat has been suggested as a likely cause of decline in southern California (Hamilton et al. 1995, Cook 2010). The extirpation of colonies from most of the coastal lowlands in southern California, despite the presence of more numerous marsh habitats relative to inland areas, suggests that foraging habitat sufficient to support breeding colonies is the population's limiting factor (Unitt 2004).

Hamilton et al. (1992) reported on the pervasive loss of foraging habitat near breeding colony sites due to expansion of cultivated agriculture and the conversion of existing agriculture to incompatible crops in the Central Valley, and considered this the primary threat to population abundance. DeHaven (2000) observed widespread habitat loss due to urban expansion and agricultural conversions to vineyards and orchards relative to the 1970s when he and others conducted Tricolored Blackbird research across the state, and suggested that habitat loss was a primary driver of continued population declines. Conversion of pastures and crops suitable for foraging by Tricolored Blackbirds was observed in Placer, Sacramento, Stanislaus, and Tulare counties. DeHaven (2000) noted especially extensive losses in Sacramento County, where urban development and expansion of vineyards had removed thousands of acres of high-quality habitat. More than 5,000 acres of habitat had been converted to vineyards in just a two-year period from 1996 to 1998, resulting in the loss of known breeding colony locations.

Grasslands have been identified as one of the most vulnerable habitats across North America, and many grassland species have experienced steep population declines in recent decades (NABCI 2016). A great deal of effort has been expended on conserving the grasslands in the central part of North America from the Great Plains to northern Mexico (Knopf and Skagen 2012). The grasslands of California have not received the same level of conservation attention, although losses of grasslands in California have been extensive.

Soulard and Wilson (2015) used Landsat satellite data to analyze land-use and land-cover change in the Central Valley from 2000 to 2010, and compared this to changes in the valley since 1973. The largest land-cover trend from 2000 to 2010 occurred in grassland/shrubland habitats. During this 10-year period, an estimated 79,200 acres of grasslands and shrublands were lost, representing a 5% decrease in the Central Valley over 10 years. Over the longer period from 1973 to 2010, grasslands and shrublands

declined by 22% (a loss of 476,900 acres), due mainly to conversions to more intensive agriculture and urban development. Although many of the grassland losses were due to agricultural intensification, losses of agriculture to urban development resulted in relatively little net change in area of agriculture in the Central Valley from 1973 to 2010.

Cameron et al. (2014) analyzed time series land cover data from the California Farmlands Mapping and Monitoring Program collected between 1984 and 2008 to evaluate rangeland habitat (grassland, shrubland, and woodland) conversion in California. The area evaluated covers much of the breeding range of the Tricolored Blackbird except for southern California. About 483,000 acres of rangelands were converted during this 20+ year period, with urban and rural development and conversion to more intensive agricultural uses accounting for most (~90%) of the rangeland loss. Agricultural intensification was primarily due to increases in vineyards and orchards, but smaller amounts of other agricultural crops that may provide foraging habitat for Tricolored Blackbird were also responsible for grassland loss. The San Joaquin Valley region, which in recent decades has been the center of abundance for breeding Tricolored Blackbirds during the early nesting season, experienced the largest amount of rangeland conversion (Figure 18).

Land cover types suitable for Tricolored Blackbird foraging in the Central Valley continue to be converted to incompatible land cover types such as orchards, vineyards, and urban development as agricultural practices evolve and cities continue to expand in the Central Valley. Due to the continued expansion of nut trees and vineyards that replace grasslands, shrublands, or agricultural crops that provide insects required for breeding (e.g., alfalfa), regions that were previously occupied by thousands of birds have now become permanently unsuitable for breeding (Meese 2016). For example, the acreage of pistachio orchards in the Central Valley has grown exponentially in recent years and the acreage of almonds continues to increase (Figures 19 and 20). The five leading pistachio producing counties in California have also supported a large proportion of the Tricolored Blackbird breeding population in recent years (Kern, Tulare, Kings, Fresno, and Madera counties), with Kern County alone supporting 42% of pistachio production in 2012 (Geisseler and Horwath 2016). In the central Sierran foothills, many colony sites and the surrounding foraging landscape are zoned for development, and several development projects that may affect Tricolored Blackbird habitat have moved forward in recent years (Airola et al. 2015a, 2016). Statewide, the proportion of grasslands within 3 miles of known breeding colony locations declined from 2008 to 2014 (NAS 2017).

Commented [MH38]: Make the focus more clearly on foraging habitats?

The California Rangeland Trust has conserved more than 300,000 acres of rangeland in 24 California counties through conservation easements (https://www.rangelandtrust.org/ranch/). Although data are not available on the extent and distribution of conserved lands within the range of the Tricolored Blackbird, some of the conserved ranches are in counties that receive regular use by breeding Tricolored Blackbirds, including Kern, Merced, Madera, and Placer counties. Data on the proximity of conserved rangelands to Tricolored Blackbird breeding colonies is not available, but these easements may provide protection of important foraging habitat for birds that breed in the foothills and grasslands on the periphery of the Central Valley.

Large losses of rangeland and suitable crop foraging habitat have occurred over the last several decades, and conversion of these suitable foraging habitats continue throughout much of the Tricolored Blackbird's range. Although large acreages of rangeland habitat have been conserved through conservation easements, these have not necessarily focused on areas of highest value to Tricolored Blackbird and are small relative to the extent of grassland in the state and the observed rate of loss over the past several decades. Future development in California is projected to be concentrated in several core areas of the Tricolored Blackbird range, including the Central Valley, the foothills of the Sierra Nevada, and on both sides of the Transverse Ranges in southern California (Jongsomjit et al. 2013; Figure 21), which would further reduce or degrade the available foraging landscape for breeding colonies. Loss of suitable rangeland foraging habitat is projected to continue into the future (see Drought, Water Availability, and Climate Change section). The proportion of grasslands in the landscape surrounding potential breeding sites has been shown to be the most important land cover type in predicting the occurrence of breeding Tricolored Blackbirds, and the proportion of alfalfa is the most important determinant of colony size (NAS 2017). Combined with regular loss of nesting substrate, the ongoing loss of foraging habitat makes it less likely that these essential breeding habitat requirements will co-occur on the landscape, with the result being a reduced number of locations suitable for successful breeding by Tricolored Blackbird colonies.

Overexploitation

Market Hunting and Depredation Killing

Neff (1937, 1942) reported hundreds of thousands of blackbirds sold on the Sacramento market, many of which were Tricolored Blackbirds. Market hunting of blackbirds in the Central Valley became a thriving business in about 1928 or 1929 and continued through the mid-1930s. Tricolored Blackbirds banded for research activities throughout the 1930s were often recovered by market hunters with which Neff collaborated (1942).

McCabe (1932) described the deliberate strychnine poisoning of 30,000 breeding Tricolored Blackbirds as part of an agricultural experiment. In the early 1930s active poisoning and shooting programs were enacted to control populations of blackbirds (McCabe 1932, Neff 1937). Tricolored Blackbirds and other blackbird species were killed by poisoned baits used as a means of blackbird control in rice fields in the Sacramento Valley, and numerous blackbirds were shot by farmers or by hired bird herders in attempts to drive the flocks away from rice and other crops (Neff 1942). During the period from 1935 to 1940 blackbird depredations in rice fields were of lesser intensity, and control operations by means of poisoned baits were almost entirely discontinued (Neff 1942).

Because the Tricolored Blackbird forages in mixed-species flocks with the European Starling and other species of blackbirds in the nonbreeding season, and because these flocks forage at feedlots and on ripening rice, the Tricolored Blackbird may be exposed to avicides intended to control nuisance and depredating flocks of blackbirds.

A depredation order under the federal Migratory Bird Treaty Act allows for the control of several species of blackbirds and corvids in agricultural situations without a permit from the USFWS (when birds are

causing serious injuries to agricultural or horticultural crops or to livestock feed; 50 CFR 21.43). In 1988, the USFWS modified the long-standing depredation order to remove the Tricolored Blackbird and prohibit killing the species without a federal permit (Beedy et al. 1991). Although Tricolored Blackbird is no longer covered by the depredation order, it is possible that misidentification of Tricolored Blackbirds when they occur in mixed flocks in the fall and winter leads to unintentional mortality of the species. Landowners are required to report on activities and on the number of birds captured or killed under the depredation order, including non-target species such as the Tricolored Blackbird (50 CFR 21.43, Nov 5, 2014). Based on reports provided to the USFWS, annual reporting appears to be inconsistent and the number of birds killed under the depredation order may be underreported. The number of Tricolored Blackbirds killed annually is unknown and therefore the killing of blackbirds to protect ripening rice in the Sacramento Valley is a known but unquantified source of Tricolored Blackbird mortality.

There has been limited documentation of the shooting of Tricolored Blackbirds in the Sacramento Valley. Two birds that had previously been banded were reported to have been shot by a rice farmer in Butte County (Meese 2009a). These birds were reported because they were banded and it seems likely that additional, unbanded birds were also shot.

Historical killing of blackbirds to protect crops and for the food market may have contributed to a long-term decline of the species, but the intentional killing of Tricolored Blackbirds has declined since the 1930s. The effect of mortality due to shooting or poisoning on annual Tricolored Blackbird survival rates is currently unknown.

Harvest of Breeding Colonies

The Tricolored Blackbird colonies that form on agricultural grain fields early in the breeding season are often the largest colonies formed each year, and the complete destruction of these colonies due to harvest can be especially damaging to annual blackbird productivity (Arthur 2015). Normal harvesting activities typically coincide with the breeding season and the harvest of fields that contain nesting colonies results in nest destruction and the loss of eggs or nestlings. The cutting of grain has also killed adult Tricolored Blackbirds but most adults appear to survive harvest operations.

Shortly after the discovery of grain colonies in the San Joaquin Valley, Hamilton et al. (1992) observed the loss of a 15,000-bird colony to harvest. As early as 1993, the USFWS intervened to encourage harvest delays and protect the largest known breeding colony (Hamilton 1993). Since then, colony protection through crop purchase or delayed harvest has been the primary conservation action implemented for the species (see Existing Management section), with mixed success. Despite annual attempts to locate and protect large colonies since the early 1990s, losses to harvest have occurred in most years (Figure 17), with 2010 and 2016 the only known exceptions. Two large colonies representing more than 60,000 breeding birds were lost due to harvest in 1994 (Hamilton et al. 1995). The two largest breeding colonies in 1995 were destroyed during harvest of the grain nesting substrate (Beedy and Hamilton 1997). At least one colony of 14,000 birds was harvested in 1999 and four colonies were lost to harvest operations in 2000 (Hamilton et al. 1999, Hamilton 2000). Colonies were destroyed in all years from 2005 to 2009, with especially large losses in 2006, 2007, and 2008 (Meese 2009b). In 2008,

several of the largest known colonies were destroyed, with six colonies representing 140,000 breeding birds being cut (Meese 2008). At least three colonies were lost to harvest in 2011, including the largest known colony, which supported 17% of the total known population (Kyle and Kelsey 2011, Meese 2011). At least two colonies in grain fields were destroyed in 2014 during the harvest of nesting substrate and at least three colonies were partially or totally destroyed due to harvest in 2015 (Meese 2014a, 2015b). After a breeding season with no known harvest losses in 2016, a large colony (estimated at up to 12,000 birds) was mostly lost in 2017 when the grain nesting substrate was cut in preparation for harvest (Colibri 2017).

No colonies are known to have been destroyed by harvest in 2010; a settlement on a dairy in Merced County was lost when the grain was harvested, but the harvest occurred during nest building before eggs were laid (Meese 2010). Beginning in 2016, a new partnership was created through a grant from NRCS, with Audubon California, dairy trade organizations, and agencies working together to conduct outreach to dairy owners and to detect and protect breeding colonies. The program succeeded in enrolling all landowners with Tricolored Blackbird colonies identified on their property in 2016, and 100% of known agricultural colonies were protected through delay of harvest. In 2017, most colonies on grain fields at dairies were again protected, but at least one large colony was destroyed when the grain was cut.

It has been argued that protection of colonies breeding on silage fields should be reevaluated because adult birds are unlikely to be killed by harvesting operations and Tricolored Blackbirds are known to breed more than once in a season. DeHaven (2000) and Hamilton (2004a, 2004b) suggested that habitat losses might be more important in population declines than nesting mortality, and resources spent protecting colonies on silage fields might be better spent protecting or restoring habitat. However, second breeding attempts are often less productive than first breeding attempts due to the energetic and physiological costs of egg formation in females, incubation and brooding, and raising of young (Martin 1987, Meese 2008). Even if these costs did not reduce the relative productivity of second breeding attempts, the elimination of a first breeding attempt may cause breeding colonies to miss the period of peak prey abundance, thereby reducing seasonal reproductive success (Martin 1987). Colony destruction through harvest typically occurs well after females have laid eggs and often after eggs have hatched, so the lost energetic input to a failed breeding and the delay before a second attempt likely reduce total annual productivity, even if birds attempt to nest a second time (Meese 2008).

Commented [MH39]: I think the simple facts of something like this are that we don't know the value of loss of habitat vs. nestlings. A whole life cycle model such as the kinds that the Cornell researchers are working on might provide answers.

The Tricolored Blackbird was shown to have experienced low reproductive success from at least 2006 to 2011 (Meese 2013). Reproductive success appears to have always been quite variable across colonies in any given year, and occasional success at large colonies may be important in maintaining the population over time (see Reproduction and Survival section). A number of factors have been shown to influence reproductive success, including predation and shortage of food, but reproductive failures caused by harvest at breeding Tricolored Blackbird colonies on agricultural fields of the San Joaquin Valley may have contributed to population declines through loss of much of the annual reproductive potential of the species in several years.

Overexploitation summary—Although direct killing of Tricolored Blackbirds was once a large source of adult mortality, the number of birds killed declined dramatically after blackbird depredations in rice fields declined in the 1930s. Killing of Tricolored Blackbirds that may be depredating crops during the post-breeding period is likely a continuing source of mortality, but the available data do not indicate this to be a large source of mortality; additional data would be required to determine the degree to which this factor effects the population. Destruction of colonies in agricultural fields has been occurring since Tricolored Blackbirds were discovered nesting in this substrate type in the early 1990s. In recent years, the protections provided to the Tricolored Blackbird as a candidate under CESA, the availability of funds, and a coordinated effort by agencies, the dairy and farming industries, and nonprofit groups has led to a dramatic decline in this source of mortality, but losses of large colonies to grain harvest have continued. The future success of breeding colonies on agricultural crops will depend on the availability of funds to continue programs that locate breeding colonies on grain fields early in the nesting season and compensate farmers for delaying harvest.

Predation

A large number of predators have been observed preying on Tricolored Blackbirds (Table 6), including their eggs or nestlings. Most observations of predation have occurred at breeding colonies when the birds are congregated in dense groups, and most predation has occurred on the eggs, nestlings, or fledglings of Tricolored Blackbirds.

Table 6. Predators of Tricolored Blackbirds.

Taxonomic Group	Predators	Sources
Birds	Black-crowned Night-Heron (*Nycticorax nycticorax*), Cattle Egret (*Bubulcus ibis*), White-faced Ibis (*Plegadis chihi*), Great Blue Heron (*Ardea herodias*), Cooper's Hawk (*Accipiter cooperii*), Swainson's Hawk (*Buteo swainsoni*), Peregrine Falcon (*Falco peregrinus*), Merlin (*Falco columbarius*), Northern Harrier (*Circus cyaneus*), Barn Owl (*Tyto alba*), Burrowing Owl (*Athene cunicularia*), Short-eared Owl (*Asio flammeus*), Yellow-billed Magpie (*Pica nuttalli*), American Crow (*Corvus brachyrhynchos*), Common Raven (*Corvus corax*), Great-tailed Grackle (*Quiscalus mexicanus*)	Mailliard (1900), Neff (1937), Payne (1969), Hamilton et al. (1995), Beedy and Hamilton (1997), Hamilton (2000), Kelsey (2008), Meese (2010), Meese (2012), Airola et al. (2015a), Meese (2016), Beedy et al. (2017)
Mammals	coyote (*Canis latrans*), wolf (*Canis lupus*), gray fox (*Urocyon cinereoargenteus*), raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), long-tailed weasel (*Mustela frenata*), feral domestic cat (*Felis catus*), and possibly mink (*Mustela vison*)	Evermann (1919), Neff (1937), Payne (1969), Hamilton et al. (1995), Beedy and Hamilton (1997), Wilson et al. (2016), Beedy et al. (2017)
Snakes	gopher snake (*Pituophis catenifer*), king snake (*Lampropeltis* sp.), garter snake (*Thamnophis* sp.), and possibly western rattlesnake (*Crotalus oreganus*)	Neff (1937), Payne (1969), Hamilton et al. (1995)

Small areas of native vegetation may be especially vulnerable to predation, especially if they are near sites at which predator populations are artificially high due to the availability of augmented food sources

from human activities. In the early 1990s, Hamilton and others found that many breeding colonies in emergent wetland nesting substrates suffered partial or complete destruction by predation (primarily by Black-crowned Night-Herons; Hamilton et al. 1992, 1995, Hamilton 1993), resulting in consistently lower reproductive success in wetlands compared to other nesting substrates. Beedy and Hamilton (1997) reported that more recently, Black-crowned Night-Herons eliminated all or most nests at several freshwater marsh breeding colonies. Hamilton (2000) later reported that wetland colonies with no Black-crowned Night-Heron predation were highly successful. DeHaven (2000) reported that he also observed high rates of colony failure due to predation in the 1970s, a time when the majority of the population still bred in wetland substrates. Whether recent rates of loss to predation are similar to historical rates of loss is unknown.

In recent decades, complete nesting failures have been caused by novel predators on agricultural grain fields and the increasing concentration of birds in mega-colonies may have increased their susceptibility to nest predation (Kelsey 2008). Cattle Egrets from a single rookery caused complete or near-complete failure of large breeding colonies in Tulare County from 2006 to 2011 (Meese 2012). White-faced Ibis prey on the eggs of the Tricolored Blackbird, and in 2016 caused the complete failure of a large breeding colony on a silage field in Tulare County (Meese 2016, Beedy et al. 2017).

Kelsey (2008) reported a steady increase in population sizes of several avian predators in California, including Black-crowned Night-Heron, Cattle Egret, American Crow, and Common Raven. However, the most recent breeding bird survey data show an increase for only one of these species, the Common Raven, and the data for Cattle Egret have important deficiencies that preclude trend assessment (Sauer et al. 2017b). White-faced Ibis have experienced a large population increase in California since the 1980s (Shuford et al. 1996), but BBS data are inadequate for trend assessment (Sauer et al. 2017b).

Although many species have been documented as predators of Tricolored Blackbirds, most have not had severe effects on the population or on the breeding success at nesting colonies. However, a few species have caused the complete failure of entire breeding colonies through heavy predation on eggs and nestlings. In recent decades, the predators that have destroyed entire colonies have usually been wading birds that hunt in large groups (i.e., Black-crowned Night-Heron, Cattle Egret, and White-faced Ibis). These species have had significant impacts on the overall productivity rate of Tricolored Blackbirds in several years over the last three decades (Hamilton et al. 1995, Cook and Toft 2005, Meese 2012). A few other species, including Common Raven, raccoon, and coyote have had large effects on breeding success, but these predators have typically not caused complete colony failure or have had less widespread effects.

Commented [MH40]: I remember reading something about wetlands becoming overgrown so that terrestrial predators could access them was an important factor.

Interspecific Competition

Red-winged Blackbirds and, less frequently, Yellow-headed Blackbirds, will often nest in the same locations as Tricolored Blackbird colonies, although they may occupy the less-dense portions of a marsh. Where territorial conflicts occur, Tricolored Blackbirds ignore the territorial displays of these other species and overwhelm them with their sheer numbers, displacing them to the fringes of the substrate

or pushing them out entirely (Payne 1969). There is no evidence that competition with these species is limiting the Tricolored Blackbird population (Hamilton et al. 1995).

Beedy et al. (2017) reported that Great-tailed Grackles may be aggressive toward nesting Tricolored Blackbirds but did not consider the impacts severe. White-faced Ibis may destroy Tricolored Blackbird nests when in the process of constructing their own nests, but this occurs infrequently. The Marsh Wren (*Cistothorus palustris*) may destroy eggs in Tricolored Blackbird nests that are in proximity to its own nest (Beedy et al. 2017). Competition with other species does not appear to be a large factor in the survival or reproduction of the Tricolored Blackbird.

Brood Parasitism

The Brown-headed Cowbird (*Molothrus ater*) is known to rarely parasitize nests of Tricolored Blackbirds (Hamilton et al. 1995, Beedy et al. 2017), but brood parasitism is not a major threat to the species.

Disease

Beedy et al. (2017) stated that no diseases have been reported for the Tricolored Blackbird but that in some years many nestlings have mites. Avian pox is prevalent in Tricolored Blackbirds in the Sacramento Valley, and much less so in the San Joaquin Valley (Beedy et al. 2017). West Nile virus (WNV) has been detected in dead Tricolored Blackbirds, as well as in many other species of blackbirds, orioles, and grackles nationwide (www.cdc.gov/westnile/resources/pdfs/Bird%20Species%201999-2012.pdf). Adult Tricolored Blackbirds tested positive for WNV antibodies in 2009 but did not show symptoms of the disease and were assigned a relatively low risk score (Wheeler et al. 2009, Beedy et al. 2017). Although the highly social nature of the species could place the Tricolored Blackbird at greater risk to disease transmission, the impact of disease and parasites on the species is unknown but is not thought to be a major threat to the species.

Contaminants

Feeding in agricultural environments creates numerous opportunities for exposure to contaminants. Mortality of Tricolored Blackbird eggs and nestlings due to chemical contaminants has been suggested in a number of cases. Hosea (1986) reported that two colonies in Colusa and Sacramento counties near rice fields were over-sprayed during aerial application of herbicides resulting in the poisoning of almost all of the nestlings. Beedy and Hayworth (1992) described the effects of possible selenium toxicosis on a Tricolored Blackbird colony by comparing the reproductive success of a colony at Kesterson Reservoir in Merced County, which had a history of selenium contamination, with the success at four other colonies. Nesting failures were documented and deformities in Tricolored Blackbird nestlings were observed at the colony at Kesterson, and livers from dead nestlings collected at Kesterson had elevated levels of selenium. The area was cleaned up and the use of selenium-laden agricultural drain water to maintain the wetlands at Kesterson was discontinued. There have been no apparent selenium impacts on Tricolored Blackbird nesting success since. Hamilton et al. (1995) reported evidence of chemical-induced egg mortality from mosquito abatement operations in Kern County.

In 1995, Hamilton et al. concluded that, “Despite the limited evidence that Tricolored Blackbirds are suffering some mortality as a result of patterns of chemical use in agricultural areas, poisons do not appear to be inducing a serious population problem for Tricolored Blackbirds.” Hamilton (2000) knew of no evidence that toxic contaminants had adversely affected the Tricolored Blackbird since the early 1990s.

Neonicotinoid Insecticides

A relatively new class of insecticides, neonicotinoids, has been implicated in the decline of invertebrate communities and, in a few cases, the decline of insectivorous birds. The application of neonicotinoids has increased dramatically in California, especially since the early to mid-2000s (https://water.usgs.gov/nawqa/pnsp/usage/maps/). Neonicotinoids are relatively stable, and are water soluble so can be incorporated into the tissues of plants. They are commonly applied to crops as seed treatments, with the insecticide taken up systemically by the growing plant (Godfray et al. 2014). In the two decades since their introduction, neonicotinoid insecticides have become the most widely used insecticides in the world (Goulson 2013). They are highly effective at killing insects and have relatively low mammal and bird toxicity. However, at higher concentrations they can have lethal and sublethal impacts to vertebrates (Mineau and Palmer 2013).

Acute toxicity of neonicotinoids has been assessed for only a few bird species, with wide variation in results. Bobwhite and Mallard are the species typically used in acute toxicity testing for regulatory purposes, but where smaller species have been tested, including songbirds, the body weight-corrected dosage resulting in mortality is much lower (Mineau and Palmer 2013). A potential acute impact mechanism for species that are partly granivorous, like the Tricolored Blackbird, is sublethal or lethal effects through the ingestion of neonicotinoid-coated seeds. Ingestion of only a few neonicotinoid-coated seeds (a single seed in the case of corn) might be sufficient to kill a songbird, but there has been little work conducted on the availability and consumption of treated seeds by vertebrates (Goulson 2013, Mineau and Palmer 2013). Although not limited to neonicotinoids, a study that evaluated the effect of multiple potential factors found that acute toxicity of pesticides was the strongest correlate to declines of grassland bird species in the U.S., followed by habitat loss caused by agricultural intensification (Mineau and Whiteside 2013). No data are available on the acute toxicity of any neonicotinoid insecticide specifically to Tricolored Blackbirds, but seeds treated with imidacloprid, a widely used neonicotinoid insecticide, caused ataxia and retching in captive Red-winged Blackbirds and Brown-headed Cowbirds (Avery et al. 1993). These effects were transitory and birds learned to avoid consumption of treated seeds when alternative grains were available. Neonicotinoids may also have chronic toxicity effects (exposure over longer time periods) on reproductive success, but chronic effects are even less studied than acute effects (Mineau and Palmer 2013).

Neonicotinoids may also indirectly affect Tricolored Blackbirds through suppression of insect prey populations. They have been shown to have adverse effects on a number of non-target invertebrate species, with most studies focusing on bees (Hopwood et al. 2012, Godfray et al. 2014). In California, long-term observational data have revealed declines in the number of butterfly species and declines in abundance for many butterfly species in the Central Valley, both of which were negatively associated

with annual application rates of neonicotinoid insecticides (Forister et al. 2016). Imidacloprid was shown to have a negative association with a wide variety of insectivorous bird populations in the Netherlands, suggesting that the pesticide may have led to food deprivation in birds (Hallmann et al. 2014). The evidence linking imidacloprid concentrations to bird population declines was circumstantial, but the authors ruled out confounding effects from other land use changes and showed that the timing of observed declines in bird populations corresponds to the introduction of neonicotinoid insecticides (Goulson 2014, Hallmann et al. 2014).

Depending on environmental conditions, neonicotinoids can persist and accumulate in soils and in waterways, and levels measured in soils, waterways, and field margin plants have sometimes overlapped substantially with concentrations that are sufficient to control pests in crops (Goulson 2013). Neonicotinoids degrade through photolysis when exposed to sunlight and so would not be expected to occur at high levels in clear water (Goulson 2013). However, Starner and Goh (2012) detected imidacloprid in 89% of water samples taken from rivers, creeks, and drains in agricultural regions of California, with 19% of samples exceeding the US Environmental Protection Agency guideline concentration of 1.05 µg/L; this suggests that the insecticide moves off of treatment areas and may impact non-target aquatic insects. Little is known about the uptake of neonicotinoids from soil and soil water by non-target plants, and the downstream effect on non-target invertebrates (Goulson 2013).

A study evaluating landscape effects on Tricolored Blackbird breeding colonies found that colonies are more likely to be located in areas that experience higher neonicotinoid insecticide application rates (NAS 2017). This is likely because most colonies and birds breed in the highly agricultural~~ized~~ Central Valley. The neonicotinoid application rate was also shown to increase during the 2008–2014 study period, suggesting that breeding Tricolored Blackbirds may be exposed to increasing amounts of the insecticides. The effect of this exposure on breeding Tricolored Blackbirds is unknown.

Commented [MH41]: Total area of application? Or amount per unit area. I'm presuming the former but it is not clear from the wording.

Several studies have revealed a negative relationship between insect populations and neonicotinoid use. These results, along with the large increase in application of neonicotinoids, suggest a potential mechanism leading to observed reductions in reproductive success in Tricolored Blackbirds (Meese 2013). It is possible that this relatively new group of insecticides has resulted in declines of non-target insect species within the breeding range of the Tricolored Blackbird resulting in a declining prey base, but no data have been collected that can directly support this. It is also possible that acute effects resulting from ingestion of neonicotinoid-coated seeds has had an impact on the population, but the number of Tricolored Blackbirds suffering sublethal or lethal effects due to exposure to neonicotinoids is unknown. In addition to Tricolored Blackbirds, population declines in insectivorous birds have been documented across North America, with specific examples from California's Central Valley (Nebel et al. 2010, Airola et al. 2014). Neonicotinoids may be playing a role in driving these declines, but more study is needed. There is a need for mechanistic research to compliment results from observational data; these should include testing exposure rates of Tricolored Blackbirds to neonicotinoids, effect of exposure on body condition and fitness (direct effects), and investigations into potential insect-based food-web impacts (indirect effects).

Invasive Species

With the exception of occasional impacts due to nonnative predators (e.g., Cattle Egret, Great-tailed Grackle), invasive species have not been reported to have a large impact on the ability of the Tricolored Blackbird to survive and reproduce. The availability of many nonnative plant species as nesting substrates have allowed the Tricolored Blackbird to breed in locations that would otherwise be unavailable. Invasive species are not considered a major threat to the species.

Weather Events

Hamilton et al. (1995) stated that high mortality of Tricolored Blackbird nestlings can result from severe or prolonged storms and that some observed reproductive failure may be the result of chilling of adult and nestling birds. Also, some adult female mortality at nests appears to have been induced by cold and rainy weather (Hamilton et al. 1995). Heavy winds or precipitation have been documented to knock down nesting substrates, often in triticale or other grain colonies, but also in milk thistle colonies (Meese 2010, 2016), eliminating the reproductive effort for all or a part of breeding colonies. Weather events may have widespread impacts on reproductive success in some years, but impacts are usually isolated and the overall effect on the population's ability to reproduce is limited in most years.

Drought, Water Availability, and Climate Change

Drought reduces water supply reliability and has far-reaching impacts on most habitat types in California (DWR 2014, 2015a). Several significant statewide droughts have occurred in California over the last century (1928–1934, 1976–1977, 1987–1992, and 2007–2009) (DWR 2015a), and California recently experienced the four driest consecutive years of statewide precipitation in the historical record between 2012 and 2014. The winter of 2015 produced a record low statewide mountain snowpack of only 5% of average.

Drought effects on availability of nesting substrate

Tricolored Blackbirds have adapted to use a variety of novel vegetation types as nesting substrate, but wetlands continue to support the largest number of breeding colonies each year. Because of the need for wetlands that are flooded during the spring and summer breeding season, the various approaches to wetland management, and the dependence on water deliveries to maintain wetland habitats in most of the Tricolored Blackbird's range, assessing the availability of suitable wetland nesting substrate in a given year is difficult. A recent method applied reflectance to satellite imagery in order to identify areas of open surface water in the Central Valley (Reiter et al. 2015). Although not an ideal approach to quantifying and assessing distribution of wetlands, the method would identify wetlands with large amounts of open water. In addition, identification of open water on the landscape during the Tricolored Blackbird breeding season is likely a good proxy for the availability of water for wetland management. Reiter et al. (2015) showed that open surface water declined across the Central Valley between 2000 and 2011. Drought had a significant negative effect on open surface water in the late summer and early fall. Cumulative years of drought resulted in a noticeable reduction in surface water. Although not a direct measure of Tricolored Blackbird breeding habitat, declines in surface water during the drought

likely resulted in reduced availability of wetlands with sufficient water to provide high quality nesting substrates.

Although more resilient to dry conditions than wetland vegetation, plants species that provide upland nesting substrate for Tricolored Blackbird colonies also experience negative effects due to drought. After several years of dry conditions during California's most recent drought, many Himalayan blackberry copses that have historically supported Tricolored Blackbird colonies were observed to be dry and mostly barren of leaves. In a few cases, extremely dry blackberry bushes continued to be used by breeding colonies, but many were unoccupied. Milk thistle, which provides high-quality nesting substrate across much of the Tricolored Blackbird range when annual precipitation patterns support vigorous growth, was largely absent from historically used areas until California experienced an average water year in the winter of 2015–2016 (Airola et al. 2016). The wetter weather created nesting substrate in areas that had not been used by Tricolored Blackbirds in several years, and breeding colonies once again occupied these areas.

Drought effects on prey populations

The availability of large insect prey is an important factor in Tricolored Blackbird reproductive success, and may influence colony site selection. Large landscapes with suitable foraging habitat are strong drivers of colony site occupancy and abundance (NAS 2017).

Insect abundance is highly related to biomass of herbaceous vegetation, including important Tricolored Blackbird prey items like grasshoppers in grasslands (Falcone 2010). Climate, especially drought, is thought to play a key role in abundance of grasshoppers and other insect species in grasslands (Vose et al. 2016). The response of insect populations can differ depending on drought severity. For example, non-severe drought and warm temperatures can have a positive effect on grasshopper populations through increased survival and faster population growth (Kemp and Cigliano 1994). However, extreme or prolonged drought can negatively affect grasshopper populations through desiccation of eggs or through decreased biomass of primary producer food sources (i.e., grasses and forbs) (Vose et al. 2016). Reductions in precipitation not only lead to reductions in the abundance of insects in grasslands, but may also make insect prey less accessible through changes in behavior (e.g., moving underground) (Barnett and Facey 2016). Severe droughts likely have strong negative effects on grasshoppers and insect prey biodiversity in general (Kemp and Cigliano 1994, Vose et al. 2016).

The established impacts of precipitation on insect populations in grasslands, especially grasshoppers, suggests a mechanism for drought impacts on Tricolored Blackbird productivity. Research is needed that measures grasshopper and other prey abundance relative to precipitation and primary productivity around occupied Tricolored Blackbird colonies, and evaluates the effect on Tricolored Blackbird reproductive success.

Climate Change

Average annual temperatures have been rising in California in recent decades, and climate models are in broad agreement that temperatures in California will rise significantly over the next century (DWR

2015b). The average temperature is expected to rise by approximately 2.7°F by 2050, and depending on the emissions scenario, average temperatures could increase by 4.1–8.6°F by the year 2100 (Moser et al. 2012). Summer temperatures will rise more than winter temperatures, and the increases will be greater in inland California. As a result, the average number of extremely hot days (at least 105°F) per year in Sacramento is expected to increase fivefold (up to 20 days) by the middle of the century, and may increase to as many as 50 days per year by 2100 (Moser et al. 2012). Tricolored Blackbirds have been observed to cease initiation of breeding when temperatures rose above 90°F, although care of existing nests continued in temperatures over 100°F (Hamilton et al. 1995). Rising temperatures may directly affect annual Tricolored Blackbird productivity by truncating or interrupting the breeding season, although more work is needed on the effect of temperature on initiation and success of nesting attempts.

Along with projected impacts to Tricolored Blackbird foraging habitat due to housing development discussed above, the areas of California with the largest climate-projected effects on a variety of bird species are largely concentrated within the Tricolored Blackbird range in the Central Valley (Jongsomjit et al. 2013). A suite of analyses integrating the effects of climate change and land use changes in California's rangelands concluded that grassland habitat loss in California could reach 37% by the year 2100 (Byrd et al. 2015).

The recent severe drought in California was at least in part due to and made more severe by climate change (Diffenbaugh et al. 2015). Climate change is projected to bring longer and more severe droughts to California in the future (Diffenbaugh et al. 2015, Williams et al. 2015), exacerbating the impacts to Tricolored Blackbird habitat described above. The Central Valley may be particularly vulnerable to warming-driven drought increases in the future (Williams et al. 2015). Water deliveries are projected to be reduced by 5.6% from 2013 to 2033 due to climate change effects on reliability (DWR 2014). Climate change effects on water supplies and stream flows are expected to increase competition among urban and agricultural water users and environmental needs (Moser et al. 2012). This competition may lead to decreases in available wetland nesting substrate provided by private and public land managers. Declines in the availability of water for agriculture may also reduce prey populations provided by high quality crops like alfalfa and rice.

SUMMARY OF LISTING FACTORS

[Note to reviewers: This section will provide summaries of information in the status review, arranged under each of the factors that the Fish and Game Commission must consider in making a determination as to whether listing is warranted (Cal. Code Regs., Tit. 14, § 670.1). These summaries will be prepared after peer review.]

Present or Threatened Modification or Destruction of Habitat

Overexploitation

Predation

Competition

Disease

Other Natural Events or Human-Related Activities

PROTECTION AFFORDED BY LISTING

It is the policy of the State to conserve, protect, restore and enhance any endangered or threatened species and its habitat (Fish & G. Code, § 2052). The conservation, protection, and enhancement of listed species and their habitat is of statewide concern (Fish & G. Code, § 2051(c)). CESA defines "take" as hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill (Fish & G. Code, § 86). The Fish and Game Code provides the Department with related authority to allow "take" of species listed as threatened or endangered under certain circumstances through incidental take permits, memoranda of understandings, natural community conservation plans, or other plans or agreements approved by or entered into by the Department (Fish & G. Code, §§ 2081, 2081.1, 2086, 2087, and 2835).

If the Tricolored Blackbird is listed under CESA, impacts of take caused by activities authorized through incidental take permits must be minimized and fully mitigated according to state standards. These standards typically include protection of the land in perpetuity with an easement, development and implementation of a species-specific adaptive management plan, and funding through an endowment to pay for long-term monitoring and maintenance to ensure the mitigation land meets performance criteria. Obtaining an incidental take permit is voluntary. The Department cannot force compliance; however, any person violating the take prohibition may be punishable under state law.

Additional protection of Tricolored Blackbird following listing would be expected to occur through state and local agency environmental review under CEQA. CEQA requires that affected public agencies analyze and disclose project-related environmental effects, including potentially significant impacts on rare, threatened, and endangered species. In common practice, potential impacts to listed species are examined more closely in CEQA documents than potential impacts to unlisted species. Where significant impacts are identified under CEQA, the Department expects that project-specific avoidance, minimization, and mitigation measures will benefit the species. State listing, in this respect, and consultation with the Department during state and local agency environmental review under CEQA, would be expected to benefit the Tricolored Blackbird in terms of reducing impacts from individual projects, which might otherwise occur absent listing.

For some species, CESA listing may prompt increased interagency coordination and the likelihood that state and federal land and resource management agencies will allocate funds toward protection and recovery actions. In the case of the Tricolored Blackbird, the Tricolored Blackbird Working Group signatory agencies already meet and coordinate regularly, but a state listing could result in increased availability of conservation funds.

LISTING RECOMMENDATION

CESA directs the Department to prepare this report regarding the status of the Tricolored Blackbird in California based upon the best scientific information. CESA also directs the Department based on its analysis to indicate in the status report whether the petitioned action is warranted (Fish & G. Code, § 2074.6; Cal. Code Regs., tit. 14, § 670.1, subd. (f)). In addition to evaluating whether the petitioned action (i.e., listing as endangered) was warranted, the Department considered whether listing as threatened under CESA was warranted.

The Department includes and makes its recommendation in its status report as submitted to the Commission in an advisory capacity based on the best available science. In consideration of the scientific information contained herein, the Department has determined that listing the Tricolored Blackbird as threatened or endangered under CESA is [warranted/not warranted] at this time.

[Note to reviewers: The Department's recommendation will be finalized following peer review and completion of the status review report.]

MANAGEMENT RECOMMENDATIONS

The Department evaluated existing management recommendations and identified the following, listed in no particular order, as necessary to achieve conservation of the Tricolored Blackbird. The *Conservation Plan for the Tricolored Blackbird* (TBWG 2007) identifies goals, objectives, and tasks required to maintain a viable Tricolored Blackbird population throughout the current range of the species. The Department continues to support implementation of the conservation plan as revised by the Tricolored Blackbird Working Group. The goals, objectives, and tasks identified in the plan are not repeated in their entirety here, but many of the management recommendations listed below are related to, or based on, activities identified in the plan.

Habitat Protection, Restoration, and Enhancement

Land ownership patterns across the range of the Tricolored Blackbird, coupled with the diverse nesting and foraging habitats used by the species, necessitate cooperative efforts among government, industry, and the public in order to conserve the species.

Management of habitat must consider the large landscapes utilized by breeding colonies and the integral relationship between nesting colony sites and associated upland foraging areas (Hamilton

1993). Land management plans that do not specifically consider the landscape needs of Tricolored Blackbirds will not necessarily result in the protection or creation of suitable breeding habitat.

1. Determine the best areas for conservation, building off the recent research on habitat suitability conducted by the National Audubon Society (NAS 2017). It is difficult to predict the distribution of widespread species, and even more difficult when the distribution within the range is not stable, as with the dynamic colony site use of Tricolored Blackbirds. Breeding locations that should be prioritized for protection include those that are regularly occupied, those that support large colonies, those that support high reproductive success, and those with a secure foraging landscape (Meese and Beedy 2015).
2. Identify areas in the Tricolored Blackbird range with high quality foraging landscapes, but that lack suitable nesting substrate. Consider conservation actions to create or restore nesting substrate in areas with high probability of use by breeding Tricolored Blackbirds.
3. Secure funding and implement the highest priority nesting substrate protection, enhancement and restoration projects and foraging habitat protection projects.
4. Create a system for tracking habitat protection and restoration projects, including appropriate measures of success. Work with the Tricolored Blackbird Working Group to encourage reporting of habitat projects from all stakeholders.

Commented [MH42]: Consistently high? To account for between year variation. Variation in prey is probably over short time scales relative to the time taken to establish some breeding substrates.

Breeding Colony Protection

In addition to the long-term goal of providing suitable alternative habitat away from silage fields on public and private land, the near-term priority must continue to be placed on identifying and conserving the colonies nesting in silage on private property each year.

5. Fully fund and implement a silage colony protection program. Continue work in the Tricolored Blackbird Working Group's agriculture subcommittee to plan for and implement a silage colony response plan, with participation from a diverse set of stakeholders including members of the dairy industry.
6. Identify locations that regularly support large and productive Tricolored Blackbird breeding colonies, with secure foraging landscape. Prioritize these locations for protection through acquisition or conservation easement.
7. Assess the effectiveness of provision of alternate nesting habitat (e.g., fresh emergent wetlands) to draw birds away from nesting in dairy silage fields (Beedy et al. 2017).

Monitoring and Research

8. Determine the factors that influence nest site selection and especially how relative insect abundance may affect site occupancy (Airola et al. 2016).
9. Determine the amount, type, and distribution of foraging habitat needed to support viable breeding colonies of various sizes. How does type, proximity to colony site, and diversity of foraging habitats influence the extent of foraging habitat required and the rate of reproductive success?

10. Determine the environmental factors that result in abundant large insect prey populations in grassland habitats and in commonly used agricultural crops, and their variability in time and space.
11. Conduct mechanistic research to compliment results from observational data that have shown correlations between neonicotinoid pesticides and declines in songbirds; these should include testing exposure rates of Tricolored Blackbirds to neonicotinoids, effect of exposure on body condition and fitness, and investigations into potential insect-based food web effects.
12. Estimate rates of within season and interannual movements and genetic exchange between populations breeding in different regions, especially between southern California and the Central Valley (Beedy et al. 2017).
13. Quantify annual adult survivorship and investigate factors that affect survival, including the magnitude of post-breeding mortality caused by shooting to reduce crop depredation.
14. Investigate new methods to measure productivity in Tricolored Blackbird breeding colonies. Current methods that utilize nest transects or counts of fledglings might not be comparable, and nest transects can be difficult to implement and may negatively affect breeding birds.
15. Examine degree of colony cohesion between first and subsequent breeding attempts, and between breeding seasons (Beedy et al. 2017).
16. Develop and implement a statistically valid, standardized protocol for the long-term, statewide monitoring of Tricolored Blackbird abundance, including population estimate confidence.

Commented [MH43]: A more general factor in movement might be that birds get exposed to different risks in different areas. There could be a carryover of negative effects of pesticide in one area that has subsequent effects on breeding in another area. Add something like: "There is also a general need for evaluation of habitats used throughout the year to provide continuous habitats and understand when and where threats are encountered."

Commented [MH44]: "Create a standardized method" would be more appropriate.

Education and Outreach

17. Raise awareness of Tricolored Blackbird nesting behavior and conservation options on ranch and farmlands, stressing the importance of protecting large silage nesting colonies. Build off recent efforts by the Tricolored Blackbird Working Group and the dairy industry.
18. Conduct outreach and coordination with landowners whose grazing lands in the foothills support breeding colonies (Airola et al. 2015b).
19. Provide land managers with habitat management guidance for creation and management of Tricolored Blackbird habitat. Continue work recently undertaken by the Tricolored Blackbird Working Group's habitat subcommittee.

ECONOMIC CONSIDERATIONS

The Department is charged in an advisory capacity in the present context to provide a written report and a related recommendation to the Commission based on the best scientific information available regarding the status of Tricolored Blackbird in California. The topic areas and related factors the Department is required to address as part of that effort are biological and not economic, therefore the Department is not required to prepare an analysis of economic impacts (See Fish & G. Code, § 2074.6; Cal. Code Regs., tit. 14, § 670.1, subd. (f)).

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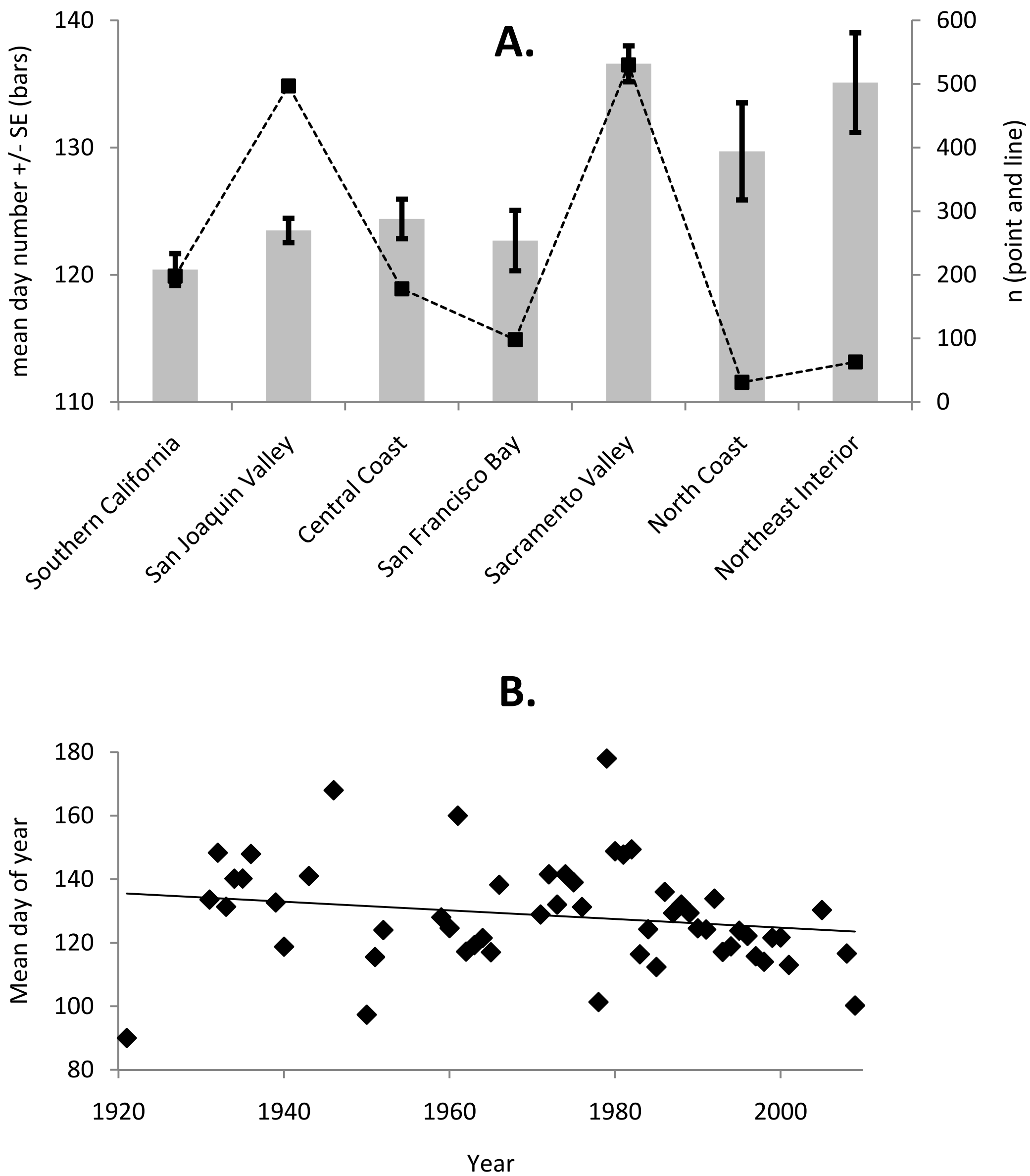
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Regression Summary for Dependent Variable: day of record (Sheet1 in regions_and_substrates.stw)   R= .28044894 R^2= .07865161 Adjusted R^2= .(

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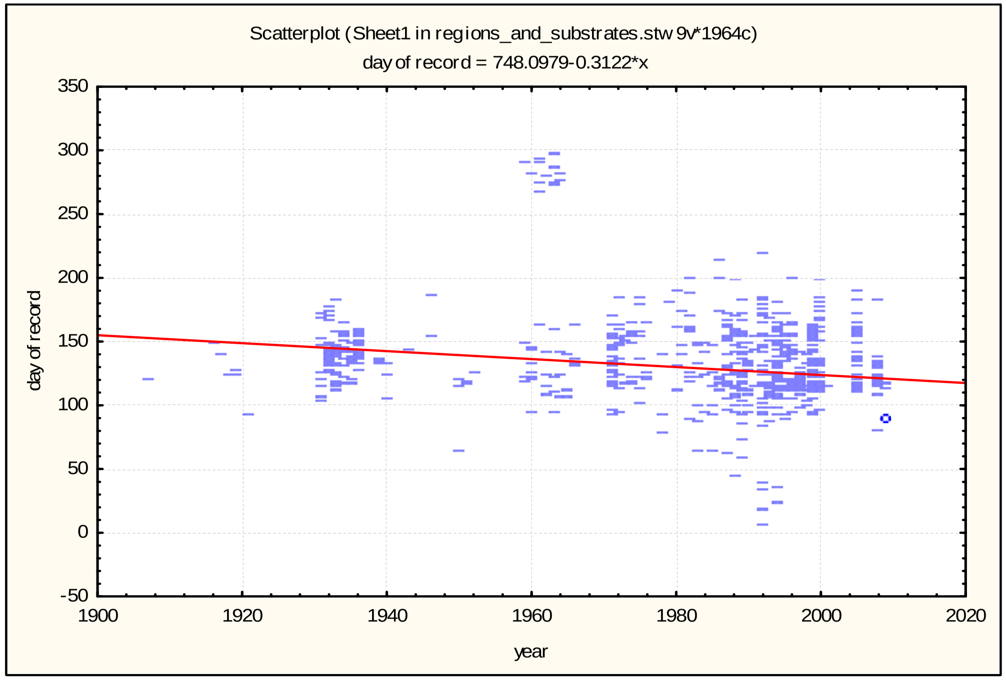

From: Doster, Rob [redacted]
Sent: Friday, November 17, 2017 3:39 PM
To: Clipperton, Neil@Wildlife
Subject: Re: Draft Tricolored Blackbird Status Review - peer review

Hi Neil,

Thank you for the opportunity to review the Draft Status Review of the Tricolored Blackbird in California for the California Department of Fish and Wildlife. I've completed my examination of the primary document and the three appendices. In general, I find the report to be very well written and quite an exhaustive analysis of all that is known about the species, its past and current population status, the various environmental challenges it faces, and current efforts to conserve what is left of Tricolored Blackbirds in California. The document is supported by an extensive range of agency gray literature reports along with many of the primary publications on the species and relevant data sources, all of which help to make this a comprehensive assessment.

I've included a few minor edits and comments in Track Changes for the main assessment and Appendix 1 (I made no marks on Appendices 2 or 3) and those are attached to this message. In addition to those marks, I have just a few further comments to offer for consideration, as follows.

1.) Most of the document was easy to read though, however I did find the section under Existing Management (p. 42) to be the slowest to review and my tendency was to skim when reading these details of management plans and HCPs. I suggest perhaps keeping the discussion here brief in the main review document, referring to Table 4 often, and moving the detailed discussions to an appendix.

2.) Our sister agency, the Bureau of Land Management, has had much success in attracting Tricolored Blackbirds to a recently-restored wetland at their Atwell Island Restoration Project site (Tulare County) inside of the former Tulare Lake bed. In the past two years this site has had upwards of 10,000 breeding Tricolored Blackbirds in restored cattail and bulrush marsh. I think it would be noteworthy to bring attention to this site, and the BLM, in the Existing Management section.

3.) In many locations throughout the document the illegal destruction of nesting colonies due to agricultural harvest is mentioned. I agree that this constant loss of reproductive output through destruction of nests, eggs, and nestlings likely has contributed to a decline in the overall Tricolored Blackbird population. What surprises me, however, is that there is no mention of this activity being stopped as a violation of Federal and State laws. I know that law enforcement action is a very sensitive subject, however, in my view, it deserves some mention of whether enforcement actions have had success in stopping destruction of nesting colonies. I believe that in 2006 the Service declined to list Tricolored Blackbirds under ESA, in part, because they were currently afforded protections under existing laws. True, but that protection is only useful if those existing laws are enforced. This Status Review may not be the best place to bring up this argument, but I think if the California Fish and Game Commission is considering a CESA listing, at least some mention of the necessity of law enforcement actions to protect the species is warranted.

Thank you again for the opportunity to provide feedback on this important assessment. If you have any questions about my review comments and suggestions, please don't hesitate to contact me.

Regards,
Rob

STATE OF CALIFORNIA
NATURAL RESOURCES AGENCY
DEPARTMENT OF FISH AND WILDLIFE

REPORT TO THE FISH AND GAME COMMISSION
A STATUS REVIEW OF THE
TRICOLORED BLACKBIRD
(*Agelaius tricolor*) IN CALIFORNIA

CHARLTON H. BONHAM, DIRECTOR
CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE
Draft – October 13, 2017

CONFIDENTIAL—CDFW EXTERNAL PEER REVIEW DRAFT—DO NOT CIRCULATE

Table of Contents

EXECUTIVE SUMMARY

[Note to reviewers: The executive summary will be prepared after peer review.]

REGULATORY FRAMEWORK

Petition Evaluation Process

A petition to list the Tricolored Blackbird (*Agelaius tricolor*) as endangered under the California Endangered Species Act (CESA) was submitted to the Fish and Game Commission (Commission) on August 19, 2015 by the Center for Biological Diversity. Commission staff transmitted the petition to the Department of Fish and Wildlife (Department) pursuant to Fish and Game Code section 2073 on August 20, 2015, and published a formal notice of receipt of the petition on September 4, 2015 (Cal. Reg. Notice Register 2015, No. 36-Z, p. 1514). The Department's charge and focus in its advisory capacity to the Commission is scientific. A petition to list or delist a species under the CESA must include "information regarding the population trend, range, distribution, abundance, and life history of a species, the factors affecting the ability of the population to survive and reproduce, the degree and immediacy of the threat, the impact of existing management efforts, suggestions for future management, and the availability and sources of information. The petition shall also include information regarding the kind of habitat necessary for species survival, a detailed distribution map, and any other factors that the petitioner deems relevant" (Fish & G. Code, § 2072.3).

On October 2, 2015, the Department provided the Commission with its evaluation of the petition, "Evaluation of the Petition from the Center for Biological Diversity to List Tricolored Blackbird (*Agelaius tricolor*) as Endangered Under the California Endangered Species Act," to assist the Commission in making a determination as to whether the petitioned action may be warranted based on the sufficiency of scientific information (Fish & G. Code, §§ 2073.5 & 2074.2; Cal. Code Regs., tit. 14, § 670.1, subds. (d) & (e)). Focusing on the information available to the Department relating to each of the relevant categories, the Department recommended to the Commission that the petition be accepted.

At its scheduled public meeting on December 10, 2015, in San Diego, California, the Commission considered the petition, the Department's petition evaluation and recommendation, and comments received. The Commission found that sufficient information existed to indicate the petitioned action may be warranted and accepted the petition for consideration. Upon publication of the Commission's notice of its findings, the Tricolored Blackbird was designated a candidate species on January 8, 2016 (Cal. Reg. Notice Register 2016, No. 2-Z, p. 57).

Status Review Overview

The Commission's action designating the Tricolored Blackbird as a candidate species triggered the Department's process for conducting a status review to inform the Commission's decision on whether to list the species. At its scheduled public meeting on December 8, 2016, in San Diego, California, the

Commission granted the Department a six-month extension to complete the status review and facilitate external peer review.

This status review report is not intended to be an exhaustive review of all published scientific literature relevant to the Tricolored Blackbird; rather, it is intended to summarize the key points from the best scientific information available relevant to the status of the species. The final report represents the Department's evaluation of the current and future conservation status of the species and is informed by independent peer review of a draft report by scientists with expertise relevant to Tricolored Blackbird. It is intended to provide the Commission with the most current information on the Tricolored Blackbird and to serve as the basis for the Department's recommendation to the Commission on whether the petitioned action is warranted. The status review report also presents identification of habitat that may be essential to the continued existence of the species and provides management recommendations for recovery of the species (Fish & G. Code, § 2074.6). Receipt of this report is to be placed on the agenda for the next available meeting of the Commission after delivery. At that time, the report will be made available to the public for a 30-day public comment period prior to the Commission taking any action on the petition.

Existing Regulatory Status

California Endangered Species Act

The Tricolored Blackbird was the subject of three previous CESA listing petitions. In 1991, the Yolo chapter of the National Audubon Society submitted a petition to the Commission to list the species as endangered. After reviewing the document and other available information, the Department determined that the petitioned action might be warranted and recommended to the Commission that it accept and consider the petition. In March 1992, the Commission voted to accept the petition and designated the Tricolored Blackbird as a candidate for listing. Researchers working during the 1992 breeding season discovered that the population was much larger than previously thought and the Yolo Audubon Society withdrew the petition based on the new population data. The Commission allowed the petition to be withdrawn, but urged the Department to work with interested persons and groups to develop conservation measures for the Tricolored Blackbird. The species was again petitioned to be listed under CESA in 2004 (Cal. Reg. Notice Register 2004, No. 18-Z, p. 568). The petition evaluation report by the Department (Gustafson and Steele 2004) stated there was sufficient information to indicate the petitioned action may be warranted; however, the Commission voted to reject the petition (Fish and Game Commission meeting, Feb. 3, 2005). On October 8, 2014, the Center for Biological Diversity submitted a petition to list the Tricolored Blackbird as endangered (Cal. Reg. Notice Register 2014, No. 44-Z, p. 1861). The Commission referred the petition to the Department for an initial evaluation on October 15, 2014. At its December 3, 2014 meeting in Van Nuys, California, the Commission voted to take emergency action to add Tricolored Blackbird to the list of endangered species pursuant to Fish and Game Code section 2076.5, with the related regulation as approved by the Office of Administrative Law taking effect for an initial term of six months beginning on December 29, 2014 (Cal. Reg. Notice Register 2015, No. 2-Z, p. 91). At its meeting in Mammoth Lakes on June 11, 2015,

the Commission voted to reject the 2014 petition and on June 30, 2015 the emergency regulation adopted in December 2014 expired by operation of law.

Federal Endangered Species Act

The Tricolored Blackbird also has a listing history under the federal Endangered Species Act (ESA). In 1988, the United States Fish and Wildlife Service (USFWS) contracted for a compilation of all historical information on distribution and abundance of the Tricolored Blackbird, resulting in the work of Beedy et al. (1991). In 1991, the USFWS identified the Tricolored Blackbird as a category 2 candidate for federal listing. However, in 1996, the USFWS eliminated category 2 species from the list of candidate species. In 2004, the USFWS received a petition to list the Tricolored Blackbird as a threatened or endangered species from the Center for Biological Diversity. In 2006, the USFWS issued a 90-day finding in response to the petition that listing the Tricolored Blackbird was not warranted (50 CFR Part 17, Dec 5, 2006). On February 3, 2015, the Center for Biological Diversity submitted a petition to the USFWS to list the Tricolored Blackbird as an endangered species under the federal endangered species act and to designate critical habitat concurrent with listing. The petition is currently under review by the USFWS (50 CFR Part 17, Sept 18, 2015).

California Species of Special Concern and USFWS Birds of Conservation Concern

The Tricolored Blackbird is listed as a Priority 1 Species of Special Concern (SSC) by the Department. The Department's SSC designation is administrative and is intended to alert biologists, land managers, and others to a species' declining or at-risk status, to encourage additional management considerations for these species to ensure population viability, and to preclude the need for listing under CESA. SSCs are defined as species, subspecies, or distinct populations of animals native to California that currently satisfy one or more of the following criteria: extirpated from the state in the recent past; listed under ESA as threatened or endangered, but not under CESA; meets the state definition of threatened or endangered but has not been formally listed; experiencing, or formerly experienced, serious (noncyclical) population declines or range retractions (that have not been reversed), which if continued or resumed could qualify for threatened or endangered status under CESA; has naturally small populations and/or range size and exhibits high susceptibility to risk from any factor that, if realized, could lead to declines that would qualify it for threatened or endangered status (Shuford and Gardali 2008). In 2008, the USFWS updated its Birds of Conservation Concern report, identifying "species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act of 1973" (USFWS 2008). The Tricolored Blackbird was included on two Bird Conservation Region lists (Coastal California and Great Basin), the USFWS Region 8 list (California and Nevada) and the National list. Neither of these "species of concern" designations provides the species with formal regulatory status like the ESA or CESA; however, impacts to SSC are generally considered potentially significant under CEQA, and therefore mitigation for impacts may be provided (see Existing Management section).

Migratory Bird Treaty Act

The Tricolored Blackbird is included on the list of species protected under the Migratory Bird Treaty Act (MBTA). The MBTA makes it unlawful to take, possess, transport, sell, or purchase any bird listed in the Act, or its nest or eggs, without a permit issued by the USFWS.

California Fish and Game Code

The Fish and Game Code includes certain protections for birds, including nongame birds. Sections applicable to the Tricolored Blackbird include the following:

> Section 3503 – It is unlawful to take, possess, or needlessly destroy the nest or eggs of any bird, except as otherwise provided by this code or any regulation made pursuant thereto.
>
> Section 3513 – It is unlawful to take or possess any migratory nongame bird as designated in the Migratory Bird Treaty Act or any part of such migratory nongame bird except as provided by rules and regulations adopted by the Secretary of the Interior under provisions of the Migratory Treaty Act.
>
> Section 3800(a) – All birds occurring naturally in California that are not resident game birds, migratory game birds, or fully protected birds are nongame birds. It is unlawful to take any nongame bird except as provided in this code or in accordance with regulations of the commission.

BIOLOGY AND ECOLOGY

Species Description

The Tricolored Blackbird was first collected by Nuttall in 1836 near Santa Barbara, CA (Nuttall 1840, Baird et al. 1874). A male specimen was sent to John James Audubon who described it as a unique form of blackbird in his well-known *Ornithological Biography* (Audubon 1839).

The Tricolored Blackbird is sexually dimorphic, with the male plumage entirely black except for the bright red lesser wing coverts forming a conspicuous red patch on the wing (“shoulder” or “epaulets”) and white median coverts forming a distinct border to the red. The black body plumage is glossed bluish when viewed in sunlight. The female is mostly dark brown dorsally and heavily streaked ventrally with dark brown streaks merging to form a largely solid dark brown belly (Beedy et al. 2017). The head of the female is indistinctly patterned with a whitish supercilium, malar, chin, and throat.

Although similar in appearance to the related Red-winged Blackbird (*A. phoeniceus*), several features can be used to distinguish the two species (described by Nuttall 1840, Cooper 1870, Baird et al. 1874). The black plumage of the Tricolored Blackbird male has a soft bluish luster that is lacking in the Red-winged Blackbird. The lesser wing coverts (the red “shoulder”) on the male Tricolored Blackbird are a much deeper red (described as crimson, carmine, or the color of venous blood) compared to the brighter red color (vermilion or scarlet) in the Red-winged Blackbird. The median coverts in the Tricolored Blackbird are white (pale-yellowish when fresh) and create a stark contrast between the black

and red feathers on the wing, whereas in the Red-winged Blackbird they are generally yellowish (or black in the subspecies that breeds in much of the Central Valley). The bill of the Tricolored Blackbird averages thinner and can appear more sharply pointed. In flight, the wings of the Tricolored Blackbird appear to have a more pointed shape (vs. rounded in the Red-winged Blackbird) due to differences in length of the primary flight feathers. Female Tricolored Blackbirds have darker plumage than most female Red-winged Blackbirds, although this difference is less pronounced in the Central Valley where the subspecies of Red-winged Blackbird is relatively dark (Beedy et al. 2017).

Taxonomy

The Tricolored Blackbird is a species in the avian family Icteridae, which is restricted to the Americas in the Western Hemisphere and includes blackbirds, orioles, cowbirds, grackles, and meadowlarks (Skutch 1996). There are about 100 species in the family, most of which occur in the tropics. Following recent taxonomic changes that removed several South American species from the genus *Agelaius*, there are currently five species in the genus worldwide (Remsen 2017). In addition to the Tricolored Blackbird, the only other species that occurs on the North America mainland is the much more widespread and diverse Red-winged Blackbird. The other three species in the genus occur in the Greater Antilles: *A. assimilis* (the Red-shouldered Blackbird of western Cuba), *A. humeralis* (the Tawny-shouldered Blackbird of Hispaniola and Cuba), and *A. xanthomus* (the Yellow-shouldered Blackbird of Puerto Rico) (Beedy et al. 2017). There are no recognized subspecies of Tricolored Blackbird (AOU 1957).

Geographic Range and Distribution

The Tricolored Blackbird is nearly endemic to the state of California, with small numbers of birds extending the species' range into neighboring states of Oregon, Washington, Nevada, and Baja California.

Breeding Range

The majority of the Tricolored Blackbird's breeding range is composed of two disjunct regions of California and Baja California, separated by the Transverse Ranges of southern California (Figure 1). The larger of the two areas occupies the lowlands west of the Sierra Nevada, extending west across the Central Valley to the coast from Sonoma County south to Santa Barbara County. The second area is composed of the lowlands west of the deserts in southern California, extending south into northwestern Baja California. Small numbers of birds extend the range to the north in isolated low-lying areas on the northern California coast and to isolated areas in northeastern California, Oregon, and eastern Washington. Similarly, the range extends east from the southern Central Valley to small areas in the Mojave Desert, and to a single area in Douglas County, Nevada (Skutch 1996, Ammon and Woods 2008, Beedy et al. 2017).

Winter Range

In the winter the Tricolored Blackbird mostly withdraws from the portion of its breeding range north of the Central Valley (northeastern CA, Oregon, and Washington) and from Nevada to the lowlands of

central and coastal California (Wahl et al. 2005, Ammon and Woods 2008, Beedy et al. 2017), although a small number of birds are occasionally documented throughout the northern breeding range during winter months (Gilligan et al. 1994, Spencer 2003, eBird Dataset 2016). The species can be found in most of the remainder of its range year-round, with shifts in distribution as described below.

Distribution of Breeding Colonies

Within the breeding range, the largest breeding colonies and the large majority of the breeding population occur in the Central Valley of California (Figure 2b). In all California statewide surveys conducted since 1994, most (≥90% in all years but 1997) of the population has occurred in the Central Valley counties during the early breeding season (Hamilton et al. 1995, Beedy and Hamilton 1997, Hamilton 2000, Kelsey 2008, Kyle and Kelsey 2011, Meese 2014a).

Although the overall distribution and breeding locations vary from year to year, Tricolored Blackbirds exhibit some fidelity to traditional use areas. These areas likely provide all of the critical resources needed by breeding colonies, while the specific nesting sites used in the area can change from year to year (Beedy et al. 1991). In the Central Valley, there are distinct regions that frequently support multiple colonies and a large proportion of the breeding population. In the southern San Joaquin Valley, the largest colonies are typically found annually in an area centered at the junction of Kern, Kings, and Tulare counties (Figure 2). In the northern San Joaquin Valley, Merced County regularly supports multiple large colonies. Further north in the Central Valley and Sierra Nevada foothills, breeding colonies are regularly distributed more broadly from Sacramento County north through the Sacramento Valley to Butte and Colusa counties. In southern California, breeding colonies are located mainly in the western portions of Riverside and San Bernardino Counties, south through the interior of San Diego County (Figure 2; Feenstra 2009). Colonies are patchily distributed throughout the rest of the species' range in California, particularly in the Coast Ranges and on the coastal slope.

The limited range of the species in Oregon, Washington, and Nevada is maintained by irregular occurrences of relatively small numbers of birds (Gilligan et al. 1994, Spencer 2003, Wahl et al. 2005, Ammon and Woods 2008). These neighboring states have historically supported less than 1% of the species' population (Beedy et al. 1991). Although previously more widespread, breeding in Baja California now occurs at only a few isolated locations (Erickson et al. 2007, Erickson and de la Cueva 2008, Feenstra 2013, Erickson et al. 2016). Currently, no more than about 1% of the species' population breeds outside of California.

Breeding colonies typically occur in valleys or low-lying areas with suitable nesting habitat and extensive grassland, agriculture, or other suitable foraging habitat. However, the elevation of colony locations varies greatly across the range. The majority of the population breeds below an elevation of about 300 feet in the Central Valley. In the central Sierra foothills, colonies occur up to 1,720 feet, although most occur near the valley floor at or below about 300 feet elevation (Airola et al. 2015a). In the southern California portion of the range, most colonies occur below about 1,500 feet, although colonies at more inland locations are at higher elevations. Further inland, such as in the Mojave Desert and to the northeast in the Modoc Plateau, colonies occur at elevations up to several thousand feet. Grinnell and

Miller (1944) included a record of 4,400 feet on the "South Fork of the Pit River" in Modoc County. The single breeding location in Nevada is at 4,730 feet elevation (Ammon and Woods 2008).

Winter Distribution

Although Tricolored Blackbirds can be found throughout much of the California breeding range year-round, most birds withdraw from the southern San Joaquin Valley and the northern Sacramento Valley in the winter (Grinnell and Miller 1944, Beedy et al. 2017). Band recoveries and observational studies have documented movement of birds away from these portions of the range toward the central part of the valley surrounding and including the Sacramento-San Joaquin Delta region (Neff 1942, DeHaven and Neff 1973, DeHaven et al. 1975b). There is a general concentration of birds in this region during the winter, as well as in the northern San Joaquin Valley in Merced County and coastal areas north and south of the San Francisco Bay area (Orians 1961a, Payne 1969, Stallcup 2004) (Figure 3). Evidence from banded birds recovered outside the Central Valley is limited, but birds from throughout the northern range are thought to follow the general pattern of winter movement to central and coastal California (DeHaven et al. 1975b, Beedy 2008). Although a relatively large portion of the population winters in this region, wintering flocks can be found at widely scattered points throughout the species' range north of the Transverse Ranges (DeHaven et al. 1975b).

South of the Transverse Ranges, birds from Santa Barbara County south to Baja California appear to occupy the region year-round (Unitt 2004, Beedy 2008), although distribution in the southern portion of the range is patchy in all seasons. Recoveries of birds banded in southern California have revealed much more localized movements compared to those from the Central Valley (Neff 1942, DeHaven and Neff 1973).

Genetics and Population Structure

Hamilton (2004) documented behavioral differences between Central Valley and southern populations of the Tricolored Blackbird, and suggested that a lack of gene flow may have led to genetically distinct populations. While banding studies indicate extensive movement of the Tricolored Blackbird population throughout the entire length of the Central Valley (DeHaven et al. 1975b), DeHaven and Neff (1973) reported on recoveries of banded birds from the Central Valley and southern California and suggested that little or no interchange occurs between populations north and south of the Transverse Ranges. The observation of a single banded bird in the Mojave Desert of northern Los Angeles County was the first data documenting movement of the species from the Central Valley to the desert (Feenstra 2009), although there is a report from the late 1800s documenting a flock of Tricolored Blackbirds moving in the opposite direction (Belding 1890). In 2014 and 2016, the second and third Tricolored Blackbirds that had been banded in the Central Valley were photographed in San Bernardino County, providing further confirmation of movement from the valley to the Mojave Desert (Meese 2014b, Aug 2017 email from R. Meese to N. Clipperton; unreferenced).

A single genetic study on the Tricolored Blackbird did not find evidence of significant population structuring between the Central Valley and a southern population composed of birds from the Mojave Desert and southern California. The birds sampled in the southern population were found to exhibit

higher allelic diversity, suggesting that the southern population may be an important reservoir of genetic variation for the species (Berg et al. 2010). In assessing population structure, it may be inappropriate to combine birds from the Mojave Desert with birds from south of the Transverse Ranges to represent a single southern population, especially if the Mojave Desert birds are linked to the Central Valley. In addition, samples were obtained at only two colonies south of the Transverse Ranges and at two colonies in the desert, sample sizes were small at some sites, and the study used a relatively small number of genetic markers. Researchers at UCLA are currently conducting a study using more advanced genomic techniques to characterize genetic variation, population structure, and spatial and temporal patterns of movement throughout the range of the Tricolored Blackbird (Feb 2017 email from K. Barr to N. Clipperton; unreferenced).

Movements

Most Tricolored Blackbirds are resident in the state of California, with seasonal movements leading to shifts in distribution within the state over the course of a year. Grinnell and Miller (1944) wrote that the Tricolored Blackbird is “resident within State [California], but partly migratory within the Sacramento-San Joaquin drainage system; all populations are in some degree nomadic and in fall and winter normally leave the immediate vicinity of the nesting colonies.” Banding studies (Neff 1942, DeHaven and Neff 1973, DeHaven et al. 1975b) and observations of unbanded birds (Payne 1969) demonstrated that most Tricolored Blackbirds reside throughout the Central Valley March through September, and then move into the Sacramento-San Joaquin Delta and northern San Joaquin Valley (primarily Merced County) and coastal locations during winter. More extensive migratory movements are made by small numbers of birds that breed north of the Central Valley as far north as the state of Washington (Wahl et al. 2005); these migratory individuals apparently mostly return to California in the winter. In southern California south of the Transverse Ranges, birds seem to undergo much more localized seasonal movements compared to those from the Central Valley (Neff 1942, DeHaven and Neff 1973).

Itinerant Breeding

Individual Tricolored Blackbirds often occupy and breed at two or more sites during the breeding season, a phenomenon known as itinerant breeding (Hamilton 1998). Itinerant breeding is a very rare trait among birds, and occurs exclusively in species that move between breeding attempts to locate or follow locally abundant food sources (Jaeger et al. 1986). Although early observers suspected that Tricolored Blackbirds nested more than once in a season at multiple locations (e.g., Neff 1937), the movements of Tricolored Blackbirds have been described as “sheerly and illogically erratic” (Neff 1942), “wanderings” (Payne 1969), and highly nomadic (Beedy et al. 1991). Recoveries of banded Tricolored Blackbirds provided documentation of interannual breeding at widely separated locations, but within-year movements during a single breeding season were not documented prior to the 1990s (Neff 1942, DeHaven and Neff 1973). The movements of Tricolored Blackbirds continue to be somewhat unpredictable from year to year, but Hamilton et al. (1995) demonstrated that most of the adults in the Central Valley breed more than once and often at different locations. This itinerant breeding follows a pattern of initial breeding in the south, mostly San Joaquin Valley and southern foothills to Sacramento County, with a shift north for a second breeding attempt, primarily in the Sacramento Valley and

adjacent foothills. The timing and degree to which this shift occurs vary from year to year (Hamilton 1998). The timing of breeding in Sacramento County was intermediate to that of the San Joaquin and Sacramento Valleys, with initiation of breeding in Sacramento County 10 days later than in the San Joaquin Valley, but over a month before most breeding in the northern Sacramento Valley (Figure 4). On the Central California Coast in Monterey County, 25% of radio-tagged birds moved between study colonies during a breeding season, suggesting itinerant breeding on a smaller scale (Wilson et al. 2016).

The following discussion of seasonal movements is largely from Beedy and Hamilton (1997) and Beedy et al. (2017).

<u>Spring Movements from Wintering Areas</u>

The species vacates wintering areas concentrated around the Sacramento-San Joaquin River Delta and along coastal California in mid-February. Birds arrive at breeding locations and establish colonies in Sacramento County and throughout the San Joaquin Valley from early March to early April (DeHaven et al. 1975b). Colonies at foothill locations adjacent to the San Joaquin and Sacramento valleys may be settled by late March, but many are not settled until May. In southern California and Baja California, the species may nest anytime throughout April and May.

Flocks of Tricolored Blackbirds roam widely within the breeding range in the weeks before breeding begins and between breeding attempts. Breeding season wanderings may serve to locate areas of abundant insect food resources near which breeding colonies are established (Payne 1969). Similar behaviors have been documented in nomadic flocking species of semiarid habitats in Asia, Africa, and Australia, where colonial breeding occurs opportunistically in areas of high prey abundance (Payne 1969).

<u>Breeding Season Movements</u>

During the breeding season, Central Valley birds often move north to the Sacramento Valley after first nesting efforts (March–April) in the San Joaquin Valley and Sacramento County, with small numbers moving further north to northeastern California and southern Oregon (Beedy and Hamilton 1997, Hamilton 1998). On the floor of the Sacramento Valley north of Sacramento County, the largest colonies are typically not settled until May or early June. Recent banding results suggest a degree of colony cohesion, where many birds at a colony may move and breed together again in a new location, but banding results also suggest a high degree of mixing between breeding attempts. Although later nesting is typical in northern portions of the range, small colonies may form throughout the breeding season anywhere in the geographic distribution (Hamilton 1998). Radio telemetry studies have shown that birds move from one breeding colony to another while both are active, due presumably to reproductive failures at the first colony, but the causes of these movements remain undocumented (Wilson et al. 2016).

Post-breeding Movements

Most Central Valley birds occur in the Sacramento Valley at the end of the breeding season and remain until mid-September, apparently attracted to ripening and recently harvested rice (DeHaven et al. 1975b). In mid-September most move south into the Sacramento-San Joaquin Delta, Merced County, and coastal locations.

Winter Movements

In winter, numbers decline in the Sacramento Valley and increase in the Sacramento-San Joaquin Delta and northern San Joaquin Valley (Neff 1942, Orians 1961a, Payne 1969, DeHaven et al. 1975b). Large foraging flocks have traditionally occurred in pasturelands in southern Solano County by late October and may join large flocks of several blackbird species to roost on islands in the eastern part of Suisun Marsh. Wintering flocks formerly numbering more than 10,000 birds assembled near dairies on the Point Reyes Peninsula, Marin County, by mid-October, but these numbers have been reduced in recent years. Highly variable numbers of birds also winter in the central and southern San Joaquin Valley, with flocks of hundreds or thousands seen in most years in the general area where large colonies breed in the early spring (Kern and Tulare counties; eBird Dataset 2016). Winter flocks consist at times of only Tricolored Blackbirds, either mixed-sex or single-sex, and at other times Tricolored Blackbirds occur in mixed-species blackbird flocks. Birds from one large winter roost in Sacramento County foraged over an area 32 km in diameter (Neff 1937). Winter distribution and movements need further study.

Home Range and Territoriality

Unlike most species of songbirds that defend a territory in which they nest and acquire most of their necessary resources, the Tricolored Blackbird breeds in dense colonies in which adult males defend only a small area surrounding the nest site, and this only until nests are established and eggs are laid (Lack and Emlen 1939, Payne 1969). Nest density and male territory size can vary among colonies with individual nests in the densest colonies built within a foot or less of each other (Hosea 1986, Beedy et al. 1991). In some cases two nests may even share interwoven strands of nest material (Lack and Emlen 1939). Male territories have been measured from 1.8 m^2 to 3.25 m^2 (Lack and Emlen 1939, Orians 1961) and nest densities have been observed at up to six nests per square meter (Beedy et al. 2017). The greatest nesting density reported occurred in a rare nesting substrate, giant cane (*Arundo* sp.), with 2,500 adults nesting in an area 42 x 13 feet (equivalent to 4.5 birds per square foot) (DeHaven et al. 1975a).

The small territories in dense breeding colonies cannot supply sufficient food for the adults and for the growing young, therefore most foraging occurs away from the colony site. While breeding, most foraging occurs within 2–3 miles of colony sites (Orians 1961, Hamilton et al. 1992), although longer foraging flights have been documented (up to 8 miles or more). Typically, only a portion of the landscape surround a breeding colony is suitable for foraging and the range used by individual birds in colonies is variable depending on the extent and quality of the foraging landscape.

Colonial Breeding and Social Behavior

> "To one in search of something utterly different I can heartily recommend an hour, or a day, in a Tricolor swamp… *Agelaius tricolor* is intensely gregarious, more so than perhaps any other American bird. Every major act of its life is performed in close association with its fellows… the very day of its nesting is agreed upon in concert. In continuous procession the individuals of a colony repair to a field agreed upon in quest of building material; and when the babies are clamoring the loudest for food, the deploying foragers join their nearest fellows and return to the swamps by platoons and volleys, rather than as individuals." – Dawson (1923).

Coloniality in birds is typically defined as the breeding by a number of individuals at a more or less centralized place from which colony residents regularly depart from to search for food. This breeding strategy is most common among seabirds, in which more than 95% of species nest colonially (Danchin and Wagner 1997), and is relatively uncommon among North American landbirds.

The Tricolored Blackbird forms by far the largest breeding colony aggregations of any North American landbird (Neff 1937, Lack and Emlen 1939, Orians 1961, Skutch 1996). Bent (1958) found that the Tricolored Blackbird "nests in enormous, most densely populated colonies, the nests being placed more closely together than in any other colonies of marsh-nesting blackbirds." Grinnell and Miller (1944) stated, "one essential would seem to be provision at the site of the colony for a large number of individuals. Nests apparently must be close together and pairs usually [must be] in excess of 50 in order to meet the instinctive requirements of the species." Breeding colonies are seldom smaller than 100 nests, and in the past have been as large as 100,000 to 200,000 nests (Neff 1937, Orians 1961). Each male breeds, on average, with two females resulting in a skewed sex ratio at many breeding colonies (Lack and Emlen 1939, Orians 1961, Payne 1969, Hamilton 1998, Beedy and Hamilton 1999). Although Payne (1969) observed breeding colonies consisting of as little as four nests, of the 21 colonies monitored, no colonies containing less than 100 nests were successful in fledging young.

While the great concentration of birds in a small area is the most conspicuous feature of Tricolored Blackbird colonies, the degree of synchrony among members of the colony is no less unique (Orians 1960). Breeding within a colony is often highly synchronized, with all females in a colony typically initiating nest building within a few days (Orians 1961, Payne 1969). A flock of Tricolored Blackbirds can appear in an area in which it has been absent for months and begin nesting within days (Orians 1961). Food resources for both the breeding adults and for the provisioning of young are mostly obtained from sites away from the colony location. Insect-rich foraging areas appear to be identified and utilized by all or large portions of the breeding adults in a colony until the prey base is exhausted, at which time new areas are identified and breeding birds collectively shift to new foraging sites.

<u>Occupancy dynamics</u>—Tricolored Blackbird breeding colonies frequently shift locations from year to year, though sites used each year often occur in the same traditionally used areas. In some cases Tricolored Blackbirds exhibit high inter-annual site fidelity, perhaps driven by the continued availability of essential resources, including suitable nesting substrate, water, and foraging habitat (Beedy and

Hamilton 1997). Of 72 occupied colony locations between 1992 and 1994, only 19 (26%) were active in all three years and an additional 11 (15%) were active in at least two years (Hamilton et al. 1995). In the central Sierra Nevada foothills, 58% (11 of 19) of occupied breeding colony sites in 2015 were also occupied in 2014 (Airola et al. 2015b). Of 44 sites surveyed during a three year period in the central foothills, only eight (18%) were active in all three years and seven (16%) were active in two of three years (Airola et al. 2016). Of four colony locations monitored for three consecutive years in coastal Monterey County, all four were occupied in one year and only two were occupied in the other years (Wilson et al. 2016). Annual occupancy rates vary across nesting substrate types, with wetland, thistle, and Himalayan blackberry locations having similar rates of about 40% (Holyoak et al. 2014). Occupancy rates are lower for triticale and other grain sites and higher for nettle colony sites. Although any given site may be unoccupied in some years, birds often return to sites over longer time periods and some sites are used in almost every year. Hosea (1986) reported on a colony that had been occupied for more than 30 years in Sacramento County, and was able to locate several active colonies by visiting locations reported in the literature decades earlier. The result of these complex occupancy dynamics is an extremely variable rate of site fidelity over the short-term, but fidelity to breeding locations and general breeding areas are high over the longer term.

Beedy et al. (1991) compiled all available information on breeding colony locations and identified 696 historical breeding colony locations. As of the 2016 breeding season, the number of known historical and current breeding colony locations had grown to 1,272, including all records since 1907 (Figure 2a). The large majority of these historical locations are not used in any given year, and many no longer meet the habitat requirements of the species and so are no longer considered suitable. During recent thorough statewide surveys conducted between 2008 and 2014 the number of occupied breeding locations has averaged about 140 (Kelsey 2008, Kyle and Kelsey 2011, Meese 2014). New locations are discovered each year, while other sites cease to be used. This turnover of breeding locations likely reflects shifting habitat conditions across the range and results in complex occupancy dynamics described above. Most sites, once established, are used repeatedly over the course of many years.

Fluctuations in colony site selection and colony size have been attributed to a response of Tricolored Blackbirds to changes in local insect abundance within and across years (Orians 1961, Payne 1969, DeHaven et al. 1975a). Their colonial breeding behavior requires that the foraging landscape surrounding the nest site provide abundant insect food sources. The colonial nesting, compressed breeding cycle, and social structure of Tricolored Blackbirds are well suited for rapid exploitation of unpredictable resources when they become temporarily very abundant. Initiation of nesting may also be triggered by an abundant food source (Payne 1969).

In some cases, large breeding colonies have been observed to exhibit higher reproductive success than smaller colonies (Orians 1961, Payne 1969, Hamilton et al. 1992), and in some years a few large colonies have been responsible for the majority of the reproductive output for the year (Hamilton 1993). However, there are many examples when a positive correlation between colony size and reproductive success was not observed, and a wide variation in reproductive success has been observed in both small and large colonies (Payne 1969, Meese 2013).

Adaptive advantages of colonial breeding may be conferred by decreasing risk of predation or increasing foraging efficiency (Ward and Zahavi 1973, Beauchamp 1999), both of which could lead to increased success in production of young. The following mechanisms have been proposed as advantages to colonial breeding:

1. Predator avoidance
2. Joint anti-predator responses
3. Predator satiation
4. Social food-finding
5. Information sharing

Predator avoidance—Colonial breeding birds frequently select sites that are inaccessible to predators (Ward and Zahavi 1973), or in some cases that are naturally free of predators (e.g., seabirds nesting on isolated islands). Tricolored Blackbirds typically select breeding locations that provide a degree of protection from predators, either by selecting inaccessible sites (e.g., wetlands surrounded by or inundated by relatively deep water) or protective nesting substrates (e.g., dense, thorny, or spinous vegetation) that limit access to predators. Wetland sites may primarily limit access to terrestrial predators, whereas some dense or armored substrates may also limit access by predatory birds. In the case of a nomadic species like the Tricolored Blackbird, which does not necessarily use the same breeding location each year due to annual shifts in substrate suitability, social behavior may enhance the ability to locate these suitable locations.

Anti-predator responses—Social mobbing of predators or other aggressive behaviors is a common trait among colonial nesting birds. However, Tricolored Blackbirds do not exhibit strong defensive responses to the presence of a predator. Unlike Red-winged Blackbirds that will fiercely defend territories from potential predators that approach the nest, Tricolored Blackbirds provide little in the way of defense to eggs or nestlings (Skutch 1996). For example, when a hawk is sighted the adults in a colony may stop vocalizing and settle low within the nesting substrate, with the entire colony sometimes going silent (Orians and Christman 1968, Payne 1969). Adults may hover in the vicinity of a predator as nestlings are taken, but no pursuit of the predator is offered. Complete reproductive failure in colonies of thousands of birds can result from the efforts of relatively few predators (Beedy and Hamilton 1999). Tricolored Blackbirds do not benefit from social anti-predator responses.

Predator satiation—The massive quantity of readily available prey in the form of eggs or nestlings at a Tricolored Blackbird breeding colony may reduce the chance of loss of any one nest by satiating territorial predators (e.g., raptors). Payne (1969) observed a single pair of Northern Harriers preying on a Tricolored Blackbird colony of 10,000 nests, with no impact on the large majority of the colony. Satiation of predators may be less likely in species that hunt in groups, such as many species of wading birds. In recent decades, Cattle Egrets and White-faced Ibis have caused complete failure of large breeding colonies (Meese 2012, 2016). Predator satiation may provide a benefit to breeding Tricolored Blackbirds, depending on the number and type of predators.

Food-finding and information sharing—Roosting and colonial birds may take advantage of social behavior to more efficiently locate patches of concentrated food resources, and colony sites may serve as information centers where locations of good feeding sites can be shared among individuals (Ward and Zahavi 1973, Emlen and DeLong 1975, Brown 1988). Under this scenario, larger colonies may be more successful because there is a larger pool of information on the whereabouts of good feeding places within the foraging area being exploited by the colony (Ward and Zahavi 1973). This increased foraging efficiency, along with the highly synchronized nesting and the compressed length of a nesting cycle in Tricolored Blackbirds, may ensure that temporarily abundant prey will remain available to the young in a colony for the duration of the breeding cycle. Coloniality may result from situations when suitable breeding sites are limited among areas of high food availability (Danchin and Wagner 1997).

Because of occasional destruction of entire Tricolored Blackbird breeding colonies by predators and observations of prey-following by adults, Orians (1961) and Payne (1969) suggested that colonial nesting by Tricolored Blackbirds is more likely related to location and exploitation of a locally abundant food supply than to a strategy of predator avoidance or response. However, the choice of flooded or dense and armored vegetation for breeding suggests that suitable nesting locations provide some protection from predators, and predator satiation may be a successful strategy for confronting territorial predators.

Habitat that May be Essential for the Species' Continued Existence in California

For breeding, Tricolored Blackbirds require three critical resources: 1) secure nesting substrate, 2) a source of water, and 3) suitable foraging habitat.

Nesting Substrate

The nesting substrate for Tricolored Blackbird breeding colonies is defined as the vegetation in which nests are constructed. In most cases the nesting substrate is either flooded by water, as in wetland colony sites, or is composed of thorny or spiny vegetation that is impenetrable to many predators (Beedy and Hamilton 1997). In some cases, Tricolored Blackbird colonies occur in upland nesting substrates that lack these protective characteristics (e.g., silage grain, weedy mustard fields); in these cases the nesting substrate is usually extremely dense and therefore may provide similar protection.

The majority of Tricolored Blackbird breeding colonies have occurred in one of five nesting substrate types: 1) wetlands (either cattail [*Typha* sp.] or bulrush [*Schoenoplectus* sp.] vegetation), 2) Himalayan blackberry (*Rubus armeniacus*), 3) thistle, usually milk thistle (*Silybum marianum*) or bull thistle (*Cirsium vulgare*), 4) stinging nettle (*Urtica* sp.), or 5) agricultural grain fields, especially triticale, a wheat-rye hybrid grain grown as silage for dairy cattle. Several additional nesting substrates have been used to a lesser degree (less than 5% of colonies in total), with the more common being mustard (*Brassica* sp.), willows (*Salix* sp.), mallow (*Malva* sp.), wild rose (*Rosa* sp.), tamarisk (*Tamarix* sp.), and giant reed (*Arundo* sp.) (Beedy et al. 1991, Beedy and Hamilton 1997, Beedy et al. 2017, Tricolored Blackbird Portal 2017).

The primary nesting substrates used by Tricolored Blackbirds have different distributions across the breeding range in California (Figure 5). Wetland sites with cattail or bulrush substrate are fairly evenly

distributed across the range. Himalayan blackberry sites are mostly restricted to Merced County and north through the Sierra foothills to the Sacramento Valley. Triticale and other agricultural grain sites are found mainly in the southern San Joaquin Valley and Merced County, with a few additional sites in southern California. In recent years stinging nettle sites have mainly occurred in the southern San Joaquin Valley portion of Kern County including the surrounding foothill grasslands, although historically they were also common at the extreme northern portion of the California range in Siskiyou and Shasta counties. Thistle sites have been located throughout much of the range in California, and ~~has~~ have been the primary nesting substrates used in the southern Sierra Nevada foothills (Airola et al. 2016). Thistle sites are typically only available to breeding Tricolored Blackbirds in years with weather patterns that support abundant thistle growth.

Historically, most breeding colonies were in freshwater marshes dominated by cattails and tules (Beedy 2008). In the 1930s, 93% of breeding colonies were in freshwater marsh vegetation with the remaining colonies in willows, blackberries, thistles, and nettles (Neff 1937). The proportion of colonies in freshwater marshes had decreased to about 70% by the 1970s as Tricolored Blackbirds began using novel, nonnative vegetation types, especially Himalayan blackberry and thistles (DeHaven et al. 1975a). By 2008, the proportion of colonies established in freshwater marsh during the statewide survey had declined to 35% (Kelsey et al. 2008).

Tricolored Blackbirds are known to have bred in blackberry bushes from the early 1900s (Booth 1926, Neff 1934, 1937), but this was a very infrequent occurrence. Sacramento County has a long history of breeding by Tricolored Blackbirds, with colonies in the 1930s found entirely in wetland substrates and colonies in the 1970s still mainly located in wetlands (Neff 1937, DeHaven et al. 1975a). In the 1980s and 1990s, an increasing percentage of breeding colonies were reported in nonnative Himalayan blackberry (Hosea 1986, Beedy and Hamilton 1997). Over 55,000 breeding Tricolored Blackbirds were located in Sacramento County in 1993, with the large majority of these in Himalayan blackberry and a small number in wetland substrates (Hamilton 1993). Himalayan blackberry is currently the dominant nesting substrate throughout the northern and central Sierra Nevada foothills. From 2014 to 2016, 65–80% of foothill colonies have occurred in Himalayan blackberry annually (Airola et al. 2016). Between 1994 and 2004, a large shift from cattail marsh colonies to Himalayan blackberry colonies occurred in the rice-growing region of Sacramento Valley (Hamilton 2004a). This was in part due to the loss or destruction of specific cattail marsh sites, but was also likely due in part to an increase in distribution of Himalayan blackberry.

Commented [RHD1]: Seems like the overall loss of wetland habitat is the main culprit in the shift. Do we know when Himalayan blackberry was introduced or when it really began to proliferate in CA?

Tricolored Blackbirds were discovered breeding in grain fields in the San Joaquin Valley in 1991 and 1992 (Hamilton et al. 1992). Prior to this, nesting in large cultivated grain fields was unknown and little work on the status of the species in the southern San Joaquin Valley had been conducted (Beedy et al. 1991, Hamilton et al. 1992). The only previous report of nesting in a cultivated grain field was from 1944, when a colony was observed in mustard-infested barley (Bent 1958). The discovery of breeding on grain fields in the 1990s corresponded to an increase in planting of triticale. This wheat-rye hybrid grain may be attractive to breeding Tricolored Blackbirds due to its robust structure that is well suited to support nests and it dense growth that is relatively impenetrable to terrestrial predators. Relatively little triticale had been planted for silage in the San Joaquin Valley by 1994, but by 2005 the planted acreage had

grown to about 75,000 acres (Aksland and Wright 2005). Of the nesting substrates used by Tricolored Blackbirds, triticale and other grain fields are unique in that they are available in abundance each year in the San Joaquin Valley, and in recent years, many of the largest colonies have occurred on grain fields. Fifty percent of the breeding Tricolored Blackbirds detected in California during the 2008 statewide survey were observed nesting in triticale fields (Kelsey 2008).

During the April 2011 statewide survey, the majority of colonies (54%) in the San Joaquin Valley and Tulare Basin were located on agricultural grain crops, with an additional 22% in milk thistle. Conversely, 70% of colonies in the Sacramento Valley and Sierra Nevada foothills were in Himalayan blackberry. The majority of colonies in southern California, on the central coast, and in extreme northern California continued to occur in wetland habitats. Statewide, wetlands continued to support more colonies than any other substrate type (37%), although these wetland colonies supported only 5% of the population (Kyle and Kelsey 2011).

The areal extent of nesting substrate used by breeding Tricolored Blackbird colonies has ranged from a few square meters to more than 200 acres (Tricolored Blackbird Portal 2017). The smallest colonies have occurred in a variety of nesting substrate types, including cattail or bulrush marsh, Himalayan blackberry, and willows. The largest colonies of 100 acres or more have been located in triticale in recent years, although historically very large colonies occurred in wetland habitats (Neff 1937). The large majority of colonies occupy less than 10 acres of nesting substrate, with many being smaller than one acre. DeHaven et al. (1975a) found that the area occupied by nests in all substrates types averaged less than two acres per colony, and the largest colonies observed from 1968 to 1972 occupied only 10 acres.

Nest densities vary widely across nesting substrates. DeHaven et al. (1975a) observed densities up to 66,670 nests per acres (100,000 breeding adults per acre) in Himalayan blackberry colonies, with the average density in blackberry colonies closer to 16,000 nests per acre. Densities in other common nesting substrates (cattails, bulrush, thistle, and willows) had densities of up to 13,340–20,000 nests per acres (20,000–30,000 breeding adults per acre), with average densities ranging from 3,300 to 4,800 nests per acre (DeHaven et al. 1975a).

Water

Breeding Tricolored Blackbirds require an open, accessible water source in the vicinity of the breeding location. Adults use the water for drinking and bathing, and will sometimes submerge insect prey items before provisioning young. The requirement for open water can be met by any of a number of sources, including wetlands, streams, ponds, reservoirs, and agricultural canals or ditches. Water must be available within a few hundred meters of the nesting substrate (Hamilton 1995). The loss of local water sources during the nesting cycle has caused entire colonies to abandon their nests (Beedy et al. 1991).

Commented [RHD2]: They also dip nesting material in water to, presumably, make it more pliable for use in construction. I've observed this myself. It's also mentioned by Beedy et al. (2017).

Foraging Habitat

The Tricolored Blackbird breeds in dense colonies with the individual territories that are defended by each male consisting of a very small area. These dense congregations of large numbers of birds exert large pressures on the foraging landscape surrounding the nesting location. Unlike most other landbirds,

Tricolored Blackbirds forage almost exclusively away from the nesting territory, and colonies require suitable foraging habitat with abundant insect prey within a few miles of the colony site. Because provisioning success and the resulting rate of nestling starvation have been shown to influence reproductive success, the availability of high quality foraging habitat is as important to Tricolored Blackbird breeding as is the availability of suitable nesting substrate (Hamilton et al. 1992). The proximity to highly abundant insect food supplies may be a factor in the selection of breeding sites by Tricolored Blackbirds (Neff 1937, Orians 1961, Payne 1969), and their nomadic and colonial behavior may have evolved as a strategy for maximizing the ability to locate and exploit unpredictable and temporarily abundant insect food sources. The required foraging habitat for successful breeding has a much greater spatial extent than nesting substrate. Although data are not available to define the minimum extent of foraging habitat, it has been reported that colonies with less than 200–300 acres of foraging habitat do not persist and access to several thousand acres is necessary to maintain most large colonies (Hamilton 2004b).

Primary foraging habitats during the breeding season include grasslands, shrublands, pastures, dry seasonal pools, and certain agricultural crops including alfalfa and rice, which provide for high production of insect prey for breeding Tricolored Blackbirds. Grasslands and alfalfa have been shown to be important in predicting presence of breeding Tricolored Blackbird colonies, with probability of colony occurrence increasing with increasing proportion of these land cover types within 3 miles (NAS 2017). Adults will also sometimes exhibit aerial foraging above wetland colonies when aquatic insects are hatching (Beedy et al. 2017). Adult birds also frequently feed at cattle feedlots and dairies where they have access to abundant grain sources. Among grassland foraging habitats, Hamilton et al. (1995) reported that ungrazed grasslands were preferred over heavily grazed grasslands by foraging Tricolored Blackbirds, but this conclusion has not been reported in later studies of grassland foraging birds (Meese 2013, Airola et al. 2015a, 2016). Tricolored Blackbirds breeding in agricultural landscapes make little use of most row crops, vineyards, or orchards (Hamilton et al. 1992). During the 2000 statewide survey, Hamilton (2000) found that over 90% of observed Tricolored Blackbird foraging activity occurred on private property.

In Sacramento County, Hamilton et al. (1992) reported that 96% of all foraging by breeding Tricolored Blackbirds occurred in grasslands. This reliance on grasslands by Sacramento County and foothill breeding birds has persisted. In 2014, 90% of birds breeding in the central Sierra Nevada foothills, including Sacramento County, foraged in grasslands and pasture (Airola et al. 2015a).

Mailliard (1900) described the distinctive flight of Tricolored Blackbirds in the process of feeding nestlings as a "stream composed of birds going toward the tules with their bills full of bugs and of equal numbers returning to the fields for fresh supplies." Both prey abundance and proximity to the colony site likely influence the reproductive success of a colony. In at least some cases, adults foraging near the colony site bring few prey items to their young, while adults foraging more distant return with many more prey items (Orians 1980, *cited in* Skutch 1996). This may be a mechanism to conserve energy by making fewer long-distance flights and shows the value of foraging habitats in close proximity to colony sites; however, the possibility that proximate food sources had been exhausted during observations cannot be ruled out. When abundant insect prey are available adjacent to colony locations, adults will

make only very short foraging flights to acquire prey. Most foraging occurs within about 3 miles of the colony location, although Hamilton et al. (1992) reported maximum foraging flight distances by breeding birds of up to 8 miles. In the Central Valley from 2006 to 2011, Meese (2013) observed adult Tricolored Blackbirds foraging up to 5.6 miles from the colony location.

Several authors have suggested that regional insect abundance plays a role in breeding colony site selection, and that a super-abundant insect population may stimulate nesting behavior (Lack 1954, Orians 1961b, Orians and Collier 1963, Collier 1968, Payne 1969). This could explain the variation in general distribution of colonies between years (DeHaven et al. 1975b). The highly synchronized and colonial breeding system may have adapted to exploit an unpredictable environment where locations of nesting substrate and abundant insect food resources changed unpredictably from year to year (Orians and Collier 1963). Although Meese (2013) demonstrated that colony reproductive success depends on local availability of insect prey (usually within 3-5 miles of the nesting location), the role that insect abundance in foraging habitats has on colony site selection has not been investigated.

Diet and Food Habits

For most of the year, the majority of food items taken by Tricolored Blackbirds consist of plant material, especially seeds. However, during the breeding season, adult females require large amounts of high-protein insect prey for egg production and nestlings require a protein-rich diet for growth and development (Crase and DeHaven 1977). Nestlings are fed almost exclusively animal matter for the first nine days after hatching, at which point parents begin to introduce plant matter into the diet (Hamilton et al. 1995). Colonies consisting of many thousands of adult birds and growing nestlings require an immense amount of insect prey during short windows of time. The availability of insect prey in the foraging landscape likely influences the establishment of breeding colonies, and an abundant prey base is essential for successful breeding.

Nestlings have been provisioned with a wide variety of prey items, including grasshoppers and crickets (order Orthoptera), beetles, weevils, and water beetle larvae (order Coleoptera), moths and butterflies (including caterpillars; order Lepidoptera), and to a lesser degree spiders, flies, tadpoles, snails, and emergent dragonflies, damselflies, and midges (Payne 1969, Crase and DeHaven 1977, Skorupa et al. 1980). At three breeding colonies in Merced County where adults often foraged for prey in alfalfa and grain fields, animal matter made up 91% of food volume for nestlings and fledglings, with moth larvae, beetles, and weevils the primary food items (Skorupa et al. 1980). In foothill grasslands, grasshoppers have often been the primary prey item fed to nestlings (Payne 1969, Airola et al. 2015a). In a diet study that included colonies from several regions of the Central Valley located among a variety of foraging substrates, animal matter made up more than 86% of the total volume of nestling food (Crase and DeHaven 1977). Ground beetles were the predominant food item when averaging across all colonies, followed by water beetle larvae, grasshoppers and crickets, and weevils. Colonies differed significantly in the primary food items provided to nestlings, with differences in foraging substrate responsible in some cases. For example, colonies with water beetle larvae as the predominant food source were located in rice-growing areas, and the greatest percent of grasshoppers were fed to nestlings at colonies bordered by grassland (Crase and DeHaven 1977).

Early observers noted that nestling and fledgling Tricolored Blackbirds were frequently fed grasshoppers, leading to descriptions of the species as a grasshopper-follower (Belding 1890, Bendire 1895, Mailliard 1914, Orians 1961). Payne (1969) observed breeding adult Tricolored Blackbirds at colonies in the Sacramento Valley foraging primarily in grasslands and providing nestlings with a diet composed of 47% grasshoppers; crickets, beetles, and spiders were also acquired in grasslands and fed to young in smaller amounts. Payne (1969) suggested that the movements of Tricolored Blackbirds during the breeding season paralleled the nomadic movements of rangeland grasshoppers in California and compared the Tricolored Blackbird with "locust bird" species of Asia and Africa. Grasshoppers continue to provide a valuable food source to Tricolored Blackbird colonies, especially when adjacent to grasslands and pastures (Airola 2015a), but Tricolored Blackbirds have been shown to be more flexible in breeding season diet, as long as an abundant insect source is available.

In the spring and summer, the proportion of animal material consumed by adult Tricolored Blackbirds in the rice-growing region of the Sacramento Valley was 28% and 39%, respectively, with primary prey items including ground beetles, water beetle larvae, and orthopterans (Crase and DeHaven 1978). At four breeding colonies in agricultural areas of Merced County, animal matter made up 56% of food volume for adult females and 28% for adult males (Skorupa et al. 1980). The most consumed animal foods were beetles and weevils, moth larvae, and flies; the predominant plant foods consisted of oats (*Avena* sp.) and filaree (*Erodium* sp.), and to a lesser degree chickweed (*Stellaria* sp.) and pigweed (*Amaranthus* sp.). In the nonbreeding season, Tricolored Blackbirds are more strictly granivorous, although a variety of plant and animal matter is taken opportunistically. One study in the rice-growing region of the Sacramento Valley revealed that about 90% of the fall and winter diet consisted of plant material, primarily seeds of rice, other grains, and weed seeds (Crase and DeHaven 1978).

Reproduction and Survival

Breeding typically extends from mid-March through early August (Beedy et al. 2017). Autumnal breeding has been observed in the Central Valley (September–November; Orians 1960, Payne 1969) and in Marin County (July–September; Stallcup 2004), although not since 1964 and 2003 in the Central Valley and Marin County, respectively. From initiation of nest building to independence of fledged young, the nesting cycle of the Tricolored Blackbird is about 10 days shorter than that of the Red-winged Blackbird, mostly due to rapid progression through the nest building and egg laying stages (Payne 1969). The condensed length of the nesting cycle may be a function of the synchronized colonial nesting and an adaptation to take advantage of unpredictable periods of abundant and temporary insect food sources (Payne 1969, Skutch 1996).

Nest building and incubation are performed exclusively by the female, but the male takes an active role in feeding the young (Lack and Emlen 1939, Orians 1960). Although female Tricolored Blackbirds breed in their first year, most males may defer breeding until they are at least two years old (Payne 1969). This contributes to a skewed sex ratio at many breeding colonies, with each male breeding on average with two females (Lack and Emlen 1939, Orians 1961, Payne 1969). Although colonies with even sex ratios or with more skewed sex ratios (each male breeding with more than two females) have been observed

(Hamilton et al. 1995), for monitoring purposes it is often assumed that each nest in a colony represents 1.5 breeding birds.

Successful breeding (i.e., production of any fledglings) was found to be positively correlated with colony size by Payne (1969); all colonies (n=7) that produced no fledglings contained 200 or fewer nests, while only one of seven successful colonies was smaller than 400 nests. Hamilton (1993) observed that the largest colonies in a single year of observation produced the highest estimates of reproductive success. Meese (2013) demonstrated a weak positive correlation between reproductive success and colony size over a six-year period ($r = 0.53$, $r^2 = 0.28$).

Reproductive success, defined here as the number of young fledged per nest, has been the generally accepted method for estimating productivity of Tricolored Blackbird colonies (Hamilton et al. 1995, Meese 2013, Holyoak et al. 2014, Airola et al. 2015a). Reproductive success has been estimated in one of two ways: visual estimation of the number of fledglings or nest sampling via walking transects through active colonies. When estimating reproductive success by visual counts of fledglings, colonies are visited at several-day intervals (often four days but in practice this has been variable), and fledglings observed at each visit are assumed to represent unique birds. The total number of fledglings observed on all site visits and the estimated number of nests based on the number of breeding birds are used to estimate the number of fledglings produced per nest. When estimating reproductive success by nest transects, it has been common practice to count the number of young per nest during the portion of the nest cycle when nestlings are 7–9 days old (Hamilton et al. 1995, Meese 2013). Entering colonies when nestlings are less than seven days old inflates the reproductive success estimate by underestimating nestling mortality and entering colonies when greater than 9 days of age causes the nestlings to jump from the nests prematurely. As a result, reproductive success estimates obtained by the transect method represent the maximum number of young fledged per nest. Therefore, the two methods of estimating reproductive success measure two somewhat different indices of productivity.

In 1992, reproductive success was relatively high at three colonies on wetlands and agricultural crops in the San Joaquin Valley (average RS = 2.7) and at Himalayan blackberry colonies in Sacramento County (average RS = 2.2) (Hamilton et al. 1992). Average reproductive success on wetlands in the Sacramento Valley was lower that year at 0.6 young per nest. Similar values of reproductive success were observed in 1994 (Hamilton et al. 1995). In 2000, reproductive success improved in the Sacramento Valley with three large colonies that did not experience heavy predation averaging 1.4 young per nest (Hamilton 2000), although the average reproductive success across all locations and substrate types was lower at 0.9 in 2000.

Many Tricolored Blackbird colonies in the Central Valley exhibited relatively low reproductive success from 2006 to 2011. Meese (2013) estimated reproductive success at 47 colonies, representing most of the largest colonies each year, during this six-year period ranging in size from 800 to 138,000 breeding birds. About half of the monitored colonies were in wetlands (n = 23), with the rest in thistle (n = 11), triticale (n = 9), and Himalayan blackberry (n = 4). The average reproductive success across all sites and years was 0.62. Reproductive success did not vary significantly across substrate type, although colonies that were destroyed by harvest of the grain nesting substrate were not included in the study results.

Low productivity during this time resulted in very few young Tricolored Blackbirds being produced in the southern San Joaquin Valley where a large portion of the population's first annual breeding attempts occur (Figure 6). Incidental observations in 2012 and 2013 suggested that the trend of low reproductive success continued. Meese (2013) linked reproductive success at Central Valley colonies to relative abundance of insect prey at foraging sites, suggesting that many Tricolored Blackbird colonies may have been food-limited. High levels of predation plus destruction of colonies to harvest during this time also contributed to the low overall production of fledglings (Meese 2011, 2012).

Although limited research has been conducted to estimate reproductive success at colonies since 2011, observations of large numbers of fledglings at multiple colonies suggest that the species has had at least some success in recent years. In 2015, the estimated reproductive success at five colonies on agricultural grain fields averaged 0.6–1.9 fledglings produced per nest (Aug 2015 presentation from NRCS to Tricolored Blackbird Working Group; unreferenced). In 2016, eight of nine known colonies on agricultural grain fields fledged at least some young, although efforts to estimate reproductive success were limited. Only one colony in silage was both accessible and uniform in nest density to allow for nest transects and resulted in an estimated reproductive success of 0.44 (Frazer 2016). At four colonies in Himalayan blackberry, cattail, and milk thistle that ranged in size from 5,000 to 12,000 birds, reproductive success estimates ranged from 0.4 to 0.67 (Meese 2016). In 2017, all known silage colonies at seven locations fledged at least some young. Some of these experienced very low reproductive success, but at least two had high success and produced several thousand fledglings. Several additional colonies in other nesting substrates were reported to have high (although unquantified) reproductive success in 2017, with four wetland colonies in the San Joaquin and Sacramento valleys producing at least several thousand young (Colibri 2017, Meese 2017). As in other years, many other colonies were observed to have low success. These limited quantitative estimates and additional qualitative assessments are difficult to compare directly to previous work due to the high variability in reproductive success across colonies and the inconsistent methods used to evaluate reproductive success.

Parents reduce the size of broods at many colonies after the hatching of eggs (Hamilton et al. 1995). Often the majority of eggs in a clutch (usually three or four) will hatch but each nest typically fledges a reduced number of young, either due to parents not feeding all nestlings which leads to starvation, or by the active removal of nestlings from the nest by parents (Payne 1969, Hamilton et al. 1995). This is likely because of a shortage of food supplies. When abundant food is available each nest produces more fledglings (Meese 2013), and as many as four young are raised per nest at productive colonies (Hamilton et al. 1995).

In many years, overall reproductive success at many or most colonies has been relatively low, but estimates have also been highly variable across colonies. Of 21 colonies observed by Payne (1969) from nest building through termination of the breeding effort, including both successful and unsuccessful colonies, only about 40% of nests produced fledglings. High rates of reproductive success at a few large colonies can produce large numbers of fledglings. For example, three colonies representing 50,000 nests accounted for the production of an estimated 100,000 fledglings in 1993, while many smaller colonies produced no or few fledglings in the same year (Hamilton 1993). Meese (2013) observed high variability in reproductive success in both triticale and milk thistle colonies from 2006 to 2011 (range 0.01–1.44).

The relatively high reproductive success at a small number of colonies was demonstrated to be a function of a high insect abundance in nearby foraging areas (Meese 2013). Low reproductive success has been implicated in Tricolored Blackbird population declines over the last two decades (Cook and Toft 2005, Meese 2013). Occasional high rates of reproductive success at a few large colonies may be a successful strategy for long-term population viability, but the degree to which infrequent bouts of high success can compensate for the low reproductive success that may be persistent and widespread across most colonies is unknown.

Reproductive output has been observed to vary across substrate types (Hamilton et al. 1992, Hamilton 2000, Holyoak et al. 2014). Holyoak et al. (2014) modeled occupancy rates in the most common nesting habitat types in recent years (2006–2011) and considered data on abundance, reproductive success, and frequency of use for each nesting habitat type to determine the net reproductive output of different nesting habitats over time. Occupancy rates and other factors that influence reproductive output varied across habitat types, resulting in variation in the importance of habitats to Tricolored Blackbird productivity. Four nesting habitat types had sufficient sample size to make strong conclusions about average reproductive output, including Himalayan blackberry, nettles, wetlands, and grain fields. Himalayan blackberry and nettle colonies exhibited higher than average reproductive output. High overall reproductive output for nettle colonies is a little unexpected given that there are very few colonies, which are of average size, in this nesting substrate. However, high rates of occupancy and reproductive success result in high overall reproductive output for nettle colonies. Himalayan blackberry colonies exhibit average occupancy rates and size, but high reproductive success and the large number of colonies in this nesting substrate (the second most frequent colony type after wetlands) lead to high overall reproductive output. Grain field colonies exhibit average overall reproductive output, despite having low occupancy rates, low reproductive success, and a small number of colonies on grain fields each year; the very large size of grain field colonies increases the overall reproductive output. Of the four nesting habitat types assessed, wetlands remain the most common nesting habitat used by breeding Tricolored Blackbird colonies in recent years. Despite this, average levels of occupancy, reproductive success, and size of marsh colonies have led to the lowest overall contribution to reproductive output among the four nesting habitat types.

Between 1992 and 2003, estimated reproductive success was significantly higher in nonnative Himalayan blackberry (RS = 2.0) than in native emergent cattail and bulrush marshes (RS = 0.5; Cook and Toft 2005). Excluding colonies that were lost to harvest, colonies on silage grain fields had an intermediate reproductive success (RS = 1.0). Meese (2013) did not observe this pattern from 2006 to 2011, when overall reproductive success was much lower and differences in reproductive success between substrates were not significant (unharvested triticale RS = 0.73; Himalayan blackberry RS = 0.44; wetland RS = 0.31), although only four Himalayan blackberry colonies were included in the sampled colonies. In 2014, Airola et al. (2015a) estimated the average reproductive success at four Himalayan blackberry colonies in Sacramento County as 0.84 fledglings per nest. Although the methods used were slightly different, this estimate is within the range of reproductive success estimates observed in all nesting substrate types by Meese (2013) during six years of low reproductive success

(average RS = 0.62; range 0.01–1.44), but the range of values observed by Airola et al. was much narrower (0.66–0.90).

After fledging, Tricolored Blackbirds often leave the vicinity of the nest and congregate in groups of young birds from many different nests. These fledgling groups will often congregate near the edge of the nesting substrate nearest the foraging grounds being used by the adults, where they are fed when adults return to the colony site (Payne 1969). A group of fledgling Tricolored Blackbirds has been referred to as a crèche (Hamilton 1998, Beedy et al. 2017). The formation of crèches generally occurs among birds that breed in large colonies and whose eggs all hatch at about the same time (examples of other crèche-forming species include terns and penguins). Supervision of unrelated offspring by a small number of adult guardians is usually considered a characteristic of crèches, although it is unclear whether this is the case in Tricolored Blackbirds. A single large colony of Tricolored Blackbirds can produce many crèches, and a single crèche may include several thousand fledglings. Crèches can persist for up to one to two weeks, and have been observed as far as three miles from a colony site (Payne 1969, Hamilton et al. 1995).

There are no published studies on the annual survival rate of Tricolored Blackbirds, but banding studies have shown that individuals can live up to 13 years (Neff 1942, DeHaven and Neff 1973). Meese (2014b) used recapture data to estimate the average annual adult survivorship of Tricolored Blackbirds as 60%. Estimates of annual survival rates for other temperate blackbirds have ranged from 42% to 60%, with rates for the closely-related Red-winged Blackbird ranging from 42% to 54% (Fankhauser 1971, Searcy and Yasukawa 1981).

[Note to reviewers: Results of recent analyses of banding data by Cornell University provide revised estimates of apparent annual survival that differ from that reported here (adult female survival rate ~0.5-0.9, depending on year). Results have not been finalized and will be incorporated after further discussion with Cornell to verify preliminary results.]

STATUS AND TRENDS IN CALIFORNIA

Range

Nuttall (1840) observed the Tricolored Blackbird along the coast of California in the 1830s and, without offering any supporting evidence, suggested that the Tricolored Blackbird range extended into Oregon and Mexico. In the mid-1800s, Cooper (1870) reported the species to be common on the southern California coast from Santa Barbara to San Diego, with the range to the north passing "more into the interior, extending up as far as Klamath Lake and southern Oregon." Bendire (1895) reported the range as "[s]outhwestern Oregon, south through California, west of the Sierra Nevada, to northern Lower [Baja] California." Bendire knew of no reports of the species north of Klamath Lake in southwestern Oregon, and thought it to be uncommon there. The range of the species was confirmed to include northern Baja California in the late 1800s, with A. W. Anthony reporting them "[r]ather common along the northwest coast, breeding in all fresh-water marshes" (Bendire 1895).

Following a period of years with no reported sightings of Tricolored Blackbird in Oregon, Neff (1933) reported a number of observations of the species from 1931 to 1933, all within 30 miles of Klamath Falls, and consisting collectively of fewer than 60 birds. Richardson (1961) reported up to several hundred Tricolored Blackbirds near Medford, Oregon in 1957 and documented breeding colonies of 1,500 and 1,800 birds in the region in 1958 and 1960, respectively. Inconsistent observations during the 1800s and early 1900s at the northern extent of the species range may represent shifts in distribution over time or are perhaps the result of limited survey coverage. The species has continued to breed in small numbers in the vicinity of Klamath Falls to the present time, and small numbers of birds continue to occur near Medford during the breeding season. Small breeding colonies (30 or fewer birds) were observed in three northern Oregon counties (Multnomah, Umatilla, and Wheeler) in the 1980s (Beedy et al. 1991). Since the 1990s, several hundreds of birds have occurred regularly in central Oregon near the town of Prineville in Crook County, and breeding has been confirmed in the area. In recent decades, the species has been documented in several other isolated locations in western Oregon and eastern Washington, almost always in very low numbers but occasionally numbering in the hundreds of birds (Gilligan et al. 1994, Spencer 2003, eBird Dataset 2016). The degree to which these records represent recent range expansion to isolated areas, irregular use of the region, or increased survey coverage is unclear, but it appears that small numbers of birds may have recently expanded the species' range to at least some isolated areas in the north (Gilligan et al. 1994, Wahl et al. 2005).

Ammon and Woods (2008) describe the recent discovery and status of breeding Tricolored Blackbirds at a single location in western Nevada, and report that there was no confirmed breeding in Nevada prior to 1996. However, Wheelock (1904) described the distribution of the species in the early 1900s, and reported that in the vicinity of Lake Tahoe, "these birds stray across the crest, but not in the numbers in which they are found westward." The species was also reported to have bred at Lake Tahoe in the early 1900s (Dawson 1923) and Hosea (1986) reported a breeding colony in Carson City, Nevada in 1980.

In the early 1900s, the Tricolored Blackbird occurred in northwestern Baja California south to about the 30th parallel north (Grinnell 1928). This is consistent with recent breeding records from the southern extreme of the species range near El Rosario (Erickson et al. 2007, Feenstra 2013).

The above historic accounts from the periphery of the range are largely consistent with the current range of the species, and overall, the range of the Tricolored Blackbird has changed little since at least the mid-1930s (Beedy et al. 2017). However, the species appears to be experiencing a range retraction in the southern California portion of the range and in Baja California, as discussed below.

Distribution

There are no descriptions of the distribution of the Tricolored Blackbird before the widespread conversion of native habitats across much of its range in California. However, accounts by early naturalists in California provide several records of the Tricolored Blackbird in the 1800s and early 1900s that document the local abundance, and to some extent, the distribution of the species prior to any systematic study of the species across its range.

The early anecdotal reports from the 1800s and early 1900s, although typically not quantitative, informed the historical distribution of birds and demonstrated the occurrence of large numbers regionally. Most early observations of large numbers of birds were from the Central Valley and southern California, and only small numbers of birds have occurred north of the Central Valley, both historically and in recent years. Therefore, this report discusses changes in distribution for the Central Valley and for southern California, which have supported the majority of the population and for which adequate information is available to assess long-term changes in distribution.

Central Valley

In 1852, Heermann reported frequent encounters with winter flocks of Tricolored Blackbirds in the Suisun Valley that numbered “so many thousands as to darken the sky for some distance by their masses” (Baird et al. 1874). The Tricolored Blackbird was known to be an abundant breeder in the interior valleys of California in the late 1800s (Bendire 1895). Belding (1890) observed “an immense colony” near Stockton in 1879. Ray (1906) noted the species breeding at various points on an automobile trip down the San Joaquin Valley from Stockton to Porterville in 1905. Linton (1908) observed a breeding colony at Buena Vista Lake at the southern edge of the Central Valley in 1907. Lamb and Howell (1913) reported seeing “hordes” of Tricolored Blackbirds at Buena Vista Lake in 1912. Dawson (1923) reported the species as “locally abundant in the Great Interior [Central] Valley.”

Neff (1937) was the first to attempt to document the rangewide status and distribution of Tricolored Blackbirds. Over a six-year period from 1931 to 1936, Neff located breeding colonies throughout the Central Valley and at a few additional locations in California and southern Oregon; however, Neff’s surveys focused on the Sacramento Valley in most years. Based on his somewhat geographically limited efforts, Neff (1937) reported nesting birds in 26 California counties over the six-year study. During this period, the rice-growing areas of the Sacramento Valley appear to have been the heart of the Tricolored Blackbird’s distribution, although it is not clear whether this was due to survey efforts being focused there and the limited effort applied further south in the San Joaquin Valley.

Bent (1958) reported that the center of abundance for the species seemed to be in the San Joaquin Valley. Orians and Christman (1968) reported that the largest colonies occurred in the rice-growing districts of the Central Valley (mainly the Sacramento Valley and northern San Joaquin Valley). Neither of these reports were based on systematic surveys of the valley and have limited utility in documenting species distribution, other than that the majority of the population continued to occur in the Central Valley.

The distribution of colonies encountered over a five-year period by DeHaven et al. (1975a) was similar to that observed 35 years earlier by Neff (1937). DeHaven et al. (1975a) reported that 78% of colonies located between 1968 and 1972 were in the Central Valley. Most colonies and breeding birds were found in the Sacramento and northern San Joaquin Valleys, including Butte, Colusa, Glenn, Yolo, Sacramento, Merced, and Stanislaus counties. In the 1980s, the largest colonies and the majority of the known population continued to breed in the Sacramento and northern San Joaquin valleys (Hosea 1986, Beedy et al. 1991).

An apparent early nesting season shift in distribution from the Sacramento Valley to the southern San Joaquin Valley occurred at the end of the 20th century. Although breeding had been documented in the San Joaquin Valley since the 1800s, this region had not been the focus of intense monitoring efforts prior to the 1990s. DeHaven et al. (1975a) reported that areas with suitable nesting substrates were scarce in the arid southern San Joaquin Valley in the 1970s. As described above, loss of native wetland breeding habitat had resulted in a shift to novel nonnative vegetation types beginning by the 1970s, and the distribution shift away from the Sacramento Valley is presumably in part due to these changes in nesting substrate availability. In the early 1990s, Tricolored Blackbirds were discovered breeding in grain fields in the San Joaquin Valley (Hamilton et al. 1992, Hamilton 1993). This discovery corresponded to an increase in the number of dairies and the associated expansion of triticale in the San Joaquin Valley as dairies began growing this new crop for silage. By 1994, most of the largest colonies and 40% of known breeding birds in the early part of the breeding season were found in the southern San Joaquin Valley associated with dairies and cattle feedlots (Hamilton et al. 1995). Relatively little triticale had been planted for silage in the San Joaquin Valley by 1994, but by 2005 the planted acreage had grown to about 75,000 acres (Aksland and Wright 2005).

The shift in distribution to the San Joaquin Valley during the early breeding season has persisted, with very large proportions of the population nesting in a few large "mega-colonies" adjacent to dairies in the San Joaquin Valley (Kelsey 2008). In 1994, 68% of the estimated population in the early nesting season occurred in the San Joaquin Valley; this increased to 86% and 89% by 2008 and 2011, respectively (Hamilton et al. 1995, Kelsey 2008, Kyle and Kelsey 2011). In 2011, the 10 largest colonies were in the San Joaquin Valley during the early season survey (Kyle and Kelsey 2011). Breeding sites on triticale and other silage crops are also generally near other important habitat features, including irrigated pasture, grassland, or alfalfa crops for foraging, and available open water. The degree to which the apparent shift from the Sacramento Valley to the southern San Joaquin Valley is due to the loss of nesting habitat, the availability of a novel nesting substrate, or an increase in survey effort in the San Joaquin Valley is unknown (DeHaven 2000). Nevertheless, there has been a consistent use of the region by a majority of the Tricolored Blackbird population since the mid-1990s (Figure 7). The proportion of the population breeding in the San Joaquin Valley during the early part of the breeding season dropped to about 52% in 2014. This drop was in part due to increases in the number of birds in the Sacramento Valley, including the Sierra Nevada foothills, and southern California, but was primarily the result of a large rangewide decline, with most of the decline in number of birds occurring in the San Joaquin Valley (see the Regional Shifts in Abundance section). In 2017, the proportion of birds nesting in the San Joaquin Valley in the early breeding season returned to almost 70% (Meese 2017).

The grasslands and pastures of southeastern Sacramento County have seen consistent use by breeding Tricolored Blackbirds for at least the last 80 years (Neff 1937, DeHaven et al. 1975a, Hosea 1986, Beedy et al. 1991, Cook and Toft 2005, Airola et al. 2016), even as the dominant nesting substrate in the region has shifted from native wetlands to Himalayan blackberry (see Nesting Substrate section). DeHaven et al. (1975a) described the pasturelands of southern Sacramento County as the most consistently used area during a five-year study. Until recently, little emphasis has been placed on monitoring Tricolored Blackbird colonies in the Sierra Nevada foothills and grasslands/pasturelands of the eastern Central

Valley relative to population centers in the Central Valley and in southern California. Observations of colonies from this region during statewide surveys have usually been lumped with the Central Valley for reporting purposes. Starting in 2014, these grasslands in the low elevation foothills have received focused monitoring as a distinct breeding area (Airola et al. 2015a, 2015b, 2016), with regular use reported for not only Sacramento County, but also from Butte County in the north to Stanislaus County in the south. In 2016, precipitation patterns supported growth of milk thistle patches across extensive areas in the foothills further south as far as Fresno County, resulting in breeding by more than 22,000 birds that had not been observed in the region in the two previous years (Airola et al. 2016). When milk thistle is available for nesting by Tricolored Blackbirds, this nonnative plant may extent the distribution of the species into the southern Sierra Nevada foothills.

Although shifts may have occurred within the Central Valley and some areas of the valley that once supported large numbers of birds now support few or no breeding colonies, while other areas appear to have become much more important, the Central Valley and surrounding foothills as a whole have supported the majority of the Tricolored Blackbird population both historically and in recent years. Additional information on use of the Central Valley is presented in the Regional Shifts in Abundance section.

Southern California and Baja California

The first Tricolored Blackbird specimen was collected by Nuttall near Santa Barbara in 1836 (Baird et al. 1874, Bent 1958). Although he did not observe breeding colonies, Nuttall reported that the Tricolored Blackbird was very common around Santa Barbara and Monterey in the month of April (Nuttall 1840). In the mid-1800s, Cooper (1870) found the Tricolored Blackbird to be the most abundant species near San Diego and Los Angeles, and they were not rare near Santa Barbara. In the late 1800s, the species was described as an abundant winter resident in Los Angeles and Orange counties, occurring in very large flocks, with several colonies known to breed in tule marshes up to 1,500 feet in elevation (Bendire 1895). Grinnell (1898) reported the species to occur in “considerable numbers” throughout the lowlands of the Pacific slope of Los Angeles County, and Willett (1912) considered the species a common resident throughout the lowlands of coastal southern California. Dawson (1923) reported the species as “locally abundant…in the San Diegan district.”

There is evidence that the Tricolored Blackbird had experienced declines in a large portion of its range in southern California, even by the 1930s. In a revision of his former description of the species’ status in coastal southern California, Willett (1933) described the species as a “formerly common resident…Now rare throughout former range in southern California, excepting in some sections of San Diego County.” Grinnell and Miller (1944) described the status of the Tricolored Blackbird as “common to abundant locally” but noted a general decrease in southern California.

In 1980, the Tricolored Blackbird was characterized as a fairly common resident in the southern California coastal district that bred locally in all coastal counties (Garrett and Dunn 1981). The species no longer occurs at many historical sites in coastal southern California. Small numbers of breeding birds were documented at a few locations in coastal Santa Barbara County through the 1970s, with the last

known colony of 200 birds in 1979 (Lehman 1994, Tricolored Blackbird Portal 2017). The last known colony in Ventura County, of 53 birds, occurred in 1994. About 200 birds persisted as breeders in the portion of Los Angeles County south of the Transverse Ranges through the 1990s, with the last known breeding attempt in 1999 (Allen et al. 2016, Tricolored Blackbird Portal 2017). Several hundred breeding birds occupied multiple sites in Orange County through the 1990s, but only a single colony of 14 birds has been observed breeding in the county in two years since 2000. The highly urbanized coastal portion of San Diego County, which supported thousands of breeding birds through at least the 1970s, has supported less than a thousand breeding birds at only three locations since 2000 (Tricolored Blackbird Portal 2017). Very few Tricolored Blackbirds now breed in the coastal lowlands of southern California where they were once abundant (Garrett et al. 2012).

The status of the Tricolored Blackbird population in Baja California has followed a similar pattern to that for southern California. In the late 1800s, the species was described as "rather common along the northwest coast [of Baja California], breeding in all fresh water marshes" (Bryant 1889). Grinnell (1928) described the species as a "Fairly common resident locally in the northwestern section of the territory, north from about 30 degrees." In the 1980s, the species was described as a "local resident in northwestern Baja California south to El Rosario" (Wilbur 1987). A search of the entire Baja California range turned up a single breeding colony of 80 birds in 2007 (Erickson et al. 2007) and four breeding colonies totaling 240 birds in 2008 (Erickson and de la Cueva 2008). A follow-up survey several years later located three breeding colonies supporting an estimated 240–340 birds (Feenstra 2013). In recent years, most breeding in Baja California has occurred in the north within about 70 miles of the U.S. border. Breeding continued at a disjunct area at the historical southern extent of the species' range (about 100 miles farther south than the next nearest breeding location) near El Rosario through at least 2013 (Erickson and de la Cueva 2008, Feenstra 2013). By 2016 all known breeding colonies occurred within about 12 miles of the U.S. border (Erickson et al. 2016). In 2017, the only known breeding colonies occurred within five miles of the U.S. border and eight nonbreeding Tricolored Blackbirds were observed at a historic breeding site about 70 miles south of the U.S. border. No birds were observed south of this point, leaving the southernmost 100 miles of the species range in Baja California apparently unoccupied (April 2017 email from R. Erickson to N. Clipperton; unreferenced).

Where previously abundant and widespread south of the Transverse Ranges, the distribution of breeding colonies is now mostly restricted to inland sites in western Riverside and San Bernardino counties, and in the interior of San Diego County (Feenstra 2009). This represents a long-term decline in southern California, with remnant colonies disappearing in recent decades throughout much of the southern range (Figure 8). This may represent a permanent breeding range retraction from portions of the range where the species was previously abundant, and is likely the result of ongoing urban development and declines in population numbers. The small numbers of birds that have occasionally bred at the extreme southern limit of the species' range in Baja California, separated by 100 miles from the next most southern breeding colony locations in recent years, were not observed in 2017. The majority of the historical range in Baja California has been unoccupied in recent years (Erickson et al. 2016).

Allen et al. (2016) reported that nesting commenced late in the 20th century in the Mojave Desert portion of northern Los Angeles County, and attributed this to manmade reservoirs and other impoundments, but breeding by small numbers of birds was known for the area since at least the 1970s (DeHaven et al. 1975a, Beedy et al. 1991). The species was known to occur in the Mojave Desert since at least 1890, but breeding was not documented (Belding 1890). The region has not supported more than a few thousand breeding birds in any year.

Population Trend

Breeding Population

Assessments of the rangewide population abundance of the Tricolored Blackbird prior to the 1990s are limited to published literature describing research by a limited number of individuals in the 1930s (Neff 1937) and an additional rangewide assessment using similar methods in the 1970s (DeHaven et al. 1975a). An additional recent published study used all available breeding colony data collected over more than 100 years (1907–2009) to evaluate changes in average colony size (Graves et al. 2013). The most intensive efforts to estimate rangewide population abundance have occurred since 1994, with results presented in reports prepared by academic researchers, Audubon California biologists, and in reports prepared for the USFWS and the Department. These represent the best available information for assessing trends in the rangewide population over the last two decades.

Over a period of six years (1931–1936), Neff (1937) surveyed Tricolored Blackbird colonies across California. Neff located several breeding colonies of more than 100,000 nests in the Sacramento Valley, with the largest composed of greater than 200,000 nests (corresponding to approximately 300,000 adult Tricolored Blackbirds). Breeding colonies were located throughout the Central Valley and in a few additional locations in California and southern Oregon; however, Neff's surveys focused on the Sacramento Valley in most years. An effort to cover the entire known range of the species was attempted by Neff in only one year (1932). Most areas outside the Sacramento Valley were covered only incidentally as "cooperators drove up or down the State in the performance of routine duties," and in the regions of the state that were most thoroughly surveyed, it was impossible to make complete surveys of all possible locations (Neff 1937). Neff concluded that obtaining an estimate of the statewide population was not possible. Working alone in 1934, Neff observed an estimated 491,250 nests (about 737,000 breeding birds), almost all of which were in the Sacramento Valley. The presence of birds in the San Joaquin Valley and southern California was noted in the same year, but no effort was made to estimate numbers. Several authors have cited Neff (1937) in statements about the Tricolored Blackbird population in the 1930s, sometimes suggesting that the population numbered in the millions (e.g., Beedy et al. 1991, Hamilton et al. 1995, Kyle and Kelsey 2011). Neff himself did not attempt to extrapolate his results to a region-wide estimate, although the roughly 737,000 breeding birds observed in a single year is likely an underestimate of the population at the time.

No attempts were made to describe the Tricolored Blackbird distribution or abundance during the 1940s, 1950s, or 1960s. From 1969 to 1972, DeHaven et al. (1975a) attempted to survey the entire range of the Tricolored Blackbird to document the distribution of the species and to compare estimates of abundance to those provided by Neff (1937). The surveys were carried out by a few individuals surveying vast areas by road, and in most areas were limited to one or two drives through each county where Tricolored Blackbirds were known to occur in California and southern Oregon. Still, the search effort was at least as extensive as that carried out by Neff in the 1930s, and included the benefit of improved transportation and an increased number of roads. In many counties the survey consisted of driving county roads with little knowledge of historical colony sites, but this was an improvement over much of the effort of the 1930s, when counties were considered covered if visited incidental to other activities. Despite a greater search effort, all measures of abundance indicated a decline: the number of active colonies detected per year declined from 43 to 41; nonbreeding birds encountered declined from >50,000 in a single year to <15,000 over four years; maximum colony size declined from hundreds of thousands to tens of thousands of birds; and number of birds observed per year within the study period declined from about 375,000 per year to about 133,000 per year (DeHaven et al. 1975a). Although no population estimate was provided, the authors suggested that the Tricolored Blackbird population declined by more than 50% in 35 years. Like Neff three decades before, DeHaven et al. (1975a) were unable to thoroughly cover the entire range of the species, including large portions of the southern San Joaquin Valley.

Following more than a decade with no survey to assess the statewide population, Beedy et al. (1991) compiled all historical records of Tricolored Blackbird breeding colonies and conducted limited field surveys from 1986 to 1990 to evaluate long-term population trends. Bill Hamilton and others (Hamilton et al. 1992, Hamilton 1993) conducted ecological investigations in 1992 and 1993 that included documentation of colony locations and sizes, the discovery of large breeding colonies on grain fields in the San Joaquin Valley, and the initial observations that suggested Tricolored Blackbirds are itinerant breeders (Hamilton et al. 1995). Based on the increased understanding of the species' biology and distribution, a new approach to estimating the statewide population of Tricolored Blackbirds was proposed by Ted Beedy and Bill Hamilton (Hamilton 1998, Meese 2015a). The discovery of itinerant breeding with broad movements between nesting attempts made it clear that a survey of the statewide population should occur during a narrow window in order to maximize the likelihood of detecting nesting colonies and to avoid double-counting birds (Hamilton et al. 1995, Beedy and Hamilton 1997). A survey conducted in a minor portion of the range or carried out over a long time period would either miss breeding colonies or double count birds over multiple breeding attempts. An improved understanding of colony occupancy dynamics suggested a need for early season colony-detection efforts to locate active colonies (Hamilton et al. 1995), while also considering the compiled information on all historical breeding locations in order to visit as many potential breeding locations as possible.

The new approach to surveying the statewide population was first implemented during the 1994 breeding season. The survey was conducted on a single day in the early part of the season (April 23). The choice of a survey date is an effort to select a time period when most birds have initiated a first nesting attempt and can be detected and counted at breeding colony sites, but before the first breeding cycle is completed and birds have moved to the north (usually) for the second breeding attempt. The goals of the survey were to visit as many known breeding locations as possible, document occupancy status, and estimate colony size at all occupied locations. This was also the first survey to be largely volunteer-based and to enlist a large number of observers over a narrow time period. Compared to the surveys of the 1930s and 1970s, these surveys employed many more surveyors to more thoroughly cover as much of the state and known colonies as possible. The discovery of breeding by a large proportion of the population on silage fields near dairies had recently been documented (Hamilton et al. 1992, 1995), and therefore unlike previous statewide survey efforts, the 1994 survey focused heavily on the San Joaquin Valley.

After the establishment of the new approach to conduct a statewide census, attempts to survey the population were carried out in 13 years between 1994 and 2017. Despite a consistent approach in many of the early years of this time period, methods varied considerably for many of these surveys. The years 1994, 1997, and 2000 produced a set of three triennial surveys that were considered to have been comparable in effort by the survey organizers (Beedy and Hamilton 1997, Hamilton 2000). After a period of years with surveys that followed inconsistent and variable approaches, another set of four triennial surveys were conducted using similar methods in 2008, 2011, 2014, and 2017 (Kelsey 2008, Kyle and Kelsey 2011, Meese 2014a, Meese 2017). The effort and results of these seven surveys are summarized in Table 1. Although the other six survey years (1995, 1996, 1999, 2001, 2004, and 2005) are not discussed further here, they are briefly summarized in Table 2 and in a larger discussion of Tricolored Blackbird surveys included in Appendix 1.

Table 1. Comparison of survey effort and results for seven statewide surveys.

Year	Duration	Participants	Counties surveyed (occupied)	Number of sites surveyed (breeding sites)	Occupied breeding locations	Birds observed
1994	1 day (3 days)[1]	60[2]	– (32)	–	100	369,400
1997	1 day (3 days)[1]	55[2]	– (33)	–	71[3]	232,960
2000	4 days	81[2]	33 (25)	231 (181)	72	162,000
2008	3 days	155	38 (32)	361 (284)	135	395,000
2011	3 days	100	38 (29)	608	138	259,000
2014	3 days	143	41 (37)	802	143	145,000
2017	3 days	181	44 (37)	884	168	177,656

[1] Observations of birds not associated with colonies from one day before and after the survey day were accepted, effectively expanding the survey window to three days.
[2] Number includes participants who submitted written reports. A larger number of volunteers may have searched for birds.
[3] As reported by Hamilton (2000).
"—" = data not reported

The statewide survey efforts in 1994, 1997, and 2000 followed similar methods to locate and survey as many colonies as possible. Although the duration of the survey and the survey effort varied across these years, the organizers of the surveys reported these three surveys had used the most consistent methods to date and could be compared to assess the population trend (Beedy and Hamilton 1997, Hamilton 2000). However, inconsistencies in effort still occurred with the 1994 survey conducting only a limited survey of southern California, and the 2000 survey using more observers to visit more sites than the other two survey years. Hamilton (2000), however, concluded that "…the method of the Census and the survey, to reinvestigate all known breeding places and to search for new ones, has become an increasingly complete assessment of Tricolored Blackbird distribution and abundance. The 2000 Census probably located a greater proportion of the entire population than did censuses in previous years." The number of birds observed declined 56% from 369,400 birds in 1994 to about 162,000 birds in 2000 (Hamilton 2000, Cook and Toft 2005). In addition to the results of the surveys showing declines in the 1990s, Hamilton (2000) stated that personal observations over long intervals by many regional experts had also suggested declines during this time period.

Table 2. Description and summary of effort for 13 surveys that attempted to estimate the size of the statewide Tricolored Blackbird population between 1994 and 2017.

Survey year	Summary of effort and results	Sources
1994	The first year a statewide survey was conducted in a narrow time period, was informed by knowledge of historical breeding locations and by pre-survey colony detection work, and enlisted the help of a large number of volunteers.	Hamilton et al. (1995) Beedy and Hamilton (1997)
1995 and 1996	Limited pre-survey effort. Incomplete county coverage. Large colonies may have been overlooked. Results are not considered representative of the total population.	Beedy and Hamilton (1997)
1997	Used the same coverage, methods, and personnel as did the 1994 survey. Participation was greater than in 1994. Surveys from 1994, 1997, and 2000 are considered comparable.	Beedy and Hamilton (1997)
1999	Participation in the survey was low. Results considered an underestimate of population size by the survey organizer.	Hamilton et al. (1999, 2000) Hamilton (2000)
2000	Used the same methods applied in 1994 and 1997, although a greater number of observers were used to visit more locations. Training was provided to participants. Surveys from 1994, 1997, and 2000 are considered comparable.	Hamilton (2000)
2001	Followed a very different approach compared to standardized methods used since 1994. A limited number of sites were visited and estimates were compiled from observations made throughout the breeding season.	Humple and Churchwell (2002)
2004	Not intended to provide an estimate of the statewide population size that was comparable to previous surveys. Surveys limited to colony sites that had historically supported more than 2,000 birds. Focused on sites in the Central Valley.	Green and Edson (2004)
2005	No report was produced and no record is available describing the survey effort.	Meese (2015a)
2008	Used similar methods as in the 2000 survey, although estimates not adjusted using nest density. Also, county coordinators were used for the first time to ensure each county was well surveyed by volunteers. Maps with all survey locations were provided for the first time, and a website improved communication and data management. Number of survey participants and number of sites surveyed greatly increased relative to earlier surveys.	Kelsey (2008)
2011	Methods followed those used in 2008, although county coordinators were not used to lead surveys in individual counties. Surveys from 2008, 2011, 2014, and 2017 are considered comparable.	Kyle and Kelsey (2011)
2014	Used the same methods as in 2008 and 2011, and again used county coordinators to ensure each county was thoroughly covered. The number of counties and number of sites visited exceeded all other surveys to date. Surveys conducted 2008–2017 are considered comparable.	Meese (2014a)
2017	Used the same methods as in 2008–2014. The number of survey participants and the number of counties and sites visited exceeded all other surveys to date. Surveys conducted 2008–2017 are considered comparable.	Meese (2017)

Commented [RHD3]: It might be worth noting that a mobile mapping application was used this year for the first time so as to aid in locating historical breeding sites in the field.

As during the early set of survey years, the survey effort increased each year from 2008 to 2017. More counties were surveyed in 2014 than on any previous survey and the number of observers participating on the 2014 survey (n = 143) was exceeded on only one previous survey (n = 155 in 2008). There was a large increase in the number of sites visited in each survey year between 2008 and 2014, and the number of colony sites visited in 2017 exceeded that of any other survey (Figure 9). The 2017 survey was the most extensive survey conducted to date based on all available metrics of effort (Table 1). The number of birds observed on statewide surveys declined 63% from 395,000 birds in 2008 to an all-time low of about 145,000 birds in 2014 (Kelsey 2008, Meese 2014a) (Table 1). From 2014 to 2017, the number of birds observed increased 22% to 177,656. The number of birds observed in 2017 represents a 55% decline in the population over the nine years since 2008.

Although the conclusion following each of the two groups of survey years (1994–2000 and 2008–2017) was that a population decline had occurred, differences in survey methods and effort make it difficult to combine the two groups of surveys to make longer-term conclusions (Meese 2015a). Does the estimated number of birds in 2008 represent an increase in population size following the decline of the 1990s, or do increased survey effort and other changes to survey methodology preclude comparison of results from the two survey periods? In addition to differences in duration of the survey, geographic scope, and effort shown in Table 1, there were important differences in methods used between the two groups of surveys (see Appendix 1). Methods unique to the earlier 1994–2000 surveys include: 1) Birds counted at colonies before the survey were included in the results if the colony remained active after the survey period (although not counted on the survey day), 2) Birds observed and counted at colonies after the survey were included if nest phenology led to a conclusion that the colony was active on the survey date (although not observed), and 3) Visual colony size estimates were often adjusted using observed nest densities, as determined by walking transects through colony sites after the survey; this resulted in final colony size estimates that in some cases differed significantly from those reported by survey participants (Hamilton et al. 1995). Unfortunately, the impact (both the magnitude and direction) of these methodological differences on the overall population estimates is unknown, and therefore a direct comparison of results from the two time periods is not appropriate. At a minimum, the large step change in survey effort between the two time periods must be taken into account if the data are to be used to inform a longer-term population trend.

As shown in Table 1, the individual metrics of survey effort were not consistently reported across survey years. The number of sites surveyed has been used to describe survey effort in recent years (Meese 2014a, 2015, 2017), but this number is not known for the surveys conducted in the 1990s. The number of counties surveyed was also not reported for surveys conducted in the 1990s. The number of participants and the number of occupied breeding locations were reported for all survey years. It is not known whether an increase in effort as measured by any of these metrics results in a proportional increase in the number of birds observed, but Graves et al. (2013) reported that total counts of breeding birds are correlated with the number of sites sampled. The number of sites sampled is also related to the proportion of the landscape searched by survey participants (Figure 9) and therefore might be the most appropriate metric of effort with which to standardize survey results.

In order to make use of as many survey years as possible to evaluate population trend over time, survey results were adjusted for effort when available (Figure 10a-c). Viewed as a whole, when adjusting for survey effort the results suggest a consistent pattern in the Tricolored Blackbird population since 1994. Regardless of the metric used to adjust population estimates for survey effort, the trend shows a long-term decline over the 23-year period with a partial recovery between 2000 and 2008. Depending on the metric used to correct for effort, either 2014 or 2017 represents the all-time low for effort-adjusted number of birds observed.

As the number of locations visited has increased with each successive statewide survey, so too has the number of locations with some uncertainty regarding the exact location. These are historical breeding locations for which the exact coordinates were not reported, and therefore the level of confidence is recorded as "uncertain" in the Tricolored Blackbird Portal database (2017). As a result, surveyors have visited an increasing number of locations that have not necessarily supported Tricolored Blackbird breeding in the past (Table 3). This is not wasted effort, as the visits to uncertain locations increase the size of the landscape area searched for colonies during the survey (Figure 9), and the locations are likely near historical colony sites. Nevertheless, for the 2017 survey, participants were directed to focus on sites with known coordinates, resulting in a large decline in the number of "uncertain" sites surveyed. To be conservative in interpreting changes in survey effort over time, the uncertain locations were removed from the count of sites visited during the 2000, 2008, 2011, 2014, and 2017 surveys to adjust the effort for those survey years (Table 3). The adjusted number of sites surveyed each year continues to show an increase in survey effort over time. A graph prepared using the revised number of sites surveyed (Figure 10d) revealed little effect on the pattern of birds observed per site shown in Figure 10b.

Table 3. Number of sites surveyed during recent statewide surveys, adjusted to remove uncertain locations.

Survey year	Number of sites surveyed	Number of uncertain sites	Revised number of sites surveyed
2000	231	4	227
2008	361	8	353
2011	608	54	554
2014	802	127	675
2017	884	25	859

The linear regression trendlines for each of the effort-corrected survey results indicate that the Tricolored Blackbird population has declined by 75%–90% in the last 23 years (Figure 10). The observed rates of decline of -5.8% to -10.5% per year indicate that this species has been in severe decline over the last two decades. These rates of decline are in the range of the steepest declines observed across all North American landbird species based on Breeding Bird Survey data (Sauer et al. 2017a). Results of the most recent 2017 statewide survey suggest that the Tricolored Blackbird population decline may have slowed or reversed since 2014, but the population remains at or near its smallest size ever recorded. Coupled with the earlier declines between the 1930s and 1970s, the recent declines have resulted in a population that is a small fraction of its historical abundance.

There are several potential sources of uncertainty in the population estimates from statewide surveys. Attempts to quantify this uncertainty have been limited and inconsistent across years. Comments on the approach used to estimate the size of the population during recent statewide surveys, along with a discussion of uncertainty, are provided in Appendix 2.

Colony Size

In recent statewide survey years, the size of the largest colonies (including the single largest colony and the average of the several largest colonies per year) have been reported as an alternative metric to total counts of birds for tracking trends over time. Use of the size of large colonies to evaluate trends is only appropriate if the survey effort is sufficient to detect most of the largest colonies. Although the survey effort required to detect most of the largest colonies is unknown, Graves et al. (2013) reported that average colony size observed, based on colony data from 1907 to 2009, was not strongly correlated to the total number of sites sampled annually, suggesting that sampling may generally be sufficient to detect the largest colonies. Larger colonies may be more likely to be detected and therefore survey effort may have less effect on size of largest colonies observed compared to total counts of birds.

Neff (1937) located several breeding colonies of more than 100,000 nests in the Sacramento Valley, with the largest composed of greater than 200,000 nests (about 300,000 adult birds). Orians (1961a) reported that, in 1959 and 1960, there were four Tricolored Blackbird colonies larger than 100,000 adults; three were in the rice-growing area in Colusa and Yolo counties and one was in Sacramento County. The largest reported colonies in the 1970s were in Colusa and Yolo counties and comprised about 30,000 adults (DeHaven et al. 1975a, Beedy and Hayworth 1992). All but one of the colonies observed by DeHaven et al. (1975a) that were larger than 20,000 birds were located in the Sacramento Valley. In the 1980s, the largest reported colony was in the northern San Joaquin Valley at Kesterson Reservoir (Merced County) in 1986, with an estimated 47,000 adults (Beedy and Hayworth 1992).

The occurrence of Tricolored Blackbird breeding colonies on grain fields in the San Joaquin Valley was discovered in the early 1990s (Hamilton et al. 1995), and the size of the largest colonies in several subsequent years once again grew to more than 100,000 birds, so-called “mega-colonies.” Beedy and Hamilton (1997) reported that 1994 and 1997 were the only two survey years to date with sufficient survey effort to detect “virtually all large colonies.” In 1994, Hamilton et al. (1995) found that the largest colony, at San Luis National Wildlife Refuge, numbered about 105,000 adult Tricolored Blackbirds. In 1997, Beedy and Hamilton (1997) reported the largest colony to contain about 80,000 adults. The documentation of large colonies during this time period is likely due in part to the formation of mega-colonies on grain fields, but may also be a result of increased survey effort in the San Joaquin Valley.

Colonies of at least 80,000 breeding birds continued to occur through 2010 (Meese 2009a, Meese 2010). From 2008 to 2017, maximum colony size declined from 80,000 to fewer than 20,000 birds (Kelsey 2008, Kyle and Kelsey 2011, Meese 2017). In 2014, only a single colony consisted of more than 20,000 birds and only three colonies consisted of 10,000 birds or more (Meese 2014a). The proportion of birds observed in the 10 largest colonies during the years 2008, 2011, 2014, and 2017 was 77% (306,000), 81% (208,800), 64% (93,000), and 55% (98,050) of the statewide population estimate for those years,

respectively. This reflects a downward trend in the sizes of the largest colonies, without a large increase in the number of occupied breeding locations (Figure 11). The trend in the largest colonies from 1994 to 2017 is similar to those in Figure 10 for effort-corrected statewide survey results: a long-term decline over the 23-year period with a partial recovery between 2000 and 2008.

Graves et al. (2013) performed an evaluation of trends in the average size of Tricolored Blackbird colonies over a more than 100-year period (1907–2009) using data compiled from a variety of sources. Average colony size, rather than total abundance, was used as the metric to evaluate trends to account for the effects of variable sampling effort across years. Graves et al. (2013) found a significant decline in the average colony size from 1935 to 1975, with the average colony size declining by more than 60%. This corresponds to the period over which DeHaven et al. (1975) concluded that the population size had declined by about 50%. Despite large amounts of data on colony sizes from the 1980s onward, no significant decline was detected in average colony size from 1980 to 2009. This finding is counter to reports of declines for portions of the 1980–2009 period (e.g., Beedy et al. 1991, Hamilton 2000, Meese 2014a, Meese 2015a). However, the statistical evaluation conducted by Graves et al. (2013) used data only through 2009, so it does not include much of the time period during which the recent population decline was observed (2008–2014). In addition, it is unlikely that sampling effort was sufficient in all years to detect most of the largest Tricolored Blackbird colonies, which may have influenced the estimates of average colony size.

The degree to which size of the largest or average colonies are correlated to total population size in any given year is unknown. However, during statewide survey years since 1994, the sizes of the largest colonies follow a pattern similar to that of the total numbers of birds observed. Given that in many years the majority of the population occurs in a small number of the largest colonies and the number of occupied colonies per year has not increased dramatically with increased survey effort (Table 1), it is likely that short-term declines in colony size often reflect real changes in the population size. Over longer periods, the correlation between colony size and population might be expected to break down due to shifts in breeding distribution and selection of novel nesting substrates. For example, when the population began using agricultural grain crops in the early 1990s and experienced an apparent shift in early breeding season distribution to the San Joaquin Valley, very large colonies were reported for the first time in many years. These changes in nesting substrate availability and distribution could have influenced the size of the largest colonies (and average colony size) by concentrating the population at a small number of breeding locations without necessarily reflecting a change in population size. In fact, Graves et al. (2013) reported that colonies in triticale and other grain crops were 40 times larger than colonies in other habitats during the last 20 years. This may explain in part why they did not find a reduction in average colony size from 1980 to 2009, a time when breeding surveys revealed declines in total number of birds observed.

Winter Population

The Christmas Bird Count (CBC) is a volunteer-based survey conducted each winter at designated 15-mile diameter circles across North America. CBC data consist of counts of all bird species encountered during a single day at each circle for which a count is conducted. There are more than 2,400 count

circles across North America, some of which have been run since the early 1900s (Soykan et al. 2016). The number of count circles increased dramatically through the 1950s and 1960s, especially in the western region of the U.S. (Niven et al. 2004), and long-term trend assessments have often used a start date in the late 1960s to avoid any influence of increased survey coverage on apparent trends (Butcher et al. 2006). This is also the time period when the Breeding Bird Survey was initiated, which allows for comparisons between breeding and wintering populations (Niven et al. 2004). Counts are not necessarily conducted for every circle each year, and some circles are run more consistently than others. The number of volunteer observers and the duration of the count can vary from year to year, and yearly differences in effort can significantly influence the results of the counts. Therefore, the number of party-hours is often used as a measure of effort to standardize count results. Count circle locations are also not randomly selected, so data cannot be extrapolated to provide population estimates across the range of a species, but if corrected for effort can provide an index that can inform population change in areas covered by count circles.

Soykan et al. (2016) used a hierarchical model to evaluate population change from 1966 to 2013 for several hundred species sampled by the CBC, including Tricolored Blackbird. The analysis assessed change in each U.S. state and in each Bird Conservation Region (BCR; a map of BCRs is available at http://nabci-us.org/resources/bird-conservation-regions-map/), with the Coastal California BCR being the primary BCR in which Tricolored Blackbird occurs. Trends for Tricolored Blackbird were non-significant at both the California and the BCR scales. Hierarchical models are more efficient than linear regression approaches when assessing population change for a large number of species across multiple geographic scales, and can control for variation in survey effort among circles and across years. However, the use of large spatial scales for analysis may introduce variability in the quality of information that may not be accounted for in the models. Although the Coastal California BCR captures the majority of the Tricolored Blackbird range in California, it is neither geologically nor biologically uniform. Also, the addition of count circles over time has not been evenly distributed across the BCR or the state. Due to the variability in habitat and species distribution at these broad scales, any apparent population trend, or lack thereof, can be an artifact of the years in which count circles were added or removed, or the years in which particular circles were surveyed across a heterogeneous landscape. A finer-scale approach that considers the impacts of this variability on a single species is warranted.

In California, count circles increased through the 1960s as has been documented in other areas, but the number of circles continued to increase through the early 1990s. The number of circles in California detecting Tricolored Blackbird doubled from 1974 (25 circles) to 1986 (50 circles) and the number of circles with Tricolored Blackbird detections did not stabilize until the 1990s. Since 1992 the number of circles with Tricolored Blackbird detections has been fairly stable and has fluctuated between 54 and 66. Because of the continued increase in the number of count circles through the 1990s, and the inconsistent running of counts at some circles over time, the sampling intensity has varied across the range of the Tricolored Blackbird in California. Based on the number of count circles surveyed in California over time, and by establishing criteria for consistency of effort, the Department assessed trends based on CBC data for two time periods: 1974–2015 and 1995–2015. These two periods capture a longer term extending back to the 1970s when the breeding-season surveys of DeHaven et al. (1975a)

were conducted, and a shorter term covering the time since the first statewide surveys of the 1990s and when CBC data quality was highest and most consistent. The distribution of count circles that met a set of criteria and that were therefore included in the analyses provides fairly good coverage of the core of the winter distribution of the species (Figure 12; Appendix 3). Population trends were estimated from the slope of the regression of the log-transformed counts on year (see Butcher et al. 1990). Results of the CBC data analyses indicate declines in the Tricolored Blackbird population over both the longer term 1974–2015 period and the shorter term 1995–2015 period (Appendix 3).

Improvement in bird identification skills by volunteer observers has been apparent within the past 20 years, and poses a significant challenge in the interpretation of trends based on CBC data. This may be especially true for species with potential identification problems and for flocking species such as the Tricolored Blackbird (Butcher et al. 1990). As a result, counts that are adjusted by party-hour may be positively biased in recent years, which would tend to result in a positive bias in observed trends.

A number of historical winter observations of large numbers of Tricolored Blackbirds corroborate the observed decline in CBC data. Wintering flocks numbering 12,000–14,000 once assembled near dairies on the Point Reyes Peninsula, Marin County, which was one of the most reliable locations to observe large numbers of wintering Tricolored Blackbirds. In recent years, these flocks have been in the range of 2,000–3,000 birds (eBird Dataset 2016, Beedy et al. 2017).

Regional Shifts in Abundance

Because of the Tricolored Blackbird's nomadic tendency and the potential for large interannual shifts in breeding distribution, year-to-year changes in regional abundance are common. Tricolored Blackbird surveys have regularly revealed large annual changes in local abundance that would not be expected due to productivity or mortality rates alone (Hamilton 1998). During statewide surveys, large declines in one region are often coupled with large increases in other regions, and therefore caution is warranted when interpreting year-to-year changes in local abundance. That said, persistent long-term changes in distribution and regional abundance likely represent shifts in regional habitat suitability or population abundance.

Central Valley

Following incidental observations on the regional abundance of Tricolored Blackbirds in the 1800s and early 1900s, the Central Valley was described as the center of abundance for the species. The first systematic attempt to assess the species' rangewide distribution and population confirmed this, with most birds observed in the Sacramento Valley (Neff 1937). Additional observations and study of breeding colonies occurred through the 1960s before a second attempt at quantifying rangewide abundance in the early 1970s, with the majority of birds again found in the Sacramento Valley and northern San Joaquin Valley (DeHaven et al. 1975a).

Within the Central Valley, shifts in regional abundance over relatively short time periods have been a regular occurrence. Over a period of five years in the 1930s, Neff (1937) observed regular shifts in the annual centers of abundance between the rice-growing regions of the Sacramento Valley (Butte and

Glenn counties) and regions to the south in Sacramento and Merced counties. DeHaven et al. (1975a) noted substantial yearly variation in centers of breeding abundance, even in their limited study area consisting of the Sacramento and northern San Joaquin valleys. For example, they observed 57,000 Tricolored Blackbirds nesting in Colusa County in 1969, but only 2,000 the following year. This pattern was mirrored in Yolo County where the number of breeding birds observed declined from 25,000 to 5,000. At the same time, other counties in the Sacramento Valley experienced increases in the number of breeding birds, with Glenn County increasing from 2,000 to 18,500 birds, and Yuba County increasing from 1,000 to 5,250 birds. A larger region comprising the major rice-growing region of the Sacramento Valley (Butte, Colusa, Glenn, Yolo, and Yuba counties) also varied considerably in the proportion of the known population it supported, with the proportion of known breeding birds in the region ranging from 29% to 59% during a four-year study period (DeHaven et al. 1975a). In the year when the smallest proportion of birds were located in this rice-growing region, the largest known congregation of birds occurred to the south in the pasturelands of southeastern Sacramento County. These regional shifts in abundance demonstrate the species' ability to undergo large interannual shifts in breeding distribution, likely in response to an unpredictable food supply or other habitat components.

In addition to short-term shifts in regional abundance, the Central Valley has experienced longer-term changes, with some regions of the valley experiencing long-term declines in number of breeding colonies or breeding birds. For example, Kings County supported tens of thousands of breeding birds per year through the 1990s, with 65,000 birds breeding in the county in 1992. In recent years, the county has hosted only a few hundred to a few thousand breeding birds. Glenn County, which once supported hundreds of thousands of birds per year and continued to support at least 10,000 birds into the 1990s, has not hosted more than 1,400 birds in any year since 2000. San Joaquin County regularly supported up to about 10,000 birds per year through the 1990s, but has hosted only a few small colonies since then, with the largest recent colony of 1,800 birds in 2015. As described above, the Tricolored Blackbird appears to have experienced a population increase from the 1990s through the 2000s in the San Joaquin Valley as a whole, with a corresponding decrease in the Sacramento Valley. Following this increase, the population in the San Joaquin Valley experienced a severe decline of 78% from 2008 to 2014 (Meese 2015a). This is a time period during which the species declined by 63% rangewide, and the majority of this decrease was due to declines in the San Joaquin Valley. The total number of birds lost from the San Joaquin Valley portion of the range during this period (~267,000 birds) exceeded the rangewide decline (250,000 birds), with a small portion of the loss compensated by increases in the breeding population elsewhere (Figure 13) (Meese 2015a). The number of birds breeding in the San Joaquin Valley rebounded somewhat by 2017, but declines in this region remain the primary contributor to range-wide population declines since 2008.

Southern California and Baja California

As described above under Distribution, the Tricolored Blackbird was once abundant on the coastal slope of the southern California portion of the range, from Santa Barbara County to San Diego and into Baja California. Although the early reports of species abundance were not quantitative, they serve as a comparison to numbers of birds in the region in recent decades. Neff (1937) provided the first quantitative estimates for southern California, although San Diego and Santa Barbara counties were the

only counties his collaborators spent a significant amount of time surveying; thousands of birds were documented in both of these counties. DeHaven et al. (1975a) reported colonies of up to 10,000 birds in southern California (Riverside County), with thousands of birds documented in all counties south of the Transverse Ranges, except Orange County.

The first statewide survey to include all counties in southern California was conducted in 1997 (Beedy and Hamilton 1997). That year, more than 40,000 Tricolored Blackbirds bred in the southern California portion of the range, with more than 90% occurring in western Riverside County (Feenstra 2009, Cook 2010). Since this time, the largest proportion of the southern California breeding population has continued to occur in western Riverside County (Cook 2010). The 2005 statewide survey located about 12,500 breeding birds south of the Transverse Ranges. A thorough search of historical breeding locations in southern California in 2008, 2009, and 2011 revealed a population south of the Transverse Ranges of consistently less than 5,000 breeding birds (Figure 14) (Kelsey 2008, Feenstra 2009, Kyle and Kelsey 2011). By 2009 the coastal slope portion of the region had declined to only 750 Tricolored Blackbirds breeding at a single site in San Diego County (Feenstra 2009). The 2014 survey located a slightly larger population consisting of about 6,400 breeding birds (Meese 2014a). In 2017, the number of birds observed increased again to about 8,800, although the large majority of these (>90%) were again located in one small region of western Riverside County. San Diego was the only other county with breeding birds in 2017, with seven small colonies totaling fewer than 700 birds. Most breeding colonies of the Tricolored Blackbird in Southern California have tended to be small in recent years, averaging a few hundred birds (Feenstra 2009).

In the last decade the breeding population in the Mojave Desert portion of the range in San Bernardino and northern Los Angeles counties appears to have grown somewhat, from just over 1,000 breeding birds located during surveys in 2008–2011, to more than 5,000 breeding birds in 2014 (Meese 2014a). It is unclear whether the Mojave Desert birds are more closely associated with the southern California population or to the birds in the Central Valley, although observations of three banded birds since 2009 and observations of a flying flock in the 1800s have documented birds moving between the desert and the Central Valley. Ongoing genomic studies will address the population structure and patterns of movement throughout California.

Originally considered common in northwestern Baja California, numbers appear to have declined by the late 1900s. Recent surveys have shown that the northwestern Baja California population has declined to only several hundred individuals (Erickson et al. 2007, Erickson and de la Cueva 2008, Feenstra 2013, Erickson et al. 2016, Meese 2017).

Summary—The Tricolored Blackbird, once described as the most abundant species in southern California, had declined dramatically by the time statewide surveys were established in the 1990s. Tens of thousands of breeding birds continued to occupy the region during the first complete survey of 1997. The most recent intensive searches of the southern California portion of the range located only thousands of breeding birds at a small number of locations. Following the first comprehensive survey of southern California counties in 1997, the Tricolored Blackbird population declined by nearly 90%, to lows of fewer than 5,000 birds from 2008 to 2011. The southern California population rebounded

somewhat by 2014, but most of the increase can be attributed to birds in the Mojave Desert. This decline coincides with the disappearance of the species from much of the southern California portion of the range and is mirrored by declines in abundance and distribution in the Baja California portion of the species' range. If recent trends continue, the species may decline to extirpation in the southern portion of its range in the near future.

Northern and Central Coasts

Small numbers of birds bred annually during the late nesting season (July–September; thought to represent second breeding attempts by birds that previously nested elsewhere) in western Marin County until 2003 (Stallcup 2004). There has been no documented breeding in Marin County since then.

EXISTING MANAGEMENT

Land Ownership within the California Range

There is a paucity of public lands in the Central Valley, with the region that regularly supports more than 90% of the breeding population composed primarily of privately-owned lands (Figure 15). The total area in the range of the Tricolored Blackbird in California is more than 34 million acres. Privately-owned lands compose 84% of this area, with state and federal lands totaling about 12%. Much of the area under federal ownership is composed of forested areas that are not suitable for the species. The USFWS National Wildlife Refuges and Department Wildlife Areas comprise about 250,000 and 254,000 acres, respectively (1.5% of the range, combined).

Of the 1,045 historical breeding locations with known coordinates in the Tricolored Blackbird Portal database (as of January 2017), 191 (18%) have been located on public lands. A minority of breeding colonies continue to occur on public lands each year. For example, during the 2011 statewide survey, colonies were found on a county park, a Department Ecological Reserve in San Diego County and an Ecological Reserve in Kern County, and on three National Wildlife Refuges in the Central Valley (Kyle and Kelsey 2011). These colonies totaled 66,325 breeding birds (about 25% of the estimated statewide population in that year), the large majority of which were from a single colony on a USFWS National Wildlife Refuge.

Habitat Conservation Plans

Habitat Conservation Plans (HCPs) are long-term landscape level plans that provide the basis for regulatory compliance with the ESA by nonfederal entities. HCPs provide a mechanism to authorize incidental take of federally threatened and endangered species under section 10(a) of the ESA, while also describing how impacts to covered species will be minimized or mitigated in the plan area. An HCP must minimize and mitigate the impacts of take to the maximum extent practicable.

There are five approved HCPs in California that include the Tricolored Blackbird as a covered species and two additional HCPs that are in the planning stage (Figure 16; Table 4):

Approved HCPs:

- Natomas Basin
- San Joaquin County Multi-species Conservation Plan
- PG&E San Joaquin Valley Operations & Maintenance
- Kern Water Bank
- Orange County Southern Subregion

Planning Stage:

- South Sacramento
- Solano Multi-Species

Table 4. Current and Planned HCPs/NCCPs in California that include Tricolored Blackbird as a covered species.

Plan title	Counties	Plan acreage	Date permit issued	Term
Natomas Basin HCP	Sacramento, Sutter	53,342	June 2003	50 years
San Joaquin County Multi-species Conservation Plan HCP	San Joaquin	896,000	May 2001	50 years
PG&E San Joaquin Valley Operations & Maintenance HCP	Portions of nine counties: San Joaquin, Stanislaus, Merced, Fresno, Kings, Kern, Mariposa, Madera, Tulare	276,350	December 2007	30 years
Kern Water Bank HCP	Kern	19,900	October 1997	75 years
Orange County Southern Subregion HCP	Orange	132,000	January 2007	75 years
South Sacramento HCP	Sacramento	317,656	Planning stage	TBD
Solano Multi-species HCP	Solano, Yolo (edge)	580,000	Planning stage	TBD
East Contra Costa County (NCCP)	Contra Costa	175,435	July 2007	30 years
Santa Clara Valley Habitat Plan (NCCP)	Santa Clara	460,205	July 2013	50 years
Western Riverside County Multiple Species Habitat Conservation Plan (NCCP)	Riverside	1,300,000	June 2004	75 years
San Diego County Multiple Species Conservation Program (NCCP)	San Diego	511,878	August 1998	50 years
San Diego Gas & Electric Subregional (NCCP)	San Diego, Orange, Riverside	Linear projects[1]	December 1995	55 years
San Diego County Water Authority (NCCP)	San Diego, Riverside	Linear projects[1]	December 2011	55 years
Butte Regional Conservation Plan (NCCP)	Butte	564,270	Planning stage	TBD
Yuba-Sutter Regional Conservation Plan (NCCP)	Yuba, Sutter	468,552	Planning stage	TBD
Placer County Conservation Plan Phase I (NCCP)	Placer	201,000	Planning stage	TBD
Yolo Habitat Conservancy (NCCP)	Yolo	653,663	Planning stage	TBD
San Diego East County Multiple Species Conservation Plan (NCCP)	San Diego	1,600,000	Planning stage	TBD
San Diego North County Multiple Species Conservation Plan (NCCP)	San Diego	311,800	Planning stage	TBD

[1] These NCCPs cover discrete linear or energy projects but have larger plan areas that overlap with other NCCPs.
Primary Sources:
USFWS endangered species page for Tricolored Blackbird under conservation plans:
https://ecos.fws.gov/ecp0/profile/speciesProfile?spcode=B06P#conservationPlans
Summary of Natural Community Conservation Plans (NCCPs) September 2016
https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=15329&inline

The goals, objectives, and conservation measures for Tricolored Blackbird included in approved HCPs are summarized below.

Natomas Basin HCP

The Natomas Basin Habitat Conservation Plan (NBHCP) covers 53,342 acres in the northwestern part of Sacramento County and southern Sutter County. The City of Sacramento and County of Sutter are participants. The 50-year term expires June 2053.

Tricolored Blackbirds nest and forage in the Natomas Basin. At the time of the planning effort, one active nesting colony was known from the eastern edge of the Natomas Basin (Betts Kismat-Silva Reserve) and nine documented occurrences were noted for Sutter County. Based on habitat preferences of Tricolored Blackbirds, the Natomas Basin supported about 1,998 acres of potential nesting habitat and 41,310 acres of potential foraging habitat (NBHCP 2003).

A total of 449 acres of potential nesting habitat will be converted to urban development as a result of implementing the proposed action. A loss of 15,311 acres of potential foraging habitat (non-rice crops = 6,517 acres, grassland = 560 acres, pasture = 147 acres, and rice = 8,087 acres) will result from the planned development (USFWS June 24, 2003).

Under the plan, 2,137.5 acres of managed marsh habitat will be preserved in a reserve system. Wetland reserves are intended to benefit wetland-associated Covered Species such as Tricolored Blackbirds. The managed marsh reserves will provide potential nesting habitat for Tricolored Blackbirds in close proximity to foraging habitat, which is expected to increase suitable nesting opportunities for this species. Additionally, 4,375 acres of rice and 2,187.5 acres of upland habitats will be added to the reserve system. Generally, acquisition of upland habitat is prioritized first for the conservation of Swainson's Hawk (*Buteo swainsoni*) then secondarily for other upland-associated Covered Species including Tricolored Blackbird (USFWS June 24, 2003).

Take minimization measures include pre-construction surveys for Tricolored Blackbirds, avoidance of actively nesting colonies/minimization of disturbance during the nesting season, establishment of a physical protective barrier 500 feet from the active nesting sites, and a "reasonable" buffer for foraging lands on reserve lands. The NBHCP includes measures to avoid, minimize, and mitigate take of the giant garter snake (*Thamnophis gigas*) with timing restrictions, pre-construction site dewatering, and vegetation control management. Because the Tricolored Blackbird shares some habitat similarities with the snake, these measures may also benefit the blackbird (NBHCP 2003).

Monitoring Covered Species is provided for in the plan. The USFWS commented on monitoring the Tricolored Blackbirds nesting colony in the final EIR/EIS (USFWS April 2003): "…the success of this population will be monitored annually and the reserve acquisition program of the NBHCP could be modified if it is determined that foraging habitat is a limiting factor for the colony. This colony is located well outside of the City's Permit Area, and this colony may forage upon unincorporated lands within Sacramento County. If, through the annual monitoring, it is determined that additional foraging habitat is required, the NBHCP would allow for modification of both acquisition programs and habitat

management/restoration to provide enhanced foraging. The long-term success of the NBHCP will rely not on establishing a rigid Operating Conservation Program based on limited information, but rather will result from a flexible program that responds to new information collected through monitoring as well as evolving scientific data as applicable to the Covered Species."

San Joaquin County Multi-Species Conservation Plan HCP

The San Joaquin County Multi-Species Conservation Plan HCP (SJMSCP) spans 896,000 acres in San Joaquin County. Participating entities include the Cities of Escalon, Lathrop, Lodi, Manteca, Ripon, Stockton, and Tracy and the County of San Joaquin. The 50-year term expires May 2051.

The SJMSCP identified 9,374 acres of "occupied" habitat for the Tricolored Blackbird in the plan area and an additional 47,193 acres of potential habitat including foraging and wintering areas. It is expected that 1,614 acres of Tricolored Blackbird habitat will be converted under full build-out.

The SJMSCP conservation strategy relies on minimizing, avoiding, and mitigating impacts for Covered Species including the Tricolored Blackbird. Mitigating impacts to Covered Species will largely be accomplished through the creation, enhancement and management of Preserves. Tricolored Blackbirds are associated with five planned Preserves: Primary Zone of the Delta (Large and Small Water's Edge Preserve), Vernal Pool Zone (Vernal Pool Grassland Preserve), Central Zone (Row and Field Crop/Riparian Preserve), Central Zone (Wetlands Preserve), Central/Southwest Transition Zone (Use Central Zone Row and Field Crop/Riparian Preserve). Tricolored Blackbirds are considered indicators of Preserve health and will be monitored at the species-level, accordingly.

Incidental take minimization measures include a setback of 500 feet from nesting areas during the nesting season for the period encompassing nest building and continuing until fledglings leave nests. This setback applies whenever construction or other ground-disturbing activities must begin during the nesting season in the presence of nests that are known to be occupied. Setbacks shall be marked by brightly-colored temporary fencing.

Pacific Gas & Electric San Joaquin Valley Operations & Maintenance HCP

The PG&E San Joaquin Valley Operations & Maintenance HCP (PG&E HCP) plan area includes 276,350 acres in portions of nine counties in the San Joaquin Valley, as follows: San Joaquin, Stanislaus, Merced, Fresno, Kings, Kern, Mariposa, Madera, and Tulare. The 30-year term expires in 2037.

The following discussion is derived from USFWS 2007:

> Tricolored Blackbirds occupied approximately 1,443 acres of existing PG&E right-of-way in the plan area (52 occurrences in CNDDB as of 2007).
>
> As part of the planning process, PG&E will establish a map book for the Tricolored Blackbird by, prior to initiation of any covered activities, determining where PG&E facility lines occur within 100 meters of CNDDB-documented occurrences of breeding colonies. Active nesting birds will be avoided. If an active breeding colony could be disrupted by the covered activity, an exclusion

zone of at least 350 feet around the colony will be established. This exclusion zone will be established in the field based on site conditions, the covered activity, and professional judgment by a qualified PG&E biologist, and will be greater than the minimum distance. Work will not occur in this exclusion zone during April 1–July 31.

The PG&E HCP estimated that covered activities would directly disturb approximately 4 acres of suitable nesting or foraging habitat each year (120 acres of temporary disturbance over 30 years), with most of this disturbance occurring in foraging habitat. Less than 0.1 acre per year of blackbird nesting habitat is expected to be permanently lost each year (less than 3 acres of nesting habitat permanently lost over 30 years). Other covered activities that may disturb Tricolored Blackbirds (e.g., off-road travel and tree trimming that do not disturb ground surfaces) will affect 34 acres of suitable Tricolored Blackbird habitat each year (1,020 acres over the 30-year permit term). These impacts are expected to be individually small, widely dispersed and, therefore, likely to be insignificant and discountable.

Permanent loss of suitable foraging or nesting habitat will be compensated at a 3:1 ratio and temporary disturbance to suitable habitat will be compensated at a 0.5:1 ratio. The HCP estimates PG&E will provide 0.37 acres of Tricolored Blackbird compensation in the North San Joaquin Valley, 0.91 acres of compensation in the Central San Joaquin Valley, and 0.57 acres of compensation in the South San Joaquin Valley annually. Overall, PG&E will provide approximately 2.3 acres of Tricolored Blackbird compensation annually (approximately 69 acres over 30 years).

Kern Water Bank HCP

The Kern Water Bank HCP covers 19,900 acres of central Kern County. The 75-year term expires in 2072. Planning documents list no known Tricolored Blackbird colonies from the Kern Water Bank area; however, it was acknowledged that the species might move into the HCP area in the future. Impacts were described as "negligible; high mobility of the species allows easy escape from project-related impacts" (Kern Water Bank Authority 1997). A monitoring effort conducted in 2011 documented five small colonies numbering ~400 individuals in nettles under mesquite within the plan area. A large colony numbering several thousand individuals settled in an historic site along the Kern River channel but the colony was abandoned; they may have joined a successful colony in Basin 6 on city property of approximately 10,000 individuals that successfully fledged young. The author did not identify whether the earlier failed effort or the successful colony was located within the plan area (Hardt 2011).

Orange County Southern Subregion HCP

The Orange County Southern Subregion HCP comprises 132,000 acres in the study area, including the Cleveland National Forest (40,000 acres). Excluding certain urbanized areas and the National Forest property, the planning area totals 86,000 acres within southern Orange County. The County of Orange and Rancho Mission Viejo are signatory to the implementing agreement. The 75-year term expires in 2082.

Six general Tricolored Blackbird breeding locations have been documented in the planning area historically and include: Middle Chiquita Canyon, Coto de Caza, Radio Tower Road, Verdugo Canyon in San Juan Creek, lower Gabino Canyon, and Trampas Canyon settling ponds. Not all sites have been used consistently or recently. A total of 18,759 acres of potential foraging habitat was identified in the planning area. One of the known historic breeding sites, Trampas Canyon, will be directly impacted by the proposed covered activities and an estimated 3,769 acres of foraging habitat will be developed or otherwise made unsuitable for Tricolored Blackbirds (USFWS 2007).

The plan conserves four of the breeding colony sites within a planned habitat reserve: Middle Chiquita Canyon, Verdugo Canyon, Radio Tower Road, and Lower Gabino Canyon. Adequate foraging habitat within a four-mile radius of these sites also would be conserved. Planners assumed that “at least 1,000 acres of foraging habitat within four miles of a nest site would be more than adequate to sustain the relatively small nesting colonies that occur in the study area” (Dudek and Associates 2006). Adequate foraging habitat will also be conserved at the Cota de Caza site. A total of 8,015 acres of foraging habitat for Tricolored Blackbirds in the planning area, including the four historic nest site locations, will be cooperatively managed within the habitat reserve. Additional open space habitats exist within County Parks (1,694 acres) which will be managed with overall conservation goals of the HCP (USFWS 2007).

Management actions to benefit Tricolored Blackbirds will focus on nonnative predators, grazing, minimizing pesticide use near colonies, and managing human disturbance near colonies (Dudek and Associates 2006).

South Sacramento HCP

The South Sacramento HCP is currently in the planning stage. The proposed study area encompasses 317,656 acres in Sacramento County. Anticipated partners include the County of Sacramento and the Cities of Rancho Cordova and Galt.

Solano Multi-Species HCP

Solano Multi-Species HCP is currently in the planning stage. The proposed study area includes 577,000 acres in Solano County and an additional 8,000 acres in Yolo County. Participants in this effort include the Cities of Dixon, Fairfield, Rio Vista, Suisun City, Vacaville, and Vallejo.

Natural Community Conservation Plans

Like HCPs, Natural Community Conservation Plans (NCCPs) are long-term landscape-level conservation plans. Under California state law, the Natural Community Conservation Planning Act (Fish & G. Code, §§ 2800-2835) provides a mechanism to obtain authorization for incidental take of CESA-listed and other species. An NCCP provides for the protection of habitat, natural communities, and species diversity on a landscape or ecosystem level, while allowing compatible and appropriate economic activity. An NCCP is broader in its objectives than the take authorization provided under the California and Federal ESAs, and may require conservation measures that go beyond mitigation of impacts to meet the recovery needs of

covered species. All approved NCCPs are also HCPs and so provide authorization for take of federally-listed species through section 10 of the ESA.

There are six approved NCCPs in California that include the Tricolored Blackbird as a covered species and six additional NCCPs that are in the planning stage (Figure 16; Table 4):

Approved NCCPs:

- East Contra Costa County
- Santa Clara Valley Habitat Plan
- Western Riverside County Multiple Species Habitat Conservation Plan
- San Diego County Multiple Species Conservation Program
- San Diego Gas & Electric Subregional
- San Diego County Water Authority

Planning Stage:

- Butte Regional Conservation Plan
- Yuba-Sutter Regional Conservation Plan
- Placer County Conservation Plan Phase I
- Yolo Natural Heritage Program
- San Diego East County Multiple Species Conservation Plan
- San Diego North County Multiple Species Conservation Plan

The goals, objectives, and conservation measures for Tricolored Blackbird included in approved NCCPs are summarized below.

East Contra Costa County NCCP

The East Contra Costa County NCCP (ECCC) spans 174,018 acres in eastern Contra Costa County. The following local governments are signatory to the implementing agreement: cities of Brentwood, Clayton, Oakley, and Pittsburg, and the County of Contra Costa. The city of Antioch is not part of the agreement. The 30-year term will expire August 2037.

The ECCC is located within the Bay Delta and Central Coast Province (CDFW 2015). Six natural communities are found in the study area: streams/riparian woodland, wetland, grassland, oak woodland, chaparral/scrub, and agricultural lands.

During the project planning phase, Tricolored Blackbirds were described as sporadic in the plan area; two breeding colonies were noted on the northern border of Los Vaqueros Watershed and several additional small colonies were detected during fieldwork for the county bird atlas project (ECCC 2006). The Contra Costa County Bird Atlas project found the Tricolored Blackbird to be a "fairly common permanent but highly local resident of freshwater marshes and weedy fields, particularly in East County but also locally elsewhere. Most breeding birds were present in the vicinity of… Byron" (Glover 2009). The largest colony detected numbered several hundred pairs. The Atlas confirmed breeding in six blocks,

found five additional blocks with possible nesting and an additional possible nesting colony just south of the county border (Glover 2009).

ECCC development guidelines require avoidance of occupied Tricolored Blackbird nests during the breeding season. Under the agreement, impacts of up to 204 acres of core habitat and 9,621 acres of primary foraging habitat may be permitted as a result of covered activities. A planned preserve system will protect 126–164 acres of suitable core habitat and 16,747–20,138 acres of primary foraging habitat under the initial urban development area or maximum urban development area, respectively. The preserve system will also protect at least seven of 13 ponds, all of which may provide potential breeding habitat. Additional pond and wetland creation (an estimated 85 acres of perennial wetland plus an estimated 16 acres of pond habitat) will be created or restored. Managed habitat is predicted to be of higher quality than what had existed prior to the agreement. Conservation easements will be acquired on 250–400 acres of cropland or pasture; landowners will be required to enhance habitat for Tricolored Blackbird and other covered species (CDFG 2007).

Annual progress reports prepared under the ECCC documented two recent land acquisitions with value for Tricolored Blackbirds. Vaquero Farms North, a 575-acre property adjacent to the Los Vaqueros Reservoir Watershed lands was purchased in 2010. It is situated entirely west of Vasco Road, with primary access from Vasco Road (ECCHC 2011). Vaquero Farms Central, a 320-acre property bounded by two existing Preserve System properties, Vaquero Farms North and Vaquero Farms South, was purchased in 2012 (ECCHC 2013). No progress towards pond creation was reported in the latest available annual report of activities (ECCHC 2016).

Santa Clara Valley Habitat Plan NCCP

The Santa Clara Valley Habitat Plan NCCP (SCVHP) includes the cities of Gilroy, Morgan Hill, and San Jose (excluding Alviso and the Baylands) and the County of Santa Clara. The study area encompasses 519,506 acres; the permits areas, however, differ from the study area. Two permits were issued under the plan, one solely for Burrowing Owl (48,464 acres) and another for all other covered species. The “all other covered species” permit, including Tricolored Blackbird, totals 460,205 acres and excludes Henry Coe State Park and a portion of Pacheco State Park. The term of the permit is for 50 years and will expire July 2063.

The SCVHP is found within the Bay Delta and Central Coast Province (CDFW 2015). Natural communities within the planning area include grassland (including serpentine grasslands), chaparral and scrub, coastal scrub, conifer woodland, oak savannah, oak woodland, riparian woodland scrub, mixed evergreen forest, wetlands, aquatic, rock outcrop, irrigated, and agriculture.

Tricolored Blackbirds appear to be relatively uncommon in Santa Clara County. Breeding colonies are few and fairly small. During the Santa Clara County Breeding Bird Atlas project, Tricolored Blackbirds were found in 29 blocks with breeding confirmed in 19 blocks. Hundreds to several thousand individuals were documented. Confirmed breeding occurred in Santa Clara Valley, Diablo Range, Calaveras Reservoir, San Felipe Lake, Coyote Reservoir, small pond on Coyote Ranch numbering fewer than 100

individuals, Horse Valley stock pond, in the upper Smith Creek watershed (Bousman 2007). These data and CNDDB records were assessed under the SCVHP.

Conservation goals for Tricolored Blackbirds include protection for at least four sites that support, historically supported, or could support nesting colonies. Each protected site will have at least 2 acres of breeding (marsh) habitat and will have at least 200 acres of foraging habitat within 2 miles. These breeding sites will either be enhanced or restored breeding habitat in historically/currently occupied areas within the Reserve System or newly-created ponds suitable for breeding Tricolored Blackbirds (ICF 2012).

Take of, or impacts to, existing or historic breeding colonies is prohibited. Impacts to this species are limited to loss of habitat. Mitigation measures consist of pre-construction surveys, impact avoidance or minimization, and land acquisition. Acquisitions will focus on the following:

- Four historical breeding sites with adequate nearby foraging habitat referenced above;
- At least 22,840 acres of modeled Tricolored Blackbird habitat;
- Enhancement of acquired habitat specifically for Tricolored Blackbirds; and
- Creation of new ponds and wetlands that may provide breeding and foraging habitat for the species (CDFW 2013).

Western Riverside County Multiple Species Habitat Conservation Plan NCCP

The Western Riverside County Multiple Species Habitat Conservation Plan NCCP (WRC-MSHCP) covers approximately 1,300,000 acres in western Riverside County and is located wholly within the South Coast Province (CDFW 2015). All unincorporated county land west of the crest of the San Jacinto mountains to the Orange County line, as well as the cities of Temecula, Murrieta, Lake Elsinore, Canyon Lake, Norco, Corona, Riverside, Moreno Valley, Banning, Beaumont, Calimesa, Perris, Hemet, and San Jacinto are included in the plan area. The 75-year term will expire 2079.

Tricolored Blackbirds were described as “widely scattered” throughout the lowlands and foothills of Riverside County. Few current or historic breeding locations were documented within the planning area (Dudek and Associates 2003). Tricolored Blackbird potential habitat was assessed; a total of 480 acres of primary habitat and 259,695 acres of secondary habitat was identified as occurring within the planning area. Of these totals, a loss of 60 acres of primary habitat and 193,180 acres of secondary habitat was projected. Secondary habitat losses included approximately 102,000 acres of agricultural land and 88,000 acres of grassland (Dudek and Associates 2003). Mitigation identified in the plan includes the following actions:

- Include within the Conservation Area, 420 acres of suitable primary habitat (freshwater marsh, cismontane alkali marsh).
- Include within the Conservation Area the five identified Core Areas for Tricolored Blackbirds. The Core Areas include San Jacinto River floodplain (7,320 acres), Mystic Lake/San Jacinto Wildlife Area (17,470 acres), Collier Marsh and Lake Elsinore grasslands (1,810 acres), Alberhill (3,460 acres), and Vail Lake/Wilson Valley/eastern Temecula Creek (50,000 acres).

- Include within the Conservation Area, 66,510 acres of secondary habitat (playa and vernal pool, grasslands, agriculture land, and riparian scrub, woodland, and forest).
- Maintain (once every 5 years) the continued use of and successful reproduction within at least one of the identified Core Areas. Successful reproduction is defined as a nest that fledges at least one known young.
- Maintain, preserve, and if feasible, restore hydrological processes within the five Core Areas.
- Include within the Conservation Area a 100-meter buffer around any known nesting locations.

Although not considered a Tricolored Blackbird Core Area, a total of 9,670 acres within the Prado Basin/Santa Ana River area will be conserved within Criteria Area and Public/Quasi-Public designations. This area may support Tricolored Blackbirds in the future (Dudek & Associates 2003).

The most recent biological monitoring report for Tricolored Blackbirds (2013 breeding season) described the following results:

> Six breeding colonies were detected during targeted searches for Tricolored Blackbirds. These included the Potrero Unit of the San Jacinto Wildlife Area (~350 birds), San Timoteo Canyon (10 birds), Lake Riverside (~200 birds), Highway 371 in Tule Valley (45 birds), and Garner Valley (~150 birds). All counts sum to a total estimated population size of 2,755 birds. Mean and median colony sizes were 459 and 175, respectively. Biologists were unable to confirm reproductive success for the Garner Valley, Highway 371, or San Timoteo Canyon colonies. Tricolored Blackbirds successfully reproduced in Potrero and Tule Valley in 2013. Only one colony, Potrero, was located inside the existing Conservation Area; however, no colony was located within a designated Tricolored Blackbird Core Area. The largest colony (~2,000 birds) occupied a 40-acre field on private land in the San Jacinto Valley. It suffered complete reproductive failure when the field was cut; adults were incubating eggs at the time (WRCRCA 2015).

Biological monitors made management and monitoring recommendations to improve conservation conditions for the Tricolored Blackbird in the Plan area. According to recent biological monitoring reports (WRC-MSHCP 2013), three of the five Core Areas identified for Tricolored Blackbird conservation purposes (Alberhill, Collier Marsh/Lake Elsinore grasslands, and San Jacinto River floodplain) do not provide suitable or sufficient breeding habitat for the species. Other sites were recommended as additional Core Areas based on recent Tricolored Blackbird recent activity. Further, recommendations to change the Tricolored Blackbird species account in the Plan so that it “be modified to recognize loss of foraging habitat in the vicinity of breeding sites as a significant threat to the survival of the species, and that the stated management objectives be reconsidered as well. In particular, the prescription for managing ‘… this species in order to maintain (once every five years) the continued use of, and successful reproduction within at least one of the identified Core Areas’ (Dudek & Associates 2003) is likely insufficient for a rapidly declining species that is dependent on patchy and unpredictable breeding habitats which are being rapidly lost throughout the Plan Area” (WRC-MSHCP 2011, 2013, WRCRCA

2015). Finally, the monitoring regime was deemed inadequate to provide conservation awareness for the Tricolored Blackbird. Monitoring should be conducted with surveys for breeding colonies every year rather than every five years and the survey period be extended to allow multiple visits to active sites before, during, and after nesting (WRC-MSHCP 2011).

San Diego County Multiple Species Conservation Program

The San Diego County Multiple Species Conservation Program NCCP (SDCMSCP) covers approximately 511,878 acres in San Diego County and is located wholly within the South Coast Province (CDFW 2015). SDCMSCP participants include the County of San Diego, Cities of Chula Vista, San Diego, La Mesa, and Poway; implementing agreements are in progress for Coronado, Del Mar, Santee, and El Cajon. Subarea plans have been or will be prepared for each participating entity. Imperial Beach, National City, and Lemon Grove are not developing subarea plans but reserve the right to do so at a later date. The 50-year term expires 2048.

A detailed status assessment of the Tricolored Blackbird within the planning area was not provided in the planning documents. The Plan did identify a rationale for including Tricolored Blackbirds as a covered species: "…77% of potential habitat [4,800 acres], including 59% of mapped localities, will be conserved. Breeding colonies move from season to season, and with a goal of no net loss of wetlands, most of the suitable breeding sites will continue to be available. This species forages in grasslands and agricultural fields near its breeding habitat. Foraging habitat near the known nesting colonies will be conserved at 70–100%. Additionally, foraging opportunities will continue to be provided and created in turfed areas such as golf courses and cemeteries. Jurisdictions will require surveys during the CEQA review process in suitable breeding habitat proposed to be impacted. Participating jurisdictions' guidelines and ordinances and state and federal wetland regulations will provide additional habitat protection resulting in no net loss of wetlands" (Ogden Environmental 1998).

Under the plan, 23% of breeding habitat (1,400 acres) has the potential for development or impacts.

Additionally, the following conditions were specified for Tricolored Blackbirds: "Project approvals must require avoidance of active nesting areas during the breeding season. Area-specific management directives must include measures to avoid impacts to breeding colonies and specific measures to protect against detrimental edge effects to this species. Area-specific management directives for preserve areas will include specific guidelines for managing and monitoring covered species and their habitats including best management practices. Edge effects may include (but not be limited to) trampling, dumping, vehicular traffic, competition with invasive species, parasitism by cowbirds, predation by domestic animals, noise, collecting, recreational activities, & other human intrusions" (Ogden Environmental 1998).

Annual reports are available online for the South County Subarea of the SDCMSCP (http://www.sandiegocounty.gov/content/sdc/parks/openspace/MSCP.html). These reports typically document habitat losses and gains associated with development projects and do not mention Tricolored Blackbirds specifically.

San Diego Gas & Electric Company Subregional NCCP

The San Diego Gas & Electric Company (SDG&E) Subregional NCCP covers discrete linear or energy projects but has a larger plan area that overlaps with other NCCPs. The plan area traverses 2,000,000 acres of SDG&E service territory in San Diego, Orange, and Riverside counties and is located wholly within the South Coast Province (CDFW 2015). Its 55-year term will expire December 2050. Although the term of the agreement is 55 years, SDG&E may, at its election, terminate the agreement after the 25th year and every 10 years thereafter.

In total, the SDG&E plan will result in a combined permanent loss of no greater than 400 acres with 50 miles of electric transmission and/or new gas transmission lines. This acreage figure includes an estimated permanent loss of 124 acres of habitat. The most common and most affected habitat types will likely be coastal sage scrub, chaparral, oak woodland, and grasslands (SDG&E 1995).

Impacts to Tricolored Blackbirds were considered to be generally very small and minimized or mitigated (in that order) when potential impacts occur to the species' habitats (SDG&E 1995). Tricolored Blackbird habitat was categorized under Mitigation Category III: beach, marsh, and wetland species. Mitigation measures taken for this category include:

- Construction in marsh areas, soft sand, or open water in most cases will be accomplished through the use of helicopters for the delivery of materials, poles, personnel, and platforms; and
- Roads should be avoided to the extent feasible.

In general, the following conditions apply: wildlife will not be killed unless to protect life and limb of staff, personnel training will be provided, and pre-activity surveys will be conducted (SDG&E 1995).

Planning documents available online did not include site-specific information on Tricolored Blackbird colony locations or foraging sites.

San Diego County Water Authority NCCP

The San Diego County Water Authority NCCP covers discrete linear projects but has a larger plan area that overlaps with other NCCPs. The plan area traverses 992,000 acres in western San Diego and southwestern Riverside counties and is located wholly within the South Coast Province (CDFW 2015). Nearly all Covered Activities will occur within the probable impact zone: 1,000 feet on either side of the pipelines or facilities, or approximately 64,600 acres along the existing pipeline rights-of-way, and other connected water conveyance, storage, and treatment facilities. The 55-year term of the agreement will expire December 2066.

One Tricolored Blackbird colony was documented near the Sweetwater Reservoir during the planning process; no colonies were noted within the planned impact zone (CNDDB in SDCWA and RECON 2010).

A total of 1,830 acres of wetland/riparian habitat exists within the probable impact zone; of this total, approximately 16 acres of potential Tricolored Blackbird breeding habitat could be impacted by

permitted activities. Twenty-one acres of potentially suitable breeding habitat in the existing preserve area may be used to mitigate impacts to Tricolored Blackbird. Suitable foraging habitat is conserved in the 1,186 acre San Miguel Habitat Management Area within the San Diego National Wildlife Refuge (Merkel and Associates 1997 in SDCWA and RECON 2010); however, no nesting has been documented there.

No direct take of breeding Tricolored Blackbirds or their nests is allowable; avoidance and/or minimization measures will be undertaken to conserve breeding colonies. Biological mitigation is habitat-based at approved ratios, which are based on the resource value of the impacted habitat. Mitigation for unavoidable impacts may include acquisition of additional preserve area lands, acquisition of credits in other conservation/wetland banks, or development of a biologically superior conservation alternative for the species at appropriate locations in the planning area.

Butte Regional Conservation Plan NCCP

The Butte Regional Conservation Plan NCCP is currently in the planning stage. The proposed study area encompasses 564,270 acres in Butte County. A planning agreement was completed in December 2007 and was signed by Butte County and the cities of Biggs, Chico, Gridley, and Oroville. An independent science advisors report was completed in 2007. Formal public review of draft planning documents closed June 8, 2016; however, public comments are still being accepted.

Yuba-Sutter Regional Conservation Plan NCCP

The Yuba-Sutter Regional Conservation Plan NCCP is currently in the planning stage. The proposed study area encompasses 468,552 acres in Yuba and Sutter counties. A planning agreement was completed in September 2012 and was signed by the counties of Butte and Yuba, the cities of Yuba City, Live Oak, and Wheatland. An independent science advisors report was completed in February 2006. Draft plan documents are in preparation.

Placer County Conservation Plan Phase I NCCP

The Placer County Conservation Plan Phase I NCCP is currently in the planning stage. The proposed study area (phase one of an anticipated three phases) encompasses 201,000 acres in western Placer County. A planning agreement was prepared October 2001 and was signed by the county of Placer. An independent science advisors report was completed January 2004. Draft plan documents are in preparation.

Yolo Habitat Conservation Plan/NCCP

Yolo Habitat Conservation Plan/NCCP (formerly Yolo Natural Heritage Program) is currently in the planning stage. The proposed study area encompasses 653,663 acres in Yolo County. A planning agreement was prepared February 2005 and signed by the Yolo Habitat Conservation Plan/Natural Communities Conservation Plan Joint Powers Agency. An independent science advisors report was completed March 2006. Draft plan documents are in preparation.

San Diego East County Multiple Species Conservation Plan NCCP

The San Diego East County Multiple Species Conservation Plan NCCP is currently in the planning stage. The proposed study area encompasses 1,600,000 acres in eastern San Diego County. The following communities are expected participants: Central Mountain, Cuyamaca, Descanso, Pine Valley, Desert/Borrego Springs, Julian, Mountain Empire, Boulevard, Jacumba, Lake Morena/Campo, Potrero, Tecate, Dulzura (in part), and Palomar/North Mountain. A planning agreement for San Diego East County and San Diego North County was prepared in 2008, amended May 2014, and signed by San Diego County. However, separate NCCPs will be prepared. An independent science advisors report, Part 1, was completed March 2006. Draft plan documents are in preparation.

San Diego North County Multiple Species Conservation Plan NCCP

The San Diego North County Multiple Species Conservation Plan NCCP is currently in the planning stage. The proposed study area encompasses 311,800 acres in northern San Diego County. The following communities are expected participants: Bonsall, De Luz, Fallbrook, Harmony Grove, Lilac, Pala, Pauma Valley, Rainbow, Rincon Springs, Twin Oaks Valley, Valley Center, and Ramona (in part). Excluded from the study area are Carlsbad, Encinitas, Escondido, Oceanside, San Marcos, Solana Beach, and Vista. A planning agreement for San Diego North County and San Diego East County was prepared in 2008, amended May 2014, and signed by San Diego County. However, separate NCCPs will be prepared. Independent science advisors reports were prepared in 2001 and 2002. Draft plan documents underwent public review in 2009 and are now under revision.

Conservation Plan for the Tricolored Blackbird

Following the 1991 petition to list the Tricolored Blackbird under CESA, a multi-stakeholder working group was formed to plan for and implement conservation actions. This resulted in the first of many statewide surveys, the first silage buyout to protect a breeding colony, and ongoing research. However, the working group made limited progress in developing comprehensive conservation measures for the Tricolored Blackbird and eventually dissolved in the mid-1990s. In 1997, a status update and management guidelines for the Tricolored Blackbird was completed (Beedy and Hamilton 1997). The species was again petitioned to be listed under CESA in 2004. After this petition was rejected by the Fish and Game Commission, a new multi-stakeholder Tricolored Blackbird Working Group was formed in 2005 and the group released a conservation plan in 2007 detailing the conservation and management, research and monitoring, data management, and education and outreach goals for the species (TBWG 2007). Working group members, including the Department, signed a Memorandum of Understanding agreeing to implement the actions in the conservation plan. Most of the goals and objectives in the plan are still relevant today and portions of the plan are currently being updated by the Tricolored Blackbird Working Group. Progress toward meeting objectives by the Department, USFWS, and partners on the working group has focused on protecting large breeding colonies that are threatened by harvest of agricultural grain fields and increasing knowledge through monitoring and research. New information is being used to update goals and objectives in the conservation plan.

Protection of Agriculture Colonies from Losses to Harvest

As described above, a large portion of the Tricolored Blackbird population has been nesting on agricultural grain fields since the 1990s, mostly adjacent to dairies. Although dairies often provide nesting substrate (the grain grown to feed cattle), a water source (e.g., drainage ditches or wastewater ponds), and food for adult birds (stored grains), colonies located adjacent to dairies have often suffered from low productivity. In many cases, the entire reproductive effort of silage colonies has been lost when the nesting substrate is harvested while the young or eggs are still in the nest (Meese 2013). The timing of grain harvest typically coincides with the Tricolored Blackbird breeding season, resulting in the destruction of nests, eggs, and nestlings, and occasionally mortality of adult Tricolored Blackbirds. The Tricolored Blackbird colonies that form on agricultural grain fields early in the breeding season are often the largest colonies formed each year, and the complete destruction of these colonies due to harvest can be especially damaging to annual blackbird productivity (Arthur 2015).

The protection of large colonies that occur on agricultural grain fields has been the primary conservation action implemented for Tricolored Blackbird since the species was discovered breeding in this substrate type in the early 1990s. Shortly after the discovery of grain colonies in the San Joaquin Valley, the USFWS intervened to encourage harvest delays and protect the largest known breeding colony (Hamilton 1993). In 1994, a crop was bought to protect a 28,000-bird colony (Kelsey 2008). Hamilton et al. (1995) calculated that interventions in 1992, 1993, and 1994 may have been responsible "for the presence of over 75,000 adult Tricolored Blackbirds in 1995 [which had been nestlings in the three previous years], about 25% of the known population." In 1999, the Department and USFWS protected a colony that was composed of one-third of the known population at the time, which otherwise would have been destroyed by routine harvesting activities (Hamilton et al. 1999). In 2004, silage purchases by the Department and USFWS protected three colonies totaling over 100,000 adult Tricolored Blackbirds. In 2006, the two largest known colonies, totaling more than 200,000 breeding birds, were protected through silage buyouts (Meese 2006). Meese (2009b) estimated that payments to landowners for harvest delays resulted in the protection of 364,000 nests and about 396,000 Tricolored Blackbird fledglings in the five years from 2005 to 2009. Despite these efforts to protect birds breeding on agricultural fields, losses to harvest have continued to occur in most years (Figure 17).

The Natural Resources Conservation Service (NRCS) established a fund in 2012 that was used for three breeding seasons to protect colonies on agricultural lands and to enhance habitat for the Tricolored Blackbird. Landowner participation in the program varied from year to year, with many thousands of nests protected each year while some colonies continued to be lost to harvest.

Regional Conservation Partnership Program

In 2015, the NRCS awarded a Regional Conservation Partnership Program (RCPP) grant to a group of conservation and dairy organizations (Arthur 2015). The grant provided five years of funding to protect, restore, and enhance Tricolored Blackbird habitat on agricultural lands, with the primary objective being to prevent loss of breeding colonies to harvest. During the first year of implementation in the 2016 breeding season, the program succeeded in enrolling all landowners with Tricolored Blackbird colonies

identified on their property, and 100% of known agricultural colonies representing more than 60,000 breeding birds were protected through delay of harvest. In 2017, a single large colony (estimated at up to 12,500 breeding birds) was lost to harvest at a location that was not enrolled in the NRCS program.

Despite efforts by landowners and the state and federal government to protect colonies, losses to harvest have continued. The protection of all known colonies on agricultural fields in the 2016 breeding season is encouraging progress, although ongoing success will require a stable funding source to compensate landowners that delay harvest. See the section on Harvest of Breeding Colonies below for a discussion of this ongoing threat to the species.

Habitat Restoration and Enhancement

USFWS National Wildlife Refuges

The USFWS owns and manages several National Wildlife Refuges (NWR) in the breeding range of the Tricolored Blackbird. In northeastern California, the Lower Klamath and Tule Lake NWRs have supported breeding colonies at several locations, although colony size has been relatively small as is typical for this portion of the range. The Sacramento National Wildlife Refuge Complex in the Sacramento Valley, the San Luis National Wildlife Refuge Complex in the northern San Joaquin Valley, and Kern and Pixley NWRs in the southern San Joaquin Valley have all supported breeding Tricolored Blackbird colonies.

The Sacramento National Wildlife Refuge Complex has actively managed selected wetlands to maintain suitable Tricolored Blackbird habitat for some time, and they have been frequently successful in attracting breeding colonies to Delevan NWR. Recent restoration at Colusa NWR has resulted in a return of breeding birds after many years of absence. Portions of the Merced NWR have been managed to provide breeding substrate for Tricolored Blackbirds in recent years, and the refuge has been successful in attracting multiple colonies of several thousand breeding birds. The Kern NWR has supported suitable habitat, and for many years hosted breeding colonies. Despite continued efforts to provide flooded spring wetlands, in recent years use of the refuge by breeding colonies has been limited, although a colony of 3,000 birds nested on the refuge in 2017. The Pixley NWR has not supported breeding colonies in recent years, but the USFWS is implementing management to attract breeding birds.

NRCS Easements and Incentive Programs

Through a combination of easements on privately owned lands and 3-year incentive programs, the NRCS has enrolled about 500 acres of land (as of January 2017) in programs that will provide habitat suitable for Tricolored Blackbird nesting. These programs focus on providing dense cattail habitat using water management practices compatible with Tricolored Blackbird nesting habitat. The majority of current NRCS habitat projects are in the Grasslands District of Merced County, with a smaller acreage in the southern San Joaquin Valley in Kern and Tulare Counties. Existing habitat projects have proven successful, with Tricolored Blackbirds breeding on three NRCS easement properties in 2016 (report to the Tricolored Blackbird Working Group, January 31, 2017; unreferenced).

California Department of Fish and Wildlife Lands

On many of the Department wildlife areas and ecological reserves located in the breeding range of the Tricolored Blackbird, management practices include spring or permanent wetland habitats that can support suitable nesting substrate for breeding colonies. In some cases, these wetlands have been managed specifically for Tricolored Blackbirds by setting back wetland succession through burning or mechanical methods, and in other cases the wetlands are typically managed for a broader suite of species. Use of Department wildlife areas and ecological reserves by breeding colonies includes (Tricolored Blackbird Portal 2017):

Northeastern California – The Honey Lake Wildlife Area has supported breeding colonies at two wetland locations. The number of breeding birds has been small, with the most recent observation of 200 breeding birds in 1996.

Sacramento Valley – Four wildlife areas in the Sacramento Valley have supported breeding colonies. Three of these wildlife areas are in Butte County (Oroville, Gray Lodge, and Upper Butte Basin), each of which have supported colonies at a single location, with the most recent observations including 1,600 birds on a wetland at Gray Lodge Wildlife Area in 2011 and 2,000 birds in willows at Oroville Wildlife Area in 2015. Oroville Wildlife Area also regularly supports foraging birds in the post-breeding season (B. Stone, pers. comm.). The Yolo Bypass Wildlife Area in Yolo County has hosted small breeding colonies at three separate locations in wetlands and button willow shrubs.

San Joaquin Valley – Four wildlife areas in the San Joaquin Valley have supported breeding colonies. Three of these are in Merced County, with North Grasslands Wildlife Area supporting three colony locations in milk thistle and mustard, Los Banos Wildlife Area supporting five colony locations in wetlands, and O'Neill Forebay Wildlife Area supporting four colony locations in Himalayan blackberry. The most recent use includes a 9,000 bird colony on a wetland at Los Banos Wildlife Area in 2008 and a 3,500 bird colony in Himalayan blackberry at O'Neill Forebay Wildlife Area in 2005. The fourth wildlife area in the San Joaquin Valley, Mendota Wildlife Area, is located in Fresno County. This wildlife area has supported breeding colonies at three separate wetland locations, with the last reported breeding by 1,000 birds in 1995.

Southern California – The Rancho Jamul Ecological Reserve in San Diego County has hosted a small breeding colony on a wetland in most years since 2007. This colony is usually fewer than 200 breeding birds. In Riverside County, the San Jacinto Wildlife Area has supported breeding colonies at 12 different locations. Most of the colonies have occurred in wetland habitats, with a few locations in other vegetation types including stinging nettle, thistles, and mallow. This wildlife area is located in perhaps the most important region for breeding Tricolored Blackbirds south of the Transverse Ranges. The wildlife area regularly hosts several thousand breeding birds, with a single location supporting 10,000 birds in 2005. During the 2017 statewide survey, 6,300 birds were observed at a single location on the wildlife area.

The Department has also worked with private landowners to create nesting habitat using a variety of incentive programs. The goals of the programs have included management of water to create spring

wetland habitat with emergent cattail vegetation. Several of these projects were successful in attracting Tricolored Blackbird colonies, with colonies of up to several thousand birds breeding on private wetlands created through these programs from at least 2005 through 2011. Funding has been limited in recent years, resulting in declining participation and a reduction in available wetland habitat on private lands.

California Environmental Quality Act

The California Environmental Quality Act (CEQA; Public Resources Code Section 21000 et seq.) requires state and local agencies to publicly disclose, analyze, and potentially mitigate environmental impacts from projects over which they have discretionary approval power. In particular, CEQA requires that actions that may substantially reduce the habitat, decrease the number, or restrict the range of any species that can be considered rare, threatened, or endangered must be identified, disclosed, considered, and mitigated or justified (Cal. Code Regs., tit. 14, §§ 15065(a)(1), 15380).

The environmental review process required by CEQA can be costly and time consuming, and compliance is not always thorough. Agencies may also make the determination that projects are exempt (i.e., they do not need to go through the impact analysis, public disclosure, and mitigation process). Mitigation is required if a project is not CEQA-exempt and impacts would be potentially “significant.” Mitigation must reduce impacts to below a level of significance or minimize unavoidable significant impacts, where feasible. The CEQA process generally incentivizes agencies and project applicants to implement mitigation, thereby avoiding significant impacts.

Due to its SSC designation, impacts to Tricolored Blackbirds are generally considered potentially significant if agencies determine on a project-specific basis that the species meets the CEQA criteria for rare, threatened, or endangered. However, agencies are not required to make this determination for Tricolored Blackbirds and other species that are not listed under CESA or ESA.

FACTORS AFFECTING ABILITY TO SURVIVE AND REPRODUCE

Small Population Size and Colonial Breeding

A key question is whether the colonially breeding Tricolored Blackbird can maintain a viable population at some reduced population abundance that ~~supports~~ is comprised of only small colonies or concentrates the majority of the population into very few colonies. That is, what is the minimum number of individuals that can continue to support a well-distributed breeding population with colonies that are productive and resilient to the dynamic breeding and foraging landscape within their range? Another North American colonially breeding bird, the Passenger Pigeon (*Ectopistes migratorius*), declined to extinction as a result of multiple population pressures, and the species seemed to have an inability to survive and reproduce at low population numbers (Bucher 1992). In addition to the well-known effect of market hunting in the decline of the Passenger Pigeon, habitat alteration and a lack of social facilitation in food finding due to reduced population size have been implicated in the extinction of the species (Bucher 1992). The Tricolored Blackbird is similar to the Passenger Pigeon in that they are highly social, colonial breeders with nomadic tendencies that likely evolved for locating highly abundant food sources and other breeding habitat requirements. Tricolored Blackbird has experienced, or continues to experience, many of the population pressures that led to extinction of the Passenger Pigeon; however, unlike the passenger pigeon, the Tricolored Blackbird has adapted to the wide-scale loss of wetland nesting substrate habitat by using a variety of upland vegetation types.

As described in the section on Biology and Ecology, Tricolored Blackbirds may benefit from social and colonial behaviors by reducing mortality due to predation during the nesting cycle and by facilitating food finding and information sharing. Smaller groups of birds would likely retain the ability to locate and use secure nesting substrates, but small colonies might lose the potential benefits of predator satiation and of social food finding and information sharing. The locating and exploitation of abundant food sources could affect small groups of birds both in the selection of productive breeding locations and in acquiring sufficient prey with which to provision young after a site is selected.

Some bird species are known to nest in colonies when conditions are suitable, but can also nest in smaller groups or as single pairs. For example, the White-winged Dove (*Zenaida asiatica*) once nested in extremely large colonies in Mexico. In 1978, 22 breeding colonies contained a collective population size of more than eight million birds (Sanchez Johnson et al. 2009). Individual birds were shown to have very high site fidelity to breeding areas, sometimes returning to nest in the same tree across years (Schwertner et al. 1999). Habitat changes driven by urbanization and intensification of agricultural practices and urbanization caused the loss and fragmentation of nesting habitat and now the White-winged Dove nests singly or in smaller colonies at more dispersed locations in Mexico, and appears to have adapted to use urban areas (Schwertner et al. 1999, Sanchez Johnson et al. 2009).

Commented [RHD4]: Redundant?

Although the Tricolored Blackbird has been observed to nest in very small colonies (as few as 4 nests), the species has not been observed to nest as single pairs. Very small colonies (<100 birds) are quite rare, and although nesting success varies greatly across colonies of all sizes, there is some evidence that very small colonies are not as successful as larger colonies (Payne 1969, Weintraub et al. 2016), and that larger colonies produce more young per female (Hamilton 1993, Meese 2013). Reductions in population size may make the Tricolored Blackbird more vulnerable to additional declines due to inherent natural history factors, but the degree to which a small population would limit the species' ability to survive and reproduce is not known.

The fact that half or more of the total population will often occur in a small number of large colonies in silage fields during the first nesting attempt makes the species ~~vulnerability~~ vulnerable to losses of productivity (Meese 2012, Beedy et al. 2017). In 2011, 65% of the total known population was located at only six colony sites in Merced, Kern, and Tulare counties (Kyle and Kelsey 2011). This concentration of large portions of the population makes the species vulnerable to a number of potential threats, especially colony destruction through harvest, predation, or extreme weather events (Weintraub et al. 2016). The enhanced risk to the species due to colonial breeding may be realized primarily through exacerbation of other threats that can ~~effect~~ affect a large portion of the total population.

Habitat Loss

Loss of Nesting Habitat

The conversion of wetland nesting habitat to agricultural and urban uses has been implicated in the long-term decline of the species. Neff (1937) observed, "[t]he destruction of [Tricolored Blackbird] nesting habitats by man is of most importance," and cited reclamation and drainage as key factors in the loss of many favorable sites, along with "dredging or cleaning of reservoirs, marshes, and canals in order to destroy the growths of cattails and tules." Only about 15% of the four million acres of wetlands that existed in the Central Valley in the 1850s remained when Neff conducted his work in the 1930s, and about 40% of those remaining wetlands were lost between 1939 and the 1980s (Frayer et al. 1989). Of the freshwater emergent wetlands most likely to be used by breeding Tricolored Blackbirds in the Central Valley, 50% were lost between 1939 and the 1980s, with an average loss of 5,200 acres per year (Frayer et al. 1989). These losses were primarily due to conversion of wetlands to agriculture.

DeHaven et al. (1975a) found no nesting substrate at several locations in Los Angeles, Kern, Sacramento, and Yolo counties where earlier researchers had studied the species. Subsequent investigators have continued to document habitat loss at known breeding colony locations through the present. For example, Beedy et al. (1991) found that 9.3% (n = 17) of all colony locations used in the 1980s were extirpated through permanent removal of nesting habitat. Hamilton et al. (1999) observed the removal of a wetland that had supported a productive breeding colony in 1998. DeHaven (2000) noted the loss of several breeding colonies in Sacramento County to urban development and the expansion of vineyards. Humple and Churchwell (2002) reported on the draining of a wetland and the removal of Himalayan blackberry that had previously supported breeding colonies. Hamilton (2004a) documented the loss or destruction of cattail nesting substrates that had supported 90,000 breeding birds between 1994 and 2004. During the 2017 statewide survey, local experts and survey participants were asked to score the suitability of nesting substrate for all sites visited. Of the 636 sites for which scores were reported before or during the survey, 70 sites were scored as permanently unsuitable, usually due to development or conversion to permanent crops like orchards or vineyards (Table 5). An additional 80 sites had no nesting substrate present during the survey and 101 sites had vegetation present, but were considered unsuitable by the survey participant.

Table 5. Nesting substrate suitability for 636 sites scored before and during the 2017 statewide survey.

Score	Number of sites	Notes on suitability scores
Suitable	385	Nesting substrate present and considered suitable for nesting.
Unsuitable	101	Nesting substrate present but appears to be unsuitable for nesting (e.g., it is immature, too short, lacks sufficient foliage, too sparse, or has recently been burned).
Substrate absent	80	Nesting substrate absent because it has been removed or died (e.g., former grain field planted to alfalfa, milk thistle stand or Himalayan blackberry that has been mowed, wetland that has dried up).
Permanently unsuitable	70	Nesting substrate is absent and cannot be replaced (e.g., has been converted to urban development, orchard, or vineyard).

Following a low point in the extent of wetlands in the 1980s, aggressive restoration actions resulted in an increase of 65,000 acres of managed wetlands between 1990 and 2005 (CVJV 2006). The majority of the wetlands in the Central Valley are managed lands that are maintained by application of water, and many areas undergo occasional land recontouring or vegetation control to maintain desired conditions. As of 2006, there were about 205,000 acres of managed wetlands in the Central Valley (CVJV 2006). Most managed wetlands (~90%) are flooded primarily in the fall and winter for wintering waterfowl (i.e., seasonal wetlands), and a small proportion are managed as semi-permanent or permanent wetlands that hold water during the spring and summer (Iglecia and Kelsey 2012). Semi-permanent wetlands are often managed to support brood habitat for waterfowl; the small proportion of semi-permanent and permanent wetlands are those that can potentially be suitable as nesting substrate for breeding Tricolored Blackbirds.

Replacement of wetland breeding habitat with novel, nonnative upland nesting substrates may have lessened the impact of the decline in Central Valley wetlands to the Tricolored Blackbird population. However, these nonnative vegetation types are often considered undesirable and are frequently removed. Himalayan blackberry habitat with a history of use by breeding colonies has been removed by burning, treatment with herbicide, or mechanical removal (Airola et al. 2015a, 2015b). Milk thistle colonies have been destroyed when landowners have removed or sprayed the invasive weed while Tricolored Blackbirds are actively nesting (Airola et al. 2016). Blackberry control is generally localized and occurs on multi-year intervals, and therefore may not have a large overall effect on the population, although there are cases where removal of nesting substrate has resulted in permanently unsuitable conditions. In the central Sierra Nevada foothills where Tricolored Blackbird colonies frequently nest in Himalayan blackberry, 32% of colonies active in 2014 occurred in areas zoned for development or that were proposed for rezoning for development (Airola et al. 2015a). In 2017, a group of Himalayan blackberry sites that had supported 13,000 breeding Tricolored Blackbirds were removed or degraded by aggregate mining activities (Oct 2017 email from D. Airola to N. Clipperton; unreferenced). The Department is unaware of any available information to evaluate distribution or trends of these nonnative nesting substrates across the range of the Tricolored Blackbird in California.

Although the loss of wetlands in California's Central Valley is well documented and there are many examples of nesting substrate being removed or degraded at historical Tricolored Blackbird colony locations, there also appears to be suitable nesting substrate in some areas that goes unused in many years. However, there are other regions where large areas of apparently suitable foraging habitat have no available nesting substrate, or where nesting substrate is only available during years when rainfall patterns support vigorous growth of upland nesting substrates (Airola et al. 2016). Most managed wetlands in the Central Valley are not suitable as nesting substrate for the Tricolored Blackbird, but wetlands remain the substrate type most frequently used by breeding colonies and upland nesting substrates provide additional habitat. The dynamic occupancy patterns at breeding locations from year to year and the need for abundant insect prey in surrounding foraging habitat makes it difficult to reach conclusions about nesting substrate suitability based on occupancy in a single year. It is likely that loss of nesting substrate has caused local declines and shifts in distribution, but the overall effect on the population is difficult to assess, especially without considering other breeding requirements. Losses of

nesting substrate at historically large or productive colony locations, or in areas surrounded by high quality foraging habitat, would have the largest impact on the population.

Loss of Foraging Habitat

The extent of foraging habitat required for successful breeding is much greater than the extent of nesting substrate. The abundance of insect prey in foraging habitat has been linked to reproductive success, and Tricolored Blackbirds may choose breeding locations in part based on the local prey populations. Because insect populations are variable and unpredictable from year to year, the Tricolored Blackbird population likely requires much more foraging habitat on the landscape than is used in any given year, and once lost, large landscapes with suitable habitat are difficult to replace. For these reasons, loss of foraging habitat is likely as important, or more so, than the documented losses of nesting substrate on the long-term viability of the Tricolored Blackbird population.

The loss of foraging habitat has been suggested as a likely cause of decline in southern California (Hamilton et al. 1995, Cook 2010). The extirpation of colonies from most of the coastal lowlands in southern California, despite the presence of more numerous marsh habitats relative to inland areas, suggests that foraging habitat sufficient to support breeding colonies is the population’s limiting factor (Unitt 2004).

Hamilton et al. (1992) reported on the pervasive loss of foraging habitat near breeding colony sites due to expansion of cultivated agriculture and the conversion of existing agriculture to incompatible crops in the Central Valley, and considered this the primary threat to population abundance. DeHaven (2000) observed widespread habitat loss due to urban expansion and agricultural conversions to vineyards and orchards relative to the 1970s when he and others conducted Tricolored Blackbird research across the state, and suggested that habitat loss was a primary driver of continued population declines. Conversion of pastures and crops suitable for foraging by Tricolored Blackbirds was observed in Placer, Sacramento, Stanislaus, and Tulare counties. DeHaven (2000) noted especially extensive losses in Sacramento County, where urban development and expansion of vineyards had removed thousands of acres of high-quality habitat. More than 5,000 acres of habitat had been converted to vineyards in just a two-year period from 1996 to 1998, resulting in the loss of known breeding colony locations.

Grasslands have been identified as one of the most vulnerable habitats across North America, and many grassland species have experienced steep population declines in recent decades (NABCI 2016). A great deal of effort has been expended on conserving the grasslands in the central part of North America from the Great Plains to northern Mexico (Knopf and Skagen 2012). The grasslands of California have not received the same level of conservation attention, although losses of grasslands in California have been extensive.

Soulard and Wilson (2015) used Landsat satellite data to analyze land-use and land-cover change in the Central Valley from 2000 to 2010, and compared this to changes in the valley since 1973. The largest land-cover trend from 2000 to 2010 occurred in grassland/shrubland habitats. During this 10-year period, an estimated 79,200 acres of grasslands and shrublands were lost, representing a 5% decrease in the Central Valley over 10 years. Over the longer period from 1973 to 2010, grasslands and shrublands

declined by 22% (a loss of 476,900 acres), due mainly to conversions to more intensive agriculture and urban development. Although many of the grassland losses were due to agricultural intensification, losses of agriculture to urban development resulted in relatively little net change in area of agriculture in the Central Valley from 1973 to 2010.

Cameron et al. (2014) analyzed time series land cover data from the California Farmlands Mapping and Monitoring Program collected between 1984 and 2008 to evaluate rangeland habitat (grassland, shrubland, and woodland) conversion in California. The area evaluated covers much of the breeding range of the Tricolored Blackbird except for southern California. About 483,000 acres of rangelands were converted during this 20+ year period, with urban and rural development and conversion to more intensive agricultural uses accounting for most (~90%) of the rangeland loss. Agricultural intensification was primarily due to increases in vineyards and orchards, but smaller amounts of other agricultural crops that may provide foraging habitat for Tricolored Blackbirds were also responsible for grassland loss. The San Joaquin Valley region, which in recent decades has been the center of abundance for breeding Tricolored Blackbirds during the early nesting season, experienced the largest amount of rangeland conversion (Figure 18).

Land cover types suitable for Tricolored Blackbird foraging in the Central Valley continue to be converted to incompatible land cover types such as orchards, vineyards, and urban development as agricultural practices evolve and cities continue to expand ~~in the Central Valley~~. Due to the continued expansion of nut trees and vineyards that replace grasslands, shrublands, or agricultural crops that provide insects required for breeding (e.g., alfalfa), regions that were previously occupied by thousands of birds have now become permanently unsuitable for breeding (Meese 2016). For example, the acreage of pistachio orchards in the Central Valley has grown exponentially in recent years and the acreage of almonds continues to increase (Figures 19 and 20). The five leading pistachio producing counties in California have also supported a large proportion of the Tricolored Blackbird breeding population in recent years (Kern, Tulare, Kings, Fresno, and Madera counties), with Kern County alone supporting 42% of pistachio production in 2012 (Geisseler and Horwath 2016). In the central Sierran foothills, many colony sites and the surrounding foraging landscape are zoned for development, and several development projects that may affect Tricolored Blackbird habitat have moved forward in recent years (Airola et al. 2015a, 2016). Statewide, the proportion of grasslands within 3 miles of known breeding colony locations declined from 2008 to 2014 (NAS 2017).

The California Rangeland Trust has conserved more than 300,000 acres of rangeland in 24 California counties through conservation easements (https://www.rangelandtrust.org/ranch/). Although data are not available on the extent and distribution of conserved lands within the range of the Tricolored Blackbird, some of the conserved ranches are in counties that receive regular use by breeding Tricolored Blackbirds, including Kern, Merced, Madera, and Placer counties. Data on the proximity of conserved rangelands to Tricolored Blackbird breeding colonies is not available, but these easements may provide protection of important foraging habitat for birds that breed in the foothills and grasslands on the periphery of the Central Valley.

Large losses of rangeland and suitable crop foraging habitat have occurred over the last several decades, and conversion of these suitable foraging habitats continue throughout much of the Tricolored Blackbird's range. Although large acreages of rangeland habitat have been conserved through conservation easements, these have not necessarily focused on areas of highest value to Tricolored Blackbird and are small relative to the extent of grassland in the state and the observed rate of loss over the past several decades. Future development in California is projected to be concentrated in several core areas of the Tricolored Blackbird range, including the Central Valley, the foothills of the Sierra Nevada, and on both sides of the Transverse Ranges in southern California (Jongsomjit et al. 2013; Figure 21), which would further reduce or degrade the available foraging landscape for breeding colonies. Loss of suitable rangeland foraging habitat is projected to continue into the future (see Drought, Water Availability, and Climate Change section). The proportion of grasslands in the landscape surrounding potential breeding sites has been shown to be the most important land cover type in predicting the occurrence of breeding Tricolored Blackbirds, and the proportion of alfalfa is the most important determinant of colony size (NAS 2017). Combined with regular loss of nesting substrate, the ongoing loss of foraging habitat makes it less likely that these essential breeding habitat requirements will co-occur on the landscape, with the result being a reduced number of locations suitable for successful breeding by Tricolored Blackbird colonies.

Overexploitation

Market Hunting and Depredation Killing

Neff (1937, 1942) reported hundreds of thousands of blackbirds sold on the Sacramento market, many of which were Tricolored Blackbirds. Market hunting of blackbirds in the Central Valley became a thriving business in about 1928 or 1929 and continued through the mid-1930s. Tricolored Blackbirds banded for research activities throughout the 1930s were often recovered by market hunters with which Neff collaborated (1942).

McCabe (1932) described the deliberate strychnine poisoning of 30,000 breeding Tricolored Blackbirds as part of an agricultural experiment. In the early 1930s active poisoning and shooting programs were enacted to control populations of blackbirds (McCabe 1932, Neff 1937). Tricolored Blackbirds and other blackbird species were killed by poisoned baits used as a means of blackbird control in rice fields in the Sacramento Valley, and numerous blackbirds were shot by farmers or by hired bird herders in attempts to drive the flocks away from rice and other crops (Neff 1942). During the period from 1935 to 1940 blackbird depredations in rice fields were of lesser intensity, and control operations by means of poisoned baits were almost entirely discontinued (Neff 1942).

Because the Tricolored Blackbird forages in mixed-species flocks with the European Starling and other species of blackbirds in the nonbreeding season, and because these flocks forage at feedlots and on ripening rice, the Tricolored Blackbird may be exposed to avicides intended to control nuisance and depredating flocks of blackbirds.

A depredation order under the federal Migratory Bird Treaty Act allows for the control of several species of blackbirds and corvids in agricultural situations without a permit from the USFWS (when birds are

causing serious injuries to agricultural or horticultural crops or to livestock feed; 50 CFR 21.43). In 1988, the USFWS modified the long-standing depredation order to remove the Tricolored Blackbird and prohibit killing the species without a federal permit (Beedy et al. 1991). Although Tricolored Blackbird is no longer covered by the depredation order, it is possible that misidentification of Tricolored Blackbirds when they occur in mixed flocks in the fall and winter leads to unintentional mortality of the species. Landowners are required to report on activities and on the number of birds captured or killed under the depredation order, including non-target species such as the Tricolored Blackbird (50 CFR 21.43, Nov 5, 2014). Based on reports provided to the USFWS, annual reporting appears to be inconsistent and the number of birds killed under the depredation order may be underreported. The number of Tricolored Blackbirds killed annually is unknown and therefore the killing of blackbirds to protect ripening rice in the Sacramento Valley is a known but unquantified source of Tricolored Blackbird mortality.

There has been limited documentation of the shooting of Tricolored Blackbirds in the Sacramento Valley. Two birds that had previously been banded were reported to have been shot by a rice farmer in Butte County (Meese 2009a). These birds were reported because they were banded and it seems likely that additional, unbanded birds were also shot.

Historical killing of blackbirds to protect crops and for the food market may have contributed to a long-term decline of the species, but the intentional killing of Tricolored Blackbirds has declined since the 1930s. The effect of mortality due to shooting or poisoning on annual Tricolored Blackbird survival rates is currently unknown.

Harvest of Breeding Colonies

The Tricolored Blackbird colonies that form on agricultural grain fields early in the breeding season are often the largest colonies formed each year, and the complete destruction of these colonies due to harvest can be especially damaging to annual blackbird productivity (Arthur 2015). Normal harvesting activities typically coincide with the breeding season and the harvest of fields that contain nesting colonies results in nest destruction and the loss of eggs or nestlings. The cutting of grain has also killed adult Tricolored Blackbirds but most adults appear to survive harvest operations.

Shortly after the discovery of grain colonies in the San Joaquin Valley, Hamilton et al. (1992) observed the loss of a 15,000-bird colony to harvest. As early as 1993, the USFWS intervened to encourage harvest delays and protect the largest known breeding colony (Hamilton 1993). Since then, colony protection through crop purchase or delayed harvest has been the primary conservation action implemented for the species (see Existing Management section), with mixed success. Despite annual attempts to locate and protect large colonies since the early 1990s, losses to harvest have occurred in most years (Figure 17), with 2010 and 2016 the only known exceptions. Two large colonies representing more than 60,000 breeding birds were lost due to harvest in 1994 (Hamilton et al. 1995). The two largest breeding colonies in 1995 were destroyed during harvest of the grain nesting substrate (Beedy and Hamilton 1997). At least one colony of 14,000 birds was harvested in 1999 and four colonies were lost to harvest operations in 2000 (Hamilton et al. 1999, Hamilton 2000). Colonies were destroyed in all years from 2005 to 2009, with especially large losses in 2006, 2007, and 2008 (Meese 2009b). In 2008, several of the largest known colonies were destroyed, with six colonies being cut that hosted ~~representing~~ 140,000 breeding birds ~~being cut~~ (Meese 2008). At least three colonies were lost to harvest in 2011, including the largest known colony, which supported 17% of the total known population (Kyle and Kelsey 2011, Meese 2011). At least two colonies in grain fields were destroyed in 2014 during the harvest of nesting substrate and at least three colonies were partially or totally destroyed due to harvest in 2015 (Meese 2014a, 2015b). After a breeding season with no known harvest losses in 2016, a large colony (estimated at up to 12,000 birds) was mostly lost in 2017 when the grain nesting substrate was cut in preparation for harvest (Colibri 2017).

No colonies are known to have been destroyed by harvest in 2010; a settlement on a dairy in Merced County was lost when the grain was harvested, but the harvest occurred during nest building before eggs were laid (Meese 2010). Beginning in 2016, a new partnership was created through a grant from NRCS, with Audubon California, dairy trade organizations, and agencies working together to conduct outreach to dairy owners and to detect and protect breeding colonies. The program succeeded in enrolling all landowners with Tricolored Blackbird colonies identified on their property in 2016, and 100% of known agricultural colonies were protected through delay of harvest. In 2017, most colonies on grain fields at dairies were again protected, but at least one large colony was destroyed when the grain was cut.

It has been argued that protection of colonies breeding on silage fields should be reevaluated because adult birds are unlikely to be killed by harvesting operations and Tricolored Blackbirds are known to breed more than once in a season. DeHaven (2000) and Hamilton (2004a, 2004b) suggested that habitat losses might be more important in population declines than nesting mortality, and resources spent protecting colonies on silage fields might be better spent protecting or restoring habitat. However, second breeding attempts are often less productive than first breeding attempts due to the energetic and physiological costs of egg formation in females, incubation and brooding, and raising of young (Martin 1987, Meese 2008). Even if these costs did not reduce the relative productivity of second breeding attempts, the elimination of a first breeding attempt may cause breeding colonies to miss the period of peak prey abundance, thereby reducing seasonal reproductive success (Martin 1987). Colony destruction through harvest typically occurs well after females have laid eggs and often after eggs have hatched, so the lost energetic input to a failed breeding and the delay before a second attempt likely reduce total annual productivity, even if birds attempt to nest a second time (Meese 2008).

The Tricolored Blackbird was shown to have experienced low reproductive success from at least 2006 to 2011 (Meese 2013). Reproductive success appears to have always been quite variable across colonies in any given year, and occasional success at large colonies may be important in maintaining the population over time (see Reproduction and Survival section). A number of factors have been shown to influence reproductive success, including predation and shortage of food, but reproductive failures caused by harvest at breeding Tricolored Blackbird colonies on agricultural fields of the San Joaquin Valley may have contributed to population declines through loss of much of the annual reproductive potential of the species in several years.

Overexploitation summary—Although direct killing of Tricolored Blackbirds was once a large source of adult mortality, the number of birds killed declined dramatically after blackbird depredations in rice fields declined in the 1930s. Killing of Tricolored Blackbirds that may be depredating crops during the post-breeding period is likely a continuing source of mortality, but the available data do not indicate this to be a large source of mortality; additional data would be required to determine the degree to which this factor effects the population. Destruction of colonies in agricultural fields has been occurring since Tricolored Blackbirds were discovered nesting in this substrate type in the early 1990s. In recent years, the protections provided to the Tricolored Blackbird as a candidate under CESA, the availability of funds, and a coordinated effort by agencies, the dairy and farming industries, and nonprofit groups has led to a dramatic decline in this source of mortality, but losses of large colonies to grain harvest have continued. The future success of breeding colonies on agricultural crops will depend on the availability of funds to continue programs that locate breeding colonies on grain fields early in the nesting season and compensate farmers for delaying harvest.

Predation

A large number of predators have been observed preying on Tricolored Blackbirds (Table 6), including their eggs or nestlings. Most observations of predation have occurred at breeding colonies when the birds are congregated in dense groups, and most predation has occurred on the eggs, nestlings, or fledglings of Tricolored Blackbirds.

Table 6. Predators of Tricolored Blackbirds.

Taxonomic Group	Predators	Sources
Birds	Black-crowned Night-Heron (*Nycticorax nycticorax*), Cattle Egret (*Bubulcus ibis*), White-faced Ibis (*Plegadis chihi*), Great Blue Heron (*Ardea herodias*), Cooper's Hawk (*Accipiter cooperii*), Swainson's Hawk (*Buteo swainsoni*), Peregrine Falcon (*Falco peregrinus*), Merlin (*Falco columbarius*), Northern Harrier (*Circus cyaneus*), Barn Owl (*Tyto alba*), Burrowing Owl (*Athene cunicularia*), Short-eared Owl (*Asio flammeus*), Yellow-billed Magpie (*Pica nuttalli*), American Crow (*Corvus brachyrhynchos*), Common Raven (*Corvus corax*), Great-tailed Grackle (*Quiscalus mexicanus*)	Mailliard (1900), Neff (1937), Payne (1969), Hamilton et al. (1995), Beedy and Hamilton (1997), Hamilton (2000), Kelsey (2008), Meese (2010), Meese (2012), Airola et al. (2015a), Meese (2016), Beedy et al. (2017)
Mammals	coyote (*Canis latrans*), wolf (*Canis lupus*), gray fox (*Urocyon cinereoargenteus*), raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), long-tailed weasel (*Mustela frenata*), feral domestic cat (*Felis catus*), and possibly mink (*Mustela vison*)	Evermann (1919), Neff (1937), Payne (1969), Hamilton et al. (1995), Beedy and Hamilton (1997), Wilson et al. (2016), Beedy et al. (2017)
Snakes	gopher snake (*Pituophis catenifer*), king snake (*Lampropeltis* sp.), garter snake (*Thamnophis* sp.), and possibly western rattlesnake (*Crotalus oreganus*)	Neff (1937), Payne (1969), Hamilton et al. (1995)

Small areas of native vegetation may be especially vulnerable to predation, especially if they are near sites at which predator populations are artificially high due to the availability of augmented food sources

from human activities. In the early 1990s, Hamilton and others found that many breeding colonies in emergent wetland nesting substrates suffered partial or complete destruction by predation (primarily by Black-crowned Night-Herons; Hamilton et al. 1992, 1995, Hamilton 1993), resulting in consistently lower reproductive success in wetlands compared to other nesting substrates. Beedy and Hamilton (1997) reported that more recently, Black-crowned Night-Herons eliminated all or most nests at several freshwater marsh breeding colonies. Hamilton (2000) later reported that wetland colonies with no Black-crowned Night-Heron predation were highly successful. DeHaven (2000) reported that he also observed high rates of colony failure due to predation in the 1970s, a time when the majority of the population still bred in wetland substrates. Whether recent rates of loss to predation are similar to historical rates of loss is unknown.

In recent decades, complete nesting failures have been caused by novel predators on agricultural grain fields and the increasing concentration of birds in mega-colonies may have increased their susceptibility to nest predation (Kelsey 2008). Cattle Egrets from a single rookery caused complete or near-complete failure of large breeding colonies in Tulare County from 2006 to 2011 (Meese 2012). White-faced Ibis prey on the eggs of the Tricolored Blackbird, and in 2016 caused the complete failure of a large breeding colony on a silage field in Tulare County (Meese 2016, Beedy et al. 2017).

Kelsey (2008) reported a steady increase in population sizes of several avian predators in California, including Black-crowned Night-Heron, Cattle Egret, American Crow, and Common Raven. However, the most recent breeding bird survey data show an increase for only one of these species, the Common Raven, and the data for Cattle Egret have important deficiencies that preclude trend assessment (Sauer et al. 2017b). White-faced Ibis have experienced a large population increase in California since the 1980s (Shuford et al. 1996), but BBS data are inadequate for trend assessment (Sauer et al. 2017b).

Although many species have been documented as predators of Tricolored Blackbirds, most have not had severe effects on the population or on the breeding success at nesting colonies. However, a few species have caused the complete failure of entire breeding colonies through heavy predation on eggs and nestlings. In recent decades, the predators that have destroyed entire colonies have usually been wading birds that hunt in large groups (i.e., Black-crowned Night-Heron, Cattle Egret, and White-faced Ibis). These species have had significant impacts on the overall productivity rate of Tricolored Blackbirds in several years over the last three decades (Hamilton et al. 1995, Cook and Toft 2005, Meese 2012). A few other species, including Common Raven, raccoon, and coyote have had large effects on breeding success, but these predators have typically not caused complete colony failure or have had less widespread effects.

Competition

Red-winged Blackbirds and, less frequently, Yellow-headed Blackbirds, will often nest in the same locations as Tricolored Blackbird colonies, although they may occupy the less-dense portions of a marsh. Where territorial conflicts occur, Tricolored Blackbirds ignore the territorial displays of these other species and overwhelm them with their sheer numbers, displacing them to the fringes of the substrate

or pushing them out entirely (Payne 1969). There is no evidence that competition with these species is limiting the Tricolored Blackbird population (Hamilton et al. 1995).

Beedy et al. (2017) reported that Great-tailed Grackles may be aggressive toward nesting Tricolored Blackbirds but did not consider the impacts severe. White-faced Ibis may destroy Tricolored Blackbird nests when in the process of constructing their own nests, but this occurs infrequently. The Marsh Wren (*Cistothorus palustris*) may destroy eggs in Tricolored Blackbird nests that are in proximity to its own nest (Beedy et al. 2017). Competition with other species does not appear to be a large factor in the survival or reproduction of the Tricolored Blackbird.

Brood Parasitism

The Brown-headed Cowbird (*Molothrus ater*) is known to rarely parasitize nests of Tricolored Blackbirds (Hamilton et al. 1995, Beedy et al. 2017), but brood parasitism is not a major threat to the species.

Disease

Beedy et al. (2017) stated that no diseases have been reported for the Tricolored Blackbird but that in some years many nestlings have mites. Avian pox is prevalent in Tricolored Blackbirds in the Sacramento Valley, and much less so in the San Joaquin Valley (Beedy et al. 2017). West Nile virus (WNV) has been detected in dead Tricolored Blackbirds, as well as in many other species of blackbirds, orioles, and grackles nationwide (www.cdc.gov/westnile/resources/pdfs/Bird%20Species%201999-2012.pdf). Adult Tricolored Blackbirds tested positive for WNV antibodies in 2009 but did not show symptoms of the disease and were assigned a relatively low risk score (Wheeler et al. 2009, Beedy et al. 2017). Although the highly social nature of the species could place the Tricolored Blackbird at greater risk to disease transmission, the impact of disease and parasites on the species is unknown but is not thought to be a major threat to the species.

Contaminants

Feeding in agricultural environments creates numerous opportunities for exposure to contaminants. Mortality of Tricolored Blackbird eggs and nestlings due to chemical contaminants has been suggested in a number of cases. Hosea (1986) reported that two colonies in Colusa and Sacramento counties near rice fields were over-sprayed during aerial application of herbicides resulting in the poisoning of almost all of the nestlings. Beedy and Hayworth (1992) described the effects of possible selenium toxicosis on a Tricolored Blackbird colony by comparing the reproductive success of a colony at Kesterson Reservoir in Merced County, which had a history of selenium contamination, with the success at four other colonies. Nesting failures were documented and deformities in Tricolored Blackbird nestlings were observed at the colony at Kesterson, and livers from dead nestlings collected at Kesterson had elevated levels of selenium. The area was cleaned up and the use of selenium-laden agricultural drain water to maintain the wetlands at Kesterson was discontinued. There have been no apparent selenium impacts on Tricolored Blackbird nesting success since. Hamilton et al. (1995) reported evidence of chemical-induced egg mortality from mosquito abatement operations in Kern County.

In 1995, Hamilton et al. concluded that, "Despite the limited evidence that Tricolored Blackbirds are suffering some mortality as a result of patterns of chemical use in agricultural areas, poisons do not appear to be inducing a serious population problem for Tricolored Blackbirds." Hamilton (2000) knew of no evidence that toxic contaminants had adversely affected the Tricolored Blackbird since the early 1990s.

Neonicotinoid Insecticides

A relatively new class of insecticides, neonicotinoids, has been implicated in the decline of invertebrate communities and, in a few cases, the decline of insectivorous birds. The application of neonicotinoids has increased dramatically in California, especially since the early to mid-2000s (https://water.usgs.gov/nawqa/pnsp/usage/maps/). Neonicotinoids are relatively stable, and are water soluble so can be incorporated into the tissues of plants. They are commonly applied to crops as seed treatments, with the insecticide taken up systemically by the growing plant (Godfray et al. 2014). In the two decades since their introduction, neonicotinoid insecticides have become the most widely used insecticides in the world (Goulson 2013). They are highly effective at killing insects and have relatively low mammal and bird toxicity. However, at higher concentrations they can have lethal and sublethal impacts to vertebrates (Mineau and Palmer 2013).

Acute toxicity of neonicotinoids has been assessed for only a few bird species, with wide variation in results. Bobwhite and Mallard are the species typically used in acute toxicity testing for regulatory purposes, but where smaller species have been tested, including songbirds, the body weight-corrected dosage resulting in mortality is much lower (Mineau and Palmer 2013). A potential acute impact mechanism for species that are partly granivorous, like the Tricolored Blackbird, is sublethal or lethal effects through the ingestion of neonicotinoid-coated seeds. Ingestion of only a few neonicotinoid-coated seeds (a single seed in the case of corn) might be sufficient to kill a songbird, but there has been little work conducted on the availability and consumption of treated seeds by vertebrates (Goulson 2013, Mineau and Palmer 2013). Although not limited to neonicotinoids, a study that evaluated the effect of multiple potential factors found that acute toxicity of pesticides was the strongest correlate to declines of grassland bird species in the U.S., followed by habitat loss caused by agricultural intensification (Mineau and Whiteside 2013). No data are available on the acute toxicity of any neonicotinoid insecticide specifically to Tricolored Blackbirds, but seeds treated with imidacloprid, a widely used neonicotinoid insecticide, caused ataxia and retching in captive Red-winged Blackbirds and Brown-headed Cowbirds (Avery et al. 1993). These effects were transitory and birds learned to avoid consumption of treated seeds when alternative grains were available. Neonicotinoids may also have chronic toxicity effects (exposure over longer time periods) on reproductive success, but chronic effects are even less studied than acute effects (Mineau and Palmer 2013).

Neonicotinoids may also indirectly affect Tricolored Blackbirds through suppression of insect prey populations. They have been shown to have adverse effects on a number of non-target invertebrate species, with most studies focusing on bees (Hopwood et al. 2012, Godfray et al. 2014). In California, long-term observational data have revealed declines in the number of butterfly species and declines in abundance for many butterfly species in the Central Valley, both of which were negatively associated

with annual application rates of neonicotinoid insecticides (Forister et al. 2016). Imidacloprid was shown to have a negative association with a wide variety of insectivorous bird populations in the Netherlands, suggesting that the pesticide may have led to food deprivation in birds (Hallmann et al. 2014). The evidence linking imidacloprid concentrations to bird population declines was circumstantial, but the authors ruled out confounding effects from other land use changes and showed that the timing of observed declines in bird populations corresponds to the introduction of neonicotinoid insecticides (Goulson 2014, Hallmann et al. 2014).

Depending on environmental conditions, neonicotinoids can persist and accumulate in soils and in waterways, and levels measured in soils, waterways, and field margin plants have sometimes overlapped substantially with concentrations that are sufficient to control pests in crops (Goulson 2013). Neonicotinoids degrade through photolysis when exposed to sunlight and so would not be expected to occur at high levels in clear water (Goulson 2013). However, Starner and Goh (2012) detected imidacloprid in 89% of water samples taken from rivers, creeks, and drains in agricultural regions of California, with 19% of samples exceeding the US Environmental Protection Agency guideline concentration of 1.05 µg/L; this suggests that the insecticide moves off of treatment areas and may impact non-target aquatic insects. Little is known about the uptake of neonicotinoids from soil and soil water by non-target plants, and the downstream effect on non-target invertebrates (Goulson 2013).

A study evaluating landscape effects on Tricolored Blackbird breeding colonies found that colonies are more likely to be located in areas that experience higher neonicotinoid insecticide application rates (NAS 2017). This is likely because most colonies and birds breed in the highly agriculturalized Central Valley. The neonicotinoid application rate was also shown to increase during the 2008–2014 study period, suggesting that breeding Tricolored Blackbirds may be exposed to increasing amounts of the insecticides. The effect of this exposure on breeding Tricolored Blackbirds is unknown.

Several studies have revealed a negative relationship between insect populations and neonicotinoid use. These results, along with the large increase in application of neonicotinoids, suggest a potential mechanism leading to observed reductions in reproductive success in Tricolored Blackbirds (Meese 2013). It is possible that this relatively new group of insecticides has resulted in declines of non-target insect species within the breeding range of the Tricolored Blackbird resulting in a declining prey base, but no data have been collected that can directly support this. It is also possible that acute effects resulting from ingestion of neonicotinoid-coated seeds has had an impact on the population, but the number of Tricolored Blackbirds suffering sublethal or lethal effects due to exposure to neonicotinoids is unknown. In addition to Tricolored Blackbirds, population declines in insectivorous birds have been documented across North America, with specific examples from California's Central Valley (Nebel et al. 2010, Airola et al. 2014). Neonicotinoids may be playing a role in driving these declines, but more study is needed. There is a need for mechanistic research to compliment results from observational data; these should include testing exposure rates of Tricolored Blackbirds to neonicotinoids, effect of exposure on body condition and fitness (direct effects), and investigations into potential insect-based food-web impacts (indirect effects).

Invasive Species

With the exception of occasional impacts due to nonnative predators (e.g., Cattle Egret, Great-tailed Grackle), invasive species have not been reported to have a large impact on the ability of the Tricolored Blackbird to survive and reproduce. The availability of many nonnative plant species as nesting substrates have allowed the Tricolored Blackbird to breed in locations that would otherwise be unavailable. Invasive species are not considered a major threat to the species.

Weather Events

Hamilton et al. (1995) stated that high mortality of Tricolored Blackbird nestlings can result from severe or prolonged storms and that some observed reproductive failure may be the result of chilling of adult and nestling birds. Also, some adult female mortality at nests appears to have been induced by cold and rainy weather (Hamilton et al. 1995). Heavy winds or precipitation have been documented to knock down nesting substrates, often in triticale or other grain colonies, but also in milk thistle colonies (Meese 2010, 2016), eliminating the reproductive effort for all or a part of breeding colonies. Weather events may have widespread impacts on reproductive success in some years, but impacts are usually isolated and the overall effect on the population's ability to reproduce is limited in most years.

Drought, Water Availability, and Climate Change

Drought reduces water supply reliability and has far-reaching impacts on most habitat types in California (DWR 2014, 2015a). Several significant statewide droughts have occurred in California over the last century (1928–1934, 1976–1977, 1987–1992, and 2007–2009) (DWR 2015a), and California recently experienced the four driest consecutive years of statewide precipitation in the historical record between 2012 and 2014. The winter of 2015 produced a record low statewide mountain snowpack of only 5% of average.

Drought effects on availability of nesting substrate

Tricolored Blackbirds have adapted to use a variety of novel vegetation types as nesting substrate, but wetlands continue to support the largest number of breeding colonies each year. Because of the need for wetlands that are flooded during the spring and summer breeding season, the various approaches to wetland management, and the dependence on water deliveries to maintain wetland habitats in most of the Tricolored Blackbird's range, assessing the availability of suitable wetland nesting substrate in a given year is difficult. A recent method applied reflectance to satellite imagery in order to identify areas of open surface water in the Central Valley (Reiter et al. 2015). Although not an ideal approach to quantifying and assessing distribution of wetlands, the method would identify wetlands with large amounts of open water. In addition, identification of open water on the landscape during the Tricolored Blackbird breeding season is likely a good proxy for the availability of water for wetland management. Reiter et al. (2015) showed that open surface water declined across the Central Valley between 2000 and 2011. Drought had a significant negative effect on open surface water in the late summer and early fall. Cumulative years of drought resulted in a noticeable reduction in surface water. Although not a direct measure of Tricolored Blackbird breeding habitat, declines in surface water during the drought

likely resulted in reduced availability of wetlands with sufficient water to provide high quality nesting substrates.

Although more resilient to dry conditions than wetland vegetation, plants species that provide upland nesting substrate for Tricolored Blackbird colonies also experience negative effects due to drought. After several years of dry conditions during California's most recent drought, many Himalayan blackberry copses that have historically supported Tricolored Blackbird colonies were observed to be dry and mostly barren of leaves. In a few cases, extremely dry blackberry bushes continued to be used by breeding colonies, but many were unoccupied. Milk thistle, which provides high-quality nesting substrate across much of the Tricolored Blackbird range when annual precipitation patterns support vigorous growth, was largely absent from historically used areas until California experienced an average water year in the winter of 2015–2016 (Airola et al. 2016). The wetter weather created nesting substrate in areas that had not been used by Tricolored Blackbirds in several years, and breeding colonies once again occupied these areas.

Drought effects on prey populations

The availability of large insect prey is an important factor in Tricolored Blackbird reproductive success, and may influence colony site selection. Large landscapes with suitable foraging habitat are strong drivers of colony site occupancy and abundance (NAS 2017).

Insect abundance is highly related to biomass of herbaceous vegetation, including important Tricolored Blackbird prey items like grasshoppers in grasslands (Falcone 2010). Climate, especially drought, is thought to play a key role in abundance of grasshoppers and other insect species in grasslands (Vose et al. 2016). The response of insect populations can differ depending on drought severity. For example, non-severe drought and warm temperatures can have a positive effect on grasshopper populations through increased survival and faster population growth (Kemp and Cigliano 1994). However, extreme or prolonged drought can negatively affect grasshopper populations through desiccation of eggs or through decreased biomass of primary producer food sources (i.e., grasses and forbs) (Vose et al. 2016). Reductions in precipitation not only lead to reductions in the abundance of insects in grasslands, but may also make insect prey less accessible through changes in behavior (e.g., moving underground) (Barnett and Facey 2016). Severe droughts likely have strong negative effects on grasshoppers and insect prey biodiversity in general (Kemp and Cigliano 1994, Vose et al. 2016).

The established impacts of precipitation on insect populations in grasslands, especially grasshoppers, suggests a mechanism for drought impacts on Tricolored Blackbird productivity. Research is needed that measures grasshopper and other prey abundance relative to precipitation and primary productivity around occupied Tricolored Blackbird colonies, and evaluates the effect on Tricolored Blackbird reproductive success.

Climate Change

Average annual temperatures have been rising in California in recent decades, and climate models are in broad agreement that temperatures in California will rise significantly over the next century (DWR

2015b). The average temperature is expected to rise by approximately 2.7°F by 2050, and depending on the emissions scenario, average temperatures could increase by 4.1–8.6°F by the year 2100 (Moser et al. 2012). Summer temperatures will rise more than winter temperatures, and the increases will be greater in inland California. As a result, the average number of extremely hot days (at least 105°F) per year in Sacramento is expected to increase fivefold (up to 20 days) by the middle of the century, and may increase to as many as 50 days per year by 2100 (Moser et al. 2012). Tricolored Blackbirds have been observed to cease initiation of breeding when temperatures rose above 90°F, although care of existing nests continued in temperatures over 100°F (Hamilton et al. 1995). Rising temperatures may directly affect annual Tricolored Blackbird productivity by truncating or interrupting the breeding season, although more work is needed on the effect of temperature on initiation and success of nesting attempts.

Along with projected impacts to Tricolored Blackbird foraging habitat due to housing development discussed above, the areas of California with the largest climate-projected effects on a variety of bird species are largely concentrated within the Tricolored Blackbird range in the Central Valley (Jongsomjit et al. 2013). A suite of analyses integrating the effects of climate change and land use changes in California's rangelands concluded that grassland habitat loss in California could reach 37% by the year 2100 (Byrd et al. 2015).

The recent severe drought in California was at least in part due to and made more severe by climate change (Diffenbaugh et al. 2015). Climate change is projected to bring longer and more severe droughts to California in the future (Diffenbaugh et al. 2015, Williams et al. 2015), exacerbating the impacts to Tricolored Blackbird habitat described above. The Central Valley may be particularly vulnerable to warming-driven drought increases in the future (Williams et al. 2015). Water deliveries are projected to be reduced by 5.6% from 2013 to 2033 due to climate change effects on reliability (DWR 2014). Climate change effects on water supplies and stream flows are expected to increase competition among urban and agricultural water users and environmental needs (Moser et al. 2012). This competition may lead to decreases in available wetland nesting substrate provided by private and public land managers. Declines in the availability of water for agriculture may also reduce prey populations provided by high quality crops like alfalfa and rice.

SUMMARY OF LISTING FACTORS

[Note to reviewers: This section will provide summaries of information in the status review, arranged under each of the factors that the Fish and Game Commission must consider in making a determination as to whether listing is warranted (Cal. Code Regs., Tit. 14, § 670.1). These summaries will be prepared after peer review.]

Present or Threatened Modification or Destruction of Habitat

Overexploitation

Predation

Competition

Disease

Other Natural Events or Human-Related Activities

PROTECTION AFFORDED BY LISTING

It is the policy of the State to conserve, protect, restore and enhance any endangered or threatened species and its habitat (Fish & G. Code, § 2052). The conservation, protection, and enhancement of listed species and their habitat is of statewide concern (Fish & G. Code, § 2051(c)). CESA defines "take" as hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill (Fish & G. Code, § 86). The Fish and Game Code provides the Department with related authority to allow "take" of species listed as threatened or endangered under certain circumstances through incidental take permits, memoranda of understandings, natural community conservation plans, or other plans or agreements approved by or entered into by the Department (Fish & G. Code, §§ 2081, 2081.1, 2086, 2087, and 2835).

If the Tricolored Blackbird is listed under CESA, impacts of take caused by activities authorized through incidental take permits must be minimized and fully mitigated according to state standards. These standards typically include protection of the land in perpetuity with an easement, development and implementation of a species-specific adaptive management plan, and funding through an endowment to pay for long-term monitoring and maintenance to ensure the mitigation land meets performance criteria. Obtaining an incidental take permit is voluntary. The Department cannot force compliance; however, any person violating the take prohibition may be punishable under state law.

Additional protection of Tricolored Blackbird following listing would be expected to occur through state and local agency environmental review under CEQA. CEQA requires that affected public agencies analyze and disclose project-related environmental effects, including potentially significant impacts on rare, threatened, and endangered species. In common practice, potential impacts to listed species are examined more closely in CEQA documents than potential impacts to unlisted species. Where significant impacts are identified under CEQA, the Department expects that project-specific avoidance, minimization, and mitigation measures will benefit the species. State listing, in this respect, and consultation with the Department during state and local agency environmental review under CEQA, would be expected to benefit the Tricolored Blackbird in terms of reducing impacts from individual projects, which might otherwise occur absent listing.

For some species, CESA listing may prompt increased interagency coordination and the likelihood that state and federal land and resource management agencies will allocate funds toward protection and recovery actions. In the case of the Tricolored Blackbird, the Tricolored Blackbird Working Group signatory agencies already meet and coordinate regularly, but a state listing could result in increased availability of conservation funds.

LISTING RECOMMENDATION

CESA directs the Department to prepare this report regarding the status of the Tricolored Blackbird in California based upon the best scientific information. CESA also directs the Department based on its analysis to indicate in the status report whether the petitioned action is warranted (Fish & G. Code, § 2074.6; Cal. Code Regs., tit. 14, § 670.1, subd. (f)). In addition to evaluating whether the petitioned action (i.e., listing as endangered) was warranted, the Department considered whether listing as threatened under CESA was warranted.

The Department includes and makes its recommendation in its status report as submitted to the Commission in an advisory capacity based on the best available science. In consideration of the scientific information contained herein, the Department has determined that listing the Tricolored Blackbird as threatened or endangered under CESA is [warranted/not warranted] at this time.

[Note to reviewers: The Department's recommendation will be finalized following peer review and completion of the status review report.]

MANAGEMENT RECOMMENDATIONS

The Department evaluated existing management recommendations and identified the following, listed in no particular order, as necessary to achieve conservation of the Tricolored Blackbird. The *Conservation Plan for the Tricolored Blackbird* (TBWG 2007) identifies goals, objectives, and tasks required to maintain a viable Tricolored Blackbird population throughout the current range of the species. The Department continues to support implementation of the conservation plan as revised by the Tricolored Blackbird Working Group. The goals, objectives, and tasks identified in the plan are not repeated in their entirety here, but many of the management recommendations listed below are related to, or based on, activities identified in the plan.

Habitat Protection, Restoration, and Enhancement

Land ownership patterns across the range of the Tricolored Blackbird, coupled with the diverse nesting and foraging habitats used by the species, necessitate cooperative efforts among government, industry, and the public in order to conserve the species.

Management of habitat must consider the large landscapes utilized by breeding colonies and the integral relationship between nesting colony sites and associated upland foraging areas (Hamilton

1993). Land management plans that do not specifically consider the landscape needs of Tricolored Blackbirds will not necessarily result in the protection or creation of suitable breeding habitat.

1. Determine the best areas for conservation, building off the recent research on habitat suitability conducted by the National Audubon Society (NAS 2017). It is difficult to predict the distribution of widespread species, and even more difficult when the distribution within the range is not stable, as with the dynamic colony site use of Tricolored Blackbirds. Breeding locations that should be prioritized for protection include those that are regularly occupied, those that support large colonies, those that support high reproductive success, and those with a secure foraging landscape (Meese and Beedy 2015).
2. Identify areas in the Tricolored Blackbird range with high quality foraging landscapes, but that lack suitable nesting substrate. Consider conservation actions to create or restore nesting substrate in areas with high probability of use by breeding Tricolored Blackbirds.
3. Secure funding and implement the highest priority nesting substrate protection, enhancement and restoration projects and foraging habitat protection projects.
4. Create a system for tracking habitat protection and restoration projects, including appropriate measures of success. Work with the Tricolored Blackbird Working Group to encourage reporting of habitat projects from all stakeholders.

Breeding Colony Protection

In addition to the long-term goal of providing suitable alternative habitat away from silage fields on public and private land, the near-term priority must continue to be placed on identifying and conserving the colonies nesting in silage on private property each year.

5. Fully fund and implement a silage colony protection program. Continue work in the Tricolored Blackbird Working Group's agriculture subcommittee to plan for and implement a silage colony response plan, with participation from a diverse set of stakeholders including members of the dairy industry.
6. Identify locations that regularly support large and productive Tricolored Blackbird breeding colonies, with secure foraging landscape. Prioritize these locations for protection through acquisition or conservation easement.
7. Assess the effectiveness of provision of alternate nesting habitat (e.g., fresh emergent wetlands) to draw birds away from nesting in dairy silage fields (Beedy et al. 2017).

Monitoring and Research

8. Determine the factors that influence nest site selection and especially how relative insect abundance may affect site occupancy (Airola et al. 2016).
9. Determine the amount, type, and distribution of foraging habitat needed to support viable breeding colonies of various sizes. How does type, proximity to colony site, and diversity of foraging habitats influence the extent of foraging habitat required and the rate of reproductive success?

10. Determine the environmental factors that result in abundant large insect prey populations in grassland habitats and in commonly used agricultural crops, and their variability in time and space.
11. Conduct mechanistic research to compliment results from observational data that have shown correlations between neonicotinoid pesticides and declines in songbirds; these should include testing exposure rates of Tricolored Blackbirds to neonicotinoids, effect of exposure on body condition and fitness, and investigations into potential insect-based food web effects.
12. Estimate rates of within season and interannual movements and genetic exchange between populations breeding in different regions, especially between southern California and the Central Valley (Beedy et al. 2017).
13. Quantify annual adult survivorship and investigate factors that affect survival, including the magnitude of post-breeding mortality caused by shooting to reduce crop depredation.
14. Investigate new methods to measure productivity in Tricolored Blackbird breeding colonies. Current methods that utilize nest transects or counts of fledglings might not be comparable, and nest transects can be difficult to implement and may negatively affect breeding birds.
15. Examine degree of colony cohesion between first and subsequent breeding attempts, and between breeding seasons (Beedy et al. 2017).
16. Develop and implement a statistically valid, standardized protocol for the long-term, statewide monitoring of Tricolored Blackbird abundance, including population estimate confidence.

Education and Outreach

17. Raise awareness of Tricolored Blackbird nesting behavior and conservation options on ranch and farmlands, stressing the importance of protecting large silage nesting colonies. Build off recent efforts by the Tricolored Blackbird Working Group and the dairy industry.
18. Conduct outreach and coordination with landowners whose grazing lands in the foothills support breeding colonies (Airola et al. 2015b).
19. Provide land managers with habitat management guidance for creation and management of Tricolored Blackbird habitat. Continue work recently undertaken by the Tricolored Blackbird Working Group's habitat subcommittee.

ECONOMIC CONSIDERATIONS

The Department is charged in an advisory capacity in the present context to provide a written report and a related recommendation to the Commission based on the best scientific information available regarding the status of Tricolored Blackbird in California. The topic areas and related factors the Department is required to address as part of that effort are biological and not economic, therefore the Department is not required to prepare an analysis of economic impacts (See Fish & G. Code, § 2074.6; Cal. Code Regs., tit. 14, § 670.1, subd. (f)).

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Appendix 1
Tricolored Blackbird surveys, 1986-2017

This Appendix briefly describes each effort to survey the Tricolored Blackbird population since 1986. As discussed in the body of the report, the survey approach varied across survey years, with two groups of years (1994, 1997, 2000; and 2008, 2011, 2014, 2017) following relatively consistent approaches and resulting in comparable results. Although surveys in these two groups of years followed similar approaches, there were several differences in methods and in survey effort that preclude direct comparisons of results across these two groups of survey years. Where possible, results have been adjusted for survey effort when discussed in the report.

1986-1990

Beedy et al. (1991) compiled all historical records of Tricolored Blackbird breeding colonies to evaluate the long-term population trends and current status of the species for the USFWS. They also conducted intensive observations at seven colonies in four counties during 1987 and 1988 and made additional irregular observations in seven counties between 1986 and 1990. They concluded that the population had continued to decline since the 1970s (DeHaven et al. 1975) to an average of 51,600 breeding birds at known colonies in the 1980s. In response to the report by Beedy et al. (1991), a more thorough survey was organized by the Department in 1992, with survey locations informed by ongoing research on the species by Bill Hamilton and others (see below). Results revealed the population to be much larger, indicating that an ad hoc compilation of observation records combined with a limited survey effort over multiple years does not provide an accurate measure of overall population size. Like previous efforts, the surveys by Beedy et al. (1991) included only sporadic surveys in the southern San Joaquin Valley.

1992-1993

Basic ecological investigations were conducted that included documentation of colony locations and sizes, discovery of large breeding colonies on grain fields in the San Joaquin Valley, and initial observations that suggested Tricolored Blackbirds are itinerant breeders, but efforts were not extensive enough to provide estimates of the statewide population (Hamilton et al. 1992, Hamilton 1993, Beedy and Hamilton 1997).

1994

Itinerant breeding had recently been documented in Tricolored Blackbirds and this was the first statewide survey conducted over a narrow time period to avoid double-counting birds that shift location between breeding attempts (Hamilton et al. 1995). The documentation of all historical colony sites (Beedy et al. 1991) and recent colony sites (Hamilton et al. 1992, Hamilton 1993) was used to inform a rangewide survey that attempted to visit all known Tricolored Blackbird breeding locations in 1994. The survey was largely volunteer-based and was carried out on a single day (April 23) early in the nesting season to detect as many birds as possible in colonies during their first breeding attempt of the year. The goals of the survey were to document occupancy status and to estimate the size of all active

colonies. Volunteers were asked to visit all known colony locations, estimate numbers at occupied sites, and to drive public roads near known breeding locations to identify previously undocumented colonies (Beedy and Hamilton 1997).

All colonies larger than 10,000 birds were revisited by Hamilton et al. (1995) to verify and sometimes refine estimates. At selected colony sites, the estimates of colony sizes provided by survey volunteers were adjusted using estimated nest densities. This was achieved by running transects through the nesting substrate when nests were active to obtain an estimate of average nest density and the proportion of observed nests that appeared active. More extensive transects were then run after breeding was completed to refine the estimate of nest density. This refined estimate was corrected for the proportion of active nests and multiplied by the total occupied area to obtain an estimate of the number of active nests in the colony. This number was then multiplied by 1.5 to account for an assumed male to female ratio of 1:2. The intent of this approach was to estimate the number of birds that ultimately nested in a breeding colony, but it might not have accurately represented the number of birds present during the survey period. For example, the approach would dismiss large groups of birds that may have been present during colony settlement that ultimately did not breed at a site (i.e., the method fails to account for the presence of any non-breeding adults). This is inconsistent with the goal of the statewide survey to estimate the total number of birds in the population. The approach also violates the condition that observations should be made during a narrow survey window to avoid double-counting birds.

Tricolored Blackbirds were observed in 32 California counties. One hundred active breeding colonies were observed in 28 counties. Ten previously occupied counties were not surveyed. The estimated number of birds observed was 369,400 (+/- 15%) (Beedy and Hamilton 1997). The assumed +/- 15% range in the estimate was based on a small sample of breeding colonies where visual estimates of colony size and estimates based on nest density varied by no more than 15% (Hamilton et al. 1995, Hamilton 1998).

Hamilton et al. (1995) felt that the survey effort in 1994 was “minimal” and that a larger number of birds would have been observed if a more substantial survey had been organized. The survey effort in the southern California portion of the range was especially limited. A single observer made two trips to southern California to search for colonies during the breeding season and organizers considered this portion of the range to be under-surveyed.

1995-1996

Volunteer surveys were conducted on a single day. Surveys were not informed by pre-survey monitoring as in the 1994 survey, and results did not include rangewide follow-up surveys. Some counties were surveyed incompletely, or not at all, and large breeding colonies may have been overlooked. Beedy and Hamilton (1997) concluded that the results of these surveys should not be considered total population estimates for Tricolored Blackbirds.

1997

The 1997 survey used the same coverage, methods, and personnel as did the 1994 survey (Beedy and Hamilton 1997). Participation was greater than in 1994 and most historically occupied counties received at least some coverage (Beedy and Hamilton 1997). The survey in the southern California portion of the range was much more thorough than that conducted in 1994. The volunteer survey was conducted on April 26.

Breeding and nonbreeding birds were observed in 33 California counties, plus additional birds in one county in Oregon and in Baja California. Seventy-one active breeding colonies were observed (Hamilton 2000). The estimated number of birds observed was 232,960 (+/- 15%) (Beedy and Hamilton 1997).

Despite the 1994 survey being described as a minimal effort that overlooked some unknown number of birds (Hamilton et al. 1995), Beedy and Hamilton (1997) reported that 1994 and 1997 were the only two survey years to date with sufficient survey effort to detect “virtually all large colonies.” The observed number of birds declined by 37%, with the greatest declines occurring in the core of the species’ distribution in Sacramento, Fresno, Kern, and Merced counties (Beedy and Hamilton 1997).

1999

The organizers of the one-day survey in 1999 (Hamilton et al. 1999, 2000) attempted to follow the same methods as those used in 1994 and 1997, but participation in the survey was low and the total count of about 95,000 birds was considered an underestimate by Hamilton (2000). Much of the population began breeding later than in previous years and many colonies ~~were located after the survey that~~ were not detected ~~on~~ until after the survey date (Hamilton et al. 1999).

2000

As with the 1994 and 1997 surveys, the 2000 survey attempted to locate all breeding colonies and estimate the number of birds in each colony. The 2000 survey used the same methods used in these two previous surveys, although a greater number of observers participated and visited more locations. A workshop was also held before the 2000 survey to train participants in colony size estimation. Unlike the previous survey years that focused on a single day, the 2000 survey was conducted over four days, from April 21-24. Hamilton (2000) suggested that this differed little from the 1994 and 1997 surveys because records in those years were accepted from one day before and after the survey date, effectively accepting reports over a three-day period, and the addition of a fourth day in 2000 only accounted for an additional 1,750 birds observed. As in 1994 and 1997, survey locations were informed by pre-survey colony detection and monitoring.

Breeding and nonbreeding birds were observed in 25 California counties. Seventy-two active breeding colonies were observed (Hamilton 2000).

Although Hamilton concluded that the 2000 survey located a greater proportion of the entire population than did censuses in previous years, he still felt that the San Joaquin Valley, with its potentially large silage colonies, was not surveyed completely (Hamilton 2000). Nevertheless, he concluded that the

Tricolored Blackbird population had declined during the 1990s, from an estimated 370,000 birds in 1994 to 162,000 birds in 2000.

2001

The survey conducted in 2001 followed a very different approach compared to standardized methods used in the 1990s to survey the statewide population. Only 48 sites were surveyed and sites were visited throughout the breeding season rather than being restricted to a narrow survey window of a few days (Humple and Churchwell 2002). As had been demonstrated in the 1990s, a season-long approach to detecting and surveying colonies may result in double-counting of birds that move between locations. Conversely, the limited number of sites visited likely underrepresented the breeding population. The effect of these inconsistencies in methodology and effort on survey results is unclear, and results cannot be compared to those of other survey years.

2004

The four-day survey conducted in 2004 was not intended to produce an estimate of the statewide population size comparable to previous surveys. The survey was limited to colony sites that had historically supported more than 2,000 birds and focused on those located in the Central Valley (Green and Edson 2004). Participation was low with only 29 volunteers conducting surveys. Based on well-documented occupancy dynamics of Tricolored Blackbird, this approach is likely to miss large breeding colonies. No training was provided to participants prior to the survey.

2005

There was no report produced describing the 2005 survey and its results, and the only record available to the Department is a spreadsheet listing occupied sites with estimates of colony size at each location. There is no record of the survey methods used nor the effort expended in conducting the survey.

The number of birds observed was reported as about 258,000 birds at 121 occupied sites (Meese 2015).

2008

The survey methods used to obtain the population estimate in 2008 were similar to those used in statewide surveys conducted in the previous survey years of 1994, 1997, and 2000 (Kelsey 2008). However, the methods differed in a number of ways that likely effected the estimated number of birds and precluded a direct comparison of the earlier surveys with results from 2008:

1. The volunteer survey was conducted on a single day in 1994 and 1997 and over four days in 2000, compared to three days in 2008. However, in 1994 and 1997, birds that were observed one day before and after the survey day but not associated with a colony were included in the estimate, effectively expanding the survey to three days for incidental observations.
2. Despite the narrow survey windows established in each of the survey years, no survey has practiced strict adherence to the requirement that all observations occur during the survey window. For example, in the earlier survey years (1994-2000), birds seen at colonies before the survey date were included in the estimate if those colonies remained active after the survey window but were not observed during the survey dates. Also, breeding birds found after the

date of the surveys were included if nest phenology suggested a colony must have been active during the survey dates. Since 2008, there has been a greater emphasis on adhering to the survey dates, but exceptions have been made on a case-by-case basis each year if observations suggest that birds were missed during the survey window (July 2017 email from B. Meese to N. Clipperton; unreferenced).

3. In the earlier survey years, when multiple observations were available at colonies throughout the breeding effort, the number of birds at a colony was recorded based on the maximum number of nests, which ignored any changes in colony size over time, as opposed to using the number of birds observed only during the survey window. However, Hamilton et al. (1995) stated that the difference between maximum and minimum observations were not great at any large colony. In recent years, when multiple observations at a location during the survey window resulted in multiple estimates, the average has typically been reported as the number of birds for the location.
4. In the earlier survey years, the estimates of colony sizes provided by survey volunteers were sometimes adjusted using estimated nest densities, as described above under the 1994 survey. This adjustment has not been employed in surveys conducted since 2008. The proportion of colonies with estimates adjusted using this approach varied across survey years 1994, 1997, and 2000 and was not always reported.

These methodological differences between survey years may have had both positive and negative effects on the overall estimate, and the magnitude and direction of effect on the estimates are not known. Therefore, caution is warranted in making comparisons between the earlier group of surveys and those conducted since 2008.

The 2008 survey also included several enhancements relative to the earlier surveys:

1. County coordinators were used for the first time to ensure that each surveyed county was well-surveyed by local volunteers.
2. Maps with all survey locations were provided for the first time, and a website was available for downloading all survey materials and uploading survey data (Tricolored Blackbird Portal; http://tricolor.ice.ucdavis.edu/).
3. The number of survey participants and the number of sites surveyed greatly increased relative to earlier surveys (Kelsey 2008). The result was a more complete survey and more reliable data collection and reporting.

The effect of these new procedures and increased effort on the proportion of the Tricolored Blackbird population observed is unknown, but a larger proportion of the population was likely observed compared to previous surveys. As was first implemented in 2000, training sessions were also provided to survey volunteers. The 2008 survey was conducted from April 25-27.

A total of 155 volunteers participated in the 2008 survey and visited 361 historical and new locations in 38 counties (Kelsey 2008). The total estimate for number of birds observed was 394,858. Many of the larger colonies were visited by Tricolored Blackbird experts, which is consistent with earlier statewide surveys. Kelsey (2008) reported that some portion of the increase in observed number of birds since the 2000 survey may have been attributable to increased survey effort, but did not think that the increase was entirely due to the increased effort.

2011

The survey methods followed in 2011 were largely the same as those used during the 2008 survey (Kyle and Kelsey 2011), although a different approach to coordinating the survey was used. Rather than establishing county coordinators to ensure complete coverage of each surveyed county, the 2011 survey was organized by a statewide coordinator using online resources. Volunteers were asked to sign up for survey areas using the online portal and a statewide coordinator tracked survey coverage. The survey was conducted over three days, from April 15-17.

A total of 100 volunteers participated in the 2011 survey and visited 608 historical and new locations in 38 counties (Kyle and Kelsey 2011). The total estimate for number of birds observed was 259,322.

2014

The 2014 survey followed the methods used in 2008 and 2011. As in the 2008 survey, county coordinators were again used to ensure thorough coverage of each county (Meese 2014). The survey was conducted over three days, from April 18-20.

A total of 143 volunteers participated in the 2014 survey and visited 802 historical and new locations in 41 counties (Meese 2014). Based on number of volunteers, counties covered, and number of sites visited, this was the most complete statewide completed to date. The total estimate for the number of birds observed was 145,135.

2017

The 2017 survey followed the methods used in 2008-2014. The survey was conducted over three days, from April 7-9 (Meese 2017). For 2017, additional survey forms were used to collect additional information on weather conditions, survey effort, site occupancy, and the suitability of nesting habitat at each surveyed location. Maps of survey locations were also updated and included online maps that could be used to navigate to sites in the field using a smartphone app.

A total of 181 volunteers participated in the 2017 survey and visited 884 historical and new locations in 44 counties (Meese 2017). Based on number of volunteers, counties covered, and the number of sites visited, the 2017 survey was even more thorough than the 2014 survey. The total estimate for the number of birds observed was 177,656.

Dear Neil,

Thank you for the opportunity to comment on your Draft Report to the Fish and Game Commission: A Status Review of the Tricolored Blackbird (*Agelaius tricolor*) in California.

I'm not sure why the Department is recommending the species be listed as Threatened but I strongly believe it should be Endangered. I think that the parallels between this species and the Passenger Pigeon are too great to ignore and that we need to take this lesson from history and try not to repeat it. It's true that the Tricolored Blackbird has shifted its use of nesting substrate types in response to widespread loss of marsh habitat, but what might be the most important factor is foraging habitat, including the amount of it and its productivity of insects. If the productivity of foraging habitats is declining, as suggested by Meese (2017 and earlier reports), then we may be witnessing a cycle in which decline is accelerating in a feedback loop, i.e. the smaller the population becomes, the less likely it will be that enough prospecting flocks of birds will be able to locate suitable breeding habitat.

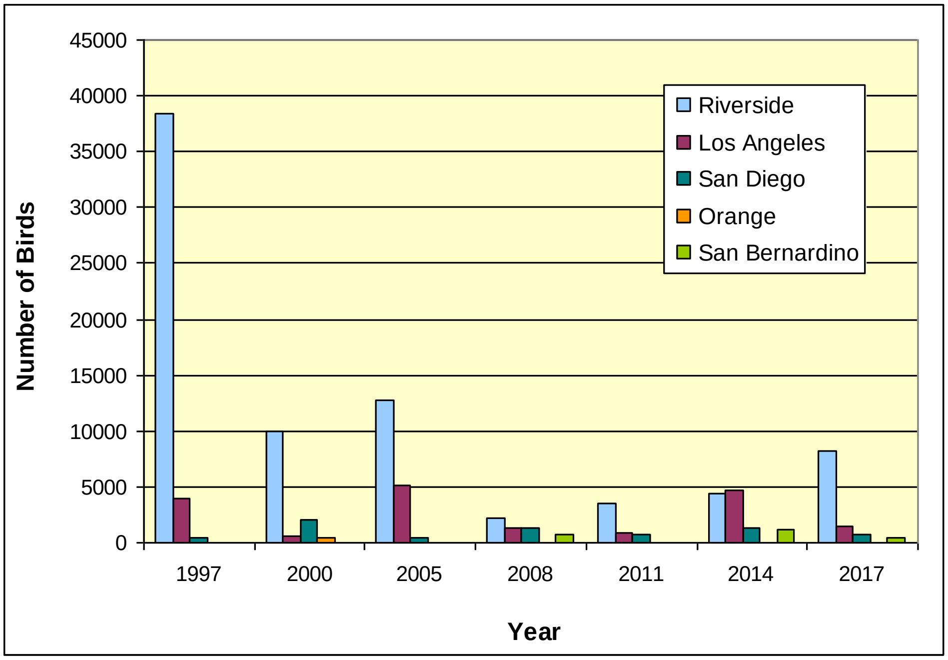
Like the Passenger Pigeon, the Tricolored Blackbird is a colonial species in all respects as so eloquently described by Dawson (1923). There is now good evidence that Allee effects contributed to the very sudden and rapid demise of the Passenger Pigeon after years of overexploitation (see below under Factors Affecting Ability to Survive and Reproduce). Knowledge of this fact along with the multitude of factors impacting the Tricolored Blackbird throughout its range and life stages, and the strong parallels to the Passenger Pigeon in terms of habitat loss and destruction of individuals on a massive level, should impel us to take the most conservative approach possible.

The threats to the southern California population are immediate and profound. Would it be possible to list this population segment as Endangered even if the CV population is listed as Threatened?

General Comments

I suggest defining southern California as that area south of the Transverse Ranges early in the document. It might be confusing to some to see this area defined in different ways and you shouldn't have to keep explaining it. I recommend defining the area biogeographically, and if there I some question about just where the limits are (e.g., in the section on range shifts), then present that discussion as just that.

I've been thinking more about the question of boundaries lately, and the genetic work that is in progress now will hopefully shed some light on it. Tricolored Blackbirds seem to be willing and able to travel large distances to breed, such as Washington and Nevada, crossing large distances and mountain ranges to get there. It seems to me that either the birds in the high desert areas of southern California (north of the Transverse Ranges) are an extension of the Central Valley population, or there is no real separation between the two population segments, although perhaps more movement in one direction than the other. Consider the figure below which suggests pulses of increase in LA County (the high desert area) with subsequent declines. This suggests to me that there is immigration into the area in some years and emigration in others. The number of birds breeding in Riverside County appears to have increased slowly since 2008 with a relatively large increase since 2014. The cause is not clear but be either an increase in recruitment from the highly successful year they had in 2015 or immigration from outside of southern California.



Specific Comments

P 13. PP 4. The text states that "In recent decades, Cattle Egrets and White-faced Ibis have caused complete failure of large breeding colonies (Meese 2012, 2016)." Please note that Hamilton et al. documented large losses due to Black-crowned Night Herons. They considered this species to be the most significant predator on Tricolored Blackbirds, primarily on colonies nesting in wetlands of CV wildlife refuges. I notice you do under Factors Affecting Ability to Survive and Reproduce, but it would be worth mentioning here as well.

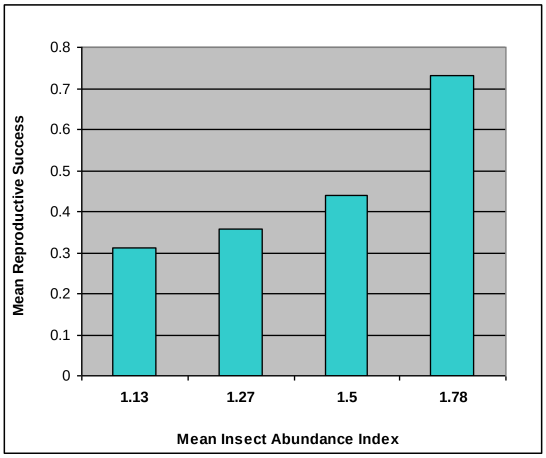
Habitat that May be Essential for the Species' Continued Existence in California

P 17. PP 2. Please highlight the importance of alfalfa as a foraging habitat. There is a heavy concentration of attention on grasslands which are very important of course, but alfalfa is a vital, and in many places the only, source of insects for colonies nesting at dairies in the CV and in southern California. It is the only source of food for young in the Mojave Desert area of San Bernardino County. Threats to the continued production of alfalfa exist. The most immediate one in the Mojave where the groundwater is being mined for alfalfa production (Dave Goodward personal communication). Dairies in the Central Valley may also start to disappear as more people move into the valley. Already, there are problems with air and water quality associated with dairies in that area.

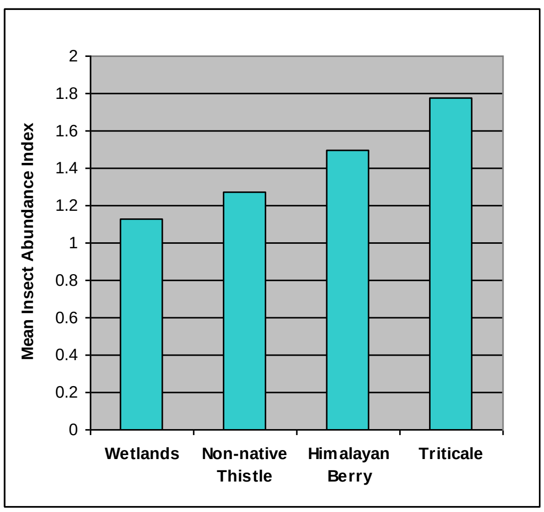
Reproduction and Survival

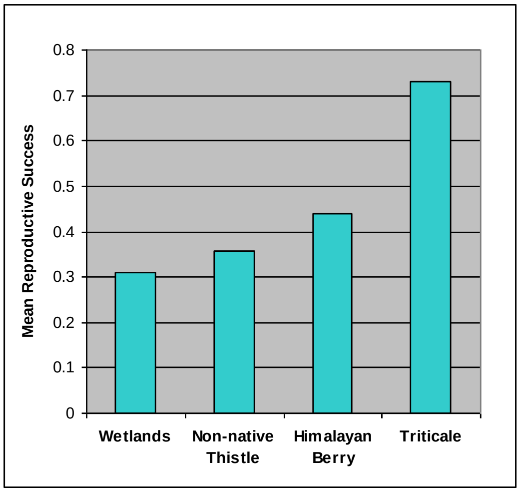
Page 20. PP 3. Cook and Toft (2005) found large and significant differences in reproductive success (RS) between different substrate types. Please report those results, they are important.

Page 20. PP4. In an analysis of the data in Table 1, Meese (2013), I found that higher RS was associated with greater abundance of favored insect groups in foraging habitats surrounding colonies, as the following figure shows.



However, RS co-varied in this study with both insect abundance and substrate type making it impossible to distinguish between causal factor(s). Notably, RS was significantly higher in triticale than wetland (cattail) substrates (P = 0.021, Mann-Whitney U-Test).





In a study involving a larger sample size, Cook and Toft (2005) also found RS to be significantly higher in all groups of upland substrate types (triticale, Himalayan blackberry, and combined other types) than wetlands. They suggested that predation was the most logical causal factor for this relationship. A portion of their Table 3 is shown below.

	n	mean RS	se RS
Himalayan blackberry	23	2.0	0.16
Other upland plants	7	1.2	0.37
Triticale	4	1.0	0.26
Emergent marsh	40	0.5	0.09

Understanding the factors that promote productivity are essential for management of this species. I recommend revising the information on pages 20 and 22. There is no support for a change in the relationship between RS and substrate type between 2006-2011 and 1992-2003, rather the opposite.

Regional Shifts in Abundance

Central Valley

Itinerate breeding behavior was not known to Neff and DeHaven. Did these apparent shifts in distribution account for time of year? Were these investigators able to search all major regions of California throughout the breeding season? Is there an explanation, at least in theory, for these apparent changes in distribution? I think it is inconsistent to cast the results of 1994-2000 and 2008-2014 as incomparable but interpret the patterns described by Neff and Dehaven as results of behavioral shifts in population abundance without question. I'm not saying these changes didn't happen, but how strong is the evidence for them?

Page 40, PP 2. I am troubled by the information presented here. Yes, it is true that the Central Valley has experienced long term changes, and that there are areas such as Kings County that really stand out. However, the entire Central Valley population has declined dramatically in recent decades. The changes that appear more stark, in Kings or Glenn Counties for example, are probably the results of either loss of habitat there or the shrinking of the population geographically into areas of superior habitat. I strongly disagree that the population as a whole experienced an increase from the later 90's to 2008. Where is the objective evidence for this? As someone who participated in surveys of the southern San Joaquin in the early 90's up to 2005 and then again in 2008, I find this impossible to believe. The changes were remarkable. I surveyed the whole of the breeding range of Tulare, Kings, Fresno, and Kern in 2004 and again in 2008, and could not believe the magnitude of change that had occurred in those years.

Without good evidence to the contrary, I believe we must err on the cautionary side, and presume that the differences in counts from 1994-2000 and 2008-2014 are due to significant differences in survey effort, not only in number of observers but geographic coverage. I would argue that this is not only precautionary, but the simplest and most reasonable interpretation of the data. This is an extremely important point because otherwise, we would have to believe that the population was capable of a large increase in size despite the large scale loss of habitat and the ongoing destruction of nesting sites supporting some of the largest colonies. Please supply a sound explanation for a significant increase in population or to remove this section from the document.

Habitat loss and the associated loss of breeding colonies was most profound in the late 90's in the southern Sacramento Valley, an area described by Cook and Toft (2005) as the most productive part of the species range and as a center of population abundance by earlier authors. From their paper:

> "A portion of the decline in the Tricolored Blackbird population during the 1990s was probably a result of its near extirpation from southern Sacramento County, where extensive Himalayan blackberry patches and rangeland once supported a large and highly successful breeding population (Cook 1996). This region served, as early as 1994, as the single largest source location for fledgling production. In recent years, pressure from the human population, including conversion of rangelands to vineyards, has been particularly intense there, resulting in the loss of the largest colony-sites and approximately two thirds of all known breeding locations in the region. Ultimate causes have included one or both of direct destruction of Himalayan blackberry patches themselves and permanent changes in land-use that reduce or degrade the suitability of the available surrounding foraging habitat. Substantially reduced breeding in southern Sacramento County most likely explains the more recent increasing trend toward nesting again in emergent marshes, especially in the nearby Sacramento Valley, where reproductive success is lowest on average."

Please consider the scientific axiom, Occam's Razor and the rules of parsimony, that the simplest explanation is usually the right one. We accept that the population has declined dramatically since the turn of the last century. Grave et al. (2013) also found evidence for this in their analysis of long term trend. We accept that this is due primarily to human actions. The surveys conducted by Hamilton et al. from 1994-2000 were, admittedly not complete. However, they did cover the most productive parts of the Central Valley (lower San Joaquin, upper Sacramento, and southern Sacramento County). They did this with increasing effort and with consistent methods. They accurately identified the areas that supported the largest colonies and monitored them consistently. The simplest and most reasonable explanation is that the total population was underestimated by Hamilton et al. but that the trend is real. In my opinion, it would require an unjustified leap of reason to conclude that the differences in their methods versus those implemented in 2008 could account for the year over year decline observed from 1994-2000 which is essentially identical to that observed between 2008-2014. This interpretation, and the acceptance of a population increase from 2000-2008 despite massive habitat conversion in a center of productivity and the large scale destruction of dairy colony sites which resulted in zero productivity for those colonies, requires such a complex and unlikely explanation (which is not provided), that it is, in the absence of convincing evidence to the contrary, not worth the attention it is getting in this presentation. It muddies the waters and casts way too much doubt on previous scientific methods and what we learned from those earlier studies. I believe it is also dangerous, because it can easily lead someone with lesser knowledge of the system to conclude that the population naturally experiences large fluctuations in size regardless of human impact, and that the species is in less danger of extinction than it is.

Protection of Agriculture Colonies from Losses to Harvest

P 57. PP2. I think the information in this section is a little overstated. It seems to give the impression that a lot of buyouts happened since the early 90's although in fact, it was never more than a small percentage of colonies, even a small percentage of the largest colonies that were saved. Furthermore, at least up to 2005 (I'm not sure what happened after that), these buyouts rarely included whole colonies, but a portion of them, usually the densest area of nesting. Unfortunately, removal of all of the substrate around the unharvested area left it exposed to edge effects (e.g., wind) and predators. I am not saying that the buyouts didn't help, but the population exhibited steep declines throughout the 90's and 2000's despite them. Cook and Toft (2005) suggested that the large scale reproductive failure in dairy colonies, and the massive amount of land conversion to unsuitable habitat in southern Sacramento County were the principal causes and that seems most logical to me.

FACTORS AFFECTING ABILITY TO SURVIVE AND REPRODUCE

Small Population Size and Colonial Breeding

I think it is important to note that of the 9 species of birds that have gone extinct in North America since the arrival of European man, 7 were colonial or highly social. They include:

- Passenger Pigeon (*Ectopistes migratorius*)
- Carolina Parakeet (*Conuropsis carolinensis*)
- Heath Hen (*Cupido cupid*)
- Great Auk (*Pinguinus impennis*)
- Ivory-billed Woodpecker (*Campephilus principalis*)
- Imperial Woodpecker (*Campephilus imperialis*)
- Bachman's Warbler (*Vermivora bachmanii*)

Of these species, the Tricolored Blackbird most resembles the Passenger Pigeon in degree of coloniality and the threats facing it throughout its range. It is apparent now that the Passenger Pigeon suffered Allee effects which precipitated a sudden and very rapid descent into extinction. There has been some speculation lately that the population had fluctuated widely, sometimes to very low numbers in the period preceding human impacts and that it was already on its way out. However, very recent genetic analysis (Beth Shapiro, NPR Nov 17, 2017) indicates that this was not the case. The species had lived in the billions for most of the last 100,000 years. It was human hunting and habitat loss that the reduced their numbers to an unsustainable level. Nobody knows what that level was and we don't know what it might be for the Tricolored Blackbird. I don't think that the question we should be whether the species can exist in small numbers or few colonies, but how can we rebuild the population to safer levels. Even if it were the case that they could survive in much reduced numbers, would we find this acceptable?

Please include a discussion of Allee effects along with the extinction of the Passenger Pigeon. Without a discussion of what could happen if this comes into play, I'm afraid people less familiar with colonial species and the threats facing the Tricolored Blackbird could easily come to the conclusion that 150,000 birds is a lot and the species is in no real danger. This is very concerning since we have seen how quickly their populations can decline. And if the species has experienced consistent low reproduction over the last 4 or 5 years as Bob Meese suspects, then it is likely that the age structure is skewed toward older adults. If this is the case, we could see a very sudden and rapid decline, with unknown consequences.

Present or Threatened Modification or Destruction of Habitat.

Loss of habitat, particularly foraging habitat is the single greatest threat to the survival of the species in southern California. Large residential and commercial developments are planned for much of the San Jacinto Valley which will result in significant loss of dairy lands and their alfalfa fields used by Tricolored Blackbirds that nest both on and off the San Jacinto Wildlife Area.

Overexploitation.

The loss of the first breeding attempt would reduce annual productivity anyway since birds nest twice. The species has obviously evolved an itinerant breeding strategy in order to nest more than once in a season. Even if both breeding attempts are equally productive, the loss of one means a decline in productivity.

Two nesting cycles could be critical if e.g., reproductive failure of whole colonies has occurred naturally over the evolution of the species. Itinerate breeding may be an adaptation for coping with normally high losses. Compounding those losses through human activity could well exceed the ability of the species to sustain its numbers.

The primary threat is harvesting of colony sites at dairies although this problem has been addressed with a high degree of success in recent years with only one dairy colony impacted since 2011.

Predation.

Currently does not appear to be a significant problem in Riverside County. That could change in the future, if for example, Black-crowned Night Herons and other predators increase in number at Tricolored Blackbird colony sites. This is specially a concern where nesting occurs fairly regularly since there are so few breeding sites left, and regular occupancy can encourage herons to form breeding colonies nearby.

Competition.

None that I am aware of in southern California.

Disease.

West Nile virus is present at the San Jacinto Wildlife Area but the population in the San Jacinto Valley (where most birds in southern California breed each year) appears to be increasing in recent years, due perhaps to conservation management at the Wildlife Area.

Other Natural Events or Human-Related Activities.

Over the longer term, the increase in the human population in the San Joaquin may well cause the dairies to move out. Some are leaving now for Texas to avoid some of the stricter regulations in California.

In southern California, the loss of the remaining dairies seems imminent with the advancement of leapfrog development in the San Jacinto Valley, the stronghold for the species in southern California. The listing of this species, along with specific management aimed at enhancing habitat, are probably our last hope for its survival in this region.

Appendix 1

Page A1-2

It’s hard to completely avoid double counting. For example, it is possible for birds to move from one colony to another within the three day survey period. I observed active colonies increasing suddenly in size during surveys in the southern San Joaquin Valley in 2004. Harvesting was occurring throughout the region at the same time, and it is possible that birds from disturbed colonies were resettling rapidly in other colonies nearby. It was my impression that this was happening. However, we might expect that the smaller number of colonies and the lower density of them has reduced the likelihood of double counting over time.

Current methods of counting also might not accurately represent the number of birds present during the survey period. For example, it can be very difficult, if not impossible, to obtain a good estimate of colony size at certain stages of the nesting cycle, especially incubation. If several of the largest colonies in the southern San Joaquin were to be incubating during the three day survey period, this could affect total counts in a significant way. It is not clear to me that the current method reduces uncertainty in total counts over those used by Hamilton et al. This has not been demonstrated convincingly although it seems to be implied.

Additional References

Cook R. R. 2016. Enhancement of Tricolored Blackbird Breeding Habitat at the San Jacinto Wildlife Area. Final report prepared for the California Department of Fish and Wildlife, Local Assistance Grant # P1382102. Sacramento, California.

Western Riverside County Multiple Species Habitat Conservation Plan (WRC-MSHCP), Biological Monitoring Program. February 24, 2017. 2016 Tricolored Blackbird (*Agelaius tricolor*), Survey Report.

Western Riverside County Multiple Species Habitat Conservation Plan (WRC-MSHCP), Biological Monitoring Program. May 8, 2014. 2013 Tricolored Blackbird (*Agelaius tricolor*), Survey Report.

Nero R. W. 1984. Redwings. Smithsonian. Institution Press. 169 pp.

STATE OF CALIFORNIA
NATURAL RESOURCES AGENCY
DEPARTMENT OF FISH AND WILDLIFE

REPORT TO THE FISH AND GAME COMMISSION
A STATUS REVIEW OF THE
TRICOLORED BLACKBIRD
(*Agelaius tricolor*) IN CALIFORNIA

CHARLTON H. BONHAM, DIRECTOR
CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE
Draft – October 13, 2017

CONFIDENTIAL—CDFW EXTERNAL PEER REVIEW DRAFT—DO NOT CIRCULATE

Table of Contents

EXECUTIVE SUMMARY

[Note to reviewers: The executive summary will be prepared after peer review.]

REGULATORY FRAMEWORK

Petition Evaluation Process

A petition to list the Tricolored Blackbird (*Agelaius tricolor*) as endangered under the California Endangered Species Act (CESA) was submitted to the Fish and Game Commission (Commission) on August 19, 2015 by the Center for Biological Diversity. Commission staff transmitted the petition to the Department of Fish and Wildlife (Department) pursuant to Fish and Game Code section 2073 on August 20, 2015, and published a formal notice of receipt of the petition on September 4, 2015 (Cal. Reg. Notice Register 2015, No. 36-Z, p. 1514). The Department's charge and focus in its advisory capacity to the Commission is scientific. A petition to list or delist a species under the CESA must include "information regarding the population trend, range, distribution, abundance, and life history of a species, the factors affecting the ability of the population to survive and reproduce, the degree and immediacy of the threat, the impact of existing management efforts, suggestions for future management, and the availability and sources of information. The petition shall also include information regarding the kind of habitat necessary for species survival, a detailed distribution map, and any other factors that the petitioner deems relevant" (Fish & G. Code, § 2072.3).

On October 2, 2015, the Department provided the Commission with its evaluation of the petition, "Evaluation of the Petition from the Center for Biological Diversity to List Tricolored Blackbird (*Agelaius tricolor*) as Endangered Under the California Endangered Species Act," to assist the Commission in making a determination as to whether the petitioned action may be warranted based on the sufficiency of scientific information (Fish & G. Code, §§ 2073.5 & 2074.2; Cal. Code Regs., tit. 14, § 670.1, subds. (d) & (e)). Focusing on the information available to the Department relating to each of the relevant categories, the Department recommended to the Commission that the petition be accepted.

At its scheduled public meeting on December 10, 2015, in San Diego, California, the Commission considered the petition, the Department's petition evaluation and recommendation, and comments received. The Commission found that sufficient information existed to indicate the petitioned action may be warranted and accepted the petition for consideration. Upon publication of the Commission's notice of its findings, the Tricolored Blackbird was designated a candidate species on January 8, 2016 (Cal. Reg. Notice Register 2016, No. 2-Z, p. 57).

Status Review Overview

The Commission's action designating the Tricolored Blackbird as a candidate species triggered the Department's process for conducting a status review to inform the Commission's decision on whether to list the species. At its scheduled public meeting on December 8, 2016, in San Diego, California, the

Commission granted the Department a six-month extension to complete the status review and facilitate external peer review.

This status review report is not intended to be an exhaustive review of all published scientific literature relevant to the Tricolored Blackbird; rather, it is intended to summarize the key points from the best scientific information available relevant to the status of the species. The final report represents the Department's evaluation of the current and future conservation status of the species and is informed by independent peer review of a draft report by scientists with expertise relevant to Tricolored Blackbird. It is intended to provide the Commission with the most current information on the Tricolored Blackbird and to serve as the basis for the Department's recommendation to the Commission on whether the petitioned action is warranted. The status review report also presents identification of habitat that may be essential to the continued existence of the species and provides management recommendations for recovery of the species (Fish & G. Code, § 2074.6). Receipt of this report is to be placed on the agenda for the next available meeting of the Commission after delivery. At that time, the report will be made available to the public for a 30-day public comment period prior to the Commission taking any action on the petition.

Existing Regulatory Status

California Endangered Species Act

The Tricolored Blackbird was the subject of three previous CESA listing petitions. In 1991, the Yolo chapter of the National Audubon Society submitted a petition to the Commission to list the species as endangered. After reviewing the document and other available information, the Department determined that the petitioned action might be warranted and recommended to the Commission that it accept and consider the petition. In March 1992, the Commission voted to accept the petition and designated the Tricolored Blackbird as a candidate for listing. Researchers working during the 1992 breeding season discovered that the population was much larger than previously thought and the Yolo Audubon Society withdrew the petition based on the new population data. The Commission allowed the petition to be withdrawn, but urged the Department to work with interested persons and groups to develop conservation measures for the Tricolored Blackbird. The species was again petitioned to be listed under CESA in 2004 (Cal. Reg. Notice Register 2004, No. 18-Z, p. 568). The petition evaluation report by the Department (Gustafson and Steele 2004) stated there was sufficient information to indicate the petitioned action may be warranted; however, the Commission voted to reject the petition (Fish and Game Commission meeting, Feb. 3, 2005). On October 8, 2014, the Center for Biological Diversity submitted a petition to list the Tricolored Blackbird as endangered (Cal. Reg. Notice Register 2014, No. 44-Z, p. 1861). The Commission referred the petition to the Department for an initial evaluation on October 15, 2014. At its December 3, 2014 meeting in Van Nuys, California, the Commission voted to take emergency action to add Tricolored Blackbird to the list of endangered species pursuant to Fish and Game Code section 2076.5, with the related regulation as approved by the Office of Administrative Law taking effect for an initial term of six months beginning on December 29, 2014 (Cal. Reg. Notice Register 2015, No. 2-Z, p. 91). At its meeting in Mammoth Lakes on June 11, 2015,

the Commission voted to reject the 2014 petition and on June 30, 2015 the emergency regulation adopted in December 2014 expired by operation of law.

Federal Endangered Species Act

The Tricolored Blackbird also has a listing history under the federal Endangered Species Act (ESA). In 1988, the United States Fish and Wildlife Service (USFWS) contracted for a compilation of all historical information on distribution and abundance of the Tricolored Blackbird, resulting in the work of Beedy et al. (1991). In 1991, the USFWS identified the Tricolored Blackbird as a category 2 candidate for federal listing. However, in 1996, the USFWS eliminated category 2 species from the list of candidate species. In 2004, the USFWS received a petition to list the Tricolored Blackbird as a threatened or endangered species from the Center for Biological Diversity. In 2006, the USFWS issued a 90-day finding in response to the petition that listing the Tricolored Blackbird was not warranted (50 CFR Part 17, Dec 5, 2006). On February 3, 2015, the Center for Biological Diversity submitted a petition to the USFWS to list the Tricolored Blackbird as an endangered species under the federal endangered species act and to designate critical habitat concurrent with listing. The petition is currently under review by the USFWS (50 CFR Part 17, Sept 18, 2015).

California Species of Special Concern and USFWS Birds of Conservation Concern

The Tricolored Blackbird is listed as a Priority 1 Species of Special Concern (SSC) by the Department. The Department's SSC designation is administrative and is intended to alert biologists, land managers, and others to a species' declining or at-risk status, to encourage additional management considerations for these species to ensure population viability, and to preclude the need for listing under CESA. SSCs are defined as species, subspecies, or distinct populations of animals native to California that currently satisfy one or more of the following criteria: extirpated from the state in the recent past; listed under ESA as threatened or endangered, but not under CESA; meets the state definition of threatened or endangered but has not been formally listed; experiencing, or formerly experienced, serious (noncyclical) population declines or range retractions (that have not been reversed), which if continued or resumed could qualify for threatened or endangered status under CESA; has naturally small populations and/or range size and exhibits high susceptibility to risk from any factor that, if realized, could lead to declines that would qualify it for threatened or endangered status (Shuford and Gardali 2008). In 2008, the USFWS updated its Birds of Conservation Concern report, identifying "species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act of 1973" (USFWS 2008). The Tricolored Blackbird was included on two Bird Conservation Region lists (Coastal California and Great Basin), the USFWS Region 8 list (California and Nevada) and the National list. Neither of these "species of concern" designations provides the species with formal regulatory status like the ESA or CESA; however, impacts to SSC are generally considered potentially significant under CEQA, and therefore mitigation for impacts may be provided (see Existing Management section).

Migratory Bird Treaty Act

The Tricolored Blackbird is included on the list of species protected under the Migratory Bird Treaty Act (MBTA). The MBTA makes it unlawful to take, possess, transport, sell, or purchase any bird listed in the Act, or its nest or eggs, without a permit issued by the USFWS.

California Fish and Game Code

The Fish and Game Code includes certain protections for birds, including nongame birds. Sections applicable to the Tricolored Blackbird include the following:

> Section 3503 – It is unlawful to take, possess, or needlessly destroy the nest or eggs of any bird, except as otherwise provided by this code or any regulation made pursuant thereto.
>
> Section 3513 – It is unlawful to take or possess any migratory nongame bird as designated in the Migratory Bird Treaty Act or any part of such migratory nongame bird except as provided by rules and regulations adopted by the Secretary of the Interior under provisions of the Migratory Treaty Act.
>
> Section 3800(a) – All birds occurring naturally in California that are not resident game birds, migratory game birds, or fully protected birds are nongame birds. It is unlawful to take any nongame bird except as provided in this code or in accordance with regulations of the commission.

BIOLOGY AND ECOLOGY

Species Description

The Tricolored Blackbird was first collected by Nuttall in 1836 near Santa Barbara, CA (Nuttall 1840, Baird et al. 1874). A male specimen was sent to John James Audubon who described it as a unique form of blackbird in his well-known *Ornithological Biography* (Audubon 1839).

The Tricolored Blackbird is sexually dimorphic, with the male plumage entirely black except for the bright red lesser wing coverts forming a conspicuous red patch on the wing (“shoulder” or “epaulets”) and white median coverts forming a distinct border to the red. The black body plumage is glossed bluish when viewed in sunlight. The female is mostly dark brown dorsally and heavily streaked ventrally with dark brown streaks merging to form a largely solid dark brown belly (Beedy et al. 2017). The head of the female is indistinctly patterned with a whitish supercilium, malar, chin, and throat.

Although similar in appearance to the related Red-winged Blackbird (*A. phoeniceus*), several features can be used to distinguish the two species (described by Nuttall 1840, Cooper 1870, Baird et al. 1874). The black plumage of the Tricolored Blackbird male has a soft bluish luster that is lacking in the Red-winged Blackbird. The lesser wing coverts (the red “shoulder”) on the male Tricolored Blackbird are a much deeper red (described as crimson, carmine, or the color of venous blood) compared to the brighter red color (vermilion or scarlet) in the Red-winged Blackbird. The median coverts in the Tricolored Blackbird are white (pale-yellowish when fresh) and create a stark contrast between the black

and red feathers on the wing, whereas in the Red-winged Blackbird they are generally yellowish (or black in the subspecies that breeds in much of the Central Valley). The bill of the Tricolored Blackbird averages thinner and can appear more sharply pointed. In flight, the wings of the Tricolored Blackbird appear to have a more pointed shape (vs. rounded in the Red-winged Blackbird) due to differences in length of the primary flight feathers. Female Tricolored Blackbirds have darker plumage than most female Red-winged Blackbirds, although this difference is less pronounced in the Central Valley where the subspecies of Red-winged Blackbird is relatively dark (Beedy et al. 2017).

Taxonomy

The Tricolored Blackbird is a species in the avian family Icteridae, which is restricted to the Americas in the Western Hemisphere and includes blackbirds, orioles, cowbirds, grackles, and meadowlarks (Skutch 1996). There are about 100 species in the family, most of which occur in the tropics. Following recent taxonomic changes that removed several South American species from the genus *Agelaius*, there are currently five species in the genus worldwide (Remsen 2017). In addition to the Tricolored Blackbird, the only other species that occurs on the North America mainland is the much more widespread and diverse Red-winged Blackbird. The other three species in the genus occur in the Greater Antilles: *A. assimilis* (the Red-shouldered Blackbird of western Cuba), *A. humeralis* (the Tawny-shouldered Blackbird of Hispaniola and Cuba), and *A. xanthomus* (the Yellow-shouldered Blackbird of Puerto Rico) (Beedy et al. 2017). There are no recognized subspecies of Tricolored Blackbird (AOU 1957).

Geographic Range and Distribution

The Tricolored Blackbird is nearly endemic to the state of California, with small numbers of birds extending the species' range into neighboring states of Oregon, Washington, Nevada, and Baja California.

Breeding Range

The majority of the Tricolored Blackbird's breeding range is composed of two disjunct regions of California and Baja California, separated by the Transverse Ranges of southern California (Figure 1). The larger of the two areas occupies the lowlands west of the Sierra Nevada, extending west across the Central Valley to the coast from Sonoma County south to Santa Barbara County. The second area is composed of the lowlands west of the deserts in southern California, extending south into northwestern Baja California. Small numbers of birds extend the range to the north in isolated low-lying areas on the northern California coast and to isolated areas in northeastern California, Oregon, and eastern Washington. Similarly, the range extends east from the southern Central Valley to small areas in the Mojave Desert, and to a single area in Douglas County, Nevada (Skutch 1996, Ammon and Woods 2008, Beedy et al. 2017).

Winter Range

In the winter the Tricolored Blackbird mostly withdraws from the portion of its breeding range north of the Central Valley (northeastern CA, Oregon, and Washington) and from Nevada to the lowlands of

central and coastal California (Wahl et al. 2005, Ammon and Woods 2008, Beedy et al. 2017), although a small number of birds are occasionally documented throughout the northern breeding range during winter months (Gilligan et al. 1994, Spencer 2003, eBird Dataset 2016). The species can be found in most of the remainder of its range year-round, with shifts in distribution as described below.

Distribution of Breeding Colonies

Within the breeding range, the largest breeding colonies and the large majority of the breeding population occur in the Central Valley of California (Figure 2b). In all California statewide surveys conducted since 1994, most (≥90% in all years but 1997) of the population has occurred in the Central Valley counties during the early breeding season (Hamilton et al. 1995, Beedy and Hamilton 1997, Hamilton 2000, Kelsey 2008, Kyle and Kelsey 2011, Meese 2014a).

Although the overall distribution and breeding locations vary from year to year, Tricolored Blackbirds exhibit some fidelity to traditional use areas. These areas likely provide all of the critical resources needed by breeding colonies, while the specific nesting sites used in the area can change from year to year (Beedy et al. 1991). In the Central Valley, there are distinct regions that frequently support multiple colonies and a large proportion of the breeding population. In the southern San Joaquin Valley, the largest colonies are typically found annually in an area centered at the junction of Kern, Kings, and Tulare counties (Figure 2). In the northern San Joaquin Valley, Merced County regularly supports multiple large colonies. Further north in the Central Valley and Sierra Nevada foothills, breeding colonies are regularly distributed more broadly from Sacramento County north through the Sacramento Valley to Butte and Colusa counties. In southern California, breeding colonies are located mainly in the western portions of Riverside and San Bernardino Counties, south through the interior of San Diego County (Figure 2; Feenstra 2009). Colonies are patchily distributed throughout the rest of the species' range in California, particularly in the Coast Ranges and on the coastal slope.

The limited range of the species in Oregon, Washington, and Nevada is maintained by irregular occurrences of relatively small numbers of birds (Gilligan et al. 1994, Spencer 2003, Wahl et al. 2005, Ammon and Woods 2008). These neighboring states have historically supported less than 1% of the species' population (Beedy et al. 1991). Although previously more widespread, breeding in Baja California now occurs at only a few isolated locations (Erickson et al. 2007, Erickson and de la Cueva 2008, Feenstra 2013, Erickson et al. 2016). Currently, no more than about 1% of the species' population breeds outside of California.

Breeding colonies typically occur in valleys or low-lying areas with suitable nesting habitat and extensive grassland, agriculture, or other suitable foraging habitat. However, the elevation of colony locations varies greatly across the range. The majority of the population breeds below an elevation of about 300 feet in the Central Valley. In the central Sierra foothills, colonies occur up to 1,720 feet, although most occur near the valley floor at or below about 300 feet elevation (Airola et al. 2015a). In the southern California portion of the range, most colonies occur below about 1,500 feet, although colonies at more inland locations are at higher elevations. Further inland, such as in the Mojave Desert and to the northeast in the Modoc Plateau, colonies occur at elevations up to several thousand feet. Grinnell and

Miller (1944) included a record of 4,400 feet on the "South Fork of the Pit River" in Modoc County. The single breeding location in Nevada is at 4,730 feet elevation (Ammon and Woods 2008).

Winter Distribution

Although Tricolored Blackbirds can be found throughout much of the California breeding range year-round, most birds withdraw from the southern San Joaquin Valley and the northern Sacramento Valley in the winter (Grinnell and Miller 1944, Beedy et al. 2017). Band recoveries and observational studies have documented movement of birds away from these portions of the range toward the central part of the valley surrounding and including the Sacramento-San Joaquin Delta region (Neff 1942, DeHaven and Neff 1973, DeHaven et al. 1975b). There is a general concentration of birds in this region during the winter, as well as in the northern San Joaquin Valley in Merced County and coastal areas north and south of the San Francisco Bay area (Orians 1961a, Payne 1969, Stallcup 2004) (Figure 3). Evidence from banded birds recovered outside the Central Valley is limited, but birds from throughout the northern range are thought to follow the general pattern of winter movement to central and coastal California (DeHaven et al. 1975b, Beedy 2008). Although a relatively large portion of the population winters in this region, wintering flocks can be found at widely scattered points throughout the species' range north of the Transverse Ranges (DeHaven et al. 1975b).

South of the Transverse Ranges, birds from Santa Barbara County south to Baja California appear to occupy the region year-round (Unitt 2004, Beedy 2008), although distribution in the southern portion of the range is patchy in all seasons. Recoveries of birds banded in southern California have revealed much more localized movements compared to those from the Central Valley (Neff 1942, DeHaven and Neff 1973).

Genetics and Population Structure

Hamilton (2004) documented behavioral differences between Central Valley and southern populations of the Tricolored Blackbird, and suggested that a lack of gene flow may have led to genetically distinct populations. While banding studies indicate extensive movement of the Tricolored Blackbird population throughout the entire length of the Central Valley (DeHaven et al. 1975b), DeHaven and Neff (1973) reported on recoveries of banded birds from the Central Valley and southern California and suggested that little or no interchange occurs between populations north and south of the Transverse Ranges. The observation of a single banded bird in the Mojave Desert of northern Los Angeles County was the first data documenting movement of the species from the Central Valley to the desert (Feenstra 2009), although there is a report from the late 1800s documenting a flock of Tricolored Blackbirds moving in the opposite direction (Belding 1890). In 2014 and 2016, the second and third Tricolored Blackbirds that had been banded in the Central Valley were photographed in San Bernardino County, providing further confirmation of movement from the valley to the Mojave Desert (Meese 2014b, Aug 2017 email from R. Meese to N. Clipperton; unreferenced).

A single genetic study on the Tricolored Blackbird did not find evidence of significant population structuring between the Central Valley and a southern population composed of birds from the Mojave Desert and southern California. The birds sampled in the southern population were found to exhibit

higher allelic diversity, suggesting that the southern population may be an important reservoir of genetic variation for the species (Berg et al. 2010). In assessing population structure, it may be inappropriate to combine birds from the Mojave Desert with birds from south of the Transverse Ranges to represent a single southern population as Berg et al. (2010), especially if the ~~Mojave Desert birds are linked to the Central Valley~~ population in the Mojave Desert is connected through immigration and gene flow with the central Valley.. In addition, samples were obtained at only two colonies south of the Transverse Ranges and at two colonies in the desert, sample sizes were small at some sites, and the study used a relatively small number of genetic markers. Researchers at UCLA are currently conducting a study using more advanced genomic techniques to characterize genetic variation, population structure, and spatial and temporal patterns of movement throughout the range of the Tricolored Blackbird (Feb 2017 email from K. Barr to N. Clipperton; unreferenced).

Movements

Most Tricolored Blackbird are resident in the state of California, with seasonal movements leading to shifts in distribution within the state over the course of a year. Grinnell and Miller (1944) wrote that the Tricolored Blackbird is "resident within State [California], but partly migratory within the Sacramento-San Joaquin drainage system; all populations are in some degree nomadic and in fall and winter normally leave the immediate vicinity of the nesting colonies." Banding studies (Neff 1942, DeHaven and Neff 1973, DeHaven et al. 1975b) and observations of unbanded birds (Payne 1969) demonstrated that most Tricolored Blackbirds reside throughout the Central Valley March through September, and then move into the Sacramento-San Joaquin Delta and northern San Joaquin Valley (primarily Merced County) and coastal locations during winter. More extensive migratory movements are made by small numbers of birds that breed north of the Central Valley as far north as the state of Washington (Wahl et al. 2005); these migratory individuals apparently mostly return to California in the winter. In southern California south of the Transverse Ranges, birds seem to undergo much more localized seasonal movements compared to those from the Central Valley (Neff 1942, DeHaven and Neff 1973).

Itinerant Breeding

Individual Tricolored Blackbirds often occupy and breed at two or more sites during the breeding season, a phenomenon known as itinerant breeding (Hamilton 1998). Itinerant breeding is a very rare trait among birds, and occurs exclusively in species that move between breeding attempts to locate or follow locally abundant food sources (Jaeger et al. 1986). Although early observers suspected that Tricolored Blackbirds nested more than once in a season at multiple locations (e.g., Neff 1937), the movements of Tricolored Blackbirds have been described as "sheerly and illogically erratic" (Neff 1942), "wanderings" (Payne 1969), and highly nomadic (Beedy et al. 1991). Recoveries of banded Tricolored Blackbirds provided documentation of interannual breeding at widely separated locations, but within-year movements during a single breeding season were not documented prior to the 1990s (Neff 1942, DeHaven and Neff 1973). The movements of Tricolored Blackbirds continue to be somewhat unpredictable from year to year, but Hamilton et al. (1995) demonstrated that most of the adults in the Central Valley breed more than once and often at different locations. This itinerant breeding follows a pattern of initial breeding in the south, mostly San Joaquin Valley and southern foothills to Sacramento

County, with a shift north for a second breeding attempt, primarily in the Sacramento Valley and adjacent foothills. The timing and degree to which this shift occurs vary from year to year (Hamilton 1998). The timing of breeding in Sacramento County was intermediate to that of the San Joaquin and Sacramento Valleys, with initiation of breeding in Sacramento County 10 days later than in the San Joaquin Valley, but over a month before most breeding in the northern Sacramento Valley (Figure 4). On the Central California Coast in Monterey County, 25% of radio-tagged birds moved between study colonies during a breeding season, suggesting itinerant breeding on a smaller scale (Wilson et al. 2016).

The following discussion of seasonal movements is largely from Beedy and Hamilton (1997) and Beedy et al. (2017).

Spring Movements from Wintering Areas

The species vacates wintering areas concentrated around the Sacramento-San Joaquin River Delta and along coastal California in mid-February. Birds arrive at breeding locations and establish colonies in Sacramento County and throughout the San Joaquin Valley from early March to early April (DeHaven et al. 1975b). Colonies at foothill locations adjacent to the San Joaquin and Sacramento valleys may be settled by late March, but many are not settled until May. In southern California and Baja California, the species may nest anytime throughout April and May.

Commented [RRC1]: Nesting started in Riverside early March of 2015. Nesting extends into mid-June in some years.

Flocks of Tricolored Blackbirds roam widely within the breeding range in the weeks before breeding begins and between breeding attempts. Breeding season wanderings may serve to locate areas of abundant insect food resources near which breeding colonies are established (Payne 1969). Similar behaviors have been documented in nomadic flocking species of semiarid habitats in Asia, Africa, and Australia, where colonial breeding occurs opportunistically in areas of high prey abundance (Payne 1969).

Breeding Season Movements

During the breeding season, Central Valley birds often move north to the Sacramento Valley after first nesting efforts (March–April) in the San Joaquin Valley and Sacramento County, with small numbers moving further north to northeastern California and southern Oregon (Beedy and Hamilton 1997, Hamilton 1998). On the floor of the Sacramento Valley north of Sacramento County, the largest colonies are typically not settled until May or early June. Recent banding results suggest a degree of colony cohesion, where many birds at a colony may move and breed together again in a new location, but banding results also suggest a high degree of mixing between breeding attempts. Although later nesting is typical in northern portions of the range, small colonies may form throughout the breeding season anywhere in the geographic distribution (Hamilton 1998). Radio telemetry studies have shown that birds move from one breeding colony to another while both are active, due presumably to reproductive failures at the first colony, but the causes of these movements remain undocumented (Wilson et al. 2016).

Commented [RRC2]: I have observed this too at the San Jacinto Wildlife Area. It is my believe that birds moved from one colony site to another in response to changes in insect supply. I documented this in Cook (2016)

Post-breeding Movements

Most Central Valley birds occur in the Sacramento Valley at the end of the breeding season and remain until mid-September, apparently attracted to ripening and recently harvested rice (DeHaven et al. 1975b). In mid-September most move south into the Sacramento-San Joaquin Delta, Merced County, and coastal locations.

Winter Movements

In winter, numbers decline in the Sacramento Valley and increase in the Sacramento-San Joaquin Delta and northern San Joaquin Valley (Neff 1942, Orians 1961a, Payne 1969, DeHaven et al. 1975b). Large foraging flocks have traditionally occurred in pasturelands in southern Solano County by late October and may join large flocks of several blackbird species to roost on islands in the eastern part of Suisun Marsh. Wintering flocks formerly numbering more than 10,000 birds assembled near dairies on the Point Reyes Peninsula, Marin County, by mid-October, but these numbers have been reduced in recent years. Highly variable numbers of birds also winter in the central and southern San Joaquin Valley, with flocks of hundreds or thousands seen in most years in the general area where large colonies breed in the early spring (Kern and Tulare counties; eBird Dataset 2016). Winter flocks consist at times of only Tricolored Blackbirds, either mixed-sex or single-sex, and at other times Tricolored Blackbirds occur in mixed-species blackbird flocks. Birds from one large winter roost in Sacramento County foraged over an area 32 km in diameter (Neff 1937). Winter distribution and movements need further study.

Commented [RRC3]: I recently analyzed the data on winter observations in Riverside County over the last 20 years from eBird, a dataset compiled by the UCR Center for Conservation Biology, and observations reported by WRC-MSHCP Biological Monitoring Program staff. These overlap almost entirely with breeding locations. I can update this information with data from our winter survey and send it to you next week if you would like.

Home Range and Territoriality

Unlike most species of songbirds that defend a territory in which they nest and acquire most of their necessary resources, the Tricolored Blackbird breeds in dense colonies in which adult males defend only a small area surrounding the nest site, and this only until nests are established and eggs are laid (Lack and Emlen 1939, Payne 1969). Nest density and male territory size can vary among colonies with individual nests in the densest colonies built within a foot or less of each other (Hosea 1986, Beedy et al. 1991). In some cases two nests may even share interwoven strands of nest material (Lack and Emlen 1939). Male territories have been measured from 1.8 m^2 to 3.25 m^2 (Lack and Emlen 1939, Orians 1961) and nest densities have been observed at up to six nests per square meter (Beedy et al. 2017). The greatest nesting density reported occurred in a rare nesting substrate, giant cane (*Arundo* sp.), with 2,500 adults nesting in an area 42 x 13 feet (equivalent to 4.5 birds per square foot) (DeHaven et al. 1975a).

Commented [RRC4]: I believe the original source for this is Cook and Toft 2005. Substrate in Himalayan Blackberry.

The small territories in dense breeding colonies cannot supply sufficient food for the adults and for the growing young, therefore most foraging occurs away from the colony site. While breeding, most foraging occurs within 2–3 miles of colony sites (Orians 1961, Hamilton et al. 1992), although longer foraging flights have been documented (up to 8 miles or more). Typically, only a portion of the landscape surround a breeding colony is suitable for foraging and the range used by individual birds in colonies is variable depending on the extent and quality of the foraging landscape.

Colonial Breeding and Social Behavior

> "To one in search of something utterly different I can heartily recommend an hour, or a day, in a Tricolor swamp… *Agelaius tricolor* is intensely gregarious, more so than perhaps any other American bird. Every major act of its life is performed in close association with its fellows… the very day of its nesting is agreed upon in concert. In continuous procession the individuals of a colony repair to a field agreed upon in quest of building material; and when the babies are clamoring the loudest for food, the deploying foragers join their nearest fellows and return to the swamps by platoons and volleys, rather than as individuals." – Dawson (1923).

Coloniality in birds is typically defined as the breeding by a number of individuals at a more or less centralized place from which colony residents regularly depart from to search for food. This breeding strategy is most common among seabirds, in which more than 95% of species nest colonially (Danchin and Wagner 1997), and is relatively uncommon among North American landbirds.

The Tricolored Blackbird forms by far the largest breeding colony aggregations of any North American landbird (Neff 1937, Lack and Emlen 1939, Orians 1961, Skutch 1996). Bent (1958) found that the Tricolored Blackbird "nests in enormous, most densely populated colonies, the nests being placed more closely together than in any other colonies of marsh-nesting blackbirds." Grinnell and Miller (1944) stated, "one essential would seem to be provision at the site of the colony for a large number of individuals. Nests apparently must be close together and pairs usually [must be] in excess of 50 in order to meet the instinctive requirements of the species." Breeding colonies are seldom smaller than 100 nests, and in the past have been as large as 100,000 to 200,000 nests (Neff 1937, Orians 1961). Each male breeds, on average, with two females resulting in a skewed sex ratio at many breeding colonies (Lack and Emlen 1939, Orians 1961, Payne 1969, Hamilton 1998, Beedy and Hamilton 1999). Although Payne (1969) observed breeding colonies consisting of as little as four nests, of the 21 colonies monitored, no colonies containing less than 100 nests were successful in fledging young.

While the great concentration of birds in a small area is the most conspicuous feature of Tricolored Blackbird colonies, the degree of synchrony among members of the colony is no less unique (Orians 1960). Breeding within a colony is often highly synchronized, with all females in a colony typically initiating nest building within a few days (Orians 1961, Payne 1969). A flock of Tricolored Blackbirds can appear in an area in which it has been absent for months and begin nesting within days (Orians 1961). Food resources for both the breeding adults and for the provisioning of young are mostly obtained from sites away from the colony location. Insect-rich foraging areas appear to be identified and utilized by all or large portions of the breeding adults in a colony until the prey base is exhausted, at which time new areas are identified and breeding birds collectively shift to new foraging sites.

<u>Occupancy dynamics</u>—Tricolored Blackbird breeding colonies frequently shift locations from year to year, though sites used each year often occur in the same traditionally used areas. In some cases Tricolored Blackbirds exhibit high inter-annual site fidelity, perhaps driven by the continued availability of essential resources, including suitable nesting substrate, water, and foraging habitat (Beedy and

Hamilton 1997). Of 72 occupied colony locations between 1992 and 1994, only 19 (26%) were active in all three years and an additional 11 (15%) were active in at least two years (Hamilton et al. 1995). In the central Sierra Nevada foothills, 58% (11 of 19) of occupied breeding colony sites in 2015 were also occupied in 2014 (Airola et al. 2015b). Of 44 sites surveyed during a three year period in the central foothills, only eight (18%) were active in all three years and seven (16%) were active in two of three years (Airola et al. 2016). Of four colony locations monitored for three consecutive years in coastal Monterey County, all four were occupied in one year and only two were occupied in the other years (Wilson et al. 2016). Annual occupancy rates vary across nesting substrate types, with wetland, thistle, and Himalayan blackberry locations having similar rates of about 40% (Holyoak et al. 2014). Occupancy rates are lower for triticale and other grain sites and higher for nettle colony sites. Although any given site may be unoccupied in some years, birds often return to sites over longer time periods and some sites are used in almost every year. Hosea (1986) reported on a colony that had been occupied for more than 30 years in Sacramento County, and was able to locate several active colonies by visiting locations reported in the literature decades earlier. The result of these complex occupancy dynamics is an extremely variable rate of site fidelity over the short-term, but fidelity to breeding locations and general breeding areas are high over the longer term.

Beedy et al. (1991) compiled all available information on breeding colony locations and identified 696 historical breeding colony locations. As of the 2016 breeding season, the number of known historical and current breeding colony locations had grown to 1,272, including all records since 1907 (Figure 2a). The large majority of these historical locations are not used in any given year, and many no longer meet the habitat requirements of the species and so are no longer considered suitable. During recent thorough statewide surveys conducted between 2008 and 2014 the number of occupied breeding locations has averaged about 140 (Kelsey 2008, Kyle and Kelsey 2011, Meese 2014). New locations are discovered each year, while other sites cease to be used. This turnover of breeding locations likely reflects shifting habitat conditions across the range and results in complex occupancy dynamics described above. Most sites, once established, are used repeatedly over the course of many years.

Fluctuations in colony site selection and colony size have been attributed to a response of Tricolored Blackbirds to changes in local insect abundance within and across years (Orians 1961, Payne 1969, DeHaven et al. 1975a). Their colonial breeding behavior requires that the foraging landscape surrounding the nest site provide abundant insect food sources. The colonial nesting, compressed breeding cycle, and social structure of Tricolored Blackbirds are well suited for rapid exploitation of unpredictable resources when they become temporarily very abundant. Initiation of nesting may also be triggered by an abundant food source (Payne 1969).

In some cases, large breeding colonies have been observed to exhibit higher reproductive success than smaller colonies (Orians 1961, Payne 1969, Hamilton et al. 1992), and in some years a few large colonies have been responsible for the majority of the reproductive output for the year (Hamilton 1993). However, there are many examples when a positive correlation between colony size and reproductive success was not observed, and a wide variation in reproductive success has been observed in both small and large colonies (Payne 1969, Meese 2013).

Commented [RRC5]: However, as mentioned below, "Meese (2013) demonstrated a positive correlation between reproductive success and colony size over a six-year period ($r = 0.53$, $r^2 = 0.28$)."

Adaptive advantages of colonial breeding may be conferred by decreasing risk of predation or increasing foraging efficiency (Ward and Zahavi 1973, Beauchamp 1999), both of which could lead to increased success in production of young. The following mechanisms have been proposed as advantages to colonial breeding:

1. Predator avoidance
2. Joint anti-predator responses
3. Predator satiation
4. Social food-finding
5. Information sharing

Predator avoidance—Colonial breeding birds frequently select sites that are inaccessible to predators (Ward and Zahavi 1973), or in some cases that are naturally free of predators (e.g., seabirds nesting on isolated islands). Tricolored Blackbirds typically select breeding locations that provide a degree of protection from predators, either by selecting inaccessible sites (e.g., wetlands surrounded by or inundated by relatively deep water) or protective nesting substrates (e.g., dense, thorny, or spinous vegetation) that limit access to predators. Wetland sites may primarily limit access to terrestrial predators, whereas some dense or armored substrates may also limit access by predatory birds. In the case of a nomadic species like the Tricolored Blackbird, which does not necessarily use the same breeding location each year due to annual shifts in substrate suitability, social behavior may enhance the ability to locate these suitable locations.

Anti-predator responses—Social mobbing of predators or other aggressive behaviors is a common trait among colonial nesting birds. However, Tricolored Blackbirds do not exhibit strong defensive responses to the presence of a predator. Unlike Red-winged Blackbirds that will fiercely defend territories from potential predators that approach the nest, Tricolored Blackbirds provide little in the way of defense to eggs or nestlings (Skutch 1996). For example, when a hawk is sighted the adults in a colony may stop vocalizing and settle low within the nesting substrate, with the entire colony sometimes going silent (Orians and Christman 1968, Payne 1969). Adults may hover in the vicinity of a predator as nestlings are taken, but no pursuit of the predator is offered. Complete reproductive failure in colonies of thousands of birds can result from the efforts of relatively few predators (Beedy and Hamilton 1999). Tricolored Blackbirds do not benefit from social anti-predator responses.

Predator satiation—The massive quantity of readily available prey in the form of eggs or nestlings at a Tricolored Blackbird breeding colony may reduce the chance of loss of any one nest by satiating territorial predators (e.g., raptors). Payne (1969) observed a single pair of Northern Harriers preying on a Tricolored Blackbird colony of 10,000 nests, with no impact on the large majority of the colony. Satiation of predators may be less likely in species that hunt in groups, such as many species of wading birds. In recent decades, Cattle Egrets and White-faced Ibis have caused complete failure of large breeding colonies (Meese 2012, 2016). Predator satiation may provide a benefit to breeding Tricolored Blackbirds, depending on the number and type of predators.

Commented [RRC6]: See written comments.

Food-finding and information sharing—Roosting and colonial birds may take advantage of social behavior to more efficiently locate patches of concentrated food resources, and colony sites may serve as information centers where locations of good feeding sites can be shared among individuals (Ward and Zahavi 1973, Emlen and DeLong 1975, Brown 1988). Under this scenario, larger colonies may be more successful because there is a larger pool of information on the whereabouts of good feeding places within the foraging area being exploited by the colony (Ward and Zahavi 1973). This increased foraging efficiency, along with the highly synchronized nesting and the compressed length of a nesting cycle in Tricolored Blackbirds, may ensure that temporarily abundant prey will remain available to the young in a colony for the duration of the breeding cycle. Coloniality may result from situations when suitable breeding sites are limited among areas of high food availability (Danchin and Wagner 1997).

Because of occasional destruction of entire Tricolored Blackbird breeding colonies by predators and observations of prey-following by adults, Orians (1961) and Payne (1969) suggested that colonial nesting by Tricolored Blackbirds is more likely related to location and exploitation of a locally abundant food supply than to a strategy of predator avoidance or response. However, the choice of flooded or dense and armored vegetation for breeding suggests that suitable nesting locations provide some protection from predators, and predator satiation may be a successful strategy for confronting territorial predators.

Habitat that May be Essential for the Species' Continued Existence in California

For breeding, Tricolored Blackbirds require three critical resources: 1) secure nesting substrate, 2) a source of water, and 3) suitable foraging habitat.

Nesting Substrate

The nesting substrate for Tricolored Blackbird breeding colonies is defined as the vegetation in which nests are constructed. In most cases the nesting substrate is either flooded by water, as in wetland colony sites, or is composed of thorny or spiny vegetation that is impenetrable to many predators (Beedy and Hamilton 1997). In some cases, Tricolored Blackbird colonies occur in upland nesting substrates that lack these protective characteristics (e.g., silage grain, weedy mustard fields); in these cases the nesting substrate is usually extremely dense and therefore may provide similar protection.

The majority of Tricolored Blackbird breeding colonies have occurred in one of five nesting substrate types: 1) wetlands (either cattail [*Typha* sp.] or bulrush [*Schoenoplectus* sp.] vegetation), 2) Himalayan blackberry (*Rubus armeniacus*), 3) thistle, usually milk thistle (*Silybum marianum*) or bull thistle (*Cirsium vulgare*), 4) stinging nettle (*Urtica* sp.), or 5) agricultural grain fields, especially triticale, a wheat-rye hybrid grain grown as silage for dairy cattle. Several additional nesting substrates have been used to a lesser degree (less than 5% of colonies in total), with the more common being mustard (*Brassica* sp.), willows (*Salix* sp.), mallow (*Malva* sp.), wild rose (*Rosa* sp.), tamarisk (*Tamarix* sp.), and giant reed (*Arundo* sp.) (Beedy et al. 1991, Beedy and Hamilton 1997, Beedy et al. 2017, Tricolored Blackbird Portal 2017).

The primary nesting substrates used by Tricolored Blackbirds have different distributions across the breeding range in California (Figure 5). Wetland sites with cattail or bulrush substrate are fairly evenly

distributed across the range. Himalayan blackberry sites are mostly restricted to Merced County and north through the Sierra foothills to the Sacramento Valley. Triticale and other agricultural grain sites are found mainly in the southern San Joaquin Valley and Merced County, with a few additional sites in southern California. In recent years stinging nettle sites have mainly occurred in the southern San Joaquin Valley portion of Kern County including the surrounding foothill grasslands, although historically they were also common at the extreme northern portion of the California range in Siskiyou and Shasta counties. Thistle sites have been located throughout much of the range in California, and has been the primary nesting substrate used in the southern Sierra Nevada foothills (Airola et al. 2016). Thistle sites are typically only available to breeding Tricolored Blackbirds in years with weather patterns that support abundant thistle growth.

Historically, most breeding colonies were in freshwater marshes dominated by cattails and tules (Beedy 2008). In the 1930s, 93% of breeding colonies were in freshwater marsh vegetation with the remaining colonies in willows, blackberries, thistles, and nettles (Neff 1937). The proportion of colonies in freshwater marshes had decreased to about 70% by the 1970s as Tricolored Blackbirds began using novel, nonnative vegetation types, especially Himalayan blackberry and thistles (DeHaven et al. 1975a). By 2008, the proportion of colonies established in freshwater marsh during the statewide survey had declined to 35% (Kelsey et al. 2008).

Tricolored Blackbirds are known to have bred in blackberry bushes from the early 1900s (Booth 1926, Neff 1934, 1937), but this was a very infrequent occurrence. Sacramento County has a long history of breeding by Tricolored Blackbirds, with colonies in the 1930s found entirely in wetland substrates and colonies in the 1970s still mainly located in wetlands (Neff 1937, DeHaven et al. 1975a). In the 1980s and 1990s, an increasing percentage of breeding colonies were reported in nonnative Himalayan blackberry (Hosea 1986, Beedy and Hamilton 1997). Over 55,000 breeding Tricolored Blackbirds were located in Sacramento County in 1993, with the large majority of these in Himalayan blackberry and a small number in wetland substrates (Hamilton 1993). Himalayan blackberry is currently the dominant nesting substrate throughout the northern and central Sierra Nevada foothills. From 2014 to 2016, 65–80% of foothill colonies have occurred in Himalayan blackberry annually (Airola et al. 2016). Between 1994 and 2004, a large shift from cattail marsh colonies to Himalayan blackberry colonies occurred in the rice-growing region of Sacramento Valley (Hamilton 2004a). This was in part due to the loss or destruction of specific cattail marsh sites, but was also likely due in part to an increase in distribution of Himalayan blackberry.

Tricolored Blackbirds were discovered breeding in grain fields in the San Joaquin Valley in 1991 and 1992 (Hamilton et al. 1992). Prior to this, nesting in large cultivated grain fields was unknown and little work on the status of the species in the southern San Joaquin Valley had been conducted (Beedy et al. 1991, Hamilton et al. 1992). The only previous report of nesting in a cultivated grain field was from 1944, when a colony was observed in mustard-infested barley (Bent 1958). The discovery of breeding on grain fields in the 1990s corresponded to an increase in planting of triticale. This wheat-rye hybrid grain may be attractive to breeding Tricolored Blackbirds due to its robust structure that is well suited to support nests and it dense growth that is relatively impenetrable to terrestrial predators. Relatively little triticale had been planted for silage in the San Joaquin Valley by 1994, but by 2005 the planted acreage had

grown to about 75,000 acres (Aksland and Wright 2005). Of the nesting substrates used by Tricolored Blackbirds, triticale and other grain fields are unique in that they are available in abundance each year in the San Joaquin Valley, and in recent years, many of the largest colonies have occurred on grain fields. Fifty percent of the breeding Tricolored Blackbirds detected in California during the 2008 statewide survey were observed nesting in triticale fields (Kelsey 2008).

During the April 2011 statewide survey, the majority of colonies (54%) in the San Joaquin Valley and Tulare Basin were located on agricultural grain crops, with an additional 22% in milk thistle. Conversely, 70% of colonies in the Sacramento Valley and Sierra Nevada foothills were in Himalayan blackberry. The majority of colonies in southern California, on the central coast, and in extreme northern California continued to occur in wetland habitats. Statewide, wetlands continued to support more colonies than any other substrate type (37%), although these wetland colonies supported only 5% of the population (Kyle and Kelsey 2011).

The areal extent of nesting substrate used by breeding Tricolored Blackbird colonies has ranged from a few square meters to more than 200 acres (Tricolored Blackbird Portal 2017). The smallest colonies have occurred in a variety of nesting substrate types, including cattail or bulrush marsh, Himalayan blackberry, and willows. The largest colonies of 100 acres or more have been located in triticale in recent years, although historically very large colonies occurred in wetland habitats (Neff 1937). The large majority of colonies occupy less than 10 acres of nesting substrate, with many being smaller than one acre. DeHaven et al. (1975a) found that the area occupied by nests in all substrates types averaged less than two acres per colony, and the largest colonies observed from 1968 to 1972 occupied only 10 acres.

Nest densities vary widely across nesting substrates. DeHaven et al. (1975a) observed densities up to 66,670 nests per acres (100,000 breeding adults per acre) in Himalayan blackberry colonies, with the average density in blackberry colonies closer to 16,000 nests per acre. Densities in other common nesting substrates (cattails, bulrush, thistle, and willows) had densities of up to 13,340–20,000 nests per acres (20,000–30,000 breeding adults per acre), with average densities ranging from 3,300 to 4,800 nests per acre (DeHaven et al. 1975a).

Water

Breeding Tricolored Blackbirds require an open, accessible water source in the vicinity of the breeding location. Adults use the water for drinking and bathing, and will sometimes submerge insect prey items before provisioning young. The requirement for open water can be met by any of a number of sources, including wetlands, streams, ponds, reservoirs, and agricultural canals or ditches. Water must be available within a few hundred meters of the nesting substrate (Hamilton 1995). The loss of local water sources during the nesting cycle has caused entire colonies to abandon their nests (Beedy et al. 1991).

Foraging Habitat

The Tricolored Blackbird breeds in dense colonies with the individual territories that are defended by each male consisting of a very small area. These dense congregations of large numbers of birds exert large pressures on the foraging landscape surrounding the nesting location. Unlike most other landbirds,

Tricolored Blackbirds forage almost exclusively away from the nesting territory, and colonies require suitable foraging habitat with abundant insect prey within a few miles of the colony site. Because provisioning success and the resulting rate of nestling starvation have been shown to influence reproductive success, the availability of high quality foraging habitat is as important to Tricolored Blackbird breeding as is the availability of suitable nesting substrate (Hamilton et al. 1992). The proximity to highly abundant insect food supplies may be a factor in the selection of breeding sites by Tricolored Blackbirds (Neff 1937, Orians 1961, Payne 1969), and their nomadic and colonial behavior may have evolved as a strategy for maximizing the ability to locate and exploit unpredictable and temporarily abundant insect food sources. The required foraging habitat for successful breeding has a much greater spatial extent than nesting substrate. Although data are not available to define the minimum extent of foraging habitat, it has been reported that colonies with less than 200–300 acres of foraging habitat do not persist and access to several thousand acres is necessary to maintain most large colonies (Hamilton 2004b).

Primary foraging habitats during the breeding season include grasslands, shrublands, pastures, dry seasonal pools, and certain agricultural crops including alfalfa and rice, which provide for high production of insect prey for breeding Tricolored Blackbirds. Grasslands and alfalfa have been shown to be important in predicting presence of breeding Tricolored Blackbird colonies, with probability of colony occurrence increasing with increasing proportion of these land cover types within 3 miles (NAS 2017). Adults will also sometimes exhibit aerial foraging above wetland colonies when aquatic insects are hatching (Beedy et al. 2017). Adult birds also frequently feed at cattle feedlots and dairies where they have access to abundant grain sources. Among grassland foraging habitats, Hamilton et al. (1995) reported that ungrazed grasslands were preferred over heavily grazed grasslands by foraging Tricolored Blackbirds, but this conclusion has not been reported in later studies of grassland foraging birds (Meese 2013, Airola et al. 2015a, 2016). Tricolored Blackbirds breeding in agricultural landscapes make little use of most row crops, vineyards, or orchards (Hamilton et al. 1992). During the 2000 statewide survey, Hamilton (2000) found that over 90% of observed Tricolored Blackbird foraging activity occurred on private property.

Commented [RRC7]: I think it's important to discuss the extensive use of alfalfa fields used by dairy colonies.

In Sacramento County, Hamilton et al. (1992) reported that 96% of all foraging by breeding Tricolored Blackbirds occurred in grasslands. This reliance on grasslands by Sacramento County and foothill breeding birds has persisted. In 2014, 90% of birds breeding in the central Sierra Nevada foothills, including Sacramento County, foraged in grasslands and pasture (Airola et al. 2015a).

Mailliard (1900) described the distinctive flight of Tricolored Blackbirds in the process of feeding nestlings as a "stream composed of birds going toward the tules with their bills full of bugs and of equal numbers returning to the fields for fresh supplies." Both prey abundance and proximity to the colony site likely influence the reproductive success of a colony. In at least some cases, adults foraging near the colony site bring few prey items to their young, while adults foraging more distant return with many more prey items (Orians 1980, *cited in* Skutch 1996). This may be a mechanism to conserve energy by making fewer long-distance flights and shows the value of foraging habitats in close proximity to colony sites; however, the possibility that proximate food sources had been exhausted during observations cannot be ruled out. When abundant insect prey are available adjacent to colony locations, adults will

Commented [RRC8]: Shorter foraging distances also reduce the mount of time that eggs and young are exposed to predators and the elements. A colony in the provisioning stage on the San Jacinto Wildlife Area failed in 2016 during a period of daytime temperatures over 100. Birds were traveling over 3 km just to feed themselves at a dairy. WRC-MSHCP 2017

make only very short foraging flights to acquire prey. Most foraging occurs within about 3 miles of the colony location, although Hamilton et al. (1992) reported maximum foraging flight distances by breeding birds of up to 8 miles. In the Central Valley from 2006 to 2011, Meese (2013) observed adult Tricolored Blackbirds foraging up to 5.6 miles from the colony location.

Several authors have suggested that regional insect abundance plays a role in breeding colony site selection, and that a super-abundant insect population may stimulate nesting behavior (Lack 1954, Orians 1961b, Orians and Collier 1963, Collier 1968, Payne 1969). This could explain the variation in general distribution of colonies between years (DeHaven et al. 1975b). The highly synchronized and colonial breeding system may have adapted to exploit an unpredictable environment where locations of nesting substrate and abundant insect food resources changed unpredictably from year to year (Orians and Collier 1963). Although Meese (2013) demonstrated that colony reproductive success depends on local availability of insect prey (usually within 3-5 miles of the nesting location), the role that insect abundance in foraging habitats has on colony site selection has not been investigated.

Diet and Food Habits

For most of the year, the majority of food items taken by Tricolored Blackbirds consist of plant material, especially seeds. However, during the breeding season, adult females require large amounts of high-protein insect prey for egg production and nestlings require a protein-rich diet for growth and development (Crase and DeHaven 1977). Nestlings are fed almost exclusively animal matter for the first nine days after hatching, at which point parents begin to introduce plant matter into the diet (Hamilton et al. 1995). Colonies consisting of many thousands of adult birds and growing nestlings require an immense amount of insect prey during short windows of time. The availability of insect prey in the foraging landscape likely influences the establishment of breeding colonies, and an abundant prey base is essential for successful breeding.

Nestlings have been provisioned with a wide variety of prey items, including grasshoppers and crickets (order Orthoptera), beetles, weevils, and water beetle larvae (order Coleoptera), moths and butterflies (including caterpillars; order Lepidoptera), and to a lesser degree spiders, flies, tadpoles, snails, and emergent dragonflies, damselflies, and midges (Payne 1969, Crase and DeHaven 1977, Skorupa et al. 1980). At three breeding colonies in Merced County where adults often foraged for prey in alfalfa and grain fields, animal matter made up 91% of food volume for nestlings and fledglings, with moth larvae, beetles, and weevils the primary food items (Skorupa et al. 1980). In foothill grasslands, grasshoppers have often been the primary prey item fed to nestlings (Payne 1969, Airola et al. 2015a). In a diet study that included colonies from several regions of the Central Valley located among a variety of foraging substrates, animal matter made up more than 86% of the total volume of nestling food (Crase and DeHaven 1977). Ground beetles were the predominant food item when averaging across all colonies, followed by water beetle larvae, grasshoppers and crickets, and weevils. Colonies differed significantly in the primary food items provided to nestlings, with differences in foraging substrate responsible in some cases. For example, colonies with water beetle larvae as the predominant food source were located in rice-growing areas, and the greatest percent of grasshoppers were fed to nestlings at colonies bordered by grassland (Crase and DeHaven 1977).

Early observers noted that nestling and fledgling Tricolored Blackbirds were frequently fed grasshoppers, leading to descriptions of the species as a grasshopper-follower (Belding 1890, Bendire 1895, Mailliard 1914, Orians 1961). Payne (1969) observed breeding adult Tricolored Blackbirds at colonies in the Sacramento Valley foraging primarily in grasslands and providing nestlings with a diet composed of 47% grasshoppers; crickets, beetles, and spiders were also acquired in grasslands and fed to young in smaller amounts. Payne (1969) suggested that the movements of Tricolored Blackbirds during the breeding season paralleled the nomadic movements of rangeland grasshoppers in California and compared the Tricolored Blackbird with "locust bird" species of Asia and Africa. Grasshoppers continue to provide a valuable food source to Tricolored Blackbird colonies, especially when adjacent to grasslands and pastures (Airola 2015a), but Tricolored Blackbirds have been shown to be more flexible in breeding season diet, as long as an abundant insect source is available.

In the spring and summer, the proportion of animal material consumed by adult Tricolored Blackbirds in the rice-growing region of the Sacramento Valley was 28% and 39%, respectively, with primary prey items including ground beetles, water beetle larvae, and orthopterans (Crase and DeHaven 1978). At four breeding colonies in agricultural areas of Merced County, animal matter made up 56% of food volume for adult females and 28% for adult males (Skorupa et al. 1980). The most consumed animal foods were beetles and weevils, moth larvae, and flies; the predominant plant foods consisted of oats (*Avena* sp.) and filaree (*Erodium* sp.), and to a lesser degree chickweed (*Stellaria* sp.) and pigweed (*Amaranthus* sp.). In the nonbreeding season, Tricolored Blackbirds are more strictly granivorous, although a variety of plant and animal matter is taken opportunistically. One study in the rice-growing region of the Sacramento Valley revealed that about 90% of the fall and winter diet consisted of plant material, primarily seeds of rice, other grains, and weed seeds (Crase and DeHaven 1978).

Reproduction and Survival

Breeding typically extends from mid-March through early August (Beedy et al. 2017). Autumnal breeding has been observed in the Central Valley (September–November; Orians 1960, Payne 1969) and in Marin County (July–September; Stallcup 2004), although not since 1964 and 2003 in the Central Valley and Marin County, respectively. From initiation of nest building to independence of fledged young, the nesting cycle of the Tricolored Blackbird is about 10 days shorter than that of the Red-winged Blackbird, mostly due to rapid progression through the nest building and egg laying stages (Payne 1969). The condensed length of the nesting cycle may be a function of the synchronized colonial nesting and an adaptation to take advantage of unpredictable periods of abundant and temporary insect food sources (Payne 1969, Skutch 1996).

Nest building and incubation are performed exclusively by the female, but the male takes an active role in feeding the young (Lack and Emlen 1939, Orians 1960). Although female Tricolored Blackbirds breed in their first year, most males may defer breeding until they are at least two years old (Payne 1969). This contributes to a skewed sex ratio at many breeding colonies, with each male breeding on average with two females (Lack and Emlen 1939, Orians 1961, Payne 1969). Although colonies with even sex ratios or with more skewed sex ratios (each male breeding with more than two females) have been observed

(Hamilton et al. 1995), for monitoring purposes it is often assumed that each nest in a colony represents 1.5 breeding birds.

Successful breeding (i.e., production of any fledglings) was found to be positively correlated with colony size by Payne (1969); all colonies (n=7) that produced no fledglings contained 200 or fewer nests, while only one of seven successful colonies was smaller than 400 nests. Hamilton (1993) observed that the largest colonies in a single year of observation produced the highest estimates of reproductive success. Meese (2013) demonstrated a weak positive correlation between reproductive success and colony size over a six-year period ($r = 0.53$, $r^2 = 0.28$).

Reproductive success, defined here as the number of young fledged per nest, has been the generally accepted method for estimating productivity of Tricolored Blackbird colonies (Hamilton et al. 1995, Meese 2013, Holyoak et al. 2014, Airola et al. 2015a). Reproductive success has been estimated in one of two ways: visual estimation of the number of fledglings or nest sampling via walking transects through active colonies. When estimating reproductive success by visual counts of fledglings, colonies are visited at several-day intervals (often four days but in practice this has been variable), and fledglings observed at each visit are assumed to represent unique birds. The total number of fledglings observed on all site visits and the estimated number of nests based on the number of breeding birds are used to estimate the number of fledglings produced per nest. When estimating reproductive success by nest transects, it has been common practice to count the number of young per nest during the portion of the nest cycle when nestlings are 7–9 days old (Hamilton et al. 1995, Meese 2013). Entering colonies when nestlings are less than seven days old inflates the reproductive success estimate by underestimating nestling mortality and entering colonies when greater than 9 days of age causes the nestlings to jump from the nests prematurely. As a result, reproductive success estimates obtained by the transect method represent the maximum number of young fledged per nest. Therefore, the two methods of estimating reproductive success measure two somewhat different indices of productivity.

In 1992, reproductive success was relatively high at three colonies on wetlands and agricultural crops in the San Joaquin Valley (average RS = 2.7) and at Himalayan blackberry colonies in Sacramento County (average RS = 2.2) (Hamilton et al. 1992). Average reproductive success on wetlands in the Sacramento Valley was lower that year at 0.6 young per nest. Similar values of reproductive success were observed in 1994 (Hamilton et al. 1995). In 2000, reproductive success improved in the Sacramento Valley with three large colonies that did not experience heavy predation averaging 1.4 young per nest (Hamilton 2000), although the average reproductive success across all locations and substrate types was lower at 0.9 in 2000.

Many Tricolored Blackbird colonies in the Central Valley exhibited relatively low reproductive success from 2006 to 2011. Meese (2013) estimated reproductive success at 47 colonies, representing most of the largest colonies each year, during this six-year period ranging in size from 800 to 138,000 breeding birds. About half of the monitored colonies were in wetlands (n = 23), with the rest in thistle (n = 11), triticale (n = 9), and Himalayan blackberry (n = 4). The average reproductive success across all sites and years was 0.62. Reproductive success did not vary significantly across substrate type, although colonies that were destroyed by harvest of the grain nesting substrate were not included in the study results.

Low productivity during this time resulted in very few young Tricolored Blackbirds being produced in the southern San Joaquin Valley where a large portion of the population's first annual breeding attempts occur (Figure 6). Incidental observations in 2012 and 2013 suggested that the trend of low reproductive success continued. Meese (2013) linked reproductive success at Central Valley colonies to relative abundance of insect prey at foraging sites, suggesting that many Tricolored Blackbird colonies may have been food-limited. High levels of predation plus destruction of colonies to harvest during this time also contributed to the low overall production of fledglings (Meese 2011, 2012).

Although limited research has been conducted to estimate reproductive success at colonies since 2011, observations of large numbers of fledglings at multiple colonies suggest that the species has had at least some success in recent years. In 2015, the estimated reproductive success at five colonies on agricultural grain fields averaged 0.6–1.9 fledglings produced per nest (Aug 2015 presentation from NRCS to Tricolored Blackbird Working Group; unreferenced). In 2016, eight of nine known colonies on agricultural grain fields fledged at least some young, although efforts to estimate reproductive success were limited. Only one colony in silage was both accessible and uniform in nest density to allow for nest transects and resulted in an estimated reproductive success of 0.44 (Frazer 2016). At four colonies in Himalayan blackberry, cattail, and milk thistle that ranged in size from 5,000 to 12,000 birds, reproductive success estimates ranged from 0.4 to 0.67 (Meese 2016). In 2017, all known silage colonies at seven locations fledged at least some young. Some of these experienced very low reproductive success, but at least two had high success and produced several thousand fledglings. Several additional colonies in other nesting substrates were reported to have high (although unquantified) reproductive success in 2017, with four wetland colonies in the San Joaquin and Sacramento valleys producing at least several thousand young (Colibri 2017, Meese 2017). As in other years, many other colonies were observed to have low success. These limited quantitative estimates and additional qualitative assessments are difficult to compare directly to previous work due to the high variability in reproductive success across colonies and the inconsistent methods used to evaluate reproductive success.

Parents reduce the size of broods at many colonies after the hatching of eggs (Hamilton et al. 1995). Often the majority of eggs in a clutch (usually three or four) will hatch but each nest typically fledges a reduced number of young, either due to parents not feeding all nestlings which leads to starvation, or by the active removal of nestlings from the nest by parents (Payne 1969, Hamilton et al. 1995). This is likely because of a shortage of food supplies. When abundant food is available each nest produces more fledglings (Meese 2013), and as many as four young are raised per nest at productive colonies (Hamilton et al. 1995).

In many years, overall reproductive success at many or most colonies has been relatively low, but estimates have also been highly variable across colonies. Of 21 colonies observed by Payne (1969) from nest building through termination of the breeding effort, including both successful and unsuccessful colonies, only about 40% of nests produced fledglings. High rates of reproductive success at a few large colonies can produce large numbers of fledglings. For example, three colonies representing 50,000 nests accounted for the production of an estimated 100,000 fledglings in 1993, while many smaller colonies produced no or few fledglings in the same year (Hamilton 1993). Meese (2013) observed high variability in reproductive success in both triticale and milk thistle colonies from 2006 to 2011 (range 0.01–1.44).

The relatively high reproductive success at a small number of colonies was demonstrated to be a function of a high insect abundance in nearby foraging areas (Meese 2013). Low reproductive success has been implicated in Tricolored Blackbird population declines over the last two decades (Cook and Toft 2005, Meese 2013). Occasional high rates of reproductive success at a few large colonies may be a successful strategy for long-term population viability, but the degree to which infrequent bouts of high success can compensate for the low reproductive success that may be persistent and widespread across most colonies is unknown.

Reproductive output has been observed to vary across substrate types (Hamilton et al. 1992, Hamilton 2000, Holyoak et al. 2014). Holyoak et al. (2014) modeled occupancy rates in the most common nesting habitat types in recent years (2006–2011) and considered data on abundance, reproductive success, and frequency of use for each nesting habitat type to determine the net reproductive output of different nesting habitats over time. Occupancy rates and other factors that influence reproductive output varied across habitat types, resulting in variation in the importance of habitats to Tricolored Blackbird productivity. Four nesting habitat types had sufficient sample size to make strong conclusions about average reproductive output, including Himalayan blackberry, nettles, wetlands, and grain fields. Himalayan blackberry and nettle colonies exhibited higher than average reproductive output. High overall reproductive output for nettle colonies is a little unexpected given that there are very few colonies, which are of average size, in this nesting substrate. However, high rates of occupancy and reproductive success result in high overall reproductive output for nettle colonies. Himalayan blackberry colonies exhibit average occupancy rates and size, but high reproductive success and the large number of colonies in this nesting substrate (the second most frequent colony type after wetlands) lead to high overall reproductive output. Grain field colonies exhibit average overall reproductive output, despite having low occupancy rates, low reproductive success, and a small number of colonies on grain fields each year; the very large size of grain field colonies increases the overall reproductive output. Of the four nesting habitat types assessed, wetlands remain the most common nesting habitat used by breeding Tricolored Blackbird colonies in recent years. Despite this, average levels of occupancy, reproductive success, and size of marsh colonies have led to the lowest overall contribution to reproductive output among the four nesting habitat types.

Between 1992 and 2003, estimated reproductive success was significantly higher in nonnative Himalayan blackberry (RS = 2.0) than in native emergent cattail and bulrush marshes (RS = 0.5; Cook and Toft 2005). Excluding colonies that were lost to harvest, colonies on silage grain fields had an intermediate reproductive success (RS = 1.0). Meese (2013) did not observe this pattern from 2006 to 2011, when overall reproductive success was much lower and differences in reproductive success between substrates were not significant (unharvested triticale RS = 0.73; Himalayan blackberry RS = 0.44; wetland RS = 0.31), although only four Himalayan blackberry colonies were included in the sampled colonies. In 2014, Airola et al. (2015a) estimated the average reproductive success at four Himalayan blackberry colonies in Sacramento County as 0.84 fledglings per nest. Although the methods used were slightly different, this estimate is within the range of reproductive success estimates observed in all nesting substrate types by Meese (2013) during six years of low reproductive success

(average RS = 0.62; range 0.01–1.44), but the range of values observed by Airola et al. was much narrower (0.66–0.90).

After fledging, Tricolored Blackbirds often leave the vicinity of the nest and congregate in groups of young birds from many different nests. These fledgling groups will often congregate near the edge of the nesting substrate nearest the foraging grounds being used by the adults, where they are fed when adults return to the colony site (Payne 1969). A group of fledgling Tricolored Blackbirds has been referred to as a crèche (Hamilton 1998, Beedy et al. 2017). The formation of crèches generally occurs among birds that breed in large colonies and whose eggs all hatch at about the same time (examples of other crèche-forming species include terns and penguins). Supervision of unrelated offspring by a small number of adult guardians is usually considered a characteristic of crèches, although it is unclear whether this is the case in Tricolored Blackbirds. A single large colony of Tricolored Blackbirds can produce many crèches, and a single crèche may include several thousand fledglings. Crèches can persist for up to one to two weeks, and have been observed as far as three miles from a colony site (Payne 1969, Hamilton et al. 1995).

There are no published studies on the annual survival rate of Tricolored Blackbirds, but banding studies have shown that individuals can live up to 13 years (Neff 1942, DeHaven and Neff 1973). Meese (2014b) used recapture data to estimate the average annual adult survivorship of Tricolored Blackbirds as 60%. Estimates of annual survival rates for other temperate blackbirds have ranged from 42% to 60%, with rates for the closely-related Red-winged Blackbird ranging from 42% to 54% (Fankhauser 1971, Searcy and Yasukawa 1981).

Commented [RRC9]: Nero (1984) estimates 60% for red-wings.

[Note to reviewers: Results of recent analyses of banding data by Cornell University provide revised estimates of apparent annual survival that differ from that reported here (adult female survival rate ~0.5-0.9, depending on year). Results have not been finalized and will be incorporated after further discussion with Cornell to verify preliminary results.]

STATUS AND TRENDS IN CALIFORNIA

Range

Nuttall (1840) observed the Tricolored Blackbird along the coast of California in the 1830s and, without offering any supporting evidence, suggested that the Tricolored Blackbird range extended into Oregon and Mexico. In the mid-1800s, Cooper (1870) reported the species to be common on the southern California coast from Santa Barbara to San Diego, with the range to the north passing “more into the interior, extending up as far as Klamath Lake and southern Oregon.” Bendire (1895) reported the range as “[s]outhwestern Oregon, south through California, west of the Sierra Nevada, to northern Lower [Baja] California.” Bendire knew of no reports of the species north of Klamath Lake in southwestern Oregon, and thought it to be uncommon there. The range of the species was confirmed to include northern Baja California in the late 1800s, with A. W. Anthony reporting them “[r]ather common along the northwest coast, breeding in all fresh-water marshes” (Bendire 1895).

Following a period of years with no reported sightings of Tricolored Blackbird in Oregon, Neff (1933) reported a number of observations of the species from 1931 to 1933, all within 30 miles of Klamath Falls, and consisting collectively of fewer than 60 birds. Richardson (1961) reported up to several hundred Tricolored Blackbirds near Medford, Oregon in 1957 and documented breeding colonies of 1,500 and 1,800 birds in the region in 1958 and 1960, respectively. Inconsistent observations during the 1800s and early 1900s at the northern extent of the species range may represent shifts in distribution over time or are perhaps the result of limited survey coverage. The species has continued to breed in small numbers in the vicinity of Klamath Falls to the present time, and small numbers of birds continue to occur near Medford during the breeding season. Small breeding colonies (30 or fewer birds) were observed in three northern Oregon counties (Multnomah, Umatilla, and Wheeler) in the 1980s (Beedy et al. 1991). Since the 1990s, several hundreds of birds have occurred regularly in central Oregon near the town of Prineville in Crook County, and breeding has been confirmed in the area. In recent decades, the species has been documented in several other isolated locations in western Oregon and eastern Washington, almost always in very low numbers but occasionally numbering in the hundreds of birds (Gilligan et al. 1994, Spencer 2003, eBird Dataset 2016). The degree to which these records represent recent range expansion to isolated areas, irregular use of the region, or increased survey coverage is unclear, but it appears that small numbers of birds may have recently expanded the species' range to at least some isolated areas in the north (Gilligan et al. 1994, Wahl et al. 2005).

Ammon and Woods (2008) describe the recent discovery and status of breeding Tricolored Blackbirds at a single location in western Nevada, and report that there was no confirmed breeding in Nevada prior to 1996. However, Wheelock (1904) described the distribution of the species in the early 1900s, and reported that in the vicinity of Lake Tahoe, "these birds stray across the crest, but not in the numbers in which they are found westward." The species was also reported to have bred at Lake Tahoe in the early 1900s (Dawson 1923) and Hosea (1986) reported a breeding colony in Carson City, Nevada in 1980.

In the early 1900s, the Tricolored Blackbird occurred in northwestern Baja California south to about the 30th parallel north (Grinnell 1928). This is consistent with recent breeding records from the southern extreme of the species range near El Rosario (Erickson et al. 2007, Feenstra 2013).

The above historic accounts from the periphery of the range are largely consistent with the current range of the species, and overall, the range of the Tricolored Blackbird has changed little since at least the mid-1930s (Beedy et al. 2017). However, the species appears to be experiencing a range retraction in the southern California portion of the range and in Baja California, as discussed below.

Distribution

There are no descriptions of the distribution of the Tricolored Blackbird before the widespread conversion of native habitats across much of its range in California. However, accounts by early naturalists in California provide several records of the Tricolored Blackbird in the 1800s and early 1900s that document the local abundance, and to some extent, the distribution of the species prior to any systematic study of the species across its range.

The early anecdotal reports from the 1800s and early 1900s, although typically not quantitative, informed the historical distribution of birds and demonstrated the occurrence of large numbers regionally. Most early observations of large numbers of birds were from the Central Valley and southern California, and only small numbers of birds have occurred north of the Central Valley, both historically and in recent years. Therefore, this report discusses changes in distribution for the Central Valley and for southern California, which have supported the majority of the population and for which adequate information is available to assess long-term changes in distribution.

Central Valley

In 1852, Heermann reported frequent encounters with winter flocks of Tricolored Blackbirds in the Suisun Valley that numbered "so many thousands as to darken the sky for some distance by their masses" (Baird et al. 1874). The Tricolored Blackbird was known to be an abundant breeder in the interior valleys of California in the late 1800s (Bendire 1895). Belding (1890) observed "an immense colony" near Stockton in 1879. Ray (1906) noted the species breeding at various points on an automobile trip down the San Joaquin Valley from Stockton to Porterville in 1905. Linton (1908) observed a breeding colony at Buena Vista Lake at the southern edge of the Central Valley in 1907. Lamb and Howell (1913) reported seeing "hordes" of Tricolored Blackbirds at Buena Vista Lake in 1912. Dawson (1923) reported the species as "locally abundant in the Great Interior [Central] Valley."

Neff (1937) was the first to attempt to document the rangewide status and distribution of Tricolored Blackbirds. Over a six-year period from 1931 to 1936, Neff located breeding colonies throughout the Central Valley and at a few additional locations in California and southern Oregon; however, Neff's surveys focused on the Sacramento Valley in most years. Based on his somewhat geographically limited efforts, Neff (1937) reported nesting birds in 26 California counties over the six-year study. During this period, the rice-growing areas of the Sacramento Valley appear to have been the heart of the Tricolored Blackbird's distribution, although it is not clear whether this was due to survey efforts being focused there and the limited effort applied further south in the San Joaquin Valley.

Bent (1958) reported that the center of abundance for the species seemed to be in the San Joaquin Valley. Orians and Christman (1968) reported that the largest colonies occurred in the rice-growing districts of the Central Valley (mainly the Sacramento Valley and northern San Joaquin Valley). Neither of these reports were based on systematic surveys of the valley and have limited utility in documenting species distribution, other than that the majority of the population continued to occur in the Central Valley.

The distribution of colonies encountered over a five-year period by DeHaven et al. (1975a) was similar to that observed 35 years earlier by Neff (1937). DeHaven et al. (1975a) reported that 78% of colonies located between 1968 and 1972 were in the Central Valley. Most colonies and breeding birds were found in the Sacramento and northern San Joaquin Valleys, including Butte, Colusa, Glenn, Yolo, Sacramento, Merced, and Stanislaus counties. In the 1980s, the largest colonies and the majority of the known population continued to breed in the Sacramento and northern San Joaquin valleys (Hosea 1986, Beedy et al. 1991).

An apparent early nesting season shift in distribution from the Sacramento Valley to the southern San Joaquin Valley occurred at the end of the 20th century. Although breeding had been documented in the San Joaquin Valley since the 1800s, this region had not been the focus of intense monitoring efforts prior to the 1990s. DeHaven et al. (1975a) reported that areas with suitable nesting substrates were scarce in the arid southern San Joaquin Valley in the 1970s. As described above, loss of native wetland breeding habitat had resulted in a shift to novel nonnative vegetation types beginning by the 1970s, and the distribution shift away from the Sacramento Valley is presumably in part due to these changes in nesting substrate availability. In the early 1990s, Tricolored Blackbirds were discovered breeding in grain fields in the San Joaquin Valley (Hamilton et al. 1992, Hamilton 1993). This discovery corresponded to an increase in the number of dairies and the associated expansion of triticale in the San Joaquin Valley as dairies began growing this new crop for silage. By 1994, most of the largest colonies and 40% of known breeding birds in the early part of the breeding season were found in the southern San Joaquin Valley associated with dairies and cattle feedlots (Hamilton et al. 1995). Relatively little triticale had been planted for silage in the San Joaquin Valley by 1994, but by 2005 the planted acreage had grown to about 75,000 acres (Aksland and Wright 2005).

The shift in distribution to the San Joaquin Valley during the early breeding season has persisted, with very large proportions of the population nesting in a few large "mega-colonies" adjacent to dairies in the San Joaquin Valley (Kelsey 2008). In 1994, 68% of the estimated population in the early nesting season occurred in the San Joaquin Valley; this increased to 86% and 89% by 2008 and 2011, respectively (Hamilton et al. 1995, Kelsey 2008, Kyle and Kelsey 2011). In 2011, the 10 largest colonies were in the San Joaquin Valley during the early season survey (Kyle and Kelsey 2011). Breeding sites on triticale and other silage crops are also generally near other important habitat features, including irrigated pasture, grassland, or alfalfa crops for foraging, and available open water. The degree to which the apparent shift from the Sacramento Valley to the southern San Joaquin Valley is due to the loss of nesting habitat, the availability of a novel nesting substrate, or an increase in survey effort in the San Joaquin Valley is unknown (DeHaven 2000). Nevertheless, there has been a consistent use of the region by a majority of the Tricolored Blackbird population since the mid-1990s (Figure 7). The proportion of the population breeding in the San Joaquin Valley during the early part of the breeding season dropped to about 52% in 2014. This drop was in part due to increases in the number of birds in the Sacramento Valley, including the Sierra Nevada foothills, and southern California, but was primarily the result of a large rangewide decline, with most of the decline in number of birds occurring in the San Joaquin Valley (see the Regional Shifts in Abundance section). In 2017, the proportion of birds nesting in the San Joaquin Valley in the early breeding season returned to almost 70% (Meese 2017).

Commented [RRC10]: Not really adjacent to dairies. They were on dairies if you consider the whole farm to be a dairy rather than just the feedlot. Please clarify because this is confusing.

Commented [RRC11]: And foraging habitat – alfalfa.

Commented [RRC12]: I think the SoCal increase you are referring to is the 4500 birds that year at Holiday Lake. Was this enough to make a significant dent in the SJV population?

The grasslands and pastures of southeastern Sacramento County have seen consistent use by breeding Tricolored Blackbirds for at least the last 80 years (Neff 1937, DeHaven et al. 1975a, Hosea 1986, Beedy et al. 1991, Cook and Toft 2005, Airola et al. 2016), even as the dominant nesting substrate in the region has shifted from native wetlands to Himalayan blackberry (see Nesting Substrate section). DeHaven et al. (1975a) described the pasturelands of southern Sacramento County as the most consistently used area during a five-year study. Until recently, little emphasis has been placed on monitoring Tricolored Blackbird colonies in the Sierra Nevada foothills and grasslands/pasturelands of the eastern Central

Valley relative to population centers in the Central Valley and in southern California. Observations of colonies from this region during statewide surveys have usually been lumped with the Central Valley for reporting purposes. Starting in 2014, these grasslands in the low elevation foothills have received focused monitoring as a distinct breeding area (Airola et al. 2015a, 2015b, 2016), with regular use reported for not only Sacramento County, but also from Butte County in the north to Stanislaus County in the south. In 2016, precipitation patterns supported growth of milk thistle patches across extensive areas in the foothills further south as far as Fresno County, resulting in breeding by more than 22,000 birds that had not been observed in the region in the two previous years (Airola et al. 2016). When milk thistle is available for nesting by Tricolored Blackbirds, this nonnative plant may extent the distribution of the species into the southern Sierra Nevada foothills.

Although shifts may have occurred within the Central Valley and some areas of the valley that once supported large numbers of birds now support few or no breeding colonies, while other areas appear to have become much more important, the Central Valley and surrounding foothills as a whole have supported the majority of the Tricolored Blackbird population both historically and in recent years. Additional information on use of the Central Valley is presented in the Regional Shifts in Abundance section.

Commented [RRC13]: May not be due so much to shifts as population decline.

Commented [RRC14]: Not sure that they have become more important. The Sierra foothills region was, as you stated above, under-surveyed in the earlier years.

Southern California and Baja California

The first Tricolored Blackbird specimen was collected by Nuttall near Santa Barbara in 1836 (Baird et al. 1874, Bent 1958). Although he did not observe breeding colonies, Nuttall reported that the Tricolored Blackbird was very common around Santa Barbara and Monterey in the month of April (Nuttall 1840). In the mid-1800s, Cooper (1870) found the Tricolored Blackbird to be the most abundant species near San Diego and Los Angeles, and they were not rare near Santa Barbara. In the late 1800s, the species was described as an abundant winter resident in Los Angeles and Orange counties, occurring in very large flocks, with several colonies known to breed in tule marshes up to 1,500 feet in elevation (Bendire 1895). Grinnell (1898) reported the species to occur in “considerable numbers” throughout the lowlands of the Pacific slope of Los Angeles County, and Willett (1912) considered the species a common resident throughout the lowlands of coastal southern California. Dawson (1923) reported the species as “locally abundant…in the San Diegan district.”

There is evidence that the Tricolored Blackbird had experienced declines in a large portion of its range in southern California, even by the 1930s. In a revision of his former description of the species’ status in coastal southern California, Willett (1933) described the species as a “formerly common resident…Now rare throughout former range in southern California, excepting in some sections of San Diego County.” Grinnell and Miller (1944) described the status of the Tricolored Blackbird as “common to abundant locally” but noted a general decrease in southern California.

In 1980, the Tricolored Blackbird was characterized as a fairly common resident in the southern California coastal district that bred locally in all coastal counties (Garrett and Dunn 1981). The species no longer occurs at many historical sites in coastal southern California. Small numbers of breeding birds were documented at a few locations in coastal Santa Barbara County through the 1970s, with the last

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known colony of 200 birds in 1979 (Lehman 1994, Tricolored Blackbird Portal 2017). The last known colony in Ventura County, of 53 birds, occurred in 1994. About 200 birds persisted as breeders in the portion of Los Angeles County south of the Transverse Ranges through the 1990s, with the last known breeding attempt in 1999 (Allen et al. 2016, Tricolored Blackbird Portal 2017). Several hundred breeding birds occupied multiple sites in Orange County through the 1990s, but only a single colony of 14 birds has been observed breeding in the county in two years since 2000. The highly urbanized coastal portion of San Diego County, which supported thousands of breeding birds through at least the 1970s, has supported less than a thousand breeding birds at only three locations since 2000 (Tricolored Blackbird Portal 2017). Very few Tricolored Blackbirds now breed in the coastal lowlands of southern California where they were once abundant (Garrett et al. 2012).

Approximatel 60-80% of the southern California population (south of the Transverse Ranges) nests in most years, in the San Jacinto Valley of western Riverside County (Cook 2010). This area supports the State of California's San Jacinto Wildlife Area and one of the last remaining agricultural communities in southern California. The numerous dairies in the valley along with the wetlands and grasslands of the Wildlife area constitute the last stronghold for breeding Tricolored Blackbirds in southern California. Currently, nearly all farmland in the valley is slated for large scale residential and commercial development.

The status of the Tricolored Blackbird population in Baja California has followed a similar pattern to that for southern California. In the late 1800s, the species was described as "rather common along the northwest coast [of Baja California], breeding in all fresh water marshes" (Bryant 1889). Grinnell (1928) described the species as a "Fairly common resident locally in the northwestern section of the territory, north from about 30 degrees." In the 1980s, the species was described as a "local resident in northwestern Baja California south to El Rosario" (Wilbur 1987). A search of the entire Baja California range turned up a single breeding colony of 80 birds in 2007 (Erickson et al. 2007) and four breeding colonies totaling 240 birds in 2008 (Erickson and de la Cueva 2008). A follow-up survey several years later located three breeding colonies supporting an estimated 240–340 birds (Feenstra 2013). In recent years, most breeding in Baja California has occurred in the north within about 70 miles of the U.S. border. Breeding continued at a disjunct area at the historical southern extent of the species' range (about 100 miles farther south than the next nearest breeding location) near El Rosario through at least 2013 (Erickson and de la Cueva 2008, Feenstra 2013). By 2016 all known breeding colonies occurred within about 12 miles of the U.S. border (Erickson et al. 2016). In 2017, the only known breeding colonies occurred within five miles of the U.S. border and eight nonbreeding Tricolored Blackbirds were observed at a historic breeding site about 70 miles south of the U.S. border. No birds were observed south of this point, leaving the southernmost 100 miles of the species range in Baja California apparently unoccupied (April 2017 email from R. Erickson to N. Clipperton; unreferenced).

Where previously abundant and widespread south of the Transverse Ranges, the distribution of breeding colonies is now mostly restricted to inland sites in western Riverside and San Bernardino counties, and in the interior of San Diego County (Feenstra 2009). This represents a long-term decline in southern California, with remnant colonies disappearing in recent decades throughout much of the southern range (Figure 8). This may represent a permanent breeding range retraction from portions of the range where the species was previously abundant, and is likely the result of ongoing urban development and declines in population numbers. The small numbers of birds that have occasionally bred at the extreme southern limit of the species' range in Baja California, separated by 100 miles from the next most southern breeding colony locations in recent years, were not observed in 2017. The majority of the historical range in Baja California has been unoccupied in recent years (Erickson et al. 2016).

Allen et al. (2016) reported that nesting commenced late in the 20th century in the Mojave Desert portion of northern Los Angeles County, and attributed this to manmade reservoirs and other impoundments, but breeding by small numbers of birds was known for the area since at least the 1970s (DeHaven et al. 1975a, Beedy et al. 1991). The species was known to occur in the Mojave Desert since at least 1890, but breeding was not documented (Belding 1890). The region has not supported more than a few thousand breeding birds in any year.

Population Trend

Breeding Population

Assessments of the rangewide population abundance of the Tricolored Blackbird prior to the 1990s are limited to published literature describing research by a limited number of individuals in the 1930s (Neff 1937) and an additional rangewide assessment using similar methods in the 1970s (DeHaven et al. 1975a). An additional recent published study used all available breeding colony data collected over more than 100 years (1907–2009) to evaluate changes in average colony size (Graves et al. 2013). The most intensive efforts to estimate rangewide population abundance have occurred since 1994, with results presented in reports prepared by academic researchers, Audubon California biologists, and in reports prepared for the USFWS and the Department. These represent the best available information for assessing trends in the rangewide population over the last two decades.

Over a period of six years (1931–1936), Neff (1937) surveyed Tricolored Blackbird colonies across California. Neff located several breeding colonies of more than 100,000 nests in the Sacramento Valley, with the largest composed of greater than 200,000 nests (corresponding to approximately 300,000 adult Tricolored Blackbirds). Breeding colonies were located throughout the Central Valley and in a few additional locations in California and southern Oregon; however, Neff's surveys focused on the Sacramento Valley in most years. An effort to cover the entire known range of the species was attempted by Neff in only one year (1932). Most areas outside the Sacramento Valley were covered only incidentally as "cooperators drove up or down the State in the performance of routine duties," and in the regions of the state that were most thoroughly surveyed, it was impossible to make complete surveys of all possible locations (Neff 1937). Neff concluded that obtaining an estimate of the statewide population was not possible. Working alone in 1934, Neff observed an estimated 491,250 nests (about 737,000 breeding birds), almost all of which were in the Sacramento Valley. The presence of birds in the San Joaquin Valley and southern California was noted in the same year, but no effort was made to estimate numbers. Several authors have cited Neff (1937) in statements about the Tricolored Blackbird population in the 1930s, sometimes suggesting that the population numbered in the millions (e.g., Beedy et al. 1991, Hamilton et al. 1995, Kyle and Kelsey 2011). Neff himself did not attempt to extrapolate his results to a region-wide estimate, although the roughly 737,000 breeding birds observed in a single year is likely an underestimate of the population at the time.

No attempts were made to describe the Tricolored Blackbird distribution or abundance during the 1940s, 1950s, or 1960s. From 1969 to 1972, DeHaven et al. (1975a) attempted to survey the entire range of the Tricolored Blackbird to document the distribution of the species and to compare estimates of abundance to those provided by Neff (1937). The surveys were carried out by a few individuals surveying vast areas by road, and in most areas were limited to one or two drives through each county where Tricolored Blackbirds were known to occur in California and southern Oregon. Still, the search effort was at least as extensive as that carried out by Neff in the 1930s, and included the benefit of improved transportation and an increased number of roads. In many counties the survey consisted of driving county roads with little knowledge of historical colony sites, but this was an improvement over much of the effort of the 1930s, when counties were considered covered if visited incidental to other activities. Despite a greater search effort, all measures of abundance indicated a decline: the number of active colonies detected per year declined from 43 to 41; nonbreeding birds encountered declined from >50,000 in a single year to <15,000 over four years; maximum colony size declined from hundreds of thousands to tens of thousands of birds; and number of birds observed per year within the study period declined from about 375,000 per year to about 133,000 per year (DeHaven et al. 1975a). Although no population estimate was provided, the authors suggested that the Tricolored Blackbird population declined by more than 50% in 35 years. Like Neff three decades before, DeHaven et al. (1975a) were unable to thoroughly cover the entire range of the species, including large portions of the southern San Joaquin Valley.

Following more than a decade with no survey to assess the statewide population, Beedy et al. (1991) compiled all historical records of Tricolored Blackbird breeding colonies and conducted limited field surveys from 1986 to 1990 to evaluate long-term population trends. Bill Hamilton and others (Hamilton et al. 1992, Hamilton 1993) conducted ecological investigations in 1992 and 1993 that included documentation of colony locations and sizes, the discovery of large breeding colonies on grain fields in the San Joaquin Valley, and the initial observations that suggested Tricolored Blackbirds are itinerant breeders (Hamilton et al. 1995). Based on the increased understanding of the species' biology and distribution, a new approach to estimating the statewide population of Tricolored Blackbirds was proposed by Ted Beedy and Bill Hamilton (Hamilton 1998, Meese 2015a). The discovery of itinerant breeding with broad movements between nesting attempts made it clear that a survey of the statewide population should occur during a narrow window in order to maximize the likelihood of detecting nesting colonies and to avoid double-counting birds (Hamilton et al. 1995, Beedy and Hamilton 1997). A survey conducted in a minor portion of the range or carried out over a long time period would either miss breeding colonies or double count birds over multiple breeding attempts. An improved understanding of colony occupancy dynamics suggested a need for early season colony-detection efforts to locate active colonies (Hamilton et al. 1995), while also considering the compiled information on all historical breeding locations in order to visit as many potential breeding locations as possible.

The new approach to surveying the statewide population was first implemented during the 1994 breeding season. The survey was conducted on a single day in the early part of the season (April 23). The choice of a survey date is an effort to select a time period when most birds have initiated a first nesting attempt and can be detected and counted at breeding colony sites, but before the first breeding cycle is completed and birds have moved to the north (usually) for the second breeding attempt. The goals of the survey were to visit as many known breeding locations as possible, document occupancy status, and estimate colony size at all occupied locations. This was also the first survey to be largely volunteer-based and to enlist a large number of observers over a narrow time period. Compared to the surveys of the 1930s and 1970s, these surveys employed many more surveyors to more thoroughly cover as much of the state and known colonies as possible. The discovery of breeding by a large proportion of the population on silage fields near dairies had recently been documented (Hamilton et al. 1992, 1995), and therefore unlike previous statewide survey efforts, the 1994 survey focused heavily on the San Joaquin Valley.

After the establishment of the new approach to conduct a statewide census, attempts to survey the population were carried out in 13 years between 1994 and 2017. Despite a consistent approach in many of the early years of this time period, methods varied considerably for many of these surveys. The years 1994, 1997, and 2000 produced a set of three triennial surveys that were considered to have been comparable in effort by the survey organizers (Beedy and Hamilton 1997, Hamilton 2000). After a period of years with surveys that followed inconsistent and variable approaches, another set of four triennial surveys were conducted using similar methods in 2008, 2011, 2014, and 2017 (Kelsey 2008, Kyle and Kelsey 2011, Meese 2014a, Meese 2017). The effort and results of these seven surveys are summarized in Table 1. Although the other six survey years (1995, 1996, 1999, 2001, 2004, and 2005) are not discussed further here, they are briefly summarized in Table 2 and in a larger discussion of Tricolored Blackbird surveys included in Appendix 1.

Table 1. Comparison of survey effort and results for seven statewide surveys.

Year	Duration	Participants	Counties surveyed (occupied)	Number of sites surveyed (breeding sites)	Occupied breeding locations	Birds observed
1994	1 day (3 days)[1]	60[2]	– (32)	–	100	369,400
1997	1 day (3 days)[1]	55[2]	– (33)	–	71[3]	232,960
2000	4 days	81[2]	33 (25)	231 (181)	72	162,000
2008	3 days	155	38 (32)	361 (284)	135	395,000
2011	3 days	100	38 (29)	608	138	259,000
2014	3 days	143	41 (37)	802	143	145,000
2017	3 days	181	44 (37)	884	168	177,656

[1] Observations of birds not associated with colonies from one day before and after the survey day were accepted, effectively expanding the survey window to three days.
[2] Number includes participants who submitted written reports. A larger number of volunteers may have searched for birds.
[3] As reported by Hamilton (2000).
"—" = data not reported

The statewide survey efforts in 1994, 1997, and 2000 followed similar methods to locate and survey as many colonies as possible. Although the duration of the survey and the survey effort varied across these years, the organizers of the surveys reported these three surveys had used the most consistent methods to date and could be compared to assess the population trend (Beedy and Hamilton 1997, Hamilton 2000). However, inconsistencies in effort still occurred with the 1994 survey conducting only a limited survey of southern California, and the 2000 survey using more observers to visit more sites than the other two survey years. Hamilton (2000), however, concluded that "…the method of the Census and the survey, to reinvestigate all known breeding places and to search for new ones, has become an increasingly complete assessment of Tricolored Blackbird distribution and abundance. The 2000 Census probably located a greater proportion of the entire population than did censuses in previous years." The number of birds observed declined 56% from 369,400 birds in 1994 to about 162,000 birds in 2000 (Hamilton 2000, Cook and Toft 2005). In addition to the results of the surveys showing declines in the 1990s, Hamilton (2000) stated that personal observations over long intervals by many regional experts had also suggested declines during this time period.

Table 2. Description and summary of effort for 13 surveys that attempted to estimate the size of the statewide Tricolored Blackbird population between 1994 and 2017.

Survey year	Summary of effort and results	Sources
1994	The first year a statewide survey was conducted in a narrow time period, was informed by knowledge of historical breeding locations and by pre-survey colony detection work, and enlisted the help of a large number of volunteers.	Hamilton et al. (1995) Beedy and Hamilton (1997)
1995 and 1996	Limited pre-survey effort. Incomplete county coverage. Large colonies may have been overlooked. Results are not considered representative of the total population.	Beedy and Hamilton (1997)
1997	Used the same coverage, methods, and personnel as did the 1994 survey. Participation was greater than in 1994. Surveys from 1994, 1997, and 2000 are considered comparable.	Beedy and Hamilton (1997)
1999	Participation in the survey was low. Results considered an underestimate of population size by the survey organizer.	Hamilton et al. (1999, 2000) Hamilton (2000)
2000	Used the same methods applied in 1994 and 1997, although a greater number of observers were used to visit more locations. Training was provided to participants. Surveys from 1994, 1997, and 2000 are considered comparable.	Hamilton (2000)
2001	Followed a very different approach compared to standardized methods used since 1994. A limited number of sites were visited and estimates were compiled from observations made throughout the breeding season.	Humple and Churchwell (2002)
2004	Not intended to provide an estimate of the statewide population size that was comparable to previous surveys. Surveys limited to colony sites that had historically supported more than 2,000 birds. Focused on sites in the Central Valley.	Green and Edson (2004)
2005	No report was produced and no record is available describing the survey effort.	Meese (2015a)
2008	Used similar methods as in the 2000 survey, although estimates not adjusted using nest density. Also, county coordinators were used for the first time to ensure each county was well surveyed by volunteers. Maps with all survey locations were provided for the first time, and a website improved communication and data management. Number of survey participants and number of sites surveyed greatly increased relative to earlier surveys.	Kelsey (2008)
2011	Methods followed those used in 2008, although county coordinators were not used to lead surveys in individual counties. Surveys from 2008, 2011, 2014, and 2017 are considered comparable.	Kyle and Kelsey (2011)
2014	Used the same methods as in 2008 and 2011, and again used county coordinators to ensure each county was thoroughly covered. The number of counties and number of sites visited exceeded all other surveys to date. Surveys conducted 2008–2017 are considered comparable.	Meese (2014a)
2017	Used the same methods as in 2008–2014. The number of survey participants and the number of counties and sites visited exceeded all other surveys to date. Surveys conducted 2008–2017 are considered comparable.	Meese (2017)

As during the early set of survey years, the survey effort increased each year from 2008 to 2017. More counties were surveyed in 2014 than on any previous survey and the number of observers participating on the 2014 survey (n = 143) was exceeded on only one previous survey (n = 155 in 2008). There was a large increase in the number of sites visited in each survey year between 2008 and 2014, and the number of colony sites visited in 2017 exceeded that of any other survey (Figure 9). The 2017 survey was the most extensive survey conducted to date based on all available metrics of effort (Table 1). The number of birds observed on statewide surveys declined 63% from 395,000 birds in 2008 to an all-time low of about 145,000 birds in 2014 (Kelsey 2008, Meese 2014a) (Table 1). From 2014 to 2017, the number of birds observed increased 22% to 177,656. The number of birds observed in 2017 represents a 55% decline in the population over the nine years since 2008.

Although the conclusion following each of the two groups of survey years (1994–2000 and 2008–2017) was that a population decline had occurred, differences in survey methods and effort make it difficult to combine the two groups of surveys to make longer-term conclusions (Meese 2015a). Does the estimated number of birds in 2008 represent an increase in population size following the decline of the 1990s, or do increased survey effort and other changes to survey methodology preclude comparison of results from the two survey periods? In addition to differences in duration of the survey, geographic scope, and effort shown in Table 1, there were important differences in methods used between the two groups of surveys (see Appendix 1). Methods unique to the earlier 1994–2000 surveys include: 1) Birds counted at colonies before the survey were included in the results if the colony remained active after the survey period (although not counted on the survey day), 2) Birds observed and counted at colonies after the survey were included if nest phenology led to a conclusion that the colony was active on the survey date (although not observed), and 3) Visual colony size estimates were often adjusted using observed nest densities, as determined by walking transects through colony sites after the survey; this resulted in final colony size estimates that in some cases differed significantly from those reported by survey participants (Hamilton et al. 1995). Unfortunately, the impact (both the magnitude and direction) of these methodological differences on the overall population estimates is unknown, and therefore a direct comparison of results from the two time periods is not appropriate. At a minimum, the large step change in survey effort between the two time periods must be taken into account if the data are to be used to inform a longer-term population trend.

Commented [RRC15]: As someone who was out surveying in early 2000s, I can tell you that there was a huge drop between that period and 2008 in the southern CV which I believe is a good indicator of change overall.

Commented [RRC16]: Were they often adjusted? What proportion of them were?

Commented [RRC17]: I agree that a direct comparison in numbers is not appropriate. However, I doubt that the trend observed between 1994 and 2000 would likely have been affected by the methods. That does not seem plausible and it concerns me that it is being used here to suggest that the trend may not be real since an extension of that notion is that the population was capable of jumping back to 1994 levels by 2008. I doubt anybody who was in the field, observing birds in those intervening years would believe that. The methods used by Hamilton et al. were essentially consistent across years which means that the sharp decline documented are probably real. I think it would be better if this discussion leaned toward the likelihood of that pattern rather than against it.

Commented [RRC18]: Graves et al. (2013) documented a significant trend using all of the data back to the 1930's.

As shown in Table 1, the individual metrics of survey effort were not consistently reported across survey years. The number of sites surveyed has been used to describe survey effort in recent years (Meese 2014a, 2015, 2017), but this number is not known for the surveys conducted in the 1990s. The number of counties surveyed was also not reported for surveys conducted in the 1990s. The number of participants and the number of occupied breeding locations were reported for all survey years. It is not known whether an increase in effort as measured by any of these metrics results in a proportional increase in the number of birds observed, but Graves et al. (2013) reported that total counts of breeding birds are correlated with the number of sites sampled. The number of sites sampled is also related to the proportion of the landscape searched by survey participants (Figure 9) and therefore might be the most appropriate metric of effort with which to standardize survey results.

In order to make use of as many survey years as possible to evaluate population trend over time, survey results were adjusted for effort when available (Figure 10a-c). Viewed as a whole, when adjusting for survey effort the results suggest a consistent pattern in the Tricolored Blackbird population since 1994. Regardless of the metric used to adjust population estimates for survey effort, the trend shows a long-term decline over the 23-year period with a partial recovery between 2000 and 2008. Depending on the metric used to correct for effort, either 2014 or 2017 represents the all-time low for effort-adjusted number of birds observed.

As the number of locations visited has increased with each successive statewide survey, so too has the number of locations with some uncertainty regarding the exact location. These are historical breeding locations for which the exact coordinates were not reported, and therefore the level of confidence is recorded as "uncertain" in the Tricolored Blackbird Portal database (2017). As a result, surveyors have visited an increasing number of locations that have not necessarily supported Tricolored Blackbird breeding in the past (Table 3). This is not wasted effort, as the visits to uncertain locations increase the size of the landscape area searched for colonies during the survey (Figure 9), and the locations are likely near historical colony sites. Nevertheless, for the 2017 survey, participants were directed to focus on sites with known coordinates, resulting in a large decline in the number of "uncertain" sites surveyed. To be conservative in interpreting changes in survey effort over time, the uncertain locations were removed from the count of sites visited during the 2000, 2008, 2011, 2014, and 2017 surveys to adjust the effort for those survey years (Table 3). The adjusted number of sites surveyed each year continues to show an increase in survey effort over time. A graph prepared using the revised number of sites surveyed (Figure 10d) revealed little effect on the pattern of birds observed per site shown in Figure 10b.

Table 3. Number of sites surveyed during recent statewide surveys, adjusted to remove uncertain locations.

Survey year	Number of sites surveyed	Number of uncertain sites	Revised number of sites surveyed
2000	231	4	227
2008	361	8	353
2011	608	54	554
2014	802	127	675
2017	884	25	859

The linear regression trendlines for each of the effort-corrected survey results indicate that the Tricolored Blackbird population has declined by 75%–90% in the last 23 years (Figure 10). The observed rates of decline of -5.8% to -10.5% per year indicate that this species has been in severe decline over the last two decades. These rates of decline are in the range of the steepest declines observed across all North American landbird species based on Breeding Bird Survey data (Sauer et al. 2017a). Results of the most recent 2017 statewide survey suggest that the Tricolored Blackbird population decline may have slowed or reversed since 2014, but the population remains at or near its smallest size ever recorded. Coupled with the earlier declines between the 1930s and 1970s, the recent declines have resulted in a population that is a small fraction of its historical abundance.

There are several potential sources of uncertainty in the population estimates from statewide surveys. Attempts to quantify this uncertainty have been limited and inconsistent across years. Comments on the approach used to estimate the size of the population during recent statewide surveys, along with a discussion of uncertainty, are provided in Appendix 2.

Colony Size

In recent statewide survey years, the size of the largest colonies (including the single largest colony and the average of the several largest colonies per year) have been reported as an alternative metric to total counts of birds for tracking trends over time. Use of the size of large colonies to evaluate trends is only appropriate if the survey effort is sufficient to detect most of the largest colonies. Although the survey effort required to detect most of the largest colonies is unknown, Graves et al. (2013) reported that average colony size observed, based on colony data from 1907 to 2009, was not strongly correlated to the total number of sites sampled annually, suggesting that sampling may generally be sufficient to detect the largest colonies. Larger colonies may be more likely to be detected and therefore survey effort may have less effect on size of largest colonies observed compared to total counts of birds.

Neff (1937) located several breeding colonies of more than 100,000 nests in the Sacramento Valley, with the largest composed of greater than 200,000 nests (about 300,000 adult birds). Orians (1961a) reported that, in 1959 and 1960, there were four Tricolored Blackbird colonies larger than 100,000 adults; three were in the rice-growing area in Colusa and Yolo counties and one was in Sacramento County. The largest reported colonies in the 1970s were in Colusa and Yolo counties and comprised about 30,000 adults (DeHaven et al. 1975a, Beedy and Hayworth 1992). All but one of the colonies observed by DeHaven et al. (1975a) that were larger than 20,000 birds were located in the Sacramento Valley. In the 1980s, the largest reported colony was in the northern San Joaquin Valley at Kesterson Reservoir (Merced County) in 1986, with an estimated 47,000 adults (Beedy and Hayworth 1992).

The occurrence of Tricolored Blackbird breeding colonies on grain fields in the San Joaquin Valley was discovered in the early 1990s (Hamilton et al. 1995), and the size of the largest colonies in several subsequent years once again grew to more than 100,000 birds, so-called “mega-colonies.” Beedy and Hamilton (1997) reported that 1994 and 1997 were the only two survey years to date with sufficient survey effort to detect “virtually all large colonies.” In 1994, Hamilton et al. (1995) found that the largest colony, at San Luis National Wildlife Refuge, numbered about 105,000 adult Tricolored Blackbirds. In 1997, Beedy and Hamilton (1997) reported the largest colony to contain about 80,000 adults. The documentation of large colonies during this time period is likely due in part to the formation of mega-colonies on grain fields, but may also be a result of increased survey effort in the San Joaquin Valley.

Colonies of at least 80,000 breeding birds continued to occur through 2010 (Meese 2009a, Meese 2010). From 2008 to 2017, maximum colony size declined from 80,000 to fewer than 20,000 birds (Kelsey 2008, Kyle and Kelsey 2011, Meese 2017). In 2014, only a single colony consisted of more than 20,000 birds and only three colonies consisted of 10,000 birds or more (Meese 2014a). The proportion of birds observed in the 10 largest colonies during the years 2008, 2011, 2014, and 2017 was 77% (306,000), 81% (208,800), 64% (93,000), and 55% (98,050) of the statewide population estimate for those years,

respectively. This reflects a downward trend in the sizes of the largest colonies, without a large increase in the number of occupied breeding locations (Figure 11). The trend in the largest colonies from 1994 to 2017 is similar to those in Figure 10 for effort-corrected statewide survey results: a long-term decline over the 23-year period with a partial recovery between 2000 and 2008.

Graves et al. (2013) performed an evaluation of trends in the average size of Tricolored Blackbird colonies over a more than 100-year period (1907–2009) using data compiled from a variety of sources. Average colony size, rather than total abundance, was used as the metric to evaluate trends to account for the effects of variable sampling effort across years. Graves et al. (2013) found a significant decline in the average colony size from 1935 to 1975, with the average colony size declining by more than 60%. This corresponds to the period over which DeHaven et al. (1975) concluded that the population size had declined by about 50%. Despite large amounts of data on colony sizes from the 1980s onward, no significant decline was detected in average colony size from 1980 to 2009. This finding is counter to reports of declines for portions of the 1980–2009 period (e.g., Beedy et al. 1991, Hamilton 2000, Meese 2014a, Meese 2015a). However, the statistical evaluation conducted by Graves et al. (2013) used data only through 2009, so it does not include much of the time period during which the recent population decline was observed (2008–2014). In addition, it is unlikely that sampling effort was sufficient in all years to detect most of the largest Tricolored Blackbird colonies, which may have influenced the estimates of average colony size.

The degree to which size of the largest or average colonies are correlated to total population size in any given year is unknown. However, during statewide survey years since 1994, the sizes of the largest colonies follow a pattern similar to that of the total numbers of birds observed. Given that in many years the majority of the population occurs in a small number of the largest colonies and the number of occupied colonies per year has not increased dramatically with increased survey effort (Table 1), it is likely that short-term declines in colony size often reflect real changes in the population size. Over longer periods, the correlation between colony size and population might be expected to break down due to shifts in breeding distribution and selection of novel nesting substrates. For example, when the population began using agricultural grain crops in the early 1990s and experienced an apparent shift in early breeding season distribution to the San Joaquin Valley, very large colonies were reported for the first time in many years. These changes in nesting substrate availability and distribution could have influenced the size of the largest colonies (and average colony size) by concentrating the population at a small number of breeding locations without necessarily reflecting a change in population size. In fact, Graves et al. (2013) reported that colonies in triticale and other grain crops were 40 times larger than colonies in other habitats during the last 20 years. This may explain in part why they did not find a reduction in average colony size from 1980 to 2009, a time when breeding surveys revealed declines in total number of birds observed.

Winter Population

The Christmas Bird Count (CBC) is a volunteer-based survey conducted each winter at designated 15-mile diameter circles across North America. CBC data consist of counts of all bird species encountered during a single day at each circle for which a count is conducted. There are more than 2,400 count

circles across North America, some of which have been run since the early 1900s (Soykan et al. 2016). The number of count circles increased dramatically through the 1950s and 1960s, especially in the western region of the U.S. (Niven et al. 2004), and long-term trend assessments have often used a start date in the late 1960s to avoid any influence of increased survey coverage on apparent trends (Butcher et al. 2006). This is also the time period when the Breeding Bird Survey was initiated, which allows for comparisons between breeding and wintering populations (Niven et al. 2004). Counts are not necessarily conducted for every circle each year, and some circles are run more consistently than others. The number of volunteer observers and the duration of the count can vary from year to year, and yearly differences in effort can significantly influence the results of the counts. Therefore, the number of party-hours is often used as a measure of effort to standardize count results. Count circle locations are also not randomly selected, so data cannot be extrapolated to provide population estimates across the range of a species, but if corrected for effort can provide an index that can inform population change in areas covered by count circles.

Soykan et al. (2016) used a hierarchical model to evaluate population change from 1966 to 2013 for several hundred species sampled by the CBC, including Tricolored Blackbird. The analysis assessed change in each U.S. state and in each Bird Conservation Region (BCR; a map of BCRs is available at http://nabci-us.org/resources/bird-conservation-regions-map/), with the Coastal California BCR being the primary BCR in which Tricolored Blackbird occurs. Trends for Tricolored Blackbird were non-significant at both the California and the BCR scales. Hierarchical models are more efficient than linear regression approaches when assessing population change for a large number of species across multiple geographic scales, and can control for variation in survey effort among circles and across years. However, the use of large spatial scales for analysis may introduce variability in the quality of information that may not accounted for in the models. Although the Coastal California BCR captures the majority of the Tricolored Blackbird range in California, it is neither geologically nor biologically uniform. Also, the addition of count circles over time has not been evenly distributed across the BCR or the state. Due to the variability in habitat and species distribution at these broad scales, any apparent population trend, or lack thereof, can be an artifact of the years in which count circles were added or removed, or the years in which particular circles were surveyed across a heterogeneous landscape. A finer-scale approach that considers the impacts of this variability on a single species is warranted.

In California, count circles increased through the 1960s as has been documented in other areas, but the number of circles continued to increase through the early 1990s. The number of circles in California detecting Tricolored Blackbird doubled from 1974 (25 circles) to 1986 (50 circles) and the number of circles with Tricolored Blackbird detections did not stabilize until the 1990s. Since 1992 the number of circles with Tricolored Blackbird detections has been fairly stable and has fluctuated between 54 and 66. Because of the continued increase in the number of count circles through the 1990s, and the inconsistent running of counts at some circles over time, the sampling intensity has varied across the range of the Tricolored Blackbird in California. Based on the number of count circles surveyed in California over time, and by establishing criteria for consistency of effort, the Department assessed trends based on CBC data for two time periods: 1974–2015 and 1995–2015. These two periods capture a longer term extending back to the 1970s when the breeding-season surveys of DeHaven et al. (1975a)

were conducted, and a shorter term covering the time since the first statewide surveys of the 1990s and when CBC data quality was highest and most consistent. The distribution of count circles that met a set of criteria and that were therefore included in the analyses provides fairly good coverage of the core of the winter distribution of the species (Figure 12; Appendix 3). Population trends were estimated from the slope of the regression of the log-transformed counts on year (see Butcher et al. 1990). Results of the CBC data analyses indicate declines in the Tricolored Blackbird population over both the longer term 1974–2015 period and the shorter term 1995–2015 period (Appendix 3).

Improvement in bird identification skills by volunteer observers has been apparent within the past 20 years, and poses a significant challenge in the interpretation of trends based on CBC data. This may be especially true for species with potential identification problems and for flocking species such as the Tricolored Blackbird (Butcher et al. 1990). As a result, counts that are adjusted by party-hour may be positively biased in recent years, which would tend to result in a positive bias in observed trends.

A number of historical winter observations of large numbers of Tricolored Blackbirds corroborate the observed decline in CBC data. Wintering flocks numbering 12,000–14,000 once assembled near dairies on the Point Reyes Peninsula, Marin County, which was one of the most reliable locations to observe large numbers of wintering Tricolored Blackbirds. In recent years, these flocks have been in the range of 2,000–3,000 birds (eBird Dataset 2016, Beedy et al. 2017).

Regional Shifts in Abundance

Because of the Tricolored Blackbird's nomadic tendency and the potential for large interannual shifts in breeding distribution, year-to-year changes in regional abundance are common. Tricolored Blackbird surveys have regularly revealed large annual changes in local abundance that would not be expected due to productivity or mortality rates alone (Hamilton 1998). During statewide surveys, large declines in one region are often coupled with large increases in other regions, and therefore caution is warranted when interpreting year-to-year changes in local abundance. That said, persistent long-term changes in distribution and regional abundance likely represent shifts in regional habitat suitability or population abundance.

Central Valley

Following incidental observations on the regional abundance of Tricolored Blackbirds in the 1800s and early 1900s, the Central Valley was described as the center of abundance for the species. The first systematic attempt to assess the species' rangewide distribution and population confirmed this, with most birds observed in the Sacramento Valley (Neff 1937). Additional observations and study of breeding colonies occurred through the 1960s before a second attempt at quantifying rangewide abundance in the early 1970s, with the majority of birds again found in the Sacramento Valley and northern San Joaquin Valley (DeHaven et al. 1975a).

Within the Central Valley, shifts in regional abundance over relatively short time periods have been a regular occurrence. Over a period of five years in the 1930s, Neff (1937) observed regular shifts in the annual centers of abundance between the rice-growing regions of the Sacramento Valley (Butte and

Glenn counties) and regions to the south in Sacramento and Merced counties. DeHaven et al. (1975a) noted substantial yearly variation in centers of breeding abundance, even in their limited study area consisting of the Sacramento and northern San Joaquin valleys. For example, they observed 57,000 Tricolored Blackbirds nesting in Colusa County in 1969, but only 2,000 the following year. This pattern was mirrored in Yolo County where the number of breeding birds observed declined from 25,000 to 5,000. At the same time, other counties in the Sacramento Valley experienced increases in the number of breeding birds, with Glenn County increasing from 2,000 to 18,500 birds, and Yuba County increasing from 1,000 to 5,250 birds. A larger region comprising the major rice-growing region of the Sacramento Valley (Butte, Colusa, Glenn, Yolo, and Yuba counties) also varied considerably in the proportion of the known population it supported, with the proportion of known breeding birds in the region ranging from 29% to 59% during a four-year study period (DeHaven et al. 1975a). In the year when the smallest proportion of birds were located in this rice-growing region, the largest known congregation of birds occurred to the south in the pasturelands of southeastern Sacramento County. These regional shifts in abundance demonstrate the species' ability to undergo large interannual shifts in breeding distribution, likely in response to an unpredictable food supply or other habitat components.

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In addition to short-term shifts in regional abundance, the Central Valley has experienced longer-term changes, with some regions of the valley experiencing long-term declines in number of breeding colonies or breeding birds. For example, Kings County supported tens of thousands of breeding birds per year through the 1990s, with 65,000 birds breeding in the county in 1992. In recent years, the county has hosted only a few hundred to a few thousand breeding birds. Glenn County, which once supported hundreds of thousands of birds per year and continued to support at least 10,000 birds into the 1990s, has not hosted more than 1,400 birds in any year since 2000. San Joaquin County regularly supported up to about 10,000 birds per year through the 1990s, but has hosted only a few small colonies since then, with the largest recent colony of 1,800 birds in 2015. As described above, the Tricolored Blackbird appears to have experienced a population increase from the 1990s through the 2000s in the San Joaquin Valley as a whole, with a corresponding decrease in the Sacramento Valley. Following this increase, the population in the San Joaquin Valley experienced a severe decline of 78% from 2008 to 2014 (Meese 2015a). This is a time period during which the species declined by 63% rangewide, and the majority of this decrease was due to declines in the San Joaquin Valley. The total number of birds lost from the San Joaquin Valley portion of the range during this period (~267,000 birds) exceeded the rangewide decline (250,000 birds), with a small portion of the loss compensated by increases in the breeding population elsewhere (Figure 13) (Meese 2015a). The number of birds breeding in the San Joaquin Valley rebounded somewhat by 2017, but declines in this region remain the primary contributor to range-wide population declines since 2008.

Southern California and Baja California

As described above under Distribution, the Tricolored Blackbird was once abundant on the coastal slope of the southern California portion of the range, from Santa Barbara County to San Diego and into Baja California. Although the early reports of species abundance were not quantitative, they serve as a comparison to numbers of birds in the region in recent decades. Neff (1937) provided the first quantitative estimates for southern California, although San Diego and Santa Barbara counties were the

only counties his collaborators spent a significant amount of time surveying; thousands of birds were documented in both of these counties. DeHaven et al. (1975a) reported colonies of up to 10,000 birds in southern California (Riverside County), with thousands of birds documented in all counties south of the Transverse Ranges, except Orange County.

The first statewide survey to include all counties in southern California was conducted in 1997 (Beedy and Hamilton 1997). That year, more than 40,000 Tricolored Blackbirds bred in the southern California portion of the range, with more than 90% occurring in western Riverside County (Feenstra 2009, Cook 2010). Since this time, the largest proportion of the southern California breeding population has continued to occur in western Riverside County (Cook 2010). The 2005 statewide survey located about 12,500 breeding birds south of the Transverse Ranges. A thorough search of historical breeding locations in southern California in 2008, 2009, and 2011 revealed a population south of the Transverse Ranges of consistently less than 5,000 breeding birds (Figure 14) (Kelsey 2008, Feenstra 2009, Kyle and Kelsey 2011). By 2009 the coastal slope portion of the region had declined to only 750 Tricolored Blackbirds breeding at a single site in San Diego County (Feenstra 2009). The 2014 survey located a slightly larger population in southern California of ~~consisting of~~ about 6,400 breeding birds (Meese 2014a). In 2017, the number of birds observed increased again to about 8,800, although the large majority of these (~~>90~~80%) were again located in ~~one small region~~the San jacinto Valley region of western Riverside County. San Diego was the only other county with breeding birds in 2017, with seven small colonies totaling fewer than 700 birds. Most breeding colonies of the Tricolored Blackbird in Southern California have tended to be small in recent years, averaging a few hundred birds (Feenstra 2009). The exception has been the larger colonies consisting of thousands of birds in recent years that have nested at the San Jacinto Wildlife Area or the dairies nearby (Cook 2016, WRC-MSHCP 2017).

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In the last decade the breeding population in the Mojave Desert portion of the range in San Bernardino and northern Los Angeles counties appears to have grown somewhat, from just over 1,000 breeding birds located during surveys in 2008–2011, to more than 5,000 breeding birds in 2014 (Meese 2014a). It is unclear whether the Mojave Desert birds are more closely associated with the southern California population or to the birds in the Central Valley, although observations of three banded birds since 2009 and observations of a flying flock in the 1800s have documented birds moving between the desert and the Central Valley. Ongoing genomic studies will address the population structure and patterns of movement throughout California.

Originally considered common in northwestern Baja California, numbers appear to have declined by the late 1900s. Recent surveys have shown that the northwestern Baja California population has declined to only several hundred individuals (Erickson et al. 2007, Erickson and de la Cueva 2008, Feenstra 2013, Erickson et al. 2016, Meese 2017).

Summary—The Tricolored Blackbird, once described as the most abundant species in southern California, had declined dramatically by the time statewide surveys were established in the 1990s. Tens of thousands of breeding birds continued to occupy the region during the first complete survey of 1997. The most recent intensive searches of the southern California portion of the range located only thousands of breeding birds at a small number of locations. Following the first comprehensive survey of southern California counties in 1997, the Tricolored Blackbird population declined by nearly 90%, to lows of fewer than 5,000 birds from 2008 to 2011. The southern California population rebounded somewhat by 2014, but most of the increase can be attributed to birds in the Mojave Desert. This decline coincides with the disappearance of the species from much of the southern California portion of the range and is mirrored by declines in abundance and distribution in the Baja California portion of the species' range. If recent trends continue, the species may decline to extirpation in the southern portion of its range in the near future.

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Northern and Central Coasts

Small numbers of birds bred annually during the late nesting season (July–September; thought to represent second breeding attempts by birds that previously nested elsewhere) in western Marin County until 2003 (Stallcup 2004). There has been no documented breeding in Marin County since then.

EXISTING MANAGEMENT

Land Ownership within the California Range

There is a paucity of public lands in the Central Valley, with the region that regularly supports more than 90% of the breeding population composed primarily of privately-owned lands (Figure 15). The total area in the range of the Tricolored Blackbird in California is more than 34 million acres. Privately-owned lands compose 84% of this area, with state and federal lands totaling about 12%. Much of the area under federal ownership is composed of forested areas that are not suitable for the species. The USFWS National Wildlife Refuges and Department Wildlife Areas comprise about 250,000 and 254,000 acres, respectively (1.5% of the range, combined).

Of the 1,045 historical breeding locations with known coordinates in the Tricolored Blackbird Portal database (as of January 2017), 191 (18%) have been located on public lands. A minority of breeding colonies continue to occur on public lands each year. For example, during the 2011 statewide survey, colonies were found on a county park, a Department Ecological Reserve in San Diego County and an Ecological Reserve in Kern County, and on three National Wildlife Refuges in the Central Valley (Kyle and Kelsey 2011). These colonies totaled 66,325 breeding birds (about 25% of the estimated statewide population in that year), the large majority of which were from a single colony on a USFWS National Wildlife Refuge.

Habitat Conservation Plans

Habitat Conservation Plans (HCPs) are long-term landscape level plans that provide the basis for regulatory compliance with the ESA by nonfederal entities. HCPs provide a mechanism to authorize incidental take of federally threatened and endangered species under section 10(a) of the ESA, while also describing how impacts to covered species will be minimized or mitigated in the plan area. An HCP must minimize and mitigate the impacts of take to the maximum extent practicable.

There are five approved HCPs in California that include the Tricolored Blackbird as a covered species and two additional HCPs that are in the planning stage (Figure 16; Table 4):

Approved HCPs:

- Natomas Basin
- San Joaquin County Multi-species Conservation Plan
- PG&E San Joaquin Valley Operations & Maintenance
- Kern Water Bank
- Orange County Southern Subregion

Planning Stage:

- South Sacramento
- Solano Multi-Species

Table 4. Current and Planned HCPs/NCCPs in California that include Tricolored Blackbird as a covered species.

Plan title	Counties	Plan acreage	Date permit issued	Term
Natomas Basin HCP	Sacramento, Sutter	53,342	June 2003	50 years
San Joaquin County Multi-species Conservation Plan HCP	San Joaquin	896,000	May 2001	50 years
PG&E San Joaquin Valley Operations & Maintenance HCP	Portions of nine counties: San Joaquin, Stanislaus, Merced, Fresno, Kings, Kern, Mariposa, Madera, Tulare	276,350	December 2007	30 years
Kern Water Bank HCP	Kern	19,900	October 1997	75 years
Orange County Southern Subregion HCP	Orange	132,000	January 2007	75 years
South Sacramento HCP	Sacramento	317,656	Planning stage	TBD
Solano Multi-species HCP	Solano, Yolo (edge)	580,000	Planning stage	TBD
East Contra Costa County (NCCP)	Contra Costa	175,435	July 2007	30 years
Santa Clara Valley Habitat Plan (NCCP)	Santa Clara	460,205	July 2013	50 years
Western Riverside County Multiple Species Habitat Conservation Plan (NCCP)	Riverside	1,300,000	June 2004	75 years
San Diego County Multiple Species Conservation Program (NCCP)	San Diego	511,878	August 1998	50 years
San Diego Gas & Electric Subregional (NCCP)	San Diego, Orange, Riverside	Linear projects[1]	December 1995	55 years
San Diego County Water Authority (NCCP)	San Diego, Riverside	Linear projects[1]	December 2011	55 years
Butte Regional Conservation Plan (NCCP)	Butte	564,270	Planning stage	TBD
Yuba-Sutter Regional Conservation Plan (NCCP)	Yuba, Sutter	468,552	Planning stage	TBD
Placer County Conservation Plan Phase I (NCCP)	Placer	201,000	Planning stage	TBD
Yolo Habitat Conservancy (NCCP)	Yolo	653,663	Planning stage	TBD
San Diego East County Multiple Species Conservation Plan (NCCP)	San Diego	1,600,000	Planning stage	TBD
San Diego North County Multiple Species Conservation Plan (NCCP)	San Diego	311,800	Planning stage	TBD

[1] These NCCPs cover discrete linear or energy projects but have larger plan areas that overlap with other NCCPs.
Primary Sources:
USFWS endangered species page for Tricolored Blackbird under conservation plans:
https://ecos.fws.gov/ecp0/profile/speciesProfile?spcode=B06P#conservationPlans
Summary of Natural Community Conservation Plans (NCCPs) September 2016
https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=15329&inline

The goals, objectives, and conservation measures for Tricolored Blackbird included in approved HCPs are summarized below.

Natomas Basin HCP

The Natomas Basin Habitat Conservation Plan (NBHCP) covers 53,342 acres in the northwestern part of Sacramento County and southern Sutter County. The City of Sacramento and County of Sutter are participants. The 50-year term expires June 2053.

Tricolored Blackbirds nest and forage in the Natomas Basin. At the time of the planning effort, one active nesting colony was known from the eastern edge of the Natomas Basin (Betts Kismat-Silva Reserve) and nine documented occurrences were noted for Sutter County. Based on habitat preferences of Tricolored Blackbirds, the Natomas Basin supported about 1,998 acres of potential nesting habitat and 41,310 acres of potential foraging habitat (NBHCP 2003).

A total of 449 acres of potential nesting habitat will be converted to urban development as a result of implementing the proposed action. A loss of 15,311 acres of potential foraging habitat (non-rice crops = 6,517 acres, grassland = 560 acres, pasture = 147 acres, and rice = 8,087 acres) will result from the planned development (USFWS June 24, 2003).

Under the plan, 2,137.5 acres of managed marsh habitat will be preserved in a reserve system. Wetland reserves are intended to benefit wetland-associated Covered Species such as Tricolored Blackbirds. The managed marsh reserves will provide potential nesting habitat for Tricolored Blackbirds in close proximity to foraging habitat, which is expected to increase suitable nesting opportunities for this species. Additionally, 4,375 acres of rice and 2,187.5 acres of upland habitats will be added to the reserve system. Generally, acquisition of upland habitat is prioritized first for the conservation of Swainson's Hawk (*Buteo swainsoni*) then secondarily for other upland-associated Covered Species including Tricolored Blackbird (USFWS June 24, 2003).

Take minimization measures include pre-construction surveys for Tricolored Blackbirds, avoidance of actively nesting colonies/minimization of disturbance during the nesting season, establishment of a physical protective barrier 500 feet from the active nesting sites, and a "reasonable" buffer for foraging lands on reserve lands. The NBHCP includes measures to avoid, minimize, and mitigate take of the giant garter snake (*Thamnophis gigas*) with timing restrictions, pre-construction site dewatering, and vegetation control management. Because the Tricolored Blackbird shares some habitat similarities with the snake, these measures may also benefit the blackbird (NBHCP 2003).

Monitoring Covered Species is provided for in the plan. The USFWS commented on monitoring the Tricolored Blackbirds nesting colony in the final EIR/EIS (USFWS April 2003): "…the success of this population will be monitored annually and the reserve acquisition program of the NBHCP could be modified if it is determined that foraging habitat is a limiting factor for the colony. This colony is located well outside of the City's Permit Area, and this colony may forage upon unincorporated lands within Sacramento County. If, through the annual monitoring, it is determined that additional foraging habitat is required, the NBHCP would allow for modification of both acquisition programs and habitat

management/restoration to provide enhanced foraging. The long-term success of the NBHCP will rely not on establishing a rigid Operating Conservation Program based on limited information, but rather will result from a flexible program that responds to new information collected through monitoring as well as evolving scientific data as applicable to the Covered Species."

San Joaquin County Multi-Species Conservation Plan HCP

The San Joaquin County Multi-Species Conservation Plan HCP (SJMSCP) spans 896,000 acres in San Joaquin County. Participating entities include the Cities of Escalon, Lathrop, Lodi, Manteca, Ripon, Stockton, and Tracy and the County of San Joaquin. The 50-year term expires May 2051.

The SJMSCP identified 9,374 acres of "occupied" habitat for the Tricolored Blackbird in the plan area and an additional 47,193 acres of potential habitat including foraging and wintering areas. It is expected that 1,614 acres of Tricolored Blackbird habitat will be converted under full build-out.

The SJMSCP conservation strategy relies on minimizing, avoiding, and mitigating impacts for Covered Species including the Tricolored Blackbird. Mitigating impacts to Covered Species will largely be accomplished through the creation, enhancement and management of Preserves. Tricolored Blackbirds are associated with five planned Preserves: Primary Zone of the Delta (Large and Small Water's Edge Preserve), Vernal Pool Zone (Vernal Pool Grassland Preserve), Central Zone (Row and Field Crop/Riparian Preserve), Central Zone (Wetlands Preserve), Central/Southwest Transition Zone (Use Central Zone Row and Field Crop/Riparian Preserve). Tricolored Blackbirds are considered indicators of Preserve health and will be monitored at the species-level, accordingly.

Incidental take minimization measures include a setback of 500 feet from nesting areas during the nesting season for the period encompassing nest building and continuing until fledglings leave nests. This setback applies whenever construction or other ground-disturbing activities must begin during the nesting season in the presence of nests that are known to be occupied. Setbacks shall be marked by brightly-colored temporary fencing.

Pacific Gas & Electric San Joaquin Valley Operations & Maintenance HCP

The PG&E San Joaquin Valley Operations & Maintenance HCP (PG&E HCP) plan area includes 276,350 acres in portions of nine counties in the San Joaquin Valley, as follows: San Joaquin, Stanislaus, Merced, Fresno, Kings, Kern, Mariposa, Madera, and Tulare. The 30-year term expires in 2037.

The following discussion is derived from USFWS 2007:

> Tricolored Blackbirds occupied approximately 1,443 acres of existing PG&E right-of-way in the plan area (52 occurrences in CNDDB as of 2007).
>
> As part of the planning process, PG&E will establish a map book for the Tricolored Blackbird by, prior to initiation of any covered activities, determining where PG&E facility lines occur within 100 meters of CNDDB-documented occurrences of breeding colonies. Active nesting birds will be avoided. If an active breeding colony could be disrupted by the covered activity, an exclusion

zone of at least 350 feet around the colony will be established. This exclusion zone will be established in the field based on site conditions, the covered activity, and professional judgment by a qualified PG&E biologist, and will be greater than the minimum distance. Work will not occur in this exclusion zone during April 1–July 31.

The PG&E HCP estimated that covered activities would directly disturb approximately 4 acres of suitable nesting or foraging habitat each year (120 acres of temporary disturbance over 30 years), with most of this disturbance occurring in foraging habitat. Less than 0.1 acre per year of blackbird nesting habitat is expected to be permanently lost each year (less than 3 acres of nesting habitat permanently lost over 30 years). Other covered activities that may disturb Tricolored Blackbirds (e.g., off-road travel and tree trimming that do not disturb ground surfaces) will affect 34 acres of suitable Tricolored Blackbird habitat each year (1,020 acres over the 30-year permit term). These impacts are expected to be individually small, widely dispersed and, therefore, likely to be insignificant and discountable.

Permanent loss of suitable foraging or nesting habitat will be compensated at a 3:1 ratio and temporary disturbance to suitable habitat will be compensated at a 0.5:1 ratio. The HCP estimates PG&E will provide 0.37 acres of Tricolored Blackbird compensation in the North San Joaquin Valley, 0.91 acres of compensation in the Central San Joaquin Valley, and 0.57 acres of compensation in the South San Joaquin Valley annually. Overall, PG&E will provide approximately 2.3 acres of Tricolored Blackbird compensation annually (approximately 69 acres over 30 years).

Kern Water Bank HCP

The Kern Water Bank HCP covers 19,900 acres of central Kern County. The 75-year term expires in 2072. Planning documents list no known Tricolored Blackbird colonies from the Kern Water Bank area; however, it was acknowledged that the species might move into the HCP area in the future. Impacts were described as "negligible; high mobility of the species allows easy escape from project-related impacts" (Kern Water Bank Authority 1997). A monitoring effort conducted in 2011 documented five small colonies numbering ~400 individuals in nettles under mesquite within the plan area. A large colony numbering several thousand individuals settled in an historic site along the Kern River channel but the colony was abandoned; they may have joined a successful colony in Basin 6 on city property of approximately 10,000 individuals that successfully fledged young. The author did not identify whether the earlier failed effort or the successful colony was located within the plan area (Hardt 2011).

Orange County Southern Subregion HCP

The Orange County Southern Subregion HCP comprises 132,000 acres in the study area, including the Cleveland National Forest (40,000 acres). Excluding certain urbanized areas and the National Forest property, the planning area totals 86,000 acres within southern Orange County. The County of Orange and Rancho Mission Viejo are signatory to the implementing agreement. The 75-year term expires in 2082.

Six general Tricolored Blackbird breeding locations have been documented in the planning area historically and include: Middle Chiquita Canyon, Coto de Caza, Radio Tower Road, Verdugo Canyon in San Juan Creek, lower Gabino Canyon, and Trampas Canyon settling ponds. Not all sites have been used consistently or recently. A total of 18,759 acres of potential foraging habitat was identified in the planning area. One of the known historic breeding sites, Trampas Canyon, will be directly impacted by the proposed covered activities and an estimated 3,769 acres of foraging habitat will be developed or otherwise made unsuitable for Tricolored Blackbirds (USFWS 2007).

The plan conserves four of the breeding colony sites within a planned habitat reserve: Middle Chiquita Canyon, Verdugo Canyon, Radio Tower Road, and Lower Gabino Canyon. Adequate foraging habitat within a four-mile radius of these sites also would be conserved. Planners assumed that "at least 1,000 acres of foraging habitat within four miles of a nest site would be more than adequate to sustain the relatively small nesting colonies that occur in the study area" (Dudek and Associates 2006). Adequate foraging habitat will also be conserved at the Cota de Caza site. A total of 8,015 acres of foraging habitat for Tricolored Blackbirds in the planning area, including the four historic nest site locations, will be cooperatively managed within the habitat reserve. Additional open space habitats exist within County Parks (1,694 acres) which will be managed with overall conservation goals of the HCP (USFWS 2007).

Management actions to benefit Tricolored Blackbirds will focus on nonnative predators, grazing, minimizing pesticide use near colonies, and managing human disturbance near colonies (Dudek and Associates 2006).

South Sacramento HCP

The South Sacramento HCP is currently in the planning stage. The proposed study area encompasses 317,656 acres in Sacramento County. Anticipated partners include the County of Sacramento and the Cities of Rancho Cordova and Galt.

Solano Multi-Species HCP

Solano Multi-Species HCP is currently in the planning stage. The proposed study area includes 577,000 acres in Solano County and an additional 8,000 acres in Yolo County. Participants in this effort include the Cities of Dixon, Fairfield, Rio Vista, Suisun City, Vacaville, and Vallejo.

Natural Community Conservation Plans

Like HCPs, Natural Community Conservation Plans (NCCPs) are long-term landscape-level conservation plans. Under California state law, the Natural Community Conservation Planning Act (Fish & G. Code, §§ 2800-2835) provides a mechanism to obtain authorization for incidental take of CESA-listed and other species. An NCCP provides for the protection of habitat, natural communities, and species diversity on a landscape or ecosystem level, while allowing compatible and appropriate economic activity. An NCCP is broader in its objectives than the take authorization provided under the California and Federal ESAs, and may require conservation measures that go beyond mitigation of impacts to meet the recovery needs of

covered species. All approved NCCPs are also HCPs and so provide authorization for take of federally-listed species through section 10 of the ESA.

There are six approved NCCPs in California that include the Tricolored Blackbird as a covered species and six additional NCCPs that are in the planning stage (Figure 16; Table 4):

Approved NCCPs:

- East Contra Costa County
- Santa Clara Valley Habitat Plan
- Western Riverside County Multiple Species Habitat Conservation Plan
- San Diego County Multiple Species Conservation Program
- San Diego Gas & Electric Subregional
- San Diego County Water Authority

Planning Stage:

- Butte Regional Conservation Plan
- Yuba-Sutter Regional Conservation Plan
- Placer County Conservation Plan Phase I
- Yolo Natural Heritage Program
- San Diego East County Multiple Species Conservation Plan
- San Diego North County Multiple Species Conservation Plan

The goals, objectives, and conservation measures for Tricolored Blackbird included in approved NCCPs are summarized below.

East Contra Costa County NCCP

The East Contra Costa County NCCP (ECCC) spans 174,018 acres in eastern Contra Costa County. The following local governments are signatory to the implementing agreement: cities of Brentwood, Clayton, Oakley, and Pittsburg, and the County of Contra Costa. The city of Antioch is not part of the agreement. The 30-year term will expire August 2037.

The ECCC is located within the Bay Delta and Central Coast Province (CDFW 2015). Six natural communities are found in the study area: streams/riparian woodland, wetland, grassland, oak woodland, chaparral/scrub, and agricultural lands.

During the project planning phase, Tricolored Blackbirds were described as sporadic in the plan area; two breeding colonies were noted on the northern border of Los Vaqueros Watershed and several additional small colonies were detected during fieldwork for the county bird atlas project (ECCC 2006). The Contra Costa County Bird Atlas project found the Tricolored Blackbird to be a “fairly common permanent but highly local resident of freshwater marshes and weedy fields, particularly in East County but also locally elsewhere. Most breeding birds were present in the vicinity of… Byron” (Glover 2009). The largest colony detected numbered several hundred pairs. The Atlas confirmed breeding in six blocks,

found five additional blocks with possible nesting and an additional possible nesting colony just south of the county border (Glover 2009).

ECCC development guidelines require avoidance of occupied Tricolored Blackbird nests during the breeding season. Under the agreement, impacts of up to 204 acres of core habitat and 9,621 acres of primary foraging habitat may be permitted as a result of covered activities. A planned preserve system will protect 126–164 acres of suitable core habitat and 16,747–20,138 acres of primary foraging habitat under the initial urban development area or maximum urban development area, respectively. The preserve system will also protect at least seven of 13 ponds, all of which may provide potential breeding habitat. Additional pond and wetland creation (an estimated 85 acres of perennial wetland plus an estimated 16 acres of pond habitat) will be created or restored. Managed habitat is predicted to be of higher quality than what had existed prior to the agreement. Conservation easements will be acquired on 250–400 acres of cropland or pasture; landowners will be required to enhance habitat for Tricolored Blackbird and other covered species (CDFG 2007).

Annual progress reports prepared under the ECCC documented two recent land acquisitions with value for Tricolored Blackbirds. Vaquero Farms North, a 575-acre property adjacent to the Los Vaqueros Reservoir Watershed lands was purchased in 2010. It is situated entirely west of Vasco Road, with primary access from Vasco Road (ECCHC 2011). Vaquero Farms Central, a 320-acre property bounded by two existing Preserve System properties, Vaquero Farms North and Vaquero Farms South, was purchased in 2012 (ECCHC 2013). No progress towards pond creation was reported in the latest available annual report of activities (ECCHC 2016).

Santa Clara Valley Habitat Plan NCCP

The Santa Clara Valley Habitat Plan NCCP (SCVHP) includes the cities of Gilroy, Morgan Hill, and San Jose (excluding Alviso and the Baylands) and the County of Santa Clara. The study area encompasses 519,506 acres; the permits areas, however, differ from the study area. Two permits were issued under the plan, one solely for Burrowing Owl (48,464 acres) and another for all other covered species. The "all other covered species" permit, including Tricolored Blackbird, totals 460,205 acres and excludes Henry Coe State Park and a portion of Pacheco State Park. The term of the permit is for 50 years and will expire July 2063.

The SCVHP is found within the Bay Delta and Central Coast Province (CDFW 2015). Natural communities within the planning area include grassland (including serpentine grasslands), chaparral and scrub, coastal scrub, conifer woodland, oak savannah, oak woodland, riparian woodland scrub, mixed evergreen forest, wetlands, aquatic, rock outcrop, irrigated, and agriculture.

Tricolored Blackbirds appear to be relatively uncommon in Santa Clara County. Breeding colonies are few and fairly small. During the Santa Clara County Breeding Bird Atlas project, Tricolored Blackbirds were found in 29 blocks with breeding confirmed in 19 blocks. Hundreds to several thousand individuals were documented. Confirmed breeding occurred in Santa Clara Valley, Diablo Range, Calaveras Reservoir, San Felipe Lake, Coyote Reservoir, small pond on Coyote Ranch numbering fewer than 100

individuals, Horse Valley stock pond, in the upper Smith Creek watershed (Bousman 2007). These data and CNDDB records were assessed under the SCVHP.

Conservation goals for Tricolored Blackbirds include protection for at least four sites that support, historically supported, or could support nesting colonies. Each protected site will have at least 2 acres of breeding (marsh) habitat and will have at least 200 acres of foraging habitat within 2 miles. These breeding sites will either be enhanced or restored breeding habitat in historically/currently occupied areas within the Reserve System or newly-created ponds suitable for breeding Tricolored Blackbirds (ICF 2012).

Take of, or impacts to, existing or historic breeding colonies is prohibited. Impacts to this species are limited to loss of habitat. Mitigation measures consist of pre-construction surveys, impact avoidance or minimization, and land acquisition. Acquisitions will focus on the following:

- Four historical breeding sites with adequate nearby foraging habitat referenced above;
- At least 22,840 acres of modeled Tricolored Blackbird habitat;
- Enhancement of acquired habitat specifically for Tricolored Blackbirds; and
- Creation of new ponds and wetlands that may provide breeding and foraging habitat for the species (CDFW 2013).

Western Riverside County Multiple Species Habitat Conservation Plan NCCP

The Western Riverside County Multiple Species Habitat Conservation Plan NCCP (WRC-MSHCP) covers approximately 1,300,000 acres in western Riverside County and is located wholly within the South Coast Province (CDFW 2015). All unincorporated county land west of the crest of the San Jacinto mountains to the Orange County line, as well as the cities of Temecula, Murrieta, Lake Elsinore, Canyon Lake, Norco, Corona, Riverside, Moreno Valley, Banning, Beaumont, Calimesa, Perris, Hemet, and San Jacinto are included in the plan area. The 75-year term will expire 2079.

Tricolored Blackbirds were described as “widely scattered” throughout the lowlands and foothills of Riverside County. Few current or historic breeding locations were documented within the planning area (Dudek and Associates 2003). Tricolored Blackbird potential habitat was assessed; a total of 480 acres of primary habitat and 259,695 acres of secondary habitat was identified as occurring within the planning area. Of these totals, a loss of 60 acres of primary habitat and 193,180 acres of secondary habitat was projected. Secondary habitat losses included approximately 102,000 acres of agricultural land and 88,000 acres of grassland (Dudek and Associates 2003). Mitigation identified in the plan includes the following actions:

- Include within the Conservation Area, 420 acres of suitable primary habitat (freshwater marsh, cismontane alkali marsh).
- Include within the Conservation Area the five identified Core Areas for Tricolored Blackbirds. The Core Areas include San Jacinto River floodplain (7,320 acres), Mystic Lake/San Jacinto Wildlife Area (17,470 acres), Collier Marsh and Lake Elsinore grasslands (1,810 acres), Alberhill (3,460 acres), and Vail Lake/Wilson Valley/eastern Temecula Creek (50,000 acres).

- Include within the Conservation Area, 66,510 acres of secondary habitat (playa and vernal pool, grasslands, agriculture land, and riparian scrub, woodland, and forest).
- Maintain (once every 5 years) the continued use of and successful reproduction within at least one of the identified Core Areas. Successful reproduction is defined as a nest that fledges at least one known young.
- Maintain, preserve, and if feasible, restore hydrological processes within the five Core Areas.
- Include within the Conservation Area a 100-meter buffer around any known nesting locations.

Although not considered a Tricolored Blackbird Core Area, a total of 9,670 acres within the Prado Basin/Santa Ana River area will be conserved within Criteria Area and Public/Quasi-Public designations. This area may support Tricolored Blackbirds in the future (Dudek & Associates 2003).

The most recent biological monitoring report for Tricolored Blackbirds (2013 breeding season) described the following results:

Commented [RRC27]: We have completed reports for 2014, 2015, and 2016. They are not on the RCA website yet. I will send them.

> Six breeding colonies were detected during targeted searches for Tricolored Blackbirds. These included the Potrero Unit of the San Jacinto Wildlife Area (~350 birds), San Timoteo Canyon (10 birds), Lake Riverside (~200 birds), Highway 371 in Tule Valley (45 birds), and Garner Valley (~150 birds). All counts sum to a total estimated population size of 2,755 birds. Mean and median colony sizes were 459 and 175, respectively. Biologists were unable to confirm reproductive success for the Garner Valley, Highway 371, or San Timoteo Canyon colonies. Tricolored Blackbirds successfully reproduced in Potrero and Tule Valley in 2013. Only one colony, Potrero, was located inside the existing Conservation Area; however, no colony was located within a designated Tricolored Blackbird Core Area. The largest colony (~2,000 birds) occupied a 40-acre field on private land in the San Jacinto Valley. It suffered complete reproductive failure when the field was cut; adults were incubating eggs at the time (WRCRCA 2015).

Biological monitors made management and monitoring recommendations to improve conservation conditions for the Tricolored Blackbird in the Plan area. According to recent biological monitoring reports (WRC-MSHCP 2013), three of the five Core Areas identified for Tricolored Blackbird conservation purposes (Alberhill, Collier Marsh/Lake Elsinore grasslands, and San Jacinto River floodplain) do not provide suitable or sufficient breeding habitat for the species. Other sites were recommended as additional Core Areas based on recent Tricolored Blackbird recent activity. Further, recommendations to change the Tricolored Blackbird species account in the Plan so that it "be modified to recognize loss of foraging habitat in the vicinity of breeding sites as a significant threat to the survival of the species, and that the stated management objectives be reconsidered as well. In particular, the prescription for managing '… this species in order to maintain (once every five years) the continued use of, and successful reproduction within at least one of the identified Core Areas' (Dudek & Associates 2003) is likely insufficient for a rapidly declining species that is dependent on patchy and unpredictable breeding habitats which are being rapidly lost throughout the Plan Area" (WRC-MSHCP 2011, 2013, WRCRCA

2015). Finally, the monitoring regime was deemed inadequate to provide conservation awareness for the Tricolored Blackbird. Monitoring should be conducted with surveys for breeding colonies every year rather than every five years and the survey period be extended to allow multiple visits to active sites before, during, and after nesting (WRC-MSHCP 2011).

San Diego County Multiple Species Conservation Program

The San Diego County Multiple Species Conservation Program NCCP (SDCMSCP) covers approximately 511,878 acres in San Diego County and is located wholly within the South Coast Province (CDFW 2015). SDCMSCP participants include the County of San Diego, Cities of Chula Vista, San Diego, La Mesa, and Poway; implementing agreements are in progress for Coronado, Del Mar, Santee, and El Cajon. Subarea plans have been or will be prepared for each participating entity. Imperial Beach, National City, and Lemon Grove are not developing subarea plans but reserve the right to do so at a later date. The 50-year term expires 2048.

A detailed status assessment of the Tricolored Blackbird within the planning area was not provided in the planning documents. The Plan did identify a rationale for including Tricolored Blackbirds as a covered species: "…77% of potential habitat [4,800 acres], including 59% of mapped localities, will be conserved. Breeding colonies move from season to season, and with a goal of no net loss of wetlands, most of the suitable breeding sites will continue to be available. This species forages in grasslands and agricultural fields near its breeding habitat. Foraging habitat near the known nesting colonies will be conserved at 70–100%. Additionally, foraging opportunities will continue to be provided and created in turfed areas such as golf courses and cemeteries. Jurisdictions will require surveys during the CEQA review process in suitable breeding habitat proposed to be impacted. Participating jurisdictions' guidelines and ordinances and state and federal wetland regulations will provide additional habitat protection resulting in no net loss of wetlands" (Ogden Environmental 1998).

Under the plan, 23% of breeding habitat (1,400 acres) has the potential for development or impacts.

Additionally, the following conditions were specified for Tricolored Blackbirds: "Project approvals must require avoidance of active nesting areas during the breeding season. Area-specific management directives must include measures to avoid impacts to breeding colonies and specific measures to protect against detrimental edge effects to this species. Area-specific management directives for preserve areas will include specific guidelines for managing and monitoring covered species and their habitats including best management practices. Edge effects may include (but not be limited to) trampling, dumping, vehicular traffic, competition with invasive species, parasitism by cowbirds, predation by domestic animals, noise, collecting, recreational activities, & other human intrusions" (Ogden Environmental 1998).

Annual reports are available online for the South County Subarea of the SDCMSCP (http://www.sandiegocounty.gov/content/sdc/parks/openspace/MSCP.html). These reports typically document habitat losses and gains associated with development projects and do not mention Tricolored Blackbirds specifically.

San Diego Gas & Electric Company Subregional NCCP

The San Diego Gas & Electric Company (SDG&E) Subregional NCCP covers discrete linear or energy projects but has a larger plan area that overlaps with other NCCPs. The plan area traverses 2,000,000 acres of SDG&E service territory in San Diego, Orange, and Riverside counties and is located wholly within the South Coast Province (CDFW 2015). Its 55-year term will expire December 2050. Although the term of the agreement is 55 years, SDG&E may, at its election, terminate the agreement after the 25^{th} year and every 10 years thereafter.

In total, the SDG&E plan will result in a combined permanent loss of no greater than 400 acres with 50 miles of electric transmission and/or new gas transmission lines. This acreage figure includes an estimated permanent loss of 124 acres of habitat. The most common and most affected habitat types will likely be coastal sage scrub, chaparral, oak woodland, and grasslands (SDG&E 1995).

Impacts to Tricolored Blackbirds were considered to be generally very small and minimized or mitigated (in that order) when potential impacts occur to the species' habitats (SDG&E 1995). Tricolored Blackbird habitat was categorized under Mitigation Category III: beach, marsh, and wetland species. Mitigation measures taken for this category include:

- Construction in marsh areas, soft sand, or open water in most cases will be accomplished through the use of helicopters for the delivery of materials, poles, personnel, and platforms; and
- Roads should be avoided to the extent feasible.

In general, the following conditions apply: wildlife will not be killed unless to protect life and limb of staff, personnel training will be provided, and pre-activity surveys will be conducted (SDG&E 1995).

Planning documents available online did not include site-specific information on Tricolored Blackbird colony locations or foraging sites.

San Diego County Water Authority NCCP

The San Diego County Water Authority NCCP covers discrete linear projects but has a larger plan area that overlaps with other NCCPs. The plan area traverses 992,000 acres in western San Diego and southwestern Riverside counties and is located wholly within the South Coast Province (CDFW 2015). Nearly all Covered Activities will occur within the probable impact zone: 1,000 feet on either side of the pipelines or facilities, or approximately 64,600 acres along the existing pipeline rights-of-way, and other connected water conveyance, storage, and treatment facilities. The 55-year term of the agreement will expire December 2066.

One Tricolored Blackbird colony was documented near the Sweetwater Reservoir during the planning process; no colonies were noted within the planned impact zone (CNDDB in SDCWA and RECON 2010).

A total of 1,830 acres of wetland/riparian habitat exists within the probable impact zone; of this total, approximately 16 acres of potential Tricolored Blackbird breeding habitat could be impacted by

permitted activities. Twenty-one acres of potentially suitable breeding habitat in the existing preserve area may be used to mitigate impacts to Tricolored Blackbird. Suitable foraging habitat is conserved in the 1,186 acre San Miguel Habitat Management Area within the San Diego National Wildlife Refuge (Merkel and Associates 1997 in SDCWA and RECON 2010); however, no nesting has been documented there.

No direct take of breeding Tricolored Blackbirds or their nests is allowable; avoidance and/or minimization measures will be undertaken to conserve breeding colonies. Biological mitigation is habitat-based at approved ratios, which are based on the resource value of the impacted habitat. Mitigation for unavoidable impacts may include acquisition of additional preserve area lands, acquisition of credits in other conservation/wetland banks, or development of a biologically superior conservation alternative for the species at appropriate locations in the planning area.

Butte Regional Conservation Plan NCCP

The Butte Regional Conservation Plan NCCP is currently in the planning stage. The proposed study area encompasses 564,270 acres in Butte County. A planning agreement was completed in December 2007 and was signed by Butte County and the cities of Biggs, Chico, Gridley, and Oroville. An independent science advisors report was completed in 2007. Formal public review of draft planning documents closed June 8, 2016; however, public comments are still being accepted.

Yuba-Sutter Regional Conservation Plan NCCP

The Yuba-Sutter Regional Conservation Plan NCCP is currently in the planning stage. The proposed study area encompasses 468,552 acres in Yuba and Sutter counties. A planning agreement was completed in September 2012 and was signed by the counties of Butte and Yuba, the cities of Yuba City, Live Oak, and Wheatland. An independent science advisors report was completed in February 2006. Draft plan documents are in preparation.

Placer County Conservation Plan Phase I NCCP

The Placer County Conservation Plan Phase I NCCP is currently in the planning stage. The proposed study area (phase one of an anticipated three phases) encompasses 201,000 acres in western Placer County. A planning agreement was prepared October 2001 and was signed by the county of Placer. An independent science advisors report was completed January 2004. Draft plan documents are in preparation.

Yolo Habitat Conservation Plan/NCCP

Yolo Habitat Conservation Plan/NCCP (formerly Yolo Natural Heritage Program) is currently in the planning stage. The proposed study area encompasses 653,663 acres in Yolo County. A planning agreement was prepared February 2005 and signed by the Yolo Habitat Conservation Plan/Natural Communities Conservation Plan Joint Powers Agency. An independent science advisors report was completed March 2006. Draft plan documents are in preparation.

San Diego East County Multiple Species Conservation Plan NCCP

The San Diego East County Multiple Species Conservation Plan NCCP is currently in the planning stage. The proposed study area encompasses 1,600,000 acres in eastern San Diego County. The following communities are expected participants: Central Mountain, Cuyamaca, Descanso, Pine Valley, Desert/Borrego Springs, Julian, Mountain Empire, Boulevard, Jacumba, Lake Morena/Campo, Potrero, Tecate, Dulzura (in part), and Palomar/North Mountain. A planning agreement for San Diego East County and San Diego North County was prepared in 2008, amended May 2014, and signed by San Diego County. However, separate NCCPs will be prepared. An independent science advisors report, Part 1, was completed March 2006. Draft plan documents are in preparation.

San Diego North County Multiple Species Conservation Plan NCCP

The San Diego North County Multiple Species Conservation Plan NCCP is currently in the planning stage. The proposed study area encompasses 311,800 acres in northern San Diego County. The following communities are expected participants: Bonsall, De Luz, Fallbrook, Harmony Grove, Lilac, Pala, Pauma Valley, Rainbow, Rincon Springs, Twin Oaks Valley, Valley Center, and Ramona (in part). Excluded from the study area are Carlsbad, Encinitas, Escondido, Oceanside, San Marcos, Solana Beach, and Vista. A planning agreement for San Diego North County and San Diego East County was prepared in 2008, amended May 2014, and signed by San Diego County. However, separate NCCPs will be prepared. Independent science advisors reports were prepared in 2001 and 2002. Draft plan documents underwent public review in 2009 and are now under revision.

Conservation Plan for the Tricolored Blackbird

Following the 1991 petition to list the Tricolored Blackbird under CESA, a multi-stakeholder working group was formed to plan for and implement conservation actions. This resulted in the first of many statewide surveys, the first silage buyout to protect a breeding colony, and ongoing research. However, the working group made limited progress in developing comprehensive conservation measures for the Tricolored Blackbird and eventually dissolved in the mid-1990s. In 1997, a status update and management guidelines for the Tricolored Blackbird was completed (Beedy and Hamilton 1997). The species was again petitioned to be listed under CESA in 2004. After this petition was rejected by the Fish and Game Commission, a new multi-stakeholder Tricolored Blackbird Working Group was formed in 2005 and the group released a conservation plan in 2007 detailing the conservation and management, research and monitoring, data management, and education and outreach goals for the species (TBWG 2007). Working group members, including the Department, signed a Memorandum of Understanding agreeing to implement the actions in the conservation plan. Most of the goals and objectives in the plan are still relevant today and portions of the plan are currently being updated by the Tricolored Blackbird Working Group. Progress toward meeting objectives by the Department, USFWS, and partners on the working group has focused on protecting large breeding colonies that are threatened by harvest of agricultural grain fields and increasing knowledge through monitoring and research. New information is being used to update goals and objectives in the conservation plan.

Protection of Agriculture Colonies from Losses to Harvest

As described above, a large portion of the Tricolored Blackbird population has been nesting on agricultural grain fields since the 1990s, mostly adjacent to dairies. Although dairies often provide nesting substrate (the grain grown to feed cattle), a water source (e.g., drainage ditches or wastewater ponds), and food for adult birds (stored grains), colonies located adjacent to dairies have often suffered from low productivity. In many cases, the entire reproductive effort of silage colonies has been lost when the nesting substrate is harvested while the young or eggs are still in the nest (Meese 2013). The timing of grain harvest typically coincides with the Tricolored Blackbird breeding season, resulting in the destruction of nests, eggs, and nestlings, and occasionally mortality of adult Tricolored Blackbirds. The Tricolored Blackbird colonies that form on agricultural grain fields early in the breeding season are often the largest colonies formed each year, and the complete destruction of these colonies due to harvest can be especially damaging to annual blackbird productivity (Arthur 2015).

The protection of large colonies that occur on agricultural grain fields has been the primary conservation action implemented for Tricolored Blackbird since the species was discovered breeding in this substrate type in the early 1990s. Shortly after the discovery of grain colonies in the San Joaquin Valley, the USFWS intervened to encourage harvest delays and protect the largest known breeding colony (Hamilton 1993). In 1994, a crop was bought to protect a 28,000-bird colony (Kelsey 2008). Hamilton et al. (1995) calculated that interventions in 1992, 1993, and 1994 may have been responsible "for the presence of over 75,000 adult Tricolored Blackbirds in 1995 [which had been nestlings in the three previous years], about 25% of the known population." In 1999, the Department and USFWS protected a colony that was composed of one-third of the known population at the time, which otherwise would have been destroyed by routine harvesting activities (Hamilton et al. 1999). In 2004, silage purchases by the Department and USFWS protected three colonies totaling over 100,000 adult Tricolored Blackbirds. In 2006, the two largest known colonies, totaling more than 200,000 breeding birds, were protected through silage buyouts (Meese 2006). Meese (2009b) estimated that payments to landowners for harvest delays resulted in the protection of 364,000 nests and about 396,000 Tricolored Blackbird fledglings in the five years from 2005 to 2009. Despite these efforts to protect birds breeding on agricultural fields, losses to harvest have continued to occur in most years (Figure 17).

The Natural Resources Conservation Service (NRCS) established a fund in 2012 that was used for three breeding seasons to protect colonies on agricultural lands and to enhance habitat for the Tricolored Blackbird. Landowner participation in the program varied from year to year, with many thousands of nests protected each year while some colonies continued to be lost to harvest.

Regional Conservation Partnership Program

In 2015, the NRCS awarded a Regional Conservation Partnership Program (RCPP) grant to a group of conservation and dairy organizations (Arthur 2015). The grant provided five years of funding to protect, restore, and enhance Tricolored Blackbird habitat on agricultural lands, with the primary objective being to prevent loss of breeding colonies to harvest. During the first year of implementation in the 2016 breeding season, the program succeeded in enrolling all landowners with Tricolored Blackbird colonies

Commented [RRC28]: This is confusing. What is a dairy? The birds are nesting on dairy lands. I think most people would consider the whole farm to be the dairy. The birds may be near the feedlots, more or less, but this should be more clearly stated.

Commented [RRC29]: But often, only a portion of the colonies were protected. Usually the densest part of the colony, although the clearing of substrate around them left them with no buffer at all. Certainly better than nothing, but not quite the same thing as protecting the whole colony.

Commented [RRC30]: I'm not sure about this. I think there were only 2 although 3 were approached, in Tulare/Kern. I was involved with this and I recall that only portions of the colonies were protected. I don't believe it totaled 100,000 birds. Maybe you can check the details.

Commented [RRC31]: Also the largest colony in SoCal.

Commented [RRC32]: Really, until very recently, most dairy colonies were lost to harvest. It is likely these losses that have contributed the most to the severe decline we've seen over the last 23 years.

Commented [RRC33]: Probably most.

identified on their property, and 100% of known agricultural colonies representing more than 60,000 breeding birds were protected through delay of harvest. In 2017, a single large colony (estimated at up to 12,500 breeding birds) was lost to harvest at a location that was not enrolled in the NRCS program.

Commented [RRC34]: Large only by today's standards.

Despite efforts by landowners and the state and federal government to protect colonies, losses to harvest have continued. The protection of all known colonies on agricultural fields in the 2016 breeding season is encouraging progress, although ongoing success will require a stable funding source to compensate landowners that delay harvest. See the section on Harvest of Breeding Colonies below for a discussion of this ongoing threat to the species.

Habitat Restoration and Enhancement

USFWS National Wildlife Refuges

The USFWS owns and manages several National Wildlife Refuges (NWR) in the breeding range of the Tricolored Blackbird. In northeastern California, the Lower Klamath and Tule Lake NWRs have supported breeding colonies at several locations, although colony size has been relatively small as is typical for this portion of the range. The Sacramento National Wildlife Refuge Complex in the Sacramento Valley, the San Luis National Wildlife Refuge Complex in the northern San Joaquin Valley, and Kern and Pixley NWRs in the southern San Joaquin Valley have all supported breeding Tricolored Blackbird colonies.

The Sacramento National Wildlife Refuge Complex has actively managed selected wetlands to maintain suitable Tricolored Blackbird habitat for some time, and they have been frequently successful in attracting breeding colonies to Delevan NWR. Recent restoration at Colusa NWR has resulted in a return of breeding birds after many years of absence. Portions of the Merced NWR have been managed to provide breeding substrate for Tricolored Blackbirds in recent years, and the refuge has been successful in attracting multiple colonies of several thousand breeding birds. The Kern NWR has supported suitable habitat, and for many years hosted breeding colonies. Despite continued efforts to provide flooded spring wetlands, in recent years use of the refuge by breeding colonies has been limited, although a colony of 3,000 birds nested on the refuge in 2017. The Pixley NWR has not supported breeding colonies in recent years, but the USFWS is implementing management to attract breeding birds.

NRCS Easements and Incentive Programs

Through a combination of easements on privately owned lands and 3-year incentive programs, the NRCS has enrolled about 500 acres of land (as of January 2017) in programs that will provide habitat suitable for Tricolored Blackbird nesting. These programs focus on providing dense cattail habitat using water management practices compatible with Tricolored Blackbird nesting habitat. The majority of current NRCS habitat projects are in the Grasslands District of Merced County, with a smaller acreage in the southern San Joaquin Valley in Kern and Tulare Counties. Existing habitat projects have proven successful, with Tricolored Blackbirds breeding on three NRCS easement properties in 2016 (report to the Tricolored Blackbird Working Group, January 31, 2017; unreferenced).

California Department of Fish and Wildlife Lands

On many of the Department wildlife areas and ecological reserves located in the breeding range of the Tricolored Blackbird, management practices include spring or permanent wetland habitats that can support suitable nesting substrate for breeding colonies. In some cases, these wetlands have been managed specifically for Tricolored Blackbirds by setting back wetland succession through burning or mechanical methods, and in other cases the wetlands are typically managed for a broader suite of species. Use of Department wildlife areas and ecological reserves by breeding colonies includes (Tricolored Blackbird Portal 2017):

Northeastern California – The Honey Lake Wildlife Area has supported breeding colonies at two wetland locations. The number of breeding birds has been small, with the most recent observation of 200 breeding birds in 1996.

Sacramento Valley – Four wildlife areas in the Sacramento Valley have supported breeding colonies. Three of these wildlife areas are in Butte County (Oroville, Gray Lodge, and Upper Butte Basin), each of which have supported colonies at a single location, with the most recent observations including 1,600 birds on a wetland at Gray Lodge Wildlife Area in 2011 and 2,000 birds in willows at Oroville Wildlife Area in 2015. Oroville Wildlife Area also regularly supports foraging birds in the post-breeding season (B. Stone, pers. comm.). The Yolo Bypass Wildlife Area in Yolo County has hosted small breeding colonies at three separate locations in wetlands and button willow shrubs.

San Joaquin Valley – Four wildlife areas in the San Joaquin Valley have supported breeding colonies. Three of these are in Merced County, with North Grasslands Wildlife Area supporting three colony locations in milk thistle and mustard, Los Banos Wildlife Area supporting five colony locations in wetlands, and O'Neill Forebay Wildlife Area supporting four colony locations in Himalayan blackberry. The most recent use includes a 9,000 bird colony on a wetland at Los Banos Wildlife Area in 2008 and a 3,500 bird colony in Himalayan blackberry at O'Neill Forebay Wildlife Area in 2005. The fourth wildlife area in the San Joaquin Valley, Mendota Wildlife Area, is located in Fresno County. This wildlife area has supported breeding colonies at three separate wetland locations, with the last reported breeding by 1,000 birds in 1995.

Southern California – The Rancho Jamul Ecological Reserve in San Diego County has hosted a small breeding colony on a wetland in most years since 2007. This colony is usually fewer than 200 breeding birds. In Riverside County, the San Jacinto Wildlife Area has supported breeding colonies at 12 different locations. Most of the colonies have occurred in wetland habitats, with a few locations in other vegetation types including stinging nettle, thistles, and mallow. This wildlife area is located in ~~perhaps~~ the most important region for breeding Tricolored Blackbirds ~~south of the Transverse Ranges~~in southern California. The wildlife area regularly hosts several thousand breeding birds, with a single location supporting 10,000 birds in 2005. During the 2017 statewide survey, 6,300 birds were observed at a single location on the wildlife area.

Commented [RRC35]: Not perhaps.

The Department has also worked with private landowners to create nesting habitat using a variety of incentive programs. The goals of the programs have included management of water to create spring

wetland habitat with emergent cattail vegetation. Several of these projects were successful in attracting Tricolored Blackbird colonies, with colonies of up to several thousand birds breeding on private wetlands created through these programs from at least 2005 through 2011. Funding has been limited in recent years, resulting in declining participation and a reduction in available wetland habitat on private lands.

California Environmental Quality Act

The California Environmental Quality Act (CEQA; Public Resources Code Section 21000 et seq.) requires state and local agencies to publicly disclose, analyze, and potentially mitigate environmental impacts from projects over which they have discretionary approval power. In particular, CEQA requires that actions that may substantially reduce the habitat, decrease the number, or restrict the range of any species that can be considered rare, threatened, or endangered must be identified, disclosed, considered, and mitigated or justified (Cal. Code Regs., tit. 14, §§ 15065(a)(1), 15380).

The environmental review process required by CEQA can be costly and time consuming, and compliance is not always thorough. Agencies may also make the determination that projects are exempt (i.e., they do not need to go through the impact analysis, public disclosure, and mitigation process). Mitigation is required if a project is not CEQA-exempt and impacts would be potentially “significant.” Mitigation must reduce impacts to below a level of significance or minimize unavoidable significant impacts, where feasible. The CEQA process generally incentivizes agencies and project applicants to implement mitigation, thereby avoiding significant impacts.

Due to its SSC designation, impacts to Tricolored Blackbirds are generally considered potentially significant if agencies determine on a project-specific basis that the species meets the CEQA criteria for rare, threatened, or endangered. However, agencies are not required to make this determination for Tricolored Blackbirds and other species that are not listed under CESA or ESA.

FACTORS AFFECTING ABILITY TO SURVIVE AND REPRODUCE

Small Population Size and Colonial Breeding

A key question is whether the colonially breeding Tricolored Blackbird can maintain a viable population at some reduced population abundance that supports only small colonies or concentrates the majority of the population into very few colonies. That is, what is the minimum number of individuals that can continue to support a well-distributed breeding population with colonies that are productive and resilient to the dynamic breeding and foraging landscape within their range? Another North American colonially breeding bird, the Passenger Pigeon (*Ectopistes migratorius*), declined to extinction as a result of multiple population pressures, and the species seemed to have an inability to survive and reproduce at low population numbers (Bucher 1992). In addition to the well-known effect of market hunting in the decline of the Passenger Pigeon, habitat alteration and a lack of social facilitation in food finding due to reduced population size have been implicated in the extinction of the species (Bucher 1992). The Tricolored Blackbird is similar to the Passenger Pigeon in that they are highly social, colonial breeders

with nomadic tendencies that likely evolved for locating highly abundant food sources and other breeding habitat requirements. Tricolored Blackbird has experienced, or continues to experience, many of the population pressures that led to extinction of the Passenger Pigeon; however, unlike the passenger pigeon, the Tricolored Blackbird has adapted to the wide-scale loss of wetland nesting substrate habitat by using a variety of upland vegetation types.

Commented [RRC36]: I'm not sure that this is a significant point. What might impact the species the most is the loss of foraging habitat.

As described in the section on Biology and Ecology, Tricolored Blackbirds may benefit from social and colonial behaviors by reducing mortality due to predation during the nesting cycle and by facilitating food finding and information sharing. Smaller groups of birds would likely retain the ability to locate and use secure nesting substrates, but small colonies might lose the potential benefits of predator satiation and of social food finding and information sharing. The locating and exploitation of abundant food sources could affect small groups of birds both in the selection of productive breeding locations and in acquiring sufficient prey with which to provision young after a site is selected.

Some bird species are known to nest in colonies when conditions are suitable, but can also nest in smaller groups or as single pairs. For example, the White-winged Dove (*Zenaida asiatica*) once nested in extremely large colonies in Mexico. In 1978, 22 breeding colonies contained a collective population size of more than eight million birds (Sanchez Johnson et al. 2009). Individual birds were shown to have very high site fidelity to breeding areas, sometimes returning to nest in the same tree across years (Schwertner et al. 1999). Habitat changes driven by urbanization and intensification of agricultural practices ~~and urbanization~~ caused the loss and fragmentation of nesting habitat and now the White-winged Dove nests singly or in smaller colonies at more dispersed locations in Mexico, and appears to have adapted to use urban areas (Schwertner et al. 1999, Sanchez Johnson et al. 2009).

Commented [RRC37]: Was this species as highly colonial in all aspects as the Tricolored Blackbird is?

Commented [RRC38]: Please note too that of the 9 avian species that have gone extinct since the arrival of European man, 7 were colonial or highly social. See written comments.

Although the Tricolored Blackbird has been observed to nest in very small colonies (as few as 4 nests), the species has not been observed to nest as single pairs. Very small colonies (<100 birds) are quite rare, and although nesting success varies greatly across colonies of all sizes, there is some evidence that very small colonies are not as successful as larger colonies (Payne 1969, Weintraub et al. 2016), and that larger colonies produce more young per female (Hamilton 1993, Meese 2013). Reductions in population size may make the Tricolored Blackbird more vulnerable to additional declines due to inherent natural history factors, but the degree to which a small population would limit the species' ability to survive and reproduce is not known.

The fact that half or more of the total population will often occur in a small number of large colonies in silage fields during the first nesting attempt makes the species vulnerability to losses of productivity (Cook and Toft 2005, Meese 2012, Beedy et al. 2017). In 2011, 65% of the total known population was located at only six colony sites in Merced, Kern, and Tulare counties (Kyle and Kelsey 2011). This concentration of large portions of the population makes the species vulnerable to a number of potential threats, especially colony destruction through harvest, predation, or extreme weather events (Weintraub et al. 2016). The enhanced risk to the species due to colonial breeding may be realized primarily through exacerbation of other threats that can effect a large portion of the total population.

Habitat Loss

Loss of Nesting Habitat

The conversion of wetland nesting habitat to agricultural and urban uses has been implicated in the long-term decline of the species. Neff (1937) observed, "[t]he destruction of [Tricolored Blackbird] nesting habitats by man is of most importance," and cited reclamation and drainage as key factors in the loss of many favorable sites, along with "dredging or cleaning of reservoirs, marshes, and canals in order to destroy the growths of cattails and tules." Only about 15% of the four million acres of wetlands that existed in the Central Valley in the 1850s remained when Neff conducted his work in the 1930s, and about 40% of those remaining wetlands were lost between 1939 and the 1980s (Frayer et al. 1989). Of the freshwater emergent wetlands most likely to be used by breeding Tricolored Blackbirds in the Central Valley, 50% were lost between 1939 and the 1980s, with an average loss of 5,200 acres per year (Frayer et al. 1989). These losses were primarily due to conversion of wetlands to agriculture.

DeHaven et al. (1975a) found no nesting substrate at several locations in Los Angeles, Kern, Sacramento, and Yolo counties where earlier researchers had studied the species. Subsequent investigators have continued to document habitat loss at known breeding colony locations through the present. For example, Beedy et al. (1991) found that 9.3% (n = 17) of all colony locations used in the 1980s were extirpated through permanent removal of nesting habitat. Hamilton et al. (1999) observed the removal of a wetland that had supported a productive breeding colony in 1998. DeHaven (2000) noted the loss of several breeding colonies in Sacramento County to urban development and the expansion of vineyards. Humple and Churchwell (2002) reported on the draining of a wetland and the removal of Himalayan blackberry that had previously supported breeding colonies. Hamilton (2004a) documented the loss or destruction of cattail nesting substrates that had supported 90,000 breeding birds between 1994 and 2004. During the 2017 statewide survey, local experts and survey participants were asked to score the suitability of nesting substrate for all sites visited. Of the 636 sites for which scores were reported before or during the survey, 70 sites were scored as permanently unsuitable, usually due to development or conversion to permanent crops like orchards or vineyards (Table 5). An additional 80 sites had no nesting substrate present during the survey and 101 sites had vegetation present, but were considered unsuitable by the survey participant.

Table 5. Nesting substrate suitability for 636 sites scored before and during the 2017 statewide survey.

Score	Number of sites	Notes on suitability scores
Suitable	385	Nesting substrate present and considered suitable for nesting.
Unsuitable	101	Nesting substrate present but appears to be unsuitable for nesting (e.g., it is immature, too short, lacks sufficient foliage, too sparse, or has recently been burned).
Substrate absent	80	Nesting substrate absent because it has been removed or died (e.g., former grain field planted to alfalfa, milk thistle stand or Himalayan blackberry that has been mowed, wetland that has dried up).
Permanently unsuitable	70	Nesting substrate is absent and cannot be replaced (e.g., has been converted to urban development, orchard, or vineyard).

Following a low point in the extent of wetlands in the 1980s, aggressive restoration actions resulted in an increase of 65,000 acres of managed wetlands between 1990 and 2005 (CVJV 2006). The majority of the wetlands in the Central Valley are managed lands that are maintained by application of water, and many areas undergo occasional land recontouring or vegetation control to maintain desired conditions. As of 2006, there were about 205,000 acres of managed wetlands in the Central Valley (CVJV 2006). Most managed wetlands (~90%) are flooded primarily in the fall and winter for wintering waterfowl (i.e., seasonal wetlands), and a small proportion are managed as semi-permanent or permanent wetlands that hold water during the spring and summer (Iglecia and Kelsey 2012). Semi-permanent wetlands are often managed to support brood habitat for waterfowl; the small proportion of semi-permanent and permanent wetlands are those that can potentially be suitable as nesting substrate for breeding Tricolored Blackbirds.

Replacement of wetland breeding habitat with novel, nonnative upland nesting substrates may have lessened the impact of the decline in Central Valley wetlands to the Tricolored Blackbird population. However, these nonnative vegetation types are often considered undesirable and are frequently removed. Himalayan blackberry habitat with a history of use by breeding colonies has been removed by burning, treatment with herbicide, or mechanical removal (Airola et al. 2015a, 2015b). Milk thistle colonies have been destroyed when landowners have removed or sprayed the invasive weed while Tricolored Blackbirds are actively nesting (Airola et al. 2016). Blackberry control is generally localized and occurs on multi-year intervals, and therefore may not have a large overall effect on the population, although there are cases where removal of nesting substrate has resulted in permanently unsuitable conditions. In the central Sierra Nevada foothills where Tricolored Blackbird colonies frequently nest in Himalayan blackberry, 32% of colonies active in 2014 occurred in areas zoned for development or that were proposed for rezoning for development (Airola et al. 2015a). In 2017, a group of Himalayan blackberry sites that had supported 13,000 breeding Tricolored Blackbirds were removed or degraded by aggregate mining activities (Oct 2017 email from D. Airola to N. Clipperton; unreferenced). The Department is unaware of any available information to evaluate distribution or trends of these nonnative nesting substrates across the range of the Tricolored Blackbird in California.

Commented [RRC39]: Currently? Large scale removal in southern Sac County in the late 90's resulted in the loss to the area of most of its Tricolored Blackbird colonies (Cook and Toft 2005).

Although the loss of wetlands in California's Central Valley is well documented and there are many examples of nesting substrate being removed or degraded at historical Tricolored Blackbird colony locations, there also appears to be suitable nesting substrate in some areas that goes unused in many years. However, there are other regions where large areas of apparently suitable foraging habitat have no available nesting substrate, or where nesting substrate is only available during years when rainfall patterns support vigorous growth of upland nesting substrates (Airola et al. 2016). Most managed wetlands in the Central Valley are not suitable as nesting substrate for the Tricolored Blackbird, but wetlands remain the substrate type most frequently used by breeding colonies and upland nesting substrates provide additional habitat. The dynamic occupancy patterns at breeding locations from year to year and the need for abundant insect prey in surrounding foraging habitat makes it difficult to reach conclusions about nesting substrate suitability based on occupancy in a single year. It is likely that loss of nesting substrate has caused local declines and shifts in distribution, but the overall effect on the population is difficult to assess, especially without considering other breeding requirements. Losses of

nesting substrate at historically large or productive colony locations, or in areas surrounded by high quality foraging habitat, would have the largest impact on the population.

Loss of Foraging Habitat

The extent of foraging habitat required for successful breeding is much greater than the extent of nesting substrate. The abundance of insect prey in foraging habitat has been linked to reproductive success, and Tricolored Blackbirds may choose breeding locations in part based on the local prey populations. Because insect populations are variable and unpredictable from year to year, the Tricolored Blackbird population likely requires much more foraging habitat on the landscape than is used in any given year, and once lost, large landscapes with suitable habitat are difficult to replace. For these reasons, loss of foraging habitat is likely as important, or more so, than the documented losses of nesting substrate on the long-term viability of the Tricolored Blackbird population.

The loss of foraging habitat has been suggested as a likely cause of decline in southern California (Hamilton et al. 1995, Cook 2010). The extirpation of colonies from most of the coastal lowlands in southern California, despite the presence of more numerous marsh habitats relative to inland areas, suggests that foraging habitat sufficient to support breeding colonies is the population's limiting factor (Unitt 2004).

Hamilton et al. (1992) reported on the pervasive loss of foraging habitat near breeding colony sites due to expansion of cultivated agriculture and the conversion of existing agriculture to incompatible crops in the Central Valley, and considered this the primary threat to population abundance. DeHaven (2000) observed widespread habitat loss due to urban expansion and agricultural conversions to vineyards and orchards relative to the 1970s when he and others conducted Tricolored Blackbird research across the state, and suggested that habitat loss was a primary driver of continued population declines. Conversion of pastures and crops suitable for foraging by Tricolored Blackbirds was observed in Placer, Sacramento, Stanislaus, and Tulare counties. DeHaven (2000) noted especially extensive losses in Sacramento County, where urban development and expansion of vineyards had removed thousands of acres of high-quality habitat. More than 5,000 acres of habitat had been converted to vineyards in just a two-year period from 1996 to 1998, resulting in the loss of known breeding colony locations.

Grasslands have been identified as one of the most vulnerable habitats across North America, and many grassland species have experienced steep population declines in recent decades (NABCI 2016). A great deal of effort has been expended on conserving the grasslands in the central part of North America from the Great Plains to northern Mexico (Knopf and Skagen 2012). The grasslands of California have not received the same level of conservation attention, although losses of grasslands in California have been extensive.

Soulard and Wilson (2015) used Landsat satellite data to analyze land-use and land-cover change in the Central Valley from 2000 to 2010, and compared this to changes in the valley since 1973. The largest land-cover trend from 2000 to 2010 occurred in grassland/shrubland habitats. During this 10-year period, an estimated 79,200 acres of grasslands and shrublands were lost, representing a 5% decrease in the Central Valley over 10 years. Over the longer period from 1973 to 2010, grasslands and shrublands

declined by 22% (a loss of 476,900 acres), due mainly to conversions to more intensive agriculture and urban development. Although many of the grassland losses were due to agricultural intensification, losses of agriculture to urban development resulted in relatively little net change in area of agriculture in the Central Valley from 1973 to 2010.

Cameron et al. (2014) analyzed time series land cover data from the California Farmlands Mapping and Monitoring Program collected between 1984 and 2008 to evaluate rangeland habitat (grassland, shrubland, and woodland) conversion in California. The area evaluated covers much of the breeding range of the Tricolored Blackbird except for southern California. About 483,000 acres of rangelands were converted during this 20+ year period, with urban and rural development and conversion to more intensive agricultural uses accounting for most (~90%) of the rangeland loss. Agricultural intensification was primarily due to increases in vineyards and orchards, but smaller amounts of other agricultural crops that may provide foraging habitat for Tricolored Blackbird were also responsible for grassland loss. The San Joaquin Valley region, which in recent decades has been the center of abundance for breeding Tricolored Blackbirds during the early nesting season, experienced the largest amount of rangeland conversion (Figure 18).

Land cover types suitable for Tricolored Blackbird foraging in the Central Valley continue to be converted to incompatible land cover types such as orchards, vineyards, and urban development as agricultural practices evolve and cities continue to expand in the Central Valley. Due to the continued expansion of nut trees and vineyards that replace grasslands, shrublands, or agricultural crops that provide insects required for breeding (e.g., alfalfa), regions that were previously occupied by thousands of birds have now become permanently unsuitable for breeding (Meese 2016). For example, the acreage of pistachio orchards in the Central Valley has grown exponentially in recent years and the acreage of almonds continues to increase (Figures 19 and 20). The five leading pistachio producing counties in California have also supported a large proportion of the Tricolored Blackbird breeding population in recent years (Kern, Tulare, Kings, Fresno, and Madera counties), with Kern County alone supporting 42% of pistachio production in 2012 (Geisseler and Horwath 2016). In the central Sierran foothills, many colony sites and the surrounding foraging landscape are zoned for development, and several development projects that may affect Tricolored Blackbird habitat have moved forward in recent years (Airola et al. 2015a, 2016). Statewide, the proportion of grasslands within 3 miles of known breeding colony locations declined from 2008 to 2014 (NAS 2017).

The California Rangeland Trust has conserved more than 300,000 acres of rangeland in 24 California counties through conservation easements (https://www.rangelandtrust.org/ranch/). Although data are not available on the extent and distribution of conserved lands within the range of the Tricolored Blackbird, some of the conserved ranches are in counties that receive regular use by breeding Tricolored Blackbirds, including Kern, Merced, Madera, and Placer counties. Data on the proximity of conserved rangelands to Tricolored Blackbird breeding colonies is not available, but these easements may provide protection of important foraging habitat for birds that breed in the foothills and grasslands on the periphery of the Central Valley.

Large losses of rangeland and suitable crop foraging habitat have occurred over the last several decades, and conversion of these suitable foraging habitats continue throughout much of the Tricolored Blackbird's range. Although large acreages of rangeland habitat have been conserved through conservation easements, these have not necessarily focused on areas of highest value to Tricolored Blackbird and are small relative to the extent of grassland in the state and the observed rate of loss over the past several decades. Future development in California is projected to be concentrated in several core areas of the Tricolored Blackbird range, including the Central Valley, the foothills of the Sierra Nevada, and on both sides of the Transverse Ranges in southern California (Jongsomjit et al. 2013; Figure 21), which would further reduce or degrade the available foraging landscape for breeding colonies. Loss of suitable rangeland foraging habitat is projected to continue into the future (see Drought, Water Availability, and Climate Change section). The proportion of grasslands in the landscape surrounding potential breeding sites has been shown to be the most important land cover type in predicting the occurrence of breeding Tricolored Blackbirds, and the proportion of alfalfa is the most important determinant of colony size (NAS 2017). Combined with regular loss of nesting substrate, the ongoing loss of foraging habitat makes it less likely that these essential breeding habitat requirements will co-occur on the landscape, with the result being a reduced number of locations suitable for successful breeding by Tricolored Blackbird colonies.

Overexploitation

Market Hunting and Depredation Killing

Neff (1937, 1942) reported hundreds of thousands of blackbirds sold on the Sacramento market, many of which were Tricolored Blackbirds. Market hunting of blackbirds in the Central Valley became a thriving business in about 1928 or 1929 and continued through the mid-1930s. Tricolored Blackbirds banded for research activities throughout the 1930s were often recovered by market hunters with which Neff collaborated (1942).

McCabe (1932) described the deliberate strychnine poisoning of 30,000 breeding Tricolored Blackbirds as part of an agricultural experiment. In the early 1930s active poisoning and shooting programs were enacted to control populations of blackbirds (McCabe 1932, Neff 1937). Tricolored Blackbirds and other blackbird species were killed by poisoned baits used as a means of blackbird control in rice fields in the Sacramento Valley, and numerous blackbirds were shot by farmers or by hired bird herders in attempts to drive the flocks away from rice and other crops (Neff 1942). During the period from 1935 to 1940 blackbird depredations in rice fields were of lesser intensity, and control operations by means of poisoned baits were almost entirely discontinued (Neff 1942).

Because the Tricolored Blackbird forages in mixed-species flocks with the European Starling and other species of blackbirds in the nonbreeding season, and because these flocks forage at feedlots and on ripening rice, the Tricolored Blackbird may be exposed to avicides intended to control nuisance and depredating flocks of blackbirds.

A depredation order under the federal Migratory Bird Treaty Act allows for the control of several species of blackbirds and corvids in agricultural situations without a permit from the USFWS (when birds are

causing serious injuries to agricultural or horticultural crops or to livestock feed; 50 CFR 21.43). In 1988, the USFWS modified the long-standing depredation order to remove the Tricolored Blackbird and prohibit killing the species without a federal permit (Beedy et al. 1991). Although Tricolored Blackbird is no longer covered by the depredation order, it is possible that misidentification of Tricolored Blackbirds when they occur in mixed flocks in the fall and winter leads to unintentional mortality of the species. Landowners are required to report on activities and on the number of birds captured or killed under the depredation order, including non-target species such as the Tricolored Blackbird (50 CFR 21.43, Nov 5, 2014). Based on reports provided to the USFWS, annual reporting appears to be inconsistent and the number of birds killed under the depredation order may be underreported. The number of Tricolored Blackbirds killed annually is unknown and therefore the killing of blackbirds to protect ripening rice in the Sacramento Valley is a known but unquantified source of Tricolored Blackbird mortality.

Commented [RRC40]: As is the number killed by avicides. This is probably not being reported at all.

There has been limited documentation of the shooting of Tricolored Blackbirds in the Sacramento Valley. Two birds that had previously been banded were reported to have been shot by a rice farmer in Butte County (Meese 2009a). These birds were reported because they were banded and it seems likely that additional, unbanded birds were also shot.

Historical killing of blackbirds to protect crops and for the food market may have contributed to a long-term decline of the species, but the intentional killing of Tricolored Blackbirds has declined since the 1930s. The effect of mortality due to shooting or poisoning on annual Tricolored Blackbird survival rates is currently unknown.

Harvest of Breeding Colonies

The Tricolored Blackbird colonies that form on agricultural grain fields early in the breeding season are often the largest colonies formed each year, and the complete destruction of these colonies due to harvest can be especially damaging to annual blackbird productivity (Arthur 2015). Normal harvesting activities typically coincide with the breeding season and the harvest of fields that contain nesting colonies results in nest destruction and the loss of eggs or nestlings. The cutting of grain has also killed adult Tricolored Blackbirds but most adults appear to survive harvest operations.

Shortly after the discovery of grain colonies in the San Joaquin Valley, Hamilton et al. (1992) observed the loss of a 15,000-bird colony to harvest. As early as 1993, the USFWS intervened to encourage harvest delays and protect the largest known breeding colony (Hamilton 1993). Since then, colony protection through crop purchase or delayed harvest has been the primary conservation action implemented for the species (see Existing Management section), with mixed success. Despite annual attempts to locate and protect large colonies since the early 1990s, losses to harvest have occurred in most years (Figure 17), with 2010 and 2016 the only known exceptions. Two large colonies representing more than 60,000 breeding birds were lost due to harvest in 1994 (Hamilton et al. 1995). The two largest breeding colonies in 1995 were destroyed during harvest of the grain nesting substrate (Beedy and Hamilton 1997). At least one colony of 14,000 birds was harvested in 1999 and four colonies were lost to harvest operations in 2000 (Hamilton et al. 1999, Hamilton 2000). Colonies were destroyed in all years from 2005 to 2009, with especially large losses in 2006, 2007, and 2008 (Meese 2009b). In 2008,

Commented [RRC41]: This section focuses on large colonies but in reality most colonies in agriculture were lost to harvest. Protection was the exception.

Commented [RRC42]: And in 2004. One of the largest in the San Joaquin Valley that year (pers obs.)

several of the largest known colonies were destroyed, with six colonies representing 140,000 breeding birds being cut (Meese 2008). At least three colonies were lost to harvest in 2011, including the largest known colony, which supported 17% of the total known population (Kyle and Kelsey 2011, Meese 2011). At least two colonies in grain fields were destroyed in 2014 during the harvest of nesting substrate and at least three colonies were partially or totally destroyed due to harvest in 2015 (Meese 2014a, 2015b). After a breeding season with no known harvest losses in 2016, a large colony (estimated at up to 12,000 birds) was mostly lost in 2017 when the grain nesting substrate was cut in preparation for harvest (Colibri 2017).

Commented [RRC43]: The largest colony with most of the SoCal population was lost to harvest in 2013 in Riverside County. WRC-MSHCP 2014

No colonies are known to have been destroyed by harvest in 2010; a settlement on a dairy in Merced County was lost when the grain was harvested, but the harvest occurred during nest building before eggs were laid (Meese 2010). Beginning in 2016, a new partnership was created through a grant from NRCS, with Audubon California, dairy trade organizations, and agencies working together to conduct outreach to dairy owners and to detect and protect breeding colonies. The program succeeded in enrolling all landowners with Tricolored Blackbird colonies identified on their property in 2016, and 100% of known agricultural colonies were protected through delay of harvest. In 2017, most colonies on grain fields at dairies were again protected, but at least one large colony was destroyed when the grain was cut.

It has been argued that protection of colonies breeding on silage fields should be reevaluated because adult birds are unlikely to be killed by harvesting operations and Tricolored Blackbirds are known to breed more than once in a season. DeHaven (2000) and Hamilton (2004a, 2004b) suggested that habitat losses might be more important in population declines than nesting mortality, and resources spent protecting colonies on silage fields might be better spent protecting or restoring habitat. However, second breeding attempts are often less productive than first breeding attempts due to the energetic and physiological costs of egg formation in females, incubation and brooding, and raising of young (Martin 1987, Meese 2008). Even if these costs did not reduce the relative productivity of second breeding attempts, the elimination of a first breeding attempt may cause breeding colonies to miss the period of peak prey abundance, thereby reducing seasonal reproductive success (Martin 1987). Colony destruction through harvest typically occurs well after females have laid eggs and often after eggs have hatched, so the lost energetic input to a failed breeding and the delay before a second attempt likely reduce total annual productivity, even if birds attempt to nest a second time (Meese 2008).

Commented [RRC44]: But it would reduce annual productivity anyway since birds nest twice. The population has obviously evolved an itinerate breeding strategy in order to nest more than once in a season. Even If both breeding attempts are equally productive, the loss of one means a decline in productivity.

The Tricolored Blackbird was shown to have experienced low reproductive success from at least 2006 to 2011 (Meese 2013). Reproductive success appears to have always been quite variable across colonies in any given year, and occasional success at large colonies may be important in maintaining the population over time (see Reproduction and Survival section). A number of factors have been shown to influence reproductive success, including predation and shortage of food, but reproductive failures caused by harvest at breeding Tricolored Blackbird colonies on agricultural fields of the San Joaquin Valley may have contributed to population declines through loss of much of the annual reproductive potential of the species in several years.

Overexploitation summary—Although direct killing of Tricolored Blackbirds was once a large source of adult mortality, the number of birds killed declined dramatically after blackbird depredations in rice fields declined in the 1930s. Killing of Tricolored Blackbirds that may be depredating crops during the post-breeding period is likely a continuing source of mortality, but the available data do not indicate this to be a large source of mortality; additional data would be required to determine the degree to which this factor effects the population. Destruction of colonies in agricultural fields has been occurring since Tricolored Blackbirds were discovered nesting in this substrate type in the early 1990s. In recent years, the protections provided to the Tricolored Blackbird as a candidate under CESA, the availability of funds, and a coordinated effort by agencies, the dairy and farming industries, and nonprofit groups has led to a dramatic decline in this source of mortality, but losses of large colonies to grain harvest have continued. The future success of breeding colonies on agricultural crops will depend on the availability of funds to continue programs that locate breeding colonies on grain fields early in the nesting season and compensate farmers for delaying harvest.

Predation

A large number of predators have been observed preying on Tricolored Blackbirds (Table 6), including their eggs or nestlings. Most observations of predation have occurred at breeding colonies when the birds are congregated in dense groups, and most predation has occurred on the eggs, nestlings, or fledglings of Tricolored Blackbirds.

Table 6. Predators of Tricolored Blackbirds.

Taxonomic Group	Predators	Sources
Birds	Black-crowned Night-Heron (*Nycticorax nycticorax*), Cattle Egret (*Bubulcus ibis*), White-faced Ibis (*Plegadis chihi*), Great Blue Heron (*Ardea herodias*), Cooper's Hawk (*Accipiter cooperii*), Swainson's Hawk (*Buteo swainsoni*), Peregrine Falcon (*Falco peregrinus*), Merlin (*Falco columbarius*), Northern Harrier (*Circus cyaneus*), Barn Owl (*Tyto alba*), Burrowing Owl (*Athene cunicularia*), Short-eared Owl (*Asio flammeus*), Yellow-billed Magpie (*Pica nuttalli*), American Crow (*Corvus brachyrhynchos*), Common Raven (*Corvus corax*), Great-tailed Grackle (*Quiscalus mexicanus*)	Mailliard (1900), Neff (1937), Payne (1969), Hamilton et al. (1995), Beedy and Hamilton (1997), Hamilton (2000), Kelsey (2008), Meese (2010), Meese (2012), Airola et al. (2015a), Meese (2016), Beedy et al. (2017)
Mammals	coyote (*Canis latrans*), wolf (*Canis lupus*), gray fox (*Urocyon cinereoargenteus*), raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), long-tailed weasel (*Mustela frenata*), feral domestic cat (*Felis catus*), and possibly mink (*Mustela vison*)	Evermann (1919), Neff (1937), Payne (1969), Hamilton et al. (1995), Beedy and Hamilton (1997), Wilson et al. (2016), Beedy et al. (2017)
Snakes	gopher snake (*Pituophis catenifer*), king snake (*Lampropeltis* sp.), garter snake (*Thamnophis* sp.), and possibly western rattlesnake (*Crotalus oreganus*)	Neff (1937), Payne (1969), Hamilton et al. (1995)

Small areas of native vegetation may be especially vulnerable to predation, especially if they are near sites at which predator populations are artificially high due to the availability of augmented food sources

from human activities. In the early 1990s, Hamilton and others found that many breeding colonies in emergent wetland nesting substrates suffered partial or complete destruction by predation (primarily by Black-crowned Night-Herons; Hamilton et al. 1992, 1995, Hamilton 1993), resulting in consistently lower reproductive success in wetlands compared to other nesting substrates. Beedy and Hamilton (1997) reported that more recently, Black-crowned Night-Herons eliminated all or most nests at several freshwater marsh breeding colonies. Hamilton (2000) later reported that wetland colonies with no Black-crowned Night-Heron predation were highly successful. DeHaven (2000) reported that he also observed high rates of colony failure due to predation in the 1970s, a time when the majority of the population still bred in wetland substrates. Whether recent rates of loss to predation are similar to historical rates of loss is unknown.

Commented [RRC45]: Even large ones.

In recent decades, complete nesting failures have been caused by novel predators on agricultural grain fields and the increasing concentration of birds in mega-colonies may have increased their susceptibility to nest predation (Kelsey 2008). Cattle Egrets from a single rookery caused complete or near-complete failure of large breeding colonies in Tulare County from 2006 to 2011 (Meese 2012). White-faced Ibis prey on the eggs of the Tricolored Blackbird, and in 2016 caused the complete failure of a large breeding colony on a silage field in Tulare County (Meese 2016, Beedy et al. 2017).

Kelsey (2008) reported a steady increase in population sizes of several avian predators in California, including Black-crowned Night-Heron, Cattle Egret, American Crow, and Common Raven. However, the most recent breeding bird survey data show an increase for only one of these species, the Common Raven, and the data for Cattle Egret have important deficiencies that preclude trend assessment (Sauer et al. 2017b). White-faced Ibis have experienced a large population increase in California since the 1980s (Shuford et al. 1996), but BBS data are inadequate for trend assessment (Sauer et al. 2017b).

Although many species have been documented as predators of Tricolored Blackbirds, most have not had severe effects on the population or on the breeding success at nesting colonies. However, a few species have caused the complete failure of entire breeding colonies through heavy predation on eggs and nestlings. In recent decades, the predators that have destroyed entire colonies have usually been wading birds that hunt in large groups (i.e., Black-crowned Night-Heron, Cattle Egret, and White-faced Ibis). These species have had significant impacts on the overall productivity rate of Tricolored Blackbirds in several years over the last three decades (Hamilton et al. 1995, Cook and Toft 2005, Meese 2012). A few other species, including Common Raven, raccoon, and coyote have had large effects on breeding success, but these predators have typically not caused complete colony failure or have had less widespread effects.

Competition

Red-winged Blackbirds and, less frequently, Yellow-headed Blackbirds, will often nest in the same locations as Tricolored Blackbird colonies, although they may occupy the less-dense portions of a marsh. Where territorial conflicts occur, Tricolored Blackbirds ignore the territorial displays of these other species and overwhelm them with their sheer numbers, displacing them to the fringes of the substrate

or pushing them out entirely (Payne 1969). There is no evidence that competition with these species is limiting the Tricolored Blackbird population (Hamilton et al. 1995).

Beedy et al. (2017) reported that Great-tailed Grackles may be aggressive toward nesting Tricolored Blackbirds but did not consider the impacts severe. White-faced Ibis may destroy Tricolored Blackbird nests when in the process of constructing their own nests, but this occurs infrequently. The Marsh Wren (*Cistothorus palustris*) may destroy eggs in Tricolored Blackbird nests that are in proximity to its own nest (Beedy et al. 2017). Competition with other species does not appear to be a large factor in the survival or reproduction of the Tricolored Blackbird.

Brood Parasitism

The Brown-headed Cowbird (*Molothrus ater*) is known to rarely parasitize nests of Tricolored Blackbirds (Hamilton et al. 1995, Beedy et al. 2017), but brood parasitism is not a major threat to the species.

Disease

Beedy et al. (2017) stated that no diseases have been reported for the Tricolored Blackbird but that in some years many nestlings have mites. Avian pox is prevalent in Tricolored Blackbirds in the Sacramento Valley, and much less so in the San Joaquin Valley (Beedy et al. 2017). West Nile virus (WNV) has been detected in dead Tricolored Blackbirds, as well as in many other species of blackbirds, orioles, and grackles nationwide (www.cdc.gov/westnile/resources/pdfs/Bird%20Species%201999-2012.pdf). Adult Tricolored Blackbirds tested positive for WNV antibodies in 2009 but did not show symptoms of the disease and were assigned a relatively low risk score (Wheeler et al. 2009, Beedy et al. 2017). Although the highly social nature of the species could place the Tricolored Blackbird at greater risk to disease transmission, the impact of disease and parasites on the species is unknown but is not thought to be a major threat to the species.

Contaminants

Feeding in agricultural environments creates numerous opportunities for exposure to contaminants. Mortality of Tricolored Blackbird eggs and nestlings due to chemical contaminants has been suggested in a number of cases. Hosea (1986) reported that two colonies in Colusa and Sacramento counties near rice fields were over-sprayed during aerial application of herbicides resulting in the poisoning of almost all of the nestlings. Beedy and Hayworth (1992) described the effects of possible selenium toxicosis on a Tricolored Blackbird colony by comparing the reproductive success of a colony at Kesterson Reservoir in Merced County, which had a history of selenium contamination, with the success at four other colonies. Nesting failures were documented and deformities in Tricolored Blackbird nestlings were observed at the colony at Kesterson, and livers from dead nestlings collected at Kesterson had elevated levels of selenium. The area was cleaned up and the use of selenium-laden agricultural drain water to maintain the wetlands at Kesterson was discontinued. There have been no apparent selenium impacts on Tricolored Blackbird nesting success since. Hamilton et al. (1995) reported evidence of chemical-induced egg mortality from mosquito abatement operations in Kern County.

Commented [RRC46]: Feeding in residential areas can expose birds too. There was a case a few years ago of poisoning at the Lake Riverside Estates colony site (which I would refer to as a community in the Anza Valley). Birds had injected gopher bait that was probably applied incorrectly.

In 1995, Hamilton et al. concluded that, "Despite the limited evidence that Tricolored Blackbirds are suffering some mortality as a result of patterns of chemical use in agricultural areas, poisons do not appear to be inducing a serious population problem for Tricolored Blackbirds." Hamilton (2000) knew of no evidence that toxic contaminants had adversely affected the Tricolored Blackbird since the early 1990s.

Neonicotinoid Insecticides

A relatively new class of insecticides, neonicotinoids, has been implicated in the decline of invertebrate communities and, in a few cases, the decline of insectivorous birds. The application of neonicotinoids has increased dramatically in California, especially since the early to mid-2000s (https://water.usgs.gov/nawqa/pnsp/usage/maps/). Neonicotinoids are relatively stable, and are water soluble so can be incorporated into the tissues of plants. They are commonly applied to crops as seed treatments, with the insecticide taken up systemically by the growing plant (Godfray et al. 2014). In the two decades since their introduction, neonicotinoid insecticides have become the most widely used insecticides in the world (Goulson 2013). They are highly effective at killing insects and have relatively low mammal and bird toxicity. However, at higher concentrations they can have lethal and sublethal impacts to vertebrates (Mineau and Palmer 2013).

Acute toxicity of neonicotinoids has been assessed for only a few bird species, with wide variation in results. Bobwhite and Mallard are the species typically used in acute toxicity testing for regulatory purposes, but where smaller species have been tested, including songbirds, the body weight-corrected dosage resulting in mortality is much lower (Mineau and Palmer 2013). A potential acute impact mechanism for species that are partly granivorous, like the Tricolored Blackbird, is sublethal or lethal effects through the ingestion of neonicotinoid-coated seeds. Ingestion of only a few neonicotinoid-coated seeds (a single seed in the case of corn) might be sufficient to kill a songbird, but there has been little work conducted on the availability and consumption of treated seeds by vertebrates (Goulson 2013, Mineau and Palmer 2013). Although not limited to neonicotinoids, a study that evaluated the effect of multiple potential factors found that acute toxicity of pesticides was the strongest correlate to declines of grassland bird species in the U.S., followed by habitat loss caused by agricultural intensification (Mineau and Whiteside 2013). No data are available on the acute toxicity of any neonicotinoid insecticide specifically to Tricolored Blackbirds, but seeds treated with imidacloprid, a widely used neonicotinoid insecticide, caused ataxia and retching in captive Red-winged Blackbirds and Brown-headed Cowbirds (Avery et al. 1993). These effects were transitory and birds learned to avoid consumption of treated seeds when alternative grains were available. Neonicotinoids may also have chronic toxicity effects (exposure over longer time periods) on reproductive success, but chronic effects are even less studied than acute effects (Mineau and Palmer 2013).

Neonicotinoids may also indirectly affect Tricolored Blackbirds through suppression of insect prey populations. They have been shown to have adverse effects on a number of non-target invertebrate species, with most studies focusing on bees (Hopwood et al. 2012, Godfray et al. 2014). In California, long-term observational data have revealed declines in the number of butterfly species and declines in abundance for many butterfly species in the Central Valley, both of which were negatively associated

with annual application rates of neonicotinoid insecticides (Forister et al. 2016). Imidacloprid was shown to have a negative association with a wide variety of insectivorous bird populations in the Netherlands, suggesting that the pesticide may have led to food deprivation in birds (Hallmann et al. 2014). The evidence linking imidacloprid concentrations to bird population declines was circumstantial, but the authors ruled out confounding effects from other land use changes and showed that the timing of observed declines in bird populations corresponds to the introduction of neonicotinoid insecticides (Goulson 2014, Hallmann et al. 2014).

Depending on environmental conditions, neonicotinoids can persist and accumulate in soils and in waterways, and levels measured in soils, waterways, and field margin plants have sometimes overlapped substantially with concentrations that are sufficient to control pests in crops (Goulson 2013). Neonicotinoids degrade through photolysis when exposed to sunlight and so would not be expected to occur at high levels in clear water (Goulson 2013). However, Starner and Goh (2012) detected imidacloprid in 89% of water samples taken from rivers, creeks, and drains in agricultural regions of California, with 19% of samples exceeding the US Environmental Protection Agency guideline concentration of 1.05 µg/L; this suggests that the insecticide moves off of treatment areas and may impact non-target aquatic insects. Little is known about the uptake of neonicotinoids from soil and soil water by non-target plants, and the downstream effect on non-target invertebrates (Goulson 2013).

A study evaluating landscape effects on Tricolored Blackbird breeding colonies found that colonies are more likely to be located in areas that experience higher neonicotinoid insecticide application rates (NAS 2017). This is likely because most colonies and birds breed in the highly agriculturalized Central Valley. The neonicotinoid application rate was also shown to increase during the 2008–2014 study period, suggesting that breeding Tricolored Blackbirds may be exposed to increasing amounts of the insecticides. The effect of this exposure on breeding Tricolored Blackbirds is unknown.

Several studies have revealed a negative relationship between insect populations and neonicotinoid use. These results, along with the large increase in application of neonicotinoids, suggest a potential mechanism leading to observed reductions in reproductive success in Tricolored Blackbirds (Meese 2013). It is possible that this relatively new group of insecticides has resulted in declines of non-target insect species within the breeding range of the Tricolored Blackbird resulting in a declining prey base, but no data have been collected that can directly support this. It is also possible that acute effects resulting from ingestion of neonicotinoid-coated seeds has had an impact on the population, but the number of Tricolored Blackbirds suffering sublethal or lethal effects due to exposure to neonicotinoids is unknown. In addition to Tricolored Blackbirds, population declines in insectivorous birds have been documented across North America, with specific examples from California's Central Valley (Nebel et al. 2010, Airola et al. 2014). Neonicotinoids may be playing a role in driving these declines, but more study is needed. There is a need for mechanistic research to compliment results from observational data; these should include testing exposure rates of Tricolored Blackbirds to neonicotinoids, effect of exposure on body condition and fitness (direct effects), and investigations into potential insect-based food-web impacts (indirect effects).

Invasive Species

With the exception of occasional impacts due to nonnative predators (e.g., Cattle Egret, Great-tailed Grackle), invasive species have not been reported to have a large impact on the ability of the Tricolored Blackbird to survive and reproduce. The availability of many nonnative plant species as nesting substrates have allowed the Tricolored Blackbird to breed in locations that would otherwise be unavailable. Some non-native plants such as curly dock (*Rumex crispus*) can provide an important food source Cook (2016). Invasive species are not considered a major threat to the species.

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Weather Events

Hamilton et al. (1995) stated that high mortality of Tricolored Blackbird nestlings can result from severe or prolonged storms and that some observed reproductive failure may be the result of chilling of adult and nestling birds. Also, some adult female mortality at nests appears to have been induced by cold and rainy weather (Hamilton et al. 1995). Heavy winds or precipitation have been documented to knock down nesting substrates, often in triticale or other grain colonies, but also in milk thistle colonies (Meese 2010, 2016), eliminating the reproductive effort for all or a part of breeding colonies. Weather events may have widespread impacts on reproductive success in some years, but impacts are usually isolated and the overall effect on the population's ability to reproduce is limited in most years.

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Drought, Water Availability, and Climate Change

Drought reduces water supply reliability and has far-reaching impacts on most habitat types in California (DWR 2014, 2015a). Several significant statewide droughts have occurred in California over the last century (1928–1934, 1976–1977, 1987–1992, and 2007–2009) (DWR 2015a), and California recently experienced the four driest consecutive years of statewide precipitation in the historical record between 2012 and 2014. The winter of 2015 produced a record low statewide mountain snowpack of only 5% of average.

Drought effects on availability of nesting substrate

Tricolored Blackbirds have adapted to use a variety of novel vegetation types as nesting substrate, but wetlands continue to support the largest number of breeding colonies each year. Because of the need for wetlands that are flooded during the spring and summer breeding season, the various approaches to wetland management, and the dependence on water deliveries to maintain wetland habitats in most of the Tricolored Blackbird's range, assessing the availability of suitable wetland nesting substrate in a given year is difficult. A recent method applied reflectance to satellite imagery in order to identify areas of open surface water in the Central Valley (Reiter et al. 2015). Although not an ideal approach to quantifying and assessing distribution of wetlands, the method would identify wetlands with large amounts of open water. In addition, identification of open water on the landscape during the Tricolored Blackbird breeding season is likely a good proxy for the availability of water for wetland management. Reiter et al. (2015) showed that open surface water declined across the Central Valley between 2000 and 2011. Drought had a significant negative effect on open surface water in the late summer and early fall. Cumulative years of drought resulted in a noticeable reduction in surface water. Although not a direct measure of Tricolored Blackbird breeding habitat, declines in surface water during the drought likely resulted in reduced availability of wetlands with sufficient water to provide high quality nesting substrates.

Although more resilient to dry conditions than wetland vegetation, plants species that provide upland nesting substrate for Tricolored Blackbird colonies also experience negative effects due to drought. After several years of dry conditions during California's most recent drought, many Himalayan blackberry copses that have historically supported Tricolored Blackbird colonies were observed to be dry and mostly barren of leaves. In a few cases, extremely dry blackberry bushes continued to be used by breeding colonies, but many were unoccupied. Milk thistle, which provides high-quality nesting substrate across much of the Tricolored Blackbird range when annual precipitation patterns support vigorous growth, was largely absent from historically used areas until California experienced an average water year in the winter of 2015–2016 (Airola et al. 2016). The wetter weather created nesting substrate in areas that had not been used by Tricolored Blackbirds in several years, and breeding colonies once again occupied these areas.

Drought effects on prey populations

The availability of large insect prey is an important factor in Tricolored Blackbird reproductive success, and may influence colony site selection. Large landscapes with suitable foraging habitat are strong drivers of colony site occupancy and abundance (NAS 2017).

Insect abundance is highly related to biomass of herbaceous vegetation, including important Tricolored Blackbird prey items like grasshoppers in grasslands (Falcone 2010). Climate, especially drought, is thought to play a key role in abundance of grasshoppers and other insect species in grasslands (Vose et al. 2016). The response of insect populations can differ depending on drought severity. For example, non-severe drought and warm temperatures can have a positive effect on grasshopper populations through increased survival and faster population growth (Kemp and Cigliano 1994). However, extreme or prolonged drought can negatively affect grasshopper populations through desiccation of eggs or through decreased biomass of primary producer food sources (i.e., grasses and forbs) (Vose et al. 2016). Reductions in precipitation not only lead to reductions in the abundance of insects in grasslands, but may also make insect prey less accessible through changes in behavior (e.g., moving underground) (Barnett and Facey 2016). Severe droughts likely have strong negative effects on grasshoppers and insect prey biodiversity in general (Kemp and Cigliano 1994, Vose et al. 2016).

The established impacts of precipitation on insect populations in grasslands, especially grasshoppers, suggests a mechanism for drought impacts on Tricolored Blackbird productivity. Research is needed that measures grasshopper and other prey abundance relative to precipitation and primary productivity around occupied Tricolored Blackbird colonies, and evaluates the effect on Tricolored Blackbird reproductive success.

Climate Change

Average annual temperatures have been rising in California in recent decades, and climate models are in broad agreement that temperatures in California will rise significantly over the next century (DWR 2015b). The average temperature is expected to rise by approximately 2.7°F by 2050, and depending on the emissions scenario, average temperatures could increase by 4.1–8.6°F by the year 2100 (Moser et al. 2012). Summer temperatures will rise more than winter temperatures, and the increases will be greater in inland California. As a result, the average number of extremely hot days (at least 105°F) per year in Sacramento is expected to increase fivefold (up to 20 days) by the middle of the century, and may increase to as many as 50 days per year by 2100 (Moser et al. 2012). Tricolored Blackbirds have been observed to cease initiation of breeding when temperatures rose above 90°F, although care of existing nests continued in temperatures over 100°F (Hamilton et al. 1995). Rising temperatures may directly affect annual Tricolored Blackbird productivity by truncating or interrupting the breeding season, although more work is needed on the effect of temperature on initiation and success of nesting attempts.

Along with projected impacts to Tricolored Blackbird foraging habitat due to housing development discussed above, the areas of California with the largest climate-projected effects on a variety of bird species are largely concentrated within the Tricolored Blackbird range in the Central Valley (Jongsomjit et al. 2013). A suite of analyses integrating the effects of climate change and land use changes in California's rangelands concluded that grassland habitat loss in California could reach 37% by the year 2100 (Byrd et al. 2015).

The recent severe drought in California was at least in part due to and made more severe by climate change (Diffenbaugh et al. 2015). Climate change is projected to bring longer and more severe droughts to California in the future (Diffenbaugh et al. 2015, Williams et al. 2015), exacerbating the impacts to Tricolored Blackbird habitat described above. The Central Valley may be particularly vulnerable to warming-driven drought increases in the future (Williams et al. 2015). Water deliveries are projected to be reduced by 5.6% from 2013 to 2033 due to climate change effects on reliability (DWR 2014). Climate change effects on water supplies and stream flows are expected to increase competition among urban and agricultural water users and environmental needs (Moser et al. 2012). This competition may lead to decreases in available wetland nesting substrate provided by private and public land managers. Declines in the availability of water for agriculture may also reduce prey populations provided by high quality crops like alfalfa and rice.

SUMMARY OF LISTING FACTORS

[Note to reviewers: This section will provide summaries of information in the status review, arranged under each of the factors that the Fish and Game Commission must consider in making a determination as to whether listing is warranted (Cal. Code Regs., Tit. 14, § 670.1). These summaries will be prepared after peer review.]

Present or Threatened Modification or Destruction of Habitat

Overexploitation

Predation

Competition

Disease

Other Natural Events or Human-Related Activities

PROTECTION AFFORDED BY LISTING

It is the policy of the State to conserve, protect, restore and enhance any endangered or threatened species and its habitat (Fish & G. Code, § 2052). The conservation, protection, and enhancement of listed species and their habitat is of statewide concern (Fish & G. Code, § 2051(c)). CESA defines "take" as hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill (Fish & G. Code, § 86). The Fish and Game Code provides the Department with related authority to allow "take" of species listed as threatened or endangered under certain circumstances through incidental take permits, memoranda of understandings, natural community conservation plans, or other plans or agreements approved by or entered into by the Department (Fish & G. Code, §§ 2081, 2081.1, 2086, 2087, and 2835).

If the Tricolored Blackbird is listed under CESA, impacts of take caused by activities authorized through incidental take permits must be minimized and fully mitigated according to state standards. These standards typically include protection of the land in perpetuity with an easement, development and implementation of a species-specific adaptive management plan, and funding through an endowment to pay for long-term monitoring and maintenance to ensure the mitigation land meets performance criteria. Obtaining an incidental take permit is voluntary. The Department cannot force compliance; however, any person violating the take prohibition may be punishable under state law.

Additional protection of Tricolored Blackbird following listing would be expected to occur through state and local agency environmental review under CEQA. CEQA requires that affected public agencies analyze and disclose project-related environmental effects, including potentially significant impacts on rare, threatened, and endangered species. In common practice, potential impacts to listed species are examined more closely in CEQA documents than potential impacts to unlisted species. Where significant impacts are identified under CEQA, the Department expects that project-specific avoidance, minimization, and mitigation measures will benefit the species. State listing, in this respect, and consultation with the Department during state and local agency environmental review under CEQA, would be expected to benefit the Tricolored Blackbird in terms of reducing impacts from individual projects, which might otherwise occur absent listing.

For some species, CESA listing may prompt increased interagency coordination and the likelihood that state and federal land and resource management agencies will allocate funds toward protection and recovery actions. In the case of the Tricolored Blackbird, the Tricolored Blackbird Working Group signatory agencies already meet and coordinate regularly, but a state listing could result in increased availability of conservation funds.

LISTING RECOMMENDATION

CESA directs the Department to prepare this report regarding the status of the Tricolored Blackbird in California based upon the best scientific information. CESA also directs the Department based on its analysis to indicate in the status report whether the petitioned action is warranted (Fish & G. Code, § 2074.6; Cal. Code Regs., tit. 14, § 670.1, subd. (f)). In addition to evaluating whether the petitioned action (i.e., listing as endangered) was warranted, the Department considered whether listing as threatened under CESA was warranted.

The Department includes and makes its recommendation in its status report as submitted to the Commission in an advisory capacity based on the best available science. In consideration of the scientific information contained herein, the Department has determined that listing the Tricolored Blackbird as threatened or endangered under CESA is [warranted/not warranted] at this time.

[Note to reviewers: The Department's recommendation will be finalized following peer review and completion of the status review report.]

MANAGEMENT RECOMMENDATIONS

The Department evaluated existing management recommendations and identified the following, listed in no particular order, as necessary to achieve conservation of the Tricolored Blackbird. The *Conservation Plan for the Tricolored Blackbird* (TBWG 2007) identifies goals, objectives, and tasks required to maintain a viable Tricolored Blackbird population throughout the current range of the species. The Department continues to support implementation of the conservation plan as revised by the Tricolored Blackbird Working Group. The goals, objectives, and tasks identified in the plan are not repeated in their entirety here, but many of the management recommendations listed below are related to, or based on, activities identified in the plan.

Habitat Protection, Restoration, and Enhancement

Land ownership patterns across the range of the Tricolored Blackbird, coupled with the diverse nesting and foraging habitats used by the species, necessitate cooperative efforts among government, industry, and the public in order to conserve the species.

Management of habitat must consider the large landscapes utilized by breeding colonies and the integral relationship between nesting colony sites and associated upland foraging areas (Hamilton

1993). Land management plans that do not specifically consider the landscape needs of Tricolored Blackbirds will not necessarily result in the protection or creation of suitable breeding habitat.

1. Determine the best areas for conservation, building off the recent research on habitat suitability conducted by the National Audubon Society (NAS 2017). It is difficult to predict the distribution of widespread species, and even more difficult when the distribution within the range is not stable, as with the dynamic colony site use of Tricolored Blackbirds. Breeding locations that should be prioritized for protection include those that are regularly occupied, those that support large colonies, those that support high reproductive success, and those with a secure foraging landscape (Meese and Beedy 2015).
2. Identify areas in the Tricolored Blackbird range with high quality foraging landscapes, but that lack suitable nesting substrate. Consider conservation actions to create or restore nesting substrate in areas with high probability of use by breeding Tricolored Blackbirds.
3. Secure funding and implement the highest priority nesting substrate protection, enhancement and restoration projects and foraging habitat protection projects.
4. Create a system for tracking habitat protection and restoration projects, including appropriate measures of success. Work with the Tricolored Blackbird Working Group to encourage reporting of habitat projects from all stakeholders.

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Breeding Colony Protection

In addition to the long-term goal of providing suitable alternative habitat away from silage fields on public and private land, the near-term priority must continue to be placed on identifying and conserving the colonies nesting in silage on private property each year.

5. Fully fund and implement a silage colony protection program. Continue work in the Tricolored Blackbird Working Group's agriculture subcommittee to plan for and implement a silage colony response plan, with participation from a diverse set of stakeholders including members of the dairy industry.
6. Identify locations that regularly support large and productive Tricolored Blackbird breeding colonies, with secure foraging landscape. Prioritize these locations for protection through acquisition or conservation easement.
7. Assess the effectiveness of provision of alternate nesting habitat (e.g., fresh emergent wetlands) to draw birds away from nesting in dairy silage fields (Beedy et al. 2017).

Monitoring and Research

8. Determine the factors that influence nest site selection and especially how relative insect abundance may affect site occupancy (Airola et al. 2016).
9. Determine the amount, type, and distribution of foraging habitat needed to support viable breeding colonies of various sizes. How does type, proximity to colony site, and diversity of foraging habitats influence the extent of foraging habitat required and the rate of reproductive success?

~~10.~~Determine the environmental factors that result in abundant large insect prey populations in grassland habitats and in commonly used agricultural crops, and their variability in time and space.

10.

11. Conduct mechanistic research to compliment results from observational data that have shown correlations between neonicotinoid pesticides and declines in songbirds; these should include testing exposure rates of Tricolored Blackbirds to neonicotinoids, effect of exposure on body condition and fitness, and investigations into potential insect-based food web effects.
12. Estimate rates of within season and interannual movements and genetic exchange between populations breeding in different regions, especially between southern California and the Central Valley (Beedy et al. 2017).
13. Quantify annual adult survivorship and investigate factors that affect survival, including the magnitude of post-breeding mortality caused by shooting to reduce crop depredation.
14. Investigate new methods to measure productivity in Tricolored Blackbird breeding colonies. Current methods that utilize nest transects or counts of fledglings might not be comparable, and nest transects can be difficult to implement and may negatively affect breeding birds.
15. Examine degree of colony cohesion between first and subsequent breeding attempts, and between breeding seasons (Beedy et al. 2017).
16. Develop and implement a statistically valid, standardized protocol for the long-term, statewide monitoring of Tricolored Blackbird abundance, including population estimate confidence.

Education and Outreach

17. Raise awareness of Tricolored Blackbird nesting behavior and conservation options on ranch and farmlands, stressing the importance of protecting large silage nesting colonies. Build off recent efforts by the Tricolored Blackbird Working Group and the dairy industry.
18. Conduct outreach and coordination with landowners whose grazing lands in the foothills support breeding colonies (Airola et al. 2015b).
19. Provide land managers with habitat management guidance for creation and management of Tricolored Blackbird habitat. Continue work recently undertaken by the Tricolored Blackbird Working Group's habitat subcommittee.

ECONOMIC CONSIDERATIONS

The Department is charged in an advisory capacity in the present context to provide a written report and a related recommendation to the Commission based on the best scientific information available regarding the status of Tricolored Blackbird in California. The topic areas and related factors the Department is required to address as part of that effort are biological and not economic, therefore the Department is not required to prepare an analysis of economic impacts (See Fish & G. Code, § 2074.6; Cal. Code Regs., tit. 14, § 670.1, subd. (f)).

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Commented [RRC51]: I would add to this, independent monitoring and reporting to help ensure that management objectives are achieved. In my experience with the SJWA, this is essential.

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From: Erica Fleishman [redacted]
Sent: Monday, November 27, 2017 7:17 AM
To: Clipperton, Neil@Wildlife
Subject: peer review of draft CDFW Tricolored Blackbird status review
Attachments: TRBL_letter.pdf; Draft_TRBL_StatusReview_2017Oct13_EF.docx

Dear Neil,

Thank you for the opportunity to serve as a scientific peer reviewer of the draft Tricolored Blackbird status review. Extensive comments on the draft review, and a letter summarizing my comments, are attached. I'm happy to discuss these with you at your convenience, or to provide any further assistance to CDFW.

Best wishes,
Erica

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Erica Fleishman, Ph.D.
Director, Center for Environmental Management of Military Lands Professor, Department of Fish, Wildlife and Conservation Biology Colorado State University Fort Collins, CO 80523 [redacted]

WARNER COLLEGE OF NATURAL RESOURCES
COLORADO STATE UNIVERSITY
1490 Campus Delivery
Fort Collins, Colorado 80523

26 November 2017

Neil Clipperton
California Department of Fish and Wildlife
Wildlife Branch
1812 Ninth Street
Sacramento, CA 95814

Dear Neil,

Thank you for the opportunity to serve as a scientific peer reviewer of the draft *Status Review of the Tricolored Blackbird (*Agelaius tricolor*) in California*.

The transmittal memo from Kari Lewis on 13 October 2017 states that the California Department of Fish and Wildlife (CDFW) "believes the available science indicates that listing the [Tricolored Blackbird] as threatened under [the California Endangered Species Act] is warranted." Given the statutory definition of *threatened*, this statement implies that CDFW believes that in the foreseeable future, Tricolored Blackbirds are likely to become extinct throughout all or a significant portion of their range if special protection and management efforts are not implemented.

As a scientific peer reviewer, I was asked to analyze the scientific validity of the draft status review and its assessment of the status of Tricolored Blackbirds in California and to review the science and analysis regarding present or threatened habitat modification, overexploitation, competition, disease, and other natural occurrences or human-related activities that could affect the species.

I do not believe that the best science available and draft status review suggest that in the foreseeable future, Tricolored Blackbirds are likely to become extinct unless protection and management efforts that would be afforded by listing are implemented. There are tremendous and largely downplayed uncertainties in data on the species' distribution, abundance, and reproductive success; the report suggests that current protection and management activities are effective; and a population model, which would provide information on potential viability of the species given different demographic and management scenarios, has not been developed. The geographic distribution of Tricolored Blackbirds well may be much smaller than the historical distribution, and the abundance of Tricolored Blackbirds well may be much lower than the historical abundance. The same is known to be true or likely to be true of a high proportion of native species, especially those associated with wetlands, in the Central Valley. But without a population model, one cannot infer whether current or potential future levels of survival and reproduction are likely to lead to extinction.

Drafts of the executive summary, summary of listing factors, and listing recommendation were not provided to scientific peer reviewers. This is quite troubling given that these sections arguably are the most likely to inform the California Fish and Game Commission's determination of whether to list the Tricolored Blackbird as threatened. Without drafts of these sections, scientific peer reviewers are unable to evaluate whether the best science available, and associated scientific uncertainties, are represented fully and objectively. The report also notes that results of recent analyses of banding data, which may provide estimates survival of adult females, are not included. As a result, reviewers are unable to exercise due diligence in assessing the information content of these results. I am concerned that CDFW erroneously will give the executive summary, summary of listing factors, and listing recommendation the imprimatur of scientific peer review.

The report no doubt reflects a considerable amount of effort, and I believe that the effort was conducted in good faith. Nevertheless, the report contains much information on Tricolored Blackbirds that is not relevant to the status of the species, and numerous redundancies. Inclusion of information that is tangential to the status of the species dilutes the focus of the report. For example, several sections of *Biology and Ecology* are not closely related to the status of the species. As another example, quotations from early workers throughout the document are charming, but unnecessary. Many sections include long lists of uncertain observations from literature that was not peer-reviewed in lieu of a few sentences that synthesize those observations and include citations. I have flagged many of these instances on the document, and urge CDFW to consider that the potential of a document to inform action is affected not only by content but presentation. As a result of the unnecessary material and redundancies, the report does not meet one of its stated intents: "This status review report is not intended to be an exhaustive review of all published scientific literature relevant to the Tricolored Blackbird; rather, it is intended to summarize the key points from the best scientific information available relevant to the status of the species."

Given the report's intent to be a scientific document, metric rather than English units of measurement should be used, or metric equivalents provided. References to reproduction, which is more relevant to viability than any other metric, should be defined at first use and standardized throughout the report. It appears that reproductive success is defined as the number of young fledged per nest. Accordingly, reproductive success may vary within a breeding season and among breeding seasons. It is scientifically irresponsible to omit any indication of uncertainty (e.g., error estimates) from the figures.

In many instances, the report borders on plagiarism. For example, *Biology and Ecology* not only draws heavily on the *Birds of North America* account, which is acknowledged in part, but includes language that is nearly identical to that account. Elsewhere, language in the report is remarkably similar to language in other peer-reviewed and unpublished documents. It is not sufficient to note that "discussion is largely from" a particular source. Direct quotations should be included in quotation marks. Furthermore, it is preferable to simply refer readers to the original sources (e.g., the Birds of North America account), and, as necessary, to obtain permission from publishers to make copyright-protected sources available to readers.

It is essential to differentiate between the best science or best scientific information available and reliable science or scientific information. The best scientific information available on the status of Tricolored Blackbirds has extraordinary uncertainty. As a result, one cannot draw reliable or precise inferences about the status and trend of the species. CDFW may decide to follow the precautionary principle in recommending listing, but doing so given the current scientific uncertainty will reflect personal or policy values rather than a careful analysis of the best scientific information available.

An examination of the literature cited in the report indicates that survey methods for Tricolored Blackbirds are not rigorous. The methods have been cited in the peer-reviewed literature, but do not appear to have been peer reviewed in and of themselves. Most of the grey literature (e.g., reports to CDFW) does not contain sufficient detail about survey methods that the methods could be replicated by new observers. To the contrary, the survey methods described in the grey literature suggest that estimates of occurrence, nest density, abundance, and reproductive success likely are confounded by factors including but not limited to variation among observers, locations surveyed, observation distances and methods, observation duration, and judgments about habitat presence and quality. Leaders of the surveys have high confidence in the survey results, but their confidence does not appear to be based on scientific evidence, and therefore may not be defensible. For example, the protocol for the 2017 statewide survey claims, “For small colonies (approximately less than 500 birds), a precise count of the number of birds will usually be feasible. With care, this should provide a very precise estimate of the number of birds present.” This claim is not scientifically credible. Comments in the report such as “surveys were considered to have been comparable in effort by the survey organizers” and “the organizers of the surveys reported these three surveys . . . could be compared to assess the population trend” similarly allude to opinions that, at best, are not well informed by statistical knowledge. The strong reliance on these opinions of thoroughness and comparability by CDFW is not warranted.

Appendixes often are overlooked by readers or considered tangential. By contrast, much of the material in Appendix 2 is highly relevant to the confidence that readers reasonably may have in the scientific information in the report. Therefore, I believe that this material should be included in the report itself. Exposition of the extensive uncertainties in methods and estimates of status and trend should precede all other discussions in the report. Reorganizing the report to coalesce related information, and removal of redundancies and extraneous information, will leave ample room to include the material in Appendix 2 without increasing the length of the report.

The report does not mention or describe efforts to estimate detection probability. It is necessary to differentiate between occurrence (presence) and occupancy, given that over the past decade, occupancy increasingly is defined as a probability that accounts for imperfect detection.

Status Review Overview contends that the report “presents identification of habitat that may be essential to the continued existence of the species.” First, despite common and incorrect use, *habitat* is a species-specific construct. Habitat refers to the environmental attributes that are necessary and sufficient for survival and reproduction. Suitable habitat is redundant, although habitat quality may vary in space and time, and unsuitable habitat is an oxymoron. Also despite common and incorrect use, *selection* (e.g., of nesting locations) cannot be inferred unless rigorous choice experiments have been conducted. It is odd to reference *nesting substrate*, even if previous workers have done so. Tricolored Blackbirds do not nest in substrates; they nest in vegetation. I suggest changing this reference throughout. It is difficult to understand in the report whether some references are to the distribution of vegetation types or to the distribution of colonies in a given vegetation type. Estimates of inbreeding and effective population size are glossed over, but are highly relevant to inferences about the status of the species.

Habitat That May be Essential for the Species' Continued Existence in California does not identify habitat that may be essential. Instead, it describes vegetation types in which the species has nested and notes that the species requires open water and, during the breeding season, insects and plants on which to feed. It would be erroneous to conclude that all wetlands dominated by cattail or bulrush; all patches of Himalayan blackberry, thistle, and stinging nettle; and all fields of triticale within the historic range of Tricolored Blackbirds (or all wetlands, patches, and fields that exceed a given size) are essential for the species' continued existence. Similarly, it would be erroneous to conclude that all grasslands, shrublands, pastures, dry seasonal pools, and agricultural crops (including but not limited to alfalfa and rice) within ca. 3 miles of the above vegetation types are essential to the continued existence of the species. With respect to habitat, *Factors Affecting Ability to Survive and Reproduce* primarily notes that wetlands and grasslands in the Central Valley are much less extensive than before major expansion of human settlements and agriculture in the region.

Methods for estimating nest density, colony size, and reproductive success should be described in the report, and the uncertainties associated with those methods addressed explicitly and clearly. The methods that are described in the literature cited are not well explained, and estimates are likely to vary among observers. For example, Meese (2011) "re-entered colonies after the young had fledged and both young and adults had left the area and estimated nest densities by counting nests within six-foot wide line transects of variable lengths." Meese (2011) does not provide information on the number of transects per colony or per unit area, nor on the range of lengths of transects. Area occupied often was estimated visually; any validation of these estimates is not described. The number of nests along the transects was extrapolated to number of nests per acre, and then multiplied by the estimate of number of acres occupied by breeding birds. Uncertainty propagates extensively as a result of these extrapolations. In many cases, estimates of reproductive success were based on visual estimates of the number of fledglings divided by the estimated number of nests. These estimates have high uncertainty, which is not emphasized in the report.

It appears that a population model for Tricolored Blackbirds has not been developed, and that there currently are no explicit measures that can indicate whether a given abundance or reproductive level of the species is consistent with long-term viability. Population models represent the biology of a species and its demographic rates. Multiple methods can be used to estimate population growth. Estimates of demographic rates, typically including at a minimum survival and fecundity, are necessary to parameterize these models and estimate whether population size is increasing, decreasing, or stable. By changing values of parameters in the model, one can determine which demographic rates have the greatest effects on the population growth rate, and what values of demographic rates are necessary to minimize the probability that a population will become extirpated in a given period of time. A population model for Tricolored Blackbirds would allow for exploration of questions such as whether current estimates of survival and fecundity in different vegetation types are comparable and whether they are sufficient for population persistence, and how environmental changes could affect demography and likelihoods of persistence. Such a model also could help elucidate what range of confidence is needed around estimated demographic rates to infer positive or negative effects on a population given how these rates affect population growth in model results. Without a population model, population-level effects of changes in demographic rates that may be driven by land use or natural environmental variation are difficult to project or place in context. Similarly, without a population model, it is more likely that low precision might lead one to underestimate the potential effects of a change in survival or other demographic rates on probability of persistence.

Population models facilitate assessment, via analyses of elasticity or sensitivity, of the relative effects of given demographic rates, or ages of individuals, on population growth rates. By systematically increasing or decreasing each demographic rate in extensive simulations of the population model, one can identify components of a population that have the greatest relative effect on the population's growth rate. Many population models also can incorporate environmental stochasticity.

Some might question whether enough information is available to construct a population model for Tricolored Blackbirds. Data gaps may hinder parameterizing a model and using the results to inform management. However, the parameterization process would allow for a data inventory, lead to structured identification of existing data or knowledge gaps, and inform future priorities for research, such as new field studies to estimate demographic rates. Moreover, formal expert elicitation, which is not the same as asking people what they think, could be used to estimate values of parameters for which empirical data are sparse. Expert elicitation encompasses a rigorous set of methods for synthesizing expert knowledge to inform decision-making, and has proven reliable and practical when field data are limited. It is useful for identifying plausible alternative hypotheses, estimating model parameters, and prioritizing collection of data that may have considerable bearing on policy or management decisions. The information may be elicited as point estimates or as distributions of parameters. Expert elicitation may yield useful information until such time as empirical estimates are available. I am happy to provide more information on these methods.

Status and Trends in California does not synthesize the available information into clear statements about apparent trend and associated uncertainties. Table 2 does not in fact summarize effort, nor does it provide information on the actual methods used. Drawing comparison between two groups of years that differ in duration (1994–2000 and 2008–2017) is questionable. Attempts to standardize sampling effort that are described in the report, and analyses of Christmas Bird Count data, include numerous dubious assumptions, many of which I flagged on the report itself.

Existing Management includes summaries of habitat conservation plans and natural community conservation plans that address Tricolored Blackbirds. This section relies heavily on documents produced by permit holders or permit applicants and their consultants. The section does not critically evaluate the claims in these documents, and does not present evidence of whether the mitigation actions have been effective. Additionally, because much material in the section includes local geographic references, the details will not be intelligible to individuals who are not quite familiar with the area covered by the existing or pending permits.

Factors Affecting Ability to Survive and Reproduce does not provide an estimate of the number or proportion of Tricolored Blackbirds that are shot or poisoned each year. Despite some observations of mortality, there is no evidence that shooting or poisoning, or predation by other wild animals, is a major source of mortality. The report does not address potential effects of predation by domestic or feral animals, such as cats. Referencing “loss” or “destruction” of a colony as a result of agricultural harvest is misleading. The report instead should reference failure of one brood during a given breeding season.

On the basis of the available scientific information, the potential ramifications of agricultural harvest are unclear. Arguments that after harvest, individuals that were nesting in the harvested field are less likely to fledge young are speculative and rely heavily on a report (Meese 2008) that was not peer reviewed. Martin (1987), cited in both Meese (2008) and the report, is a review rather than an assessment of Tricolored Blackbirds. It is possible that reproductive success following harvest is lower that reproductive success in the absence of harvest, but without a population model, the potential effects of changes in reproductive success on population viability cannot be assessed. Potential effects of neonicotinoids on population viability also are unknown, but the effects of different levels of mortality could be simulated with a population model.

Protection Afforded by Listing does not make a strong case that listing is more likely to increase the species’ long term viability than current activities. As noted in the report, Tricolored Blackbirds are designated as a species of special concern by CDFW. Among the actions prompted by such designation are “to encourage additional management . . . to ensure population viability, and to preclude the need for listing under CESA.” As a species of special concern, Tricolored Blackbirds already are covered in habitat conservation plans and natural community conservation plans, and are the subject of collaborative conservation between regulatory agencies and landowners. Increasing the availability of funds for conservation is not a compelling (or legally permissible) rationale for listing. I do not believe that a listing is scientifically warranted, at least until the results of a population model are available.

Not only ecological goals (e.g., reduction in threats to a species or increases in species’ distributions, abundances, or vital rates) but social and institutional goals affect perceptions of whether conservation actions are successful. Conservation is unlikely to succeed without, for example, feelings of ownership by stakeholders and the implementation of actions that are widely supported. The report notes that CDFW “continues to support implementation of the conservation plan as revised by the Tricolored Blackbird Working Group,” and generally suggests a high level of cooperation among the public and private sector. *Management Recommendations* include supporting cooperative efforts among government, industry, and the public and extensive conservation on private lands. *Protection Afforded by Listing* indicates that the primary benefit of listing would be increases in the amount of conservation funds available. The report does not indicate that the desirable effects of listing are likely to outweigh the challenges to conservation that well may result from listing, or that listing is well-supported by the best scientific information available.

Thank you again for the opportunity to review the report. I’m happy to discuss any of the comments in this letter, or tracked on the draft report, at your convenience, or to review any subsequent drafts or related materials.

Sincerely,

Erica Fleishman

Erica Fleishman, Ph.D.
Professor, Department of Fish, Wildlife and Conservation Biology
Director, Center for Environmental Management of Military Lands

STATE OF CALIFORNIA
NATURAL RESOURCES AGENCY
DEPARTMENT OF FISH AND WILDLIFE

REPORT TO THE FISH AND GAME COMMISSION
A STATUS REVIEW OF THE
TRICOLORED BLACKBIRD
(*Agelaius tricolor*) IN CALIFORNIA

CHARLTON H. BONHAM, DIRECTOR
CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE
Draft – October 13, 2017

CONFIDENTIAL—CDFW EXTERNAL PEER REVIEW DRAFT—DO NOT CIRCULATE

Table of Contents

EXECUTIVE SUMMARY

[Note to reviewers: The executive summary will be prepared after peer review.]

Commented [EF1]: Needs to be made available to scientific peer reviewers to ensure that the best science available, and associated scientific uncertainties, are represented fully, objectively, and transparently

REGULATORY FRAMEWORK

Petition Evaluation Process

A petition to list the Tricolored Blackbird (*Agelaius tricolor*) as endangered under the California Endangered Species Act (CESA) was submitted to the Fish and Game Commission (Commission) on August 19, 2015 by the Center for Biological Diversity. Commission staff transmitted the petition to the Department of Fish and Wildlife (Department) pursuant to Fish and Game Code section 2073 on August 20, 2015, and published a formal notice of receipt of the petition on September 4, 2015 (Cal. Reg. Notice Register 2015, No. 36-Z, p. 1514). The Department's charge and focus in its advisory capacity to the Commission is scientific. A petition to list or delist a species under the CESA must include "information regarding the population trend, range, distribution, abundance, and life history of a species, the factors affecting the ability of the population to survive and reproduce, the degree and immediacy of the threat, the impact of existing management efforts, suggestions for future management, and the availability and sources of information. The petition shall also include information regarding the kind of habitat necessary for species survival, a detailed distribution map, and any other factors that the petitioner deems relevant" (Fish & G. Code, § 2072.3).

On October 2, 2015, the Department provided the Commission with its evaluation of the petition, "Evaluation of the Petition from the Center for Biological Diversity to List Tricolored Blackbird (*Agelaius tricolor*) as Endangered Under the California Endangered Species Act," to assist the Commission in making a determination as to whether the petitioned action may be warranted based on the sufficiency of scientific information (Fish & G. Code, §§ 2073.5 & 2074.2; Cal. Code Regs., tit. 14, § 670.1, subds. (d) & (e)). Focusing on the information available to the Department relating to each of the relevant categories, the Department recommended to the Commission that the petition be accepted.

At its scheduled public meeting on December 10, 2015, in San Diego, California, the Commission considered the petition, the Department's petition evaluation and recommendation, and comments received. The Commission found that sufficient information existed to indicate the petitioned action may be warranted and accepted the petition for consideration. Upon publication of the Commission's notice of its findings, the Tricolored Blackbird was designated a candidate species on January 8, 2016 (Cal. Reg. Notice Register 2016, No. 2-Z, p. 57).

Status Review Overview

The Commission's action designating the Tricolored Blackbird as a candidate species triggered the Department's process for conducting a status review to inform the Commission's decision on whether to list the species. At its scheduled public meeting on December 8, 2016, in San Diego, California, the

Commission granted the Department a six-month extension to complete the status review and facilitate external peer review.

This status review report is not intended to be an exhaustive review of all published scientific literature relevant to the Tricolored Blackbird; rather, it is intended to summarize the key points from the best scientific information available relevant to the status of the species. The final report represents the Department's evaluation of the current and potential future ~~conservation~~ status of the species and is informed by independent peer review of a draft report by scientists with expertise relevant to Tricolored Blackbird. It is intended to provide the Commission with the most current information on the Tricolored Blackbird and to serve as the basis for the Department's recommendation to the Commission on whether the petitioned action is warranted. The status review report also ~~presents~~ identifi~~cation of~~es habitat that may be essential to the continued existence of the species and provides management recommendations for recovery of the species (Fish & G. Code, § 2074.6). Receipt of this report is to be placed on the agenda for the next available meeting of the Commission after delivery. At that time, the report will be made available to the public for a 30-day ~~public~~ comment period prior to the Commission taking any action on the petition.

Existing Regulatory Status

California Endangered Species Act

The Tricolored Blackbird was the subject of three previous CESA listing petitions. In 1991, the Yolo chapter of the National Audubon Society submitted a petition to the Commission to list the species as endangered. After reviewing the document and other available information, the Department determined that the petitioned action might be warranted and recommended to the Commission that it accept and consider the petition. In March 1992, the Commission voted to accept the petition and designated the Tricolored Blackbird as a candidate for listing. ~~Researchers working d~~During the 1992 breeding season, researchers discovered that the ~~population~~ abundance of the species (number of individuals) was much ~~larger~~ greater than previously thought, and the Yolo Audubon Society withdrew the petition ~~based~~ on basis of the new ~~population~~ abundance data. The Commission allowed the petition to be withdrawn, but urged the Department to work with interested persons and groups to develop conservation measures for the Tricolored Blackbird. The species was again petitioned to be listed under CESA in 2004 (Cal. Reg. Notice Register 2004, No. 18-Z, p. 568). The petition evaluation report by the Department (Gustafson and Steele 2004) stated there was sufficient information to indicate the petitioned action may be warranted; however, the Commission voted to reject the petition (Fish and Game Commission meeting, Feb. 3, 2005). On October 8, 2014, the Center for Biological Diversity submitted a petition to list the Tricolored Blackbird as endangered (Cal. Reg. Notice Register 2014, No. 44-Z, p. 1861). The Commission referred the petition to the Department for an initial evaluation on October 15, 2014. At its December 3, 2014 meeting in Van Nuys, California, the Commission voted to take emergency action to add Tricolored Blackbird to the list of endangered species pursuant to Fish and Game Code section 2076.5, with the related regulation as approved by the Office of Administrative Law taking effect for an initial term of six months beginning on December 29, 2014 (Cal. Reg. Notice Register 2015, No. 2-Z, p. 91). At its meeting in Mammoth Lakes on June 11, 2015,

the Commission voted to reject the 2014 petition and on June 30, 2015 the emergency regulation adopted in December 2014 expired by operation of law.

Federal Endangered Species Act

The Tricolored Blackbird also has a ~~listing~~ history of consideration for listing under the federal Endangered Species Act (ESA). In 1988, the United States Fish and Wildlife Service (USFWS) issued a contract~~ed~~ for a compilation of all historical information on the distribution and abundance of the Tricolored Blackbird, resulting in the work of Beedy et al. (1991). In 1991, the USFWS identified the Tricolored Blackbird as a category 2 candidate for ~~federal~~ listing. However, in 1996, the USFWS eliminated category 2 species from the list of candidate species. In 2004, the USFWS received a petition to list the Tricolored Blackbird as a threatened or endangered species from the Center for Biological Diversity. In 2006, the USFWS issued a 90-day finding in response to the petition that listing the Tricolored Blackbird was not warranted (50 CFR Part 17, Dec 5, 2006). On February 3, 2015, the Center for Biological Diversity submitted a petition to the USFWS to list the Tricolored Blackbird as an endangered species ~~under the federal endangered species act~~ and to designate critical habitat concurrent with listing. The petition is currently under review by the USFWS (50 CFR Part 17, Sept 18, 2015).

Commented [EF2]: if USFWS is involved, it's likely federal by definition

California Species of Special Concern and USFWS Birds of Conservation Concern

The Tricolored Blackbird is listed as a Priority 1 Species of Special Concern (SSC) by the Department. The Department's SSC designation is administrative and is intended to alert biologists, land managers, and others to a species' declining or at-risk status, to encourage additional management ~~considerations for~~of these species to ensure population viability, and to preclude the need for listing under CESA. SSCs are defined as species, subspecies, or distinct populations of animals native to California that currently satisfy one or more of the following criteria: extirpated from the state in the recent past; listed under ESA as threatened or endangered, but not under CESA; meets the state definition of threatened or endangered but has not been formally listed; experiencing, or formerly experienced, serious (noncyclical) population declines or range retractions (that have not been reversed), which if continued or resumed could qualify the species for threatened or endangered status under CESA; has naturally small populations ~~and/~~or range size and exhibits high susceptibility to risk from any factor that, if realized, could lead to declines that would qualify it for threatened or endangered status (Shuford and Gardali 2008). In 2008, the USFWS updated its Birds of Conservation Concern report, identifying "species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act of 1973" (USFWS 2008). The Tricolored Blackbird was included on two Bird Conservation Region lists (Coastal California and Great Basin), the USFWS Region 8 (California and Nevada) list~~, (California and Nevada)~~ and the ~~N~~national list. Neither ~~of these~~the state-level nor the federal ~~"~~species of concern~~"~~ designations provides the species with formal regulatory status ~~like~~ as does the the CESA or ESA ~~or CESA~~; however, impacts to SSC are generally considered potentially significant under CEQA, and therefore mitigation for impacts may be provided (see Existing Management section).

Commented [EF3]: This does not seem to be the best citation for an administrative designation that is not restricted to birds

Commented [EF4]: Need to provide more context for this statement by noting that coastal California and the Great Basin appear to be on the edge of the species' distribution

Commented [EF5]: Are all of these lists developed by USFWS?

Commented [EF6]: Clarify that throughout the document, "impacts" is being used as a synonym for negative effects. The word has other definitions and interpretations, and some of those interpretations are positive. Ideally, increase clarity by simply referring to negative effects

Commented [EF7]: Provided, or required?

Migratory Bird Treaty Act

The Tricolored Blackbird is included on the list of species protected under the Migratory Bird Treaty Act (MBTA). ~~The MBTA makes i~~It is unlawful to take, possess, transport, sell, or purchase any bird listed in the Act, or its nest or eggs, without a permit issued by the USFWS.

California Fish and Game Code

The Fish and Game Code includes certain protections for game and nongame birds~~, including nongame birds~~. Sections applicable to the Tricolored Blackbird include the following. CESA defines take as hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill (Fish & G. Code, § 86).~~:~~

Commented [EF8]: Moved up from "Protection afforded by listing"

> Section 3503 – It is unlawful to take, possess, or needlessly destroy the nest or eggs of any bird, except as otherwise provided by this code or any regulation made pursuant thereto.
>
> Section 3513 – It is unlawful to take or possess any migratory nongame bird as designated in the Migratory Bird Treaty Act or any part of such migratory nongame bird except as provided by rules and regulations adopted by the Secretary of the Interior under provisions of the Migratory Treaty Act.
>
> Section 3800(a) – All birds occurring naturally in California that are not resident game birds, migratory game birds, or fully protected birds are nongame birds. It is unlawful to take any nongame bird except as provided in this code or in accordance with regulations of the commission.

BIOLOGY AND ECOLOGY

Commented [EF9]: It would be preferable to focus this section on the biology and ecology most relevant to the status of the species. Other information could be included in an appendix. The species' morphology and taxonomy, for example, are not relevant to its status.

Species Description

The Tricolored Blackbird was first collected by Nuttall in 1836 near Santa Barbara, California~~A~~ (Nuttall 1840, Baird et al. 1874). A male specimen was sent to John James Audubon who described it as a unique form of blackbird in his well-known *Ornithological Biography* (Audubon 1839).

The Tricolored Blackbird is sexually dimorphic, with the male plumage entirely black except for the bright red lesser wing coverts forming a conspicuous red patch ~~on the wing~~ ("shoulder" or "epaulets") on the wing and white median coverts forming a distinct border to the red. The black body plumage is glossed bluish when viewed in sunlight. The female is mostly dark brown dorsally and heavily streaked ventrally with dark brown streaks merging to form a largely solid dark brown belly (Beedy et al. 2017). The head of the female is indistinctly patterned with a whitish supercilium, malar, chin, and throat.

Commented [EF10]: The description of appearance largely is copied from the Birds of North America account. My impression is that a few words were changed so it would not be a direct quotation. It would be more appropriate to refer readers to the account and obtain permission to make the account available to readers who do not have institutional or other access. Alternatively, directly cite the account and include the material in quotation marks.

Although similar in appearance to the related Red-winged Blackbird (*A. phoeniceus*), several features can be used to distinguish the two species (described by Nuttall 1840, Cooper 1870, Baird et al. 1874). The black plumage of the Tricolored Blackbird male has a soft bluish luster that is lacking in the Red-winged Blackbird. The lesser wing coverts (the red "shoulder") on the male Tricolored Blackbird are a much deeper red (described as crimson, carmine, or the color of venous blood) compared to the brighter red color (vermilion or scarlet) in the Red-winged Blackbird. The median coverts in the

Tricolored Blackbird are white (pale-yellowish when fresh) and create a stark contrast between the black and red feathers on the wing, whereas in the Red-winged Blackbird they are generally yellowish (or black in the subspecies that breeds in much of the Central Valley). The bill of the Tricolored Blackbird averages thinner and can appear more sharply pointed. In flight, the wings of the Tricolored Blackbird appear to have a more pointed shape (vs. rounded in the Red-winged Blackbird) due to differences in length of the primary flight feathers. Female Tricolored Blackbirds have darker plumage than most female Red-winged Blackbirds, although this difference is less pronounced in the Central Valley where the subspecies of Red-winged Blackbird is relatively dark (Beedy et al. 2017).

Taxonomy

The Tricolored Blackbird is a ~~species in the avian family~~member of the Icteridae, which is restricted to the Americas ~~in the Western Hemisphere~~ and includes blackbirds, orioles, cowbirds, grackles, and meadowlarks (Skutch 1996). There are about 100 species in the family, most of which occur in the tropics. Following recent taxonomic changes that removed several South American species from the genus *Agelaius*, there are currently five species in the genus worldwide (Remsen 2017). ~~In addition to the Tricolored Blackbird, t~~The only other species that occurs on the North America mainland is the much more widespread and diverse Red-winged Blackbird. The other three species in the genus occur in the Greater Antilles: *A. assimilis* (the Red-shouldered Blackbird of western Cuba), *A. humeralis* (the Tawny-shouldered Blackbird of Hispaniola and Cuba), and *A. xanthomus* (the Yellow-shouldered Blackbird of Puerto Rico) (Beedy et al. 2017). There are no recognized subspecies of Tricolored Blackbird (AOU 1957).

Commented [EF11]: Use the most recent AOU checklist of North and Middle American birds rather than a version that is 60 years old

Geographic Range and Distribution

The Tricolored Blackbird primarily occurs in ~~is nearly endemic to the state of~~ California, with small numbers of birds ~~extending the species' range~~ in~~to~~ ~~neighboring states of~~ Oregon, Washington, and Nevada, and in Baja California.

Commented [EF12]: Washington is not adjacent to California

Breeding Range

~~The majority of the~~ Tricolored Blackbird's ~~breeding range is composed o~~inhabit ~~f~~ two disjunct regions in~~of~~ California and Baja California, separated by the Transverse Ranges of southern California (Figure 1). The larger of the two areas ~~occupies~~ includes the lowlands west of the Sierra Nevada, extending west across the Central Valley to the coast from Sonoma County south to Santa Barbara County. The second area ~~is composed~~includes ~~of~~ the lowlands west of the deserts in southern California, extending south into northwestern Baja California. Small numbers of birds extend the range to the north in isolated low-lying areas on the northern California coast and to isolated areas in northeastern California, Oregon, and eastern Washington. Similarly, the range extends east from the southern Central Valley to small areas in the Mojave Desert~~, and to a~~. The species currently is known to occupy a single area in Douglas County, Nevada (Skutch 1996, Ammon and Woods 2008, Beedy et al. 2017).

Winter Range

In ~~the~~ winter, ~~the~~ Tricolored Blackbirds mostly ~~withdraws~~ are absent from the~~portion of its~~ir breeding range north of the Central Valley (northeastern California~~A~~, Oregon, and Washington) and from Nevada to the lowlands of central and coastal California (Wahl et al. 2005, Ammon and Woods 2008, Beedy et al. 2017), although a small number of birds are occasionally documented throughout the northern breeding range during winter ~~months~~ (Gilligan et al. 1994, Spencer 2003, eBird Dataset 2016). The species ~~can be found~~occurs in most of the remainder of its range year-round, with shifts in distribution as described below.

Distribution of Breeding Colonies

Within the breeding range, the largest breeding colonies and the large majority of the breeding population occur in the Central Valley of California (Figure 2b). In all California statewide surveys conducted since 1994, most (≥90% in all years but 1997) of the ~~population has~~ ~~occurred~~ observed birds were detected in the Central Valley counties during the early breeding season (Hamilton et al. 1995, Beedy and Hamilton 1997, Hamilton 2000, Kelsey 2008, Kyle and Kelsey 2011, Meese 2014a).

Commented [EF13]: Truth is not known – this is an inference drawn from observations

Commented [EF14]: What are the approximate dates of the early breeding season?

Although the overall distribution and breeding locations vary from year to year, Tricolored Blackbirds at the species level exhibit some site fidelity ~~to traditional use areas~~. ~~These areas likely provide all of the critical resources needed by breeding colonies, while the specific nesting sites used in the area can change from year to year (Beedy et al. 1991). In the Central Valley, there are distinct regions that frequently support multiple colonies and a large proportion of the breeding population.~~ In the southern San Joaquin Valley, the largest colonies are typically ~~found annually~~detected in an area centered at the junction of Kern, Kings, and Tulare counties (Figure 2). In the northern San Joaquin Valley, multiple large colonies regularly are detected in Merced County ~~regularly supports multiple large colonies~~. Further north in the Central Valley and Sierra Nevada foothills, breeding colonies are regularly ~~distributed more broadly~~detected from Sacramento County north through the Sacramento Valley to Butte and Colusa counties. In southern California, breeding colonies are ~~located~~ detected mainly in the western portions of Riverside and San Bernardino Counties, south through the interior of San Diego County (Figure 2; Feenstra 2009). Colonies ~~are~~ appear to be patchily distributed throughout the rest of the species' range in California, particularly in the Coast Ranges and on the coastal slope.

Commented [EF15]: Not necessarily known whether individuals breed in the same locations among years

The limited known range of the species in Oregon, Washington, and Nevada is believed to be maintained by irregular occurrences of relatively small numbers of birds (Gilligan et al. 1994, Spencer 2003, Wahl et al. 2005, Ammon and Woods 2008). These ~~neighboring~~ states are believed to have historically supported less than 1% of the species' population (Beedy et al. 1991). Although breeding previously was more widespread, breeding in Baja California now appears to occur~~s~~ at ~~only~~ a few isolated locations (Erickson et al. 2007, Erickson and de la Cueva 2008, Feenstra 2013, Erickson et al. 2016). Currently, no more than about 1% of the species' population is believed to breed~~s~~ outside of California.

Breeding colonies typically occur in valleys or low-lying areas with ~~suitable~~ nesting habitat and extensive grassland, agriculture, or other land-cover or land-use types in which the species ~~suitable~~ forag~~ing~~

Commented [EF16]: Despite common and incorrect use, habitat is suitable by definition, although its quality can vary

~~habitat~~es. ~~However, t~~The elevation of colony locations varies greatly across the range. The majority of the population breeds below an elevation of about 300 feet in the Central Valley. In the central Sierra foothills, colonies occur up to 1,720 feet, although most ~~occur~~ have been detected near the valley floor at or below about 300 feet elevation (Airola et al. 2015a). In ~~the~~ southern California ~~portion of the range~~, most colonies occur below about 1,500 feet, although inland colonies ~~at more inland locations~~ are at higher elevations. Further inland, such as in the Mojave Desert and to the northeast in the Modoc Plateau, colonies occur at elevations up to several thousand feet. Grinnell and Miller (1944) included a record of 4,400 feet on the “South Fork of the Pit River” in Modoc County. The single known breeding location in Nevada is at 4,730 feet ~~elevation~~ (Ammon and Woods 2008).

Commented [EF17]: This is purported to be a scientific document, so metric units should be provided throughout

Winter Distribution

Although Tricolored Blackbirds ~~can be found~~are present throughout much of the California breeding range year-round, most birds withdraw from the southern San Joaquin Valley and the northern Sacramento Valley in the winter (Grinnell and Miller 1944, Beedy et al. 2017). Band recoveries and observational studies have documented movement of birds away from these portions of the range toward the central part of the valley surrounding and including the Sacramento-San Joaquin Delta region (Neff 1942, DeHaven and Neff 1973, DeHaven et al. 1975b). There is a general concentration of birds in this region ~~during the winter~~, a~~s well as~~nd in the northern San Joaquin Valley in Merced County and coastal areas north and south of the San Francisco Bay area, during winter (Orians 1961a, Payne 1969, Stallcup 2004) (Figure 3). Evidence from banded birds recovered outside the Central Valley is limited, but birds from throughout the northern range are ~~thought~~ hypothesized to follow the general pattern of winter movement to central and coastal California (DeHaven et al. 1975b, Beedy 2008). Although a relatively large portion of the population winters in this region, wintering flocks ~~can be found~~have been detected at widely scattered ~~points~~ locations throughout the species' range north of the Transverse Ranges (DeHaven et al. 1975b).

Commented [EF18]: Unclear

South of the Transverse Ranges, birds from Santa Barbara County south to Baja California appear to occupy the region year-round (Unitt 2004, Beedy 2008), although distribution in the southern portion of the range is patchy in all seasons. Recoveries of birds banded in southern California have revealed ~~much more localized~~ movements over much shorter distances ~~compared to~~than those of birds from the Central Valley (Neff 1942, DeHaven and Neff 1973).

Genetics and Population Structure

Hamilton (2004) documented behavioral differences between Central Valley and southern populations of ~~the~~ Tricolored Blackbirds, and suggested that a lack of gene flow may have led to genetically distinct populations. While banding studies indicate extensive movement of ~~the~~ Tricolored Blackbird ~~populations~~ throughout the entire length of the Central Valley (DeHaven et al. 1975b), DeHaven and Neff (1973) ~~reported on recoveries of banded birds from the Central Valley and southern California and~~ suggested that little or no ~~interchange~~ exchange occurs between populations north and south of the Transverse Ranges. The observation of a single banded bird in the Mojave Desert of northern Los Angeles County was the first ~~data~~ datum documenting movement of the species from the Central Valley to the desert (Feenstra 2009)~~, although there is a report from the late 1800s documenting a flock of Tricolored Blackbirds moving in the opposite direction (Belding 1890)~~. In 2014 and 2016, the second and third Tricolored Blackbirds that had been banded in the Central Valley were photographed in San Bernardino County, providing further ~~confirmation~~ evidence of movement from the valley to the Mojave Desert (Meese 2014b, Aug 2017 email from R. Meese to N. Clipperton; unreferenced).

A ~~single genetic study~~ microsatellite and mitochondrial DNA analysis (Berg et al. 2010) on the Tricolored Blackbird did not find evidence of ~~significant~~ substantial genetic differentiation ~~population structuring~~ between the Central Valley and ~~a southern population composed of birds from~~ the Mojave Desert and southern California. The birds sampled in the south~~ern population were found to exhibit~~ had higher allelic diversity~~, suggesting that the southern population may be an important reservoir of genetic variation for the species (Berg et al. 2010)~~. ~~In assessing population structure, it may be inappropriate to combine b~~Birds from the Mojave Desert ~~with~~ and birds from south of the Transverse Ranges ~~to~~ were not genetically distinct~~represent a single southern population, especially if the Mojave Desert birds are linked to the Central Valley~~. There was statistically significant evidence of inbreeding (F_{IS}) in both putative populations, and F_{IS} was about 33% greater in southern than in central California. A greater percentage of birds appeared to move from southern to Central California than vice versa. The historical effective population size (Ne) was estimated to be three to eight times greater in southern California than in central California, and reductions in Ne appeared to be considerably greater in southern California. ~~In addition,~~A caveat is that samples were obtained at only two colonies south of the Transverse Ranges and at two colonies in the desert, sample sizes were small at some sites, and the study used a relatively small number of genetic markers. Researchers at UCLA are currently conducting a study ~~using~~ with more advanced genomic techniques to characterize genetic variation, population structure, and spatial and temporal patterns of movement throughout the range of the Tricolored Blackbird (Feb 2017 email from K. Barr to N. Clipperton; unreferenced).

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Commented [EF19]: Estimates of inbreeding and effective population size are highly relevant to the species' status

Commented [EF20]: colonies?

Commented [EF21]: What are those methods?

Movements

Most Tricolored Blackbird are resident in ~~the state of~~ California, with seasonal movements leading to shifts in distribution within the state over the course of a year. ~~Grinnell and Miller (1944) wrote that the Tricolored Blackbird is "resident within State [California], but partly migratory within the Sacramento-San Joaquin drainage system; all populations are in some degree nomadic and in fall and winter normally leave the immediate vicinity of the nesting colonies."~~ Banding studies (Neff 1942, DeHaven and Neff 1973, DeHaven et al. 1975b) and observations of unbanded birds (Payne 1969) ~~demonstrated~~ suggested that most Tricolored Blackbirds reside throughout the Central Valley from March through September, and then move into the Sacramento-San Joaquin Delta and northern San Joaquin Valley (primarily Merced County) and coastal locations during winter. More extensive migratory movements are made by small numbers of birds that breed north of the Central Valley as far north as ~~the state of~~ Washington (Wahl et al. 2005); most of these migratory individuals apparently ~~mostly~~ return to California in ~~the~~ winter. ~~In southern California south of the Transverse Ranges, birds seem to undergo much more localized seasonal movements compared to those from the Central Valley (Neff 1942, DeHaven and Neff 1973).~~

Commented [EF22]: Last sentence redundant with above

Itinerant Breeding

Individual Tricolored Blackbirds often occupy and breed at two or more sites during the breeding season, a phenomenon known as itinerant breeding (Hamilton 1998). ~~Itinerant breeding is a very rare trait among birds, and occurs exclusively in species that move between breeding attempts to locate or follow locally abundant food sources (Jaeger et al. 1986). Although early observers suspected that Tricolored Blackbirds nested more than once in a season at multiple locations (e.g., Neff 1937), the movements of Tricolored Blackbirds have been described as "sheerly and illogically erratic" (Neff 1942), "wanderings" (Payne 1969), and highly nomadic (Beedy et al. 1991).~~ Recoveries of banded Tricolored Blackbirds ~~provided~~ document~~ation of~~ed ~~inter~~annual breeding at widely separated locations, but within-year movements during ~~a single~~the breeding season were not documented prior to the 1990s (Neff 1942, DeHaven and Neff 1973). ~~The movements of Tricolored Blackbirds continue to be somewhat unpredictable from year to year, but~~ Hamilton et al. (1995) ~~demonstrated~~ suggested that most of the adults in the Central Valley breed more than once and often at different locations. ~~This itinerant breeding follows a pattern of i~~Initial breeding is believed to occur in the south, mostly San Joaquin Valley and southern foothills to Sacramento County, with a shift north for a second breeding attempt, primarily in the Sacramento Valley and adjacent foothills. The timing and degree to which this shift occurs ~~vary~~ varies from year to year (Hamilton 1998). The timing of breeding in Sacramento County was intermediate to that of the San Joaquin and Sacramento Valleys, with initiation of breeding in Sacramento County 10 days later than in the San Joaquin Valley, but over a month before most breeding in the northern Sacramento Valley (Figure 4). ~~On the Central California Coast in Monterey County, 25% of radio-tagged birds moved between study colonies during a breeding season, suggesting itinerant breeding on a smaller scale (Wilson et al. 2016).~~

The following discussion of seasonal movements is largely from Beedy and Hamilton (1997) and Beedy et al. (2017).

Spring Movements from Wintering Areas

The species vacates wintering areas concentrated around the Sacramento-San Joaquin River Delta and along coastal California in mid-February. Birds arrive at breeding locations and establish colonies in Sacramento County and throughout the San Joaquin Valley from early March to early April (DeHaven et al. 1975b). Colonies at foothill locations adjacent to the San Joaquin and Sacramento valleys may be settled by late March, but many are not settled until May. In southern California and Baja California, the species may nest anytime ~~throughout~~ during April and May.

Flocks of Tricolored Blackbirds roam widely within the breeding range in the weeks before breeding begins and between breeding attempts~~. Breeding season wanderings may serve~~, perhaps to locate areas of abundant insect ~~food resources near which breeding colonies are established~~prey (Payne 1969). Similar behaviors have been documented in nomadic flocking species of semiarid habitats in Asia, Africa, and Australia, where colonial breeding occurs opportunistically in areas of high prey abundance (Payne 1969).

Commented [EF23]: Actually it's fairly common, but the distance moved varies among individuals and species

Commented [EF24]: Quantify

Commented [EF25]: Does this mean that they fledge multiple broods, or that they attempt to breed more than once if the first attempt fails?

Commented [EF26]: Redundant with below

Commented [EF27]: Why paraphrase so extensively here rather than directing readers to those sources? Any language taken verbatim from those sources should be placed within quotation marks. Although a few words have been changed, the sections below are so similar to the Birds of North America account that they arguably qualify as plagiarism.

Breeding Season Movements

Commented [EF28]: Redundant with above

~~During the breeding season, Central Valley birds often move north to the Sacramento Valley after first nesting efforts (March–April) in the San Joaquin Valley and Sacramento County, with small numbers moving further north to northeastern California and southern Oregon (Beedy and Hamilton 1997, Hamilton 1998).~~ On the floor of the Sacramento Valley north of Sacramento County, the largest colonies are typically not settled until May or early June. Recent banding results suggest ~~a degree of colony cohesion, where~~that many birds in~~at~~ a colony may move and breed together again in a new location, but banding results also suggest a high degree of mixing between breeding attempts. ~~Although later nesting is typical in northern portions of the range, s~~Small colonies may form throughout the breeding season anywhere in the ~~geographic distribution~~species' range (Hamilton 1998). On the Central California Coast in Monterey County, 25% of radio-tagged birds moved between study colonies during a breeding season~~Radio telemetry studies have shown that birds move from one breeding colony to another while both are active~~, due presumably to reproductive failures at the first colony, but the causes of these movements ~~remain undocumente~~are not known~~d~~ (Wilson et al. 2016).

Commented [EF29]: Include citation

Post-breeding Movements

Most Central Valley birds occur in the Sacramento Valley at the end of the breeding season and remain until mid-September, apparently attracted to ripening and recently harvested rice (DeHaven et al. 1975b). In mid-September most move south into the Sacramento-San Joaquin Delta, Merced County, and coastal locations.

Winter Movements

In winter, numbers decline in the Sacramento Valley and increase in the Sacramento-San Joaquin Delta and northern San Joaquin Valley (Neff 1942, Orians 1961a, Payne 1969, DeHaven et al. 1975b). Large foraging flocks ~~have traditionally~~historically ~~occurred in~~occupied pasture~~land~~s in southern Solano County by late October and may join large flocks of several blackbird species to roost on islands in the eastern part of Suisun Marsh. Wintering flocks ~~formerly numbering~~of more than 10,000 birds assembled near dairies on the Point Reyes Peninsula, Marin County, by mid-October, but these numbers have been reduced in recent years. Highly variable numbers of birds also winter in the central and southern San Joaquin Valley, with flocks of hundreds or thousands ~~seen~~ reported in most years in the general area where large colonies breed in ~~the~~ early spring (Kern and Tulare counties; eBird Dataset 2016). Winter flocks consist at times of only Tricolored Blackbirds, either mixed-sex or single-sex, and at other times Tricolored Blackbirds occur in mixed-species blackbird flocks. Birds from one large winter roost in Sacramento County foraged over an area 32 km in diameter (Neff 1937). Winter distribution and movements ~~need further study~~are not well understood.

Commented [EF30]: past tense or current tense?

Commented [EF31]: Possibly does not accurately represent proportions of different species

Commented [EF32]: Relevance here unclear

Home Range and Territoriality

~~Unlike most species of songbirds that defend a territory in which they nest and acquire most of their necessary resources, t~~The Tricolored Blackbird breeds in dense colonies in which adult males defend only a small area surrounding the nest site, and this only until nests are established and eggs are laid

(Lack and Emlen 1939, Payne 1969). Nest density and male territory size can vary among colonies with individual nests in the densest colonies built within a foot or less of each other (Hosea 1986, Beedy et al. 1991). In some cases two nests may even share interwoven strands of nest material (Lack and Emlen 1939). Male territories have been measured from 1.8 m^2 to 3.25 m^2 (Lack and Emlen 1939, Orians 1961) and nest densities have been observed at up to six nests per square meter (Beedy et al. 2017). The greatest nesting density reported occurred in a rare nesting substrate (the vegetation in which nests are constructed), giant cane (*Arundo* sp.), with 2,500 adults nesting in an area 42 x 13 feet (equivalent to 4.5 birds per square foot) (DeHaven et al. 1975a).

Commented [EF33]: Nice to have metric, but here there is a sudden shift from English to metric units – apparently reflecting extent to which the text is drawn from the Birds of North America account

Commented [EF34]: described as giant reed elsewhere—be consistent

~~The small territories in dense breeding colonies cannot supply sufficient food for the adults and for the growing young, therefore m~~Most foraging occurs away from the colony site. While breeding, most foraging occurs within 2–3 miles of colony sites (Orians 1961, Hamilton et al. 1992), although longer foraging flights have been documented (up to 8 miles or more). Typically, only a portion of the landscape surround a breeding colony is suitable for foraging and the foraging range ~~used by~~of individual birds in colonies is variable depending on the extent and quality of ~~the~~ foraging ~~landscape~~habitat.

Colonial Breeding and Social Behavior

> "To one in search of something utterly different I can heartily recommend an hour, or a day, in a Tricolor swamp… *Agelaius tricolor* is intensely gregarious, more so than perhaps any other American bird. Every major act of its life is performed in close association with its fellows… the very day of its nesting is agreed upon in concert. In continuous procession the individuals of a colony repair to a field agreed upon in quest of building material; and when the babies are clamoring the loudest for food, the deploying foragers join their nearest fellows and return to the swamps by platoons and volleys, rather than as individuals." – Dawson (1923).

Coloniality in birds is typically defined as ~~the~~ breeding by a number of individuals at a more or less centralized place from which colony residents regularly depart from to search for food. This breeding strategy is most common among seabirds, in which more than 95% of species nest colonially (Danchin and Wagner 1997), and is relatively uncommon among North American landbirds.

Commented [EF35]: Canada to Panama, or do you mean Canada and the United States (which is not North America)? Also, not highly relevant to status of the Tricolored Blackbrid

The Tricolored Blackbird forms by far the largest breeding colony aggregations of any North American landbird (Neff 1937, Lack and Emlen 1939, Orians 1961, Skutch 1996). ~~Bent (1958) found that the Tricolored Blackbird "nests in enormous, most densely populated colonies, the nests being placed more closely together than in any other colonies of marsh-nesting blackbirds."~~ Grinnell and Miller (1944) stated, "~~one essential would seem to be provision at the site of the colony for a large number of individuals.~~ Nests apparently must be close together and pairs usually [must be] in excess of 50 in order to meet the instinctive requirements of the species." The number of nests in a b~~B~~reeding coloni~~es are~~y seldom ~~smaller~~ is less than 100 ~~nests~~, and in the past ~~have been as large as~~was estimated at 100,000 to 200,000 ~~nests~~ (Neff 1937, Orians 1961). Each male breeds, on average, with two females, resulting in a skewed sex ratio at many breeding colonies (Lack and Emlen 1939, Orians 1961, Payne 1969, Hamilton

1998, Beedy and Hamilton 1999). Although Payne (1969) observed breeding colonies consisting of as ~~little~~ few as four nests, of the 21 colonies monitored, no colonies containing less than 100 nests ~~were successful in~~ fledg~~ing~~ed young. Although colonies with even sex ratios or with more skewed sex ratios (each male breeding with more than two females) have been observed (Hamilton et al. 1995), ~~for~~ monitoring ~~purposes it is~~programs often assume~~d~~ that each nest in a colony represents 1.5 breeding birds.

~~While the great concentration of birds in a small area is the most conspicuous feature of Tricolored Blackbird colonies, the degree of synchrony among members of the colony is no less unique (Orians 1960).~~ Breeding within a colony is often highly synchronized, with all females in a colony typically initiating nest building within a few days (Orians 1961, Payne 1969). A flock of Tricolored Blackbirds can appear in an area in which they~~it~~ have~~s~~ been absent for months and begin nesting within days (Orians 1961). Food ~~re~~sources for both the breeding adults and for the provisioning of young are mostly obtained from sites away from the colony location. Insect-rich foraging areas appear to be identified and utilized by all or large portions of the breeding adults in a colony until the prey base is exhausted, at which time new areas are identified and breeding birds collectively shift to new foraging sites.

~~Occupancy~~ Occurrence dynamics—Tricolored Blackbird breeding colonies ~~frequently~~ shift locations from year to year, though sites used each year often occur in the same ~~traditionally used~~ areas. ~~In some cases Tricolored Blackbirds exhibit high inter-annual site fidelity, perhaps driven by the continued availability of essential resources, including suitable nesting substrate, water, and foraging habitat (Beedy and Hamilton 1997).~~ Of 72 occupied colony locations observed between 1992 and 1994, ~~only~~ 19 (26%) were active in all three years and an additional 11 (15%) were active in at least two years (Hamilton et al. 1995). In the central Sierra Nevada foothills, 58% (11 of 19) of ~~occupied~~ breeding colony sites that were observed to be occupied in 2015 were also occupied in 2014 (Airola et al. 2015b). Of 44 sites surveyed during a three year period in the central foothills, ~~only~~ eight (18%) were active in all three years and seven (16%) were active in two of three years (Airola et al. 2016). Of four colony locations monitored for three consecutive years in coastal Monterey County, all four were occupied in one year and ~~only~~ two were occupied in the other years (Wilson et al. 2016). From xxx to xxx in the xxx, a~~A~~nnual ~~occupancy~~ occurrence ~~rates~~ varied~~y~~ across nesting substrate~~ type~~s~~, with~~. Occurrence in wetland, thistle, and Himalayan blackberry ~~locations having~~was similar ~~rates of~~(about 40%~~ (Holyoak et al. 2014). Occupancy~~); occurrence ~~rates are~~was lower in~~for~~ colonies in triticale and other grain~~ sites~~s and higher ~~for~~ in colonies in nettle~~ colony sites~~s (Holyoak et al. 2014). Although any given site may be unoccupied in some years, birds often return to sites over longer time periods and some sites are used in almost every year. ~~Hosea (1986) reported on a colony that had been occupied for more than 30 years in Sacramento County, and was able to locate several active colonies by visiting locations reported in the literature decades earlier. The result of these complex occupancy dynamics is an extremely variable rate of site fidelity over the short-term, but fidelity to breeding locations and general breeding areas are high over the longer term.~~

Beedy et al. (1991) ~~compiled all available information on breeding colony locations and~~ identified 696 historical breeding colony locations. As of the 2016 breeding season, the number of known historical and current breeding colony locations had grown to 1,272, including all records since 1907 (Figure 2a).

Commented [EF36]: Occupancy has come to reference detection-weighted occupancy. That is not an accurate characterization of these observations.

Commented [EF37]: Summarize in one sentence rather than reciting all observations

Commented [EF38]: provide the context

The large majority of these historical locations are not used in any given year, and many no longer ~~meet~~ provide ~~the~~ habitat ~~requirements of~~for the species ~~and so are no longer considered suitable~~. During ~~recent thorough~~ statewide surveys conducted between 2008 and 2014 with inconsistent methods, the number of occupied breeding locations ~~has~~ averaged about 140 (Kelsey 2008, Kyle and Kelsey 2011, Meese 2014). New locations are discovered each year, while Tricolored Blackbirds are not observed in other sites ~~cease to be used~~. This turnover of breeding locations likely reflects shifting habitat conditions across the range ~~and results in complex occupancy dynamics described above~~. Most sites~~, once established,~~ are used repeatedly over the course of many years.

Commented [EF39]: If not established, not a site

Fluctuations in colony ~~site selection~~location and colony size have been attributed to a response of Tricolored Blackbirds to changes in local insect abundance within and across years (Orians 1961, Payne 1969, DeHaven et al. 1975a). ~~Their colonial breeding behavior requires that the foraging landscape surrounding the nest site provide abundant insect food sources. The colonial nesting, compressed breeding cycle, and social structure of Tricolored Blackbirds are well suited for rapid exploitation of unpredictable resources when they become temporarily very abundant.~~ Initiation of nesting may also be triggered by an abundant food source (Lack 1954, Orians 1961b, Orians and Collier 1963, Collier 1968, Payne 1969). However, the role that insect abundance has on the location of colonies has not been investigated.

In some but far from all cases, large breeding colonies have ~~been observed to exhibit~~ higher reproductive success (number of young fledged per nest) than smaller colonies (Orians 1961, Payne 1969, Hamilton et al. 1992, Meese 2013), and in some years a few large colonies have been responsible for the majority of the known reproductive output for the year (Hamilton 1993). ~~However, there are many examples when a positive correlation between colony size and reproductive success was not observed, and a~~W~~w~~ide variation in reproductive success has been observed in both small and large colonies (Payne 1969, Meese 2013).

Adaptive advantages of colonial breeding may be conferred by decreasing risk of predation or increasing foraging efficiency (Ward and Zahavi 1973, Beauchamp 1999), both of which could lead to increased reproductive success ~~in production of young~~. The following mechanisms have been proposed as advantages to colonial breeding:

1. Predator avoidance
2. Joint anti-predator responses
3. Predator satiation
4. Social food-finding
5. Information sharing

Commented [EF40]: Not clear how this discussion is relevant to the status of the species

Predator avoidance—Colonial breeding birds frequently ~~select~~ occupy sites that are inaccessible to predators (Ward and Zahavi 1973), or in some cases that are naturally free of predators (e.g., seabirds nesting on isolated islands). Tricolored Blackbirds nest in ~~typically select breeding locations that provide a degree of protection from predators,~~ either ~~by selecting~~ inaccessible sites (e.g., wetlands surrounded by or inundated by relatively deep water) or ~~protective nesting substrates~~in vegetation (e.g., dense,

Commented [EF41]: selection cannot be inferred unless choice experiments are conducted thorny, or spiny~~ous~~ vegetation) that limits access to predators. Wetland~~ site~~s may primarily limit access to terrestrial predators, whereas some dense or armored ~~substrates~~ vegetation may also limit access by predatory birds. ~~In the case of a nomadic species like t~~The Tricolored Blackbird~~, which does not necessarily use the same breeding location each year due to annual shifts in substrate suitability,~~'s social behavior may enhance the ability to locate ~~these suitable locations~~protected sites.

Anti-predator responses—Social mobbing of predators or other aggressive behaviors is ~~a~~ common ~~trait~~ among colonial nesting birds. However, Tricolored Blackbirds do not ~~exhibit~~ have strong defensive responses to the presence of a predator. Unlike Red-winged Blackbirds that will fiercely defend territories from potential predators that approach the nest, Tricolored Blackbirds provide little ~~in the way of~~ defense to eggs or nestlings (Skutch 1996). For example, when a hawk is sighted the adults in a colony may stop vocalizing and settle low within the nesting substrate, with the entire colony sometimes going silent (Orians and Christman 1968, Payne 1969). Adults may hover in the vicinity of a predator as nestlings are taken, but ~~no~~ do not pursue~~it of~~ the predator~~ is offered~~. Complete annual reproductive failure in colonies of thousands of birds can result from the efforts of relatively few predators (Beedy and Hamilton 1999). Tricolored Blackbirds do not appear to benefit from social anti-predator responses.

Predator satiation—The ~~massive quantity of readily available prey in the form of~~many eggs or nestlings at a Tricolored Blackbird breeding colony may reduce the chance of loss of any one nest by satiating territorial predators (e.g., raptors). ~~Payne (1969) observed a single pair of Northern Harriers preying on a Tricolored Blackbird colony of 10,000 nests, with no impact on the large majority of the colony.~~ Satiation of predators may be less likely in species that hunt in groups, such as many species of wading birds. In recent decades, Cattle Egrets and White-faced Ibis were believed to ~~have~~ cause~~d~~ reproductive ~~complete~~ failure of large breeding colonies (Meese 2012, 2016). ~~Predator satiation may provide a benefit to breeding Tricolored Blackbirds, depending on the number and type of predators.~~

Food-finding and information sharing—Roosting and colonial birds may take advantage of social behavior to more efficiently locate ~~patches of~~ concentrations of~~ed~~ food~~ resources~~, and colon~~y sit~~ies may serve as information centers where locations of good feeding sites can be shared among individuals (Ward and Zahavi 1973, Emlen and DeLong 1975, Brown 1988). Under this scenario, larger colonies may be more successful than smaller colonies because there is a larger pool of information on the whereabouts of ~~good feeding places within the foraging area being exploited by the colony~~foraging habitat (Ward and Zahavi 1973). This increased foraging efficiency, along with the highly synchronized nesting and the compressed length of a nesting cycle in Tricolored Blackbirds, may ensure that temporarily abundant prey will remain available to the young in a colony for the duration of the breeding cycle. Coloniality may result from situations when ~~suitable~~ breeding sites are limited ~~among~~ within areas of high food availability (Danchin and Wagner 1997).

~~Because of occasional destruction of entire Tricolored Blackbird breeding colonies by predators and observations of prey-following by adults,~~ Orians (1961) and Payne (1969) suggested that colonial nesting by Tricolored Blackbirds is more likely related to location and exploitation of a locally abundant food supply than to ~~a strategy of~~ predator avoidance or response. ~~However, the choice of flooded or dense~~

Commented [EF42]: Not included in literature cited

Commented [EF43]: a or b?

~~and armored vegetation for breeding suggests that suitable nesting locations provide some protection from predators, and predator satiation may be a successful strategy for confronting territorial predators.~~

Habitat that May be Essential for the Species' Continued Existence in California

For breeding, Tricolored Blackbirds require three ~~critical~~ resources: 1) secure vegetation in which to nest~~ing substrate~~, 2) a source of water, and 3) ~~suitable~~ f~~oraging habitat~~ood.

Commented [EF44]: if required, then *critical* is redundant

Nesting ~~*Substrate*~~

The majority of Tricolored Blackbird breeding colonies have occurred in one of five ~~substrates~~vegetation types: 1) wetlands (either cattail [*Typha* sp.] or bulrush [*Schoenoplectus* sp.]~~ vegetation~~), 2) Himalayan blackberry (*Rubus armeniacus*), 3) thistle, usually milk thistle (*Silybum marianum*) or bull thistle (*Cirsium vulgare*), 4) stinging nettle (*Urtica* sp.), or 5) fields of agricultural grain~~ field~~s, especially triticale, a wheat-rye hybrid ~~grain~~ grown as silage for dairy cattle. Use of s~~S~~everal additional nesting substrates ~~have~~ has been ~~used~~ documented to a lesser degree (less than 5% of colonies in total), with the more common being mustard (*Brassica* sp.), willows (*Salix* sp.), mallow (*Malva* sp.), wild rose (*Rosa* sp.), tamarisk (*Tamarix* sp.), and giant reed (Beedy et al. 1991, Beedy and Hamilton 1997, Beedy et al. 2017, Tricolored Blackbird Portal 2017).

Commented [EF45]: Change throughout

Commented [EF46]: cattails and bulrushes are plants, so the reference to vegetation is redundant

Commented [EF47]: the true proportion of colonies in different vegetaton types is unknown

The primary nesting substrates used by Tricolored Blackbirds have different distributions across the breeding range in California (Figure 5). Wetland~~ site~~s with cattail or bulrush substrate are fairly evenly distributed across the range. Himalayan blackberry ~~sites are~~is mostly restricted to Merced County and north through the Sierra foothills to the Sacramento Valley. Triticale and other agricultural grain~~ site~~s are ~~found~~ mainly in the southern San Joaquin Valley and Merced County, ~~with~~ and a few additional ~~sites~~ areas in southern California. In recent years stinging nettle~~ site~~s have mainly occurred in the southern San Joaquin Valley portion of Kern County including the surrounding foothill grasslands, although historically they were also common at the extreme northern portion of the California range in Siskiyou and Shasta counties. Thistle~~ sites have beens~~ are located throughout much of the range in California, and ~~has been the primary nesting substrate~~most nests ~~used~~ observed in the southern Sierra Nevada foothills were in thistles (Airola et al. 2016). ~~Thistle sites are typically only available to breeding Tricolored Blackbirds in years with w~~Weather patterns that support abundant thistle growth do not occur every year.

Commented [EF48]: Not clear whether this paragraph is referencing the distribution of the vegetation types or the distribution of colonies that have been detected in those vegetation types. "Sites" implies the latter.

Commented [EF49]: and what are those weather patterns?

Historically, most breeding colonies were reported from ~~in~~ freshwater marshes dominated by cattails and tules (Beedy 2008). In the 1930s, 93% of detected breeding colonies were reported in freshwater marsh~~ vegetation~~es with the remaining colonies in willows, blackberries, thistles, and nettles (Neff 1937). The reported proportion of colonies in freshwater marshes had decreased to about 70% by the 1970s as Tricolored Blackbirds began using ~~novel,~~ nonnative vegetation types to a greater extent, especially Himalayan blackberry and thistles (DeHaven et al. 1975a). By 2008, the proportion of colonies reported to be established in freshwater marsh during the statewide survey had declined to 35% (Kelsey et al. 2008). In 2011, the majority of colonies in southern California, on the central coast, and in extreme northern California were reported from wetlands. Statewide, wetlands continued to be reported to

Commented [EF50]: both of which were noted in the 1930s, so already were building nests in these vegetation types support more colonies than any other vegetation type (37%), although these wetland colonies supported only 5% of the estimated population (Kyle and Kelsey 2011).

Tricolored Blackbirds are known to have bred in blackberry bushes from the early 1900s (Booth 1926, Neff 1934, 1937), but this was ~~a very~~reported infrequent~~ occurrence~~ly. Sacramento County has a long history of breeding by Tricolored Blackbirds, with colonies in the 1930s ~~found~~ reported entirely in wetland~~ substrate~~s and colonies in the 1970s still reported mainly ~~located~~ in wetlands (Neff 1937, DeHaven et al. 1975a). In the 1980s and 1990s, an increasing percentage of breeding colonies were reported in ~~nonnative~~ Himalayan blackberry (Hosea 1986, Beedy and Hamilton 1997). ~~Over~~ An estimated more than 55,000 breeding Tricolored Blackbirds were ~~located in~~reported from Sacramento County in 1993, with the large majority of these reported in Himalayan blackberry and a small number in wetland~~ substrate~~s (Hamilton 1993). Himalayan blackberry is currently believed to be the dominant nesting substrate throughout the northern and central Sierra Nevada foothills. From 2014 to 2016, 65–80% of foothill colonies ~~have occurred~~were reported in Himalayan blackberry annually (Airola et al. 2016). Between 1994 and 2004, a large shift from cattail marsh colonies to Himalayan blackberry colonies ~~occurred~~ was reported in the rice-growing region of Sacramento Valley (Hamilton 2004a). This ~~was~~ may in part be due to the loss or destruction of ~~specific~~ cattail marsh~~ sites~~es, but ~~was~~ also may be~~likely~~ due in part to an increase in distribution of Himalayan blackberry.

Commented [EF51]: destruction = loss. is this statement trying to differentiate mechanisms?

The only previous report of nesting in a cultivated grain field was from 1944, when a colony was observed in mustard-~~infested~~colonized barley (Bent 1958). Tricolored Blackbirds then were discovered breeding in grain fields in the San Joaquin Valley in 1991 and 1992 (Hamilton et al. 1992). Prior to this, ~~nesting in large cultivated grain fields was unknown and~~ little work on the status of the species in the southern San Joaquin Valley had been conducted (Beedy et al. 1991, Hamilton et al. 1992). ~~The only previous report of nesting in a cultivated grain field was from 1944, when a colony was observed in mustard-infested barley (Bent 1958).~~ The discovery of breeding on grain fields in the 1990s corresponded to an increase in planting of triticale. ~~This wheat-rye hybrid grain may be attractive to breeding Tricolored Blackbirds due to its robust structure that is well suited to support nests and it dense growth that is relatively impenetrable to terrestrial predators.~~ Relatively little triticale had been planted for silage in the San Joaquin Valley by 1994, but by 2005 the planted ~~acreage~~ area had grown to about 75,000 acres (Aksland and Wright 2005). Of the nesting substrates used by Tricolored Blackbirds, triticale and other grain fields are ~~unique in that they are available in abundance~~the most consistently reported over time~~each year~~ in the San Joaquin Valley, and in recent years, many of the largest colonies ~~have occurred on~~ were reported from grain fields. Fifty percent of the breeding Tricolored Blackbirds detected in California during the 2008 statewide survey were observed nesting in triticale fields (Kelsey 2008).

During the April 2011 statewide survey, the majority of colonies (54%) in the San Joaquin Valley and Tulare Basin were ~~located~~ reported on agricultural grain crops, with an additional 22% in milk thistle. Conversely, 70% of colonies in the Sacramento Valley and Sierra Nevada foothills were reported in Himalayan blackberry. ~~The majority of colonies in southern California, on the central coast, and in extreme northern California continued to occur in wetland habitats. Statewide, wetlands continued to~~

~~support more colonies than any other substrate type (37%), although these wetland colonies supported only 5% of the population (Kyle and Kelsey 2011).~~

The area~~l extent of nesting substrate~~ reported to be used by a given breeding Tricolored Blackbird colon~~ies~~y has ranged from a few square meters to more than 200 acres (Tricolored Blackbird Portal 2017). The smallest colonies ~~have~~ were reported to occur~~red~~ in a variety of ~~nesting substrate~~vegetation types, including cattail or bulrush marsh, Himalayan blackberry, and willows. The largest colonies, reported to cover ~~of~~ 100 acres or more~~ have been located in~~, were reported from triticale in recent years, although historically very large colonies ~~occurred~~ were reported in wetland~~ habitat~~s (Neff 1937). The large majority of colonies are believed to occupy less than 10 acres~~ of nesting substrate~~, with many ~~being smaller~~occupying less than one acre. DeHaven et al. (1975a) ~~found~~ suggested that the area occupied by ~~nests~~ colonies in all ~~substrates~~ vegetation types averaged less than two acres~~ per colony, and the largest colonies observed from 1968 to 1972 occupied only 10 acres~~.

Commented [EF52]: Here, explain how extent is estimated, and associated uncertainties

Commented [EF53]: And now mixing metric and English

Nest densities vary widely across nesting substrates. DeHaven et al. (1975a) ~~observed~~ estimated densities up to 66,670 nests per acre~~s~~ (100,000 breeding adults per acre) in colonies in Himalayan blackberry~~ colonies~~, with the average estimated density in blackberry ~~colonies~~ closer to 16,000 nests per acre. Densities in other common nesting substrates (cattails, bulrush, thistle, and willows) ~~had densities of~~were estimated to be up to 13,340–20,000 nests per acres (20,000–30,000 breeding adults per acre), with average densities ranging from 3,300 to 4,800 nests per acre (DeHaven et al. 1975a).

Commented [EF54]: Here, explain how density is estimated, and associated uncertainties

Commented [EF55]: Again, how estimated? uncertainties?

Water

Breeding Tricolored Blackbirds require an open~~, accessible~~ water source within a few hundred meters of the nesting substrate (Hamilton 1995)~~in the vicinity of the breeding location~~. Adults use the water for drinking and bathing, and ~~will~~ sometimes submerge insect~~ prey item~~s before ~~provisioning~~ feeding young. The requirement for open water can be met by ~~any of a number of sources, including~~ wetlands, streams, ponds, reservoirs, and agricultural canals or ditches. ~~Water must be available within a few hundred meters of the nesting substrate (Hamilton 1995).~~ The loss of local water sources during the nesting cycle ~~has~~ is reported to have caused entire colonies to abandon their nests (Beedy et al. 1991).

Fo~~raging Habitat~~od

~~The Tricolored Blackbird breeds in dense colonies with the individual territories that are defended by each male consisting of a very small area. These dense congregations of large numbers of birds exert large pressures on the foraging landscape surrounding the nesting location. Unlike most other landbirds,~~ Tricolored Blackbirds forage almost exclusively away from the nesting territory, and colonies require ~~suitable foraging habitat with~~ abundant insect prey within a few miles~~ of the colony site~~. ~~Because provisioning success and the resulting rate of nestling starvation have been shown to influence reproductive success, the availability of high quality foraging habitat is as important to Tricolored Blackbird breeding as is the availability of suitable nesting substrate (Hamilton et al. 1992). The proximity to highly abundant insect food supplies may be a factor in the selection of breeding sites by Tricolored Blackbirds (Neff 1937, Orians 1961, Payne 1969), and their nomadic and colonial behavior may have evolved as a strategy for maximizing the ability to locate and exploit unpredictable and~~

~~temporarily abundant insect food sources.~~ The ~~required~~ extent of foraging habitat ~~for successful breeding has a~~is believed to be much greater ~~spatial extent~~ than that of nesting ~~substrate~~habitat. Although data are not available to define the minimum extent of foraging habitat, it has been reported that colonies with less than 200–300 acres of foraging habitat do not persist and that ~~access to~~ several thousand acres is necessary to maintain most large colonies (Hamilton 2004b).

Primary foraging habitats during the breeding season include grasslands, shrublands, pastures, dry seasonal pools, and ~~certain~~ agricultural crops including alfalfa and rice~~, which provide for high production of insect prey for breeding Tricolored Blackbirds~~. Grasslands and alfalfa have been ~~shown to be important in predicting~~associated with presence of breeding Tricolored Blackbird colonies, with probability of colony occurrence increasing with increasing proportion of these land cover types within 3 miles (NAS 2017). Adults will also sometimes ~~exhibit aerial~~ foragi~~ng~~e above wetland colonies when aquatic insects are hatching (Beedy et al. 2017). Adult birds also frequently feed at cattle feedlots and dairies where they have access to abundant grain ~~sources~~. Among grassland ~~foraging habitat~~s, Hamilton et al. (1995) reported that ungrazed grasslands were ~~preferred over~~used to a greater extent than heavily grazed grasslands by foraging Tricolored Blackbirds, but this ~~conclusion~~ has not been reported in later studies ~~of grassland foraging birds~~ (Meese 2013, Airola et al. 2015a, 2016). Tricolored Blackbirds breeding in agricultural landscapes are believed to make little use of most row crops, vineyards, or orchards (Hamilton et al. 1992). ~~During~~ Following the 2000 statewide survey, Hamilton (2000) ~~found~~ reported that over 90% of observed Tricolored Blackbird foraging ~~activity~~ occurred on private property.

In Sacramento County, Hamilton et al. (1992) reported that 96% of ~~all~~ foraging by breeding Tricolored Blackbirds occurred in grasslands. This reported reliance on grasslands by Sacramento County and foothill breeding birds has persisted. In 2014, 90% of birds observed breeding in the central Sierra Nevada foothills, including Sacramento County, were observed foraging~~ed~~ in grasslands and pasture (Airola et al. 2015a).

~~Mailliard (1900) described the distinctive flight of Tricolored Blackbirds in the process of feeding nestlings as a "stream composed of birds going toward the tules with their bills full of bugs and of equal numbers returning to the fields for fresh supplies."~~ Both prey abundance and proximity to the colony site likely influence the reproductive success of a colony. In at least some cases, adults foraging near the colony ~~site~~ bring few prey items to their young, while adults foraging more distant return with many more prey items (Orians 1980, *cited in* Skutch 1996). This may be a mechanism to conserve energy by making fewer long-distance flights ~~and shows the value of foraging habitats in close proximity to colony sites~~; however, the possibility that proximate food sources had been exhausted during observations cannot be ruled out. When abundant insect prey are available adjacent to colony locations, adults ~~will~~ make ~~only very~~ short foraging flights ~~to acquire prey~~. ~~Most foraging occurs within about 3 miles of the colony location, although Hamilton et al. (1992) reported maximum foraging flight distances by breeding birds of up to 8 miles. In the Central Valley from 2006 to 2011, Meese (2013) observed adult Tricolored Blackbirds foraging up to 5.6 miles from the colony location.~~

~~the role that insect abundance in foraging habitats has on colony site selection has not been investigated.~~

Commented [EF56]: not clear. colonies are not permanent.

Commented [EF57]: Fine, but not related to land-use or land-cover type

Commented [EF58]: citations?

Commented [EF59]: foraging distances described above

Commented [EF60]: Everything in this paragraph was addressed above

Diet ~~and Food Habits~~

For most of the year, the majority of food ~~items taken~~eaten by Tricolored Blackbirds ~~consist of~~is plant material, especially seeds. However, during the breeding season, adult females require large amounts of high-protein insect prey for egg production and nestlings require a protein-rich diet for growth and development (Crase and DeHaven 1977). Nestlings are fed almost exclusively animal matter for the first nine days after hatching, at which point parents begin to introduce plant matter into the diet (Hamilton et al. 1995). ~~Colonies consisting of many thousands of adult birds and growing nestlings require an immense amount of insect prey during short windows of time. The availability of insect prey in the foraging landscape likely influences the establishment of breeding colonies, and an abundant prey base is essential for successful breeding.~~

Nestlings have been ~~provisioned with~~fed a wide variety of prey ~~items~~, including grasshoppers and crickets (order Orthoptera), beetles, weevils, and water beetle larvae (order Coleoptera), larval and adult moths and butterflies (~~including caterpillars;~~ order Lepidoptera), and to a lesser degree spiders, flies, tadpoles, snails, and emergent dragonflies, damselflies, and midges (Payne 1969, Crase and DeHaven 1977, Skorupa et al. 1980). ~~At three breeding colonies in Merced County where adults often foraged for prey in alfalfa and grain fields, animal matter made up 91% of food volume for nestlings and fledglings, with moth larvae, beetles, and weevils the primary food items (Skorupa et al. 1980). In foothill grasslands, grasshoppers have often been the primary prey item fed to nestlings (Payne 1969, Airola et al. 2015a). In a diet study that included colonies from several regions of the Central Valley located among a variety of foraging substrates, animal matter made up more than 86% of the total volume of nestling food (Crase and DeHaven 1977). Ground beetles were the predominant food item when averaging across all colonies, followed by water beetle larvae, grasshoppers and crickets, and weevils.~~ Colonies may differed ~~significantly~~ substantially in the primary food items provided to nestlings~~, with differences in foraging substrate responsible in some cases~~. For example, colonies with water beetle larvae as the predominant food source were located in rice-growing areas, and the greatest percent of grasshoppers were fed to nestlings at colonies bordered by grassland (Crase and DeHaven 1977).

Early observers noted that nestling and fledgling Tricolored Blackbirds were frequently fed grasshoppers, leading to descriptions of the species as a grasshopper-follower (Belding 1890, Bendire 1895, Mailliard 1914, Orians 1961). ~~Payne (1969) observed breeding adult Tricolored Blackbirds at colonies in the Sacramento Valley foraging primarily in grasslands and providing nestlings with a diet composed of 47% grasshoppers; crickets, beetles, and spiders were also acquired in grasslands and fed to young in smaller amounts.~~ Payne (1969) suggested that the movements of Tricolored Blackbirds during the breeding season paralleled the ~~nomadic~~ movements of ~~rangeland~~ grasshoppers in California ~~and compared the Tricolored Blackbird with "locust bird" species of Asia and Africa~~. ~~Grasshoppers continue to provide a valuable food source to Tricolored Blackbird colonies, especially when adjacent to grasslands and pastures (Airola 2015a), but Tricolored Blackbirds have been shown to be more flexible in breeding season diet, as long as an abundant insect source is available.~~

Commented [EF61]: this is not helpful

Commented [EF62]: last two sentences contradict previous paragraph

~~In the spring and summer, the proportion of animal material consumed by adult Tricolored Blackbirds in the rice-growing region of the Sacramento Valley was 28% and 39%, respectively, with primary prey items including ground beetles, water beetle larvae, and orthopterans (Crase and DeHaven 1978). At four breeding colonies in agricultural areas of Merced County, animal matter made up 56% of food volume for adult females and 28% for adult males (Skorupa et al. 1980). The most consumed animal foods were beetles and weevils, moth larvae, and flies; the predominant plant foods consisted of oats (*Avena* sp.) and filaree (*Erodium* sp.), and to a lesser degree chickweed (*Stellaria* sp.) and pigweed (*Amaranthus* sp.). In the nonbreeding season, Tricolored Blackbirds are more strictly granivorous, although a variety of plant and animal matter is taken opportunistically. One study in the rice-growing region of the Sacramento Valley revealed that about 90% of the fall and winter diet consisted of plant material, primarily seeds of rice, other grains, and weed seeds (Crase and DeHaven 1978).~~

Reproduction and Survival

Commented [EF63]: Development of a population model would be much more useful than the recitation of estimates from various studies.

Breeding typically extends from mid-March through early August (Beedy et al. 2017). Autumn~~al~~ breeding has been observed in the Central Valley (September–November; Orians 1960, Payne 1969) and in Marin County (July–September; Stallcup 2004), although not since 1964 and 2003 in the Central Valley and Marin County, respectively. From initiation of nest building to independence of fledged young, the nesting cycle of the Tricolored Blackbird is about ~~10~~ XX days~~ shorter than that of the Red-winged Blackbird, mostly due to rapid progression through the nest building and egg laying stages (Payne 1969). The condensed length of the nesting cycle may be a function of the synchronized colonial nesting and an adaptation to take advantage of unpredictable periods of abundant and temporary insect food sources (Payne 1969, Skutch 1996)~~.

Nest building and incubation are performed exclusively by the female, but the male takes an active role in feeding the young (Lack and Emlen 1939, Orians 1960). Although female Tricolored Blackbirds breed in their first year, most males may defer breeding until they are at least two years old (Payne 1969). ~~This contributes to a skewed sex ratio at many breeding colonies, with each male breeding on average with two females (Lack and Emlen 1939, Orians 1961, Payne 1969). Although colonies with even sex ratios or with more skewed sex ratios (each male breeding with more than two females) have been observed (Hamilton et al. 1995), for monitoring purposes it is often assumed that each nest in a colony represents 1.5 breeding birds.~~

Commented [EF64]: association between colony size and reproductive success covered above

~~Successful breeding (i.e., production of any fledglings) was found to be positively correlated with colony size by Payne (1969); all colonies (n=7) that produced no fledglings contained 200 or fewer nests, while only one of seven successful colonies was smaller than 400 nests. Hamilton (1993) observed that the largest colonies in a single year of observation produced the highest estimates of reproductive success. Meese (2013) demonstrated a weak positive correlation between reproductive success and colony size over a six-year period (r = 0.53, r^2 = 0.28).~~

Commented [EF65]: need to differentiate between individual level and colony level

Commented [EF66]: Tenor seems to contradict with first half of the paragraph.

Reproductive success~~, defined here as the number of young fledged per nest,~~ has been the generally accepted method for estimating productivity of Tricolored Blackbird colonies (Hamilton et al. 1995, Meese 2013, Holyoak et al. 2014, Airola et al. 2015a). Reproductive success has been estimated in one of two ways: visual estimation of the number of fledglings or nest sampling ~~via~~ by walking along transects through active colonies. When estimating reproductive success by visual counts of fledglings, colonies are visited at several-day intervals (often four days but ~~in practice~~ this has been variable), and fledglings observed at each visit are assumed to represent unique birds. The total number of fledglings observed on all site visits and the estimated number of nests based on the number of breeding birds are used to estimate the number of fledglings produced per nest. When estimating reproductive success by nest transects, it has been common practice to count the number of young per nest ~~during the portion of the nest cycle~~ when nestlings are 7–9 days old (Hamilton et al. 1995, Meese 2013). Entering colonies when nestlings are less than seven days old inflates the reproductive success estimate by underestimating nestling mortality and entering colonies when greater than 9 days of age causes the nestlings to jump from the nests prematurely. As a result, reproductive success estimates obtained by the transect method represent the maximum number of young fledged per nest. Therefore, the two methods of estimating reproductive success yield different measure~~two somewhat different indice~~s of productivity.

Commented [EF67]: What is known about the accuracy of these methods?

Commented [EF68]: and how is the number of breeding birds estimated?

In 1992, estimated reproductive success was relatively high at three colonies on wetlands and agricultural crops in the San Joaquin Valley (average RS = 2.7) and at Himalayan blackberry colonies in Sacramento County (average RS = 2.2) (Hamilton et al. 1992). Average reproductive success on wetlands in the Sacramento Valley was lower that year at 0.6 young per nest. Similar values of reproductive success were observed in 1994 (Hamilton et al. 1995). In 2000, estimated reproductive success ~~improved~~ in the Sacramento Valley was greater, with three large colonies that did not experience heavy predation averaging 1.4 young per nest (Hamilton 2000), although the average reproductive success across all locations and substrate types was lower at 0.9 in 2000.

Commented [EF69]: measured how? given that the methods do not yield comparable measures, the method should be noted in all cases

Commented [EF70]: what is the point that the text is trying to make? the inference appears to be that estimated annual reproductive success varies among years, which is neither unusual among birds nor a strong indication of lifetime fecundity or population viability

Many Tricolored Blackbird colonies in the Central Valley ~~exhibited~~ were estimated to have relatively low reproductive success from 2006 to 2011. Meese (2013) estimated reproductive success at 47 colonies, representing most of the largest colonies each year, which during this six-year period ~~ranging~~ ranged in size from an estimated 800 to 138,000 breeding birds. About half of the monitored colonies were in wetlands (n = 23), with the rest in thistle (n = 11), triticale (n = 9), and Himalayan blackberry (n = 4). The average estimated reproductive success across all sites and years was 0.62. Reproductive success did not vary significantly across substrate type, although colonies that were ~~destroyed~~ disbanded by harvest of the grain nesting substrate were not included in the study results. Low productivity during this time would result~~ed~~ in ~~very~~ few young Tricolored Blackbirds being produced in the southern San Joaquin Valley ~~where a large portion of the population's first annual breeding attempts occur~~ (Figure 6). Incidental observations in 2012 and 2013 suggested that the trend of low reproductive success continued. Meese (2013) ~~linked~~ suggested that reproductive success at Central Valley colonies ~~to~~ may have been limited by low relative abundance of insect~~preys at foraging sites, suggesting that many Tricolored Blackbird colonies may have been food-limited~~. High levels of predation plus ~~destruction~~ disbanding of colonies to harvest during this time also were hypothesized to contribute~~d~~ to the low overall production of fledglings (Meese 2011, 2012).

Commented [EF71]: colonies aren't destroyed in the sense that all of the birds are killed

~~L~~Although limited research has been conducted to estimate reproductive success at colonies since 2011~~,~~ ~~observations of large numbers of fledglings at multiple colonies suggest that the species has had at least~~

Commented [EF72]: actual research, or anecdotal observations?

Commented [EF73]: seems evident that some reproduction has occurred

~~some success in recent years~~. In 2015, the estimated reproductive success at five colonies on agricultural grain fields averaged 0.6–1.9 ~~fledglings produced per nest~~ (Aug 2015 presentation from NRCS to Tricolored Blackbird Working Group; unreferenced). In 2016, eight of nine known colonies on agricultural grain fields fledged at least some young, although efforts to estimate reproductive success were limited. Only one colony in silage was both accessible and uniform in nest density to allow for nest transectsm and ~~resulted in an~~ its estimated reproductive success was~~of~~ 0.44 (Frazer 2016). At four colonies in Himalayan blackberry, cattail, and milk thistle that ranged in size from an estimated 5,000 to 12,000 birds, reproductive success estimates ranged from 0.4 to 0.67 (Meese 2016). In 2017, all known silage colonies at seven locations fledged at least some young. Some of these experienced very low reproductive success, but at least two had high success and produced an estimated several thousand fledglings. Several additional colonies in other nesting substrates were reported to have high (although unquantified) reproductive success in 2017, with four wetland colonies in the San Joaquin and Sacramento valleys producing at least several thousand young (Colibri 2017, Meese 2017). As in other years, many other colonies were observed to have low success. These limited quantitative estimates and additional qualitative assessments are difficult to compare directly to previous work due to the high variability in reproductive success across colonies and the inconsistent methods used to evaluate reproductive success.

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Commented [EF75]: quantify

Commented [EF76]: quantify

Commented [EF77]: Not informative

Commented [EF78]: not informative

Commented [EF79]: Exactly! The information content is extremely limited, and the estimates / assessments do not contribute to a reliable evaluation of the status of the species

~~Parents reduce the size of broods at many colonies after the hatching of eggs (Hamilton et al. 1995).~~ Often the majority of eggs in a clutch (usually three or four) will hatch but each nest typically fledges a ~~reduced~~ lower number of young, either due to parents not feeding all nestlings, which leads to starvation, or by the active removal of nestlings from the nest by parents (Payne 1969, Hamilton et al. 1995). This is likely because of a shortage of food ~~supplies~~. ~~When abundant food is available each nest produces more fledglings (Meese 2013), and a~~As many as four young are raised per nest at productive colonies (Hamilton et al. 1995).

In many years, overall reproductive success at many or most colonies has been relatively low, but estimates have also been highly variable across colonies. Of 21 colonies observed by Payne (1969) from nest building through termination of the breeding effort, including both successful and unsuccessful colonies, ~~only~~ about 40% of nests produced fledglings. High rates of reproductive success at a few large colonies can produce large numbers of fledglings. For example, three colonies representing an estimated 50,000 nests accounted for the production of an estimated 100,000 fledglings in 1993, while many smaller colonies produced no or few fledglings in the same year (Hamilton 1993). Meese (2013) observed high variability in reproductive success in both triticale and milk thistle colonies from 2006 to 2011 (range 0.01–1.44). The relatively high reproductive success at a small number of colonies was suggested~~demonstrated~~ to be a function of a high insect abundance in nearby foraging areas (Meese 2013). Low reproductive success has been implicated in Tricolored Blackbird population declines over the last two decades (Cook and Toft 2005, Meese 2013). Occasional high rates of reproductive success at a few large colonies may ~~be a successful strategy for~~lead to long-term population viability, but ~~the degree to which infrequent bouts of high success can compensate for the low reproductive success that may be persistent and widespread across most colonies is unknown~~this has not been quantified.

Commented [EF80]: quantify

Commented [EF81]: does this mean fledging?

Commented [EF82]: what makes a colony successful or unsuccessful

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Commented [EF84]: but readily could be estimated through simulation modeling

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Reproductive success~~output~~ has been observed to vary across ~~substrate~~ vegetation types (Hamilton et al. 1992, Hamilton 2000, Holyoak et al. 2014). Holyoak et al. (2014) modeled occupancy of nesting sites ~~rates~~ in the most common nesting habitat types in recent years (2006–2011) and ~~considered~~ evaluated data on abundance, reproductive success (in this case, defined as defined as the number of chicks alive per nest at c. 7–9 days after hatching of the first egg), and ~~frequency~~ extent of use for each nesting habitat type ~~to determine the net reproductive output of different nesting habitats over time~~. Occupancy ~~rates~~ and other factors that ~~influence~~ can be associated with reproductive ~~output~~ success varied across habitat types~~, resulting in variation in the importance of habitats to Tricolored Blackbird productivity~~. Four nesting habitat types had sufficient sample size to make strong conclusions about average reproductive ~~output~~success, including Himalayan blackberry, nettles, wetlands, and grain fields. Himalayan blackberry and nettle colonies ~~exhibited~~ had higher than average reproductive ~~output~~success. Although~~High overall reproductive output for nettle colonies is a little unexpected given that~~ there ~~are~~ were very few colonies in nettle, ~~which are~~and they were of average size~~, in this nesting substrate. However~~, they had high ~~rates of~~ occupancy ~~and reproductive success result in high overall reproductive output for nettle colonies~~. Himalayan blackberry colonies ~~exhibit~~ had average occupancy ~~rates~~ and size, but high reproductive success, and there were many ~~and the large number of~~ colonies in this nesting substrate ~~(the second most frequent colony type after wetlands) lead to high overall reproductive output.~~ The relatively small number of colonies in g~~G~~rain field~~ colonie~~s ~~exhibit~~ had ~~average overall reproductive output, despite having~~ low occupancy ~~rates, low~~ and reproductive success, ~~and a small number of colonies on grain fields each year; the~~but were very large ~~size of grain field colonies increases the overall reproductive output~~. Of the four nesting habitat types assessed, the greatest number of colonies were in wetlands ~~remain the most common nesting habitat used by breeding Tricolored Blackbird colonies in recent years~~. ~~Despite this~~Wetlands had~~,~~ average levels of occupancy, reproductive success, and size ~~of marsh colonies have led to the lowest overall contribution to reproductive output among the four nesting habitat types~~.

Between 1992 and 2003, estimated reproductive success was significantly higher in nonnative Himalayan blackberry (RS = 2.0) than in native emergent cattail and bulrush marshes (RS = 0.5; Cook and Toft 2005). Excluding colonies that were ~~lost to~~disrupted by harvest, colonies on silage grain fields had an intermediate reproductive success (RS = 1.0). Meese (2013) did not observe this pattern from 2006 to 2011, ~~when~~ finding that overall reproductive success was much lower and differences in reproductive success between substrates were not statistically significant (unharvested triticale RS = 0.73; Himalayan blackberry RS = 0.44; wetland RS = 0.31), although only four Himalayan blackberry colonies were included in the sampled colonies. In 2014, Airola et al. (2015a) estimated the average reproductive success at four Himalayan blackberry colonies in Sacramento County as 0.84 fledglings per nest. Although the methods used were slightly different, this estimate is within the range of reproductive success estimates observed in all nesting substrate types by Meese (2013) during six years of low reproductive success (average RS = 0.62; range 0.01–1.44), but the range of values observed by Airola et al. was much narrower (0.66–0.90).

After fledging, Tricolored Blackbirds often leave the vicinity of the nest and congregate in groups of young birds from many different nests. These fledgling groups will often congregate near the edge of the nesting substrate nearest the foraging grounds being used by the adults, where they are fed when adults return to the colony site (Payne 1969). A group of fledgling Tricolored Blackbirds has been referred to as a crèche (Hamilton 1998, Beedy et al. 2017). The formation of crèches generally occurs

Commented [EF85]: frequency is per unit time

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Commented [EF87]: this matters considerably, and the methods should be specified among birds that breed in large colonies and whose eggs all hatch at about the same time (examples of other crèche-forming species include terns and penguins). Supervision of unrelated offspring by a small number of adult guardians is usually considered a characteristic of crèches, although it is unclear whether this is the case in Tricolored Blackbirds. A single large colony of Tricolored Blackbirds can produce many crèches, and a single crèche may include several thousand fledglings. Crèches can persist for up to one to two weeks, and have been observed as far as three miles from a colony site (Payne 1969, Hamilton et al. 1995).

There are no published studies on the annual survival ~~rate~~ of Tricolored Blackbirds, but banding studies have shown that individuals can live up to 13 years (Neff 1942, DeHaven and Neff 1973). Meese (2014b) used recapture data to estimate the average annual adult survivorship of Tricolored Blackbirds as 60%. Estimates of annual survival rates for other temperate blackbirds have ranged from 42% to 60%, with rates for the closely-related Red-winged Blackbird ranging from 42% to 54% (Fankhauser 1971, Searcy and Yasukawa 1981).

[Note to reviewers: Results of recent analyses of banding data by Cornell University provide revised estimates of apparent annual survival that differ from that reported here (adult female survival rate ~0.5-0.9, depending on year). Results have not been finalized and will be incorporated after further discussion with Cornell to verify preliminary results.]

Commented [EF88]: The reliability of this estimate is impossible to evaluate given the information in the report—"We used my recapture data and Program Mark to estimate the average annual survivorship of tricolored blackbirds."

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STATUS AND TRENDS IN CALIFORNIA

Range

Historic accounts from the periphery of the range are largely consistent with the currently known range of the species, and overall, the range of the Tricolored Blackbird appears to have changed little since at least the mid-1930s (Beedy et al. 2017). However, the species appears to be experiencing a range retraction in the southern California portion of the range and in Baja California, as discussed below.

Inconsistent observations during the 1800s and early 1900s at the northern extent of the species' range may represent shifts in distribution over time or are perhaps the result of limited survey coverage. Nuttall (1840) observed the Tricolored Blackbird along the coast of California in the 1830s and, without offering any supporting evidence, suggested that the Tricolored Blackbird range extended into Oregon and Mexico. In the mid-1800s, Cooper (1870) reported the species to be common on the southern California coast from Santa Barbara to San Diego, with the range to the north passing "more into the interior, extending up as far as Klamath Lake and southern Oregon." Bendire (1895) reported the range as "[s]outhwestern Oregon, south through California, west of the Sierra Nevada, to northern Lower [Baja] California." ~~Bendire knew of no reports of the species north of Klamath Lake in southwestern Oregon, and thought it to be uncommon there.~~ The range of the species was confirmed to include northern Baja California in the late 1800s, with A. W. Anthony reporting them "[r]ather common along the northwest coast, breeding in all fresh-water marshes" (Bendire 1895).

Following a period of years with no reported sightings of Tricolored Blackbird in Oregon, Neff (1933) reported a number of observations of the species from 1931 to 1933, all within 30 miles of Klamath Falls, and consisting collectively of fewer than 60 birds. Richardson (1961) reported up to several hundred Tricolored Blackbirds near Medford, Oregon in 1957 and ~~documented~~ breeding colonies of an estimated 1,500 and 1,800 birds in the region in 1958 and 1960, respectively. ~~Inconsistent observations during the 1800s and early 1900s at the northern extent of the species range may represent shifts in distribution over time or are perhaps the result of limited survey coverage.~~ The species has continued to breed in small numbers in the vicinity of Klamath Falls to the present time, and small numbers of birds continue to occur near Medford during the breeding season. Small breeding colonies (30 or fewer birds) were observed in three northern Oregon counties (Multnomah, Umatilla, and Wheeler) in the 1980s (Beedy et al. 1991). The degree to which these records represent recent range expansion to isolated areas, irregular use of the region, or increased survey coverage is unclear, but it appears that small numbers of birds may have recently expanded the species' range to at least some isolated areas in the north (Gilligan et al. 1994, Wahl et al. 2005). Since the 1990s, several hundreds of birds have ~~occurred~~ been observed regularly in central Oregon near the town of Prineville in Crook County, and breeding has been confirmed in the area. In recent decades, the species has been documented in several other isolated locations in western Oregon and eastern Washington, almost always in very low numbers but occasionally numbering in the hundreds of birds (Gilligan et al. 1994, Spencer 2003, eBird Dataset 2016). ~~The degree to which these records represent recent range expansion to isolated areas, irregular use of the region, or increased survey coverage is unclear, but it appears that small numbers of birds may have recently expanded the species' range to at least some isolated areas in the north (Gilligan et al. 1994, Wahl et al. 2005).~~

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Ammon and Woods (2008) described the recent discovery and status of breeding Tricolored Blackbirds at a single location in western Nevada, and reported that there was no confirmed breeding in Nevada prior to 1996. However, Wheelock (1904) described the distribution of the species in the early 1900s, and reported that in the vicinity of Lake Tahoe, "these birds stray across the crest, but not in the numbers in which they are found westward." The species was also reported to have bred at Lake Tahoe in the early 1900s (Dawson 1923) and Hosea (1986) reported a breeding colony in Carson City, Nevada in 1980.

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In the early 1900s, the Tricolored Blackbird was reported from~~occurred in~~ northwestern Baja California south to about the 30th parallel north (Grinnell 1928). This is consistent with recent breeding records from the southern extreme of the species range near El Rosario (Erickson et al. 2007, Feenstra 2013).

~~The above historic accounts from the periphery of the range are largely consistent with the current range of the species, and overall, the range of the Tricolored Blackbird has changed little since at least the mid-1930s (Beedy et al. 2017). However, the species appears to be experiencing a range retraction in the southern California portion of the range and in Baja California, as discussed below.~~

Distribution

There are no descriptions of the distribution of the Tricolored Blackbird before the widespread conversion of native ~~habitats~~ vegetation across much of its range in California. ~~However, accounts by early naturalists in California provide several records of the Tricolored Blackbird in the 1800s and early 1900s that document the local abundance, and to some extent, the distribution of the species prior to any systematic study of the species across its range.~~

~~The e~~Early anecdotal reports from the 1800s and early 1900s, although typically not quantitative, informed current assumptions about the historical distribution of birds and ~~demonstrated~~ suggested the occurrence of large numbers regionally. Most early observations of large numbers of birds were from the Central Valley and southern California, and only small numbers of birds have occurred north of the Central Valley, both historically and in recent years. Therefore, this report discusses changes in distribution for the Central Valley and for southern California~~, which have supported the majority of the population and for which adequate information is available to assess long-term changes in distribution~~.

Central Valley

It appears that during the early breeding season, Tricolored Blackbirds breed in the southern San Joaquin Valley to a greater extent than 50-100 years ago, when they were believed to breed in the Sacramento Valley early in the breeding season. This apparent shift may correspond to loss of native wetlands and increases in the area of triticale. However, surveys of the distribution of the species have considerable uncertainty.

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~~In 1852, Heermann reported frequent encounters with winter flocks of Tricolored Blackbirds in the Suisun Valley that numbered "so many thousands as to darken the sky for some distance by their masses" (Baird et al. 1874).~~ The Tricolored Blackbird was ~~known~~ reported to be an abundant breeder in the interior valleys of California in the late 1800s (Belding 1890, Bendire 1895, Lamb and Howell 1913, Dawson 1923). ~~Belding (1890) observed "an immense colony" near Stockton in 1879. Ray (1906) noted the species breeding at various points on an automobile trip down the San Joaquin Valley from Stockton to Porterville in 1905. Linton (1908) observed a breeding colony at Buena Vista Lake at the southern edge of the Central Valley in 1907. Lamb and Howell (1913) reported seeing "hordes" of Tricolored Blackbirds at Buena Vista Lake in 1912. Dawson (1923) reported the species as "locally abundant in the Great Interior [Central] Valley."~~

Commented [EF93]: nice quotation, but not helpful for rigorously estimating trends

Neff (1937) was the first to attempt to document the rangewide status and distribution of Tricolored Blackbirds. Over a six-year period from 1931 to 1936, Neff reported nesting birds in 26 California counties~~located breeding colonies throughout the Central Valley~~ and ~~at a few additional locations in California and~~ southern Oregon; however, Neff's surveys focused on the Sacramento Valley in most years, and limited effort applied further south in the San Joaquin Valley. ~~Based on his somewhat geographically limited efforts, Neff (1937) reported nesting birds in 26 California counties over the six-year study. During this period, the rice-growing areas of the Sacramento Valley appear to have been the heart of the Tricolored Blackbird's distribution, although it is not clear whether this was due to survey efforts being focused there and the limited effort applied further south in the San Joaquin Valley.~~

Bent (1958) reported that the center of abundance for the species seemed to be in the San Joaquin Valley. Orians and Christman (1968) reported that the largest colonies occurred in the rice-growing districts of the Central Valley (mainly the Sacramento Valley and northern San Joaquin Valley). Neither of these reports were based on systematic surveys of the valley and have limited utility in documenting species distribution~~, other than that the majority of the population continued to occur in the Central Valley~~.

Commented [EF94]: then why include them?

The distribution of colonies encountered over a five-year period by DeHaven et al. (1975a) was similar to that observed 35 years earlier by Neff (1937). DeHaven et al. (1975a) reported that 78% of colonies located between 1968 and 1972 were in the Central Valley. Most colonies and breeding birds were found in the Sacramento and northern San Joaquin Valleys, including Butte, Colusa, Glenn, Yolo, Sacramento, Merced, and Stanislaus counties. In the 1980s, the largest colonies and the majority of the known population reportedly continued to breed in the Sacramento and northern San Joaquin valleys (Hosea 1986, Beedy et al. 1991).

An apparent early nesting season shift in distribution from the Sacramento Valley to the southern San Joaquin Valley occurred at the end of the 20th century. The degree to which the apparent shift from the Sacramento Valley to the southern San Joaquin Valley is due to the loss or addition of nesting habitat or an increase in survey effort in the San Joaquin Valley is unknown (DeHaven 2000). ~~Although breeding had been documented in the San Joaquin Valley since the 1800s, this region had not been the focus of intense monitoring efforts prior to the 1990s.~~ DeHaven et al. (1975a) reported that areas with ~~suitable~~ nesting substrates were scarce in the arid southern San Joaquin Valley in the 1970s. ~~As described above, loss of native wetland breeding habitat had resulted in a shift to novel nonnative vegetation types beginning by the 1970s, and the distribution shift away from the Sacramento Valley is presumably in part due to these changes in nesting substrate availability. In the early 1990s, Tricolored Blackbirds were discovered breeding in grain fields in the San Joaquin Valley (Hamilton et al. 1992, Hamilton 1993). This discovery corresponded to an increase in the number of dairies and the associated expansion of triticale in the San Joaquin Valley as dairies began growing this new crop for silage.~~ By 1994, most of the largest colonies and 40% of ~~known~~ breeding birds in the early part of the breeding season were ~~found in~~reported from the southern San Joaquin Valley associated with dairies and cattle feedlots (Hamilton et al. 1995). ~~Relatively little triticale had been planted for silage in the San Joaquin Valley by 1994, but by 2005 the planted acreage had grown to about 75,000 acres (Aksland and Wright 2005).~~

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The apparent shift in distribution to the San Joaquin Valley during the early breeding season has persisted, with very large proportions of the population nesting in a few extremely large ~~"mega-~~colonies~~"~~ adjacent to dairies in the San Joaquin Valley (Kelsey 2008). In 1994, 68% of the estimated population in the early nesting season was reported to occur~~red~~ in the San Joaquin Valley; this increased to 86% and 89% by 2008 and 2011, respectively (Hamilton et al. 1995, Kelsey 2008, Kyle and Kelsey 2011). In 2011, the 10 largest colonies detected during the early season survey were in the San Joaquin Valley ~~during the early season survey~~ (Kyle and Kelsey 2011). ~~Breeding sites on~~Colonies in triticale and other silage crops are also generally near other ~~important~~ habitat features, including irrigated pasture, grassland, ~~or~~ alfalfa crops ~~for foraging~~, and ~~available~~ open water. ~~The degree to which the apparent shift from the Sacramento Valley to the southern San Joaquin Valley is due to the loss of nesting habitat, the~~

~~availability of a novel nesting substrate, or an increase in survey effort in the San Joaquin Valley is unknown (DeHaven 2000). Nevertheless, there has been a consistent use of the region by a majority of the Tricolored Blackbird population since the mid-1990s (Figure 7).~~ The proportion of the population breeding in the San Joaquin Valley during the early part of the breeding season reportedly dropped to about 52% in 2014. This drop was believed to be in part due to increases in the number of birds in the Sacramento Valley, including the Sierra Nevada foothills, and southern California, but ~~was~~ primarily ~~the result of~~to a large rangewide decline, with most of the decline in number of birds occurring in the San Joaquin Valley (see the Regional Shifts in Abundance section). In 2017, the proportion of birds nesting in the San Joaquin Valley in the early breeding season ~~returned~~ was estimated to be almost 70% (Meese 2017).

Commented [EF96]: from what in when?

Commented [EF97]: this could be summarized as "distribution of the species varies among years"

The grasslands and pastures of southeastern Sacramento County have seen consistent use by breeding Tricolored Blackbirds for at least the last 80 years (Neff 1937, DeHaven et al. 1975a, Hosea 1986, Beedy et al. 1991, Cook and Toft 2005, Airola et al. 2016), even as ~~the dominant nesting substrate~~most colonies in the region ~~has shifted from native wetlands to~~now are reported to occur in Himalayan blackberry (see Nesting Substrate section). ~~DeHaven et al. (1975a) described the pasturelands of southern Sacramento County as the most consistently used area during a five-year study.~~ Until recently, little emphasis has been placed on monitoring Tricolored Blackbird colonies in the Sierra Nevada foothills and ungrazed or grazed grasslands~~/pasturelands~~ of the eastern Central Valley relative to population centers in the Central Valley and in southern California. Observations of colonies from this region during statewide surveys have usually been lumped with the Central Valley for reporting purposes. Starting in 2014, these grasslands in the low elevation foothills have received focused monitoring as a distinct breeding area (Airola et al. 2015a, 2015b, 2016), with regular use reported for not only Sacramento County, but also from Butte County in the north to Stanislaus County in the south. In 2016, precipitation patterns supported growth of milk thistle patches across extensive areas in the foothills further south as far as Fresno County, ~~resulting~~ which was associated with~~in~~ breeding by an estimated more than 22,000 birds that had not been observed in the region in the two previous years (Airola et al. 2016). ~~When m~~Milk thistle ~~is available for nesting by Tricolored Blackbirds, this nonnative plant~~ may exten~~d~~t the distribution of the species into the southern Sierra Nevada foothills.

Although shifts in the distribution of the species may have occurred within the Central Valley ~~and some areas of the valley that once supported large numbers of birds now support few or no breeding colonies, while other areas appear to have become much more important~~, the Central Valley and surrounding foothills as a whole are believed to have supported the majority of the Tricolored Blackbird population both historically and in recent years. Additional information on use of the Central Valley is presented in the Regional Shifts in Abundance section.

Southern California and Baja California

~~The first Tricolored Blackbird specimen was collected by Nuttall near Santa Barbara in 1836 (Baird et al. 1874, Bent 1958). Although he did not observe breeding colonies, Nuttall reported that the Tricolored Blackbird was very common around Santa Barbara and Monterey in the month of April (Nuttall 1840). In the mid-1800s, Cooper (1870) found the Tricolored Blackbird to be the most abundant species near San~~

~~Diego and Los Angeles, and they were not rare near Santa Barbara. In the late 1800s, the species was described as an abundant winter resident in Los Angeles and Orange counties, occurring in very large flocks, with several colonies known to breed in tule marshes up to 1,500 feet in elevation (Bendire 1895). Grinnell (1898) reported the species to occur in "considerable numbers" throughout the lowlands of the Pacific slope of Los Angeles County, and Willett (1912) considered the species a common resident throughout the lowlands of coastal southern California. Dawson (1923) reported the species as "locally abundant…in the San Diegan district."~~

There ~~is evidence~~were reports that the Tricolored Blackbird had ~~experienced~~ declined~~s~~ in a large portion of its range in southern California, even by the 1930s~~. In a revision of his former description of the species' status in coastal southern California,~~ (Willett ~~(~~1933~~) described the species as a "formerly common resident…Now rare throughout former range in southern California, excepting in some sections of San Diego County."~~, Grinnell and Miller ~~(~~1944) ~~described the status of the Tricolored Blackbird as "common to abundant locally" but noted a general decrease in southern California~~. The range of the species in southern California and Baja California appears to have decreased.

In 1980, the Tricolored Blackbird was characterized as a fairly common resident in the southern California coastal district that bred locally in all coastal counties (Garrett and Dunn 1981). The species no longer appears to occur~~s~~ at many historical sites in coastal southern California. Small numbers of breeding birds were documented at a few locations in coastal Santa Barbara County through the 1970s, with the last known colony of 200 birds in 1979 (Lehman 1994, Tricolored Blackbird Portal 2017). The last known colony in Ventura County, of 53 birds, ~~occurred~~ was reported in 1994. About 200 birds persisted as breeders in the portion of Los Angeles County south of the Transverse Ranges through the 1990s, with the last known breeding attempt in 1999 (Allen et al. 2016, Tricolored Blackbird Portal 2017). Several hundred breeding birds occupied multiple sites in Orange County through the 1990s, but only a single colony of 14 birds has been observed breeding in the county in two years since 2000. The highly urbanized coastal portion of San Diego County, which supported thousands of breeding birds through at least the 1970s, is believed to have~~s~~ supported less than a thousand breeding birds at ~~only~~ three locations since 2000 (Tricolored Blackbird Portal 2017). Very few Tricolored Blackbirds now breed in the coastal lowlands of southern California where they were once abundant (Garrett et al. 2012).

Commented [EF98]: which implies limited survey effort

The status of the Tricolored Blackbird population in Baja California has followed a similar pattern to that for southern California. ~~In the late 1800s, the species was described as "rather common along the northwest coast [of Baja California], breeding in all fresh water marshes" (Bryant 1889). Grinnell (1928) described the species as a "Fairly common resident locally in the northwestern section of the territory, north from about 30 degrees."~~ In the 1980s, the species was described as a "local resident in northwestern Baja California south to El Rosario" (Wilbur 1987). A search of the entire Baja California range ~~turned up~~detected a single breeding colony of an estimated 80 birds in 2007 (Erickson et al. 2007) and four breeding colonies totaling an estimated 240 birds in 2008 (Erickson and de la Cueva 2008). A follow-up survey several years later located three breeding colonies supporting an estimated 240–340 birds (Feenstra 2013). In recent years, most breeding in Baja California has occurred in the north within about 70 miles of the U.S. border. Breeding continued at a disjunct area at the historical southern extent of the species' range (about 100 miles farther south than the next nearest breeding location) near El

Rosario through at least 2013 (Erickson and de la Cueva 2008, Feenstra 2013). By 2016 all known breeding colonies occurred within about 12 miles of the U.S. border (Erickson et al. 2016). In 2017, the only known breeding colonies occurred within five miles of the U.S. border and eight nonbreeding Tricolored Blackbirds were observed at a historic breeding site about 70 miles south of the U.S. border. No birds were observed south of this point, leaving the southernmost 100 miles of the species range in Baja California apparently unoccupied (April 2017 email from R. Erickson to N. Clipperton; unreferenced).

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Where previously abundant and widespread south of the Transverse Ranges, the distribution of breeding colonies reportedly is now mostly restricted to inland sites in western Riverside and San Bernardino counties, and in the interior of San Diego County (Feenstra 2009). This may represent~~s~~ a long-term decline in southern California, with remnant colonies disappearing in recent decades throughout much of the southern range (Figure 8). This may represent a permanent breeding range retraction from portions of the range where the species was previously abundant~~, and is likely the result of ongoing urban development and declines in population numbers. The small numbers of birds that have occasionally bred at the extreme southern limit of the species' range in Baja California, separated by 100 miles from the next most southern breeding colony locations in recent years, were not observed in 2017. The majority of the historical range in Baja California has been unoccupied in recent years (Erickson et al. 2016)~~.

Allen et al. (2016) reported that nesting commenced late in the 20th century in the Mojave Desert portion of northern Los Angeles County, and attributed this to manmade reservoirs and other impoundments, but breeding by small numbers of birds was known for the area since at least the 1970s (DeHaven et al. 1975a, Beedy et al. 1991). The species was known to occur in the Mojave Desert since at least 1890, but breeding was not documented (Belding 1890). The region ~~has~~ is not known to have supported more than a few thousand breeding birds in any year.

Population Trend

Breeding Population

Assessments of the rangewide population abundance of the Tricolored Blackbird prior to the 1990s are limited to published literature describing ~~research~~ observations by a limited number of individuals in the 1930s (Neff 1937) and an additional rangewide assessment using similar methods in the 1970s (DeHaven et al. 1975a). Neff (1937) concluded that obtaining an estimate of the statewide population was not possible. An additional recent published study used all available breeding colony data collected over more than 100 years (1907–2009) to evaluate changes in average colony size (Graves et al. 2013). The most intensive efforts to estimate rangewide population abundance have occurred since 1994, with results presented in reports prepared by academic researchers, Audubon California biologists, and in reports prepared for the USFWS and the Department. These represent the best available information for assessing trends in the rangewide population over the last two decades.

Commented [EF100]: which were what?

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Commented [EF102]: However, they do not necessarily represent reliable information. Methods are not described in detail, methods have not been consistent, and credible estimates and confidence intervals of any response variables do not exist.

~~Over a period of six years~~From ~~(~~1931–1936~~)~~, Neff (1937) ~~surveyed Tricolored Blackbird colonies across California. Neff~~ located several breeding colonies ~~of~~ estimated to include more than 100,000 nests in the

Sacramento Valley, with the largest composed of greater than 200,000 nests (corresponding to approximately 300,000 adult Tricolored Blackbirds). ~~Breeding colonies were located throughout the Central Valley and in a few additional locations in California and southern Oregon; however, Neff's surveys focused on the Sacramento Valley in most years.~~ An effort to cover the entire known range of the species was attempted by Neff in only one year (1932). Most areas outside the Sacramento Valley were covered only incidentally ~~as "cooperators drove up or down the State in the performance of routine duties,"~~, and in the regions of the state that were most thoroughly surveyed, it was impossible to make complete surveys of all possible locations (Neff 1937). ~~Neff concluded that obtaining an estimate of the statewide population was not possible.~~ Working alone in 1934, Neff observed an estimated 491,250 nests (about 737,000 breeding birds), almost all of which were in the Sacramento Valley. ~~The presence of birds in the San Joaquin Valley and southern California was noted in the same year, but no effort was made to estimate numbers. Several authors have cited Neff (1937) in statements about the Tricolored Blackbird population in the 1930s, sometimes suggesting that the population numbered in the millions (e.g., Beedy et al. 1991, Hamilton et al. 1995, Kyle and Kelsey 2011).~~ Neff ~~himself~~ did not attempt to extrapolate his results to a region-wide estimate~~, although the roughly 737,000 breeding birds observed in a single year is likely an underestimate of the population at the time~~.

No attempts were made to describe the Tricolored Blackbird distribution or abundance during the 1940s, 1950s, or 1960s. From 1969 to 1972, DeHaven et al. (1975a) attempted to survey the entire range of the Tricolored Blackbird to document the distribution of the species and to compare estimates of abundance to those provided by Neff (1937). The surveys were carried out by a few individuals surveying vast areas by road, and in most areas were limited to one or two drives through each county where Tricolored Blackbirds were known to occur in California and southern Oregon. Still, the search effort was at least as extensive as that carried out by Neff in the 1930s, and included the benefit of improved transportation and an increased number of roads. In many counties the survey consisted of driving county roads with little knowledge of historical colony sites, but this was an improvement over much of the effort of the 1930s, when counties were considered covered if visited incidental to other activities. Despite a greater search effort, all measures of abundance indicated a decline: the number of active colonies detected per year declined from 43 to 41; the estimated number of nonbreeding birds encountered declined from >50,000 in a single year to <15,000 over four years; maximum estimated colony size declined from hundreds of thousands to tens of thousands of birds; and number of birds observed per year within the study period declined from an estimate of about 375,000 per year to about 133,000 per year (DeHaven et al. 1975a). Although no population estimate was provided, the authors suggested that the Tricolored Blackbird population declined by more than 50% in 35 years. Like Neff three decades before, DeHaven et al. (1975a) were unable to thoroughly cover the entire range of the species, including large portions of the southern San Joaquin Valley.

Following more than a decade with no survey to assess the statewide population, Beedy et al. (1991) compiled all historical records of Tricolored Blackbird breeding colonies and conducted limited field surveys from 1986 to 1990 ~~to evaluate long-term population trends~~. Bill Hamilton and others (Hamilton et al. 1992, Hamilton 1993) conducted ecological investigations in 1992 and 1993 that included documentation of colony locations and estimation of abundances ~~sizes~~, the discovery of large breeding

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colonies on grain fields in the San Joaquin Valley, and the initial observations that suggested Tricolored Blackbirds are itinerant breeders (Hamilton et al. 1995). Based on the increased understanding of the species' biology and distribution, a new approach to estimating the statewide population of Tricolored Blackbirds was proposed by ~~Ted~~ Beedy and ~~Bill~~ Hamilton (Hamilton 1998, Meese 2015a). The ~~discovery of itinerant breeding with broad movements between nesting attempts made it cleary~~ suggested that a survey of the statewide population should occur during a narrow window in order to maximize the likelihood of detecting nesting colonies and to avoid double-counting birds (Hamilton et al. 1995, Beedy and Hamilton 1997). ~~A survey conducted in a minor portion of the range or carried out over a long time period would either miss breeding colonies or double count birds over multiple breeding attempts.~~ An improved understanding of colony occupancy dynamics suggested a need for early season colony-detection efforts ~~to locate active colonies~~ (Hamilton et al. 1995), while also considering the compiled information on all historical breeding locations in order to visit as many potential breeding locations as possible.

The new approach to surveying the statewide population was first implemented during the 1994 breeding season. The survey was conducted on a single day in the early part of the season (April 23). The choice of a survey date is an effort to select a time period when most birds have initiated a first nesting attempt and can be detected and counted at breeding colony sites, but before the first breeding cycle is completed and birds have moved to the north (usually) for the second breeding attempt. The goals of the survey were to visit as many known breeding locations as possible, document occu~~pancy status~~rrence, and estimate colony size~~ at all occupied locations~~s. This was also the first survey to be largely volunteer-based and to enlist a large number of observers over a narrow time period. Compared to the surveys of the 1930s and 1970s, these surveys employed many more surveyors to more thoroughly cover as much of the state and known colonies as possible. The discovery of breeding by a large proportion of the population on silage fields near dairies had recently been documented (Hamilton et al. 1992, 1995), and therefore unlike previous statewide survey efforts, the 1994 survey focused heavily on the San Joaquin Valley.

After the establishment of the new approach to conduct a statewide census, attempts to survey the population were carried out in 13 years between 1994 and 2017. Despite a consistent approach in many of the early years of this time period, methods varied considerably for many of these surveys. The years 1994, 1997, and 2000 produced a set of three triennial surveys that were considered to have been comparable in effort by the survey organizers (Beedy and Hamilton 1997, Hamilton 2000). After a period of years with surveys that followed inconsistent and variable approaches, another set of four triennial surveys were conducted using similar methods in 2008, 2011, 2014, and 2017 (Kelsey 2008, Kyle and Kelsey 2011, Meese 2014a, Meese 2017)~~. The effort and results of these seven surveys are summarized in~~ (Table 1). Although the other six survey years (1995, 1996, 1999, 2001, 2004, and 2005) are not discussed further here, they are briefly summarized in Table 2 and in a larger discussion of Tricolored Blackbird surveys included in Appendix 1.

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Table 1. Comparison of survey effort and results for seven statewide surveys.

Year	Duration	~~Participants~~Number of observers	Counties surveyed (occupied)	Number of sites surveyed (breeding sites)	Occupied breeding locations	Number of b~~B~~irds ~~observed~~estimated
1994	1 day (3 days)[1]	60[2]	– (32)	–	100	369,400
1997	1 day (3 days)[1]	55[2]	– (33)	–	71[3]	232,960
2000	4 days	81[2]	33 (25)	231 (181)	72	162,000
2008	3 days	155	38 (32)	361 (284)	135	395,000
2011	3 days	100	38 (29)	608	138	259,000
2014	3 days	143	41 (37)	802	143	145,000
2017	3 days	181	44 (37)	884	168	177,656

[1] Observations of birds not associated with colonies from one day before and after the survey day were accepted, effectively expanding the survey window to three days.
[2] Number includes participants who submitted written reports. A larger number of volunteers may have searched for birds.
[3] As reported by Hamilton (2000).
"—" = data not reported

The statewide survey efforts in 1994, 1997, and 2000 followed similar methods to locate and survey as many colonies as possible. Although the duration of the survey and the survey effort varied across these years, the organizers of the surveys reported these three surveys had used the most consistent methods to date and could be compared to assess the population trend (Beedy and Hamilton 1997, Hamilton 2000). However, inconsistencies in effort still occurred with the 1994 survey conducting only a limited survey of southern California, and the 2000 survey using more observers to visit more sites than the other two survey years. Hamilton (2000), however, concluded that "…the method of the Census and the survey, to reinvestigate all known breeding places and to search for new ones, has become an increasingly complete assessment of Tricolored Blackbird distribution and abundance. The 2000 Census probably located a greater proportion of the entire population than did censuses in previous years." The number of birds ~~observed~~ estimated declined 56% from 369,400 birds in 1994 to about 162,000 birds in 2000 (Hamilton 2000, Cook and Toft 2005). In addition to the results of the surveys ~~showing~~ suggesting declines in the 1990s, Hamilton (2000) stated that personal observations over long intervals by many regional experts had also suggested declines during this time period.

Commented [EF110]: This paragraph leaves the perception, albeit perception that may not reflect reality, that the survey leaders have a vested interest in the reliability of the surveys and cannot necessarily regard results objectively

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Table 2. Description and summary of effort for 13 surveys that attempted to estimate the size of the statewide Tricolored Blackbird population between 1994 and 2017.

Survey year	~~Summary of e~~Effort and results	Sources
1994	The first year a statewide survey was conducted in a narrow time period, was informed by knowledge of historical breeding locations and by pre-survey colony detection work, and enlisted the help of a large number of volunteers.	Hamilton et al. (1995) Beedy and Hamilton (1997)
1995 and 1996	Limited pre-survey effort. Incomplete county coverage. Large colonies may have been overlooked. Results are not considered representative of the total population.	Beedy and Hamilton (1997)
1997	Used the same coverage, methods, and personnel as did the 1994 survey. Participation was greater than in 1994. Surveys from 1994, 1997, and 2000 are considered comparable.	Beedy and Hamilton (1997)
1999	Participation in the survey was low. Results considered an underestimate of population size by the survey organizer.	Hamilton et al. (1999, 2000) Hamilton (2000)
2000	Used the same methods applied in 1994 and 1997, although a greater number of observers were used to visit more locations. Training was provided to participants. Surveys from 1994, 1997, and 2000 are considered comparable.	Hamilton (2000)
2001	Followed a very different approach compared to standardized methods used since 1994. A limited number of sites were visited and estimates were compiled from observations made throughout the breeding season.	Humple and Churchwell (2002)
2004	Not intended to provide an estimate of the statewide population size that was comparable to previous surveys. Surveys limited to colony sites that had historically supported more than 2,000 birds. Focused on sites in the Central Valley.	Green and Edson (2004)
2005	No report was produced and no record is available describing the survey effort.	Meese (2015a)
2008	Used similar methods as in the 2000 survey, although estimates not adjusted ~~using~~ on the basis of nest density. Also, county coordinators were used for the first time to ensure each county was well surveyed by volunteers. Maps with all survey locations were provided for the first time, and a website improved communication and data management. Number of survey participants and number of sites surveyed greatly increased relative to earlier surveys.	Kelsey (2008)
2011	Methods followed those used in 2008, although county coordinators were not used to lead surveys in individual counties. Surveys from 2008, 2011, 2014, and 2017 are considered comparable.	Kyle and Kelsey (2011)
2014	Used the same methods as in 2008 and 2011, and again used county coordinators to ensure each county was thoroughly covered. The number of counties and number of sites visited exceeded all other surveys to date. Surveys conducted 2008–2017 are considered comparable.	Meese (2014a)
2017	Used the same methods as in 2008–2014. The number of survey participants and the number of counties and sites visited exceeded all other surveys to date. Surveys conducted 2008–2017 are considered comparable.	Meese (2017)

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As during the early set of survey years, the survey effort increased each year from 2008 to 2017. More counties were surveyed in 2014 than on any previous survey and the number of observers participating on the 2014 survey (n = 143) was exceeded on only one previous survey (n = 155 in 2008). There was a large increase in the number of sites visited in each survey year between 2008 and 2014, and the number of colony sites visited in 2017 exceeded that of any other survey (Figure 9). The 2017 survey was the most extensive survey conducted to date based on all available metrics of effort (Table 1). The number of birds ~~observed~~ estimated on statewide surveys declined 63% from 395,000 birds in 2008 to an all-time low of about 145,000 birds in 2014 (Kelsey 2008, Meese 2014a) (Table 1). From 2014 to 2017, the number of birds observed increased 22% to 177,656. The number of birds observed in 2017 represents a 55% decline in the estimated population over the nine years since 2008.

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Although the conclusion following each of the two groups of survey years (1994–2000 and 2008–2017) was that a population decline had occurred, differences in survey methods and effort make it difficult to ~~combine the two groups of surveys to make longer-term conclusion~~draw reliable inferences (Meese 2015a). ~~Does~~ It is unclear whether the estimated number of birds in 2008 represents an increase in population size following the decline of the 1990s, or whether~~do~~ increased survey effort and other changes to survey ~~methodology~~ methods preclude comparison of results from the two survey periods.~~?~~ In addition to differences in duration of the survey, geographic scope, and effort~~ shown in Table 1~~, there were important differences in methods used ~~between the two groups of surveys~~among years (see Appendix 1). Methods unique to the ~~earlier~~ 1994–2000 surveys included: 1) Birds ~~counted~~ estimated at colonies before the survey were included in the results if the colony remained active after the survey period (although not counted on the survey day), 2) Birds observed and estimated~~counted~~ at colonies after the survey were included if nest phenology led to a conclusion that the colony was active on the survey date (although not observed), and 3) Visual colony size estimates were often adjusted using estimated~~observed~~ nest densities, as determined by walking transects through colony sites after the survey; this resulted in final colony size estimates that in some cases differed ~~significantly~~ substantially from those reported by survey participants (Hamilton et al. 1995). ~~Unfortunately, t~~The impact (both the magnitude and direction) of these methodological differences on the overall population estimates is unknown, and therefore a direct comparison of results ~~from the two time periods~~among years is not appropriate. At a minimum, the large ~~step~~ changes in survey effort ~~between the two time periods~~among years must be taken into account if the data are to be used to ~~inform a~~gauge whether there has been a long~~er~~-term population trend.

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~~As shown in Table 1, t~~The individual metrics of survey effort were not consistently reported across survey years (Table 1). The number of sites surveyed has been used to describe survey effort in recent years (Meese 2014a, 2015, 2017), but ~~this~~ the number of sites surveyed in the 1990s is not known~~ for the surveys conducted in the 1990s~~. The number of counties surveyed was also not reported for surveys conducted in the 1990s. The number of participants and the number of occupied breeding locations were reported for all survey years. It is not known whether an increase in effort as measured by any of these metrics results in a proportional increase in the number of birds observed, but Graves et al. (2013) reported that total counts of breeding birds are correlated with the number of sites sampled. The number of sites sampled is also related to the ~~proportion of the landscape~~area searched by survey

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participants (Figure 9) and therefore might be the most appropriate metric of effort with which to standardize survey results.

In order to make use of as many survey years as possible to evaluate population trend over time, survey results were adjusted for effort when available (Figure 10a-c). Viewed as a whole, when adjusting for survey effort the results suggest a consistent pattern in the Tricolored Blackbird population since 1994. Regardless of the metric used to adjust population estimates for survey effort, the trend shows a long-term decline over the 23-year period with a partial recovery between 2000 and 2008. Depending on the metric used to correct for effort, either 2014 or 2017 represents the all-time low for effort-adjusted number of birds observed.

As the number of locations visited has increased with each successive statewide survey, so too has the number of locations ~~with some~~for which coordinates are uncertain~~ty regarding the exact location~~. These are historical breeding locations for which the exact coordinates were not reported, and therefore the level of confidence is recorded as "uncertain" in the Tricolored Blackbird Portal database (2017). As a result, surveyors have visited an increasing number of locations that have not necessarily supported Tricolored Blackbird breeding in the past (Table 3). ~~This is not wasted effort, as t~~The visits to uncertain locations increase the ~~size of the landscape~~ area searched ~~for colonies~~ during the survey (Figure 9), and the locations are likely near historical colony sites. Nevertheless, for the 2017 survey, participants were directed to focus on sites ~~with~~ for which coordinates were known ~~coordinates~~, resulting in a large decline in the number of "uncertain" sites surveyed. To be conservative in interpreting changes in survey effort over time, the uncertain locations were removed from the count of sites visited during the 2000, 2008, 2011, 2014, and 2017 surveys ~~to adjust the effort for those survey years~~ (Table 3). The adjusted number of sites surveyed each year continues to ~~show an~~ increase ~~in survey effort~~ over time. ~~A graph prepared using t~~The revised number of sites surveyed (Figure 10d) ~~revealed little effect on~~was not strongly correlated with the ~~pattern~~ number of birds ~~observed~~ estimated per site ~~shown in~~(Figure 10b).

Table 3. Number of sites surveyed during recent statewide surveys, adjusted to remove uncertain locations.

Survey year	Number of sites surveyed	Number of uncertain sites	Revised number of sites surveyed
2000	231	4	227
2008	361	8	353
2011	608	54	554
2014	802	127	675
2017	884	25	859

The linear regression ~~trendline~~s for each of the effort-corrected survey ~~result~~s indicate that the estimated abundance of Tricolored Blackbird ~~populations~~ has declined by 75%–90% in the last 23 years (Figure 10). The observed rates of decline ~~of~~ are -5.8% to -10.5% per year ~~indicate that this species has been in severe decline over the last two decades~~. These rates of decline are in the range of the steepest declines observed across all ~~North American~~ landbird species in the United States and Canada based on Breeding Bird Survey data (Sauer et al. 2017a). Results of the most recent 2017 statewide survey suggest

Commented [EF121]: describe methods

Commented [EF122]: the apparent methods are questionable. they assume, for example, that all else being equal, participants search comparable areas and that colony sizes are equal. "Birds per known location" doesn't make sense – birds will not be in unknown locations

Commented [EF123]: Strongly disagree given inconsistencies in methods

Commented [EF124]: One of the many reasons why the standardization relies on numerous assumptions that may be erroneous, and cannot be used to infer long-term decline

Commented [EF125]: not provided to peer reviewers that the Tricolored Blackbird population decline may have slowed or reversed since 2014, but the population remains at or near its smallest size ever recorded. Coupled with the earlier declines between the 1930s and 1970s, the recent declines have resulted in a population that is a small fraction of its historical abundance.

There are several potential sources of uncertainty in the population estimates from statewide surveys. Attempts to quantify this uncertainty have been limited and inconsistent across years. Comments on the approach used to estimate the size of the population during recent statewide surveys, along with a discussion of uncertainty, are provided in Appendix 2.

Colony Size

Include synthesis statement about apparent trends in colony size

In recent statewide survey years, the sizes of the largest colonies (including the single largest colony and the average of the several largest colonies per year) have been reported as an alternative metric to total ~~counts~~ estimated abundance of birds for tracking trends over time. Use of the size of large colonies to evaluate trends is only appropriate if the survey effort is sufficient to detect most of the largest colonies, and estimation of the number of individuals per colony is accurate. Although the survey effort required to detect most of the largest colonies is unknown, Graves et al. (2013) reported that average colony size observed, based on colony data from 1907 to 2009, was not strongly correlated to the total number of sites sampled annually, suggesting that sampling may generally be sufficient to detect the largest colonies. Larger colonies may be more likely to be detected and therefore survey effort may have less effect on size of largest colonies observed compared to total counts of birds.

~~Neff (1937) located several breeding colonies of more than 100,000 nests in the Sacramento Valley, with the largest composed of greater than 200,000 nests (about 300,000 adult birds).~~ Orians (1961a) reported that, in 1959 and 1960, there were four Tricolored Blackbird colonies larger than 100,000 adults; three were in the rice-growing area in Colusa and Yolo counties and one was in Sacramento County. The largest reported colonies in the 1970s were in Colusa and Yolo counties and comprised ~~about~~ an estimated 30,000 adults (DeHaven et al. 1975a, Beedy and Hayworth 1992). All but one of the colonies observed by DeHaven et al. (1975a) that were larger than 20,000 birds were located in the Sacramento Valley. In the 1980s, the largest reported colony was in the northern San Joaquin Valley at Kesterson Reservoir (Merced County) in 1986, with an estimated 47,000 adults (Beedy and Hayworth 1992).

The documentation of large colonies in the San Joaquin Valley in the 1990s may be accurate, or may be a result of increased survey effort in the San Joaquin Valley.The estimated size of the largest colonies in ~~occurrence of Tricolored Blackbird breeding colonies on~~ grain fields in the San Joaquin Valley ~~was discovered in the early 1990s (Hamilton et al. 1995), and the size of the largest colonies in several subsequent years once again grew to~~was more than 100,000 birds~~, so-called "mega-colonies~~ in xxxx.~~"~~ Beedy and Hamilton (1997) reported that 1994 and 1997 were the only two survey years to that date with sufficient survey effort to detect "virtually all large colonies." In 1994, Hamilton et al. (1995) ~~found~~ estimated that the largest colony, at San Luis National Wildlife Refuge, numbered about 105,000 adult

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Tricolored Blackbirds. In 1997, Beedy and Hamilton (1997) reported the largest colony to contain about 80,000 adults. ~~The documentation of large colonies during this time period is likely due in part to the formation of mega-colonies on grain fields, but may also be a result of increased survey effort in the San Joaquin Valley.~~

Colonies of at least 80,000 breeding birds continued to ~~occur~~ be reported through 2010 (Meese 2009a, Meese 2010). From 2008 to 2017, maximum estimated colony size declined from 80,000 to fewer than 20,000 birds (Kelsey 2008, Kyle and Kelsey 2011, Meese 2017). In 2014, ~~only a single~~one colony consisted of more than 20,000 birds and ~~only~~ three colonies consisted of 10,000 birds or more (Meese 2014a). The percentage~~roportion~~ of birds observed in the 10 largest colonies during the years 2008, 2011, 2014, and 2017 was 77% (306,000), 81% (208,800), 64% (93,000), and 55% (98,050) of the statewide population estimate for those years, respectively. This reflects a downward trend in the aggregate sizes of the largest colonies, without a large increase in the number of occupied breeding locations (Figure 11). The estimated trend in the largest colonies from 1994 to 2017 is similar to those ~~in Figure 10~~ for effort-corrected statewide survey~~ result~~s: a long-term decline over the 23-year period with a partial recovery between 2000 and 2008.

Graves et al. (2013) ~~performed an~~ evaluat~~ion of~~ed trends in the average size of Tricolored Blackbird colonies ~~over a more than 100-year period~~from ~~(~~1907–2009~~) using~~ with data compiled from a variety of sources. Average colony size, rather than total abundance, was used as the metric to evaluate trends to account for the effects of variable sampling effort across years. Graves et al. (2013) found a significant decline in the average colony size from 1935 to 1975, with the average colony size declining by more than 60%. This corresponds to the period over which DeHaven et al. (1975) concluded that the total population size had declined by about 50%. Despite large amounts of data on colony sizes from the 1980s onward, no significant decline was detected in average colony size from 1980 to 2009 (Graves et al. 2013). This finding is counter to reports of declines for portions of the 1980–2009 period (e.g., Beedy et al. 1991, Hamilton 2000, Meese 2014a, Meese 2015a). However, the statistical evaluation conducted by Graves et al. (2013) used data only through 2009, so it does not include much of the time period during which the recent population decline was observed (2008–2014). In addition, it is unlikely that sampling effort was sufficient in all years to detect most of the largest Tricolored Blackbird colonies, which may have influenced the estimates of average colony size.

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Commented [EF136]: On what evidence is this assertion based?

The degree to which size of the largest or average colonies are correlated to total population size in any given year is unknown. However, during statewide survey years since 1994, the sizes of the largest colonies follow a pattern similar to that of the total numbers of birds observed. Given that in many years the majority of the population may occur~~s~~ in a small number of ~~the~~ largest colonies and the number of occupied colonies per year has not increased dramatically with increased survey effort (Table 1), it is likely that short-term declines in colony size often reflect real changes in the population size. Over longer periods, the correlation between colony size and population might be expected to ~~break down~~be weak due to shifts in breeding distribution and ~~selection~~ use of novel nesting substrates. For example, when the population began using agricultural grain crops in the early 1990s and experienced an apparent shift in early breeding season distribution to the San Joaquin Valley, very large colonies were reported for the first time in many years. These changes in nesting substrate availability and distribution

Commented [EF137]: highly speculative could have influenced the size of the largest colonies (and average colony size) by concentrating the population at a small number of breeding locations without necessarily reflecting a change in population size. In fact, Graves et al. (2013) reported that colonies in triticale and other grain crops were 40 times larger than colonies in other habitats during the last 20 years. This may explain in part why they did not find a reduction in average colony size from 1980 to 2009, a time when breeding surveys ~~revealed~~ suggested declines in total number of birds observed.

Commented [EF138]: in the absence of citations, seems like speculation

Winter Population

The Christmas Bird Count (CBC) is a volunteer-based survey conducted each winter at designated 15-mile diameter circles across ~~North America~~the United States and Canada. CBC data consist of counts of all bird species encountered during a single day at each circle for which a count is conducted. There are more than 2,400 count circles across North America, some of which have been ~~run~~ surveyed since the early 1900s (Soykan et al. 2016). The number of count circles increased dramatically through the 1950s and 1960s, especially in the western ~~region of the U.S.~~United States (Niven et al. 2004), and long-term trend assessments have often used a start date in the late 1960s to avoid any influence of increased survey coverage on apparent trends (Butcher et al. 2006). This is also the time period when the Breeding Bird Survey was initiated, which allows for comparisons between breeding and wintering populations (Niven et al. 2004). ~~Counts are not necessarily conducted for~~Surveys of every circle are not conducted each year, and some circles are ~~run~~ surveyed more consistently than others. The number of volunteer observers and the duration of the count can vary from year to year, and yearly differences in effort can significantly influence the results of the counts. Therefore, the number of party-hours is often used as a measure of effort to standardize count results. Count circle locations are also not randomly selected, so data cannot be extrapolated to provide population estimates across the range of a species, but if corrected for effort can provide an index that can ~~inform~~ suggest population change in areas covered by count circles.

Commented [EF139]: number of bird species (species richness), or abundance (number of individuals) of each species?

Commented [EF140]: not exactly what the article contends

Commented [EF141]: statistically? and is the assertion based on data?

Commented [EF142]: define

Soykan et al. (2016) used a hierarchical model to evaluate population change from 1966 to 2013 for several hundred species sampled by the CBC, including Tricolored Blackbird. The analysis assessed change in each U.S. state and in each Bird Conservation Region (BCR; a map of BCRs is available at http://nabci-us.org/resources/bird-conservation-regions-map/)~~, with t~~. The Coastal California BCR ~~being~~ is the primary BCR in which Tricolored Blackbirds occur~~s~~. Trends for Tricolored Blackbird were non-significant at both the California and the BCR scales. Hierarchical models are more efficient than linear regression approaches when assessing population change for a large number of species across multiple geographic scales, and can control for variation in survey effort among circles and across years. However, the use of large spatial scales for analysis may introduce variability in the quality of information that may not accounted for in the models. Although the Coastal California BCR captures the majority of the Tricolored Blackbird range in California, it is neither geologically nor biologically uniform. Also, the addition of count circles over time has not been evenly distributed across the BCR or the state. Due to the variability in habitat and species distribution at these broad scales, any apparent population trend, or lack thereof, can be an artifact of the years in which count circles were added or removed, or the years in which particular circles were surveyed across a heterogeneous landscape. A finer-scale approach that considers the impacts of this variability on a single species is warranted.

Commented [EF143]: not necessarily – citations here would be good

Commented [EF144]: neither is the area covered by the statewide surveys

Commented [EF145]: The take-home message from this paragraph seems to be that the CBC data cannot be used with confidence to draw inference to trends

In California, the number of count circles increased through the 1960s ~~as has been documented in other areas~~, but the number of circles continued to increase through the early 1990s. The number of circles in California ~~detecting~~ in which Tricolored Blackbird was detected doubled from 1974 (25 circles) to 1986 (50 circles) and the number of circles with Tricolored Blackbird detections did not stabilize until the 1990s. Since 1992 the number of circles with Tricolored Blackbird detections has been fairly stable and has fluctuated between 54 and 66. Because of the continued increase in the number of count circles through the 1990s, and the inconsistent number of surveys~~running of counts~~ at some circles over time, the sampling intensity has varied across the range of the Tricolored Blackbird in California. Based on the number of count circles surveyed in California over time, and by establishing criteria for consistency of effort, the Department assessed trends based on CBC data for two time periods: 1974–2015 and 1995–2015. ~~These two periods capture a longer term extending back to the 1970s when the breeding-season surveys of DeHaven et al. (1975a) were conducted, and a shorter term covering the time since the first statewide surveys of the 1990s and when CBC data quality was highest and most consistent.~~ The distribution of count circles that met a set of criteria and that were therefore included in the analyses provides fairly good coverage of the known core of the winter distribution of the species (Figure 12; Appendix 3). Population trends were estimated from the slope of the regression of the log-transformed counts on year (see Butcher et al. 1990). Results of the CBC data analyses indicate declines in the Tricolored Blackbird population over both ~~the longer term~~ 1974–2015 ~~period~~ and ~~the shorter term~~ 1995–2015 period (Appendix 3).

Improvement in bird identification skills by volunteer observers has been apparent within the past 20 years, and poses a significant challenge in the interpretation of trends based on CBC data. This may be especially true for species ~~with potential identification problems~~that are difficult to identify and for flocking species such as the Tricolored Blackbird (Butcher et al. 1990). As a result, counts that are adjusted by party-hour may be positively biased in recent years~~, which would tend to result in a positive bias in observed trends~~.

A number of historical winter observations of large numbers of Tricolored Blackbirds ~~corroborate~~ are consistent with the observed decline in CBC data. Wintering flocks numbering an estimated 12,000–14,000 once assembled near dairies on the Point Reyes Peninsula, Marin County~~, which was one of the most reliable locations to observe large numbers of wintering Tricolored Blackbirds~~. In recent years, these flocks have been estimated in the range of 2,000–3,000 birds (eBird Dataset 2016, Beedy et al. 2017).

Regional Shifts in Abundance

~~Because of the Tricolored Blackbird's nomadic tendency and the potential for large interannual shifts in breeding distribution, year-to-year changes in regional abundance are common.~~ Tricolored Blackbird surveys have regularly ~~revealed~~ suggested large annual changes in local abundance that would not be expected due to productivity or mortality rates alone (Hamilton 1998). During statewide surveys, large declines in one region are often coupled with large increases in other regions, and therefore caution is warranted when interpreting year-to-year changes in local abundance. That said, persistent long-term

Commented [EF146]: Not clear. Do you mean that the number of survey locations increased until the early 1990s?

Commented [EF147]: but how much variation in the interim

Commented [EF148]: which are what?

Commented [EF149]: explain these here

Commented [EF150]: on the basis of what?

Commented [EF151]: or statewide survey data

Commented [EF152]: only if in mixed flocks with morphologically similar species changes in distribution and regional abundance likely represent shifts in regional habitat ~~suitability~~ quality or ~~population~~ abundance.

Central Valley

Following incidental observations on the regional abundance of Tricolored Blackbirds in the 1800s and early 1900s, the Central Valley was described as the center of abundance for the species. The first systematic attempt to assess the species' rangewide distribution and population ~~confirmed~~ was consistent with this description, with most birds observed in the Sacramento Valley (Neff 1937). Additional observations and study of breeding colonies occurred through the 1960s before a second attempt at quantifying rangewide abundance in the early 1970s, with the majority of birds again ~~found~~ detected in the Sacramento Valley and northern San Joaquin Valley (DeHaven et al. 1975a).

Within the Central Valley, observed shifts in regional abundance over relatively short time periods ~~have been a regular occurrence~~are common~~. Over a period of five years in the 1930s,~~ (Neff (1937~~) observed regular shifts in the annual centers of abundance between the rice-growing regions of the Sacramento Valley (Butte and Glenn counties) and regions to the south in Sacramento and Merced counties.~~ , DeHaven et al. (1975a) ~~noted substantial yearly variation in centers of breeding abundance, even in their limited study area consisting of the Sacramento and northern San Joaquin valleys~~. ~~For example, they observed 57,000 Tricolored Blackbirds nesting in Colusa County in 1969, but only 2,000 the following year. This pattern was mirrored in Yolo County where the number of breeding birds observed declined from 25,000 to 5,000. At the same time, other counties in the Sacramento Valley experienced increases in the number of breeding birds, with Glenn County increasing from 2,000 to 18,500 birds, and Yuba County increasing from 1,000 to 5,250 birds. A larger region comprising the major rice-growing region of the Sacramento Valley (Butte, Colusa, Glenn, Yolo, and Yuba counties) also varied considerably in the proportion of the known population it supported, with the proportion of known breeding birds in the region ranging from 29% to 59% during a four-year study period (DeHaven et al. 1975a). In the year when the smallest proportion of birds were located in this rice-growing region, the largest known congregation of birds occurred to the south in the pasturelands of southeastern Sacramento County. These regional shifts in abundance demonstrate the species' ability to undergo large interannual shifts in breeding distribution, likely in response to an unpredictable food supply or other habitat components.~~

~~In addition to short~~Longer-term shifts in regional abundance~~,~~ in the Central Valley ~~has experienced longer-term changes, with some regions of the valley experiencing long-term declines in number of breeding colonies or breeding birds~~also have been observed. For example, Kings County was reported to support~~ed~~ tens of thousands of breeding birds per year through the 1990s, with 65,000 birds breeding in the county in 1992. In recent years, ~~the county has hosted only~~ a few hundred to a few thousand breeding birds were reported in the county. In Glenn County, which once was reported to support~~ed~~ hundreds of thousands of birds per year and ~~continued to support~~ at least 10,000 birds into the 1990s, has not been reported to host~~ed~~ more than 1,400 birds in any year since 2000. San Joaquin County regularly was reported to support~~ed~~ up to about 10,000 birds per year through the 1990s, but has been reported to host~~ed only~~ a few small colonies since then, with the largest recent reported colony of 1,800 birds in 2015. As described above, the Tricolored Blackbird appears to have experienced a population

Commented [EF153]: largely redundant with material above

Commented [EF154]: but as noted above, "however, Neff's surveys focused on the Sacramento Valley in most years"

Commented [EF155]: citations needed throughout this paragraph

Commented [EF156]: citations?

increase from the 1990s through the 2000s in the San Joaquin Valley as a whole, with a corresponding decrease in the Sacramento Valley. Following this increase, the population in the San Joaquin Valley was reported to ~~experienced a severe~~ decline by~~of~~ 78% from 2008 to 2014 (Meese 2015a). This is a time period during which the species reportedly declined by 63% rangewide, and the majority of this decrease was ~~due~~ attributed to declines in the San Joaquin Valley. The total ~~number of birds lost from~~ estimated reduction in population size in the San Joaquin Valley portion ~~of the range~~ during this period (~267,000 birds) exceeded the rangewide decline (250,000 birds), with a small portion of the loss compensated by increases in the breeding population elsewhere (Figure 13) (Meese 2015a). The estimated number of birds breeding in the San Joaquin Valley rebounded somewhat by 2017, but estimated declines in this region remain the primary contributor to estimated range-wide population declines since 2008.

Southern California and Baja California

As described above under Distribution, the Tricolored Blackbird was once reported to be abundant on the coastal slope of the southern California ~~portion of the range~~, from Santa Barbara County to San Diego and into Baja California. ~~Although the e~~Early reports of species abundance were not quantitative, and therefore ~~they serve as a~~ comparisons to reported numbers of birds in the region in recent decades have high uncertainty. Neff (1937) provided the first quantitative estimates for southern California, although San Diego and Santa Barbara counties were the only counties his collaborators spent a ~~significant amount of~~ considerable time surveying; thousands of birds were ~~documented~~ estimated in both of these counties. DeHaven et al. (1975a) reported colonies of up to 10,000 birds in southern California (Riverside County), with thousands of birds ~~documented~~ estimated in all counties south of the Transverse Ranges, except Orange County.

The first statewide survey that~~to~~ included all counties in southern California was ~~conducted~~ in 1997 (Beedy and Hamilton 1997). That year, more than 40,000 Tricolored Blackbirds were estimated to breed in ~~the~~ southern California ~~portion of the range~~, with more than 90% ~~occurring~~ in western Riverside County (Feenstra 2009, Cook 2010). Since this time, the largest proportion of the southern California breeding population ~~has continued to occur~~was reported in western Riverside County (Cook 2010). The 2005 statewide survey ~~located~~ estimated about 12,500 breeding birds south of the Transverse Ranges. A ~~thorough search~~survey of historical breeding locations in southern California in 2008, 2009, and 2011 estimated~~revealed~~ a population south of the Transverse Ranges of consistently less than 5,000 breeding birds (Figure 14) (Kelsey 2008, Feenstra 2009, Kyle and Kelsey 2011). By 2009 the coastal slope portion of the region ~~had~~ was estimated to decline~~d~~ to ~~only~~ 750 Tricolored Blackbirds breeding at a single site in San Diego County (Feenstra 2009). The 2014 survey ~~located~~ reported a slightly larger population ~~consisting~~ of about 6,400 breeding birds (Meese 2014a). In 2017, the number of birds estimated~~observed~~ increased ~~again~~ to about 8,800, although the large majority of these (>90%) were ~~again located~~ in one small region of western Riverside County. San Diego was the only other county ~~with~~ from which breeding birds were detected in 2017, with seven small colonies ~~totaling~~ estimated to include fewer than 700 birds. Most breeding colonies of the Tricolored Blackbird in Southern California ~~have tended~~were estimated to be small in recent years, averaging a few hundred birds (Feenstra 2009).

In the last decade the breeding population in the Mojave Desert portion of the range in San Bernardino and northern Los Angeles counties ~~appears~~ was estimated to ~~have grown somewhat,~~grow from ~~just over~~about 1,000 breeding birds ~~located~~ during surveys in 2008–2011, to more than 5,000 breeding birds in 2014 (Meese 2014a). It is unclear whether the Mojave Desert birds are more closely associated with the southern California population or ~~to~~ the ~~birds~~ population in the Central Valley~~, although observations of three banded birds since 2009 and observations of a flying flock in the 1800s have documented birds moving between the desert and the Central Valley~~. ~~Ongoing genomic studies will address the population structure and patterns of movement throughout California.~~

Originally considered common in northwestern Baja California, numbers appear to have declined by the late 1900s. Recent surveys ~~have shown~~suggested that the northwestern Baja California population ~~has declined to only~~was several hundred individuals (Erickson et al. 2007, Erickson and de la Cueva 2008, Feenstra 2013, Erickson et al. 2016, Meese 2017).

Summary—The Tricolored Blackbird ~~, once described as the most abundant species in southern California, had~~ reportedly declined dramatically by the time statewide surveys were established in the 1990s. Tens of thousands of breeding birds ~~continued to occupy the region~~were estimated ~~during the first complete survey of~~in 1997. The most recent intensive searches of ~~the~~ southern California ~~portion of the range located~~estimated ~~only~~ thousands of breeding birds at a small number of locations. Following the first comprehensive survey of southern California counties in 1997, the Tricolored Blackbird population ~~declined by nearly 90%, to lows of~~was estimated to include fewer than 5,000 birds from 2008 to 2011. The southern California population rebounded somewhat by 2014, but most of the increase ~~can~~ may be attributed to birds in the Mojave Desert. This decline coincides with the reported disappearance of the species from much of ~~the~~ southern California ~~portion of the range and is mirrored by~~and reported declines in abundance and distribution in ~~the~~ Baja California ~~portion of the species' range~~. ~~If recent trends continue, the species may decline to extirpation in the southern portion of its range in the near future.~~

Commented [EF157]: pure speculation

Northern and Central Coasts

Small numbers of birds reportedly bred annually during the late nesting season (July–September; thought to represent second breeding attempts by birds that previously nested elsewhere) in western Marin County until 2003 (Stallcup 2004). There has been no documented breeding in Marin County since ~~then~~.

EXISTING MANAGEMENT

Land Ownership within the California Range

~~There is a paucity of public lands in the Central Valley, with the region that regularly supports more than 90% of the breeding population composed primarily of privately-owned lands (Figure 15).~~ The total ~~area in the~~ estimated range of the Tricolored Blackbird in California is more than 34 million acres. Privately ~~-~~ owned lands compose 84% of this area, with state and federal lands totaling about 12% (Figure 15).

Much of the area under federal ownership is ~~composed of~~ forested ~~areas that are~~ and not ~~suitable~~ habitat for the species. The USFWS National Wildlife Refuges and Department Wildlife Areas comprise about 250,000 and 254,000 acres, respectively (1.5% of the range, combined).

Of the 1,045 historical breeding locations with known coordinates in the Tricolored Blackbird Portal database (as of January 2017), 191 (18%) ~~have been located~~are on public lands. A minority of breeding colonies continue to occur on public lands each year. For example, during the 2011 statewide survey, colonies were found on a county park, a Department Ecological Reserve in San Diego County and an Ecological Reserve in Kern County, and on three National Wildlife Refuges in the Central Valley (Kyle and Kelsey 2011). These colonies were estimated to include ~~totaled~~ 66,325 breeding birds (about 25% of the estimated statewide population in that year), the large majority of which were from a single colony on a USFWS National Wildlife Refuge.

Habitat Conservation Plans

Habitat Conservation Plans (HCPs) are long-term ~~landscape level~~ plans that provide the basis for regulatory compliance with the ESA by nonfederal entities. HCPs ~~provide a mechanism to authorize~~are permits for incidental take of species listed as ~~federally~~ threatened and endangered ~~species~~ under the US Endangered Species Act. They are applicable to private lands and authorized by ~~under~~ section 10(a) of the ESA~~, while also describing how impacts to covered species will be minimized or mitigated in the plan area~~. An HCP must minimize and mitigate the impacts of take to the maximum extent practicable.

~~There are f~~Five approved HCPs in California ~~that~~ include the Tricolored Blackbird ~~as a covered species~~ and two additional HCPs ~~that~~ are in the planning stage (Figure 16; Table 4):

Approved HCPs:

- Natomas Basin
- San Joaquin County Multi-species Conservation Plan
- PG&E San Joaquin Valley Operations & Maintenance
- Kern Water Bank
- Orange County Southern Subregion

Planning Stage:

- South Sacramento
- Solano Multi-Species

Commented [EF158]: indicate number of years

Commented [EF159]: landscape-level doesn't provide much information without quantification, and most HCPs on the books are for individual species and small areas

Table 4. Current and Planned HCPs and ~~/~~NCCPs in California that include Tricolored Blackbird ~~as a covered species~~.

Plan title	Counties	Plan ~~acreage~~area	Date permit issued	Term
Natomas Basin HCP	Sacramento, Sutter	53,342	June 2003	50 years
San Joaquin County Multi-species Conservation Plan HCP	San Joaquin	896,000	May 2001	50 years
PG&E San Joaquin Valley Operations & Maintenance HCP	~~Portions of nine counties:~~ San Joaquin, Stanislaus, Merced, Fresno, Kings, Kern, Mariposa, Madera, Tulare	276,350	December 2007	30 years
Kern Water Bank HCP	Kern	19,900	October 1997	75 years
Orange County Southern Subregion HCP	Orange	132,000	January 2007	75 years
South Sacramento HCP	Sacramento	317,656	Planning stage	TBD
Solano Multi-species HCP	Solano, Yolo (edge)	580,000	Planning stage	TBD
East Contra Costa County (NCCP)	Contra Costa	175,435	July 2007	30 years
Santa Clara Valley Habitat Plan (NCCP)	Santa Clara	460,205	July 2013	50 years
Western Riverside County Multiple Species Habitat Conservation Plan (NCCP)	Riverside	1,300,000	June 2004	75 years
San Diego County Multiple Species Conservation Program (NCCP)	San Diego	511,878	August 1998	50 years
San Diego Gas & Electric Subregional (NCCP)	San Diego, Orange, Riverside	Linear projects[1]	December 1995	55 years
San Diego County Water Authority (NCCP)	San Diego, Riverside	Linear projects[1]	December 2011	55 years
Butte Regional Conservation Plan (NCCP)	Butte	564,270	Planning stage	TBD
Yuba-Sutter Regional Conservation Plan (NCCP)	Yuba, Sutter	468,552	Planning stage	TBD
Placer County Conservation Plan Phase I (NCCP)	Placer	201,000	Planning stage	TBD
Yolo Habitat Conservancy (NCCP)	Yolo	653,663	Planning stage	TBD
San Diego East County Multiple Species Conservation Plan (NCCP)	San Diego	1,600,000	Planning stage	TBD
San Diego North County Multiple Species Conservation Plan (NCCP)	San Diego	311,800	Planning stage	TBD

[1] These NCCPs cover discrete linear or energy projects but have larger plan areas that overlap with other NCCPs.
Primary Sources:
USFWS endangered species page for Tricolored Blackbird under conservation plans:
https://ecos.fws.gov/ecp0/profile/speciesProfile?spcode=B06P#conservationPlans

Commented [EF160]: These need to be explained up front given that they are referenced in the table

Commented [EF161]: include metric equivalents

Commented [EF162]: virtually all include portions of counties

Summary of Natural Community Conservation Plans (NCCPs) September 2016
https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=15329&inline

The goals, objectives, and conservation measures for Tricolored Blackbird included in approved HCPs are summarized below.

Natomas Basin HCP

The City of Sacramento and County of Sutter hold the permits for t~~T~~he Natomas Basin Habitat Conservation Plan (NBHCP)~~ covers 53,342 acres in the northwestern part of Sacramento County and southern Sutter County~~. ~~The City of Sacramento and County of Sutter are participants~~. The 50-year term expires June 2053.

Commented [EF163]: throughout, don't repeat information in the table. Expiration dates can be added to the table

Tricolored Blackbirds nest and forage in the Natomas Basin. At the time of the planning effort, one active nesting colony was known from the eastern edge of the Natomas Basin (Betts Kismat-Silva Reserve) and nine ~~documented~~ occurrences were documentedin~~noted for~~ Sutter County. Based on habitat ~~preferences~~ associations of Tricolored Blackbirds, the Natomas Basin supported about 1,998 acres of potential nesting habitat and 41,310 acres of potential foraging habitat (NBHCP 2003).

A total of 449 acres of potential nesting habitat will be converted to urban development as a result of implementing the proposed action. A loss of 15,311 acres of potential foraging habitat (non-rice crops = 6,517 acres, grassland = 560 acres, pasture = 147 acres, and rice = 8,087 acres) will result from the planned development (USFWS June 24, 2003).

Under the plan, 2,137.5 acres of managed marsh ~~habitat~~ will be preserved in a reserve system. Wetland reserves are intended to benefit wetland-associated c~~C~~overed s~~S~~pecies such as Tricolored Blackbirds. The managed marsh reserves will provide potential nesting habitat for Tricolored Blackbirds in close proximity to foraging habitat, which is expected to increase the area of ~~suitable~~ nesting ~~opportunities~~ habitat for this species. Additionally, 4,375 acres of rice and 2,187.5 acres of potential upland habitats will be added to the reserve system. Generally, acquisition of upland habitat is prioritized first for the conservation of Swainson's Hawk (*Buteo swainsoni*) then secondarily for other upland-associated Covered Species including Tricolored Blackbird (USFWS June 24, 2003).

Take minimization measures include pre-construction surveys for Tricolored Blackbirds, avoidance of ~~actively~~ nesting colonies and ~~/~~minimization of disturbance during the nesting season, establishment of a physical ~~protective~~ barrier 500 feet from the ~~active~~ nesting sites, and a "reasonable" buffer for foraging lands on reserve lands. The NBHCP includes measures to avoid, minimize, and mitigate take of the giant garter snake (*Thamnophis gigas*) with timing restrictions, pre-construction site dewatering, and vegetation control management. Because some elements of habitat for ~~the~~ Tricolored Blackbirds ~~shares some habitat similarities with~~and giant gartersnakes are the same~~ the snake~~, these measures may also benefit the blackbird (NBHCP 2003).

Commented [EF164]: as opposed to passively nesting colonies?

Commented [EF165]: means what?

Monitoring Covered Species is provided for in the plan. The USFWS commented on monitoring the Tricolored Blackbirds nesting colony in the final EIR/EIS (USFWS April 2003): "…the success of this population will be monitored annually and the reserve acquisition program of the NBHCP could be modified if it is determined that foraging habitat is a limiting factor for the colony. This colony is located well outside of the City's Permit Area, and this colony may forage upon unincorporated lands within Sacramento County. If, through the annual monitoring, it is determined that additional foraging habitat is required, the NBHCP would allow for modification of both acquisition programs and habitat management/restoration to provide enhanced foraging. The long-term success of the NBHCP will rely not on establishing a rigid Operating Conservation Program based on limited information, but rather will result from a flexible program that responds to new information collected through monitoring as well as evolving scientific data as applicable to the Covered Species."

Commented [EF166]: And what have the data in the past 15 years suggested?

San Joaquin County Multi-Species Conservation Plan HCP

The San Joaquin County Multi-Species Conservation Plan HCP (SJMSCP) spans 896,000 acres in San Joaquin County. Participating entities include the Cities of Escalon, Lathrop, Lodi, Manteca, Ripon, Stockton, and Tracy and the County of San Joaquin. The 50-year term expires May 2051.

The SJMSCP identified 9,374 acres of "occupied" habitat for the Tricolored Blackbird in the plan area and an additional 47,193 acres of potential habitat including foraging and wintering areas. It is expected that 1,614 acres of Tricolored Blackbird habitat will be converted under full build-out.

Commented [EF167]: why in quotation marks? is it not actually occupied?

~~The SJMSCP conservation strategy relies on minimizing, avoiding, and mitigating impacts for Covered Species including the Tricolored Blackbird.~~ Mitigating impacts to Covered Species will largely be accomplished through the creation, enhancement and management of p~~P~~reserves. Tricolored Blackbirds are associated with five planned p~~P~~reserves: Primary Zone of the Delta (Large and Small Water's Edge Preserve), Vernal Pool Zone (Vernal Pool Grassland Preserve), Central Zone (Row and Field Crop/Riparian Preserve), Central Zone (Wetlands Preserve), Central/Southwest Transition Zone (Use Central Zone Row and Field Crop/Riparian Preserve). Tricolored Blackbirds are considered indicators of Preserve health and will be monitored at the species-level, accordingly.

Incidental take minimization measures include a setback of 500 feet from nesting areas during the nesting season ~~for the period encompassing nest building~~ and continuing until fledglings leave nests. This setback applies whenever construction or other ground-disturbing activities must begin during the nesting season in the presence of nests that are known to be occupied. Setbacks shall be marked by brightly~~-~~ colored temporary fencing.

Pacific Gas & Electric San Joaquin Valley Operations & Maintenance HCP

The PG&E San Joaquin Valley Operations & Maintenance HCP (PG&E HCP) plan area includes 276,350 acres in portions of nine counties in the San Joaquin Valley, as follows: San Joaquin, Stanislaus, Merced, Fresno, Kings, Kern, Mariposa, Madera, and Tulare. The 30-year term expires in 2037.

The following discussion is derived from USFWS 2007:

> Tricolored Blackbirds occupied approximately 1,443 acres of existing PG&E right-of-way in the plan area (52 occurrences in CNDDB as of 2007).

As part of the planning process, PG&E will establish a map book for the Tricolored Blackbird by, prior to initiation of any covered activities, determining where PG&E facility lines occur within 100 meters of CNDDB-documented occurrences of breeding colonies. Active nesting birds will be avoided. If an active breeding colony could be disrupted by the covered activity, an exclusion zone of at least 350 feet around the colony will be established. This exclusion zone will be established in the field based on site conditions, the covered activity, and professional judgment by a qualified PG&E biologist, and will be greater than the minimum distance. Work will not occur in this exclusion zone during April 1–July 31.

The PG&E HCP estimated that covered activities would directly disturb approximately 4 acres of ~~suitable~~ nesting or foraging habitat each year (120 acres of temporary disturbance over 30 years), with most of this disturbance occurring in foraging habitat. Less than 0.1 acre per year of blackbird nesting habitat is expected to be permanently lost each year (less than 3 acres of nesting habitat permanently lost over 30 years). Other covered activities that may disturb Tricolored Blackbirds (e.g., off-road travel and tree trimming that do not disturb ground surfaces) will affect 34 acres of suitable Tricolored Blackbird habitat each year (1,020 acres over the 30-year permit term). These impacts are expected to be individually small, widely dispersed and, therefore, likely to be insignificant and discountable.

Permanent loss of suitable foraging or nesting habitat will be compensated at a 3:1 ratio and temporary disturbance to suitable habitat will be compensated at a 0.5:1 ratio. The HCP estimates PG&E will provide 0.37 acres of Tricolored Blackbird compensation in the North San Joaquin Valley, 0.91 acres of compensation in the Central San Joaquin Valley, and 0.57 acres of compensation in the South San Joaquin Valley annually. Overall, PG&E will provide approximately 2.3 acres of Tricolored Blackbird compensation annually (approximately 69 acres over 30 years).

Kern Water Bank HCP

Commented [EF168]: This doesn't provide information about conservation actions

The Kern Water Bank HCP covers 19,900 acres of central Kern County. The 75-year term expires in 2072. Planning documents list no known Tricolored Blackbird colonies from the Kern Water Bank area; however, it was acknowledged that the species might move into the HCP area in the future. Impacts were described as "negligible; high mobility of the species allows easy escape from project-related impacts" (Kern Water Bank Authority 1997). A monitoring effort conducted in 2011 documented five small colonies numbering ~400 individuals in nettles under mesquite within the plan area. A large colony numbering several thousand individuals settled in an historic site along the Kern River channel but the colony was abandoned; they may have joined a ~~successful~~ colony in Basin 6 on city property of approximately 10,000 individuals that ~~successfully~~ fledged young. The author did not identify whether the earlier failed effort or the successful colony was located within the plan area (Hardt 2011).

Commented [EF169]: unclear

Orange County Southern Subregion HCP

The Orange County Southern Subregion HCP comprises 132,000 acres in the study area, including the Cleveland National Forest (40,000 acres). Excluding certain urbanized areas and the National Forest

Commented [EF170]: ?

~~property~~, the planning area totals 86,000 acres within southern Orange County. The County of Orange and Rancho Mission Viejo are signatories~~y~~ to the implementing agreement. The 75-year term expires in 2082.

Six general Tricolored Blackbird breeding locations have been documented in the planning area historically and include: Middle Chiquita Canyon, Coto de Caza, Radio Tower Road, Verdugo Canyon in San Juan Creek, lower Gabino Canyon, and Trampas Canyon settling ponds. Not all sites have been used consistently or recently. A total of 18,759 acres of potential foraging habitat was identified in the planning area. One of the known historic breeding ~~sites~~locations, Trampas Canyon, will be directly impacted by the proposed covered activities and an estimated 3,769 acres of foraging habitat will be developed or otherwise made unsuitable for Tricolored Blackbirds (USFWS 2007).

The plan conserves four of the breeding ~~colony sites~~locations within a planned habitat reserve: Middle Chiquita Canyon, Verdugo Canyon, Radio Tower Road, and Lower Gabino Canyon. ~~Adequate f~~Foraging habitat within a four-mile radius of these sites also ~~would be~~is conserved. Planners assumed that "at least 1,000 acres of foraging habitat within four miles of a nest site would be more than adequate to sustain the relatively small nesting colonies that occur in the study area" (Dudek and Associates 2006). Adequate foraging habitat will also be conserved at the Cota de Caza site. A total of 8,015 acres of foraging habitat for Tricolored Blackbirds in the planning area, including the four historic ~~nest site~~breeding locations, will be cooperatively managed within the habitat reserve. Additional open space habitats exist within County Parks (1,694 acres) which will be managed with overall conservation goals of the HCP (USFWS 2007).

Management actions to benefit Tricolored Blackbirds will focus on nonnative predators, grazing, minimizing pesticide use near colonies, and managing human disturbance near colonies (Dudek and Associates 2006).

South Sacramento HCP

The South Sacramento HCP is currently in the planning stage. The proposed study area encompasses 317,656 acres in Sacramento County. Anticipated partners include the County of Sacramento and the Cities of Rancho Cordova and Galt.

Solano Multi-Species HCP

Solano Multi-Species HCP is currently in the planning stage. The proposed study area includes 577,000 acres in Solano County and an additional 8,000 acres in Yolo County. Participants in this effort include the Cities of Dixon, Fairfield, Rio Vista, Suisun City, Vacaville, and Vallejo.

Natural Community Conservation Plans

Like HCPs, Natural Community Conservation Plans (NCCPs) are long-term landscape-level conservation plans. Under California state law, the Natural Community Conservation Planning Act (Fish & G. Code, §§ 2800-2835) provides a mechanism to obtain authorization for incidental take of CESA-listed and other species. An NCCP provides for the protection of habitat, natural communities, and species diversity on a

Commented [EF171]: in what manner

Commented [EF172]: And is this a credible assumption?

Commented [EF173]: adequate for what?

Commented [EF174]: Great, but connection to Tricolored Blackbirds not clear

Commented [EF175]: meaning what? what are the actual actions and what is the evidence that the actions will affect Tricolored Blackbirds?

landscape or ecosystem level, while allowing compatible and appropriate economic activity. An NCCP is broader in its objectives than the ~~take authorization provided under the~~ California and Federal ESAs, and may require conservation measures that go beyond mitigation of impacts to meet the recovery needs of covered species. All approved NCCPs are also HCPs and so provide authorization for take of federally ~~-~~listed species through section 10 of the ESA.

Commented [EF176]: is this the statutory language?

There are six approved NCCPs in California that include the Tricolored Blackbird as a covered species and six additional NCCPs that are in the planning stage (Figure 16; Table 4):

Approved NCCPs:

- East Contra Costa County
- Santa Clara Valley Habitat Plan
- Western Riverside County Multiple Species Habitat Conservation Plan
- San Diego County Multiple Species Conservation Program
- San Diego Gas & Electric Subregional
- San Diego County Water Authority

Planning Stage:

- Butte Regional Conservation Plan
- Yuba-Sutter Regional Conservation Plan
- Placer County Conservation Plan Phase I
- Yolo Natural Heritage Program
- San Diego East County Multiple Species Conservation Plan
- San Diego North County Multiple Species Conservation Plan

The goals, objectives, and conservation measures for Tricolored Blackbird included in approved NCCPs are summarized below.

East Contra Costa County NCCP

The East Contra Costa County NCCP (ECCC) spans 174,018 acres in eastern Contra Costa County. The following local governments are signatory to the implementing agreement: cities of Brentwood, Clayton, Oakley, and Pittsburg, and the County of Contra Costa. The city of Antioch is not part of the agreement. The 30-year term will expire August 2037.

The ECCC is located within the Bay Delta and Central Coast Province (CDFW 2015). Six natural communities are found in the study area: streams/riparian woodland, wetland, grassland, oak woodland, chaparral/scrub, and agricultural lands.

During the project planning phase, Tricolored Blackbirds were described as sporadic in the plan area; two breeding colonies were noted on the northern border of Los Vaqueros Watershed and several additional small colonies were detected during fieldwork for the county bird atlas project (ECCC 2006). The Contra Costa County Bird Atlas project ~~found~~ characterized the Tricolored Blackbird ~~to be~~as a “fairly common permanent but highly local resident of freshwater marshes and weedy fields, particularly in East County but also locally elsewhere. Most breeding birds were present in the vicinity of… Byron" (Glover 2009). The largest colony detected ~~numbered~~ was estimated to include several hundred pairs. The a~~A~~tlas confirmed breeding in six blocks, and found five additional blocks with possible nesting and an additional possible nesting colony just south of the county border (Glover 2009).

Commented [EF177]: what is a block?

Commented [EF178]: unclear – species present but nesting uncertain?

Commented [EF179]: not clear

ECCC development guidelines require avoidance of ~~occupied~~ Tricolored Blackbird nests during the breeding season. Under the agreement, ~~impacts~~ loss of up to 204 acres of core habitat and 9,621 acres of primary foraging habitat may be permitted as a result of covered activities. A planned preserve system will protect 126–164 acres of ~~suitable~~ core habitat and 16,747–20,138 acres of primary foraging habitat under the initial urban development area or maximum urban development area, respectively. The preserve system will also protect at least seven of 13 ponds, all of which may provide ~~potential~~ breeding habitat. Additional pond and wetland creation (an estimated 85 acres of perennial wetland plus an estimated 16 acres of pond ~~habitat~~) will be created or restored. Managed habitat is predicted to be of higher quality than what had existed prior to the agreement. Conservation easements will be acquired on 250–400 acres of cropland or pasture; landowners will be required to enhance habitat for Tricolored Blackbird and other covered species (CDFG 2007).

Commented [EF180]: what is primary habitat?

Commented [EF181]: by whom, and on the basis of what evidence?

Commented [EF182]: how?

Annual progress reports prepared under the ECCC documented two recent land acquisitions with value for Tricolored Blackbirds. Vaquero Farms North, a 575-acre property adjacent to the Los Vaqueros Reservoir Watershed lands was purchased in 2010. It is situated entirely west of Vasco Road, with primary access from Vasco Road (ECCHC 2011). Vaquero Farms Central, a 320-acre property bounded by two existing p~~P~~reserve s~~S~~ystem properties, Vaquero Farms North and Vaquero Farms South, was purchased in 2012 (ECCHC 2013). No progress towards pond creation was reported in the latest available annual report of activities (ECCHC 2016).

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Santa Clara Valley Habitat Plan NCCP

The Santa Clara Valley Habitat Plan NCCP (SCVHP) includes the cities of Gilroy, Morgan Hill, and San Jose (excluding Alviso and the Baylands) and the County of Santa Clara. The study area encompasses 519,506 acres; the permits areas, however, differ from the study area. Two permits were issued under the plan, one solely for Burrowing Owl (48,464 acres) and another for all other covered species. The "all other covered species" permit, including Tricolored Blackbird, totals 460,205 acres and excludes Henry Coe State Park and a portion of Pacheco State Park. The term of the permit is ~~for~~ 50 years and the permit will expire July 2063.

The SCVHP is ~~found~~ within the Bay Delta and Central Coast Province (CDFW 2015). Natural communities within the planning area include grassland (including serpentine grasslands), chaparral and scrub, coastal scrub, conifer woodland, oak savannah, oak woodland, riparian woodland scrub, mixed evergreen forest, wetlands, aquatic, rock outcrop, irrigated, and agriculture.

Tricolored Blackbirds appear to be relatively uncommon in Santa Clara County. Breeding colonies are few and fairly small. During the Santa Clara County Breeding Bird Atlas project, Tricolored Blackbirds were found in 29 blocks with breeding confirmed in 19 blocks. Hundreds to several thousand individuals

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were ~~documented~~estimated. Confirmed breeding occurred in Santa Clara Valley, Diablo Range, Calaveras Reservoir, San Felipe Lake, Coyote Reservoir, a small pond on Coyote Ranch numbering fewer than 100 individuals, Horse Valley stock pond, and ~~in~~ the upper Smith Creek watershed (Bousman 2007). These data and CNDDB records were assessed under the SCVHP.

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Conservation goals for Tricolored Blackbirds include protection for at least four sites that support, historically supported, or could support nesting colonies. Each protected site will have at least 2 acres of ~~breeding (~~marsh~~) habitat~~ and ~~will have~~ at least 200 acres of foraging habitat within 2 miles. These breeding sites will either be enhanced or restored breeding habitat in historically or ~~/~~currently occupied areas within the r~~R~~eserve s~~S~~ystem or newly ~~-~~created ponds hypothesized to be suitable for breeding Tricolored Blackbirds (ICF 2012).

Commented [EF186]: on what basis?

Take of, or impacts to, existing or historic breeding colonies is prohibited. Impacts to this species are limited to loss of habitat. Mitigation measures consist of pre-construction surveys, impact avoidance or minimization, and land acquisition. Acquisitions will focus on the following:

Commented [EF187]: does this mean breeding locations? otherwise does not make sense

- Four historical breeding sites with ~~adequate~~ nearby foraging habitat referenced above;
- At least 22,840 acres of modeled Tricolored Blackbird habitat;
- Enhancement of acquired habitat specifically for Tricolored Blackbirds; and
- Creation of new ponds and wetlands that may provide breeding and foraging habitat for the species (CDFW 2013).

Western Riverside County Multiple Species Habitat Conservation Plan NCCP

The Western Riverside County Multiple Species Habitat Conservation Plan NCCP (WRC-MSHCP) covers approximately 1,300,000 acres in western Riverside County ~~and is located wholly~~, within the South Coast Province (CDFW 2015). All unincorporated county land west of the crest of the San Jacinto mountains to the Orange County line, as well as the cities of Temecula, Murrieta, Lake Elsinore, Canyon Lake, Norco, Corona, Riverside, Moreno Valley, Banning, Beaumont, Calimesa, Perris, Hemet, and San Jacinto, are included in the plan area. The 75-year term will expire 2079.

Tricolored Blackbirds were described as "widely scattered" throughout the lowlands and foothills of Riverside County. Few current or historic breeding locations were documented within the planning area (Dudek and Associates 2003). Tricolored Blackbird potential habitat was assessed; a total of 480 acres of primary habitat and 259,695 acres of secondary habitat was identified as occurring within the planning area. Of these totals, a loss of 60 acres of primary habitat and 193,180 acres of secondary habitat was projected. Secondary habitat losses included approximately 102,000 acres of agricultural land and 88,000 acres of grassland (Dudek and Associates 2003). Mitigation identified in the plan includes the following actions:

Commented [EF188]: in the NCCP?

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- Include within the Conservation Area, 420 acres of ~~suitable~~ primary habitat (freshwater marsh, cismontane alkali marsh).
- Include within the Conservation Area the five identified Core Areas for Tricolored Blackbirds. The Core Areas include San Jacinto River floodplain (7,320 acres), Mystic Lake/San Jacinto

Wildlife Area (17,470 acres), Collier Marsh and Lake Elsinore grasslands (1,810 acres), Alberhill (3,460 acres), and Vail Lake/Wilson Valley/eastern Temecula Creek (50,000 acres).

- Include within the Conservation Area~~,~~ 66,510 acres of secondary habitat (playa and vernal pool, grasslands, agriculture land, and riparian scrub, woodland, and forest).
- Maintain (once every 5 years) the continued use of and successful reproduction within at least one of the identified Core Areas. Successful reproduction is defined as a nest that fledges at least one known young.
- Maintain, preserve, and if feasible, restore hydrological processes within the five Core Areas.
- Include within the Conservation Area a 100-meter buffer around any known nesting locations.

Commented [EF191]: this isn't something within human control, although it may be a goal

Although not considered a Tricolored Blackbird Core Area, a total of 9,670 acres within the Prado Basin/Santa Ana River area will be conserved within Criteria Area and Public/Quasi-Public designations. This area may support Tricolored Blackbirds in the future (Dudek & Associates 2003).

The most recent biological monitoring report for Tricolored Blackbirds (2013 breeding season) described the following results:

> Six breeding colonies were detected during targeted searches for Tricolored Blackbirds. These included the Potrero Unit of the San Jacinto Wildlife Area (~350 birds), San Timoteo Canyon (10 birds), Lake Riverside (~200 birds), Highway 371 in Tule Valley (45 birds), and Garner Valley (~150 birds). All counts sum to a ~~total~~n estimated ~~population size of~~ 2,755 birds. Mean and median colony sizes were 459 and 175, respectively. Biologists were unable to confirm reproductive success for the Garner Valley, Highway 371, or San Timoteo Canyon colonies. Tricolored Blackbirds successfully reproduced in Potrero and Tule Valley in 2013. Only one colony, Potrero, was located inside the existing Conservation Area; however, no colony was located within a designated Tricolored Blackbird Core Area. The largest colony (~2,000 birds) occupied a 40-acre field on private land in the San Jacinto Valley. It suffered complete reproductive failure when the field was cut; adults were incubating eggs at the time (WRCRCA 2015).

Biological monitors made management and monitoring recommendations to improve conservation conditions for the Tricolored Blackbird in the Plan area. According to recent biological monitoring reports (WRC-MSHCP 2013), three of the five Core Areas identified for Tricolored Blackbird conservation purposes (Alberhill, Collier Marsh/Lake Elsinore grasslands, and San Jacinto River floodplain) do not provide ~~suitable or sufficient~~ breeding habitat for the species. Other sites were recommended as additional Core Areas based on recent Tricolored Blackbird ~~recent~~ activity. Furthermore, recommendations including~~to~~ changinge the Tricolored Blackbird species account in the Plan so that it "~~be modified to~~ recognize loss of foraging habitat in the vicinity of breeding sites as a significant threat to the survival of the species, and that the stated management objectives be reconsidered as well. In particular, the prescription for managing '… this species in order to maintain (once every five years) the continued use of, and successful reproduction within at least one of the identified Core Areas' (Dudek &

Associates 2003) is likely insufficient for a rapidly declining species that is dependent on patchy and unpredictable breeding habitats which are being rapidly lost throughout the Plan Area" (WRC-MSHCP 2011, 2013, WRCRCA 2015). Finally, the monitoring regime was deemed inadequate to provide conservation awareness for the Tricolored Blackbird. ~~Monitoring should be conducted with s~~Surveys for breeding colonies should be conducted every year rather than every five years and the survey period should be extended to allow multiple visits to active sites before, during, and after nesting (WRC-MSHCP 2011).

Commented [EF192]: not clear how monitoring can provide conservation awareness.

San Diego County Multiple Species Conservation Program

The San Diego County Multiple Species Conservation Program NCCP (SDCMSCP) covers approximately 511,878 acres in San Diego County and is located wholly within the South Coast Province (CDFW 2015). SDCMSCP participants include the County of San Diego, Cities of Chula Vista, San Diego, La Mesa, and Poway; implementing agreements are in progress for Coronado, Del Mar, Santee, and El Cajon. Subarea plans have been or will be prepared for each participating entity. Imperial Beach, National City, and Lemon Grove are not developing subarea plans but reserve the right to do so at a later date. The 50-year term expires 2048.

A detailed status assessment of the Tricolored Blackbird within the planning area was not provided in the planning documents. The Plan~~ did identify a~~'s rationale for including Tricolored Blackbirds as a covered species~~:~~ was "…77% of potential habitat [4,800 acres], including 59% of mapped localities, will be conserved. Breeding colonies move from season to season, and with a goal of no net loss of wetlands, most of the suitable breeding sites will continue to be available. This species forages in grasslands and agricultural fields near its breeding habitat. Foraging habitat near the known nesting colonies will be conserved at 70–100%. Additionally, foraging opportunities will continue to be provided and created in turfed areas such as golf courses and cemeteries. Jurisdictions will require surveys during the CEQA review process in suitable breeding habitat proposed to be impacted. Participating jurisdictions' guidelines and ordinances and state and federal wetland regulations will provide additional habitat protection resulting in no net loss of wetlands" (Ogden Environmental 1998).

Under the plan, 23% of breeding habitat (1,400 acres) has the potential for development or impacts.

Additionally, the following conditions were specified for Tricolored Blackbirds: "Project approvals must require avoidance of active nesting areas during the breeding season. Area-specific management directives must include measures to avoid impacts to breeding colonies and specific measures to protect against detrimental edge effects to this species. Area-specific management directives for preserve areas will include specific guidelines for managing and monitoring covered species and their habitats including best management practices. Edge effects may include (but not be limited to) trampling, dumping, vehicular traffic, competition with invasive species, parasitism by cowbirds, predation by domestic animals, noise, collecting, recreational activities, & other human intrusions" (Ogden Environmental 1998).

Annual reports are available online for the South County Subarea of the SDCMSCP (http://www.sandiegocounty.gov/content/sdc/parks/openspace/MSCP.html). These reports typically document habitat losses and gains associated with development projects and do not mention Tricolored Blackbirds specifically.

San Diego Gas & Electric Company Subregional NCCP

The San Diego Gas & Electric Company (SDG&E) Subregional NCCP covers discrete linear or energy projects but has a larger plan area that overlaps with other NCCPs. The plan area traverses 2,000,000 acres of SDG&E service territory in San Diego, Orange, and Riverside counties and is located wholly within the South Coast Province (CDFW 2015). Its 55-year term will expire December 2050. Although the term of the agreement is 55 years, SDG&E may, at its election, terminate the agreement after the 25th year and every 10 years thereafter.

In total, the SDG&E plan will result in a combined permanent loss of no greater than 400 acres with 50 miles of electric transmission and/or new gas transmission lines. This acreage figure includes an estimated permanent loss of 124 acres of habitat. The most common and most affected habitat types will likely be coastal sage scrub, chaparral, oak woodland, and grasslands (SDG&E 1995).

Impacts to Tricolored Blackbirds were considered to be generally very small and minimized or mitigated (in that order) when potential impacts occur to the species' habitats (SDG&E 1995). Tricolored Blackbird habitat was categorized under Mitigation Category III: beach, marsh, and wetland species. Mitigation measures taken for this category include:

- Construction in marsh areas, soft sand, or open water in most cases will be accomplished through the use of helicopters for the delivery of materials, poles, personnel, and platforms; and
- Roads should be avoided to the extent feasible.

In general, the following conditions apply: wildlife will not be killed unless to protect life and limb of staff, personnel training will be provided, and pre-activity surveys will be conducted (SDG&E 1995).

Planning documents available online did not include site-specific information on Tricolored Blackbird colony locations or foraging sites.

San Diego County Water Authority NCCP

The San Diego County Water Authority NCCP covers discrete linear projects but has a larger plan area that overlaps with other NCCPs. The plan area traverses 992,000 acres in western San Diego and southwestern Riverside counties and is located wholly within the South Coast Province (CDFW 2015). Nearly all Covered Activities will occur within the probable impact zone: 1,000 feet on either side of the pipelines or facilities, or approximately 64,600 acres along the existing pipeline rights-of-way, and other connected water conveyance, storage, and treatment facilities. The 55-year term of the agreement will expire December 2066.

One Tricolored Blackbird colony was documented near the Sweetwater Reservoir during the planning process; no colonies were noted within the planned impact zone (CNDDB in SDCWA and RECON 2010).

A total of 1,830 acres of wetland/riparian habitat exists within the probable impact zone; of this total, approximately 16 acres of potential Tricolored Blackbird breeding habitat could be impacted by permitted activities. Twenty-one acres of potentially suitable breeding habitat in the existing preserve area may be used to mitigate impacts to Tricolored Blackbird. Suitable foraging habitat is conserved in the 1,186 acre San Miguel Habitat Management Area within the San Diego National Wildlife Refuge (Merkel and Associates 1997 in SDCWA and RECON 2010); however, no nesting has been documented there.

No direct take of breeding Tricolored Blackbirds or their nests is allowable; avoidance ~~and/~~or minimization measures will be undertaken to conserve breeding colonies. Biological mitigation is habitat-based at approved ratios, which are based on the estimated resource value of the impacted habitat. Mitigation for unavoidable impacts may include acquisition of additional preserve area lands, acquisition of credits in other conservation/wetland banks, or development of a biologically superior conservation alternative for the species at appropriate locations in the planning area.

Butte Regional Conservation Plan NCCP

The Butte Regional Conservation Plan NCCP is currently in the planning stage. The proposed study area encompasses 564,270 acres in Butte County. A planning agreement was completed in December 2007 and was signed by Butte County and the cities of Biggs, Chico, Gridley, and Oroville. An independent science advisors report was completed in 2007. Formal public review of draft planning documents closed June 8, 2016; however, public comments are still being accepted.

Yuba-Sutter Regional Conservation Plan NCCP

The Yuba-Sutter Regional Conservation Plan NCCP is currently in the planning stage. The proposed study area encompasses 468,552 acres in Yuba and Sutter counties. A planning agreement was completed in September 2012 and was signed by the counties of Butte and Yuba, the cities of Yuba City, Live Oak, and Wheatland. An independent science advisors report was completed in February 2006. Draft plan documents are in preparation.

Placer County Conservation Plan Phase I NCCP

The Placer County Conservation Plan Phase I NCCP is currently in the planning stage. The proposed study area (phase one of an anticipated three phases) encompasses 201,000 acres in western Placer County. A planning agreement was prepared October 2001 and was signed by the county of Placer. An independent science advisors report was completed January 2004. Draft plan documents are in preparation.

Yolo Habitat Conservation Plan/NCCP

Yolo Habitat Conservation Plan/NCCP (formerly Yolo Natural Heritage Program) is currently in the planning stage. The proposed study area encompasses 653,663 acres in Yolo County. A planning agreement was prepared February 2005 and signed by the Yolo Habitat Conservation Plan/Natural

Communities Conservation Plan Joint Powers Agency. An independent science advisors report was completed March 2006. Draft plan documents are in preparation.

San Diego East County Multiple Species Conservation Plan NCCP

The San Diego East County Multiple Species Conservation Plan NCCP is currently in the planning stage. The proposed study area encompasses 1,600,000 acres in eastern San Diego County. The following communities are expected participants: Central Mountain, Cuyamaca, Descanso, Pine Valley, Desert/Borrego Springs, Julian, Mountain Empire, Boulevard, Jacumba, Lake Morena/Campo, Potrero, Tecate, Dulzura (in part), and Palomar/North Mountain. A planning agreement for San Diego East County and San Diego North County was prepared in 2008, amended May 2014, and signed by San Diego County. However, separate NCCPs will be prepared. An independent science advisors report, Part 1, was completed March 2006. Draft plan documents are in preparation.

San Diego North County Multiple Species Conservation Plan NCCP

The San Diego North County Multiple Species Conservation Plan NCCP is currently in the planning stage. The proposed study area encompasses 311,800 acres in northern San Diego County. The following communities are expected participants: Bonsall, De Luz, Fallbrook, Harmony Grove, Lilac, Pala, Pauma Valley, Rainbow, Rincon Springs, Twin Oaks Valley, Valley Center, and Ramona (in part). Excluded from the study area are Carlsbad, Encinitas, Escondido, Oceanside, San Marcos, Solana Beach, and Vista. A planning agreement for San Diego North County and San Diego East County was prepared in 2008, amended May 2014, and signed by San Diego County. However, separate NCCPs will be prepared. Independent science advisors reports were prepared in 2001 and 2002. Draft plan documents underwent public review in 2009 and are now under revision.

Conservation Plan for the Tricolored Blackbird

Following the 1991 petition to list the Tricolored Blackbird under CESA, a multi-stakeholder working group was formed to plan ~~for~~ and implement conservation actions. This resulted in the first of many statewide surveys, the first silage buyout to protect a breeding colony, and ongoing research. However, the working group made limited progress in developing comprehensive conservation measures for the Tricolored Blackbird and eventually dissolved in the mid-1990s. In 1997, a status update and management guidelines for the Tricolored Blackbird was completed (Beedy and Hamilton 1997). The species was again petitioned to be listed under CESA in 2004. After this petition was rejected by the Fish and Game Commission, a new multi-stakeholder Tricolored Blackbird Working Group was formed in 2005 and the group released a conservation plan in 2007 detailing the conservation and management, research and monitoring, data management, and education and outreach goals for the species (TBWG 2007). Working group members, including the Department, signed a Memorandum of Understanding agreeing to implement the actions in the conservation plan. Most of the goals and objectives in the plan are still relevant today and portions of the plan are currently being updated by the Tricolored Blackbird Working Group. Progress toward meeting objectives by the Department, USFWS, and partners on the working group has focused on protecting large breeding colonies that are threatened by harvest of agricultural grain fields and increasing knowledge through monitoring and research. New information is being used to update goals and objectives in the conservation plan.

Protection of Agriculture Colonies from Losses to Harvest

As described above, a large portion of the Tricolored Blackbird population has been nesting on agricultural grain fields since the 1990s, mostly adjacent to dairies. Although dairies often provide nesting ~~substrate~~ habitat (the grain grown to feed cattle), a water source (e.g., drainage ditches or wastewater ponds), and food for adult birds (stored grains), colonies located adjacent to dairies ~~have~~ often ~~suffered from~~have low productivity. In many cases, ~~the entire~~one reproductive effort of the breeding individuals in silage colonies in a given year has been lost when the nesting substrate is harvested while the young or eggs are still in the nest (Meese 2013). The timing of grain harvest typically coincides with the Tricolored Blackbird breeding season, resulting in the destruction of nests, eggs, and nestlings, and occasionally mortality of adult Tricolored Blackbirds. The Tricolored Blackbird colonies that form on agricultural grain fields early in the breeding season are often the largest colonies ~~formed~~ each year, and the ~~complete~~ destruction of these colonies due to harvest can be especially damaging to annual blackbird productivity (Arthur 2015).

Commented [EF193]: "suffered" is a value-laden term

The protection of large colonies that occur on agricultural grain fields has been the primary conservation action implemented for Tricolored Blackbird since the species was discovered breeding in this substrate ~~type~~ in the early 1990s. Shortly after the discovery of grain colonies in the San Joaquin Valley, the USFWS intervened to encourage harvest delays and protect the largest known breeding colony (Hamilton 1993). In 1994, a crop was bought to protect a 28,000-bird colony (Kelsey 2008). Hamilton et al. (1995) calculated that interventions in 1992, 1993, and 1994 may have been responsible "for the presence of over 75,000 adult Tricolored Blackbirds in 1995 [which had been nestlings in the three previous years], about 25% of the known population." In 1999, the Department and USFWS protected a colony that was composed of one-third of the known population at the time, which otherwise would have been destroyed by routine harvesting activities (Hamilton et al. 1999). In 2004, silage purchases by the Department and USFWS protected three colonies totaling over 100,000 adult Tricolored Blackbirds. In 2006, the two largest known colonies, totaling more than 200,000 breeding birds, were protected through silage buyouts (Meese 2006). Meese (2009b) estimated that payments to landowners for harvest delays resulted in the protection of 364,000 nests and about 396,000 Tricolored Blackbird fledglings in the five years from 2005 to 2009. Despite these efforts to protect birds breeding on agricultural fields, losses to harvest have continued to occur in most years (Figure 17).

Commented [EF194]: sounds like an opinion, not a calculation

Commented [EF195]: unclear

Commented [EF196]: what kind of losses?

The Natural Resources Conservation Service (NRCS) established a fund in 2012 that was used for three breeding seasons to protect colonies on agricultural lands and to enhance habitat for the Tricolored Blackbird. Landowner participation in the program varied from year to year, with many thousands of nests protected each year while some colonies continued to be lost to harvest.

Regional Conservation Partnership Program

In 2015, the NRCS awarded a Regional Conservation Partnership Program (RCPP) grant to a group of conservation and dairy organizations (Arthur 2015). The grant provided five years of funding to protect, restore, and enhance Tricolored Blackbird habitat on agricultural lands, with the primary objective being to prevent loss of breeding colonies to harvest. During the first year of implementation in the 2016 breeding season, the program ~~succeeded in~~ enrolleded~~ing~~ all landowners with Tricolored Blackbird colonies identified on their property, and 100% of known agricultural colonies representing more than 60,000 breeding birds were protected through delay of harvest. In 2017, a single large colony (estimated at up to 12,500 breeding birds) was lost to harvest at a location that was not enrolled in the NRCS program.

Commented [EF197]: does this mean that all individuals were killed?

Despite efforts by landowners and the state and federal government to protect colonies, losses to harvest have continued. The protection of all known colonies on agricultural fields in the 2016 breeding season is encouraging progress, although ongoing success will require a stable funding source to compensate landowners that delay harvest. See the section on Harvest of Breeding Colonies below for a discussion of this ongoing threat to the species.

Habitat Restoration and Enhancement

USFWS National Wildlife Refuges

The USFWS ~~owns and~~ manages several National Wildlife Refuges (NWR) in the breeding range of the Tricolored Blackbird. In northeastern California, the Lower Klamath and Tule Lake NWRs have supported breeding colonies at several locations, although colony size has been relatively small as is typical for this portion of the range. The Sacramento National Wildlife Refuge Complex in the Sacramento Valley, the San Luis National Wildlife Refuge Complex in the northern San Joaquin Valley, and Kern and Pixley NWRs in the southern San Joaquin Valley have all supported breeding Tricolored Blackbird colonies.

Commented [EF198]: public lands are owned by the citizens of the United States

The Sacramento National Wildlife Refuge Complex has actively managed selected wetlands to maintain ~~suitable~~ Tricolored Blackbird habitat for some time, and ~~they have been frequently successful in attracting~~ breeding colonies frequently have occurred at~~to~~ Delevan NWR. Recent restoration at Colusa NWR has resulted in a return of breeding birds after many years of absence. Portions of the Merced NWR have been managed to provide breeding substrate for Tricolored Blackbirds in recent years, and the refuge has been ~~successful in attracting~~occupied by multiple colonies of several thousand breeding birds. The Kern NWR has supported ~~suitable~~ habitat, and for many years hosted breeding colonies. Despite continued efforts to provide flooded spring wetlands, in recent years use of the refuge by breeding colonies has been limited, although a colony of 3,000 birds nested on the refuge in 2017. The Pixley NWR has not supported breeding colonies in recent years, but the USFWS is implementing management intended to attract breeding birds.

NRCS Easements and Incentive Programs

Through a combination of easements on privately owned lands and 3-year incentive programs, the NRCS has enrolled about 500 acres of land (as of January 2017) in programs that ~~will~~ are intended provide nesting habitat ~~suitable~~ for Tricolored Blackbird~~ nestings~~. These programs focus on providing dense cattail ~~habitat~~ using water management practices compatible with Tricolored Blackbird nesting~~ habitat~~. The majority of current NRCS habitat projects are in the Grasslands District of Merced County, with a smaller acreage in the southern San Joaquin Valley in Kern and Tulare Counties. Existing habitat projects have proven successful, with Tricolored Blackbirds breeding on three NRCS easement properties in 2016 (report to the Tricolored Blackbird Working Group, January 31, 2017; unreferenced).

California Department of Fish and Wildlife Lands

On many of the Department wildlife areas and ecological reserves located in the breeding range of the Tricolored Blackbird, management practices include spring or permanent wetland habitats that can support ~~suitable~~ nesting substrate for breeding colonies. In some cases, these wetlands have been managed specifically for Tricolored Blackbirds by setting back wetland succession through burning or mechanical methods, and in other cases the wetlands are typically managed for a broader suite of species. Use of Department wildlife areas and ecological reserves by breeding colonies includes (Tricolored Blackbird Portal 2017):

Northeastern California – The Honey Lake Wildlife Area has supported breeding colonies at two wetland locations. The number of breeding birds has been small, with the most recent observation of 200 breeding birds in 1996.

Sacramento Valley – Four wildlife areas in the Sacramento Valley have supported breeding colonies. Three of these wildlife areas are in Butte County (Oroville, Gray Lodge, and Upper Butte Basin), each of which have supported colonies at a single location, with the most recent observations including 1,600 birds on a wetland at Gray Lodge Wildlife Area in 2011 and 2,000 birds in willows at Oroville Wildlife Area in 2015. Oroville Wildlife Area also regularly supports foraging birds in the post-breeding season (B. Stone, pers. comm.). The Yolo Bypass Wildlife Area in Yolo County has hosted small breeding colonies at three separate locations in wetlands and button willow shrubs.

San Joaquin Valley – Four wildlife areas in the San Joaquin Valley have supported breeding colonies. Three of these are in Merced County, with North Grasslands Wildlife Area supporting three colon~~y locations~~ies in milk thistle and mustard, Los Banos Wildlife Area supporting five colon~~y location~~ies in wetlands, and O'Neill Forebay Wildlife Area supporting four colon~~y location~~ies in Himalayan blackberry. The most recent use includes a 9,000 bird colony on a wetland at Los Banos Wildlife Area in 2008 and a 3,500 bird colony in Himalayan blackberry at O'Neill Forebay Wildlife Area in 2005. The fourth wildlife area in the San Joaquin Valley, Mendota Wildlife Area, is located in Fresno County. This wildlife area has supported breeding colonies at three separate wetland locations, with the last reported breeding by 1,000 birds in 1995.

Southern California – The Rancho Jamul Ecological Reserve in San Diego County has hosted a small breeding colony on a wetland in most years since 2007. This colony is usually fewer than 200 breeding birds. In Riverside County, the San Jacinto Wildlife Area has supported breeding colonies at 12 different locations. Most of the colonies have occurred in wetland habitats, with a few locations in other vegetation types including stinging nettle, thistles, and mallow. This wildlife area is located in perhaps the most important region for breeding Tricolored Blackbirds south of the Transverse Ranges. The wildlife area regularly hosts several thousand breeding birds, with a single location supporting 10,000 birds in 2005. During the 2017 statewide survey, 6,300 birds were observed at a single location on the wildlife area.

The Department has also worked with private landowners to create nesting habitat using a variety of incentive programs. The goals of the programs have included management of water to create spring wetland habitat with emergent cattail vegetation. Several of these projects were successful in attracting Tricolored Blackbird colonies, with colonies of up to several thousand birds breeding on private wetlands created through these programs from at least 2005 through 2011. Funding has been limited in recent years, resulting in declining participation and a reduction in ~~available~~ the area of wetland habitat on private lands.

California Environmental Quality Act

The California Environmental Quality Act (CEQA; Public Resources Code Section 21000 et seq.) requires state and local agencies to publicly disclose, analyze, and potentially mitigate environmental impacts from projects over which they have discretionary approval power. In particular, CEQA requires that actions that may substantially reduce the habitat, decrease the number, or restrict the range of any species that can be considered rare, threatened, or endangered must be identified, disclosed, considered, and mitigated or justified (Cal. Code Regs., tit. 14, §§ 15065(a)(1), 15380).

The environmental review process required by CEQA can be costly and time consuming, and compliance is not always thorough. Agencies may also make the determination that projects are exempt (i.e., they do not need to go through the impact analysis, public disclosure, and mitigation process). Mitigation is required if a project is not CEQA-exempt and impacts would be potentially “significant.” Mitigation must reduce impacts to below a level of significance or minimize unavoidable significant impacts, where feasible. The CEQA process generally incentivizes agencies and project applicants to implement mitigation, thereby avoiding significant impacts.

Due to its SSC designation, impacts to Tricolored Blackbirds are generally considered potentially significant if agencies determine on a project-specific basis that the species meets the CEQA criteria for rare, threatened, or endangered. However, agencies are not required to make this determination for Tricolored Blackbirds and other species that are not listed under CESA or ESA.

FACTORS AFFECTING ABILITY TO SURVIVE AND REPRODUCE

Small Population Size and Colonial Breeding

A key question is ~~whether the colonially breeding Tricolored Blackbird can maintain a viable population at some reduced population abundance that supports only small colonies or concentrates the majority of the population into very few colonies. That is, what is~~ the minimum number of individuals that can ~~continue to~~ support a well-distributed breeding population with colonies that are productive and resilient to the dynamic location and quality of breeding and foraging ~~landscape within their range~~habitat.~~?~~ ~~Another North American colonially breeding bird, the Passenger Pigeon (*Ectopistes*~~

~~*migratorius*), declined to extinction as a result of multiple population pressures, and the species seemed to have an inability to survive and reproduce at low population numbers (Bucher 1992). In addition to the well-known effect of market hunting in the decline of the Passenger Pigeon, habitat alteration and a lack of social facilitation in food finding due to reduced population size have been implicated in the extinction of the species (Bucher 1992). The Tricolored Blackbird is similar to the Passenger Pigeon in that they are highly social, colonial breeders with nomadic tendencies that likely evolved for locating highly abundant food sources and other breeding habitat requirements. Tricolored Blackbird has experienced, or continues to experience, many of the population pressures that led to extinction of the Passenger Pigeon; however, unlike the passenger pigeon, the Tricolored Blackbird has adapted to the wide-scale loss of wetland nesting substrate habitat by using a variety of upland vegetation types.~~

As described in the section on Biology and Ecology, Tricolored Blackbirds may benefit from social and colonial behaviors by reducing mortality due to predation during the nesting cycle and by facilitating food finding and information sharing. Smaller groups of birds would likely retain the ability to locate and use secure nesting substrates, but small colonies might lose the potential benefits of predator satiation and of social food finding and information sharing. The locating and exploitation of abundant food sources could affect small groups of birds both in the selection of productive breeding locations and in acquiring sufficient prey with which to provision young after a site is selected.

~~Some bird species are known to nest in colonies when conditions are suitable, but can also nest in smaller groups or as single pairs. For example, the White-winged Dove (*Zenaida asiatica*) once nested in extremely large colonies in Mexico. In 1978, 22 breeding colonies contained a collective population size of more than eight million birds (Sanchez Johnson et al. 2009). Individual birds were shown to have very high site fidelity to breeding areas, sometimes returning to nest in the same tree across years (Schwertner et al. 1999). Habitat changes driven by urbanization and intensification of agricultural practices and urbanization caused the loss and fragmentation of nesting habitat and now the White-winged Dove nests singly or in smaller colonies at more dispersed locations in Mexico, and appears to have adapted to use urban areas (Schwertner et al. 1999, Sanchez Johnson et al. 2009).~~

Although the Tricolored Blackbird has been observed to nest in very small colonies (as few as 4 nests), the species has not been observed to nest as single pairs. Very small colonies (<100 birds) are quite rare, and although ~~nesting~~ reproductive success varies greatly across colonies of all sizes, there is ~~some~~ limited evidence that very small colonies are not as successful as larger colonies (Payne 1969, Weintraub et al. 2016), and that larger colonies produce more young per female (Hamilton 1993, Meese 2013). Reductions in population size may make the Tricolored Blackbird more vulnerable to additional declines due to ~~inherent natural history factors~~demographic or environmental stochasticity, but the degree to which a small population would limit the species' ability to survive and reproduce is not known.

The fact that half or more of the total population ~~will often~~may occur in a small number of large colonies in silage fields during the first nesting attempt may make~~s~~ the species ~~vulnerability~~ vulnerable to lo~~sses of~~w ~~productivity~~ reproductive success in these colonies and locations (Meese 2012, Beedy et al. 2017). In 2011, 65% of the total known population was located at only six colony sites in Merced, Kern, and Tulare counties (Kyle and Kelsey 2011). This concentration of large portions of the population makes the

Commented [EF199]: to some extent, all species are vulnerable to low reproduction species vulnerable to a number of potential threats, especially colony destruction through harvest, predation, or extreme weather events (Weintraub et al. 2016). The enhanced risk to the species due to colonial breeding may be realized primarily through exacerbation of other threats that can a~~e~~ffect a large portion of the total population.

Habitat Loss

Loss of Nesting Habitat

The conversion of wetland nesting habitat to agricultural and urban uses has been implicated in the long-term decline of the species. ~~Neff (1937) observed, "[t]he destruction of [Tricolored Blackbird] nesting habitats by man is of most importance," and cited reclamation and drainage as key factors in the loss of many favorable sites, along with "dredging or cleaning of reservoirs, marshes, and canals in order to destroy the growths of cattails and tules." Only a~~About 15% of the four million acres of wetlands that existed in the Central Valley in the 1850s remained when Neff conducted his work in the 1930s, and about 40% of those remaining wetlands were lost between 1939 and the 1980s (Frayer et al. 1989). Of the freshwater emergent wetlands most likely to be used by breeding Tricolored Blackbirds in the Central Valley, 50% were lost between 1939 and the 1980s, with an average loss of 5,200 acres per year (Frayer et al. 1989). These losses were primarily due to conversion of wetlands to agriculture.

DeHaven et al. (1975a) found no nesting ~~substrate~~ habitat at several locations in Los Angeles, Kern, Sacramento, and Yolo counties where earlier researchers had studied the species. Subsequent investigators have continued to document habitat loss at known breeding colony locations through the present. For example, Beedy et al. (1991) found that 9.3% (n = 17) of all colony locations used in the 1980s were extirpated through permanent removal of nesting habitat. Hamilton et al. (1999) observed the removal of a wetland that had supported a productive breeding colony in 1998. DeHaven (2000) noted the loss of several breeding colonies in Sacramento County to urban development and the expansion of vineyards. Humple and Churchwell (2002) reported on the draining of a wetland and the removal of Himalayan blackberry that had previously supported breeding colonies. Hamilton (2004a) documented the loss or destruction of cattail ~~nesting substrate~~s that had supported 90,000 breeding birds between 1994 and 2004. During the 2017 statewide survey, local experts and survey participants were asked to score the ~~suitability~~ quality of nesting substrate for all sites visited. Of the 636 sites for which scores were reported before or during the survey, 70 sites were scored as permanently unsuitable, usually due to development or conversion to permanent crops like orchards or vineyards (Table 5). An additional 80 sites had no nesting substrate present during the survey and 101 sites had vegetation present, but were considered unsuitable by the survey participant.

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Table 5. Nesting substrate suitability for 636 sites scored before and during the 2017 statewide survey.

Score	Number of sites	Notes on suitability scores
Suitable	385	Nesting substrate present and considered suitable for nesting.
Unsuitable	101	Nesting substrate present but appears to be unsuitable for nesting (e.g., it is immature, too short, lacks sufficient foliage, too sparse, or has recently been burned).
Substrate absent	80	Nesting substrate absent because it has been removed or died (e.g., former grain field planted to alfalfa, milk thistle stand or Himalayan blackberry that has been mowed, wetland that has dried up).
Permanently unsuitable	70	Nesting substrate is absent and cannot be replaced (e.g., has been converted to urban development, orchard, or vineyard).

Following a ~~low point~~minimum in the extent of wetlands in the 1980s, aggressive restoration actions resulted in an increase of 65,000 acres of managed wetlands between 1990 and 2005 (CVJV 2006). The majority of the wetlands in the Central Valley are managed lands that are maintained by application of water, and many areas undergo occasional land recontouring or vegetation control to maintain desired conditions. As of 2006, there were about 205,000 acres of managed wetlands in the Central Valley (CVJV 2006). Most managed wetlands (~90%) are flooded primarily in ~~the~~ fall and winter for wintering waterfowl (i.e., seasonal wetlands), and a small proportion are managed as semi-permanent or permanent wetlands that hold water during ~~the~~ spring and summer (Iglecia and Kelsey 2012). Semi-permanent wetlands are often managed to support brood habitat for waterfowl; the small proportion of semi-permanent and permanent wetlands are those that can potentially be ~~suitable as~~ nesting substrate for breeding Tricolored Blackbirds.

Replacement of wetland breeding habitat with novel, nonnative upland nesting substrates may have lessened the impact of the decline in Central Valley wetlands to the Tricolored Blackbird population. However, these nonnative vegetation types are often considered undesirable and are frequently removed. Himalayan blackberry ~~habitat~~ with a history of use by breeding colonies has been removed by burning, treatment with herbicide, or mechanical removal (Airola et al. 2015a, 2015b). Milk thistle colonies have ~~been destroyed~~disbanded when landowners have removed or sprayed the invasive weed while Tricolored Blackbirds are ~~actively~~ nesting (Airola et al. 2016). Blackberry control is generally localized and occurs on multi-year intervals, and therefore may not have a large overall effect on the population, although there are cases where removal of nesting substrate has resulted in permanently unsuitable conditions. In the central Sierra Nevada foothills where Tricolored Blackbird colonies frequently nest in Himalayan blackberry, 32% of colonies active in 2014 occurred in areas zoned for development or that were proposed for rezoning for development (Airola et al. 2015a). In 2017, a group of Himalayan blackberry ~~sites~~ patches that had supported an estimated 13,000 breeding Tricolored Blackbirds were removed or degraded by aggregate mining activities (Oct 2017 email from D. Airola to N. Clipperton; unreferenced). The Department is unaware of any ~~available~~ information to evaluate distribution or trends of these nonnative nesting substrates across the range of the Tricolored Blackbird in California.

Although the loss of wetlands in California's Central Valley is well documented and there are many examples of nesting substrate being removed or degraded at historical Tricolored Blackbird colony locations, there also appears to be ~~suitable~~ nesting substrate in some areas that goes unused in many years. However, there are other regions where large areas of apparent~~ly suitable~~ foraging habitat have no available nesting substrate, or where nesting substrate is only available during years when rainfall patterns support vigorous growth of upland nesting substrates (Airola et al. 2016). Most managed wetlands in the Central Valley are not ~~suitable as~~ nesting substrate for the Tricolored Blackbird, but wetlands remain the substrate type most frequently used by breeding colonies and upland nesting substrates provide additional habitat. The dynamic occupancy patterns at breeding locations from year to year and the need for abundant insect prey ~~in surrounding foraging habitat~~ makes it difficult to reach conclusions about the quality of nesting ~~substrate suitability~~habitat based on occupancy in a single year. It is likely that loss of nesting substrate has caused local declines and shifts in distribution, but the overall effect on the population is difficult to assess, especially without considering other breeding requirements. Losses of nesting substrate at historically large or productive colony locations, or in areas surrounded by high quality foraging habitat, would have the largest impact on the population.

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Loss of Foraging Habitat

The extent of foraging habitat required for successful breeding is much greater than the extent of nesting substrate. The abundance of insect~~ prey~~s in foraging habitat has been linked to reproductive success, and Tricolored Blackbirds may choose breeding locations in part based on the local prey populations. Because insect populations are variable and unpredictable from year to year, the Tricolored Blackbird population likely requires much more foraging habitat on the landscape than is used in any given year, and once lost, large landscapes with ~~suitable~~ habitat are difficult to replace. For these reasons, loss of foraging habitat is likely as important, or more so, than the documented losses of nesting substrate on the long-term viability of the Tricolored Blackbird population.

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The loss of foraging habitat has been suggested as a likely cause of decline in southern California (Hamilton et al. 1995, Cook 2010). The extirpation of colonies from most of the coastal lowlands in southern California, despite the presence of more numerous marsh~~ habitat~~es relative to inland areas, suggests that foraging habitat sufficient to support breeding colonies is the population's limiting factor (Unitt 2004).

Hamilton et al. (1992) reported on the pervasive loss of foraging habitat near breeding colony sites due to expansion of cultivated agriculture and the conversion of existing agriculture to incompatible crops in the Central Valley, and considered this the primary threat to population abundance. DeHaven (2000) observed widespread habitat loss due to urban expansion and agricultural conversions to vineyards and orchards relative to the 1970s when he and others conducted Tricolored Blackbird research across the state, and suggested that habitat loss was a primary driver of continued population declines. Conversion of pastures and crops suitable for foraging by Tricolored Blackbirds was observed in Placer, Sacramento, Stanislaus, and Tulare counties. DeHaven (2000) noted especially extensive losses in Sacramento County, where urban development and expansion of vineyards had removed thousands of acres of high-quality habitat. More than 5,000 acres of habitat had been converted to vineyards ~~in just a two-year period~~ from 1996 to 1998, resulting in the loss of known breeding colony locations.

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Grasslands have been identified as one of the most vulnerable ~~habitats~~ land-cover types across North America, and many grassland species have experienced steep population declines in recent decades (NABCI 2016). A great deal of effort has been expended on conserving the grasslands in the central part of North America from the Great Plains to northern Mexico (Knopf and Skagen 2012). The grasslands of California have not received the same level of conservation attention, although losses of grasslands in California have been extensive.

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Soulard and Wilson (2015) used Landsat ~~satellite~~ data to analyze land-use and land-cover change in the Central Valley from 2000 to 2010, and compared this to changes in the valley since 1973. The largest land-cover trend from 2000 to 2010 occurred in grasslands or ~~/~~shrubland ~~habitat~~s. During this 10-year period, an estimated 79,200 acres of grasslands and shrublands were lost, representing a 5% decrease in the Central Valley over 10 years. Over the longer period from 1973 to 2010, grasslands and shrublands declined by 22% (a loss of 476,900 acres), due mainly to conversions to more intensive agriculture and urban development. Although many of the grassland losses were due to agricultural intensification, losses of agriculture to urban development resulted in relatively little net change in area of agriculture in the Central Valley from 1973 to 2010.

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Cameron et al. (2014) analyzed time series land cover data from the California Farmlands Mapping and Monitoring Program collected between 1984 and 2008 to evaluate ~~rangeland habitat (~~grassland, shrubland, and woodland~~)~~ conversion in California. The area evaluated covers much of the breeding range of the Tricolored Blackbird except for southern California. About 483,000 acres of grassland, shrubland, and woodland~~rangelands~~ were converted during this 20+ year period, with urban and rural development and conversion to more intensive agricultural uses accounting for most (~90%) of the rangeland loss. Agricultural intensification was primarily due to increases in vineyards and orchards, but smaller amounts of other agricultural crops that may provide foraging habitat for Tricolored Blackbird were also responsible for grassland loss. The San Joaquin Valley region, which in recent decades has been the center of abundance for breeding Tricolored Blackbirds during the early nesting season, experienced the largest amount of ~~rangeland~~ grassland conversion (Figure 18).

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Commented [EF208]: range is a land use, not a land-cover type. Referring to grasslands as rangelands implies that this vegetation exists to serve livestock

Land cover types suitable for Tricolored Blackbird foraging in the Central Valley continue to be converted to incompatible land cover types such as orchards, vineyards, and urban development as agricultural practices evolve and cities continue to expand in the Central Valley. Due to the continued expansion of nut trees and vineyards that replace grasslands, shrublands, or agricultural crops that provide insects required for breeding (e.g., alfalfa), regions that were previously occupied by thousands of birds have now become ~~permanently~~ unsuitable for breeding (Meese 2016). For example, the acreage of pistachio orchards in the Central Valley has grown exponentially in recent years and the acreage of almonds continues to increase (Figures 19 and 20). The five leading pistachio producing counties in California have also supported a large proportion of the Tricolored Blackbird breeding population in recent years (Kern, Tulare, Kings, Fresno, and Madera counties), with Kern County alone supporting 42% of pistachio production in 2012 (Geisseler and Horwath 2016). In the central Sierran foothills, many colony sites and the surrounding foraging landscape are zoned for development, and several development projects that may affect Tricolored Blackbird habitat have moved forward in recent years (Airola et al. 2015a, 2016). Statewide, the proportion of grasslands within 3 miles of known breeding colony locations declined from 2008 to 2014 (NAS 2017).

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The California Rangeland Trust has conserved more than 300,000 acres of rangeland in 24 California counties through conservation easements (https://www.rangelandtrust.org/ranch/). Although data are not available on the extent and distribution of conserved lands within the range of the Tricolored Blackbird, some of the conserved ranches are in counties that receive regular use by breeding Tricolored Blackbirds, including Kern, Merced, Madera, and Placer counties. Data on the proximity of conserved rangelands to Tricolored Blackbird breeding colonies is not available, but these easements may provide protection of ~~important~~ foraging habitat for birds that breed in the foothills and grasslands on the periphery of the Central Valley.

Commented [EF210]: grassland on which grazing occurs?

Large losses of grassland, shrubland, and woodland~~rangeland~~ and ~~suitable crop~~agricultural foraging habitat have occurred over the last several decades, and conversion of these ~~suitable~~ foraging habitats continues throughout much of the Tricolored Blackbird's range. Although large acreages of grassland, shrubland, and woodland~~rangeland habitat~~ have been conserved through conservation easements, these have not necessarily focused on areas of highest ~~value~~ quality for~~to~~ Tricolored Blackbird and are small relative to the extent of grassland in the state and the observed rate of loss over the past several decades. Future development in California is projected to be concentrated in several core areas of the Tricolored Blackbird range, including the Central Valley, the foothills of the Sierra Nevada, and on both sides of the Transverse Ranges in southern California (Jongsomjit et al. 2013; Figure 21), which would further reduce or degrade the available foraging landscape for breeding colonies. Loss of grassland, shrubland, and woodland~~suitable rangeland~~ foraging habitat is projected to continue into the future (see Drought, Water Availability, and Climate Change section). The proportion of grasslands in the landscape surrounding potential breeding sites ~~has been shown to be the most important land cover type in predicting the~~is more strongly correlated with occurrence of breeding Tricolored Blackbirds than xxxx, and the proportion of alfalfa is the most ~~important determinant of~~ strongly correlated with colony size (NAS 2017). Combined with regular loss of nesting substrate, the ongoing loss of foraging habitat makes it less likely that ~~these essential~~ breeding habitat ~~requirements~~ will ~~co-occur on the landscape~~be present, with the result being a reduced number of locations suitable for ~~successful~~ breeding by Tricolored Blackbird colonies.

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Overexploitation

Market Hunting and Depredation Killing

Historical killing of blackbirds to protect crops and for the food market may have contributed to a long-term decline of the species, but the intentional killing of Tricolored Blackbirds has declined since the 1930s. The effect of mortality due to shooting or poisoning on annual Tricolored Blackbird survival rates is unknown.

~~Neff (1937, 1942) reported hundreds of thousands of blackbirds sold on the Sacramento market, many of which were Tricolored Blackbirds.~~ Market hunting of blackbirds in the Central Valley became a thriving business in about 1928 or 1929 and continued through the mid-1930s. Tricolored Blackbirds banded for research activities throughout the 1930s were often recovered by market hunters with which Neff collaborated (1942).

~~McCabe (1932) described the deliberate strychnine poisoning of 30,000 breeding Tricolored Blackbirds as part of an agricultural experiment.~~ In the early 1930s active poisoning and shooting programs were enacted to control populations of blackbirds (McCabe 1932, Neff 1937). Tricolored Blackbirds and other blackbird species were killed by poisoned baits used as a means of blackbird control in rice fields in the Sacramento Valley, and numerous blackbirds were shot by farmers or by hired bird herders in attempts to drive the flocks away from rice and other crops (Neff 1942). During the period from 1935 to 1940 blackbird depredations in rice fields were of lesser intensity, and control operations by means of poisoned baits were almost entirely discontinued (Neff 1942).

Because the Tricolored Blackbird forages in mixed-species flocks with the European Starling and other species of blackbirds in the nonbreeding season, and because these flocks forage at feedlots and on ripening rice, the Tricolored Blackbird may be exposed to avicides intended to control nuisance and depredating flocks of other species of blackbirds.

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A depredation order under the federal Migratory Bird Treaty Act allows for the control of several species of blackbirds and corvids in agricultural situations without a permit from the USFWS (when birds are causing serious injuries to agricultural or horticultural crops or to livestock feed; 50 CFR 21.43). In 1988, the USFWS modified the long-standing depredation order to remove the Tricolored Blackbird and prohibit killing the species without a federal permit (Beedy et al. 1991). Although Tricolored Blackbird is no longer covered by the depredation order, it is possible that misidentification of Tricolored Blackbirds when they occur in mixed flocks in the fall and winter leads to unintentional mortality of the species. Landowners are required to report on activities and on the number of birds captured or killed under the depredation order, including non-target species such as the Tricolored Blackbird (50 CFR 21.43, Nov 5, 2014). Based on reports provided to the USFWS, annual reporting appears to be inconsistent and the number of birds killed under the depredation order may be underreported. The number of Tricolored Blackbirds killed annually is unknown and therefore the killing of blackbirds to protect ripening rice in the Sacramento Valley is a known but unquantified source of Tricolored Blackbird mortality.

There has been limited documentation of the shooting of Tricolored Blackbirds in the Sacramento Valley. Two birds that had previously been banded were reported to have been shot by a rice farmer in Butte County (Meese 2009a). These birds were reported because they were banded and it seems likely that additional, unbanded birds were also shot.

~~Historical killing of blackbirds to protect crops and for the food market may have contributed to a long-term decline of the species, but the intentional killing of Tricolored Blackbirds has declined since the 1930s. The effect of mortality due to shooting or poisoning on annual Tricolored Blackbird survival rates is currently unknown.~~

Harvest of Breeding Colonies

The Tricolored Blackbird colonies that ~~form on~~nest in agricultural grain fields early in the breeding season are often the largest colonies formed each year, and ~~the complete destruction of~~effects of harvest on these colonies ~~due to harvest~~ can be especially damaging to annual blackbird productivity (Arthur 2015). Normal harvesting activities typically coincide with the breeding season and the harvest of fields that contain nesting colonies results in nest destruction and the loss of eggs or nestlings. The cutting of grain has also killed adult Tricolored Blackbirds, but most adults appear to survive harvest operations.

Commented [EF215]: not clear. sounds like all of the birds are wiped out, which is not the case

Shortly after the discovery of grain colonies in the San Joaquin Valley, Hamilton et al. (1992) observed the loss of a 15,000-bird colony to harvest. As early as 1993, the USFWS intervened to encourage harvest delays and protect the largest known breeding colony (Hamilton 1993). Since then, colony protection through crop purchase or delayed harvest has been the primary conservation action implemented for the species (see Existing Management section), with mixed ~~success~~results. Despite annual attempts to locate and protect large colonies since the early 1990s, losses to harvest have occurred in most years (Figure 17), with 2010 and 2016 the only known exceptions. Two large colonies representing more than 60,000 breeding birds were lost due to harvest in 1994 (Hamilton et al. 1995). The two largest breeding colonies in 1995 were destroyed during harvest of the grain nesting substrate (Beedy and Hamilton 1997). At least one colony of 14,000 birds was harvested in 1999 and four colonies were lost to harvest operations in 2000 (Hamilton et al. 1999, Hamilton 2000). Colonies were destroyed in all years from 2005 to 2009, with especially large losses in 2006, 2007, and 2008 (Meese 2009b). In 2008, several of the largest known colonies were destroyed, with six colonies representing 140,000 breeding birds being cut (Meese 2008). At least three colonies were lost to harvest in 2011, including the largest known colony, which supported 17% of the total known population (Kyle and Kelsey 2011, Meese 2011). At least two colonies in grain fields were destroyed in 2014 during the harvest of nesting substrate and at least three colonies were partially or totally destroyed due to harvest in 2015 (Meese 2014a, 2015b). After a breeding season with no known harvest losses in 2016, a large colony (estimated at up to 12,000 birds) was mostly lost in 2017 when the grain nesting substrate was cut in preparation for harvest (Colibri 2017).

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No colonies are known to have been destroyed by harvest in 2010; a settlement on a dairy in Merced County was lost when the grain was harvested, but the harvest occurred during nest building before eggs were laid (Meese 2010). Beginning in 2016, a new partnership was created through a grant from NRCS, with Audubon California, dairy trade organizations, and agencies working together to conduct outreach to dairy owners and to detect and protect breeding colonies. The program succeeded in enrolling all landowners with Tricolored Blackbird colonies identified on their property in 2016, and 100% of known agricultural colonies were protected through delay of harvest. In 2017, most colonies on grain fields at dairies were again protected, but at least one large colony was destroyed when the grain was cut.

It has been argued that protection of colonies breeding on silage fields should be reevaluated because adult birds are unlikely to be killed by harvesting operations and Tricolored Blackbirds ~~are known to~~can breed more than once in a season. DeHaven (2000) and Hamilton (2004a, 2004b) suggested that habitat losses might have a greater effect on reproduction ~~be more important in population declines~~ than nesting mortality, and resources spent protecting colonies on silage fields might be better spent protecting or restoring habitat. However, second breeding attempts are often less productive than first breeding attempts due to the energetic and physiological costs of egg formation in females, incubation and brooding, and raising of young (Martin 1987, Meese 2008). Even if these costs did not reduce the relative productivity of second breeding attempts, the elimination of a first breeding attempt may cause breeding colonies to miss the period of peak prey abundance, thereby reducing seasonal reproductive success (Martin 1987). Colony destruction through harvest typically occurs well after females have laid eggs and often after eggs have hatched, so the lost energetic input to a failed breeding and the delay before a second attempt likely reduce total annual productivity, even if birds attempt to nest a second time (Meese 2008).

Commented [EF217]: So the report is arguing that resources are not better spent on habitat protection or restoration than on protecting colonies in silage fields?

The Tricolored Blackbird ~~was shown to have experienced~~reportedly had low reproductive success from at least 2006 to 2011 (Meese 2013). Annual r~~R~~eproductive success appears to have always been quite variable across colonies~~ in any given year, and occasional success at large colonies may be important in maintaining the population over time (see Reproduction and Survival section)~~. A number of factors have been~~ shown to influence~~ associated with reproductive success, including predation and shortage of food, but reproductive failures caused by harvest at breeding Tricolored Blackbird colonies on agricultural fields of the San Joaquin Valley may have contributed to population declines through loss of much of the annual reproductive potential of the species in several years.

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Overexploitation summary—Although ~~direct~~ killing of Tricolored Blackbirds was once a large source of adult mortality, the number of birds killed declined dramatically after blackbird depredations in rice fields declined in the 1930s. Killing of Tricolored Blackbirds that may be depredating crops during the post-breeding period is ~~likely~~ a continuing source of mortality, but the available data do not indicate this to be a large source of mortality~~; additional data would be required to determine the degree to which this factor effects the population~~. ~~Destruction~~ Killing of birds in colonies in agricultural fields has been occurring since Tricolored Blackbirds were discovered nesting in this substrate type in the early 1990s. In recent years, the protections provided to the Tricolored Blackbird as a candidate under CESA, the availability of funds, and a coordinated effort by agencies, the dairy and farming industries, and nonprofit groups has led to a dramatic decline in this source of mortality, but losses of large colonies to grain harvest have continued. The future success of breeding colonies on agricultural crops will depend on the availability of funds to continue programs that locate breeding colonies on grain fields early in the nesting season and compensate farmers for delaying harvest.

Predation

A large number of species pre~~dators have been observed preying on~~y on adult Tricolored Blackbirds (Table 6)~~, including~~ and their eggs or nestlings. Most observations of predation have occurred at breeding colonies when the birds are congregated in dense groups, and most predation has occurred on the eggs, nestlings, or fledglings of Tricolored Blackbirds.

Table 6. Predators of Tricolored Blackbirds.

Taxonomic Group	Predators	Sources
Birds	Black-crowned Night-Heron (*Nycticorax nycticorax*), Cattle Egret (*Bubulcus ibis*), White-faced Ibis (*Plegadis chihi*), Great Blue Heron (*Ardea herodias*), Cooper's Hawk (*Accipiter cooperii*), Swainson's Hawk (*Buteo swainsoni*), Peregrine Falcon (*Falco peregrinus*), Merlin (*Falco columbarius*), Northern Harrier (*Circus cyaneus*), Barn Owl (*Tyto alba*), Burrowing Owl (*Athene cunicularia*), Short-eared Owl (*Asio flammeus*), Yellow-billed Magpie (*Pica nuttalli*), American Crow (*Corvus brachyrhynchos*), Common Raven (*Corvus corax*), Great-tailed Grackle (*Quiscalus mexicanus*)	Mailliard (1900), Neff (1937), Payne (1969), Hamilton et al. (1995), Beedy and Hamilton (1997), Hamilton (2000), Kelsey (2008), Meese (2010), Meese (2012), Airola et al. (2015a), Meese (2016), Beedy et al. (2017)
Mammals	coyote (*Canis latrans*), wolf (*Canis lupus*), gray fox (*Urocyon cinereoargenteus*), raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), long-tailed weasel (*Mustela frenata*), feral domestic cat (*Felis catus*), and possibly mink (*Mustela vison*)	Evermann (1919), Neff (1937), Payne (1969), Hamilton et al. (1995), Beedy and Hamilton (1997), Wilson et al. (2016), Beedy et al. (2017)
Snakes	gopher snake (*Pituophis catenifer*), king snake (*Lampropeltis* sp.), garter snake (*Thamnophis* sp.), and possibly western rattlesnake (*Crotalus oreganus*)	Neff (1937), Payne (1969), Hamilton et al. (1995)

Tricolored Blackbirds in s~~S~~mall areas of native vegetation may be especially vulnerable to predation, especially if they are near sites at which predator populations are ~~artificially~~ high due to ~~the availability of augmented~~ food sources from human activities. In the early 1990s, Hamilton and others found that many breeding colonies in emergent wetland nesting substrates ~~suffered~~ were partially or completely ~~destruction~~ destroyed by predation (primarily by Black-crowned Night-Herons; Hamilton et al. 1992, 1995, Hamilton 1993), resulting in consistently lower reproductive success in wetlands compared to other nesting substrates. Beedy and Hamilton (1997) reported that more recently, Black-crowned Night-Herons eliminated all or most nests at several freshwater marsh breeding colonies. Hamilton (2000) later reported that wetland colonies with no Black-crowned Night-Heron predation were highly successful. DeHaven (2000) reported that he also observed high rates of colony failure due to predation in the 1970s, a time when the majority of the population still bred in wetland~~ substrate~~s. Whether recent rates of loss to predation are similar to historical rates of loss is unknown.

Commented [EF219]: the nests themselves? adults? uoung?

In recent decades, ~~complete nesting~~ failures of one reproductive effort have been caused by novel predators on agricultural grain fields and the increasing concentration of birds in ~~mega-~~colonies of more than 100,000 estimated individuals may have increased their susceptibility to nest predation (Kelsey 2008). Cattle Egrets from a single rookery caused complete or near-complete failure of large breeding colonies in Tulare County from 2006 to 2011 (Meese 2012). White-faced Ibis prey on the eggs of the Tricolored Blackbird, and in 2016 caused the complete failure of a large breeding colony on a silage field in Tulare County (Meese 2016, Beedy et al. 2017).

Kelsey (2008) reported a steady increase in population sizes of ~~several~~ avian ~~predators~~ species in California that prey on Tricolord Blackbirds, including Black-crowned Night-Heron, Cattle Egret, American Crow, and Common Raven. However, the most recent breeding data from the Breeding Bird

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Survey~~bird survey~~ data show an increase for only one of these species, the Common Raven, and the data for Cattle Egret have ~~important~~ deficiencies that preclude trend assessment (Sauer et al. 2017b). White-faced Ibis have experienced a large population increase in California since the 1980s (Shuford et al. 1996), but Breeding Bird Survey data are inadequate for trend assessment (Sauer et al. 2017b).

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Although many species have been documented as predators of Tricolored Blackbirds, most ~~have not~~are not known to have~~d~~ severe effects on the population or on the breeding success at nesting colonies. However, a few species have caused ~~the~~ annual reproductive ~~complete~~ failure ~~of entire breeding colonies~~ through heavy predation on eggs and nestlings. In recent decades, the predators that have ~~destroyed entire colonies~~caused reproductive failure have usually been wading birds that hunt in large groups (e~~i~~.g~~e~~., Black-crowned Night-Heron, Cattle Egret, and White-faced Ibis). These species have had ~~significant~~ considerable impacts on the overall productivity rate of Tricolored Blackbirds in several years over the last three decades (Hamilton et al. 1995, Cook and Toft 2005, Meese 2012). A few other species, including Common Raven, raccoon, and coyote, have had large effects on ~~breeding~~ reproductive success, but these predators have typically not caused ~~complete colony~~annual reproductive failure or have had less widespread effects.

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Competition

Red-winged Blackbirds and, less frequently, Yellow-headed Blackbirds, ~~will often~~ nest in the same locations as Tricolored Blackbird~~ colonie~~s, although they may occupy the less-dense portions of a marsh. Where territorial conflicts occur, Tricolored Blackbirds ignore the territorial displays of these other species and overwhelm them with their sheer numbers, displacing them to the fringes of the substrate or pushing them out entirely (Payne 1969). There is no evidence that competition with these species is limiting the Tricolored Blackbird population (Hamilton et al. 1995).

Beedy et al. (2017) reported that Great-tailed Grackles may be aggressive toward nesting Tricolored Blackbirds but did not consider the impacts severe. White-faced Ibis may destroy Tricolored Blackbird nests when in the process of constructing their own nests, but this occurs infrequently. The Marsh Wren (*Cistothorus palustris*) may destroy eggs in Tricolored Blackbird nests that are ~~in proximity~~close to its own nest (Beedy et al. 2017). Competition with other species does not appear to be a large factor in the survival or reproduction of the Tricolored Blackbird.

Brood Parasitism

The Brown-headed Cowbird (*Molothrus ater*) is known to rarely parasitize nests of Tricolored Blackbirds (Hamilton et al. 1995, Beedy et al. 2017), but brood parasitism is not a major threat to the species.

Disease

Beedy et al. (2017) stated that no diseases have been reported for the Tricolored Blackbird but that in some years many nestlings have mites. Avian pox is prevalent in Tricolored Blackbirds in the Sacramento Valley, and much less so in the San Joaquin Valley (Beedy et al. 2017). West Nile virus ~~(WNV)~~ has been detected in dead Tricolored Blackbirds, as well as in many other species of blackbirds, orioles, and grackles nationwide (www.cdc.gov/westnile/resources/pdfs/Bird%20Species%201999-2012.pdf). Adult Tricolored Blackbirds tested positive for West Nile virus ~~WNV~~ antibodies in 2009 but did not show symptoms of the disease and were assigned a relatively low risk score (Wheeler et al. 2009, Beedy et al. 2017). Although the highly social nature of the species could place the Tricolored Blackbird at greater risk to disease transmission, the impact of disease and parasites on the species is unknown but is not thought to be a major threat to the species.

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Contaminants

Feeding in agricultural environments creates numerous opportunities for exposure to contaminants. Mortality of Tricolored Blackbird eggs and nestlings due to chemical contaminants has been suggested in a number of cases. Hosea (1986) reported that two colonies in Colusa and Sacramento counties near rice fields were ~~over~~ sprayed during aerial application of herbicides, resulting in the poisoning of almost all of the nestlings. Beedy and Hayworth (1992) described ~~the effects of~~ possible selenium toxicosis on a Tricolored Blackbird colony by comparing the reproductive success of a colony at Kesterson Reservoir in Merced County, which had a history of selenium contamination, with the success at four other colonies. Nesting failures were documented and deformities in Tricolored Blackbird nestlings were observed at the colony at Kesterson, and livers from dead nestlings collected at Kesterson had elevated levels of selenium. The area was cleaned up and the use of selenium-laden agricultural drain water to maintain the wetlands at Kesterson was discontinued. There have been no apparent selenium impacts on Tricolored Blackbird ~~nesting~~ reproductive success since. Hamilton et al. (1995) reported evidence of chemical-induced egg mortality from mosquito abatement operations in Kern County.

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~~In 1995,~~ Hamilton et al. (1995) concluded that, “Despite the limited evidence that Tricolored Blackbirds are suffering some mortality as a result of patterns of chemical use in agricultural areas, poisons do not appear to be inducing a serious population problem for Tricolored Blackbirds.” Hamilton (2000) knew of no evidence that toxic contaminants had adversely affected the Tricolored Blackbird since the early 1990s.

Neonicotinoid Insecticides

A relatively new class of insecticides, neonicotinoids, has been implicated in the decline of invertebrate communities and, in a few cases, the decline of insectivorous birds. The application of neonicotinoids has increased dramatically in California, especially since the early to mid-2000s (https://water.usgs.gov/nawqa/pnsp/usage/maps/). Neonicotinoids are relatively stable, and are water soluble so can be incorporated into the tissues of plants. They are commonly applied to crop~~s as~~ seeds ~~treatments~~, with the insecticide taken up systemically by the growing plant (Godfray et al. 2014). In the two decades since their introduction, neonicotinoid insecticides have become the most widely used insecticides in the world (Goulson 2013). They are highly effective at killing insects and, at relatively low concentrations, have relatively low mammal and bird toxicity. However, at higher concentrations they can have lethal and sublethal impacts to vertebrates (Mineau and Palmer 2013).

Acute toxicity of neonicotinoids has been assessed for only a few bird species, with wide variation in results. Bobwhite and Mallard are the species typically used in acute toxicity testing for regulatory

Commented [EF226]: include scientific names purposes, but where smaller-bodied species have been tested, including songbirds, the body weight-corrected dosage resulting in mortality is much lower (Mineau and Palmer 2013). A potential acute ~~impact~~ mechanism for species that are partly granivorous, like the Tricolored Blackbird, is sublethal or lethal effects through the ingestion of neonicotinoid-coated seeds. Ingestion of only a few neonicotinoid-coated seeds (a single seed in the case of corn) might be sufficient to kill a songbird, but there has been little work conducted on the availability and consumption of treated seeds by vertebrates (Goulson 2013, Mineau and Palmer 2013). Although not limited to neonicotinoids, a study that evaluated the effect of multiple potential factors found that acute toxicity of pesticides was the strongest correlate to declines of grassland bird species in the United ~~.~~States~~.~~, followed by habitat loss caused by agricultural intensification (Mineau and Whiteside 2013). No data are available on the acute toxicity of any neonicotinoid insecticide specifically to Tricolored Blackbirds, but seeds treated with imidacloprid, a widely used neonicotinoid insecticide, caused ataxia and retching in captive Red-winged Blackbirds and Brown-headed Cowbirds (Avery et al. 1993). These effects were transitory and birds learned ~~to avoid~~not to consum~~ption of~~e treated seeds when alternative grains were available. Neonicotinoids may also have chronic toxicity effects (exposure over longer time periods) on reproductive success, but chronic effects are even less studied than acute effects (Mineau and Palmer 2013).

Neonicotinoids may also indirectly affect Tricolored Blackbirds through suppression of insect prey populations. They have been shown to have adverse effects on a number of non-target invertebrate species, with most studies focusing on bees (Hopwood et al. 2012, Godfray et al. 2014). In California, long-term observational data have revealed declines in the number of butterfly species and declines in abundance of~~for~~ many butterfly species in the Central Valley, both of which were negatively associated with annual application rates of neonicotinoid insecticides (Forister et al. 2016). Imidacloprid was shown to have a negative association with a wide variety of insectivorous bird populations in the Netherlands, suggesting that the pesticide may have led to food deprivation in birds (Hallmann et al. 2014). The evidence linking imidacloprid concentrations to bird population declines was circumstantial, but the authors ruled out confounding effects from other land use changes and showed that the timing of observed declines in bird populations corresponded~~s~~ to the introduction of neonicotinoid insecticides (Goulson 2014, Hallmann et al. 2014).

Depending on environmental conditions, neonicotinoids can persist and accumulate in soils and in waterways, and levels measured in soils, waterways, and field margin plants have sometimes overlapped substantially with concentrations that are sufficient to control pests in crops (Goulson 2013). Neonicotinoids degrade through photolysis when exposed to sunlight and so would not be expected to occur at high levels in clear water (Goulson 2013). However, Starner and Goh (2012) detected imidacloprid in 89% of water samples taken from rivers, creeks, and drains in agricultural regions of California, with 19% of samples exceeding the US Environmental Protection Agency guideline concentration of 1.05 µg/L; this suggests that the insecticide ~~moves off~~runs off of treatment areas and may impact non-target aquatic insects. Little is known about the uptake of neonicotinoids from soil and soil water by non-target plants, and the downstream effect on non-target invertebrates (Goulson 2013).

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Commented [EF229]: what were the response variables? "bird populations" is not informative

Commented [EF230]: area occupied? abundance? reproduction?

~~A study evaluating landscape effects on~~ Tricolored Blackbird breeding colonies ~~found that colonies~~ are more likely to be located in areas ~~that experience~~ with higher~~er~~ neonicotinoid insecticide application rates than with low application rates (NAS 2017). This is likely because most colonies and birds breed in ~~the highly agriculturalized~~agricultural areas of Central Valley. The neonicotinoid application rate was also shown to increase during the 2008–2014 study period, suggesting that breeding Tricolored Blackbirds may be exposed to increasing amounts of the insecticides. The effect of this exposure on breeding Tricolored Blackbirds is unknown.

Several studies have revealed a negative relationship between insect populations and neonicotinoid use. These results, along with the large increase in application of neonicotinoids, suggest a potential mechanism ~~leading to~~of observed reductions in reproductive success in Tricolored Blackbirds (Meese 2013)~~. It is possible that this relatively new group of insecticides has resulted in declines of non-target insect species within the breeding range of the Tricolored Blackbird resulting in a declining prey base~~, but no data have been collected that ~~can~~ provide evidence whether this hypothesis is correct~~directly support this~~. It is also possible that acute effects resulting from ingestion of neonicotinoid-coated seeds has had an impact on the population, but the number of Tricolored Blackbirds suffering sublethal or lethal effects due to exposure to neonicotinoids is unknown. In addition to Tricolored Blackbirds, population declines in insectivorous birds have been documented across North America, ~~with specific examples from~~including California's Central Valley (Nebel et al. 2010, Airola et al. 2014). Whether n~~N~~eonicotinoids may be playing a role in driving these declines~~, but more study is needed~~, levels of ~~. There is a need for mechanistic research to compliment results from observational data; these should include testing~~ exposure ~~rates~~ of Tricolored Blackbirds to neonicotinoids, and effects of exposure on body condition and fitness ~~(direct effects), and investigations into potential insect-based food-web impacts (indirect effects)~~ are unknown.

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Invasive Species

With the exception of occasional ~~impacts due to nonnative~~ predat~~ors~~ion (e.g., Cattle Egret, Great-tailed Grackle), invasive species have not been reported to have a large impact on the ability of the Tricolored Blackbird to survive and reproduce. ~~The availability of many~~Tricolored Blackbirds have adapted to nest in some nonnative plant species ~~as nesting substrates have allowed the Tricolored Blackbird to breed in locations that would otherwise be unavailable~~. Nonnative i~~I~~nvasive species are not considered a major threat to the species.

Weather Events

Hamilton et al. (1995) stated that high mortality of Tricolored Blackbird nestlings can result from severe or prolonged storms and that some observed reproductive failure may be the result of chilling of adults and nestling ~~birds~~s. Also, some adult female mortality at nests appears to have been induced by cold and rainy weather (Hamilton et al. 1995). Heavy winds or precipitation have been documented to knock down nesting substrates, often ~~in~~ triticale or other grain ~~colonie~~s, but also ~~in~~ milk thistle ~~colonie~~s (Meese 2010, 2016), eliminating the reproductive effort for all or a part of breeding colonies. Weather

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events may have widespread impacts on reproductive success in some years, but impacts are usually isolated and the overall effect on the population's ability to reproduce is limited in most years.

Drought, Water Availability, and Climate Change

Drought reduces water supply reliability and has far-reaching impacts on most ~~habitat~~ land-cover types in California (DWR 2014, 2015a). Several ~~significant~~ major statewide droughts have occurred in California over the last century (1928–1934, 1976–1977, 1987–1992, and 2007–2009) (DWR 2015a), and California ~~recently~~ experienced the four driest consecutive years of statewide precipitation in the historical record between 2012 and 2014. The winter of 2015 produced a record low statewide mountain snowpack of ~~only~~ 5% of average.

Drought effects on availability of nesting substrate

Tricolored Blackbirds have adapted to use a variety of novel vegetation types as nesting substrate, but wetlands continue to support the largest number of breeding colonies each year. Because of the need for wetlands that are flooded during the spring and summer breeding season, the various approaches to wetland management, and the dependence on water deliveries to maintain wetland~~ habitats~~s in most of the Tricolored Blackbird's range, assessing the availability of ~~suitable~~ wetland nesting substrate in a given year is difficult. A recent method ~~applied reflectance to~~used satellite imagery ~~in order~~ to identify ~~areas of~~ open surface water in the Central Valley (Reiter et al. 2015). Although not an ideal approach to quantifying and assessing distribution of wetlands, the method ~~would~~ may identify wetlands with large amounts of open water. In addition, identification of open water ~~on the landscape~~ during the Tricolored Blackbird breeding season ~~is likely~~may be a good proxy for the availability of water for wetland management. Reiter et al. (2015) showed that open surface water declined across the Central Valley between 2000 and 2011. Drought had a significant negative effect on open surface water in the late summer and early fall. Cumulative years of drought resulted in a noticeable reduction in surface water. Although not a direct measure of Tricolored Blackbird breeding habitat, declines in surface water during the drought likely resulted in reduced availability of wetlands with sufficient water to provide high quality nesting substrates.

Although more resilient to dry conditions than wetland vegetation, plant~~s~~ species that provide upland nesting substrate for Tricolored Blackbird colonies also ~~experience~~ are negative~~ effects due to~~ly affected by drought. After several years of dry conditions during California's most recent drought, many Himalayan blackberry copses that ~~have~~ historically supported Tricolored Blackbird colonies were observed to be dry and mostly ~~barren of leaves~~leafless. In a few cases, extremely dry blackberry bushes continued to be used by breeding colonies, but many were unoccupied. Milk thistle~~, which provides high-quality nesting substrate across much of the Tricolored Blackbird range when annual precipitation patterns support vigorous growth,~~ was largely absent from historically used areas until California experienced an average water year in the winter of 2015–2016 (Airola et al. 2016). ~~The wetter weather created nesting substrate in areas that had not been used by Tricolored Blackbirds in several years, and breeding colonies once again occupied these areas.~~

Drought effects on prey populations

The availability of large insect prey is ~~an important factor in~~hypothesized to be associated with Tricolored Blackbird reproductive success, and may ~~influence~~ affect colony ~~site selection~~location. ~~Large landscapes with suitable foraging habitat are strong drivers of colony site occupancy and abundance (NAS 2017).~~

In some cases, ~~Insect~~ abundance of insects, including grasshoppers, is highly related to biomass of herbaceous vegetation~~, including important Tricolored Blackbird prey items like grasshoppers in grasslands~~ (Falcone 2010). Climate, especially drought, ~~is thought to play a key role in~~may affect abundance of grasshoppers and other insect species in grasslands (Vose et al. 2016). The response of insect populations can differ depending on drought severity. For example, non-severe drought and warm temperatures can have a positive effect on grasshopper populations through increased survival and faster population growth (Kemp and Cigliano 1994). However, extreme or prolonged drought can negatively affect grasshopper populations through desiccation of eggs or through decreased biomass of primary producer food sources (i.e., grasses and forbs) (Vose et al. 2016). Reductions in precipitation not only lead to reductions in the abundance of insects in grasslands, but may also make insect prey less accessible through changes in behavior (e.g., moving underground) (Barnett and Facey 2016). Severe droughts likely have strong negative effects on grasshoppers and insect prey ~~biodiversity~~ in general (Kemp and Cigliano 1994, Vose et al. 2016).

~~The established impacts of precipitation on insect populations in grasslands, especially grasshoppers, suggests a mechanism for drought impacts on Tricolored Blackbird productivity. Research is needed that measures grasshopper and other prey abundance relative to precipitation and primary productivity around occupied Tricolored Blackbird colonies, and evaluates the effect on Tricolored Blackbird reproductive success.~~

Climate Change

Average annual temperatures and variability in temperature have been rising in California in recent decades, and climate models are in broad agreement that temperatures in California will rise ~~significantly~~ substantially over the next century (DWR 2015b). The average temperature is ~~expected~~ projected to rise by approximately 2.7°F by 2050, and depending on the emissions scenario, average temperatures could increase by 4.1–8.6°F by the year 2100 (Moser et al. 2012). Summer temperatures ~~will~~ are projected to rise more than winter temperatures, and the increases ~~will be~~are projected to be greater in inland California. As a result, the average number of ~~extremely hot~~ days on which maximum temperatures are ~~(~~at least 105°F~~)~~ per year in Sacramento is ~~expected~~ projected to increase fivefold (up to 20 days) by the middle of the century, and may increase to as many as 50 days per year by 2100 (Moser et al. 2012). Tricolored Blackbirds ~~have been~~were observed to cease initiation of breeding when temperatures rose above 90°F, although care of existing nests continued in temperatures over 100°F (Hamilton et al. 1995). Rising temperatures may directly affect annual Tricolored Blackbird ~~productivity~~ reproductive success by truncating or interrupting the breeding season, although ~~more work is needed~~

Commented [EF233]: extremes are relative. 105 wil not be consiered extreme by 2100

~~on~~ the effect of temperature on initiation and success of nesting attempts and on potential adaptation of the species to increases in temperature means and extremes is not known.

Along with projected ~~impacts to~~negative effects Tricolored Blackbird foraging habitat due to housing development discussed above, the areas of California with the largest climate-projected effects on a variety of bird species are largely concentrated within the Tricolored Blackbird range in the Central Valley (Jongsomjit et al. 2013). A suite of analyses integrating the effects of climate change and land use changes in California's ~~rangelands~~ grasslands, shrublands, and woodlands concluded that grassland ~~habitat~~ loss in California could reach 37% by the year 2100 (Byrd et al. 2015).

The recent severe drought in California likely was at least in part due to and made more severe by climate change (Diffenbaugh et al. 2015). Climate change is projected to bring longer and more severe droughts to California in the future (Diffenbaugh et al. 2015, Williams et al. 2015)~~, exacerbating the impacts to Tricolored Blackbird habitat described above~~. The Central Valley may be particularly vulnerable to warming-driven drought increases in the future (Williams et al. 2015). Water deliveries are projected to ~~be reduced~~decrease by 5.6% from 2013 to 2033 due to climate change effects on reliability (DWR 2014). Climate ~~change effects on~~-driven reduction in water supplies and stream flows are expected to increase competition among urban and agricultural water users and environmental needs (Moser et al. 2012). This competition may lead to decreases in the area of ~~available~~ wetland ~~nesting substrates~~ provided by private and public land managers. Declines in the availability of water for agriculture may also reduce prey populations ~~provided by~~in ~~high quality~~ crops like alfalfa and rice.

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SUMMARY OF LISTING FACTORS

[Note to reviewers: This section will provide summaries of information in the status review, arranged under each of the factors that the Fish and Game Commission must consider in making a determination as to whether listing is warranted (Cal. Code Regs., Tit. 14, § 670.1). These summaries will be prepared after peer review.]

Commented [EF235]: Needs to be made available to scientific peer reviewers to ensure that the best science available, and associated scientific uncertainties, are represented fully, objectively, and transparently

Present or Threatened Modification or Destruction of Habitat

Overexploitation

Predation

Competition

Disease

Other Natural Events or Human-Related Activities

PROTECTION AFFORDED BY LISTING

It is the policy of the State to conserve, protect, restore, and enhance any endangered or threatened species and its habitat (Fish & G. Code, § 2052). The conservation, protection, and enhancement of listed species and their habitat is of statewide concern (Fish & G. Code, § 2051(c)). ~~CESA defines "take" as hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill (Fish & G. Code, § 86).~~ The Fish and Game Code provides the Department with related authority to allow ~~"~~take~~"~~ of species listed as threatened or endangered under certain circumstances through incidental take permits, memoranda of understanding~~s~~, natural community conservation plans, or other plans or agreements approved by or entered into by the Department (Fish & G. Code, §§ 2081, 2081.1, 2086, 2087, and 2835).

If the Tricolored Blackbird is listed under CESA, ~~impacts~~ negative effects of take caused by activities authorized through incidental take permits must be minimized and fully mitigated according to state standards. These standards typically include protection of the land in perpetuity with an easement, development and implementation of a species-specific adaptive management plan, and funding through an endowment to pay for long-term monitoring and maintenance to ~~ensure~~ evaluate whether the mitigation land meets performance criteria. Obtaining an incidental take permit is voluntary. The Department cannot force compliance; however, any person violating the take prohibition may be punishable under state law.

Additional protection of Tricolored Blackbird following listing ~~would be~~is expected to occur through state and local agency environmental review under CEQA. CEQA requires that affected public agencies analyze and disclose project-related environmental effects, including potentially significant impacts (albeit these have not been quantified) on rare, threatened, and endangered species. In common practice, potential ~~impacts to~~negative effects on listed species are examined more closely in CEQA documents than potential ~~impacts to~~negative effects on unlisted species. Where significant impacts are identified under CEQA, the Department expects that project-specific avoidance, minimization, and mitigation measures will benefit the species. State listing, in this respect, and consultation with the Department during state and local agency environmental review under CEQA, ~~would be~~is expected to

Commented [EF236]: which are not defined objectively benefit the Tricolored Blackbird in terms of reducing ~~impacts~~ negative effects of~~from~~ individual projects~~,~~ that otherwise ~~which~~ might ~~otherwise~~ occur~~ absent listing~~.

For some species, CESA listing may prompt increased interagency coordination and the likelihood that state and federal land and resource management agencies will allocate funds toward protection and recovery actions. In the case of the Tricolored Blackbird, the Tricolored Blackbird Working Group signatory agencies already meet and coordinate regularly, but a state listing could ~~result in~~ increase~~d~~ availability of conservation funds.

LISTING RECOMMENDATION

CESA directs the Department to prepare this report regarding the status of the Tricolored Blackbird in California based upon the best scientific information. CESA also directs the Department based on its analysis to indicate in the status report whether the petitioned action is warranted (Fish & G. Code, § 2074.6; Cal. Code Regs., tit. 14, § 670.1, subd. (f)). In addition to evaluating whether the petitioned action (i.e., listing as endangered) was warranted, the Department considered whether listing as threatened under CESA was warranted.

The Department includes and makes its recommendation in its status report as submitted to the Commission in an advisory capacity based on the best ~~available~~ science available. In consideration of the scientific information contained herein, the Department has determined that listing the Tricolored Blackbird as threatened or endangered under CESA is [warranted/not warranted] at this time.

[Note to reviewers: The Department's recommendation will be finalized following peer review and completion of the status review report.]

Commented [EF237]: Needs to be made available to scientific peer reviewers to ensure that the best science available, and associated scientific uncertainties, are represented fully, objectively, and transparently

MANAGEMENT RECOMMENDATIONS

The Department evaluated existing management recommendations and identified the following, listed in no particular order, as necessary to achieve conservation of the Tricolored Blackbird. The *Conservation Plan for the Tricolored Blackbird* (TBWG 2007) identifies goals, objectives, and tasks required to maintain a viable Tricolored Blackbird population throughout the current range of the species. The Department continues to support implementation of the conservation plan as revised by the Tricolored Blackbird Working Group. The goals, objectives, and tasks identified in the plan are not repeated in their entirety here, but many of the management recommendations listed below are related to, or based on, activities identified in the plan.

Habitat Protection, Restoration, and Enhancement

Land ownership patterns across the range of the Tricolored Blackbird, coupled with the diverse nesting and foraging habitats used by the species, necessitate cooperative conservation efforts among government, industry, and the public~~ in order to conserve the species~~.

Management of habitat must consider the large ~~landscapes~~ areas utilized by breeding colonies and the integral relationship between nesting ~~colony sites and associated upland~~and foraging ~~areas~~ habitat (Hamilton 1993). ~~Land management plans that do not specifically consider the landscape needs of Tricolored Blackbirds will not necessarily result in the protection or creation of suitable breeding habitat.~~

1. ~~Determine the best~~Prioritize areas for conservation~~, building off the recent research on habitat suitability conducted by the National Audubon Society (NAS 2017). It is difficult to predict the distribution of widespread species, and even more difficult when the distribution within the range is not stable, as with the dynamic colony site use of Tricolored Blackbirds. Breeding locations that should be prioritized for protection~~, includinge those that are regularly occupied, ~~those that~~ support large colonies, ~~those that support~~have high reproductive success, and ~~those with a secure~~are close to foraging ~~landscape~~ habitat (Meese and Beedy 2015).
2. Identify areas in the Tricolored Blackbird range with high quality foraging landscapes, but that lack ~~suitable~~ nesting substrate. Consider conservation actions to create or restore nesting substrate in areas with high probability of use by breeding Tricolored Blackbirds.
3. Secure funding and implement protection of the highest priority nesting ~~substrate protection~~locations and habitat~~,~~ enhancement and restoration projects ~~and foraging habitat protection projects~~.
4. ~~Create a system for t~~Track~~ing~~ habitat protection and restoration projects, including appropriate measures of success~~. Work with the Tricolored Blackbird Working Group to encourage reporting of habitat projects from~~, by all ~~stakeholders~~parties.

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Breeding Colony Protection

In addition to the long-term goal of providing ~~suitable alternative~~ habitat away from silage fields on public and private land, ~~the near-term priority must continue to be placed on~~ identify~~ing~~ and conserv~~e~~~~ing~~ the colonies nesting in silage on private property each year.

5. Fully fund and implement a silage colony protection program. Continue work in the Tricolored Blackbird Working Group's agriculture subcommittee to plan for and implement a silage colony response plan, with participation from a diverse set of stakeholders including members of the dairy industry.
6. Identify locations that regularly support large and productive Tricolored Blackbird breeding colonies, with secure foraging landscape. Prioritize these locations for protection through acquisition or conservation easement.
7. Assess ~~the effectiveness of provision of~~ whether alternate nesting habitat (e.g., fresh emergent wetlands) ~~to~~ draws birds away from nesting in dairy silage fields (Beedy et al. 2017).

Monitoring and Research

8. ~~Determine the~~Identify any factors, including insect abundance, that reliably ~~influence~~ are associated with nest ~~site selection~~location ~~and especially how relative insect abundance may affect site occupancy (Airola et al. 2016)~~.

9. ~~Determine~~ Test whether the amount, type, and distribution of foraging habitat ~~needed to support~~is associated with ~~viable breeding colonies of various sizes. How does type, proximity to colony site, and diversity of foraging habitats influence the extent of foraging habitat required and the rate of~~ reproductive success~~?~~.
10. ~~Determine the~~Identify any environmental factors, including exposure to pesticides, that ~~result in abundant~~are associated with abundance of ~~large~~ insect~~ prey population~~s in grassland~~ habitat~~s and in ~~commonly used~~ agricultural crops commonly used by Tricolored Blackbirds~~, and their variability in time and space~~.
11. ~~Conduct mechanistic research to compliment results from observational data that have shown correlations between neonicotinoid pesticides and declines in songbirds; these should include t~~Test~~ing~~ whether exposure ~~rates~~ of Tricolored Blackbirds to neonicotinoids~~, effect of exposure on~~ affects their body condition and fitness~~, and investigations into potential insect-based food web effects~~.
12. Estimate rates of within season and ~~inter~~annual movements and genetic exchange between putative populations ~~breeding~~ in different regions, especially ~~between~~ southern California and the Central Valley (Beedy et al. 2017).
13. Quantify annual adult surviv al~~orship~~ and investigate whether any factors ~~that~~ reliably affect survival, including ~~the magnitude of post-breeding mortality caused by~~ shooting ~~to~~ with the aim of reducinge crop depredation.
14. Investigate new methods to ~~measure~~ estimate ~~productivity in Tricolored Blackbird breeding colonies~~nest success. ~~Current methods that utilize nest transects or counts of fledglings might not be comparable, and nest transects can be difficult to implement and may negatively affect breeding birds.~~
15. Examine the degree of colony cohesion ~~between first and subsequent~~among breeding attempts~~,~~ and ~~between breeding~~ seasons (Beedy et al. 2017).
16. Develop and implement a statistically valid, standardized protocol for ~~the~~ long-term, statewide monitoring of Tricolored Blackbird abundance~~, including population estimate~~ and confidence.

Education and Outreach

~~17.~~ Raise awareness of Tricolored Blackbird nesting behavior and conservation options on ranches and farm~~land~~s, ~~stressing the importance of~~including protecting large silage nesting colonies. Build ~~off~~ on recent efforts by the Tricolored Blackbird Working Group and the dairy industry.

~~18.~~17. ~~Conduct outreach and coordination with landowners whose grazing lands in the foothills support breeding colonies (Airola et al. 2015b).~~

~~19.~~18. Provide land managers with ~~habitat management~~ guidance for ~~creation and~~ manag~~ement of~~ing Tricolored Blackbird habitat. Continue work recently undertaken by the Tricolored Blackbird Working Group's habitat subcommittee.

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ECONOMIC CONSIDERATIONS

The Department is charged in an advisory capacity in the present context to provide a written report and a related recommendation to the Commission based on the best scientific information available regarding the status of Tricolored Blackbird in California. The topic areas and related factors the Department is required to address as part of that effort are biological and not economic~~, t~~. Therefore, the Department is not required to prepare an analysis of economic impacts (See Fish & G. Code, § 2074.6; Cal. Code Regs., tit. 14, § 670.1, subd. (f)).

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