Tricolored Blackbird Status Update and Management Guidelines

Prepared for:

Migratory Birds and Habitat Programs
U.S. Fish and Wildlife Service

Bird and Mammal Conservation Program
California Department of Fish and Game

Prepared by:

Edward C. Beedy
Jones & Stokes Associates, Inc.

and

William J. Hamilton III
Division of Environmental Studies
University of California, Davis

September 1997

TRICOLORED BLACKBIRD STATUS UPDATE AND MANAGEMENT GUIDELINES

PREPARED FOR:

Nongame Migratory Bird Program
U.S. Fish and Wildlife Service
911 N.E. 11th Avenue
Portland, OR 97232-4181

and

California Department of Fish and Game
Bird and Mammal Conservation Program
1416 Ninth Street
Sacramento, CA 95814
Contact: FG6161 WM, Report 97-07

PREPARED BY:

Edward C. Beedy
Jones & Stokes Associates, Inc.
2600 V Street, Suite 100
Sacramento, CA 95818-1914

and

William J. Hamilton III
Division of Environmental Studies
University of California
Davis, CA 95616

SEPTEMBER 1997

Table of Contents

List of Tables and Figure

Acknowledgments

Funding to prepare this report was provided by the Migratory Birds and Habitat Programs of the U.S. Fish and Wildlife Service (USFWS), Portland, OR, and the Bird and Mammal Conservation Program of the California Department of Fish and Game (DFG), Sacramento, CA. Tara Zimmerman provided in-depth reviews, coordinated USFWS funding, and provided project oversight and guidance. Kevin Hunting coordinated DFG funding and reviewed this report. Bob Barnes of the National Audubon Society and Lyann Comrack and Kevin Hunting of the California Department of Fish and Game organized the Volunteer Surveys and compiled the survey data. Tim Manolis prepared the tricolored blackbird illustration for the cover.

We gratefully acknowledge the continuing efforts of many field ornithologists throughout California for monitoring tricolored blackbird breeding colonies as part of the recent, rangewide Volunteer Surveys. The following individuals participated in these surveys: Daniel Airola, Jack Allen, Amy Augustine, Sy Baldwin, Jim Banks, Alan Barron, John Beckstrand, Edward Beedy, Don Blake, William Bousman, Rhys Bowen, Steve Bruggemann, Michael Bumgardner, Carl Burke, Eric Caine, Steve Cameron, Chantelle Carroll, Mark Chichester, Harry Childs, Harold Connor, Liz Cook, Al Demartini, David Desante, Bruce Deuel, Jeannine Dewald, Thomas Edell, Ray Ekstrom, Joe Engler, Dick Erickson, Rick Farris, David Feliz, John Fitch, Sam Fitton, Bob Foley, Gary Fregien, Jim Gain, Kimball Garrett, Dan Gifford, Paul Gorenzel, Steve Granholm, Helen Green, Bill Grummer, Kevin Guse, Bill Haas, William Hamilton, Robert Hansen, Keith Hansen, Stanley Harris, Steve Haydock, Loren Hays, Fred Heath, Tom Heindel, Jo Heindel, Matthew Heindel, Dorothy Hester, Rob Hewitt, Paul Hofmann, Waldo Holt, Joel Hornstein, Kevin Hunting, Warner Jacobsen, Lee Jones, Guy Kay, Robert Keiffer, John Kelly, Marti Kie, Rick Knoemschild, Jeri Langham, Arthur Langton, Steve Laymon, Robin Leong, Michael Long, Tim Manolis, Dave Mauser, Guy McCaskies, DennisMcDonnel, Chet McGaugh, Darlene McGriff, Robert McKernan, Greg Mensik, Peter Metropulos, Patrick Mock, Arthur Morley, Daniel Murphy, Summer Nicholson, Chris Otahal, Benjamin Pat-meter, Michael Patten, Tom Paulek, Anita Peacemaker, Hans Peeters, Mike Peters, Peter Pyle, John Ranlett, Harold Reeve, Robert Richmond, A. Ries, Mike Rigney, Michael Rippey, Michael Robbins, Don Roberson, Jim Rowoth, Jim Royer, Pete Sands, Rick Saval, Katherine Scarlett, Michelle Scully, David Shuford, Joe Silveira, Jim Snowden, Rich Stallcup, Bradley Stoval, Emilie Strauss, David Suddjian, Lee Swanberg, Barbara Tatman, Scott Terrill, Dorothy Tobkin, Philip Unitt, Kent Vanvuren, Dee Warenycia, Bette Wentzel, Mark White, Jerry White, Margaret & William Widdowson, Brian Williams, Randy Wilson, Mark Wimer, Jon Winter, Mike Wolder, Dennis Woolington, Larry Wycoff, David Yee, and Bob Yutzy.

I. Introduction

The tricolored blackbird *(Agelaius tricolor)* is a highly colonial species that is largely endemic to California. It is most numerous in the Central Valley and vicinity, but also occurs in the foothills surrounding that valley. In addition, the species occurs sparsely in coastal California, Oregon, northwestern Baja California (Dawson 1923, Neff 1937, Grinnell and Miller 1944, DeHaven et al. 1975a, Beedy et al. 1991), and rarely in western Nevada (Chisholm pers. comm.). Historical and recent surveys indicate that the tricolored blackbird's (tricolor's) overall distribution and choice of nesting locations varies from year to year (Neff 1937, DeHaven et al. 1975a, Hamilton et al. 1995).

The current and future status of tricolors is of concern because the colonial behavior of this species may make them vulnerable to large-scale nesting failures and their geographical range is limited (Neff 1937, DeHaven et al. 1975a, Beedy et al. 1991). Local declines and extirpations of this species have been confirmed (Beedy et al. 1991), and DeHaven et al. (1975a) reported that the overall population was greatly reduced from that observed by Neff (1937) during the 1930s.

Based on concerns about the tricolor's population status, the U.S. Fish and Wildlife Service (USFWS) included this species as a candidate (Category 2) for federal listing as either threatened or endangered (59 Federal Register [219]:58990) in 1991. USFWS policy changes in 1995 eliminated the Category 2 candidate designation nationwide and the tricolor is now considered a nongame bird of management concern (U. S. Fish and Wildlife Service 1995). It is also considered a bird species of special concern in California by the California Department of Fish and Game (DFG) (Comrack and Hunting pers. comms.). These designations do not provide any specific legal protection; however, the species is afforded basic protection under the federal Migratory Bird Treaty Act of 1918, and the species of special concern designation means that tricolors must be considered during project actions subject to the California Environmental Quality Act.

In 1989, the USFWS Sacramento Field Office commissioned a literature review and update of the tricolor's population status (Beedy et al. 1991). From 1991 through 1994, USFWS and DFG cooperatively funded intensive breeding season surveys to document the current status, habitat associations, and reproductive success of tricolors (Hamilton et al. 1995). Incomplete surveys were conducted in 1995 and 1996. In 1997, DFG coordinated an intensive survey throughout the historical range of the tricolor in California.

This report was prepared to: 1) assist public and private land managers in understanding and enhancing populations and habitats of this species, and 2) to provide the background information and direction needed to incorporate tricolor conservation actions into broader multispecies, ecosystem-based conservation planning efforts in the Central Valley and in southern California. Included are a summary of the tricolor's life

history, historical and current population statuses, threats to populations, and conservation and management recommendations.

2. Life History Summary

Habitat Requirements

Breeding

Tricolors are among the most colonial of North American passerine birds (Bent 1958; Orians 1961a, 1980; Orians and Collier 1963). Neff (1937) described one colony in Glenn County with more than 200,000 nests. As many as 100,000 nests have been recorded in cattail marshes of 4 hectares (ha) or less (Neff 1937, DeHaven et al. 1975a), and individual nests may be built immediately adjacent to each other (Neff 1937). The tricolor's highly synchronized and colonial breeding system may have adapted to exploit a rapidly changing environment where the locations of secure nesting habitat and rich insect food supplies were ephemeral and likely to change each year (Orians 1961b, Orians and Collier 1963, Collier 1968, Payne 1969).

Tricolors have three basic requirements for selecting their breeding colony sites: (1) open accessible water; (2) a protected nesting substrate, which is usually either flooded or thorny or spiny vegetation; and (3) a suitable foraging space providing adequate insect prey within a few kilometers (km) of the nesting colony (Beedy 1989, Hamilton et al. 1995).

Almost 93 % of the 252 tricolor breeding colonies reported by Neff (1937) were in freshwater marshes dominated by tules *(Scirpus* sp.) and cattails *(Typha* sp.). The remaining colonies in Neff's study were in willows *(Salix* spp.), blackberries *(Rubus* sp.), thistles *(Cirsium* and *Centaurea* spp.), or nettles *(Urtica* sp.). In contrast, only 53 % of the colonies reported during the 1970s were in cattails and tules (DeHaven et al. 1975a).

An increasing percentage of tricolor colonies in the 1980s and 1990s were reported in Himalaya berries *(Rubus discolor),* and some of the largest recent colonies are in silage and grain fields (Hamilton et al. 1995). Other substrates where tricolors have been observed nesting include giant cane *(Arundo donax),* safflower *(Carthamus tinctorius)* (DeHaven et al. 1975a), tamarisk trees *(Tamarix* spp.), and poison-oak *(Toxicodendron diversilobum).* In addition, they have been found in habitats that include riparian scrublands (e.g., *Salix, Populus, Fraxinus)* and forests and a lemon orchard (American Birds file data).

Foraging

Tricolor foraging habitats in all seasons include pastures, dry seasonal pools, agricultural fields (such as large tracts of alfalfa with continuous mowing schedules), rice fields, feedlots, and dairies. Tricolors also forage occasionally in riparian scrub, saltbush *(Atriplex spp.)* scrub, marsh borders, and grassland habitats. Weed free row crops and intensively managed orchards and vineyards do not serve as regular foraging sites.

During nesting, tricolors forage away from their nest sites, often well out of sight of the colony. Most tricolors forage within 5 km of their colony sites (Orians 1961b), but commute distances of up to 13 km have been reported (Hamilton pers. obs.). Short-distance foraging (i.e., within sight of the colony) for nestling provisioning also is common. Both sexes provision nestlings.

Often only a minor fraction of the area within the commuting range of a colony provides suitable foraging habitat. For example, within a 5-km radius there may be low-quality foraging habitats, such as cultivated row crops, orchards, vineyards, and heavily grazed rangelands, in association with high-quality foraging areas, such as irrigated pastures, lightly grazed nonnative grasslands, dry seasonal pools, and recently mowed alfalfa fields.

Large flocks of foraging tricolors may appear to roll across the landscape, as smaller groups leap-frog over those in front of them. The flight speed of tricolors in still air is about 48 km per hour, and foraging flocks can often be tracked with a moving automobile (Hamilton pers. obs.).

Reproductive Ecology

Female tricolors breed in their first year, but most males apparently defer breeding until they are at least 2 years old (Payne 1969). Nest construction, done exclusively by females, is often highly synchronous and may be initiated as soon as the day of arrival at the breeding colony (Neff 1937). Additional birds may be recruited to that colony site and initiate nesting later; these birds may nest in a continuing concentric wave at the margin of the colony (Orians 1961b). One female tricolor moved from one colony to another and renested less than 10 days after her previous nest failed (Payne 1969).

Hamilton et al. (1995) observed that most initial spring breeding occurs in late March through April. Most of the largest April colonies are in the San Joaquin Valley and are associated with dairies and cattle feedlots. As nests fail from predation, inclement weather, and agricultural operations, disrupted nesters may renest, both at established locations and at more distant sites. In May and June of 1992, 1993, and 1994, additional colony locations included the Sacramento Valley north of Sacramento

County. Overall, reproductive success for entire colonies was higher in Himalaya berry colonies than in cattail marshes (Cook 1996).

As colonization of a breeding site proceeds, the area occupied by nests expands (Tyler 1907), engulfing any previously established breeding red-winged blackbirds *(Agelaius phoeniceus).* At some colonies, the expansion process ends before all suitable nesting habitats are occupied, while at others all suitable habitats are used for nesting (Hamilton pers. obs.). At some colonies, later nests may be initiated in parts of the colony where advanced, active nests are already present. This pattern occurs at colony sites where all the available nesting area is occupied, suggesting that suitable unoccupied nesting sites are not available.

Tricolor nests are bound to upright plant stems from a few centimeters up to about 2 m above water or ground (Harrison 1978); however, nests in the canopies of willows and ashes may be several meters high (Hamilton and Beedy pers. obs.). Tricolor nests are rarely built on the ground (Neff 1937). Deep cup nests are constructed with outer layers of long leaves (e.g., cattail thatch, annual grasses, or forbs) woven tightly around supporting stems. A middle layer is built within the shaped nests and consists of mud or algal fibers. The inner nest layer is soft plant down. Nest building takes about 4 days (Payne 1969).

Egg laying can begin as early as the second day after nest initiation but ordinarily starts about 4 days after the arrival of tricolors at breeding sites (Payne 1969). One egg per day is laid, and clutch size is usually three or four eggs, but may include as few as one or two or as many as five eggs (Payne 1969, Hamilton et al. 1995).

Male song ceases after the last egg is laid, and a waning colony chorus indicates that laying has been completed (Hamilton pers. obs.). Emlen (1941) and Orians (1961a) estimated the tricolor's incubation period at 11 or 12 days, while Payne (1969) estimated this interval at 11-14 days. Incubation begins before clutches are completed, and hatching of eggs within individual nests is asynchronous (Bowen and Hamilton pers. obs.).

Tricolor clutches take about 9 days from hatching until the oldest nestling is willing to jump from the nest when disturbed. Young require about 15 days from this prefledging date until they are independent of their parents. Thus, one successful nesting effort for a reproductive pair takes about 45 days (Payne 1969). The nesting effort of a successful colony may take additional time depending on whether additional females are: recruited into the colony or are renesting at the colony after the initial nesting establishment.

Tricolor activity during the early stages of colony settlement may give the erroneous impression of high local nesting densities because initially more males are typically present at some colonies than will attract mates (Hamilton et al. 1995). Flight activity over colonies during the settlement phase is mainly by males that have not established nesting territories. Males gaining breeding territories may remain below the canopy of nesting substrates and, thus, out of view. The mean number of females per male is

estimated to be two (Lack and Emlen 1939, Orians 1961b, Payne 1969), but some colonies may have nearly as many males as females (Cook and Hamilton pers. obs.). A count of active tricolor nests per unit area is, thus, a better indication of local abundance than numbers of singing males (Neff 1937).

During incubation, males form all-male flocks and may spend the day several kilometers from colonies. After young hatch, however, some males actively attend nests. Whether individual males provide food for nestlings at more than one nest is not known.

Females on nests are quiet during incubation, and active colonies may appear to be largely deserted. The more synchronous colonies are particularly inconspicuous at this stage and can be underestimated or overlooked. Close approach by an observer, however causes females to leave their nests and fly away. Sometimes incubating females by catch during incubation, and there may be a steady upward flight of birds to capture aerial insects over the colony. Grasshopper migrations may be intercepted in this way by colonies provisioning nestlings (Hamilton pers. obs.).

A creche of tricolors is an assembly of fledglings that have left the nest and assembled (Payne 19 69) either at the colony site or at locations between colonies and favorable foraging areas. These fledglings are conspicuous, both because they are vociferous and because adults are feeding them as rapidly as possible (Hamilton pers. obs).

Demography

Banding studies, summarized by Neff (1942) and DeHaven and Neff (1973), indicate that tricolors can live for at least 13 years. There are no annual survivorship studies of tricolors, and available banding data are inadequate to provide this information.

Feeding Ecology

Tricolors were characterized by Orians (1961a) as grasshopper followers, the counterpart of Old World locust-dependent starlings. When Crase and DeHaven's (1977) observations failed to confirm this relationship, they suggested that the decline in tricolor abundance they reported (for the 1968-1972 interval compared with Neff's observations in the 1930s) might reflect a loss of California's grasslands and grasshoppers. However, it is possible that tricolors are opportunistic foragers that consume any locally abundant insect resource, including grasshoppers, and a decline in grasshoppers may not relate directly to a decline in tricolors.

Foods delivered to tricolor nestlings include beetles and weevils, grasshoppers, caddis fly larvae, moth and butterfly larvae (Orians 1961b, Crase and DeHaven 1977,

Skorupa et al. 1980), and, especially in current rice-growing areas, dragonfly larvae (Hamilton pers. obs.). Breeding season foraging studies in Merced County showed that animal matter makes up about 91% of the food volume of nestlings and fledglings, 56% of the food volume of adult females, and 28% of that of adult males (Skorupa et al. 1980).

Adults may continue to consume plant foods throughout the nesting cycle but also forage on insects and other animal foods. Immediately before and during nesting, adult tricolors are often attracted to the vicinity of dairies, where they take high-energy items from livestock feed rations. Adults with access to livestock feed, such as cracked corn, begin providing it to nestlings when they are about 10 days old (Hamilton et al. 1995).

Knowledge of winter feeding habits of tricolors comes from the Sacramento Valley (Crase and DeHaven 1978). More than 88% of all winter food is plant material, primarily seeds of rice and other grains but also weed seeds. In winter, tricolors often associate with other blackbirds, but flocks as large as 15,000 individuals (almost all tricolors) may aggregate at one location and disperse to foraging sites. Some winter foraging flocks are composed almost exclusively of one sex (Hamilton and Beedy pers. obs.).

Blackbirds, including tricolors, have a long history of destructiveness to agricultural crops (Tyler 1907). They consume newly sprouted rice, ripening oats (Skorupa et al. 1980), barley, and rice seed heads (Hamilton pers. obs.). However, tricolors may also provide a considerable benefit as agents of insect control on a variety of agricultural lands (Skorupa et al. 1980).

Movements

DeHaven et al. (1975b) found that most tricolors do not nest at the sites where they hatched or where they had nested the year before. Of a total of 33,058 birds banded as nestlings, 33 were later shot as adults at breeding colonies. Only 13 birds had returned within 16 km of their natal colonies. Breeding colonies, however, often exhibit site fidelity and the same areas may be used year after year if they continue to provide essential resources, including adequate nesting sites, water, and suitable foraging habitats. Of the 72 total colonies located in 1991 through 1994, Hamilton et al. (1995) found 19 active in the same locations each year. An additional 11 colonies (15 % of the total) located in 1994 were active at the same locations in either 1992 or 1993, but not in both years.

Approximately 25 of the 75 total colonies that were active on April 26, 1997, were within 0.5 km of sites that were also used in 1994. This suggests that tricolors will continue to use the same nesting areas in subsequent years if favorable breeding and foraging habitats persist in those locations.

Spring Movements from Wintering Area

In late March and early April, tricolors vacate wintering areas in the Sacramento-San Joaquin River Delta and along coastal central California and arrive at breeding locations in Sacramento County and throughout the San Joaquin Valley (DeHaven et al. 1975b). A substantial, but as yet unmeasured, number of tricolors also winter in the northern San Joaquin Valley (Hamilton pers. obs.). Smaller colonies at foothill locations and those in the San Joaquin Valley are typically settled by early April (Hamilton et al. 1995).

Breeding Season Movements

During the breeding season, tricolors appear to exhibit itinerant breeding, moving to new breeding locations following previous nesting attempts elsewhere Hamilton (in prep). Most tricolors probably move from the San Joaquin Valley and Sacramento County to Colusa and Glenn Counties and elsewhere in the Sacramento Valley. While this trend was noted in all 4 years of an intensive study, colonies may form at any time during the breeding season (April- July) throughout the known breeding distribution of this species (Hamilton et al. 1995).

Postbreeding Season Movements

Long-term banding studies by DeHaven et al. (1975b) demonstrated a major postbreeding season movement into the Sacramento Valley from other breeding locales. At the time of their study, a major tricolor roost existed at Colusa National Wildlife Refuge (NWR). Large postbreeding roosts continue to develop in the Sacramento Valley from late summer (August) into fall (Hamilton pers. obs.).

Movements to Wintering Areas

The timing of major movements to wintering areas is unknown. Large foraging flocks can be seen in pastureland north of Rio Vista, Solano County, by late October (Beedy pers. obs.), and Hamilton (pers. obs.) has seen large flocks in the Sacramento and San Joaquin River Delta by late November. Wintering flocks numbering 12,000-14,000 assemble near dairies on the Point Reyes peninsula, Marin County, by mid-October (Stallcup pers. comm.).

Adult, Juvenile, and Nestling Mortality Factors

Direct Mortality

Until the 1930s market hunting was a major mortality factor when more than 300,000 tricolors and redwings were marketed {killed and sold} in the Sacramento Valley during a 5-year period (Neff 1937).

Starvation and Nestling Loss

At almost all sites in all years of a 3-year study, Hamilton et al. (1995) found that most broods were reduced by parents. Most eggs (three or four, sometimes five) hatch, but it is uncommon to find more than two or three nestlings in nests at fledging. This is because when food supplies are short parents choose not to feed all of their nestlings, thereby reducing the number of nestlings that survive to fledging. However, if abundant food is available, tricolors may raise as many as four young (Hamilton et al. 1995).

Predation

At present (i.e., 1985-1995), predation is a major cause of complete nesting failure at some colonies, especially in permanent Central Valley marshes (Beedy and Hayworth 1992, Hamilton et al. 1995). This factor is discussed in more detail under Section 4, "Population Threats and Impacts".

Weather Conditions

Severe or prolonged storms can cause high mortality among tricolor nestlings (Engler 1994, Hamilton et al. 1995, Cook 1996). Chilling of adult and nestling tricolors may account for some observations of reproductive failure (Hamilton et al. 1995), and adult females occasionally found dead on nests may be victims of hypothermia (Hamilton pers. obs.).

Brood Parasitism

Nestling mortality as a result of brown-headed cowbird *(Molothrus ater)* brood parasitism has not been reported. Most cowbird eggs laid in tricolor nests (N = 23 of 23) do not hatch (Hamilton et al. 1995).

3. Population Status And Trends

Historical Surveys

Historically, river systems flowing into the Central Valley overflowed to create extensive marshes that provided abundant breeding habitat for tricolors and a myriad of water birds. Of more than 4 million acres of wetlands that existed in the Central Valley in the 1850s however, only about 560,500 (about 14%) remained in 1939. An estimated 480,000 acres of freshwater emergent marshes (about 85% of the total

freshwater wetlands in 1939) were reduced by nearly 50% to about 243,000 acres by the mid-1980s (Frayer et al. 1989). Similarly, native perennial grasslands, prime tricolor foraging habitat, have been reduced by more than 99% in the Central Valley and surrounding foothills (Kreissman 1991).

There are few 19th-century accounts of tricolors and their extensive marshland and grassland habitats; therefore, their historical numbers and distribution are unknown. Heermann (1853) described fall flocks of thousands of tricolors in the Shasta region and saw a wintering flock in the Suisun Valley, Solano County, " . . . numbering so many thousands as to darken the sky for some distance by their masses". Belding (1890) observed an "immense" colony near Stockton, San Joaquin County. According to the notes of J. G. Cooper, the tricolor was "the most abundant species near San Diego and Los Angeles, and not rare at Santa Barbara" (Baird 1870). Unfortunately, only a few additional accounts of tricolors were published before 1900, and most of those provided brief descriptions of single colonies or the results of egg-collecting exlpeditions (e.g., Skirm 1884, Bendire 1885, Barlow 1900).

Published and unpublished accounts of historical tricolor breeding observations were summarized by Dawson (1923), Neff (1937), Grinnell and Miller (1944), and Beedy et al. (1991). Hamilton et al. (1995) also provided an update of historical tricolor observations. The first systematic, rangewide surveys of the tricolor's population status and distribution were conducted by Neff (1937, 1942). He observed as many as 736,500 adults per year (1934) in just eight counties. During a 5-year interval, he observed tricolors in 26 California counties. Historical breeding colonies also were described in Jackson and Klamath Counties, Oregon (Neff 1933, Richardson 1961). Egg sets collected in 1928 near Minden (Western Foundation of Vertebrate Zoology, Sumida pers. comm.) document the historical nesting of this species in western Nevada. Bryant (1889) described tricolors as common in the marshes of northwestern Baja California.

Neff (1937) summarized his observations of 252 California colonies. These surveys were conducted after most Central Valley wetlands were lost (Frayer et al. 1989, Wilen and Frayer 1990). Neff (1937) found many large colonies, including one in Glenn County, which contained more than 200,000 nests (about 300,000 adults) and covered more than 24 ha, and several others in Sacramento and Butte Counties that contained more than 100,000 nests (about 150,000 adults). Most large tricolor colonies observed by Neff (1937) were associated with freshwater emergent wetlands in rice-growing areas of California.

Orians (1961b) and Payne (1969) made detailed accounts of the ecology and breeding biology of tricolors. They observed colonies of up to 100,000 nests in Colusa, Yolo, and Yuba Counties, but did not attempt to survey the entire range of the species. For example, their surveys did not include major parts of the San Joaquin Valley or southern California, and they did not attempt to estimate the tricolor's overall population size.

DeHaven et al. (1975a) conducted population surveys and banding studies of tricolors in the Central Valley from 1969 through 1972. They concluded that the tricolor's geographic range and major breeding areas were unchanged in the 35 years since Neff's (1937) study. They observed an average of about 133,000 individuals per year, and estimated that the overall population size had declined by more than 50% since the 1930s. It is possible, however, that DeHaven et al. (1975a) underestimated the tricolor's total population size because they did not survey large portions of the southern San Joaquin Valley.

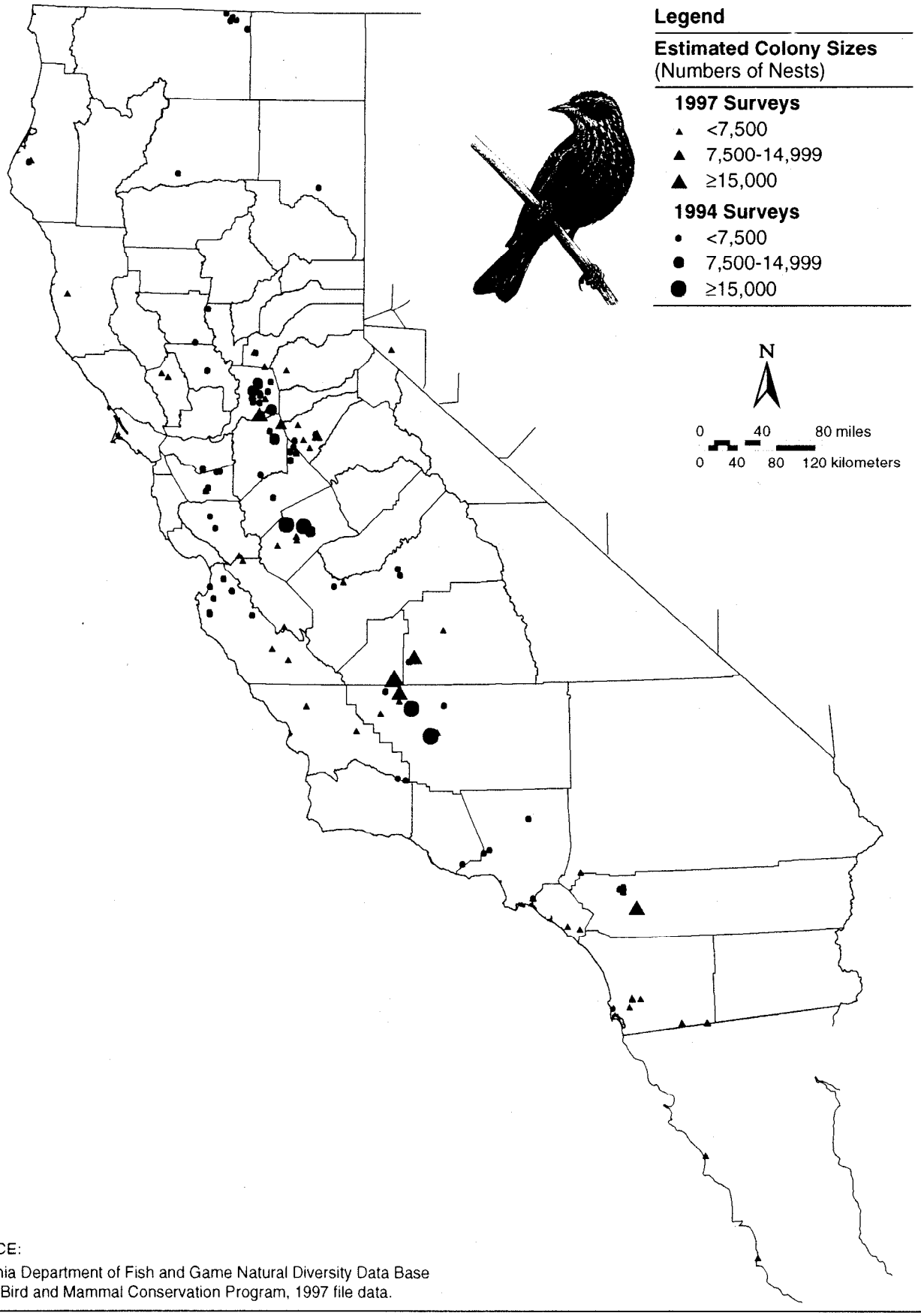
Recent Surveys

In a survey of tricolor distribution and abundance, Beedy et al. (1991) summarized all historical and recent breeding records, including unpublished reports and inventories. Based upon this information, and field surveys in the Sacramento Valley and portions of the San Joaquin Valley, they concluded that tricolor populations had declined further from those reported by DeHaven et al. (1975a), and that this decline was coincident with continuing losses of wetland habitats in the Central Valley. They reported a range of about 35,000-l 10,000 breeding adults per year in the 1980s with an approximate average of 52,000 breeding adults reported per year in that decade.

Population estimates by Beedy et al. (1991) were incomplete because they included only sporadic surveys in the southern San Joaquin Valley (i.e., south of Merced County), where several previously undescribed and very large (i.e., more than 30,000 nests) tricolor colonies were found in agricultural fields by Hamilton et al. (1995). Beedy et al. (1991) and Beedy and Hayworth (1992) made intensive surveys for tricolor colonies in Merced, Sacramento, San Joaquin, Yolo, Colusa, Yuba, Butte, and Glenn Counties but were unable to relocate many of the colonies reported there by Orians (1961b), Payne (1969), and DeHaven et al. (1975a). Perhaps the prolonged drought that prevailed in California during the mid- and late 1980s influenced the timing and occurrence of tricolors in the Sacramento Valley and the population estimates made there by Beedy et al. (1991).

From 1991 through 1994, USFWS and DFG cosponsored a multiyear survey and basic ecological investigations that included studying colony location and size, colony habitat characteristics, pre- and postsettlement behavior, and land ownership patterns; monitoring reproductive success and associations with habitat types; and development of a best estimate of the total population size and distribution. The survey area included the Sacramento Valley, San Joaquin Valley, and southern California. The most intensive effort was made in 1994 ,when Hamilton et al. (1995), documented 74 colonies in 32 California counties (Figure 1).

In an effort to continue monitoring the annual distribution and abundance of the tricolor population, a yearly, one-day, rangewide, volunteer survey (Volunteer Survey) was initiated in 1994. This survey is coordinated by the National Audubon Society Western Regional Office, DFG, and USFWS. Based on colony locations and the breeding



SOURCE:
California Department of Fish and Game Natural Diversity Data Base and Bird and Mammal Conservation Program, 1997 file data.

Jones & Stokes Associates, Inc.

Figure 1
Approximate Locations of Late April 1994 and 1997 Tricolored Blackbird Colonies Observed in California, Nevada, and Baja California

distribution summarized by Beedy et al. (1991) and Hamilton et al. (1995), experienced local volunteers are asked to visit all historical and recent tricolor breeding sites to describe the colonies' current status and numbers. Observers are also requested to drive all accessible roads in suitable tricolor habitats in their respective counties to attempt to locate previously undocumented colonies. Federal and state biologists continue to provide survey data for publicly owned lands and adjacent areas.

The 1994 Volunteer Survey was conducted during the week of April 23, 1994. Tricolors were observed in 32 California counties, and breeding colonies were found in 26 counties (Table 1). Ten historically occupied counties were not surveyed during this census, and six occupied (i.e., foraging flocks observed) counties apparently did not host breeding colonies at the time of the census. The largest colony was at San Luis NWR, Merced County, and contained approximately 70,000 nests; other large colonies were observed in Colusa and Tulare Counties (Table 2). All large (> 10,000) and many smaller colonies identified in the 1994 Volunteer Survey, and by federal and state biologists, were revisited by Hamilton et al. (1995) and were incorporated into the 1994 tricolor population estimate of approximately 369,400 (+/-15 %) total adults (Table 1).

The effectiveness of the 1994 Volunteer Survey was enhanced by the rangewide observations of Hamilton et al. (1995) in the 1992, 1993, and 1994 breeding seasons. In contrast, the 1995 and 1996 Volunteer Surveys did not include rangewide follow up surveys and large breeding colonies may have been overlooked. Surveys conducted during the week of April 22, 1995, located about 208,000 breeding tricolors in 20 counties. The two largest colonies, including about 25,300 nests in Tulare County and 18,000 nests in Merced County, were later destroyed during routine crop harvesting and land preparation activities (Hamilton pers. obs.). Another Volunteer Survey, conducted on May 22, 1995, located about 180,500 adult tricolors in only 17 counties; this census was less complete than the first two (Comrack pers. comm.).

A Volunteer Survey conducted on April 27, 1996 was even less complete than the 1995 surveys and detected only 56,890 tricolors in 21 counties. Volunteer Surveys were conducted on a single day, and some counties (e.g., Colusa, Kern and Kings) were surveyed incompletely, or not at all, in 1995 and 1996. Therefore, the relative survey effort and coverage of individual counties should be considered when interpreting the overall census results for any county or year (Comrack and Hunting pers. comms.). Years when intensive, follow-up surveys throughout the breeding season were not conducted should not be considered total population estimates for this species.

In 1997, DFG coordinated an intensive survey effort throughout California using the same coverage, methods and personnel as in 1994, when the last reliable population estimate was made. Participation in the April 26, 1997 Volunteer Survey was increased from previous years and most historically occupied counties received at least some coverage. Professional surveyors (Hamilton and Bowen) made repeated observational and nest-count surveys at most large colony sites that were observed in 1997.

The April 26, 1997 Volunteer and follow-up surveys documented approximately 232,960 (+/- 15 %) breeding and nonbreeding tricolors in 32 California counties; this total includes about 50 nonbreeding adults in Klamath County, Oregon, and 950 breeding adults in northwestern Baja California that were observed within one week of the survey (Table 1). This population estimate represents an overall decline of approximately 37% since 1994.

Population declines were most apparent in historical strongholds of the species' range in the Central Valley including Sacramento, Fresno, Kern, and Merced Counties.

During the entire 1997 breeding season, the two largest observed colonies were in Colusa and Tulare Counties (Table 2). The Colusa County colony was initiated in May, after the 1997 Volunteer Survey, and birds that probably nested elsewhere earlier in the season congregated at the Capitol Outing Club to form the largest colony reported in the 1997 breeding season. Birds continued to join the Tulare County colony after the 1997 Volunteer Survey. Other large colonies (i.e., more than 20,000 nests) were located in Kings and Riverside Counties during the 1997 breeding season. One striking exception to the trend of lower numbers in 1997 was a colony of about 23,300 nests at a recently created wetland (1994) near Hemet in Riverside County, which represented a dramatic increase in the Southern California total compared to the 1994 census.

Recent Population and Distribution Trends

Tricolors were characterized as " . . . sheerly and illogically erratic in (their) seasonal movements and activities" (Neff 1937). Fluctuations in the local abundance of tricolors have been interpreted as responses to local differences in insect abundance (Payne 1969, DeHaven et al. 1975a).

Despite their notably erratic behavior, recent intensive statewide surveys have identified several important distribution and population trends for tricolors.

- Statewide and local distribution varies from year to year, but annual trends in total population size are unknown (Neff 1937, DeHaven et al. 1975a, Hamilton et al. 1995).

- Reported tricolor colony size estimates in 1994 compared to the total count in 1997 (the only two years when survey efforts were sufficient to detect virtually all large colonies) indicated that the total tricolor population declined by about 37%, and the greatest declines occurred in Sacramento, Fresno, Kern, and Merced Counties, which hosted about 72% of the total adults observed in April 1994.

- In some portions of their range, tricolors have definitely declined or been eliminated, including local extirpation in portions of the Central Valley where

Table 1. Summary Comparison of Tricolored Blackbird Surveys
Conducted in Late April 1994 and 1997

Region and County	1994			1997		
	Breeding	Nonbreeding	Total	Breeding	Nonbreeding	Total
Sacramento Valley						
Colusa	25	2	27	100	4,075	4,175
El Dorado	0	0	0	200	0	200
Glenn	2,000	0	2,000	0	0	0
Placer	1,000	0	1,000	430	228	658
Sacramento	93,225	803	94,028	25,730	5,608	31,338
Sutter	35	200	235	0	0	0
Tehama	0	0	0	35	0	35
Yolo	400	75	475	200	0	200
Yuba	0	597	597	0	950	950
Subtotal	96,685	1,677	98,362	26,695	10,861	37,556
San Joaquin Valley						
Calaveras	0	0	0	8,253	60	8,313
Fresno	21,150	0	21,150	2,500	50	2,550
Kern	70,600	1,655	72,255	16,950	50	17,000
Kings	0	10,000	10,000	33,300	0	33,300
Merced	60,100	19,000	79,100	12,500	500	13,000
San Joaquin	13,750	2,228	15,978	11,750	107	11,857
Stanislaus	2,500	1,428	3,928	150	0	150
Tulare	50,000	0	50,000	53,500	2,000	55,500
Subtotal	218,100	34,311	252,411	138,903	2,767	141,670
San Francisco Bay and Delta						
Alameda	20	4	24	1,200	0	1,200
Contra Costa	400	0	400	0	0	0
Marin	0	400	400	0	0	0
Napa	11	0	11	350	50	400
Santa Clara	3,350	150	3,500	550	0	550
Solano	0	5	5	37	38	75
Subtotal	3,781	559	4,340	2,137	88	2,225
North Coast						
Humboldt	100	0	100	32	0	32
Lake	0	0	0	0	60	60
Mendocino	0	0	0	12	0	12
Sonoma	0	30	30	0	0	0
Subtotal	100	30	130	44	60	104

Table 1. Continued

Region and County	1994			1997		
	Breeding	Nonbreeding	Total	Breeding	Nonbreeding	Total
Central Coast						
Monterey	2,200	20	2,220	5,500	400	5,900
San Luis Obispo	0	0	0	660	0	660
Santa Barbara	2,000	0	2,000	0	0	0
San Benito	0	0	0	460	318	778
Subtotal	4,200	20	4,220	6,620	718	7,338
Southern California						
Los Angeles	755	60	815	430	0	430
Orange	1,000	34	1,034	231	0	231
Riverside	2,100	75	2,175	37,950	406	38,356
San Bernardino	0	0	0	300	0	300
San Diego	2,000	0	2,000	3,178	58	3,236
Ventura	90	0	90	0	0	0
Subtotal	5,945	169	6,114	42,089	464	42,553
Northeast Interior						
Lassen	0	0	0	0	6	6
Modoc	0	250	250	0	250	250
Shasta	2,500	85	2,585	0	0	0
Siskiyou	400	547	947	250	0	250
Subtotal	2,900	882	3,782	250	256	506
Oregon						
Klamath	0	0	0	0	50	50
Nevada						
Douglas	0	0	0	8	0	8
Mexico						
Baja California	0	0	0	950	0	950
Total	331,711	37,648	369,359	217,696	15,264	232,960

Note: California counties where found: 32 31

Percent change from 1994 to 1997: 36.9%

Table 2. The 10 Largest Tricolored Blackbird Colonies Documented in the Breeding Seasons of 1992, 1993 1994, and 1997

Site	County	Number of Nests
1992		
Lettuce I-5	Kings	43,333
Lurline CL-COC	Colusa	40,000
Lurline Ck-Harbison	Colusa	20,000
Rancho Seco	Sacramento	13,333
Bozick Ranch	Sacramento	13,333
Lost Hills	Kern	12,000
Kern NWR	Kern	10,000
Dairy	Tulare	8,000
San Luis NWR	Merced	6,667
Quarry	Glenn	4,000
1993		
Dairy	Tulare	32,000
Lettuce I-5	Kings	13,000
Cherokee	Butte	10,000
San Luis NWR	Merced	6,500
East Park	Colusa	6,000
Delevan NWR	Colusa	6,000
Botta	Sacramento	5,000
O'Neill Forebay	Merced	5,000
Moore	Sacramento	5,000
Campbell	Sacramento	4,667
1994		
San Luis NWR	Merced	70,000
Lurline CL-CCC	Colusa	33,333
Tulare	Tulare	33,333
Thunder Hill	Glenn	21,333
Mid-Am	Glenn	18,667
Wildwood	Kern	18,667
Bakersfield	Kern	16,666
Ranch Seco	Sacramento	13,333
Knox Road	Sacramento	10,000
Yuba	Yuba	9.000
1997		
Capitol Outing Club	Colusa	53,333
Toledo pit	Tulare	46,666
Tulare Lake	Kings	30,000
Road 120	Tulare	26,667
Hemet	Riverside	23,333
Kern NWR	Kern	10,000
Cherokee	Sacramento	10,000
Delevan NWR	Colusa	8,333
Highway 12	San Joaquin	6,667
East Hacienda	Kings	6,667

they were once abundant (e.g., Yolo County and large portions of southern Sacramento County), and many historical sites in coastal southern California counties (i.e., Santa Barbara, Ventura, Los Angeles, Orange, and San Diego Counties) (Beedy et al. 1991).

- Once abundant in coastal southern California (Baird 1870), tricolor populations there were reported to be less than 20,000 breeding adults in 1994 (Hamilton et al. 1995). In 1997, however,, an estimated 35,000 breeding adults were observed at a colony in Riverside County.

- In 1994, 71.5% of all tricolors observed throughout the breeding range nested in colonies of 10,000 or more birds, and at least 60% of all tricolors located in all years were found in the 10 largest colonies (Hamilton et al. 1995).

- In 1997, 75% of all adult tricolors counted in late April were in the largest 10 colonies.

- Rangewide surveys of both public and private properties found that 70% of all tricolored blackbird nests and. 86% of all foraging by nesting birds occurred on private agricultural land in 1994 (Hamilton et al. 1995).

The largest numbers of breeding tricolors have always been in the Central Valley, and in 1994 and 1997, more than 75 % of all observed breeding adults were found there (Table 1). Smaller colonies also occur in foothills throughout cismontane California (Hamilton et al. 1995), and locally in Oregon (i.e., Multnomah, Umatilla, Wheeler, Jackson [Beedy et al. 1991], and Klamath Counties [Follansbee and Mauser 1994]), and near Minden, Douglas County, Nevada in 1996 and 1997 (Chisholm pers. comm.). A few recent breeding colonies have ‘been observed at marshes near Rosario, northwestern Baja California (Anderson pers. comm., Hamilton pers. obs.).

In recent years and possibly also in the past, more than half of all observed nesting efforts by tricolors occurred in a few,, large colonies (Table 2). Concentrations of such a high proportion of the known population in a few breeding colonies increases the risk of continued population declines if major reproductive failures occur. Colonies situated in active agricultural fields are especially vulnerable to destruction when crops are harvested.

Recent Habitat Trends

In the absence of the vast marshlands and perennial grasslands that once characterized the Central Valley and foothills, most tricolors now breed and forage in a diversity of upland and agricultural habitats (DeHaven et al. 1975, Beedy et al. 1991). Today, the largest tricolor colonies (i.e., more than 30,000 nests) are often at dairy farms or associated with irrigated pastures, alfalfa, and silage fields on private lands in the San

Joaquin Valley and at rice ranches in the Sacramento Valley (DeHaven et al. 1975a, Hamilton et al. 1995).

Dairies and feedlots are a feature of many tricolor habitats in the San Joaquin Valley and in Sacramento County (Hamilton et al. 1995). This relationship was not mentioned in earlier accounts of the species (e.g., Neff 1937, Orians 1961a, 1961b; Payne 1969; DeHaven et al. 1975a, 1975b). The current dependence of tricolors upon dairies is of particular importance because, in 1994, 54.5 % of all observed tricolor nesting efforts were associated with dairies and their crops. In some places, the nesting substrate, water source, and foraging habitat are all contained on a single, large dairy operation (Hamilton pers. obs.).

In the 1930s Neff (1937) reported few tricolors nesting in Himalaya berry patches or other upland habitats. By 1994, however, 36% of all observed colonies and 23% of all individual tricolors nested in this plant (Hamilton et al. 1995). In the early 1990s 64% of all observed tricolor nesting was in exotic plants, including the most successful efforts (Hamilton et al. 1995, Cook 1996).

Himalaya berry patches associated with irrigated pastures, vernal pools, and grassland habitats in southern Sacramento County were an important stronghold of the tricolor's breeding population (Hamilton et al. 1.995). During the 1990s, vast areas of grassland and irrigated pastures in southern Sacramento County were converted to vineyards, an unsuitable tricolor foraging habitat. Land use changes from range lands to cotton, orchards, and vineyards continue to occur at a rapid pace throughout the Central Valley and elsewhere in California (Kreissman 1991). Widespread losses of historical tricolor breeding and foraging habitats may be responsible for the species' overall population decline since 1994.

4. Threats to Populations

Natural Factors

Predation

Predation is at present (i.e., 1985-1997) a major cause of complete nesting failure at some tricolor colonies (Hamilton et al. 1995, Beedy and Hayworth 1992). Historical accounts document the destruction of nesting colonies by a diversity of predators, including wolves *(Canis lupus)* and gray foxes *(Urocyon cinereoargenteus)* (Heermann 1853), skunks *(Mephitis sp.)* and possibly opossums *(Didelphis virginiana)* (Evermann 1919), Swainson's hawks *(Buteo swainsoni)*, black-crowned night-herons *(Nycticorax nycticorax)* (Mailliard 1900), Cooper's hawks *(Accipiter cooperii)*, burrowing owls

(Athene cunicularia), American crows *(Corvus brachyrhynchos),* raccoons *(Procyon lotor),* and mink *(Mustela vison)* (Nefff 1937).

More recently, Payne (1969) reported predation of tricolor nests by feral cats *(Felis catus),* northern harriers *(Circus cyaneus),* barn owls *(Tyto alba),* short-eared owls *(Asio flammeus),* and yellow-billed magpies *(Pica nuttallii).* Merlins *(Falco columbarius)* may associate with flocks of wintering tricolors and have been observed preying on adults (Manolis and Winter pers. comms.).

At some recent colonies, especially those in permanent freshwater marshes, black-crowned night-herons devastate nesting efforts and eliminate all or most nests (Hamilton et al. 1995, Mauser pers. comm.). At foothill locations and in the southern San Joaquin Valley, ravens *(Corvus corax)* may assemble and destroy all or almost all nests within colonies. In the Central Valley, coyotes *(Canis latrans)* are a major predator on tricolor colonies in terrestrial settings, especially in silage field colonies, but also in cattail colonies when water is withdrawn (Hamilton pers. obs.).

Responses of tricolors to predators differ strikingly from those of redwings nesting at the same locations. Redwings fly up to attack predators, especially crows, ravens and harriers, while tricolors usually do not. It is, thus, a common sight to see a raven pair pass high over a tricolor colony being actively pursued by a few redwings, while several thousand nesting tricolors at the same location ignore them (Hamilton pers. obs.).

Weather Conditions

Weather conditions were discussed under "Adult, Juvenile, and Nestling Mortality Factors".

Anthropogenic Factors

Habitat Loss and Alteration

Virtually all alluvial soils in the Central Valley once supported riparian woodlands, marshlands, or perennial grasslands, but they have now been converted by agriculture and urbanization (Frayer et al. 1989, Wilen and Frayer 1990). Many former agricultural areas within the historical. range of the tricolor are now being urbanized. Many tricolors in Sacramento County forage in the extensive, ungrazed annual grasslands associated with rural subdivisions (Cook pers. comm.). This transitional land use currently provides suitable habitat for tricolors that will be largely eliminated as current land conversion patterns continue.

In some places, most historical tricolor breeding and foraging habitats have been eliminated and there is currently little or no breeding effort where there once were

large colonies (Orians 1961b, Beedy et al. 1991). Elsewhere, tricolors have shifted from cattails as a primary nesting substrate (Neff 1937) to Himalaya berries (DeHaven 1975a) and more recently to cereal crops and barley silage (Hamilton et al. 1995). Nests and nest contents in cereal crops and silage are often destroyed by agricultural operations (Hamilton et al. 1995). Harvesting of silage and plowing of weedy fields are: currently the most common reasons tricolor nesting colonies are destroyed on agricultural lands.

Some habitats are sources (Pulliam 1988)(e.g., Himalaya berries) of successful tricolor fledging while others are often sinks (e.g., many permanent marshes and most silage fields near dairies), consuming reproductive effort without producing enough fledglings to compensate for losses from predation and crop harvesting (Hamilton et al. 1995).

Prospects for successful tricolor nesting in dairy settings without active management are low, but could be enhanced by communication and negotiation with sympathetic landowners. Long-term maintenance of tricolor populations in agricultural areas, such as dairies and rice fields could be enhanced by establishment of small cattail ponds to provide more secure nesting habitats in areas where large colonies are often destroyed during routine harvesting operations. The costs and benefits to private landowners and state and federal agencies should be evaluated so that viable alternate nesting habitats can be restored and large-scale nesting failures can be reduced.

Poisoning

McCabe (1932) described the strychnine poisoning of 30,000 breeding tricolors as part of an agricultural experiment, Poisoning to regulate numbers of blackbirds preying upon crops in California, especially rice, was considered a major source of adult mortality by Neff (1942). This practice continued until the 1960s and thousands of tricolors and other blackbirds were exterminated to control damage to rice crops in the Central Valley. However, improved harvesting methods, earlier ripening rice varieties, and fewer blackbirds have resulted in few recent reports of blackbird crop depredation, and no control programs are currently operating (Clark pers. comm.).

Contaminants and Pollution

During 1986, Beedy and Hayworth (1992) observed a complete nesting failure of a large (about 47,000 breeding adults) tricolor colony at Kesterson Reservoir, Merced County. External examinations of dead nestlings collected from roads surrounding the reservoir revealed that two of the 10 specimens had club feet (Grau pers. comm.); similar deformities were found for shorebirds and other water birds that were also collected at Kesterson Reservoir (Ohlendorf et al. 1986). Pathological examinations of the tricolor nestlings revealed some evidence of heart muscle degeneration, and selenium toxicosis was suspected as the cause of death (Stroud pers. comm.).

Lalboratory results from composite liver samples from dead tricolor nestlings from Kesterson Reservoir revealed that they had significantly higher concentrations of selenium than livers collected from redwing nestlings collected in an uncontaminated

area at Merced NWR (Paveglio pers. comm.). Laboratory feeding trials of two tricolor nestlings revealed that they did not live beyond 4 days on a diet containing 100 parts per million selenium (dry weight), but a selenium dose-response relationship has not been developed for tricolors or other passerine birds (Grau et al. 1987).

Hamilton (pers. obs.) observed a colony sprayed by mosquito abatement operators in Kern County, and all sprayed eggs failed to hatch. Hosea (1986) attributed the loss of at least two tricolor colonies to aerial herbicide applications. The relationship of pesticides to tricolor reproduction is poorly known. An improved understanding of the potential for chemically induced mortality of this species could be gained through laboratory testing of dead adults, nestlings, and failed eggs. Nevertheless, at the present time (1997) chemical threats to tricolors are a far less serious problem than are habitat losses.

Human Disturbance

Tricolors are sensitive to human disturbance of active nesting colonies and casual entry into colonies should be avoided. Effective management and scientific studies, however, demand careful entry into active colonies to make accurate assessments of nesting chronology and reproductive success. To avoid unnecessary disturbance of the nesting birds, however, human observers should not remain in active colonies for extended periods (i.e., several hours), and they should avoid creating numerous trails or disturbing the vegetation near dense nesting clusters. Hosea (pers. comm.) reported that conducting daylong nest censuses caused abandonment of an entire colony within 2 days. Similarly, Beedy and Haywortlh (1992) observed that they caused localized abandonment of active nests in Himalaya berries and cattails by entering colonies for several hours to collect eggs for contaminant analyses. They also observed that the trails they created through the cattails facilitated access to the colony by avian and mammalian predators, especially raccoons. Hamilton et al. (1995), however, did not observe any nest abandonment in a prickly lettuce colony after making repeated, short-term entries into active colonies, including weighing of all chicks in selected nests four times (N = 22 of 23 monitored nests were successful). In general, periodic, careful entry into colonies by experienced research personnel does not cause widespread nesting abandonment.

5. Summary of Current Conservaltion Actions

Recent Management Actions

In 1991, the Yolo Audubon Society submitted a petition to the California Fish and Game Commission to list this species as endangered under the state Endangered Species Act. This petition was based on the findings of Beedy et al. (1991). The petition was

withdrawn in 1992 following two breeding seasons of intensive fieldwork by Hamilton et al. (1995) and their estimates of the size of the total tricolor breeding population.

After the petition was withdrawn, DFG and USFWS continued monitoring tricolor populations. Monitoring activities included partial DFG and USFWS funding of surveys and ecological investigations conducted by Hamilton et al. (1995) and organizing the statewide Volunteer Survey (1994-1996).

Management on Public Lands

Management actions on public lands have focused primarily on basic protection, reduction of disturbance, and water management. NWR staff routinely monitor tricolor breeding colonies and provide protection for these sites from disturbance or habitat loss. Active management of water levels to maintain stable conditions for breeding colonies during the breeding season has been implemented on Kern NWR, San Luis NWR Complex, and Sacramento NWR Complex.

In 1994, a large nesting colony (about 100,000 adults) was established in a silage field on newly acquired lands on San Luis NWR. The former land owner retained temporary grazing/farming rights and cooperated with refuge staff to delay silage harvest until after the colony had fledged. An estimated 47,000 young successfully fledged from this colony (Hamilton et al. 1995). Historically, active management on public lands has also included the hazing of colonies during initial settlement stages to decrease the chances of colony establishment on contaminated lands at Kesterson Reservoir (Zahm pers. comm.).

Management on Private Lands

During 1993 and 1994, several large tricolor colonies were found in silage fields associated with dairies in Kings, Fresno, and Tulare Counties (Hamilton et al. 1995). As a result of the efforts of DFG and USFWS, portions of these crops were purchased to preserve the largest colonies in 1993 and 1994. Hamilton et al. (1995) estimated that direct intervention and voluntary participation by land owners (e.g., delaying harvest to protect active nesting colonies) resulted in the addition of an estimated 37,000 and 44,000 adult tricolors to the 1994 and 1995 breeding season populations, respectively. USFWS and DFG, however, do not consider crop purchases or reimbursements for delayed harvest to be a feasible long-term solution for tricolor habitat management on private agricultural lands (Zimmerman and Hunting pers. comms).

Two large silage field colonies (27,000 and 38,000 adults) were destroyed during harvesting in 1995 and another colony of about 40,000 adults was destroyed in 1997. Insufficient funds exist at either the state or federal levels, however, to make crop

purchases an effective long-term strategy for preserving tricolor colonies in agricultural settings. In the absence of such management efforts, large colonies in active agricultural fields may result in lost tricolor reproductive effort.

Some private landowners are taking advantage of opportunities to create tricolor habitats on private agricultural lands. For example, in 1995, Westlake Farms (Kings County) attracted about 7,000 adult tricolors to a restored marsh where they nested successfully (Shelton pers. comm.). 'The owner and his agent agreed to continue management for tricolors in spite of substantial losses of nearby barley crops to pre- and postbreeding adults. Management actions included predator control (coyotes and skunks) and creation of deep water canals to reduce the impact of mammalian predators.

6. Conservation and Management Recommendations

Conservation Goals and Objectives

The overall goal for the conservation of the tricolored blackbird is to maintain viable, self-sustaining populations distributed throughout the current range of the species. This will require a coordinated mix of management, monitoring, and research activities implemented on both public and private lands. The conservation objectives presented below highlight needs and opportunities on both public and private lands and emphasize a coordinated approach to management of tricolors and their habitats. The primary conservation objectives for tricolored blackbirds are to:

- avoid losses of tricolor colonies and their reproductive effort throughout their range,
- increase the breeding opportunities on suitable public lands and on private lands managed for this species,
- enhance public awareness and support for protection of this unique species, and
- minimize losses of important foraging habitat for both nesting and wintering populations.

In recognition of the differing roles and opportunities that public and private land bases may serve in tricolor conservation, management recommendations have been developed for both public and private lands as a comprehensive strategy to meet the overall goals and objectives for tricolor conservation.

Management Recommendations for Public Lands

Federal and State Wildlife Refuges and Other Public lands

Public land bases, particularly those lands specifically designated for wildlife resources as state or federal wildlife refuges, can serve a specific and unique role in the conservation and management of tricolors. The focus of tricolor management on public lands should be to:

- maintain and enhance existing habitat suitable for nesting and foraging tricolors,
- create additional habitat to support nesting and foraging tricolors to increase the potential carrying capacity of public lands for this species, and
- improve reproductive success of colonies located on public lands.

Habitat Protection and Maintenance

Protection and enhancement of tricolor colonies located on state or federal refuge lands is primarily focused on water management because most of these colonies are located in marshlands. Once a tricolor colony is detected, it should be fully protected from rising or fluctuating water levels to avoid flooding nests or providing easy access to mammalian predators, such as raccoons and coyotes. Colonies should be protected from human intrusion and disturbance; however, inspection of colonies can provide important information for water management. The methods described by Hamilton et al. (1995) for entering colonies and assessing reproductive stages and success are recommended when entry into active colonies is desirable for management purposes (Appendix A).

Carrying Capacity

Breeding tricolors need to be lured or deflected away from dairies and other active agricultural operations to protected habitats where they are more likely to succeed. Increasing the carrying capacity of public land bases for tricolors will require site specific assessments of current conditions and the identification of limiting factors. Potential tricolor habitat areas can be enhanced by providing missing elements in places where only parts of their habitat requirements are met. Of the three major tricolor breeding requirements (i.e., water, foraging habitat, and nesting substrate), nesting halbitat is the easiest to create. However, nesting habitat is useful only if a water source, such as a canal, wetland, river, or lake, is present within a few hundred meters and suitable foraging habitat is within about 5 km, and preferably closer. On some refuges, it may be desirable to promote the growth of nettles, California blackberries, and other naturally armored native plants to provide secure nesting sites for tricolors. Incorporating these plantings into ongoing riparian restoration projects is an effective strategy for increasing nesting habitat adjacent to suitable water sources. Thistles and

mustard on levees and elsewhere may also provide productive habitat for breeding colonies. If occupied by nesting tricolors, mowing or spraying of this vegetation on levees or other upland areas should be deferred until after the breeding season.

The management of foraging areas on private lands may require basic protection through the use of conservation, agricultural, or farming easements. Grazing, mowing, and other management practices influencing vegetation characteristics should incorporate tricolor needs.

Opportunities exist to create tricolor habitat on other public land bases, especially along California Department of Transportation (Caltrans) and Department of Water Resources rights-of-way. Possibilities for such development include establishment of cattail and blackberry copses on public properties near sources of water, such as irrigation ponds. Other possibilities for creating off-refuge colony sites on public lands include water agency corridors and reservoirs. These habitats may be especially promising because they often provide access to sources of open water. Irrigation canals are the water source for some of the largest tricolor colonies (Hamilton et al. 1995).

Reproductive Success

Recent monitoring efforts have documented poor reproductive success in the majority of colonies using large cattail marshes for nesting because of heavy losses to predators, especially black-crowned night-herons (Hamilton et al. 1995). However, tricolors may nest successfully in some small cattail marshes because these areas appear to support smaller populations of black-crowned night-herons and other predators. Intensive demographic monitoring and research are needed to determine if there are differences in reproductive success of cattail colonies based on wetland sizes and spatial relationships with other wetlands. Results of these investigations will yield information valuable to developing effective management strategies for increasing tricolor reproductive capabilities in cattail colonies.

Management Recommendation for Private Lands

The focus of tricolor management on private lands should be to:

- encourage private landowners to protect active tricolor breeding colonies;
- encourage consideration of tricolor nesting and foraging requirements in the creation of mitigation wetlands; and

- include tricolor population and habitat conservation actions in developing Habitat Conservation Plans (HCPs), other multispecies conservation plans, and ongoing private land habitat conservation programs within the range of this species.

Habitat Protection

State and federal refuge lands cannot accommodate the 1997 tricolor breeding population of about 230,000 adults. Protecting colony sites on private lands should be encouraged where possible because most of the landscape settled by tricolors is privately owned (Hamilton et al. 1995). Destruction of large colonies of this endemic species could lead to global population declines, especially if current source habitats are lost. Breeding colonies, whether on public or private land, are protected under the authorities of the Migratory Bird Treaty Act. Destruction of major colonies conflicts with overall DFG and USFWS obligations and policies to protect native birds and sends an undesirable message to the public about the value of nongame wildlife. Priority should be placed on identifying the largest colonies each year, and identifying mechanisms for protecting nesting and foraging habitats suitable for successful tricolor reproduction. Possible approaches for protecting active colonies threatened by crop harvesting on private lands include contacts with sympathetic landowners and conservation easements.

Habitat Conservation Planning Efforts

Federal multispecies HCPs and state Natural Community Conservation plans are under development throughout the core breeding distribution of tricolors in the Central Valley and southern California. The USFWS is also exploring possible "safe harbor" programs for species protection on private lands. These and similar programs that encourage, coordinate, and implement wildlife conservation on private land bases should include conservation measures for tricolors, especially in rapidly developing areas of the Central Valley and southern California. Possible tricolor conservation strategies include developing nesting areas, managing foraging areas to provide quality forage, and deferring harvest of grain crops harboring nesting colonies until after the breeding season. These programs offer promising cooperative opportunities to incorporate habitat conservation measures for tricolors on private lands throughout their core breeding range.

Public and private partnership programs for wetland habitat enhancement offer additional opportunities to actively manage for tricolor populations. Opportunities to restore marshlands on private lands in foothills surrounding the Central Valley and in southern California are of particular interest because these sites are often successful and may contribute significantly to the recruitment of young tricolors into the population (Hamilton et al. 1995).

7. Monitoring Recommendations

Effective monitoring programs are essential to conserving the global population of tricolors. Information resulting from monitoring programs can serve to identify and prioritize management and research needs and to meet agency mandates to track the status and trends of this unique species. The monitoring recommendations presented have been developed to meet the following goals:

- track the annual distribution and long-term population trends of the tricolor;
- monitor reproductive success to more effectively assess population viability and to determine habitat characteristics associated with nesting success;
- identify threats to the population;
- identify and prioritize management and research needs; and
- enhance public awareness, knowledge, and support for tricolor conservation.

Monitoring recommendations are presented in a hierarchical order beginning with Level 1 programs designed to maintain a baseline of information sufficient to track the general occurrence and distribution of tricolors on an annual basis. Level 2 monitoring builds upon this baseline to track long-term trends in abundance and reproductive success of selected colonies. Level 3 monitoring targets demographic parameters, such as reproductive success, which can provide information critical to developing and implementing effective management programs. Various aspects of this tiered monitoring approach can and should occur concurrently. Monitoring results may also compliment or directly support recommended research activities.

Because the tricolor population is distributed across the landscape in various habitats and land ownerships, public and private partnerships to fund and implement these activities will be crucial. The foundation for such partnerships has already been established with past monitoring programs and should be fostered to continue and strengthen ongoing cooperative efforts.

Level I Monitoring

The primary objectives of Level 1 baseline monitoring are to:

- document the presence, absence, and distribution of tricolor breeding colonies throughout their historic range;
- estimate the size (numbers of birds) of selected colonies; and

• heighten public awareness of this species, its status, and conservation issues.

Methods

The Volunteer Survey initiated in 1994 provides useful information on tricolor distribution and is the recommended survey method for Level 1 monitoring. Implemented on an annual basis, participants are requested to visit previously documented colony locations within their county and are encouraged to explore other potentially suitable habitat areas. Standard survey forms and instructions (Appendices B and C) are provided to document the exact colony location, acreage, vegetative substrate, breeding behavior (e.g., singing males, food carrying, and presence of fledglings), and total number of adults as estimated from a recommended distance of 25 meters from the nesting area. Repeat visits later in the breeding season are recommended to determine the fate of active colonies. Entry into active colonies is discouraged. Colonies located on National Wildlife Refuges and those monitored by experienced, skilled observers serve as a core subset of sites for more accurately estimating colony size (Level 2 and 3 monitoring).

The Volunteer Surveys will be especially valuable if they are conducted over a period of years, using consistent methods and an increasing core of experienced observers. New breeding localities and lost habitats will be documented and public awareness and skills in species and habitat identification will be enhanced over time.

Survey Area

The Central Valley represents the core survey area, but volunteers are also solicited to survey documented sites throughout the historic range of the species, including valley foothill areas, southern California, and portions of northern California.

Frequency and Timing

The surveys are conducted annually during the last weekend in April or the first weekend in May. Follow-up surveys throughout the breeding season are encouraged.

Coordination

Survey forms and general instructions are currently distributed by DFG and National Audubon Society. DFG has served as the recipient of survey results and compiles summaries of data, the extent of geographic coverage, and the survey effort compared to prior years. A designated coordinator to contact potential surveyors, send out mailings, and assign coverage greatly enhances the success of the Volunteer Surveys.

Training

A workshop for volunteers and other wildlife biologists interested in this species should be conducted in the breeding season to improve the overall quality of the data gathered

during the Volunteer Surveys. This workshop should include field sessions to improve skills in species identification, colony detection and status, estimating colony sizes, and the identification of creches.

Level II Monitoring

The Volunteer Survey (Level I Monitoring) provides useful information on tricolor distribution, but it does not produce reliable estimates of annual trends in global abundance. The objectives of Level II Monitoring are to:

- document the distribution and abundance trends of the tricolor breeding population over time, and
- monitor a subset of the population to assess reproductive success relative to habitat type.

Methods

The best way to monitor global tricolor population trends is to conduct intensive, Periodic Rangewide Surveys during the breeding season; these surveys were sponsored by USFWS and DFG in 1992, 1994, and 1997 and conducted in those years by Hamilton et al. (1995). A core crew of at least three experienced surveyors is trained to: 1) detect colonies, 2) accurately estimate colony size, 3) monitor colony attendance, 4) measure reproductive success within a selected subset of the population, and 5) estimate the size of the breeding population over the course of the survey period.

Calony locations, size, and persistence are documented throughout the breeding range using a series of repeated, visual estimates over the course of consecutive breeding seasons between the core dates of April 10 and June 15 (Hamilton 1995). Intensive data collection is implemented on selected colonies to more accurately estimate numbers and to monitor reproductive success. This subset typically includes the largest known colonies (Table 2).

Nest transects are conducted after the breeding season through these selected colonies to provide more precise estimates of colony size. The size of a colony can be determined after the breeding season by mapping the outline of the colony and establishing transects through the periphery and center. A 1.5 meter stick held horizontally while walking transects is a useful aid in counting nests, and a measuring wheel or tape run along the outside of the colony can be used to estimate the area of a colony, as described by Hamilton et al. (1995).

Reproductive success is measured by repeat visits to active nests during the nesting period to document egg laying, incubation, hatching, and fledging. Colonies selected for demographic monitoring may vary depending on where the largest colonies occur

and specific, additional objectives, such as correlating reproductive success to selected habitat types or specific geographic areas of interest within the range of the species. Following completion of the three-year Periodic Rangewide Survey, an annual estimate of the global population is calculated and an overall estimate of the population size, distribution, and status is determined.

Survey Area

The Periodic Rangewide Survey includes systematic, repeated coverage of all historically occupied counties in California (with emphasis on the Central Valley), Oregon, and Baja California. Historical nesting sites and areas of potential habitat are searched for breeding populations.

Frequency and Timing

Rangewide surveys should be conducted for at least three consecutive years so that variations in tricolor populations can be identified and to avoid misinterpretation of naturally occurring fluctuations in annual distribution and abundance. Such surveys should be conducted as frequently as possible and not less than once every 5 years. The survey period begins in April and continues until the culmination of the breeding season. The first Periodic Rangewide Survey was conducted from 1991-1994 by Hamilton et al. (1995) and a similar survey was done in 1997. It would be desirable to continue this survey for at least 2 more years to substantiate the population decline indicated since the 1994 survey. Thus, the next Periodic Rangewide Survey should be initiated no later than 2002.

Coordination

In 1991-1997, surveys were jointly sponsored by USFWS and DFG and surveys were implemented by a contract field crew, which included an experienced supervisor and two field biologists. Agency biologists and managers implemented portions of the monitoring on public lands. Public agency support and private partnerships are encouraged to meet the need for implementing future Periodic Rangewide Surveys.

Level III Monitoring

The objective of Level III monitoring is to collect demographic data to more effectively assess population viability and to examine reproductive success in relation to habitat associations and management practices. This information builds upon and further supplements the data accumulated with the annual Volunteer Survey and the Periodic Rangewide Survey. Demographic data will be used to identify population and habitat management needs vital to the conservation of the species.

Methods

At selected colonies, experienced observers examine the contents of a representative subsample of nests repeatedly during the season to monitor nesting success. Methods are described in Hamilton et al. (1995) and Follansbee et al (1994). Such entries should be made only by skilled, experienced observers and should be completed late in the nesting cycle (after egg laying) but before average hatchling age of 8 days to avoid inducing preflight nestlings from jumping from their nests. Premature departure from the nest may result in death from drowning, predation, or exposure. After breeding is colmpleted, nest count transects should be conducted through the entire colony to more accurately estimate colony size.

Survey Area

The largest, active colonies located on public lands are the priority for monitoring reproductive success on an annual basis. Because monitoring reproductive success requires access, repeated entries into breeding colonies, and strict adherence to protocols, colonies located on public lands are often the most suitable sites for monitoring reproductive success. However, these colonies may not reflect the full array of habitat types, size, or geographic distribution of active colonies during the breeding season. On private land bases, the largest colonies are the priority for monitoring reproductive success, but monitoring will depend on landowner permission to access these sites. Colony locations and sizes reported in the Volunteer Survey effort will help to identify the larger colonies.

Frequency and Timing

Demographic monitoring is both time consuming and expensive. Priorities regarding the location and frequency of this activity will need to be assessed annually. Findings of Level I and II monitoring efforts in previous years and site specific management needs are factors to consider when identifying and prioritizing demographic monitoring needs. When implemented, monitoring should be initiated at the onset of colony establishment and should continue until the colony disperses. Monitoring reproductive success typically requires a multiyear effort to ensure an adequate and representative sample to assist in interpreting the results in the context of changes in weather and other factors that vary annually.

Coordination

Results of the annual Level I Volunteer Survey summarized by DFG will guide the priorities for monitoring reproductive success. Communication among observers, public land managers, USFWS, and the DFG - Bird and Mammal Conservation Program during the breeding season is important to identify large colony sites early in the breeding season. Biologists and managers on public lands should maintain records of demographic monitoring and provide copies to DFG - Bird and Mammal

Conservation Program, Sacramento, California and USFWS Regional Nongame Bird Coordinator, Portland Oregon.

8. Research Recommendations

Much of the tricolor life history information necessary to effectively manage this species is either unknown or unreported (Hamilton et al. 1995). Key unreported information includes habitat selection mechanisms; the confirmation and role of itinerant breeding; predation response behaviors and relationships to predators; the relationship of wetland size, type and quality to reproductive success; analysis of brood reduction mechanisms; and the pattern of male participation in provisioning. An intensive study of the breeding biology at some locations, including the use of blinds, video cameras, and other monitoring equipment could greatly enhance our understanding of this species and could facilitate management decisions on public and private lands. In addition to intensive! life history studies, a number of specific research needs are presented below in priority order.

Investigate Land Uses Near Colonies

The nesting substrate required by nesting colonies has been well defined, and such substrates could relatively easily be established in many areas not currently used by tricolors. However, the necessary components of foraging habitat that nesting colonies rely upon are less well understood. The success of new habitat for breeding tricolors will depend on the availability of both the appropriate nesting and foraging habitats. In order to gain a better understanding of the habitat requirements of nesting tricolors, a study should be conducted that would measure the time and space use by tricolors of the various habitats surrounding existing successful nesting colonies. This study should also measure the reproductive success of the observed colonies. Such a study would require the evaluation of dozens of private and public properties where nesting colonies currently exist.

Evaluate Predator - Prey Relationships

The interactions between tricolors and other predators, such as coyotes, ravens, and black-crowned night-herons, require further study and evaluation. The goal is to identify management practices to minimize predation at breeding colonies. In particular, black-crowned night-herons are major predators upon tricolor colonies, especially in the large Central Valley cattail marshes. Such studies should include comparisons of predation and reproductive success of colonies located in large cattail wetland systems and those located in smaller, isolated wetlands.

Itinerant Breeding Investigations

The goal of these studies should be to confirm and further evaluate itinerant breeding and to more closely evaluate tricolor movements through the breeding season. Confirmation of itinerant breeding and the role of such a reproductive strategy is a key factor in evaluating the long-term viability of this population. This is particularly significant in consideration of the documented failures and losses of large nesting colonies each year early in the breeding season. The capability of these colonies to reestablish and successfully reproduce may significantly influence estimates of reproductive success and population viability.

Inventory and Analyze Peripheral Colonies

Many small colonies inhabit isolated sites along the coast and in the foothills on both sides of the Central Valley; similar colonies are also present in Oregon. Although the total number of individuals inhabiting these colonies is small, they are of great value for several reasons.

- These colonies reliably produce several thousand tricolors annually (e.g., colonies in southern Monterey County and New Cuyama, San Luis Obispo County). Some of these colonies are highly successful, presumably because the suitable nesting areas are small and densities per unit of foraging area are low.

- Some peripheral colonies are the only tricolors found in substantial geographic areas (e.g., Fortuna, Humboldt County and Fort Ross, Mendocino County).

- Knowledge of the existence of small colonies provides valuable educational opportunities and may enhance the support base for tricolor conservation. Some of these colonies are in spectacular settings and the behavior of these birds is of great interest to local residents. These sites include the late-season colony near Drake's Beach, Point Reyes National Seashore, Marin County; the Bitter Creek NWR colonies, Kern County; the Kern River headwaters colonies near Lake Isabella, Kern County; eastern Sacramento County colonies; Jacumba, San Diego County; the gateway to Laguna Seca, Monterey County; and several other sites.

These sites offer unique opportunities to study colony and foraging base habitat features associated with successful breeding colonies. Reproductive success and other aspects of breeding ecology and behavior could also be intensively investigated on these sites when access is given by landowners.

Demographic Monitoring

Tricolors are readily captured when traps are baited with decoy birds, such as blackbirds and starlings (DeHaven pers. comm.). A routine banding operation continued for several years could be used to establish the age structure and annual survivorship of the tricolor population. A demographic study also would enhance prospects for monitoring population changes and for identifying population regulation mechanisms. It is possible that experienced volunteers could be identified who would implement aspects of this project.

Determine the Taxonomic Status of Southern California Tricolor Populations

All returns of tricolors banded in southern California were recovered there (Neff 1942 [N = 3], DeHaven and Neff 1973 [N= l0]). None of the birds banded in the Central Valley, and eventually recovered, were found in southern California (0 of 136). Although these returns are represented by small sample sizes, they support the hypothesis that tricolors may consist of two separate and largely distinct metapopulations. Genetic analyses of the two metapopulations, possibly including DNA hybridization studies, should be undertaken. These results could contribute to the determination of the population status of tricolors in southern California. Even if such studies revealed no genetically distinct populations, however, the remaining tricolor breeding colonies in southern California should be preserved.

Literature Cited

Printed References

Baird, S. F. (ed.). 1870. Ornithology of California. Volume I: Land birds. From the manuscript and notes of J. G. Cooper. U.S. Geologic Survey of California. Welch Bigelow and Co. Cambridge, MA.

Barlow, C. 1900. Some additions to Van Denburgh's list of land birds of Santa Clara County, California. Condor 2: 131-133.

Beedy, E. C. 1989. Draft habitat suitability index model, tricolored blackbird *(Agelaius tricolor).* Prepared by Jones & Stokes Associates for U.S. Bureau of Reclamation, Sacramento, CA.

Beedy, E. C., S. D. Sanders, and D. Bloom. 1991. Breeding status, distribution, and habitat associations of the tricolored blackbird *(Agelaius tricolor)* 1850-1989. Prepared by Jones & Stokes Associates for U.S. Fish and Wildlife Service, Sacramento, CA.

Beedy, E. C. and A. Hayworth. 1992. Tricolored blackbird nesting failures in the Central Valley of California: general trends or isolated phenomena? Pages 33-46 in D. F. Williams, S. Byrne, and T. A. Rado (eds.), Endangered and sensitive species of the San Joaquin Valley, California. California Energy Commission. Sacramento, CA.

Bellding, L. 1890. Land birds of the Pacific district. Occasional paper. California Academy of Science II.

Bendire, C. E. 1885. Life histories of North American birds. United States Natural Museum Special Bulletin No. 3. Washington, DC.

Bent, A. C. 1958. Life histories of North American blackbirds, orioles, tanagers, and allies. Dover Publications, Inc. New York, NY.

Bryant, W .E. 1889. A catalogue of the birds of Lower California, Mexico. Proc. Cal. Acad. Sci., Series 2, 2, 237-320.

Collier, G. 1968. Annual cycle and behavioral relationships in the red-winged and tricolored blackbirds of southern California. Ph.D. dissertation. University of California, Los Angeles, CA.

Cook, L. 1996. Nesting adaptations of tricolored blackbirds *(Agelaius tricolor)* M.S. Thesis, University of California, Davis.

Crase, F. T., and R. W. DeHaven. 1977. Food of nestling tricolored blackbirds. Condor 79:265-269.

Crase, F. T., and R. W. DeHaven. 1978. Food selection by five sympatric California blackbird species. California Fish and Game 64:255-267.

Dawson, W.L. 1923. The birds of California: Vol. 1. South Moulton Co., San Francisco, CA.

DeHaven, R. W. 1975. Plumages of the tricolored blackbird. Western Bird Bander 50:59-61.

DeHaven, R. W., F. T. Crase, and P. D. Woronecki. 1975a. Breeding status of the tricolored blackbird, 1969-1972. California Fish and Game 61:166-180.

_____ 1975b. Movements of tricolored blackbirds banded in the Central Valley of California. Bird-Banding 46:220-229.

DeHaven, R. W., and J. A. Neff. 1973. Recoveries and returns of tricolored blackbirds. 1941-1964. Western Bird Bander 48:10-11.

Emlen, J. T. 1941. An experimental analysis of the breeding cycle of the tricolored red-wing. Condor 43:209-219.

Engler, J. D. 1994. 1994 tricolored blackbird production, Kern National Wildlife Refuge Complex. Unpublished file report for U.S. Fish and Wildlife Service, filed at Kern NWR, Delano, CA.

Evermann, B. W. 1919. A colony of tricolored blackbirds. The Gull 1: 2-3.

Follansbee, D.M. and D.W. Mauser. 1994. Breeding ecology of tricolored blackbirds in the Klamath Basin of northern California and southern Oregon. Unpublished file report for USFWS, filed at Klamath NWR, Tulelake, CA.

Frayer, W. E., D. D. Peters, and H. R. Pywell. 1989. Wetlands of the California Central Valley: status and trends .- 1939 to mid-1980s. U.S. Fish and Wildlife Service, Region 1, Portland, OR.

Grau, C. R., E. Rychlik, G. Santolo, T. E. Roudybush, and T. Guido. 1987. Toxicity of selenium to nestling tricolored blackbirds *(Agelaius tricolor).* Unpublished report prepared for the U.S. Bureau of Reclamation, Sacramento, CA.

Grinnell, J., and A. H. Miller. 1944. The distribution of the birds of California. Pacific Coast Avifauna, No. 27. Berkeley, CA.

Hamilton, W. J. III. In prep. Movements of tricolored blackbirds, *Agelaius tricolor,* during the spring breeding season. Will be submitted to Condor.

Hamilton, W. J. III, L. Cook, and R. Grey. 1995. Tricolored blackbird project 1994. Unpublished report prepared for U.S. Fish and Wildlife Service, Portland, OR.

Harrison, C. 1978. A field guide to the nests, eggs, and nestlings of North American birds. The Stephen Greene Press. Brattleboro, VT.

Heermann, A. L. 1853. Notes on the birds of California, observed during a residence of three years in that country. J. Academy of Natural Sciences 2:259-272.

Hosea, R. C. 1986. A population census of the tricolored blackbird, *Agelaius tricolor* (Audubon), in four counties in northern Central Valley of California. M.S. thesis. California State University, Sacramento, California.

Kreissman, B. 1991. California: an environmental atlas and guide. Bear Klaw Press. Davis, CA.

Lack, D., and J. T. Emlen. 1939. Observations on breeding behavior in tricolored red-wings. Condor 41:225-230.

Mailliard, J.W. 1900. Breeding of *Agelaius tricolor* in Madera County. Condor 11: 122-124.

Mailliard, J. 1914. Notes on a colony of tricolored redwings. Condor 16:204-207.

McCabe, T. T. 1932. Wholesale poison for the red-wings. Condor 34:49-50.

Ne:ff, J. A. 1933. The tri-colored red-wing in Oregon. Condor 35:234-235.

_____ . 1937. Nesting distribution of the tricolored red-wing. Condor 39:61-81.

_____ . 1942. Migration of the tricolored red-wing in central California. Condor 44:45-53.

Ohlendorf, H. M., D. J. Hoffman, M. K. Saiki, and T. W. Aldrich. 1986. Embryonic mortality and abnormalities of aquatic birds. Science of the Total Environment 52:49-63.

Orians, G. H. 1961a. Social stimulation within blackbird colonies. Condor 63: 330-***337.***

_____ . 1961b. The ecology of blackbird *(Agelaius)* social systems. Ecological Monographs 3 1: 285-3 12.

Orians, G.H. 1980. Some adaptations of marsh-nesting blackbirds. Monographs in Population Biology. Princeton University Press, Princeton, NJ.

Orians, G.H. and G. Collier. 1963. Competition and blackbird social systems. Evolution 17:449-459.

Payne, R. 1969. Breeding seasons and reproductive physiology of tricolored blackbirds and red-winged blackbirds. University of California Publications in Zoology, Volume 90. University of California Press. Berkeley, CA.

Pulliam, H. R. 1988. Sources, sinks, and population regulation. American Naturalist 132:652-661.

Richardson, C. Tricolored blackbirds nesting in Jackson County, Oregon. Condor 66:507-508.

Skirm, J. 1884. List of birds of Santa Cruz, California. Ornithology and Oology 9: 149-150.

Skorupa, J. P., R. L. Hothem and R. W. DeHaven. 1980. Foods of breeding tricolored blackbirds in agricultural areas of Merced County, California. Condor 82:465-467.

Tyler, J. G. 1907. A colony of tri-colored blackbirds. Condor 9: 199-178.

U.S. Fish and Wildlife Service. 1995. Migratory nongame birds of management concern in the United States: The 1995 list. Prepared by the Office of Migratory Bird Management, U.S. Fish and Wildlife Service, Washington, D.C.

Wilen, B.O. and W.E. Frayer. 1990. Status and trends of United States wetlands and deepwater habitats. Forest Ecology and Mangement 33:181-192.

Personal Communications

Barnes, Bob. Biologist/Ornithologist. National Audubon Society, Sacramento, CA. Meetings and correspondence in 1994 and 1995.

Bowen, Rhys. Graduate student in ecology, Division of environmental Studies, University of California, Davis, CA. Conversations with William J. Hamilton III during 1994.

Chisholm, Graham. Director, Nevada Breeding Bird Atlas project. Reno, NV. August 27, 1997 telephone message.

Clark, Jerry. Wildlife depredation control. California Department of Food and Agriculture, Sacramento, CA. May 15, 1991 - telephone conversation.

Comrack, Lyann. Nongame wildlife biologist. California Department of Fish and Game, Sacramento, CA. Meetings and correspondence in 1994 and 1995.

Cook, Liz. Graduate student. University of California, Davis, CA. Meetings during 1991 - 1994.

DeHaven, Richard. Retired biologist. U.S. Fish and Wildlife Service, Sacramento, CA. Telephone conversations and correspondence in 1990 and 1991.

Grau, Richard. Professor of avian sciences. University of California, Davis, CA. September 16, 1987 - letter.

Hunting, Kevin. Nongame wildlife biologist. California Department of Fish and Game, Sacramento, CA. Meetings, telephone conversations, and correspondence during 1997.

Manolis, Tim. Ornithologist, Author of the Sacramento County Bird Atlas (in prep). Sacramento Audubon Society, Sacramento CA. Conversations with Ted Beedy in 1989 - 1996.

Mauser, David. Wildlife biologist. U.S. Fish and Wildlife Service, Sacramento National Wildlife Refuge Complex, Willows, CA. July 7, 1987 - unpublished memorandum.

Paveglio, Fred. Contaminant specialist, U.S. Fish and Wildlife Service, San Luis NWR Complex, Los Banos, CA. Correspondence and conversations during 1986 to 1988.

Shelton, John. M. Chief, environmental section. Department of Water Resources, Fresno, CA. October 8, 1994 - telephone conversation.

Stallcup, Rich. Field ornithologist. Point Reyes Bird Observatory, Stinson Beach, CA. October 17. 1995 - letter.

Stroud, Richard. Veterinary pathologist. U. S. Fish and Wildlife Service, National Wildlife Health Center, Madison, WI. September 26, 1986 - diagnostic services case report.

Sumida, Clark. Collections manager. Western Foundation of Vertebrate Zoology, Camarillo, CA. June 23, 1997 - letter and summary of egg collection cards.

Winter, Jon. Ornithologist. RMI Associates, Santa Rosa, CA. Telephone conversations during 1989-1995.

Zahm, Gary. Project Leader. San Luis National Wildlife Refuge Complex, Los Banos, CA. Conversations and correspondence during 1987.

Zimmerman, Tara. Regional nongame coordinator. U.S. Fish and Wildlife Service, Portland, OR. Telephone conversations, meetings, and correspondence from 1994 to 1997.

Appendix A. General Guidelines for locating and Monitoring Tricolored Blackbird Colonies

Appendix A

General Guidelines For Locating And Monitoring Tricolored Blackbird Colonies

Several factors should be considered for all levels of tricolor monitoring:

- Observers can often identify the location of colonies when tricolors are provisioning nestlings by observing the flight direction of adults with food in their bills. An appropriate change in position by the observer will give a second azimuth, permitting approximate triangulation of the colony location.

- Estimates of numbers depend on the stage of a colony. Settling colonies often attract far more males than actually remain to breed and estimates of numbers may be inflated early in the season. Estimates should be verified by nest counts after the breeding season.

- It is useful for several observers to estimate the size of colonies that will be closely measured after the breeding season so that estimation skills can be developed.

- The size of a colony can be determined after the breeding season by mapping the outline of the colony and establishing walking transects through the peripheries and center. A l.5-meter stick held horizontally can be used as a useful aid to counting nests. A measuring wheel or tape run along the outside of the colony can be used to estimate the area of a colony (Hamilton et al. 1995).

- To distinguish between creches and colonies, it is necessary either to know that a collection of birds is a nesting colony from observation of breeding behavior (e.g., male song or female nest building) or to enter a creche or colony to search for nests. Creches account for some observations of smaller colonies and may distort reports of overall numbers of nesting tricolors. Creches often occur in unsuitable tricolor nesting habitats, such as oleanders, black walnut, and fig trees, and small, linear patches of cattails and other emergent vegetation (Hamilton pers. obs.).

- Establishing a driving survey route to annually monitor historically known colonies in a given local area of interest can be a useful adjunct to the Volunteer and Periodic Rangewide Surveys. This persistent observation of targeted sites over a period of years can result in trends in distribution and abundance within the survey area. Driving routes linking documented colony sites could be established and new colonies incorporated as

they are observed or reported. To implement this more intensive level of monitoring, routes should be driven at least monthly from April 10 through June 15 to ensure adequate documentation of colony establishment, early failures, and successful nesting attempts.

Appendix B. 1997 Statewide Tricolored Blackbird Survey Guidelines and Instructions for Completing Survey Forms

1997 STATEWIDE TRICOLORED BLACKBIRD SURVEY
SURVEY GUIDELINES AND INSTRUCTIONS FOR COMPLETING SURVEY FORMS

Survey Purpose

The primary purpose of the 1997 statewide survey is to determine the number of active tricolored blackbird *(Agelaius tricolor)* colonies and each colonies location. Although we recognize that April 26-27 may precede establishment of nesting colonies in some areas (e.g., Sacramento valley) we have selected these dates to maximize the likelihood of detecting nesting colonies in most of the state. Because some birds may have completed a successful nesting cycle and others may have experienced a nest failure or are beginning a re-nesting attempt, we expect volunteers to observe colonies in all stages of the nesting process including birds which are not associated with colonies or in the early phase of colony development.

Survey Dates

We selected the April 26-27 dates as a focus for the volunteer efforts because we learned, as a result of the 1994 and 1995 efforts, that tricolored blackbirds are itinerant breeders (i.e., many individuals nest at more than one location during the breeding season) and that following loss of a nest to predation or other causes, adults may re-nest, either at the same location or in a new colony, within 10 days. Therefore, to avoid duplicate counts of breeding colonies, surveys are limited to a single two-day period. If you are unable to conduct surveys on April 26-27 but can survey within about one week of these dates, please clearly indicate the dates the colonies were surveyed.

To determine nest success and historic colony site use, however, researchers will attempt to gather data on nesting colonies throughout the breeding season. Therefore, we encourage reports from volunteer surveyors during the entire nesting period. Records form new and historic colonies collected throughout the season will allow researchers to more precisely determine the true. 1997 nesting population size.

Colony Counts

It is important to accurately estimate the number of birds you observe at a nesting colony. For active colonies, please provide your best estimate of the total number of adults present at the site. Repeat visits later in the breeding season are encouraged to determine the fate of active colonies, but under no circumstances should you enter an active colony or otherwise disturb the birds while attempting to census them more accurately. As a general rule, you should hide behind vegetation or other natural blinds while making your count and stay 15-25 meters away from any nesting area.

Because of the frenetic activity associated with most breeding colonies, it is almost impossible to make an exact count of all adults present for even short time intervals. Therefore, make your best estimate based on a 10 to 15 minute period to minimize

disturbance to the colony. Please round your numbers according to the size of the colony. For example, small colonies (i.e., about 100 adults) should be rounded to l0s, and medium-sized colonies (i.e., about 1,000 adults) should be rounded to l00s, and large colonies (i.e. 10,000 or more adults) should be rounded to 1,000s. Please avoid using the greater than or less than symbols (< >) or a range when recording estimates on field survey forms. The data you submit will be entered into an existing database and we have no way of determining the degree to which greater than or less than or a range of values should be applied. Your estimate is the best indicator we have so please provide a numeric value as we recognize, and will account for, the variation in colony estimates.

As a reminder, please secure access to private property from the landowner before you enter his or her property. If there is any question about access, use caution and stay on public property. Remember, tricolored blackbirds are not a listed species and colony protection is entirely voluntary and is most successful when a positive, informative approach is used. The Department or the primary researchers will make landowner contacts but we would appreciate any information which may assist us in this effort.

Field Survey Forms

Please include all requested information on the enclosed field survey forms. Please complete a separate form for each colony observed. Because survey forms may be separated prior to entry in the database, please avoid statements such as “see previous form” or “same as previous location” statements. The following are specific instructions for completing field survey forms.

Top Section - Please complete all information. It is essential that survey forms include the county in which observations were made. Include your name, address, phone and a fax number or e-mail address so that we can contact you if we require additional information.

We ask that survey forms be returned immediately to the address indicated in Section 2. You may fax or mail completed forms. Survey information from the 1997 effort, combined with past survey information, will be included in a comprehensive Status Review and Management Guidelines document which must be completed in May. If you discover a previously undocumented site or visit a site which may require verification or additional site visits, researchers will be available to visit this site within a few days of the survey date. Fax completed forms for these sites directly to Dr. William Hamilton at (916) 752-3350. You may leave a message for Dr. Hamilton at any time at (916) 752-1122. Dr. Hamilton and Dr. Edward Beedy are the primary researchers on this project and transmittal of information on new or uncertain colonies directly to them would be greatly appreciated. Please note that completed survey forms for these sites should also be forwarded to Kevin Hunting.

Nesting Status - Please indicate either nesting or non-nesting status in the following section. Each colony will either have a nesting or non-nesting status

and it is important that volunteer surveyors determine the colony status. If you are unsure of the status of the colony, fill out the non-nesting section and indicate observations in comments on the reverse of the form. If nesting and non-nesting colonies are observed in close proximity to each other, please complete separate field survey forms for each colony observed. As previously discussed, enter only a single whole number for a colony size estimate. If you have difficulty estimating colony size, please contact Dr. Hamilton at (916) 752-3350 for assistance. We recognize the variability in estimating colony size and will account for this when the data are analyzed. Please estimate the area (in acres) occupied by both the colony and of available habitat. Again, please use a single whole number for estimates. Distance to nearest water and the type of water (e.g., fresh water marsh, open water) is also important to note.

- Location - We have recently created a database which includes all past survey information and are in the process of assigning United Transverse Mercator (UTM) coordinates to each observation so the information can be used and analyzed in a Geographic Information System (GIS). This tool will allow us to quickly identify high priority conservation areas or areas where limited management funds may be applied. Therefore, providing meaningful, accurate geographic locations on survey forms is very important. We prefer UTM or Latilong coordinates if they can be readily determined. If not, please include a map indicating the location of the observation. Preferred formats (in order of preference) are; USGS quad map, Metsker© maps, county or city street maps. If you are using a copy of a portion of a map, please write the name (quad name) and county on the map so that it may be referenced prior to data entry.

  History - Information on historic nest colony sites is very important in assessing trends, management and conservation needs and breeding behavior. Please indicate if the observed colony is nesting in a known historic site, when, if known, the site was active. Notes on habitat condition, current or potential threats or ownership (ie., private or public) are very valuable for future efforts.

Contact either Kevin Hunting or Dr. Bill Hamilton if you have any questions regarding the survey effort, completing survey forms or if you require additional forms or other information. Thank you for your assistance in this effort. This effort would not be possible without your help and we hope the 1997 survey effort can be used as a model for volunteer status assessments for other species.

Appendix C. 1997 Tricolored Blackbird Survey Form