State of California
Natural Resources Agency
Department of Fish and Wildlife

REPORT TO THE FISH AND GAME COMMISSION
A STATUS REVIEW OF THE
HUMBOLDT MARTEN
(*Martes caurina humboldtensis*)
IN CALIFORNIA

Keith Slauson photo used with permission

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EXECUTIVE SUMMARY

This status review report contains the most current information available on the Humboldt marten (*Martes caurina humboldtensis*) and serves as the basis for the California Department of Fish and Wildlife's (Department) recommendation to the California Fish and Game Commission (Commission) on whether to list the species as threatened or endangered under the California Endangered Species Act.

The Environmental Protection Information Center and the Center for Biological Diversity, as joint petitioners, submitted a "Petition to List the Humboldt Marten (*Martes caurina humboldtensis*) as an Endangered Species under the California Endangered Species Act" (Petition) to the Commission on June 8, 2015. At its scheduled public meeting on February 11, 2016, the Commission considered the Petition, and based in part on the Department's petition evaluation and recommendation, found that sufficient information existed to indicate the petitioned action may be warranted and accepted the Petition for consideration. Upon publication of the Commission's notice of its findings, the Humboldt marten was designated a candidate species on February 26, 2016.

Humboldt martens are currently designated a California Species of Special Concern, a non-regulatory designation intended to focus attention on animals at conservation risk, stimulate research on poorly known species, and achieve conservation and recovery of these animals before they meet criteria for listing as threatened or endangered under the California Endangered Species Act (CESA; Fish & G. Code, § 2050 et seq.). Additionally, Humboldt martens throughout their range in California and Oregon are currently under review for listing as threatened or endangered under the federal Endangered Species Act by the U.S. Fish and Wildlife Service.

Species Description, Biology, and Ecology - Martens have yellowish to dark brown fur with a contrasting lighter chest patch, the long, sleek body form typical of members of the mustelid (weasel) family, a relatively long bushy tail, and typically weigh 0.4-1.25 kg (0.88-2.76 lbs.). Humboldt martens in California have subtle physiological differences from Sierra martens (*M. caurina sierra*) which also occur in California. Within California, Humboldt martens historically occupied near-coastal forests from Sonoma County north to the Oregon border; however, the current distribution within the state is limited to two small areas of Del Norte, northern Humboldt, and western Siskiyou counties, a small fraction of the historical range.

Humboldt martens breed once per year and females typically first give birth at two years of age and reach peak productivity from three to five years of age, although not all females attempt to breed each year. Kits are born in natal dens where they remain completely dependent on the mother for seven to eight weeks, after which the mother typically moves them to one or a series of maternal dens until the kits disperse, typically in late summer. Dispersal distances of Humboldt martens are largely unknown, but likely similar to distances of other North American martens, which typically average less than 15 km (9.3 mi.). Available information suggests that home ranges of Humboldt martens are similar to Sierra marten home range sizes in California, 70 – 733 ha (173 – 1,811 ac.).

In California, Humboldt martens subsist on a diet composed primarily of small mammals (squirrels, chipmunks, and voles) and birds, and to a lesser degree reptiles, fruits, and insects. Known predators of martens in North America include bobcats, coyotes, foxes, fishers, and great-horned owls, with bobcats being the primary predator of Humboldt martens in California.

Humboldt martens in California are associated with two distinct habitat types: late-successional coastal redwood, Douglas-fir, and mixed conifer forests with dense mature shrub layers; and serpentine

habitats with variable tree cover, dense shrub cover, and rock piles and outcrops. Consistent among the two habitat types is the requirement for structures for denning, resting, and escape cover. In late-successional forests, structures used include tree cavities, defects, snags, and logs; while in serpentine habitats rock piles and outcrops are commonly used in addition to tree structures. Humboldt martens also rely on extensive stands of dense shrub cover in both habitat types.

Status and Trends - There are no historical Humboldt marten population estimates available, but anecdotal evidence from early naturalists and trapping records suggests the species was far more common and widespread in the early 20th century than they are today. The California population is currently estimated to number fewer than 200 individuals. It appears the Oregon population also numbers fewer than a few hundred individuals and there is uncertainty about the degree to which animals in Oregon and California interact and exchange genes.

Humboldt martens historically ranged from the coastal forests of northwestern Sonoma County north to Oregon's Curry County within the narrow humid coastal zone (Figure 1). The historical described range was roughly 22,000 km^2 (8,500 mi^2). By the 1940s, a significant decline in Humboldt marten trapping returns was noted and a retraction of the southern end of the range appears to have occurred. In California, over the last 25 years Humboldt martens have only been detected in Del Norte, northern Humboldt, and extreme western Siskiyou Counties; suggesting a range reduction greater than 93% (Figure 2).

Threats - The Department has identified multiple potential threats to the long-term persistence of the California Humboldt marten population. Some of these threats are largely the result of historical practices while others are ongoing. Ongoing threats include habitat loss from timber harvesting, wildfires, urbanization, cannabis cultivation; elevated predation rates; exposure to toxicants and diseases; climate change; and risks inherent to small populations.

Historical accounts suggest that trapping pressure on Humboldt martens in the late 19th and early 20th centuries was intense, and declines in the population were noted by the early 1900s. Marten harvest continued essentially unchecked until 1946 when the Commission instituted the first Humboldt marten trapping closure. Historical trapping, coupled with habitat loss, was likely the cause of the dramatic reduction in the marten's California range. Today, trapping of Humboldt martens is prohibited in California and no longer poses a significant threat to the population. In addition, the probability of unintended bycatch is extremely low due to current trapping regulations and the low number of active trappers within the extant range.

Humboldt marten populations have been negatively impacted by historical and ongoing habitat degradation and loss from timber harvesting and other silvicultural treatments of older forests, wildfires and associated salvage logging, development of coastal forests for human settlement, as well as the clearing of forests for the cultivation of cannabis. Forest conditions in the range of the Humboldt marten today have largely been shaped by a legacy of over 100 years of logging and timber management which has reduced the area of old growth conifer forest in the Pacific Northwest by an estimated 72% since European settlement. In recent decades the logging of old growth forest stands on private and public lands has dramatically slowed from peaks in the second half of the 20th century due to more restrictive regulations and market conditions. However, it will likely take decades for the forest stands degraded and fragmented from historical logging to recover the dense shrub cover, and centuries to recruit the large tree structures needed to restore high quality Humboldt marten habitat conditions.

Humboldt marten habitat suitability may be reduced under commonly used timber harvest methods through reduction of overstory canopy cover and the loss of dense shrub cover. Shrub layers can be destroyed or degraded through post-harvest stand management treatments such as burning, mechanical clearing, herbicide application, and through competitive exclusion by densely planted conifers in plantations which shade out understory shrubs. Shrub cover has been found to be more patchily distributed in thinned stands than in old growth stands on federal forest lands, and decades are required to restore dense shrub layers following harvests.

Wildfires and the associated salvage logging of damaged trees can threaten the already small Humboldt marten population by reducing and fragmenting the remaining habitat. On federal lands in north coastal California there was a net 5.6% loss of old forest habitat over the period of 1993-2012, primarily attributed to wildfires, despite gains from forest succession. Connectivity between old forest stands was found to have decreased over the same period, mainly due to fragmentation caused by wildfires. Large fires in southwest Oregon (the 2002 Biscuit Complex Fire and 2017 Chetco Bar Fire) have likely isolated the California – Oregon border Humboldt marten population from the two extant Oregon population areas (Figure 7). Additionally, vegetation management activities designed to reduce the risk of wildland fire by removing shrubs, reducing canopy cover, and removing snags and logs can degrade marten habitat and contribute to habitat fragmentation.

Humboldt marten researchers and land managers consider wildland fire a serious threat to the extant population in California, estimating that a single large fire could eliminate 31% to 70% of the currently occupied habitat. The negative impacts of wildland fires on marten habitat vary with the intensity of the burn and include the removal of large tree structures and dense shrub layers as well as the fragmentation of habitat. The number of fires, mean fire size, and annual area burned in northwestern California were all found to have increased over the century from 1908 – 2008, suggesting the threat to Humboldt martens from wildland fires is increasing.

Habitat loss and degradation from human settlement and residential development rapidly increased in the 1850s, and several portions of the historical range have been converted from forests to urban areas, primarily in and around Crescent City, Humboldt Bay, Fortuna, Fort Bragg, and Willits; and much of the historical range south of Del Norte County has been parceled and occupied by very low density housing. However, the core population areas currently occupied by Humboldt martens in California are almost entirely unoccupied by humans, with the exception of some areas adjacent to the Klamath River on Yurok Tribal lands. While further human development of the historical range will likely continue into the future, a modeled analysis of future land conversions under several human population growth scenarios found the probability of significant conversions to urban and agricultural uses in the northwest California coast region to be very low for the remainder of this century.

Large-scale marijuana cultivation in remote forests throughout California has increased since the mid-1990s, coinciding with the passage of California laws legalizing certain uses of cannabis. Cultivation can impact Humboldt martens through the clearing and fragmentation of forests and the application of pesticides, including highly toxic anticoagulant rodenticides. Humboldt and Del Norte counties are known centers of legal and illegal cannabis cultivation in California due to the remote and rugged nature of the land and abundant water sources, although to date a relatively small percentage of the land area has been impacted by these practices. The extent to which land clearing for legal and illegal cannabis cultivation will contribute to future Humboldt marten habitat loss and degradation is unknown.

Forest fragmentation from timber harvest, wildfires, and roads also poses a threat to Humboldt marten individuals and populations. Observations indicate Pacific martens are reluctant to cross open areas, so it can be surmised that the same is true for Humboldt martens. Individuals may be forced to move over greater distances to acquire food in fragmented landscapes, increasing their energetic costs and exposing them to more predators, and fragmentation likely decreases the ability of individuals to disperse. Fragmented habitat conditions exist throughout much of the Humboldt marten's historical and current range, and the four extant marten populations in coastal California and Oregon appear to be isolated from one another by unsuitable habitat degraded by logging, severe wildfire, and urbanization.

Although no known road-killed Humboldt martens have been recovered from California to date, several Humboldt marten mortalities resulting from vehicle strikes have been documented in Oregon. Modeling conducted on coastal Oregon populations suggests the addition of two to three vehicle strike mortalities annually in those small populations could substantially increase the probability of population extinctions. As major highways in California pass near extant Humboldt marten population areas, vehicle strikes should be considered a potential, though likely minor threat to the population.

Evidence suggests predation on Humboldt martens can limit population distributions and growth rates in the wild. Multiple studies of Humboldt and Pacific martens have demonstrated that predation is the primary source of marten mortality. Most documented predation on Humboldt martens in California is caused by bobcats. There appears to be an important interaction between habitat quality and the rate of predation on Humboldt martens by larger habitat-generalist predators such as bobcats and coyotes. Where landscapes are fragmented by timber harvesting or roads and lack large tree structure and extensive dense shrub cover generalist predators are more common and predation rates on Humboldt martens increase. In such areas, predation rates on Humboldt martens may exceed marten reproduction rates, driving the population towards extirpation.

Humboldt marten populations are also threatened by exposure to toxic pesticides, most commonly associated with the cultivation of cannabis. Although there is little information available regarding Humboldt martens, Pacific fishers recovered from near and within the Humboldt marten range have tested positive for exposure to powerful anticoagulant rodenticides, and in several cases appear to have died as a result. The magnitude of this threat is unknown. Disease exposure is also a potential threat to Humboldt marten populations. Several highly virulent diseases (e.g. canine parvovirus and canine distemper virus) exist in the northwestern California carnivore community and can cause high rates of mortality in mustelids. Although the threat posed to Humboldt marten populations from disease outbreaks is unknown, an outbreak of a virulent disease in one or more of the extant population areas has the potential to substantially reduce the population.

Climatic conditions in the range of Humboldt martens appear to be changing in recent decades due to an influx of greenhouse gas emissions resulting from human activities. These changes are projected to continue and modeling suggests changes in precipitation patterns, temperature, and daily coastal fog intrusion will result in the contraction of suitable Humboldt marten habitat northwards and towards the coast. The timing and level of threat posed to Humboldt marten populations from these climate-mediated changes are uncertain.

Finally, small, isolated populations like the California Humboldt marten extant populations are inherently vulnerable to extinction due to reduced adaptive capacity from the loss of genetic diversity, the accumulation and fixing of maladaptive genes in the population, and random genetic drift; as well as through demographic stochasticity (changes in age and sex ratios resulting in less than optimal breeding opportunities due to random variation in birth and death rates). In studied wildlife populations, genetic diversity is strongly correlated with population fitness (increased survival and reproduction rates) and decreased extinction risk.

In addition to genetic effects, small populations are at great risk due to unpredictable changes in the natural environment such as droughts, fires, earthquakes, disease outbreaks, and changes in prey or predator populations. In small, isolated populations all or nearly all individuals can be impacted by such events. As populations get smaller they become more vulnerable to demographic variation, environmental variations, genetic drift, and inbreeding depression. Each of these effects can amplify the impact of the other effects, further reducing population size and accelerating the species towards extinction. The most recent Humboldt martin population estimate in California is fewer than 200 individuals, far below the population size necessary to ensure long-term viability of a wild population.

Habitat Essential for the Continued Existence of the Species - The Department considers all currently occupied Humboldt marten habitat, as well as suitable but apparently unoccupied habitat near the currently occupied habitat, essential for the continued existence of the species in California. Together these areas total less than 20% of the species' historical California range. However, even if the area was fully occupied by Humboldt martens, the maximum theoretical population would still be far short of recommended minimum viable population size. Therefore additional habitat that is not currently suitable but which could be restored within coming decades should also be considered essential to the recovery of the species over time.

Management Recommendations – The Department recommends maintaining and creating suitable habitat in and near the areas currently occupied by Humboldt martens in California, as well as actions to increase habitat connectivity and reduce barriers to dispersal. The Department also recommends balancing the conservation of Humboldt marten habitat with the need to attenuate potential habitat losses from severe wildfires through carefully designed fuel reduction actions. Finally, the Department recommends continued research on the Humboldt marten population size and distribution, the population's genetic diversity, habitat associations, and the potential threats to population persistence.

Recommendation - The California Endangered Species Act directs the Commission to determine whether a petitioned species' continued existence is in serious danger or is threatened by any one or any combination of the following factors: (1) present or threatened modification or destruction of its habitat; (2) overexploitation; (3) predation; (4) competition; (5) disease; or (6) other natural occurrences or human-related activities.

The Department provides this status review report, including its recommendation, to the Commission in an advisory capacity based on the best scientific information available. Through its evaluation, the Department has determined that historic trapping and habitat loss have extirpated Humboldt martens from significant portions of their range. Additionally, historic and ongoing habitat loss, habitat fragmentation, and associated elevated predation rates, coupled with unquantified, but potentially significant threats to the species from a small population size, disease, toxicants, wildfire, and climate change place the remaining California Humboldt marten population at risk of extinction. Therefore, the Department's recommendation to the Commission is that listing Humboldt marten as endangered under CESA is warranted.

A STATUS REVIEW OF THE HUMBOLDT MARTEN (Martes caurina humboldtensis) IN CALIFORNIA

REGULATORY SETTING

A "Petition to List the Humboldt Marten (*Martes caurina humboldtensis*) as an Endangered Species under the California Endangered Species Act" (Petition) was submitted to the Fish and Game Commission (Commission) on June 8, 2015, by the Environmental Protection Information Center and the Center for Biological Diversity (Petitioners). Commission staff transmitted the Petition to the California Department of Fish and Wildlife (Department) pursuant to Fish and Game Code section 2073 on June 18, 2015, and published a formal notice of receipt of the Petition on July 24, 2015 (Cal. Reg. Notice Register 2015, No. 30-Z, p. 1237). The Department serves in an advisory capacity to the Commission by providing scientific reviews of petitions.

On November 11, 2015, the Department provided the Commission with its evaluation of the Petition, "Evaluation of the Petition from the Environmental Protection Information Center and the Center for Biological Diversity to List the Humboldt Marten (*Martes caurina humboldtensis*) as Endangered Under the California Endangered Species Act," to assist the Commission in making a determination as to whether the petitioned action may be warranted based on the sufficiency of scientific information (Fish & G. Code, §§ 2073.5 & 2074.2; Cal. Code Regs., tit. 14, § 670.1, subds. (d) & (e)). Focusing on the information available to it relating to each of the relevant categories, the Department recommended to the Commission that the Petition be accepted.

At its scheduled public meeting on February 11, 2016, in Sacramento, California, the Commission considered the Petition, the Department's petition evaluation and recommendation, and comments received. The Commission found that sufficient information existed to indicate the petitioned action may be warranted and accepted the Petition for consideration. Upon publication of the Commission's notice of its findings, the Humboldt marten was designated a candidate species on February 26, 2016 (Cal. Reg. Notice Register 2016, No. 9-Z, p. 290).

Status Review Overview

The Commission's action designating the Humboldt marten a candidate species triggered the Department's process for conducting a status review intended to inform the Commission's decision on whether listing the species is warranted. At its scheduled public meeting on February 8, 2017, in Rohnert Park, California, the Commission granted the Department a six-month extension to facilitate external peer review.

This written status review report, based upon the best scientific information available and including independent peer review of the draft report by scientists with expertise relevant to the Humboldt marten, is intended to provide the Commission with the most current information available on the Humboldt marten and to serve as the basis for the Department's recommendation to the Commission on whether the petitioned action is warranted. The status review report also identifies habitat that may be essential to the continued existence of the species and provides management recommendations for recovery of the species (Fish & G. Code, § 2074.6). Receipt of this report is to be placed on the agenda for the next available meeting of the Commission after delivery. Additionally, the report will be made available to the public for a minimum of 30 days prior to the Commission taking any action on the Petition.

Concurrent Federal Petition

Humboldt marten populations in northwestern California and coastal Oregon are currently under review for potential listing under the federal Endangered Species Act of 1973 (ESA) (16 U.S.C. § 1531 et seq.) in response to a 2010 petition also submitted by the Environmental Protection Information Center and the Center for Biological Diversity. The petitioned populations include the entire Humboldt marten range in California, as well as two populations of coastal Oregon Humboldt martens. In 2015, the USFWS released a 12-Month Finding that listing the Humboldt marten was not warranted. The federal petitioners challenged the finding in federal court, specifically challenging the USFWS conclusion that Humboldt marten populations were not in danger of extinction due to the risks associated with small, isolated populations. The court issued a summary judgement in favor of the Petitioners' claim that Humboldt marten populations in northwestern California are threatened by small, isolated populations (*Center for Biological Diversity v. U.S. Fish and Wildlife*. 15-cv-05754-JST, (N.D. Cal. Mar. 28, 2017). As a result, the USFWS is currently reevaluating the status of Humboldt martens in California and Oregon. For purposes of this status review, it is important to note that while the ESA requires the USFWS to assess whether species are threatened or endangered in the United States, CESA directs the Department to assess a species' status only within California.

BIOLOGY AND ECOLOGY

Systematics

The Humboldt marten is a carnivorous mammal (order Carnivora, family Mustelidae), classified as a subspecies of Pacific marten, a species occurring west of the Rocky Mountain Divide which was recently split from the American marten (*Martes americana*), (Dawson et al. 2017). The taxonomy of martens in the Pacific Northwest is currently unsettled. Historically the range of Humboldt martens was described as entirely within the north coastal portion of California (Grinnell and Dixon 1926, Grinnell et al. 1937); however, recent genetic evidence suggests Humboldt martens and martens in coastal Oregon (currently classified as *M. caurina caurina*) are diagnosably distinct from other western martens and are one phylogenetic lineage. Consequently experts now believe martens in northwestern California and coastal Oregon should collectively be classified as Humboldt martens (*M. caurina humboldtensis*) (Slauson et al. 2009a, USFWS 2015, Schwartz and Pilgrim 2017).

California is also home to the closely related Sierra marten, which is traditionally considered to range throughout the Sierra Nevada and northern interior mountains (Figure 1). The Sierra marten is not the subject of this Petition. Within this report references to North American martens may refer to any species or subspecies of marten occurring in North America (i.e. *M. americana, M. caurina, M. caurina sierrae, M. caurina caurina,* and/or *M. caurina humboldtensis*), and references to Pacific martens include any or all subspecies of *M. caurina* (including Sierra, Humboldt, *M. caurina vulpina*, and other subspecies).

Species Description

Martens have elongated and low-to-the-ground bodies, as do other members of the weasel family. Martens are intermediate in size among North American mustelid species. Martens are larger and stockier than long-tailed weasels (*Mustela frenata*) and short-tailed weasels (*Mustela erminea*), and

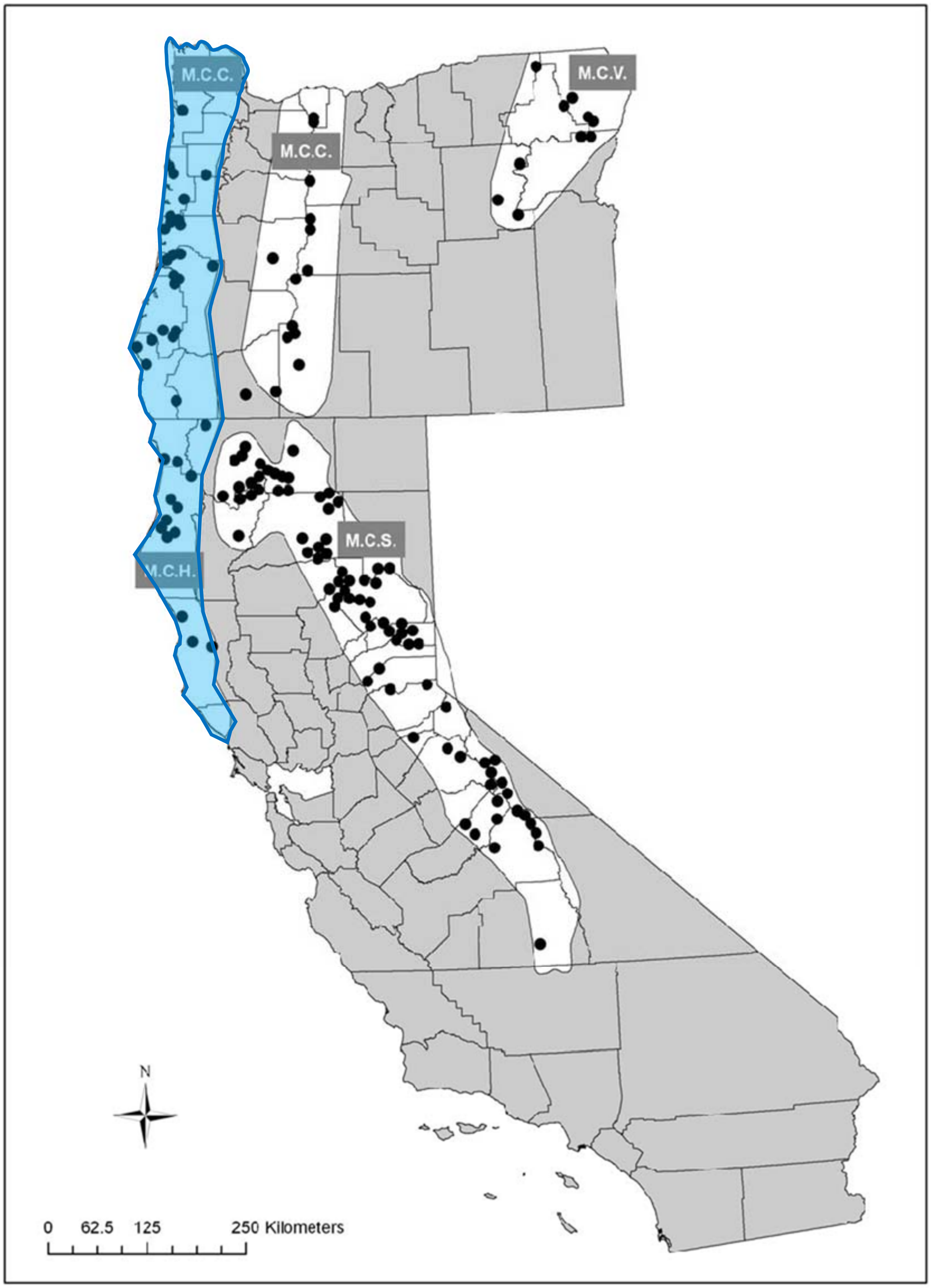

Figure 1. Historical range and distribution of Pacific marten subspecies occurring in Oregon and California. Range boundaries (white polygons) and historical records of occurrence (black circles) are modified from Zielinski et al. (2001, p. 480). Blue polygon denotes historical range of Humboldt marten as currently understood. Subspecies: M.C.H. = *M. caurina humboldtensis*, M.C.S. = *M. c. sierra*, M.C.C. = *M. c. caurina*, M.C.V. = *M. c. vulpina*. Source: USFWS 2015. Used with permission.

have longer tail and body fur than similarly sized minks (*Neovison vison*). They are noticeably smaller and more slender than the larger mustelids of North America, including wolverines (*Gulo gulo*), river otters (*Lontra canadensis*), and American badger (*Taxidea taxus*). Martens are typically smaller than fishers (*Pekania pennanti*).

Marten pelage (fur) is brown (varying from yellowish buff to nearly black), with a contrasting lighter patch on the throat and chest. The marten's bushy tail constitutes more than one-third of the overall body length. Overall body lengths range from 45-70 cm (18-28 in.) and body mass ranges from 0.4-1.25 kg (0.88-2.76 lbs.), with males averaging 15% longer and up to 65% heavier than females (Clark et al. 1987, Powell et al. 2003). Humboldt martens in California generally differ from the Sierra martens by having darker, richer golden fur; a smaller throat patch, more extensive dark fur on the feet, legs, and tail; smaller skulls, narrower faces (rostra), and differences in dentition (Grinnell and Dixon 1926, Grinnell et al. 1937, USFWS 2015).

Geographic Range and Distribution

Within California, Humboldt martens historically occupied the coastal forests from Sonoma County north to the Oregon border from sea level to 915 m (3,000 ft.) within 35 km (22 mi.) of the coast (Grinnell and Dixon 1926, Zielinski et al. 2001, USFWS 2015; Figure 2). The current distribution within the state is limited to areas of Del Norte, northern Humboldt, and western Siskiyou counties and encompasses less than 7% of the probable historical range in the state (Slauson et al. 2009b, Slauson et al. 2017). The majority of contemporary California marten detections are from a 812 km^2 (313 mi^2) core area (hereafter referred to as the core population) which includes the South Fork of the Smith River, Blue Creek, Bluff Creek, Camp Creek, Cappell Creek, Pecwan Creek, Slate Creek, and Rock Creek watersheds (USFWS 2015). An additional population exists east of U.S. Highway 199 near the California-Oregon border in northeastern Del Norte County (hereafter referred to as the California – Oregon border population), and a few Humboldt martens have recently been detected west of the core area in Prairie Creek Redwoods State Park (USFWS 2015, K. Slauson pers. comm. 10/10/2017). These extant population areas (depicted in Figure 4) appear to be isolated from one another by substantial areas of currently suboptimal habitat. East and south of the core population precipitation rapidly declines in the canyon of the Klamath River. The drier climatic conditions of the river canyon do not support the dense tree and shrub cover that typically characterize the habitat of Humboldt martens within the core population (Slauson et al. 2007). West of the core population lies an 8-16 km (5-10 mi.) wide band of industrial timberlands between the core population and large patches of late-successional conifer forest in State and National Parks where a few martens have been detected periodically in the last decade. These industrial timberlands are typically harvested every 40-60 years, and in this zone late-succesional forest is generally absent and dense shrub cover can be less extensive. Small residual late seral stands and individual old growth trees associated with dense shrub cover habitat do remain here, but are often fragmented by roads and recent timber harvests.

Within coastal Oregon, Humboldt martens have been detected from the California border through Lincoln County (Zielinski et al. 2001, Moriarty et al. 2016). Recent survey efforts and road kill records indicate Humboldt martens currently occupy four remnant population areas in the two states (Figure 3). The degree to which animals in the small California-Oregon border population area freely move back and forth across the state border is unknown.

The Department develops species range maps using the established convention of including the USDA Forest Service Ecological Subregions of California (https://map.dfg.ca.gov/bios/) which encompass species detections from the last 20 years, and when necessary modifies the boundaries along geological features (California Interagency Wildlife Task Group 2014). For the Humboldt marten range used in

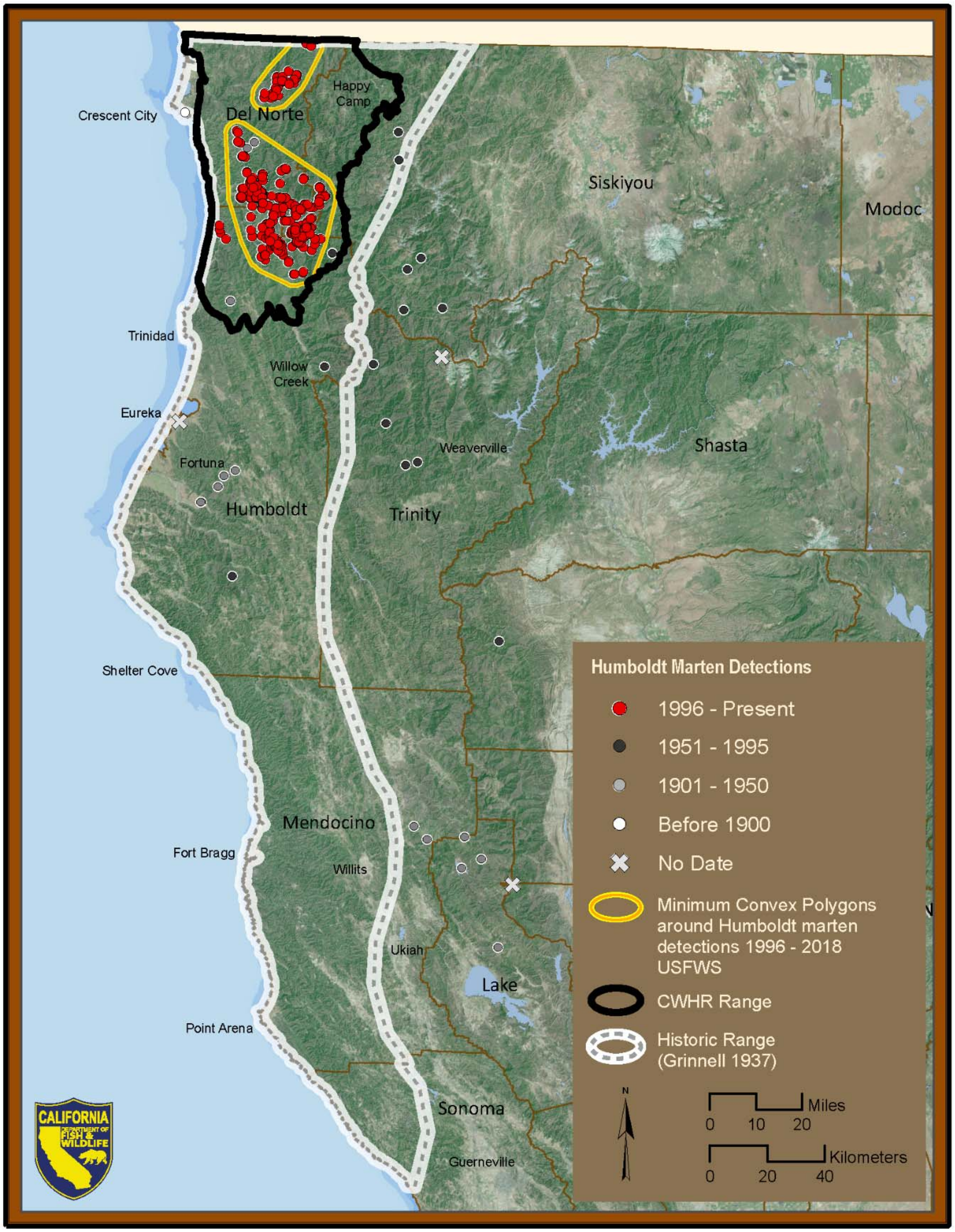

Figure 2. Historical and contemporary range of Humboldt marten in California with marten detections by date and minimum convex polygons around extant population areas.

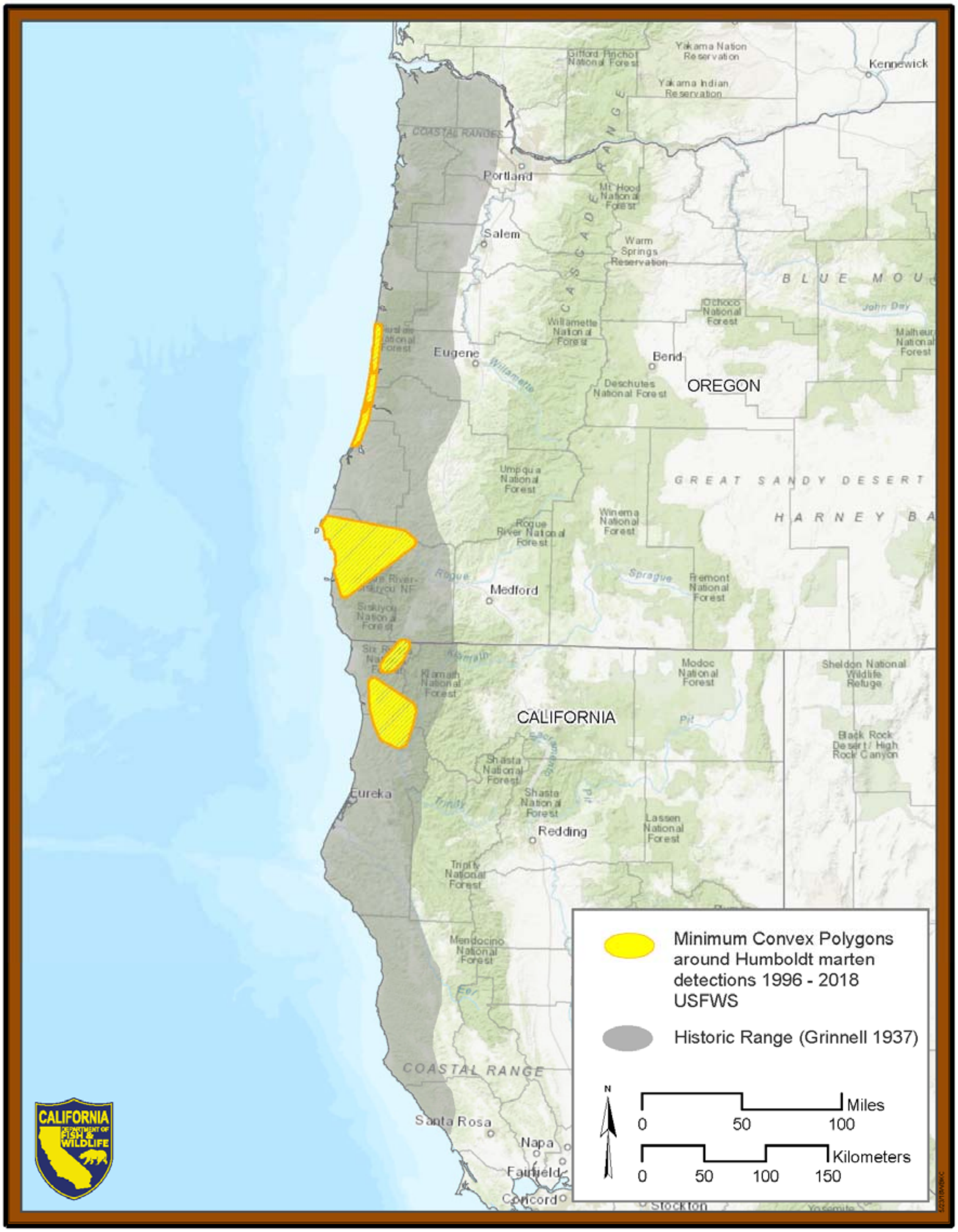

Figure 3. Humboldt marten extant population areas in California and Oregon (yellow polygons) imposed on historical range of Humboldt marten (shaded). Polygons are minimum convex polygons drawn around contemporary (1996 - 2018) verified groups of ≥5 Humboldt marten detections and buffered by 2 km.

Figures 2 and 8, the ecological subregions were cut along the Klamath River and the Redwood Creek watershed boundary to omit large areas where no contemporary Humboldt marten detections have occurred, and the urban area surrounding Crescent City. It is recognized that this convention can result in the inclusion of substantial unoccupied areas within the range bounds. Humboldt martens are distributed unevenly within the bounds of their range, with only a fraction of the mapped range containing the requisite habitat conditions to support Humboldt marten populations.

Habitat Associations and Use

Humboldt martens in California are currently known to be associated with two distinct habitat types: late-successional conifer forests with dense mature shrub layers where abundant live and dead standing and downed tree structures are used for resting, denning, and escape cover; and on serpentine soils (hereafter serpentine habitats) composed of various seral stages with variable tree cover, dense shrub cover, and rock piles and rock outcrops used for resting, denning, and escape cover (Slauson et al. 2007, Slauson et al. 2017, Slauson et al. in review). Large patches (>50 ha [>124 ac.]) of habitat appear necessary to support Humboldt marten individual home ranges, with larger patches (>80 ha [>198 ac.]) of late seral forest supporting the most stable occupancy (Slauson et al. 2007, Slauson et al. 2017, K. Slauson pers. comm. 11/10/2017). Along the western edge of the largest California population, a small number of Humboldt marten territories and dens have also been found in younger, managed forests. The managed landscape occupied by these marten home ranges was harvested predominantly in the 1950-60s, when more large trees, snags, and logs were retained on the landscape during harvest compared to how stands are typically harvested today (Delheimer 2015). However, populations in these areas may not be sustainable in the absence of individuals dispersing from the nearby late-successional forest landscape to the east due to the high level of predation these individuals are subject to from larger-bodied predators associated with young managed stands (Slauson pers. com. 11/10/2017). In coastal central Oregon, Humboldt martens occupy a third habitat type: shore pine (*Pinus contorta* subsp. *contorta*) forests with extensive dense shrub understories, similar in structure to serpentine habitats (Zielinski et al. 2001, Moriarty et al. 2016, Slauson et al. 2017, Linnell et al. 2018). Although Humboldt martens are not known to occur in this habitat type in California, small stands of shore pine exist north of Crescent City, northwest of Humboldt Bay, and along the Mendocino and northern Sonoma County coast (Griffin and Critchfield 1976, CNPS 2018).

Humboldt martens appear to select habitat at three scales (micro-habitat, stand, and home range scales), and populations of martens are affected by the arrangement of habitat at a fourth scale, the landscape. The following outline of habitat use is taken largely from Slauson et al. (2017). It should be noted that the best available information specific to Humboldt marten is presented here, but in some cases, information from other subspecies or from the American marten is referenced.

At the micro-habitat scale (the locations at which martens feed, rest, and den), North American martens rest or den in structures that provide cover for thermoregulation and protection from predators, and they forage in locations where prey is abundant and available (Taylor and Buskirk 1994, Andruskiw et al. 2008). In order of importance, Siskiyou chipmunks (*Tamias siskiyou*), medium sized birds (most frequently Stellar's jays [*Cyanocitta stelleri*]), western red-backed voles (*Myodes californicus*), Douglas' squirrels (*Tamiasciurus douglasii*), Humboldt's flying squirrels (*Glaucomys oregonensis*), and deer mice (*Peromyscus maniculatus*) are the prey species which contribute the most metabolizable energy to the annual diets of Humboldt martens (Slauson and Zielinski 2017). Most of these prey species are associated with late-successional conifer forest stands characterized by abundant large logs, snags, and decadent live trees; or with extensive, dense stands of ericaceous shrubs (i.e. evergreen huckleberry

[*Vaccinium ovatum*], salal [*Gaultheria shallon*], and rhododendron [*Rhododendron macrophyllum*]) (Zeiner et al. 1990, Allgood 1996, Slauson et al. 2017).

Den sites of North American martens are used by females to give birth to their young (natal dens) and to rear young until weaning and independence (maternal dens). Martens tend to be highly selective in their choice of denning sites, favoring large trees and snags with cavities that prevent larger predators from entering (Payer and Harrison 2003, Fuller and Harrison 2005, Thompson et al. 2012). Moriarty et al. (2017) found that Pacific martens in the Sierra Nevada used standing trees and snags almost exclusively for natal (n=7) and maternal (n=22) dens, but after kits weaned and became more mobile 59% of maternal rest structures (n=27) were ground-based, including stumps, logs, and rock piles; indicating reproductive females require a diversity of structure types to rear their young. The available data on Humboldt marten den sites (Slauson and Zielinski 2009, Slauson et al. unpublished data, Green Diamond Resource Company unpublished data) are consistent with the general North American marten pattern. A study of Humboldt marten denning ecology on managed timberlands in northern California categorized the type of structure used for 34 identified dens (Table 1. Data from Early et al. unpublished presentation 2016):

Table 1. Humboldt marten dens by structure type and marten use from Early et al. 2016.

			Structure Type		
Den Type	Live Tree	Snag	Log or Rock Pile	Artificial Nest Box	Underground
Natal	5	0	2	0	1
Maternal	19	4	1	2	0

Trees and snags used for denning in the study were typically large, averaging 91 cm (36 in.) diameter at breast height (dbh), ranging from 46-183 cm (18-72 in.) dbh, and were predominantly hardwood species, including chinquapin (*Chrysolepis chrysophylla*) and tanoak (*Notholithocarpus densiflorus*). Den trees typically had complex structural features such as broken tops, dead tops, large limbs, complex branching, basal hollows, and cavities.

Rest structures, used between periods of foraging by both male and female Pacific martens, include the kinds of sites used for denning as well as other sites that are less protective and less insulated than cavities or hollows, such as large tree limbs (Buskirk and Ruggiero 1994). Martens typically select the largest available structures for resting and denning (Spencer 1987, Gilbert et al. 1997, Slauson and Zielinski 2009, Moriarty et al. 2017). Rest structures used by Humboldt martens in largely unmanaged forests averaged 95 cm (37 in.) dbh for snags, 94 cm (37 in.) dbh for live trees, and 88 cm (35 in.) large-end diameter for downed logs. Structures on average exceeded 300 years of age (Slauson and Zielinski 2009). Preliminary data on Humboldt marten rest structures from more intensively managed lands (n=55) indicate a similar pattern of use of large-diameter conifer structures, with 70 percent of structures >70 cm (>28 in.) dbh (Slauson et al., unpublished data). Most resting locations (i.e., the actual resting place in the structure) were in tree cavities (33%), on platforms in broken-top snags and on large live branches (33%), or in chambers within log piles and rock outcrops (28%) (Slauson and Zielinski 2009). Rest structures which provide cavities or chambers may be especially important during the late fall through the late spring, when wet rainy conditions are common.

At the stand scale of habitat selection (forest patches used for foraging, denning, and resting), Pacific martens are found in forest stands that provide abundant structures suitable for resting and denning, as well as good foraging habitat, which includes both abundant prey and overhead cover to reduce predation risk (Buskirk and Ruggiero 1994, Slauson et al. 2017). Outside of serpentine habitats Humboldt martens have been shown to preferentially use late seral forest stands and to avoid use of early-successional stands (Slauson et al. 2007). The preferred late seral stands were Douglas-fir (*Pseudotsuga menziesii*) dominated, but also included mature tanoak or chinquapin understories. As mentioned above, late-successional forest stands with dense shrub layers and available habitat elements such as large snags, tree cavities, large downed logs and woody debris, as well as serpentine soil forest stands with abundant rock cover appear to provide the necessary combination of habitat features at the stand scale.

Where Humboldt martens have been radio-tracked on managed timberlands with younger tree age distributions, they were associated with second-growth stands several decades old, which provide substantial overhead cover. Importantly, these younger stands retained sufficient late-successional habitat elements such as large old trees, snags, and logs through earlier harvests. It is likely that these retained old growth structural elements provide the micro-scale habitat features needed by martens for resting, and denning (Slauson et al. 2014, Slauson et al. 2017).

Humboldt martens have also been found in forest stands growing in serpentine soils in near proximity (less than 30 km) of the coast (Slauson and Zielinski 2001). Serpentine soils are characterized by having low plant productivity due to naturally low concentration of essential nutrients (and in some areas naturally high heavy metal concentrations). Serpentine stands used by the Humboldt marten are associated with a variety of conifers, including lodgepole pine (*Pinus contorta*), western white pine (*Pinus monticola*), and Douglas-fir in dense to sparse overstories (Slauson et al. 2007). Humboldt marten resting sites in serpentine habitat are strongly associated with the presence of dense shrub cover and abundant rock outcrops, which are used for resting cover (Slauson and Zielinski 2009).

Some evidence indicates that serpentine habitat areas may be less productive than late-successional forest stands on non-serpentine soils. Population monitoring suggests serpentine habitats support lower proportions of females and marten occupancy is less stable than old forest habitats (Slauson et al. 2009b, Slauson et al. in review). Therefore, serpentine habitat areas may have less value to Humboldt marten population persistence than old forest habitat (Slauson et al. in review).

Dense, spatially extensive shrub layers (>70% cover) are a consistent feature of Humboldt marten habitat wherever they occur (Slauson et al. 2002, Slauson et al. 2007, Slauson et al. 2010). In mature forests on productive soils associated with Humboldt marten occupancy, shrub layers are typically composed of ericaceous species including evergreen huckleberry, salal, and rhododendron. In serpentine habitats associated with Humboldt marten occupancy, shrub layers are dominated by huckleberry oak, the shrub variety of tanoak (*Notholithocarpus densiflorus var. echinoides*), and California red huckleberry (*Vaccinium. parviflora*) (Slauson et al. 2017). Importantly, the shrub community favored by Humboldt martens does not include the shade-intolerant, short-lived shrub species such as *Ceanothus* spp. that occupy more xeric (dry) sites, and dominate sites following logging and other disturbances (Slauson et al. 2007).

At the home range scale, Humboldt martens appear to select areas with a high proportion of late-succession forest stands. The limited information available on Humboldt marten home ranges in California (n=3) indicates they are on the order of 300 - 500 ha (750 - 1250 ac.) (Slauson et al. 2017). In shore pine habitat in coastal Oregon, male Humboldt marten home ranges (n=7) varied from 100 – 431 ha (247 – 1,065 ac.) and female home ranges (n=9) from 59 – 90 ha (146 - 222 ac.) (Moriarty et al. 2017b, Linnell et al. 2018). Habitat selection analysis of radio-telemetered Humboldt martens indicates that home ranges typically include ≥70% stand-scale suitable habitat arranged in large patches [≥150 ha (>370 ac.) in area] (Slauson et al. 2007, Slauson et al. 2017).

Humboldt martens have also been found to reproduce in younger conifer stands (40-50 years post-harvest) in the Pecwan Creek watershed and surrounding areas on the western margin of the core population area. While these stands are not considered late-successional or old growth, the quadratic mean tree diameter is greater than 61 cm (24 in.) dbh, and stands retain abundant residual large tree, snag, and log structures as a legacy of historical logging practices which only harvested the most valuable conifers (high grading), leaving most hardwoods and less merchantable conifers behind (K. Slauson pers. comm. 10/10/2017, K. Hamm pers. comm. 5/23/2018). This type of silviculture is no longer practiced in California (Pub. Resources Code, § 4511 et seq.). Although reproducing martens have been found in these younger conifer stands, mortality rates are high, particularly from bobcat (*Lynx rufus*) predation (K. Slauson pers. comm. 10/10/2017). It is unknown if female reproductive rates in these younger managed landscapes are high enough to offset the high predation rates and sustain the population until the predator numbers are reduced. This predator reduction can occur naturally when young stands grow out of the age classes that support the important prey of larger-bodied predators. Male-skewed sex ratios and an age structure skewed to younger individuals in these areas suggests that a large proportion of the population occupying younger conifer stands consists of animals dispersing from the adjacent core population area (K. Slauson pers. comm. 10/10/2017, 5/24/2018).

At the landscape scale, Humboldt martens appear to select areas of occupancy based on the amount of old forest structure or serpentine habitat present in areas that receive abundant annual precipitation. Slauson et al. (in review) developed a landscape scale Humboldt marten habitat selection model to predict which regions of the historical range contain suitable marten habitat. The model was developed by relating field survey results to the environmental and habitat attributes hypothesized to influence marten distribution. The variables that best distinguished between occupied and unoccupied survey locations included: (1) measures of old growth structural index [a combination of stand age indices and the number of large trees >100cm (39 in.) dbh]; (2) the number of large snags >50 cm (20 in.) dbh and >15 m (49 ft.) tall; (3) the volume of large snags, (4) a tree size diversity index measured at the 1-km (0.62 mi.) scale; (5) the amount of serpentine habitat measured at the 3 km (1.89 mi.) scale; and (6) annual precipitation measured at the 3 km (1.89 mi.) scale.

Growth, Reproduction, and Survival

Humboldt martens are assumed to be polygynous, like American martens and other Pacific martens, where individual males can breed with multiple females. The following information is based on general characteristics of American and Pacific martens. Martens typically produce one litter per year (Calder 1984) and mating occurs in summer, with a peak in July (Markley and Bassett 1942). The fertilized embryo does not implant in the endometrium for seven or eight months (Ashbrook and Hanson 1927). Active pregnancy begins upon implantation in mid-winter (February). Parturition typically occurs in March or April, after 27 days of gestation (Jonkel and Weckwerth 1963). In a radio-telemetry study of Humboldt martens (Early et al. unpublished presentation 2016), adult females reduced their daily movements from mid-March through early April, consistent with near-term pregnancy and immediate post-parturition. Typical litter size is two or three young (Strickland et al. 1982) and ranges from one to five young (Strickland and Douglas 1987).

Young are born with little fur, ears and eyes closed, and have a body mass at birth of about 28 g (1 oz.) (Brassard and Bernard 1939). The ears open at about 24 days, eyes at 39 days, and by 7 to 8 weeks of age they are active enough for the mother to move them to another den (or succession of dens) for subsequent rearing (Ruggiero et al. 1998). Male parents do not provide care for the young, though by excluding other males from their territories, they may indirectly increase prey availability for the females and their young (Clark et al. 1987). Young are typically weaned at 18 weeks of age (Strickland

and Douglas 1987), and may begin dispersing from the natal area as early as August, continuing through the following summer (USFWS 2015).

Females may mate as early as 15 months of age and, because of delayed implantation, typically give birth at about 24 months of age (Strickland et al. 1982). The proportion of adult females that may attempt breeding can be related to environmental conditions (severity of winter and availability of prey). In a Canadian population of the American marten only about 50% of adult females became pregnant in environmentally stressful years (Thompson and Colgan 1987); however, it is possible the relatively mild conditions within the Humboldt marten's geographic range may mean that a higher proportion of females may be pregnant each year (Slauson et al. 2017). Although data for Humboldt martens are lacking, female martens of other subspecies achieved highest reproductive potential between 3 and 5 years of age (Mead 1994, Fortin and Cantin 2004).

In a radio telemetry study of Humboldt martens in northwestern California (Early et al. unpublished presentation 2016), 11 females were collared and monitored to determine reproductive fates. Over the course of the three year study (2014 – 2016) researchers were able to obtain breeding season information on adult females on 16 occasions by monitoring some of the collared animals through more than one breeding seasons. There were 12 reproduction attempts amongst the 16 breeding seasons monitored (75%). All but one of the 12 reproduction attempts produced kits (94%). Of the 20 kits produced, 17 survived to weaning (Early et al. unpublished presentation 2016).

Humboldt marten survival rates between age classes for males and females are not known. In California, Pacific martens seldom survive longer than 5 years in the wild (USFWS 2015, Slauson 2017). Building upon the population model for martens developed by Buskirk et al. (2012), Slauson et al. (2017) posited age-class specific survival rates for Humboldt marten of 0.50 for juveniles (i.e., from birth to age 1 year) and 0.70 for all adult age classes (from age 1 year to age 2 years, age 2 to 3 years, 3 to 4 years, etc.). The model indicates that population growth is most influenced by adult, and secondarily by juvenile, survival rates. Therefore higher rates of adult marten mortality, such as from predation, would have large impacts on population growth, overall population size, trend, and rates of recovery after population decrease (Slauson et al. 2017).

Diet and Food Habits

North American martens require 15-25% of their body mass in prey daily to meet their energetic requirements (Gilbert et al. 2009). The diet of Humboldt martens consists primarily of small mammals and birds, along with lesser amounts of reptiles, insects, and berries (Slauson et al. 2017). Humboldt marten diets shift seasonally, with berries consumed more frequently in the summer and fall than at other times of the year (Slauson et al. 2007, Slauson and Zielinski 2017).

A recent investigation of the diets of Humboldt martens in California estimated the proportion of metabolizable energy (ME) contributed to the marten diet from various prey items (Slauson and Zielinski 2017). Using the results of scat analysis, an average of 72% of Humboldt martens' metabolizable energy came from mammals, 22% from birds (most frequently Stellar's jays), with berries, insects, and reptiles collectively contributing <10% (Slauson and Zielinski 2017). Mammals were the most important food source by ME in all seasons, with squirrels and chipmunks comprising 42% of the mammalian ME, and voles and mice comprising 20.6%. In order of importance, Siskiyou chipmunks, red-backed voles, Douglas' squirrels, and flying squirrels constituted the majority of year round mammalian ME. Red-backed voles, Douglas' squirrels, and flying squirrels reach their highest densities in late-successional conifer forest stands where the foods they specialize on (conifer seeds and truffles) can be found, while chipmunks, flying squirrels, and overall small mammal abundance are positively correlated with ericaceous shrub density (Smith et al. 2002 and Luoma et al. 2003 *reviewed in* Slauson et al. 2017).

In summer and fall ground-dwelling squirrels and chipmunks predominate the mammalian prey while arboreal (tree-dwelling) squirrels predominate in the winter and spring. While voles are a major dietary component of most North American martens (Martin 1994), voles were not found to be the dominant Humboldt marten prey species in any season (Slauson and Zielinski 2017). Compared to the studied diets of other North American martens, the Humboldt marten in California has a more diverse diet, depends less on voles, and includes more birds (Slauson and Zielinski 2017).

The only significant insect food consumed appeared to be the adults and larvae of wasps and bees. Berries constituted 98.5% of the plant matter consumed, primarily salal, evergreen huckleberry, California red huckleberry, and manzanita (*Arctostaphylos sp*.) fruits. Berries were consumed most often in summer and fall (Slauson and Zielinski 2017). While invertebrates and berries contribute little energy to the Humboldt marten diet, they may be important nutritionally (Slauson and Zielinski 2017). Reptiles also composed a relatively small proportion of the diet; however, they were more important in the spring and summer (12% and 10% of ME respectively), when predation on mammals was lowest.

Diets of Humboldt martens in coastal shore pine habitat in central Oregon appear to differ from California Humboldt martens. Eriksson et al. (in review) quantified the frequency of dietary items in Humboldt marten scats and found voles to be the most frequent mammalian prey (present in 55% of scats) while chipmunk remains were present in only 2% of examined scats. Bird remains were detected in 55% of scats on an annual basis, and 88% of scats collected in the winter. Although frequency data is not directly comparable to ME data, this suggests that larger mammalian prey (chipmunks and squirrels) are less important prey items of martens in Oregon shore pine habitat compared to martens in old forest and serpentine habitats in California, and that birds may be more important.

No major differences were observed between the diets of male and female Humboldt martens nor between adult and subadult diets (Slauson and Zielinski 2017). However, recent research on Sierra martens has revealed that male and female diets differ most during the denning season when females utilize large- and medium-sized sciurids much more than males to support the increased energetic demands of raising kits (Slauson and Zielinski in review). This research indicates the availability of Douglas' squirrels may be critical to the nutritional needs of female martens at the onset of the breeding season. The diets of reproducing Sierra marten females was found to shift to include more small, ground-dwelling prey species as young approached independence, presumably while teaching hunting skills to their young (Slauson and Zielinski in review). Whether Humboldt martens make similar shifts in prey species related to reproduction is currently unknown.

Surprisingly, dusky-footed woodrats (*Neotoma fuscipes*) appeared in only one of the scat samples analyzed by Slauson and Zielinski (2017). Woodrats are a widespread and often abundant small mammal in coastal redwood (*Sequoia sempervirens*) forests. They are especially abundant in regenerating (<20 year-old) stands in managed forests (Hamm and Diller 2009). Although woodrats would seem to be ideal prey for martens based on their size and microhabitat use, it may be that bobcat prevalence in younger forests effectively precludes martens from taking them. Woodrats (and brush rabbits [*Sylvilagus bachmani*], another herbivore found in young forest stands) are the dominant prey of both bobcats and fishers in managed forests (K. Slauson unpublished data). The risk of predation from, and competition with bobcats may effectively preclude Humboldt martens from utilizing this abundant prey resource (K. Slauson pers. comm. 10/17/2017).

Predators (see also Threats below)

Known predators of martens in western North America include coyote (*Canis latrans*), red fox (*Vulpes vulpes*), bobcat, and great horned owl (*Bubo virginianus*) (Thompson 1994, Bull and Heater 2001). Fishers are also known to kill martens, and the distribution of fisher populations may limit the distribution of marten (Krohn et al. 2004, USFWS 2015). In a recent study of radio-telemetered Humboldt martens (Slauson et al. 2014), nine mortalities of martens were observed (including eight collared martens and one uncollared marten) over the course of two years. All nine of the martens that died were either confirmed or determined likely to have been killed by bobcats (Slauson et al. 2014). Slauson (K. Slauson unpublished presentation 2017) reviewed several North American marten research projects (Thompson 1994, Hodgman et al. 1997, Ellis 1998, Bull and Heater 2001, Raphael 2004 [see also Wilk and Raphael in press], and McCann et al. 2010) which found predation to be an important source of mortality in monitored marten populations. Among these studies, Slauson (Slauson et al. 2017, and K. Slauson unpublished presentation 2017) noticed a correlation between the intensity of timber harvest in the study areas and the proportion of marten mortality attributed to predation by larger-bodied generalist carnivores including bobcats. In the three study sites located in areas with high timber harvest rates and a mosaic of young forest stands and edge habitat, bobcats were the predominant predator (Bull and Heater 2001, Raphael 2004, Slauson et al. 2014).

Home Range and Territoriality

Martens are intrasexually territorial—adults exclude members of the same sex from their home ranges, but not members of the opposite sex (Powell 1994, Powell et al. 2003). Intrasexual territoriality is believed to benefit adult females energetically by reducing direct competition from other females for prey, and adult males by providing exclusive reproductive access to females within their home ranges.

Pacific marten home ranges in the Sierra Nevada vary from 130 to 733 ha (321 – 1,811 ac.) for males and from 70 to 580 ha (173–1,433 ac.) for females (Simon 1980, Spencer 1981, and Zielinski et al. 1997 *reviewed in* Buskirk and Zielinski 1997; Moriarty et al. 2016b). The limited available information from three collared male Humboldt martens in California indicates home ranges are similar in size to Sierra marten, in the range of 300 – 400 ha (741 – 988 ac.) (Slauson et al. 2017). Moriarty et al. (2016) estimated the average fall home range areas in coastal Oregon to be 280 ha (692 ac.) for three males and 65 ha (160 ac.) for eight females, and Moriarty et al. (2017) calculated wintertime home ranges of three male Humboldt martens in shore pine habitat of 181 – 431 ha (447 – 1,065 ac.) and 78 – 90 ha (193 – 222 ac.) for three females.

Dispersal

Humboldt marten kits begin dispersing from their maternal home range as early as August and dispersal continues through at least the following summer (Slauson et al. 2017). Although dispersal distances in excess of 70 km (43.5 mi) have been reported (Fecske and Jenks 2002), the average dispersal distance of North American martens is typically less than 15 km (9.3 mi) (Phillips 1994, Broquet et al. 2006, Pauli et al. 2012 reviewed in both USFWS 2015 and Slauson et al. 2017).

CONSERVATION STATUS

Regulatory Status

The Humboldt marten is not currently listed as threatened or endangered in California under the CESA or the ESA. However, California Fish and Game Code section 2085 extends all of the protections afforded threatened and endangered species to those species under review in response to accepted petitions. Accordingly, during the current candidacy period CESA's legal protections are in place for the Humboldt marten until the Commission adopts findings either formally listing the species or rejecting the petitioned action.

The Humboldt marten is currently designated as a Species of Special Concern by the Department (CDFW 2017). Species of Special Concern (SSC) are species, subspecies, or distinct populations of vertebrate animals native to California that have been extirpated from the state, are ESA (but not CESA) listed as Threatened or Endangered, have naturally small populations or are experiencing serious population or range declines that could qualify them for Threatened or Endangered status. SSC is an administrative designation that conveys no formal legal status or protection. The intent of SSC status is to focus attention on animals at conservation risk, stimulate research on poorly known species, and achieve conservation and recovery of these animals before they meet criteria for listing as threatened or endangered under CESA (CDFW Species of Special Concern website accessible at https://www.wildlife.ca.gov/Conservation/SSC).

A Mammal Species of Special Concern list update is currently underway. This project ranks the conservation concern of all native land mammals (both species and subspecies) using eight criteria, including population size and trend, geographic range size and trend, level of threats, endemism in California, population concentration, and expected impact of future climate change. After species experts scored each of California's 588 land mammal species and subspecies, the scores were peer reviewed by other experts to determine final scores and to propose the highest ranking for designation as Species of Special Concern. Given the Humboldt marten's small and diminished geographic range, the very small estimated population size, and the degree of threats from various factors, the subspecies scored among the highest levels of concern for California mammals, with scores similar to several federally and/or state-listed mammal taxa. If the Humboldt marten is not listed as threatened or endangered, it is expected to be designated as Priority 1 status in the updated Mammal Species of Special Concern list (Scott Osborn pers. comm., 5/15/2018).

On United States Forest Service (USFS) lands in Region 5 (which encompasses all of California), the Humboldt marten is designated a Sensitive Species and a Priority Species. Its Sensitive Species status requires management projects subject to the National Environmental Policy Act (NEPA) to analyze impacts to the species; however, this obligation carries no attendant requirement to minimize or mitigate impacts to the species.

Habitat Essential for the Continued Existence of the Species (FGC § 2074.6)

The Department considers all currently occupied Humboldt marten habitat (Extant Population Areas, see discussion below) essential for the continued existence of the species in California. Additionally, suitable but apparently unoccupied habitat near the currently occupied habitat (Population Re-establishment Areas, see below) is also considered essential for species. Further, additional habitat that is not currently suitable but which could be restored to suitability within the near term should also be considered essential.

This determination is based on analysis of information provided by Slauson (2003) and Slauson et al. (2017). For example, Slauson (2003) summarized the condition and management of the currently occupied Humboldt marten range by stating:

> A significant number of marten detections (38%) occurred on lands (private industrial timberlands and USFS matrix lands) that are available for logging currently and lack strategies to maintain suitable marten habitat ... Both martens and their habitat are patchily distributed

> in the area, and further loss or degradation of limited suitable habitat could decrease the chances for the persistence of this remnant population. A conservation strategy based solely on measures to maintain current conditions for this population is unlikely to ensure its long-term persistence. The two major challenges for persistence and restoration of the coastal California marten population are: 1) the longer a population remains small, the greater the chance that it will lose its genetic variation (Nei et al. 1975) or that it will be eliminated due to stochastic demographic or environmental events (e.g., wildfire), (Fager 1991); and 2) restoration of forest habitats with the structural characteristics necessary to be suitable for martens may take many decades.

Based on figures in Slauson et al. (2017), approximately 81,000 ha (200,155 ac.) of currently suitable or recruitable habitat exist in two Extant Populations Areas (EPAs, the geographic range of the known extant reproductive population based on verified Humboldt marten detections and a 2 km-wide (1.24 mi.) buffer of the surrounding suitable habitat)) in California (Figure 4). If fully saturated, and assuming non-overlapping adult female home ranges of 350 ha (865 ac.), which is intermediate to those reported for Sierra martens (Buskirk and Zielinski 1997), the EPAs could support approximately 231 female home ranges. The four Population Reestablishment Areas (PRAs, areas of modeled suitable habitat in patches large enough to support at least five female marten home ranges which are currently unoccupied or support fewer than five females) identified in Slauson et al. (2017) encompass 198,713 ha (491,031 ac.), which could theoretically support a maximum of an additional 568 female marten home ranges were martens able to colonize them. Therefore, existing habitat in California, if fully saturated and assuming non-overlapping female home ranges could be expected to support 800 or fewer adult females. These crude estimates should be considered unrealistically high because a species rarely occupies all the habitat that is suitable, and the estimate assumes an optimal spatial arrangement of the home ranges within suitable habitat. Additionally, the PRAs are currently thought to be unoccupied. Establishment of populations within these areas may require active translocation of individuals, restoration of functional habitat, or both.

Active forest management within areas essential to the continued existence of the Humboldt marten may be appropriate to promote the development of quality Humboldt marten habitat. For example, areas which are not currently suitable habitat could be thinned to open canopies for the promotion of dense shrub layers and the recruitment of large tree structures. Additionally, landscape-scale planning and management would be required to balance the promotion and retention of large patches of high quality habitat with the risk of catastrophic habitat loss from wildfire. All six areas, especially the four PRAs, are a mix of suitable and unsuitable habitat conditions. Management actions aimed at increasing suitability (availability of structural elements, dense shrub layer, and closed overstory canopy) over time could increase the number of marten home ranges supported over current conditions and reduce the threats associated with fragmented habitat in these areas; however, it would take decades for these changes to occur (Slauson 2003).

Even if suitable habitat in these six areas were fully developed and fully occupied, Humboldt martens would number no more than 800 adult females, and only an approximate 20% of the historical geographic range in California would be occupied (Slauson et al. 2017). This number, added to the number of adult male martens that would also occupy the area, is at or below the theoretical minimum viable population size thresholds for mammal populations of several thousand individuals (Traill et al. 2007). Therefore, additional areas within or adjacent to the historical range would need to be evaluated for the potential to provide or recruit large patches of suitable habitat capable of supporting a larger marten population more resilient to extinction. Evaluations of potentially recruitable habitat would need to consider the distribution and composition of forest stands in future climate scenarios. Absent

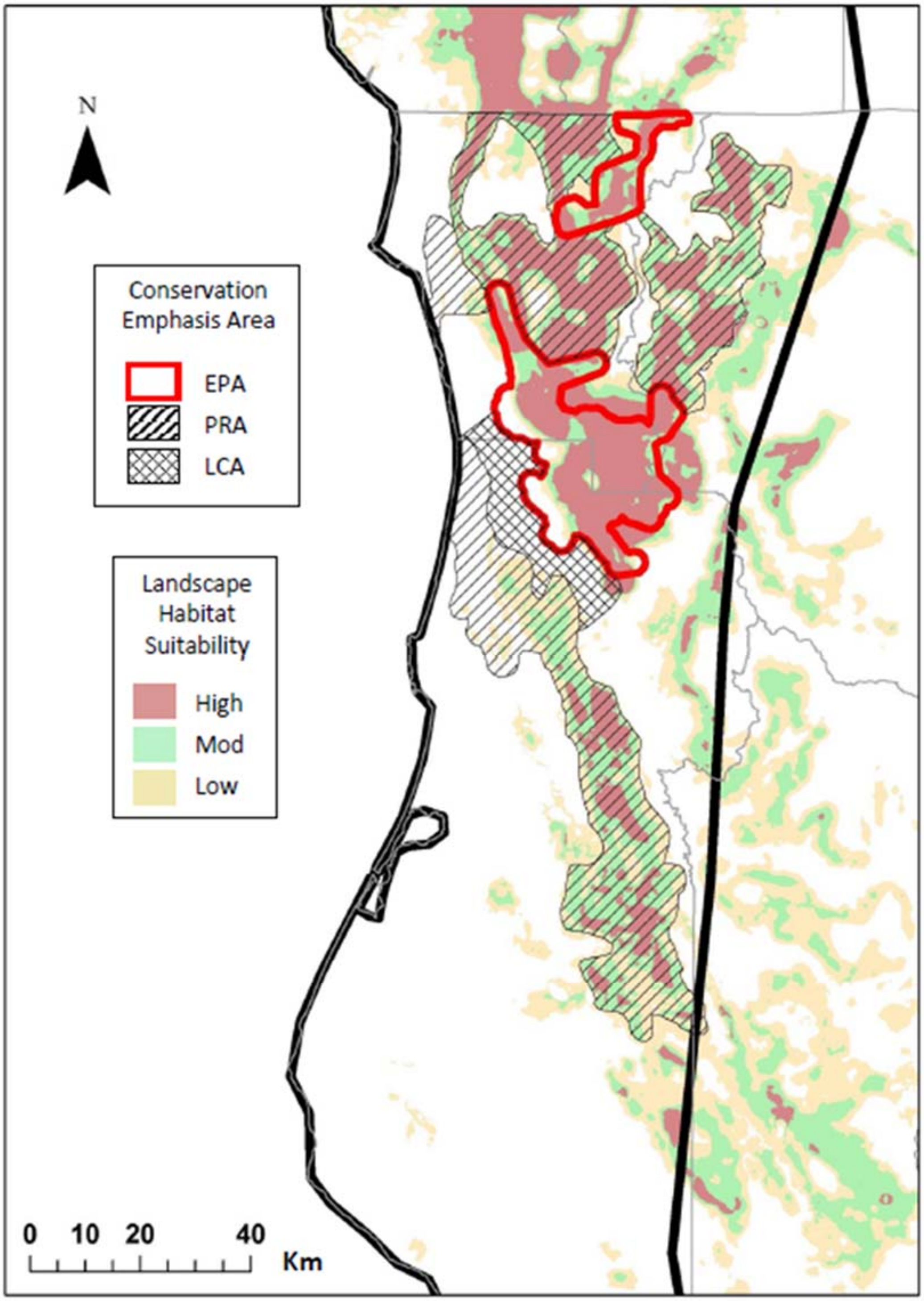

Figure 4. Extant Population Areas (EPA); Population Re-establishment Areas (PRA) - currently unoccupied areas of suitable habitat ≥ 1,500 ha (3,707 ac.); and Landscape Connectivity Areas (LCA) – areas with capacity to provide functional dispersal zones between EPAs and PRAs from *A Conservation Assessment and Strategy for Humboldt Martens in California and Oregon* (Slauson et al. 2017). Landscape Habitat Suitability was calculated by Slauson et al. (in review) and derives from measures of late seral forest (OGSI), precipitation, and serpentine soil.

the protection and recruitment of additional suitable habitat, Humboldt martens are likely to remain at risk of extirpation in California in the foreseeable future due to one or a combination of the threat factors discussed in this report, including high rates of predation, effects of small population size, and impacts from stochastic (random, unpredictable) events such as wildfire.

Range and Distribution Trends

Historically, Humboldt martens ranged from the coastal forests of northwestern Sonoma County north to Curry County Oregon within the narrow humid coastal zone ≤35 km (22 mi.) from the coast (Grinnell et al. 1937, Kucera 1998, Zielinski et al. 2001) (Figure 1). In California, records of occurrence exist from Colusa, Del Norte, Glenn, Humboldt, Lake, Mendocino, Siskiyou, Tehama, and Trinity Counties (California Natural Diversity Database accessed October 23, 2017), but when the habitat affinities of Humboldt and Sierra martens are considered along with recent genetic research (Schwartz and Pilgrim 2017), marten records from Colusa, Glenn, Lake, and Tehama Counties should be attributed to the Sierra marten subspecies rather than Humboldt marten (Slauson and Zielinski 2007b).

The historical range described by Grinnell et al. (1937) was roughly 22,000 km^2 (8,500 mi^2), although not all of the habitat within the bounds of the historical range would have been suitable or occupied. Within the historical range, the distribution of marten record locations is uneven, with concentrations of records from northern Lake and east-central Mendocino County, an area southeast of Eureka, and near the intersection of Del Norte, Humboldt, and Siskiyou counties (Figure. 2). By the 1940s, a significant decline in Humboldt marten trapping returns and a retraction of the southern end of the range had been noted (Anonymous 1920, Twining and Hensley 1947). Zielinski et al. (2001) conducted an exhaustive review of historical coastal marten records from California, Oregon, and Washington including published reports, museum specimens, unpublished notes of naturalists and trappers, and interviews of tribal members and others. Based on their review they concluded that a significant reduction in occupied range has occurred.

The Department is aware of Humboldt marten records only from Del Norte, northern Humboldt, and extreme western Siskiyou Counties in the last 25 years (California Natural Diversity Database query October 22, 2017) despite the fact that surveys during that period covered a much larger portion of the historical range (USFWS 2015). The occupied range (as of year 2008) as circumscribed by a minimum convex polygon drawn around detection locations was found to be 627 km^2 (242 mi^2) by Slauson et al. (2009b). Since that time, the known occupied range has expanded slightly with two detections of Humboldt martens a few kilometers from the coast in Prairie Creek Redwoods State Park, first in 2013 and most recently in 2017 (CDFW 2014, K. Slauson pers. comm. 10/10/2017); and additional detections near the Oregon border (Slauson et al. 2017). The martens detected in Prairie Creek Redwoods State Park were not detected during rigorous surveys in the same area in 2002, thus they are likely recent emigrants from the core population (Slauson pers. comm. 10/10/2017). Despite these recent expansions in the known range, Humboldt martens appear to have been extirpated from >93% of their historic range in California (Slauson et al. 2009b, Slauson et al. 2017).

Although martens were historically distributed throughout the coastal regions of Oregon, there are currently just two disjunct coastal populations of Humboldt martens (Grinnell et al. 1937, Moriarty et al. 2016), (Figure 3). In Oregon, the range appears to have remained unchanged since 2001; however, there are no indications that the population is expanding (Moriarty et al. 2016).

Population Size and Trend

From 1945-1995 Humboldt martens were virtually undetected in California, leading some to speculate that the species had gone extinct until they were again detected in 1996 (Kucera and Zielinski 1995, Zielinski and Golightly 1996, Slauson and Zielinski 2004, Slauson et al. 2009b). Based on changes in estimated occupancy from surveys in the modern era the population appears to have declined by over 40% over the period 2000-2008, and then remained unchanged during the period 2008-2012 (Slauson et al. 2009b, USFWS 2015). In the only contemporary population estimate, Slauson et al. (2009b), estimated the extant Humboldt marten population in California consisted of less than 100 individuals. Since that time an additional population area has been discovered and estimates of the California population have increased slightly, but it remains below 200 individuals (Slauson et al. 2017). Moriarty et al. (2016) detected a minimum of 28 unique Humboldt martens in coastal Oregon during surveys in 2015, and concluded "martens in coastal forests are rare and likely limited by unknown factors, especially compared to their former range." Additional surveys in the central coastal Oregon shore pine population resulted in an estimate of 71 adult martens in that population alone (Linnell et al. 2018). It is not known if Oregon populations are in contact with California populations facilitating the exchange of genes between the two states.

Historically Humboldt martens appear to have been more common and widespread. Grinnell et al. (1937) stated that Humboldt martens were "fairly numerous" in "earlier years", though apparent declines in the Humboldt marten population, at least locally, were noted as early as the 1920s. The authors report a tale of one trapper capturing 50 Humboldt martens in a single winter near Fortuna, California. While no rigorous historical population estimate exists, one can reasonably infer from the recorded anecdotal information that the number of martens present at that time was larger than the population present in the 1990s when no detections of the species had been recorded for the previous 50 years (Zielinski and Golightly 1996).

THREATS

Trapping

Early trapping of Humboldt marten was intensive, with accounts of individual trappers taking 35-50 martens in a single winter (Grinnell et al. 1937). By the early 1900s annual harvest of Humboldt martens was already declining, prompting Joseph Dixon to call for closing the trapping season in California to prevent an extirpation; however, marten harvest continued until a partial closure was enacted in northwestern California in 1946, depleting populations and likely reducing genetic variation within the remaining population (Dixon 1925, Twining and Hensley 1947, Zielinski et al. 2001).

Today trapping of all martens is prohibited statewide (§ 460, Title 14, California Code of Regulations (CCR)), although it is possible that Humboldt martens could be inadvertently taken by trappers pursuing other fur bearers or nongame mammals that may be legally harvested for recreation, commerce in fur, or depredation. Trapping in California is highly regulated, and trappers must pass a Department examination demonstrating their skills and knowledge of laws and regulations prior to obtaining a license (Fish & G. Code § 4005). Additionally, only live-traps may be used to take furbearers or nongame mammals for recreation or commerce in fur and trappers are required to check traps daily and release non-target animals (*Id*. §§ 3003.1, 4004, and, 4152 and § 465.5, Title 14, CCR). With the passage of Proposition 4 in 1998, body-gripping traps (including snares and leg-hold traps) were banned in California for commerce in fur and recreational trapping (*Id.* § 3003.1). Trapping records indicate that there were no licensed fur trappers operating in Del Norte County from 2010 to 2016, and fewer than two trappers operating annually in Humboldt County in the same period suggesting a very low probability of Humboldt marten bycatch (California Automated License Data System 2018). However, some body-gripping traps may be used by licensed trappers for purposes unrelated to recreation or commerce in fur, including protection of property or by government employees, or their authorized agents, while acting in their official capacities (*Id.* § 3003.1 and § 465.5, Title 14, CCR).

Trapping of Humboldt martens remains legal in neighboring Oregon where trappers are required to obtain a trapping license and take an educational course (Hiller 2011). In recent years only four to eight trappers per year reported pursuing martens in Oregon (Hiller 2011). Oregon trapping records are organized by county making it difficult to determine if reported trapped martens were coastal Humboldt martens or interior *Martes caurina caurina*. Review of trapping record from 2007 to 2016 indicates that as many as nine Humboldt martens may have been trapped in Oregon (D. Broman pers. comm. 3/17/2017). Linnell et al. (2018) modeled Humboldt marten population viability in a coastal shore pine population and determined that the annual removal of two to three individuals from the population from human causes such as trapping and road kills would greatly increase the likelihood of extirpation within a 30-year period.

Trapping pressure on Humboldt martens was intense during the late 1800s and early 1900s, and very likely resulted in significant declines in population size as well as a dramatic reduction in range. There have been no studies on the population level effects of Humboldt marten trapping, but the loss of even a few adult martens, especially when combined with other mortality sources, could reduce the likelihood of long-term population viability (USFWS 2015). However, it is unlikely that trapping continues to threaten Humboldt martens in California due to the ban on trapping martens, the small number of active fur trappers, restrictions on the types of traps that may be used for other species, as well as requirements that licensed trappers check traps daily and release non-target animals.

Habitat Loss and Degradation

Changes in the structure and landscape configuration of Humboldt marten habitat can negatively impact survival, reproduction, and population connectivity of the species. In particular, timber harvest and other silvicultural treatments of older forests; wildland fires, salvage logging, and fuel reduction projects; development of coastal forests for human settlement; and the clearing of forests for the cultivation of cannabis can all lead to loss, degradation, and fragmentation of Humboldt marten habitat. The USFWS (2015) Humboldt marten species report concluded habitat loss and degradation from historical and current logging is the most plausible reason the marten is absent from much of its historical range, noting most of the remaining suitable habitat is located on federally owned land (Zielinski et al. 2001).

Forest conditions in the range of the Humboldt marten today have largely been shaped by a legacy of over 100 years of logging and timber management. It is estimated that the area of old growth conifer forest in the Pacific Northwest has been reduced by 72% since European settlement (Strittholt et al. 2006), and only 10% of the historical range of redwood forests remains in old growth stands today (Fox 1996). While timber harvest continues in the area, the logging of old growth forest stands on private and public lands has dramatically slowed from peaks in the second half of the 20th Century. Today, 33% of remaining old forest on federal lands in the Northwest Forest Plan area is fully protected from harvest, and 80% is afforded some level of management protection (Strittholt et al. 2006). The rate of timber harvest on private lands in the area has declined in recent decades due to more restrictive regulations and market conditions (Figure 5). Harvest on federal lands declined sharply following implementation of the Northwest Forest Plan in 1994 (Strittholt et al. 2006) (Figure 6). The area of older forests (forests with structural development typical of stands ≥200 years old) on federal lands in the coastal and Klamath mountains of northwestern California declined 8.4% from 1993-2012, largely due to wildfires, while the area of older forests on non-federal lands increased 1.3%, despite losses to timber

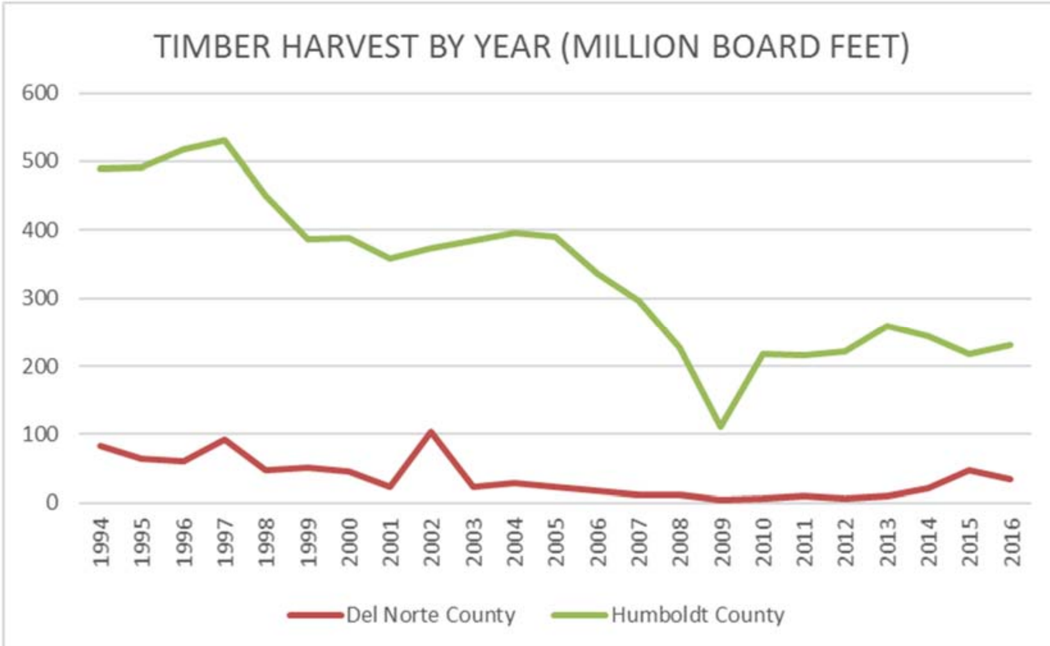

Figure 5. Annual volume of timber harvested 1994 - 2015 in Del Norte and Humboldt Counties. Source: California State Board of Equalization.

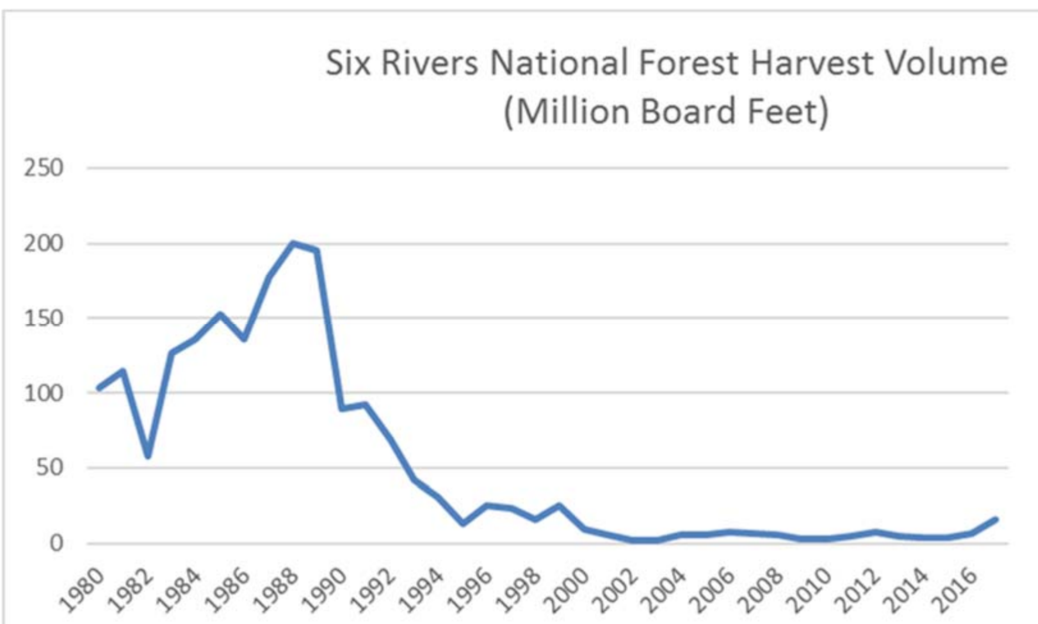

Figure 6. Annual volume of timber harvested 1980 - 2017 from the Six Rivers National Forest. Source: Headwaters Economics.

harvest (Davis et al. 2015). While recent losses of old forest stands in the Humboldt marten range have been relatively small, forest stands degraded and fragmented from historical logging will take decades to recover dense ericaceous shrub layers and centuries to recruit the large tree structures needed to restore high quality Humboldt marten habitat conditions (Slauson and Zielinski 2009).

Wildfires and associated salvage logging of damaged trees can threaten the already small Humboldt marten population by reducing and fragmenting the remaining habitat (Slauson and Zielinski 2004). On federal lands in north coastal California there was a net 5.6% loss of old forest habitat over the period of 1993-2012 despite gains from forest succession (Davis et al. 2015). This loss was primarily attributed to wildfires. Connectivity between old forest stands was found to have decreased over the same period, mainly due to fragmentation caused by wildfires (Davis et al. 2015). In southwest Oregon the 2002 Biscuit Complex Fire burned 229,388 ha (566,829 ac.) and the 2017 Chetco Bar Fire burned an additional contiguous 77,346 ha (191,125 ac.) between the southern Oregon Humboldt marten population and the California – Oregon border population, perhaps functionally isolating the two populations from one another (GeoMAC Wildland Fire Support data).

Vegetation management activities designed to reduce the risk of wildland fire by removing shrubs, reducing canopy cover, and removing snags and logs impacts martens by removing required habitat structures and shrub cover which can reduce prey abundance and improve access for competitors (USFWS 2015). On federal lands, salvage logging and fuels management activities can occur on all land allocation categories except for wilderness areas (Hamlin et al. 2010), and on private lands salvage logging plans are exempt from normal review procedures and are automatically approved by the California Department of Forestry and Fire Protection (CAL FIRE) through a ministerial process if all applicable Forest Practice Rules are abided (Title 14, CCR §1052).

While thinning and fuel reduction management can fragment and degrade Humboldt marten habitat, it is important to note that severe wildfires can also substantially fragment and degrade marten habitat. However, Moriarty et al. (2017) found that implementing fuel reduction treatments (mechanical or prescribed fire) on as little as 10-20% of the landscape significantly reduced the probability of Pacific marten habitat loss from wildfires. Credo (2017) also modeled how effectively prescribed fire and mechanical thinning fuel reduction treatments in and surrounding marten habitat would limit the spread of large wildfires. He found that in nearly every case treating only the landscape outside of predicted marten habitat was equally as effective as conducting fuel reduction treatments in marten habitat, so long as at least 30% of the landscape is available for treatment. However, modeling also showed that excluding fuel treatments from all predicted marten habitat in watersheds increased the risk of net loss of marten habitat from wildfires over time. Management for the creation and conservation of resilient Humboldt marten habitat will require land managers to carefully plan for both habitat patches and fuel reduction zones over the landscape over time.

Habitat loss and degradation from human settlement and residential development rapidly increased in the 1850s when pioneers of European descent began harvesting lumber, farming, mining, and fishing along California's north coast (Del Norte County Community Development Department 2003). Since that time minor portions of the historical range have been converted from forests to urban areas, primarily in and around Crescent City, Humboldt Bay, Fortuna, Fort Bragg, and Willits; and much of the historical range south of Del Norte County has been parceled and occupied by very low density housing (≤1 housing unit/16 ha [40 ac.])(Cal Fire 2010). However, the core population area currently occupied by Humboldt martens in California is almost entirely unoccupied by humans, with the exception of some areas adjacent to the Klamath River on Yurok Tribal lands (Cal Fire 2010). Low-density human occupancy does not necessarily equate with the loss of mature forest habitat favored by martens but human occupancy likely renders such areas unsuitable for martens. Impacts from the presence of humans, livestock, and pets, the construction and use of rural roads, and the use of household pesticides can frighten wildlife away, introduce novel predators, diseases, and toxicants, deplete prey populations, and degrade and fragment habitat (Merenlender et al. 2009). While further human development of the historical range will likely continue into the future, a modeled analysis of future land conversions under several human population growth scenarios found the probability of significant conversions to urban and agricultural uses in the northwest California coast region to be very low for the remainder of this century (Sleeter et al. 2017).

Large-scale marijuana cultivation in remote forests throughout California has increased since the mid-1990s, coinciding with the 1996 passage of Proposition 215, the Compassionate Use Act of 1996 (Health & Safety Code, § 11362.5), which allowed the legal use and growth of marijuana for certain medical purposes (Bauer et al. 2015). Humboldt and Del Norte counties are known centers of legal and illegal cannabis cultivation in California due to the remote and rugged nature of the land and abundant water sources (National Drug Intelligence Center 2007, Bauer et al. 2015). The recent passage of California Proposition 64, the Control, Regulate and Tax Adult Use of Marijuana Act, further decriminalized the adult use of cannabis for recreational use beginning in January 2018. In 2017, the California Legislature approved the Medical and Adult Use of Cannabis Regulation and Safety Act which provides state and local governments the authority to regulate the production and processing of cannabis products, including regulation of the environmental impacts from growing cannabis. It remains to be seen what effect these new laws will have on the conversion of forests for the production of cannabis. A recent study found the majority of cannabis cultivation sites in Humboldt County were located >500 m (1,640 ft.) from the nearest road, indicating cultivation may contribute to landscape fragmentation, although the amount of land area under cannabis cultivation was found to be minor, at less than 1% of the land under organic crop cultivation (Bustic and Brenner 2016). The extent to which land clearing for legal and illegal cannabis cultivation contributes to Humboldt marten habitat loss and degradation is unknown.

The following requisite Humboldt marten habitat features may be particularly at risk from habitat loss and degradation resulting from the above activities:

Large Tree Structures

The large tree structures used by Humboldt martens for resting, denning, and cover from predators were typically removed during timber harvests, both during initial harvests of original-growth forests as well as through harvest of "residual" old growth trees in subsequent entries in second-growth forests (Slauson et al. 2010, USFWS 2015). Delheimer (2015) compared the availability of potential Humboldt marten rest site structures (large trees, snags, logs, slash piles, platforms, and cavities) in occupied and unoccupied second-growth forest study sites in northern California and found there were significantly more structures available in the occupied sites. Large diameter trees, snags, and downed logs with cavities and platforms used as resting and denning structures by Humboldt martens are significantly reduced in second-growth forest stands compared to old growth stands (Slauson et al. 2003, Slauson et al. 2010). In Douglas-fir stands these structures begin to rapidly accumulate at 200-350 years of age (Franklin et al. 2002) and in second-growth stands it is estimated that it could take more than 200 years to recruit such structures (Slauson et al. 2010). The minimum age of live and dead tree structures used for resting by martens in north coastal California was 176 and 254 years, respectively (Slauson and Zielinski 2009).

Other silvicultural treatments also reduce marten habitat structures. For example thinned stands (n=26) have been found to have significantly fewer potential resting and denning structures than Humboldt marten-occupied stands (n=7) (Slauson et al. 2010). Conversely, retention of woody structures during timber harvests (platforms in large trees, large diameter snags, slash piles, large diameter cull logs) appears to increase the probability of retaining marten populations in harvested forests (Slauson et al. 2010, Delheimer 2015).

Tree and Shrub Canopy Cover

Humboldt marten habitat suitability is reduced under most of the commonly used timber harvest methods, both through overstory canopy cover reduction and through loss of dense ericaceous shrub layers (Allgood 1996, USFWS 2015). Shrub layers can be destroyed or degraded through conifer stand management which favors trees over shrubs (such as mechanical brush clearing and application of herbicides that target shrub species) and through the competitive exclusion of densely planted conifers which shade out understory shrubs (Franklin et al. 2002, Slauson et al. 2010). Under the Z'berg – Nejedly Forest Practices Act, even-aged silvicultural methods on industrial north coast timberlands may completely eliminate post-harvest canopy cover in clear cuts over areas of up to 16 ha (40 acres). In practice, openings in Green Diamond Resources Company even-aged harvest units average approximately 6 ha (15 ac.)(Green Diamond Resource Company 2017). Such conditions, which are typically avoided by Pacific marten (Slauson 2017), persist for years until the regenerated stand achieves suitable canopy closure

Shrub cover has been found to be more patchily distributed in thinned stands than in old growth stands on federal forest lands (Slauson et al. 2010). Dense regenerating conifer stands that were thinned were found to regenerate moderately dense shade-tolerant native species shrub layers within 15-30 years following thinning; however, shrub cover remained significantly lower than levels found in the old growth redwood stands used by Humboldt martens (Slauson et al. 2010). Given relatively short harvest rotations, typically less than 60 years (USDA 1992, Green Diamond Resource Company 2012, Yurok Tribal Forestry Department 2012) in the coastal forests of northern California, overstory conditions suitable for martens are likely to exist on only a proportion of the intensively managed landscape at any given time

Slauson et al. (2010) found that shrub flowering and fruiting are greatly reduced in stands thinned within the prior 30 years compared to stands occupied by martens. Only 38% of thinned stands were observed with a fruiting or flowering shrub component, compared to fruiting or flowering in 100% of old forest stands occupied by Humboldt martens. In addition to directly providing food for martens, fruiting shrubs support greater densities of marten prey animals such as small mammals, hornets and migratory birds (Slauson et al. 2010).

Vegetation management activities designed to efficiently produce timber and reduce the risk of wildland fire by removing shrubs, reducing canopy cover, and removing snags and logs may negatively impact martens by removing required habitat structures and by removing shrub cover which can reduce prey abundance and improve access for competitors and larger-bodied predators such as bobcats.

Large-scale Habitat Fragmentation

Forest fragmentation also poses threats to Humboldt marten individuals and populations. Male and female Pacific martens in the Sierra Nevada avoided crossing open ski runs between forest patches wider than 18 m (60 ft.) and 13 m (43 ft.) respectively in the Sierra Nevada mountains (Slauson 2017).

Individuals may be forced to move over greater distances to acquire food in fragmented landscapes, increasing their energetic costs and exposing them to more predators. Populations may be impacted by reducing the likelihood of successful juvenile dispersal and the ability of breeding individuals to move safely between population areas. Fragmented habitat conditions exist throughout much of the Humboldt marten's historical and current range, and the four extant marten populations in coastal California and Oregon appear to be isolated from one another by unsuitable habitat degraded by logging, severe wildfire, and urbanization (Slauson et al. 2017). Fragmentation of habitat can also be detrimental at finer scales, where the fragments may not be large enough to support a single marten territory. For example, the Redwood National and State Parks complex contains only three patches of late-successional forest greater than 2,023 ha (5,000 ac.) in area, with most patches less than 40 ha (100 ac.) in area (USFWS 2015).

Slauson et al. (2017) concluded that early trapping combined with the extensive habitat loss and fragmentation from unregulated timber harvesting were the two factors most likely responsible for the decline in distribution and abundance of Humboldt martens. Moriarty et al. (2016) suggested habitat fragmentation (both natural and anthropogenic) is the most serious threat to martens in coastal Oregon:

> Habitat fragmentation through natural and anthropogenic alterations likely poses the largest threat to marten conservation. Marten populations decline with as little as 30% of the forest cover removed (Hargis and others 1999; Potvin and others 2000), and fuel reduction treatments typically decreased cover and connectivity in the Sierra Nevada (Moriarty and others 2015). Martens were deterred by low-canopy-cover openings, seldom moving 17 m (56 ft.) beyond cover (Cushman and others 2011), and most often moving 50 m (164 ft.) within forest patches to avoid such openings (Moriarty and others 2015).

Similarly, Credo (2017) found that Pacific martens avoided forest stands following mechanical thinning and prescribed fire treatments on the Lassen National Forest.

Degraded landscapes may lack obvious barriers to marten movement while at the same time acting as functional barriers to movement by decreasing the likelihood of daily survival and successful dispersal. American marten dispersal distances were found to decrease by approximately 50% in intensively logged forests in Ontario compared to unlogged forests, and the percent of juveniles successfully dispersing and establishing new territories declined from 49% in unlogged forests to 25% in logged forests (Johnson et al. 2009). Thompson (1994) found daily survival rates in recently harvested (3-40 year old) forest stands in Ontario were nearly five times lower than in uncut forests.

Because roads favor generalist predators that prey on martens, crossing roads to move between fragmented patches of habitat means martens are more likely to encounter a predator than if they were able to remain in dense shrub habitat (Slauson et al. 2010). Fragmentation of dense shrub stands by roads also appears to confer a competitive advantage to generalist carnivores like fishers, gray foxes (*Urocyon cinereoargenteus*), and bobcats, which compete with and prey upon martens. Slauson et al. (2010) found that 80% of camera detections of generalist carnivores such as gray fox and bobcats were on roads, while 80% of habitat specialist carnivore (e.g. fisher and Humboldt marten) detections came from areas away from roads. The majority of roads in the extant range of Humboldt martens in California are used periodically for the seasonal hauling of timber; however, U.S. Highway 101, which is a four lane highway in some sections lies between the extant core population and late seral redwood habitat in state and federal redwood parks to the west and U.S. Highway 199 closely parallels the

California-Oregon population area. These highways may constitute a significant barrier to marten movement (S. Prokop and B. Silver 6/29/2016 letter to CDFW).

The amount of Humboldt marten habitat in California has been substantially reduced since the species' range was first described by early naturalists, primarily as a result of past timber harvesting and timber production practices which removed the large tree structures and dense shrub layers martens require for denning and protection from predators. Although the rate of timber harvesting appears to have decreased in recent years, it will take centuries recruit large tree structures to replace what has been lost. Wildfire and the conversion of land to urban and agricultural uses including cannabis cultivation have also contributed to habitat loss and degradation over the last century. Where habitat remains, degraded conditions and fragmentation caused by roads, timber harvesting, cannabis cultivation, and other land use practices can limit its usefulness to the marten population. Degraded and fragmented habitats may allow larger carnivores to colonize traditional Humboldt marten habitat potentially resulting in increased rates of predation on martens. Because historical habitat loss and degradation severely limits the spatial extent of suitable habitat available to the population, it continues to pose a potentially significant threat to Humboldt martens. However, increases in the extent of mature coastal forest and reductions in habitat fragmentation from recruitment of large tree and shrub structure over the coming decades on protected lands could significantly contribute to the recovery of Humboldt martens in California.

Predation

Predation can significantly limit marten populations in the wild (Hodgman et al. 1997, Bull and Heater 2001, McCann et al. 2010, Slauson et al 2017). Known or expected predators of Humboldt martens include bobcats, gray foxes, coyotes, mountain lions (*Puma concolor*), great horned owls, goshawks (*Accipiter gentilis*), and Pacific fishers (Buskirk and Ruggiero 1994, Bull and Heater 2001, Slauson et al. 2009b, Woodford et al. 2013). Moriarty et al. (2016) detected the following potential predators at camera traps within 5 km (3.1 mi.) of known Humboldt marten detections: black bear (*Ursus americana*), bobcat, gray fox, domestic dog (*Canis familiaris*), domestic cat (*Felis catus*), coyote, and mountain lion. Gray foxes were the most frequently observed species with detections near 29% of the known marten stations. Bobcats, black bears, and domestic dogs were detected near 26%, 23%, and 11% of the known marten stations, respectively. Detections of coyotes, domestic cats, and mountain lion were less frequent, ranging from two to four percent.

Bull and Heater (2001) documented 22 Pacific marten mortalities in their northeastern Oregon radio telemetry study; of these, 18 were attributed to predation by bobcats (44%), raptors (22%), coyotes (11%), and other martens[1] (22%). The martens killed by predators accounted for 51% of the collared population over their four year study (Bull and Heater 2001). In Wilk and Raphael's (in press) study of Pacific martens in the Oregon Cascades, 35 of 47 marten mortalities were attributed to predation (74%, mostly from coyotes and bobcats). In a Humboldt marten dispersal study in California (Slauson et al. 2014), nine martens (39% of collared martens) were killed by predation over the course of less than one year, and all nine of the predation events were by bobcats. Comparing the effect of varying levels of bobcat occupancy in different watersheds in the California range of the Humboldt marten, Slauson (unpublished presentation 2017) suggests an inverse relationship between bobcat occupancy and marten occupancy, and a direct relationship between bobcat occupancy and marten predation rates.

[1] The four marten deaths attributed to other martens were all males, including two juveniles. The carcasses were not eaten, but showed trauma suggestive of fighting. The authors surmised resident male martens engaged in territorial defense were responsible for these mortalities.

Predator – Vegetative Community Interactions

Coastal forest ecosystems are complex, with tree, shrub, and herbaceous plant layers creating multiple structural layers. Historically, dense continuous shrub understories were common in mature forests in the redwood region (Morgan 1953, Allgood 1996, Slauson and Zielinski 2007a). These shrub understories have been drastically reduced in many areas and modified through a century of logging and related forest management such as burning, mechanical clearing, road building, and planting dense stands of trees which compete for sunlight with shrubs and herbs (Slauson and Zielinski 2007a). The time period over which shrub layer extent, density, and species composition drastically changed corresponded with observed reductions in Humboldt marten distribution and the observed expansion of generalist mesocarnivore (mid-sized carnivores) distributions in the redwood region (Slauson and Zielinski 2007a).

Dense shrub layers may play an important role in excluding marten predators. Most North American martens occupy areas where deep snow accumulates which effectively excludes larger carnivores with higher body mass to foot surface area ratios. It rarely snows in the coastal forests occupied by Humboldt martens, but it is thought that extensive, extremely dense shrub layers effectively exclude larger bodied carnivores and provide a niche for Humboldt martens to exploit (Slauson et al. 2010). Humboldt martens, with the smallest body size of North American marten subspecies (Hagmeier 1961), are adapted to the dense foliage and stems found near ground level in coastal forest ecosystems, allowing them to move quickly through the dense cover and successfully capture prey.

Humboldt martens appear to require dense shrub stand patches of >50-100 ha (124-247 ac.) (Slauson et al. 2007). Where shrub layers have been removed or reduced, fishers and gray foxes - both potential marten predators, have expanded their historic ranges into the previously unoccupied redwood region (Slauson and Zielinski 2007a). Conversely, in the remaining old tree conifer stands with intact dense shrub layers that Humboldt martens select as preferred habitat, fishers and gray foxes are rarely detected (Slauson 2003, Slauson and Zielinski 2007a). Humboldt martens in northwestern California showed the strongest preference for stands with ≥80% shrub cover, and avoided stands with <60% shrub cover, while fishers and foxes avoided stands with ≥80% shrub cover and used stands with <60% shrub cover in proportion to their availability (Slauson 2003); however, in the shore pine coastal dune habitat of central Oregon Eriksson et al. (in review) found Humboldt martens and gray foxes coexisting in the same habitat.

The high predation rates noted in the Pacific marten and Humboldt marten studies above occurred in areas that included intensively-managed forests. Raphael (2004 *in* Slauson et al. 2017) described his central Oregon Pacific marten study as a "high-harvest" area. Bull and Heater's (2001) 400 km^2 (154 mi^2) northeastern Oregon Pacific marten study area included a relatively small area (53 km^2) (20 mi^2) of uncut forest surrounded by an area "extensively harvested for timber (approximately 80%) and… fragmented by partial cuts, regeneration cuts, and roads." More than 90% of the Slauson et al. (2014) Humboldt marten dispersal study area had been previously harvested. Managed forests with open overstories, less dense shrub layers, and high road density appear to favor larger-bodied generalist predators such a bobcats, gray foxes, and fishers, which may prey on or kill Humboldt martens (Slauson and Zielinski 2007a, Slauson et al. 2010, Slauson unpublished presentation 2017). Fragmentation of dense shrub stands by roads also appears to confer a competitive advantage to generalist carnivores like fishers, bobcats, and gray foxes, which compete with and prey upon martens. Slauson et al. (2010) found that 80% of camera detections of generalist carnivores such as fisher, gray fox, and bobcats were on roads while 80% of marten detections came from off road areas. Because roads favor generalist predators, crossing roads to move between fragmented patches of habitat means martens are much more likely to encounter a predator than they would be if they were able to remain in dense shrub habitat (Slauson et al. 2010).

A landscape-scale habitat shift has occurred within the Humboldt marten's geographic range since the advent of industrial logging in the 20th century; from large, contiguous old forest stands with extensive dense shrub layers to a more patchy landscape of younger stands with degraded shrub layers divided by road systems. It is thought that small-bodied martens have a competitive advantage over the larger bodied carnivores when foraging and moving through dense shrub stands (Slauson and Zielinski 2007a), so this shift in habitat can disadvantage marten while simultaneously favoring larger-bodied generalist carnivores such as bobcats, fishers, and gray foxes. These changes, along with the increased density of roads in the area, appear to have allowed generalist predators to expand their distributions into areas they did not traditionally occupy and prey upon martens at higher rates than historically occurred. Although it is unknown whether predation alone threatens the existence of Humboldt martens in California, adult survival rates are known to be the most influential parameters in marten population growth models (Slauson et al. 2017, Linnell et al. 2018). Predation rates therefore potentially have a substantial influence on Humboldt marten population trends.

Competition

No data or studies were identified that assess the impacts of competition between Humboldt martens and other species and the USFWS Humboldt marten species report (2015) does not identify competition as a significant stressor on Humboldt martens. Additionally, species with very specific habitat associations, such as Humboldt marten would be expected have a competitive advantage within their preferred habitat over habitat generalist species in the same area (Ricklefs 1990, Zabala et al. 2009). Further, carnivore species typically select prey species of a certain size as a function of the predator's own mass, effectively limiting competition with smaller and larger carnivores in the same community (Sinclair et al. 2003, Owen-Smith and Mills 2008). However, Peterson et al. (in review) found that increased diversity in the predator community appears to restrict the breadth of diet diversity in Pacific martens, suggesting that competition for food resources does influence marten ecology. In coastal Oregon, Moriarty et al. (2016) detected the following potential competitor predators at camera traps within 5 km (3.1 mi.) of historical marten detections (reported as percent of camera trap sample units with detections): spotted skunk (*Spilogale gracilis*) at 41% of stations, opossum (*Didelphis viriginiana*) at 25% of stations, and short-tailed weasel at 8% of stations. Of these, only the spotted skunk is similar in size to Humboldt martens (Maser et al. 1981) and it is a habitat generalist. Eriksson et al. (in review) theorized that gray foxes, raccoons, and western spotted skunks would be the most likely dietary competitors with Humboldt martens in Oregon shore pine habitats but found gray foxes and raccoons were common in stands occupied by martens which suggests competition for food resources in shore pine habitat does not limit the distribution of martens.

There is significant overlap in the prey species of Humboldt martens, northern spotted owls (*Strix occidentalis caurina*), and barred owls (*Strix varia*); including Douglas' squirrels, flying squirrels, voles, deer mice, and songbirds (Wiens et al. 2014). While northern spotted owls and Humboldt martens have historically occupied the same range, the range of barred owls in North America has radically expanded in the last several decades; the species first being detected in northwestern California coastal forests in the early 1980's (Dark et al. 1998). The dietary overlap and shared habitat affinities of Humboldt martens and barred owls suggest competition for resources with newly-arrived barred owls may present an emerging threat to Humboldt marten populations (Holm et al. 2016). The degree of threat to Humboldt martens from competition with barred owls is unknown. However, if barred owl populations continue to increase in northern California, Humboldt marten prey species may decline, potentially decreasing the marten carrying capacity (maximum marten population size the available habitat can sustain) of the available habitat and changing the food-web dynamics of the coastal forest ecosystem (Holm et al. 2016).

Toxicants

The control of predators and other animals perceived as pests through poisoning was historically common in the western states. Two former methods had the potential to kill non-target predators such as the Humboldt marten: poisoning livestock carcasses and aerial broadcast of poisoned baits. In one report, dead fishers and martens were observed in the vicinity of poisoned ungulate carcasses in Washington State (Zielinski et al. 2001). While such practices had largely ceased by the 1970s, the historical impact on Humboldt marten population size and distribution is unknown but potentially significant. Recently the use of rodenticides and other toxicants at illegal cannabis plantations has been observed to be a widespread practice (Gabriel et al. 2018). Anticoagulant rodenticides detected near cannabis plantations in northwestern California include brodifacoum, bromodiolone, chlorophacinone, diphacinone, and warfarin. Brodifacoum and bromodiolone are considered second-generation anticoagulant rodenticides which were introduced when rodents developed resistance to first-generation compounds in the 1970s (Gabriel et al. 2012, 2013, Thompson et al. 2014). First-generation compounds generally require several doses to cause intoxication, while second-generation anticoagulant rodenticides, which are more acutely toxic, often require only a single dose to cause intoxication or death and persist in tissues and in the environment (Gabriel et al. 2012). Additionally, other highly toxic pesticides, some of which are banned in the United States, have been found at illegal cannabis grow sites (Thompson et al. 2014).

A recent study conducted on Green Diamond Resource Company and surrounding lands in Humboldt and Del Norte Counties detected anticoagulant rodenticide exposure in the tissues of 70% of northern spotted owls (*Strix occidentalis caurina*, n=10) and 40% of barred owls (n=84) examined, although none of 36 rodent livers examined had traces of rodenticides (Gabriel et al. 2018). The authors hypothesized a recent increase in cannabis cultivation sites in northwestern California may have led to the increased use of anticoagulant rodenticides in the area. In an earlier study, Gabriel et al. (2015) detected the presence of anticoagulant rodenticides in the tissues of >85% of the dead fishers tested in California. Within their northern California study area (i.e., Hoopa Valley Indian Reservation) 52 fishers were tested for anticoagulant rodenticide exposure. Seven fishers were confirmed to have died from anticoagulant rodenticide poisoning, all of which had trespass marijuana grows within their home ranges (Gabriel et al. 2015). Because fisher and martens have similar foraging habits and diets, rodenticide exposure likely also poses a significant threat to the Humboldt marten population in California (Slauson et al. 2017). In recent necropsies of deceased Humboldt martens, one out of six carcasses examined showed traces of rodenticides in its tissues (Slauson et al. 2014). Although exposure to rodenticides was not necessarily the cause of death of the exposed animals, the acute toxicity of these compounds makes it likely that the salvaged animals were either directly killed by rodenticides or negatively affected to the extent that death from other causes such as exposure, predation, or starvation became more likely.

Disease

In their Humboldt marten species report (2015), the UFSWS noted: "The outbreak of a lethal pathogen within one of the three coastal marten populations could result in a rapid reduction in population size and distribution, likely resulting in a reduced probability of population persistence, given the small size of these populations." North American martens are known to be susceptible to a variety of diseases, including: rabies, plague, distemper, toxoplasmosis, leptospirosis, trichinosis, sarcoptic mange, canine adenovirus, parvovirus, herpes virus, West Nile virus, and Aleutian disease (Strickland et al. 1982, Zielinski 1984, Williams et al. 1988, Banci 1989, Brown et al. 2008, Green et al. 2008). Although Strickland et al. (1982) found that American martens in their central Ontario study tested positive for toxoplasmosis, Aleutian disease (a carnivore parvovirus), and leptospirosis; none of the diseases was considered to be a significant mortality factor for martens. Similarly, although Zielinski (1984) discovered antibodies to plague (*Yersinia pestis*) in four of 13 Sierra martens in the Sierra Nevada, he noted martens only appear to show transient clinical signs of the disease.

Gray foxes within the current range of Humboldt martens in California are known to have been exposed to canine distemper, parvovirus, toxoplasmosis, west Nile Virus, and rabies, all of which are transmittable to martens (Brown et al. 2008, Gabriel et al. 2012). In their Hoopa Valley Reservation Study, Brown et al. (2008) found that dead fishers within the range of Humboldt marten had been exposed to canine parvovirus and canine distemper which is known to cause high rates of mortality in mustelids (Deem et al. 2000). Wengert and Gabriel (2017 unpublished report) tested 19 whole blood samples from coastal Oregon Humboldt martens for the presence of antibodies to canine distemper virus, canine parvovirus, and *Toxoplasma gondii* protozoan parasites. Detection of antibodies to a specific pathogen in a blood sample indicates the animal was exposed to that pathogen at some time in the past. Antibodies to canine distemper virus were not detected in any sample; five samples (26%) had antibodies to parvovirus; and 14 (74%) had antibodies to toxoplasma. The absence of canine distemper virus could be explained by the small sample size examined; indicate infrequent interactions between martens and infected carnivores (e.g. gray foxes, skunks, raccoons) in the community; or suggest that infected martens generally do not survive canine distemper virus infection (Deana Clifford pers. comm. 5/21/2018).

Because several potentially lethal diseases are known from the environment, a disease outbreak in one or both of the remaining Humboldt marten population areas in California should be considered a potential threat to the species. Although it is not known if this threat alone imperils the persistence of the species in California, when combined with the serious threats of small, isolated populations, habitat loss from wildland fire, cannabis cultivation and timber management, and other threats, the possibility of a catastrophic disease outbreak further reduces the certainty that the Humboldt marten population will persist into the foreseeable future.

Wildland Fire

Slauson (2003) states that stochastic events such as wildfire present a major challenge to the persistence of Humboldt marten, and the *Conservation Assessment and Strategy for Humboldt Martens in California and Oregon* (Slauson et al. 2017) classified wildfires as a serious threat over a large area of the extant population areas in California and Oregon. In the near-coastal areas occupied by Humboldt martens, conditions that promote the ignition and spread of wildfire rarely exist due to the typically wet winters and foggy summers of the local climate. However, fires become more frequent in the extant Humboldt marten range with distance inland from the coast (Oneal et al. 2006). By examining the size of recent fires in the extant range, Slauson et al. (2017) concluded that a single large fire could affect 31% - 70% of the currently occupied suitable habitat in California. Others have concluded that a single wildfire could burn an entire core population area (USFWS 2015). The effects of fires vary with the intensity of the burn and the severity of the impact on the vegetative community; ranging from high severity burns which can kill and consume most vegetation, including large tree structures, to low severity burns which consume only the ground level vegetation, leaving shrub and tree layers largely unaffected (USFWS 2015). Slauson et al. (2017) state that even a low severity burn would be likely to reduce Humboldt marten habitat suitability by reducing shrub cover; however, when a portion of the 2008 Siskiyou Complex Fire burned through approximately 25% of a studied Humboldt marten population area in the interval between surveys in 2008 and 2012, no change in marten occupancy post-fire was detected, indicating that any fire-related impacts the population were slight and/or short lived (Slauson et al. 2017). More recently in the summer of 2015, the Nickowitz fire burned approximately 2,800ha (7,000 ac.) in and adjacent to the current known range of Humboldt martens in Del Norte County, but the impact to Humbodlt martens has not been assessed (InciWeb 2015).

Wildfires can impact Humboldt martens by destroying and degrading suitable habitat thereby reducing the carrying capacity or theoretical maximum population size the landscape can support. Large, high-severity burns can create open landscapes devoid of overhead cover and the dense shrub cover martens rely on for protection from predators. These areas are likely functional barriers to marten movements and dispersal as Pacific martens are known to avoid crossing openings in excess of 18 m (60 ft.) (Slauson 2017). The 2002 Biscuit Complex Fire and the 2017 Chetco Bar Fire burned a combined 306,733 ha (757,954 ac.) (GeoMAC Wildland Fire Support data), with some overlap, in the area between the southern Oregon Humboldt marten population and the California-Oregon border population (Figure 7), likely preventing the exchange of individuals and genes between the two populations.

Miller et al. (2012) reported that the annual number of fires, mean fire size, maximum fire size, and area burned all increased in northwestern California over the period of 1910-2008. Miller et al. (2012) also noted that high severity fires tended to be clustered in years when region-wide lighting strikes caused multiple ignitions, indicating that weather conditions in some years are conducive to widespread high severity fires in northwestern California. The effects of wildland fire on the landscape are difficult to predict due to variations in ignition frequency and burn severity based on vegetation type, geography, and weather patterns. However, it is clear that fires have the potential to degrade or destroy Humboldt marten habitat over entire population areas, further reducing the carrying capacity of the landscape and fragmenting populations (Davis et al. 2015). Therefore, habitat loss from wildland fire should be considered a potentially significant threat to persistence of the California Humboldt marten population.

Climate Change

The North American continent has already experienced the climatic effects of human-mediated increases in greenhouse gas emissions (USGCRP 2017). The annual average temperature in the contiguous United States has been 0.7°C (1.2°F) warmer over the past 30 years compared to the period 1895 - 2016, and is projected to further increase to 1.4°C (2.5°F) warmer over the period 2021-2050 (Vose et al. 2017). By the end of the century annual average temperatures are projected to be 1.6°C – 4.1°C (2.8°F – 7.3°F) warmer based on low emissions scenarios, to 3.2°C – 6.6°C (5.8°F – 11.9°F) warmer under high emissions scenarios (Vose et al. 2017).

In northwestern California annual precipitation levels have been 10-15% lower in the last three decades compared to the period 1901-1960 (Easterling et al. 2017). While future precipitation levels in this region are not projected to change radically, the frequency of drought events is projected to increase due to increased evapotranspiration resulting from increasing temperatures (Easterling et al. 2017). Additionally, projected warming of ocean surface temperatures 2.7°C ± 0.7°C (4.9°F ±1.3°F) (Jewett and Romanou 2017) will likely result in reduced daily coastal fog formation.

The Humboldt marten's coastal redwood and Douglas-fir forest ecosystem is characterized by moderate temperatures, high annual precipitation, and summer fog which supports dense conifer tree and shrub cover (Slauson et al. 2007, USFWS 2015). This ecosystem is currently limited in spatial extent to near coastal Oregon and northern California. Climate projections suggest that the coastal zone where precipitation is frequent will narrow in the future (PRBO 2011). The intrusion of coastal fog into inland forests has already been observed to be decreasing in frequency (Johnstone and Dawson 2010), though

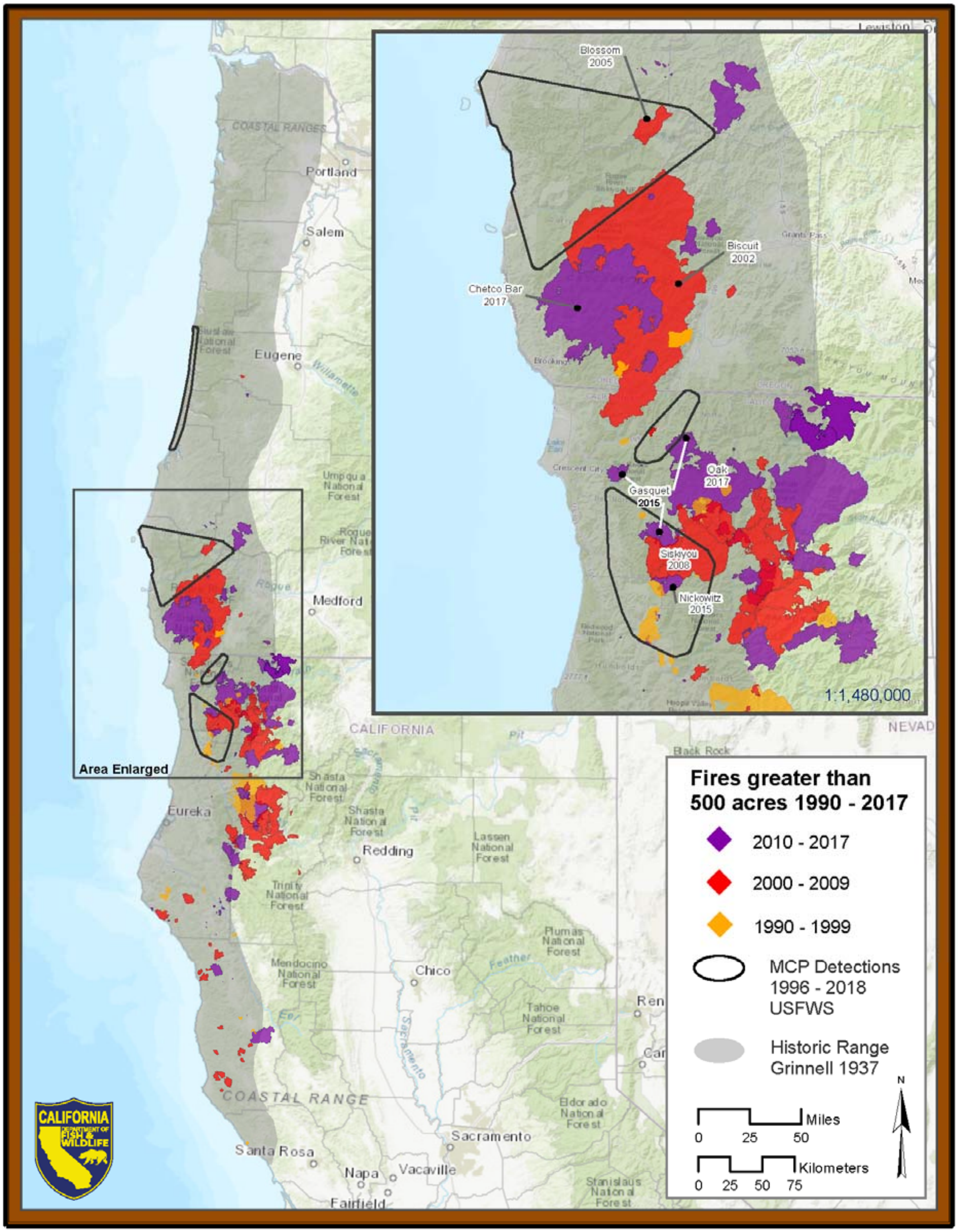

Figure 7. Large (>202 ha [>500 ac.]) wildfires 1990 – 2017 within and between Humboldt marten extant population area minimum convex polygons.

whether this pattern will continue into the future is unclear (PRBO 2011). Less extensive coastal precipitation, reduced fog intrusion, and globally increasing temperatures together could cause the southern extent of mesic coastal forest to retract northward, further reducing the amount of suitable habitat available to Humboldt martens (USFWS 2015, Slauson et al. 2017). These climatic changes could cause a shift from current conifer dominated vegetative communities to hardwood forests unsuitable to martens, and the dense, shade-tolerant shrub layer required by marten may be lost (USFWS 2015). These vegetation transitions could create conditions more favorable to marten predators and could further fragment the remaining patches of suitable habitat (USFWS 2015). Under moderate emissions scenarios the bioclimatic conditions that support Humboldt marten habitat are projected to reliably occur only in Del Norte County and northern Humboldt County (DellaSala 2013).

Projected climatic changes could further impact Humboldt martens by changing the fire regime in the range of the subspecies. Miller et al. (2012) reported the number of fires per year, mean fire size, maximum fire size, and area burned all increased in northwestern California over the period 1910-2008 and that observed changes in the local climate explained much of the fire trends. This research demonstrates that the effects of a changing climate may already be impacting Humboldt marten habitat and highlights the link between climate patterns and wildfire trends in northwestern California forests. In addition to wildfire-mediated habitat changes resulting from changes in climate, other studies have projected climate-related changes in forest disease, insect damage, and other disturbance events which could affect marten habitat quality or availability (USFWS 2015). Finally, Lawler et al. (2012) suggested that martens (all North American species) will be highly sensitive to climate change and will likely experience the greatest impacts at the southernmost latitudes and lowest elevations within their range.

In a recent modeling study, Stewart et al. (2016) assessed climate change vulnerability to 20 of California's terrestrial mammals, including the Humboldt marten. Their study included three components of climate change vulnerability for each taxon. The first component is the taxon's projected response to future climate change, which is the percent of climatically suitable potential habitat projected to be lost (or added) due to climate change. It is based on the climatic conditions within the historical range and projections of those conditions in future climate scenarios. The second vulnerability component is exposure/niche breadth. This component scores the projected amount of change in climate within the taxon's range, and is expressed as percent change compared to current conditions within the historical range of the taxon. The final component is based on an assessment of the taxon's physical, behavioral, and physiological characteristics that affect its sensitivity and adaptive capacity to respond to climate change. Overall climate change vulnerability was assessed by combining the scores for the three components. Two emission scenarios (high, low) and two global climate models (hot/dry and warm/wet) were used to project four future climates. Overall vulnerability scores were partitioned into five categories, ranging from "may benefit" through "less", "moderately", "highly", and "extremely" vulnerable to future climate change impacts.

Depending on the scenario, the Humboldt marten's vulnerability was assessed to be either less vulnerable (low emission, warm/wet scenario), moderately vulnerable (low emission, hot/dry scenario and high emission, warm/wet scenarios), or highly vulnerable (high emission, hot/dry scenario). By the end of the century, projected habitat conditions at the locations Humboldt martens have been detected to date would remain largely suitable under the low emission, warm/wet scenario (only about 1% loss of suitable locations), but 77% of the locations would become unsuitable under the high emission, hot/dry scenario. The following excerpt from Stewart et al. (2016) summarizes the results from the models:

> Distribution models suggest that the Humboldt marten would benefit (increase area of climatically suitable habitat) under wet climate scenarios, but would be adversely

> impacted (decrease area of climatically suitable habitat) under drier future climate scenarios. Under the wet scenarios, suitable habitat is projected to increase in extent around the currently suitable areas in the southern portion of its coastal range. Under the hot dry scenarios, suitable habitat on the coast is projected to retract into the core area currently known to be occupied by the subspecies. Distribution models map large areas of suitable climate where the Humboldt marten is not currently known to occur. These include areas in the southern coastal part of the Humboldt marten's presumed historical range, as well as areas within the geographic range of the Sierran subspecies of the Pacific marten (*Martes caurina sierra*). Given the current understanding of Humboldt marten's requirements for forest structure (large decadent trees with cavities for denning, dense shrub layers) that do not occur in much of the coastal forests of northern California, it is not surprising that the species does not currently occur in a large proportion of the coastal area predicted as currently climatically suitable.

In summary, there is relatively high certainty that temperatures will continue to increase within the range of Humboldt martens, which is likely to increase the frequency of drought events due to increased evapotranspiration. Although there is less confidence in projected changes in total precipitation, fire regimes, and the distribution of vegetative communities, it is apparent that significant changes are possible within the century. Changes in the distribution and abundance of preferred Humboldt marten habitat could significantly impact the existing Humboldt marten population and limit opportunities for population expansion. Therefore, climate change should be considered a threat to the long-term persistence of the Humboldt marten population in California.

Vehicle Strikes

Mortalities resulting from collisions with vehicles are a documented threat to Humboldt martens, with 17 road killed martens documented in coastal Oregon by Moriarty et al. (2016). Vehicle strikes were the greatest source of mortality in their Oregon study. Linnell et al. (2018) modeled the probability that a small (N=30) Oregon Humboldt marten population in shore pine habitat would persist over 30 years, and found that the addition of two or three vehicle strike mortalities per year could drive the population to extinction (modeled extinction probabilities were 32% and 99% respectively). Slauson et al. (2017) classified the impact of vehicle collisions on Humboldt marten populations as extremely severe, but limited in scope to a few areas where frequently traveled roads intersect marten population areas. There have been no recorded road-killed Humboldt martens in California since 1980 (USFWS 2015); however, sections of Highway 101 are high speed, multi-lane road surface. In places Highway 101 transects potentially suitable Humboldt marten habitat, and likely poses a risk to martens attempting to cross (S. Prokop and B. Silver 6/29/2016 letter to CDFW). Additionally, Highway 199 parallels the California-Oregon population for several miles. The impact of vehicle strikes on the overall Humboldt marten population is unknown but potentially locally significant when adult females rearing dependent young could be killed in spring and summer. In these cases the adult female is lost as well as the kits in her care. Mortalities from collisions, although apparently not spatially extensive, may combine with mortality from predation, toxicants, and other sources to exceed recruitment rates, at least in localized areas, and limit population viability (USFWS 2015).

Small Populations

Small, isolated populations are inherently vulnerable to extinction due to loss of genetic variability; inbreeding depression and genetic drift; reduced genetic capacity to respond to changes in the environment; as well as through demographic stochasticity (changes in age and sex ratios resulting in less than optimal breeding opportunities) due to random variation in birth and death rates (Primack 1993, Reed and Frankham 2003). In studied wildlife populations, genetic diversity is strongly correlated with population fitness (increased survival and reproduction rates) and decreased extinction risk (Hedrick and Kalinowski 2000, Reed and Frankham 2003). The smaller the population size, the more likely other threats will drive it to extinction (Primack 2010).

The only recent estimate of the Humboldt marten population was that less than 100 individuals exist in California (Slauson et al. 2009b). Since that time an additional small population has been discovered and the current estimate is that there are less than 80 breeding-age females in the state (K. Slauson pers. comm. 4/24/2018), far below the population size experts believe to be required to ensure long-term viability of a species (Traill et al. 2007, Traill et al. 2010, Flather et al. 2011). The loss of genetic diversity inherent to small, isolated populations can be expected to increase their risk of extinction because small and inbred populations have reduced ability to adapt with changing environments due to diminished pools of potentially adaptive heritable phenotypes (Frankham 2005). Populations of at least several hundred reproductive individuals are believed to be required to ensure the long term viability of vertebrate species, with several thousand individuals being the goal (Primack 1993). However, observations of wild populations indicate that it is possible for small populations to persist, at least in the short term, in the face of genetic challenges, but these observations do not inform the probability or durability of recovery (Harding et al. 2016).

In wild populations, reproductive output and survival vary amongst individuals and from year to year. In large populations this variance averages out, but in small populations this variation, termed demographic stochasticity, can cause the population size to fluctuate randomly up or down (Primack 1993). The smaller the population size the more pronounced the effect. Once a population size drops, its next generation is even more susceptible to further stochasticity and random inequalities in the sex ratio resulting in fewer mating opportunities and a declining birth rate (Primack 1993). Due to their small population size, Humboldt martens may be vulnerable to these effects.

Linnell et al. (2018) modeled the probability that a small coastal Oregon Humboldt marten population would persist over a 30-year window under several different initial population sizes, population growth rates, and rates of human-caused mortality (trapping and vehicle strikes). When the population growth rate and the human-caused mortality rate was held constant and only the initial population size was changed the differences in modeled extinction probabilities was dramatic. Under one scenario the modeled extinction probability for an initial population of 40 animals was 0.03 (or a 97% probability of population persistence for 30 years) versus an extinction probability of 1.00 (or certain population extirpation within 30 years) for an initial population of 20 animals.

Unpredictable changes in the natural environment and biological communities can cause the size of small populations to vary dramatically where larger, more widely distributed populations would remain more stable because these changes normally occur in localized areas (Primack 1993). For example, unpredictable changes in a species' prey or predator populations, climate, vegetative community, or disease and parasite exposure can cause the size of a small, isolated population to fluctuate wildly, and possibly lead to extinction (Primack 1993). Additionally, natural disasters such as droughts, fires, earthquakes, and severe storms can lead to dramatic population changes if the population is small and localized such that the disaster impacts all or most of the individuals. Although the probability of such events is generally rare in any given year, over the course of generations the probability becomes much greater (Primack 1993). Ecological modeling studies have demonstrated that the influence of random environmental stochasticity has a greater influence on extinction probability than demographic stochasticity (Primack 1993). Environmental and genetic effects can work in concert with each other to seriously threaten small populations. As populations get smaller they become more vulnerable to demographic variation, environmental variations, genetic drift, and inbreeding depression. Each of these effects can amplify the impact of the other effects, further reducing population size and accelerating the species towards extinction in what has been termed an extinction vortex (Primack 1993).

Small populations, and populations that have experienced periods of low population numbers in the past lose genetic diversity and may suffer the effects of inbreeding depression - the concentration of deleterious alleles (maladaptive genes) in the population from the mating of closely related individuals resulting in offspring with reduced fitness (Frankham 2005, Harding et al. 2016). Closely related to inbreeding depression is genetic drift, or the accumulation and fixation of detrimental alleles in in the population due to a limited breeding pool (Hedrick and Kalinowski 2000). In large populations maladaptive genes do not accumulate in the population due to random mate pairings and the elimination of less fit offspring through natural selection. However, in small, isolated populations natural selection can have less of an effect on the population genotype than genetic drift. When this happens deleterious genes can become fixed in the population's genotype resulting in decreased reproductive fitness in all individuals, and potentially negative population growth (Hedrick and Kalinowski 2000, Frankham 2005).

The influence of inbreeding depression on fitness-related traits appears variable across populations, heritable traits, and environments (Hedrick and Kalinowski 2000). Inbreeding depression affects nearly every well studied wildlife species, and contributes to extinction risk in most wild populations of naturally outbreeding species (Frankham 2005). It is uncertain whether inbreeding depression occurs within the California Humboldt marten population, but the small population size and apparent period of isolation from other populations make it likely that significant genetic diversity has been lost (Slauson et al. 2017).

The loss of genetic diversity and the accumulation of deleterious genes can largely be mitigated by the exchange of breeding individuals between population centers (Primack 1993). When individuals migrate from their natal population to new population areas, the novel genes they introduce can balance the effects of genetic drift and inbreeding depression. As few as one migrant per generation in a population of 120 individuals could negate the effects of genetic drift (Primack 2010). Consequently, habitat fragmentation can seriously increase the genetic risks to isolated subpopulations, and habitat connectivity between populations can substantially mitigate these risks.

While the genetic risks associated with small populations may significantly increase a population's risk of extinction, it is important to note that a small population size alone is not necessarily predictive of population viability over time. A well planned conservation strategy can substantially mitigate risks associated with small populations. A comprehensive plan for long term viability should include the principles of representation, resiliency, and redundancy (Shaffer and Stein 2000, Wolf et al. 2015). These principles require recovered species be present in multiple large populations across the entire spectrum of habitats used by the species, and these populations must also be resilient to environmental changes, identified threats, and genetic threats (Wolf et al. 2015). The California Humboldt marten population, numbering less than 80 breeding females, is currently highly exposed to the environmental and genetic risks inherent to small populations; however, a carefully designed program of habitat protection, connection, as well as the possibility of facilitated translocations could connect isolated breeding populations, increase the number of populations, and partially mitigate these risks.

Research and Handling

Wildlife research in California is regulated through the state's Scientific Collecting Permit program (Fish & G. Code § 1002 et seq.). The program requires researchers to disclose their study design, wild animal handling protocols, and demonstrate their professional experience with the species of interest. Notwithstanding this oversight, mortalities are a risk of any wildlife research that requires the capture and handling of live animals. In early 2016, a Humboldt marten in California died of exposure in a trap set by researchers when the field technician checking the trap did not follow the protocol for safely securing the door on a pre-baited trap was that left unchecked for several days. Later that year a radio-collared female marten was recovered from a den tree after her collar emitted a mortality signal. Investigators believe the animal may have become entrapped in a narrow tree cavity due to the presence of its radio telemetry collar (Clifford 2016 unpublished report, Early 2016 unpublished report). Two kits who were still dependent on the female were recovered from the den site and later also died, apparently from starvation (Clifford 2016 unpublished report, Early 2016 unpublished report). These two incidents are the only documented research-related Humboldt marten mortalities in California despite the fact that dozens of martens have been captured and fitted with radio collars to date. Species experts believe it is unlikely that research would be conducted on more than 10% of the Humboldt marten population at any one time (Slauson et al. 2017). Therefore, it is unlikely that research and handling presents a significant threat to the population.

EXISTING MANAGEMENT

Land Ownership within the California Range

In California, the majority of the land within the Humboldt marten's range is owned and managed by the U.S. Forest Service, with smaller portions owned and managed by the Yurok Tribe, Green Diamond Resource Company, and State and National Redwood Parks (Figure 8). Land management strategies and practices vary across and within ownerships.

National Forest Lands

The U.S. Forest Service manages the majority of the land within the marten's range on the Six Rivers and Klamath National Forests. As mentioned in the Conservation Status Section, on Forest Service lands in Region 5 (California), the Humboldt marten is designated as a Sensitive Species. Management projects subject to the National Environmental Policy Act (NEPA) must analyze impacts to the Sensitive Species; however, there is no requirement to minimize or mitigate project impacts to the species. National Forest lands in northern California are managed under the Northwest Forest Plan (USDA and USDI 1994) which sets land management guidelines according to seven allocations: Congressionally Reserved Areas, Late Successional Reserves, Managed Late Successional Areas, Adaptive Management Areas, Administratively Withdrawn Areas, Riparian Reserves, and Matrix lands. Matrix lands units are intended for timber harvest, yet Slauson (2003) detected Humboldt marten on Matrix lands in 8 out of 31 sample units, and 20% of Slauson et al.'s (2007) analysis area was designated as Matrix land available for logging with 16% of the Matrix land previously logged. Late Successional Reserves (LSR) are intended to support viable populations of late-successional and old-growth dependent species such as spotted owls and Humboldt martens. However, logging is not prohibited in this land allocation class, and not all LSRs are currently in a late-successional condition, but rather managed to grow into late-successional habitat and therefore may not currently provide Humboldt marten habitat. Forty percent of Slauson et al.'s (2007) study area was designated LSR, with martens detected in 13 of 66 sample units in LSR; 13% of the land designated LSR in the marten's range has been logged (Slauson et al. 2007). The Humboldt marten was

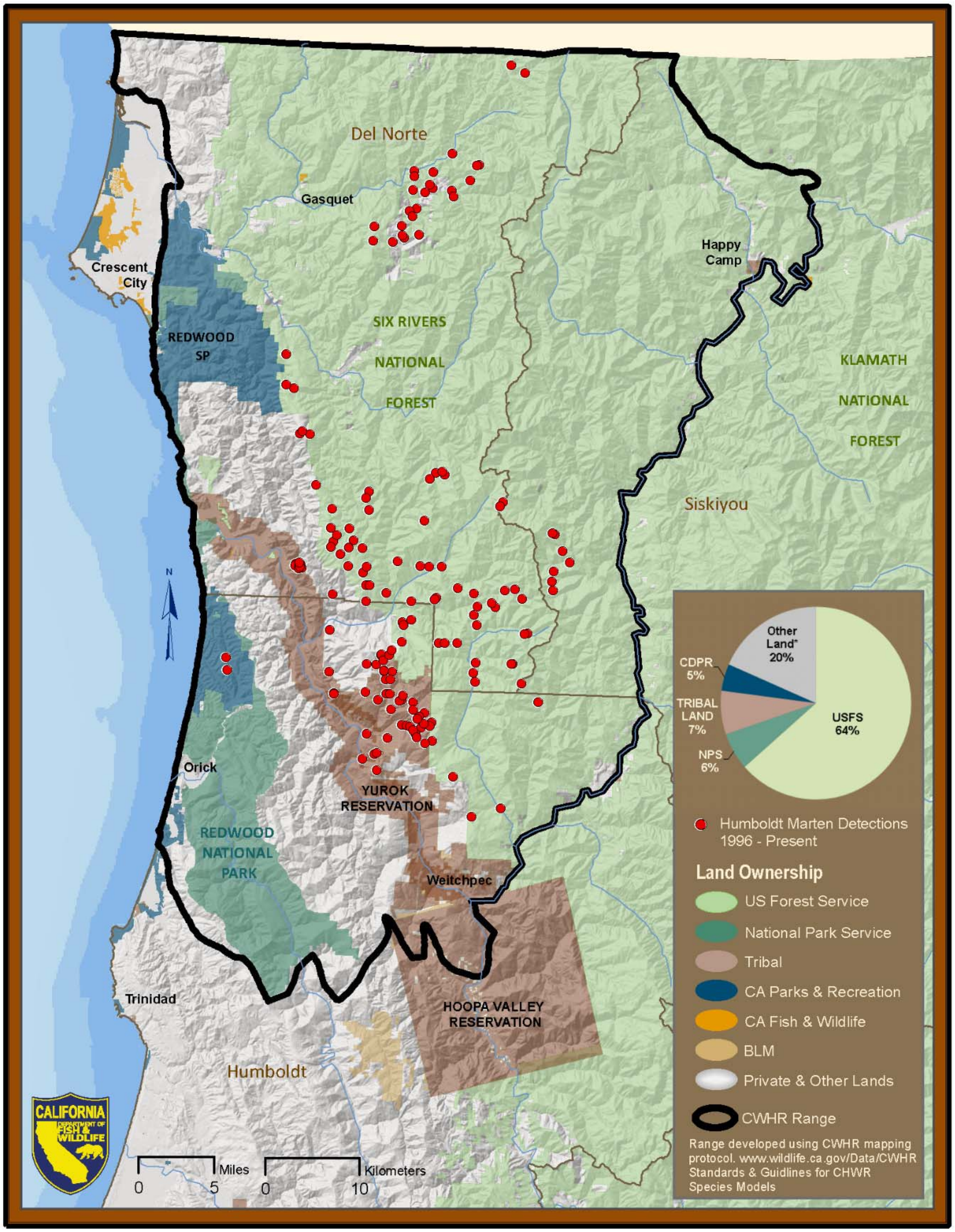

Figure 8. Land ownership within the contemporary range of Humboldt marten with percent of range by ownership classification.

given only a 67% likelihood of remaining well distributed within the range of the northern spotted owl by the Northwest Forest Plan scientific analysis team (USDA and USDI 1994). Slauson et al. (2009b) concluded that the Northwest Forest Plan does not completely protect the extant population, with 38% of the Humboldt marten distribution occurring outside of NWFP reserves.

Forest management on individual national forests is governed by Land and Resources Management Plans (LRMP). The LRMP for the Six Rivers National Forest, where much of the extant Humboldt marten population is located, includes provisions to protect known active Pacific marten den sites and the surrounding habitat within 152 m (500 ft.) from disturbance and land-altering activities. However, there is no requirement to conduct pre-project surveys for martens, so there is little probability that active marten dens would be detected and subsequently protected, leaving denning martens and their habitat outside of protected land allocations vulnerable to disturbance and destruction (Six Rivers National Forest 1996).

A small portion of the Humboldt marten range is contained within the Siskiyou Wilderness Area, and only a portion of the wilderness area is composed of vegetation suitable for martens. Slauson (2003) detected martens on only 3 out of 23 sample units located in Siskiyou Wilderness. The U.S. Forest Service also manages the Smith River National Recreation Area (SRNRA), which covers a small portion of the marten's range. The SRNRA is not vulnerable to logging, but management of the area prioritizes recreation over wildlife values.

Redwood National and State Parks Management

State and National Park Service land in the Humboldt marten range includes the Redwood National Parks Complex consisting of Redwood National Park, Prairie Creek Redwoods State Park, Jedediah Smith Redwoods State Park, and Del Norte Coast Redwoods State Park. These parks are managed by the National Parks Service and California Department of Parks and Recreation (California State Parks) and total over 53,412 ha. (131,983 ac.) in northwestern California, of which approximately 30% is currently composed of old-growth forest. Forests in state and national parks are not subject to harvest, except where younger stands are managed to more rapidly develop old-growth characteristics (Slauson et al. 2017). The General Plan/General Management Plan governing the management of the parks does not identify specific management actions for Humboldt martens. Approximately 33% of the Park lands are managed as primitive zones where no development or facilities construction occurs and visitor use is limited to foot traffic on existing trails. An additional, 55.4% of the Park lands are managed as backcountry zones where the preservation and restoration of the natural environment is emphasized, and modification of the environment related to visitor use is limited. Where suitable marten habitat exists within these management zones, it is likely maintained and protected from significant modification and degradation (USDI NPS and California State Parks 2000).

As of 2010, State and National parks had removed over 350 km of roads and thinned 4-6% of the second growth stands within their boundaries (Slauson et al. 2010). Prairie Creek Redwoods State Park had at least one Humboldt marten detection each year from 2009-2013, and again in 2017, although it does not appear to currently support a viable reproducing marten population (K. Slauson pers. comm. 10/10/2017).

Private and Tribal Lands

The largest private land owner within the contemporary Humboldt marten range is the Green Diamond Resource Company, which manages approximately 151,000 ha (373,000 ac) primarily in Humboldt and Del Norte Counties, California (Green Diamond Resource Company 2017). Although only a small fraction of the ownership is within the contemporary range of the Humboldt marten, an important portion lies between the core population area and potentially suitable coastal habitat in the Redwood State and National Parks (Figure 8), although much of this area was recently transferred to the Yurok Tribe. Green Diamond lands are dominated by redwood forest in coastal and low elevation areas and by Douglas-fir as elevation and distance from the coast increase. Hardwoods are common in all forest types and in places compose the majority of the stand (Green Diamond Resource Company 2012). Most of the ownership has been logged at least once over the last century and now consists of second and third growth stands from recently harvested to 120 years old (Hamm et al. 2012). Small old growth forest areas which have never been logged are scattered throughout the ownership and total 267 ha (659 ac.), less than 1% of Green Diamond Resource Company land.

Green Diamond operates under a Maximum Sustained Production Plan approved pursuant to a provision of California Code of Regulations, Title 14, Section 913.11 subdivision (a) ("Option A") filed with the CAL FIRE. The Option A plan is intended to balance forest growth and timber harvest over a 100 year period. With some exceptions, Green Diamond plans to practice even-aged silviculture management on the ownership using clear-cutting as the primary harvest and regeneration method. Conifer stands are typically thinned 10-20 years after planting, again after 30 years, and harvested at or after 45 years in clear cut harvest units of 16 ha (40 ac.) or less. Streamside zones, steep slopes, and special habitat areas are managed differently, including single tree selection harvest and retention of trees for wildlife values. Collectively, these areas comprise approximately 25% of the ownership (Green Diamond Resource Company 2017). At least 10% of the pre-harvest basal area is typically retained in harvest units in streamside zones, habitat areas, and scattered trees to retain forest structural elements through the harvest rotation as a deliberate management action to provide size class and structural diversity to regenerating stands. Regeneration involves removing logging slash through prescribed burning and/or mechanical slash treatment (chipping), tree planting, and the control of competing vegetation with herbicides (Green Diamond Resource Company 2017). Under current Green Diamond management plan, approximately 85% of the ownership will have overhead cover from trees ≥10 years old at all times at all times (Jameson and Robards 2007, Keith Hamm pers. comm. 4/13/2018).

Green Diamond has periodically surveyed their lands for the presence of fishers and martens, including surveys in 1994-1995, 2004-2006 and 2010-2011 (Hamm et al. 2012). No Humboldt martens were detected in the earliest surveys (1994-1995), and Slauson (2003) also surveyed a portion of the Green Diamond ownership in 2001-2002 and did not detect marten. However, in a repeat survey in 2004-2005 Humboldt marten were detected on Green Diamond land within approximately 1 km (0.6 mi.) of the adjacent known Humboldt marten core population on public lands. Martens were detected again in the area in 2006. In 2010-2011 camera station surveys on Green Diamond lands detected martens at 14 stations within a few kilometers of the border with public lands, some co-occurring with fishers. This series of surveys indicates that marten detections are persistent on these lands adjacent to occupied public lands (Hamm et al. 2012). Green Diamond has partnered with the United States Department of Agriculture's Forest Service Redwood Sciences Lab and the Yurok Tribe to conduct research on the species since 2012 (K. Hamm pes. Comm. Oct. 24, 2017). As of 2016, 33 Humboldt martens have been captured, and 24 were fitted with radio collars to study dispersal ecology (Slauson et al. 2014), and habitat use and den site characteristics in this joint study (Early et al. 2016). Most of the land covered by these surveys and studies was recently acquired by the Yurok Tribe through land purchases in 2009 and 2018.

Green Diamond Resource Company manages most of its land under the conditions of two federally-approved Habitat Conservation Plans (HCPs), one for the northern spotted owl and the other for anadromous salmonid fish and stream-dwelling amphibians. The Yurok Tribe assumed responsibility for complying with the aquatic HCP covering the lands they recently acquired from Green Diamond. The HCPs allow for incidental take of listed species and may deviate from Forest Practice Rule guidelines for species covered under the HCPs. Under ESA's Section 10(a), incidental take, defined as take that is incidental to, and not the purpose of an otherwise lawful activity, may be authorized for federally threatened and endangered species covered under an approved HCP. For both HCPs, the Department has determined that the federal Incidental Take Statement is consistent with CESA pursuant to Fish and Game Code section 2080.1. The HCPs require the retention of more streamside zone canopy cover, wider streamside zone management areas, and less frequent harvesting of streamside zones than the Forest Practice Rules require. During development of the northern spotted owl HCP Green Diamond prepared a 30-year timber stand age-class forecast model. The age-class forecast covered 1991 through 2021, and assumed timber harvest would occur at an annual rate of 3,000-6,000 acres. Results indicated that second-growth stands in the 46+ year age-class would more than double, the 31-45 year age-class would increase by approximately 50,000 acres in first 10 years then return to 1991 levels, and the 8-30 year age-class would generally decrease over time. Although neither HCP specifically covers Humboldt marten, the plans are designed, in part, to retain and recruit larger tree structure which may improve marten habitat suitability on company lands over time.

Fish and Game Code sections 2089.2 through 2089.26 allow the Department to authorize incidental take of a species listed as endangered, threatened, candidate, or a rare plant, through a Safe Harbor Agreement (SHA) if implementation of the agreement is reasonably expected to provide a net conservation benefit to the species, among other provisions. SHAs are intended to encourage landowners to voluntarily manage their lands to benefit CESA-listed species without subjecting those landowners to additional regulatory restrictions as a result of their conservation efforts. At the end of the agreement period, participants may return the enrolled property to the baseline conditions that existed at the beginning of the SHA. Green Diamond Resource Company has voluntarily applied for a Humboldt marten SHA, and the Department approved a final SHA on April 27, 2018 (Appendix A). Among the net conservation benefits expected to result from the SHA are: (1) $490,000 in funds and in-kind resources toward studying and implementing assisted dispersal of marten; (2) $30,000 toward adaptive management strategies if needed; (3) modification of the tree scorecard[2] to increase score for small cavities and add a point in the 127,217 acre Marten Special Management Area, and use of the tree scorecard in all CalWater planning watersheds that marten disperse or expand to; (4) designation of a 2,098 acre no-harvest marten reserve; (5) retention of all den structures for collared martens; and (5) monitoring and reporting and a commitment to accommodate marten-specific research on the enrolled lands. The SHA anticipates neighboring landowner enrollment for the Yurok Tribe pursuant to Fish and Game Code section 2089.23.

The other significant land owner within the range of the Humboldt marten is the Yurok tribe which owns approximately 23,876 ha (59,000 ac.) of land in or near the Humboldt marten range. The Tribe also manages an additional 1,528 ha (3,776 ac.) of federal land held in trust for the Tribe (Yurok Tribal Information Services website accessed October 25, 2017).

Yurok Tribal objectives for the management of Tribal lands include: Establishment of a regular, periodic, long term sustained yield of timber products; generation of Tribal income and employment from timber

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[2] The tree scorecard is a system used by Green Diamond field staff to rank the relative habitat values of large trees in harvest units in consideration of their retention. For more information on the system see Attachment 5 of Appendix A.

sales; limiting the use of clear cutting and eliminating the use of herbicides; protecting and enhancing areas considered culturally significant; acquisition of lands (including cutover lands) to increase the Tribal land base; protection and enhancement of fisheries; use of prescribed burning when possible; generating Tribal income from the sale of carbon credits; and providing oversight and professional expertise on the best way to utilize Tribal forestland for non-timber use. To achieve these goals, the Yurok primarily use uneven-aged silviculture practices (harvest of individually selected trees and small groups rather than large clear cuts) (Yurok Tribal Forestry Department 2012). A specific goal of Yurok Tribal forest management is the protection of Humboldt marten dens and large tree and shrub cover habitat across the landscape, and the Tribe intends to manage a recent 5,985 ha (14,790 ac.) acquisition in the Pecwan Creek and Blue Creek area as a late seral reserve to benefit culturally important wildlife species such as the Humboldt marten (E. Mann pers. comm. 10/25/2017).

Both Green Diamond Resource Company lands and Yurok Tribe fee lands (outside of the Yurok Reservation) are subject to the Z'berg-Nejedly Forest Practices Act of 1973 (Pub. Resources Code, § 4511 et seq.) and the California Forest Practice Rules (chapters 4, 4.5, and 10, Title 14, CCR), which are administrated by the California Department of Forestry and Fire Protection (CAL FIRE). The California Forest Practice Rules specify that an objective of forest management is the maintenance of functional wildlife habitat in sufficient condition for continued use by the existing wildlife community within planning watersheds (§ 897(b)(1)(B), Title 14, CCR). This language may result in actions on private lands beneficial to martens. Nevertheless, specific guidelines to retain habitat for martens are not provided in the Forest Practice Rules. Further, this guidance would at best conserve habitat where Humboldt martens are known to exist, but would not be expected to result in the creation of additional habitat. Additionally, section 919.16 of the Forest Practice Rules requires landowners to provide CAL FIRE with information when late-successional forest stands are proposed for harvesting if the harvest will "significantly reduce the amount and distribution of late-successional forest stands or their functional wildlife value so that it constitutes a significant adverse impact on the environment". However, this rule does not specify protective or mitigation measures to offset potentially significant impacts associated with late-successional forest loss.

Habitat suitable for martens may be retained within Watercourse and Lake Protection Zones (§ 916 et seq., Title 14, CCR) on private timberlands. Watercourse and Lake Protection Zones are defined areas along streams where the Forest Practice Rules limit the amount of timber harvested in order to protect in-stream habitat quality for fish and other resources. Harvest restrictions and retention standards vary according to the presence of anadromous and other fish species, as well as other aquatic life forms. These zones may encompass 15-45 m (50-150 ft.) on each side of a watercourse, 30-91 m (100-300 ft.) in total width depending on side slope, and location in the state. Within Watercourse and Lake Protection Zones, the prescriptions vary by watercourse classification. For fish bearing streams (Class I watercourses), the retention standards vary from 50%- 80% overstory canopy (depending on distance to the watercourse) and require leaving a multi-storied stand composed of a diversity of species similar to that found before the start of timber operations. For watersheds that fall within Anadromous Salmonid Protection rules (§§ 916.9, 936.9, and 956.9, Title 14, CCR), the 13 largest trees per acre (live or dead) must also be retained within Class I Watercourse and Lake Protection Zone. For non-fish bearing streams (Class II watercourses), Watercourse and Lake Protection Zone retention standards vary from 50 % total canopy to 80% overstory canopy depending on the type and location of the watercourse.

MANAGEMENT RECOMMENDATIONS

The Department has evaluated existing management recommendations and available literature applicable to the management and conservation of the Humboldt martens to arrive at the following recommendations. The recommendations largely derive from *A Conservation Assessment and Strategy for the Humboldt Marten in California* (Slauson et al. 2017). The Department recognizes the scientific expertise and judgement of the Executive Team that developed the Strategy, and deems the information provided a reliable synthesis of current scientific literature on the species, thus constituting the best available science.

Habitat Protection, Management, and Restoration

Given the many conservation challenges identified for the Humboldt marten, achieving the goal of recovering and maintaining sustainable reproductive marten populations in California necessitates cooperation and support among government and private land managers. Achieving the overarching goal of Humboldt marten population recovery and persistence necessitates managing the landscape toward habitat conditions suitable for marten occupancy within much of their historic range. Specific management objectives can be further refined within the following Conservation Emphasis Areas (CEAs) from Slauson et al. (2017) (Figure 4).

Extant Population Areas (EPA)

EPAs are areas where five or more Humboldt marten detections have been documented since 1980 that are no more than 5 km (3.1 mi.) from the nearest neighboring detection. These clusters of detections are then buffered to include 2 km (1.24 mi.) of the surrounding landscape.

1. Design land management activities in and adjacent to EPAs to maintain conditions characterized as highly suitable marten habitat[3], and where feasible, improve habitat conditions in areas of moderate and low suitability

2. The current extent of the two California EPAs is 81,182 ha (202,162 ac.), which is 3.9% of the historic range; however, a habitat suitability model developed by Slauson et al. (in review) classifies 15,566 ha (38,464 ac.) of this extent as currently unsuitable for marten occupancy. Assess areas classified as unsuitable habitat within EPAs for their potential to be managed toward conditions characterized as high suitability marten habitat.

3. Continue surveys for the Humboldt marten within their historical range, and as new detections are documented, EPAs should be re-assessed periodically to include new detections, following methods described in the Conservation Strategy (Slauson et al. 2017). Collect data, including genetic material, to accurately estimate population size and determine if populations are increasing or decreasing.

4. Identify high priority areas for restoration within EPAs based on their potential for connecting fragmented suitable habitat patches.

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[3] Briefly, areas with high precipitation levels and a high Old Growth Structural Index (many large trees and snags and high tree size diversity), or serpentine soils (see Slauson et al. in review for details).

5. Evaluate the degree to which major roads within EPAs fragment suitable habitat patches, create major barriers to marten movement, or pose a substantial collision risk to crossing martens. Consider installation of wildlife crossing structures where appropriate.

6. Protect currently suitable resting and denning structures within EPAs (i.e. large trees, snags and downed logs) and manage forest stands to ensure continual recruitment of structures.

7. Protect dense ericaceous shrub layers within EPAs. Facilitate the regeneration of ericaceous shrub layers where they have been eliminated by wildfires, competition with closely planted trees, or where their absence is limiting habitat suitability.

8. Where timber harvest occurs retain large tree structures (large diameter trees with platforms, breaks, and cavities; large diameter snags and logs, and well distributed slash piles) through harvest. Avoid clearing harvested sites by burning of chipping.

Population Re-establishment Areas (PRA)

PRAs are areas within the Humboldt marten historical range which currently do not contain self-sustaining populations, and where recovery actions are required to accelerate the recolonization of self-sustaining marten populations. For a PRA to support a self-sustaining population, the amount of contiguous suitable marten habitat should be greater than 1,500 ha (3,707 ac.), which corresponds to the estimated area capable of supporting five or more female home ranges. Based on these criteria, Slauson et al. (2017) identified four potential PRAs within California (Figure 4), which should be considered for immediate Humboldt marten population recovery.

9. Manage habitat with the PRAs towards a landscape condition that is suitable to sustain Humboldt martens.

10. Where major roads (e.g. Highways 101, 199, and 299) separate PRAs from EPAs and may act as barriers to marten dispersal, evaluate the availability of existing structures such as bridges, large culverts, and overpasses which could be used by martens to safely cross. Where such structures are limited, work with state and federal highway agencies to plan and install state of the art wildlife crossing structures.

11. Once a PRA is determined to have a sufficient amount of suitable habitat, assess it to determine if population recolonization would require human assisted dispersal, or whether natural dispersal of animals is a reliable means for recolonizing the PRA.

Landscape Connectivity Areas (LCA)

Providing dispersal habitat that Humboldt martens may use to move safely between an EPA to restored habitat in a PRA is critical for recolonizing newly restored habitat, and within a metapopulation context, provides essential connectivity for gene flow to occur between extant marten populations. LCAs are characterized by low amounts of currently suitable reproductive habitat and low potential to develop additional suitable reproductive marten habitat, but they have capacity to provide important functional dispersal zones. Currently, only one LCA has been identified in California, and it lies in a critically important dispersal zone between the southernmost EPA and the restorable 1,430 km^2 (552 $mi.^2$) Redwood-Prairie Creek PRA (Figure 4). Unfortunately, suitable habitat conditions for an LCA are poorly understood, and additional research is needed to better understand functional dispersal habitat requirements for the Humboldt Marten. Given this uncertainty, management of LCAs should balance the need for maintaining and improving connectivity with other management objectives.

12. Avoid actions within the LCAs which could significantly reduce or permanently restrict the ability of Humboldt martens to move between EPAs and PRAs.

Wildland Fire

Given that the current distribution of extant Humboldt marten populations in California is limited to two relatively small EPAs occupying < 7% of the species' historical geographic range, large catastrophic fires have the potential to severely impact up to 70% of occupied suitable habitat in California over the next 15 years (Slauson et al. 2017). Additionally, large wildfires have likely created barriers of unsuitable habitat between extant populations. However, Moriarty et al. (2017) found that treating as little as 10-20% of the landscape with mechanical or prescribed fire treatments to reduce fuels can significantly reduce the risk of Pacific marten habitat loss from severe wildfires in high elevation forest habitats of the southern Cascades and northern Sierra Nevada; and Credo (2017), working in the same area, found that wildfire spread can be effectively attenuated through fuel reduction projects located primarily outside of marten habitat patches.

13. Design and implement fuel management prescriptions to reduce the wildfire risk to EPAs and PRAs. Fuel reduction projects should be located outside of high quality Humboldt marten habitat when possible and prescriptions should preserve important Humboldt marten habitat elements like dense shrub understories, abundant large snags, dead and dying trees and downed logs in occupied habitat to the greatest degree possible while achieving risk reduction goals.

14. Expand the range and increase the resiliency of Humboldt marten populations in California, including managing for multiple large EPAs connected by LCAs to reduce the risk of a substantial loss of the current extant marten population due to a single catastrophic fire.

Research, Surveys, and Monitoring

15. Research is needed to determine whether the Humboldt marten's small population size has resulted in a loss of genetic diversity, and whether the subspecies is at risk of population declines due to reduced fitness affecting their ability to evolve and adapt to environment changes due to climate change and other causes.

16. Determine the extent to which Humboldt marten populations in California and Oregon interbreed and quantify the genetic contribution to California populations from animals dispersing to and from Oregon.

17. Conduct continued surveys in the largest areas of potentially suitable habitat that have yet to be surveyed, and employ probabilistic sampling of other vegetative communities to survey for Humboldt martens which may be occupying habitats outside of those identified by current habitat predictive models.

18. Develop and implement consistent survey and monitoring strategies that reliably produce metrics on population size, distribution, and trends.

19. Develop a better understanding of specific silvicultural practices that result in high suitability habitat for the Humboldt marten and its prey species or accelerate recruitment of suitable habitat.

20. Study and develop siliviculture techniques in early seral stands which discourage occupancy by marten predators while recently harvested or burned stands are regenerating.

21. Study the lethal and sub-lethal effects of rodenticides and other toxicants on Humboldt martens, model potential population effects, and work to reduce sources of exposure.

22. Identify the impact diseases have on Humboldt marten fitness and mortality, and work to reduce sources for exposure.

23. Continue to collect demographic parameters of extant marten populations, and identify key parameters affecting population growth and persistence.

24. Study habitat relationships of the primary marten predators (i.e. bobcats), and identify management options that reduce predator abundance and distribution within marten habitat (e.g. restorative thinning to stimulate shrub growth and road removal).

SUMMARY OF LISTING FACTORS

CESA directs the Department to prepare this report regarding the status of the Humboldt marten based upon the best scientific information available to the Department. CESA's implementing regulations identify key factors that are relevant to the Department's analyses. Specifically, a "species shall be listed as endangered or threatened ... if the Commission determines that its continued existence is in serious danger or is threatened by any one or any combination of the following factors: (1) present or threatened modification or destruction of its habitat; (2) overexploitation; (3) predation; (4) competition; (5) disease; or (6) other natural occurrences or human-related activities." (§ 670.1(i)(1)(A), Title 14, CCR.). The definitions of endangered and threatened species in the Fish and Game Code provide key guidance to the Department's scientific determination. An endangered species under CESA is one "which is in serious danger of becoming extinct throughout all, or a significant portion, of its range due to one or more causes, including loss of habitat, change in habitat, over exploitation, predation, competition, or disease." (Fish & Game Code, § 2062). A threatened species under CESA is one "that, although not presently threatened with extinction, is likely to become an endangered species in the foreseeable future in the absence of special protection and management efforts required by [CESA]." (*Id*., § 2067). The following summarizes the Department's determination regarding the factors to be considered by the Commission in making its decision on whether to list the Humboldt marten. This summary is based on the best available scientific information, as presented in the foregoing sections of the report.

Present or Threatened Modification or Destruction of Habitat

The geographic range of the Humboldt marten has retracted to less than seven percent of the extent documented by naturalists in the early 20th Century. Although historical trapping pressure is implicated in the initial decline of the species in the state, today the species population is limited by the amount, distribution, and quality of its remaining preferred habitat. Historical and ongoing management for timber production threatens the species by removing, degrading, and fragmenting the dense shrub layers and large tree structures the species is dependent upon for cover, denning, and foraging.

Although watercourse protection zone and voluntary tree retention measures on private timber lands may moderate these impacts and hasten the recovery of suitable marten habitat in regenerating forest stands over time, timber harvesting destroys and degrades marten habitat in the short term and may create habitat conditions that expose Humboldt martens to increased predation pressure. In a dynamic managed forest landscape, substantial areas of unsuitable habitat are likely to exist across the landscape at any given time. Some portions of the remaining occupied habitat are protected by wilderness and other land use designations, but large areas remain vulnerable to continued timber harvesting and other uses which can fail to retain required habitat elements on the landscape and virtually all existing habitat is vulnerable to degradation and loss from wildfires. Until additional areas of suitable forest habitat are allowed to develop with careful management and the passage of time, the limited extent of suitable habitat will continue to prevent recovery of the California Humboldt marten population for several decades at a minimum.

Overexploitation

Intensive trapping pressure during the late 19th and first half of the 20th centuries appears to have significantly reduced the Humboldt marten population and the species' distribution in the state. However, due to changes in trapping laws and practices, overexploitation no longer threatens the species in California.

Predation

Predation is a major cause of Humboldt marten mortality in California populations. While predation is natural in wildlife communities, predation rates by larger predators appear to be elevated in landscapes managed for timber production due to the removal of large tree and shrub layer cover and the association between the primary prey of larger predators and early seral forest habitat. The degree to which predation by larger predators limits Humboldt marten populations on or adjacent to managed landscapes and what management actions may effectively reduce this mortality factor in these areas warrants further research. In the interim, observations suggest that ongoing timber harvest and occasional wildland fires which create early seral forest conditions in or adjacent to extant populations or areas identified as important for population re-establishment and connectivity will continue to elevate predation risk, potentially lead to declining population trajectories, and prevent recovery of the California Humboldt marten population.

Competition

There is no indication in the available information to indicate that competition poses a substantial threat to Humboldt marten populations in California at this time. However, there is substantial overlap between the habitat preferences and prey species of Humboldt martens and invasive barred owls which may impact marten populations over time if barred owl populations continue to increase.

Disease

Although there is little available information on disease rates and associated mortality in Humboldt marten populations, the presence of highly virulent diseases has been documented in the occupied range. Because Humboldt marten populations are small and isolated, a virulent disease outbreak in one or both core population area could seriously threaten the statewide population. However, the probability of such an outbreak is difficult to predict.

Other Natural Events or Human-Related Activities

Small Populations

In California the two remnant Humboldt marten populations are each believed to total less than 100 individuals. Assuming an equal sex ratio and adult-biased age structure (≥ 2 years old), as has been observed in marten populations elsewhere in California, each population may contain fewer than 40 breeding females. Populations of this size are vulnerable to inherent genetic and environmental threats including, inbreeding depression, demographic stochasticity, environmental stochasticity, and loss of genetic diversity. These effects can result in decreased reproductive output, inability to adapt to changing environmental conditions, concentration of maladaptive genetic traits, and other deleterious effects. Small, isolated populations are also inherently at greater risk of extinction due to environmental events such as wildfires and disease outbreaks. Small population effects can interact with other threats (such as disease, toxicants, climate change, and others) synergistically to amplify the negative impacts on the Humboldt marten population. While these small population effects almost certainly impact the California Humboldt marten population, research would be required to quantify the degree to which these effects threaten the persistence of the population.

Wildland Fires

Because the two California Humboldt marten populations are small, disjunct, and limited to small geographic ranges, a single catastrophic wildfire has the potential to significantly impact either extant population's size and range. Fires can destroy the dense shrub understories and large tree structures martens depend on for cover, denning, and foraging. Additionally, habitat changes caused by large high-intensity wildfires have likely contributed to the fragmentation of extant populations and have the potential to further fragment the remaining habitat in the future. Although it is impossible to predict the timing and location of wildfires, it is likely that fires will impact Humboldt marten habitat and populations in northwestern California in the foreseeable future. The degree to which wildland fires threaten the persistence of the California Humboldt marten population is unknown.

Climate Change

Past and ongoing changes to the north coast climate such as rising temperatures, declining precipitation, and decreased daily fog will likely result in long term changes to the vegetative community in the region. How these changes will impact the preferred habitat of Humboldt martens is difficult to predict, but some modeling studies indicate that the geographic extent of suitable marten habitat is likely to retract northward and towards the coast in California. While there is a high degree of confidence in projected warming trends, and less certainty in projected precipitation changes, the degree to which these changes will threaten Humboldt martens in the foreseeable future is unknown.

Toxicants

Although there is little available information on Humboldt marten exposure to toxicants, the presence of highly toxic anticoagulant rodenticides and other pesticides is well documented within the California range. These compounds are known to frequently kill closely related fishers in northwestern California; however, the degree to which toxicant exposure threatens the Humboldt marten population is unknown.

LISTING RECOMMENDATION

CESA directs the Department to prepare this report regarding the status of the Humboldt marten in California based upon the best scientific information. CESA also directs the Department, based on its analysis, to indicate in the status report whether the petitioned action is warranted (Fish & G. Code, § 2074.6; Cal. Code Regs., tit. 14, § 670.1, subd. (f), Title 14, CCR). In addition to evaluating whether the petitioned action (i.e., listing as endangered) was warranted, the Department considered whether listing as threatened under CESA was warranted. The Department includes and makes its recommendation in its status report as submitted to the Commission in an advisory capacity based on the best available science. In consideration of the scientific information contained herein, the Department has determined that historic trapping and habitat loss has extirpated Humboldt martens from significant portions of the species' range. Additionally, historic and ongoing habitat loss, habitat fragmentation, and associated elevated predation rates, coupled with unquantified, but potentially significant ongoing threats to the species from a small population size, disease, toxicants, wildfire, and climate change place the remaining California Humboldt marten population at risk of extinction. Therefore, the Department recommends listing the Humboldt marten as endangered under CESA is warranted at this time.

Protection Afforded by Listing

It is the policy of the State to conserve, protect, restore and enhance any endangered or threatened species and its habitat (Fish & Game Code § 2052). The conservation, protection, and enhancement of listed species and their habitat is of statewide concern (*Id*. § 2051 subd. (c)). CESA prohibits the import, export, take, possession, purchase or sale of any species the Commission determines is endangered or threatened (*Id*. § 2050 et seq.). CESA defines "take" as hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill (Fish & G. Code, § 86). The Fish and Game Code authorizes the Department to allow "take" of species listed as threatened or endangered under certain circumstances through incidental take permits, memoranda of understanding, natural community conservation plans, safe harbor agreements, or other plans or agreements approved by or entered into by the Department (Fish & G. Code, §§ 2081, 2081.1, 2086, 2087, 2089.2, and 2835).

If the Humboldt marten is listed under CESA, impacts of take caused by activities authorized through incidental take permits must be minimized and fully mitigated according to state standards. These standards typically include protection of the land in perpetuity with an easement, development and implementation of a species-specific adaptive management plan, and funding through an endowment to pay for long-term monitoring and maintenance to ensure the mitigation land meets performance criteria. Additionally, the Department would be prohibited from approving incidental take permits which could jeopardize the continued existence of the species in the state (Fish & G. Code, § 2081, subd. (b)(4)). Obtaining an incidental take permit is voluntary. The Department cannot force compliance; however, any person violating the take prohibition may be punishable under state law.

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

Although the protections afforded listed species by CESA do not apply to the actions of federal management agencies on federal lands, CESA listing may prompt increased interagency coordination and the likelihood that state and federal land and resource management agencies will allocate funds toward protection and recovery actions. In the case of the Humboldt marten, the Humboldt Marten Working Group signatory agencies already meet and coordinate regularly, but a state listing could result in increased availability of conservation funds.

Economic Considerations

The Department is not required to prepare an analysis of economic impacts (Fish & G. Code, § 2074.6).

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PERSONAL COMMUNICATIONS

Derek J. Broman, Furbearer Coordinator, Oregon Department of Fish and Wildlife. March 17, 2017

Deana Clifford, DVM, MPVM, PhD, Senior Wildlife Veterinarian, California Department of Fish and Wildlife. May 21, 2018.

Keith Hamm, Wildlife Biologist, Green Diamond Resource Company. October 24, 2017, April 13, 2018, May 23, 2018.

Edward Mann, Yurok Tribal Forestry Director. October 25, 2017.

Scott Osborn, PhD, Mammal Coordinator, California Department of Fish and Wildlife. May 15, 2018.

Stephan Prokop, Redwood National Park Superintendent, and Brett Silver, Redwood State Parks Superintendent. Letter to Daniel Applebee, California Department of Fish and Wildlife. June 29, 2016.

Keith M. Slauson, PhD, Research Ecologist, USDA Forest Service Redwood Sciences Lab. October 10, 2017; November 10, 2017; April 24, 2018; May 24, 2018.

Keith M. Slauson, Research Ecologist, USDA Forest Service Redwood Sciences Lab. E-mail exchange with Scott Osborn and Daniel Applebee, CDFW. November 17, 2017.

APPENDIX A – GREEN DIAMOND RESOURCES COMPANY SAFE HARBOR AGREEMENT

State of California – Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
Deputy Director
Ecosystem Conservation Division
P.O. Box 944209
Sacramento, CA 94244-2090
www.wildlife.ca.gov

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

April 27, 2018

Mr. Neal D. Ewald
Senior Vice President
Green Diamond Resource Company
California Timberlands
Post Office Box 1089
Arcata, CA 95518-1089

Dear Mr. Ewald:

Subject: SAFE HARBOR AGREEMENT FOR HUMBOLDT MARTEN ON GREEN DIAMOND RESOURCE COMPANY TIMBERLANDS IN CALIFORNIA (2089-2016-002-01)

The California Department of Fish and Wildlife (CDFW) has worked closely with your team at Green Diamond Resource Company (GDRCo) since July 2016 to negotiate and craft a safe harbor agreement under the California State Safe Harbor Agreement Program Act (Act)(Fish & Game Code, §§ 2089.2 et seq.). As described in the Act, a safe harbor agreement will contain detailed maps, a description of current and future management practices that might affect Humboldt marten and its habitat; the duration of the agreement, the management actions; and description of a monitoring program. The Act requires that a safe harbor agreement must provide a net conservation benefit to the covered species, Humboldt marten.

Please find enclosed a copy of the Green Diamond Resource Company Humboldt Marten Safe Harbor Agreement. Please review the entire document including attachments and figures, with specific attention to the commitments and management actions that CDFW and GDRCo developed together. If you concur, please sign where indicated and return two copies with original signatures to:

California Department of Fish and Wildlife
Attention: Ms. Tiffany Manko
601 Locust Street
Redding, California 96001

Mr. Neal Ewald, Senior Vice President
Green Diamond Resources Company
April 27, 2018
Page 2

CDFW is grateful for the opportunity to develop this agreement with your team, and is confident that the commitments will contribute to a net conservation benefit for the covered species. Please direct questions or comments to Environmental Program Manager Joe Croteau at (530) 340-0767, or via e-mail at joe.croteau@wildlife.ca.gov.

Sincerely,

Tina Bartlett, Acting Deputy Director
Ecosystem Conservation Division

ec: **Green Diamond Resource Company**

Galen Schuler
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Gary Rynearson
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Keith Hamm
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California Department of Fish and Wildlife

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California Department of Fish and Wildlife
Northern Region
601 Locust Street
Redding CA 96001

California Endangered Species Act
Safe Harbor Agreement No. 2089-2016-002-01

Green Diamond Resource Company Humboldt Marten Safe Harbor Agreement

Authority

This Safe Harbor Agreement (Agreement) is entered into by and between the California Department of Fish and Wildlife (CDFW) and Green Diamond Resource Company (Green Diamond) pursuant to the California State Safe Harbor Agreement Program Act (Program)(Fish & G. Code, § 2089.2 et seq.). The California Endangered Species Act (CESA) (*Id.*, § 2050 et seq.) prohibits the take[1] of any species designated by the California Fish and Game Commission as an endangered, threatened, or candidate species.[2] CDFW may authorize the take of any such species through an Agreement if the conditions set forth in Fish and Game Code section 2089.6 are met.

Covered Species and Covered Activities

The purpose of this Agreement is to provide a net conservation benefit to the CESA candidate species Humboldt marten[3] *(Martes caurina humboldtensis*) (Covered Species), and assure Green Diamond that no additional regulatory burdens, fines, or penalties will result from Management Practices or Management Activities (the Covered Activities as defined below) that are conditioned and designed to benefit the Covered Species within 363,967 acres of property, as specifically identified below (Figure 1).

Effective Date and Term of this Agreement

This Agreement shall be executed in duplicate original form and shall become effective when both copies are signed by Green Diamond and received by CDFW as described in the Execution and Delivery section of this Agreement. Unless renewed or cancelled by Green Diamond or CDFW, this Agreement shall expire on **December 31, 2057**.

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[1] Pursuant to Fish and Game Code section 86, "take' means hunt pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill."
[2] The definitions of endangered, threatened, and candidate species for purposes of CESA are found in Fish and Game Code sections 2062, 2067, and 2068, respectively.
[3] Fish and Game Code section 2068. The species' status may change following the decision of the Fish and Game Commission to designate the species as threatened or endangered; if there is such a designation, the species will remain a Covered Species.

Land Classifications under This Agreement

Enrolled Lands means all forestland subject to timber harvesting rights in Del Norte and Humboldt Counties, California owned by Green Diamond and managed subject to this Agreement during its term. Figure 2a depicts the specific area this Agreement pertains to on the Effective Date as the Enrolled Lands. Green Diamond may add newly acquired forestland and timber harvesting rights acquired after the Effective Date of this Agreement to the Enrolled Area by providing written notice to CDFW describing the additional Enrolled Lands and the effect of adding such lands on landscape baseline conditions.

Potential Marten Source Area means all lands CDFW knows to be occupied by the Covered Species and that are potential source areas for Covered Species capture, collaring, assisted dispersal, and monitoring. The Marten Assisted Dispersal Feasibility Study, a prescribed Management Activity under this Agreement, will evaluate the capacity and recommended conditions for use of the Potential Marten Source Area in assisted dispersal of the Covered Species into potential marten release areas.

Marten Special Management Area (MSMA) is shown in Figure 1. The MSMA will serve several roles providing a net conservation benefit for the Covered Species. The MSMA will serve as the location for assisted dispersal of the Covered Species. The MSMA is a high priority connectivity area and habitat linkage area for marten because of its location between known occupied sites east of the Klamath River and the Redwood National and State Parks (Figure 2b).

Marten Reserve Area means a designated portion of the MSMA that is known to be occupied by the Covered Species and shall not be subject to timber harvesting during the term of this Agreement. The Marten Reserve Area is shown in Figure 2b.

Riparian Management Zone (RMZ) refers to forestlands designated in the 2008 Aquatic Habitat Conservation Plan approved by the National Marine Fisheries Service. RMZs encompass forestlands along both sides of a watercourse or around the circumference of a lake or spring, where additional practices may be required for protection of the quality and beneficial uses of water, fish and riparian wildlife habitat, other forest resources and for controlling erosion.

Introduction

The Covered Species, one of the recognized subspecies of the Pacific marten (Grinnell and Dixon 1926), was historically distributed throughout the coastal, fog-influenced forests of the coast redwood (*Sequoia sempervirens*) region in California from northwestern Sonoma County northward to the Oregon border (Figure 3; Grinnell et al. 1937). In California, the Humboldt marten has been extirpated from approximately 95 percent of its historical range. Until recently, the subspecies was known only from a single population that likely contained fewer than 100 individuals (Slauson et al. 2009a). Most recently, between 2011 and 2015 martens were detected on National Forest lands at 8 locations near tributaries of the Middle Fork of the Smith River and 2 locations on Green Diamond's Moore Tract near the California-Oregon border, suggesting that a small population exists in that area.

In February 2016, the California Fish and Game Commission accepted a petition that requested Humboldt marten be added to the list of threatened or endangered species under CESA. CDFW has initiated a status review of the Humboldt marten in California. During this review period, the Humboldt marten holds the status of "candidate" for state listing, and is afforded all the legal protections provided a formally listed species under California law.

Of the 363,967 acres included as Enrolled Lands, 137,461 acres is within 15 km of the currently known extant populations (Figure 4). The Enrolled Lands account for approximately 12 percent of the area that includes or is within 15 km of the known extant populations.

Baseline Conditions

Baseline conditions can mean the population size, the extent and quality of habitat, or both the population size and the extent and quality of habitat for the Covered Species on the lands to be enrolled in a safe harbor agreement that sustain seasonal or permanent use by the Covered Species. For the purpose of this Agreement, the "baseline conditions" shall mean the current estimated population size of the Covered Species and the current understanding of habitat, and is defined by reference to lands covered by this Agreement.

Pursuant to Fish and Game Code section 2089.4, subdivision (b), the Program requires a complete description of baseline conditions for the species covered in this Agreement. CDFW determines baseline conditions in consultation with the applicant, and the baseline conditions are based on the best available science and objective scientific methodologies. For purposes of establishing baseline conditions, a qualified person who is not employed by CDFW may conduct habitat surveys, if that person has appropriate species expertise and has been approved by CDFW. The baseline described in this Agreement has been determined and approved by CDFW after consultation with the applicant, Green Diamond, and its qualified person. Under Fish and Game Code section 2089.4, CDFW has determined that the following individual is a "Qualified Person" for purposes of this Agreement:

Keith A. Hamm, Conservation Planning Manager, California Timberlands; Certified Wildlife Biologist®

Green Diamond Resource Company
900 Riverside Road
Korbel, CA 95550
707-668-4437

Based on survey efforts by Green Diamond and other parties, CDFW agrees that the Covered Species is rare or absent from the majority of the Enrolled Lands (Figure 4). Presence of the Covered Species has been confirmed in the Moore tract and Marten Reserve Area. Based on the limited number of detections and spatial extent of non-detections, a reliable estimate of the number of martens currently using habitat on Enrolled Lands is likely very small and transitory. Accordingly, it is not possible for CDFW to include a reliable trend assessment for the Covered Species' population on the Enrolled Lands at this time.

The Covered Species' use of habitat within the Enrolled Lands remains unknown because Covered Species expansion into managed lands is a limited and recent discovery. A reliable and accepted definition of suitable habitat for the Covered Species on managed coastal redwood forest does not exist. This Agreement characterizes the condition of forest stands on the Enrolled Lands as of the Effective Date to establish a habitat baseline at a landscape scale. This baseline condition shall be monitored over the term of this Agreement to ensure compliance and develop a better understanding of suitable habitat for the Covered Species on managed timberlands.

To evaluate current forest age and predict changes in forest age over the Enrolled Lands, Green Diamond used a focal mean analysis of its forest inventory data and output from its 50-year forest growth and harvest modeling. Green Diamond calculated the average age of forest stands for 10-meter pixels within a 1-kilometer radius circle. The radius circle was used to approximate the average home range of the Covered Species. The focal mean analysis was conducted using forest age as the metric of interest for describing baseline habitat conditions at the start of the permit and at decadal intervals over the duration of the permit (i.e., 40 years). The starting point for baseline conditions is average age at year 2015. The goal of this Agreement is to increase average forest age and retain critical habitat elements over the permit term.

Within the managed landscape of the Enrolled Lands, the starting point for baseline habitat conditions is an average forest age of approximately 41 years (Figure 5) as calculated using the focal mean. At the end of the Agreement term, the average forest age is projected to increase (Figure 5). CDFW expects that that the extent and quality of habitat will increase over the Agreement term. Riparian Management Zones (RMZ) will increase, creating networks of older forests, with high tree basal area and dense canopy cover adjacent to harvest areas (Unencumbered Areas) containing younger seral stages. Overhead tree canopy and retained individual and clumped mature trees will accelerate the development of younger stands. Approximately 25-percent of the Enrolled Lands are in RMZs (see Figure 6) and other partial harvest retention areas (Encumbered Areas) with stands that will increase from the current average stand age of 54 years to an average of 94 years over the next 40 years. While not considered old growth, stands of this age in the redwood region develop large trees with cavities, broken tops, debris accumulations and various types of nests built by a variety of birds and mammals.

Table 1. Average forest age for the Enrolled Lands (Landscape Baseline), Unencumbered Areas and Encumbered Areas using a focal mean analysis on a 1 km radius circle.

Average Forest Age[4]

Year	Baseline and Projected Enrolled Lands	Enrolled Lands' Unencumbered Areas	Enrolled Lands' Encumbered Areas	MSMA and Projected MSMA	MSMA Unencumbered	MSMA Encumbered
2015	40	35	54	43	41	49
2025	43	36	64	48	43	59
2035	46	36	74	50	42	69
2045	48	35	84	52	41	79
2055	50	34	94	53	38	89

The dynamic forest baseline is a matrix of Unencumbered Areas subject to even-age management under the California Forest Practice Rules with individual and group tree retention to accelerate development of key ecological elements within early seral stands after harvest. Encumbered Areas such as RMZs are subject to uneven-age management and single harvest entry within the 50-year harvest cycle, and other protected areas such as geologic zones are also subject to uneven-age management. Again, the 1-km radius circle, or approximately 776 acres, is used to approximate a marten home range. The focal mean analysis is used to calculate average forest age within a home range circle to describe baseline conditions at the beginning of the permit period and at 10-year intervals based on modeled growth and harvest of the forest landscape. The average-age analysis information is also extracted from the 127,217-acre MSMA to illustrate projected average age for the MSMA relative to the baseline and Enrolled Lands.

Summary of Development of Baseline Conditions

Population

- The Covered Species was thought to be extirpated in California due to trapping and loss of habitat from harvesting of late seral forests until a small population was rediscovered in 1996 within a portion of the historical range (Zielinski and Golightly 1996).

- Mesocarnivore surveys conducted on or near the Enrolled Lands since 1996 indicate that the Covered Species is rare or absent on the Enrolled Lands with the exception of a few recent detections on the Moore Tract and Marten Reserve Area. The Enrolled Lands are not included as locations of any of the currently extant and viable populations recognized by the Humboldt Marten Conservation

[4] Average age, expressed as a single number at a specified time, is calculated using a focal mean analysis conducted on raster data generated at 10-m resolution. The focal mean for each 10-m^2 cell is calculated over a simulated marten home range area represented by a 1-km radius circle.

Group. It is not possible to reliably assess any trend in the marten population on the Enrolled Lands at this time. The Covered Species is absent/rare/transient except for the Moore tract and Marten Reserve Area.

Habitat

- There is limited contemporary information on habitat use by the Covered Species at the home range scale, and that which is available was collected from public lands from a small portion (<5%) of the Covered Species' historic range in Del Norte County, California.

- Slauson et al. (In prep.) developed a landscape habitat suitability model (HSM) for Humboldt marten in coastal California and coastal Oregon to guide survey, monitoring, and conservation planning efforts in the region with the overall objective of creating a model that would indicate the occurrence of martens and habitat.

- Green Diamond evaluated the HSM on Enrolled Lands. The HSM includes the average Old Growth Structural Index (OGSI) at the 1km scale, precipitation, stream density, latitude adjusted elevation, and geology. The OGSI index is an average combination of four separate indices representing stand age and four structural features: number of large trees (>100 cm dbh), large snags (>50 cm dbh and >15 m tall), volume of large wood, and tree size diversity (Spies et al. 2007). The OGSI was the only vegetative model parameter in the HSM potentially influenced by Green Diamond's forest management activities.

- Initially, CDFW advocated for the use of OGSI to determine baseline. However, Green Diamond compared OGSI to inventory data and identified that the satellite imagery data on OGSI contains substantial commission and omission errors within the Enrolled Lands. Green Diamond did not have and cannot reliably predict future values of OGSI through time. Green Diamond explained in drafts of the Agreement that the RMZs would be developing into older forests over time and the expectation is that RMZs (25% of ownership) will increase in OGSI.

- CDFW then asked Green Diamond if they could analyze radio telemetry data for HUMA detections east of the Klamath and compare that to Enrolled Lands. The studies conducted east of the Klamath were not designed to estimate home range and no data were analyzed at that scale. For comparative purposes, Green Diamond provided CWHR tree size information from its forest inventory for areas east of the Klamath and the Enrolled Lands. Green Diamond used the den site information from east of the Klamath to improve the TREE model to benefit marten.

- Previous experience attempting to delineate and predict future home ranges for northern spotted owls on Enrolled Lands indicates that CDFW and Green Diamond cannot predict with high certainty when and where terrestrial species will establish home ranges. CDFW and Green Diamond agreed to allow the

Covered Species monitoring efforts to inform use of denning and home range habitat on the Enrolled Lands.

- In the absence of the ability to project future conditions for the HSM or OGSI within the Enrolled Lands, Green Diamond used forest stand age information available from Green Diamond's forest inventory data to describe the one parameter from OGSI, forest age that could be influenced by Green Diamond's forest Management Practices (defined below) through time.

- Green Diamond used GIS and stand inventory to arrive at a projected average stand age (similar moving windows analysis to OGSI) at the 10m pixel scale and arrived at the expected average forest age in Table 1 of this Agreement.

Management Practices

Green Diamond manages the Enrolled Lands primarily using Timber Harvesting Plans (THP) for timber production and other purposes pursuant to California's Timberland Productivity Act of 1982 (Gov. Code, §§ 51100-51104), the Z'Berg-Nejedly Forest Practice Act (Pub. Resources Code, § 4511 et seq.), the California Board of Forestry's Forest Practice Rules (Cal. Code Regs., tit. 14, § 895 et seq.), various other state laws, and Green Diamond's internal management documents, policies, and guidelines.

Current Management Practices are Green Diamond's land use and maintenance activities on the Enrolled Lands that affect the Covered Species or their habitat. Green Diamond's Management Practices on the Enrolled Lands include Timber Operations, as defined within the California State Forest Practices Act as of January 1, 2017.

> ***Public Resources Code section 4527 subdivision (a) (1)*** *"Timber operations" means the cutting or removal, or both, of timber or other solid wood forest products, including Christmas trees, from timberlands for commercial purposes, together with all the incidental work, including, but not limited to, construction and maintenance of roads, fuel breaks, firebreaks, stream crossings, landings, skid trails, and beds for the falling of trees, fire hazard abatement, and site preparation that involves disturbance of soil or burning of vegetation following timber harvesting activities, but excluding preparatory work such as tree marking, surveying, or road flagging.*

Green Diamond's Management Practices also include: timber cruising, tree marking, harvest planning, use of roads for transport of equipment, timber and rock, use of roads for any other forest management activities, vegetation management, pre-commercial thinning, in-woods chipping and removal of woody biomass, development and excavation of rock resources for forest management, maintenance and use of water tanks, collection of minor forest products, grazing, fire suppression, surveying, sampling, monitoring and other research activities related to fish, wildlife, and habitat, and authorized recreation (e.g., hunting).

If there are other Management Practices on Enrolled Lands that are not described above, Green Diamond shall provide CDFW with a written description of the activities and request that CDFW provide a written determination whether the described Management Practices are Covered Activities consistent with this Agreement and Fish and Game Code section 2089.14. All Exemptions (Cal. Code Regs., tit. 14, § 1038 et seq.) shall comply with the commitments under this Agreement.

Management Actions

Management Actions are activities conducted on the Enrolled Lands that are reasonably expected to provide a net conservation benefit for the Covered Species within the Enrolled Lands. The Management Actions to be conducted under this Agreement include:

Assisted Dispersal Commitments

1. Green Diamond shall provide financial and technical support for a marten assisted dispersal (MAD) feasibility analysis conducted by CDFW. Via the MAD feasibility analysis, CDFW will evaluate and assess habitat suitability of potential release sites for martens within their historical range that are within typical dispersal distance of the core population.

2. Green Diamond shall provide financial and technical support for capture and assisted dispersal of marten based on the recommendations of the MAD feasibility analysis completed under Commitment 1. Green Diamond shall work with CDFW and other partners to capture, collar, and release martens from recommended source areas for purposes of assisted dispersal into recommended release areas. Marten release areas shall include portions of Enrolled Lands.

3. Green Diamond shall provide financial and in-kind technical support to monitor collared martens in recommended release areas. The details of monitoring shall be described in the MAD feasibility analysis completed under Assisted Dispersal Commitment 1, and shall include monitoring to determine fate, movements, territory establishment, reproductive activity, use of resting and denning structures, and habitat use.

4. Green Diamond's financial commitment to the assisted dispersal project shall include funding of up to a total of $245,000, which may be disbursed over a period of up to five years following the commencement of the assisted dispersal analysis. Green Diamond shall also contribute in-kind support of staff and equipment at a total value of $245,000, which may be incurred for a period of up to five years following the commencement of the assisted dispersal project. How the funding and in-kind contributions are deployed shall be based on a feasibility study and agreed to prior to encumbering. Additionally, the MAD feasibility analysis may require third-party financial support, therefore Green Diamond's

financial commitment may be used as match to secure additional funds from other sources.

Habitat Management Commitments

Green Diamond shall develop a training program to educate managers, employees, and contractors on implementation of this Agreement on an annual basis. The training program shall include a summary of marten biology, habitat use and the management actions within this Agreement. Green Diamond shall document this training program and make a summary available to CDFW upon request.

1. Green Diamond shall implement measures as currently defined under the federally approved Aquatic Habitat Conservation Plan (AHCP) for Green Diamond Timberlands or as modified through federally approved adaptive management under the AHCP on all Enrolled Lands except those not covered by the AHCP. For Enrolled Lands outside AHCP Coverage (approximately 7,777 acres), riparian and geological retention measures shall be implemented in accordance with the California Forest Practice Rules, with the exception that RMZs in the Moore Tract (because of localized Covered Species detections) shall be limited to only one harvest entry within RMZ during the life of this Agreement concurrent with the even-aged harvest of the adjacent stand. The only exception shall be light thinning conducted with the specific objective of enhancing wildlife structure.

2. Green Diamond shall implement the TREE Guidelines for Green (Live) Tree and Snag Retention on all Enrolled Lands (Attachment 4) in THPs and Exemptions. Specific TREE measures designed as a conservation benefit to marten are applied through a marten-specific safe harbor agreement scorecard on Green Diamond timberlands within the Marten Special Management Area, the Moore Tract, (tracts 51, 53, 56, 61, 66, 67, 70, 71, 72, 73, 85, 87, 88, 98, Figure 7), and within California Interagency Watershed Map (i.e., Calwater 2.2.1) watersheds when the Covered Species are detected. Tables summarizing scorecard tree retention shall be included in proposed THPs.

3. Green Diamond shall establish a 127,217- acre “Marten Special Management Area” for the Covered Species located between the known occupied marten sites east of the Klamath River that supports an extant population of the Covered Species, and the state and federal parks to the north, west, and south of the MSMA (Figure 2b). Within the MSMA Green Diamond shall use additional habitat management and monitoring measures (Monitoring and Reporting Requirements, below) to assess whether and how dispersing marten use managed forest lands and the characteristics of habitat features that are most useful to martens.

4. Within the Special Management Area, Green Diamond shall establish a 2,098-acre “Marten Reserve Area” in Del Norte County where the Covered Species are

known to occupy an area of serpentine habitat within the Green Diamond Enrolled Lands (Figure 2b). Green Diamond shall not conduct any timber harvest within the Marten Reserve Area during the term of this Agreement.

5. Within the MSMA and the Moore Tract (shown in Figure 2) (as Enrolled Lands in northeast Del Norte County with baseline marten detection), Green Diamond shall incorporate into THPs a prescription for retention of downed large woody debris to enhance structural complexity, foraging, denning, resting and escape cover benefitting marten. Harvest units shall retain pre-existing non-merchantable large woody debris and merchantable large woody debris with existing hollows or evidence of internal rot and hollows.

6. Within the MSMA and the Moore Tract, Green Diamond shall incorporate into THPs a prescription for harvesting practices that creates slash piles to benefit marten occupancy through increased structural complexity, cover, resting and denning habitat. Within each ground-based timber harvest unit, Green Diamond shall create and retain slash pile(s) for marten at a rate averaging one structure for every 5 – 10 acres of clear-cut. Slash piles may be created over existing large woody debris to enhance function of those structures.

7. When Green Diamond discovers or is made aware of natal or maternal den structures used by marten, as determined by radio telemetry and camera monitoring through its own or cooperative efforts as part of the assisted dispersal project, Green Diamond shall retain these den structures on the landscape and incorporate tree retention (Commitment 2) around the den structure during and post timber harvest operations.

   The standard for tree retention around a natal den structure shall be a no-less-than 0.5-acre no-harvest habitat retention area (HRA). Any harvest conducted within the natal den HRA may only be done in consultation with CDFW and shall be to protect the biological integrity of the site and increase/accelerate development of large trees within the HRA.

   Habitat retention around maternal den structures shall include any of the following: the individual den structure element (live tree, snag, log, etc.), the individual structure with tree clump retention, or the individual structure and a 0.5-acre HRA with 70 percent over story tree canopy composed of a variety of tree sizes and tree species present in the existing pre-harvest stand. The intent of the tree retention around known den structures shall be to incorporate and retain existing biologically important habitat elements such as large trees, snags and large down wood. Green Diamond's Forestry and Wildlife staff shall coordinate to determine appropriate tree retention around the maternal den structure. Habitat retention around den site structures shall be summarized in annual reports, and CDFW shall be provided access to the site(s) to evaluate post-harvest retention.

8. When conducting vegetation management activities such as herbicide application

and manual treatment of brush with chainsaws, Green Diamond shall conduct the following procedures to protect habitat retained to benefit marten:

- Green Diamond's Wildlife Department shall review all proposed hack and squirt treatments.
- Wildlife habitat shall be retained in accordance with Green Diamond's TREE (Commitment 2).
- Herbicide applications shall be summarized in the annual report.

Implementation of the Covered Activities

Implementation of the Covered Activities, including Timber Operations, may result in habitat modification and the incidental take of the Covered Species. Road construction, harvest operations, and forest management practices may take denning females and kits through removal of the denning structure, or disturbance causing abandonment of the occupied den resulting in death of dependent kits and possible, but unlikely, direct harm or death to the female. Vehicular strikes resulting from use of forest roads and accidental entrapment in water storage facilities resulting in death or drowning of marten may also take marten.

The Program requires this Agreement to provide a net conservation benefit for the Covered Species. "Net Conservation Benefit" means that, considered cumulatively, Green Diamond's proposed Management Actions are reasonably expected to result in an increase in the population of the Covered Species and/or the enhancement, restoration, or maintenance of the Covered Species' habitat on Enrolled Lands.[5]

In addition to providing a Net Conservation Benefit, this Agreement includes measures designed to avoid or minimize incidental take of the Covered Species, and it includes measures to monitor the effectiveness of the Management Actions and compliance with this Agreement.

Assurances Regarding Take of Covered Species

The Safe Harbor Program is designed to increase species' populations, create new habitats, and enhance existing habitats. Although this increase may be temporary or long-term, any Agreement issued pursuant to this Program shall not reduce the existing populations of species or habitat present at the time the baseline is established by CDFW. As noted above, based on the limited number and spatial extent of detections, a reliable estimate of the number of martens currently existing on Enrolled Lands is unavailable and it is not possible to assess any trend in the marten population at this time.

[5] Fish and Game Code section 2089.4, subd. (g).

The Program allows CDFW to authorize the incidental take of a covered species through an Agreement if the conditions set forth in the Fish and Game Code section 2089.6 are met. This Agreement authorizes the incidental take of the Covered Species and only the Covered Species. With respect to incidental take of the Covered Species, CDFW authorizes Green Diamond, its employees, contractors, and agents to take the Covered Species incidental to implementing the Management Actions and Management Practices described herein subject to the limitations described in this section and the Avoidance and Minimization Measures identified below. This Agreement does not authorize take of the Covered Species from activities outside the scope of this Agreement, take of the Covered Species resulting from violation of this Agreement, or intentional take of the Covered Species except as authorized by this Agreement.

The process to return the Enrolled Lands back to baseline shall include, at a minimum, the following steps:

1. Green Diamond shall contact CDFW, with at least 60 days advance notice, to inform CDFW of the desire to return the Enrolled Lands to the baseline condition.

2. CDFW will determine if surveys/collection/relocation are appropriate or needed at the site.

3. If deemed appropriate by CDFW, Green Diamond and CDFW will schedule times when surveys/collection/relocation will occur.

Avoidance and Minimization Measures

By implementing the following Avoidance and Minimization Measures (AMM) Green Diamond agrees, to the maximum extent practicable, to avoid or minimize any incidental take of the Covered Species, including returning the Enrolled Lands to baseline conditions.

AMM 1. For any known occupied den site, Green Diamond shall mark for retention or non-disturbance the occupied den tree or other structure (e.g., leave tree or downed wood undisturbed). If the marked den site is within 0.25 miles of a timber harvesting unit included in a planned, approved or active THP, the occupied den site shall be protected with a 0.25-mile radius buffer that excludes Timber Operations during the marten denning season (March 15 – August 15) until either the marten denning season has ended, or it has been determined, with the concurrence of CDFW, that the den site is unoccupied. Timber Operations may occur within a den site buffer under the following limited circumstances:

- Timber Operations associated with road use of existing roads (i.e., log hauling, road watering, water drafting, road grading, and culvert replacement).
- If a female marten establishes an occupied den site within 0.25 miles of active timber harvesting operations after such operations have commenced, harvesting

Timber Operations that modify habitat may continue provided that area where active timber falling, yarding, and road construction occurs (the footprint of activities that modify habitat) does not move any closer to the occupied den site.

- Tail holds and guy line anchors for timber yarding are permitted within the 0.25-mile marten den site buffer provided that they are not located within 500-feet of the occupied marten den site.

- All confirmed den trees shall be retained.

AMM 2. Green Diamond shall ensure all water tanks and pipes used for timberland management in the Enrolled Lands are marten-proofed to prevent entrapment and/or drowning. Green Diamond shall ensure that any such facility or structure found to not be secured in the future shall be repaired, retrofitted, or replaced in a timely manner to ensure its inaccessibility to marten. Green Diamond shall include in the first annual report a catalog and map of all current and abandoned water tanks within the Enrolled Lands and documentation that each structure has been checked at least once a year to ensure that it is secured against potential entry by marten.

AMM 3. To discourage and prevent unauthorized marijuana cultivation and associated abuse of pesticides on the Enrolled Lands, Green Diamond shall maintain a system of controlled access for its Enrolled Lands using locked gates on roads, security patrols, and written permits for authorized use of the Enrolled Property. To detect and remove unauthorized activities, Green Diamond shall maintain security patrols for the Enrolled Property, conduct at least one annual aerial surveillance for marijuana cultivation hot spots where marten are likely to be exposed to pesticide use on the Enrolled Lands, and provide annual safety training for field employees on detection and reporting of suspicious and unauthorized use of the Enrolled Property. When Green Diamond detects unauthorized marijuana cultivation and/or pesticide abuse, it shall be reported to local law enforcement. If Green Diamond finds evidence of pesticide abuse that may take marten, it shall report the circumstances to CDFW for investigation and possible prosecution.

Monitoring and Reporting Requirements (MRR)

In accordance with Fish and Game Code section 2089.6, Green Diamond shall implement a monitoring program for this Agreement (as described in Attachment 2) and submit annual monitoring reports (Attachment 2) that are (1) based upon objective scientific methodologies, and (2) intended to provide information for CDFW to evaluate the effectiveness and efficiency of this Agreement, including whether the Net Conservation Benefits set forth in this Agreement are being achieved and whether the provisions of this Agreement are being implemented. Green Diamond will summarize the results for each of the following MRR in the annual reports for this Agreement. If results are not available or appropriate for a specific MRR, Green Diamond will provide a brief description on status of each MRR.

MRR 1. As noted in Assisted Dispersal Commitment 3, Green Diamond shall provide technical support and financial assistance to monitor radio-collared martens captured and released pursuant to the Assisted Dispersal Strategy.

MRR 2. Within three years of Agreement approval, Green Diamond shall use non-invasive survey results to estimate marten occupancy within the MSMA and Enrolled Lands and lands located within the Potential Marten Source Area. An analysis of occupancy rates shall be submitted in the fourth annual report.

MRR 3. After an initial effort to assess occupancy and trends of marten within the MSMA (lasting 3 years), Green Diamond shall continue to monitor marten occupancy by conducting non-invasive surveys on at least one-half of the MSMA every five years such that a complete survey would occur by year ten. A summary of occupancy surveys and estimates shall be included in annual reports coincident with the survey intervals.

MRR 4. After two complete surveys to assess marten occupancy within the MSMA, provided that (contingent upon) the existence of adequate sample size for analysis, Green Diamond shall attempt to develop a model estimating the probability of marten occupancy and associate with various habitat and physiographic variables. This modelling effort shall attempt to include all available and complementary survey efforts conducted within the range of the marten on the Enrolled Lands. A preliminary occupancy model, contingent upon sufficient data, shall be included in the annual reports coincident with the commitment interval.

MRR 5. Green Diamond shall designate an internal compliance team including an Agreement Coordinator working in conjunction with Green Diamond's forestry, operations, and wildlife staff. Green Diamond shall staff the Agreement Coordinator position with an academically trained and experienced wildlife biologist. Green Diamond shall ensure the Agreement Coordinator reviews each proposed THP during its development and informs the registered professional forester (RPF) preparing the THP when any special Agreement-related restrictions and/or mitigations occur in the area. Green Diamond also shall ensure the RPF completes a pre-harvest checklist during THP development covering all necessary Agreement compliance elements.

The Agreement Coordinator or compliance team members shall prepare and maintain documentation indicating Agreement compliance for internal use for every THP within the Enrolled Lands. Following state THP review and approval, Green Diamond's RPF shall implement the THP as written, prepare a THP post-harvest completion form documenting THP compliance with the Agreement provisions and submit this form to the Agreement Coordinator. Green Diamond's Agreement Coordinator shall review the form to ensure compliance.

MRR 6. When planning and seeking approval of THPs for future timber harvests on Enrolled Lands, Green Diamond shall incorporate applicable Agreement commitments into all THPs.

MRR 7. In accordance with Fish and Game Code section 2089.20, Green Diamond shall provide CDFW with access privileges to verify compliance with baseline commitments, monitor the effectiveness of the Agreement, and salvage individuals of the Covered Species that may be taken, subject to prior notice requirements.

MRR 8. Green Diamond shall submit annual monitoring reports that are based upon objective scientific methodologies, intended to provide information for CDFW to evaluate the effectiveness and efficiency of this Agreement, including whether the Net Conservation Benefits set forth in this Agreement are being achieved and whether the provisions of this Agreement are being implemented.

Green Diamond shall prepare and submit an annual report to CDFW by March 1 following the first full year after this Agreement Effective Date and every year thereafter during the Term.

MRR 9. To evaluate Habitat Management Commitment 2, Green Diamond will use a stratified random sample to analyze 10 percent of the THP units (pre-harvest)) to quantify tree retention using the modified TREE guidelines versus other Green Diamond retention practices. Green Diamond will use the data to analyze trends in retention under the Agreement. Green Diamond will conduct and report the results of this analysis at 5-year intervals of the Agreement. Green Diamond and the CDFW will evaluate the results at the 5-year reporting intervals and during the adaptive management review in year 25 to determine if this monitoring process should be modified during the permit term.

MRR 10. To document implementation compliance with Habitat Management Commitments 5, 6, and 7, Green Diamond will report ocular estimates of pre- and post-harvest amounts of large woody debris and post-harvest amounts of slash piles retained in ground-based harvest units. Implementation of HRA's will be summarized in the annual report as appropriate.

Adaptive Management

Adaptive Management allows for mutually agreed-upon changes to the Agreement's Management Actions and Management Practices in response to changing conditions or new information, where those changes will avoid or minimize take to the maximum extent practicable and provide a Net Conservation Benefit to the Covered Species.

If the implementation of the Management Actions or Management Practices are determined to be ineffective or do not achieve the desired results as determined through annual reports or quantitative field observations by Green Diamond and CDFW, those actions or practices may be modified within a reasonable and mutually agreed upon range to meet the stated goals of the Agreement.

The following are examples of Adaptive Management changes that will occur in response to biological information indicating that the Management Actions or Management Practices are ineffective at meeting the stated goals of the Agreement:

1. Green Diamond and CDFW agree to modify Avoidance and Minimization Measure 1 if monitoring reveals that protection measures for denning female marten may be inadequate to minimize or avoid take.
2. Green Diamond and CDFW agree to modify Habitat Management Commitment 2 if monitoring of radio collared marten reveals that a specific feature of marten den tree is inadequately quantified within the TREE scorecard and the resulting changes would provide a Net Conservation Benefit to marten through increased retention of potential denning habitat.
3. Green Diamond and CDFW agree to modify Habitat Management Commitment 6 if monitoring reveals that marten are benefitting from slash piles and that either an increase in slash piles or altered arrangement of slash (windrows) would provide a Net Conservation Benefit to marten.
4. Green Diamond and CDFW agree to modify Habitat Management Commitment 7 if monitoring on Enrolled Lands indicates an insufficient or unknown quantity or quality of natal and maternal den sites in Tracts or watersheds known to support the Covered Species.
5. Green Diamond and CDFW agree to modify Assisted Dispersal Commitments 3 and 4 if it is determined that inadequate funding exists to implement the MAD or that additional time is needed to successfully implement the MAD. The annual increase in financial contribution shall not exceed $10,000 annually and extend beyond 3 years in total.

Adaptive Management Changes Resulting From Monitoring And Adaptive Management Under The AHCP

As described in Section 6.2.6.1 of the AHCP, Green Diamond shall institute the adaptive management process under the AHCP in the event of a yellow light threshold trigger, a red light threshold trigger, SSS trigger (as these terms are defined in the AHCP), or results from the experimental watersheds monitoring program that identify an appropriate change in the conservation measures. Should Green Diamond propose any adaptive management change in the RMZ width and prescriptions under the AHCP, such a proposal shall also be deemed to be a proposed adaptive management measure under this Agreement and it shall require approval by the CDFW before it shall be implemented on Enrolled Lands by Green Diamond. The intent of this provision is that no adaptive management measures shall be taken under this Agreement unless they are judged by mutual agreement between Green Diamond and the CDFW to result in neutral or positive effects to the Humboldt marten.

Year 25 Review

The term of the Safe Harbor Agreement shall be 40 years with an adaptive management review in year 25. The purpose of the adaptive management review in year 25 shall be to evaluate the effectiveness of Management Actions providing a Net Conservation Benefit to the Covered Species. The review shall include: 1) analysis of marten occupancy and population on Enrolled Lands; 2) analysis of marten habitat on Enrolled Lands; 3) a report on the status of the Assisted Dispersal program; 4) projected habitat conditions on Enrolled Lands for the remainder of the permit term (based on the original projection of average age and potential improvements in the understanding of marten habitat use on managed lands at the time of review from 1 and 2 above); and 5) a discussion of changes, if any, to Management Actions providing a Net Conservation Benefit to marten for the remainder of the permit term.

Marten Research Commitment: Green Diamond shall cooperate with state, federal, tribal, or non-governmental organizations engaged in original research on the Covered Species to advance the understanding of the ecology, conservation, and management of the species. Cooperation shall include a range of activities including but not limited to permitted access to its timberlands, contributions of biological staff time and expertise, or voluntary monetary contributions. Any additional commitments to marten research will be voluntary and established at the time of, and subject to, the terms of an agreed study design with measurable objectives, and a demonstrated capacity to complete the research.

Funding

CDFW has determined that Green Diamond, the initial Permittee, shall provide sufficient funding to carry out Management Actions including monitoring for the Term of this Agreement. Green Diamond has provided CDFW with a letter, signed by Green Diamond's Senior Vice President and General Manager for California Operations, that includes information regarding total cost associated with Green Diamond's implementation of Management Actions under this Agreement, including all monitoring and reporting requirements set forth in this Agreement.

Green Diamond shall budget and expend such funds necessary to fulfill its obligations under the Agreement.

Land Transactions and Adjustments to Enrolled Lands

Nothing in this Agreement limits the right of Green Diamond to acquire, sell, or otherwise transfer interests in Enrolled Lands and timber harvest from Enrolled Lands nor does it limit the right of a third party to acquire Enrolled Lands.

Green Diamond may add newly acquired forestland and timber harvesting rights, located within Del Norte or Humboldt counties, acquired after the Effective Date of this Agreement, to the Enrolled Area by providing written notice to CDFW describing the additional Enrolled Lands and the effect of adding such lands on landscape baseline conditions. Within 30 days of the close of any land transactions, Green Diamond shall provide CDFW with a GIS/Geodatabase file of ownership boundaries for Enrolled Lands existing at the time of signature. Hard copy maps and spreadsheets shall be furnished to CDFW upon request. In each annual report, Green Diamond shall provide a summary of land transactions (acquisitions and disposals affecting Enrolled Lands) and minor modifications that result from corrections to ownership boundaries from survey information and updates to GIS data.

Green Diamond may grant real property interests and property use privileges in the Enrolled Lands to third parties without approval by CDFW, provided that Green Diamond shall provide CDFW with a minimum of 60 days notice prior to alienating Green Diamond's interest in the land or water through a transfer of a fee interest in the Enrolled Lands or perpetual harvest rights. Any Green Diamond contract, lease, or other agreement transferring harvesting rights on the Enrolled Lands that are less than perpetual shall be subject to compliance with the terms of this Agreement.

Grants by Green Diamond of fee interest or perpetual timber harvesting rights in Enrolled Lands are subject to compliance with Fish and Game Code sections 2089.12, subdivision (a)(3), 2089.14, and 2089.16. If Green Diamond grants a fee interest or perpetual timber harvesting rights interest in Enrolled Lands to a third party, Green Diamond must notify CDFW 60 days prior to the transfer that either:

(1) the affected Enrolled Lands will be withdrawn from Enrolled Lands status under this Agreement pursuant to section 2089.16 (with loss of "Assurances" under this Agreement for the former Enrolled Lands), or

(2) the third party assuming the interest in the Enrolled Lands agrees to assume Green Diamond's duties under this Agreement or enter into a new Safe Harbor Agreement approved by CDFW. A prospective Permittee that acquires a fee interest or perpetual harvest rights in Enrolled Lands may assume all Permittee obligations and Assurances for and maintain the status of Enrolled Lands under this Agreement through a written and signed assignment and assumption agreement or a separate Safe Harbor Agreement approved and signed by CDFW.

Withdrawal of Lands from this Agreement

If Enrolled Lands will be removed from this Agreement, Green Diamond shall notify CDFW 60 days prior and:

(1) Provide CDFW with a description and map of the affected Enrolled Lands to be removed from Enrolled Lands status, and access and an opportunity to salvage and remove any Covered Species from the subject lands.

(2) The termination of Enrolled Lands' status, Assurances, and obligations under this Agreement shall be effective upon delivery of written notice to CDFW given in accordance with this Section.

(3) If the cumulative reduction in Enrolled Lands, after considering the cumulative total of Enrolled Lands withdrawn from this Agreement and lands added to

Enrolled Lands, is fifteen percent (15%) or less of the total Enrolled Lands on the Effective Date, no amendment to this Agreement is required for withdrawal of Enrolled Lands. For withdrawals of Enrolled Lands resulting in a cumulative reduction in the initial Enrolled Lands greater than 15%, CDFW will assess whether an amendment is necessary for this Agreement to continue to provide a Net Conservation Benefit to the Covered Species or whether to terminate the Agreement in its entirety.

The following types of transactions affecting Enrolled Lands shall not be considered reductions in the total acreage of the Enrolled Lands requiring amendment pursuant to section 2089.14:

1. Transfers of Enrolled Property to any person or nonstate or federal entity that signs an assignment and assumption of this Agreement, approved by CDFW, as it applies to the affected Enrolled Lands (Fish & G. Code, §§ 2089.4, subd. (d) and 2089.16);

2. Transfers to any person or nonstate or federal entity that enters into a new agreement with CDFW as to the affected Enrolled Lands (*Ibid.*); or

3. Transfers of Enrolled Property to an agency of the State of California or an agency of the federal government, including transfers involving third parties (i.e., conservation groups) in which the ultimate owner of the affected Enrolled Lands shall be a state or federal agency and, prior to transfer, CDFW determines that the transfer of Enrolled Lands shall not compromise the effectiveness of this Agreement based on the future management of such land by the agency, without assignment and assumption of this Agreement as it applies to the affected Enrolled Lands;

Safe Harbor Agreement Termination

This Agreement shall be for the duration of 40 years. CDFW may terminate this Agreement prior to its expiration under the following conditions.

1. Green Diamond fails to perform a mandatory Management Action after CDFW provides Green Diamond with written notice of a breach of this Agreement and a 60-day opportunity to cure or commence cure of the breach, which Green Diamond fails to do without excuse. A breach of this Agreement by Green Diamond may be excused if it is caused by force majeure conditions such as natural disasters (e.g., fire, earthquake, flood), war, or government actions (e.g., conflict with federal Endangered Species Act) beyond the reasonable control of Green Diamond; or

2. Green Diamond takes any action or actions that individually or cumulatively cause the landscape condition of the Enrolled Lands to be below the baseline; or

3. Based on the 25-Year Adaptive Management Review, CDFW determines that the

Management Actions under this Agreement have not produced a "net conservation benefit" as defined by Fish and Game Code section 2089.4, subdivision (g) for the Covered Species and Green Diamond will not agree to new or revised Management Actions that are expected to provide Net Conservation Benefits for the Covered Species.

4. CDFW determines, in its sole discretion, that the Agreement is not providing the Net Conservation Benefit anticipated or otherwise not satisfying the requirements of the Program.

Green Diamond may terminate this Agreement by providing at least 60 days advance written notice and subject to the requirements of the Safe Harbor Agreement Program for return to baseline.

Green Diamond acknowledges that termination of this Agreement shall result in a loss of the regulatory assurances and the Covered Species incidental take authority provided by the Agreement.

Contact Information

Any formal correspondence that Green Diamond or CDFW submits to the other during implementation of this Agreement shall be delivered to the addresses below. Green Diamond or CDFW shall inform the other of any changes to the contact information below. Notices, reports, and other communications shall reference this Agreement name, Green Diamond, and Agreement number (2089-2016-002-01) in a cover letter and on any other associated documents.

Unless Green Diamond is notified otherwise, CDFW's contact information for written correspondence is:

Neil Manji, Regional Manager
California Department of Fish and Wildlife
Northern Region
601 Locust Street
Redding, CA 96001

And a copy to:

Habitat Conservation Planning Branch
California Department of Fish and Wildlife
Attention: CESA Permitting Program
1416 Ninth Street, Suite 1266
Sacramento, CA 95814
CESA@wildlife.ca.gov

Unless Green Diamond is notified otherwise, CDFW's contact person for purposes of addressing issues that arise during implementation of this Agreement is:

Susan Sniado, Senior Environmental Scientist (Specialist)
619 Second Street
Eureka, CA 95501
(707) 441-3970
susan.sniado@wildlife.ca.gov

Unless CDFW is notified otherwise, Green Diamond's contact information is:

Neal Ewald
P.O. Box 68
Korbel, CA 95550
707-668-3714
707-668-4402

Unless CDFW is notified otherwise, Green Diamond's contact information person for purposes of addressing issues that arise during implementation of this Agreement is:

Desiree Early
P.O. Box 68
Korbel, CA 95550
707-668-4438
707-668-4402

Agreement Findings

These findings document CDFW's compliance with the specific findings requirements set forth in Fish and Game Code section 2089.6 under the State Safe Harbor Agreement Program Act.

(1) CDFW has received a complete application from Green Diamond that contains all of the information required by Fish and Game Code section 2089.8;

(2) Take of the Covered Species as defined in this Agreement will be incidental to the otherwise lawful activities covered under this Agreement;

(3) Implementation of this Agreement is reasonably expected to provide a Net Conservation Benefit to the Covered Species under this Agreement. This finding takes into consideration that the length of this Agreement is of sufficient duration and has appropriate assurances to realize these benefits and that implementation of this Agreement is expected to result in an increase in Covered Species productivity that more than offsets any potential impacts of the take expected from implementation of Management Actions. A summary of Net Conservation Benefit elements follow;

Assisted dispersal commitment:

- Contribute $490,000 in funds and in-kind resources toward feasibility and assisted dispersal.
- Contribute up to an additional $30,000 in adaptive management if more funds are needed.

TREE (tree scorecard)

- Modified TREE to increase score for small cavities and add a point if in the 127,217 acre Marten Special Management Area.
- Use TREE scorecard in all CalWater planning watersheds that marten disperse/expand to.

2,098 acre No-Harvest Marten Reserve

Designated portion of the Marten Special Management Area that is known to be occupied by the Covered Species and will not be subject to timber harvesting during the term of this Agreement. The Marten Reserve Area is shown in Figure 2b.

Marten Special Management Area

127,217 acres identified in connectivity area to maintain advanced stand age

The MSMA will serve several roles providing a Net Conservation Benefit for the Covered Species. The MSMA will serve as the location for assisted dispersal of the Covered Species. The MSMA is a high priority connectivity area and habitat linkage area for marten because of its location between known occupied sites east of the Klamath River and the Redwood National and State Parks (Figure 2b).

Table 1 of the Agreement demonstrates that the average tree age at the end of the permit will be greater than at initiation of the permit for the Enrolled Lands. The MSMA is where the TREE modifications will be used. The Marten Reserve area is inside the MSMA. MSMA and Moore tract are targeted for retention of downed large wood and slash piles.

Within the MSMA Green Diamond will use additional habitat management and monitoring measures (Monitoring and Reporting Requirements, below) to assess whether and how dispersing marten use managed forest lands and the characteristics of habitat features that are most useful to martens.

Expand "single entry" for RMZ to the Moore Tract

Moore Tract is not currently enrolled in the ACHP, but has previous historical marten detections. Single entry into any RMZ segment would apply for the life of the permit (40 years for both the AHCP and this Agreement). Currently Green Diamond could hypothetically enter RMZs on the Moore Tract two to three times.

Known den site habitat retention areas (HRAs) for collared martens from assisted dispersal project. When Green Diamond discovers or is made aware of natal or maternal den structures used by marten, as determined by radio telemetry and camera monitoring through its own or cooperative efforts as part of the assisted dispersal project, Green Diamond shall retain these den structures on the landscape and incorporate tree retention (Commitment 2) around the den structure during and post Timber Operations. The standard for tree retention around a natal den structure will be a no less than 0.5-acre no-harvest HRA. Any Timber Operations conducted within the natal den HRA may only be done in consultation with CDFW and shall be to protect the biological integrity of the site and increase/accelerate development of large trees within the HRA.

Habitat retention around maternal den structures will include any of the following: the individual den structure element (live tree, snag, log, etc.), the individual structure with tree clump retention, or the individual structure and a 0.5-acre HRA with 70 percent over story tree canopy composed of a variety of tree sizes and tree species present in the existing pre-harvest stand. The intent of the tree retention around known den structures will be to incorporate and retain existing biologically important habitat elements such as large trees, snags and large down wood.

Slash Pile Retention

Within the MSMA and the Moore Tract, Green Diamond shall incorporate into THPs a prescription for harvesting practices that creates slash piles to benefit Covered Species occupancy through increased structural complexity, cover, resting and denning habitat. The Covered Species specifically thrive in thick brush habitat, and slash piles will be particularly important for refuge from predators, and there is known use and suspected rest/den sites in Pecwan, so a commitment to retain is in fact valuable for the Covered Species.

Monitoring and Reporting Requirement

Attachment 2 to this Agreement is designed for martens but will also detect other species like fisher, bobcats, etc. Monitoring will also be implemented outside of Enrolled Lands in the marten source area.

Research commitment to accommodate marten-specific research on Enrolled Lands as feasible

Neighboring Landowner Enrollment

Fish and Game Code section 2089.23 allows a landowner that owns land that abuts a property that is enrolled in a state safe harbor agreement to secure incidental take authority so long as certain conditions are met. The ownership and management of areas such as Western Rivers

Conservancy, the Yurok Tribe, and others present unique opportunities for marten conservation. The Yurok Tribe plans to manage the Blue Creek drainage (roughly 17,000 acres) as a tribal park and carbon sequestration project where they will restore late seral forest conditions. The balance of roughly 30,000 acres acquired from Green Diamond are managed as timberland for the production of timber and sequestration of carbon. Approximately 24,000 acres are currently managed under the Yurok HCP, which was created by an assignment and assumption of the Green Diamond AHCP as a means for issuance of an incidental take permit and enhancement of survival permit covering Yurok forest management.

(4) The take authorized by this Agreement will not jeopardize the continued existence of the Covered Species based upon provisions of subdivision (c) of section 2081 of the Fish and Game Code. This finding is based on the best scientific and other information reasonably available, and this finding includes consideration of the Covered Species' capability to survive and reproduce, and any adverse impacts of the taking on those abilities in light of: (1) known population trends; (2) known threats to the Covered Species; and (3) reasonably foreseeable impacts on the Covered Species from other related projects and activities;

(5) Green Diamond has agreed to avoid or minimize, to the maximum extent practicable, any incidental take authorized in this Agreement including when altering or modifying the Enrolled Lands for the purpose of returning lands to baseline conditions;

(6) CDFW has established or approved a monitoring program, based upon objective scientific methodologies, to provide information for CDFW to evaluate the effectiveness and efficiency of this Agreement program, including whether or not conservation benefits set forth in this Agreement are being achieved and whether Green Diamond is implementing the provisions of this Agreement.

(7) Sufficient funding is ensured to determine baseline conditions on the Enrolled Property, implement the Management Actions, and conduct monitoring for the duration of this Agreement; and

(8) Implementation of this Agreement will not be in conflict with any existing CDFW-approved conservation or recovery programs for the species covered by this Agreement.

Figures

Attachments

Authority of Signatory

If the person signing this Agreement (signatory) is doing so as a representative of Green Diamond, the signatory hereby acknowledges that he or she is doing so on Green Diamond's behalf and represents and warrants that he or she has the authority to legally bind Green Diamond to the provisions herein.

Execution and Delivery of this Agreement

Green Diamond shall deliver a fully executed duplicate original of this Agreement by registered first class mail or overnight delivery to the following address:

Habitat Conservation Planning Branch
California Department of Fish and Wildlife
Attention: CESA Permitting Program
1416 Ninth Street, Suite 1266
Sacramento, CA 95814

Signatures

The undersigned accepts and agrees to comply with all provisions contained herein.

FOR CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE

on 4/27/2018

Tina Bartlett
Tina Bartlett
Acting Deputy Director
Ecosystem Conservation Division

FOR GREEN DIAMOND RESOURCE COMPANY, PERMITTEE

By:______________________________________ Date: _______________________
Neal Ewald, Senior Vice President
California Timberlands

References

Grinnell, J.; Dixon, J.S. 1926. Two new races of the pine marten from the Pacific Coast of North America. Zoology. 21: 411–417.

Grinnell, J.; Dixon, J.S.; Linsdale, J.M. 1937. Fur-bearing mammals of California: their natural history, systematic status, and relations to man, Vol. 1. University of California Press, Berkeley, CA, USA. 375 p.

Slauson, K.M.; Baldwin, J.A.; Zielinski, W.J. 2009a. Status and estimated size of the only remnant population of the Humboldt subspecies of the American marten (*Martes americana humboldtensis*) in northwestern California. U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station, Arcata, CA, USA. 28 p.

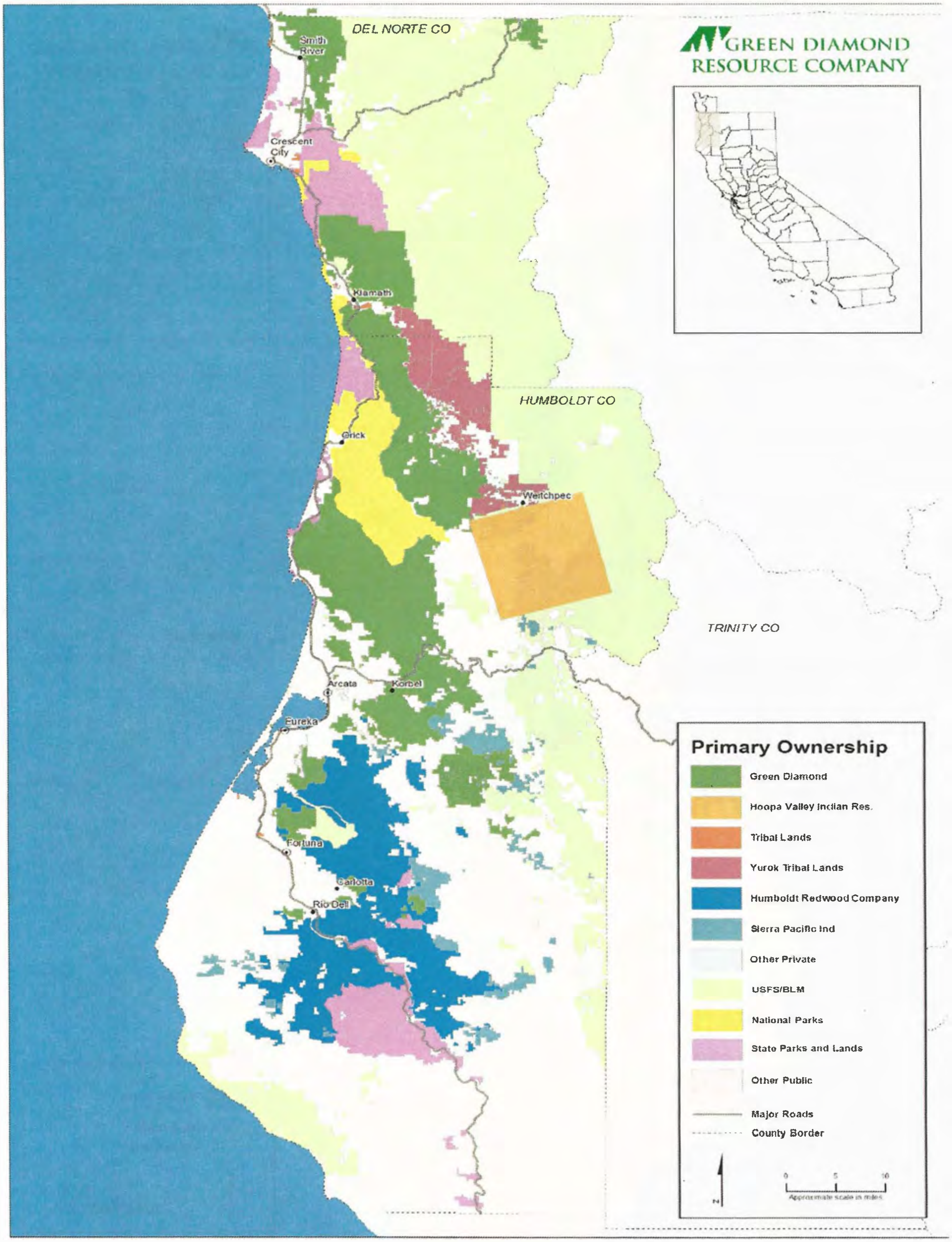

Figure 1. Primary Ownership within Marten Safe Harbor Agreement Area

1

January 2018

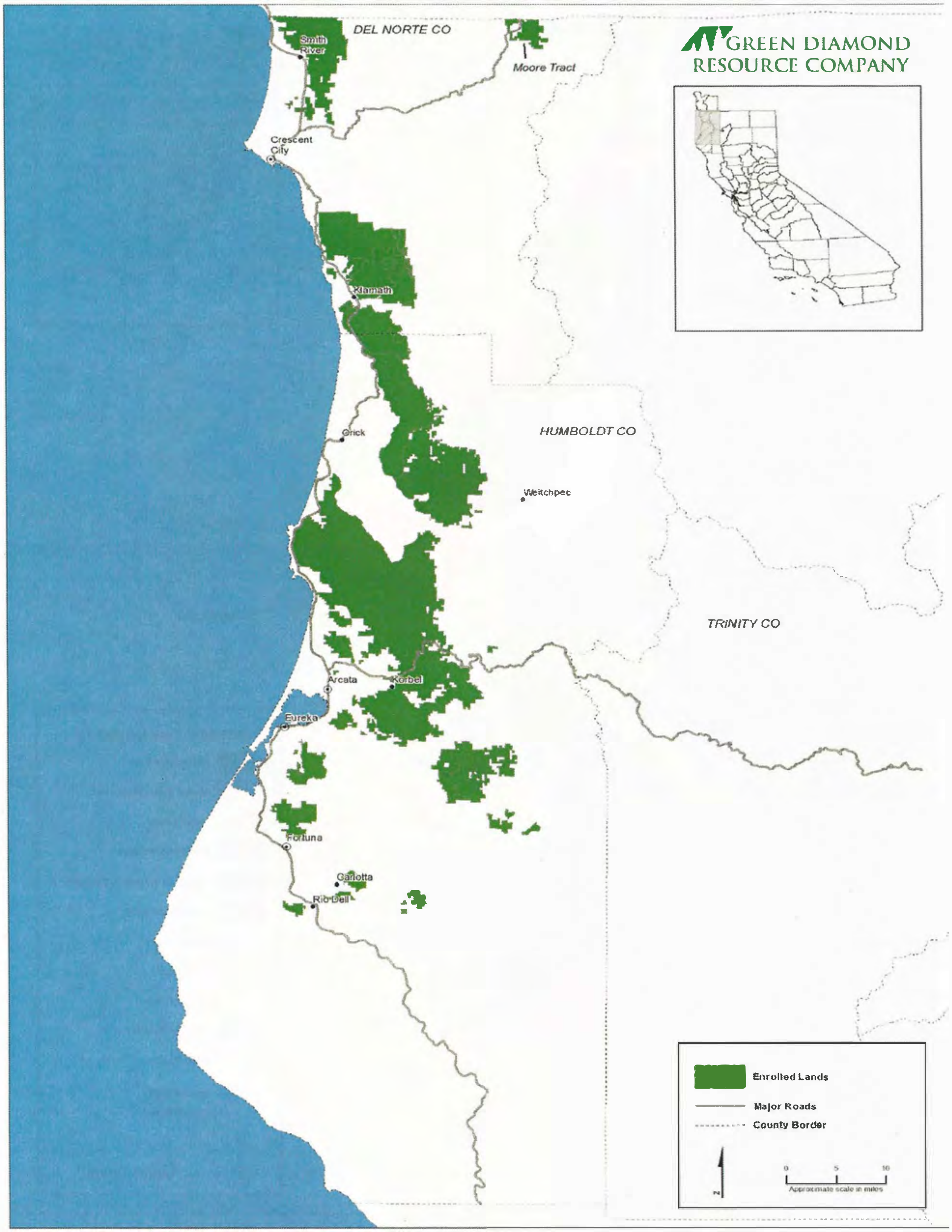

Figure 2a. Marten Safe Harbor Enrolled Lands

2a

January 2018

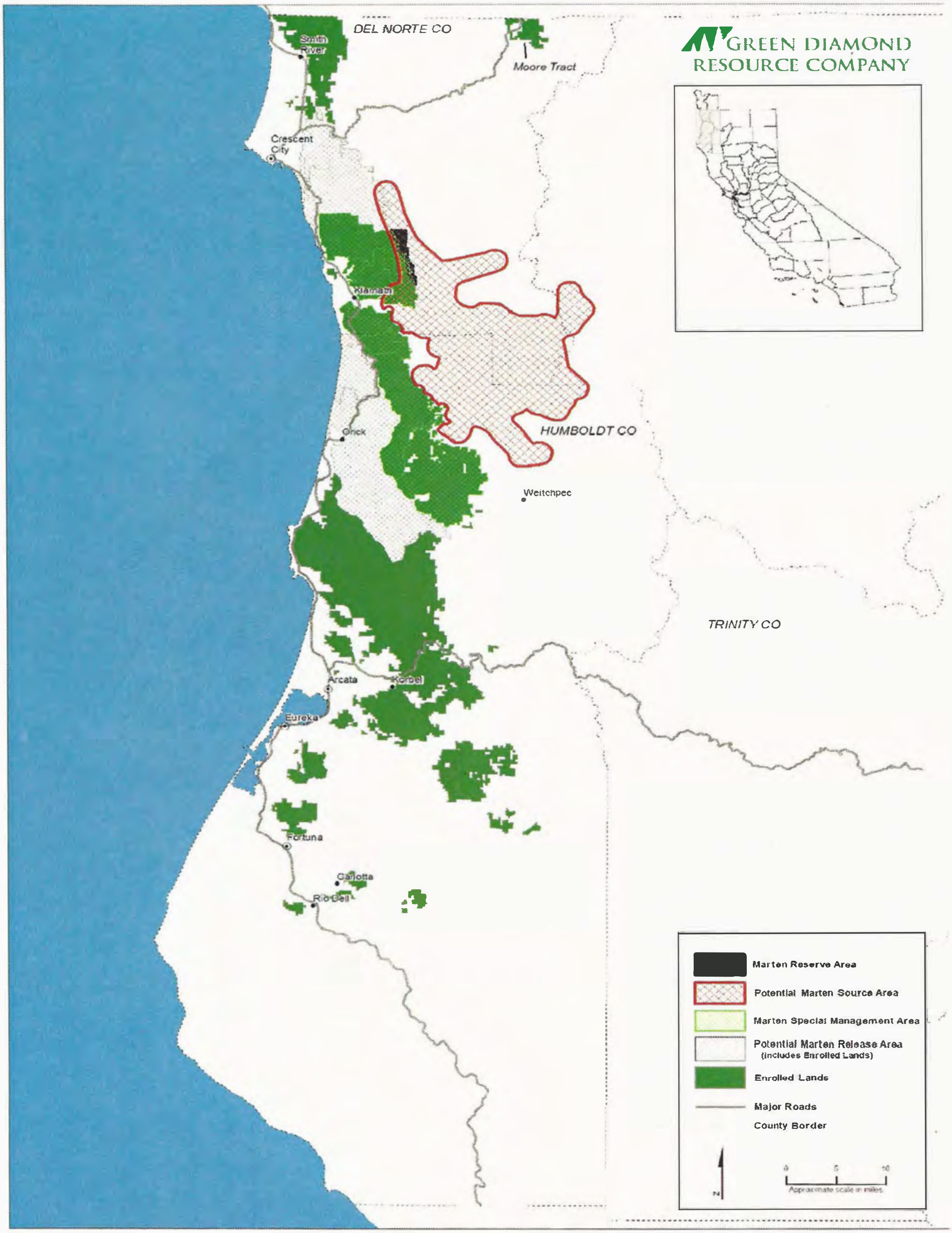

Figure 2b. Marten Safe Harbor Enrolled Lands and Special Designations

2b

January 2018

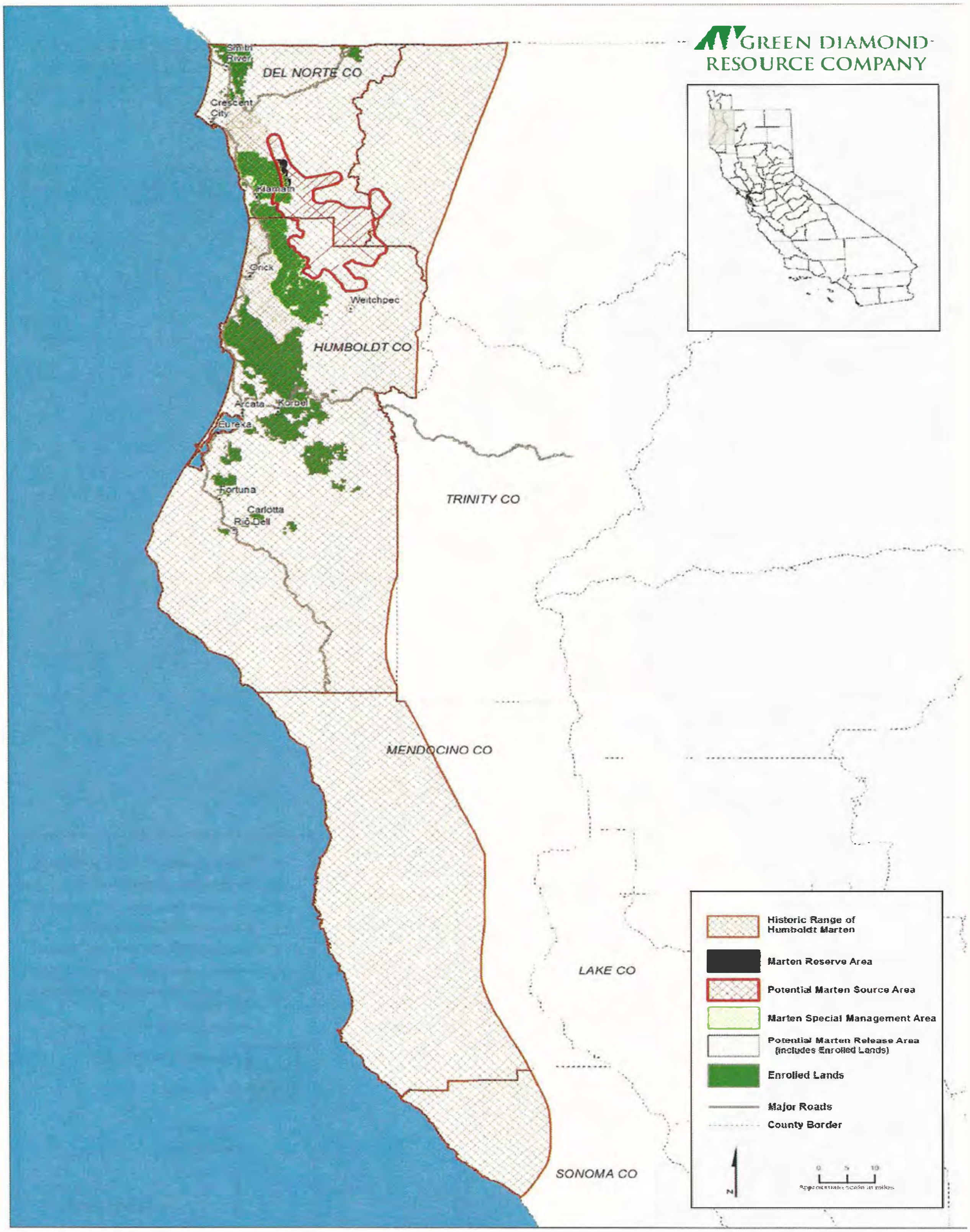

Figure 3. Historic Range of Humboldt Marten (Humboldt Marten Conservation Group 2015)

3

January 2018

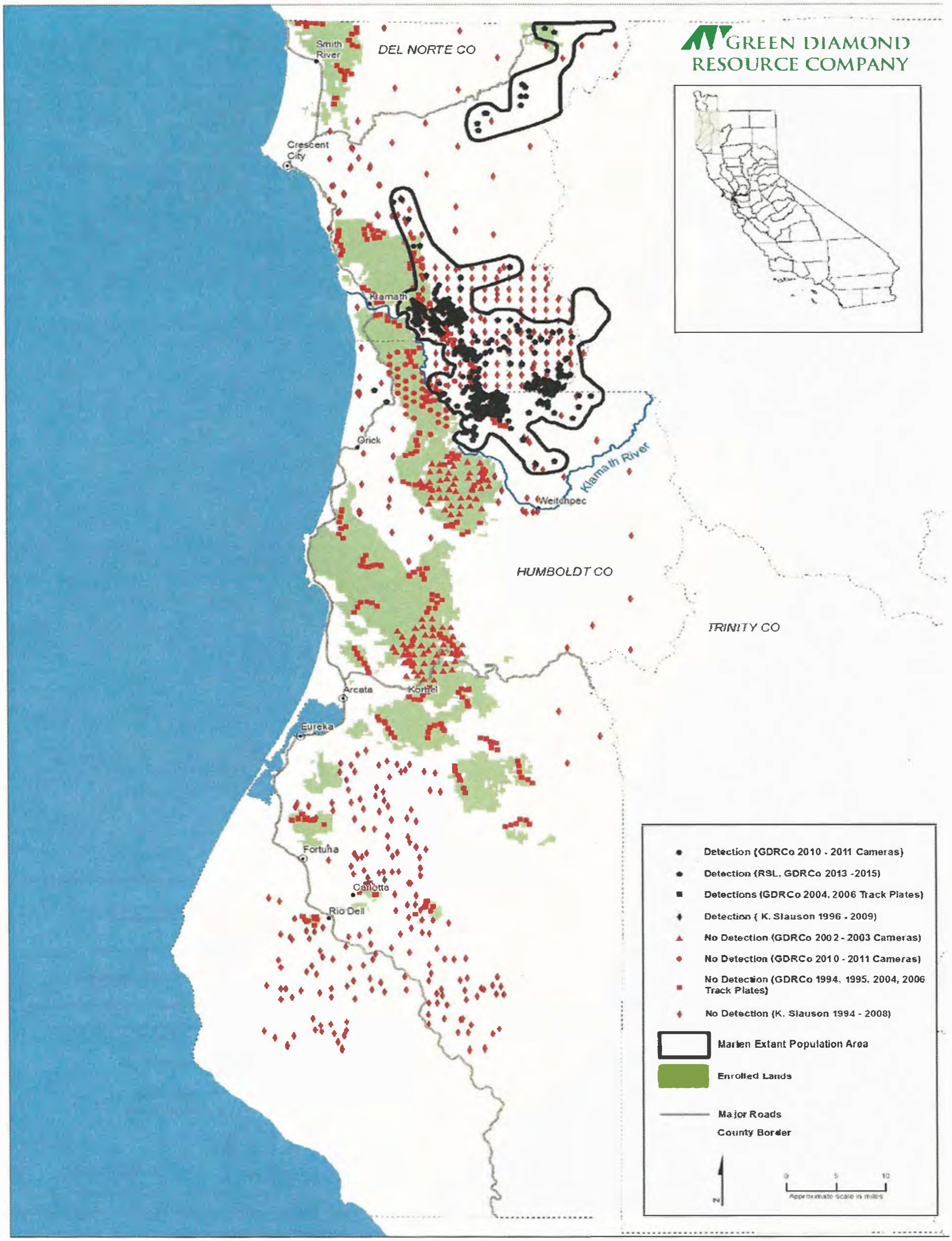

Figure 4. Marten Extant Population Area

4

January 2018

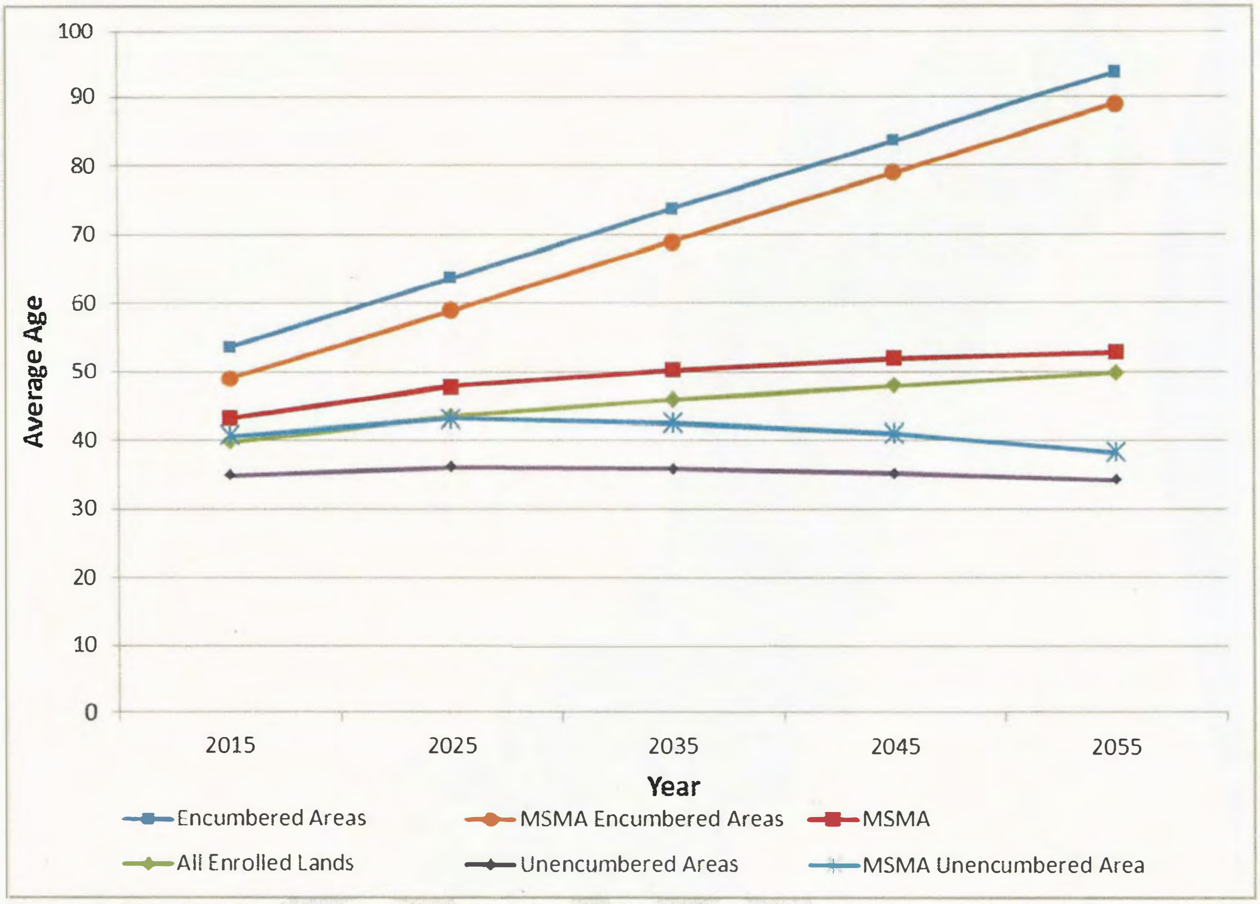

Figure 5. Baseline and Projected Change in Forest Stand Conditions

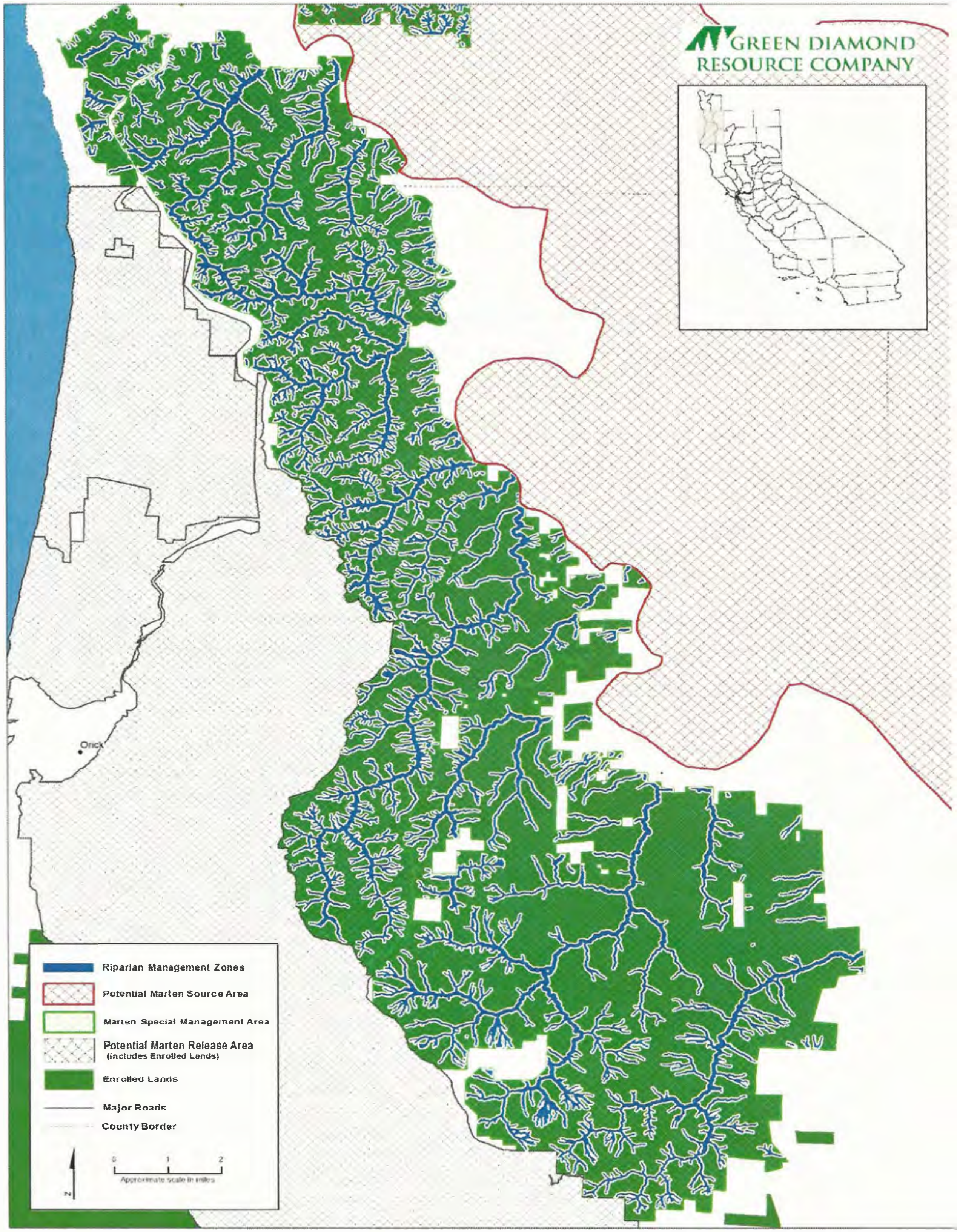

Figure 6. Example of Riparian Management Zones in Marten Special Management Area

6

January 2018

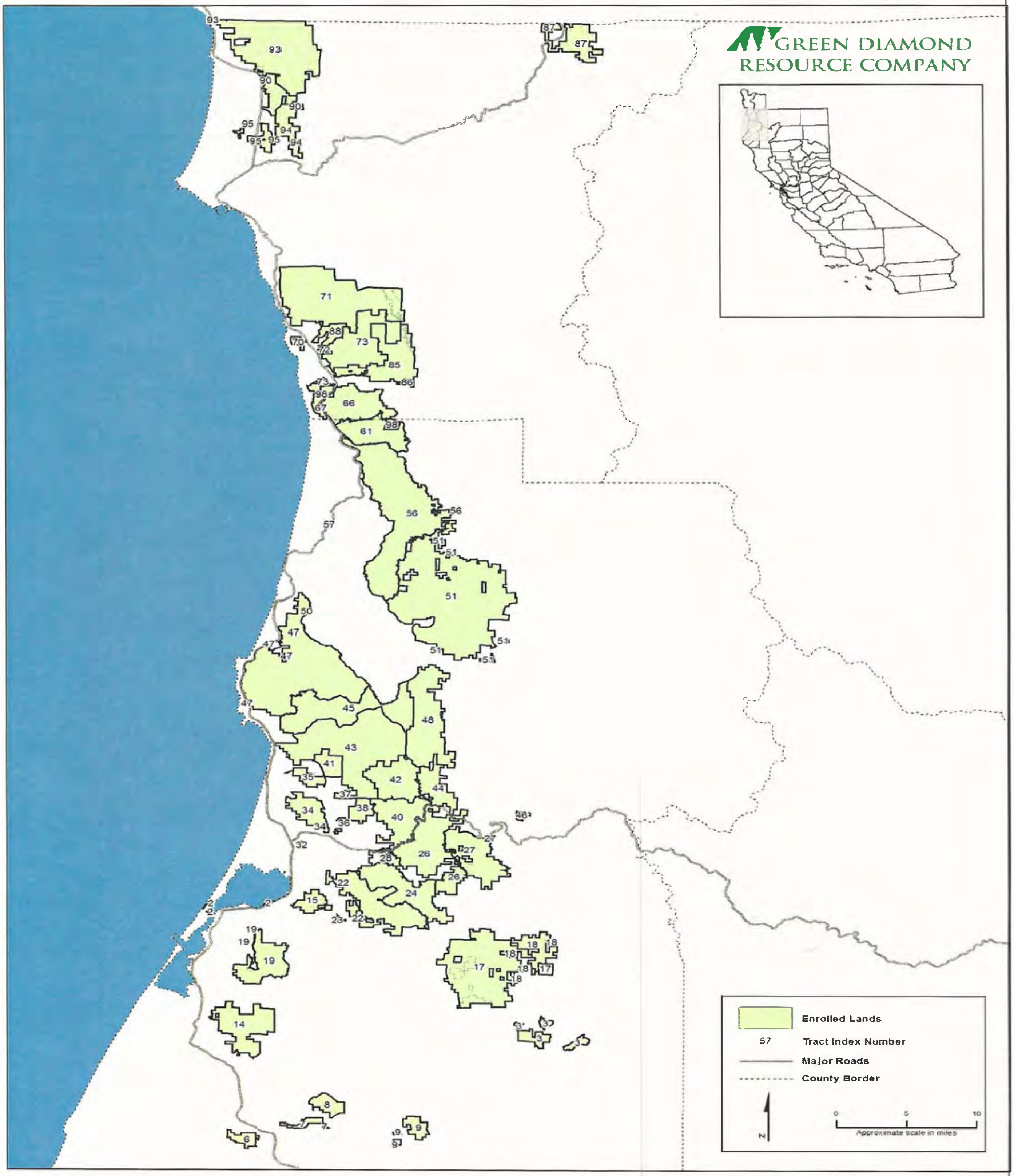

Figure 7. Marten Safe Harbor Enrolled Lands and Tracts

7

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ARTICLE 3.7. California State Safe Harbor Agreement Program Act [2089.2. - 2089.26.]

(Article 3.7 added by Stats. 2009, Ch. 184, Sec. 1.)

2089.2.

(a) This article shall be known and may be cited as the California State Safe Harbor Agreement Program Act.
(b) The Legislature finds that a key to the goals set forth in this article of conserving, protecting, restoring, and enhancing endangered, threatened, and candidate species, is their habitat. A significant portion of the state's current and potential habitat for these species exists on property owned by private citizens, municipalities, tribes, and other nonfederal entities. Conservation efforts on these lands and waters are critical to help these declining species. Using a collaborative stewardship approach to these lands and waters will help ensure the success of these efforts.
(c) The purpose of this article is to establish a program that will encourage landowners to manage their lands voluntarily to benefit endangered, threatened, or candidate species and not be subject to additional regulatory restrictions as a result of their conservation efforts.
(d) This article does not relieve landowners of any legal obligation with respect to endangered, threatened, or candidate species existing on their land. The program established by this article is designed to increase species populations, create new habitats, and enhance existing habitats. Although this increase may be temporary or long-term, California state safe harbor agreements shall not reduce the existing populations of species present at the time the baseline is established by the department.
(Added by Stats. 2009, Ch. 184, Sec. 1. Effective January 1, 2010. Repealed as of January 1, 2020, pursuant to Section 2089.26.)

2089.4.

As used in this article, the following definitions apply:
(a) "Agreement" means a state safe harbor agreement approved by the department pursuant to this article. "Agreement" includes an agreement with an individual landowner and a programmatic agreement.
(b) "Baseline conditions" means the existing estimated population size, the extent and quality of habitat, or both population size and the extent and quality of habitat, for the species on the land to be enrolled in the agreement that sustain seasonal or permanent use by the covered species. Baseline conditions shall be determined by the department, in consultation with the applicant, and shall be based on the best available science and objective scientific methodologies. For purposes of establishing baseline conditions, a qualified person that is not employed by the department may conduct habitat surveys, if that person has appropriate species expertise and has been approved by the department.

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(c) "Department" means the Department of Fish and Wildlife, acting through its director or his or her designee.
(d) "Landowner" means any person or nonstate or federal entity or entities that lawfully hold any interest in land or water to which they are committing to implement the requirements of this article.
(e) "Management actions" means activities on the enrolled land or water that are reasonably expected by the department to provide a net benefit to the species or their habitat, or both.
(f) "Monitoring program" means a program established or approved by the department in accordance with subdivision (f) of Section 2089.6.
(g) "Net conservation benefit" means the cumulative benefits of the management activities identified in the agreement that provide for an increase in a species' population or the enhancement, restoration, or maintenance of covered species' suitable habitats within the enrolled property. Net conservation benefit shall take into account the length of the agreement, any offsetting adverse effects attributable to the incidental taking allowed by the agreement, and other mutually agreed upon factors. Net conservation benefits shall be sufficient to contribute either directly or indirectly to the recovery of the covered species. These benefits include, but are not limited to, reducing fragmentation and increasing the connectivity of habitats, maintaining or increasing populations, enhancing and restoring habitats, and buffering protected areas.
(h) "Programmatic agreement" means a state safe harbor agreement issued to a governmental or nongovernmental program administrator. The program administrator for a programmatic agreement shall work with landowners and the department to implement the agreement. The program administrator and the department shall be responsible for ensuring compliance with the terms of the agreement.
(i) "Qualified person" means a person with species expertise who has been approved by the department.
(j) "Return to baseline" means, at the termination of an agreement, activities undertaken by the landowner to return the species population or extent or quality of habitat to baseline, excluding catastrophic events such as floods, unplanned fires, or earthquakes, and other factors mutually agreed upon prior to permit issuance and that are beyond the control of the landowner.
(Amended by Stats. 2012, Ch. 559, Sec. 17. Effective January 1, 2013. Repealed as of January 1, 2020, pursuant to Section 2089.26.)

2089.6.

In addition to the other provisions of this article, the department may authorize acts that are otherwise prohibited pursuant to Section 2080 through an agreement, including a programmatic agreement, if all the following conditions are met:
(a) The department receives a complete application containing all of the information described in Section 2089.8.
(b) The take is incidental to an otherwise lawful activity.
(c) The department finds that the implementation of the agreement is reasonably expected to provide a net conservation benefit to the species listed in the application. This finding shall be based, at a minimum, upon the determination that the agreement is of sufficient duration and has appropriate assurances to realize these benefits.

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(d) The take authorized by the agreement will not jeopardize the continued existence of the species. This determination shall be made based on the provisions of subdivision (c) of Section 2081.
(e) The department finds that the landowner has agreed, to the maximum extent practicable, to avoid or minimize any incidental take authorized in the agreement, including returning to baseline.
(f) The department has established or approved a monitoring program, based upon objective scientific methodologies, to provide information for the department to evaluate the effectiveness and efficiency of the agreement program, including whether the net conservation benefits set forth in the agreement are being achieved and whether the participating landowner is implementing the provisions of the agreement.
(g) The department has determined that sufficient funding is ensured, for it or its contractors or agents, to determine baseline conditions on the property, and that there is sufficient funding for the landowner to carry out management actions and for monitoring for the duration of the agreement.
(h) Implementation of the agreement will not be in conflict with any existing department-approved conservation or recovery programs for the species covered by the agreement.
(Added by Stats. 2009, Ch. 184, Sec. 1. Effective January 1, 2010. Repealed as of January 1, 2020, pursuant to Section 2089.26.)

2089.8.

The landowner shall submit all of the following:
(a) A detailed map depicting the land proposed to be enrolled in the agreement.
(b) The common and scientific names of the species for which the landowner requests incidental take authorization.
(c) A detailed description of the landowner's current land and water use and management practices that affect the covered species, and the habitat of the covered species, for which the landowner requests incidental take authorization.
(d) A detailed description of the landowner's future land and water use and management practices that may affect the covered species, and the habitat of the covered species, for which the landowner requests incidental take authorization. This description shall be used only for informational and planning purposes.
(e) The proposed duration of the agreement that is sufficient to provide a net conservation benefit to the species covered in the permit and an explanation of the basis for this conclusion.
(f) A detailed description of the proposed management actions and the timeframe for implementing them.
(g) A description of the possible incidental take that may be caused by the management actions and of the anticipated species populations and habitat changes over the duration of the permit.
(h) A detailed description of the proposed monitoring program.
(i) Any other information that the department may reasonably require in order to evaluate the application.
(Added by Stats. 2009, Ch. 184, Sec. 1. Effective January 1, 2010. Repealed as of January 1, 2020, pursuant to Section 2089.26.)

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2089.9.

(a) As used in this section, "proprietary information" means information that is all of the following:
(1) Related to an agricultural operation or land that is a part of an agricultural operation.
(2) A trade secret, or commercial or financial information, that is privileged or confidential, and is identified as such by the person providing the information to the department.
(3) Not required to be disclosed under any other provision of law or any regulation affecting the land or the agricultural operation on the land.
(b) Proprietary information received by the department pursuant to Section 2089.8 is not public information, and the department shall not release or disclose the proprietary information to any person, including any federal, state, or local governmental agency, outside of the department.
(c) Notwithstanding subdivision (b), the department may release or disclose proprietary information received pursuant to Section 2089.8 to the following entities under the following circumstances:
(1) Any person or federal, state, or local governmental agency, to enforce this article.
(2) Any person or federal, state, or local governmental agency working in cooperation with the department to provide technical or financial assistance for the purposes of implementing the program established by this article.
(3) Any entity, to the extent that the owner, operator, or producer has consented to the release or disclosure.
(4) The general public, if the information has been transformed into a statistical or aggregate form without identifying any individual owner, operator, or producer, or the specific location from which the information was gathered.
(Added by Stats. 2009, Ch. 184, Sec. 1. Effective January 1, 2010. Repealed as of January 1, 2020, pursuant to Section 2089.26.)

2089.10.

If an agreement has been approved and the department finds that the agreement is being properly implemented, the department shall allow the landowner to alter or modify the enrolled property, even if that alteration or modification will result in the incidental take of a listed species, to the extent that the alteration or modification returns the species to baseline conditions.
(Added by Stats. 2009, Ch. 184, Sec. 1. Effective January 1, 2010. Repealed as of January 1, 2020, pursuant to Section 2089.26.)

2089.12.

(a) Unless the department determines that it is inappropriate to do so based on the nature of the management actions being proposed, the species listed in the permit, or other factors, the agreement shall require that the landowner provide the department with at least 60 days' advance notice of any of the following:
(1) Any incidental take that is anticipated to occur under the agreement.
(2) The landowner's plan to return to baseline at the end of the agreement.

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(3) Any plan to transfer or alienate the landowner's interest in the land or water.
(b) (1) If the department receives any notice described in subdivision (a), the landowner shall provide the department, its contractors, or agents with access to the land or water for purposes of safely removing or salvaging the species.
(2) The department shall provide notice to the landowner at least seven days prior to accessing the land or water for the purposes of paragraph (1). The notice shall identify each person selected by the department, its contractors, or agents to access the land or water.
(3) Notwithstanding paragraph (1), during the seven-day notice period, a landowner may object, in writing, to a person selected to access the land or water. If a landowner objects, another person shall be selected by the department, its contractors, or agents, and notification shall be provided to the landowner pursuant to paragraph (2). However, if a landowner objects to a selection on two successive occasions, the landowner shall be deemed to consent to access to the land or water by a person selected by the department, its contractors, or agents. Failure by a landowner to object to the selection within the seven-day notice period shall be deemed consent to access the land or water by a person selected by the department, its contractors, or agents.
(4) If the landowner objects to a person selected to access the land or water pursuant to paragraph (3), the 60-day notice period described in subdivision (a) shall be tolled for the period between the landowner's objection to a person selected for access to the land or water and the landowner's consent to a person selected for access to the land or water.
(Amended by Stats. 2010, Ch. 328, Sec. 66. Effective January 1, 2011. Repealed as of January 1, 2020, pursuant to Section 2089.26.)

2089.14.

An agreement may be amended with the mutual consent of the landowner and the department.
(Added by Stats. 2009, Ch. 184, Sec. 1. Effective January 1, 2010. Repealed as of January 1, 2020, pursuant to Section 2089.26.)

2089.16.

If a landowner seeks to sell, transfer, or otherwise alienate the land or water enrolled in the agreement during the term of the agreement, the person or entity assuming that interest in the property shall (a) assume the existing landowner's duties under the agreement, (b) enter into a new agreement with the department, or (c) withdraw from an existing agreement under the terms provided in the agreement, as approved by the department.
(Added by Stats. 2009, Ch. 184, Sec. 1. Effective January 1, 2010. Repealed as of January 1, 2020, pursuant to Section 2089.26.)

2089.18.

The suspension and revocation of the agreement shall be governed by suspension and revocation regulations adopted by the department.
(Added by Stats. 2009, Ch. 184, Sec. 1. Effective January 1, 2010. Repealed as of

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January 1, 2020, pursuant to Section 2089.26.)

2089.20.

(a) This section does not provide the public a right of entry onto the enrolled land or water. The landowner shall provide the department, its contractors, or agents with access to the land or water proposed to be enrolled in the agreement to develop the agreement, determine the baseline conditions, monitor the effectiveness of management actions, or safely remove or salvage species proposed to be taken.
(b) The department shall provide notice to the landowner at least seven days before accessing the land or water for the purposes of subdivision (a). The notice shall identify each person selected by the department, its contractors, or agents to access the land or water.
(c) Notwithstanding subdivision (a), during the seven-day notice period, a landowner may object, in writing, to a person selected to access the land or water. If a landowner objects, another person shall be selected by the department, its contractors, or agents, and notification shall be provided to the landowner pursuant to subdivision (b). However, if a landowner objects to a selection on two successive occasions, the landowner shall be deemed to consent to access to the land or water by a person selected by the department, its contractors, or agents. Failure by a landowner to object to the selection within the seven-day notice period shall be deemed consent to access the land or water by a person selected by the department, its contractors, or agents.
(d) (1) Notwithstanding any other law, the landowner is not required to do either of the following:
(A) Maintain enrolled land or water, or land or water proposed to be enrolled in an agreement, in a condition that is safe for access, entry, or use by the department, its contractors, or agents for purposes of providing access pursuant to subdivision (a).
(B) Provide to the department, its contractors, or agents, any warning of a hazardous condition, use, structure, or activity on enrolled land or water, or land or water proposed to be enrolled in an agreement, for purposes of providing access pursuant to subdivision (a).
(2) Notwithstanding any other law, the landowner shall not be liable for any injury, and does not owe a duty of care, to the department, its contractors, or agents resulting from any act or omission described in subparagraph (A) or (B) of paragraph (1).
(3) The provision of access to land pursuant to subdivision (a) shall not be construed as any of the following:
(A) An assurance that the land or water is safe.
(B) A grant to the person accessing the land or water of a legal status for which the landowner would owe a duty of care.
(C) An assumption of responsibility or liability for any injury to a person or property caused by any act of the person to whom access to the land or water is provided.
(4) Notwithstanding paragraphs (1) to (3), inclusive, this subdivision shall not be construed to limit a landowner's liability for an injury under either of the following circumstances:
(A) Willful or malicious failure to guard or warn against a dangerous condition, use, structure, or activity on the land or water.
(B) Express invitation to a person by the landowner to access the land or water, in a

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manner that is beyond the access required to be provided pursuant to subdivision (a).
(e) Nothing in this section creates a duty of care or a ground of liability for injury to person or property.
(Added by Stats. 2009, Ch. 184, Sec. 1. Effective January 1, 2010. Repealed as of January 1, 2020, pursuant to Section 2089.26.)

2089.22.

(a) If a federal safe harbor agreement has been approved pursuant to applicable provisions of federal law and the federal safe harbor agreement contains species that are endangered, threatened, or are candidate species pursuant to this chapter, no further authorization or approval is necessary under this article for any person authorized by that agreement to take the species identified in and in accordance with the federal Safe Harbor Agreement, if that person and the department follow all of the procedures specified in Section 2080.1, except that the determination of consistency shall be made by the department based only on the issuance criteria contained in this article.
(b) The department may adopt nonregulatory guidelines to clarify how the provisions of this chapter may be used in connection with voluntary local programs for routine and ongoing agricultural activities adopted pursuant to Article 3.5 (commencing with Section 2086) and natural community conservation plans adopted pursuant to Chapter 10 (commencing with Section 2800).
(Added by Stats. 2009, Ch. 184, Sec. 1. Effective January 1, 2010. Repealed as of January 1, 2020, pursuant to Section 2089.26.)

2089.23.

(a) A landowner that owns land that abuts a property enrolled in a state safe harbor agreement shall not be required, for purposes of an incidental take permit, to undertake the management activities set forth in the state safe harbor agreement, if all of the following conditions are met:
(1) The neighboring landowner allows the department to determine baseline conditions on the property.
(2) The neighboring landowner agrees to maintain the baseline conditions for the duration specified in the safe harbor agreement.
(3) The department determines that allowing the neighboring landowner to receive an incidental take permit for the abutting property does not undermine the net conservation benefit determination made by the department in the approval of the safe harbor agreement.
(4) The take authorized by the department will not jeopardize the continued existence of the species. This determination shall be made in accordance with subdivision (c) of Section 2081.
(b) (1) Unless the department determines that it is inappropriate to do so based on the species listed in the permit, or any other factors, the neighboring landowner shall provide the department with at least 60 days' advance notice of any of the following:
(A) Any incidental take that is anticipated to occur under the permit.
(B) The neighboring landowner's plan to return to baseline conditions.

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(C) Any plan to transfer or alienate the neighboring landowner's interest in the land or water.
(2) (A) If the department receives any notice described in paragraph (1), the neighboring landowner shall provide the department, its contractors, or agents with access to the land or water for purposes of safely removing or salvaging the species.
(B) The department shall provide notice to the neighboring landowner at least seven days before accessing the land or water for the purposes of subparagraph (A). The notice shall identify each person selected by the department, its contractors, or agents to access the land or water.
(C) Notwithstanding subparagraph (B), during the seven-day notice period, the neighboring landowner may object, in writing, to a person selected to access the land or water. If the neighboring landowner objects, another person shall be selected by the department, its contractors, or agents, and notification shall be provided to the neighboring landowner pursuant to subparagraph (B). However, if the neighboring landowner objects to a selection on two successive occasions, the neighboring landowner shall be deemed to consent to access to the land or water by a person selected by the department, its contractors, or agents. Failure by the neighboring landowner to object to the selection within the seven-day notice period shall be deemed consent to access the land or water by the person selected by the department, its contractors, or agents.
(Amended by Stats. 2010, Ch. 328, Sec. 67. Effective January 1, 2011. Repealed as of January 1, 2020, pursuant to Section 2089.26.)

2089.24.

The department, for informational purposes, shall maintain a list of qualified persons who have worked with the department on an approved agreement, and persons, entities, and organizations serving as program administrators for approved agreements.
(Added by Stats. 2009, Ch. 184, Sec. 1. Effective January 1, 2010. Repealed as of January 1, 2020, pursuant to Section 2089.26.)

2089.25.

The department may promulgate regulations to implement this article.
(Added by Stats. 2009, Ch. 184, Sec. 1. Effective January 1, 2010. Repealed as of January 1, 2020, pursuant to Section 2089.26.)

2089.26.

This article shall remain in effect only until January 1, 2020, and as of that date is repealed, unless a later enacted statute, that is enacted before January 1, 2020, deletes or extends that date.
(Added by Stats. 2009, Ch. 184, Sec. 1. Effective January 1, 2010. Repealed as of January 1, 2020, by its own provisions. Note: Repeal affects Article 3.7, commencing with Section 2089.2.)

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Marten Monitoring Strategy - Safe Harbor Agreement

Introduction

Green Diamond has committed to use non-invasive survey techniques (i.e., remote cameras) to survey for presence-absence of Humboldt marten *(Martes caurina humboldtensis)* within portions of the enrolled lands (MSMA, Moore Tract) and portions of the potential marten source area (Figure 1). Presence (detection) and apparent absence (non-detection) are the biological outcome of sampling that result from detection or non-detection of the target species (Mackenzie and Royle 2005). Within three years of approval, Green Diamond proposes to survey for Humboldt marten and estimate occupancy or proportion of area used as a state variable on enrolled lands.

Proportion of area used is considered a more appropriate state variable for analysis of detection/non-detection data for wide ranging territorial carnivores that may not "occupy" a sampling plot (in our case the camera station) due to disparate sizes of home ranges within continuous habitat relative to the unknown plot size of baited camera stations (Efford and Dawson 2012, Royle and Nichols 2003). When plot size is small (or unknown) relative to home range size, proportion of area used is the more appropriate state variable (MaKenzie et al. 2004). Henceforth, occupancy and proportion of area used are considered synonymous. The analytical methods incorporate imperfect detection or detection probability (p) as a nuisance variable into estimates of the state variable, occupancy (ψ) and have this advantage over simple indices of population density (Efford and Dawson 2012).

Analysis of Pilot Study Data

To inform future marten survey protocols, West Inc. statistical consultants conducted an analysis based on pilot data Green Diamond Resource Company collected during non-invasive surveys for martens (Hamm et al. 2012). The analysis addressed the following objectives:

1. Analyze pilot data to estimate the detection probability of martens surveyed using a paired-camera setup at bait stations.
2. Describe the tradeoff between survey effort (i.e., length of time cameras are deployed) and estimates of detection probability from an occupancy model.

The dataset contained detection/non-detection data collected at eight sites, and each site was comprised of two independent cameras focused on a single bait station. The data consisted of summarized encounter histories, one per camera, where each day was considered a capture occasion. Values within the encounter history could be one (marten detected that day), zero (no marten detected that day), or NA (no camera deployed that day). The number of days cameras were deployed at a site ranged from 28 – 57 days.

Methods

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We calculated the proportion of sites that had accumulated at least one marten detection over the course of the study (from 6 – 57 days). Next, we fit an occupancy model to the full dataset, estimating the detection probability (p). We used a single-season occupancy model (MacKenzie et al. 2002) fit using the unmarked package (Fiske and Chandler 2011) in Program R (R Core Team 2017) for all analyses.

We also conducted a simulation to describe the tradeoff between survey effort (i.e., the length of time cameras are deployed, hereafter "study length") and the stability of the detection-accumulation pattern and the stability and precision of estimates of p from occupancy models. We re-ran the analysis after selecting a hypothetical study length and randomly selecting the start of the hypothetical study. In all, we ran the analysis 520 times, once for each of 52 study lengths times each of 10 randomly selected study starts. The shortest study we considered was the number of days it took to record the first detection (6 days), and the longest study length we considered was the full study (57 days). For each study length, we randomly selected 10 study periods of that length from the data, and refit the occupancy model to that data subset. The number of possible study periods declined as study length increased, so all estimates converge at the maximum study length of 57 days.

Results of Pilot Analysis

The first marten was detected on day 6, and all sites (but not all cameras) had detected a marten by day 17 (Figure 1). Using the full data set, the probability of detecting a marten at a site given it was present was 0.703 (95% CI = 0.514 – 0.841).

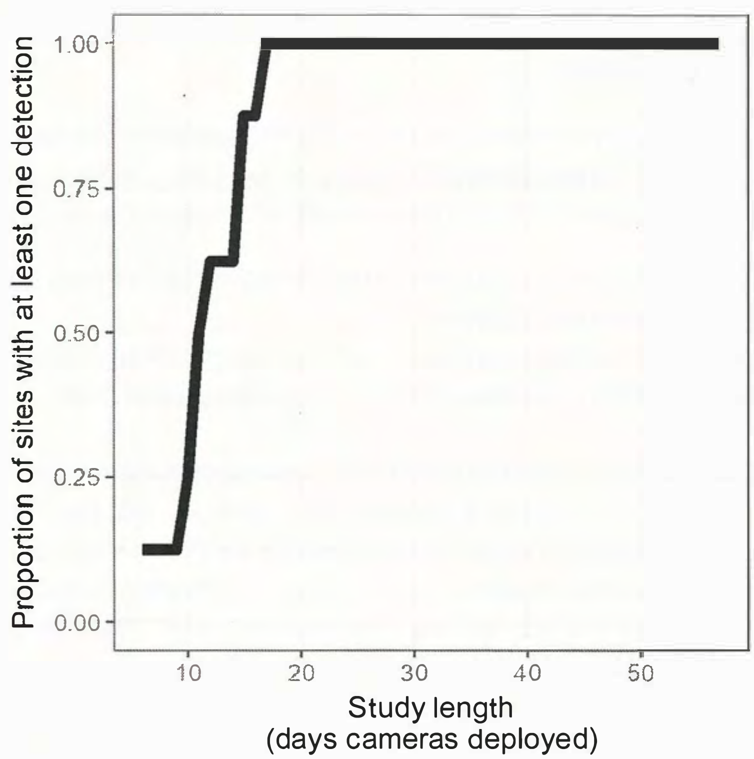

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Figure 1. Detection-accumulation curve for full dataset of marten surveys at eight sites in 2011.

Across simulated subsets of the dataset of various lengths, the earliest that all sites had detected a marten was day 13 (Figure 2). The probability of detecting a marten at a site given it was present ranged widely from 0 – 1 across the simulated datasets (Figure 2). The point estimates for detection probability stabilized with increasing study length, with a noticeable gain for surveys longer than ~20 days (Figure 3).

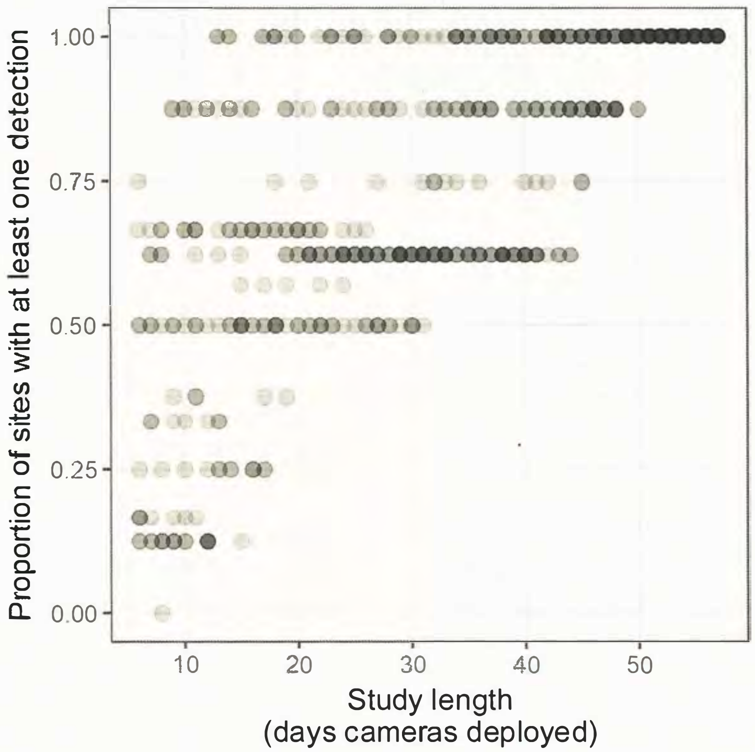

Figure 2. Detection-accumulation patterns across simulated subsets of marten survey data collected at eight sites in 2011. Points are transparent, so darker colors represent more realizations of the simulation that had the same value.

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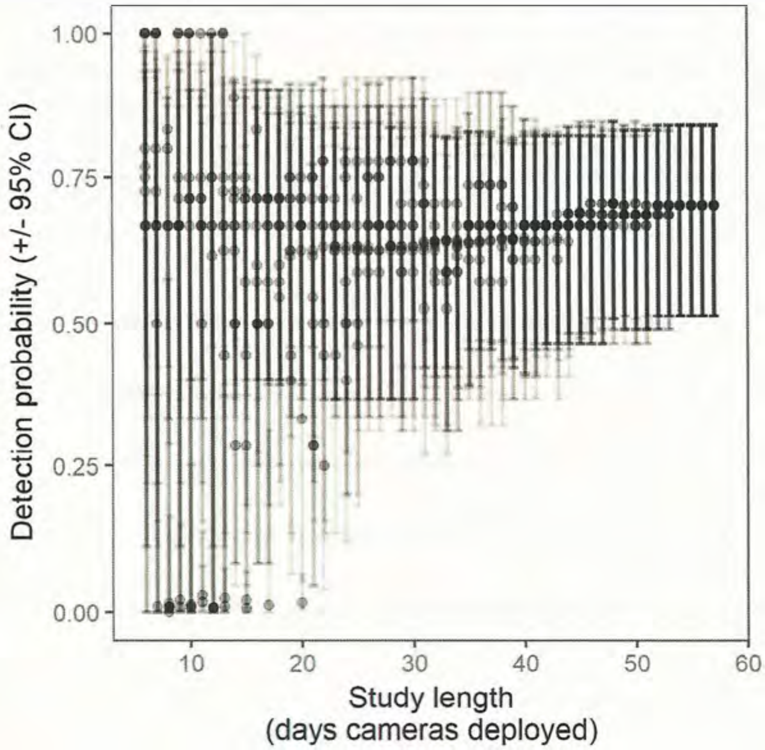

Figure 3. Point estimates (and 95% confidence interval) of detection probability (p) across simulated subsets of marten survey data collected at eight sites in 2011. Points and error bars are transparent, so darker colors represent more realizations of the simulation that had the same value.

Proposed Field Methods

To accomplish Marten Monitoring and Reporting Commitment Two, Green Diamond will establish a randomly located sampling frame for remote camera stations within its Initial Enrolled Lands and portions of the potential marten source area formerly owned by Green Diamond and now held in ownership by Western Rivers Conservancy and the Yurok Tribe.

An example sampling frame consists of points centered at 2-km grid spacing. The spacing between sampling units (camera sites) was chosen based on prior work conducted on Humboldt marten (Slauson et al. 2007) within the region (Figure 4). There are approximately 128 sample units within the MSMA and 37 sample units within the source area owned by the Yurok Tribe and Western Rivers Conservancy. The survey area may expand as agreed to by the Department and Green Diamond to include more of the IEL (Marten Monitoring and Reporting Commitment Five). Survey design is intended to be complimentary to and compatible with other regional survey efforts for marten. As part of a proposed Federal Habitat Conservation Plan, Green Diamond intends to conduct similar non-invasive surveys for fisher (*Pekania pennanti*). Those surveys would also be suitable for detecting marten. Approximately 64 sampling units for fisher occur on the enrolled lands outside of the MSMA and potential marten source area. The difference in survey protocol for fisher and marten is the spacing of sampling units. The fisher surveys will occur at a 4-km grid spacing as compared to 2-km for marten. However, all other aspects of the protocol will be identical, so surveys at the 4-km spacing will also be suitable for detecting marten.

Sampling will consist of one or two cameras (Reconyx Hyperfire HC500, HC600, PC800 or PC900) placed at the center (within the limits of accuracy of the GPS units) or within 100 m of the center of the grid location if hazardous terrain or other obstacles limit access to the site center. If placement of cameras within 100-m of the site center cannot be achieved, a site-specific evaluation will be made to determine if placement beyond 100-m raises concern over independence of adjacent sampling units. It may be possible to move site centers in a random direction to avoid issues of site independence. Sampling units will be located in the field with handheld global positioning systems and maps with light imaging detection and ranging base information (LiDAR). Whenever possible, cameras will be placed at the center of the sampling location based on accuracy of handheld GPS units and LiDAR maps. The actual location of sampling units in the field will be semi-permanent to adhere to goals and objectives for monitoring under the safe harbor agreement (Marten Monitoring and Reporting Commitment Two) to achieve multiple estimates of occupancy and distribution over time and assess variation in those estimates and distribution of marten over the permit term. In this survey, each grid location represents a site or plot and the camera station is the location where data are gathered within continuous habitat. The detection zone for a sampling unit is some unknown maximum area around the camera location potentially containing marten home range(s) with some chance of the marten(s) moving into the detection zone during the sampling period (Burton et al. 2015). The maximum detection zone of the cameras is approximately 18-m, but the actual detection zone of the cameras to the bait tree will typically be less than 10-m.

Green Diamond anticipates initially using two cameras at approximately fifty percent of survey stations to further evaluate influence of multiple cameras on estimates of detection probability. The settings on each camera will be standardized and reported. For example, the sensitivity of the camera, delay between pictures, height above ground and distance to bait.

The outcome of the survey at a site is a series of detection (1), non-detection (0) data, or a non-functional device. Green Diamond will use these repeat surveys at independent sample sites to estimate probability of detection and the outcome of presence at sample sites will be used to estimate occupancy of the survey area. Cameras will be placed on trees 1-2-m above the ground and focused on a piece of chicken attached to a nearby tree within 3-5-m of the camera location (Figure 5). A commercial trapping lure (Caven's Gusto) will be placed on the bait tree as an added attractant. Cameras will be deployed for at least 21 days based on prior analyses of pilot data and will be checked and rebaited weekly. A three-week survey period is represented by the initial deployment and baiting followed by a rebaiting/check at one week, a rebaiting/check at two weeks, and a final check/removal of equipment at three weeks. Detection data from cameras will be transferred at each weekly check period by switching secure data cards and downloading information to a computer database at the office. Detection results will be recorded in the database and catalogued with photographic evidence of detections. Surveys will be conducted during the six-month period from November through April. The survey area will be divided into subareas to accommodate logistical considerations regarding the number of

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sampling units that can be deployed and checked on a weekly basis. Green Diamond estimates that one technician can deploy and check approximately 25 sampling units during each 21-day survey period. An assumption in this survey approach is that occupancy state does not change within the 21-day survey period (i.e., there is closure and no temporary emigration). A sampling unit is occupied if it overlaps with any marten home range and the marten is detected, but the plot may not be instantaneously occupied given marten movement within the home range (Efford and Dawson 2012). Temporary absence within a plot due to movements within a home range is absorbed in calculations of detection probability. As Green Diamond accumulates survey information and occurrence data on marten, additional analyses can be conducted to predict probability of occupancy by marten within the survey area of the IEL. Green Diamond will attempt a modeling effort to associate habitat information stored within its FRIS with marten detection and non-detection data from the camera surveys. A variety of habitat and physiographic variables may help to predict marten probability of occupancy within the IEL. Ultimately, these data will help inform various adaptive management approaches available within the SHA.

As field and analytical techniques are refined and developed, modifications to the protocol may be undertaken as agreed to by Green Diamond and the Department. However, the primary goal will be to conduct surveys within the IEL to allow for a consistent estimate of marten occupancy through time. The proposed protocol is based upon the best available information for Humboldt marten. Past non-invasive surveys found that marten were rare or absent from the majority of IEL and surrounding lands and that occupancy was confirmed in two locations on the IEL based upon Green Diamond's systematic and opportunistic survey efforts using remote cameras. The two occupied locations are Rattlesnake Mountain reserve area and the Moore tract near the Oregon border. **Summary of Marten Monitoring Commitments Related to Non-invasive Surveys:**

Marten Monitoring and Reporting Commitment Two: Within three years of Safe Harbor Agreement approval, Green Diamond will use non-invasive survey results to estimate marten occupancy within the Special Management Area and Lands Eligible for Enrollment that are located within the Potential Marten Source Area. A summary of occupancy surveys will be submitted in each annual report. An analysis of occupancy rates will be submitted in the fourth annual report.

Marten Monitoring and Reporting Commitment Three: After an initial effort to assess occupancy of marten within the Special Management Area (lasting 3 years), Green Diamond shall continue to monitor marten occupancy by conducting non-invasive surveys on at least one-half of the Special Management Area every five years such that a complete survey would occur by year ten. A summary of occupancy surveys and estimates will be included in annual reports coincident with the survey intervals.

Marten Monitoring and Reporting Commitment Four: After two complete surveys to assess marten occupancy within the Special Management Area, provided that (contingent upon) the existence of adequate sample size for analysis, Green Diamond shall attempt to develop a model estimating the probability of marten occupancy and associate with various habitat and

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physiographic variables. This modelling effort would attempt to include all available and complementary survey efforts conducted within the range of the marten on the Enrolled Lands. A preliminary occupancy model, contingent upon sufficient data, will be included in the annual reports coincident with the commitment interval.

Marten Monitoring and Reporting Commitment Five: As marten occupancy expands on IEL as documented by surveys under Marten Monitoring and Reporting Commitments Two and Three, GDRCo will also expand non-invasive surveys on IEL outside of the MSMA as agreed to between GDRCo and the Department.

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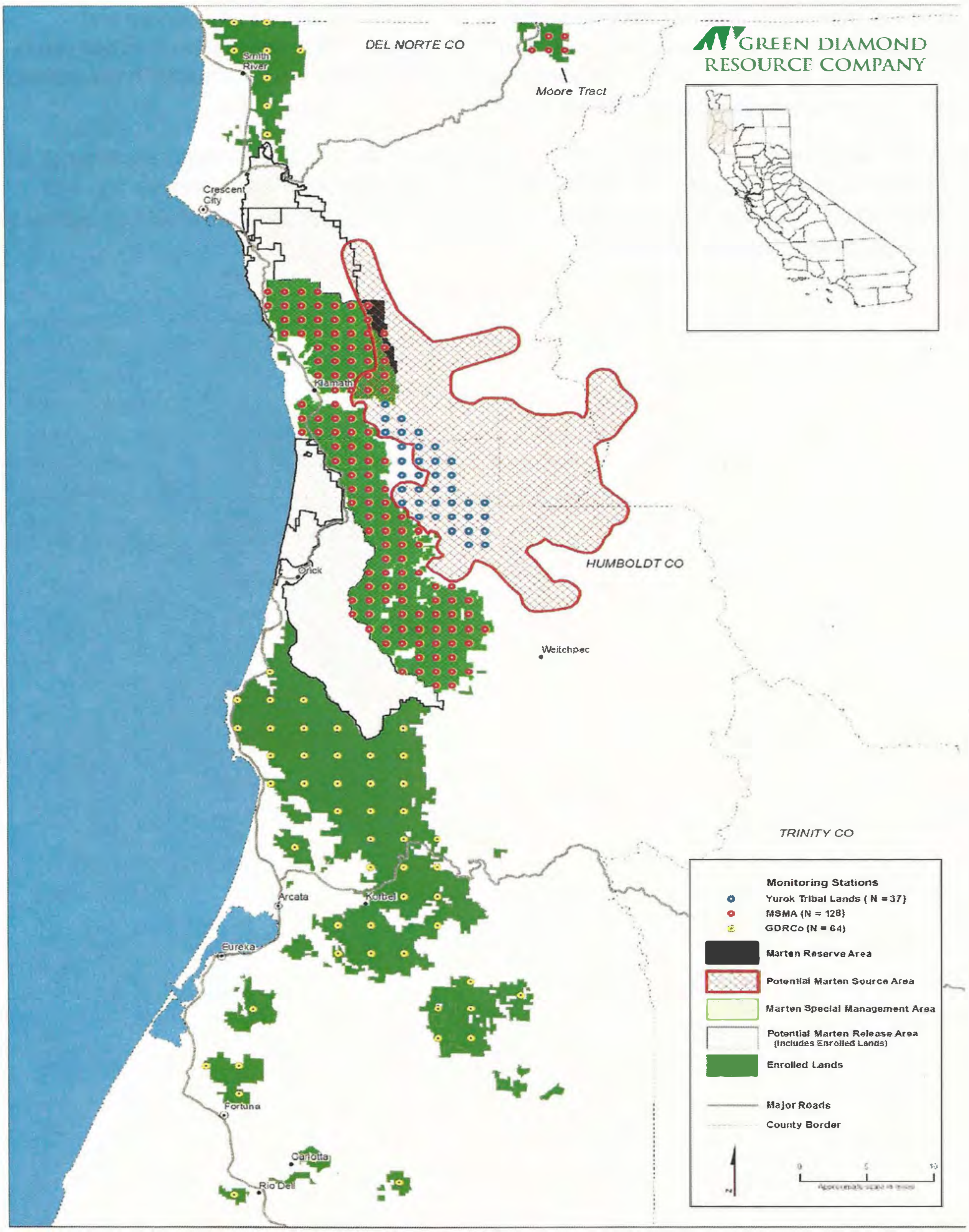

Figure 4. Monitoring Stations within the Marten Safe Harbor Agreement Area

4

January 2018

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Figure 5. Typical configuration of bait tree and remote cameras for detecting mesocarnivores.

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GREEN DIAMOND RESOURCE COMPANY Draft

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www.greendiamond.com

April 27, 2018

Mr. Neil Manji, Region 1 Manager
California Department of Fish and Wildlife
601 Locust Street
Redding, CA 96001

Re: Financial Assurances for Marten Safe Harbor Agreement

Dear Neil:

Green Diamond Resource Company ("Green Diamond") is prepared to enter into a Safe Harbor Agreement ("Agreement") with the California Department of Fish and Wildlife ("CDFW") for the conservation of Humboldt Marten pursuant to California Fish and Game Code Section 2089.2 et seq.

In connection with the Agreement, Green Diamond is required to provide CDFW with financial assurance that the management actions and monitoring specified by the Agreement will be carried out through the term of the Agreement. This letter describes the financial assurance of Green Diamond for the performance of the Agreement.

There are two components of Green Diamond's financial assurance for implementation of the Agreement; (1) direct implementation of habitat management, marten protection, monitoring and adaptive management measures, and (2) financial assistance for assisted dispersal and monitoring.

Green Diamond will fund the direct implementation of habitat management, marten protection, monitoring and adaptive management measures under the Agreement through the dedication of staff time and Company property to implementation of management actions consistent with the Agreement. As a commercial forest land owner and manager, Green Diamond can assure CDFW that Green Diamond property will be used in compliance with the Agreement and the revenues generated by the harvest and sale of timber will pay Green Diamond's direct expenses for implementation of the Agreement.

In addition, by entering into the Agreement, Green Diamond has committed to provide CDFW with direct financial aid of up to $49,000 per year for five years ($245,000 total) for the development and initial implementation of a marten assisted dispersal program. In addition, Green Diamond is

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committed to provide CDFW with up to an additional $30,000 for adaptive management and extension of the marten assisted dispersal program. This letter provides Green Diamond's assurance that the funding will be provided to CDFW as an expense paid from Green Diamond revenues derived from the harvest and sale of timber from the lands managed subject to the Agreement.

Because Green Diamond manages its lands for long-term sustainable yield of timber, in accordance with California law (and in compliance with state and federal laws including several long-term permits and agreements), CDFW can be assured that Green Diamond will continue to generate harvestable timber and produce timber revenues that are sufficient to sustain these financial assurances for the term of the Agreement.

We look forward to CDFW's approval and implementation of the Agreement in partnership with Green Diamond so that we can promote the expansion of the range and population of the Humboldt marten and learn more about how our management practices can effectively conserve marten.

Sincerely,

Neal Ewald, Senior Vice President
California Timberlands

Cc: Keith Hamm, Conservation Manager

Riparian and Geological Management Measures

Class I RMZ Characteristics – Green Diamond will establish a RMZ of at least 150 feet (slope distance) on each bank of all Class I watercourses[1] in the Plan Area. The width will be measured from the watercourse transition line or from the outer Channel Migration Zone (CMZ) edge where applicable.

Where the floodplain is wider than 150 feet on one side, the outer zone of the RMZ will extend to the outer edge of the floodplain.

An additional buffer will be added to the RMZ immediately adjacent to a floodplain, as follows:

Slide Slopes	Additional Floodplain Buffer
0-30percent	30 feet
30-60percent	40 feet
>60percent	50 Feet

Green Diamond will establish an inner zone within each RMZ, the width of which will depend upon the streamside slope in accordance with the following:

Side Slopes	Inner Zone Width
0-30percent	50 feet
30-60percent	60 feet
>60percent	70 Feet

Green Diamond will also establish an outer zone within each RMZ, which will extend from the outside limit of the Inner Zone edge to at least 150 feet from the bankfull channel (or CMZ edge) with the additional floodplain buffer set forth above.

- Conservation Measures within Class I RMZs:
  - Single Harvest Entry – During the life of the Plan, Green Diamond will carry out only one harvest entry within Class I RMZs, which will coincide with the even-aged harvest of the

[1] Class I watercourse is defined as all current or historical fish-bearing watercourses and/or domestic water supplies that are on site and/or within 100 feet downstream of the intake. The watercourse transition line is defined as that line closest to the watercourse where perennial vegetation is permanently established. The Channel Migration Zone is defined as Current boundaries of bankfull channel along the portion of the floodplain that is likely to become part of the active channel in the next 50 years. The area of the channel defined by a boundary that generally corresponds to the modern floodplain, but may also include terraces that are subject to significant bank erosion.

adjacent stand. The only exception will be light thinning conducted with the specific objective of enhancing wildlife structure. If cable corridors through RMZs are necessary to conduct intermediate treatments, e.g., commercial thinning, in adjacent stands before even-aged harvest, Green Diamond will apply the restrictions in this section except harvesting of trees in the RMZs will be limited to cable corridors only. Any cable corridors established in the RMZ as part of the intermediate treatment will, to the extent feasible, be reused during the even-aged entry in the adjacent stands.

- Overstory Canopy Closure:
  - Green Diamond will retain at least 85 percent overstory canopy closure within the Inner Zone
  - At least 70 percent canopy overstory closure will be retained within the Outer Zone CalFire protocol in effect as of the date of the Plan will be used for sampling overstory canopy cover to determine compliance with the overstory canopy closure requirements.

<u>Class II RMZ Characteristics</u> – Green Diamond will establish an RMZ of at least 75 or 100 feet on each bank of all Class II watercourses[2], as follows:

- A 75-foot minimum width will be used on the first 1,000 feet of 1st order Class II watercourses (Class II-1 watercourses[3]). Downstream of this first 1000-foot section, the RMZ will be expanded to at least 100 feet.
- A 100-foot minimum width will be used on all 2nd order or larger Class II watercourses (Class II-2 watercourses[4]).
  Green Diamond will establish an Inner Zone within the RMZ, the width of which will be 30 feet measured from the first line of perennial vegetation.
  Green Diamond will also establish an Outer Zone within the RMZ, which will extend the remaining 45 feet or 70 feet (depending on whether it is a Class II-1 watercourse or a Class II-2 watercourse, respectively).
- Conservation Measures within Class II RMZs:
  - Single Harvest Entry – During the life of the Plan, Green Diamond will carry out only one harvest entry into Class II RMZs, which will coincide with the even-aged harvest of the adjacent stand. The only exception will be light thinning conducted with the specific objective of enhancing wildlife structure. If cable corridors through RMZs are necessary to conduct intermediate treatments, e.g., commercial thinning, in adjacent stands before even-aged harvest, Green Diamond will apply the restrictions in this section except harvesting of trees in the RMZs will be limited to the cable corridors only. Any cable corridors established in the RMZ as part of the intermediate treatment will, to the extent feasible, be reused during the even-aged entry in the adjacent stand.

[2] A Class II watercourse is defined as a watercourse that contains no fish, but supports or provides habitat for aquatic vertebrates. Seeps and springs that support or provide habitat for aquatic vertebrates are also considered Class II watercourses with respect to the conservation measures.
[3] A *Class II-1 watercourse* is defined as a subset of Class II watercourses, as illustrated in Appendix C.
[4] A Class II-2 *watercourse* is defined as a subset of Class II watercourses, as illustrated in Appendix C.

- Overstory Canopy Closure:
  - Green Diamond will retain at least 85 percent overstory canopy closure within the Inner Zone
  - At least 70 percent overstory canopy closure will be retained within the Outer Zone

Class III RMZ Characteristics – Additional tree retention will occur in certain Class III watercourses[5] to maintain stream bank stability, and in geologically unstable areas. However, tree retention associated with unstable areas is a relatively minor component (approximately 10percent) of the total riparian retention.

- Conservation Measures within Class III Equipment Exclusion Zones (EEZ) – Green Diamond will apply one of two tiers of protection measures within Class III watercourses in accordance with HPA Groups and slope gradient (the average slope as measured with a clinometer, starting from the watercourse bank and running upslope for a distance of 50 feet), as follows:

HPA Group	Slope Gradient
Smith River	<65percent=Tier A
	>65percent=Tier B
Coastal Klamath	<70percent=Tier A
	>70percent=Tier B
Korbel	<65percent=Tier A
	>65percent=Tier B
Humboldt Bay	<60percent=Tier A
	>60percent=Tier B

- Class III Tier A Protection Measures:
  - EEZ:
    - Green Diamond will establish a 30-foot EEZ, except for a) existing roads; b) road watercourse crossings; and c) skid trail watercourse crossings.
    - The exception for skid trail watercourse crossings is only applicable when the following conditions are met – Construction and use of skid trail watercourse crossings within the Class III EEZ may occur only when construction and use of alternative routes to otherwise inaccessible areas outside of the RMZ would result in substantially greater impacts to aquatic resources. Preference shall be given to using existing skid trail watercourse crossing sites in the Class III over establishing new skid trail watercourse crossing sites in the Class III.
    - Within Class III EEZs, trees may be felled and harvested to facilitate skid trail watercourse crossing construction and use.
  - LWD Retention – Green Diamond will retain all LWD on the ground (not including felled trees) within the EEZ

[5] A *Class III watercourse* is defined as small seasonal channels that do not support aquatic species, but has the potential to transport sediment to Class I or II watercourses.

- Site Preparation – Green Diamond will not ignite fire during site preparation within the EEZ

- Class III Tier B Protection Measures:

  - EEZ – Green Diamond will establish a 50-foot EEZ, except for a) existing roads; b) road watercourse crossings; and c) skid trail watercourse crossings.
  - The exception for skid trail watercourse crossings is only applicable when the following conditions are met – Construction and use of skid trail watercourse crossings within the Class III EEZ may occur only when construction and use of alternative routes to otherwise inaccessible areas outside of the RMZ would result in substantially greater impacts to aquatic resources. Preference shall be given to using existing skid trail watercourse crossing sites in the Class III over establishing new skid trail watercourse crossing sites in the Class III.
  - Within Class III EEZs, trees may be felled and harvested to facilitate skid trail watercourse crossing construction and use.
  - Hardwood Retention – Green Diamond will retain all hardwoods and non-merchantable trees within the EEZ except where necessary to create cable corridors or for the safe falling of merchantable trees.
  - Site Preparation – Green Diamond will not ignite fire during site preparation within the EEZ.
  - Conifer Retention – Green Diamond will retain conifers where they contribute to maintaining bank stability or if they are acting as a control point in the channel.
  - A minimum average of one conifer 15 inches Diameter at breast height (DBH) or greater per 50 feet of stream length within the EEZ will be retained.
  - LWD Retention – Green Diamond will retain all LWD on the ground (not including felled trees) within the EEZ.

- Geological Management Measures – Green Diamond will establish a variety of measures to address geologically unstable areas. These measures include retention of trees to minimize and mitigate sediment input from steep streamside slopes, headwall swales, deep-seated landslides and shallow rapid landslides.

Attachment 5

Live Tree Retention Scorecard Used for Identification of Existing Wildlife Structure – Marten-specific SHA Tracts[a]

	Tree elements						Unit Scarcity Factor[b]	Planning Watershed Factor[c]	Total score
	DBH[d]	Bole and Crown features[e]							
	conifer >30" hardwood >18"	large cavity, hollow, basal hollow.	small cavity, broken top, reiteration	internal decay, mistletoe broom	crevice cover (fissure, loose bark, furrowed bark)	complex crown (dead or forked top, lateral large limbs, epicormic branching, ledge/platform)	Post-harvest Residual Tree density: ≤1 ac, add 2 pts >1/ac<2/ac, add 1 pt ≥2/ac, add no pts	Impaired or special wildlife value, add 1 point. All others, add no points	
Wildlife score	3	4	3	2	1	1			

[a] This score card incorporates tree retention measures specifically formulated to benefit Humboldt marten and is implemented on Green Diamond lands north of the Bald Hills Road, and Moore Tract, on Tracts 51, 56, 61, 66, 67, 70, 71, 72, 73, 85, 87, 88, 98 (Figure 7) and in future planning watersheds where Humboldt marten are detected.
[b] Unit scarcity factor is determined at the Unit level based on the number of residual trees post-harvest (conifers and hardwoods are to be evaluated separately) and is added to the tree elements score for each individual residual tree. Estimate is based on entire unit acres (including RMZs). Young-growth (i.e. non-residual) trees are assessed using the scorecard but are not subject to the addition of the unit scarcity factor.
[c] Planning watershed factor is determined programmatically based on management tract and is added to the tree elements score. The planning watershed factor is added to all trees assessed (residual and non-residual). Tracts listed in "a" above receive one point for special wildlife value.
[d] Trees not meeting the diameter threshold but exhibiting the described habitat elements should be considered as prime candidates for meeting the green tree retention guidelines if large trees are not available.
[e] See Definitions and descriptions
Trees with a score equal to or greater than 7 will be retained except under very rare circumstances where operational constraints prohibit retention as justified by Forestry and Wildlife. Trees with scores less than 7 can be harvested. The maximum score for each tree element column is depicted in the gray shaded box. For example, a tree with a complex crown and large lateral limbs would receive only 1 point for Crown Features.

Note: Trees not meeting the minimum retention score but exhibiting high potential defect (standing slash) or high harvesting costs so as to negate their value should also be considered as prime candidates for meeting green tree retention guidelines if high-scoring trees are not available.

Live Tree Retention Scorecard Used for Identification of Existing Wildlife Structure – Balance of Enrolled Lands

	Tree elements					Unit Scarcity Factor[a]	Planning Watershed Factor[b]	
	DBH[d]	Bole features[c]			Crown features[c]			
	conifer >30" hardwood >18"	internal hollow or large cavity	small cavity, internal rot or mistletoe broom	crevice cover (loose or deeply furrowed bark)	complex crown, lateral large limbs, epicormic branching	Post-harvest LSE density: =<1 ac, add 2 pts >1/ac, <2/ac, add 1 pt =>2/ac, add no pts	Impaired or special wildlife value, add 1 point. All others, add no points	Total score
Wildlife score	3	4	2	1	1			

[a] Unit scarcity factor is determined at the unit level based on the number of residuals post harvest (conifers and hardwoods are to be evaluated separately) and is added to the total score. Estimate is based on entire unit acres (including RMZs).
[b] Planning watershed factor is determined programmatically and is added to the total score.
[c] See Definitions and descriptions.
[d] Trees not meeting the diameter threshold but exhibiting the described habitat elements should be considered as prime candidates for meeting the green tree retention guidelines if large trees are not available.
Trees with a score equal to or greater than 7 will be retained except under very rare circumstances where operational constraints prohibit retention as justified by Forestry and Wildlife. Trees with scores less than 7 can be harvested. Maximum obtainable score for combined tree elements is 11. The maximum score for each tree element column is depicted in the gray shaded box. For example, a tree with a complex crown and large lateral limbs would receive only 1 point for Crown Features.

Note: Trees not meeting the minimum retention score but exhibiting high potential defect (standing slash) or high harvesting costs so as to negate their value should also be considered as prime candidates for meeting green tree retention guidelines if high-scoring trees are not available.

Late Seral Habitat Elements – Definitions and Descriptions

The following information is intended to provide guidance for foresters and biologists assessing the relative value of wildlife trees in harvest units. The terms listed here should provide a common language for describing the various late seral habitat structures encountered in California north coast forests. These definitions and descriptions are not perfect, and if interpreted too narrowly may exclude some trees of obvious wildlife value or if interpreted too broadly may include some trees of little wildlife value. These descriptions should be used to obtain a general impression of the types of structures that may be visible in the field during THP development and review.

I. Trees and Snags

A. Residual tree (Legacy tree): A tree that existed in a stand prior to the most recent harvest entry.

Description: Structure and appearance varies substantially depending on residual tree age, species, and harvest history of the stand. For conifers, including redwood, the residual tree will almost always exhibit a greater diameter than the regenerated trees in the stand. If the residual has a live top it will likely project well above the surrounding canopy.

Two types of residual tree may be recognized:

1. Old-growth residual (Legacy tree): A residual tree at least two centuries old; minimum age varies by species

Description: Usually has a much greater diameter than the second-growth trees in the stand (for redwood, dbh is typically well over 4 feet for site class I, II, or III conditions) and often relatively tall (at "true" site potential height for site class). In addition to large size, old-growth residual trees usually exhibit one to several readily observable features of "old-growth" including broken top, large reiterations and large-diameter limbs, thick bark that may have deep furrows, fire scars or basal cavity, other cavities, possibly well-developed duff layers, moss, or lichen accumulations on horizontal limbs or platforms. Crown architecture visible from the air may include emergent crown (where the surrounding stand is relatively young), irregular or flat-topped shape (as opposed to conical top), obvious dead or spike top (note these may also occur in large second-growth trees), multiple leaders due to large reiterations (which may give the crown the appearance of a cluster of tall young trees).

2. "Mature" residual ("released-growth"; Legacy tree): A residual that was probably less than 100 years old at the time of the initial harvest. The age at present is around 100 to 200 years old.

Description: Usually at or above the maximum dbh of the second-growth trees in the stand. Other characteristics (height and defect) vary depending on age, age relative to other trees in the stand, fire history, and whether damage to the residual occurred during the initial entry.

Typically, “mature” residuals show a much smaller dbh than an old-growth residual for the site class and exhibit fewer of the structural features listed above for old-growth residuals. From the air, the crown of a “mature” residual tree may emerge above the surrounding canopy (where the surrounding stand is relatively young) or may not be particularly evident if the surrounding stand is mature second-growth. If the “mature” residual grew for an extended period above a regenerating stand, it may exhibit a relatively broad crown and high degree of taper, but otherwise be relatively free of physically induced defect.

B. Snag: A standing dead tree.

Description: Snags vary tremendously in appearance and function for wildlife depending on species, size, and decay class.

C. Green Wildlife Tree: A standing live tree with important, existing wildlife structure.

Description: A conifer or hardwood tree with existing habitat elements (II. and III. described below) that result in a score ≥7 based on evaluation from the score card.

D. Green Tree: A standing live tree

Description: A conifer or hardwood tree lacking existing habitat structure and possessing few elements that contribute to a score of ≤7 based upon evaluation from the score card. It is common for trees with low economic value but some wildlife value to be retained (e.g. hardwoods, hemlock, and cedar). These trees with low economic value but some existing wildlife structure should always be considered as prime candidates for retention even where there is no requirement for retention.

II. Bole Features

A. Large cavity: A cavity (or void within a tree bole or large limb) with a relatively small entrance suitable for use by a variety of wildlife species, such as spotted owl, wood rats, Pacific fisher, or American marten, or colonies of Vaux's swift, purple martin, or bats. The small entrance precludes the entry of larger predators into the cavity. Cavities with larger entrances (classified as hollows, see below) may also be used by these species.

Description: A large cavity is generally several feet deep and at least 8 to 12 inches in diameter with an entrance size ranging from about 2.5 to 6 inches diameter. Entrance height is often at least 15 feet above the ground, but lower entrances may also be used. In practice, interior dimensions will usually just be a guess based on entrance size and appearance, as well as the characteristics of the tree, plus any observations of wildlife use of the cavity.

B. Hollow: A large cavity with an entrance or opening greater than 6 inches diameter.

Description: Hollows have similar interior dimensions as large cavities and may be used by the same suite of species for cover; however, the larger entrance size of a hollow may not prevent larger predators from entering the hollow.

C. Basal hollow (Goose pen): A large hollow at ground level typically created by fire that destroys the cambium on a portion of the bole's circumference. Repeated fires play an important role in maintaining and enlarging basal hollows.

Description: A basal hollow is a hollow that extends at least a third of the tree's diameter into the bole and is generally several feet in height. It should be capable of providing shelter to small or medium-sized wildlife.

D. Small cavity: A cavity suitable for use by a variety of small to medium-sized wildlife species, such as small to large woodpeckers, secondary cavity-nesting birds, wood ducks, individual or small numbers of bats, northern flying squirrel, Douglas squirrel, and small owls.

Description: A small cavity is generally between about 7 inches and a few feet deep and between about 4 and 8 inches in diameter with an entrance size ranging from about 1.5 to 3 inches in diameter. Entrance height is often at least 10 feet above the ground, but lower entrances may also be used. Interior dimensions will usually be a guess based on entrance size and appearance, characteristics of the tree, plus observations of wildlife.

E. Internal decay (Heart rot): Widespread or localized heart rot fungus infection within the bole of a tree. Decayed, softened wood encompasses at least enough volume to allow excavation of a small cavity.

Description: Decayed wood in old scars may be visible at ground level or with binoculars well above the ground. Good indicators of internal decay include fungal fruiting bodies, such as conk, cavity entrances, and sloughing wood and bark. In practice, it may be difficult to discern the extent of internal decay in some cases.

F. Crack (Fissure): A longitudinal gap in the bole of a tree caused either by physical damage (including wind, lighting, or fire) or by growth of two trees or leaders into each other where the gap provides cover for wildlife.

Description: Cracks must be sufficiently deep relative to their width to provide partial cover for foraging birds or complete cover for nesting birds, roosting bats, or small- to medium sized mammals. Longitudinal indentations in which the deepest portions are visible from outside the tree are not considered cracks unless they are capable of providing cover for foraging or roosting small vertebrates.

G. Furrowed bark: A relatively deep linear indentation in the bark of a tree capable of providing cover for roosting bats or foraging bole-gleaners.

Description: Furrowed bark occurs where an underlying defect (crack, old lightning or fire scar, narrow strip of removed cambium) or the line of contact between two trees growing into each other has been covered by bark. The furrow is sufficiently deep and narrow to be capable of providing cover for small vertebrates. Furrowed bark should not be used to describe the bark of a large or fast-growing redwood tree on which the bark has developed a ropey or braided look, but does not provide cover for foraging or roosting small vertebrates.

H. Loose bark: A discrete, large piece of bark that has separated from the underlying tree bole but remains attached to the tree.

Description: "Loose bark" refers to a portion of a tree's bark that provides cover for roosting bats, nesting birds, or possibly foraging bole gleaners. Typically, such bark pieces provide relatively tight, stable cover for small animals. The distance of separation from the underlying tree should be 2 inches or less and should not be so loose that the bark piece flaps in the wind. As a general rule, loose bark is attached along at least one edge at least 1 foot long. Although some bear-stripped trees may meet the definition of "loose bark", most bear-stripped trees have bark that has been pulled away from the bole along most of the strip's edges, flaps against the underlying wood in the wind, and only provides a small amount of cover at one end of the strip. Such bear-stripped bark should not be scored as "loose bark".

I. Ledge (Platform): A relatively horizontal portion of a tree limb, exposed old cavity, or cluster of epicormic branches on the bole of a tree.

Description: A ledge or platform must be of sufficient size and have adequate cover to provide a nesting or resting opportunity for a moderately large wildlife species, such as Pacific fisher or peregrine falcon.

III. Crown Features (features contributing to a "complex crown")

A. Dead top (Spike): A dead tree leader.

Description: "Dead top" refers to dead leaders that are evidenced by leaf die-back along at least the top one-fifth of the tree height or with a minimum diameter at the lowest extent of leaf die-back of about 12 inches.

B. Broken top: A tree with the original leader broken off.

Description: "Broken top" refers to broken-topped trees with a minimum diameter at the original break of about 12 inches.

C. Reiteration (Reiterated top, Bayonet, "Schoolmarm", Candelabra): A sprouted leader or limb that exhibits apical dominance.

Description: Reiterations vary greatly depending on relative age and position on tree. All reiterations include some vertical growth that gives them the appearance of a "tree-on-a-tree". Old reiterations may exhibit a high degree of decadence and may themselves have additional reiterations. A tree should be scored for reiteration only if the reiteration provides opportunities for resting, denning, or nesting, or includes a substrate or epiphytes providing foraging opportunities for vertebrate wildlife.

D. Forked top: A split in a tree's leader.

Description: A tree should only be scored for a forked top if the structure provides an opportunity for resting or nesting for vertebrate wildlife, or if defect associated with the fork suggests that other structures may be present (such as internal rot or cavity).

E. Mistletoe broom (Witch's broom): A compact spray of branches infected with mistletoe.

Description: A tree should be scored for mistletoe broom if the structure is large and solid enough to provide an opportunity for resting or nesting of vertebrate wildlife, or if smaller brooms occur in multiple locations within the tree.

F. Large limb (Platform limb): A relatively horizontal limb of sufficient girth for vertebrate wildlife to use the structure for resting or nesting (but not including bird perches).

Description: A tree should be scored for large limbs if the limbs are distinctly larger than typical for similar size trees with good growth form. Generally, such trees in a stand of merchantable age will have at least two branches at least 12 inches in diameter.

Habitat Management Commitment Two: Green Diamond shall implement the TREE Guidelines for Green (Live) Tree and Snag Retention on all Enrolled Lands. Specific TREE measures designed as a conservation benefit to marten are applied through a marten-specific SHA scorecard (items "b-d") on Green Diamond timberlands north of the Bald Hills road, and the Moore Tract, (tracts 51, 56, 61, 66, 67, 70, 71, 72, 73, 85, 87, 88, 98)(Figure 7), and in future planning watersheds where Humboldt marten are detected. Tree retention guidelines and associated scorecard criteria for the balance of Enrolled Lands are found in items "a, e-g."

a. General Candidate Tree Selection for all Green Diamond timberlands:

Retain large defective trees using the TREE's tree retention scorecard
Retain defective or poorly formed trees, e.g., animal damaged, forked top, broken top, mistletoe broom, etc.
Retain a mix of conifers and hardwoods (approximately 50/50 mix where possible
Retain conifer species preference: Douglas-fir, hemlock, white fir, cedar, spruce, redwood
Preference for evergreen hardwood species retention: tanoak, chinquapin, Pacific madrone, California laurel,
Consider protection from wind throw and site preparation burning when designating HRA and tree clump locations
Retain trees with the average diameter equal to or greater than the average diameter of trees in the THP area

b. Retention Guidelines for marten-specific SHA tracts – Evaluate the method and level of tree retention needed within each THP unit as follows:

Conifer Dominated Harvest Areas[6] with RMZ Retention:

[6] Forest stands with >15,000 board feet conifer per acre

- Retain all conifer scorecard trees ≥7 in non-clearcut areas and in clearcut areas retain conifer scorecard trees at a rate of two trees per clearcut acre. Trees with greatest wildlife value (greatest scores) will be given priority for retention.
- Retain all hardwood scorecard trees ≥7 in non-clearcut areas and in clearcut areas retain hardwood scorecard trees at a rate of three trees per clearcut acre. Trees with greatest wildlife value (greatest scores) will be given priority for retention.
- Retain other evergreen hardwoods in clearcut areas at a rate of two trees per clearcut acre where they exist. Hardwood scorecard trees in clearcut acres will be counted toward the rate of two hardwood trees per clearcut acre where they exist.

Conifer Dominated Harvest Areas without RMZ Retention:

- Retain all conifer scorecard trees ≥7 in non-clearcut areas and in clearcut areas retain conifer scorecard trees at a rate of two trees per clearcut acre. Trees with greatest wildlife value (greatest scores) will be given priority for retention.
- Retain other conifer at a rate of two trees per clearcut acre. Scorecard conifer count toward the rate of two trees per acre.
- Retain all hardwood scorecard trees ≥7 in non-clearcut areas and within clearcut areas retain hardwood scorecard trees at a rate of three trees per clearcut acre. Trees with greatest wildlife value (greatest scores) will be given priority for retention.
- Retain other evergreen hardwoods within clearcut areas at a rate of two trees per clearcut acre where they exist. Hardwood scorecard trees within clearcut acres will be counted toward the rate of two hardwood trees per clearcut acre where they exist. If the unit lacks hardwoods to meet minimum retention standards, retain conifers up to two trees per acre within clearcut areas.
- Retention should be a combination of approaches (HRA, tree clumps or scattered trees). HRAs are typically prescribed in cable yarding areas since this type of clumped retention is more practical in these areas.

Hardwood Dominated Harvest Areas[7] with RMZ Retention:

- Retention in hardwood dominated areas is at least two trees per acre within clearcut areas regardless of the watershed
- Retain all conifer scorecard trees ≥7 within non-clearcut areas and in clearcut areas retain conifer scorecard trees at a rate of two trees per clearcut acre. Trees with greatest wildlife value (greatest scores) will be given priority for retention.
- Retain all hardwood scorecard trees ≥7 in non-clearcut areas and in clearcut areas retain hardwood scorecard trees at a rate of three trees per clearcut acre. Trees with greatest wildlife value (greatest scores) will be given priority for retention.
- Retain other evergreen hardwoods in clearcut areas at a rate of two trees per clearcut acre where they exist. Hardwood scorecard trees within clearcut acres will be counted toward the rate of two hardwood trees per clearcut acre where they exist.
-

Hardwood Dominated Harvest Areas without RMZ Retention:

[7] Forest stands with <15,000 board feet conifer per acre and dominated by hardwood stems.

- Retain all conifer scorecard trees ≥7 in non-clearcut areas and in clearcut areas retain conifer scorecard trees at a rate of two trees per clearcut acre.
- Retain all hardwood scorecard trees ≥7 in non-clearcut areas and in clearcut areas retain hardwood score card trees at a rate of three trees per clearcut acre. Trees with greatest wildlife value (greatest scores) will be given priority for retention.
- Retain a minimum 0.5 acre HRA or clumps totaling 0.5 acres and additional scattered or clumped evergreen hardwood trees at a rate of two trees per clearcut acre.

c. Relationship with Snag and RMZ Retention – Live tree retention is in addition to snag and RMZ retention. Green trees retained as described in these retention guidelines will augment structure provided by snag retention and within AHCP areas, i.e., Green Diamond will not include retained snags and trees left within RMZs as part of the count for Wildlife Tree Retention.

d. Live Tree Retention Scoring Criteria Used for Identification of Existing Wildlife Habitat Elements for marten-specific SHA tracts:

Dbh – Conifers ≥30 inches and Hardwoods ≥18 inches (3 points)
Bole and Crown features[8]:

- Trees with a large cavity, hollow, basal hollow (4 points)
- Trees with a small cavity, broken top, reiteration (3 points)
- Trees with internal decay, mistletoe broom (2 points)
- Trees with crevice cover, fissure, loose bark, furrowed bark (1 point)
- Trees with complex crown, dead or forked top, lateral large limbs, epicormic branching, ledge/platform (1 point)

Unit scarcity factor, i.e., post-harvest residual tree density, <1 acre (2 points), >1/acre but <2/acre (1 point), >2/acre (0 points)
Planning watershed factor is determined programmatically based on management tract and is added to the total score. All marten-specific SHA tracts receive a watershed factor score of one point.

e. Retention Guidelines for tracts other than the marten-specific SHA Tracts – Evaluate the method and level of tree retention needed within each THP unit as follows:

Conifer Dominated Harvest Areas with RMZ Retention:

- Retain all scorecard trees ≥7
- Retain other evergreen hardwoods within clearcut areas at a rate of two trees per clearcut acre where they exist

Conifer Dominated Harvest Areas without RMZ Retention:

- Retain all scorecard trees ≥7
- Retain other conifer within clearcut areas at a minimum rate of one tree per clearcut acre.

[8] See Definitions and Descriptions in Green Diamond's TREE document

- Retain other qualifying evergreen hardwoods within clearcut areas at a rate of two trees per clearcut acre where they exist. If the unit lacks hardwoods to meet minimum retention standards, retain an additional conifer up to two trees per acre if harvest unit is in a one or two tree per clearcut acre retention area.
- Retention should be a combination of approaches (HRA, tree clumps or scattered trees). HRAs are typically prescribed in cable yarding areas since this type of clumped retention is more practical in these areas. Trees retained in Streamside Management Zones (SMZ) and Class III Tier B areas count toward overall tree retention.

Hardwood Dominated Harvest Areas with RMZ Retention:

- Retention in all hardwood dominated areas is at least two trees per acre within clearcut areas regardless of the watershed
- Retain all scorecard trees ≥7
- Retain scattered or clumped evergreen hardwood trees at a rate of two trees per clearcut

Hardwood Dominated Harvest Areas without RMZ Retention:

- Retain all scorecard trees ≥7
- Retain ½ acre HRA or clumps totaling 0.5 acres and scattered evergreen hardwood trees within clearcut areas at a rate of two trees per clearcut acre

f. Relationship with Snag and RMZ Retention – Live tree retention is in addition to snag and RMZ retention. Green trees retained as described in these retention guidelines will augment structure provided by snag retention and within AHCP areas, i.e., Green Diamond will not include retained snags and trees left within RMZs as part of the count for Wildlife Tree Retention.

g. Live Tree Retention Scoring Criteria Used for Identification of Existing Wildlife Habitat Elements:

Dbh – Conifers ≥30 inches and Hardwoods ≥18 inches (3 points)

Bole and Crown features:

- Trees with a large cavity, hollow, basal hollow (4 points)
- Trees with a small cavity, internal decay or mistletoe broom (2 points)
- Trees with crevice cover, fissure, loose bark or furrowed bark (1 point)

- Trees with complex crown, dead, broken or forked top, lateral large limbs, epicormic branching, ledge/platform (1 point)

Unit scarcity factor, i.e., post-harvest density of residual trees, <1 acre (2 points), >1/acre but <2/acre (1 point), >2/acre (0 points)

Planning watershed factor is determined programmatically and is added to the total score, impaired or special wildlife value (1 point), all others (0 points)

APPENDIX B – PUBLIC AND TRIBAL NOTICES AND COMMENTS RECEIVED

PUBLIC NOTICE

March 15, 2016

TO WHOM IT MAY CONCERN:

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

The Department has initiated this status review following related action by the Fish and Game Commission. Having provided notice on February 26, 2016, the Humboldt Marten is now a candidate species under the California Endangered Species Act (Cal. Reg. Notice Reg. 2016, No. 9-Z, p. 290; see also Fish & G. Code, §§ 2074.2, 2085).

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

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

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

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

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

If you have any questions, please contact Daniel Applebee at (209) 588-1879 or the Department via email at wildlifemgt@wildlife.ca.gov or at the address above.

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

NOTICE TO TRIBES

March 18, 2016

TO HONORABLE TRIBAL REPRESENTATIVES:

NOTICE IS HEREBY GIVEN that the California Department of Fish and Wildlife has initiated a status review of the Humboldt Marten (*Martes caurina humboldtensis*) pursuant to Fish and Game Code section 2074.6, and is providing this notice pursuant to Fish and Game Code section 2074.4, the Department's Tribal Communication and Consultation Policy, and AB 52 to solicit data and comments on the petitioned action from interested and affected parties.

The Department has initiated this status review following related action by the Fish and Game Commission. Having provided notice on February 26, 2016, the Humboldt Marten is now a candidate species under the California Endangered Species Act (Cal. Reg. Notice Reg. 2016, No. 9-Z, p. 290; see also Fish & G. Code, §§ 2074.2, 2085).

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

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

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

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

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

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

If you have any questions, please contact Daniel Applebee at (209) 588-1879 or the Department via email at wildlifemgt@wildlife.ca.gov or at the address above. If you would like to initiate consultation with the Department concerning the status review for Humboldt marten, please contact the Department's Tribal Liaison at tribal.liaison@wildlife.ca.gov

United States Department of the Interior
California Department of Parks and Recreation
Redwood National and State Parks
1111 Second Street
Crescent City, California 95531

In reply refer to:

N1427 (Humboldt marten)

February 6, 2012

RECEIVED
FEB 10 2012
Div. of Policy & Dir. Mgt.

Public Comments Processing, Attn: FWS-R8-ES-2011-0105
U.S. Fish and Wildlife Service
4401 N. Fairfax Drive, MS 2042-PDM
Arlington, VA 22203

To Whom It May Concern:

Redwood National Park (Park) has reviewed the 90-day finding on a petition [FR. Vol. 77, No. 8, Jan. 12, 2012. Docket No. FWS-R8-ES-2011-0105; 4500030113] to list the Humboldt marten *(Martes americana humboldtensis)* as endangered or threatened and designate critical habitat under the Endangered Species Act of 1973, as amended. The Park offers the following comments in response to the 90-day finding:

1. Park staff are active participants in the newly created Humboldt Marten Conservation Group. The Park will be a signatory to the final Memorandum of Understanding along with seven other signatories, including the staff at Arcata U.S. Fish and Wildlife Service Field Office responsible for preparation of the 90-Day Finding. This group will work collaboratively on a Humboldt marten conservation assessment/strategy.

2. The Park will provide support and input to the conservation of the subspecies whenever and wherever possible, and will continue to actively seek funding to support studies to fill information gaps on the population status and ecology of this species. The Park submitted a proposal to fund marten surveys during the most recent (2012) National Park Service (NPS) Servicewide Comprehensive Call (status pending).

3. In 2010, the Park along with our California State Park partners, provided support to a U.S. Forest Service forest carnivore study that surveyed forests within Redwood National and State Parks (RNSP). The study surveyed roaded and roadless areas in riparian and upland habitats using track plates and remote camera devices to detect marten and potential marten predators and competitors. The Park provided personnel, a vehicle, and supplies in support of these surveys. Marten were detected at 2 locations within Prairie Creek Redwoods State Park, on state lands adjacent to Redwood National Park managed as part of the Redwood National and State Park partnership. Although there were no detections on federal lands within Redwood National Park, the study produced information on the presence of other forest carnivores such as the fisher, gray fox, and bobcat, which may compete with, or prey upon, Humboldt marten.

4. The 90-Day Finding/Status Review states that "...conifer-dominated, late-successional stands with dense shrub cover in patches greater than or equal to 445 ac (180 ha) are estimated to be a minimum criterion to identify potential Humboldt marten home range areas (Slauson 2003)." Initial GIS analysis of old growth redwood forest patch sizes within RNSP indicates nine polygons that exceed this criterion and which could potentially provide home ranges for multiple Humboldt marten territories. For example, in two of the state parks within the RNSP partnership, there are contiguous old growth stands of approximately 9,800 acres (Prairie Creek Redwoods State Park) and 8,400 acres (Jedediah Smith Redwoods State Park). On federally-managed lands in Redwood National Park there are over 6,000 acres of contiguous old growth in the Lost Man Creek watershed, and approximately 9,750 acres of old growth in the west side of the Redwood Creek watershed ranging in patches between 446 and 3,200 acres in size. Although a range-wide habitat suitability model for the Humboldt marten is being prepared by the Forest Service which will identify the requisite habitat variables indicating the highest-quality habitat for the marten within the current and historic ranges, our preliminary analysis indicates that Redwood National Park, plus the adjacent State Parks in the RNSP partnership, may provide a relatively large amount of potentially suitable habitat for this species.

We appreciate the opportunity to provide comments on the 90-day finding. We look forward to continuing work with the U.S. Forest Service and the U.S. Fish and Wildlife Service to support and enhance conservation of the Humboldt marten.

If you have any questions or if we can be of any further assistance in providing maps or other information, please contact David Roemer, Chief of Resource Management and Science, Redwood National Park, at (707) 465-7700.

Sincerely,

Steve W. Chaney
NPS Superintendent

cc: Mietek Kolipinski, PWRO
Kristin Schmidt, REDW
Jay Harris, CDPR

APPENDIX C – PEER REVIEW SOLICITATION LETTERS

State of California – Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
Wildlife Branch
P.O. Box 944209
Sacramento, CA 94244-2090
www.wildlife.ca.gov

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

March 21, 2018

Mr. Keith Hamm
Wildlife Biologist
Green Diamond Resource Company
California Timberlands Division
P.O. Box 68
Korbel, CA 95550
KHamm@Greendiamond.com

Dear Mr. Hamm:

RE: HUMBOLDT MARTEN (*MARTES CAURINA HUMBOLDTENSIS*); DEPARTMENT OF FISH AND WILDLIFE, PEER REVIEW STATUS REPORT

Thank you for agreeing to serve as a scientific peer reviewer for the Department of Fish and Wildlife's (Department) Draft Status Review of the Humboldt marten (*Martes caurina humboldtensis*). A copy of this report, dated March 20, 2018, is enclosed for your use in that review. The Department seeks your expert analysis regarding the scientific validity of the report and its assessment of the status of Humboldt marten in California. **The Department would appreciate receiving your peer review input on or before April 13, 2018**.

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

The Commission first received the Petition to List the Humboldt Marten as an Endangered Species (Petition) on June 8, 2015 and published a formal notice of receipt on July 24, 2015 (Cal. Reg. Notice Register 2015, No. 30-Z, p. 1237). The Commission published notice of its acceptance of the petition for further consideration and formal designation of the Humboldt Marten as a candidate species on February 26, 2016 (Cal. Reg. Notice Register 2016, No. 9-Z, p. 290).

The draft report forwarded to you today reflects the Department's effort to identify and analyze the available scientific information regarding the status of Humboldt marten in

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

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

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For ease of review, I invite you to use "track changes" in Microsoft Word, or provide comments in list form by page number, section header, and paragraph. Please submit your comments electronically to Daniel Applebee, Senior Environmental Scientist – (Specialist) with the Wildlife Branch at Daniel.Applebee@wildlife.ca.gov
or at the address in the letterhead above. If you have any questions, you may reach Dan Applebee by phone at (209) 694-5206.

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

Sincerely,

Kari Lewis, Chief
Wildlife Branch
Department of Fish and Wildlife

Enclosure

ec: **Department of Fish and Wildlife**

Stafford Lehr, Deputy Director
Wildlife and Fisheries Division
Stafford.Lehr@wildlife.ca.gov

Erin Chappell, Wildlife Branch
Nongame Program Manager
Erin.Chappell@wildlife.ca.gov

Dan Applebee, Wildlife Branch
Senior Environmental Scientist (Specialist)
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EDMUND G. BROWN JR., Governor
CHARLTON H. BONHAM, Director

March 21, 2018

Katie M. Moriarty, Ph.D.
Postdoctoral Research Scientist
Pacific Northwest Research Station
USDA Forest Service
3625 93rd Ave. SW
Olympia, WA 98512
KMoriarty02@fs.fed.us

Dear Dr. Moriarty:

RE: HUMBOLDT MARTEN (*MARTES CAURINA HUMBOLDTENSIS*); DEPARTMENT OF FISH AND WILDLIFE, PEER REVIEW STATUS REPORT

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Conserving California's Wildlife Since 1870 the species as threatened under CESA is warranted. An endangered species is defined as "a native species or subspecies…which is in serious danger of becoming extinct throughout all, or a significant portion, of its range due to one or more causes, including loss of habitat, change in habitat, overexploitation, predation, competition, or disease" (Fish and G. Code, § 2062). A threatened species is defined as "a native species or subspecies…that, although not presently threatened with extinction, is likely to become an endangered species in the foreseeable future in the absence of the special protection and management efforts required by [CESA]" (Fish and G. Code, § 2067). We underscore, however, that scientific peer review plays a critical role in the Department's effort to develop and finalize its recommendation to the Commission as required by the Fish and Game Code.

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

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

Sincerely,

Kari Lewis, Chief
Wildlife Branch
Department of Fish and Wildlife

Enclosure

ec: **Department of Fish and Wildlife**

Stafford Lehr, Deputy Director
Wildlife and Fisheries Division
Stafford.Lehr@wildlife.ca.gov

Erin Chappell, Wildlife Branch
Nongame Program Manager
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Dan Applebee, Wildlife Branch
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EDMUND G. BROWN JR., Governor
CHARLTON H. BONHAM, Director

March 21, 2018

Keith M. Slauson, Ph.D.
Research Fellow
Pacific Southwest Research Station
USDA Forest Service
1700 Bayview Drive
Arcata, CA 95521-6013
KeithMSlauson@fs.fed.us

Dear Dr. Slauson:

RE: HUMBOLDT MARTEN (*MARTES CAURINA HUMBOLDTENSIS*); DEPARTMENT OF FISH AND WILDLIFE, PEER REVIEW STATUS REPORT

Thank you for agreeing to serve as a scientific peer reviewer for the Department of Fish and Wildlife's (Department) Draft Status Review of the Humboldt marten (*Martes caurina humboldtensis*). A copy of this report, dated March 20, 2018, is enclosed for your use in that review. The Department seeks your expert analysis regarding the scientific validity of the report and its assessment of the status of Humboldt marten in California. **The Department would appreciate receiving your peer review input on or before April 13, 2018.**

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Sincerely,

Kari Lewis, Chief
Wildlife Branch
Department of Fish and Wildlife

Enclosure

ec: **Department of Fish and Wildlife**

Stafford Lehr, Deputy Director
Wildlife and Fisheries Division
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Nongame Program Manager
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Dan Applebee, Wildlife Branch
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EDMUND G. BROWN JR., Governor
CHARLTON H. BONHAM, Director

March 21, 2018

Mr. Chris West
Senior Wildlife Biologist
Yurok Tribe Wildlife Program
P.O. Box 1027
Klamath, CA 95548
CWest@yuroktribe.nsn.us

Dear Mr. West:

RE: HUMBOLDT MARTEN (*MARTES CAURINA HUMBOLDTENSIS*); DEPARTMENT OF FISH AND WILDLIFE, PEER REVIEW STATUS REPORT

Thank you for agreeing to serve as a scientific peer reviewer for the Department of Fish and Wildlife's (Department) Draft Status Review of the Humboldt marten (*Martes caurina humboldtensis*). A copy of this report, dated March 20, 2018, is enclosed for your use in that review. The Department seeks your expert analysis regarding the scientific validity of the report and its assessment of the status of Humboldt marten in California. **The Department would appreciate receiving your peer review input on or before April 13, 2018.**

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Sincerely,

Kari Lewis, Chief
Wildlife Branch
Department of Fish and Wildlife

Enclosure

ec: **Department of Fish and Wildlife**

Stafford Lehr, Deputy Director
Wildlife and Fisheries Division
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Erin Chappell, Wildlife Branch
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EDMUND G. BROWN JR., Governor
CHARLTON H. BONHAM, Director

March 21, 2018

William J. Zielinski, Ph.D.
Research Ecologist, Retired
Pacific Southwest Research Station
USDA Forest Service
1700 Bayview Drive
Arcata, CA 95521-6013
BZielinski@fs.fed.us

Dear Dr. Zielinski:

RE: HUMBOLDT MARTEN (*MARTES CAURINA HUMBOLDTENSIS*);
DEPARTMENT OF FISH AND WILDLIFE, PEER REVIEW STATUS REPORT

Thank you for agreeing to serve as a scientific peer reviewer for the Department of Fish and Wildlife's (Department) Draft Status Review of the Humboldt marten (*Martes caurina humboldtensis*). A copy of this report, dated March 20, 2018, is enclosed for your use in that review. The Department seeks your expert analysis regarding the scientific validity of the report and its assessment of the status of Humboldt marten in California. **The Department would appreciate receiving your peer review input on or before April 13, 2018**.

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Dr. William Zielinski, Research Ecologist, Retired
Pacific Southwest Research Station
USDA Forest Service
March 21, 2018
Page 2

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

Sincerely,

Kari Lewis, Chief
Wildlife Branch
Department of Fish and Wildlife

Enclosure

ec: **Department of Fish and Wildlife**

Stafford Lehr, Deputy Director
Wildlife and Fisheries Division
Stafford.Lehr@wildlife.ca.gov

Erin Chappell, Wildlife Branch
Nongame Program Manager
Erin.Chappell@wildlife.ca.gov

Dan Applebee, Wildlife Branch
Senior Environmental Scientist (Specialist)
Daniel.Applebee@wildlife.ca.gov

APPENDIX D – PEER REVIEW COMMENTS

Dan,

Please see the attached documents for my review of the report. Thanks for the opportunity to review it.

Keith

Keith A. Hamm
Conservation Planning Manager, California Timberlands
Green Diamond Resource Company
900 Riverside Road
Korbel, CA 95550

Certified Wildlife Biologist®
[redacted]

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April 13, 2018

Mr. Daniel Applebee
Department of Fish and Wildlife
Wildlife Branch
P.O. Box 944209
Sacramento, CA 94424-2090

RE: HUMBOLDT MARTEN (*MARTES CAURINA HUMBOLDTENSIS*);
DEPARTMENT OF FISH AND WILDLIFE, PEER REVIEW STATUS REPORT

Dear Mr. Applebee:

Thank you for the opportunity to review the Department's draft status report for the Humboldt marten. The draft report is well written and thorough. I am electronically submitting this letter and my edits and comments on the draft status report. I provided some suggested edits in track changes within the text of the document and a separate document with a list of other comments referenced by number in the margin of the draft report.

Please contact me with any questions you may have with any of my edits and comments or if I can be of further assistance in the review. Thank you again for the opportunity to review and provide input on the report.

Sincerely,

Keith A. Hamm

Keith A. Hamm

Certified Wildlife Biologist®
Conservation Planning Manager, Green Diamond Resource Company

KAHamm comments DFW HUMA status report

Comment 1: Page three, Geographic Range and Distribution, paragraph one:
Is there a pers comm. for the student at HSU working with Micaela Szykman-Gunther? This student has information on additional detections of marten in this area.

Comment 2: Page three, Geographic Range and Distribution, paragraph one:
All of this information seems more relevant to the next section on habitat associations. There are numerous sentences where information presented is speculative. For example, how do we know that the redwood forest in State and National Parks is high quality? We simply don't have any demographic information to relate to vegetation, so we can't say with any certainty nor do we have any data to support the assertion that the habitat is high quality. Also, there simply is no information to support the statement that dense brush cover is less extensive in the managed forests of the zone between the population east of the Klamath and the Parks. Based on an intimate knowledge of this zone having worked there for the past 25+ years, there are areas that have a denser brush layer than in the supposed high quality redwood Park habitat. I suggest revising this information to remove/minimize the speculation and move any remaining information to Habitat Associations.

Comment 3: Page four, Geographic Range and Distribution, paragraph three:
Do we fully understand the habitat associations adequately to state that these areas do not contain the requisite tree and shrub cover to support marten populations? There is mounting evidence that demonstrates martens do use other habitat types and that the forest conditions capable of supporting marten occupancy are broader than what is reported by certain studies.

Comment 4: Page four, Habitat Associations and Use, paragraph one:
Generally and strongly seem to be contradictory to one another.

Comment 5: Page four, Habitat Associations and Use, paragraph one:
Please see Comment 11 for potential contradiction.

Comment 6: Page four, Habitat Associations and Use , paragraph three:
Humboldt marten prey species are also positively associated with and abundant in other forest seral stages.

Comment 7: Page 5, Habitat Associations and Use, paragraph two:
I'm not sure why the 70% cutoff is used. So, approximately one-third are less than 28". I have not had an opportunity to review this work from the collaborative study. Unfortunately, I can't confirm this summary.

Comment 8: Page 5, Habitat Associations and Use, paragraph four:
Certainly in sufficient quantities for denning and resting. We did not measure abundance within the study area, so I would be reluctant to characterize them as abundant at this point.

Comment 9: Page 5, Habitat Associations and Use, paragraph four:
The abundance of the retained old structural elements on the managed lands was not quantified. I disagree that these features were present in sufficient quantities to provide for all of the foraging needs of marten. The reason is that foraging by marten is a behavior that occurs at a larger than micro-scale. Foraging would occur in areas of the home range with abundant prey resources rather than at the scale of the rest or den site.

Comment 10: Page 6, Habitat Associations and Use, paragraph one:
Suggest using characterized? Serpentine habitats not typically dominated by tree cover. See the Figure in section 4 of the conservation assessment and strategy document depicting typical stand structures within serpentine habitat.

Comment 11: Page 6, Habitat Associations and Use, paragraph two:
Which reference is this? This paragraph seems contradictory to the referenced statement on page 4 - "Large patches (>50 ha [>124 ac.]) of late successional conifer forests or serpentine soil formations appear necessary for supporting sustainable Humboldt marten populations (Slauson et al. 2007, K. Slauson pers. comm. 11/10/2017)." Yet here it seems to call into question the value of serpentine habitat. Which is it? Less value or necessary?

Comment 12: Page 6, Habitat Associations and Use, paragraph three:
In looking at the literature cited, I'm not sure this is the correct reference for the stated information? And the summarized information is confusing to me. Habitat variables (> 50% shrub cover) measured at the stand scale predicted occupancy at the landscape scale? I wanted to review the original source to better understand the statement, but the Slauson et al. 2010 reference is a report on forest restoration. Is this out of Slauson et al. 2018 in review – the habitat suitability model? This may need to be revised.

Comment 13: Page 6, Habitat Associations and Use, paragraph three:
Again, is this the correct reference?

Comment 14: Page 6, Habitat Associations and Use, paragraph four:
I suggest a move since this paragraph may be more appropriate under the Predation section.

Comment 15: Page 6, Habitat Associations and Use, paragraph four:
I'm not sure where the information on the average tree diameter came from? Did it come from the Yurok timber inventory? Or was it from some vegetation sampling around rest or den sites? Is this meant to be a comparison to the home range scale reported above where information from 3 marten home ranges indicated that stands were 750-1250 acres? A description of the comparison or statement of how stands were identified would be critical here since it is a pers. Comm. The description of "stands" with average tree size greater than 24" needs additional spatial information. I'm quite familiar with this area of former Green Diamond ownership and the description of individual tree and group selection silviculture is incorrect. This area was essentially clearcut (high graded) prior to the CA Forest Practice Act from the 1950s to the 1970s. Please feel free to contact me on this topic since Green Diamond managed the land.

Comment 16: Page 6, Habitat Associations and Use, paragraph five:
Bull and Heater 2001 followed 35 radio marked marten in the Blue Mtns of Oregon and 18 were killed by predators (8 by bobcat). They also stated that additional research was warranted to determine if reproduction exceed mortality over the long term to sustain a viable population.

Comment 17: Page 6, Habitat Associations and Use, paragraph five:
The truth is that it is unknown whether predation rates have a significant negative effect on demographic rates such that the population would not sustain itself - or possibly productivity offsets mortality from predation and age specific survival is high enough to sustain the population. All possibilities that warrant further study.

Comment 18: Page 6, Habitat Associations and Use, paragraph five:
The discovery of occupied home ranges during the dispersal study and reproductive females was unexpected. What the discovery highlights is that sometime after the initial track plate surveys of this area in 1994-1995 (without marten detections) marten apparently began to colonize this area and were consistently detected in surveys or studies starting in 2004 and continuing through cessation of studies in 2016. In addition Slauson 2003 surveyed this area without marten detections. So, the most likely explanation is a population expansion (not supported by the predation hypothesis) some time after 2001. The dispersal study nor the data collected during the rest and den site study provide an unbiased view of age structure or sex ratios of marten occupying this expansion area. So, we don't really know if there is a gender or age skewed structure because the entire area was not surveyed -only the interface of the public and private land. No edits since this is a pers. Comm.

Comment 19: page nine, Diet and Food Habits, paragraph one:
Is this statement suggesting a behavioral response where marten are avoiding habitats where woodrats are more abundant and bobcats are presumed to be more abundant or use these areas disproportionate to availability? Woodrats are more abundant in the young seral stands 10-30 years, but they do occur along habitat edges and in older forests. It seems unlikely that bobcats would preclude marten, and the radio telemetry studies in Pecwan found marten actively using the young regenerating clearcuts and resting in slash piles in these young clearcuts about 10-15 years old. So, direct observations refute this statement. The assertion with the predation hypothesis is that bobcats might be a limiting factor for marten in managed landscapes because bobcats are assumed to be more abundant in the managed landscapes and because bobcats are known to kill marten, this interaction could have negative effects on marten demographic parameters. We don’t even know if bobcats are more abundant in the managed landscapes. Do bobcats occur at a density and distribution that would ever negatively affect Humboldt marten populations? Bobcat predation might have measureable effects on survival for certain age classes, but does this translate to population level effects? The female marten collared in the rest/den site study had greater than average naïve estimates of annual survival. This is the age class and gender where changes in survival would have the greatest potential to affect population trends. No edits suggested since this may be from Slauson and Zielinski in press. I offer an alternative view.

Comment 20: page nine, Diet and Food Habits, paragraph one:
This is simply a hypothesis that is currently untested. It is an observation based on circumstantial evidence, but there is no quantitative information to demonstrate that bobcat presence on the landscape is a limiting factor for marten. It is also equally plausible to state the alternative hypothesis that bobcat presence has no effect on the marten population. More studies would need to occur to assess the interaction between bobcats and marten. For decades biologists were uncertain about the potential negative effects of barred owls on spotted owls. It required a decade or more of demographic data to conclude that barred owls were the most likely cause of declines in spotted owl populations. And then a removal experiment was conducted to experimentally assess the treatment effect of barred owl removal on spotted owl occupancy, survival, fecundity and rate of population change. We are a long way from understanding if bobcats actually have any measureable negative effect on Humboldt marten. There is a high level of speculation on this topic. It is a hypothesis based on observations and is worthy of additional well-designed field studies. No edits suggested since this is a pers. Comm.

Comment 21: page 11, Habitat Essential for the Continued Existence of the Species (FGC § 2074.6), paragraph three:

Some areas may already provide suitable habitat given limitations of predictive habitat suitability models. And, habitat will recruit through time in protected areas on private and public lands.
Comment 22: page 12, Range and Distribution Trends, paragraph one:
Being able to review Schwartz et al. 2017 was very helpful – thanks Dan. I'm still not clear on why the records from Glenn, Lake and Colusa were deleted from the HUMA range, but it must be that they are considered to be included with sierrae in a band north to the Trinity/Marble mountains? That's a big gap and it's non-habitat to the east. The USFWS 2010 species assessment and other documents included these locations, so it would be helpful to include more explanation as to why they are deleted. But, perhaps that is not in the scope of this review since it started elsewhere.

Comment 23: page 12, Range and Distribution Trends, paragraph three:
I'm still wondering if this Slauson et al. 2010 is the correct reference – I may be missing something, but it doesn't seem to align with what is listed in the literature cited.

Comment 24: page 12, Range and Distribution Trends, paragraph three:
Isn't the occupied area in Pecwan and Blue Creek considered a range expansion – possibly the first? I'm fairly certain that K. Slauson expanded the EPA after the detections in the Pecwan area. See Slauson et al. 2003 for map of contemporary marten detections from his thesis. There were no detections in this area from his surveys.

Comment 25: page 12, Populations Size and Trend, paragraph one:
There was a 42% decline in sample unit occupancy not the population. (The current verbiage is misleading please look at the paper again). The re-surveys in 2008 did not include the entire suite of sample units from 2001 and the authors acknowledge it was a one-tailed test. They could only detect no change or a decline in occupancy from one sample period to the next. Sample unit occupancy did not change from 2008-2012.

Comment 26: page 12, Populations Size and Trend, paragraph one:
There are new population estimates in Linnell MA, Moriarty K, Green DS, Levi T. (2018) Density and population viability of coastal marten: a rare and geographically isolated small carnivore. PeerJ 6:e4530 https://doi.org/10.7717/peerj.4530

Comment 27: page 16, Habitat Degradation, Tree and Shrub Canopy Cover, paragraph one:
It would be reasonable to report what actually happens in practice rather than the maximum allowable size of even-age units under the CA FPRs. Green Diamond's average opening size is about 15 acres and all even-age units retain at least 10% of the area in tree cover. Riparian zones are 25% of the landscape and total retention is ~27% (GDRCo 2018). Franklin et al. 2018 describe Green Diamond as "an example of landscape level ecological forest management…" "All regeneration harvesting done on Green Diamond lands includes significant structural retention and consideration of biological diversity, including northern spotted owls."
Franklin, J.F., K.N. Johnson, D.L. Johnson. 2018. Page 134, Larger Spatial Scale Concerns, Landscapes and Regions, *In*: Ecological Forest Management. Waveland Press, Long Grove, Ilinois, USA, 646 pages.

Comment 28: page 16, Habitat Degradation, Tree and Shrub Canopy Cover, paragraph one:
On Green Diamond, approximately 85% of the landscape has overstory cover at any given time > 10 years old and >70% that is over 20 years of age. We are learning more about how martens use managed landscapes, so the knowledge of suitable conditions will increase over time. Marten populations have

only recently had the opportunity to occupy (recolonize) private forests managed under contemporary practices. Information from Forest Management Plan, 2014.

Comment 29: page 17, Habitat Degradation, Fragmentation, paragraph two:
Is this a general statement or taken from one of the prior references in this paragraph? It seems like it came from Thompson 1994.

Comment 30: page 17, Habitat Degradation, Fragmentation, paragraph three:
I think this perception or belief about interactions of fragmentation, shrub layer, predators and roads is best summed up on page 34 last sentence in Predation paragraph. More study is required before we can draw any conclusions supported by data from well-designed studies.

Comment 31: page 19, Predation, Predator – Vegetative Community Interactions, paragraph three:
And a high density of marten and reproductive females were discovered in a landscape previously considered unsuitable habitat - with occupancy over a minimum 12 year period. And it's more like 100% of the area was harvested. There are no intact old growth stands in this private ownership. Only remnant scattered trees and clumps that were left after the peak high grade harvests of the 1950s through 1970s. It is typical of Green Diamond ownership where "sloppy logging" of the past resulted in accelerated development of young forest habitat that is completely functional (capable of supporting occupancy and reproduction) for species like northern spotted owl, fisher and now marten. See publications by Green Diamond on these species in managed forests.

Comment 32: page 19, Predation, Predator – Vegetative Community Interactions, paragraph four:
The old forests were contiguous but shrub layers in the coastal redwood stands are not necessarily extensive. Think about the many areas in Redwood National and State parks that lack a dense shrub layer. Shrub layers are patchy and influenced by soil, aspect, fire history and other factors. The coastal redwood forest (Coast Range ecoregion) is a different vegetative community than the Klamath Mountains ecoregion where the relictual population was rediscovered in 1996. Until marten are reestablished in former areas of the historical range, we won't completely understand their habitat use or habitat selection patterns. There simply isn't a consistent pattern of alteration with the shrub layer. In many areas the shrub layer was enhanced by the harvesting practices and poor regeneration of trees after the harvest.

Comment 33: page 20, Toxicants, paragraph two:
The study was not exclusive to Green Diamond lands. The NSO were collected on other lands as well and it is unknown where the barred owls may have dispersed from before they settled (or were removed from) Green Diamond lands. You can contact Mourad directly, but the rodenticide exposure is unlikely to have occurred on the GDRCo ownership due to vigorous exclusion of this activity. At his presentation in February 2018 at the barred owl symposium in Santa Rosa, Mourad stated that the exposure was not related to occurrence of rodenticides on Green Diamond land. The suggested edit is to delete the word study.

Comment 34: page 28, Private and Tribal Lands, paragraph one:
I'm not sure where this information was sourced, but the ownership has 659 acres of old growth – GDRCo Forest Management Plan.

Comment 35: page 29, Private and Tribal Lands, paragraph one:

Marten were not detected in this area by Keith Slauson during his systematic grid survey in 2001-2002 (see thesis map/figure by Slauson 2003). Further support that marten were apparently absent and then expanded into this area of Blue Creek and northern Pecwan around 2004. This reference could be added here.

Comment 36: page29, Private and Tribal Lands, paragraph two:
I think there are some additional benefits from the Conservation Strategies from both HCPs that could be acknowledged here. The Yuroks assumed the Aquatic HCP when they purchased the Pecwan tract from Green Diamond, so those apply as well.

Comment 37: page 30, Private and Tribal Lands, paragraph one:
The Yurok Tribe has expressed their intent to enroll as an adjacent landowner under the proposed Safe Harbor Agreement. Joe Croteau pers. Comm.

Comment 38: page 31, Extant Population Areas, item 3:
I would suggest to the Department that surveys be based on probability sampling rather than subjective sampling where large patches of suitable habitat exist. Otherwise sampling is biased and we might miss areas currently occupied by Humboldt marten.

Comment 39: page 34, Present or Threatened Modification or Destruction of Habitat, paragraph one:
The empirical evidence is that marten are expanding and persisting in these managed lands (Hamm et al. 2012, Slauson et al. 2014, Early et al. 2016) rather than being threatened or excluded.

Comment 40: page 34, Predation, paragraph one:
What is the threshold for significance? This implies some statistical measure, but I'm not aware of any analysis. A suggested revision is - "Predation is a cause of mortality in Humboldt marten in California, but whether it represents a significant negative effect on population parameters is unknown."

In other words, is the effect large enough to cause a decline in the population? It is likely that an age-specific effect on juvenile male marten has no effect on the marten population. Adult female survival has the greatest influence on lambda.

Comment 40: page 34, Predation, paragraph one:
Or, they may not be. As stated above, this is a testable hypothesis, but currently there is no data to support any conclusion regarding the effects of predation on the marten population or whether it is related to or influenced by timber management.

State of California
Natural Resources Agency
Department of Fish and Wildlife

DRAFT REPORT TO THE FISH AND GAME COMMISSION
A STATUS REVIEW OF THE
HUMBOLDT MARTEN
(*Martes caurina humboldtensis***)**
IN CALIFORNIA


Keith Slauson photo used with permission

CHARLTON H. BONHAM, DIRECTOR
CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE
March 20, 2018

Contents

ACKNOWLEDGMENTS

EXECUTIVE SUMMARY

(Section will be written following peer review)

REGULATORY SETTING

A "Petition to List the Humboldt Marten (*Martes caurina humboldtensis*) as an Endangered Species under the California Endangered Species Act" (Petition) was submitted to the Fish and Game Commission (Commission) on June 8, 2015, by the Environmental Protection Information Center and the Center for Biological Diversity (Petitioners). Commission staff transmitted the Petition to the Department of Fish and Wildlife (Department) pursuant to Fish and Game Code section 2073 on June 18, 2015, and published a formal notice of receipt of the Petition on July 24, 2015 (Cal. Reg. Notice Register 2015, No. 30-Z, p. 1237). The Department serves in an advisory capacity to the Commission by providing scientific reviews of petitions.

On November 11, 2015, the Department provided the Commission with its evaluation of the Petition, "Evaluation of the Petition from the Environmental Protection Information Center and the Center for Biological Diversity to List the Humboldt Marten (*Martes caurina humboldtensis*) as Endangered Under the California Endangered Species Act," to assist the Commission in making a determination as to whether the petitioned action may be warranted based on the sufficiency of scientific information. (Fish & G. Code, §§ 2073.5 & 2074.2; Cal. Code Regs., tit. 14, § 670.1, subds. (d) & (e).) Focusing on the information available to it relating to each of the relevant categories, the Department recommended to the Commission that the Petition be accepted.

At its scheduled public meeting on February 11, 2016, in Sacramento, California, the Commission considered the Petition, the Department's petition evaluation and recommendation, and comments received. The Commission found that sufficient information existed to indicate the petitioned action may be warranted and accepted the Petition for consideration. Upon publication of the Commission's notice of its findings, the Humboldt marten was designated a candidate species on February 26, 2016 (Cal. Reg. Notice Register 2016, No. 9-Z, p. 290).

Status Review Overview

The Commission's action designating the Humboldt marten a candidate species triggered the Department's process for conducting a status review intended to inform the Commission's decision on whether listing the species is warranted. At its scheduled public meeting on February 8, 2017, in Rohnert Park, California, the Commission granted the Department a six-month extension to facilitate external peer review.

This written status review report, based upon the best scientific information available and including independent peer review of the draft report by scientists with expertise relevant to the Humboldt marten, is intended to provide the Commission with the most current information available on the

Humboldt marten and to serve as the basis for the Department's recommendation to the Commission on whether the petitioned action is warranted. The status review report also identifies habitat that may be essential to the continued existence of the species and provides management recommendations for recovery of the species. (Fish & G. Code, § 2074.6.). Receipt of this report is to be placed on the agenda for the next available meeting of the Commission after delivery. Additionally, the report will be made available to the public for a minimum of 30 days prior to the Commission taking any action on the Petition.

Concurrent Federal Petition

Humboldt marten populations in northwestern California and coastal Oregon are currently under review for potential listing under the federal Endangered Species Act of 1973 (ESA) (16 U.S.C. § 1531 et seq.) in response to a 2010 petition also submitted by the Environmental Protection Information Center and the Center for Biological Diversity. The petitioned populations include the entire Humboldt marten range in California, as well as two populations of coastal Oregon Humboldt martens. In 2015, the USFWS released a 12-Month Finding that listing the Humboldt marten was not warranted. The federal petitioners challenged the finding in federal court, specifically challenging the USFWS conclusion that Humboldt marten populations were not in danger of extinction due to the risks associated with small, isolated populations. The court issued a summary judgement in favor of the Petitioners' claim that Humboldt marten populations in northwestern California are threatened by small, isolated populations (*Center for Biological Diversity v. U.S. Fish and Wildlife*. 15-cv-05754-JST, (N.D. Cal. Mar. 28, 2017). As a result, the USFWS is currently reevaluating the status of Humboldt martens in California and Oregon. An important difference between the ESA and CESA is that the ESA requires USFWS to assess whether species are threatened or endangered in the United States, while CESA directs the Department to assess a species' status only within California.

BIOLOGY AND ECOLOGY

Systematics

The Humboldt marten is a carnivorous mammal (order Carnivora, family Mustelidae), classified as a subspecies of Pacific marten (*Martes caurina*), a species occurring west of the Rocky Mountain Divide which was recently split from the American marten (*Martes americana*, Dawson and Cook 2012). The taxonomy of martens in the Pacific Northwest is currently unsettled. Historically the range of Humboldt martens was described as entirely within the north coastal portion of California (Grinnell and Dixon 1926, Grinnell et al. 1937); however, recent genetic evidence suggests Humboldt martens and martens in coastal Oregon (currently classified as *M. caurina caurina*) are diagnosably distinct from other western martens and are one phylogenetic lineage. Consequently experts now believe martens in northwestern California and coastal Oregon should collectively be classified as Humboldt martens (*M. caurina humboldtensis*) (Slauson et al. 2009a, USFWS 2015, Moriarty et al. 2016, Schwartz and Pilgrim 2017).

California is also home to the closely related Sierra marten (*M. caurina sierrae*), which is traditionally considered to range throughout the Sierra Nevada and northern interior mountains. The Sierra marten is not the subject of this Petition (Figure 1). Within this report references to North American martens may refer to any species or subspecies of marten occurring in the North America (i.e. *M. americana, M. caurina, M. caurina sierrae, M. caurina caurina,* and/or *M. caurina humboldtensis*), and references to Pacific martens include any or all subspecies of *M. caurina* (including Sierra, Humboldt, *M. caurina vulpina*, and other subspecies).

Species Description

Martens have elongated and low-to-the-ground bodies, as do other members of the weasel family. Martens are intermediate in size among North American mustelid species. Martens are larger and stockier than long-tailed weasels (*Mustela frenata*) and short-tailed weasels (*Mustela erminea*), and have longer tail and body fur than the similarly sized minks (*Neovison vison*). They are noticeably smaller and more slender than the larger mustelids of North America, including wolverines (*Gulo gulo*), river otters (*Lontra canadensis*), and American badger (*Taxidea taxus*). Martens are typically smaller than fishers (*Pekania pennanti*), though there is some overlap in size between male martens and female fishers.

Marten pelage (fur) is brown (varying from yellowish buff to nearly black), with a contrasting lighter patch on the throat and chest. The marten's bushy tail constitutes more than one-third of the overall body length. Overall body lengths range from 45-70 cm (18-28 in.) and body mass ranges from 0.4-1.25 kg (0.88-2.76 lbs.), with males averaging 15% longer and up to 65% heavier than females (Clark et al. 1987, Powell et al. 2003). Humboldt martens generally differ from the Sierra martens by having darker, richer golden fur; smaller throat patch, more extensive dark fur on the feet, legs, and tail; smaller skulls, narrower faces (rostra), and differences in dentition (Grinnell and Dixon 1926, Grinnell et al. 1937, USFWS 2015).

Geographic Range and Distribution

Within California, Humboldt martens historically occupied the coastal mountains from Sonoma County north to the Oregon border from sea level to 915 m (3,000 ft.) within 35 km (22 mi.) of the coast (Grinnell and Dixon 1926, Zielinski et al. 2001, USFWS 2015). The current distribution within the state is limited to areas of Del Norte, northern Humboldt, and western Siskiyou counties and encompasses less than 5% of the probable historical range in the state (Slauson et al. 2009b, Slauson et al. 2017). The majority of contemporary California marten detections are from a 812 km^2 (313 mi^2) core area which includes the South Fork of the Smith River, Blue Creek, Bluff Creek, Camp Creek, Cappell Creek, Pecwan Creek, Slate Creek, and Rock Creek watersheds (USFWS 2015). An additional extant population exists east of U.S. Highway 199 near the California-Oregon border in northeastern Del Norte County, and a few Humboldt martens have recently been detected west of the core area in Prairie Creek Redwoods State Park (USFWS 2015, K. Slauson pers. comm. 10/10/2017, [Figure 2]). These extant population areas appear isolated from one another by substantial areas of currently suboptimal habitat. East and south of the core population elevation and precipitation rapidly declines in the canyon of the Klamath River. The drier climatic conditions of the river canyon do not support the dense brush cover habitat typical of Humboldt martens found in the core population. West of the core population lies an 8-16 km (5-10 mi.) wide band of industrial timberlands between the core population and redwood forest with potentially high suitability in State and National Parks where martens have been detected several times in the last decade. These industrial timberlands are typically harvested every 40-60 years, and in this zone dense brush cover may be less extensive in some areas. Where brush cover exists it can be fragmented by roads and recent timber harvests. This more open and fragmented cover may favor carnivore species that prey on or compete with Humboldt martens (this topic is discussed below in the Threats section).

Within coastal Oregon, Humboldt martens have been detected from the California border through Lincoln County (Moriarty et al. 2016). Recent survey efforts and road kill records indicate Humboldt martens currently occupy 3-4 core population areas in the two states. The degree to which the smaller California-Oregon border population area may be effectively connected to marten populations in southern Oregon is unknown.

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The Department develops species range maps using the established convention of including the USDA Forest Service Ecological Subregions of California (https://map.dfg.ca.gov/bios/) that encompass species detections from the last 20 years, and when necessary modifying the boundaries along geological features (California Interagency Wildlife Task Group 2014). For the Humboldt marten range used in Figures 2 and 7, the ecological subregions were cut along the Klamath River and the Redwood Creek watershed boundary to omit large areas where no contemporary Humboldt marten detections have occurred, and the urban area surrounding Crescent City was omitted. It is recognized that this convention can result in the inclusion of substantial unoccupied areas within the range bounds, and Humboldt martens appear to be unevenly distributed within the bounds of their range, with only a fraction of the area containing the requisite tree and shrub cover to support marten populations.

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Habitat Associations and Use

Humboldt martens in California are currently known to be associated with two distinct habitat types: late successional conifer forests with dense shrub layers where abundant live and dead standing and downed tree structures are used for resting, denning, and escape cover; and serpentine soil forest communities of various seral stages with variable tree cover, dense shrubs, and rock piles and rock outcrops used for resting, denning, and escape cover (Slauson et al. 2007, Slauson et al. 2017, Slauson et al. in review). Large patches (>50 ha [>124 ac.]) of late successional conifer forests or serpentine soil formations appear necessary for supporting sustainable Humboldt marten populations (Slauson et al. 2007, K. Slauson pers. comm. 11/10/2017). Recent studies have found Humboldt marten territories and dens in younger, previously harvested stands which retained some large trees, snags, and logs, populations in these areas may not be sustainable in the absence of individuals dispersing from nearby late successional stands (Slauson pers. com. 11/10/2017). In coastal central Oregon, Humboldt martens have recently been discovered occupying a third habitat type: shore pine (*PInus contorta* subsp. *contorta*) forests with extensive dense shrub understories (Slauson et al. 2017, Moriarty et al. 2016, 2018).

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Humboldt martens appear to select habitat at three scales (micro-habitat, stand, and home range scales), and populations of martens are affected by the arrangement of habitat at a fourth scale, the landscape. The following outline of habitat use is taken largely from Slauson et al. (2017). It should be noted that the best available information specific to Humboldt marten is presented here, but in some cases, information from other subspecies or from the American marten is referenced.

At the micro-habitat scale (the locations at which martens feed, rest, and den), North American martens rest or den in structures that provide cover for thermoregulation and protection from predators, and they forage in locations where prey is abundant (Taylor and Buskirk 1994). Humboldt marten prey species are associated with late-successional conifer forest stands characterized by abundant large logs, snags, and decadent live trees; with extensive, dense stands of ericaceous shrubs (i.e. evergreen huckleberry [*Vaccinium ovatum*], salal [*Gaultheria shallon*], and rhododendron (*Rhododendron macrophyllum*] [Allgood 1996, Slauson et al. 2017]). Den sites of North American martens are used by females to give birth to their young (natal dens) and to rear young until weaning and independence (maternal dens). Martens tend to be highly selective in their choice of denning sites, favoring large trees and snags with cavities that prevent larger predators from entering (Payer and Harrison 2003, Fuller and Harrison 2005, Thompson et al. 2012). The available data on Humboldt marten den sites (Slauson and Zielinski 2009, Slauson et al. unpublished data, Green Diamond Resource Company unpublished data) are consistent with the general North American marten pattern. A study of Humboldt marten denning ecology on managed timberlands in northern California categorized the type of substrate used for 34 identified dens (Table 1. Data from Early et al. unpublished presentation 2016):

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Table 1. Humboldt marten dens by structure type and marten use from Early et al. 2016.

			Structure Type		
Den Type	Live Tree	Snag	Log or Rock Pile	Artificial Nest Box	Underground
Natal	5	0	2	0	1
Maternal	19	4	1	2	0

Trees and snags used for denning in the study were typically large, averaging 91 cm diameter at breast height (dbh, [36 in. dbh]), ranging from 46-183 cm dbh (18-72 in. dbh). Den trees typically had complex structural features such as broken tops, dead tops, large limbs, complex branching, basal hollows, and cavities.

Rest structures, used between periods of foraging by both male and female martens, include the kinds of sites used for denning as well as other sites that are less protective and less insulated than cavities or hollows, such as large tree limbs (Slauson et al. 2017). Martens typically select the largest available structures for resting and denning (Spencer 1987, Gilbert et al. 1997). Rest structures used by Humboldt martens in largely unmanaged forests averaged 95 cm (37 in.) dbh for snags, 88 cm (35 in.) large-end diameter for downed logs, and 94 cm (37 in.) dbh for live trees. Structures on average exceeded 300 years of age (Slauson and Zielinski 2009). Preliminary data on Humboldt marten rest structures from more intensively managed lands indicate a similar pattern of use of large-diameter conifer structures, with 70 percent of structures >70 cm (>28 in.) dbh (Slauson et al., unpublished data). Most resting locations (i.e., the actual resting place in the structure) were in tree cavities (33%), on platforms in broken-top snags or on large live branches (33%), or in chambers within log piles or rock outcrops (28%) (Slauson and Zielinski 2009). Rest structures which provide cavities or chambers likely become especially important during the late fall through the late spring, when wet rainy conditions are common.

At the stand scale of habitat selection (forest patches used for foraging, denning, and resting), Humboldt martens are found in forest stands that provide abundant structures suitable for resting and denning, as well as good foraging habitat, which includes both abundant prey and overhead cover to reduce predation risk (Slauson et al. 2017). In non-serpentine soil areas, Humboldt martens have been shown to preferentially use late seral forest stands and to avoid use of early successional stands (Slauson et al. 2007). The preferred late seral stands were Douglas-fir dominated, but also included mature tanoak (*Notholithocarpus densiflorus*) or chinquapin (*Chrysolepis chrysophylla*) understories. As mentioned above, late successional forest stands with dense shrub layers and abundant habitat elements such as large snags, tree cavities, large downed logs and woody debris, as well as serpentine soil forest stands with abundant rock cover appear to provide the necessary? combination of habitat features at the stand scale.

Where Humboldt martens have been radio-tracked on managed timberlands with younger tree age distributions, they were associated with second-growth stands several decades old, which provide substantial overhead cover. Importantly, these stands retained sufficient late successional habitat elements such as large old trees, snags, and logs through earlier harvests. It is likely that these retained old growth structural elements provide the micro-scale habitat features needed by martens for resting and denning (Slauson et al. 2014, Slauson et al. 2017).

Humboldt martens have also been found in forest stands growing in serpentine soils in near proximity (less than 30 km) of the coast (Slauson and Zielinski 2001). Serpentine soils are characterized by having low plant productivity due to naturally low concentration of essential nutrients (and in some areas naturally high heavy metal concentrations). Serpentine stands used by the Humboldt marten are characterized by a variety of conifers, including lodgepole pine (*Pinus contorta*), western white pine

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(*Pinus monticola*), and Douglas-fir *(Pseudotsuga menziesii*) in dense to sparse overstories (Slauson et al. 2007). Humboldt marten resting sites in serpentine stands are strongly associated with the presence of dense shrub cover and abundant rock outcrops, which are used for resting cover (Slauson and Zielinski 2009).

Serpentine habitat areas appear to support lower proportions of female martens than late successional forest stands on non-serpentine soils. Population monitoring suggests marten occupancy is less stable in serpentine habitats than in old forest habitat (reference?). Therefore, the serpentine habitat areas may have less value to Humboldt marten population persistence than old forest habitat (Slauson et al. in review).

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Dense shrub layers (>70% cover) of salal, evergreen huckleberry, rhododendron, shrub oak (*Quercus vaccinifolia*), and tanoak is an important component of stands selected by Humboldt martens (Slauson et al. 2007). Slauson et al. (2010) modeled Humboldt marten habitat occupancy probability based on several habitat variables measured at the stand scale and found that marten occupancy was most strongly influenced by the percent of the landscape with ≥50% shrub cover. Importantly, the shrub community favored by Humboldt martens does not include the shade-intolerant, short-lived shrub species such as *Ceanothus* spp. that occupy more xeric (dry) sites, and dominate sites following logging and other disturbances (Slauson et al. 2010).

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Dense shrub layers may play an important role in excluding marten predators. Most North American martens occupy areas where deep snow accumulates which effectively excludes larger carnivores with higher body mass to foot surface area ratios. It rarely snows in the coastal forests occupied by Humboldt martens, but it is thought that extensive, extremely dense shrub layers effectively exclude larger bodied carnivores and provide a niche for Humboldt martens to exploit (Slauson et al. 2010). Humboldt martens, with the smallest body size of North American marten subspecies (Hagmeier 1961), are adapted to the dense foliage and stems found near ground level in coastal forest ecosystems, allowing them to move quickly through the dense cover and successfully capture prey.

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At the home range scale, Humboldt martens appear to select areas with a high proportion of late succession forests stands. The limited information available on Humboldt marten home ranges (n=3) indicates they are on the order of 300 - 500 ha (750 - 1250 ac.), (Slauson et al. 2017). Habitat selection analysis of radio-telemetered Humboldt martens indicates that home ranges typically include ≥70% stand-scale suitable habitat arranged in large patches (≥150 ha [>370 ac.] in area) (Slauson et al. 2007, Slauson et al. 2017). Humboldt martens have also been found reproducing in younger conifer stands (40-50 years post-harvest) in the Pecwan Creek watershed and surrounding areas on the western margin of the core population area. While these stands are not considered late successional nor old growth, the average tree size is greater than 61 cm (24 in.) dbh, and stands retain abundant large tree, snag, and log structures as a legacy of historical individual tree and small group selection silviculture no longer typical for the region (K. Slauson pers. comm. 10/10/2017). Although reproducing martens have been found in these younger conifer stands, mortality rates are high, particularly from bobcat predation. It is unlikely that native reproduction rates offset the high mortality rates to sustain the population. Male-skewed sex ratios, and an age structure skewed to younger individuals in these areas suggests that a large proportion of the population occupying younger conifer stands consists of animals dispersing from the adjacent core population area (K. Slauson pers. comm. 10/10/2017).

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At the landscape scale, Humboldt martens appear to select areas of occupancy based on the amount of old forest structure or serpentine habitat present in areas which receive abundant annual precipitation. Slauson et al. (in review) developed a landscape scale Humboldt marten habitat selection model to predict which regions of the historical range contain suitable marten habitat. The model was developed by relating field survey results to the environmental and habitat attributes hypothesized to influence marten distribution. The models that best correlated with observed landscape scale habitat selection each included measures of old growth structural index (a combination of stand age indices and the number of large trees >100cm [39 in.] dbh, the number of large snags >50 cm [20 in.] dbh and >15 m [49 ft.] tall, the volume of large wood, and a tree size diversity index measured at the 1-km [0.62 mi.] scale), serpentine habitat measured at the 3 km [1.89 mi.] scale, and annual precipitation measured at the 3 km [1.89 mi.] scale.

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Growth, Reproduction, and Survival

Humboldt martens are assumed to be polygynous, like American martens and other Pacific martens, where one male breeds with multiple females. The following information is based on general characteristics of American and Pacific martens. Martens generally produce one litter per year (Calder 1984), and mating occurs mostly in summer, with a peak in July (Markley and Bassett 1942). The fertilized embryo does not implant in the endometrium for seven or eight months (Ashbrook and Hanson 1927). Active pregnancy begins upon implantation in mid-winter (February). Parturition typically occurs in March or April, after 27 days of gestation (Jonkel and Weckwerth 1963). In a radio-telemetry study of Humboldt martens (Early et al. unpublished presentation 2016), adult females reduced their daily movements from mid-March through early April, consistent with near-term pregnancy and immediate post-parturition. Typical litter size is two or three young (Strickland et al. 1982) and ranges from one to five young (Strickland and Douglas 1987).

Young are born with little fur, ears and eyes closed, and have a body mass at birth of about 28 g (1 oz.), (Brassard and Bernard 1939). The ears open at about 24 days, eyes at 39 days, and by 7 to 8 weeks of age they are active enough for the mother to move them to another den (or succession of dens) for subsequent rearing (Ruggiero et al. 1998). Male parents do not provide care for the young, though by excluding other males from their territories, they may indirectly increase prey availability for the females and their young (Clark et al. 1987). Young are typically weaned at 18 weeks of age (Strickland and Douglas 1987), and may begin dispersing from the natal area as early as August, continuing through the following summer (USFWS 2015).

Females may mate as early as 15 months of age and, because of delayed implantation, may first give birth at about 24 months of age (Strickland et al. 1982). The proportion of adult females that may attempt breeding is likely related to environmental conditions (severity of winter and availability of prey). In a Canadian population of the American marten only about 50% of adult females became pregnant in environmentally stressful years (Thompson and Colgan 1987); however, it is possible the relatively mild conditions within the Humboldt marten’s geographic range may mean that a higher proportion of females may be pregnant each year (Slauson et al. 2017). Although data for Humboldt martens are lacking, in other martens females achieved highest reproductive potential between 3 and 5 years of age (Mead 1994, Fortin and Cantin 2004).

In a radio telemetry study of Humboldt martens in northwestern California (Early et al. unpublished presentation 2016), 11 females were collared, and over the course of the three year study 16 female territories were monitored continuously for at least a full year, with some territories being monitored in multiple years. There were 12 reproduction attempts amongst the 16 monitored females (75%). All but one of these attempts produced kits (94%). Of the 20 kits produced, 17 survived to weaning (Early et al. unpublished presentation 2016).

Humboldt marten survival rates between age classes for males and females are not known. In California, Pacific martens seldom survive longer than 5 years in the wild (USFWS 2015). Building upon the population model for martens developed by Buskirk et al. (2012), Slauson et al. (2017) posited age-class specific survival rates for Humboldt marten of 0.50 for juveniles (i.e., from birth to age 1 year) and 0.70 for all adult age classes (from age 1 year to age 2 years, age 2 to 3 years, 3 to 4 years, etc.). The model indicates that population persistence is dependent on relatively high adult survival rates. Therefore higher rates of adult marten mortality, as from predation, would have large impacts on population size, trend, and rates of recovery after population decrease (Slauson et al. 2017).

Diet and Food Habits

North American martens were found to require 15-25% of their body mass in prey daily to meet their energetic requirements (Slauson and Zielinski in press). The diet of Humboldt martens consists primarily of small mammals and birds, along with lesser amounts of reptiles, insects, and berries. Humboldt marten diets shift seasonally, with berries consumed more frequently in the summer and fall than other times of the year (Slauson et al. 2007).

A recent investigation of the Humboldt marten's diet estimated the proportion of metabolizable energy (PME) based on scat analysis (Slauson and Zielinski in press). The study found that on average 72% of Humboldt martens' metabolizable energy came from mammals, 22% from birds, 7% from reptiles, 5.3% from insects, and 2.6% from plant material, primarily fruits. Mammals were the most important food source by PME in all seasons. Although 17 different mammal taxa were evident in the analyzed scats, the vast majority of energy was derived from a few rodent taxa: 42% of mammalian PME was composed of squirrels and chipmunks and 21% of voles and mice. Chipmunks (*Tamias* spp.), red-backed voles (*Myodes californicus*), Douglas's squirrels (*Tamiasciurus douglasii*) and flying squirrels (*Glaucomys sabrinus*) constituted the majority of year round mammalian biomass. Red-backed voles, Douglas's squirrels, and flying squirrels reach their highest densities in late successional conifer forest stands where the foods they specialize on (conifer seeds and truffles) can be found, while chipmunks, flying squirrels, and overall small mammal abundance are positively correlated with ericaceous shrub density (Slauson et al. 2017).

The only significant insect food consumed appeared to be the adults and larvae of wasps and bees. Berries constituted 98.5% of the plant matter consumed, primarily salal, evergreen huckleberry, California red huckleberry (*Vaccinium. parviflora*), and manzanita (*Arctostaphylos sp*.) fruits. Berries were consumed most often in summer and fall (Slauson and Zielinski in press). Although reptiles composed a relatively small proportion of the diet, they were more important in the spring and summer (12% and 10% of diet respectively), when predation on mammals was lowest.

No major differences were observed between the diets of males and females nor between adult and subadult diets (Slauson and Zielinski in press). Compared to the studied diets of other North American martens, the Humboldt marten has a more diverse diet, depends less on voles, and includes more birds. (Slauson and Zielinski in press).

Interestingly, dusky-footed woodrats (*Neotoma fuscipes*) appeared in only one of the scat samples analyzed by Slauson and Zielinski (in press). Woodrats are a widespread and often abundant small mammal in coastal redwood forests. They are especially abundant in regenerating (<20 year-old) stands in managed forests (Hamm and Diller 2009). Although woodrats would seem to be ideal prey for martens based on their size and microhabitat use, it may be that bobcat (*Felis rufus*) prevalence in younger forests effectively precludes martens from taking them. Woodrats (and brush rabbits, another young forest herbivore) are the dominant prey of bobcats (Slauson unpublished presentation 2017). It is

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likely the risk of predation from, and competition with, bobcats effectively precludes Humboldt martens from utilizing this abundant prey resource (K. Slauson pers. comm. 10/17/2017).

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Predators (see also Threats below)

Known predators of martens in western North America include coyote (*Canis latrans*), red fox (*Vulpes vulpes*), bobcat, and great horned owl (*Bubo virginianus*) (Thompson 1994, Bull and Heater 2001). Fishers are also known to kill martens, and the distribution of fisher populations may limit the distribution of marten (Krohn et al. 2004, USFWS 2015). In a recent study of radio-telemetered Humboldt martens (Slauson et al. 2014), nine mortalities of martens were observed (including eight collared martens and one uncollared marten) over the course of two years. All nine of the martens that died were either confirmed or determined likely to have been killed by bobcats (Slauson et al. 2014). Slauson reviewed several North American marten research projects (Thompson 1994, Hodgman et al. 1997, Ellis 1998, Bull and Heater 2001, Raphael 2004, and McCann et al. 2010) which found predation to be an important source of mortality in monitored marten populations. Among these studies, Slauson (Slauson et al. 2017?, and K. Slauson unpublished presentation 2017) noticed a correlation between the intensity of timber harvest in the study areas and the proportion of marten mortality attributed to predation by generalist carnivores. In the three study sites located in areas with high timber harvest rates and a mosaic of young forest stands and edge habitat, bobcats were the predominant predator.

Home Range and Territoriality

Martens are intrasexually territorial—adults exclude members of the same sex from their home ranges, but not members of the opposite sex (Powell 1994, Powell et al. 2003). Intrasexual territoriality is believed to benefit adult females energetically by reducing direct competition from other females for prey, and adult males by providing exclusive reproductive access to females within their home ranges.

Pacific marten home ranges in the Sierra Nevada vary from 170 to 733 ha (420–1,811 ac.) for males and from 70 to 580 ha (173–1,433 ac.) for females (Buskirk and Zielinski 1997). The limited available information from three collared male Humboldt martens in California indicates home ranges are similar in size to Sierra marten, in the range of 300–400 ha (Slauson et al. 2017). Moriarty et al. (2016) estimated the average fall home range areas in coastal Oregon to be 280 ha (692 ac.) for three males and 65 ha (160 ac.) for eight females. There appears to be an inverse relationship between habitat quality and home range size, with the larger marten home ranges in coastal California and Oregon occupying more intensively managed landscapes (USFWS 2015, Moriarty et al. 2016, Slauson et al. 2017).

Dispersal

Humboldt marten kits begin dispersing from their maternal home range as early as August and dispersal continues through at least the following summer (Slauson et al. 2017). Although dispersal distances in excess of 70 km (43.5 mi) have been reported, the average dispersal distance of North American martens is typically less than 15 km (9.3 mi) (as summarized in USFWS 2015 and Slauson et al. 2017).

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CONSERVATION STATUS

Regulatory Status

The Humboldt marten is not currently listed as threatened or endangered in California under the CESA or the ESA. However, California Fish and Game Code section 2085 extends all of the protections afforded threatened and endangered species to those species under review in response to accepted petitions. Accordingly, during the current candidacy period the legal protections of the CESA are in place for the Humboldt marten until the Commission adopts findings either formally listing the species or rejecting the petitioned action.

The Humboldt marten is designated as a Species of Special Concern by the Department (CDFW 2017). Species of Special Concern (SSC) are species, subspecies, or distinct populations of vertebrate animals native to California that have been extirpated from the state, are ESA (but not CESA) listed as Threatened or Endangered, have naturally small populations or are experiencing serious population or range declines that could qualify them for Threatened or Endangered status. SSC is an administrative designation that conveys no formal legal status or protection. The intent of SSC status is to focus attention on animals at conservation risk, stimulate research on poorly known species, and achieve conservation and recovery of these animals before they meet criteria for listing as threatened or endangered under the CESA (CDFW Species of Special Concern website accessible at https://www.wildlife.ca.gov/Conservation/SSC).

On United States Forest Service (USFS) lands in Region 5 (which encompasses all of California), the Humboldt marten is designated a Sensitive Species and a Priority Species. Its Sensitive Species status requires management projects subject to the National Environmental Policy Act (NEPA) to analyze impacts to the species; however, this obligation carries no attendant requirement to minimize or mitigate impacts to the species.

Habitat Essential for the Continued Existence of the Species (FGC § 2074.6)

The Department considers all currently occupied Humboldt marten habitat (Extant Population Areas, see discussion below) essential for the continued existence of the species in California. Additionally, suitable but apparently unoccupied habitat near the currently occupied habitat (Population Re-establishment Areas, see below) is also considered essential for species. Further, additional habitat that is not currently suitable but which could be restored to suitability within the near term should also be considered essential.

This determination is based on analysis of information provided by Slauson (2003) and Slauson et al. (2017). For example, Slauson (2003) summarized the condition and management of the currently occupied Humboldt marten range by stating:

> A significant number of marten detections (38%) occurred on lands (private industrial timberlands and USFS matrix lands) that are available for logging currently and lack strategies to maintain suitable marten habitat ... Both martens and their habitat are patchily distributed in the area, and further loss or degradation of limited suitable habitat could decrease the chances for the persistence of this remnant population. A conservation strategy based solely on measures to maintain current conditions for this population is unlikely to ensure its long-term persistence. The two major challenges for persistence and restoration of the coastal California marten population are: 1) the longer a population remains small, the greater the chance that it will lose its genetic variation (Nei et al. 1975) or that it will be eliminated due to stochastic demographic or environmental events (e.g., wildfire)(Fager 1991), and 2) restoration of forest habitats with the structural characteristics necessary to be suitable for martens may take many decades.

Based on figures in Slauson et al. (2017), approximately 81,000 ha (200,155 ac.) of currently suitable or recruitable habitat exist in two Extant Populations Areas (“EPAs”, [the geographic range of the known extant reproductive population based on verified Humboldt marten detections and a 2 km-wide (1.24

mi.) buffer of the surrounding suitable habitat]) in California (Figure 4). If fully saturated, and assuming non-overlapping female home ranges of 350 ha, which is intermediate to those reported for Sierra martens (Buskirk and Zielinski 1997), the EPAs could support approximately 231 females. The four Population Reestablishment Areas (PRAs, areas of modeled suitable habitat in patches large enough to support at least five female marten home ranges which are currently unoccupied or support fewer than five females) identified in Slauson et al. (2017) encompass 198,713 ha (491,031 ac.), which could support an additional 568 female martens. Therefore existing habitat in California, if fully saturated with non-overlapping female home ranges, could be expected to support 800 or fewer adult females. These estimates should be considered unrealistically high as they assume optimally arranged home ranges and fully occupied suitable habitat. Additionally, the PRAs are currently thought to be unoccupied. Establishment of populations within these areas may require active translocation of individuals.

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Forest management within areas essential to the continued existence of the Humboldt marten would not necessarily need to be precluded to promote the development of quality Humboldt marten habitat. For example, areas which are not currently suitable habitat could be thinned to open canopies for the promotion of dense shrub layers and the recruitment of large tree structures. Additionally, landscape-scale planning and management would be required to balance the promotion and retention of large patches of high quality habitat with the risk of catastrophic habitat loss from wildfire. All six areas, especially the four PRAs, are a mix of suitable and unsuitable habitat conditions. Management actions aimed at increasing suitability (availability of structural elements, dense shrub layer, and closed overstory canopy) could increase the number of marten home ranges supported over current conditions and reduce the threats associated with fragmented habitat in these areas.

Even if suitable habitat in these six areas were fully developed and fully occupied, Humboldt martens would number no more than 800 adult females, and only an approximate 20% of the historical geographic range in California would be occupied (Slauson et al. 2017). This number (added to the number of adult male martens that would also occupy the area) is at or below the theoretical minimum viable population size thresholds for mammal populations of several thousand individuals (Traill et al. 2007). Therefore, additional areas within or adjacent to the historical range would need to be examined for the potential to provide or recruit suitable habitat supporting a larger marten population more resilient to extinction. Evaluations of potentially recruitable habitat would need to consider the distribution and composition of forest stands in future climate scenarios. Absent the protection and recruitment of suitable habitat, Humboldt martens are likely to remain at risk of extirpation in California in the foreseeable future due to one or a combination of the threat factors discussed in this report, including high rates of predation, effects of small population size, and impacts from stochastic (random, unpredictable) events such as wildfire.

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Range and Distribution Trends

Historically, Humboldt martens ranged from the coastal forests of northwestern Sonoma County north to Curry County Oregon within the narrow humid coastal zone ≤35 km (22 mi.) from the coast (Grinnell et al. 1937, Kucera 1998, Zielinski et al. 2001, Slauson et al. 2017, [Figure 2]). In California, records of occurrence exist from Colusa, Del Norte, Glenn, Humboldt, Lake, Mendocino, Siskiyou, Tehama, and Trinity Counties (California Natural Diversity Database accessed October 23, 2017), but when the habitat affinities of Humboldt and Sierra martens are considered along with recent genetic research (Schwartz and Pilgrim 2017), marten records from Colusa, Glenn, Lake, and Tehama Counties should be attributed to the Sierra marten subspecies rather than Humboldt marten.

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The historical range described by Grinnell et al. (1937) was roughly 22,000 km^2 (8,500 mi^2), although not all of the habitat within the bounds of the historical range would have been suitable or occupied. Within the historical range, the distribution of marten record locations is uneven, with concentrations of records from northern Lake and east-central Mendocino County, an area southeast of Eureka, and near the intersection of Del Norte, Humboldt, and Siskiyou counties (fig. 2). By the 1940s, a significant decline in Humboldt marten trapping returns and a retraction of the southern end of the range had been noted (Anonymous 1920, Twining and Hensley 1947). Zielinski et al. (2001) conducted an exhaustive review of historical coastal marten records from California, Oregon, and Washington including published reports, museum specimens, unpublished notes of naturalists and trappers, and interviews of tribal members and others. Based on their review they concluded that a significant reduction in occupied range has occurred.

The Department is aware of Humboldt marten records only from Del Norte, northern Humboldt, and extreme western Siskiyou Counties in the last 25 years (California Natural Diversity Database query October 22, 2017) despite the fact that surveys during that period covered a much larger portion of the historical range (USFWS 2015). The occupied range (as of year 2008) as circumscribed by a minimum convex polygon drawn around detection locations was found to be 627 km^2 (242 mi^2) by Slauson et al. (2009b). Since that time, the known occupied range has expanded slightly with two detections of Humboldt martens a few kilometers from the coast in Prairie Creek Redwoods State Park, first in 2013 and most recently in 2017 (CDFW 2014, K. Slauson pers. comm. 10/10/2017); and additional detections near the Oregon border (Slauson et al. 2017). The martens detected in Prairie Creek Redwoods State Park were not detected during rigorous surveys in the same area in 2002, thus they likely represent a recent range expansion (Slauson et al. 2010). Despite these recent expansions in the known range, Humboldt martens appear to have been extirpated from 95% of their historic range in California (Slauson et al. 2009b, Slauson et al. 2017).

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Although martens were historically distributed throughout the coastal regions of Oregon, there are currently just two disjunct coastal populations of Humboldt martens (Grinnell et al. 1937, Moriarty et al. 2016, [Figure 3]). The southern population is possibly contiguous with the northernmost populations in California. In Oregon, the range appears to have remained unchanged since 2001; however, there are no indications that the population is expanding (Moriarty et al. 2016).

Population Size and Trend

From 1945-1995 Humboldt martens were virtually undetected in California, leading some to speculate that the species had gone extinct until they were again detected in 1996 (Kucera and Zielinski 1995, Zielinski and Golightly 1996, Slauson et al. 2009b, Slauson and Zielinski 2004). Based on surveys in the modern era there was a 40% decline in sample unit occupancy over the period 2000-2008, and then remained unchanged during the period 2008-2012 (Slauson et al. 2009b, USFWS 2015). In the only contemporary population estimate Slauson et al. (2009b), estimated the extant Humboldt marten population in California consisted of less than 100 individuals. Although it is not known if Oregon populations are in contact with California populations, Moriarty et al. (2016) detected a minimum of 28 unique Humboldt martens in coastal Oregon during surveys in 2015, and concluded “martens in coastal forests are rare and likely limited by unknown factors, especially compared to their former range.”

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Historically Humboldt martens appear to have been more common and widespread. Grinnell et al. (1937) stated that Humboldt martens were “fairly numerous” in “earlier years”, though apparent declines in the Humboldt marten population, at least locally, were noted as early as the 1920s. The authors report a tale of one trapper capturing 50 Humboldt martens in a single winter near Fortuna, California. While no rigorous historical population estimate exists, one can reasonably infer from the recorded anecdotal information that the number of martens present at that time was larger than the population present in the 1990s when no detections of the species had been recorded for the previous 50 years (Zielinski and Golightly 1996).

THREATS

Trapping

Early trapping of Humboldt marten was intensive, with accounts of individual trappers taking 35-50 martens in a single winter (Grinnell et al. 1937). By the early 1900s annual harvest of Humboldt martens was already declining, prompting Joseph Dixon to call for closing the trapping season in California to prevent an extirpation; however, marten harvest continued until a partial closure was enacted in northwestern California in 1946, depleting populations and likely reducing genetic variation within the remaining population (Dixon 1925, Zielinski et al. 2001).

Today trapping of all martens is prohibited statewide (§ 460, Title 14, California Code of Regulations (CCR)). Although it is possible that Humboldt martens could be inadvertently taken by trappers pursuing other fur bearers or nongame mammals that may be legally harvested for recreation, commerce in fur, or depredation. Trapping in California is highly regulated, and trappers must pass a Department examination demonstrating their skills and knowledge of laws and regulations prior to obtaining a license (Fish & Game Code § 4005). Additionally, only live-traps may be used to take furbearers or nongame mammals for recreation or commerce in fur; trappers are required to check traps daily and release non-target animals (*Id*. §§ 3003.1, 4004, and, 4152 and § 465.5, Title 14, CCR). With the passage of Proposition 4 in 1998, body-gripping traps (including snares and leg-hold traps) were banned in California for commerce in fur and recreational trapping (*Id.* § 3003.1). However, some body-gripping traps may be used by licensed trappers for purposes unrelated to recreation or commerce in fur, including protection of property or by government employees, or their authorized agents, while acting in their official capacities (*Id.* § 3003.1 and § 465.5, Title 14, CCR). Martens incidentally captured by trappers must be immediately released § 465.5(g)(1), Title 14, CCR).

Trapping of Humboldt martens remains legal in neighboring Oregon where trappers are required to obtain a trapping license and take an educational course (Hiller 2011). In recent years very few trappers reported pursuing martens in Oregon (4-8 trappers per year [Hiller 2011]), and only three Humboldt martens were reported taken in 2013 (USFWS 2015). Oregon trapping records are organized by county making it difficult to determine if reported trapped martens were coastal Humboldt martens or interior *Martes caurina caurina*. Review of trapping record from 2007-2016 indicates that as many as nine Humboldt martens may have been trapped in Oregon and one roadkill Humboldt marten was recovered (D. Broman pers. comm. 3/17/2017).

Trapping pressure on Humboldt martens was intense during the late 1800s and early 1900s, and very likely resulted in significant declines in population size as well as a dramatic reduction in range. There have been no studies on the population level effects of Humboldt marten trapping, but the loss of even a few adult martens, especially when combined with other mortality sources, could reduce the likelihood of long-term population viability (USFWS 2015). However, it is unlikely that trapping continues to threaten Humboldt martens in California due to the ban on trapping martens, restrictions on the types of traps that may be used for other species, as well as requirements that licensed trappers check traps daily and release non-target animals.

Habitat Loss and Degradation

Changes in the structure and landscape configuration of Humboldt marten habitat can negatively impact survival, reproduction, and population connectivity of the species. In particular, timber harvest and other silvicultural treatments of older forests, salvage logging, development of coastal forests for human settlement, as well as the clearing of forests for the cultivation of cannabis can all lead to loss, degradation, and fragmentation of Humboldt marten habitat. The USFWS (2015) Humboldt marten species report concluded habitat loss and degradation from historical and current logging is the most plausible reason the marten is absent from much of its historical range, noting most of the remaining suitable habitat is located on federally owned land (Zielinski et al. 2001).

Forest conditions in the range of the Humboldt marten today are largely shaped by a legacy of over 100 years of logging and timber management. It is estimated that the area of old growth conifer forest in the Pacific Northwest has been reduced by 72% since European settlement (Strittholt et al. 2006), and only 10% of the historical range of redwood forests remains in old growth stands (Fox 1996). While timber harvest continues in the area, the logging of old growth forest stands on private and public lands has dramatically slowed from peaks in the second half of the 20th Century. Today, 33% of remaining old forest on federal lands in the Northwest Forest Plan area is fully protected from harvest, and 80% is afforded some level of management protection (Strittholt et al. 2006). The rate of timber harvest on private lands in the area has declined in recent decades due to more restrictive regulations and market conditions (Figure 5). Harvest on federal lands declined sharply following implementation of the Northwest Forest Plan in 1994 (Strittholt et al. 2006) (Figure 6.). The area of older forests (OGSI-2000) on federal lands in the coastal and Klamath mountains of northwestern California declined 8.4% from 1993-2012, largely due to wildfires, while the area of older forests on non-federal lands increased 1.3%, despite losses to timber harvest (Davis et al. 2015). While recent losses of old forest stands in the Humboldt marten range have been relatively small, forest stands degraded and fragmented from historical logging will take decades to recover dense ericaceous shrub layers and centuries to recruit the large tree structures needed to restore high quality Humboldt marten habitat conditions (Slauson et al. 2010, Slauson et al. 2017).

Habitat loss and degradation from human settlement and residential development rapidly increased in the 1850s when pioneers of European descent began harvesting lumber, farming, mining, and fishing along California's north coast (Del Norte County Community Development Department 2003). Since that time minor portions of the historical range have been converted from forests to urban areas, primarily in and around Crescent City, Humboldt Bay, Fortuna, Fort Bragg, and Willits; and much of the historical range south of Del Norte County has been parceled and occupied by very low density housing (≤1 housing unit/16 ha [40 ac.])(Cal Fire 2010). However, the core population area currently occupied by Humboldt martens is almost entirely unoccupied by humans, with the exception of some areas adjacent to the Klamath River on Yurok Tribal lands (Cal Fire 2010). Low-density human occupancy does not necessarily equate with the loss of mature forest habitat favored by martens but human occupancy likely renders such areas unsuitable for martens. Impacts from the presence of humans, livestock, and pets, the construction and use of rural roads, and the use of household pesticides can frighten wildlife away, introduce novel predators, diseases, and toxicants, deplete prey populations, and degrade and fragment habitat (Merenlender et al. 2009). While further human development of the historical range will likely continue into the future, a modeled analysis of future land conversions under several human population growth scenarios found the probability of significant conversions to urban and agricultural uses in the northwest California coast region to be very low for the remainder of this century (Sleeter et al. 2017).

Large-scale marijuana cultivation in remote forests throughout California has increased since the mid-1990s, coinciding with the 1996 passage of Proposition 215, the Compassionate Use Act of 1996 (Health & Safety Code, § 11362.5), which allowed the legal use and growth of marijuana for certain medical purposes (Bauer et al. 2015). Humboldt and Del Norte counties are known centers of legal and illegal cannabis cultivation in California due to the remote and rugged nature of the land and abundant water sources (National Drug Intelligence Center 2007, Bauer et al. 2015). The recent passage of California Proposition 64, the Control, Regulate and Tax Adult Use of Marijuana Act, further decriminalized the adult use of cannabis for recreational use beginning in January 2018. In 2017, the California Legislature approved the Medical and Adult Use of Cannabis Regulation and Safety Act which provides state and local governments the authority to regulate the production and processing of cannabis products, including regulation of the environmental impacts from growing cannabis. It remains to be seen what effect these new laws will have on the conversion of forests for the production of cannabis. A recent study found the majority of cannabis cultivation sites in Humboldt County were located >500 m (1,640 ft.) from the nearest road, indicating cultivation may contribute to landscape fragmentation, although the amount of land area under cannabis cultivation was found to be minor at less than 1% of the land under organic crop cultivation (Bustic and Brenner 2016). The extent to which land clearing for legal and illegal cannabis cultivation contributes to Humboldt marten habitat loss and degradation is unknown.

The habitat characteristics of Humboldt martens that may be particularly at risk from these activities can be considered at the four scales of habitat selection described in the BIOLOGY AND ECOLOGY section on Habitat Associations and Use above.

Large Tree Structures

At the micro-habitat scale, the large tree structures used by Humboldt martens for resting and denning were typically removed during timber harvests, both during initial harvests of original-growth forests as well as through harvest of "residual" old growth trees in subsequent entries in second-growth forests (Slauson et al. 2010, USFWS 2015). Large diameter trees, snags, and downed logs with cavities and platforms used as resting and denning structures by Humboldt martens are significantly reduced in second-growth forest stands compared to the old growth stands (Slauson et al. 2003, Slauson et al. 2010). In second-growth stands it is estimated that it could take more than 200 years to recruit such structures (Slauson et al. 2010). The minimum age of live and dead tree structures used for resting by martens in north coastal California was 176 and 254 years, respectively (Slauson and Zielinski 2009).

Other silvicultural treatments also reduce marten habitat structures. For example thinned stands (n=26) have been found to have significantly fewer potential resting and denning structures than Humboldt marten-occupied stands (n=7); although large cull logs from previous harvests in recently thinned stands can provide similar densities of large log structure to marten occupied stands (Slauson et al. 2010).

Tree and Shrub Canopy Cover

At the stand scale of habitat selection, Humboldt marten habitat suitability is reduced under most of the commonly used timber harvest methods, both through overstory canopy cover reduction and through loss of dense ericaceous shrub layers (USFWS 2015). Shrub layers can be destroyed or degraded through conifer stand management which favors trees over shrubs (such as mechanical brush clearing and application of herbicides that target brush species), and through the competitive exclusion of densely planted conifers which shade out understory shrubs (Slauson et al. 2010). Typical even-aged silvicultural methods employed on industrial timberlands completely eliminate post-harvest canopy cover in clear cuts over areas of up to 40 acres. Such conditions, unsuitable for marten use, persist for

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years until the regenerated stand achieves suitable canopy closure. It has been shown that shrub cover is more patchily distributed in thinned stands than in old growth stands on federal forests (Slauson et al. 2010). Dense regenerating conifer stands that were thinned were found to regenerate moderately dense shade-tolerant native species shrub layers within 15-30 years following thinning; however, shrub cover remained significantly lower than levels found in the old growth redwood stands used by Humboldt martens (Slauson et al. 2010). Given relatively short harvest rotations, typically less than 60 years (USDA 1992, Green Diamond Resource Company 2012, Yurok Tribal Forestry 2012) in the coastal forests of northern California, overstory conditions suitable for martens may only exist on a small proportion of the intensively managed landscape at any given time. On Green Diamond lands, approximately 85% of the landscape had overhead tree cover > 10 years old and >70% was over 20 years of age (Green Diamond 2014). Green Diamond's average opening size is about 15 acres and all even-age units retain at least 10% of the area in tree cover. Riparian zones are 25% of the landscape and total retention is approximately 27% (GDRCo 2018).

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Slauson et al. (2010) found that shrub flowering and fruiting are greatly reduced in stands thinned ≤30 years prior to harvest compared to stands occupied by martens: Only 38% of thinned stands were observed with a fruiting or flowering shrub component, compared to 100% of old forest stands occupied by Humboldt martens. In addition to directly providing food for martens, fruiting shrubs support greater densities of marten prey animals such as small mammals, hornets and migratory birds.

Vegetation management activities designed to efficiently produce timber and reduce the risk of wildland fire by removing shrubs, reducing canopy cover, and removing snags and logs may negatively impact martens by removing required habitat structures and by removing shrub cover which can reduce prey abundance and improve access for competitors and larger-bodied predators such as bobcats and gray foxes.

Fragmentation

At the home range and landscape scale, forest fragmentation poses threats to Humboldt marten individuals and populations. Individuals may be forced to move over greater distances to acquire food in fragmented landscapes, increasing their energetic costs and exposing them to more predators. Populations may be impacted by reducing the ease of juvenile dispersal and ability of breeding individuals to move between population areas. Fragmented habitat conditions exist throughout much of the Humboldt marten's historical and current range and the four extant marten populations in coastal California and Oregon appear to be isolated from one another by unsuitable habitat degraded by logging, severe wildfire, and urbanization (Slauson et al. 2017). Fragmentation of habitat can also be detrimental at finer scales, where fragments of habitat may not be large enough to support a single marten territory. For example, the Redwood National and State Parks complex contains only three patches of late successional forest greater than 2,023 ha (5,000 ac.) in area, with most patches less than 40 ha (100 ac.) in area (USFWS 2015).

Slauson et al. (2017) concluded that early trapping combined with the extensive habitat loss and fragmentation from unregulated timber harvesting were the two factors most responsible for the decline in distribution and abundance of Humboldt martens. Similarly, Moriarty et al. (2016) suggested habitat fragmentation (both natural and anthropogenic) is the most serious threat to martens in coastal Oregon (Moriarty et al. 2016):

> Habitat fragmentation through natural and anthropogenic alterations likely poses the largest threat to marten conservation. Marten populations decline with as little as 30%

of the forest cover removed (Hargis and others 1999; Potvin and others 2000), and fuel reduction treatments typically decreased cover and connectivity in the Sierra Nevada (Moriarty and others 2015). Martens were deterred by low-canopy-cover openings, seldom moving 17 m (56 ft.) beyond cover (Cushman and others 2011), and most often moving 50 m (164 ft.) within forest patches to avoid such openings (Moriarty and others 2015).

Degraded landscapes may lack obvious barriers to marten movement while acting as functional barriers to movement by decreasing the likelihood of daily survival and successful dispersal. American marten dispersal distances were found to decrease by approximately 50% in intensively logged forests in Ontario compared to unlogged forests, and the percent of juveniles successfully dispersing and establishing new territories declined from 49% in unlogged forests to 25% in logged forests (Johnson et al. 2009). Thompson (1994) found daily survival rates in recently harvested (3-40 year old) forest stands in Ontario were nearly five times lower than in uncut forests. Where habitat conditions result in decreased dispersal distances and lower survivorship of dispersing animals, habitat is functionally fragmented.

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Because roads favor generalist predators that prey on martens, crossing roads to move between fragmented patches of habitat means martens are more likely to encounter a predator than if they were able to remain in dense shrub habitat (Slauson et al. 2010). Fragmentation of dense shrub stands by roads also appears to confer a competitive advantage to generalist carnivores like fishers, gray foxes, and bobcats, which compete with and prey upon martens. Slauson et al. (2010) found that 80% of camera detections of generalist carnivores such as fisher, gray fox, and bobcats were on roads while 80% of marten detections came from areas away from roads. In northwestern California Highway 101, which is a four lane highway in some sections, may constitute a significant barrier to marten movement (S. Prokop and B. Silver 6/29/2016 letter to CDFW).

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Wildfires and associated salvage logging of damaged trees can threaten the already small Humboldt marten population by reducing and fragmenting the remaining habitat (Slauson and Zielinski 2004). Vegetation management activities designed to reduce the risk of wildland fire by removing shrubs, reducing canopy cover, and removing snags and logs impacts martens by removing required habitat structures and shrub cover which can reduce prey abundance and improve access for competitors (USFWS 2015). On federal lands, salvage logging and fuels management activities can occur on all land allocation categories except for wilderness areas (Hamlin et al. 2010), and on private lands salvage logging plans are exempt from normal review procedures and automatically approved by the California Department of Forestry and Fire Protection (CAL FIRE) through a ministerial process if all applicable Forest Practice Rules are abided (Title 14, CCR §1052).

While thinning and fuel reduction management can fragment and degrade Humboldt marten habitat, it is important to note that severe wildfires can also substantially fragment and degrade marten habitat. However, Moriarty et al. (2017) found that implementing fuel reduction treatments (mechanical or prescribed fire) on as little as 10-20% of the landscape significantly reduced the probability of marten habitat loss from wildfires. Management for the creation and conservation of resilient Humboldt marten habitat will require land managers to carefully plan for both habitat patches and fuel reduction zones over the landscape over time.

The amount of Humboldt marten habitat in California has been substantially reduced since the species' range was first described by early naturalists, primarily as a result of past timber harvesting and timber production practices which removed the large tree structures and dense shrub layers martens require for denning and protection from predators. Although the rate of timber harvesting appears to have decreased in recent years, it may take decades or centuries to recruit large tree structures to replace what has been lost. Wildfire, conversion of land to urban and agricultural uses, and cannabis cultivation have also contributed to habitat loss and degradation. Where habitat remains, degraded conditions and fragmentation caused by roads, timber harvesting, cannabis cultivation, and other land use practices can limit its usefulness to the marten population. Degraded and fragmented habitats may allow larger carnivores to colonize traditional Humboldt marten habitat potentially resulting in increased rates of predation on martens. Because historical habitat loss and degradation severely limits the spatial extent of suitable habitat available to the population, it continues to pose a potentially significant threat to Humboldt martens. However, increases in the extent of mature coastal forest from recruitment of large tree and shrub structure and reductions in habitat fragmentation could significantly contribute to the recovery of Humboldt martens in California.

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Predation

Predation can significantly limit marten populations in the wild (Hodgman et al. 1997, Bull and Heater 2001, McCann et al. 2010, Slauson et al 2017). Known or expected predators of Humboldt martens include bobcats, gray foxes (*Urocyon cinereoargenteus*), coyotes, mountain lions (*Puma concolor*), great horned owls, goshawks (*Accipiter gentilis*), and Pacific fishers (Buskirk and Ruggiero 1994, Bull and Heater 2001, Slauson et al. 2009b, Woodford et al. 2013). Moriarty et al. (2017) detected the following potential predators at camera traps within 5 km (3.1 mi.) of known Humboldt marten detections: black bear (*Ursus americana*), bobcat, gray fox, domestic dog (*Canis familiaris*), domestic cat (*Felis catus*), coyote, and mountain lion. Gray fox was the most frequently observed species with detections near 29% of the known marten stations. Bobcat, black bear, and domestic dogs were detected near 26%, 23%, and 11% of the known marten stations, respectively. Detections of coyote, domestic cat, and mountain lions were lower, ranging from two to four percent.

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Bull and Heater (2001) documented 22 mortalities in their northeastern Oregon Pacific marten radio telemetry study; of these, 18 were attributed to predation by bobcats, raptors, coyotes, and other martens[1]. The martens killed by predators accounted for 51% of the collared population over their four year study (Bull and Heater 2001). In Raphael's (2004 *in* Slauson et al. 2017) study of Pacific martens in the Oregon Cascades, 21 of 28 marten mortalities were attributed to predation (bobcats and coyotes), which constituted 18% of the monitored population. In a Humboldt marten dispersal study in California (Slauson et al. 2014), nine martens (39% of collared martens) were killed by predation over the course of less than one year. All nine of these predation events were from bobcats. Comparing the effect of varying levels of bobcat occupancy in different watersheds in the California range of the Humboldt marten, Slauson (unpublished presentation 2017) showed an inverse relationship between bobcat occupancy and marten occupancy, and a direct relationship between bobcat occupancy and marten predation rates.

Predator – Vegetative Community Interactions

Coastal forest ecosystems are complex, with tree, shrub, and herbaceous plant layers creating multiple structural layers. Historically, dense continuous shrub understories were common in mature forests in the redwood region (Morgan 1953, Allgood 1996, Slauson and Zielinski 2007). These shrub understories have been drastically reduced and modified through a century of logging and related forest

[1] The four marten deaths attributed to other martens were all males, including two juveniles. The carcasses were not eaten, but showed trauma suggestive of fighting. The authors surmised resident male martens engaged in territorial defense were responsible for these mortalities.

management such as burning, mechanical clearing, road building, and planting dense stands of trees which compete for sunlight with shrubs and herbs (Slauson and Zielinski 2007). The time period over which shrub layer extent, density, and species composition drastically changed corresponds with observed reductions in Humboldt marten distribution and the observed expansion of generalist mesocarnivore (mid-sized carnivores) distributions in the redwood region.

Martens appear to require dense shrub stand patches of >50-100 ha (124-247 ac.) (Slauson et al. 2007). Where shrub layers have been removed or reduced, fishers and gray foxes - both potential marten predators, have expanded their historic ranges into the previously unoccupied redwood region (Slauson and Zielinski 2007). Conversely, in the remaining old tree conifer stands with intact dense shrub layers that Humboldt martens select as preferred habitat, fishers and gray foxes are rarely detected (Slauson 2003, Slauson and Zielinski 2007). Martens showed the strongest preference for stands with ≥80% shrub cover, and avoided stands with <60% shrub cover, while fishers and foxes avoided stands with ≥80% shrub cover and used stands with <60% shrub cover in proportion to their availability (Slauson 2003).

The high predation rates noted in the Pacific marten and Humboldt marten studies above occurred in areas that included intensively-managed forests. Raphael (2004 *in* Slauson et al. 2017) described his study as a "high-harvest" area. Bull and Heater's (2001) 400 km^2 (154 mi^2) study area included a relatively small area (53 km^2) (20 mi^2) of uncut forest surrounded by an area "extensively harvested for timber (approximately 80%) and… fragmented by partial cuts, regeneration cuts, and roads." More than 90% of the Slauson et al. (2014) Humboldt marten dispersal study area had been previously harvested. Managed forests with open overstories, less dense shrub layers, and high road density appear to favor larger-bodied generalist predators such a bobcats, gray foxes, and fishers, which may prey on or kill Humboldt martens (Slauson and Zielinksi 2007, Slauson et al. 2010, Slauson unpublished presentation 2017). Fragmentation of dense shrub stands by roads also appears to confer a competitive advantage to generalist carnivores like fishers, bobcats, and gray foxes, which compete with and prey upon martens. Slauson et al. (2010) found that 80% of camera detections of generalist carnivores such as fisher, gray fox, and bobcats were on roads while 80% of marten detections came from off road areas. Because roads favor generalist predators, crossing roads to move between fragmented patches of habitat means martens are much more likely to encounter a predator than they would be if they were able to remain in dense shrub habitat (Slauson et al. 2010).

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A landscape-scale habitat shift has occurred within the Humboldt marten's geographic range since the advent of industrial logging in the 20th century; from large, contiguous old forest stands with extensive dense shrub layers to a more patchy landscape of younger stands with degraded shrub layers divided by road systems. It is thought that small-bodied martens have a competitive advantage over the larger bodied carnivores when foraging and moving through dense shrub stands (Slauson and Zielinski 2007), so this shift in habitat can disadvantage marten while simultaneously favoring larger-bodied generalist carnivores such as bobcats, fishers, and gray foxes. These changes, along with the increased density of roads in the area, have allowed generalist predators to expand their distributions into areas they did not traditionally occupy and prey upon martens at higher rates. Although it is unknown whether predation alone threatens the existence of Humboldt martens in California, adult survival rates are known to be the most influential parameters in marten population growth models (Slauson et al. 2017). Predation rates may or may not have a potentially significant effect on population growth and abundance.

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Competition

No data or studies were identified that assess the impacts of competition between Humboldt martens and other species. The USFWS Humboldt marten species report (2015) does not identify competition as

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a significant stressor on Humboldt martens. Additionally, species with very specific habitat associations, such as Humboldt marten would be expected have a competitive advantage within their preferred habitat over habitat generalist species in the same area (Ricklefs 1990, Zabala et al. 2009). Further, carnivore species typically select prey species of a certain size as a function of the predator's own mass, effectively limiting competition with smaller and larger carnivores in the same community (Sinclair et al. 2003, Owen-Smith and Mills 2008). In coastal Oregon, Moriarty et al. (2016) detected the following potential competitor predators at camera traps within 5 km (3.1 mi.) of historical marten detections (reported as percent of camera trap sample units with detections): spotted skunk (*Spilogale gracilis*) at 41% of stations, opossum (*Didelphis viriginiana*) at 25% of stations, and short-tailed weasel at 8% of stations. Of these, only the spotted skunk is similar in size to Humboldt martens (Maser et al. 1981) and it is a habitat generalist, and therefore unlikely to be a significant competitor.

Toxicants

The control of predators and other animals perceived as pests through poisoning was historically common in the western states. Two former methods had the potential to kill non-target predators such as the Humboldt marten: poisoning livestock carcasses and aerial broadcast of poisoned baits. In one report, dead fishers and martens were observed in the vicinity of poisoned ungulate carcasses in Washington State (Zielinski et al. 2001). While such practices had largely ceased by the 1970s, the historical impact on Humboldt marten population size and distribution is unknown but potentially significant. Recently the use of rodenticides and other toxicants at illegal cannabis plantations has been observed to be a widespread practice (Gabriel et al. 2018). Anticoagulant rodenticides detected near cannabis plantations in northwestern California include brodifacoum, bromodiolone, chlorophacinone, diphacinone, and warfarin. Brodifacoum and bromodiolone are considered second-generation anticoagulant rodenticides which were introduced when rodents developed resistance to first-generation compounds in the 1970s (Gabriel et al. 2012, 2013, Thompson et al. 2014). First-generation compounds generally require several doses to cause intoxication, while second-generation anticoagulant rodenticides, which are more acutely toxic, often require only a single dose to cause intoxication or death and persist in tissues and in the environment (Gabriel et al. 2012). Additionally, other highly toxic pesticides, some of which are banned in the United States, have been found at illegal cannabis grow sites (Thompson et al. 2014).

A recent study conducted on Green Diamond Resource Company lands in Humboldt and Del Norte Counties detected anticoagulant rodenticide exposure in the tissues of 70% of northern spotted owls (n=10) and 40% of barred owls (*Strix varia*, n=84) examined, although none of the 36 rodent livers examined had traces of rodenticides (Gabriel et al. 2018). The authors hypothesized a recent increase in cannabis cultivation sites in the area may have led to the increased use of anticoagulant rodenticides in the area. In an earlier study, Gabriel et al. (2015) detected the presence of anticoagulant rodenticides in the tissues of >85% of the dead fishers tested in California. Within their northern California study area (i.e., Hoopa Valley Indian Reservation) 52 fishers were tested for anticoagulant rodenticide exposure. Seven fishers were confirmed to have died from anticoagulant rodenticide poisoning, all of which had trespass marijuana grows within their home ranges (Gabriel et al. 2015). Because fisher and martens have similar foraging habits and diets, rodenticide exposure likely also poses a significant threat to the Humboldt marten population in California (Slauson et al. 2017). In recent necropsies of deceased Humboldt martens, one out of six carcasses examined showed traces of rodenticides in its tissues (Slauson et al. 2014). Although exposure to rodenticides was not necessarily the cause of death of the exposed animals, the acute toxicity of these compounds makes it likely that the salvaged animals were either directly killed by rodenticides or negatively affected to the extent that death from other causes such as exposure, predation, or starvation became more likely.

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Disease

In their Humboldt marten species report (2015), the UFSWS noted: "The outbreak of a lethal pathogen within one of the three coastal marten populations could result in a rapid reduction in population size and distribution, likely resulting in a reduced probability of population persistence, given the small size of these populations." North American martens are known to be susceptible to a variety of diseases, including: rabies, plague, distemper, toxoplasmosis, leptospirosis, trichinosis, sarcoptic mange, canine adenovirus, parvovirus, herpes virus, West Nile virus, and Aleutian disease (Strickland et al. 1982, Zielinski 1984, Williams et al. 1988, Banci 1989, Brown et al. 2008, Green et al. 2008). Although Strickland et al. (1982) found that American martens in their central Ontario study tested positive for toxoplasmosis, Aleutian disease (a carnivore parvovirus), and leptospirosis; none of the diseases was considered to be a significant mortality factor for martens. Similarly, although Zielinski (1984) discovered antibodies to plague (*Yersinia pestis*) in four of 13 Sierra martens in the Sierra Nevada, he noted martens only appear to show transient clinical signs of the disease. Gray foxes within the current range of Humboldt martens in California are known to have been exposed to canine distemper, parvovirus, toxoplasmosis, West Nile Virus, and rabies, all of which are transmittable to martens (Brown et al. 2008, Gabriel et al. 2012). In their Hoopa Valley Reservation Study, Brown et al. (2008) found dead fisher within the range of Humboldt marten had been exposed to canine parvovirus and canine distemper which is known to cause high rates of mortality in mustelids (Deem et al. 2000). Because several potentially lethal diseases are known from the environment, a disease outbreak in one or both of the remaining Humboldt marten population areas in California should be considered a potential threat to the species. Although it is not known if this threat alone imperils the persistence of the species in California, when combined with the more serious threat of small, isolated populations, habitat loss from wildland fire, cannabis cultivation, timber management, and other threats, the possibility of a catastrophic disease outbreak further reduces the certainty that the Humboldt marten population will persist into the foreseeable future.

Wildland Fire

Slauson (2003) states that stochastic events such as wildfire present a major challenge to the persistence of Humboldt marten, and Slauson et al. (2017) classified wildfires as a serious threat over a large area of the extant population area in California and Oregon. In the more coastal areas occupied by Humboldt martens, conditions that promote the ignition and spread of wildfire rarely exist due to the typically wet winters and foggy summers of the local climate. However, fires become more frequent in the extant Humboldt marten range with distance inland from the coast (Oneal et al. 2006). By examining the size of recent fires in the extant range, Slauson et al. (2017) concluded that a single large fire could affect 31-70% of the currently occupied suitable habitat in California. Others have concluded that a single wildfire could burn an entire core population area (USFWS 2015). The effects of fires varies with the intensity of the burn and the severity of the impact on the vegetative community; ranging from high severity burns which can kill and consume most vegetation, including large tree structures, to low severity burns which consume only the ground level vegetation, leaving shrub and tree layers largely unaffected (USFWS 2015). Slauson et al. (2017) state that even a low severity burn would be likely to reduce Humboldt marten habitat suitability by reducing shrub cover; however, when a fire burned through approximately 25% of a studied Humboldt marten population area in the interval between surveys in 2008 and 2012, no change in marten occupancy post-fire was detected, indicating that any fire-related impacts the population were slight and/or short lived (Slauson et al. 2017). More recently in the summer of 2015, the Nickowitz fire burned approximately 2,800ha (7,000 ac.) in and adjacent to the current known range of Humboldt martens in Del Norte County, but the impact has not been assessed (InciWeb 2015).

Miller et al. (2012) reported that the annual number of fires, mean fire size, maximum fire size, and area burned all increased in northwestern California over the period of 1910-2008. Miller et al. (2012) also noted that high severity fires tended to be clustered in years when region-wide lightning strikes caused multiple ignitions, indicating that weather conditions in some years are conducive to widespread high severity fires in northwestern California. The effects of wildland fire on the landscape are difficult to predict due to variations in ignition frequency and burn severity based on vegetation type, geography, and weather patterns. However, it is clear that fires have the potential to degrade or destroy Humboldt marten habitat over entire population areas, further reducing the carrying capacity of the landscape and fragmenting populations. Therefore, habitat loss from wildland fire should be considered a potentially significant threat to persistence of the California Humboldt marten population.

Climate Change

The North American continent has already experienced the climatic effects of human-mediated increases in greenhouse gas emissions (USGCRP 2017). The annual average temperature in the contiguous United States has been 0.7°C (1.2°F) warmer over the past 30 years compared to the period 1895-2016, and is projected to further increase to 1.4°C (2.5°F) warmer over the period 2021-2050 (Vose et al. 2017). By the end of the century annual average temperatures are projected to be 1.6°C – 4.1°C (2.8°F – 7.3°F) warmer based on low emissions scenarios, to 3.2°C – 6.6°C (5.8°F – 11.9°F) warmer under high emissions scenarios (Vose et al. 2017).

In northwestern California annual precipitation levels have been 10-15% lower in the last three decades compared to the period 1901-1960 (Easterling et al. 2017). While future precipitation levels in this region are not projected to change radically, the frequency of drought events is projected to increase due to increased evapotranspiration resulting from increasing temperatures (Easterling et al. 2017). Additionally, projected warming of ocean surface temperatures 2.7°C ± 0.7°C (4.9°F ±1.3°F) (Jewett and Romanou 2017) will likely result in reduced daily coastal fog formation.

The Humboldt marten's coastal redwood and Douglas-fir forest ecosystem is characterized by moderate temperatures, high annual precipitation, and summer fog which supports dense conifer tree and shrub cover (Slauson et al. 2007, USFWS 2015). This ecosystem is currently limited in spatial extent to near coastal Oregon and northern California. Climate projections suggest that the coastal zone where precipitation is frequent will narrow in the future (PRBO 2011). The intrusion of coastal fog into inland forests has already been observed to be decreasing in frequency (Johnstone and Dawson 2010), though whether this pattern will continue into the future is unclear (PRBO 2011). Less extensive coastal precipitation, reduced fog intrusion, and globally increasing temperatures together could cause the southern extent of mesic coastal forest to retract northward, further reducing the amount of suitable habitat available to Humboldt martens (USFWS 2015, Slauson et al. 2017). These climatic changes could cause a shift from current conifer dominated vegetative communities to hardwood forests unsuitable to martens, and the dense, shade-tolerant shrub layer required by marten may be lost (USFWS 2015). These vegetation transitions could create conditions more favorable to marten predators and could further fragment the remaining patches of suitable habitat (USFWS 2015). Under moderate emissions scenarios the bioclimatic conditions that support Humboldt marten habitat are projected to reliably occur only in Del Norte County and northern Humboldt County (DellaSalla 2013).

Projected climatic changes could further impact Humboldt martens by changing the fire regime in the range of the subspecies. Miller et al. (2012) reported the number of fires per year, mean fire size, maximum fire size, and area burned all increased in northwestern California over the period 1910-2008 and that observed changes in the local climate explained much of the fire trends. This research demonstrates that the effects of a changing climate may already be impacting Humboldt marten habitat and highlights the link between climate patterns and wildfire trends in northwestern California forests. In the summer of 2015 the Nickowitz fire burned approximately 2,800 ha (7,000 ac.) in and adjacent to the current known range of Humboldt martens (InciWeb 2015). In addition to wildfire-mediated habitat changes resulting from changes in climate, other studies have projected climate-related changes in forest disease, insect damage, and other disturbance events which could affect marten habitat quality or availability (USFWS 2015). Finally, Lawler et al. (2012) suggested that martens (all North American species) will be highly sensitive to climate change and will likely experience the greatest impacts at the southernmost latitudes and lowest elevations within their range.

In a recent modeling study, Stewart et al. (2016) assessed climate change vulnerability to 20 of California's terrestrial mammals, including the Humboldt marten. Their study included three components of climate change vulnerability for each taxon. The first component is the taxon's projected response to future climate change, which is the percent of climatically suitable potential habitat projected to be lost (or added) due to climate change. It is based on the climatic conditions within the historical range and projections of those conditions in future climate scenarios. The second vulnerability component is exposure/niche breadth. This component scores the projected amount of change in climate within the taxon's range, and is expressed as percent change compared to current conditions within the historical range of the taxon. The final component is based on an assessment of the taxon's physical, behavioral, and physiological characteristics that affect its sensitivity and adaptive capacity to respond to climate change. Overall climate change vulnerability was assessed by combining the scores for the three components. Two emission scenarios (high, low) and two global climate models (hot/dry and warm/wet) were used to project four future climates. Overall vulnerability scores were partitioned into five categories, ranging from "may benefit" through "less", "moderately", "highly", and "extremely" vulnerable to future climate change impacts.

Depending on the scenario, the Humboldt marten's vulnerability was assessed to be either less vulnerable (low emission, warm/wet scenario), moderately vulnerable (low emission, hot/dry scenario and high emission, warm/wet scenarios), or highly vulnerable (high emission, hot/dry scenario). By the end of the century, projected habitat conditions at the locations Humboldt martens have been detected to date would remain largely suitable under the low emission, warm/wet scenario (only about 1% loss of suitable locations), but 77% of the locations would become unsuitable under the high emission, hot/dry scenario. The following excerpt from Stewart et al. (2016) summarizes the results from the models:

> Distribution models suggest that the Humboldt marten would benefit (increase area of climatically suitable habitat) under wet climate scenarios, but would be adversely impacted (decrease area of climatically suitable habitat) under drier future climate scenarios. Under the wet scenarios, suitable habitat is projected to increase in extent around the currently suitable areas in the southern portion of its coastal range. Under the hot dry scenarios, suitable habitat on the coast is projected to retract into the core area currently known to be occupied by the subspecies. Distribution models map large areas of suitable climate where the Humboldt marten is not currently known to occur. These include areas in the southern coastal part of the Humboldt marten's presumed historical range, as well as areas within the geographic range of the Sierran subspecies of the Pacific marten (*Martes caurina sierrae*). Given the current understanding of Humboldt marten's requirements for forest structure (large decadent trees with cavities for denning, dense shrub layers) that do not occur in much of the coastal forests of northern California, it is not surprising that the species does not currently occur in a large proportion of the coastal area predicted as currently climatically suitable.

In summary, there is relatively high certainty that temperatures will continue to increase within the range of Humboldt martens, which is likely to increase the frequency of drought events due to increased evapotranspiration. Although there is less confidence in projected changes in total precipitation, fire regimes, and the distribution of vegetative communities, it is apparent that significant changes are possible within the century. Changes in the distribution and abundance of preferred Humboldt marten habitat could significantly impact the existing Humboldt marten population and limit opportunities for population expansion. Therefore, climate change should be considered a threat to the long-term persistence of the Humboldt marten population in California.

Vehicle Strikes

Mortalities resulting from collisions with vehicles is a documented threat to Humboldt martens, with 17 road kills documented in coastal Oregon by Moriarty et al. (2016). Vehicle strikes were the greatest source of mortality in their Oregon study, although the authors speculated that the impact to the population may be trivial compared to predation, disease, and exposure to poisons, particularly given their small, isolated populations. There have been no recorded roadkill Humboldt martens in California since 1980 (USFWS 2015); however, Highway 101 is a high speed, multi-lane road which transects potentially suitable Humboldt marten habitat in places, and likely would pose a risk to martens attempting to cross (S. Prokop and B. Silver 6/29/2016 letter to CDFW). Slauson et al. (2017) classified the impact of vehicle collisions on Humboldt marten populations as extremely severe, but limited in scope to a few areas where frequently traveled roads intersect marten population areas. The impact of vehicle strikes on the overall Humboldt marten population is unknown. Mortalities from collisions, although apparently not spatially extensive, may combine with mortality from predation, toxicants, and other sources to exceed recruitment rates, at least in localized areas, and limit population viability (USFWS 2015).

Small Populations

Small, isolated populations are inherently vulnerable to extinction due to loss of genetic variability; inbreeding depression and genetic drift; reduced genetic capacity to respond to changes in the environment; as well as through demographic stochasticity (changes in age and sex ratios resulting in less than optimal breeding opportunities) due to random variation in birth and death rates (Primack 1993, Reed and Frankham 2003). In studied wildlife populations, genetic diversity is strongly correlated with population fitness (increased survival and reproduction rates) and decreased extinction risk (Hedrick and Kalinowski 2000, Reed and Frankham 2003). The smaller the population size, the more likely other threats will drive it to extinction (Primack 2010).

The only estimate of the Humboldt marten population is that less than 100 individuals exist in California (Slauson et al. 2009b), far below the population size experts believe to be required to ensure long-term viability of a species (Traill et al. 2007, Traill et al. 2010, Flather et al. 2011). The loss of genetic diversity inherent to small, isolated populations can be expected to increase their risk of extinction because small and inbred populations have reduced ability to adapt with changing environments due to diminished pools of potentially adaptive heritable phenotypes (Frankham 2005). Populations of at least several hundred reproductive individuals are believed to be required to ensure the long term viability of vertebrate species, with several thousand individuals being the goal (Primack 1993). However, observations of wild populations indicate that it is possible for small populations to persist, at least in the short term, in the face of genetic challenges, but these observations do not inform the probability or durability of recovery (Harding et al. 2016).

In wild populations, reproductive output and survival vary amongst individuals and from year to year. In large populations this variance averages out, but in small populations this variation, termed demographic stochasticity, can cause the population size to fluctuate randomly up or down (Primack 1993). The smaller the population size the more pronounced the effect. Once a population size drops, its next generation is even more susceptible to further stochasticity and random inequalities in the sex ratio resulting in fewer mating opportunities and a declining birth rate (Primack 1993). Due to their small population size, Humboldt martens may be vulnerable to these effects; however, Slauson et al. (2017) believe any negative impacts associated with demographic stochasticity would likely be spatially limited in Humboldt martens.

Unpredictable changes in the natural environment and biological communities can cause the size of small populations to vary dramatically where larger, more widely distributed populations would remain more stable because these changes normally occur in localized areas (Primack 1993). For example, unpredictable changes in a species' prey or predator populations, climate, vegetative community, or disease and parasite exposure can cause the size of a small, isolated population to fluctuate wildly, and possibly lead to extinction (Primack 1993). Additionally, natural disasters such as droughts, fires, earthquakes, and severe storms can lead to dramatic population changes if the population is small and localized such that the disaster impacts all or most of the individuals. Although the probability of such events is generally rare in any given year, over the course of generations the probability becomes much greater (Primack 1993). Ecological modeling studies have demonstrated that the influence of random environmental stochasticity has a greater influence on extinction probability than demographic stochasticity (Primack 1993). Environmental and genetic effects can work in concert with each other to seriously threaten small populations. As populations get smaller they become more vulnerable to demographic variation, environmental variations, genetic drift, and inbreeding depression. Each of these effects can amplify the impact of the other effects, further reducing population size and accelerating the species towards extinction in what has been termed an extinction vortex (Primack 1993).

Small populations, and populations that have experienced periods of low population numbers in the past lose genetic diversity and may suffer the effects of inbreeding depression - the concentration of deleterious alleles (maladaptive genes) in the population from the mating of closely related individuals resulting in offspring with reduced fitness (Frankham 2005, Harding et al. 2016). Closely related to inbreeding depression is genetic drift, or the accumulation and fixation of detrimental alleles in in the population due to a limited breeding pool (Hedrick and Kalinowski 2000). In large populations maladaptive genes do not accumulate in the population due to random mate pairings and the elimination of less fit offspring through natural selection. However, in small, isolated populations natural selection can have less of an effect on the population genotype than genetic drift. When this happens deleterious genes can become fixed in the population's genotype resulting in decreased reproductive fitness in all individuals, and potentially negative population growth (Hedrick and Kalinowski 2000, Frankham 2005).

The influence of inbreeding depression on fitness-related traits appears variable across populations, heritable traits, and environments (Hedrick and Kalinowski 2000). Inbreeding depression affects nearly every well studied wildlife species, and contributes to extinction risk in most wild populations of naturally outbreeding species (Frankham 2005). It is uncertain whether inbreeding depression occurs within the California Humboldt marten population, but the small population size and apparent period of isolation from other populations make it likely that significant genetic diversity has been lost (Slauson et al. 2017).

The loss of genetic diversity and the accumulation of deleterious genes can largely be mitigated by the exchange of breeding individuals between population centers (Primack 1993). When individuals migrate from their natal population to new population areas, the novel genes they introduce can balance the effects of genetic drift and inbreeding depression. As few as one migrant per generation in a population of 120 individuals could negate the effects of genetic drift (Primack 2010). Consequently, habitat fragmentation can seriously increase the genetic risks to isolated subpopulations, and habitat connectivity between populations can substantially mitigate these risks.

While the genetic risks associated with small populations may significantly increase a population's risk of extinction, it is important to note that a small population size alone is not necessarily predictive of population viability over time. A well planned conservation strategy can substantially mitigate risks associated with small populations. A comprehensive plan for long term viability should include the principles of representation, resiliency, and redundancy (Shaffer and Stein 2000, Wolf et al. 2015). These principles require recovered species be present in multiple large populations across the entire spectrum of habitats used by the species, and these populations must also be resilient to environmental changes, identified threats, and genetic threats (Wolf et al. 2015). The California Humboldt marten population, numbering less than 100 individuals, is currently highly exposed to the environmental and genetic risks inherent to small populations; however, a carefully designed program of habitat protection, connection, as well as the possibility of facilitated translocations could connect isolated breeding populations, increase the number of populations, and decrease these risks.

Research and Handling

Wildlife research in California is regulated through the state's Scientific Collecting Permit program (Fish & Game Code § 1002 et seq.). The program requires researchers to disclose their study design, wild animal handling protocols, and demonstrate their professional experience with the species of interest. Notwithstanding this oversight, mortalities are a risk of any wildlife research that requires the capture and handling of live animals. In early 2016, a Humboldt marten in California died of exposure in a trap set by researchers when a pre-baited trap was inadvertently left open and not checked again for several days. This incident is the only documented research-related Humboldt marten mortality in California despite the fact that dozens of martens have been captured and fitted with radio collars to date. Additionally, species experts believe it is unlikely that research would be conducted on more than 10% of the Humboldt marten population at any one time (Slauson et al. 2017). Therefore, it is unlikely that research and handling presents a significant threat to the population.

EXISTING MANAGEMENT

Land Ownership within the California Range

In California, the majority of the land within the Humboldt marten's range is owned and managed by the U.S. Forest Service, with smaller portions owned and managed by the Yurok Tribe, Green Diamond Resource Company, and State and National Redwood Parks (Figure 7). Land management strategies and practices vary across and within ownerships.

National Forest Lands

The U.S. Forest Service manages the majority of the land within the marten's range on the Six Rivers and Klamath National Forests. As mentioned in the Conservation Status Section, on Forest Service lands in Region 5 (California), the Humboldt marten is designated as a Sensitive Species. Management projects subject to the National Environmental Policy Act (NEPA) must analyze impacts to the Sensitive Species;

however, there is no requirement to minimize or mitigate project impacts to the species. National Forest lands in northern California are managed under the Northwest Forest Plan (USDA and USDI 1994) which sets land management guidelines according to seven allocations: Congressionally Reserved Areas, Late Successional Reserves, Managed Late Successional Areas, Adaptive Management Areas, Administratively Withdrawn Areas, Riparian Reserves, and Matrix lands. Matrix lands units are intended for timber harvest, yet Slauson (2003) detected Humboldt marten on Matrix lands in 8 out of 31 sample units, and 20% of Slauson et al.'s (2007) analysis area was designated as Matrix land available for logging with 16% of the Matrix land previously logged. Late Successional Reserves (LSR) are intended to support viable populations of late successional and old-growth dependent species such as spotted owls and Humboldt martens. However, logging is not prohibited in this land allocation class, and not all LSRs are currently in a late successional condition, but rather managed to grow into late successional habitat and therefore may not currently provide Humboldt marten habitat. Forty percent of Slauson et al.'s (2007) study area was designated LSR, with martens detected in 13 of 66 sample units in LSR; 13% of the land designated LSR in the marten's range has been logged (Slauson et al. 2007). The Humboldt marten was given only a 67% likelihood of remaining well distributed within the range of the northern spotted owl (*Strix occidentalis caurina*) by the Northwest Forest Plan scientific analysis team (USDA and USDI 1994). Slauson et al. (2009b) concluded that the Northwest Forest Plan does not completely protect the extant population, with 38% of the Humboldt marten distribution occurring outside of NWFP reserves.

Forest management on individual national forests is governed by Land and Resources Management Plans (LRMP). The LRMP for the Six Rivers National Forest, where much of the extant Humboldt marten population is located, includes provisions to protect known active Pacific marten den sites and the surrounding habitat within 152 m (500 ft.) from disturbance and land-altering activities. However, there is no requirement to conduct pre-project surveys for martens, so there is little probability that active marten dens would be detected and subsequently protected, leaving denning martens and their habitat outside of protected land allocations vulnerable to disturbance and destruction (Six Rivers National Forest 1996).

A small portion of the Humboldt marten range is contained within the Siskiyou Wilderness Area, and only a portion of the wilderness area is composed of vegetation suitable for martens. Slauson (2003) detected martens on only 3 out of 23 sample units located in Siskiyou Wilderness. The U.S. Forest Service also manages the Smith River National Recreation Area (SRNRA), which covers a small portion of the marten's range. The SRNRA is not vulnerable to logging, but management of the area prioritizes recreation over wildlife values.

Redwood National and State Parks Management

State and National Park Service land in the Humboldt marten range includes the Redwood National Parks Complex consisting of Redwood National Park, Prairie Creek Redwoods State Park, Jedediah Smith Redwoods State Park, and Del Norte Coast Redwoods State Park. These parks are managed by the National Parks Service and California Department of Parks and Recreation (California State Parks) and total over 53,412 ha. (131,983 ac.) in northwestern California, of which approximately 30% is currently composed of old-growth forest. Forests in state and national parks are not subject to harvest, except where younger stands are managed to more rapidly develop old-growth characteristics (Slauson et al. 2017). The General Plan/General Management Plan governing the management of the parks does not identify specific management actions for Humboldt martens. Approximately 33% of the Park lands are managed as primitive zones where no development or facilities construction occurs and visitor use is limited to foot traffic on existing trails. An additional, 55.4% of the Park lands are managed as backcountry zones where the preservation and restoration of the natural environment is emphasized, and modification of the environment related to visitor use is limited. Where suitable marten habitat exists within these management zones, it is likely maintained and protected from significant modification and degradation (USDI NPS and California State Parks 2000).

As of 2010, State and National parks had removed over 350 km of roads and thinned 4-6% of the second growth stands within their boundaries (Slauson et al. 2010). Prairie Creek Redwoods State Park had at least one Humboldt marten detection each year from 2009-2013, and again in 2017, although it does not appear to currently support a viable reproducing marten population (K. Slauson pers. comm. 10/10/2017).

Private and Tribal Lands

The largest private land owner within the contemporary Humboldt marten range is the Green Diamond Resource Company, which manages approximately 151,000 ha (373,000 ac) primarily in Humboldt and Del Norte Counties, California (Green Diamond Resource Company 2017). Although only a small fraction of the ownership is within the contemporary range of the Humboldt marten, an important portion lies between the core population area and potentially suitable coastal habitat in the Redwood State and National Parks (Figure 7), although much of this area was recently transferred to the Yurok Tribe. Green Diamond lands are dominated by redwood forest in coastal and low elevation areas and by Douglas-fir as elevation and distance from the coast increase. Hardwoods are common in all forest types and in places compose the majority of the stand (Green Diamond Resource Company 2012). Most of the ownership has been logged at least once over the last century and now consists of second and third growth stands from recently harvested to 120 years old (Hamm et al. 2012). Small old growth forest areas which have never been logged are scattered throughout the ownership and total 659 acres, comprising less than 2% of Green Diamond Resource Company land. Green Diamond operates under a Maximum Sustained Production Plan approved pursuant to a provision of California Code of Regulations, Title 14, Section 913.11 subdivision (a) ("Option A") filed with the CAL FIRE. The Option A plan is intended to balance forest growth and timber harvest over a 100 year period. With some exceptions, Green Diamond plans to practice even-aged silviculture management on the ownership using clear-cutting as the primary harvest/regeneration method. Conifer stands are typically thinned 10-20 years after planting, again after 30 years, and harvested at or after 45 years in clear cuts of 16 ha (40 ac.) or less. Streamside zones, steep slopes, and special habitat areas are managed differently, including single tree selection harvest and retention for wildlife values (Green Diamond Resource Company 2012). At least 10% of the pre-harvest basal area is typically retained in streamside zones, habitat areas, and scattered trees to retain forest structural elements through the harvest rotation. Regeneration involves prescribed burning, mechanical slash treatment, tree planting, and the control of competing vegetation with herbicides (Green Diamond Resource Company 2012).

Green Diamond has periodically surveyed their lands for the presence of fishers and martens, including surveys in 1994-1995, 2004-2006 and 2010-11 (Hamm et al. 2012). No Humboldt marten were detected in the earliest surveys (1994-1995); Slauson (2003) also surveyed a portion of the Green Diamond ownership in 2001-2002 and did not detect marten. However, in a repeat survey in 2004-2005 marten were detected on Green Diamond land west of the known Humboldt marten "core" population on public lands and again in 2006. In 2010-2011 camera station surveys on Green Diamond lands detected martens at 14 stations, some co-occurring with fishers. This series of surveys indicates that martens are a persistent presence on Green Diamond lands (Hamm et al. 2012). Green Diamond has partnered with the United States Department of Agriculture's Forest Service Redwood Sciences Lab and Yurok Tribe to conduct research on the species since 2012 (K. Hamm pers. Comm. Oct. 24, 2017). As of 2016, 33 Humboldt martens were captured, and 24 fitted with radio collars to study dispersal ecology (Slauson et

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al. 2014) and habitat use and den site characteristics in this joint study (Early et al. 2016). Most of the land covered by these surveys and studies was recently acquired by the Yurok Tribe through land purchases from 2009 to 2018.

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Green Diamond Resource Company manages most of its land under the conditions of two federally-approved Habitat Conservation Plans (HCPs), one for the northern spotted owl and the other for anadromous salmonids and stream dwelling amphibians. The HCPs allow for incidental take of listed species and may deviate from Forest Practice Rule guidelines for species covered under the HCPs. Under Section 10(a) of the ESA, incidental take, defined as take that is incidental to, and not the purpose of an otherwise lawful activity, may be authorized for federally threatened and endangered species covered under an approved HCP. For both HCPs, the Department has determined that the federal Incidental Take Statement is consistent with CESA pursuant to Fish and Game Code section 2080.1. Although neither HCP specifically covers Humboldt marten, the plans are designed, in part, to retain and recruit larger tree structure which may improve marten habitat suitability on company lands over time. During development of the northern spotted owl HCP Green Diamond prepared a 30-year timber stand age-class forecast model. The age-class forecast covered 1991 through 2021, and assumed timber harvest would occur at an annual rate of 3,000-6,000 acres. Results indicated that second-growth stands in the 46+ year age-class would more than double, the 31-45 year age-class would increase by approximately 50,000 acres in first 10 years then return to 1991 levels, and the 8-30 year age-class would generally decrease over time.

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Fish and Game Code sections 2089.2 through 2089.26 allow the Department to authorize incidental take of a species listed as endangered, threatened, candidate, or a rare plant, through a Safe Harbor Agreement (SHA) if implementation of the agreement is reasonably expected to provide a net conservation benefit to the species, among other provisions. SHAs are intended to encourage landowners to voluntarily manage their lands to benefit CESA-listed species without subjecting those landowners to additional regulatory restrictions as a result of their conservation efforts. In addition, at the end of the agreement period, participants may return the enrolled property to the baseline conditions that existed at the beginning of the SHA. Green Diamond Resource Company has voluntarily applied for a Humboldt marten SHA; however, until the SHA is approved, it is not possible to describe or quantify the benefits to the Humboldt marten population that will result from the agreement.

The other significant land owner within the range of the Humboldt marten is the Yurok tribe which owns approximately 23,876 ha (59,000 ac.) of land in or near the Humboldt marten range. The Tribe also manages an additional 1,528 ha (3,776 ac.) of federal land held in trust for the Tribe (Yurok Tribal Information Services website accessed October 25, 2017).

Yurok Tribal objectives for the management of Tribal lands include: Establishment of a regular, periodic, long term sustained yield of timber products, generation of Tribal income and employment from timber sales, limiting the use of clear cutting and eliminating the use of herbicides, protecting and enhancing areas considered culturally significant, acquisition of lands (including cutover lands) to increase the Tribal land base, protection and enhancement of fisheries, use of prescribed burning when possible, generating Tribal income from the sale of carbon credits, and providing oversight and professional expertise on the best way to utilize Tribal forestland for non-timber use. To achieve these goals, the Yurok primarily use uneven-aged silviculture practices (harvest of individually selected trees and small groups rather than large clear cuts) (Yurok Tribal Forestry 2012). A specific goal of Yurok Tribal forest management is the protection of Humboldt marten dens and large tree and brush cover habitat across the landscape (E. Mann pers. comm. 10/25/2017). The Yurok Tribe also operates under an Aquatic HCP assumed during purchase of the lands from Green Diamond Resource Company.

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Both Green Diamond Resource Company lands and Yurok Tribe fee lands are subject to the Z'berg – Nejedly Forest Practices Act of 1973 (Pub. Resources Code, § 4511 et seq.) and the California Forest Practice Rules (chapters 4, 4.5, and 10, Title 14, CCR), which are administrated by the California Department of Forestry and Fire Protection (CAL FIRE). The California Forest Practice Rules specify that an objective of forest management is the maintenance of functional wildlife habitat in sufficient condition for continued use by the existing wildlife community within planning watersheds (§ 897(b)(1)(B), Title 14, CCR). This language may result in actions on private lands beneficial to martens. Nevertheless, specific guidelines to retain habitat for martens are not provided in the Forest Practice Rules. Further, this guidance would at best conserve habitat where Humboldt martens are known to exist, but would not be expected to result in the creation of additional habitat. Additionally, section 919.16 of the Forest Practice Rules requires landowners to provide CAL FIRE with information when late successional forest stands are proposed for harvesting if the harvest will "significantly reduce the amount and distribution of late successional forest stands or their functional wildlife value so that it constitutes a significant adverse impact on the environment". However, this rule does not specify protective or mitigation measures to offset potentially significant impacts associated with late successional forest loss.

Habitat suitable for martens may be retained within Watercourse and Lake Protection Zones (§ 916 et seq., Title 14, CCR) on private timberlands. Watercourse and Lake Protection Zones are defined areas along streams where the Forest Practice Rules limit the amount of timber harvested in order to protect in-stream habitat quality for fish and other resources. Harvest restrictions and retention standards vary according to the presence of anadromous and other fish species, as well as other aquatic life forms. These zones may encompass 15-45 m (50-150 ft.) on each side of a watercourse, 30-91 m (100-300 ft.) in total width depending on side slope, location in the state, and the watercourse's classification. Within Watercourse and Lake Protection Zones, the prescriptions vary by watercourse classification. For fish bearing streams (Class I watercourses), the retention standards vary from 50- 80 % overstory canopy (depending on distance to the watercourse) and include leaving a multi-storied stand composed of a diversity of species similar to that found before the start of timber operations. For watersheds that fall within Anadromous Salmonid Protection rules (§§ 916.9, 936.9, and 956.9, Title 14, CCR), the 13 largest trees per acre (live or dead) must also be retained within Class I Watercourse and Lake Protection Zone. For non-fish bearing streams (Class II watercourses), Watercourse and Lake Protection Zone retention standards vary from 50 % total canopy to 80% overstory canopy depending on the type and location of the watercourse.

MANAGEMENT RECOMMENDATIONS

The Department has evaluated existing management recommendations and available literature applicable to the management and conservation of the Humboldt martens to arrive at the following recommendations. The recommendations largely derive from *The Humboldt Marten Conservation Assessment and Strategy* (Slauson et al. 2017). The Department recognizes the scientific expertise and judgement of the Executive Team that developed the Strategy, and deems the information provided a reliable synthesis of current scientific literature on the species, thus constituting the best available science.

Habitat Protection, Management, and Restoration

Given the many conservation challenges identified for the Humboldt marten, achieving the goal of recovering and maintaining sustainable reproductive marten populations in California necessitates cooperation and support among government and private land managers. Achieving the overarching goal of Humboldt marten population recovery and persistence necessitates managing the landscape toward habitat conditions suitable for marten occupancy within much of their historic range. Specific management objectives can be further refined within the following Conservation Emphasis Areas (CEAs) from Slauson et al. (2017) (Figure 4).

Extant Population Areas (EPA)

EPAs are areas where five or more Humboldt marten detections have been documented since 1980 that are no more than 5 km (3.1 mi.) from the nearest neighboring detection. These clusters of detections are then buffered to include 2 km (1.24 mi.) of the surrounding landscape.

1. Design land management activities in and adjacent to EPAs to maintain conditions characterized as highly suitable marten habitat[2], and where feasible, improve habitat conditions in areas of moderate and low suitability

2. The current extent of the two California EPAs is 81,182 ha (202,162 ac.), which is 3.9% of the historic range; however, a habitat suitability model developed by Slauson et al. (in press) classifies 15,566 ha (38,464 ac.) of this extent as currently unsuitable for marten occupancy. Assess areas classified as unsuitable habitat within EPAs for their potential to be managed toward conditions characterized as high suitability marten habitat.

3. Continue surveys for the Humboldt marten where large patches of suitable habitat exist within their historical range, and as new detections are documented, EPAs should be re-assessed periodically to include new detections, following methods described in the Conservation Strategy (Slauson et al. 2017).

4. Identify high priority areas for restoration within EPAs based on their potential for connecting fragmented suitable habitat patches.

5. Evaluate whether major roads within EPAs fragment suitable habitat patches, create major barriers to marten movement, or pose a substantial collision risk to crossing martens. Consider installation of wildlife crossing structures where appropriate.

6. Protect currently suitable resting and denning structures within EPAs (i.e. large snags and downed logs) and manage forest stands to ensure continual recruitment of structures.

7. Protect current dense shrub layers within EPAs, and plan for the regeneration of shrub layers when it can benefit marten habitat suitability, particularly if required after a low intensity fire event.

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[2] Briefly, areas with high precipitation levels and a high Old Growth Structural Index (many large trees and snags and high tree size diversity), or serpentine soils (see Slauson et al. in press for details).

Population Re-establishment Areas (PRA)

PRAs are areas within the Humboldt marten historical range which currently do not contain self-sustaining populations, and where recovery actions are required to accelerate the recolonization of self-sustaining marten populations. For a PRA to support a self-sustaining population, the amount of contiguous suitable marten habitat should be greater than 1,500 ha (3,707 ac.), which corresponds to the estimated area capable of supporting five or more female home ranges. Based on these criteria, Slauson et al. (2017) identified four potential PRAs within California (Figure 4), which should be considered for immediate Humboldt marten population recovery.

8. Manage habitat with the PRAs towards a landscape condition that is suitable to sustain Humboldt martens.

9. Where major roads (e.g. highways 101, 199, and 299) separate PRAs from EPAs and may act as barriers to marten dispersal, evaluate the availability of existing structures such as bridges, large culverts, and overpasses which could be used by martens to safely cross. Where such structures are limited, work with state and federal highway agencies to plan and install state of the art wildlife crossing structures.

10. Once a PRA is determined to have a sufficient amount of suitable habitat, assess it to determine if population recolonization would require human assisted dispersal, or whether natural dispersal of animals is a reliable means for recolonizing the PRA.

Landscape Connectivity Areas (LCA)

Providing dispersal habitat that Humboldt martens may use to move safely between an EPA to restored habitat in a PRA is critical for recolonizing newly restored habitat, and within a metapopulation context, provides essential connectivity for gene flow to occur between extant marten populations. LCAs are characterized by low potential to develop suitable reproductive marten habitat but capacity to provide functional dispersal zones. Currently, only one LCA has been identified in California, and it lies in a critically important dispersal zone between the southernmost EPA and the restorable 1,430 km^2 (552 $mi.^2$) Redwood-Prairie Creek PRA extending into Humboldt County (Figure 4). Unfortunately, suitable habitat conditions for an LCA are poorly understood, and additional research is needed to better understand functional dispersal habitat requirements for the Humboldt Marten.

11. Avoid actions within the LCAs which could permanently restrict the ability of Humboldt martens to move between EPAs and PRAs.

Wildland Fire

Given that the current distribution of extant Humboldt marten populations in California is limited to two relatively small EPAs occupying < 5% of the species' historical geographic range, large catastrophic fires have the potential to severely impact up to 70% of occupied suitable habitat in California over the next 15 years (Slauson et al. 2017). Moriarty et al. (2017) found that treating as little as 10-20% of the landscape with mechanical or prescribed fire fuel reduction treatments can significantly reduce the risk of Pacific marten habitat loss.

12. Design and implement fuel management prescriptions to reduce the wildfire risk to EPAs and PRAs. Prescriptions should preserve important Humboldt marten habitat elements like dense shrub

understories, abundant large snags, dead and dying trees and downed logs in occupied habitat to the greatest degree possible while achieving risk reduction goals.

13. Expand the range and increase the resiliency of Humboldt marten populations in California, including managing for multiple large EPAs connected by LCAs to reduce the risk of a substantial loss of the current extant marten population due to a single catastrophic fire.

Research, Surveys, and Monitoring

14. Research is needed to determine whether the Humboldt marten's small population size has resulted in a loss of genetic diversity, and whether the subspecies is at risk of population declines due to reduced fitness affecting their ability to evolve and adapt to environment changes due to climate change and other causes.

15. Determine the extent to which Humboldt marten populations in California and Oregon interbreed and quantify the genetic contribution to California populations from animals dispersing from Oregon.

16. Conduct surveys to determine if Humboldt martens occur in shore pine habitat in California, as found in Oregon.

17. Develop and implement consistent survey and monitoring strategies that reliably produce metrics on population size, distribution, and trends.

18. Develop a better understanding of specific silvicultural practices that result in high suitability habitat for the Humboldt marten and its prey species.

19. Study and develop siliviculture techniques in early seral stands which discourage occupancy by marten predators while recently harvested or burned stands are regenerating.

20. Study the lethal and sub lethal effects of rodenticides and other toxicants on Humboldt martens, model potential population effects, and work to reduce sources of exposure.

21. Identify the impact diseases have on Humboldt marten fitness and mortality, and work to reduce sources for exposure.

22. Continue to collect demographic parameters of extant marten populations, and identify key parameters affecting population growth and persistence.

23. Study habitat relationships of the primary marten predators (i.e. bobcats), and identify management options that reduce predator abundance and distribution within marten habitat (e.g. restorative thinning to stimulate shrub growth and road removal).

SUMMARY OF LISTING FACTORS

CESA directs the Department to prepare this report regarding the status of the Humboldt marten based upon the best scientific information available to the Department. CESA's implementing regulations identify key factors that are relevant to the Department's analyses. Specifically, a "species shall be listed as endangered or threatened ... if the Commission determines that its continued existence is in serious danger or is threatened by any one or any combination of the following factors: (1) present or threatened modification or destruction of its habitat; (2) overexploitation; (3) predation; (4) competition; (5) disease; or (6) other natural occurrences or human-related activities." (§ 670.1(i)(1)(A), Title 14, CCR.). The definitions of endangered and threatened species in the Fish and Game Code provide key guidance to the Department's scientific determination. An endangered species under CESA is one "which is in serious danger of becoming extinct throughout all, or a significant portion, of its range due to one or more causes, including loss of habitat, change in habitat, over exploitation, predation, competition, or disease." (Fish & Game Code, § 2062.) A threatened species under CESA is one "that, although not presently threatened with extinction, is likely to become an endangered species in the foreseeable future in the absence of special protection and management efforts required by [CESA]." (*Id.*, § 2067). The following summarizes the Department's determination regarding the factors to be considered by the Commission in making its decision on whether to list the Humboldt marten. This summary is based on the best available scientific information, as presented in the foregoing sections of the report.

Present or Threatened Modification or Destruction of Habitat

The geographic range of the Humboldt marten has retracted to less than five percent of the extent documented by naturalists in the early 20th Century. Although historical trapping pressure is implicated in the initial decline of the species in the state, today the species population is limited by the amount, distribution, and quality of its remaining preferred habitat. Historical and ongoing management for timber production threatens the species by removing, degrading, and fragmenting the dense shrub layers and large tree structures the species is dependent upon for cover, denning, and foraging. Some portions of the remaining occupied habitat are protected by wilderness and other land use designations, but large areas remain vulnerable to continued timber harvesting and other uses which can fail to retain required habitat elements on the landscape. Until additional areas of suitable forest habitat are allowed to develop with careful management and the passage of time, the limited extent of suitable habitat will continue to prevent recovery of the California Humboldt marten population.

Overexploitation

Intensive trapping pressure during the late 19th and first half of the 20th centuries appears to have significantly reduced the Humboldt marten population and the species' distribution in the state. However, due to changes in trapping laws and practices, overexploitation no longer threatens the species in California.

Predation

Predation is a cause of Humboldt marten mortality in California populations. While predation is natural in wildlife communities, predation rates by larger predators may be elevated in landscapes managed for timber production, but it is uncertain how predation rates relate to demographic parameters of Humboldt marten on managed landscapes. Whether predation by larger predators may constitute a primary threat to Humboldt marten populations on managed landscapes is a hypothesis that warrants examination with further research.

Competition

There is no indication in the available information to indicate that competition poses a substantial threat to Humboldt marten populations in California.

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Disease

Although there is little available information on disease rates and associated mortality in Humboldt marten populations, the presence of highly virulent diseases has been documented in the occupied range. Because Humboldt marten populations are small and isolated, a virulent disease outbreak in one or more core population area could seriously threaten the statewide population. However, the probability of such an outbreak is difficult to predict.

Other Natural Events or Human-Related Activities

Small Populations

In California the Humboldt marten population is believed to be less than 100 individuals distributed in two core population areas. Populations of this size are vulnerable to inherent genetic and environmental threats including, inbreeding depression, demographic stochasticity, environmental stochasticity, and loss of genetic diversity. These effects can result in decreased reproductive output, inability to adapt to changing environmental conditions, concentration of maladaptive genetic traits, and other deleterious effects. Small, isolated populations are also at inherently at greater risk of extinction due to environmental events such as wildfires and disease outbreaks. Small population effects can interact with other threats (such as disease, toxicants, climate change, and others) synergistically to amplify the negative impacts on the Humboldt marten population. While these small population effects almost certainly impact the California Humboldt marten population, research would be required to quantify the degree to which these effects threaten the persistence of the population.

Wildland Fires

Because the California Humboldt marten population is small, and isolated to a small geographic range, a single catastrophic wildfire has the potential to significantly impact the population size and range. Fires can destroy the dense shrub understories and large tree structures martens depend on for cover, denning, and foraging. Additionally, fires have the potential to further fragment the remaining habitat. Although it is impossible to predict the timing and location of wildfires, it is likely that fires will impact Humboldt marten habitat in northwestern California in the foreseeable future. The degree to which wildland fires threaten the persistence of the California Humboldt marten population is unknown.

Climate Change

Past and ongoing changes to the north coast climate such as rising temperatures, declining precipitation, and decreased daily fog will likely result in long term changes to the vegetative community in the region. How these changes will impact the preferred habitat of Humboldt martens is difficult to predict, but some modeling studies indicate that the geographic extent of suitable marten habitat is likely to retract northward in California. While there is a high degree of confidence in projected warming trends, and less certainty in projected precipitation changes, the degree to which these changes will threaten Humboldt martens in the foreseeable future is unknown.

Toxicants

Although there is little available information on Humboldt marten exposure to toxicants, the presence of highly toxic anticoagulant rodenticides and other pesticides is well documented within the California range. These compounds are known to frequently kill closely related fishers in northwestern California; however, the degree to which toxicant exposure threatens the Humboldt marten population is unknown.

LISTING RECOMMENDATION

CESA directs the Department to prepare this report regarding the status of the Humboldt marten in California based upon the best scientific information. CESA also directs the Department, based on its analysis, to indicate in the status report whether the petitioned action is warranted. (Fish & Game Code, § 2074.6; § 670.1(f), Title 14, CCR). In addition to evaluating whether the petitioned action (i.e., listing as endangered) was warranted, the Department considered whether listing as threatened under CESA was warranted. The Department includes and makes its recommendation in its status report as submitted to the Commission in an advisory capacity based on the best available science. In consideration of the scientific information contained herein, the Department has determined that historic and ongoing habitat loss, fragmentation and associated elevated predation rates, coupled with unquantified, but potentially significant ongoing impacts to the species from a small population size, disease, toxicants, wildfire, and climate change, warrants listing the Humboldt marten as threatened under CESA.

Protection Afforded by Listing

It is the policy of the State to conserve, protect, restore and enhance any endangered or threatened species and its habitat (Fish & Game Code § 2052). The conservation, protection, and enhancement of listed species and their habitat is of statewide concern (Fish & Game Code § 2051(c)). CESA prohibits the import, export, take, possession, purchase or sale of any species the Commission determines is endangered or threatened (Fish & Game Code, § 2080 et seq.). CESA defines "take" as hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill (Fish & Game Code, § 86). The Fish and Game Code authorizes the Department to allow "take" of species listed as threatened or endangered under certain circumstances through incidental take permits, memoranda of understanding, natural community conservation plans, safe harbor agreements, or other plans or agreements approved by or entered into by the Department (Fish & Game Code, §§ 2081, 2081.1, 2086, 2087, 2089.2, and 2835).

If the Humboldt marten is listed under CESA, impacts of take caused by activities authorized through incidental take permits must be minimized and fully mitigated according to state standards. These standards typically include protection of the land in perpetuity with an easement, development and implementation of a species-specific adaptive management plan, and funding through an endowment to pay for long-term monitoring and maintenance to ensure the mitigation land meets performance criteria. Additionally, the Department is prohibited from approving incidental take permits which could jeopardize the continued existence of the species in the state (Fish & Game Code, § 2081(b)(4)). Obtaining an incidental take permit is voluntary. The Department cannot force compliance; however, any person violating the take prohibition may be punishable under state law.

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

Although the protections afforded listed species by CESA do not apply to the actions of federal management agencies on federal lands, CESA listing may prompt increased interagency coordination and the likelihood that state and federal land and resource management agencies will allocate funds toward protection and recovery actions. In the case of the Humboldt marten, the Humboldt Marten Conservation Group signatory agencies already meet and coordinate regularly, but a state listing could result in increased availability of conservation funds.

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Economic Considerations

The Department is not required to prepare an analysis of economic impacts (Fish & Game Code, § 2074.6).

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Personal Communications

Derek J. Broman, Furbearer Coordinator, Oregon Department of Fish and Wildlife. March 17, 2017

Keith Hamm, Conservation Planning Manager, Green Diamond Resource Company. October 24, 2017.

Deleted: Wildlife Biologist

Edward Mann, Yurok Tribal Forestry Director. October 25, 2017.

Stephan Prokop, Redwood National Park Superintendent, and Brett Silver, Redwood State Parks Superintendent. Letter to Daniel Applebee, California Department of Fish and Wildlife. June 29, 2016.

Keith M. Slauson, Research Ecologist, USDA Forest Service Redwood Sciences Lab. November 10, 2017.

Keith M. Slauson, Research Ecologist, USDA Forest Service Redwood Sciences Lab. E-mail exchange with Scott Osborn and Daniel Applebee, CDFW. November 17, 2017.

LIST OF FIGURES

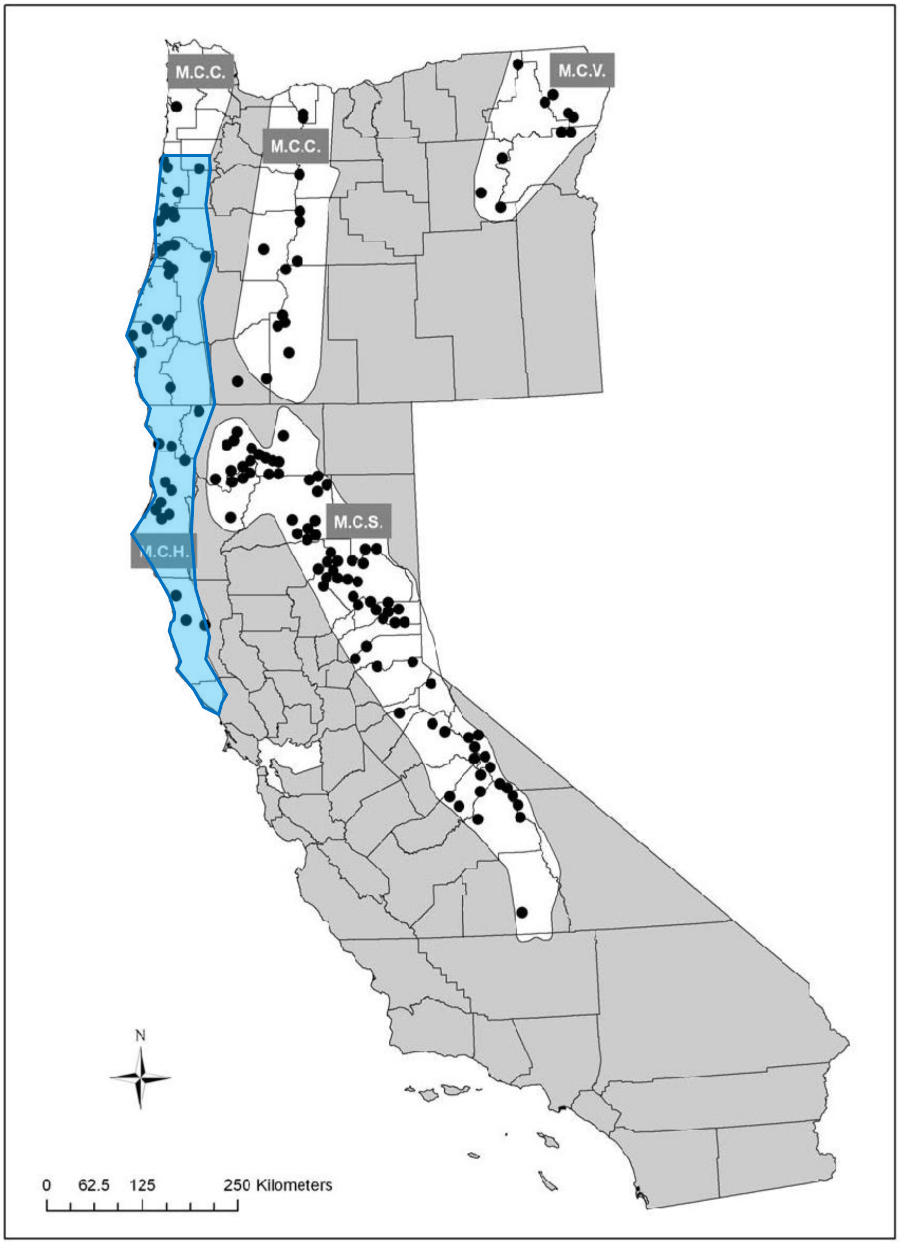
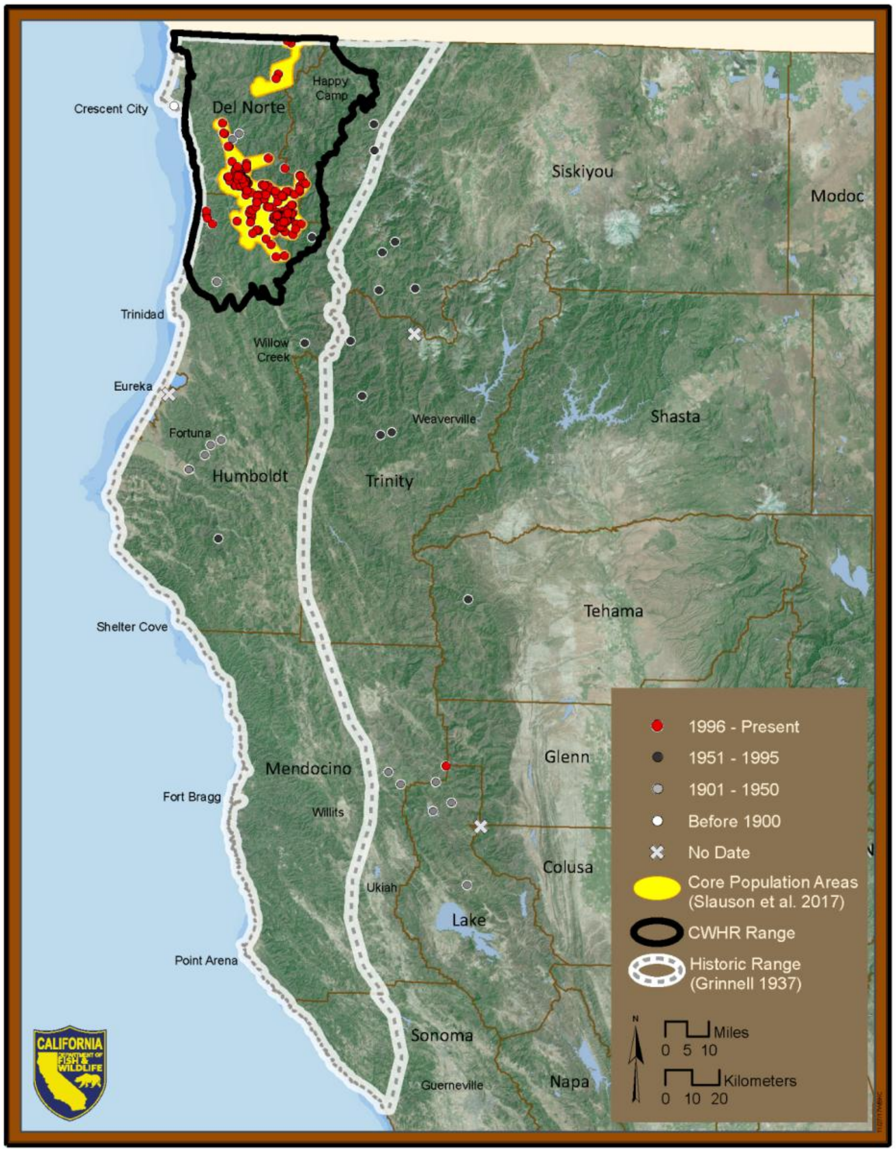


Figure 1.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Happy Camp
Siskiyou
Modoc
Trinidad
Willow Creek
Eureka
Fortuna
Humboldt
Weaverville
Trinity
Shasta
Tehama
Shelter Cove
Mendocino
Fort Bragg
Willits
Glenn
Colusa
Ukiah
Lake
Point Arena
Sonoma
Guerneville
Napa
1996 - Present
1951 - 1995
1901 - 1950
Before 1900
No Date
Core Population Areas (Slauson et al. 2017)
CWHR Range
Historic Range (Grinnell 1937)
Miles
0 5 10
Kilometers
0 10 20

Figure 2.

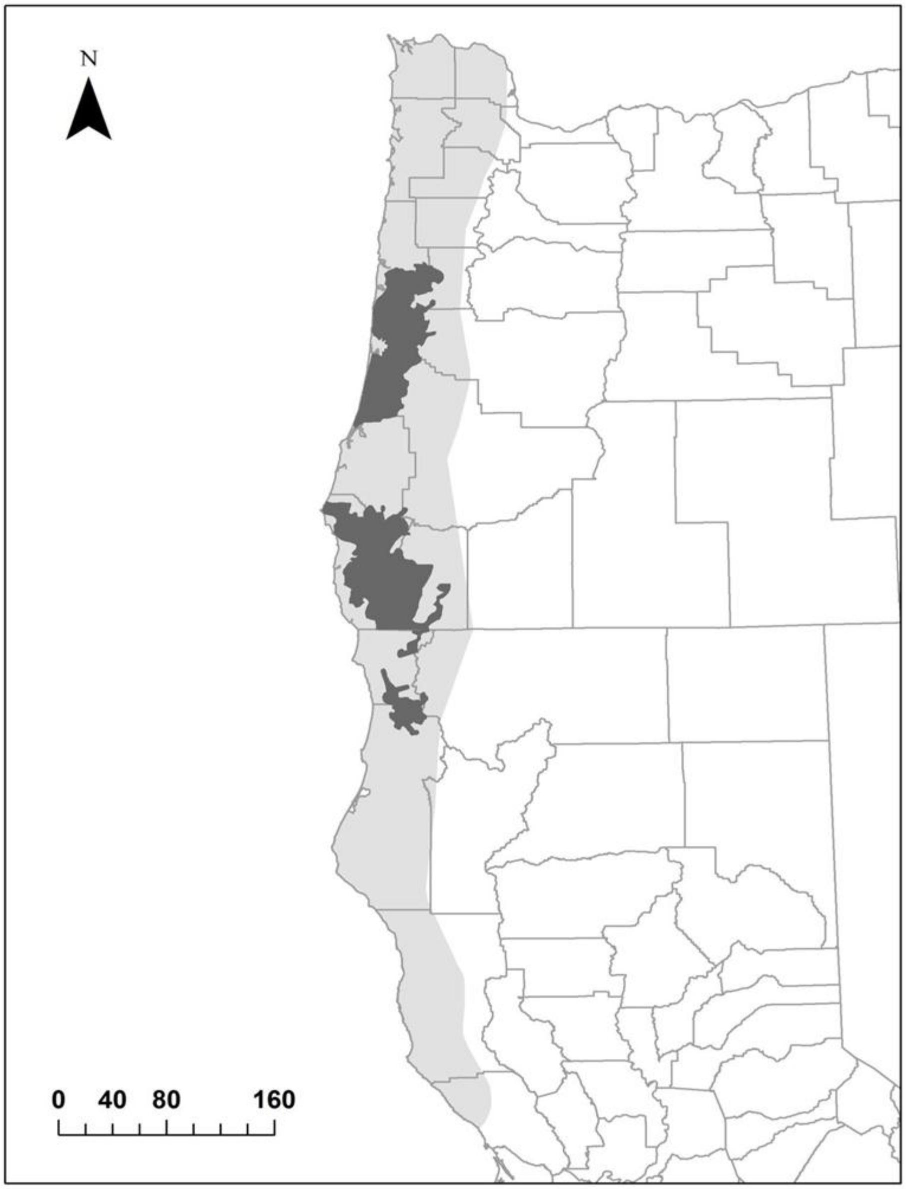
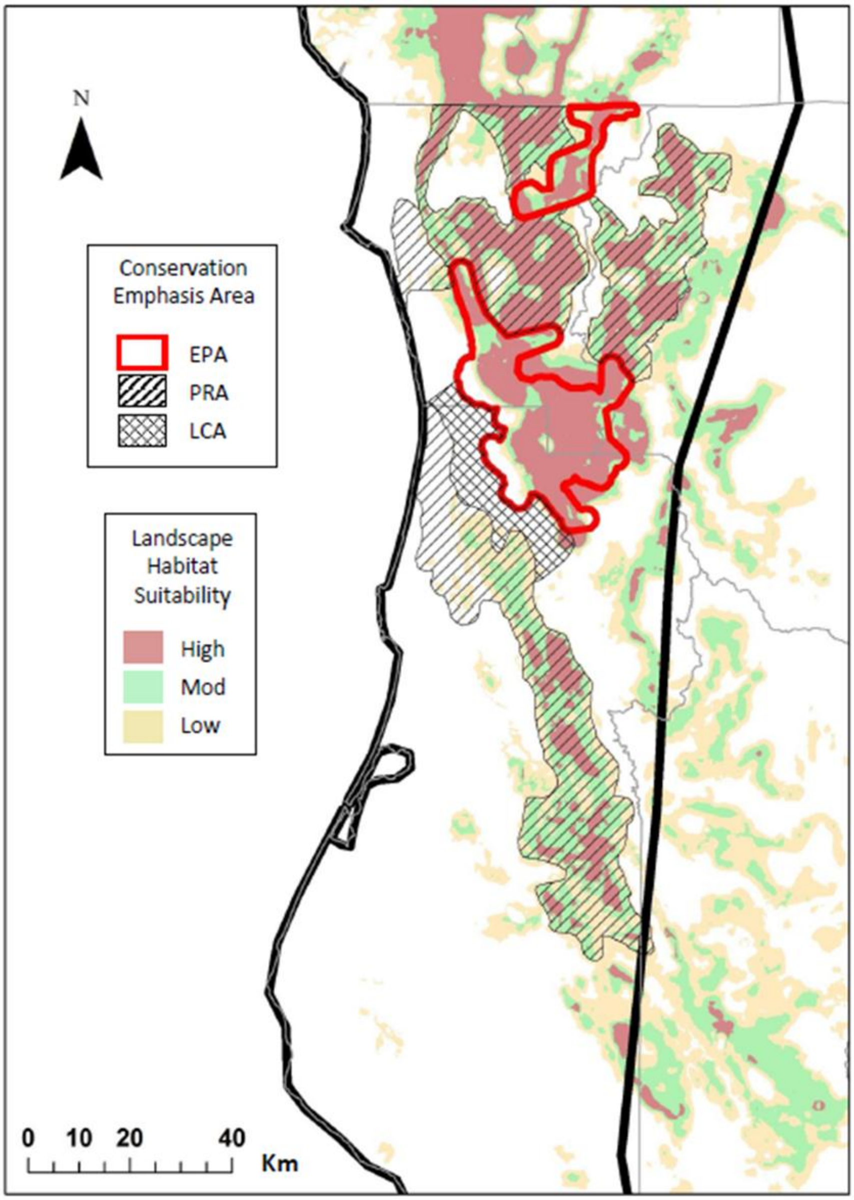


Figure 3.


N
Conservation Emphasis Area
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PRA
LCA
Landscape Habitat Suitability
High
Mod
Low
0 10 20 40
Km

Figure 4.

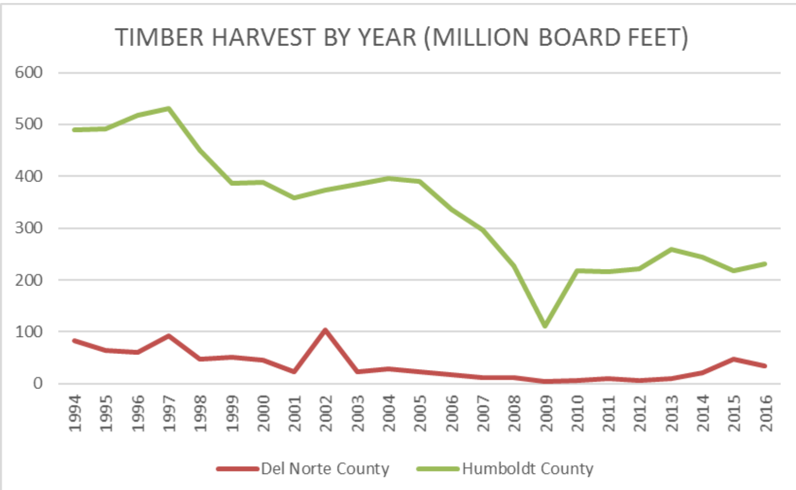

Figure 5.

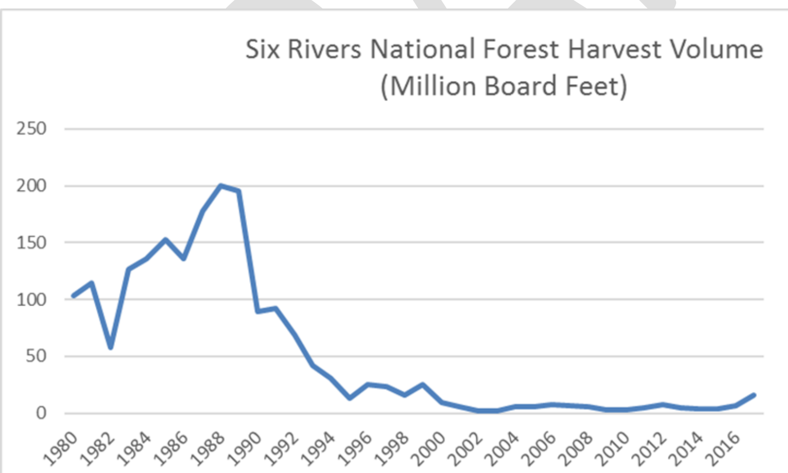

Figure 6.

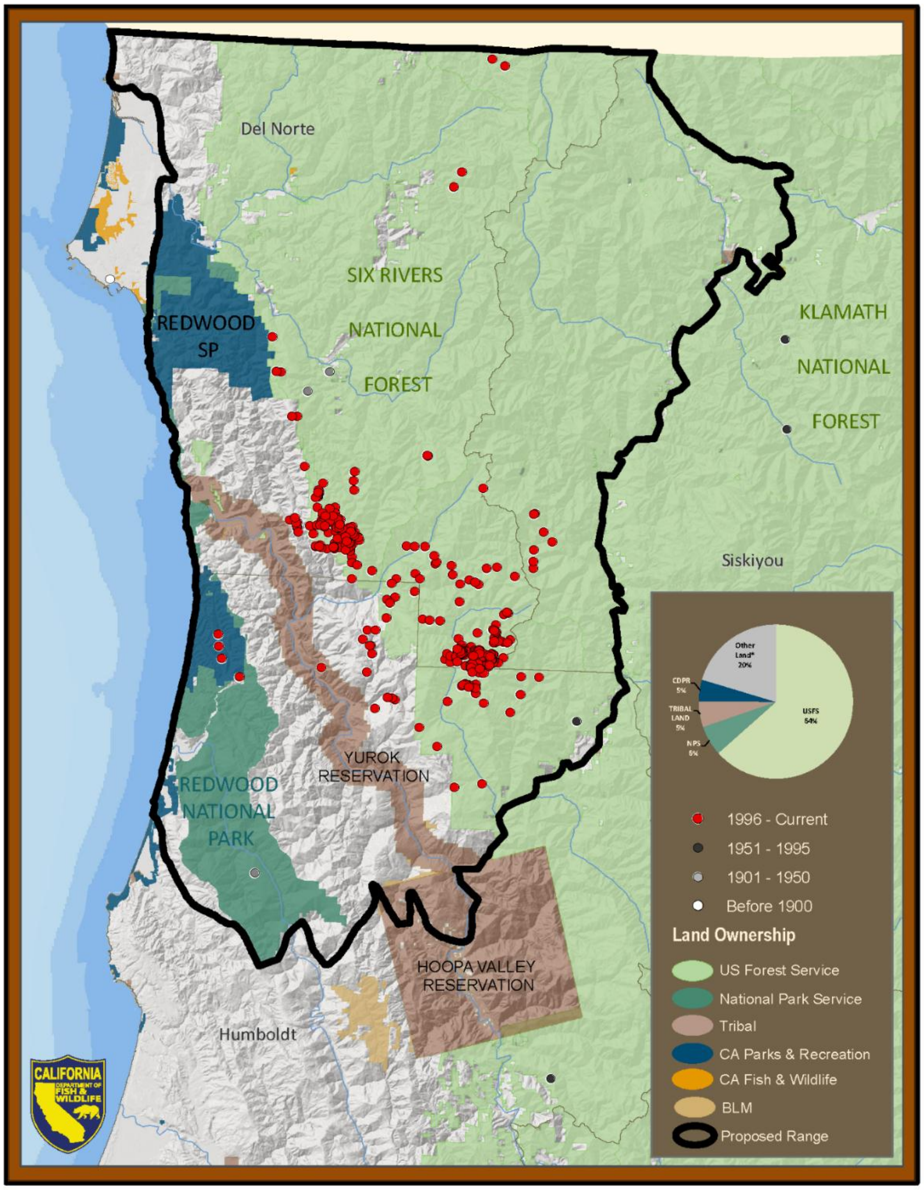
Del Norte
SIX RIVERS
NATIONAL
FOREST
REDWOOD
SP
KLAMATH
NATIONAL
FOREST
Siskiyou
YUROK
RESERVATION
REDWOOD
NATIONAL
PARK
HOOPA VALLEY
RESERVATION
Humboldt
CALIFORNIA
1996 - Current
1951 - 1995
1901 - 1950
Before 1900
Land Ownership
US Forest Service
National Park Service
Tribal
CA Parks & Recreation
CA Fish & Wildlife
BLM
Proposed Range

Figure 7.

Hi there Dan,

I've reviewed the draft Humboldt marten status report and have many comments (mostly minor). Unfortunately I likely won't have the time this week to incorporate those comments into a word document, so I'll likely scan the pdf and email that along later.

Meanwhile, I'd like to share some overall comments and literature that I think should be incorporated. This email has published literature to consider, missing from this report. I will send 3 additional emails, (1) the status report with comments, (2) a shapefile the USFWS is using for the current range in Oregon (as per a minimum convex polygon which you might want to buffer by 2km to match the Extant Population Areas), (3) literature that is in review and should not be shared, but could be incorporated as in review or unpublished data.

For literature that is currently available (in no particular order):

Population estimate for Oregon and viability analysis. This could be used in several places, but especially concerning the vehicle strike and small population sections (pg 24).
Linnell, M. A., K. Moriarty, D. S. Green, and T. Levi. 2018. Density and population viability of coastal marten: a rare and geographically isolated small carnivore. PeerJ 6:e4530 (21pg).

Martens and fire would benefit from the masters thesis (as well as our final report, Moriarty et al. 2017) and could be incorporated into your fire section (pg 21-22). Note also that you didn't include the Chetco Bar fire (2017) for a potential issue of connectivity.
Credo, K. 2017. Assessing Alternatives for Fuel Reduction Treatment and Pacific Marten Conservation in the Southern Cascades and Northern Sierra Nevada. Thesis, Oregon State University, Corvallis, OR, USA.

Habitat elements (random and used) were directly assessed in Delheimer (2015, e.g., pg 28) and could be included in your Habitat Associations and Use section. The portion on rest boxes is currently in press, but I don't have a copy.
Delheimer, M. S. 2015. Assessment of short-term effectiveness of artificial resting and denning structures for the Humboldt marten (Martes caurina humnboldtensis) in harvested forests in northwestern California. Humboldt State University.

Dawson et al. (2017) is a better citation than Dawson and Cook (2012) on pg. 2, attached.
Dawson, N. G., J. P. Colella, M. P. Small, K. D. Stone, S. L. Talbot, and J. A. Cook. 2017. Historical biogeography sets the foundation for contemporary conservation of martens (genus Martes) in northwestern North America. Journal of Mammalogy 98:715-730.

We have several estimates for home range size in the Central Oregon population that could be included in the Home range section (pg 9) and would be better than Sierra Nevada esti**mates.**
Linnell, M. A., K. Moriarty, D. S. Green, and T. Levi. 2018. Density and population viability of coastal marten: a rare and geographically isolated small carnivore. PeerJ 6:e4530 (21pg).

Moriarty, K. M., M. A. Linnell, B. Chasco, C. W. Epps, and W. J. Zielinski. 2017. Using high-resolution short-term location data to describe territoriality in Pacific martens. Journal of Mammalogy 98:679-689.

Prey sections might include also
Wilk, R. J., and M. G. Raphael. 2017. Food habits of Pacific marten from scats in south-central Oregon. Northwestern Naturalist 98:243-250.
and see the papers in review in the coming email (Eriksson et al. and Peterson et al.)

The lack of acknowledging competition seems odd to me. See Eriksson et al. in review. Also, consider barred owls as a potential predator/competitor.
Holm, S. R., B. R. Noon, J. D. Wiens, and W. J. Ripple. 2016. Potential trophic cascades triggered by the barred owl range expansion. Wildlife Society Bulletin.
Wiens, J. D., R. G. Anthony, and E. D. Forsman. 2014. Competitive interactions and resource partitioning between northern spotted owls and barred owls in western Oregon. Wildlife Monographs 185:1-50. (there's much data more now, but it's not published)

Stay tuned for several more emails!

katie

Hello,

Sorry for the delay, but here's the final installment. I was awaiting a pre-print.

Attached are papers in review or draft reports - **not to be shared without permission**. I hope that these data summaries will become available soon as several are in review; nonetheless, until they are final please incorporate as unpublished data. These reports and summaries were also sent to the USFWS for their review.

Disease: Wengert, Gabriel, and Moriarty is a report on the disease findings for the coastal dunes which can be included in your disease section (pg 20-21).

Prey and competition: Eriksson et al. (in review) details small mammal and diet results in the dunes, also exploring whether competition or predation could have influenced our distribution results. Charlotte gave a presentation with these data to Oregon TWS in 2017 (if you prefer to cite a presentation similar to Early et al. 2016). Peterson et al. (in review) highlight that marten populations have diverse diets, even within coastal systems.

Road kill summary: I compiled a list of the known road kill mortalities (attached).

I hope that helps. Thanks for your thoughtful edits and inclusion of increasing the accuracy of Oregon progress for your review!

katie

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Olympia, WA *98512*
[redacted]

Katie to do

O fill in pg 4
O return pg 11
O roadkill pg 13
O MCP → David

State of California
Natural Resources Agency
Department of Fish and Wildlife

DRAFT REPORT TO THE FISH AND GAME COMMISSION
A STATUS REVIEW OF THE
HUMBOLDT MARTEN
(*Martes caurina humboldtensis*)
IN CALIFORNIA

Review by Katie Moriarty, PhD
Submitted 10 Apr 2018


Keith Slauson photo used with permission

CHARLTON H. BONHAM, DIRECTOR
CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE
March 20, 2018

Contents

ACKNOWLEDGMENTS

EXECUTIVE SUMMARY

(Section will be written following peer review)

REGULATORY SETTING

A "Petition to List the Humboldt Marten (*Martes caurina humboldtensis*) as an Endangered Species under the California Endangered Species Act" (Petition) was submitted to the Fish and Game Commission (Commission) on June 8, 2015, by the Environmental Protection Information Center and the Center for Biological Diversity (Petitioners). Commission staff transmitted the Petition to the Department of Fish and Wildlife (Department) pursuant to Fish and Game Code section 2073 on June 18, 2015, and published a formal notice of receipt of the Petition on July 24, 2015 (Cal. Reg. Notice Register 2015, No. 30-Z, p. 1237). The Department serves in an advisory capacity to the Commission by providing scientific reviews of petitions.

On November 11, 2015, the Department provided the Commission with its evaluation of the Petition, "Evaluation of the Petition from the Environmental Protection Information Center and the Center for Biological Diversity to List the Humboldt Marten (*Martes caurina humboldtensis*) as Endangered Under the California Endangered Species Act," to assist the Commission in making a determination as to whether the petitioned action may be warranted based on the sufficiency of scientific information. (Fish & G. Code, §§ 2073.5 & 2074.2; Cal. Code Regs., tit. 14, § 670.1, subds. (d) & (e).) Focusing on the information available to it relating to each of the relevant categories, the Department recommended to the Commission that the Petition be accepted.

At its scheduled public meeting on February 11, 2016, in Sacramento, California, the Commission considered the Petition, the Department's petition evaluation and recommendation, and comments received. The Commission found that sufficient information existed to indicate the petitioned action may be warranted and accepted the Petition for consideration. Upon publication of the Commission's notice of its findings, the Humboldt marten was designated a candidate species on February 26, 2016 (Cal. Reg. Notice Register 2016, No. 9-Z, p. 290).

Status Review Overview

The Commission's action designating the Humboldt marten a candidate species triggered the Department's process for conducting a status review intended to inform the Commission's decision on whether listing the species is warranted. At its scheduled public meeting on February 8, 2017, in Rohnert Park, California, the Commission granted the Department a six-month extension to facilitate external peer review.

This written status review report, based upon the best scientific information available and including independent peer review of the draft report by scientists with expertise relevant to the Humboldt marten, is intended to provide the Commission with the most current information available on the

it's >12 months now? Confusing as to the current status & how this

Humboldt marten and to serve as the basis for the Department's recommendation to the Commission on whether the petitioned action is warranted. The status review report also identifies habitat that may be essential to the continued existence of the species and provides management recommendations for recovery of the species. (Fish & G. Code, § 2074.6.). Receipt of this report is to be placed on the agenda for the next available meeting of the Commission after delivery. Additionally, the report will be made available to the public for a minimum of 30 days prior to the Commission taking any action on the Petition.

Concurrent Federal Petition

Humboldt marten populations in northwestern California and coastal Oregon are currently under review for potential listing under the federal Endangered Species Act of 1973 (ESA) (16 U.S.C. § 1531 et seq.) in response to a 2010 petition also submitted by the Environmental Protection Information Center and the Center for Biological Diversity. The petitioned populations include the entire Humboldt marten range in California, as well as two populations of coastal Oregon Humboldt martens. In 2015, the USFWS released a 12-Month Finding that listing the Humboldt marten was not warranted. The federal petitioners challenged the finding in federal court, specifically challenging the USFWS conclusion that Humboldt marten populations were not in danger of extinction due to the risks associated with small, isolated populations. The court issued a summary judgement in favor of the Petitioners' claim that Humboldt marten populations in northwestern California are threatened by small, isolated populations (*Center for Biological Diversity v. U.S. Fish and Wildlife*. 15-cv-05754-JST, (N.D. Cal. Mar. 28, 2017). As a result, the USFWS is currently reevaluating the status of Humboldt martens in California and Oregon. An important difference between the ESA and CESA is that the ESA requires USFWS to assess whether species are threatened or endangered in the United States, while CESA directs the Department to assess a species' status only within California.

BIOLOGY AND ECOLOGY

Systematics

The Humboldt marten is a carnivorous mammal (order Carnivora, family Mustelidae), classified as a subspecies of Pacific marten (*Martes caurina*), a species occurring west of the Rocky Mountain Divide which was recently split from the American marten (*Martes americana*, Dawson and Cook 2012). The taxonomy of martens in the Pacific Northwest is currently unsettled. Historically the range of Humboldt martens was described as entirely within the north coastal portion of California (Grinnell and Dixon 1926, Grinnell et al. 1937); however, recent genetic evidence suggests Humboldt martens and martens in coastal Oregon (currently classified as *M. caurina caurina*) are diagnosably distinct from other western martens and are one phylogenetic lineage. Consequently experts now believe martens in northwestern California and coastal Oregon should collectively be classified as Humboldt martens (*M. caurina humboldtensis*) (Slauson et al. 2009a, USFWS 2015, Moriarty et al. 2016, Schwartz and Pilgrim 2017).

Dawson et al. 2017 better source but not for Humboldt marten.

California is also home to the closely related Sierra marten (*M. caurina sierra*), which is traditionally considered to range throughout the Sierra Nevada and northern interior mountains. The Sierra marten is not the subject of this Petition (Figure 1). Within this report references to North American martens may refer to any species or subspecies of marten occurring in the North America (i.e. *M. americana, M. caurina, M. caurina sierrae, M. caurina caurina,* and/or *M. caurina humboldtensis*), and references to Pacific martens include any or all subspecies of *M. caurina* (including Sierra, Humboldt, *M. caurina vulpina*, and other subspecies).

Species Description

Martens have elongated and low-to-the-ground bodies, as do other members of the weasel family. Martens are intermediate in size among North American mustelid species. Martens are larger and stockier than long-tailed weasels (*Mustela frenata*) and short-tailed weasels (*Mustela erminea*), and have longer tail and body fur than the similarly sized minks (*Neovison vison*). They are noticeably smaller and more slender than the larger mustelids of North America, including wolverines (*Gulo gulo*), river otters (*Lontra canadensis*), and American badger (*Taxidea taxus*). Martens are typically smaller than fishers (*Pekania pennanti*), though there is some overlap in size between male martens and female fishers.

Marten pelage (fur) is brown (varying from yellowish buff to nearly black), with a contrasting lighter patch on the throat and chest. The marten's bushy tail constitutes more than one-third of the overall body length. Overall body lengths range from 45-70 cm (18-28 in.) and body mass ranges from 0.4-1.25 kg (0.88-2.76 lbs.), with males averaging 15% longer and up to 65% heavier than females (Clark et al. 1987, Powell et al. 2003). Humboldt martens generally differ from the Sierra martens by having darker, richer golden fur; smaller throat patch, more extensive dark fur on the feet, legs, and tail; smaller skulls, narrower faces (rostra), and differences in dentition (Grinnell and Dixon 1926, Grinnell et al. 1937, USFWS 2015).

in California

The Oregon individuals are fairly light as documented so far. They also have large & variable throat patches.

Geographic Range and Distribution

Within California, Humboldt martens historically occupied the coastal mountains from Sonoma County north to the Oregon border from sea level to 915 m (3,000 ft.) within 35 km (22 mi.) of the coast (Grinnell and Dixon 1926, Zielinski et al. 2001, USFWS 2015). The current distribution within the state is limited to areas of Del Norte, northern Humboldt, and western Siskiyou counties and encompasses less than 5% of the probable historical range in the state (Slauson et al. 2009b, Slauson et al. 2017). The majority of contemporary California marten detections are from a 812 km^2 (313 mi^2) core area which includes the South Fork of the Smith River, Blue Creek, Bluff Creek, Camp Creek, Cappell Creek, Pecwan Creek, Slate Creek, and Rock Creek watersheds (USFWS 2015). An additional extant population exists east of U.S. Highway 199 near the California-Oregon border in northeastern Del Norte County, and a few Humboldt martens have recently been detected west of the core area in Prairie Creek Redwoods State Park (USFWS 2015, K. Slauson pers. comm. 10/10/2017, [Figure 2]). These extant population areas are currently isolated from one another by substantial areas of currently suboptimal habitat. East and south of the core population elevation and precipitation rapidly declines in the canyon of the Klamath River. The drier climatic conditions of the river canyon do not support the dense brush cover habitat of Humboldt martens. West of the core population lies an 8-16 km (5-10 mi.) wide band of industrial timberlands between the core population and high quality redwood forest habitat in State and National Parks where martens have been detected several times in the last decade. These industrial timberlands are typically harvested every 40-60 years, and in this zone dense brush cover is less extensive. Where brush cover exists it is fragmented by roads and recent timber harvests. This more open and fragmented cover may favor carnivore species that prey on or compete with Humboldt martens (this topic is discussed below in the Threats section).

Within coastal Oregon, Humboldt martens have been detected from the California border through Lincoln County (Moriarty et al. 2016). Recent survey efforts and road kill records indicate Humboldt martens currently occupy 3-4 core population areas in the two states. The degree to which the smaller California-Oregon border population area may be effectively connected to marten populations in southern Oregon is unknown.

The Department develops species range maps using the established convention of including the USDA Forest Service Ecological Subregions of California (https://map.dfg.ca.gov/bios/) that encompass species detections from the last 20 years, and when necessary modifying the boundaries along geological features (California Interagency Wildlife Task Group 2014). For the Humboldt marten range used in Figures 2 and 7, the ecological subregions were cut along the Klamath River and the Redwood Creek watershed boundary to omit large areas where no contemporary Humboldt marten detections have occurred, and the urban area surrounding Crescent City was omitted. It is recognized that this convention can result in the inclusion of substantial unoccupied areas within the range bounds. Humboldt martens are distributed unevenly within the bounds of their range, with only a fraction of the area containing the requisite tree and shrub cover to support marten populations.

Habitat Associations and Use

Generally, Humboldt martens are strongly associated with two distinct habitat types: late successional conifer forests with dense shrub layers where abundant live and dead standing and downed tree structures are used for resting, denning, and escape cover; and serpentine soil forest communities of various seral stages with variable tree cover, dense shrubs, and rock piles and rock outcrops used for resting, denning, and escape cover (Slauson et al. 2007, Slauson et al. 2017, Slauson et al. in review). Large patches (>50 ha [>124 ac.]) of late successional conifer forests or serpentine soil formations appear necessary for supporting sustainable Humboldt marten populations (Slauson et al. 2007, K. Slauson pers. comm. 11/10/2017). While Humboldt marten territories and dens have also been found in younger, previously harvested stands adjacent to late successional stands which retain some large trees, snags, and logs, populations in these areas may not be sustainable in the absence of individuals dispersing from nearby late successional stands (Slauson pers. com. 11/10/2017). In coastal central Oregon, Humboldt martens have recently been discovered occupying a third habitat type: shore pine (*Pinus contorta* subsp. *contorta*) forests with extensive dense shrub understories (Slauson et al. 2017).

Humboldt martens appear to select habitat at three scales (micro-habitat, stand, and home range scales), and populations of martens are affected by the arrangement of habitat at a fourth scale, the landscape. The following outline of habitat use is taken largely from Slauson et al. (2017). It should be noted that the best available information specific to Humboldt marten is presented here, but in some cases, information from other subspecies or from the American marten is referenced.

At the micro-habitat scale (the locations at which martens feed, rest, and den), North American martens rest or den in structures that provide cover for thermoregulation and protection from predators, and they forage in locations where prey is abundant (Taylor and Buskirk 1994). Humboldt marten prey species are associated with late-successional conifer forest stands characterized by abundant large logs, snags, and decadent live trees; with extensive, dense stands of ericaceous shrubs (i.e. evergreen huckleberry [*Vaccinium ovatum*], salal [*Gaultheria shallon*], and rhododendron (*Rhododendron macrophyllum*] [Allgood 1996, Slauson et al. 2017]). Den sites of North American martens are used by females to give birth to their young (natal dens) and to rear young until weaning and independence (maternal dens). Martens tend to be highly selective in their choice of denning sites, favoring large trees and snags with cavities that prevent larger predators from entering (Payer and Harrison 2003, Fuller and Harrison 2005, Thompson et al. 2012). The available data on Humboldt marten den sites (Slauson and Zielinski 2009, Slauson et al. unpublished data, Green Diamond Resource Company unpublished data) are consistent with the general North American marten pattern. A study of Humboldt marten denning ecology on managed timberlands in northern California categorized the type of substrate used for 34 identified dens (Table 1. Data from Early et al. unpublished presentation 2016):

structures in live trees & snags, & progress to ground based structures when the kits are too large & ackwardly moving. As such, each female needs a diversity of structure types (Moriarty et 2017, report & in Aubry et 2018 (Fisher).

Table 1. Humboldt marten dens by structure type and marten use from Early et al. 2016.

	Structure Type				
Den Type	Live Tree	Snag	Log or Rock Pile	Artificial Nest Box	Underground
Natal	5	0	2	0	1
Maternal	19	4	1	2	0

Trees and snags used for denning in the study were typically large, averaging 91 cm diameter at breast height (dbh, [36 in. dbh]), ranging from 46-183 cm dbh (18-72 in. dbh). Den trees typically had complex structural features such as broken tops, dead tops, large limbs, complex branching, basal hollows, and cavities.

A key finding here that likely applies is that females go from den

Rest structures, used between periods of foraging by both male and female martens, include the kinds of sites used for denning as well as other sites that are less protective and less insulated than cavities or hollows, such as large tree limbs (Slauson et al. 2017). Martens typically select the largest available structures for resting and denning (Spencer 1987, Gilbert et al. 1997). Rest structures used by Humboldt martens in largely unmanaged forests averaged 95 cm (37 in.) dbh for snags, 88 cm (35 in.) large-end diameter for downed logs, and 94 cm (37 in.) dbh for live trees. Structures on average exceeded 300 years of age (Slauson and Zielinski 2009). Preliminary data on Humboldt marten rest structures from more intensively managed lands indicate a similar pattern of use of large-diameter conifer structures, with 70 percent of structures >70 cm (>28 in.) dbh (Slauson et al., unpublished data). Most resting locations (i.e., the actual resting place in the structure) were in tree cavities (33%), on platforms in broken-top snags or on large live branches (33%), or in chambers within log piles or rock outcrops (28%) (Slauson and Zielinski 2009). Rest structures which provide cavities or chambers likely become especially important during the late fall through the late spring, when wet rainy conditions are common.

* more direct citation? This is a review of the literature

This is in Wisconsin but there are several studies here. Slauson & Zelinski (2009)

At the stand scale of habitat selection (forest patches used for foraging, denning, and resting), Humboldt martens are found in forest stands that provide abundant structures suitable for resting and denning, as well as good foraging habitat, which includes both abundant prey and overhead cover to reduce predation risk (Slauson et al. 2017). In non-serpentine soil areas, Humboldt martens have been shown to preferentially use late seral forest stands and to avoid use of early successional stands (Slauson et al. 2007). The preferred late seral stands were Douglas-fir dominated, but also included mature tanoak (*Notholithocarpus densiflorus*) or chinquapin (*Chrysolepis chrysophylla*) understories. As mentioned above, late successional forest stands with dense shrub layers and abundant habitat elements such as large snags, tree cavities, large downed logs and woody debris, as well as serpentine soil forest stands with abundant rock cover appear to provide the best combination of habitat features at the stand scale.

Or Moriarty et al (2017) report

* In Oregon, these stand types would diversify

Where Humboldt martens have been tracked on managed timberlands with younger tree age distributions, they have been associated with second-growth stands several decades old, which provide substantial overhead cover. Importantly, these stands retained abundant late successional habitat elements such as large old trees, snags, and logs through earlier harvests. It is likely that these retained old growth structural elements provide the micro-scale habitat features needed by martens for resting, denning, and foraging (Slauson et al. 2014, Slauson et al. 2017). *

Humboldt martens have also been found in forest stands growing in serpentine soils in near proximity (less than 30 km) of the coast (Slauson and Zielinski 2001). Serpentine soils are characterized by having low plant productivity due to naturally low concentration of essential nutrients (and in some areas naturally high heavy metal concentrations). Serpentine stands used by the Humboldt marten are dominated by a variety of conifers, including lodgepole pine (*Pinus contorta*), western white pine (*Pinus monticola*), and Douglas-fir (*Pseudotsuga menziesii*) in dense to sparse overstories (Slauson et al. 2007).

Humboldt marten resting sites in serpentine stands are strongly associated with the presence of dense shrub cover and abundant rock outcrops, which are used for resting cover (Slauson and Zielinski 2009).

Serpentine habitat areas appear to support lower proportions of female martens than late successional forest stands on non-serpentine soils. Population monitoring suggests marten occupancy is less stable in serpentine habitats than in old forest habitat. Therefore, the serpentine habitat areas may have less value to Humboldt marten population persistence than old forest habitat (Slauson et al. in review).

Dense shrub layers (>70% cover) of salal, evergreen huckleberry, rhododendron, shrub oak (*Quercus vaccinifolia*), and tanoak is an important component of stands selected by Humboldt martens (Slauson et al. 2007). Slauson et al. (2010) modeled Humboldt marten habitat occupancy probability based on several habitat variables measured at the stand scale and found that marten occupancy was most strongly influenced by the percent of the landscape with ≥50% shrub cover. Importantly, the shrub community favored by Humboldt martens does not include the shade-intolerant, short-lived shrub species such as *Ceanothus* spp. that occupy more xeric (dry) sites, and dominate sites following logging and other disturbances (Slauson et al. 2010).

Dense shrub layers may play an important role in excluding marten predators. Most North American martens occupy areas where deep snow accumulates which effectively excludes larger carnivores with higher body mass to foot surface area ratios. It rarely snows in the coastal forests occupied by Humboldt martens, but it is thought that extensive, extremely dense shrub layers effectively exclude larger bodied carnivores and provide a niche for Humboldt martens to exploit (Slauson et al. 2010). Humboldt martens, with the smallest body size of North American marten subspecies (Hagmeier 1961), are adapted to the dense foliage and stems found near ground level in coastal forest ecosystems, allowing them to move quickly through the dense cover and successfully capture prey.

At the home range scale, Humboldt martens appear to select areas with a high proportion of late succession forests stands. The limited information available on Humboldt marten home ranges (n=3) indicates they are on the order of 300 - 500 ha (750 - 1250 ac.), (Slauson et al. 2017). Habitat selection analysis of radio-telemetered Humboldt martens indicates that home ranges typically include ≥70% stand-scale suitable habitat arranged in large patches (≥150 ha [>370 ac.] in area) (Slauson et al. 2007, Slauson et al. 2017). Humboldt martens have also been found reproducing in younger conifer stands (40-50 years post-harvest) in the Pecwan Creek watershed and surrounding areas on the western margin of the core population area. While these stands are not considered late successional nor old growth, the average tree size is greater than 61 cm (24 in.) dbh, and stands retain abundant large tree, snag, and log structures as a legacy of historical individual tree and small group selection silviculture no longer typical for the region (K. Slauson pers. comm. 10/10/2017). Although reproducing martens have been found in these younger conifer stands, mortality rates are high, particularly from bobcat predation. It is unlikely that native reproduction rates offset the high mortality rates to sustain the population. Male-skewed sex ratios, and an age structure skewed to younger individuals in these areas suggests that a large proportion of the population occupying younger conifer stands consists of animals dispersing from the adjacent core population area (K. Slauson pers. comm. 10/10/2017).

At the landscape scale, Humboldt martens appear to select areas of occupancy based on the amount of old forest structure or serpentine habitat present in areas which receive abundant annual precipitation. Slauson et al. (in review) developed a landscape scale Humboldt marten habitat selection model to predict which regions of the historical range contain suitable marten habitat. The model was developed by relating field survey results to the environmental and habitat attributes hypothesized to influence marten distribution. The models that best correlated with observed landscape scale habitat selection each included measures of old growth structural index (a combination of stand age indices and the number of large trees >100cm [39 in.] dbh, the number of large snags >50 cm [20 in.] dbh and >15 m [49 ft.] tall, the volume of large snags, and a tree size diversity index measured at the 1-km [0.62 mi.] scale), serpentine habitat measured at the 3 km [1.89 mi.] scale, and annual precipitation measured at the 3 km [1.89 mi.] scale.

Growth, Reproduction, and Survival

Humboldt martens are assumed to be polygynous, like American martens and other Pacific martens, where one male breeds with multiple females. The following information is based on general characteristics of American and Pacific martens. Martens generally produce one litter per year (Calder 1984), and mating occurs mostly in summer, with a peak in July (Markley and Bassett 1942). The fertilized embryo does not implant in the endometrium for seven or eight months (Ashbrook and Hanson 1927). Active pregnancy begins upon implantation in mid-winter (February). Parturition typically occurs in March or April, after 27 days of gestation (Jonkel and Weckwerth 1963). In a radio-telemetry study of Humboldt martens (Early et al. unpublished presentation 2016), adult females reduced their daily movements from mid-March through early April, consistent with near-term pregnancy and immediate post-parturition. Typical litter size is two or three young (Strickland et al. 1982) and ranges from one to five young (Strickland and Douglas 1987).

Young are born with little fur, ears and eyes closed, and have a body mass at birth of about 28 g (1 oz.), (Brassard and Bernard 1939). The ears open at about 24 days, eyes at 39 days, and by 7 to 8 weeks of age they are active enough for the mother to move them to another den (or succession of dens) for subsequent rearing (Ruggiero et al. 1998). Male parents do not provide care for the young, though by excluding other males from their territories, they may indirectly increase prey availability for the females and their young (Clark et al. 1987). Young are typically weaned at 18 weeks of age (Strickland and Douglas 1987), and may begin dispersing from the natal area as early as August, continuing through the following summer (USFWS 2015).

Females may mate as early as 15 months of age and, because of delayed implantation, may first give birth at about 24 months of age (Strickland et al. 1982). The proportion of adult females that may attempt breeding is likely related to environmental conditions (severity of winter and availability of prey). In a Canadian population of the American marten only about 50% of adult females became pregnant in environmentally stressful years (Thompson and Colgan 1987); however, it is possible the relatively mild conditions within the Humboldt marten's geographic range may mean that a higher proportion of females may be pregnant each year (Slauson et al. 2017). Although data for Humboldt martens are lacking, in other martens females achieved highest reproductive potential between 3 and 5 years of age (Mead 1994, Fortin and Cantin 2004).

In a radio telemetry study of Humboldt martens in northwestern California (Early et al. unpublished presentation 2016), 11 females were collared, and over the course of the three year study 16 female territories were monitored continuously for at least a full year, with some territories being monitored in multiple years. There were 12 reproduction attempts amongst the 16 monitored females (75%). All but one of these attempts produced kits (94%). Of the 20 kits produced, 17 survived to weaning (Early et al. unpublished presentation 2016).

Humboldt marten survival rates between age classes for males and females are not known. In California, Pacific martens seldom survive longer than 5 years in the wild (USFWS 2015). Building upon the population model for martens developed by Buskirk et al. (2012), Slauson et al. (2017) posited age-class specific survival rates for Humboldt marten of 0.50 for juveniles (i.e., from birth to age 1 year) and

Many Slauson et 2017 citations, which is okay but that is also largely a review and not through rigorous peer review. There was not data collected to access predation risk, nor simulations for modeling....

0.70 for all adult age classes (from age 1 year to age 2 years, age 2 to 3 years, 3 to 4 years, etc.). The model indicates that population persistence is dependent on relatively high adult survival rates. Therefore higher rates of adult marten mortality, as from predation, would have large impacts on population size, trend, and rates of recovery after population decrease (Slauson et al. 2017).

Diet and Food Habits

Gilbert et al 2009 — Slauson & Zielinski (2017) didn't measure daily rates

North American martens were found to require 15-25% of their body mass in prey daily to meet their energetic requirements (~~Slauson and Zielinski in press~~ 2017). The diet of Humboldt martens consists primarily of small mammals and birds, along with lesser amounts of reptiles, insects, and berries. Humboldt marten diets shift seasonally, with berries consumed more frequently in the summer and fall than other times of the year (Slauson et al. 2007). Slauson & Zielinski 2017

Slauson et al 2017

But see also Eriksson et in review & Peterson et in review

A recent investigation of the Humboldt marten's diet estimated the proportion of metabolizable energy (PME) based on scat analysis (Slauson and Zielinski in press). The study found that on average 72% of Humboldt martens' metabolizable energy came from mammals, 22% from birds, 7% from reptiles, 5.3% from insects, and 2.6% from plant material, primarily fruits. Mammals were the most important food source by PME in all seasons. Although 17 different mammal taxa were evident in the analyzed scats, the vast majority of energy was derived from a few rodent taxa: 42% of mammalian PME was composed of squirrels and chipmunks and 21% of voles and mice. Chipmunks (*Tamias* spp.), red-backed voles (*Myodes californicus*), Douglas's squirrels (*Tamiasciurus douglasii*) and flying squirrels (*Glaucomys sabrinus*) constituted the majority of year round mammalian biomass. Red-backed voles, Douglas's squirrels, and flying squirrels reach their highest densities in late successional conifer forest stands where the foods they specialize on (conifer seeds and truffles) can be found, while chipmunks, flying squirrels, and overall small mammal abundance are positively correlated with ericaceous shrub density (Slauson et al. 2017).

The only significant insect food consumed appeared to be the adults and larvae of wasps and bees. Berries constituted 98.5% of the plant matter consumed, primarily salal, evergreen huckleberry, California red huckleberry (*Vaccinium. parviflora*), and manzanita (*Arctostaphylos sp.*) fruits. Berries were consumed most often in summer and fall (Slauson and Zielinski in press). Although reptiles composed a relatively small proportion of the diet, they were more important in the spring and summer (12% and 10% of diet respectively), when predation on mammals was lowest.

No major differences were observed between the diets of males and females nor between adult and subadult diets (Slauson and Zielinski in press). Compared to the studied diets of other North American martens, the Humboldt marten has a more diverse diet, depends less on voles, and includes more birds. (Slauson and Zielinski in press). in California

Interestingly, dusky-footed woodrats (*Neotoma fuscipes*) appeared in only one of the scat samples analyzed by Slauson and Zielinski (in press). Woodrats are a widespread and often abundant small mammal in coastal redwood forests. They are especially abundant in regenerating (<20 year-old) stands in managed forests (Hamm and Diller 2009). Although woodrats would seem to be ideal prey for martens based on their size and microhabitat use, it may be that bobcat (*Felis rufus*) prevalence in younger forests effectively precludes martens from taking them. Woodrats (and brush rabbits, another young forest herbivore) are the dominant prey of bobcats (Slauson unpublished presentation 2017). It is likely the risk of predation from, and competition with, bobcats effectively precludes Humboldt martens from utilizing this abundant prey resource (K. Slauson pers. comm. 10/17/2017).

* I think Slauson et al 2017 should be 2016 as it's not available yet (or in press).

Predators (see also Threats below)

Known predators of martens in western North America include coyote (*Canis latrans*), red fox (*Vulpes vulpes*), bobcat, and great horned owl (*Bubo virginianus*) (Thompson 1994, Bull and Heater 2001). Fishers are also known to kill martens, and the distribution of fisher populations may limit the distribution of marten (Krohn et al. 2004, USFWS 2015). In a recent study of radio-telemetered Humboldt martens (Slauson et al. 2014), nine mortalities of martens were observed (including eight collared martens and one uncollared marten) over the course of two years. All nine of the martens that died were either confirmed or determined likely to have been killed by bobcats (Slauson et al. 2014). Slauson reviewed several North American marten research projects (Thompson 1994, Hodgman et al. 1997, Ellis 1998, Bull and Heater 2001, Raphael 2004, and McCann et al. 2010) which found predation to be an important source of mortality in monitored marten populations. Among these studies, Slauson (Slauson et al. 2017, and K. Slauson unpublished presentation 2017) noticed a correlation between the intensity of timber harvest in the study areas and the proportion of marten mortality attributed to predation by generalist carnivores. In the three study sites located in areas with high timber harvest rates and a mosaic of young forest stands and edge habitat, bobcats were the predominant predator.

Home Range and Territoriality

Martens are intrasexually territorial—adults exclude members of the same sex from their home ranges, but not members of the opposite sex (Powell 1994, Powell et al. 2003). Intrasexual territoriality is believed to benefit adult females energetically by reducing direct competition from other females for prey, and adult males by providing exclusive reproductive access to females within their home ranges.

Pacific marten home ranges in the Sierra Nevada vary from 170 to 733 ha (420–1,811 ac.) for males and from 70 to 580 ha (173–1,433 ac.) for females (Buskirk and Zielinski 1997). The limited available information from three collared male Humboldt martens in California indicates home ranges are similar in size to Sierra marten, in the range of 300–400 ha (Slauson et al. 2017). Moriarty et al. (2016) estimated the average fall home range areas in coastal Oregon to be 280 ha (692 ac.) for three males and 65 ha (160 ac.) for eight females. There appears to be an inverse relationship between habitat quality and home range size, with the larger marten home ranges in coastal California and Oregon occupying ~~more intensively managed~~ landscapes (USFWS 2015, Moriarty et al. 2016, Slauson et al. 2017).

Dispersal

~~Humboldt~~ marten kits begin dispersing from their maternal home range as early as August and dispersal continues through at least the following summer (Slauson et al. 2017). Although dispersal distances in excess of 70 km (43.5 mi) have been reported, the average dispersal distance of North American martens is typically less than 15 km (9.3 mi) (USFWS 2015, Slauson et al. 2017).

CONSERVATION STATUS

Regulatory Status

The Humboldt marten is not currently listed as threatened or endangered in California under the CESA or the ESA. However, California Fish and Game Code section 2085 extends all of the protections afforded threatened and endangered species to those species under review in response to accepted petitions. Accordingly, during the current candidacy period the legal protections of the CESA are in place for the Humboldt marten until the Commission adopts findings either formally listing the species or rejecting the petitioned action.

The Humboldt marten is designated as a Species of Special Concern by the Department (CDFW 2017). Species of Special Concern (SSC) are species, subspecies, or distinct populations of vertebrate animals native to California that have been extirpated from the state, are ESA (but not CESA) listed as Threatened or Endangered, have naturally small populations or are experiencing serious population or range declines that could qualify them for Threatened or Endangered status. SSC is an administrative designation that conveys no formal legal status or protection. The intent of SSC status is to focus attention on animals at conservation risk, stimulate research on poorly known species, and achieve conservation and recovery of these animals before they meet criteria for listing as threatened or endangered under the CESA (CDFW Species of Special Concern website accessible at https://www.wildlife.ca.gov/Conservation/SSC).

On United States Forest Service (USFS) lands in Region 5 (which encompasses all of California), the Humboldt marten is designated a Sensitive Species and a Priority Species. Its Sensitive Species status requires management projects subject to the National Environmental Policy Act (NEPA) to analyze impacts to the species; however, this obligation carries no attendant requirement to minimize or mitigate impacts to the species.

Habitat Essential for the Continued Existence of the Species (FGC § 2074.6)

The Department considers all currently occupied Humboldt marten habitat (Extant Population Areas, see discussion below) essential for the continued existence of the species in California. Additionally, suitable but apparently unoccupied habitat near the currently occupied habitat (Population Re-establishment Areas, see below) is also considered essential for species. Further, additional habitat that is not currently suitable but which could be restored to suitability within the near term should also be considered essential.

This determination is based on analysis of information provided by Slauson (2003) and Slauson et al. (2017). For example, Slauson (2003) summarized the condition and management of the currently occupied Humboldt marten range by stating:

> A significant number of marten detections (38%) occurred on lands (private industrial timberlands and USFS matrix lands) that are available for logging currently and lack strategies to maintain suitable marten habitat ... Both martens and their habitat are patchily distributed in the area, and further loss or degradation of limited suitable habitat could decrease the chances for the persistence of this remnant population. A conservation strategy based solely on measures to maintain current conditions for this population is unlikely to ensure its long-term persistence. The two major challenges for persistence and restoration of the coastal California marten population are: 1) the longer a population remains small, the greater the chance that it will lose its genetic variation (Nei et al. 1975) or that it will be eliminated due to stochastic demographic or environmental events (e.g., wildfire)(Fager 1991), and 2) restoration of forest habitats with the structural characteristics necessary to be suitable for martens may take many decades.

Based on figures in Slauson et al. (2017), approximately 81,000 ha (200,155 ac.) of currently suitable or recruitable habitat exist in two Extant Populations Areas ("EPAs", [the geographic range of the known extant reproductive population based on verified Humboldt marten detections and a 2 km-wide (1.24 mi.) buffer of the surrounding suitable habitat]) in California (Figure 4). If fully occupied, and assuming a female home range size of 350 ha, which is intermediate to those reported for Sierra martens (Buskirk and Zielinski 1997), the EPAs could support approximately 231 females. The four Population Reestablishment Areas (PRAs, areas of modeled suitable habitat in patches large enough to support at least five female marten home ranges which are currently unoccupied or support fewer than five females) identified in Slauson et al. (2017) encompass 198,713 ha (491.031 ac.), which could theoretically support an additional 568 female martens. Therefore existing habitat in California, if fully occupied, could be expected to support 800 or fewer adult females. These estimates should be considered unrealistically high as they assume optimally arranged home ranges and fully occupied suitable habitat. Additionally, the RPAs are currently thought to be unoccupied. Establishment of populations within these areas may require active translocation of individuals.

Forest management within areas essential to the continued existence of the Humboldt marten would not necessarily need to be precluded to promote the development of quality Humboldt marten habitat. For example, areas which are not currently suitable habitat could be thinned to open canopies for the promotion of dense shrub layers and the recruitment of large tree structures. Additionally, landscape-scale planning and management would be required to balance the promotion and retention of large patches of high quality habitat with the risk of catastrophic habitat loss from wildfire. All six areas, especially the four PRAs, are a mix of suitable and unsuitable habitat conditions. Management actions aimed at increasing suitability (availability of structural elements, dense shrub layer, and closed overstory canopy) could increase the number of marten home ranges supported over current conditions and reduce the threats associated with fragmented habitat in these areas.

Even if suitable habitat in these six areas were fully developed and fully occupied, Humboldt martens would number no more than 800 adult females, and only an approximate 20% of the historical geographic range in California would be occupied (Slauson et al. 2017). This number (added to the number of adult male martens that would also occupy the area) is at or below the theoretical minimum viable population size thresholds for mammal populations of several thousand individuals (Traill et al. 2007). Therefore, additional areas within or adjacent to the historical range would need be examined for the potential to recruit large patches of suitable habitat and support a larger marten population more resilient to extinction. Evaluations of potentially recruitable habitat would need to consider the distribution and composition of forest stands in future climate scenarios. Absent the protection and recruitment of suitable habitat, Humboldt martens are likely to remain at risk of extirpation in California in the foreseeable future due to one or a combination of the threat factors discussed in this report, including high rates of predation, effects of small population size, and impacts from stochastic (random, unpredictable) events such as wildfire.

Range and Distribution Trends

Historically, Humboldt martens ranged from the coastal forests of northwestern Sonoma County north to Curry County Oregon within the narrow humid coastal zone ≤35 km (22 mi.) from the coast (Grinnell et al. 1937, Kucera 1998, Zielinski et al. 2001~~, Slauson et al. 2017, [Figure 2]~~). In California, records of occurrence exist from Colusa, Del Norte, Glenn, Humboldt, Lake, Mendocino, Siskiyou, Tehama, and Trinity Counties (California Natural Diversity Database accessed October 23, 2017), but when the habitat affinities of Humboldt and Sierra martens are considered along with recent genetic research (Schwartz and Pilgrim 2017), marten records from Colusa, Glenn, Lake, and Tehama Counties should be attributed to the Sierra marten subspecies rather than Humboldt marten.

The historical range described by Grinnell et al. (1937) was roughly 22,000 km^2 (8,500 mi^2), although not all of the habitat within the bounds of the historical range would have been suitable or occupied. Within the historical range, the distribution of marten record locations is uneven, with concentrations of records from northern Lake and east-central Mendocino County, an area southeast of Eureka, and near the intersection of Del Norte, Humboldt, and Siskiyou counties (fig. 2). By the 1940s, a significant decline in Humboldt marten trapping returns and a retraction of the southern end of the range had been noted (Anonymous 1920, Twining and Hensley 1947). Zielinski et al. (2001) conducted an exhaustive review of historical coastal marten records from California, Oregon, and Washington including published reports, museum specimens, unpublished notes of naturalists and trappers, and interviews of tribal members and others. Based on their review they concluded that a significant reduction in occupied range has occurred.

The Department is aware of Humboldt marten records only from Del Norte, northern Humboldt, and extreme western Siskiyou Counties in the last 25 years (California Natural Diversity Database query October 22, 2017) despite the fact that surveys during that period covered a much larger portion of the historical range (USFWS 2015). The occupied range (as of year 2008) as circumscribed by a minimum convex polygon drawn around detection locations was found to be 627 km^2 (242 mi^2) by Slauson et al. (2009b). Since that time, the known occupied range has expanded slightly with two detections of Humboldt martens a few kilometers from the coast in Prairie Creek Redwoods State Park, first in 2013 and most recently in 2017 (CDFW 2014, K. Slauson pers. comm. 10/10/2017); and additional detections near the Oregon border (Slauson et al. 2017). The martens detected in Prairie Creek Redwoods State Park were not detected during rigorous surveys in the same area in 2002, thus they likely represent a recent range expansion (Slauson et al. 2010). Despite these recent expansions in the known range, Humboldt martens appear to have been extirpated from 95% of their historic range in California (Slauson et al. 2009b, Slauson et al. 2017).

suggest new outline

Although martens were historically distributed throughout the coastal regions of Oregon, there are currently just two disjunct coastal populations of Humboldt martens (Grinnell et al. 1937, Moriarty et al. 2016, [Figure 3]). The southern population is possibly contiguous with the northernmost populations in California. In Oregon, the range appears to have remained unchanged since 2001; however, there are no indications that the population is expanding (Moriarty et al. 2016).

Population Size and Trend

From 1945-1995 Humboldt martens were virtually undetected in California, leading some to speculate that the species had gone extinct until they were again detected in 1996 (Kucera and Zielinski 1995, Zielinski and Golightly 1996, Slauson et al. 2009b, Slauson and Zielinski 2004). Based on surveys in the modern era the population appears to have declined by over 40% over the period 2000-2008, and then remained unchanged during the period 2008-2012 (Slauson et al. 2009b, USFWS 2015). In the only contemporary population estimate Slauson et al. (2009b), estimated the extant Humboldt marten population in California consisted of less than 100 individuals. Although it is not known if Oregon populations are in contact with California populations, Moriarty et al. (2016) detected a minimum of 28 unique Humboldt martens in coastal Oregon during surveys in 2015, and concluded "martens in coastal forests are rare and likely limited by unknown factors, especially compared to their former range."

in add data - a portion of surveys did not have detect but that doesn't mean the population declined → estimated occupancy decreased

early pres. 2019 pg 4 119 (or 109) captured in 3 years in "poor?" habitat. As such its highly unlikely they captured >10% of the population

See Linnell et al (2018)

Historically Humboldt martens appear to have been more common and widespread. Grinnell et al. (1937) stated that Humboldt martens were "fairly numerous" in "earlier years", though apparent declines in the Humboldt marten population, at least locally, were noted as early as the 1920s. The authors report a tale of one trapper capturing 50 Humboldt martens in a single winter near Fortuna, California. While no rigorous historical population estimate exists, one can reasonably infer from the recorded anecdotal information that the number of martens present at that time was larger than the population present in the 1990s when no detections of the species had been recorded for the previous 50 years (Zielinski and Golightly 1996).

this is fairly small compared to other marten (montane) populations

THREATS

Trapping

Early trapping of Humboldt marten was intensive, with accounts of individual trappers taking 35-50 martens in a single winter (Grinnell et al. 1937). By the early 1900s annual harvest of Humboldt martens was already declining, prompting Joseph Dixon to call for closing the trapping season in California to prevent an extirpation; however, marten harvest continued until a partial closure was enacted in northwestern California in 1946, depleting populations and likely reducing genetic variation within the remaining population (Dixon 1925, Zielinski et al. 2001).

Today trapping of all martens is prohibited statewide (§ 460, Title 14, California Code of Regulations (CCR)). Although it is possible that Humboldt martens could be inadvertently taken by trappers pursuing other fur bearers or nongame mammals that may be legally harvested for recreation, commerce in fur, or depredation. Trapping in California is highly regulated, and trappers must pass a Department examination demonstrating their skills and knowledge of laws and regulations prior to obtaining a license (Fish & Game Code § 4005). Additionally, only live-traps may be used to take furbearers or nongame mammals for recreation or commerce in fur; trappers are required to check traps daily and release non-target animals (*Id.* §§ 3003.1, 4004, and, 4152 and § 465.5, Title 14, CCR). With the passage of Proposition 4 in 1998, body-gripping traps (including snares and leg-hold traps) were banned in California for commerce in fur and recreational trapping (*Id.* § 3003.1). However, some body-gripping traps may be used by licensed trappers for purposes unrelated to recreation or commerce in fur, including protection of property or by government employees, or their authorized agents, while acting in their official capacities (*Id.* § 3003.1 and § 465.5, Title 14, CCR). Martens incidentally captured by trappers must be immediately released § 465.5(g)(1), Title 14, CCR).

Trapping of Humboldt martens remains legal in neighboring Oregon where trappers are required to obtain a trapping license and take an educational course (Hiller 2011). In recent years very few trappers reported pursuing martens in Oregon (4-8 trappers per year [Hiller 2011]), and only three Humboldt martens were reported taken in 2013 (USFWS 2015). Oregon trapping records are organized by county making it difficult to determine if reported trapped martens were coastal Humboldt martens or interior *Martes caurina caurina*. Review of trapping record from 2007-2016 indicates that as many as nine Humboldt martens may have been trapped in Oregon and one roadkill Humboldt marten was recovered (D. Broman pers. comm. 3/17/2017).

No idea where Derek got that information as I sent him a report...

→ Moriarty et al 2016 report 4 → there were 5 from 2014-2017 &

Trapping pressure on Humboldt martens was intense during the late 1800s and early 1900s, and very likely resulted in significant declines in population size as well as a dramatic reduction in range. There have been no studies on the population level effects of Humboldt marten trapping, but the loss of even a few adult martens, especially when combined with other mortality sources, could reduce the likelihood of long-term population viability (USFWS 2015). However, it is unlikely that trapping continues to threaten Humboldt martens in California due to the ban on trapping martens, restrictions on the types of traps that may be used for other species, as well as requirements that licensed trappers check traps daily and release non-target animals.

cite Linnell et al (2018)!

Habitat Loss and Degradation

Changes in the structure and landscape configuration of Humboldt marten habitat can negatively impact survival, reproduction, and population connectivity of the species. In particular, timber harvest and other silvicultural treatments of older forests, salvage logging, development of coastal forests for human settlement, as well as the clearing of forests for the cultivation of cannabis can all lead to loss, degradation, and fragmentation of Humboldt marten habitat. The USFWS (2015) Humboldt marten species report concluded habitat loss and degradation from historical and current logging is the most plausible reason the marten is absent from much of its historical range, noting most of the remaining suitable habitat is located on federally owned land (Zielinski et al. 2001).

Forest conditions in the range of the Humboldt marten today are largely shaped by a legacy of over 100 years of logging and timber management. It is estimated that the area of old growth conifer forest in the Pacific Northwest has been reduced by 72% since European settlement (Strittholt et al. 2006), and only 10% of the historical range of redwood forests remains in old growth stands (Fox 1996). While timber harvest continues in the area, the logging of old growth forest stands on private and public lands has dramatically slowed from peaks in the second half of the 20th Century. Today, 33% of remaining old forest on federal lands in the Northwest Forest Plan area is fully protected from harvest, and 80% is afforded some level of management protection (Strittholt et al. 2006). The rate of timber harvest on private lands in the area has declined in recent decades due to more restrictive regulations and market conditions (Figure 5). Harvest on federal lands declined sharply following implementation of the Northwest Forest Plan in 1994 (Strittholt et al. 2006) (Figure 6.). The area of older forests (OGSI-2000) on federal lands in the coastal and Klamath mountains of northwestern California declined 8.4% from 1993-2012, largely due to wildfires, while the area of older forests on non-federal lands increased 1.3%, despite losses to timber harvest (Davis et al. 2015). While recent losses of old forest stands in the Humboldt marten range have been relatively small, forest stands degraded and fragmented from historical logging will take decades to recover dense ericaceous shrub layers and centuries to recruit the large tree structures needed to restore high quality Humboldt marten habitat conditions (Slauson et al. 2010, Slauson et al. 2017). I would cite Slauson & Zielinski (2009) over either of those

Habitat loss and degradation from human settlement and residential development rapidly increased in the 1850s when pioneers of European descent began harvesting lumber, farming, mining, and fishing along California's north coast (Del Norte County Community Development Department 2003). Since that time minor portions of the historical range have been converted from forests to urban areas, primarily in and around Crescent City, Humboldt Bay, Fortuna, Fort Bragg, and Willits; and much of the historical range south of Del Norte County has been parceled and occupied by very low density housing (≤1 housing unit/16 ha [40 ac.])(Cal Fire 2010). However, the core population area currently occupied by Humboldt martens is almost entirely unoccupied by humans, with the exception of some areas adjacent to the Klamath River on Yurok Tribal lands (Cal Fire 2010). Low-density human occupancy does not necessarily equate with the loss of mature forest habitat favored by martens but human occupancy likely renders such areas unsuitable for martens. Impacts from the presence of humans, livestock, and pets, the construction and use of rural roads, and the use of household pesticides can frighten wildlife away, introduce novel predators, diseases, and toxicants, deplete prey populations, and degrade and fragment habitat (Merenlender et al. 2009). While further human development of the historical range will likely continue into the future, a modeled analysis of future land conversions under several human population growth scenarios found the probability of significant conversions to urban and agricultural uses in the northwest California coast region to be very low for the remainder of this century (Sleeter et al. 2017).

Large-scale marijuana cultivation in remote forests throughout California has increased since the mid-1990s, coinciding with the 1996 passage of Proposition 215, the Compassionate Use Act of 1996 (Health & Safety Code, § 11362.5), which allowed the legal use and growth of marijuana for certain medical purposes (Bauer et al. 2015). Humboldt and Del Norte counties are known centers of legal and illegal cannabis cultivation in California due to the remote and rugged nature of the land and abundant water sources (National Drug Intelligence Center 2007, Bauer et al. 2015). The recent passage of California Proposition 64, the Control, Regulate and Tax Adult Use of Marijuana Act, further decriminalized the adult use of cannabis for recreational use beginning in January 2018. In 2017, the California Legislature approved the Medical and Adult Use of Cannabis Regulation and Safety Act which provides state and local governments the authority to regulate the production and processing of cannabis products, including regulation of the environmental impacts from growing cannabis. It remains to be seen what effect these new laws will have on the conversion of forests for the production of cannabis. A recent study found the majority of cannabis cultivation sites in Humboldt County were located >500 m (1,640 ft.) from the nearest road, indicating cultivation may contribute to landscape fragmentation, although the amount of land area under cannabis cultivation was found to be minor at less than 1% of the land under organic crop cultivation (Bustic and Brenner 2016). The extent to which land clearing for legal and illegal cannabis cultivation contributes to Humboldt marten habitat loss and degradation is unknown.

The habitat characteristics of Humboldt martens that may be particularly at risk from these activities can be considered at the four scales of habitat selection described in the BIOLOGY AND ECOLOGY section on Habitat Associations and Use above.

Large Tree Structures

At the micro-habitat scale, the large tree structures used by Humboldt martens for resting and denning were typically removed during timber harvests, both during initial harvests of original-growth forests as well as through harvest of "residual" old growth trees in subsequent entries in second-growth forests (Slauson et al. 2010, USFWS 2015). Large diameter trees, snags, and downed logs with cavities and platforms used as resting and denning structures by Humboldt martens are significantly reduced in second-growth forest stands compared to the old growth stands (Slauson et al. 2003, Slauson et al. 2010). In second-growth stands it is estimated that it could take more than 200 years to recruit such structures (Slauson et al. 2010). The minimum age of live and dead tree structures used for resting by martens in north coastal California was 176 and 254 years, respectively (Slauson and Zielinski 2009).

Other silvicultural treatments also reduce marten habitat structures. For example thinned stands (n=26) have been found to have significantly fewer potential resting and denning structures than Humboldt marten-occupied stands (n=7); although large cull logs from previous harvests in recently thinned stands can provide similar densities of large log structure to marten occupied stands (Slauson et al. 2010).

Tree and Shrub Canopy Cover

At the stand scale of habitat selection, Humboldt marten habitat suitability is reduced under most of the commonly used timber harvest methods, both through overstory canopy cover reduction and through loss of dense ericaceous shrub layers (USFWS 2015). Shrub layers can be destroyed or degraded through conifer stand management which favors trees over shrubs (such as mechanical brush clearing and application of herbicides that target brush species), and through the competitive exclusion of densely planted conifers which shade out understory shrubs (Slauson et al. 2010). Typical even-aged silvicultural methods employed on industrial timberlands completely eliminate post-harvest canopy cover in clear cuts over areas of up to 40 acres. Such conditions, unsuitable for marten use, persist for years until the regenerated stand achieves suitable canopy closure. It has been shown that shrub cover is more patchily distributed in thinned stands than in old growth stands (Slauson et al. 2010). Dense regenerating conifer stands that were thinned were found to regenerate moderately dense shade-tolerant native species shrub layers within 15-30 years following thinning; however, shrub cover remained significantly lower than levels found in the old growth redwood stands used by Humboldt martens (Slauson et al. 2010). Given relatively short harvest rotations, typically less than 60 years (USDA 1992, Green Diamond Resource Company 2012, Yurok Tribal Forestry 2012) in the coastal forests of northern California, overstory conditions suitable for martens may only exist on a small proportion of the intensively managed landscape at any given time.

Slauson et al. (2010) found that shrub flowering and fruiting are greatly reduced in stands thinned ≤30 years prior to harvest compared to stands occupied by martens: Only 38% of thinned stands were observed with a fruiting or flowering shrub component, compared to 100% of old forest stands occupied by Humboldt martens. In addition to directly providing food for martens, fruiting shrubs support greater densities of marten prey animals such as small mammals, hornets and migratory birds.

Vegetation management activities designed to efficiently produce timber and reduce the risk of wildland fire by removing shrubs, reducing canopy cover, and removing snags and logs may negatively impact martens by removing required habitat structures and by removing shrub cover which can reduce prey abundance and improve access for competitors and larger-bodied predators such as bobcats and gray foxes.

<u>Fragmentation</u>

At the home range and landscape scale, forest fragmentation poses threats to Humboldt marten individuals and populations. Individuals may be forced to move over greater distances to acquire food in fragmented landscapes, increasing their energetic costs and exposing them to more predators. Populations may be impacted by reducing the ease of juvenile dispersal and ability of breeding individuals to move between population areas. Fragmented habitat conditions exist throughout much of the Humboldt marten's historical and current range and the four extant marten populations in coastal California and Oregon appear to be isolated from one another by unsuitable habitat degraded by logging, severe wildfire, and urbanization (Slauson et al. 2017). Fragmentation of habitat can also be detrimental at finer scales, where fragments of habitat may not be large enough to support a single marten territory. For example, the Redwood National and State Parks complex contains only three patches of late successional forest greater than 2,023 ha (5,000 ac.) in area, with most patches less than 40 ha (100 ac.) in area (USFWS 2015).

Slauson et al. (2017) concluded that early trapping combined with the extensive habitat loss and fragmentation from unregulated timber harvesting were the two factors most responsible for the decline in distribution and abundance of Humboldt martens. Similarly, Moriarty et al. (2016) suggested habitat fragmentation (both natural and anthropogenic) is the most serious threat to martens in coastal Oregon (Moriarty et al. 2016):

> Habitat fragmentation through natural and anthropogenic alterations likely poses the largest threat to marten conservation. Marten populations decline with as little as 30% of the forest cover removed (Hargis and others 1999; Potvin and others 2000), and fuel reduction treatments typically decreased cover and connectivity in the Sierra Nevada (Moriarty and others 2015). Martens were deterred by low-canopy-cover openings, seldom moving 17 m (56 ft.) beyond cover (Cushman and others 2011), and most often moving 50 m (164 ft.) within forest patches to avoid such openings (Moriarty and others 2015).

Degraded landscapes may lack obvious barriers to marten movement while acting as functional barriers to movement by decreasing the likelihood of daily survival and successful dispersal. American marten dispersal distances were found to decrease by approximately 50% in intensively logged forests in Ontario compared to unlogged forests, and the percent of juveniles successfully dispersing and establishing new territories declined from 49% in unlogged forests to 25% in logged forests (Johnson et al. 2009). Thompson (1994) found daily survival rates in recently harvested (3-40 year old) forest stands in Ontario were nearly five times lower than in uncut forests. Where habitat conditions result in decreased dispersal distances and lower survivorship of dispersing animals, habitat is functionally fragmented.

Because roads favor generalist predators that prey on martens, crossing roads to move between fragmented patches of habitat means martens are more likely to encounter a predator than if they were able to remain in dense shrub habitat (Slauson et al. 2010). Fragmentation of dense shrub stands by roads also appears to confer a competitive advantage to generalist carnivores like fishers, gray foxes, and bobcats, which compete with and prey upon martens. Slauson et al. (2010) found that 80% of camera detections of generalist carnivores such as fisher, gray fox, and bobcats were on roads while 80% of marten detections came from areas away from roads. In northwestern California Highway 101, which is a four lane highway in some sections, may constitute a significant barrier to marten movement (S. Prokop and B. Silver 6/29/2016 letter to CDFW).

Wildfires and associated salvage logging of damaged trees can threaten the already small Humboldt marten population by reducing and fragmenting the remaining habitat (Slauson and Zielinski 2004). Vegetation management activities designed to reduce the risk of wildland fire by removing shrubs, reducing canopy cover, and removing snags and logs impacts martens by removing required habitat structures and shrub cover which can reduce prey abundance and improve access for competitors (USFWS 2015). On federal lands, salvage logging and fuels management activities can occur on all land allocation categories except for wilderness areas (Hamlin et al. 2010), and on private lands salvage logging plans are exempt from normal review procedures and automatically approved by the California Department of Forestry and Fire Protection (CAL FIRE) through a ministerial process if all applicable Forest Practice Rules are abided (Title 14, CCR §1052).

While thinning and fuel reduction management can fragment and degrade Humboldt marten habitat, it is important to note that severe wildfires can also substantially fragment and degrade marten habitat. However, Moriarty et al. (2017) found that implementing fuel reduction treatments (mechanical or prescribed fire) on as little as 10-20% of the landscape significantly reduced the probability of marten habitat loss from wildfires. Management for the creation and conservation of resilient Humboldt marten habitat will require land managers to carefully plan for both habitat patches and fuel reduction zones over the landscape over time.

The amount of Humboldt marten habitat in California has been substantially reduced since the species' range was first described by early naturalists, primarily as a result of past timber harvesting and timber production practices which removed the large tree structures and dense shrub layers martens require for denning and protection from predators. Although the rate of timber harvesting appears to have decreased in recent years, it will take centuries recruit large tree structures to replace what has been lost. Wildfire, conversion of land to urban and agricultural uses, and cannabis cultivation have also contributed to habitat loss and degradation. Where habitat remains, degraded conditions and fragmentation caused by roads, timber harvesting, cannabis cultivation, and other land use practices can limit its usefulness to the marten population. Degraded and fragmented habitats may allow larger carnivores to colonize traditional Humboldt marten habitat resulting in increased rates of predation on martens. Because historical habitat loss and degradation severely limits the spatial extent of suitable habitat available to the population, it continues to pose a potentially significant threat to Humboldt martens. However, increases in the extent of mature coastal forest from recruitment of large tree and shrub structure and reductions in habitat fragmentation could significantly contribute to the recovery of Humboldt martens in California.

Predation

Predation can significantly limit marten populations in the wild (Hodgman et al. 1997, Bull and Heater 2001, McCann et al. 2010, Slauson et al 2017). Known or expected predators of Humboldt martens include bobcats, gray foxes (*Urocyon cinereoargenteus*), coyotes, mountain lions (*Puma concolor*), great horned owls, goshawks (*Accipiter gentilis*), and Pacific fishers (Buskirk and Ruggiero 1994, Bull and Heater 2001, Slauson et al. 2009b, Woodford et al. 2013). Moriarty et al. (2017) detected the following potential predators at camera traps within 5 km (3.1 mi.) of known Humboldt marten detections: black bear (*Ursus americana*), bobcat, gray fox, domestic dog (*Canis familiaris*), domestic cat (*Felis catus*), coyote, and mountain lion. Gray fox was the most frequently observed species with detections near 29% of the known marten stations. Bobcat, black bear, and domestic dogs were detected near 26%, 23%, and 11% of the known marten stations, respectively. Detections of coyote, domestic cat, and mountains lions were lower, ranging from two to four percent.

Bull and Heater (2001) documented 22 mortalities in their northeastern Oregon Pacific marten radio telemetry study; of these, 18 were attributed to predation by bobcats, raptors, coyotes, and other martens[1]. The martens killed by predators accounted for 51% of the collared population over their four year study (Bull and Heater 2001). In Raphael's (2004 *in* Slauson et al. 2017) study of Pacific martens in the Oregon Cascades, 21 of 28 marten mortalities were attributed to predation (bobcats and coyotes), which constituted 18% of the monitored population. In a Humboldt marten dispersal study in California (Slauson et al. 2014), nine martens (39% of collared martens) were killed by predation over the course of less than one year. All nine of these predation events were from bobcats. Comparing the effect of varying levels of bobcat occupancy in different watersheds in the California range of the Humboldt marten, Slauson (unpublished presentation 2017) showed an inverse relationship between bobcat occupancy and marten occupancy, and a direct relationship between bobcat occupancy and marten predation rates.

Predator – Vegetative Community Interactions

Coastal forest ecosystems are complex, with tree, shrub, and herbaceous plant layers creating multiple structural layers. Historically, dense continuous shrub understories were common in mature forests in the redwood region (Morgan 1953, Allgood 1996, Slauson and Zielinski 2007). These shrub understories have been drastically reduced and modified through a century of logging and related forest management such as burning, mechanical clearing, road building, and planting dense stands of trees which compete for sunlight with shrubs and herbs (Slauson and Zielinski 2007). The time period over which shrub layer extent, density, and species composition drastically changed corresponds with observed reductions in Humboldt marten distribution and the observed expansion of generalist mesocarnivore (mid-sized carnivores) distributions in the redwood region.

Martens appear to require dense shrub stand patches of >50-100 ha (124-247 ac.) (Slauson et al. 2007). Where shrub layers have been removed or reduced, fishers and gray foxes - both potential marten predators, have expanded their historic ranges into the previously unoccupied redwood region (Slauson and Zielinski 2007). Conversely, in the remaining old tree conifer stands with intact dense shrub layers

[1] The four marten deaths attributed to other martens were all males, including two juveniles. The carcasses were not eaten, but showed trauma suggestive of fighting. The authors surmised resident male martens engaged in territorial defense were responsible for these mortalities.

See Eriksson et al. in review

Not this case in this area

that Humboldt martens select as preferred habitat, fishers and gray foxes are rarely detected (Slauson 2003, Slauson and Zielinski 2007). Martens showed the strongest preference for stands with ≥80% shrub cover, and avoided stands with <60% shrub cover, while fishers and foxes avoided stands with ≥80% shrub cover and used stands with <60% shrub cover in proportion to their availability (Slauson 2003).

The high predation rates noted in the Pacific marten and Humboldt marten studies above occurred in areas that included intensively-managed forests. Raphael (2004 *in* Slauson et al. 2017) described his study as a "high-harvest" area. Bull and Heater's (2001) 400 km^2 (154 mi^2) study area included a relatively small area (53 km^2) (20 mi^2) of uncut forest surrounded by an area "extensively harvested for timber (approximately 80%) and… fragmented by partial cuts, regeneration cuts, and roads." More than 90% of the Slauson et al. (2014) Humboldt marten dispersal study area had been previously harvested. Managed forests with open overstories, less dense shrub layers, and high road density appear to favor larger-bodied generalist predators such a bobcats, gray foxes, and fishers, which may prey on or kill Humboldt martens (Slauson and Zielinksi 2007, Slauson et al. 2010, Slauson unpublished presentation 2017). Fragmentation of dense shrub stands by roads also appears to confer a competitive advantage to generalist carnivores like fishers, bobcats, and gray foxes, which compete with and prey upon martens. Slauson et al. (2010) found that 80% of camera detections of generalist carnivores such as fisher, gray fox, and bobcats were on roads while 80% of marten detections came from off road areas. Because roads favor generalist predators, crossing roads to move between fragmented patches of habitat means martens are much more likely to encounter a predator than they would be if they were able to remain in dense shrub habitat (Slauson et al. 2010).

A landscape-scale habitat shift has occurred within the Humboldt marten's geographic range since the advent of industrial logging in the 20th century; from large, contiguous old forest stands with extensive dense shrub layers to a more patchy landscape of younger stands with degraded shrub layers divided by road systems. It is thought that small-bodied martens have a competitive advantage over the larger bodied carnivores when foraging and moving through dense shrub stands (Slauson and Zielinski 2007), so this shift in habitat can disadvantage marten while simultaneously favoring larger-bodied generalist carnivores such as bobcats, fishers, and gray foxes. These changes, along with the increased density of roads in the area, have allowed generalist predators to expand their distributions into areas they did not traditionally occupy and prey upon martens at higher rates. Although it is unknown whether predation alone threatens the existence of Humboldt martens in California, adult survival rates are known to be the most influential parameters in marten population growth models (Slauson et al. 2017). Predation rates therefore likely have a potentially significant effect on population growth and abundance.

Competition

No data or studies were identified that assess the impacts of competition between Humboldt martens and other species. The USFWS Humboldt marten species report (2015) does not identify competition as a significant stressor on Humboldt martens. Additionally, species with very specific habitat associations, such as Humboldt marten would be expected have a competitive advantage within their preferred habitat over habitat generalist species in the same area (Ricklefs 1990, Zabala et al. 2009). Further, carnivore species typically select prey species of a certain size as a function of the predator's own mass, effectively limiting competition with smaller and larger carnivores in the same community (Sinclair et al. 2003, Owen-Smith and Mills 2008). In coastal Oregon, Moriarty et al. (2016) detected the following potential competitor predators at camera traps within 5 km (3.1 mi.) of historical marten detections (reported as percent of camera trap sample units with detections): spotted skunk (*Spilogale gracilis*) at 41% of stations, opossum (*Didelphis viriginiana*) at 25% of stations, and short-tailed weasel at 8% of

Barred owl! Holm et al 2016

stations. Of these, only the spotted skunk is similar in size to Humboldt martens (Maser et al. 1981) and it is a habitat generalist, and therefore unlikely to be a significant competitor.

Toxicants

The control of predators and other animals perceived as pests through poisoning was historically common in the western states. Two former methods had the potential to kill non-target predators such as the Humboldt marten: poisoning livestock carcasses and aerial broadcast of poisoned baits. In one report, dead fishers and martens were observed in the vicinity of poisoned ungulate carcasses in Washington State (Zielinski et al. 2001). While such practices had largely ceased by the 1970s, the historical impact on Humboldt marten population size and distribution is unknown but potentially significant. Recently the use of rodenticides and other toxicants at illegal cannabis plantations has been observed to be a widespread practice (Gabriel et al. 2018). Anticoagulant rodenticides detected near cannabis plantations in northwestern California include brodifacoum, bromodiolone, chlorophacinone, diphacinone, and warfarin. Brodifacoum and bromodiolone are considered second-generation anticoagulant rodenticides which were introduced when rodents developed resistance to first-generation compounds in the 1970s (Gabriel et al. 2012, 2013, Thompson et al. 2014). First-generation compounds generally require several doses to cause intoxication, while second-generation anticoagulant rodenticides, which are more acutely toxic, often require only a single dose to cause intoxication or death and persist in tissues and in the environment (Gabriel et al. 2012). Additionally, other highly toxic pesticides, some of which are banned in the United States, have been found at illegal cannabis grow sites (Thompson et al. 2014).

A recent study conducted on Green Diamond Resource Company lands in Humboldt and Del Norte Counties detected anticoagulant rodenticide exposure in the tissues of 70% of northern spotted owls (n=10) and 40% of barred owls (*Strix varia*, n=84) examined, although none of the 36 rodent livers examined had traces of rodenticides (Gabriel et al. 2018). The authors hypothesized a recent increase in cannabis cultivation sites in the study area may have led to the increased use of anticoagulant rodenticides in the area. In an earlier study, Gabriel et al. (2015) detected the presence of anticoagulant rodenticides in the tissues of >85% of the dead fishers tested in California. Within their northern California study area (i.e., Hoopa Valley Indian Reservation) 52 fishers were tested for anticoagulant rodenticide exposure. Seven fishers were confirmed to have died from anticoagulant rodenticide poisoning, all of which had trespass marijuana grows within their home ranges (Gabriel et al. 2015). Because fisher and martens have similar foraging habits and diets, rodenticide exposure likely also poses a significant threat to the Humboldt marten population in California (Slauson et al. 2017). In recent necropsies of deceased Humboldt martens, one out of six carcasses examined showed traces of rodenticides in its tissues (Slauson et al. 2014). Although exposure to rodenticides was not necessarily the cause of death of the exposed animals, the acute toxicity of these compounds makes it likely that the salvaged animals were either directly killed by rodenticides or negatively affected to the extent that death from other causes such as exposure, predation, or starvation became more likely.

Disease

In their Humboldt marten species report (2015), the UFSWS noted: "The outbreak of a lethal pathogen within one of the three coastal marten populations could result in a rapid reduction in population size and distribution, likely resulting in a reduced probability of population persistence, given the small size of these populations." North American martens are known to be susceptible to a variety of diseases, including: rabies, plague, distemper, toxoplasmosis, leptospirosis, trichinosis, sarcoptic mange, canine adenovirus, parvovirus, herpes virus, West Nile virus, and Aleutian disease (Strickland et al. 1982, Zielinski 1984, Williams et al. 1988, Banci 1989, Brown et al. 2008, Green et al. 2008). Although

Strickland et al. (1982) found that American martens in their central Ontario study tested positive for toxoplasmosis, Aleutian disease (a carnivore parvovirus), and leptospirosis; none of the diseases was considered to be a significant mortality factor for martens. Similarly, although Zielinski (1984) discovered antibodies to plague (*Yersinia pestis*) in four of 13 Sierra martens in the Sierra Nevada, he noted martens only appear to show transient clinical signs of the disease. Gray foxes within the current range of Humboldt martens in California are known to have been exposed to canine distemper, parvovirus, toxoplasmosis, West Nile Virus, and rabies, all of which are transmittable to martens (Brown et al. 2008, Gabriel et al. 2012). In their Hoopa Valley Reservation Study, Brown et al. (2008) found dead fisher within the range of Humboldt marten had been exposed to canine parvovirus and canine distemper which is known to cause high rates of mortality in mustelids (Deem et al. 2000). Because several potentially lethal diseases are known from the environment, a disease outbreak in one or both of the remaining Humboldt marten population areas in California should be considered a potential threat to the species. Although it is not known if this threat alone imperils the persistence of the species in California, when combined with the more serious threat of small, isolated populations, habitat loss from wildland fire, cannabis cultivation, timber management, and other threats, the possibility of a catastrophic disease outbreak further reduces the certainty that the Humboldt marten population will persist into the foreseeable future.

Gabriel & Wengert report Dunes

Wildland Fire

Slauson (2003) states that stochastic events such as wildfire present a major challenge to the persistence of Humboldt marten, and Slauson et al. (2017) classified wildfires as a serious threat over a large area of the extant population area in California and Oregon. In the more coastal areas occupied by Humboldt martens, conditions that promote the ignition and spread of wildfire rarely exist due to the typically wet winters and foggy summers of the local climate. However, fires become more frequent in the extant Humboldt marten range with distance inland from the coast (Oneal et al. 2006). By examining the size of recent fires in the extant range, Slauson et al. (2017) concluded that a single large fire could affect 31-70% of the currently occupied suitable habitat in California. Others have concluded that a single wildfire could burn an entire core population area (USFWS 2015). The effects of fires varies with the intensity of the burn and the severity of the impact on the vegetative community; ranging from high severity burns which can kill and consume most vegetation, including large tree structures, to low severity burns which consume only the ground level vegetation, leaving shrub and tree layers largely unaffected (USFWS 2015). Slauson et al. (2017) state that even a low severity burn would be likely to reduce Humboldt marten habitat suitability by reducing shrub cover; however, when a fire burned through approximately 25% of a studied Humboldt marten population area in the interval between surveys in 2008 and 2012, no change in marten occupancy post-fire was detected, indicating that any fire-related impacts the population were slight and/or short lived (Slauson et al. 2017). More recently in the summer of 2015, the Nickowitz fire burned approximately 2,800ha (7,000 ac.) in and adjacent to the current known range of Humboldt martens in Del Norte County, but the impact has not been assessed (InciWeb 2015).

Chetco Bar fire!! 2017

Miller et al. (2012) reported that the annual number of fires, mean fire size, maximum fire size, and area burned all increased in northwestern California over the period of 1910-2008. Miller et al. (2012) also noted that high severity fires tended to be clustered in years when region-wide lighting strikes caused multiple ignitions, indicating that weather conditions in some years are conducive to widespread high severity fires in northwestern California. The effects of wildland fire on the landscape are difficult to predict due to variations in ignition frequency and burn severity based on vegetation type, geography, and weather patterns. However, it is clear that fires have the potential to degrade or destroy Humboldt marten habitat over entire population areas, further reducing the carrying capacity of the landscape and fragmenting populations. Therefore, habitat loss from wildland fire should be considered a potentially significant threat to persistence of the California Humboldt marten population.

Climate Change

The North American continent has already experienced the climatic effects of human-mediated increases in greenhouse gas emissions (USGCRP 2017). The annual average temperature in the contiguous United States has been 0.7°C (1.2°F) warmer over the past 30 years compared to the period 1895-2016, and is projected to further increase to 1.4°C (2.5°F) warmer over the period 2021-2050 (Vose et al. 2017). By the end of the century annual average temperatures are projected to be 1.6°C – 4.1°C (2.8°F – 7.3°F) warmer based on low emissions scenarios, to 3.2°C – 6.6°C (5.8°F – 11.9°F) warmer under high emissions scenarios (Vose et al. 2017).

In northwestern California annual precipitation levels have been 10-15% lower in the last three decades compared to the period 1901-1960 (Easterling et al. 2017). While future precipitation levels in this region are not projected to change radically, the frequency of drought events is projected to increase due to increased evapotranspiration resulting from increasing temperatures (Easterling et al. 2017). Additionally, projected warming of ocean surface temperatures 2.7°C ± 0.7°C (4.9°F ±1.3°F) (Jewett and Romanou 2017) will likely result in reduced daily coastal fog formation.

The Humboldt marten's coastal redwood and Douglas-fir forest ecosystem is characterized by moderate temperatures, high annual precipitation, and summer fog which supports dense conifer tree and shrub cover (Slauson et al. 2007, USFWS 2015). This ecosystem is currently limited in spatial extent to near coastal Oregon and northern California. Climate projections suggest that the coastal zone where precipitation is frequent will narrow in the future (PRBO 2011). The intrusion of coastal fog into inland forests has already been observed to be decreasing in frequency (Johnstone and Dawson 2010), though whether this pattern will continue into the future is unclear (PRBO 2011). Less extensive coastal precipitation, reduced fog intrusion, and globally increasing temperatures together could cause the southern extent of mesic coastal forest to retract northward, further reducing the amount of suitable habitat available to Humboldt martens (USFWS 2015, Slauson et al. 2017). These climatic changes could cause a shift from current conifer dominated vegetative communities to hardwood forests unsuitable to martens, and the dense, shade-tolerant shrub layer required by marten may be lost (USFWS 2015). These vegetation transitions could create conditions more favorable to marten predators and could further fragment the remaining patches of suitable habitat (USFWS 2015). Under moderate emissions scenarios the bioclimatic conditions that support Humboldt marten habitat are projected to reliably occur only in Del Norte County and northern Humboldt County (DellaSalla 2013).

Projected climatic changes could further impact Humboldt martens by changing the fire regime in the range of the subspecies. Miller et al. (2012) reported the number of fires per year, mean fire size, maximum fire size, and area burned all increased in northwestern California over the period 1910-2008 and that observed changes in the local climate explained much of the fire trends. This research demonstrates that the effects of a changing climate may already be impacting Humboldt marten habitat and highlights the link between climate patterns and wildfire trends in northwestern California forests. In the summer of 2015 the Nickowitz fire burned approximately 2,800 ha (7,000 ac.) in and adjacent to the current known range of Humboldt martens (InciWeb 2015). In addition to wildfire-mediated habitat changes resulting from changes in climate, other studies have projected climate-related changes in forest disease, insect damage, and other disturbance events which could affect marten habitat quality or availability (USFWS 2015). Finally, Lawler et al. (2012) suggested that martens (all North American species) will be highly sensitive to climate change and will likely experience the greatest impacts at the southernmost latitudes and lowest elevations within their range.

In a recent modeling study, Stewart et al. (2016) assessed climate change vulnerability to 20 of California's terrestrial mammals, including the Humboldt marten. Their study included three components of climate change vulnerability for each taxon. The first component is the taxon's projected response to future climate change, which is the percent of climatically suitable potential habitat projected to be lost (or added) due to climate change. It is based on the climatic conditions within the historical range and projections of those conditions in future climate scenarios. The second vulnerability component is exposure/niche breadth. This component scores the projected amount of change in climate within the taxon's range, and is expressed as percent change compared to current conditions within the historical range of the taxon. The final component is based on an assessment of the taxon's physical, behavioral, and physiological characteristics that affect its sensitivity and adaptive capacity to respond to climate change. Overall climate change vulnerability was assessed by combining the scores for the three components. Two emission scenarios (high, low) and two global climate models (hot/dry and warm/wet) were used to project four future climates. Overall vulnerability scores were partitioned into five categories, ranging from "may benefit" through "less", "moderately", "highly", and "extremely" vulnerable to future climate change impacts.

Depending on the scenario, the Humboldt marten's vulnerability was assessed to be either less vulnerable (low emission, warm/wet scenario), moderately vulnerable (low emission, hot/dry scenario and high emission, warm/wet scenarios), or highly vulnerable (high emission, hot/dry scenario). By the end of the century, projected habitat conditions at the locations Humboldt martens have been detected to date would remain largely suitable under the low emission, warm/wet scenario (only about 1% loss of suitable locations), but 77% of the locations would become unsuitable under the high emission, hot/dry scenario. The following excerpt from Stewart et al. (2016) summarizes the results from the models:

> Distribution models suggest that the Humboldt marten would benefit (increase area of climatically suitable habitat) under wet climate scenarios, but would be adversely impacted (decrease area of climatically suitable habitat) under drier future climate scenarios. Under the wet scenarios, suitable habitat is projected to increase in extent around the currently suitable areas in the southern portion of its coastal range. Under the hot dry scenarios, suitable habitat on the coast is projected to retract into the core area currently known to be occupied by the subspecies. Distribution models map large areas of suitable climate where the Humboldt marten is not currently known to occur. These include areas in the southern coastal part of the Humboldt marten's presumed historical range, as well as areas within the geographic range of the Sierran subspecies of the Pacific marten (*Martes caurina sierra*). Given the current understanding of Humboldt marten's requirements for forest structure (large decadent trees with cavities for denning, dense shrub layers) that do not occur in much of the coastal forests of northern California, it is not surprising that the species does not currently occur in a large proportion of the coastal area predicted as currently climatically suitable.

In summary, there is relatively high certainty that temperatures will continue to increase within the range of Humboldt martens, which is likely to increase the frequency drought events due to increased evapotranspiration. Although there is less confidence in projected changes in total precipitation, fire regimes, and the distribution of vegetative communities, it is apparent that significant changes are possible within the century. Changes in the distribution and abundance of preferred Humboldt marten habitat could significantly impact the existing Humboldt marten population and limit opportunities for population expansion. Therefore, climate change should be considered a threat to the long-term persistence of the Humboldt marten population in California.

Vehicle Strikes

Mortalities resulting from collisions with vehicles is a documented threat to Humboldt martens, with 17 road kills documented in coastal Oregon by Moriarty et al. (2016). Vehicle strikes were the greatest source of mortality in their Oregon study, although the authors speculated that the impact to the population may be trivial compared to predation, disease, and exposure to poisons, particularly given their small, isolated populations. There have been no recorded roadkill Humboldt martens in California since 1980 (USFWS 2015); however, Highway 101 is a high speed, multi-lane road which transects potentially suitable Humboldt marten habitat in places, and likely would pose a risk to martens attempting to cross (S. Prokop and B. Silver 6/29/2016 letter to CDFW). Slauson et al. (2017) classified the impact of vehicle collisions on Humboldt marten populations as extremely severe, but limited in scope to a few areas where frequently traveled roads intersect marten population areas. The impact of vehicle strikes on the overall Humboldt marten population is unknown. Mortalities from collisions, although apparently not spatially extensive, may combine with mortality from predation, toxicants, and other sources to exceed recruitment rates, at least in localized areas, and limit population viability (USFWS 2015). Linnell et 2018

Small Populations

Small, isolated populations are inherently vulnerable to extinction due to loss of genetic variability; inbreeding depression and genetic drift; reduced genetic capacity to respond to changes in the environment; as well as through demographic stochasticity (changes in age and sex ratios resulting in less than optimal breeding opportunities) due to random variation in birth and death rates (Primack 1993, Reed and Frankham 2003). In studied wildlife populations, genetic diversity is strongly correlated with population fitness (increased survival and reproduction rates) and decreased extinction risk (Hedrick and Kalinowski 2000, Reed and Frankham 2003). The smaller the population size, the more likely other threats will drive it to extinction (Primack 2010).

The only estimate of the Humboldt marten population is that less than 100 individuals exist in California (Slauson et al. 2009b), far below the population size experts believe to be required to ensure long-term viability of a species (Traill et al. 2007, Traill et al. 2010, Flather et al. 2011). The loss of genetic diversity inherent to small, isolated populations can be expected to increase their risk of extinction because small and inbred populations have reduced ability to adapt with changing environments due to diminished pools of potentially adaptive heritable phenotypes (Frankham 2005). Populations of at least several hundred reproductive individuals are believed to be required to ensure the long term viability of vertebrate species, with several thousand individuals being the goal (Primack 1993). However, observations of wild populations indicate that it is possible for small populations to persist, at least in the short term, in the face of genetic challenges, but these observations do not inform the probability or durability of recovery (Harding et al. 2016).

In wild populations, reproductive output and survival vary amongst individuals and from year to year. In large populations this variance averages out, but in small populations this variation, termed demographic stochasticity, can cause the population size to fluctuate randomly up or down (Primack 1993). The smaller the population size the more pronounced the effect. Once a population size drops, its next generation is even more susceptible to further stochasticity and random inequalities in the sex ratio resulting in fewer mating opportunities and a declining birth rate (Primack 1993). Due to their small population size, Humboldt martens may be vulnerable to these effects; however, Slauson et al.

(2017) believe any negative impacts associated with demographic stochasticity would likely be spatially limited in Humboldt martens.

Unpredictable changes in the natural environment and biological communities can cause the size of small populations to vary dramatically where larger, more widely distributed populations would remain more stable because these changes normally occur in localized areas (Primack 1993). For example, unpredictable changes in a species' prey or predator populations, climate, vegetative community, or disease and parasite exposure can cause the size of a small, isolated population to fluctuate wildly, and possibly lead to extinction (Primack 1993). Additionally, natural disasters such as droughts, fires, earthquakes, and severe storms can lead to dramatic population changes if the population is small and localized such that the disaster impacts all or most of the individuals. Although the probability of such events is generally rare in any given year, over the course of generations the probability becomes much greater (Primack 1993). Ecological modeling studies have demonstrated that the influence of random environmental stochasticity has a greater influence on extinction probability than demographic stochasticity (Primack 1993). Environmental and genetic effects can work in concert with each other to seriously threaten small populations. As populations get smaller they become more vulnerable to demographic variation, environmental variations, genetic drift, and inbreeding depression. Each of these effects can amplify the impact of the other effects, further reducing population size and accelerating the species towards extinction in what has been termed an extinction vortex (Primack 1993).

Small populations, and populations that have experienced periods of low population numbers in the past lose genetic diversity and may suffer the effects of inbreeding depression - the concentration of deleterious alleles (maladaptive genes) in the population from the mating of closely related individuals resulting in offspring with reduced fitness (Frankham 2005, Harding et al. 2016). Closely related to inbreeding depression is genetic drift, or the accumulation and fixation of detrimental alleles in in the population due to a limited breeding pool (Hedrick and Kalinowski 2000). In large populations maladaptive genes do not accumulate in the population due to random mate pairings and the elimination of less fit offspring through natural selection. However, in small, isolated populations natural selection can have less of an effect on the population genotype than genetic drift. When this happens deleterious genes can become fixed in the population's genotype resulting in decreased reproductive fitness in all individuals, and potentially negative population growth (Hedrick and Kalinowski 2000, Frankham 2005).

The influence of inbreeding depression on fitness-related traits appears variable across populations, heritable traits, and environments (Hedrick and Kalinowski 2000). Inbreeding depression affects nearly every well studied wildlife species, and contributes to extinction risk in most wild populations of naturally outbreeding species (Frankham 2005). It is uncertain whether inbreeding depression occurs within the California Humboldt marten population, but the small population size and apparent period of isolation from other populations make it likely that significant genetic diversity has been lost (Slauson et al. 2017).

The loss of genetic diversity and the accumulation of deleterious genes can largely be mitigated by the exchange of breeding individuals between population centers (Primack 1993). When individuals migrate from their natal population to new population areas, the novel genes they introduce can balance the effects of genetic drift and inbreeding depression. As few as one migrant per generation in a population of 120 individuals could negate the effects of genetic drift (Primack 2010). Consequently, habitat fragmentation can seriously increase the genetic risks to isolated subpopulations, and habitat connectivity between populations can substantially mitigate these risks.

While the genetic risks associated with small populations may significantly increase a population's risk of extinction, it is important to note that a small population size alone is not necessarily predictive of population viability over time. A well planned conservation strategy can substantially mitigate risks associated with small populations. A comprehensive plan for long term viability should include the principles of representation, resiliency, and redundancy (Shaffer and Stein 2000, Wolf et al. 2015). These principles require recovered species be present in multiple large populations across the entire spectrum of habitats used by the species, and these populations must also be resilient to environmental changes, identified threats, and genetic threats (Wolf et al. 2015). The California Humboldt marten population, numbering less than 100 individuals, is currently highly exposed to the environmental and genetic risks inherent to small populations; however, a carefully designed program of habitat protection, connection, as well as the possibility of facilitated translocations could connect isolated breeding populations, increase the number of populations, and decrease these risks.

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Research and Handling

Wildlife research in California is regulated through the state's Scientific Collecting Permit program (Fish & Game Code § 1002 et seq.). The program requires researchers to disclose their study design, wild animal handling protocols, and demonstrate their professional experience with the species of interest. Notwithstanding this oversight, mortalities are a risk of any wildlife research that requires the capture and handling of live animals. In early 2016, a Humboldt marten in California died of exposure in a trap set by researchers when a pre-baited trap was inadvertently left open and not checked again for several days. This incident is the only documented research-related Humboldt marten mortality in California despite the fact that dozens of martens have been captured and fitted with radio collars to date. Additionally, species experts believe it is unlikely that research would be conducted on more than 10% of the Humboldt marten population at any one time (Slauson et al. 2017). Therefore, it is unlikely that research and handling presents a significant threat to the population.

EXISTING MANAGEMENT

Land Ownership within the California Range

In California, the majority of the land within the Humboldt marten's range is owned and managed by the U.S. Forest Service, with smaller portions owned and managed by the Yurok Tribe, Green Diamond Resource Company, and State and National Redwood Parks (Figure 7). Land management strategies and practices vary across and within ownerships.

National Forest Lands

The U.S. Forest Service manages the majority of the land within the marten's range on the Six Rivers and Klamath National Forests. As mentioned in the Conservation Status Section, on Forest Service lands in Region 5 (California), the Humboldt marten is designated as a Sensitive Species. Management projects subject to the National Environmental Policy Act (NEPA) must analyze impacts to the Sensitive Species; however, there is no requirement to minimize or mitigate project impacts to the species. National Forest lands in northern California are managed under the Northwest Forest Plan (USDA and USDI 1994) which sets land management guidelines according to seven allocations: Congressionally Reserved Areas, Late Successional Reserves, Managed Late Successional Areas, Adaptive Management Areas, Administratively Withdrawn Areas, Riparian Reserves, and Matrix lands. Matrix lands units are intended for timber harvest, yet Slauson (2003) detected Humboldt marten on Matrix lands in 8 out of 31 sample units, and 20% of Slauson et al.'s (2007) analysis area was designated as Matrix land available for logging with 16% of the Matrix land previously logged. Late Successional Reserves (LSR) are intended to support viable populations of late successional and old-growth dependent species such as spotted owls and Humboldt martens. However, logging is not prohibited in this land allocation class, and not all LSRs are currently in a late successional condition, but rather managed to grow into late successional habitat and therefore may not currently provide Humboldt marten habitat. Forty percent of Slauson et al.'s (2007) study area was designated LSR, with martens detected in 13 of 66 sample units in LSR; 13% of the land designated LSR in the marten's range has been logged (Slauson et al. 2007). The Humboldt marten was given only a 67% likelihood of remaining well distributed within the range of the northern spotted owl (*Strix occidentalis caurina*) by the Northwest Forest Plan scientific analysis team (USDA and USDI 1994). Slauson et al. (2009b) concluded that the Northwest Forest Plan does not completely protect the extant population, with 38% of the Humboldt marten distribution occurring outside of NWFP reserves.

Forest management on individual national forests is governed by Land and Resources Management Plans (LRMP). The LRMP for the Six Rivers National Forest, where much of the extant Humboldt marten population is located, includes provisions to protect known active Pacific marten den sites and the surrounding habitat within 152 m (500 ft.) from disturbance and land-altering activities. However, there is no requirement to conduct pre-project surveys for martens, so there is little probability that active marten dens would be detected and subsequently protected, leaving denning martens and their habitat outside of protected land allocations vulnerable to disturbance and destruction (Six Rivers National Forest 1996).

A small portion of the Humboldt marten range is contained within the Siskiyou Wilderness Area, and only a portion of the wilderness area is composed of vegetation suitable for martens. Slauson (2003) detected martens on only 3 out of 23 sample units located in Siskiyou Wilderness. The U.S. Forest Service also manages the Smith River National Recreation Area (SRNRA), which covers a small portion of the marten's range. The SRNRA is not vulnerable to logging, but management of the area prioritizes recreation over wildlife values.

Redwood National and State Parks Management

State and National Park Service land in the Humboldt marten range includes the Redwood National Parks Complex consisting of Redwood National Park, Prairie Creek Redwoods State Park, Jedediah Smith Redwoods State Park, and Del Norte Coast Redwoods State Park. These parks are managed by the National Parks Service and California Department of Parks and Recreation (California State Parks) and total over 53,412 ha. (131,983 ac.) in northwestern California, of which approximately 30% is currently composed of old-growth forest. Forests in state and national parks are not subject to harvest, except where younger stands are managed to more rapidly develop old-growth characteristics (Slauson et al. 2017). The General Plan/General Management Plan governing the management of the parks does not identify specific management actions for Humboldt martens. Approximately 33% of the Park lands are managed as primitive zones where no development or facilities construction occurs and visitor use is limited to foot traffic on existing trails. An additional, 55.4% of the Park lands are managed as backcountry zones where the preservation and restoration of the natural environment is emphasized, and modification of the environment related to visitor use is limited. Where suitable marten habitat exists within these management zones, it is likely maintained and protected from significant modification and degradation (USDI NPS and California State Parks 2000).

As of 2010, State and National parks had removed over 350 km of roads and thinned 4-6% of the second growth stands within their boundaries (Slauson et al. 2010). Prairie Creek Redwoods State Park had at least one Humboldt marten detection each year from 2009-2013, and again in 2017, although it does not appear to currently support a viable reproducing marten population (K. Slauson pers. comm. 10/10/2017).

Private and Tribal Lands

The largest private land owner within the contemporary Humboldt marten range is the Green Diamond Resource Company, which manages approximately 151,000 ha (373,000 ac) primarily in Humboldt and Del Norte Counties, California (Green Diamond Resource Company 2017). Although only a small fraction of the ownership is within the contemporary range of the Humboldt marten, an important portion lies between the core population area and potentially suitable coastal habitat in the Redwood State and National Parks (Figure 7), although much of this area was recently transferred to the Yurok Tribe. Green Diamond lands are dominated by redwood forest in coastal and low elevation areas and by Douglas-fir as elevation and distance from the coast increase. Hardwoods are common in all forest types and in places compose the majority of the stand (Green Diamond Resource Company 2012). Most of the ownership has been logged at least once over the last century and now consists of second and third growth stands from recently harvested to 120 years old (Hamm et al. 2012). Small old growth forest areas which have never been logged are scattered throughout the ownership and total 150 acres of redwood and 300 acres of Douglas-fir, comprising less than 2% of Green Diamond Resource Company land. Green Diamond operates under a Maximum Sustained Production Plan approved pursuant to a provision of California Code of Regulations, Title 14, Section 913.11 subdivision (a) ("Option A") filed with the CAL FIRE. The Option A plan is intended to balance forest growth and timber harvest over a 100 year period. With some exceptions, Green Diamond plans to practice even-aged silviculture management on the ownership using clear-cutting as the primary harvest/regeneration method. Conifer stands are typically thinned 10-20 years after planting, again after 30 years, and harvested at or after 45 years in clear cuts of 16 ha (40 ac.) or less. Streamside zones, steep slopes, and special habitat areas are managed differently, including single tree selection harvest and retention for wildlife values (Green Diamond Resource Company 2012). At least 10% of the pre-harvest basal area is typically retained in streamside zones, habitat areas, and scattered trees to retain forest structural elements through the harvest rotation. Regeneration involves prescribed burning, mechanical slash treatment, tree planting, and the control of competing vegetation with herbicides (Green Diamond Resource Company 2012).

Green Diamond has periodically surveyed their lands for the presence of fishers and martens, including surveys in 1994-1995 and 2011-2012 (Hamm et al. 2012). No Humboldt martens were detected in the earliest surveys (1994-1995); however, in a repeat survey in 2004-2005 a marten was detected on Green Diamond land west of a known Humboldt marten population on public lands, and detected again in 2006. In 2010-2011 camera station surveys on Green Diamond lands detected martens at 14 stations, some co-occurring with fishers. This series of surveys indicates that martens are a persistent presence on Green Diamond lands (Hamm et al. 2012). Green Diamond has partnered with the United States Department of Agriculture's Forest Service Redwood Sciences Lab to conduct research on the species since 2012 (K. Hamm pes. Comm. Oct. 24, 2017). As of 2016, 33 Humboldt martens have been captured, and 24 fitted with radio collars to study habitat use and den site characteristics in this joint study (Early et al. 2016). Most of the land covered by these surveys and studies was recently acquired by the Yurok Tribe through land purchases in 2011 and 2018.

n=33 captured in less than suitable habitat THEREFORE pop. estimate of 24 most ... an underestimate. Nonetheless, martens appear highly restricted and vulnerable. California would benefit from a more robust population estimate

Green Diamond Resource Company manages most of its land under the conditions of two federally-approved Habitat Conservation Plans (HCPs), one for the northern spotted owl and the other for anadromous salmonid fish. The HCPs allow for incidental take of listed species and may deviate from Forest Practice Rule guidelines for species covered under the HCPs. Under Section 10(a) of the ESA, incidental take, defined as take that is incidental to, and not the purpose of an otherwise lawful activity, may be authorized for federally threatened and endangered species covered under an approved HCP. For both HCPs, the Department has determined that the federal Incidental Take Statement is consistent with CESA pursuant to Fish and Game Code section 2080.1. Although neither HCP specifically covers Humboldt marten, the plans are designed, in part, to retain and recruit larger tree structure which may improve marten habitat suitability on company lands over time. During development of the northern spotted owl HCP Green Diamond prepared a 30-year timber stand age-class forecast model. The age-class forecast covered 1991 through 2021, and assumed timber harvest would occur at an annual rate of 3,000-6,000 acres. Results indicated that second-growth stands in the 46+ year age-class would more than double, the 31-45 year age-class would increase by approximately 50,000 acres in first 10 years then return to 1991 levels, and the 8-30 year age-class would generally decrease over time.

Fish and Game Code sections 2089.2 through 2089.26 allow the Department to authorize incidental take of a species listed as endangered, threatened, candidate, or a rare plant, through a Safe Harbor Agreement (SHA) if implementation of the agreement is reasonably expected to provide a net conservation benefit to the species, among other provisions. SHAs are intended to encourage landowners to voluntarily manage their lands to benefit CESA-listed species without subjecting those landowners to additional regulatory restrictions as a result of their conservation efforts. In addition, at the end of the agreement period, participants may return the enrolled property to the baseline conditions that existed at the beginning of the SHA. Green Diamond Resource Company has voluntarily applied for a Humboldt marten SHA; however, until the SHA is approved, it is not possible to describe or quantify the benefits to the Humboldt marten population that will result from the agreement.

The other significant land owner within the range of the Humboldt marten is the Yurok tribe which owns approximately 23,876 ha (59,000 ac.) of land in or near the Humboldt marten range. The Tribe also manages an additional 1,528 ha (3,776 ac.) of federal land held in trust for the Tribe (Yurok Tribal Information Services website accessed October 25, 2017).

Yurok Tribal objectives for the management of Tribal lands include: Establishment of a regular, periodic, long term sustained yield of timber products, generation of Tribal income and employment from timber sales, limiting the use of clear cutting and eliminating the use of herbicides, protecting and enhancing areas considered culturally significant, acquisition of lands (including cutover lands) to increase the Tribal land base, protection and enhancement of fisheries, use of prescribed burning when possible, generating Tribal income from the sale of carbon credits, and providing oversight and professional expertise on the best way to utilize Tribal forestland for non-timber use. To achieve these goals, the Yurok primarily use uneven-aged silviculture practices (harvest of individually selected trees and small groups rather than large clear cuts) (Yurok Tribal Forestry 2012). A specific goal of Yurok Tribal forest management is the protection of Humboldt marten dens and large tree and brush cover habitat across the landscape (E. Mann pers. comm. 10/25/2017).

Both Green Diamond Resource Company lands and Yurok Tribe fee lands are subject to the Z'berg – Nejedly Forest Practices Act of 1973 (Pub. Resources Code, § 4511 et seq.) and the California Forest Practice Rules (chapters 4, 4.5, and 10, Title 14, CCR), which are administrated by the California Department of Forestry and Fire Protection (CAL FIRE). The California Forest Practice Rules specify that an objective of forest management is the maintenance of functional wildlife habitat in sufficient condition for continued use by the existing wildlife community within planning watersheds (§ 897(b)(1)(B), Title 14, CCR). This language may result in actions on private lands beneficial to martens. Nevertheless, specific guidelines to retain habitat for martens are not provided in the Forest Practice

Rules. Further, this guidance would at best conserve habitat where Humboldt martens are known to exist, but would not be expected to result in the creation of additional habitat. Additionally, section 919.16 of the Forest Practice Rules requires landowners to provide CAL FIRE with information when late successional forest stands are proposed for harvesting if the harvest will "significantly reduce the amount and distribution of late successional forest stands or their functional wildlife value so that it constitutes a significant adverse impact on the environment". However, this rule does not specify protective or mitigation measures to offset potentially significant impacts associated with late successional forest loss.

Habitat suitable for martens may be retained within Watercourse and Lake Protection Zones (§ 916 et seq., Title 14, CCR) on private timberlands. Watercourse and Lake Protection Zones are defined areas along streams where the Forest Practice Rules limit the amount of timber harvested in order to protect in-stream habitat quality for fish and other resources. Harvest restrictions and retention standards vary according to the presence of anadromous and other fish species, as well as other aquatic life forms. These zones may encompass 15-45 m (50-150 ft.) on each side of a watercourse, 30-91 m (100-300 ft.) in total width depending on side slope, location in the state, and the watercourse's classification. Within Watercourse and Lake Protection Zones, the prescriptions vary by watercourse classification. For fish bearing streams (Class I watercourses), the retention standards vary from 50- 80 % overstory canopy (depending on distance to the watercourse) and include leaving a multi-storied stand composed of a diversity of species similar to that found before the start of timber operations. For watersheds that fall within Anadromous Salmonid Protection rules (§§ 916.9, 936.9, and 956.9, Title 14, CCR), the 13 largest trees per acre (live or dead) must also be retained within Class I Watercourse and Lake Protection Zone. For non-fish bearing streams (Class II watercourses), Watercourse and Lake Protection Zone retention standards vary from 50 % total canopy to 80% overstory canopy depending on the type and location of the watercourse.

MANAGEMENT RECOMMENDATIONS

The Department has evaluated existing management recommendations and available literature applicable to the management and conservation of the Humboldt martens to arrive at the following recommendations. The recommendations largely derive from *The Humboldt Marten Conservation Assessment and Strategy* (Slauson et al. 2017). The Department recognizes the scientific expertise and judgement of the Executive Team that developed the Strategy, and deems the information provided a reliable synthesis of current scientific literature on the species, thus constituting the best available science.

Habitat Protection, Management, and Restoration

Given the many conservation challenges identified for the Humboldt marten, achieving the goal of recovering and maintaining sustainable reproductive marten populations in California necessitates cooperation and support among government and private land managers. Achieving the overarching goal of Humboldt marten population recovery and persistence necessitates managing the landscape toward habitat conditions suitable for marten occupancy within much of their historic range. Specific management objectives can be further refined within the following Conservation Emphasis Areas (CEAs) from Slauson et al. (2017) (Figure 4).

Extant Population Areas (EPA)

EPAs are areas where five or more Humboldt marten detections have been documented since 1980 that are no more than 5 km (3.1 mi.) from the nearest neighboring detection. These clusters of detections are then buffered to include 2 km (1.24 mi.) of the surrounding landscape.

1. Design land management activities in and adjacent to EPAs to maintain conditions characterized as highly suitable marten habitat[2], and where feasible, improve habitat conditions in areas of moderate and low suitability

2. The current extent of the two California EPAs is 81,182 ha (202,162 ac.), which is 3.9% of the historic range; however, a habitat suitability model developed by Slauson et al. (in press) classifies 15,566 ha (38,464 ac.) of this extent as currently unsuitable for marten occupancy. Assess areas classified as unsuitable habitat within EPAs for their potential to be managed toward conditions characterized as high suitability marten habitat.

3. Continue surveys for the Humboldt marten where large patches of suitable habitat exist within their historical range, and as new detections are documented, EPAs should be re-assessed periodically to include new detections, following methods described in the Conservation Strategy (Slauson et al. 2017).

4. Identify high priority areas for restoration within EPAs based on their potential for connecting fragmented suitable habitat patches.

5. Evaluate whether major roads within EPAs fragment suitable habitat patches, create major barriers to marten movement, or pose a substantial collision risk to crossing martens. Consider installation of wildlife crossing structures where appropriate.

6. Protect currently suitable resting and denning structures within EPAs (i.e.,large snags and downed logs) and manage forest stands to ensure continual recruitment of structures.

7. Protect current dense shrub layers within EPAs, and plan for the regeneration of shrub layers when it can benefit marten habitat suitability, particularly if required after a low intensity fire event.

Population Re-establishment Areas (PRA)

PRAs are areas within the Humboldt marten historical range which currently do not contain self-sustaining populations, and where recovery actions are required to accelerate the recolonization of self-sustaining marten populations. For a PRA to support a self-sustaining population, the amount of contiguous suitable marten habitat should be greater than 1,500 ha (3,707 ac.), which corresponds to the estimated area capable of supporting five or more female home ranges. Based on these criteria, Slauson et al. (2017) identified four potential PRAs within California (Figure 4), which should be considered for immediate Humboldt marten population recovery.

[2] Briefly, areas with high precipitation levels and a high Old Growth Structural Index (many large trees and snags and high tree size diversity), or serpentine soils (see Slauson et al. in press for details).

8. Manage habitat with the PRAs towards a landscape condition that is suitable to sustain Humboldt martens.

9. Where major roads (e.g. highways 101, 199, and 299) separate PRAs from EPAs and may act as barriers to marten dispersal, evaluate the availability of existing structures such as bridges, large culverts, and overpasses which could be used by martens to safely cross. Where such structures are limited, work with state and federal highway agencies to plan and install state of the art wildlife crossing structures.

10. Once a PRA is determined to have a sufficient amount of suitable habitat, assess it to determine if population recolonization would require human assisted dispersal, or whether natural dispersal of animals is a reliable means for recolonizing the PRA.

Landscape Connectivity Areas (LCA)

Providing dispersal habitat that Humboldt martens may use to move safely between an EPA to restored habitat in a PRA is critical for recolonizing newly restored habitat, and within a metapopulation context, provides essential connectivity for gene flow to occur between extant marten populations. LCAs are characterized by low potential to develop suitable reproductive marten habitat but capacity to provide functional dispersal zones. Currently, only one LCA has been identified in California, and it lies in a critically important dispersal zone between the southernmost EPA and the restorable 1,430 km^2 (552 mi.^{2}) Redwood-Prairie Creek PRA extending into Humboldt County (Figure 4). Unfortunately, suitable habitat conditions for an LCA are poorly understood, and additional research is needed to better understand functional dispersal habitat requirements for the Humboldt Marten.

11. Avoid actions within the LCAs which could permanently restrict the ability of Humboldt martens to move between EPAs and PRAs.

Wildland Fire

Given that the current distribution of extant Humboldt marten populations in California is limited to two relatively small EPAs occupying < 5% of the species' historical geographic range, large catastrophic fires have the potential to severely impact up to 70% of occupied suitable habitat in California over the next 15 years (Slauson et al. 2017). Moriarty et al. (2017) found that treating as little as 10-20% of the landscape with mechanical or prescribed fire fuel reduction treatments can significantly reduce the risk of Pacific marten habitat loss.

12. Design and implement fuel management prescriptions to reduce the wildfire risk to EPAs and PRAs. Prescriptions should preserve important Humboldt marten habitat elements like dense shrub understories, abundant large snags, dead and dying trees and downed logs in occupied habitat to the greatest degree possible while achieving risk reduction goals.

13. Expand the range and increase the resiliency of Humboldt marten populations in California, including managing for multiple large EPAs connected by LCAs to reduce the risk of a substantial loss of the current extant marten population due to a single catastrophic fire.

Research, Surveys, and Monitoring

14. Research is needed to determine whether the Humboldt marten's small population size has resulted in a loss of genetic diversity, and whether the subspecies is at risk of population declines due to

Wilk + Raphael 2017

reduced fitness affecting their ability to evolve and adapt to environment changes due to climate change and other causes.

15. Determine the extent to which Humboldt marten populations in California and Oregon interbreed and quantify the genetic contribution to California populations from animals dispersing from Oregon.

to ?

← I'm guessing CA is the source population into southern Oregon but there's no reason to believe animals are restrict

16. Conduct surveys to determine if Humboldt martens occur in shore pine habitat in California, as found in Oregon.

Eriksson et al in Review
Pilgrim et al in review
Wilk + Raphael (2017)

17. Develop and implement consistent survey and monitoring strategies that reliably produce metrics on population size, distribution, and trends.

18. Develop a better understanding of specific silvicultural practices that result in high suitability habitat for the Humboldt marten and its prey species.

19. Study and develop siliviculture techniques in early seral stands which discourage occupancy by marten predators while recently harvested or burned stands are regenerating.

20. Study the lethal and sub-lethal effects of rodenticides and other toxicants on Humboldt martens, model potential population effects, and work to reduce sources of exposure.

21. Identify the impact diseases have on Humboldt marten fitness and mortality, and work to reduce sources for exposure.

22. Continue to collect demographic parameters of extant marten populations, and identify key parameters affecting population growth and persistence.

23. Study habitat relationships of the primary marten predators (i.e., bobcats), and identify management options that reduce predator abundance and distribution within marten habitat (e.g. restorative thinning to stimulate shrub growth and road removal).

SUMMARY OF LISTING FACTORS

Seems like they fit the bill based on cummulative evidence

CESA directs the Department to prepare this report regarding the status of the Humboldt marten based upon the best scientific information available to the Department. CESA's implementing regulations identify key factors that are relevant to the Department's analyses. Specifically, a "species shall be listed as endangered or threatened ... if the Commission determines that its continued existence is in serious danger or is threatened by any one or any combination of the following factors: (1) present or threatened modification or destruction of its habitat; (2) overexploitation; (3) predation; (4) competition; (5) disease; or (6) other natural occurrences or human-related activities." (§ 670.1(i)(1)(A), Title 14, CCR.). The definitions of endangered and threatened species in the Fish and Game Code provide key guidance to the Department's scientific determination. An endangered species under CESA is one "which is in serious danger of becoming extinct throughout all, or a significant portion, of its range due to one or more causes, including loss of habitat, change in habitat, over exploitation, predation, competition, or disease." (Fish & Game Code, § 2062.) A threatened species under CESA is one "that, although not presently threatened with extinction, is likely to become an endangered species in the foreseeable future in the absence of special protection and management efforts required by [CESA]."

(*Id.*, § 2067). The following summarizes the Department's determination regarding the factors to be considered by the Commission in making its decision on whether to list the Humboldt marten. This summary is based on the best available scientific information, as presented in the foregoing sections of the report.

Present or Threatened Modification or Destruction of Habitat

The geographic range of the Humboldt marten has retracted to less than five percent of the extent documented by naturalists in the early 20th Century. Although historical trapping pressure is implicated in the initial decline of the species in the state, today the species population is limited by the amount, distribution, and quality of its remaining preferred habitat. Historical and ongoing management for timber production threatens the species by removing, degrading, and fragmenting the dense shrub layers and large tree structures the species is dependent upon for cover, denning, and foraging. Some portions of the remaining occupied habitat are protected by wilderness and other land use designations, but large areas remain vulnerable to continued timber harvesting and other uses which can fail to retain required habitat elements on the landscape. Until additional areas of suitable forest habitat are allowed to develop with careful management and the passage of time, the limited extent of suitable habitat will continue to prevent recovery of the California Humboldt marten population.

Overexploitation

Intensive trapping pressure during the late 19th and first half of the 20th centuries appears to have significantly reduced the Humboldt marten population and the species' distribution in the state. However, due to changes in trapping laws and practices, overexploitation no longer threatens the species in California.

Predation

Predation is a significant cause of Humboldt marten mortality in California populations. While predation is natural in wildlife communities, predation rates by larger predators may be elevated in landscapes managed for timber production. It is uncertain how predation rates relate to reproductive rates of Humboldt marten on managed landscapes. Whether predation by larger predators may constitute a primary threat to Humboldt marten populations on managed landscapes is a hypothesis that warrants examination with further research.

Competition

There is no indication in the available information to indicate that competition poses a substantial threat to Humboldt marten populations in California.

Disease

Although there is little available information on disease rates and associated mortality in Humboldt marten populations, the presence of highly virulent diseases has been documented in the occupied range. Because Humboldt marten populations are small and isolated, a virulent disease outbreak in one or more core population area could seriously threaten the statewide population. However, the probability of such an outbreak is difficult to predict.

Other Natural Events or Human-Related Activities

Small Populations

In California the Humboldt marten population is believed to be less than 100 individuals distributed in two core population areas. Populations of this size are vulnerable to inherent genetic and environmental threats including, inbreeding depression, demographic stochasticity, environmental stochasticity, and loss of genetic diversity. These effects can result in decreased reproductive output, inability to adapt to changing environmental conditions, concentration of maladaptive genetic traits, and other deleterious effects. Small, isolated populations are also at inherently at greater risk of extinction due to environmental events such as wildfires and disease outbreaks. Small population effects can interact with other threats (such as disease, toxicants, climate change, and others) synergistically to amplify the negative impacts on the Humboldt marten population. While these small population effects almost certainly impact the California Humboldt marten population, research would be required to quantify the degree to which these effects threaten the persistence of the population.

<u>Wildland Fires</u>
Because the California Humboldt marten population is small, and isolated to a small geographic range, a single ~~catastrophic~~ wildfire has the potential to significantly impact the population size and range. Fires can destroy the dense shrub understories and large tree structures martens depend on for cover, denning, and foraging. Additionally, fires have the potential to further fragment the remaining habitat. Although it is impossible to predict the timing and location of wildfires, it is likely that fires will impact Humboldt marten habitat in northwestern California in the foreseeable future. The degree to which wildland fires threaten the persistence of the California Humboldt marten population is unknown.

<u>Climate Change</u>
Past and ongoing changes to the north coast climate such as rising temperatures, declining precipitation, and decreased daily fog will likely result in long term changes to the vegetative community in the region. How these changes will impact the preferred habitat of Humboldt martens is difficult to predict, but some modeling studies indicate that the geographic extent of suitable marten habitat is likely to retract northward in California. While there is a high degree of confidence in projected warming trends, and less certainty in projected precipitation changes, the degree to which these changes will threaten Humboldt martens in the foreseeable future is unknown.

<u>Toxicants</u>
Although there is little available information on Humboldt marten exposure to toxicants, the presence of highly toxic anticoagulant rodenticides and other pesticides is well documented within the California range. These compounds are known to frequently kill closely related fishers in northwestern California; however, the degree to which toxicant exposure threatens the Humboldt marten population is unknown.

LISTING RECOMMENDATION

CESA directs the Department to prepare this report regarding the status of the Humboldt marten in California based upon the best scientific information. CESA also directs the Department, based on its analysis, to indicate in the status report whether the petitioned action is warranted. (Fish & Game Code, § 2074.6; § 670.1(f), Title 14, CCR). In addition to evaluating whether the petitioned action (i.e., listing as endangered) was warranted, the Department considered whether listing as threatened under CESA was warranted. The Department includes and makes its recommendation in its status report as submitted to the Commission in an advisory capacity based on the best available science. In consideration of the scientific information contained herein, the Department has determined that historic and ongoing habitat loss, fragmentation and associated elevated predation rates, coupled with unquantified, but potentially significant ongoing impacts to the species from a small population size, disease, toxicants, wildfire, and climate change, warrants listing the Humboldt marten as threatened under CESA.

Protection Afforded by Listing

It is the policy of the State to conserve, protect, restore and enhance any endangered or threatened species and its habitat (Fish & Game Code § 2052). The conservation, protection, and enhancement of listed species and their habitat is of statewide concern (Fish & Game Code § 2051(c)). CESA prohibits the import, export, take, possession, purchase or sale of any species the Commission determines is endangered or threatened (Fish & Game Code, § 2080 et seq.). CESA defines "take" as hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill (Fish & Game Code, § 86). The Fish and Game Code authorizes the Department to allow "take" of species listed as threatened or endangered under certain circumstances through incidental take permits, memoranda of understanding, natural community conservation plans, safe harbor agreements, or other plans or agreements approved by or entered into by the Department (Fish & Game Code, §§ 2081, 2081.1, 2086, 2087, 2089.2, and 2835).

If the Humboldt marten is listed under CESA, impacts of take caused by activities authorized through incidental take permits must be minimized and fully mitigated according to state standards. These standards typically include protection of the land in perpetuity with an easement, development and implementation of a species-specific adaptive management plan, and funding through an endowment to pay for long-term monitoring and maintenance to ensure the mitigation land meets performance criteria. Additionally, the Department is prohibited from approving incidental take permits which could jeopardize the continued existence of the species in the state (Fish & Game Code, § 2081(b)(4)). Obtaining an incidental take permit is voluntary. The Department cannot force compliance; however, any person violating the take prohibition may be punishable under state law.

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

Although the protections afforded listed species by CESA do not apply to the actions of federal management agencies on federal lands, CESA listing may prompt increased interagency coordination and the likelihood that state and federal land and resource management agencies will allocate funds toward protection and recovery actions. In the case of the Humboldt marten, the Humboldt Marten Working Group signatory agencies already meet and coordinate regularly, but a state listing could result in increased availability of conservation funds.

Economic Considerations

The Department is not required to prepare an analysis of economic impacts (Fish & Game Code, § 2074.6).

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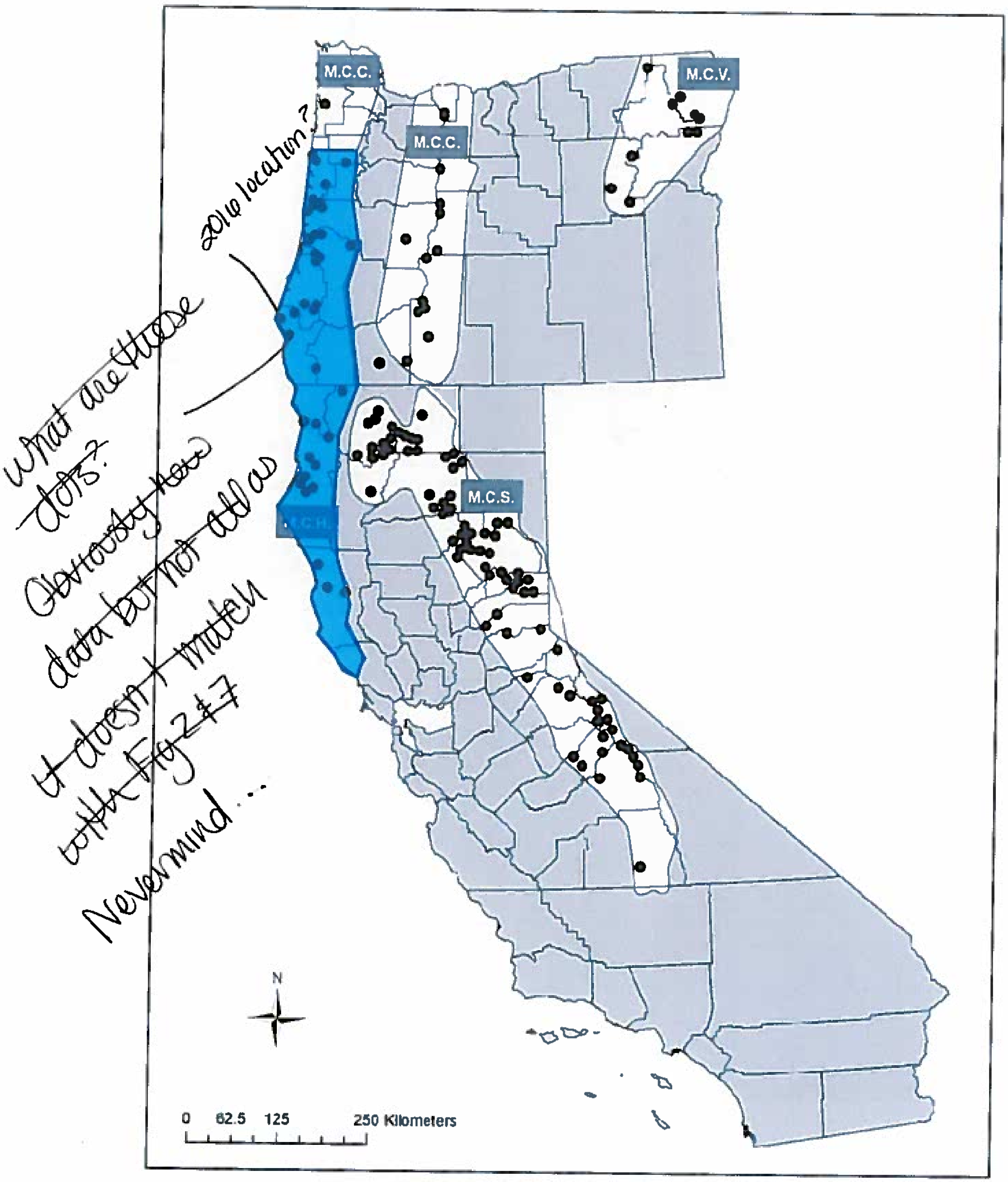
LIST OF FIGURES


M.C.C.
M.C.V.
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M.C.S.
C.H.
N
0 62.5 125 250 Kilometers
2016 location?
What are these ~~dots?~~
~~Obviously have data but not all as it doesn't match with Fig 2 & 7~~
Nevermind...

Figure 1.

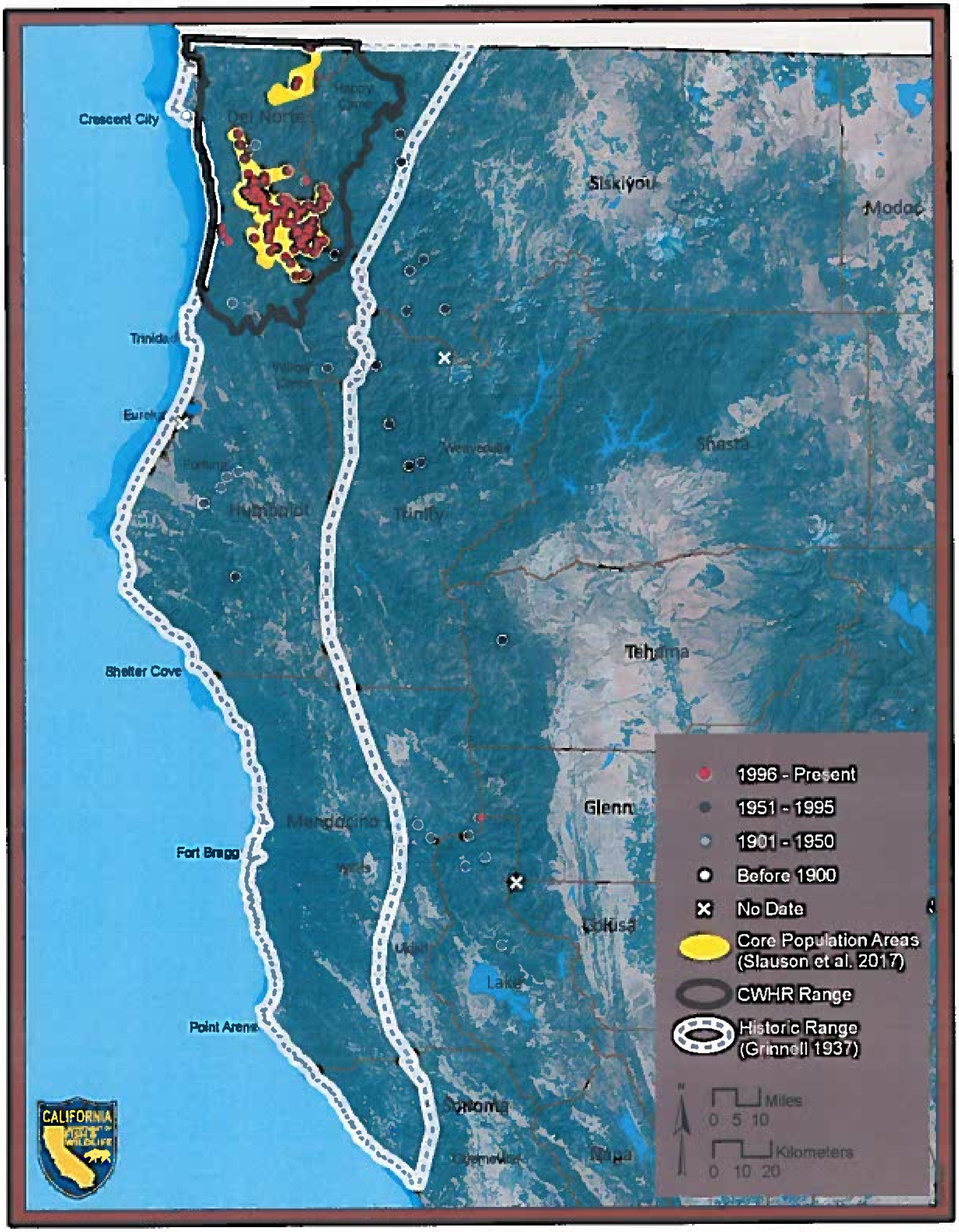
Crescent City
Del Norte
Happy Camp
Siskiyou
Modoc
Trinidad
Willow Creek
Eureka
Fortuna
Humboldt
Weaverville
Trinity
Shasta
Tehama
Shelter Cove
Glenn
Mendocino
Fort Bragg
Willits
Colusa
Ukiah
Lake
Point Arena
Sonoma
Napa
1996 - Present
1951 - 1995
1901 - 1950
Before 1900
No Date
Core Population Areas
(Slauson et al. 2017)
CWHR Range
Historic Range
(Grinnell 1937)
Miles
0 5 10
Kilometers
0 10 20

Figure 2.

Hi Dan-

Sorry for the delay getting this back to you. Overall, the status report was well done and Thorough. I greatly appreciate you and the Department's use of the HMCG's Conservation Assessment and Strategy throughout the review. I have included my major comments On the attached cover letter and minor comments and suggested edits in track changes In the attached word version of the review I was sent. I will follow this e-mail with two New publications that you can incorporate into the final version of the review.

Sincerely,

Keith

Keith Slauson, Ph.D.
Research Fellow
USDA Forest Service
Pacific Southwest Research Station
Arcata, CA 92251
[redacted]

USDA United States Department of Agriculture | Forest Service | Redwood Sciences Laboratory | 1700 Bayview Drive
Arcata, California 95521
Phone: (707) 825-2900
Fax: (707) 825-2901

Date: 22 April 2018

Subject: Review of CDFW 's Status Review of the Humboldt Marten

To: Kari Lewis, Dan Applebee

Dear Kari and Dan,

Thank you for the opportunity to review the draft report to the Fish and Game Commission entitled "A Status Review of the Humboldt Marten (*Martes caurina humboldtensis*) in California". Overall the report was well researched and contained and considered most of the relevant research pertaining to the Humboldt marten and related species. The report acknowledged and adopted many of the conservation recommendations and directions of the Humboldt Marten Conservation Group expressed in the recently completed Humboldt Marten Conservation Assessment and Strategy. These are both strong points of the status review and overall it was well done. However, conspicuously absent, unless I missed it, is any reference to the Department's own update to the Mammal Species of Special Concern where the Humboldt marten was ranked as the #2 mammal of conservation concern throughout California. Below I have included a few overall major and minor comments below and have added more detailed comments and suggested edits and additions in track changes on the word version sent to me.

Major Comments:

<u>Rationale for Recommendation for Listing as Endangered versus Threatened</u>. While it is clear that there is justification for listing the Humboldt Marten as either Endangered or Threatened based on the information presented in the status review, the rationale for recommending listing as Threatened versus Endangered is unclear and the summaries of the risk factors appear biased toward umbiguity rather than balancing summarizing what is known versus unknown. Missing in the summary of the Department's determination of the factors to be considered by the Commission is any reference the amount of time necessary to regenerate 'suitable forest habitat' and how frequently the other major risk factors are likely to occur over those time periods. For example, in most cases suitable forest habitat conditions will take decades to restore in older harvested stands or in mid seral un-managed stands. During each decade it is likely that 1-2 fires with burn in each extant population area, as they have in each over the last 15 years in both California extant population areas, and that 1-2 epizootic disease outbreaks will occur, as they do in adjacent populations of other carnivores (e.g., gray foxes) in the region. On federal lands in southwestern Oregon loss of late seral forest due to wildfire has been outpacing the regeneration rate from growth over the last 1-2 decades, which is likely the same for federal lands in California. While it is currently unclear how different degrees of fire severity affect Humboldt martens, it can be reasonably assumed that high severity fire will cause habitat loss. Given that the Humboldt marten has already been extirpated from 95% of its historical range, and the two remaining small populations will continue to be in serious risk of extinction over the next several decades due to just the two risk factors identified above, the Humboldt marten appears to better

fit "in serious danger of becoming extinct throughout all of its range" rather than "not presently threatened with extinction, but likely to become [so]" in California.

Assessment of the Risk Factor of Predation. This risk factor is very understated and does not represent the state of the science on this topic as presented in the rest of the document or in the Conservation Assessment and Strategy. There is a link between the primary prey of bobcats, dusky-footed woodrats and brush rabbits, and early seral forest habitats created thru clear-cut based timber harvest. Where these early seral conditions exist and overlap areas occupied by Humboldt martens, bobcats are the primary predator and primary mortality source. This pattern of high bobcat predation and forest landscapes fragmented with early seral habitat created from clear cut-based timber harvest has also been documented in two regions of Oregon. Furthermore, the largest documented contraction in the range of the main California population occurred in the highly fragmented Goose creek watershed once clear cuts from the 1980s and 1990s came into the prime period for woodrat production ~10-20 years post timber harvest. This area still had not recovered marten occupancy when last surveyed in 2012. This dynamic of larger-bodied predators responding to early seral forest habitat creation may also occur in the wake of high severity wildfire and is in need of further research due to the long-term (several decades) impacts they may cause. This risk factor has both a human-cause and potentially a natural (wildfire) cause, but the human-cause will continue to threaten the persistence and recovery of marten in California where the cause, clear-cut based timber harvest, occurs in or adjacent to areas important for marten persistence and recovery.

Minor Comments:

Shrub versus brush: I suggest using the term, shrub versus brush, that more accurately describes the type of vegetation Humboldt martens appear both selective and widely associated with. The understory at all sites where populations persist has a characteristics suite of shrub species present. Brush is defined as "wild vegetation, generally larger than grass and smaller than trees" as therefore can include anything whether it is a true shrub or not.

Please feel free to follow up with any questions my comments or suggested edits may raise.

Sincerely,

Keith M. Slauson

Keith M. Slauson, Ph.D.
Research Fellow
USDA Forest Service
Pacific Southwest Research Station
Arcata, CA 95521

State of California
Natural Resources Agency
Department of Fish and Wildlife

DRAFT REPORT TO THE FISH AND GAME COMMISSION
A STATUS REVIEW OF THE
HUMBOLDT MARTEN
(*Martes caurina humboldtensis***)**
IN CALIFORNIA


Keith Slauson photo used with permission

CHARLTON H. BONHAM, DIRECTOR
CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE
March 20, 2018

Contents

ACKNOWLEDGMENTS

EXECUTIVE SUMMARY

(Section will be written following peer review)

REGULATORY SETTING

A “Petition to List the Humboldt Marten (*Martes caurina humboldtensis*) as an Endangered Species under the California Endangered Species Act” (Petition) was submitted to the Fish and Game Commission (Commission) on June 8, 2015, by the Environmental Protection Information Center and the Center for Biological Diversity (Petitioners). Commission staff transmitted the Petition to the Department of Fish and Wildlife (Department) pursuant to Fish and Game Code section 2073 on June 18, 2015, and published a formal notice of receipt of the Petition on July 24, 2015 (Cal. Reg. Notice Register 2015, No. 30-Z, p. 1237). The Department serves in an advisory capacity to the Commission by providing scientific reviews of petitions.

On November 11, 2015, the Department provided the Commission with its evaluation of the Petition, “Evaluation of the Petition from the Environmental Protection Information Center and the Center for Biological Diversity to List the Humboldt Marten (*Martes caurina humboldtensis*) as Endangered Under the California Endangered Species Act,” to assist the Commission in making a determination as to whether the petitioned action may be warranted based on the sufficiency of scientific information. (Fish & G. Code, §§ 2073.5 & 2074.2; Cal. Code Regs., tit. 14, § 670.1, subds. (d) & (e).) Focusing on the information available to it relating to each of the relevant categories, the Department recommended to the Commission that the Petition be accepted.

At its scheduled public meeting on February 11, 2016, in Sacramento, California, the Commission considered the Petition, the Department’s petition evaluation and recommendation, and comments received. The Commission found that sufficient information existed to indicate the petitioned action may be warranted and accepted the Petition for consideration. Upon publication of the Commission's notice of its findings, the Humboldt marten was designated a candidate species on February 26, 2016 (Cal. Reg. Notice Register 2016, No. 9-Z, p. 290).

Status Review Overview

The Commission’s action designating the Humboldt marten a candidate species triggered the Department’s process for conducting a status review intended to inform the Commission’s decision on whether listing the species is warranted. At its scheduled public meeting on February 8, 2017, in Rohnert Park, California, the Commission granted the Department a six-month extension to facilitate external peer review.

This written status review report, based upon the best scientific information available and including independent peer review of the draft report by scientists with expertise relevant to the Humboldt marten, is intended to provide the Commission with the most current information available on the

Humboldt marten and to serve as the basis for the Department's recommendation to the Commission on whether the petitioned action is warranted. The status review report also identifies habitat that may be essential to the continued existence of the species and provides management recommendations for recovery of the species. (Fish & G. Code, § 2074.6.). Receipt of this report is to be placed on the agenda for the next available meeting of the Commission after delivery. Additionally, the report will be made available to the public for a minimum of 30 days prior to the Commission taking any action on the Petition.

Concurrent Federal Petition

Humboldt marten populations in northwestern California and coastal Oregon are currently under review for potential listing under the federal Endangered Species Act of 1973 (ESA) (16 U.S.C. § 1531 et seq.) in response to a 2010 petition also submitted by the Environmental Protection Information Center and the Center for Biological Diversity. The petitioned populations include the entire Humboldt marten range in California, as well as two populations of coastal Oregon Humboldt martens. In 2015, the USFWS released a 12-Month Finding that listing the Humboldt marten was not warranted. The federal petitioners challenged the finding in federal court, specifically challenging the USFWS conclusion that Humboldt marten populations were not in danger of extinction due to the risks associated with small, isolated populations. The court issued a summary judgement in favor of the Petitioners' claim that Humboldt marten populations in northwestern California are threatened by small, isolated populations (*Center for Biological Diversity v. U.S. Fish and Wildlife*. 15-cv-05754-JST, (N.D. Cal. Mar. 28, 2017). As a result, the USFWS is currently reevaluating the status of Humboldt martens in California and Oregon. An important difference between the ESA and CESA is that the ESA requires USFWS to assess whether species are threatened or endangered in the United States, while CESA directs the Department to assess a species' status only within California.

BIOLOGY AND ECOLOGY

Systematics

The Humboldt marten is a carnivorous mammal (order Carnivora, family Mustelidae), classified as a subspecies of Pacific marten (*Martes caurina*), a species occurring west of the Rocky Mountain Divide which was recently split from the American marten (*Martes americana*, Dawson and Cook 2012). The taxonomy of martens in the Pacific Northwest is currently unsettled. Historically the range of Humboldt martens was described as entirely within the north coastal portion of California (Grinnell and Dixon 1926, Grinnell et al. 1937); however, recent genetic evidence suggests Humboldt martens and martens in coastal Oregon (currently classified as *M. caurina caurina*) are diagnosably distinct from other western martens and are one phylogenetic lineage. Consequently experts now believe martens in northwestern California and coastal Oregon should collectively be classified as Humboldt martens (*M. caurina humboldtensis*) (Slauson et al. 2009a, USFWS 2015, Moriarty et al. 2016, Schwartz and Pilgrim 2017).

Commented [SK-F1]: Note, this citation refers to surveys data only and does not include any genetic analysis of subspecies and may only cite the other papers that do.

California is also home to the closely related Sierra marten (*M. caurina sierra*), which is traditionally considered to range throughout the Sierra Nevada and northern interior mountains. The Sierra marten is not the subject of this Petition (Figure 1). Within this report references to North American martens may refer to any species or subspecies of marten occurring in the North America (i.e. *M. americana, M. caurina, M. caurina sierrae, M. caurina caurina,* and/or *M. caurina humboldtensis*), and references to Pacific martens include any or all subspecies of *M. caurina* (including Sierra, Humboldt, *M. caurina vulpina*, and other subspecies).

Species Description

Martens have elongated and low-to-the-ground bodies, as do other members of the weasel family. Martens are intermediate in size among North American mustelid species. Martens are larger and stockier than long-tailed weasels (*Mustela frenata*) and short-tailed weasels (*Mustela erminea*), and have longer tail and body fur than the similarly sized minks (*Neovison vison*). They are noticeably smaller and more slender than the larger mustelids of North America, including wolverines (*Gulo gulo*), river otters (*Lontra canadensis*), and American badger (*Taxidea taxus*). Martens are typically smaller than fishers (*Pekania pennanti*), though there is some overlap in size between male martens and female fishers.

Marten pelage (fur) is brown (varying from yellowish buff to nearly black), with a contrasting lighter patch on the throat and chest. The marten's bushy tail constitutes more than one-third of the overall body length. Overall body lengths range from 45-70 cm (18-28 in.) and body mass ranges from 0.4-1.25 kg (0.88-2.76 lbs.), with males averaging 15% longer and up to 65% heavier than females (Clark et al. 1987, Powell et al. 2003). Humboldt martens generally differ from the Sierra martens by having darker, richer golden fur; smaller throat patch, more extensive dark fur on the feet, legs, and tail; smaller skulls, narrower faces (rostra), and differences in dentition (Grinnell and Dixon 1926, Grinnell et al. 1937, USFWS 2015).

Geographic Range and Distribution

Within California, Humboldt martens historically occupied the coastal mountains from Sonoma County north to the Oregon border from sea level to 915 m (3,000 ft.) within 35 km (22 mi.) of the coast (Grinnell and Dixon 1926, Zielinski et al. 2001, USFWS 2015). The current distribution within the state is limited to areas of Del Norte, northern Humboldt, and western Siskiyou counties and encompasses less than 5% of the probable historical range in the state (Slauson et al. 2009b, Slauson et al. 2017). The majority of contemporary California marten detections are from a 812 km^2 (313 mi^2) core area which includes the South Fork of the Smith River, Blue Creek, Bluff Creek, Camp Creek, Cappell Creek, Pecwan Creek, Slate Creek, and Rock Creek watersheds (USFWS 2015). An additional extant population exists east of U.S. Highway 199 near the California-Oregon border in northeastern Del Norte County, and a few Humboldt martens have recently been detected west of the core area in Prairie Creek Redwoods State Park (USFWS 2015, K. Slauson pers. comm. 10/10/2017, [Figure 2]). These extant population areas are currently isolated from one another by substantial areas of currently suboptimal habitat. East and south of the core population elevation and precipitation rapidly declines in the canyon of the Klamath River. The drier climatic conditions of the river canyon do not support the dense brush cover habitat of Humboldt martens. West of the core population lies an 8-16 km (5-10 mi.) wide band of industrial timberlands between the core population and high quality redwood forest habitat in State and National Parks where martens have been detected several times in the last decade. These industrial timberlands are typically harvested every 40-60 years, and in this zone late-succesional forest and dense shrub cover is much less extensive or absent. Where residual late seral patches and individual trees with dense shrub cover remain, it is fragmented by roads and recent timber harvests. This more open and fragmented, early-seral dominated landscape may favor carnivore species that prey on or compete with Humboldt martens (this topic is discussed below in the Threats section).

Within coastal Oregon, Humboldt martens have been detected from the California border through Lincoln County (Zielinski et al. 2001, Moriarty et al. 2016). Recent survey efforts and road kill records indicate Humboldt martens currently occupy 3-4 remnant populations in the two states. The degree to which the smaller California-Oregon border population may be effectively connected to marten populations in southern Oregon is unknown but likely based on the proximity of recent detections.

3

Commented [SK-F2]: I'm not sure this is correct. I don't recall any overlap in size in CA. Perhaps if you only consider the largest martens anywhere in NA (AK, Canada) and the smallest fishers (from CA) you could make this claim. Given the regional nature of this report, it would seem most accurate to compare the morphometrics for CA species/ssp.

Commented [SK-F3]: 'Forests' seems more accurate, since they occur at sea level in both CA and OR.

Commented [SK-F4]: I suggest deleting elevation, it is really the habitat change due to increasingly drier forests, lacking dense shrub cover that marks this change. Elevation is not the ecological driver for this change.

Commented [SK-F5]:

Commented [SK-F6]: See minor comment on replacing brush with shrub throughout this document.

Commented [SK-F7]: Nowhere have we made the claim that redwood-dominated forest is 'high quality'. What is high quality, and consistent with the habitat selection and habitat modeling papers, is large patches of late-seral forest. I suggest re-writing this to something like "….between the core population and large patches of late-successional conifer-dominated forest in the…."

Commented [SK-F8]: Overhead cover in these productive coastal forests returns within 10 years post clear cut, therefore 'open' conditions are not the problem.

Deleted: brush

Deleted: exists

Commented [SK-F9]: Note: in early seral stands woodrats and brush rabbits are abundant but not in any other older aged stands. Therefore it is the creation of young forest patches with high densities of these prey species with attracts the bobcats and other larger-bodied predators not simply being more 'open'.

Deleted: cover

The Department develops species range maps using the established convention of including the USDA Forest Service Ecological Subregions of California (https://map.dfg.ca.gov/bios/) that encompass species detections from the last 20 years, and when necessary modifying the boundaries along geological features (California Interagency Wildlife Task Group 2014). For the Humboldt marten range used in Figures 2 and 7, the ecological subregions were cut along the Klamath River and the Redwood Creek watershed boundary to omit large areas where no contemporary Humboldt marten detections have occurred, and the urban area surrounding Crescent City was omitted. It is recognized that this convention can result in the inclusion of substantial unoccupied areas within the range bounds. Humboldt martens are distributed unevenly within the bounds of their range, with only a fraction of the area containing the requisite habitat conditions to support marten populations.

Deleted: tree and shrub cover

Habitat Associations and Use

Generally, Humboldt martens are strongly associated with two distinct habitat types: late successional conifer forests with dense shrub layers where abundant live and dead standing and downed tree structures are used for resting, denning, and escape cover; and forest communities on serpentine soils [hereafter serpentine habitats] composed of various seral stages with variable tree cover, dense shrubs, and rock piles and rock outcrops used for resting, denning, and escape cover (Slauson et al. 2007, Slauson et al. 2017, Slauson et al. in review). Large patches (>50 ha [>124 ac.]) of late successional conifer forests or serpentine habitats appear necessary for supporting Humboldt marten individual home ranges, with larger patches (>80 ha) of late-seral forest supporting the most stable occupancy (Slauson et al. 2007, K. Slauson pers. comm. 11/10/2017, Slauson et al. 2018 [Conservation Assessment]). Along the western edge of the largest California population, a small number of Humboldt marten territories and dens have also been found in younger, managed forests. The portions of the managed landscape occupied by these marten home ranges were harvested predominatly in the 1950-60sand many large trees, snags, and logs, compared to how stands are harvested today. In addition, populations in these areas may not be sustainable in the absence of individuals dispersing from nearby late successional dominated landscape to the east due to the high level of predation these individuals are subject to from larger-bodied predators associated with young managed stands (Slauson pers. com. 11/10/2017). In coastal central Oregon, Humboldt martens occupying a third habitat type: shore pine (*PInus contorta* subsp. *contorta*) forests, similar in structure to serpentine habitats, and with extensive dense shrub understories (Zielinski et al. 2001, one of the Moriarty citations would be appropriate here, Slauson et al. 2017).

Deleted: have recently been discovered

Humboldt martens appear to select habitat at three scales (micro-habitat, stand, and home range scales), and populations of martens are affected by the arrangement of habitat at a fourth scale, the landscape. The following outline of habitat use is taken largely from Slauson et al. (2017). It should be noted that the best available information specific to Humboldt marten is presented here, but in some cases, information from other subspecies or from the American marten is referenced.

At the micro-habitat scale (the locations at which martens feed, rest, and den), North American martens rest or den in structures that provide cover for thermoregulation and protection from predators, and they forage in locations where prey is abundant (Taylor and Buskirk 1994). Humboldt marten prey species are associated with late-successional conifer forest stands characterized by abundant large logs, snags, and decadent live trees; with extensive, dense stands of ericaceous shrubs (i.e. evergreen huckleberry [*Vaccinium ovatum*], salal [*Gaultheria shallon*], and rhododendron (*Rhododendron macrophyllum*] [Allgood 1996, Slauson et al. 2017]). Den sites of North American martens are used by females to give birth to their young (natal dens) and to rear young until weaning and independence (maternal dens). Martens tend to be highly selective in their choice of denning sites, favoring large trees

Commented [SK-F12]: This is not entirely true as stated. COLLECTIVELY, the most important prey species of the HUMA are most abundant in l-s……..

Also, see and cite the new publication Slauson and Zielinski 2017 here. I would suggest adding a sentence prior to this one that identified the 'most important' prey, energetically, for the HUMA from this new pub.

and snags with cavities that prevent larger predators from entering (Payer and Harrison 2003, Fuller and Harrison 2005, Thompson et al. 2012). The available data on Humboldt marten den sites (Slauson and Zielinski 2009, Slauson et al. unpublished data, Green Diamond Resource Company unpublished data) are consistent with the general North American marten pattern. A study of Humboldt marten denning ecology on managed timberlands in northern California categorized the type of structure used for 34 identified dens (Table 1. Data from Early et al. unpublished presentation 2016):

Table 1. Humboldt marten dens by structure type and marten use from Early et al. 2016.

			Structure Type		
Den Type	Live Tree	Snag	Log or Rock Pile	Artificial Nest Box	Underground
Natal	5	0	2	0	1
Maternal	19	4	1	2	0

Trees and snags used for denning in the study were typically large, averaging 91 cm diameter at breast height (dbh, [36 in. dbh]), ranging from 46-183 cm dbh (18-72 in. dbh). Den trees typically had complex structural features such as broken tops, dead tops, large limbs, complex branching, basal hollows, and cavities.

Commented [SK-F13]: You must distinguish diameters for HARDWOOD and CONIFERs separately due to their vastly different diameter growth rates. If you don't have this data then acknowledge that fact and that most of these trees represent hardwoods such as chinquapin and tanoak.

Rest structures, used between periods of foraging by both male and female martens, include the kinds of sites used for denning as well as other sites that are less protective and less insulated than cavities or hollows, such as large tree limbs (Slauson et al. 2017). Martens typically select the largest available structures for resting and denning (Spencer 1987, Gilbert et al. 1997). Rest structures used by Humboldt martens in largely unmanaged forests averaged 95 cm (37 in.) dbh for snags, 88 cm (35 in.) large-end diameter for downed logs, and 94 cm (37 in.) dbh for live trees. Structures on average exceeded 300 years of age (Slauson and Zielinski 2009). Preliminary data on Humboldt marten rest structures from more intensively managed lands indicate a similar pattern of use of large-diameter conifer structures, with 70 percent of structures >70 cm (>28 in.) dbh (Slauson et al., unpublished data). Most resting locations (i.e., the actual resting place in the structure) were in tree cavities (33%), on platforms in broken-top snags or on large live branches (33%), or in chambers within log piles or rock outcrops (28%) (Slauson and Zielinski 2009). Rest structures which provide cavities or chambers likely become especially important during the late fall through the late spring, when wet rainy conditions are common.

At the stand scale of habitat selection (forest patches used for foraging, denning, and resting), Humboldt martens are found in forest stands that provide abundant structures suitable for resting and denning, as well as good foraging habitat, which includes both abundant prey and overhead cover to reduce predation risk (Slauson et al. 2017). In non-serpentine soil areas, Humboldt martens have been shown to preferentially use late seral forest stands and to avoid use of early successional stands (Slauson et al. 2007). The preferred late seral stands were Douglas-fir dominated, but also included mature tanoak (*Notholithocarpus densiflorus*) or chinquapin (*Chrysolepis chrysophylla*) understories. As mentioned above, late successional forest stands with dense shrub layers and abundant habitat elements such as large snags, tree cavities, large downed logs and woody debris, as well as serpentine soil forest stands with abundant rock cover appear to provide the best combination of habitat features at the stand scale.

Where Humboldt martens have been tracked on managed timberlands with younger tree age distributions, they have been associated with second-growth stands several decades old, which provide substantial overhead cover. Importantly, these stands retained abundant late successional habitat elements such as large old trees, snags, and logs through earlier harvests. It is likely that these retained old growth structural elements provide the micro-scale habitat features needed by martens for resting, denning, and foraging (Slauson et al. 2014, Slauson et al. 2017).

Humboldt martens have also been found in forest stands growing in serpentine soils in near proximity (less than 30 km) of the coast (Slauson and Zielinski 2001). Serpentine soils are characterized by having low plant productivity due to naturally low concentration of essential nutrients (and in some areas naturally high heavy metal concentrations). Serpentine stands used by the Humboldt marten are dominated by a variety of conifers, including lodgepole pine (*Pinus contorta*), western white pine (*Pinus monticola*), and Douglas-fir *(Pseudotsuga menziesii*) in dense to sparse overstories (Slauson et al. 2007). Humboldt marten resting sites in serpentine stands are strongly associated with the presence of dense shrub cover and abundant rock outcrops, which are used for resting cover (Slauson and Zielinski 2009).

Serpentine habitat areas appear to support lower proportions of female martens than late successional forest stands on non-serpentine soils. Population monitoring suggests marten occupancy is less stable in serpentine habitats than in old forest habitat. Therefore, the serpentine habitat areas may have less value to Humboldt marten population persistence than old forest habitat (Slauson et al. in review).

Dense shrub layers (>70% cover) of salal, evergreen huckleberry, rhododendron, shrub oak (*Quercus vaccinifolia*), and tanoak is an important component of stands selected by Humboldt martens (Slauson et al. 2007). Slauson et al. (2010) modeled Humboldt marten habitat occupancy probability based on several habitat variables measured at the stand scale and found that marten occupancy was most strongly influenced by the percent of the landscape with ≥50% shrub cover. Importantly, the shrub community favored by Humboldt martens does not include the shade-intolerant, short-lived shrub species such as *Ceanothus* spp. that occupy more xeric (dry) sites, and dominate sites following logging and other disturbances (Slauson et al. 2010).

Dense shrub layers may play an important role in excluding marten predators. Most North American martens occupy areas where deep snow accumulates which effectively excludes larger carnivores with higher body mass to foot surface area ratios. It rarely snows in the coastal forests occupied by Humboldt martens, but it is thought that extensive, extremely dense shrub layers effectively exclude larger bodied carnivores and provide a niche for Humboldt martens to exploit (Slauson et al. 2010). Humboldt martens, with the smallest body size of North American marten subspecies (Hagmeier 1961), are adapted to the dense foliage and stems found near ground level in coastal forest ecosystems, allowing them to move quickly through the dense cover and successfully capture prey.

At the home range scale, Humboldt martens appear to select areas with a high proportion of late succession forests stands. The limited information available on Humboldt marten home ranges (n=3) indicates they are on the order of 300 - 500 ha (750 - 1250 ac.), (Slauson et al. 2017). Habitat selection analysis of radio-telemetered Humboldt martens indicates that home ranges typically include ≥70% stand-scale suitable habitat arranged in large patches (≥150 ha [>370 ac.] in area) (Slauson et al. 2007, Slauson et al. 2017). Humboldt martens have also been found reproducing in younger conifer stands (40-50 years post-harvest) in the Pecwan Creek watershed and surrounding areas on the western margin of the core population area. While these stands are not considered late successional nor old growth, the quadratic mean tree size is greater than 61 cm (24 in.) dbh, and stands retain abundant residual large tree, snag, and log structures as a legacy of historical individual tree and small group selection silviculture no longer typical for the region (K. Slauson pers. comm. 10/10/2017). Although reproducing martens have been found in these younger conifer stands, mortality rates are high, particularly from bobcat predation. It is unlikely that kit production rates for females in these younger managed landscapes will offset the high mortality rates to sustain the population until the predator numbers are reduced. This can occur naturally from young stands growing out of the age classes where they support important prey for larger-bodied predators. Male-skewed sex ratios, and an age structure skewed to younger individuals in these areas suggests that a large proportion of the population occupying younger

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Commented [SK-F14]: Most botanical references I use call this Huckleberry oak not shrub oak. Would reduce confusion to use huckleberry too.

Commented [SK-F15]: Important, the shrub species present in serpentine and non-serpentine habitats are not the same. See the Conservation Assessment for clarification.

I think you should start with a simple topic sentence that says something like" Dense, spatially extensive shrub layers (> 70% over) are a conisistent feature in all habitats that HUMAs occur.

Commented [SK-F16]: This is not an accurate characterization of that analysis. It was really done to look at stand scale characteristics amenable to management in order to be able to evaluate habitat suitability following restoration treatments. I would recommend using some of the other publications to simply state that shrub cover is both selected by martens and influences site occupancy (e.g., Slauson et al. 2007).

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conifer stands consists of animals dispersing from the adjacent core population area (K. Slauson pers. comm. 10/10/2017).

At the landscape scale, Humboldt martens appear to select areas of occupancy based on the amount of old forest structure or serpentine habitat present in areas which receive abundant annual precipitation. Slauson et al. (in review) developed a landscape scale Humboldt marten habitat selection model to predict which regions of the historical range contain suitable marten habitat. The model was developed by relating field survey results to the environmental and habitat attributes hypothesized to influence marten distribution. The models that best distinguished between occupied andunoccupied survey locations included measures of old growth structural index (a combination of stand age indices and the number of large trees >100cm [39 in.] dbh, the number of large snags >50 cm [20 in.] dbh and >15 m [49 ft.] tall, the volume of large snags, and a tree size diversity index measured at the 1-km [0.62 mi.] scale), serpentine habitat measured at the 3 km [1.89 mi.] scale, and annual precipitation measured at the 3 km [1.89 mi.] scale.

Growth, Reproduction, and Survival

Humboldt martens are assumed to be polygynous, like American martens and other Pacific martens, where individual males can breed with multiple females. The following information is based on general characteristics of American and Pacific martens. Martens generally produce one litter per year (Calder 1984), and mating occurs in summer, with a peak in July (Markley and Bassett 1942). The fertilized embryo does not implant in the endometrium for seven or eight months (Ashbrook and Hanson 1927). Active pregnancy begins upon implantation in mid-winter (February). Parturition typically occurs in March or April, after 27 days of gestation (Jonkel and Weckwerth 1963). In a radio-telemetry study of Humboldt martens (Early et al. unpublished presentation 2016), adult females reduced their daily movements from mid-March through early April, consistent with near-term pregnancy and immediate post-parturition. Typical litter size is two or three young (Strickland et al. 1982) and ranges from one to five young (Strickland and Douglas 1987).

Young are born with little fur, ears and eyes closed, and have a body mass at birth of about 28 g (1 oz.), (Brassard and Bernard 1939). The ears open at about 24 days, eyes at 39 days, and by 7 to 8 weeks of age they are active enough for the mother to move them to another den (or succession of dens) for subsequent rearing (Ruggiero et al. 1998). Male parents do not provide care for the young, though by excluding other males from their territories, they may indirectly increase prey availability for the females and their young (Clark et al. 1987). Young are typically weaned at 18 weeks of age (Strickland and Douglas 1987), and may begin dispersing from the natal area as early as August, continuing through the following summer (USFWS 2015).

Females may mate as early as 15 months of age and, because of delayed implantation, typically give birth at about 24 months of age (Strickland et al. 1982). The proportion of adult females that may attempt breeding can be related to environmental conditions (severity of winter and availability of prey). In a Canadian population of the American marten only about 50% of adult females became pregnant in environmentally stressful years (Thompson and Colgan 1987); however, it is possible the relatively mild conditions within the Humboldt marten's geographic range may mean that a higher proportion of females may be pregnant each year (Slauson et al. 2017). Although data for Humboldt martens are lacking, females from other subspecies achieved highest reproductive potential between 3 and 5 years of age (Mead 1994, Fortin and Cantin 2004).

In a radio telemetry study of Humboldt martens in northwestern California (Early et al. unpublished presentation 2016), 11 females were collared, and over the course of the three year study 16 female territories were monitored continuously for at least a full year, with some territories being monitored in multiple years. There were 12 denning attempts amongst the 16 monitored females (75%). All but one of these attempts produced kits (94%). Of the 20 kits produced, 17 survived to weaning (Early et al. unpublished presentation 2016).

Humboldt marten survival rates between age classes for males and females are not known. In California, Pacific martens seldom survive longer than 5 years in the wild (USFWS 2015). Building upon the population model for martens developed by Buskirk et al. (2012), Slauson et al. (2017) posited age-class specific survival rates for Humboldt marten of 0.50 for juveniles (i.e., from birth to age 1 year) and 0.70 for all adult age classes (from age 1 year to age 2 years, age 2 to 3 years, 3 to 4 years, etc.). The model indicates that population growth is most influenced by on adult and secondarily juvenile survival rates. Therefore higher rates of adult marten mortality, as from predation, would have large impacts on population growth, overall size, trend, and rates of recovery after population decrease (Slauson et al. 2017).

Diet and Food Habits

North American martens were found to require 15-25% of their body mass in prey daily to meet their energetic requirements (Gilbert et al. 2009). The diet of Humboldt martens consists primarily of small mammals and birds, along with lesser amounts of reptiles, insects, and berries. Humboldt marten diets shift seasonally, with berries consumed more frequently in the summer and fall than other times of the year (Slauson et al. 2007).

A recent investigation of the Humboldt marten's diet estimated the proportion of metabolizable energy (PME) based on scat analysis (Slauson and Zielinski 2017). The study found that on average 72% of Humboldt martens' metabolizable energy came from mammals, 22% from birds, 7% from reptiles, 5.3% from insects, and 2.6% from plant material, primarily fruits. Mammals were the most important food source by PME in all seasons. Although 17 different mammal taxa were evident in the analyzed scats, the vast majority of energy was derived from a few rodent taxa: 42% of mammalian PME was composed of squirrels and chipmunks and 21% of voles and mice. Chipmunks (*Tamias* spp.), red-backed voles (*Myodes californicus*), Douglas's squirrels (*Tamiasciurus douglasii*) and flying squirrels (*Glaucomys sabrinus*) constituted the majority of year round mammalian biomass. Red-backed voles, Douglas's squirrels, and flying squirrels reach their highest densities in late successional conifer forest stands where the foods they specialize on (conifer seeds and truffles) can be found, while chipmunks, flying squirrels, and overall small mammal abundance are positively correlated with ericaceous shrub density (reviewed in Slauson et al. 2017).

The only significant insect food consumed appeared to be the adults and larvae of wasps and bees. Berries constituted 98.5% of the plant matter consumed, primarily salal, evergreen huckleberry, California red huckleberry (*Vaccinium. parviflora*), and manzanita (*Arctostaphylos sp.*) fruits. Berries were consumed most often in summer and fall (Slauson and Zielinski 2017). Although reptiles composed a relatively small proportion of the diet, they were more important in the spring and summer (12% and 10% of diet respectively), when predation on mammals was lowest.

No major differences were observed between the diets of males and females nor between adult and subadult diets (Slauson and Zielinski 2017). However, recent research has revealed that diets between males and females differ most during the denning season when females utilize large- and medium-sized sciurids much more than males to support the increased energetic demands of raising kits (Slauson and Zielinski in review). Compared to the studied diets of other North American martens, the Humboldt

Commented [SK-F18]: This does not make sense as written, were there 11 or 16 females collared and monitored? There were not 16 females resident in this study area so, I am assuming that there were 11 females collared and monitored for a total of 16 denning seasons?

Do you have Early's presentation to confirm these #'s?

Deleted: reproduction

Commented [SK-F19]: See Buskirk et al. 2012 for the most recent synthesis of this info, there is some info on these vital rates.

Commented [SK-F20]: See Slauson 2017 (dissertation in Tahoe) as well as Katie's age data for Lassen. Both have survival estimates too. Add Slauson 2017 to citation here.

Commented [SK-F21]: Or actually cite the list of studies we did to give all those authors their due credit for their work.

Commented [SK-F22]: Revise this section with the new paper. Make sure to highlight the energetic importance of certain prey and lack of energetic importance for others (e.g., insects, reptiles, berries).

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marten has a more diverse diet, depends less on voles, and includes more birds. (Slauson and Zielinski 2017).

Interestingly, dusky-footed woodrats (*Neotoma fuscipes*) appeared in only one of the scat samples analyzed by Slauson and Zielinski (2017). Woodrats are a widespread and often abundant small mammal in coastal redwood forests. They are especially abundant in regenerating (<20 year-old) stands in managed forests (Hamm and Diller 2009). Although woodrats would seem to be ideal prey for martens based on their size and microhabitat use, it may be that bobcat (*Felis rufus*) prevalence in younger forests effectively precludes martens from taking them. Woodrats (and brush rabbits, another young forest herbivore) are the dominant prey of bobcats (Slauson unpublished presentation 2017) as well as fishers in managed forests (K. Slauson unpubl. Data). It is likely the risk of predation from, and competition with, bobcats and other larger-bodied predators may effectively precludes Humboldt martens from utilizing this abundant prey resource (K. Slauson pers. comm. 10/17/2017).

Predators (see also Threats below)

Known predators of martens in western North America include coyote (*Canis latrans*), red fox (*Vulpes vulpes*), bobcat, and great horned owl (*Bubo virginianus*) (Thompson 1994, Bull and Heater 2001). Fishers are also known to kill martens, and the distribution of fisher populations may limit the distribution of marten (Krohn et al. 2004, USFWS 2015). In a recent study of radio-telemetered Humboldt martens (Slauson et al. 2014), nine mortalities of martens were observed (including eight collared martens and one uncollared marten) over the course of two years. All nine of the martens that died were either confirmed or determined likely to have been killed by bobcats (Slauson et al. 2014). Slauson et al. (XXXX?) reviewed several North American marten research projects (Thompson 1994, Hodgman et al. 1997, Ellis 1998, Bull and Heater 2001, Raphael 2004, and McCann et al. 2010) which found predation to be an important source of mortality in monitored marten populations. Among these studies, Slauson (Slauson et al. 2017, and K. Slauson unpublished presentation 2017) noticed a correlation between the intensity of timber harvest in the study areas and the proportion of marten mortality attributed to predation by larger-bodied generalist carnivores. In the three study sites located in areas with high timber harvest rates and a mosaic of young forest stands and edge habitat, bobcats were the predominant predator (list all 3 citaitons here).

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Home Range and Territoriality

Martens are intrasexually territorial—adults exclude members of the same sex from their home ranges, but not members of the opposite sex (Powell 1994, Powell et al. 2003). Intrasexual territoriality is believed to benefit adult females energetically by reducing direct competition from other females for prey, and adult males by providing exclusive reproductive access to females within their home ranges.

Pacific marten home ranges in the Sierra Nevada vary from 170 to 733 ha (420–1,811 ac.) for males and from 70 to 580 ha (173–1,433 ac.) for females (Buskirk and Zielinski 1997). The limited available information from three collared male Humboldt martens in California indicates home ranges are similar in size to Sierra marten, in the range of 300–400 ha (Slauson et al. 2017). Moriarty et al. (2016) estimated the average fall home range areas in coastal Oregon to be 280 ha (692 ac.) for three males and 65 ha (160 ac.) for eight females. There appears to be an inverse relationship between habitat quality and home range size, with the larger marten home ranges in coastal California and Oregon occupying more intensively managed landscapes (USFWS 2015, Moriarty et al. 2016, Slauson et al. 2017).

Dispersal

Humboldt marten kits begin dispersing from their maternal home range as early as August and dispersal continues through at least the following summer (Slauson et al. 2017). Although dispersal distances in excess of 70 km (43.5 mi) have been reported (citation), the average dispersal distance of North American martens is typically less than 15 km (9.3 mi) (reviewed in both USFWS 2015, Slauson et al. 2017).

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CONSERVATION STATUS

Regulatory Status

The Humboldt marten is not currently listed as threatened or endangered in California under the CESA or the ESA. However, California Fish and Game Code section 2085 extends all of the protections afforded threatened and endangered species to those species under review in response to accepted petitions. Accordingly, during the current candidacy period the legal protections of the CESA are in place for the Humboldt marten until the Commission adopts findings either formally listing the species or rejecting the petitioned action.

The Humboldt marten is designated as a Species of Special Concern by the Department (CDFW 2017). Species of Special Concern (SSC) are species, subspecies, or distinct populations of vertebrate animals native to California that have been extirpated from the state, are ESA (but not CESA) listed as Threatened or Endangered, have naturally small populations or are experiencing serious population or range declines that could qualify them for Threatened or Endangered status. SSC is an administrative designation that conveys no formal legal status or protection. The intent of SSC status is to focus attention on animals at conservation risk, stimulate research on poorly known species, and achieve conservation and recovery of these animals before they meet criteria for listing as threatened or endangered under the CESA (CDFW Species of Special Concern website accessible at https://www.wildlife.ca.gov/Conservation/SSC).

On United States Forest Service (USFS) lands in Region 5 (which encompasses all of California), the Humboldt marten is designated a Sensitive Species and a Priority Species. Its Sensitive Species status requires management projects subject to the National Environmental Policy Act (NEPA) to analyze impacts to the species; however, this obligation carries no attendant requirement to minimize or mitigate impacts to the species.

Habitat Essential for the Continued Existence of the Species (FGC § 2074.6)

The Department considers all currently occupied Humboldt marten habitat (Extant Population Areas, see discussion below) essential for the continued existence of the species in California. Additionally, suitable but apparently unoccupied habitat near the currently occupied habitat (Population Re-establishment Areas, see below) is also considered essential for species. Further, additional habitat that is not currently suitable but which could be restored to suitability within the near term should also be considered essential.

This determination is based on analysis of information provided by Slauson (2003) and Slauson et al. (2017). For example, Slauson (2003) summarized the condition and management of the currently occupied Humboldt marten range by stating:

> A significant number of marten detections (38%) occurred on lands (private industrial timberlands and USFS matrix lands) that are available for logging currently and lack strategies to maintain suitable marten habitat ... Both martens and their habitat are patchily distributed in the area, and further loss or degradation of limited suitable habitat could decrease the chances for the persistence of this remnant population. A conservation strategy based solely on measures to maintain current conditions for this population is unlikely to ensure its long-term persistence. The two major challenges for persistence and restoration of the coastal California marten population are: 1) the longer a population remains small, the greater the chance that it will lose its genetic variation (Nei et al. 1975) or that it will be eliminated due to stochastic demographic or environmental events (e.g., wildfire)(Fager 1991), and 2) restoration of forest habitats with the structural characteristics necessary to be suitable for martens may take many decades.

Based on figures in Slauson et al. (2017), approximately 81,000 ha (200,155 ac.) of currently suitable or recruitable habitat exist in two Extant Populations Areas ("EPAs", [the geographic range of the known extant reproductive population based on verified Humboldt marten detections and a 2 km-wide (1.24 mi.) buffer of the surrounding suitable habitat]) in California (Figure 4). If fully occupied, and assuming a female home range size of 350 ha, which is intermediate to those reported for Sierra martens (Buskirk and Zielinski 1997), the EPAs could support approximately 231 females. The four Population Reestablishment Areas (PRAs, areas of modeled suitable habitat in patches large enough to support at least five female marten home ranges which are currently unoccupied or support fewer than five females) identified in Slauson et al. (2017) encompass 198,713 ha (491.031 ac.), which could theoretically support an additional 568 female martens. Therefore existing habitat in California, if fully occupied, could be expected to support 800 or fewer adult females. These estimates should be considered unrealistically high as they assume optimally arranged home ranges and fully occupied suitable habitat. Additionally, the PRAs are currently thought to be unoccupied. Establishment of populations within these areas may require active translocation of individuals, restoration of functional habitat connectivity, or both.

Forest management within areas essential to the continued existence of the Humboldt marten would not necessarily need to be precluded to promote the development of quality Humboldt marten habitat. For example, areas which are not currently suitable habitat could be thinned to open canopies for the promotion of dense shrub layers and the recruitment of large tree structures. Additionally, landscape-scale planning and management would be required to balance the promotion and retention of large patches of high quality habitat with the risk of catastrophic habitat loss from wildfire. All six areas, especially the four PRAs, are a mix of suitable and unsuitable habitat conditions. Management actions aimed at increasing suitability (availability of structural elements, dense shrub layer, and closed overstory canopy) could increase the number of marten home ranges supported over current conditions and reduce the threats associated with fragmented habitat in these areas.

Even if suitable habitat in these six areas were fully developed and fully occupied, Humboldt martens would number no more than 800 adult females, and only an approximate 20% of the historical geographic range in California would be occupied (Slauson et al. 2017). This number (added to the number of adult male martens that would also occupy the area) is at or below the theoretical minimum viable population size thresholds for mammal populations of several thousand individuals (Traill et al. 2007). Therefore, additional areas within or adjacent to the historical range would need be examined for the potential to recruit large patches of suitable habitat and support a larger marten population more resilient to extinction. Evaluations of potentially recruitable habitat would need to consider the distribution and composition of forest stands in future climate scenarios. Absent the protection and recruitment of suitable habitat, Humboldt martens are likely to remain at risk of extirpation in California in the foreseeable future due to one or a combination of the threat factors discussed in this report, including high rates of predation, effects of small population size, and impacts from stochastic (random, unpredictable) events such as wildfire.

Range and Distribution Trends

Historically, Humboldt martens ranged from the coastal forests of northwestern Sonoma County north to Curry County Oregon within the narrow humid coastal zone ≤35 km (22 mi.) from the coast (Grinnell et al. 1937, Kucera 1998, Zielinski et al. 2001, Slauson et al. 2017, [Figure 2]). In California, records of occurrence exist from Colusa, Del Norte, Glenn, Humboldt, Lake, Mendocino, Siskiyou, Tehama, and Trinity Counties (California Natural Diversity Database accessed October 23, 2017), but when the habitat affinities of Humboldt and Sierra martens are considered along with recent genetic research (Schwartz and Pilgrim 2017), marten records from Colusa, Glenn, Lake, and Tehama Counties should be attributed to the Sierra marten subspecies rather than Humboldt marten.

The historical range described by Grinnell et al. (1937) was roughly 22,000 km^2 (8,500 mi^2), although not all of the habitat within the bounds of the historical range would have been suitable or occupied. Within the historical range, the distribution of marten record locations is uneven, with concentrations of records from northern Lake and east-central Mendocino County, an area southeast of Eureka, and near the intersection of Del Norte, Humboldt, and Siskiyou counties (fig. 2). By the 1940s, a significant decline in Humboldt marten trapping returns and a retraction of the southern end of the range had been noted (Anonymous 1920, Twining and Hensley 1947). Zielinski et al. (2001) conducted an exhaustive review of historical coastal marten records from California, Oregon, and Washington including published reports, museum specimens, unpublished notes of naturalists and trappers, and interviews of tribal members and others. Based on their review they concluded that a significant reduction in occupied range has occurred.

The Department is aware of Humboldt marten records only from Del Norte, northern Humboldt, and extreme western Siskiyou Counties in the last 25 years (California Natural Diversity Database query October 22, 2017) despite the fact that surveys during that period covered a much larger portion of the historical range (USFWS 2015). The occupied range (as of year 2008) as circumscribed by a minimum convex polygon drawn around detection locations was found to be 627 km^2 (242 mi^2) by Slauson et al. (2009b). Since that time, the known occupied range has expanded slightly with two detections of Humboldt martens a few kilometers from the coast in Prairie Creek Redwoods State Park, first in 2013 and most recently in 2017 (CDFW 2014, K. Slauson pers. comm. 10/10/2017); and additional detections near the Oregon border (Slauson et al. 2017). The martens detected in Prairie Creek Redwoods State Park were not detected during rigorous surveys in the same area in 2002, thus they likely represent a recent range expansion (Slauson et al. 2010). Despite these recent expansions in the known range, Humboldt martens appear to have been extirpated from 95% of their historic range in California (Slauson et al. 2009b, Slauson et al. 2017).

Although martens were historically distributed throughout the coastal regions of Oregon, there are currently just two disjunct coastal populations of Humboldt martens (Grinnell et al. 1937, Moriarty et al. 2016, [Figure 3]). The southern population is possibly contiguous with the northernmost populations in California. In Oregon, the range appears to have remained unchanged since 2001; however, there are no indications that the population is expanding (Moriarty et al. 2016).

Population Size and Trend

From 1945-1995 Humboldt martens were virtually undetected in California, leading some to speculate that the species had gone extinct until they were again detected in 1996 (Kucera and Zielinski 1995, Zielinski and Golightly 1996, Slauson et al. 2009b, Slauson and Zielinski 2004). Based on surveys in the modern era the population appears to have declined by over 40% over the period 2000-2008, and then remained unchanged during the period 2008-2012 (Slauson et al. 2009b, USFWS 2015). In the only contemporary population estimate Slauson et al. (2009b), estimated the extant Humboldt marten population in California consisted of less than 100 individuals. Although it is not known if Oregon populations are in contact with California populations, Moriarty et al. (2016) detected a minimum of 28 unique Humboldt martens in coastal Oregon during surveys in 2015, and concluded “martens in coastal forests are rare and likely limited by unknown factors, especially compared to their former range.”

Historically Humboldt martens appear to have been more common and widespread. Grinnell et al. (1937) stated that Humboldt martens were “fairly numerous” in “earlier years”, though apparent declines in the Humboldt marten population, at least locally, were noted as early as the 1920s. The authors report a tale of one trapper capturing 50 Humboldt martens in a single winter near Fortuna, California. While no rigorous historical population estimate exists, one can reasonably infer from the recorded anecdotal information that the number of martens present at that time was larger than the population present in the 1990s when no detections of the species had been recorded for the previous 50 years (Zielinski and Golightly 1996).

THREATS

Trapping

Early trapping of Humboldt marten was intensive, with accounts of individual trappers taking 35-50 martens in a single winter (Grinnell et al. 1937). By the early 1900s annual harvest of Humboldt martens was already declining, prompting Joseph Dixon to call for closing the trapping season in California to prevent an extirpation; however, marten harvest continued until a partial closure was enacted in northwestern California in 1946, depleting populations and likely reducing genetic variation within the remaining population (Dixon 1925, Zielinski et al. 2001).

Today trapping of all martens is prohibited statewide (§ 460, Title 14, California Code of Regulations (CCR)). Although it is possible that Humboldt martens could be inadvertently taken by trappers pursuing other fur bearers or nongame mammals that may be legally harvested for recreation, commerce in fur, or depredation. Trapping in California is highly regulated, and trappers must pass a Department examination demonstrating their skills and knowledge of laws and regulations prior to obtaining a license (Fish & Game Code § 4005). Additionally, only live-traps may be used to take furbearers or nongame mammals for recreation or commerce in fur; trappers are required to check traps daily and release non-target animals (*Id*. §§ 3003.1, 4004, and, 4152 and § 465.5, Title 14, CCR). With the passage of Proposition 4 in 1998, body-gripping traps (including snares and leg-hold traps) were banned in California for commerce in fur and recreational trapping (*Id.* § 3003.1). However, some body-gripping traps may be used by licensed trappers for purposes unrelated to recreation or commerce in fur, including protection of property or by government employees, or their authorized agents, while acting in their official capacities (*Id.* § 3003.1 and § 465.5, Title 14, CCR). Martens incidentally captured by trappers must be immediately released § 465.5(g)(1), Title 14, CCR).

Trapping of Humboldt martens remains legal in neighboring Oregon where trappers are required to obtain a trapping license and take an educational course (Hiller 2011). In recent years very few trappers reported pursuing martens in Oregon (4-8 trappers per year [Hiller 2011]), and only three Humboldt martens were reported taken in 2013 (USFWS 2015). Oregon trapping records are organized by county making it difficult to determine if reported trapped martens were coastal Humboldt martens or interior *Martes caurina caurina*. Review of trapping record from 2007-2016 indicates that as many as nine Humboldt martens may have been trapped in Oregon and one roadkill Humboldt marten was recovered (D. Broman pers. comm. 3/17/2017).

Trapping pressure on Humboldt martens was intense during the late 1800s and early 1900s, and very likely resulted in significant declines in population size as well as a dramatic reduction in range. There have been no studies on the population level effects of Humboldt marten trapping, but the loss of even a few adult martens, especially when combined with other mortality sources, could reduce the likelihood of long-term population viability (USFWS 2015). However, it is unlikely that trapping continues to threaten Humboldt martens in California due to the ban on trapping martens, restrictions on the types of traps that may be used for other species, as well as requirements that licensed trappers check traps daily and release non-target animals.

Habitat Loss and Degradation

Changes in the structure and landscape configuration of Humboldt marten habitat can negatively impact survival, reproduction, and population connectivity of the species. In particular, timber harvest and other silvicultural treatments of older forests, salvage logging, development of coastal forests for human settlement, as well as the clearing of forests for the cultivation of cannabis can all lead to loss, degradation, and fragmentation of Humboldt marten habitat. The USFWS (2015) Humboldt marten species report concluded habitat loss and degradation from historical and current logging is the most plausible reason the marten is absent from much of its historical range, noting most of the remaining suitable habitat is located on federally owned land (Zielinski et al. 2001).

Forest conditions in the range of the Humboldt marten today are largely shaped by a legacy of over 100 years of logging and timber management. It is estimated that the area of old growth conifer forest in the Pacific Northwest has been reduced by 72% since European settlement (Strittholt et al. 2006), and only 10% of the historical range of redwood forests remains in old growth stands (Fox 1996). While timber harvest continues in the area, the logging of old growth forest stands on private and public lands has dramatically slowed from peaks in the second half of the 20th Century. Today, 33% of remaining old forest on federal lands in the Northwest Forest Plan area is fully protected from harvest, and 80% is afforded some level of management protection (Strittholt et al. 2006). The rate of timber harvest on private lands in the area has declined in recent decades due to more restrictive regulations and market conditions (Figure 5). Harvest on federal lands declined sharply following implementation of the Northwest Forest Plan in 1994 (Strittholt et al. 2006) (Figure 6.). The area of older forests (OGSI-2000) on federal lands in the coastal and Klamath mountains of northwestern California declined 8.4% from 1993-2012, largely due to wildfires, while the area of older forests on non-federal lands increased 1.3%, despite losses to timber harvest (Davis et al. 2015). While recent losses of old forest stands in the Humboldt marten range have been relatively small, forest stands degraded and fragmented from historical logging will take decades to recover dense ericaceous shrub layers and centuries to recruit the large tree structures needed to restore high quality Humboldt marten habitat conditions (Slauson et al. 2010, Slauson et al. 2017).

Habitat loss and degradation from human settlement and residential development rapidly increased in the 1850s when pioneers of European descent began harvesting lumber, farming, mining, and fishing along California's north coast (Del Norte County Community Development Department 2003). Since that time minor portions of the historical range have been converted from forests to urban areas, primarily in and around Crescent City, Humboldt Bay, Fortuna, Fort Bragg, and Willits; and much of the historical range south of Del Norte County has been parceled and occupied by very low density housing (≤1 housing unit/16 ha [40 ac.])(Cal Fire 2010). However, the core population area currently occupied by Humboldt martens is almost entirely unoccupied by humans, with the exception of some areas adjacent to the Klamath River on Yurok Tribal lands (Cal Fire 2010). Low-density human occupancy does not necessarily equate with the loss of mature forest habitat favored by martens but human occupancy likely renders such areas unsuitable for martens. Impacts from the presence of humans, livestock, and pets, the construction and use of rural roads, and the use of household pesticides can frighten wildlife away, introduce novel predators, diseases, and toxicants, deplete prey populations, and degrade and fragment habitat (Merenlender et al. 2009). While further human development of the historical range will likely continue into the future, a modeled analysis of future land conversions under several human population growth scenarios found the probability of significant conversions to urban and agricultural uses in the northwest California coast region to be very low for the remainder of this century (Sleeter et al. 2017).

Large-scale marijuana cultivation in remote forests throughout California has increased since the mid-1990s, coinciding with the 1996 passage of Proposition 215, the Compassionate Use Act of 1996 (Health & Safety Code, § 11362.5), which allowed the legal use and growth of marijuana for certain medical purposes (Bauer et al. 2015). Humboldt and Del Norte counties are known centers of legal and illegal cannabis cultivation in California due to the remote and rugged nature of the land and abundant water sources (National Drug Intelligence Center 2007, Bauer et al. 2015). The recent passage of California Proposition 64, the Control, Regulate and Tax Adult Use of Marijuana Act, further decriminalized the adult use of cannabis for recreational use beginning in January 2018. In 2017, the California Legislature approved the Medical and Adult Use of Cannabis Regulation and Safety Act which provides state and local governments the authority to regulate the production and processing of cannabis products, including regulation of the environmental impacts from growing cannabis. It remains to be seen what effect these new laws will have on the conversion of forests for the production of cannabis. A recent study found the majority of cannabis cultivation sites in Humboldt County were located >500 m (1,640 ft.) from the nearest road, indicating cultivation may contribute to landscape fragmentation, although the amount of land area under cannabis cultivation was found to be minor at less than 1% of the land under organic crop cultivation (Bustic and Brenner 2016). The extent to which land clearing for legal and illegal cannabis cultivation contributes to Humboldt marten habitat loss and degradation is unknown.

The habitat characteristics of Humboldt martens that may be particularly at risk from these activities can be considered at the four scales of habitat selection described in the BIOLOGY AND ECOLOGY section on Habitat Associations and Use above.

Large Tree Structures

At the micro-habitat scale, the large tree structures used by Humboldt martens for resting and denning were typically removed during timber harvests, both during initial harvests of original-growth forests as well as through harvest of "residual" old growth trees in subsequent entries in second-growth forests (Slauson et al. 2010, USFWS 2015). Large diameter trees, snags, and downed logs with cavities and platforms used as resting and denning structures by Humboldt martens are significantly reduced in second-growth forest stands compared to the old growth stands (Slauson et al. 2003, Slauson et al. 2010). In second-growth stands it is estimated that it could take more than 200 years to recruit such structures (Slauson et al. 2010). The minimum age of live and dead tree structures used for resting by martens in north coastal California was 176 and 254 years, respectively (Slauson and Zielinski 2009).

Other silvicultural treatments also reduce marten habitat structures. For example thinned stands (n=26) have been found to have significantly fewer potential resting and denning structures than Humboldt marten-occupied stands (n=7); although large cull logs from previous harvests in recently thinned stands can provide similar densities of large log structure to marten occupied stands (Slauson et al. 2010).

Tree and Shrub Canopy Cover

At the stand scale, Humboldt marten habitat suitability is reduced under most of the commonly used timber harvest methods, both through overstory canopy cover reduction and through loss of dense ericaceous shrub layers (USFWS 2015). Shrub layers can be destroyed or degraded through conifer stand management which favors trees over shrubs (such as mechanical brush clearing and application of herbicides that target shrub species), and through the competitive exclusion of densely planted conifers which shade out understory shrubs (Slauson et al. 2010). Typical even-aged silvicultural methods employed on industrial timberlands completely eliminate post-harvest canopy cover in clear cuts over areas of up to 40 acres. Such conditions, unsuitable for marten use, persist for years until the regenerated stand achieves suitable canopy closure. It has been shown that shrub cover is more patchily distributed in thinned stands than in old growth stands (Slauson et al. 2010). Dense regenerating conifer stands that were thinned were found to regenerate moderately dense shade-tolerant native species shrub layers within 15-30 years following thinning; however, shrub cover remained significantly lower than levels found in the old growth redwood stands used by Humboldt martens (Slauson et al. 2010). Given relatively short harvest rotations, typically less than 60 years (USDA 1992, Green Diamond Resource Company 2012, Yurok Tribal Forestry 2012) in the coastal forests of northern California, overstory conditions suitable for martens may only exist on a small proportion of the intensively managed landscape at any given time.

Slauson et al. (2010) found that shrub flowering and fruiting are greatly reduced in stands thinned ≤30 years prior to harvest compared to stands occupied by martens: Only 38% of thinned stands were observed with a fruiting or flowering shrub component, compared to 100% of old forest stands occupied by Humboldt martens. In addition to directly providing food for martens, fruiting shrubs support greater densities of marten prey animals such as small mammals, hornets and migratory birds.

Vegetation management activities designed to efficiently produce timber and reduce the risk of wildland fire by removing shrubs, reducing canopy cover, and removing snags and logs may negatively impact martens by removing required habitat structures and by removing shrub cover which can reduce prey abundance and improve access for competitors and larger-bodied predators such as bobcats.

Large-scale Habitat Fragmentation

At the home range and landscape scale, forest fragmentation poses threats to Humboldt marten individuals and populations. Individuals may be forced to move over greater distances to acquire food in fragmented landscapes, increasing their energetic costs and exposing them to more predators. Populations may be impacted by reducing the ease of juvenile dispersal and ability of breeding individuals to move between population areas. Fragmented habitat conditions exist throughout much of the Humboldt marten's historical and current range and the four extant marten populations in coastal

California and Oregon appear to be isolated from one another by unsuitable habitat degraded by logging, severe wildfire, and urbanization (Slauson et al. 2017). Fragmentation of habitat can also be detrimental at finer scales, where fragments of habitat may not be large enough to support a single marten territory. For example, the Redwood National and State Parks complex contains only three patches of late successional forest greater than 2,023 ha (5,000 ac.) in area, with most patches less than 40 ha (100 ac.) in area (USFWS 2015).

Slauson et al. (2017) concluded that early trapping combined with the extensive habitat loss and fragmentation from unregulated timber harvesting were the two factors most likely responsible for the decline in distribution and abundance of Humboldt martens. Similarly, Moriarty et al. (2016) suggested habitat fragmentation (both natural and anthropogenic) is the most serious threat to martens in coastal Oregon (Moriarty et al. 2016):

> Habitat fragmentation through natural and anthropogenic alterations likely poses the largest threat to marten conservation. Marten populations decline with as little as 30% of mature forest cover removed (Hargis and others 1999; Potvin and others 2000), and fuel reduction treatments typically decreased cover and connectivity in the Sierra Nevada (Moriarty and others 2015). Martens were deterred by low-canopy-cover openings, seldom moving 17 m (56 ft.) beyond cover (Cushman and others 2011), and most often moving 50 m (164 ft.) within forest patches to avoid such openings (Moriarty and others 2015).

Degraded landscapes may lack obvious barriers to marten movement while acting as functional barriers to movement by decreasing the likelihood of daily survival and successful dispersal. American marten dispersal distances were found to decrease by approximately 50% in intensively logged forests in Ontario compared to unlogged forests, and the percent of juveniles successfully dispersing and establishing new territories declined from 49% in unlogged forests to 25% in logged forests (Johnson et al. 2009). Thompson (1994) found daily survival rates in recently harvested (3-40 year old) forest stands in Ontario were nearly five times lower than in uncut forests. Where habitat conditions result in decreased dispersal distances and lower survivorship of dispersing animals, habitat is functionally fragmented.

Because roads favor generalist predators that prey on martens, crossing roads to move between fragmented patches of habitat means martens are more likely to encounter a predator than if they were able to remain in dense shrub habitat (Slauson et al. 2010). Fragmentation of dense shrub stands by roads also appears to confer a competitive advantage to generalist carnivores like fishers, gray foxes, and bobcats, which compete with and prey upon martens. Slauson et al. (2010) found that 80% of camera detections of generalist carnivores such as gray fox and bobcats were on roads while 80% of habitat specialist carnivores (e.g., fishers, martens) detections came from areas away from roads. In northwestern California Highway 101, which is a four lane highway in some sections, may constitute a significant barrier to marten movement (S. Prokop and B. Silver 6/29/2016 letter to CDFW).

Wildfires and associated salvage logging of damaged trees can threaten the already small Humboldt marten population by reducing and fragmenting the remaining habitat (Slauson and Zielinski 2004). Vegetation management activities designed to reduce the risk of wildland fire by removing shrubs, reducing canopy cover, and removing snags and logs impacts martens by removing required habitat structures and shrub cover which can reduce prey abundance and improve access for competitors (USFWS 2015). On federal lands, salvage logging and fuels management activities can occur on all land allocation categories except for wilderness areas (Hamlin et al. 2010), and on private lands salvage

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logging plans are exempt from normal review procedures and automatically approved by the California Department of Forestry and Fire Protection (CAL FIRE) through a ministerial process if all applicable Forest Practice Rules are abided (Title 14, CCR §1052).

Commented [SK-F29]: Missing here are the citaitons, e.g., Davis et al. 2015, that show that late seral forest is declining on federal lands (Siskiyou NF and possibly the Six Rivers NF) within the range of the HUMA by 8.4% per decade (not sure ?) due to wildfire. This rate of loss is currently outpacing recruitment from forest growth.

While thinning and fuel reduction management can fragment and degrade Humboldt marten habitat, it is important to note that severe wildfires can also substantially fragment and degrade marten habitat. However, Moriarty et al. (2017) found that implementing fuel reduction treatments (mechanical or prescribed fire) on as little as 10-20% of the landscape significantly reduced the probability of marten habitat loss from wildfires. Management for the creation and conservation of resilient Humboldt marten habitat will require land managers to carefully plan for both habitat patches and fuel reduction zones over the landscape over time.

The amount of Humboldt marten habitat in California has been substantially reduced since the species' range was first described by early naturalists, primarily as a result of past timber harvesting and timber production practices which removed the large tree structures and dense shrub layers martens require for denning and protection from predators. Although the rate of timber harvesting appears to have decreased in recent years, it will take centuries recruit large tree structures to replace what has been lost. Wildfire, conversion of land to urban and agricultural uses, and the use of rodenticides associated with cannabis cultivation have also contributed to habitat loss and degradation. Where habitat remains, degraded conditions and fragmentation caused by roads, timber harvesting, cannabis cultivation, and other land use practices can limit its usefulness to the marten population. Degraded and fragmented habitats may allow larger carnivores to colonize traditional Humboldt marten habitat resulting in increased rates of predation on martens. Because historical habitat loss and degradation severely limits the spatial extent of suitable habitat available to the population, it continues to pose a potentially significant threat to Humboldt martens. However, increases in the extent of mature coastal forest from recruitment of large tree and shrub structure and reductions in habitat fragmentation could significantly contribute to the recovery of Humboldt martens in California.

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Predation

Predation can significantly limit marten populations in the wild (Hodgman et al. 1997, Bull and Heater 2001, McCann et al. 2010, Slauson et al 2017). Known or expected predators of Humboldt martens include bobcats, gray foxes (*Urocyon cinereoargenteus*), coyotes, mountain lions (*Puma concolor*), great horned owls, goshawks (*Accipiter gentilis*), and Pacific fishers (Buskirk and Ruggiero 1994, Bull and Heater 2001, Slauson et al. 2009b, Woodford et al. 2013). Moriarty et al. (2017) detected the following potential predators at camera traps within 5 km (3.1 mi.) of known Humboldt marten detections: black bear (*Ursus americana*), bobcat, gray fox, domestic dog (*Canis familiaris*), domestic cat (*Felis catus*), coyote, and mountain lion. Gray fox was the most frequently observed species with detections near 29% of the known marten stations. Bobcat, black bear, and domestic dogs were detected near 26%, 23%, and 11% of the known marten stations, respectively. Detections of coyote, domestic cat, and mountains lions were lower, ranging from two to four percent.

Bull and Heater (2001) documented 22 mortalities in their northeastern Oregon Pacific marten radio telemetry study; of these, 18 were attributed to predation by bobcats, raptors, coyotes, and other martens[1]. The martens killed by predators accounted for 51% of the collared population over their four year study (Bull and Heater 2001). In Raphael's (2004 *in* Slauson et al. 2017) study of Pacific martens in

[1] The four marten deaths attributed to other martens were all males, including two juveniles. The carcasses were not eaten, but showed trauma suggestive of fighting. The authors surmised resident male martens engaged in territorial defense were responsible for these mortalities.

the Oregon Cascades, 21 of 28 marten mortalities were attributed to predation (bobcats and coyotes), which constituted 18% of the monitored population. In a Humboldt marten dispersal study in California (Slauson et al. 2014), nine martens (39% of collared martens) were killed by predation over the course of less than one year. All nine of these predation events were from bobcats. Comparing the effect of varying levels of bobcat occupancy in different watersheds in the California range of the Humboldt marten, Slauson (unpublished presentation 2017) showed an inverse relationship between bobcat occupancy and marten occupancy, and a direct relationship between bobcat occupancy and marten predation rates.

Predator – Vegetative Community Interactions

Coastal forest ecosystems are complex, with tree, shrub, and herbaceous plant layers creating multiple structural layers. Historically, dense continuous shrub understories were common in mature forests in the redwood region (Morgan 1953, Allgood 1996, Slauson and Zielinski 2007). These shrub understories have been drastically reduced and modified through a century of logging and related forest management such as burning, mechanical clearing, road building, and planting dense stands of trees which compete for sunlight with shrubs and herbs (Slauson and Zielinski 2007). The time period over which shrub layer extent, density, and species composition drastically changed corresponds with observed reductions in Humboldt marten distribution and the observed expansion of generalist mesocarnivore (mid-sized carnivores) distributions in the redwood region.

Martens appear to require dense shrub stand patches of >50-100 ha (124-247 ac.) (Slauson et al. 2007). Where shrub layers have been removed or reduced, fishers and gray foxes - both potential marten predators, have expanded their historic ranges into the previously unoccupied redwood region (Slauson and Zielinski 2007). Conversely, in the remaining old tree conifer stands with intact dense shrub layers that Humboldt martens select as preferred habitat, fishers and gray foxes are rarely detected (Slauson 2003, Slauson and Zielinski 2007). Martens showed the strongest preference for stands with ≥80% shrub cover, and avoided stands with <60% shrub cover, while fishers and foxes avoided stands with ≥80% shrub cover and used stands with <60% shrub cover in proportion to their availability (Slauson 2003).

The high predation rates noted in the Pacific marten and Humboldt marten studies above occurred in areas that included intensively-managed forests. Raphael (2004 *in* Slauson et al. 2017) described his study as a "high-harvest" area. Bull and Heater's (2001) 400 km^2 (154 mi^2) study area included a relatively small area (53 km^2) (20 mi^2) of uncut forest surrounded by an area "extensively harvested for timber (approximately 80%) and… fragmented by partial cuts, regeneration cuts, and roads." More than 90% of the Slauson et al. (2014) Humboldt marten dispersal study area had been previously harvested. Managed forests with open overstories, less dense shrub layers, and high road density appear to favor larger-bodied generalist predators such a bobcats, gray foxes, and fishers, which may prey on or kill Humboldt martens (Slauson and Zielinksi 2007, Slauson et al. 2010, Slauson unpublished presentation 2017). Fragmentation of dense shrub stands by roads also appears to confer a competitive advantage to generalist carnivores like fishers, bobcats, and gray foxes, which compete with and prey upon martens. Slauson et al. (2010) found that 80% of camera detections of generalist carnivores such as fisher, gray fox, and bobcats were on roads while 80% of marten detections came from off road areas. Because roads favor generalist predators, crossing roads to move between fragmented patches of habitat means martens are much more likely to encounter a predator than they would be if they were able to remain in dense shrub habitat (Slauson et al. 2010).

A landscape-scale habitat shift has occurred within the Humboldt marten's geographic range since the advent of industrial logging in the 20th century; from large, contiguous old forest stands with extensive dense shrub layers to a more patchy landscape of younger stands with degraded shrub layers divided by road systems. It is thought that small-bodied martens have a competitive advantage over the larger bodied carnivores when foraging and moving through dense shrub stands (Slauson and Zielinski 2007), so this shift in habitat can disadvantage marten while simultaneously favoring larger-bodied generalist carnivores such as bobcats, fishers, and gray foxes. These changes, along with the increased density of roads in the area, have allowed generalist predators to expand their distributions into areas they did not traditionally occupy and prey upon martens at higher rates. Although it is unknown whether predation alone threatens the existence of Humboldt martens in California, adult survival rates are known to be the most influential parameters in marten population growth models (Slauson et al. 2017). Predation rates therefore likely have a potentially significant effect on population growth and abundance.

Competition

No data or studies were identified that assess the impacts of competition between Humboldt martens and other species. The USFWS Humboldt marten species report (2015) does not identify competition as a significant stressor on Humboldt martens. Additionally, species with very specific habitat associations, such as Humboldt marten would be expected have a competitive advantage within their preferred habitat over habitat generalist species in the same area (Ricklefs 1990, Zabala et al. 2009). Further, carnivore species typically select prey species of a certain size as a function of the predator's own mass, effectively limiting competition with smaller and larger carnivores in the same community (Sinclair et al. 2003, Owen-Smith and Mills 2008). In coastal Oregon, Moriarty et al. (2016) detected the following potential competitor predators at camera traps within 5 km (3.1 mi.) of historical marten detections (reported as percent of camera trap sample units with detections): spotted skunk (*Spilogale gracilis*) at 41% of stations, opossum (*Didelphis viriginiana*) at 25% of stations, and short-tailed weasel at 8% of stations. Of these, only the spotted skunk is similar in size to Humboldt martens (Maser et al. 1981) and it is a habitat generalist, and therefore unlikely to be a significant competitor.

Toxicants

The control of predators and other animals perceived as pests through poisoning was historically common in the western states. Two former methods had the potential to kill non-target predators such as the Humboldt marten: poisoning livestock carcasses and aerial broadcast of poisoned baits. In one report, dead fishers and martens were observed in the vicinity of poisoned ungulate carcasses in Washington State (Zielinski et al. 2001). While such practices had largely ceased by the 1970s, the historical impact on Humboldt marten population size and distribution is unknown but potentially significant. Recently the use of rodenticides and other toxicants at illegal cannabis plantations has been observed to be a widespread practice (Gabriel et al. 2018). Anticoagulant rodenticides detected near cannabis plantations in northwestern California include brodifacoum, bromodiolone, chlorophacinone, diphacinone, and warfarin. Brodifacoum and bromodiolone are considered second-generation anticoagulant rodenticides which were introduced when rodents developed resistance to first-generation compounds in the 1970s (Gabriel et al. 2012, 2013, Thompson et al. 2014). First-generation compounds generally require several doses to cause intoxication, while second-generation anticoagulant rodenticides, which are more acutely toxic, often require only a single dose to cause intoxication or death and persist in tissues and in the environment (Gabriel et al. 2012). Additionally, other highly toxic pesticides, some of which are banned in the United States, have been found at illegal cannabis grow sites (Thompson et al. 2014).

A recent study conducted on Green Diamond Resource Company lands in Humboldt and Del Norte Counties detected anticoagulant rodenticide exposure in the tissues of 70% of northern spotted owls (n=10) and 40% of barred owls (*Strix varia*, n=84) examined, although none of the 36 rodent livers examined had traces of rodenticides (Gabriel et al. 2018). The authors hypothesized a recent increase in cannabis cultivation sites in the study area may have led to the increased use of anticoagulant rodenticides in the area. In an earlier study, Gabriel et al. (2015) detected the presence of anticoagulant rodenticides in the tissues of >85% of the dead fishers tested in California. Within their northern California study area (i.e., Hoopa Valley Indian Reservation) 52 fishers were tested for anticoagulant rodenticide exposure. Seven fishers were confirmed to have died from anticoagulant rodenticide poisoning, all of which had trespass marijuana grows within their home ranges (Gabriel et al. 2015). Because fisher and martens have similar foraging habits and diets, rodenticide exposure likely also poses a significant threat to the Humboldt marten population in California (Slauson et al. 2017). In recent necropsies of deceased Humboldt martens, one out of six carcasses examined showed traces of rodenticides in its tissues (Slauson et al. 2014). Although exposure to rodenticides was not necessarily the cause of death of the exposed animals, the acute toxicity of these compounds makes it likely that the salvaged animals were either directly killed by rodenticides or negatively affected to the extent that death from other causes such as exposure, predation, or starvation became more likely.

Disease

In their Humboldt marten species report (2015), the UFSWS noted: "The outbreak of a lethal pathogen within one of the three coastal marten populations could result in a rapid reduction in population size and distribution, likely resulting in a reduced probability of population persistence, given the small size of these populations." North American martens are known to be susceptible to a variety of diseases, including: rabies, plague, distemper, toxoplasmosis, leptospirosis, trichinosis, sarcoptic mange, canine adenovirus, parvovirus, herpes virus, West Nile virus, and Aleutian disease (Strickland et al. 1982, Zielinski 1984, Williams et al. 1988, Banci 1989, Brown et al. 2008, Green et al. 2008). Although Strickland et al. (1982) found that American martens in their central Ontario study tested positive for toxoplasmosis, Aleutian disease (a carnivore parvovirus), and leptospirosis; none of the diseases was considered to be a significant mortality factor for martens. Similarly, although Zielinski (1984) discovered antibodies to plague (*Yersinia pestis*) in four of 13 Sierra martens in the Sierra Nevada, he noted martens only appear to show transient clinical signs of the disease. Gray foxes within the current range of Humboldt martens in California are known to have been exposed to canine distemper, parvovirus, toxoplasmosis, West Nile Virus, and rabies, all of which are transmittable to martens (Brown et al. 2008, Gabriel et al. 2012). In their Hoopa Valley Reservation Study, Brown et al. (2008) found dead fisher within the range of Humboldt marten had been exposed to canine parvovirus and canine distemper which is known to cause high rates of mortality in mustelids (Deem et al. 2000). Because several potentially lethal diseases are known from the environment, a disease outbreak in one or both of the remaining Humboldt marten population areas in California should be considered a potential threat to the species. Although it is not known if this threat alone imperils the persistence of the species in California, when combined with the more serious threat of small, isolated populations, habitat loss from wildland fire, cannabis cultivation, timber management, and other threats, the possibility of a catastrophic disease outbreak further reduces the certainty that the Humboldt marten population will persist into the foreseeable future.

Wildland Fire

Slauson (2003) states that stochastic events such as wildfire present a major challenge to the persistence of Humboldt marten, and Slauson et al. (2017) classified wildfires as a serious threat over a large area of the extant population area in California and Oregon. In the more coastal areas occupied by Humboldt martens, conditions that promote the ignition and spread of wildfire rarely exist due to the typically wet winters and foggy summers of the local climate. However, fires become more frequent in the extant Humboldt marten range with distance inland from the coast (Oneal et al. 2006). By examining the size of recent fires in the extant range, Slauson et al. (2017) concluded that a single large fire could affect 31-70% of the currently occupied suitable habitat in California. Others have concluded that a single wildfire could burn an entire core population area (USFWS 2015). The effects of fires varies with the intensity of the burn and the severity of the impact on the vegetative community; ranging from high severity burns which can kill and consume most vegetation, including large tree structures, to low severity burns which consume only the ground level vegetation, leaving shrub and tree layers largely unaffected (USFWS 2015). Slauson et al. (2017) state that even a low severity burn would be likely to reduce Humboldt marten habitat suitability by reducing shrub cover; however, when a fire burned through approximately 25% of a studied Humboldt marten population area in the interval between surveys in 2008 and 2012, no change in marten occupancy post-fire was detected, indicating that any fire-related impacts the population were slight and/or short lived (Slauson et al. 2017). More recently in the summer of 2015, the Nickowitz fire burned approximately 2,800ha (7,000 ac.) in and adjacent to the current known range of Humboldt martens in Del Norte County, but the impact has not been assessed (InciWeb 2015).

Miller et al. (2012) reported that the annual number of fires, mean fire size, maximum fire size, and area burned all increased in northwestern California over the period of 1910-2008. Miller et al. (2012) also noted that high severity fires tended to be clustered in years when region-wide lighting strikes caused multiple ignitions, indicating that weather conditions in some years are conducive to widespread high severity fires in northwestern California. The effects of wildland fire on the landscape are difficult to predict due to variations in ignition frequency and burn severity based on vegetation type, geography, and weather patterns. However, it is clear that fires have the potential to degrade or destroy Humboldt marten habitat over entire population areas, further reducing the carrying capacity of the landscape and fragmenting populations. Therefore, habitat loss from wildland fire should be considered a potentially significant threat to persistence of the California Humboldt marten population.

Climate Change

The North American continent has already experienced the climatic effects of human-mediated increases in greenhouse gas emissions (USGCRP 2017). The annual average temperature in the contiguous United States has been 0.7°C (1.2°F) warmer over the past 30 years compared to the period 1895-2016, and is projected to further increase to 1.4°C (2.5°F) warmer over the period 2021-2050 (Vose et al. 2017). By the end of the century annual average temperatures are projected to be 1.6°C – 4.1°C (2.8°F – 7.3°F) warmer based on low emissions scenarios, to 3.2°C – 6.6°C (5.8°F – 11.9°F) warmer under high emissions scenarios (Vose et al. 2017).

In northwestern California annual precipitation levels have been 10-15% lower in the last three decades compared to the period 1901-1960 (Easterling et al. 2017). While future precipitation levels in this region are not projected to change radically, the frequency of drought events is projected to increase due to increased evapotranspiration resulting from increasing temperatures (Easterling et al. 2017). Additionally, projected warming of ocean surface temperatures 2.7°C ± 0.7°C (4.9°F ±1.3°F) (Jewett and Romanou 2017) will likely result in reduced daily coastal fog formation.

The Humboldt marten's coastal redwood and Douglas-fir forest ecosystem is characterized by moderate temperatures, high annual precipitation, and summer fog which supports dense conifer tree and shrub cover (Slauson et al. 2007, USFWS 2015). This ecosystem is currently limited in spatial extent to near coastal Oregon and northern California. Climate projections suggest that the coastal zone where precipitation is frequent will narrow in the future (PRBO 2011). The intrusion of coastal fog into inland forests has already been observed to be decreasing in frequency (Johnstone and Dawson 2010), though whether this pattern will continue into the future is unclear (PRBO 2011). Less extensive coastal precipitation, reduced fog intrusion, and globally increasing temperatures together could cause the southern extent of mesic coastal forest to retract northward, further reducing the amount of suitable habitat available to Humboldt martens (USFWS 2015, Slauson et al. 2017). These climatic changes could cause a shift from current conifer dominated vegetative communities to hardwood forests unsuitable to martens, and the dense, shade-tolerant shrub layer required by marten may be lost (USFWS 2015). These vegetation transitions could create conditions more favorable to marten predators and could further fragment the remaining patches of suitable habitat (USFWS 2015). Under moderate emissions scenarios the bioclimatic conditions that support Humboldt marten habitat are projected to reliably occur only in Del Norte County and northern Humboldt County (DellaSalla 2013).

Projected climatic changes could further impact Humboldt martens by changing the fire regime in the range of the subspecies. Miller et al. (2012) reported the number of fires per year, mean fire size, maximum fire size, and area burned all increased in northwestern California over the period 1910-2008 and that observed changes in the local climate explained much of the fire trends. This research demonstrates that the effects of a changing climate may already be impacting Humboldt marten habitat and highlights the link between climate patterns and wildfire trends in northwestern California forests. In the summer of 2015 the Nickowitz fire burned approximately 2,800 ha (7,000 ac.) in and adjacent to the current known range of Humboldt martens (InciWeb 2015). In addition to wildfire-mediated habitat changes resulting from changes in climate, other studies have projected climate-related changes in forest disease, insect damage, and other disturbance events which could affect marten habitat quality or availability (USFWS 2015). Finally, Lawler et al. (2012) suggested that martens (all North American species) will be highly sensitive to climate change and will likely experience the greatest impacts at the southernmost latitudes and lowest elevations within their range.

In a recent modeling study, Stewart et al. (2016) assessed climate change vulnerability to 20 of California's terrestrial mammals, including the Humboldt marten. Their study included three components of climate change vulnerability for each taxon. The first component is the taxon's projected response to future climate change, which is the percent of climatically suitable potential habitat projected to be lost (or added) due to climate change. It is based on the climatic conditions within the historical range and projections of those conditions in future climate scenarios. The second vulnerability component is exposure/niche breadth. This component scores the projected amount of change in climate within the taxon's range, and is expressed as percent change compared to current conditions within the historical range of the taxon. The final component is based on an assessment of the taxon's physical, behavioral, and physiological characteristics that affect its sensitivity and adaptive capacity to respond to climate change. Overall climate change vulnerability was assessed by combining the scores for the three components. Two emission scenarios (high, low) and two global climate models (hot/dry and warm/wet) were used to project four future climates. Overall vulnerability scores were partitioned into five categories, ranging from "may benefit" through "less", "moderately", "highly", and "extremely" vulnerable to future climate change impacts.

Depending on the scenario, the Humboldt marten's vulnerability was assessed to be either less vulnerable (low emission, warm/wet scenario), moderately vulnerable (low emission, hot/dry scenario and high emission, warm/wet scenarios), or highly vulnerable (high emission, hot/dry scenario). By the end of the century, projected habitat conditions at the locations Humboldt martens have been detected to date would remain largely suitable under the low emission, warm/wet scenario (only about 1% loss of suitable locations), but 77% of the locations would become unsuitable under the high emission, hot/dry scenario. The following excerpt from Stewart et al. (2016) summarizes the results from the models:

> Distribution models suggest that the Humboldt marten would benefit (increase area of climatically suitable habitat) under wet climate scenarios, but would be adversely impacted (decrease area of climatically suitable habitat) under drier future climate scenarios. Under the wet scenarios, suitable habitat is projected to increase in extent around the currently suitable areas in the southern portion of its coastal range. Under the hot dry scenarios, suitable habitat on the coast is projected to retract into the core area currently known to be occupied by the subspecies. Distribution models map large areas of suitable climate where the Humboldt marten is not currently known to occur. These include areas in the southern coastal part of the Humboldt marten's presumed historical range, as well as areas within the geographic range of the Sierran subspecies of the Pacific marten (*Martes caurina sierra*). Given the current understanding of Humboldt marten's requirements for forest structure (large decadent trees with cavities for denning, dense shrub layers) that do not occur in much of the coastal forests of northern California, it is not surprising that the species does not currently occur in a large proportion of the coastal area predicted as currently climatically suitable.

In summary, there is relatively high certainty that temperatures will continue to increase within the range of Humboldt martens, which is likely to increase the frequency drought events due to increased evapotranspiration. Although there is less confidence in projected changes in total precipitation, fire regimes, and the distribution of vegetative communities, it is apparent that significant changes are possible within the century. Changes in the distribution and abundance of preferred Humboldt marten habitat could significantly impact the existing Humboldt marten population and limit opportunities for population expansion. Therefore, climate change should be considered a threat to the long-term persistence of the Humboldt marten population in California.

Vehicle Strikes

Mortalities resulting from collisions with vehicles is a documented threat to Humboldt martens, with 17 road kills documented in coastal Oregon by Moriarty et al. (2016). Vehicle strikes were the greatest source of mortality in their Oregon study, although the authors speculated that the impact to the population may be trivial compared to predation, disease, and exposure to poisons, particularly given their small, isolated populations. There have been no recorded roadkill Humboldt martens in California since 1980 (USFWS 2015); however, Highway 101 is a high speed, multi-lane road which transects potentially suitable Humboldt marten habitat in places, and likely would pose a risk to martens attempting to cross (S. Prokop and B. Silver 6/29/2016 letter to CDFW). Slauson et al. (2017) classified the impact of vehicle collisions on Humboldt marten populations as extremely severe, but limited in scope to a few areas where frequently traveled roads intersect marten population areas. The impact of vehicle strikes on the overall Humboldt marten population is unknown. Mortalities from collisions, although apparently not spatially extensive, may combine with mortality from predation, toxicants, and other sources to exceed recruitment rates, at least in localized areas, and limit population viability (USFWS 2015).

Small Populations

Small, isolated populations are inherently vulnerable to extinction due to loss of genetic variability; inbreeding depression and genetic drift; reduced genetic capacity to respond to changes in the environment; as well as through demographic stochasticity (changes in age and sex ratios resulting in less than optimal breeding opportunities) due to random variation in birth and death rates (Primack 1993, Reed and Frankham 2003). In studied wildlife populations, genetic diversity is strongly correlated with population fitness (increased survival and reproduction rates) and decreased extinction risk (Hedrick and Kalinowski 2000, Reed and Frankham 2003). The smaller the population size, the more likely other threats will drive it to extinction (Primack 2010).

The only estimate of the Humboldt marten population is that less than 100 individuals exist in California (Slauson et al. 2009b), far below the population size experts believe to be required to ensure long-term viability of a species (Traill et al. 2007, Traill et al. 2010, Flather et al. 2011). The loss of genetic diversity inherent to small, isolated populations can be expected to increase their risk of extinction because small and inbred populations have reduced ability to adapt with changing environments due to diminished pools of potentially adaptive heritable phenotypes (Frankham 2005). Populations of at least several hundred reproductive individuals are believed to be required to ensure the long term viability of vertebrate species, with several thousand individuals being the goal (Primack 1993). However, observations of wild populations indicate that it is possible for small populations to persist, at least in the short term, in the face of genetic challenges, but these observations do not inform the probability or durability of recovery (Harding et al. 2016).

In wild populations, reproductive output and survival vary amongst individuals and from year to year. In large populations this variance averages out, but in small populations this variation, termed demographic stochasticity, can cause the population size to fluctuate randomly up or down (Primack 1993). The smaller the population size the more pronounced the effect. Once a population size drops, its next generation is even more susceptible to further stochasticity and random inequalities in the sex ratio resulting in fewer mating opportunities and a declining birth rate (Primack 1993). Due to their small population size, Humboldt martens may be vulnerable to these effects; however, Slauson et al. (2017) believe any negative impacts associated with demographic stochasticity would likely be spatially limited in Humboldt martens.

Unpredictable changes in the natural environment and biological communities can cause the size of small populations to vary dramatically where larger, more widely distributed populations would remain more stable because these changes normally occur in localized areas (Primack 1993). For example, unpredictable changes in a species' prey or predator populations, climate, vegetative community, or disease and parasite exposure can cause the size of a small, isolated population to fluctuate wildly, and possibly lead to extinction (Primack 1993). Additionally, natural disasters such as droughts, fires, earthquakes, and severe storms can lead to dramatic population changes if the population is small and localized such that the disaster impacts all or most of the individuals. Although the probability of such events is generally rare in any given year, over the course of generations the probability becomes much greater (Primack 1993). Ecological modeling studies have demonstrated that the influence of random environmental stochasticity has a greater influence on extinction probability than demographic stochasticity (Primack 1993). Environmental and genetic effects can work in concert with each other to seriously threaten small populations. As populations get smaller they become more vulnerable to demographic variation, environmental variations, genetic drift, and inbreeding depression. Each of these effects can amplify the impact of the other effects, further reducing population size and accelerating the species towards extinction in what has been termed an extinction vortex (Primack 1993).

Small populations, and populations that have experienced periods of low population numbers in the past lose genetic diversity and may suffer the effects of inbreeding depression - the concentration of deleterious alleles (maladaptive genes) in the population from the mating of closely related individuals resulting in offspring with reduced fitness (Frankham 2005, Harding et al. 2016). Closely related to inbreeding depression is genetic drift, or the accumulation and fixation of detrimental alleles in in the population due to a limited breeding pool (Hedrick and Kalinowski 2000). In large populations maladaptive genes do not accumulate in the population due to random mate pairings and the elimination of less fit offspring through natural selection. However, in small, isolated populations natural selection can have less of an effect on the population genotype than genetic drift. When this happens deleterious genes can become fixed in the population's genotype resulting in decreased reproductive fitness in all individuals, and potentially negative population growth (Hedrick and Kalinowski 2000, Frankham 2005).

The influence of inbreeding depression on fitness-related traits appears variable across populations, heritable traits, and environments (Hedrick and Kalinowski 2000). Inbreeding depression affects nearly every well studied wildlife species, and contributes to extinction risk in most wild populations of naturally outbreeding species (Frankham 2005). It is uncertain whether inbreeding depression occurs within the California Humboldt marten population, but the small population size and apparent period of isolation from other populations make it likely that significant genetic diversity has been lost (Slauson et al. 2017).

The loss of genetic diversity and the accumulation of deleterious genes can largely be mitigated by the exchange of breeding individuals between population centers (Primack 1993). When individuals migrate from their natal population to new population areas, the novel genes they introduce can balance the effects of genetic drift and inbreeding depression. As few as one migrant per generation in a population of 120 individuals could negate the effects of genetic drift (Primack 2010). Consequently, habitat fragmentation can seriously increase the genetic risks to isolated subpopulations, and habitat connectivity between populations can substantially mitigate these risks.

While the genetic risks associated with small populations may significantly increase a population's risk of extinction, it is important to note that a small population size alone is not necessarily predictive of population viability over time. A well planned conservation strategy can substantially mitigate risks associated with small populations. A comprehensive plan for long term viability should include the principles of representation, resiliency, and redundancy (Shaffer and Stein 2000, Wolf et al. 2015). These principles require recovered species be present in multiple large populations across the entire spectrum of habitats used by the species, and these populations must also be resilient to environmental changes, identified threats, and genetic threats (Wolf et al. 2015). The California Humboldt marten population, numbering less than 100 individuals, is currently highly exposed to the environmental and genetic risks inherent to small populations; however, a carefully designed program of habitat protection, connection, as well as the possibility of facilitated translocations could connect isolated breeding populations, increase the number of populations, and decrease these risks.

Research and Handling

Wildlife research in California is regulated through the state's Scientific Collecting Permit program (Fish & Game Code § 1002 et seq.). The program requires researchers to disclose their study design, wild animal handling protocols, and demonstrate their professional experience with the species of interest. Notwithstanding this oversight, mortalities are a risk of any wildlife research that requires the capture and handling of live animals. In early 2016, a Humboldt marten in California died of exposure in a trap set by researchers when the field technician checking the trap did not follow the protocol for safely securing the door on a pre-baited trap that was to be left unchecked for several days. Later that year a radio collared female marten became entrapped by the radio collar inside a den tree, resulting in the death of her and her two kits. These two incidents are the only documented research-related Humboldt marten mortalities in California despite the fact that dozens of martens have been captured and fitted with radio collars to date. Additionally, species experts believe it is unlikely that research would be conducted on more than 10% of the Humboldt marten population at any one time (Slauson et al. 2017). Therefore, it is unlikely that research and handling presents a significant threat to the population.

EXISTING MANAGEMENT

Land Ownership within the California Range

In California, the majority of the land within the Humboldt marten's range is owned and managed by the U.S. Forest Service, with smaller portions owned and managed by the Yurok Tribe, Green Diamond Resource Company, and State and National Redwood Parks (Figure 7). Land management strategies and practices vary across and within ownerships.

National Forest Lands

The U.S. Forest Service manages the majority of the land within the marten's range on the Six Rivers and Klamath National Forests. As mentioned in the Conservation Status Section, on Forest Service lands in Region 5 (California), the Humboldt marten is designated as a Sensitive Species. Management projects subject to the National Environmental Policy Act (NEPA) must analyze impacts to the Sensitive Species; however, there is no requirement to minimize or mitigate project impacts to the species. National Forest lands in northern California are managed under the Northwest Forest Plan (USDA and USDI 1994) which sets land management guidelines according to seven allocations: Congressionally Reserved Areas, Late Successional Reserves, Managed Late Successional Areas, Adaptive Management Areas, Administratively Withdrawn Areas, Riparian Reserves, and Matrix lands. Matrix lands units are intended for timber harvest, yet Slauson (2003) detected Humboldt marten on Matrix lands in 8 out of 31 sample units, and 20% of Slauson et al.'s (2007) analysis area was designated as Matrix land available for logging with 16% of the Matrix land previously logged. Late Successional Reserves (LSR) are intended to support viable populations of late successional and old-growth dependent species such as spotted owls and Humboldt martens. However, logging is not prohibited in this land allocation class, and not all LSRs are currently in a late successional condition, but rather managed to grow into late successional habitat and therefore may not currently provide Humboldt marten habitat. Forty percent of Slauson et al.'s (2007) study area was designated LSR, with martens detected in 13 of 66 sample units in LSR; 13% of the land designated LSR in the marten's range has been logged (Slauson et al. 2007). The Humboldt marten was given only a 67% likelihood of remaining well distributed within the range of the northern spotted owl (*Strix occidentalis caurina*) by the Northwest Forest Plan scientific analysis team (USDA and USDI 1994). Slauson et al. (2009b) concluded that the Northwest Forest Plan does not completely protect the extant population, with 38% of the Humboldt marten distribution occurring outside of NWFP reserves.

Forest management on individual national forests is governed by Land and Resources Management Plans (LRMP). The LRMP for the Six Rivers National Forest, where much of the extant Humboldt marten population is located, includes provisions to protect known active Pacific marten den sites and the surrounding habitat within 152 m (500 ft.) from disturbance and land-altering activities. However, there is no requirement to conduct pre-project surveys for martens, so there is little probability that active marten dens would be detected and subsequently protected, leaving denning martens and their habitat outside of protected land allocations vulnerable to disturbance and destruction (Six Rivers National Forest 1996).

A small portion of the Humboldt marten range is contained within the Siskiyou Wilderness Area, and only a portion of the wilderness area is composed of vegetation suitable for martens. Slauson (2003) detected martens on only 3 out of 23 sample units located in Siskiyou Wilderness. The U.S. Forest

Service also manages the Smith River National Recreation Area (SRNRA), which covers a small portion of the marten's range. The SRNRA is not vulnerable to logging, but management of the area prioritizes recreation over wildlife values.

Redwood National and State Parks Management

State and National Park Service land in the Humboldt marten range includes the Redwood National Parks Complex consisting of Redwood National Park, Prairie Creek Redwoods State Park, Jedediah Smith Redwoods State Park, and Del Norte Coast Redwoods State Park. These parks are managed by the National Parks Service and California Department of Parks and Recreation (California State Parks) and total over 53,412 ha. (131,983 ac.) in northwestern California, of which approximately 30% is currently composed of old-growth forest. Forests in state and national parks are not subject to harvest, except where younger stands are managed to more rapidly develop old-growth characteristics (Slauson et al. 2017). The General Plan/General Management Plan governing the management of the parks does not identify specific management actions for Humboldt martens. Approximately 33% of the Park lands are managed as primitive zones where no development or facilities construction occurs and visitor use is limited to foot traffic on existing trails. An additional, 55.4% of the Park lands are managed as backcountry zones where the preservation and restoration of the natural environment is emphasized, and modification of the environment related to visitor use is limited. Where suitable marten habitat exists within these management zones, it is likely maintained and protected from significant modification and degradation (USDI NPS and California State Parks 2000).

As of 2010, State and National parks had removed over 350 km of roads and thinned 4-6% of the second growth stands within their boundaries (Slauson et al. 2010). Prairie Creek Redwoods State Park had at least one Humboldt marten detection each year from 2009-2013, and again in 2017, although it does not appear to currently support a viable reproducing marten population (K. Slauson pers. comm. 10/10/2017).

Private and Tribal Lands

The largest private land owner within the contemporary Humboldt marten range is the Green Diamond Resource Company, which manages approximately 151,000 ha (373,000 ac) primarily in Humboldt and Del Norte Counties, California (Green Diamond Resource Company 2017). Although only a small fraction of the ownership is within the contemporary range of the Humboldt marten, an important portion lies between the core population area and potentially suitable coastal habitat in the Redwood State and National Parks (Figure 7), although much of this area was recently transferred to the Yurok Tribe. Green Diamond lands are dominated by redwood forest in coastal and low elevation areas and by Douglas-fir as elevation and distance from the coast increase. Hardwoods are common in all forest types and in places compose the majority of the stand (Green Diamond Resource Company 2012). Most of the ownership has been logged at least once over the last century and now consists of second and third growth stands from recently harvested to 120 years old (Hamm et al. 2012). Small old growth forest areas which have never been logged are scattered throughout the ownership and total 150 acres of redwood and 300 acres of Douglas-fir, comprising less than 2% of Green Diamond Resource Company land. Green Diamond operates under a Maximum Sustained Production Plan approved pursuant to a provision of California Code of Regulations, Title 14, Section 913.11 subdivision (a) ("Option A") filed with the CAL FIRE. The Option A plan is intended to balance forest growth and timber harvest over a 100 year period. With some exceptions, Green Diamond plans to practice even-aged silviculture management on the ownership using clear-cutting as the primary harvest/regeneration method. Conifer stands are typically thinned 10-20 years after planting, again after 30 years, and harvested at or after 45 years in clear cuts of 16 ha (40 ac.) or less. Streamside zones, steep slopes, and special habitat areas are managed differently, including single tree selection harvest and retention for wildlife values (Green Diamond Resource Company 2012). At least 10% of the pre-harvest basal area is typically retained in streamside zones, habitat areas, and scattered trees to retain forest structural elements through the harvest rotation. Regeneration involves prescribed burning, mechanical slash treatment, tree planting, and the control of competing vegetation with herbicides (Green Diamond Resource Company 2012).

Green Diamond has periodically surveyed their lands for the presence of fishers and martens, including surveys in 1994-1995 and 2011-2012 (Hamm et al. 2012). No Humboldt martens were detected in the earliest surveys (1994-1995); however, in a repeat survey in 2004-2005 a marten was detected on Green Diamond land `1-km west of the known Humboldt marten population on public lands, and detected again in 2006. In 2010-2011 camera station surveys on Green Diamond lands detected martens at 14 stations within a few km of the border with public lands, some co-occurring with fishers. This series of surveys indicates that martens detections are persistent on Green Diamond lands adjacent to occupied public lands (Hamm et al. 2012). Green Diamond has partnered with the United States Department of Agriculture's Forest Service Redwood Sciences Lab to conduct research on the species since 2012 (K. Hamm pes. Comm. Oct. 24, 2017). As of 2016, 33 Humboldt martens have been captured, and 24 fitted with radio collars to study their fates, movements, habitat use, and den site characteristics in this joint study (Early et al. 2016). Most of the land covered by these surveys and studies was recently acquired by the Yurok Tribe through land purchases in 2011 and 2018.

Green Diamond Resource Company manages most of its land under the conditions of two federally-approved Habitat Conservation Plans (HCPs), one for the northern spotted owl and the other for anadromous salmonid fish. The HCPs allow for incidental take of listed species and may deviate from Forest Practice Rule guidelines for species covered under the HCPs. Under Section 10(a) of the ESA, incidental take, defined as take that is incidental to, and not the purpose of an otherwise lawful activity, may be authorized for federally threatened and endangered species covered under an approved HCP. For both HCPs, the Department has determined that the federal Incidental Take Statement is consistent with CESA pursuant to Fish and Game Code section 2080.1. Although neither HCP specifically covers Humboldt marten, the plans are designed, in part, to retain and recruit larger tree structure which may improve marten habitat suitability on company lands over time. During development of the northern spotted owl HCP Green Diamond prepared a 30-year timber stand age-class forecast model. The age-class forecast covered 1991 through 2021, and assumed timber harvest would occur at an annual rate of 3,000-6,000 acres. Results indicated that second-growth stands in the 46+ year age-class would more than double, the 31-45 year age-class would increase by approximately 50,000 acres in first 10 years then return to 1991 levels, and the 8-30 year age-class would generally decrease over time. Despite these modest age gains averaged across the entire Green Diamond ownership, stands promoting marten predators will persist and the oldest stands will be harvested before they reach suitability for supporting martens.

Fish and Game Code sections 2089.2 through 2089.26 allow the Department to authorize incidental take of a species listed as endangered, threatened, candidate, or a rare plant, through a Safe Harbor Agreement (SHA) if implementation of the agreement is reasonably expected to provide a net conservation benefit to the species on their own lands (???—if this is an accurate section of the code, then it should be included here. The following sentence suggests is does.), among other provisions. SHAs are intended to encourage landowners to voluntarily manage their lands to benefit CESA-listed species without subjecting those landowners to additional regulatory restrictions as a result of their conservation efforts. In addition, at the end of the agreement period, participants may return the enrolled property to the baseline conditions that existed at the beginning of the SHA. Green Diamond Resource Company has voluntarily applied for a Humboldt marten SHA; however, until the SHA is approved, it is not possible to describe or quantify the benefits to the Humboldt marten population that will result from the agreement.

The other significant land owner within the range of the Humboldt marten is the Yurok tribe which owns approximately 23,876 ha (59,000 ac.) of land in or near the Humboldt marten range. The Tribe also manages an additional 1,528 ha (3,776 ac.) of federal land held in trust for the Tribe (Yurok Tribal Information Services website accessed October 25, 2017).

Yurok Tribal objectives for the management of Tribal lands include: Establishment of a regular, periodic, long term sustained yield of timber products, generation of Tribal income and employment from timber sales, limiting the use of clear cutting and eliminating the use of herbicides, protecting and enhancing areas considered culturally significant, acquisition of lands (including cutover lands) to increase the Tribal land base, protection and enhancement of fisheries, use of prescribed burning when possible, generating Tribal income from the sale of carbon credits, and providing oversight and professional expertise on the best way to utilize Tribal forestland for non-timber use. To achieve these goals, the Yurok primarily use uneven-aged silviculture practices (harvest of individually selected trees and small groups rather than large clear cuts) (Yurok Tribal Forestry 2012). A specific goal of Yurok Tribal forest management is the protection of Humboldt marten dens and large tree and shrub cover habitat across the landscape (E. Mann pers. comm. 10/25/2017).

Both Green Diamond Resource Company lands and Yurok Tribe fee lands are subject to the Z'berg – Nejedly Forest Practices Act of 1973 (Pub. Resources Code, § 4511 et seq.) and the California Forest Practice Rules (chapters 4, 4.5, and 10, Title 14, CCR), which are administrated by the California Department of Forestry and Fire Protection (CAL FIRE). The California Forest Practice Rules specify that an objective of forest management is the maintenance of functional wildlife habitat in sufficient condition for continued use by the existing wildlife community within planning watersheds (§ 897(b)(1)(B), Title 14, CCR). This language may result in actions on private lands beneficial to martens. Nevertheless, specific guidelines to retain habitat for martens are not provided in the Forest Practice Rules. Further, this guidance would at best conserve habitat where Humboldt martens are known to exist, but would not be expected to result in the creation of additional habitat. Additionally, section 919.16 of the Forest Practice Rules requires landowners to provide CAL FIRE with information when late successional forest stands are proposed for harvesting if the harvest will "significantly reduce the amount and distribution of late successional forest stands or their functional wildlife value so that it constitutes a significant adverse impact on the environment". However, this rule does not specify protective or mitigation measures to offset potentially significant impacts associated with late successional forest loss.

Habitat suitable for martens may be retained within Watercourse and Lake Protection Zones (§ 916 et seq., Title 14, CCR) on private timberlands. Watercourse and Lake Protection Zones are defined areas along streams where the Forest Practice Rules limit the amount of timber harvested in order to protect in-stream habitat quality for fish and other resources. Harvest restrictions and retention standards vary according to the presence of anadromous and other fish species, as well as other aquatic life forms. These zones may encompass 15-45 m (50-150 ft.) on each side of a watercourse, 30-91 m (100-300 ft.) in total width depending on side slope, location in the state, and the watercourse's classification. Within Watercourse and Lake Protection Zones, the prescriptions vary by watercourse classification. For fish bearing streams (Class I watercourses), the retention standards vary from 50- 80 % overstory canopy (depending on distance to the watercourse) and include leaving a multi-storied stand composed of a diversity of species similar to that found before the start of timber operations. For watersheds that fall within Anadromous Salmonid Protection rules (§§ 916.9, 936.9, and 956.9, Title 14, CCR), the 13 largest trees per acre (live or dead) must also be retained within Class I Watercourse and Lake Protection Zone. For non-fish bearing streams (Class II watercourses), Watercourse and Lake Protection Zone retention standards vary from 50 % total canopy to 80% overstory canopy depending on the type and location of the watercourse.

MANAGEMENT RECOMMENDATIONS

The Department has evaluated existing management recommendations and available literature applicable to the management and conservation of the Humboldt martens to arrive at the following recommendations. The recommendations largely derive from *The Humboldt Marten Conservation Assessment and Strategy* (Slauson et al. 2017). The Department recognizes the scientific expertise and judgement of the Executive Team that developed the Strategy, and deems the information provided a reliable synthesis of current scientific literature on the species, thus constituting the best available science.

Habitat Protection, Management, and Restoration

Given the many conservation challenges identified for the Humboldt marten, achieving the goal of recovering and maintaining sustainable reproductive marten populations in California necessitates cooperation and support among government and private land managers. Achieving the overarching goal of Humboldt marten population recovery and persistence necessitates managing the landscape toward habitat conditions suitable for marten occupancy within much of their historic range. Specific management objectives can be further refined within the following Conservation Emphasis Areas (CEAs) from Slauson et al. (2017) (Figure 4).

Extant Population Areas (EPA)

EPAs are areas where five or more Humboldt marten detections have been documented since 1980 that are no more than 5 km (3.1 mi.) from the nearest neighboring detection. These clusters of detections are then buffered to include 2 km (1.24 mi.) of the surrounding landscape.

1. Design land management activities in and adjacent to EPAs to maintain conditions characterized as highly suitable marten habitat[2], and where feasible, improve habitat conditions in areas of moderate and low suitability

2. The current extent of the two California EPAs is 81,182 ha (202,162 ac.), which is 3.9% of the historic range; however, a habitat suitability model developed by Slauson et al. (in press) classifies 15,566 ha (38,464 ac.) of this extent as currently unsuitable for marten occupancy. Assess areas classified as unsuitable habitat within EPAs for their potential to be managed toward conditions characterized as high suitability marten habitat.

3. Continue surveys for the Humboldt marten where large patches of suitable habitat exist within their historical range, and as new detections are documented, EPAs should be re-assessed periodically to

[2] Briefly, areas with high precipitation levels and a high Old Growth Structural Index (many large trees and snags and high tree size diversity), or serpentine soils (see Slauson et al. in press for details).

include new detections, following methods described in the Conservation Strategy (Slauson et al. 2017).

4. Identify high priority areas for restoration within EPAs based on their potential for connecting fragmented suitable habitat patches.

5. Evaluate whether major roads within EPAs fragment suitable habitat patches, create major barriers to marten movement, or pose a substantial collision risk to crossing martens. Consider installation of wildlife crossing structures where appropriate.

6. Protect currently suitable resting and denning structures within EPAs (i.e. large snags and downed logs) and manage forest stands to ensure continual recruitment of structures.

7. Protect current dense shrub layers within EPAs, and plan for the regeneration of shrub layers when it can benefit marten habitat suitability, particularly if required after a low intensity fire event.

Population Re-establishment Areas (PRA)

PRAs are areas within the Humboldt marten historical range which currently do not contain self-sustaining populations, and where recovery actions are required to accelerate the recolonization of self-sustaining marten populations. For a PRA to support a self-sustaining population, the amount of contiguous suitable marten habitat should be greater than 1,500 ha (3,707 ac.), which corresponds to the estimated area capable of supporting five or more female home ranges. Based on these criteria, Slauson et al. (2017) identified four potential PRAs within California (Figure 4), which should be considered for immediate Humboldt marten population recovery.

8. Manage habitat with the PRAs towards a landscape condition that is suitable to sustain Humboldt martens.

9. Where major roads (e.g. highways 101, 199, and 299) separate PRAs from EPAs and may act as barriers to marten dispersal, evaluate the availability of existing structures such as bridges, large culverts, and overpasses which could be used by martens to safely cross. Where such structures are limited, work with state and federal highway agencies to plan and install state of the art wildlife crossing structures.

10. Once a PRA is determined to have a sufficient amount of suitable habitat, assess it to determine if population recolonization would require human assisted dispersal, or whether natural dispersal of animals is a reliable means for recolonizing the PRA.

Landscape Connectivity Areas (LCA)

Providing dispersal habitat that Humboldt martens may use to move safely between an EPA to restored habitat in a PRA is critical for recolonizing newly restored habitat, and within a metapopulation context, provides essential connectivity for gene flow to occur between extant marten populations. LCAs are characterized by a low amount of currently suitable reproductive habitat and low potential to develop additionally suitable reproductive marten habitat but capacity to provide important functional dispersal zones. Currently, only one LCA has been identified in California, and it lies in a critically important dispersal zone between the southernmost EPA and the restorable 1,430 km^2 (552 mi.^{2}) Redwood-Prairie Creek PRA extending into Humboldt County (Figure 4). Unfortunately, suitable habitat conditions for an LCA are poorly understood, and additional research is needed to better understand functional dispersal habitat requirements for the Humboldt Marten. Given this uncertainty, it is important to provide alternative land management options in LCAs immediately to provide adaptive management options that balance the need for connectivity maintenance or improvement versus status quo management.

11. Avoid actions within the LCAs which could significantly reduce or permanently restrict the ability of Humboldt martens to move between EPAs and PRAs.

Wildland Fire

Given that the current distribution of extant Humboldt marten populations in California is limited to two relatively small EPAs occupying < 5% of the species' historical geographic range, large catastrophic fires have the potential to severely impact up to 70% of occupied suitable habitat in California over the next 15 years (Slauson et al. 2017). Moriarty et al. (2017) found that treating as little as 10-20% of the landscape with mechanical or prescribed fire fuel reduction treatments can significantly reduce the risk of Pacific marten habitat loss in high elevation forest habitats of the Sierra Nevada.

12. Design and implement fuel management prescriptions to reduce the wildfire risk to EPAs and PRAs. Prescriptions should preserve important Humboldt marten habitat elements like dense shrub understories, abundant large snags, dead and dying trees and downed logs in occupied habitat to the greatest degree possible while achieving risk reduction goals.

13. Expand the range and increase the resiliency of Humboldt marten populations in California, including managing for multiple large EPAs connected by LCAs to reduce the risk of a substantial loss of the current extant marten population due to a single catastrophic fire.

Research, Surveys, and Monitoring

14. Research is needed to determine whether the Humboldt marten's small population size has resulted in a loss of genetic diversity, and whether the subspecies is at risk of population declines due to reduced fitness affecting their ability to evolve and adapt to environment changes due to climate change and other causes.

15. Determine the extent to which Humboldt marten populations in California and Oregon interbreed and quantify the genetic contribution to California populations from animals dispersing from Oregon.

16. Conduct surveys to determine if Humboldt martens occur in shore pine habitat in California, as found in Oregon.

17. Develop and implement consistent survey and monitoring strategies that reliably produce metrics on population size, distribution, and trends.

18. Develop a better understanding of specific silvicultural practices that result in high suitability habitat for the Humboldt marten and its prey species.

Commented [SK-F31]: There patches of this habitat type in CA are simply too small and disjunct from other forest habitat to realistically support marten populations as they do in OR. This is best stated in saying conduct continued surveys in the largest areas of potentially suitable habitat that have yet to be surveyed.

19. Study and develop siliviculture techniques in early seral stands which discourage occupancy by marten predators while recently harvested or burned stands are regenerating.

20. Study the lethal and sub lethal effects of rodenticides and other toxicants on Humboldt martens, model potential population effects, and work to reduce sources of exposure.

21. Identify the impact diseases have on Humboldt marten fitness and mortality, and work to reduce sources for exposure.

22. Continue to collect demographic parameters of extant marten populations, and identify key parameters affecting population growth and persistence.

23. Study habitat relationships of the primary marten predators (i.e. bobcats), and identify management options that reduce predator abundance and distribution within marten habitat (e.g. restorative thinning to stimulate shrub growth and road removal).

SUMMARY OF LISTING FACTORS

CESA directs the Department to prepare this report regarding the status of the Humboldt marten based upon the best scientific information available to the Department. CESA's implementing regulations identify key factors that are relevant to the Department's analyses. Specifically, a "species shall be listed as endangered or threatened ... if the Commission determines that its continued existence is in serious danger or is threatened by any one or any combination of the following factors: (1) present or threatened modification or destruction of its habitat; (2) overexploitation; (3) predation; (4) competition; (5) disease; or (6) other natural occurrences or human-related activities." (§ 670.1(i)(1)(A), Title 14, CCR.). The definitions of endangered and threatened species in the Fish and Game Code provide key guidance to the Department's scientific determination. An endangered species under CESA is one "which is in serious danger of becoming extinct throughout all, or a significant portion, of its range due to one or more causes, including loss of habitat, change in habitat, over exploitation, predation, competition, or disease." (Fish & Game Code, § 2062.) A threatened species under CESA is one "that, although not presently threatened with extinction, is likely to become an endangered species in the foreseeable future in the absence of special protection and management efforts required by [CESA]." (*Id.*, § 2067). The following summarizes the Department's determination regarding the factors to be considered by the Commission in making its decision on whether to list the Humboldt marten. This summary is based on the best available scientific information, as presented in the foregoing sections of the report.

Present or Threatened Modification or Destruction of Habitat

The geographic range of the Humboldt marten has retracted to less than five percent of the extent documented by naturalists in the early 20th Century. Although historical trapping pressure is implicated in the initial decline of the species in the state, today the species population is limited by the amount, distribution, and quality of its remaining preferred habitat. Historical and ongoing management for timber production threatens the species by removing, degrading, and fragmenting the dense shrub layers and large tree structures the species is dependent upon for cover, denning, and foraging. Some portions of the remaining occupied habitat are protected by wilderness and other land use designations, but large areas remain vulnerable to continued timber harvesting and other uses which can fail to retain required habitat elements on the landscape. Until additional areas of suitable forest habitat are allowed to develop with careful management and the passage of time, the limited extent of suitable habitat will continue to prevent recovery of the California Humboldt marten population over the next several decades at a minimum.

Overexploitation

Intensive trapping pressure during the late 19th and first half of the 20th centuries appears to have significantly reduced the Humboldt marten population and the species' distribution in the state. However, due to changes in trapping laws and practices, overexploitation no longer threatens the species in California.

Predation

Predation is a significant cause of Humboldt marten mortality in California populations. While predation is natural in wildlife communities, predation rates by larger predators appear to be elevated in landscapes managed for timber production due to the association of the primary prey of larger predators and early seral forest habitat. It is uncertain how predation rates relate to reproductive rates of Humboldt marten on managed landscapes. Whether predation by larger predators may constitute a primary threat to Humboldt marten populations on managed landscapes is a hypothesis that warrants examination with further research. The degree to which predation by larger predators limits Humboldt marten populations on or adjacent to managed landscapes and what management actions may effectively reduce this mortality factor in these areas warrants further research. In the interim it can be assumed that ongoing timber harvest that creates early seral forest conditions in or adjacent to extant populations or areas identified as important for population re-establishment and connectivity will continue to put extant populations at risk an prevent recovery of the California Humboldt marten population.

Competition

There is no indication in the available information to indicate that competition poses a substantial threat to Humboldt marten populations in California.

Disease

Although there is little available information on disease rates and associated mortality in Humboldt marten populations, the presence of highly virulent diseases has been documented in the occupied range. Because Humboldt marten populations are small and isolated, a virulent disease outbreak in one or both populations could seriously threaten the statewide population. However, the probability of such an outbreak is difficult to predict.

Other Natural Events or Human-Related Activities

Small Populations

In California the two remnant Humboldt marten populations are both believed to be less than 100 individuals distributed each. Assuming an equal sex ratio and adult-biased age structure (≥ 2 years old), as has been observed in marten populations elsewhere in California, each population may contain fewer than 40 breeding females. Populations of this size are vulnerable to inherent genetic and environmental threats including, inbreeding depression, demographic stochasticity, environmental stochasticity, and loss of genetic diversity. These effects can result in decreased reproductive output, inability to adapt to changing environmental conditions, concentration of maladaptive genetic traits, and other deleterious effects. Small, isolated populations are also at inherently at greater risk of extinction due to environmental events such as wildfires and disease outbreaks. Small population effects can interact

Commented [SK-F32]: This statement needs to acknowledge how much time is necessary for forests growth processes to regenerate suitable habitat conditions. This is not measured in years but decades or centuries depending on what the existing conditions are.

Commented [SK-F33]: These two statements have no scientific basis. Population modeling conducted by Buskirk et al. 2012 and by Slauson et al. 2018 both identify adult and juv survival as the two most influential factors for population growth. Variation in fecundity is contrast has little affect and significant variation in kit production in Pacific martens has not been found. Therefore, any factor that significantly reduces survival will have the greatest impact on population growth, regardless of what 'reproductive rates' are doing. I suggest these statement be deleted and replaced with the statement I inserted.

Commented [SK-F34]: Rabies and distemper outbreaks appear to cycle with a peak outbreak once per decade in gray foxes in Humboldt and adjacent counties. We provided additional details in the Assessment on this risk factor. It is reasonable to assume that outbreaks in overlapping populations of carnivores will occur 1-2 times per decade.

with other threats (such as disease, toxicants, climate change, and others) synergistically to amplify the negative impacts on the Humboldt marten population. While these small population effects almost certainly impact the California Humboldt marten population, research would be required to quantify the degree to which these effects threaten the persistence of the population.

Wildland Fires

Because the two California Humboldt marten populations are small, disjunct, and limited to small geographic ranges, a single catastrophic wildfire has the potential to significantly impact either population's size and range. Fires can destroy the dense shrub understories and large tree structures martens depend on for cover, denning, and foraging. Additionally, fires have the potential to further fragment the remaining habitat. Although it is impossible to predict the timing and location of wildfires, it is likely that fires will impact Humboldt marten habitat in northwestern California in the foreseeable future. The degree to which wildland fires threaten the persistence of the California Humboldt marten population is unknown.

Commented [SK-F35]: As stated in the habitat factor section, the risk to habitat loss and degradation from this factor is very undervalued here. See my comments on the cover letter on fire. The Conservation Assessment and Strategy estimated that up to 70% of the currently occupied habitat may likely be subject to wildfire over the next few centuries. I suggest this section be revised to put more realistic estimates of the total risk wildfire represents and what specific facts (e.g., both extant populations have had 2-3 fires burn in the occupied areas in the last 15 years.

I also suggest this be linked explicitly to the habitat modification and destruction section. It is more appropriate there as an important driver of habitat change/decline for the foreseeable future.

As mentioned in the cover letter Davis et al. estimated that recent fires on federal lands in southwestern Oregon are causing the rate of loss of late seral forest to outpace recruitment from growth.

Climate Change

Past and ongoing changes to the north coast climate such as rising temperatures, declining precipitation, and decreased daily fog will likely result in long term changes to the vegetative community in the region. How these changes will impact the preferred habitat of Humboldt martens is difficult to predict, but some modeling studies indicate that the geographic extent of suitable marten habitat is likely to retract northward and more coastally in California. While there is a high degree of confidence in projected warming trends, and less certainty in projected precipitation changes, the degree to which these changes will threaten Humboldt martens in the foreseeable future is unknown.

Toxicants

Although there is little available information on Humboldt marten exposure to toxicants, the presence of highly toxic anticoagulant rodenticides and other pesticides is well documented within the California range. These compounds are known to frequently kill closely related fishers in northwestern California; however, the degree to which toxicant exposure threatens the Humboldt marten population is unknown.

LISTING RECOMMENDATION

CESA directs the Department to prepare this report regarding the status of the Humboldt marten in California based upon the best scientific information. CESA also directs the Department, based on its analysis, to indicate in the status report whether the petitioned action is warranted. (Fish & Game Code, § 2074.6; § 670.1(f), Title 14, CCR). In addition to evaluating whether the petitioned action (i.e., listing as endangered) was warranted, the Department considered whether listing as threatened under CESA was warranted. The Department includes and makes its recommendation in its status report as submitted to the Commission in an advisory capacity based on the best available science. In consideration of the scientific information contained herein, the Department has determined that historic and ongoing habitat loss, fragmentation and associated elevated predation rates, coupled with unquantified, but potentially significant ongoing impacts to the species from a small population size, disease, toxicants, wildfire, and climate change, warrants listing the Humboldt marten as threatened under CESA.

Protection Afforded by Listing

It is the policy of the State to conserve, protect, restore and enhance any endangered or threatened species and its habitat (Fish & Game Code § 2052). The conservation, protection, and enhancement of listed species and their habitat is of statewide concern (Fish & Game Code § 2051(c)). CESA prohibits the import, export, take, possession, purchase or sale of any species the Commission determines is endangered or threatened (Fish & Game Code, § 2080 et seq.). CESA defines "take" as hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill (Fish & Game Code, § 86). The Fish and Game Code authorizes the Department to allow "take" of species listed as threatened or endangered under certain circumstances through incidental take permits, memoranda of understanding, natural community conservation plans, safe harbor agreements, or other plans or agreements approved by or entered into by the Department (Fish & Game Code, §§ 2081, 2081.1, 2086, 2087, 2089.2, and 2835).

If the Humboldt marten is listed under CESA, impacts of take caused by activities authorized through incidental take permits must be minimized and fully mitigated according to state standards. These standards typically include protection of the land in perpetuity with an easement, development and implementation of a species-specific adaptive management plan, and funding through an endowment to pay for long-term monitoring and maintenance to ensure the mitigation land meets performance criteria. Additionally, the Department is prohibited from approving incidental take permits which could jeopardize the continued existence of the species in the state (Fish & Game Code, § 2081(b)(4)). Obtaining an incidental take permit is voluntary. The Department cannot force compliance; however, any person violating the take prohibition may be punishable under state law.

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

Although the protections afforded listed species by CESA do not apply to the actions of federal management agencies on federal lands, CESA listing may prompt increased interagency coordination and the likelihood that state and federal land and resource management agencies will allocate funds toward protection and recovery actions. In the case of the Humboldt marten, the Humboldt Marten Working Group signatory agencies already meet and coordinate regularly, but a state listing could result in increased availability of conservation funds.

Economic Considerations

The Department is not required to prepare an analysis of economic impacts (Fish & Game Code, § 2074.6).

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Personal Communications

Derek J. Broman, Furbearer Coordinator, Oregon Department of Fish and Wildlife. March 17, 2017

Keith Hamm, Wildlife Biologist, Green Diamond Resource Company. October 24, 2017.

Edward Mann, Yurok Tribal Forestry Director. October 25, 2017.

Stephan Prokop, Redwood National Park Superintendent, and Brett Silver, Redwood State Parks Superintendent. Letter to Daniel Applebee, California Department of Fish and Wildlife. June 29, 2016.

Keith M. Slauson, Research Ecologist, USDA Forest Service Redwood Sciences Lab. November 10, 2017.

Keith M. Slauson, Research Ecologist, USDA Forest Service Redwood Sciences Lab. E-mail exchange with Scott Osborn and Daniel Applebee, CDFW. November 17, 2017.

LIST OF FIGURES

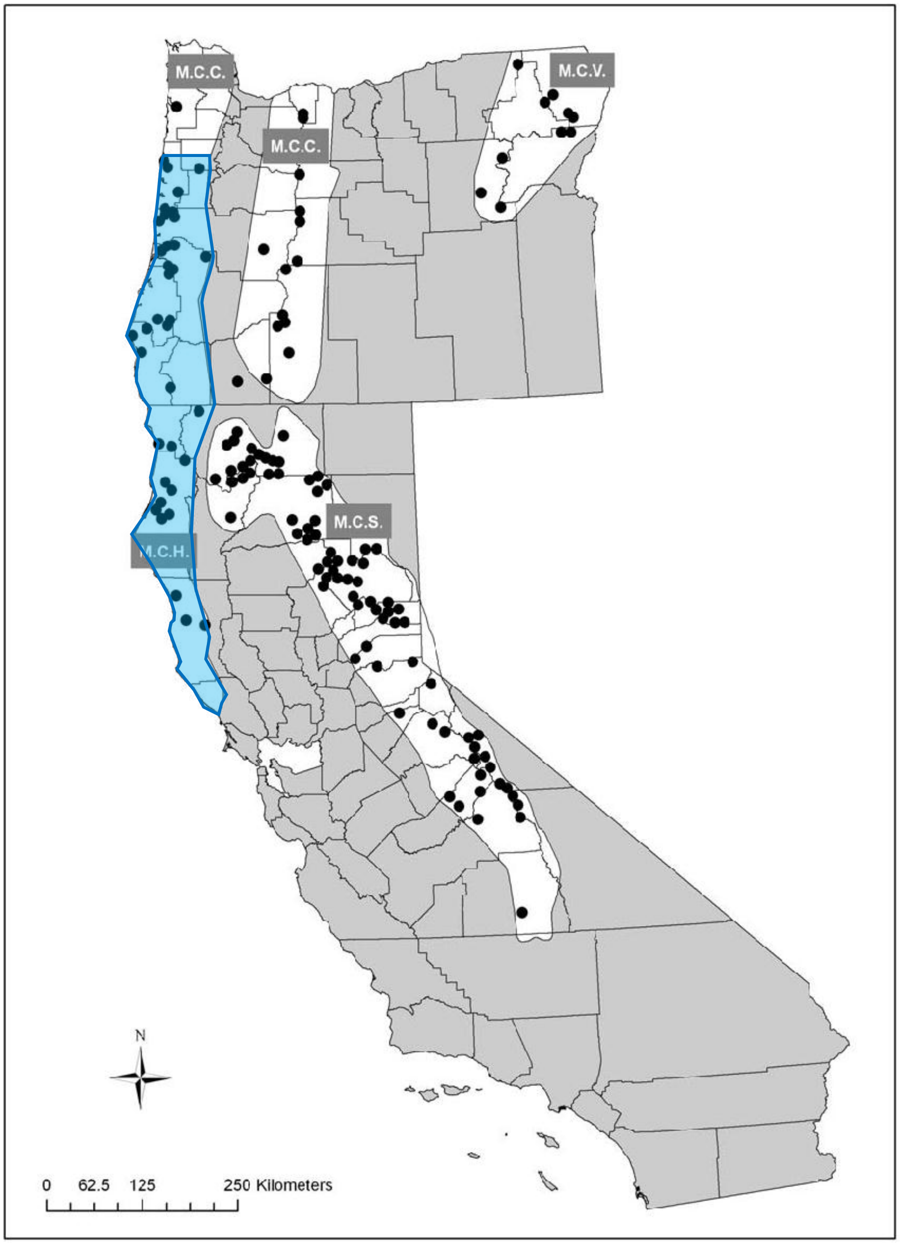
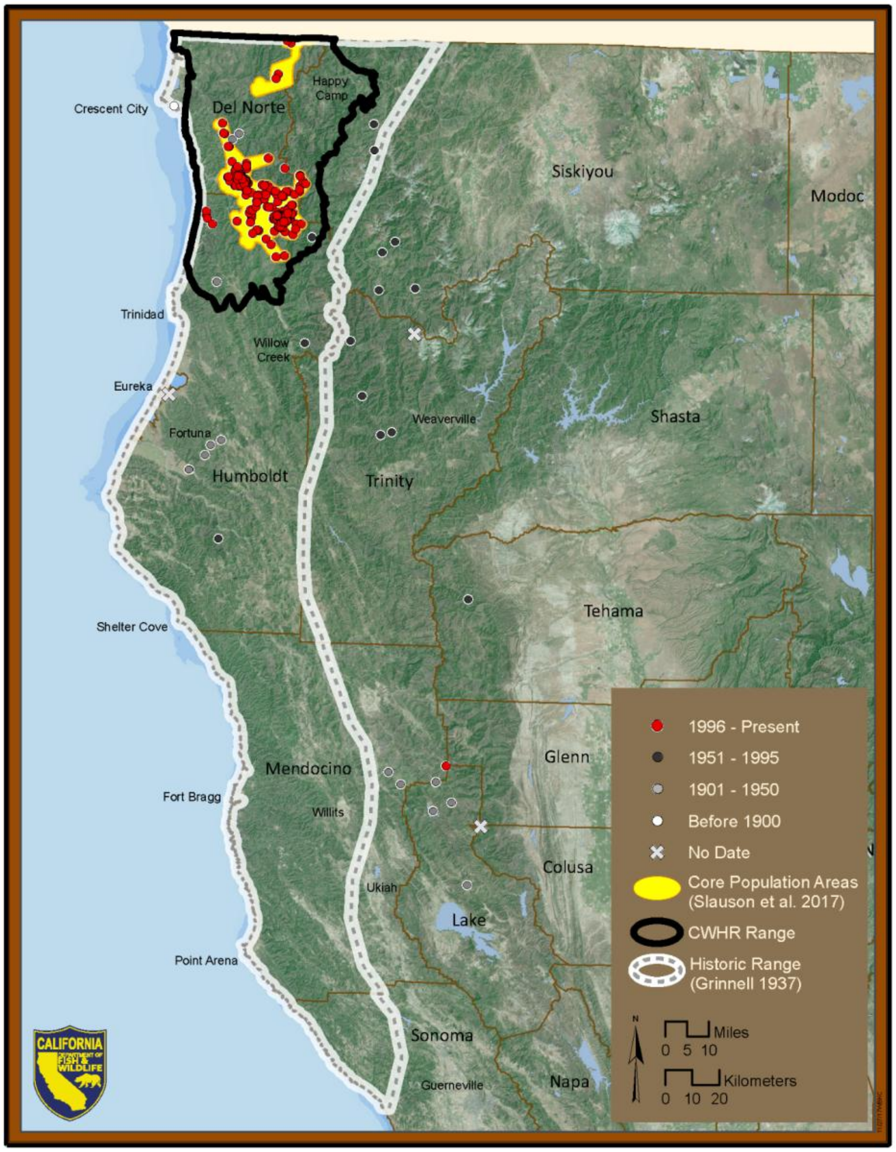


Figure 1.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Happy Camp
Siskiyou
Modoc
Trinidad
Willow Creek
Eureka
Fortuna
Humboldt
Weaverville
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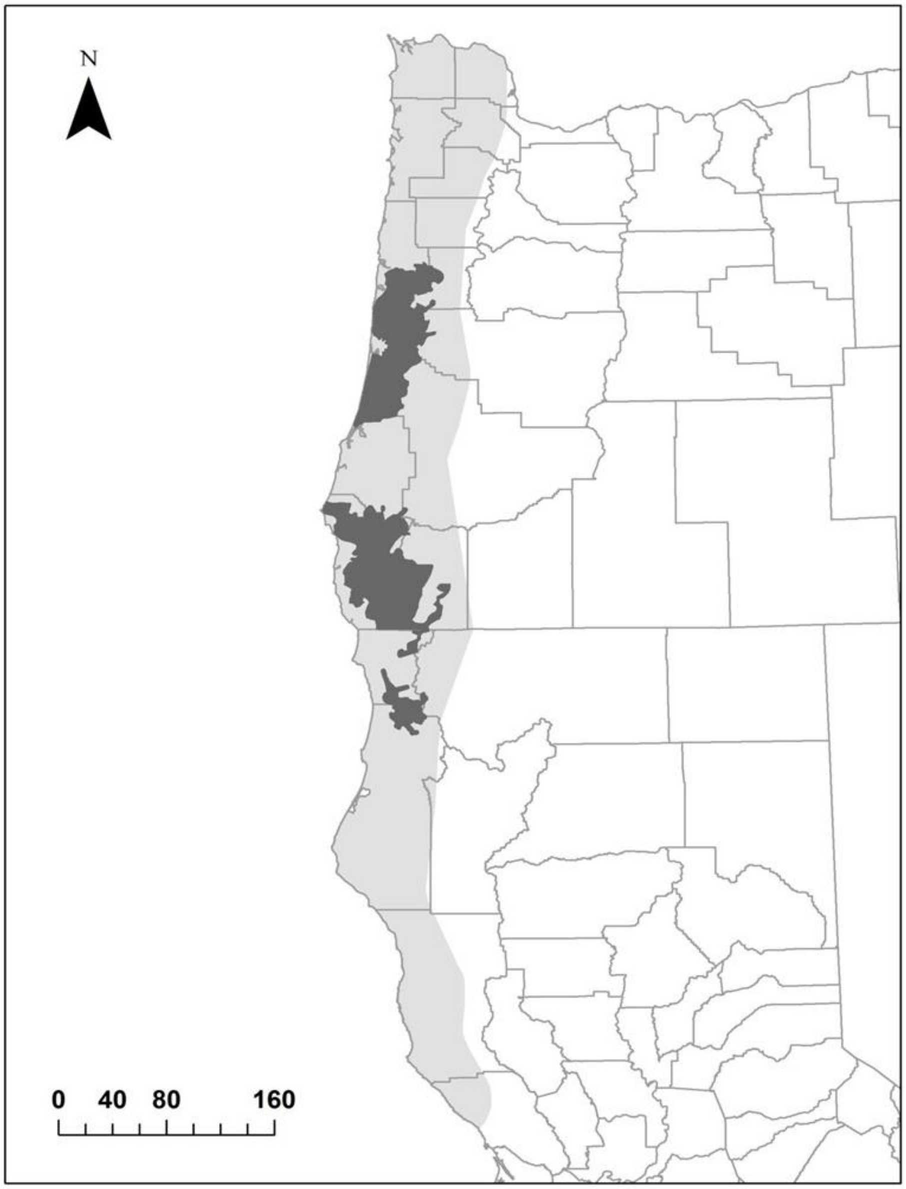
Shelter Cove
Tehama
Mendocino
Fort Bragg
Willits
Glenn
Colusa
Ukiah
Lake
Point Arena
Sonoma
Guerneville
Napa
1996 - Present
1951 - 1995
1901 - 1950
Before 1900
No Date
Core Population Areas (Slauson et al. 2017)
CWHR Range
Historic Range (Grinnell 1937)
Miles
0 5 10
Kilometers
0 10 20

Figure 2.



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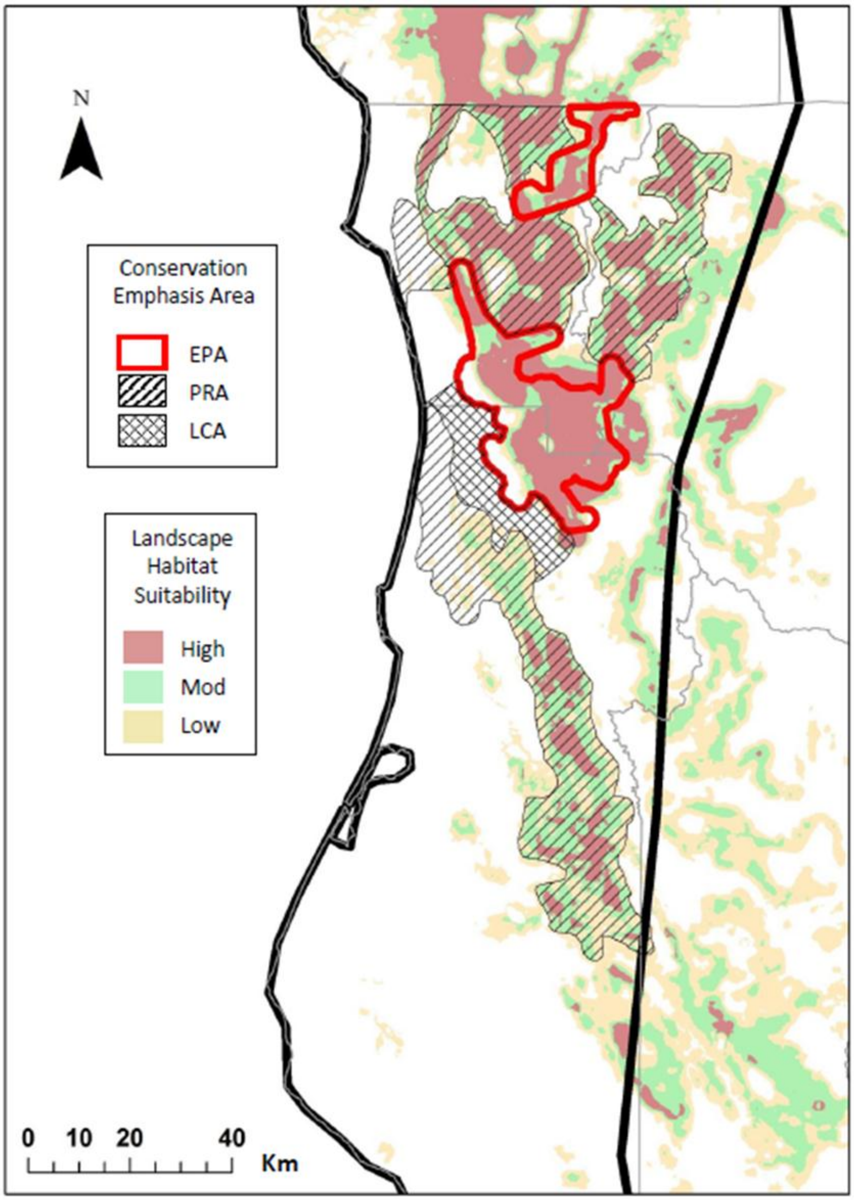
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LCA
Landscape Habitat Suitability
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Low
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Km

Figure 4.

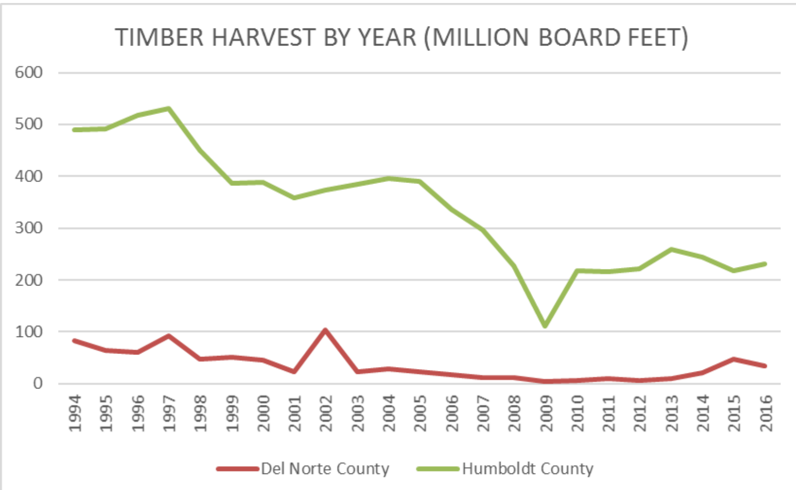

Figure 5.

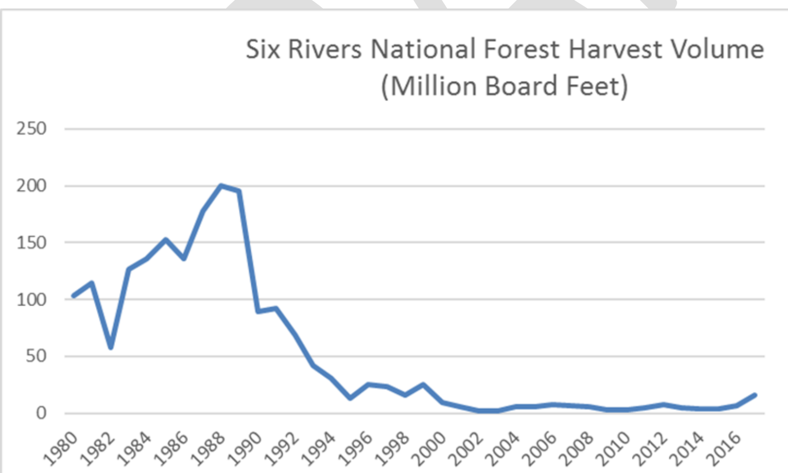

Figure 6.

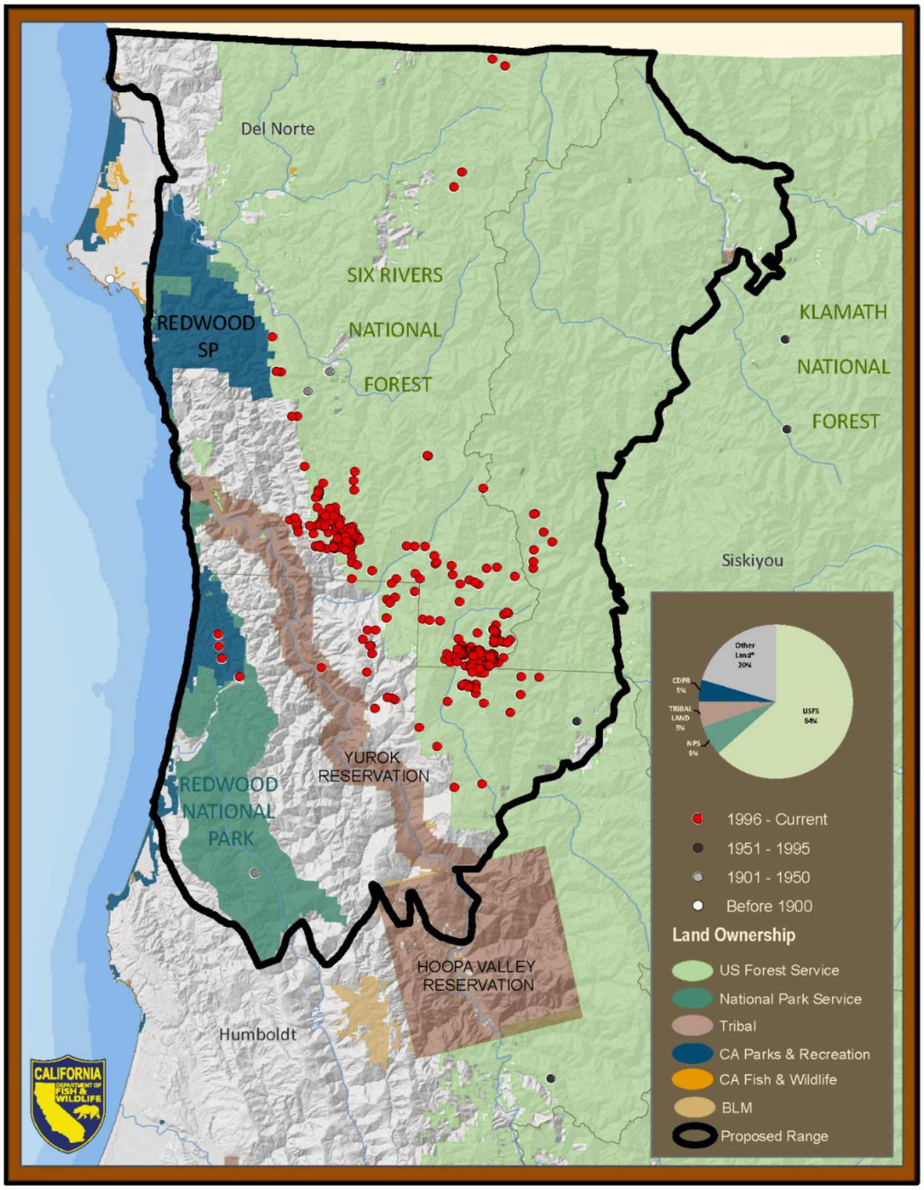
Del Norte
SIX RIVERS
NATIONAL
FOREST
REDWOOD
SP
KLAMATH
NATIONAL
FOREST
Siskiyou
YUROK
RESERVATION
REDWOOD
NATIONAL
PARK
HOOPA VALLEY
RESERVATION
Humboldt
CALIFORNIA
Other Land* 20%
CDPR 5%
TRIBAL LAND 5%
NPS 6%
USFS 64%
1996 - Current
1951 - 1995
1901 - 1950
Before 1900
Land Ownership
US Forest Service
National Park Service
Tribal
CA Parks & Recreation
CA Fish & Wildlife
BLM
Proposed Range

Figure 7.

Hello Dan,

Thank you for your patience on this. The Yurok Tribe very much appreciates your interest on having our input into this important document. We will be very interested in reading your final decision.

Chris

~~~~~~

Chris West
Senior Wildlife Biologist

Yurok Tribe
Wildlife Program, Natural Resources Division
190 Klamath Blvd, Klamath, CA 95548
[redacted]
~~~~~~

State of California
Natural Resources Agency
Department of Fish and Wildlife

DRAFT REPORT TO THE FISH AND GAME COMMISSION
A STATUS REVIEW OF THE
HUMBOLDT MARTEN
(*Martes caurina humboldtensis***)**
IN CALIFORNIA


Keith Slauson photo used with permission

CHARLTON H. BONHAM, DIRECTOR
CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE
March 20, 2018

Contents

ACKNOWLEDGMENTS

EXECUTIVE SUMMARY

(Section will be written following peer review)

REGULATORY SETTING

A "Petition to List the Humboldt Marten (*Martes caurina humboldtensis*) as an Endangered Species under the California Endangered Species Act" (Petition) was submitted to the Fish and Game Commission (Commission) on June 8, 2015, by the Environmental Protection Information Center and the Center for Biological Diversity (Petitioners). Commission staff transmitted the Petition to the Department of Fish and Wildlife (Department) pursuant to Fish and Game Code section 2073 on June 18, 2015, and published a formal notice of receipt of the Petition on July 24, 2015 (Cal. Reg. Notice Register 2015, No. 30-Z, p. 1237). The Department serves in an advisory capacity to the Commission by providing scientific reviews of petitions.

On November 11, 2015, the Department provided the Commission with its evaluation of the Petition, "Evaluation of the Petition from the Environmental Protection Information Center and the Center for Biological Diversity to List the Humboldt Marten (*Martes caurina humboldtensis*) as Endangered Under the California Endangered Species Act," to assist the Commission in making a determination as to whether the petitioned action may be warranted based on the sufficiency of scientific information. (Fish & G. Code, §§ 2073.5 & 2074.2; Cal. Code Regs., tit. 14, § 670.1, subds. (d) & (e).) Focusing on the information available to it relating to each of the relevant categories, the Department recommended to the Commission that the Petition be accepted.

At its scheduled public meeting on February 11, 2016, in Sacramento, California, the Commission considered the Petition, the Department's petition evaluation and recommendation, and comments received. The Commission found that sufficient information existed to indicate the petitioned action may be warranted and accepted the Petition for consideration. Upon publication of the Commission's notice of its findings, the Humboldt marten was designated a candidate species on February 26, 2016 (Cal. Reg. Notice Register 2016, No. 9-Z, p. 290).

Status Review Overview

The Commission's action designating the Humboldt marten a candidate species triggered the Department's process for conducting a status review intended to inform the Commission's decision on whether listing the species is warranted. At its scheduled public meeting on February 8, 2017, in Rohnert Park, California, the Commission granted the Department a six-month extension to facilitate external peer review.

This written status review report, based upon the best scientific information available and including independent peer review of the draft report by scientists with expertise relevant to the Humboldt marten, is intended to provide the Commission with the most current information available on the

Humboldt marten and to serve as the basis for the Department's recommendation to the Commission on whether the petitioned action is warranted. The status review report also identifies habitat that may be essential to the continued existence of the species and provides management recommendations for recovery of the species. (Fish & G. Code, § 2074.6.). Receipt of this report is to be placed on the agenda for the next available meeting of the Commission after delivery. Additionally, the report will be made available to the public for a minimum of 30 days prior to the Commission taking any action on the Petition.

Concurrent Federal Petition

Humboldt marten populations in northwestern California and coastal Oregon are currently under review for potential listing under the federal Endangered Species Act of 1973 (ESA) (16 U.S.C. § 1531 et seq.) in response to a 2010 petition also submitted by the Environmental Protection Information Center and the Center for Biological Diversity. The petitioned populations include the entire Humboldt marten range in California, as well as two populations of coastal Oregon Humboldt martens. In 2015, the USFWS released a 12-Month Finding that listing the Humboldt marten was not warranted. The federal petitioners challenged the finding in federal court, specifically challenging the USFWS conclusion that Humboldt marten populations were not in danger of extinction due to the risks associated with small, isolated populations. The court issued a summary judgement in favor of the Petitioners' claim that Humboldt marten populations in northwestern California are threatened by small, isolated populations (*Center for Biological Diversity v. U.S. Fish and Wildlife*. 15-cv-05754-JST, (N.D. Cal. Mar. 28, 2017). As a result, the USFWS is currently reevaluating the status of Humboldt martens in California and Oregon. An important difference between the ESA and CESA is that the ESA requires USFWS to assess whether species are threatened or endangered in the United States, while CESA directs the Department to assess a species' status only within California.

BIOLOGY AND ECOLOGY

Systematics

The Humboldt marten is a carnivorous mammal (order Carnivora, family Mustelidae), classified as a subspecies of Pacific marten (*Martes caurina*), a species occurring west of the Rocky Mountain Divide which was recently split from the American marten (*Martes americana*, Dawson and Cook 2012). The taxonomy of martens in the Pacific Northwest is currently unsettled. Historically the range of Humboldt martens was described as entirely within the north coastal portion of California (Grinnell and Dixon 1926, Grinnell et al. 1937); however, recent genetic evidence suggests Humboldt martens and martens in coastal Oregon (currently classified as *M. caurina caurina*) are diagnosably distinct from other western martens and are one phylogenetic lineage. Consequently experts now believe martens in northwestern California and coastal Oregon should collectively be classified as Humboldt martens (*M. caurina humboldtensis*) (Slauson et al. 2009a, USFWS 2015, Moriarty et al. 2016, Schwartz and Pilgrim 2017).

California is also home to the closely related Sierra marten (*M. caurina sierra*), which is traditionally considered to range throughout the Sierra Nevada and northern interior mountains. The Sierra marten is not the subject of this Petition (Figure 1). Within this report references to North American martens may refer to any species or subspecies of marten occurring in the North America (i.e. *M. americana, M. caurina, M. caurina sierrae, M. caurina caurina,* and/or *M. caurina humboldtensis*), and references to Pacific martens include any or all subspecies of *M. caurina* (including Sierra, Humboldt, *M. caurina vulpina*, and other subspecies).

Species Description

Martens have elongated and low-to-the-ground bodies, as do other members of the weasel family. Martens are intermediate in size among North American mustelid species. Martens are larger and stockier than long-tailed weasels (*Mustela frenata*) and short-tailed weasels (*Mustela erminea*), and have longer tail and body fur than the similarly sized minks (*Neovison vison*). They are noticeably smaller and more slender than the larger mustelids of North America, including wolverines (*Gulo gulo*), river otters (*Lontra canadensis*), and American badger (*Taxidea taxus*). Martens are typically smaller than fishers (*Pekania pennanti*), though there is some overlap in size between male martens and female fishers.

Marten pelage (fur) is brown (varying from yellowish buff to nearly black), with a contrasting lighter patch on the throat and chest. The marten's bushy tail constitutes more than one-third of the overall body length. Overall body lengths range from 45-70 cm (18-28 in.) and body mass ranges from 0.4-1.25 kg (0.88-2.76 lbs.), with males averaging 15% longer and up to 65% heavier than females (Clark et al. 1987, Powell et al. 2003). Humboldt martens generally differ from the Sierra martens by having darker, richer golden fur; smaller throat patch, more extensive dark fur on the feet, legs, and tail; smaller skulls, narrower faces (rostra), and differences in dentition (Grinnell and Dixon 1926, Grinnell et al. 1937, USFWS 2015).

Geographic Range and Distribution

Within California, Humboldt martens historically occupied the coastal mountains from Sonoma County north to the Oregon border from sea level to 915 m (3,000 ft.) within 35 km (22 mi.) of the coast (Grinnell and Dixon 1926, Zielinski et al. 2001, USFWS 2015). The current distribution within the state is limited to areas of Del Norte, northern Humboldt, and western Siskiyou counties and encompasses less than 5% of the probable historical range in the state (Slauson et al. 2009b, Slauson et al. 2017). The majority of contemporary California marten detections are from a 812 km^2 (313 mi^2) core area which includes the South Fork of the Smith River, Blue Creek, Bluff Creek, Camp Creek, Cappell Creek, Pecwan Creek, Slate Creek, and Rock Creek watersheds (USFWS 2015). An additional extant population exists east of U.S. Highway 199 near the California-Oregon border in northeastern Del Norte County, and a few Humboldt martens have recently been detected west of the core area in Prairie Creek Redwoods State Park (USFWS 2015, K. Slauson pers. comm. 10/10/2017, [Figure 2]). These extant population areas are currently isolated from one another by substantial areas of currently suboptimal habitat. East and south of the core population elevation and precipitation rapidly declines in the canyon of the Klamath River. The drier climatic conditions of the river canyon do not support the dense brush cover habitat of Humboldt martens. West of the core population lies an 8-16 km (5-10 mi.) wide band of industrial timberlands between the core population and high quality redwood forest habitat in State and National Parks where martens have been detected several times in the last decade. These industrial timberlands are typically harvested every 40-60 years, and in this zone dense brush cover is less extensive. Where brush cover exists it is fragmented by roads and recent timber harvests. This more open and fragmented cover may favor carnivore species that prey on or compete with Humboldt martens (this topic is discussed below in the Threats section).

Within coastal Oregon, Humboldt martens have been detected from the California border through Lincoln County (Moriarty et al. 2016). Recent survey efforts and road kill records indicate Humboldt martens currently occupy 3-4 core population areas in the two states. The degree to which the smaller California-Oregon border population area may be effectively connected to marten populations in southern Oregon is unknown.

The Department develops species range maps using the established convention of including the USDA Forest Service Ecological Subregions of California (https://map.dfg.ca.gov/bios/) that encompass species detections from the last 20 years, and when necessary modifying the boundaries along geological features (California Interagency Wildlife Task Group 2014). For the Humboldt marten range used in Figures 2 and 7, the ecological subregions were cut along the Klamath River and the Redwood Creek watershed boundary to omit large areas where no contemporary Humboldt marten detections have occurred, and the urban area surrounding Crescent City was omitted. It is recognized that this convention can result in the inclusion of substantial unoccupied areas within the range bounds. Humboldt martens are distributed unevenly within the bounds of their range, with only a fraction of the area containing the requisite tree and shrub cover to support marten populations.

Habitat Associations and Use

Generally, Humboldt martens are strongly associated with two distinct habitat types: late successional conifer forests with dense shrub layers where abundant live and dead standing and downed tree structures are used for resting, denning, and escape cover; and serpentine soil forest communities of various seral stages with variable tree cover, dense shrubs, and rock piles and rock outcrops used for resting, denning, and escape cover (Slauson et al. 2007, Slauson et al. 2017, Slauson et al. in review). Large patches (>50 ha [>124 ac.]) of late successional conifer forests or serpentine soil formations appear necessary for supporting sustainable Humboldt marten populations (Slauson et al. 2007, K. Slauson pers. comm. 11/10/2017). While Humboldt marten territories and dens have also been found in younger, previously harvested stands adjacent to late successional stands which retain some large trees, snags, and logs, populations in these areas may not be sustainable in the absence of individuals dispersing from nearby late successional stands (Slauson pers. com. 11/10/2017). In coastal central Oregon, Humboldt martens have recently been discovered occupying a third habitat type: shore pine (*PInus contorta* subsp. *contorta*) forests with extensive dense shrub understories (Slauson et al. 2017).

Humboldt martens appear to select habitat at three scales (micro-habitat, stand, and home range scales), and populations of martens are affected by the arrangement of habitat at a fourth scale, the landscape. The following outline of habitat use is taken largely from Slauson et al. (2017). It should be noted that the best available information specific to Humboldt marten is presented here, but in some cases, information from other subspecies or from the American marten is referenced.

At the micro-habitat scale (the locations at which martens feed, rest, and den), North American martens rest or den in structures that provide cover for thermoregulation and protection from predators, and they forage in locations where prey is abundant (Taylor and Buskirk 1994). Humboldt marten prey species are associated with late-successional conifer forest stands characterized by abundant large logs, snags, and decadent live trees; with extensive, dense stands of ericaceous shrubs (i.e. evergreen huckleberry [*Vaccinium ovatum*], salal [*Gaultheria shallon*], and rhododendron (*Rhododendron macrophyllum*] [Allgood 1996, Slauson et al. 2017]). Den sites of North American martens are used by females to give birth to their young (natal dens) and to rear young until weaning and independence (maternal dens). Martens tend to be highly selective in their choice of denning sites, favoring large trees and snags with cavities that prevent larger predators from entering (Payer and Harrison 2003, Fuller and Harrison 2005, Thompson et al. 2012). The available data on Humboldt marten den sites (Slauson and Zielinski 2009, Slauson et al. unpublished data, Green Diamond Resource Company unpublished data) are consistent with the general North American marten pattern. A study of Humboldt marten denning ecology on managed timberlands in northern California categorized the type of substrate used for 34 identified dens (Table 1. Data from Early et al. unpublished presentation 2016):

Table 1. Humboldt marten dens by structure type and marten use from Early et al. 2016.

			Structure Type		
Den Type	Live Tree	Snag	Log or Rock Pile	Artificial Nest Box	Underground
Natal	5	0	2	0	1
Maternal	19	4	1	2	0

Trees and snags used for denning in the study were typically large, averaging 91 cm diameter at breast height (dbh, [36 in. dbh]), ranging from 46-183 cm dbh (18-72 in. dbh). Den trees typically had complex structural features such as broken tops, dead tops, large limbs, complex branching, basal hollows, and cavities.

Rest structures, used between periods of foraging by both male and female martens, include the kinds of sites used for denning as well as other sites that are less protective and less insulated than cavities or hollows, such as large tree limbs (Slauson et al. 2017). Martens typically select the largest available structures for resting and denning (Spencer 1987, Gilbert et al. 1997). Rest structures used by Humboldt martens in largely unmanaged forests averaged 95 cm (37 in.) dbh for snags, 88 cm (35 in.) large-end diameter for downed logs, and 94 cm (37 in.) dbh for live trees. Structures on average exceeded 300 years of age (Slauson and Zielinski 2009). Preliminary data on Humboldt marten rest structures from more intensively managed lands indicate a similar pattern of use of large-diameter conifer structures, with 70 percent of structures >70 cm (>28 in.) dbh (Slauson et al., unpublished data). Most resting locations (i.e., the actual resting place in the structure) were in tree cavities (33%), on platforms in broken-top snags or on large live branches (33%), or in chambers within log piles or rock outcrops (28%) (Slauson and Zielinski 2009). Rest structures which provide cavities or chambers likely become especially important during the late fall through the late spring, when wet rainy conditions are common.

At the stand scale of habitat selection (forest patches used for foraging, denning, and resting), Humboldt martens are found in forest stands that provide abundant structures suitable for resting and denning, as well as good foraging habitat, which includes both abundant prey and overhead cover to reduce predation risk (Slauson et al. 2017). In non-serpentine soil areas, Humboldt martens have been shown to preferentially use late seral forest stands and to avoid use of early successional stands (Slauson et al. 2007). The preferred late seral stands were Douglas-fir dominated, but also included mature tanoak (*Notholithocarpus densiflorus*) or chinquapin (*Chrysolepis chrysophylla*) understories. As mentioned above, late successional forest stands with dense shrub layers and abundant habitat elements such as large snags, tree cavities, large downed logs and woody debris, as well as serpentine soil forest stands with abundant rock cover appear to provide the best combination of habitat features at the stand scale.

Where Humboldt martens have been tracked on managed timberlands with younger tree age distributions, they have been associated with second-growth stands several decades old, which provide substantial overhead cover. Importantly, these stands retained abundant late successional habitat elements such as large old trees, snags, and logs through earlier harvests. It is likely that these retained old growth structural elements provide the micro-scale habitat features needed by martens for resting, denning, and foraging (Slauson et al. 2014, Slauson et al. 2017).

Humboldt martens have also been found in forest stands growing in serpentine soils in near proximity (less than 30 km) of the coast (Slauson and Zielinski 2001). Serpentine soils are characterized by having low plant productivity due to naturally low concentration of essential nutrients (and in some areas naturally high heavy metal concentrations). Serpentine stands used by the Humboldt marten are dominated by a variety of conifers, including lodgepole pine (*Pinus contorta*), western white pine (*Pinus monticola*), and Douglas-fir *(Pseudotsuga menziesii*) in dense to sparse overstories (Slauson et al. 2007).

Humboldt marten resting sites in serpentine stands are strongly associated with the presence of dense shrub cover and abundant rock outcrops, which are used for resting cover (Slauson and Zielinski 2009).

Serpentine habitat areas appear to support lower proportions of female martens than late successional forest stands on non-serpentine soils. Population monitoring suggests marten occupancy is less stable in serpentine habitats than in old forest habitat. Therefore, the serpentine habitat areas may have less value to Humboldt marten population persistence than old forest habitat (Slauson et al. in review).

Dense shrub layers (>70% cover) of salal, evergreen huckleberry, rhododendron, shrub oak (*Quercus vaccinifolia*), and tanoak is an important component of stands selected by Humboldt martens (Slauson et al. 2007). Slauson et al. (2010) modeled Humboldt marten habitat occupancy probability based on several habitat variables measured at the stand scale and found that marten occupancy was most strongly influenced by the percent of the landscape with ≥50% shrub cover. Importantly, the shrub community favored by Humboldt martens does not include the shade-intolerant, short-lived shrub species such as *Ceanothus* spp. that occupy more xeric (dry) sites, and dominate sites following logging and other disturbances (Slauson et al. 2010).

Dense shrub layers may play an important role in excluding marten predators. Most North American martens occupy areas where deep snow accumulates which effectively excludes larger carnivores with higher body mass to foot surface area ratios. It rarely snows in the coastal forests occupied by Humboldt martens, but it is thought that extensive, extremely dense shrub layers effectively exclude larger bodied carnivores and provide a niche for Humboldt martens to exploit (Slauson et al. 2010). Humboldt martens, with the smallest body size of North American marten subspecies (Hagmeier 1961), are adapted to the dense foliage and stems found near ground level in coastal forest ecosystems, allowing them to move quickly through the dense cover and successfully capture prey.

At the home range scale, Humboldt martens appear to select areas with a high proportion of late succession forests stands. The limited information available on Humboldt marten home ranges (n=3) indicates they are on the order of 300 - 500 ha (750 - 1250 ac.), (Slauson et al. 2017). Habitat selection analysis of radio-telemetered Humboldt martens indicates that home ranges typically include ≥70% stand-scale suitable habitat arranged in large patches (≥150 ha [>370 ac.] in area) (Slauson et al. 2007, Slauson et al. 2017). Humboldt martens have also been found reproducing in younger conifer stands (40-50 years post-harvest) in the Pecwan Creek watershed and surrounding areas on the western margin of the core population area. While these stands are not considered late successional nor old growth, the average tree size is greater than 61 cm (24 in.) dbh, and stands retain abundant large tree, snag, and log structures as a legacy of historical individual tree and small group selection silviculture no longer typical for the region (K. Slauson pers. comm. 10/10/2017). Although reproducing martens have been found in these younger conifer stands, mortality rates are high, particularly from bobcat predation (citation). It is unlikely that native reproduction rates offset the high mortality rates to sustain the population. Male-skewed sex ratios, and an age structure skewed to younger individuals in these areas suggests that a large proportion of the population occupying younger conifer stands consists of animals dispersing from the adjacent core population area (K. Slauson pers. comm. 10/10/2017).

At the landscape scale, Humboldt martens appear to select areas of occupancy based on the amount of old forest structure or serpentine habitat present in areas which receive abundant annual precipitation. Slauson et al. (in review) developed a landscape scale Humboldt marten habitat selection model to predict which regions of the historical range contain suitable marten habitat. The model was developed by relating field survey results to the environmental and habitat attributes hypothesized to influence marten distribution. The models that best correlated with observed landscape scale habitat selection each included measures of old growth structural index (a combination of stand age indices and the number of large trees >100cm [39 in.] dbh, the number of large snags >50 cm [20 in.] dbh and >15 m [49 ft.] tall, the volume of large snags, and a tree size diversity index measured at the 1-km [0.62 mi.] scale), serpentine habitat measured at the 3 km [1.89 mi.] scale, and annual precipitation measured at the 3 km [1.89 mi.] scale.

Growth, Reproduction, and Survival

Humboldt martens are assumed to be polygynous, like American martens and other Pacific martens, where one male breeds with multiple females. The following information is based on general characteristics of American and Pacific martens. Martens generally produce one litter per year (Calder 1984), and mating occurs mostly in summer, with a peak in July (Markley and Bassett 1942). The fertilized embryo does not implant in the endometrium for seven or eight months (Ashbrook and Hanson 1927). Active pregnancy begins upon implantation in mid-winter (February). Parturition typically occurs in March or April, after 27 days of gestation (Jonkel and Weckwerth 1963). In a radio-telemetry study of Humboldt martens (Early et al. unpublished presentation 2016), adult females reduced their daily movements from mid-March through early April, consistent with near-term pregnancy and immediate post-parturition. Typical litter size is two or three young (Strickland et al. 1982) and ranges from one to five young (Strickland and Douglas 1987).

Young are born with little fur, ears and eyes closed, and have a body mass at birth of about 28 g (1 oz.), (Brassard and Bernard 1939). The ears open at about 24 days, eyes at 39 days, and by 7 to 8 weeks of age they are active enough for the mother to move them to another den (or succession of dens) for subsequent rearing (Ruggiero et al. 1998). Male parents do not provide care for the young, though by excluding other males from their territories, they may indirectly increase prey availability for the females and their young (Clark et al. 1987). Young are typically weaned at 18 weeks of age (Strickland and Douglas 1987), and may begin dispersing from the natal area as early as August, continuing through the following summer (USFWS 2015).

Females may mate as early as 15 months of age and, because of delayed implantation, may first give birth at about 24 months of age (Strickland et al. 1982). The proportion of adult females that may attempt breeding is likely related to environmental conditions (severity of winter and availability of prey). In a Canadian population of the American marten only about 50% of adult females became pregnant in environmentally stressful years (Thompson and Colgan 1987); however, it is possible the relatively mild conditions within the Humboldt marten's geographic range may mean that a higher proportion of females may be pregnant each year (Slauson et al. 2017). Although data for Humboldt martens are lacking, in other martens females achieved highest reproductive potential between 3 and 5 years of age (Mead 1994, Fortin and Cantin 2004).

In a radio telemetry study of Humboldt martens in northwestern California (Early et al. unpublished presentation 2016), 11 females were collared, and over the course of the three year study 16 female territories were monitored continuously for at least a full year, with some territories being monitored in multiple years. There were 12 reproduction attempts amongst the 16 monitored females (75%). All but one of these attempts produced kits (94%). Of the 20 kits produced, 17 survived to weaning (Early et al. unpublished presentation 2016).

Humboldt marten survival rates between age classes for males and females are not known. In California, Pacific martens seldom survive longer than 5 years in the wild (USFWS 2015). Building upon the population model for martens developed by Buskirk et al. (2012), Slauson et al. (2017) posited age-class specific survival rates for Humboldt marten of 0.50 for juveniles (i.e., from birth to age 1 year) and

0.70 for all adult age classes (from age 1 year to age 2 years, age 2 to 3 years, 3 to 4 years, etc.). The model indicates that population persistence is dependent on relatively high adult survival rates. Therefore higher rates of adult marten mortality, as from predation, would have large impacts on population size, trend, and rates of recovery after population decrease (Slauson et al. 2017).

Diet and Food Habits

North American martens were found to require 15-25% of their body mass in prey daily to meet their energetic requirements (Slauson and Zielinski in press). The diet of Humboldt martens consists primarily of small mammals and birds, along with lesser amounts of reptiles, insects, and berries. Humboldt marten diets shift seasonally, with berries consumed more frequently in the summer and fall than other times of the year (Slauson et al. 2007).

A recent investigation of the Humboldt marten's diet estimated the proportion of metabolizable energy (PME) based on scat analysis (Slauson and Zielinski in press). The study found that on average 72% of Humboldt martens' metabolizable energy came from mammals, 22% from birds, 7% from reptiles, 5.3% from insects, and 2.6% from plant material, primarily fruits. Mammals were the most important food source by PME in all seasons. Although 17 different mammal taxa were evident in the analyzed scats, the vast majority of energy was derived from a few rodent taxa: 42% of mammalian PME was composed of squirrels and chipmunks and 21% of voles and mice. Chipmunks (*Tamias* spp.), red-backed voles (*Myodes californicus*), Douglas's squirrels (*Tamiasciurus douglasii*) and flying squirrels (*Glaucomys sabrinus*) constituted the majority of year round mammalian biomass. Red-backed voles, Douglas's squirrels, and flying squirrels reach their highest densities in late successional conifer forest stands where the foods they specialize on (conifer seeds and truffles) can be found, while chipmunks, flying squirrels, and overall small mammal abundance are positively correlated with ericaceous shrub density (Slauson et al. 2017).

The only significant insect food consumed appeared to be the adults and larvae of wasps and bees. Berries constituted 98.5% of the plant matter consumed, primarily salal, evergreen huckleberry, California red huckleberry (*Vaccinium. parviflora*), and manzanita (*Arctostaphylos sp*.) fruits. Berries were consumed most often in summer and fall (Slauson and Zielinski in press). Although reptiles composed a relatively small proportion of the diet, they were more important in the spring and summer (12% and 10% of diet respectively), when predation on mammals was lowest.

No major differences were observed between the diets of males and females nor between adult and subadult diets (Slauson and Zielinski in press). Compared to the studied diets of other North American martens, the Humboldt marten has a more diverse diet, depends less on voles, and includes more birds. (Slauson and Zielinski in press).

Interestingly, dusky-footed woodrats (*Neotoma fuscipes*) appeared in only one of the scat samples analyzed by Slauson and Zielinski (in press). Woodrats are a widespread and often abundant small mammal in coastal redwood forests. They are especially abundant in regenerating (<20 year-old) stands in managed forests (Hamm and Diller 2009). Although woodrats would seem to be ideal prey for martens based on their size and microhabitat use, it may be that bobcat (*Felis rufus*) prevalence in younger forests effectively precludes martens from taking them. Woodrats (and brush rabbits, another young forest herbivore) are the dominant prey of bobcats (Slauson unpublished presentation 2017). It is likely the risk of predation from, and competition with, bobcats effectively precludes Humboldt martens from utilizing this abundant prey resource (K. Slauson pers. comm. 10/17/2017).

Predators (see also Threats below)

Known predators of martens in western North America include coyote (*Canis latrans*), red fox (*Vulpes vulpes*), bobcat, and great horned owl (*Bubo virginianus*) (Thompson 1994, Bull and Heater 2001). Fishers are also known to kill martens, and the distribution of fisher populations may limit the distribution of marten (Krohn et al. 2004, USFWS 2015). In a recent study of radio-telemetered Humboldt martens (Slauson et al. 2014), nine mortalities of martens were observed (including eight collared martens and one uncollared marten) over the course of two years. All nine of the martens that died were either confirmed or determined likely to have been killed by bobcats (Slauson et al. 2014). Slauson reviewed several North American marten research projects (Thompson 1994, Hodgman et al. 1997, Ellis 1998, Bull and Heater 2001, Raphael 2004, and McCann et al. 2010) which found predation to be an important source of mortality in monitored marten populations. Among these studies, Slauson (Slauson et al. 2017, and K. Slauson unpublished presentation 2017) noticed a correlation between the intensity of timber harvest in the study areas and the proportion of marten mortality attributed to predation by generalist carnivores. In the three study sites located in areas with high timber harvest rates and a mosaic of young forest stands and edge habitat, bobcats were the predominant predator.

Home Range and Territoriality

Martens are intrasexually territorial—adults exclude members of the same sex from their home ranges, but not members of the opposite sex (Powell 1994, Powell et al. 2003). Intrasexual territoriality is believed to benefit adult females energetically by reducing direct competition from other females for prey, and adult males by providing exclusive reproductive access to females within their home ranges.

Pacific marten home ranges in the Sierra Nevada vary from 170 to 733 ha (420–1,811 ac.) for males and from 70 to 580 ha (173–1,433 ac.) for females (Buskirk and Zielinski 1997). The limited available information from three collared male Humboldt martens in California indicates home ranges are similar in size to Sierra marten, in the range of 300–400 ha (Slauson et al. 2017). Moriarty et al. (2016) estimated the average fall home range areas in coastal Oregon to be 280 ha (692 ac.) for three males and 65 ha (160 ac.) for eight females. There appears to be an inverse relationship between habitat quality and home range size, with the larger marten home ranges in coastal California and Oregon occupying more intensively managed landscapes (USFWS 2015, Moriarty et al. 2016, Slauson et al. 2017).

Dispersal

Humboldt marten kits begin dispersing from their maternal home range as early as August and dispersal continues through at least the following summer (Slauson et al. 2017). Although dispersal distances in excess of 70 km (43.5 mi) have been reported, the average dispersal distance of North American martens is typically less than 15 km (9.3 mi) (USFWS 2015, Slauson et al. 2017).

CONSERVATION STATUS

Regulatory Status

The Humboldt marten is not currently listed as threatened or endangered in California under the CESA or the ESA. However, California Fish and Game Code section 2085 extends all of the protections afforded threatened and endangered species to those species under review in response to accepted petitions. Accordingly, during the current candidacy period the legal protections of the CESA are in place for the Humboldt marten until the Commission adopts findings either formally listing the species or rejecting the petitioned action.

The Humboldt marten is designated as a Species of Special Concern by the Department (CDFW 2017). Species of Special Concern (SSC) are species, subspecies, or distinct populations of vertebrate animals native to California that have been extirpated from the state, are ESA (but not CESA) listed as Threatened or Endangered, have naturally small populations or are experiencing serious population or range declines that could qualify them for Threatened or Endangered status. SSC is an administrative designation that conveys no formal legal status or protection. The intent of SSC status is to focus attention on animals at conservation risk, stimulate research on poorly known species, and achieve conservation and recovery of these animals before they meet criteria for listing as threatened or endangered under the CESA (CDFW Species of Special Concern website accessible at https://www.wildlife.ca.gov/Conservation/SSC).

On United States Forest Service (USFS) lands in Region 5 (which encompasses all of California), the Humboldt marten is designated a Sensitive Species and a Priority Species. Its Sensitive Species status requires management projects subject to the National Environmental Policy Act (NEPA) to analyze impacts to the species; however, this obligation carries no attendant requirement to minimize or mitigate impacts to the species.

Habitat Essential for the Continued Existence of the Species (FGC § 2074.6)

The Department considers all currently occupied Humboldt marten habitat (Extant Population Areas, see discussion below) essential for the continued existence of the species in California. Additionally, suitable but apparently unoccupied habitat near the currently occupied habitat (Population Re-establishment Areas, see below) is also considered essential for species. Further, additional habitat that is not currently suitable but which could be restored to suitability within the near term should also be considered essential.

This determination is based on analysis of information provided by Slauson (2003) and Slauson et al. (2017). For example, Slauson (2003) summarized the condition and management of the currently occupied Humboldt marten range by stating:

> A significant number of marten detections (38%) occurred on lands (private industrial timberlands and USFS matrix lands) that are available for logging currently and lack strategies to maintain suitable marten habitat ... Both martens and their habitat are patchily distributed in the area, and further loss or degradation of limited suitable habitat could decrease the chances for the persistence of this remnant population. A conservation strategy based solely on measures to maintain current conditions for this population is unlikely to ensure its long-term persistence. The two major challenges for persistence and restoration of the coastal California marten population are: 1) the longer a population remains small, the greater the chance that it will lose its genetic variation (Nei et al. 1975) or that it will be eliminated due to stochastic demographic or environmental events (e.g., wildfire)(Fager 1991), and 2) restoration of forest habitats with the structural characteristics necessary to be suitable for martens may take many decades.

Based on figures in Slauson et al. (2017), approximately 81,000 ha (200,155 ac.) of currently suitable or recruitable habitat exist in two Extant Populations Areas ("EPAs", [the geographic range of the known extant reproductive population based on verified Humboldt marten detections and a 2 km-wide (1.24 mi.) buffer of the surrounding suitable habitat]) in California (Figure 4). If fully occupied, and assuming a female home range size of 350 ha, which is intermediate to those reported for Sierra martens (Buskirk and Zielinski 1997), the EPAs could support approximately 231 females. The four Population Reestablishment Areas (PRAs, areas of modeled suitable habitat in patches large enough to support at least five female marten home ranges which are currently unoccupied or support fewer than five females) identified in Slauson et al. (2017) encompass 198,713 ha (491,031 ac.), which could theoretically support an additional 568 female martens. Therefore, existing habitat in California, if fully occupied, could be expected to support 800 or fewer adult females. These estimates should be considered unrealistically high as they assume optimally arranged home ranges and fully occupied suitable habitat. Additionally, the RPAs are currently thought to be unoccupied. Establishment of populations within these areas may require active translocation of individuals.

Deleted: .

Forest management within areas essential to the continued existence of the Humboldt marten would not necessarily need to be precluded to promote the development of quality Humboldt marten habitat. For example, areas which are not currently suitable habitat could be thinned to open canopies for the promotion of dense shrub layers and the recruitment of large tree structures. Additionally, landscape-scale planning and management would be required to balance the promotion and retention of large patches of high quality habitat with the risk of catastrophic habitat loss from wildfire. All six areas, especially the four PRAs, are a mix of suitable and unsuitable habitat conditions. Management actions aimed at increasing suitability (availability of structural elements, dense shrub layer, and closed overstory canopy) could increase the number of marten home ranges supported over current conditions and reduce the threats associated with fragmented habitat in these areas.

Even if suitable habitat in these six areas were fully developed and fully occupied, Humboldt martens would number no more than 800 adult females, and only an approximate 20% of the historical geographic range in California would be occupied (Slauson et al. 2017). This number (added to the number of adult male martens that would also occupy the area) is at or below the theoretical minimum viable population size thresholds for mammal populations of several thousand individuals (Traill et al. 2007). Therefore, additional areas within or adjacent to the historical range would need be examined for the potential to recruit large patches of suitable habitat and support a larger marten population more resilient to extinction. Evaluations of potentially recruitable habitat would need to consider the distribution and composition of forest stands in future climate scenarios. Absent the protection and recruitment of suitable habitat, Humboldt martens are likely to remain at risk of extirpation in California in the foreseeable future due to one or a combination of the threat factors discussed in this report, including high rates of predation, effects of small population size, and impacts from stochastic (random, unpredictable) events such as wildfire.

Range and Distribution Trends

Historically, Humboldt martens ranged from the coastal forests of northwestern Sonoma County north to Curry County Oregon within the narrow humid coastal zone ≤35 km (22 mi.) from the coast (Grinnell et al. 1937, Kucera 1998, Zielinski et al. 2001, Slauson et al. 2017, [Figure 2]). In California, records of occurrence exist from Colusa, Del Norte, Glenn, Humboldt, Lake, Mendocino, Siskiyou, Tehama, and Trinity Counties (California Natural Diversity Database accessed October 23, 2017), but when the habitat affinities of Humboldt and Sierra martens are considered along with recent genetic research (Schwartz and Pilgrim 2017), marten records from Colusa, Glenn, Lake, and Tehama Counties should be attributed to the Sierra marten subspecies rather than Humboldt marten.

The historical range described by Grinnell et al. (1937) was roughly 22,000 km^2 (8,500 mi^2), although not all of the habitat within the bounds of the historical range would have been suitable or occupied. Within the historical range, the distribution of marten record locations is uneven, with concentrations of records from northern Lake and east-central Mendocino County, an area southeast of Eureka, and near the intersection of Del Norte, Humboldt, and Siskiyou counties (fig. 2). By the 1940s, a significant decline in Humboldt marten trapping returns and a retraction of the southern end of the range had been noted (Anonymous 1920, Twining and Hensley 1947). Zielinski et al. (2001) conducted an exhaustive review of historical coastal marten records from California, Oregon, and Washington including published reports, museum specimens, unpublished notes of naturalists and trappers, and interviews of tribal members and others. Based on their review they concluded that a significant reduction in occupied range has occurred.

The Department is aware of Humboldt marten records only from Del Norte, northern Humboldt, and extreme western Siskiyou Counties in the last 25 years (California Natural Diversity Database query October 22, 2017) despite the fact that surveys during that period covered a much larger portion of the historical range (USFWS 2015). The occupied range (as of year 2008) as circumscribed by a minimum convex polygon drawn around detection locations was found to be 627 km^2 (242 mi^2) by Slauson et al. (2009b). Since that time, the known occupied range has expanded slightly with two detections of Humboldt martens a few kilometers from the coast in Prairie Creek Redwoods State Park, first in 2013 and most recently in 2017 (CDFW 2014, K. Slauson pers. comm. 10/10/2017); and additional detections near the Oregon border (Slauson et al. 2017). The martens detected in Prairie Creek Redwoods State Park were not detected during rigorous surveys in the same area in 2002, thus they likely represent a recent range expansion (Slauson et al. 2010). Despite these recent expansions in the known range, Humboldt martens appear to have been extirpated from 95% of their historic range in California (Slauson et al. 2009b, Slauson et al. 2017).

Although martens were historically distributed throughout the coastal regions of Oregon, there are currently just two disjunct coastal populations of Humboldt martens (Grinnell et al. 1937, Moriarty et al. 2016, [Figure 3]). The southern population is possibly contiguous with the northernmost populations in California. In Oregon, the range appears to have remained unchanged since 2001; however, there are no indications that the population is expanding (Moriarty et al. 2016).

Population Size and Trend

From 1945-1995 Humboldt martens were virtually undetected in California, leading some to speculate that the species had gone extinct until they were again detected in 1996 (Kucera and Zielinski 1995, Zielinski and Golightly 1996, Slauson et al. 2009b, Slauson and Zielinski 2004). Based on surveys in the modern era the population appears to have declined by over 40% over the period 2000-2008, and then remained unchanged during the period 2008-2012 (Slauson et al. 2009b, USFWS 2015). In the only contemporary population estimate Slauson et al. (2009b), estimated the extant Humboldt marten population in California consisted of less than 100 individuals. Although it is not known if Oregon populations are in contact with California populations, Moriarty et al. (2016) detected a minimum of 28 unique Humboldt martens in coastal Oregon during surveys in 2015, and concluded “martens in coastal forests are rare and likely limited by unknown factors, especially compared to their former range.”

Historically Humboldt martens appear to have been more common and widespread. Grinnell et al. (1937) stated that Humboldt martens were “fairly numerous” in “earlier years”, though apparent declines in the Humboldt marten population, at least locally, were noted as early as the 1920s. The authors report a tale of one trapper capturing 50 Humboldt martens in a single winter near Fortuna, California. While no rigorous historical population estimate exists, one can reasonably infer from the recorded anecdotal information that the number of martens present at that time was larger than the population present in the 1990s when no detections of the species had been recorded for the previous 50 years (Zielinski and Golightly 1996).

THREATS

Trapping

Early trapping of Humboldt marten was intensive, with accounts of individual trappers taking 35-50 martens in a single winter (Grinnell et al. 1937). By the early 1900s annual harvest of Humboldt martens was already declining, prompting Joseph Dixon to call for closing the trapping season in California to prevent an extirpation; however, marten harvest continued until a partial closure was enacted in northwestern California in 1946, depleting populations and likely reducing genetic variation within the remaining population (Dixon 1925, Zielinski et al. 2001).

Commented [CW1]: Clearly a sizeable population.

Today trapping of all martens is prohibited statewide (§ 460, Title 14, California Code of Regulations (CCR)). Although it is possible that Humboldt martens could be inadvertently taken by trappers pursuing other fur bearers or nongame mammals that may be legally harvested for recreation, commerce in fur, or depredation. Trapping in California is highly regulated, and trappers must pass a Department examination demonstrating their skills and knowledge of laws and regulations prior to obtaining a license (Fish & Game Code § 4005). Additionally, only live-traps may be used to take furbearers or nongame mammals for recreation or commerce in fur; trappers are required to check traps daily and release non-target animals (*Id*. §§ 3003.1, 4004, and, 4152 and § 465.5, Title 14, CCR). With the passage of Proposition 4 in 1998, body-gripping traps (including snares and leg-hold traps) were banned in California for commerce in fur and recreational trapping (*Id.* § 3003.1). However, some body-gripping traps may be used by licensed trappers for purposes unrelated to recreation or commerce in fur, including protection of property or by government employees, or their authorized agents, while acting in their official capacities (*Id.* § 3003.1 and § 465.5, Title 14, CCR). Martens incidentally captured by trappers must be immediately released § 465.5(g)(1), Title 14, CCR).

Trapping of Humboldt martens remains legal in neighboring Oregon where trappers are required to obtain a trapping license and take an educational course (Hiller 2011). In recent years very few trappers reported pursuing martens in Oregon (4-8 trappers per year [Hiller 2011]), and only three Humboldt martens were reported taken in 2013 (USFWS 2015). Oregon trapping records are organized by county making it difficult to determine if reported trapped martens were coastal Humboldt martens or interior *Martes caurina caurina*. Review of trapping record from 2007-2016 indicates that as many as nine Humboldt martens may have been trapped in Oregon and one roadkill Humboldt marten was recovered (D. Broman pers. comm. 3/17/2017).

Trapping pressure on Humboldt martens was intense during the late 1800s and early 1900s, and very likely resulted in significant declines in population size as well as a dramatic reduction in range. There have been no studies on the population level effects of Humboldt marten trapping, but the loss of even a few adult martens, especially when combined with other mortality sources, could reduce the likelihood of long-term population viability (USFWS 2015). However, it is unlikely that trapping continues to threaten Humboldt martens in California due to the ban on trapping martens, restrictions on the types of traps that may be used for other species, as well as requirements that licensed trappers check traps daily and release non-target animals.

Habitat Loss and Degradation

Changes in the structure and landscape configuration of Humboldt marten habitat can negatively impact survival, reproduction, and population connectivity of the species. In particular, timber harvest and other silvicultural treatments of older forests, salvage logging, development of coastal forests for human settlement, as well as the clearing of forests for the cultivation of cannabis can all lead to loss, degradation, and fragmentation of Humboldt marten habitat. The USFWS (2015) Humboldt marten species report concluded habitat loss and degradation from historical and current logging is the most plausible reason the marten is absent from much of its historical range, noting most of the remaining suitable habitat is located on federally owned land (Zielinski et al. 2001).

Forest conditions in the range of the Humboldt marten today are largely shaped by a legacy of over 100 years of logging and timber management. It is estimated that the area of old growth conifer forest in the Pacific Northwest has been reduced by 72% since European settlement (Strittholt et al. 2006), and only 10% of the historical range of redwood forests remains in old growth stands (Fox 1996). While timber harvest continues in the area, the logging of old growth forest stands on private and public lands has dramatically slowed from peaks in the second half of the 20th Century. Today, 33% of remaining old forest on federal lands in the Northwest Forest Plan area is fully protected from harvest, and 80% is afforded some level of management protection (Strittholt et al. 2006). The rate of timber harvest on private lands in the area has declined in recent decades due to more restrictive regulations and market conditions (Figure 5). Harvest on federal lands declined sharply following implementation of the Northwest Forest Plan in 1994 (Strittholt et al. 2006) (Figure 6.). The area of older forests (OGSI-2000) on federal lands in the coastal and Klamath mountains of northwestern California declined 8.4% from 1993-2012, largely due to wildfires, while the area of older forests on non-federal lands increased 1.3%, despite losses to timber harvest (Davis et al. 2015). While recent losses of old forest stands in the Humboldt marten range have been relatively small, forest stands degraded and fragmented from historical logging will take decades to recover dense ericaceous shrub layers and centuries to recruit the large tree structures needed to restore high quality Humboldt marten habitat conditions (Slauson et al. 2010, Slauson et al. 2017).

Commented [CW2]: Do we know numbers for specifically the CURRENT range of marten in California. This would likely paint an even more dire picture.

Habitat loss and degradation from human settlement and residential development rapidly increased in the 1850s when pioneers of European descent began harvesting lumber, farming, mining, and fishing along California's north coast (Del Norte County Community Development Department 2003). Since that time minor portions of the historical range have been converted from forests to urban areas, primarily in and around Crescent City, Humboldt Bay, Fortuna, Fort Bragg, and Willits; and much of the historical range south of Del Norte County has been parceled and occupied by very low density housing (≤1 housing unit/16 ha [40 ac.])(Cal Fire 2010). However, the core population area currently occupied by Humboldt martens is almost entirely unoccupied by humans, with the exception of some areas adjacent to the Klamath River on Yurok Tribal lands (Cal Fire 2010). Low-density human occupancy does not necessarily equate with the loss of mature forest habitat favored by martens but human occupancy likely renders such areas unsuitable for martens. Impacts from the presence of humans, livestock, and pets, the construction and use of rural roads, and the use of household pesticides can frighten wildlife away, introduce novel predators, diseases, and toxicants, deplete prey populations, and degrade and fragment habitat (Merenlender et al. 2009). While further human development of the historical range will likely continue into the future, a modeled analysis of future land conversions under several human population growth scenarios found the probability of significant conversions to urban and agricultural uses in the northwest California coast region to be very low for the remainder of this century (Sleeter et al. 2017).

Large-scale marijuana cultivation in remote forests throughout California has increased since the mid-1990s, coinciding with the 1996 passage of Proposition 215, the Compassionate Use Act of 1996 (Health & Safety Code, § 11362.5), which allowed the legal use and growth of marijuana for certain medical purposes (Bauer et al. 2015). Humboldt and Del Norte counties are known centers of legal and illegal cannabis cultivation in California due to the remote and rugged nature of the land and abundant water sources (National Drug Intelligence Center 2007, Bauer et al. 2015). The recent passage of California Proposition 64, the Control, Regulate and Tax Adult Use of Marijuana Act, further decriminalized the adult use of cannabis for recreational use beginning in January 2018. In 2017, the California Legislature approved the Medical and Adult Use of Cannabis Regulation and Safety Act which provides state and local governments the authority to regulate the production and processing of cannabis products, including regulation of the environmental impacts from growing cannabis. It remains to be seen what effect these new laws will have on the conversion of forests for the production of cannabis. A recent study found the majority of cannabis cultivation sites in Humboldt County were located >500 m (1,640 ft.) from the nearest road, indicating cultivation may contribute to landscape fragmentation, although the amount of land area under cannabis cultivation was found to be minor at less than 1% of the land under organic crop cultivation (Bustic and Brenner 2016). The extent to which land clearing for legal and illegal cannabis cultivation contributes to Humboldt marten habitat loss and degradation is unknown.

The habitat characteristics of Humboldt martens that may be particularly at risk from these activities can be considered at the four scales of habitat selection described in the BIOLOGY AND ECOLOGY section on Habitat Associations and Use above.

Large Tree Structures

At the micro-habitat scale, the large tree structures used by Humboldt martens for resting and denning were typically removed during timber harvests, both during initial harvests of original-growth forests as well as through harvest of "residual" old growth trees in subsequent entries in second-growth forests (Slauson et al. 2010, USFWS 2015). Large diameter trees, snags, and downed logs with cavities and platforms used as resting and denning structures by Humboldt martens are significantly reduced in second-growth forest stands compared to the old growth stands (Slauson et al. 2003, Slauson et al. 2010). In second-growth stands it is estimated that it could take more than 200 years to recruit such structures (Slauson et al. 2010). The minimum age of live and dead tree structures used for resting by martens in north coastal California was 176 and 254 years, respectively (Slauson and Zielinski 2009).

Commented [CW3]: This is a big deal. Lack of reasonable refugia also likely contributing to unsustainable levels of predation.

Other silvicultural treatments also reduce marten habitat structures. For example thinned stands (n=26) have been found to have significantly fewer potential resting and denning structures than Humboldt marten-occupied stands (n=7); although large cull logs from previous harvests in recently thinned stands can provide similar densities of large log structure to marten occupied stands (Slauson et al. 2010).

Tree and Shrub Canopy Cover

At the stand scale of habitat selection, Humboldt marten habitat suitability is reduced under most of the commonly used timber harvest methods, both through overstory canopy cover reduction and through loss of dense ericaceous shrub layers (USFWS 2015). Shrub layers can be destroyed or degraded through conifer stand management which favors trees over shrubs (such as mechanical brush clearing and application of herbicides that target brush species), and through the competitive exclusion of densely planted conifers which shade out understory shrubs (Slauson et al. 2010). Typical even-aged silvicultural methods employed on industrial timberlands completely eliminate post-harvest canopy cover in clear cuts over areas of up to 40 acres. Such conditions, unsuitable for marten use, persist for years until the regenerated stand achieves suitable canopy closure. It has been shown that shrub cover is more patchily distributed in thinned stands than in old growth stands (Slauson et al. 2010). Dense regenerating conifer stands that were thinned were found to regenerate moderately dense shade-tolerant native species shrub layers within 15-30 years following thinning; however, shrub cover remained significantly lower than levels found in the old growth redwood stands used by Humboldt

Commented [CW4]: According to GDRC methods detailed below, thinning happens at 15 years or so after planting, again 15 years later, and harvest is at 45 years. Never getting beyond just getting the shrub layer going. Bad news for marten. Again, management setting them up by removing refugia and opening them up to unsustainable predation. Not good.

martens (Slauson et al. 2010). Given relatively short harvest rotations, typically less than 60 years (USDA 1992, Green Diamond Resource Company 2012, Yurok Tribal Forestry 2012) in the coastal forests of northern California, overstory conditions suitable for martens may only exist on a small proportion of the intensively managed landscape at any given time.

Slauson et al. (2010) found that shrub flowering and fruiting are greatly reduced in stands thinned ≤30 years prior to harvest compared to stands occupied by martens: Only 38% of thinned stands were observed with a fruiting or flowering shrub component, compared to 100% of old forest stands occupied by Humboldt martens. In addition to directly providing food for martens, fruiting shrubs support greater densities of marten prey animals such as small mammals, hornets and migratory birds.

Vegetation management activities designed to efficiently produce timber and reduce the risk of wildland fire by removing shrubs, reducing canopy cover, and removing snags and logs may negatively impact martens by removing required habitat structures and by removing shrub cover which can reduce prey abundance and improve access for competitors and larger-bodied predators such as bobcats and gray foxes.

Fragmentation

At the home range and landscape scale, forest fragmentation poses threats to Humboldt marten individuals and populations. Individuals may be forced to move over greater distances to acquire food in fragmented landscapes, increasing their energetic costs and exposing them to more predators. Populations may be impacted by reducing the ease of juvenile dispersal and ability of breeding individuals to move between population areas. Fragmented habitat conditions exist throughout much of the Humboldt marten's historical and current range and the four extant marten populations in coastal California and Oregon appear to be isolated from one another by unsuitable habitat degraded by logging, severe wildfire, and urbanization (Slauson et al. 2017). Fragmentation of habitat can also be detrimental at finer scales, where fragments of habitat may not be large enough to support a single marten territory. For example, the Redwood National and State Parks complex contains only three patches of late successional forest greater than 2,023 ha (5,000 ac.) in area, with most patches less than 40 ha (100 ac.) in area (USFWS 2015).

Commented [CW5]: Yet another reason that marten must leave the relative safety of naturally "refugia-rich" habitat and be exposed to generalist predators that are abundant in higher levels than marten co-evolved with. Another big deal from a predation standpoint.

Slauson et al. (2017) concluded that early trapping combined with the extensive habitat loss and fragmentation from unregulated timber harvesting were the two factors most responsible for the decline in distribution and abundance of Humboldt martens. Similarly, Moriarty et al. (2016) suggested habitat fragmentation (both natural and anthropogenic) is the most serious threat to martens in coastal Oregon (Moriarty et al. 2016):

> Habitat fragmentation through natural and anthropogenic alterations likely poses the largest threat to marten conservation. Marten populations decline with as little as 30% of the forest cover removed (Hargis and others 1999; Potvin and others 2000), and fuel reduction treatments typically decreased cover and connectivity in the Sierra Nevada (Moriarty and others 2015). Martens were deterred by low-canopy-cover openings, seldom moving 17 m (56 ft.) beyond cover (Cushman and others 2011), and most often moving 50 m (164 ft.) within forest patches to avoid such openings (Moriarty and others 2015).

Degraded landscapes may lack obvious barriers to marten movement while acting as functional barriers to movement by decreasing the likelihood of daily survival and successful dispersal. American marten dispersal distances were found to decrease by approximately 50% in intensively logged forests in Ontario compared to unlogged forests, and the percent of juveniles successfully dispersing and establishing new territories declined from 49% in unlogged forests to 25% in logged forests (Johnson et al. 2009). Thompson (1994) found daily survival rates in recently harvested (3-40 year old) forest stands in Ontario were nearly five times lower than in uncut forests. Where habitat conditions result in decreased dispersal distances and lower survivorship of dispersing animals, habitat is functionally fragmented.

Because roads favor generalist predators that prey on martens, crossing roads to move between fragmented patches of habitat means martens are more likely to encounter a predator than if they were able to remain in dense shrub habitat (Slauson et al. 2010). Fragmentation of dense shrub stands by roads also appears to confer a competitive advantage to generalist carnivores like fishers, gray foxes, and bobcats, which compete with and prey upon martens. Slauson et al. (2010) found that 80% of camera detections of generalist carnivores such as fisher, gray fox, and bobcats were on roads while 80% of marten detections came from areas away from roads. In northwestern California Highway 101, which is a four lane highway in some sections, may constitute a significant barrier to marten movement (S. Prokop and B. Silver 6/29/2016 letter to CDFW).

Wildfires and associated salvage logging of damaged trees can threaten the already small Humboldt marten population by reducing and fragmenting the remaining habitat (Slauson and Zielinski 2004). Vegetation management activities designed to reduce the risk of wildland fire by removing shrubs, reducing canopy cover, and removing snags and logs impacts martens by removing required habitat structures and shrub cover which can reduce prey abundance and improve access for competitors (USFWS 2015). On federal lands, salvage logging and fuels management activities can occur on all land allocation categories except for wilderness areas (Hamlin et al. 2010), and on private lands salvage logging plans are exempt from normal review procedures and automatically approved by the California Department of Forestry and Fire Protection (CAL FIRE) through a ministerial process if all applicable Forest Practice Rules are abided (Title 14, CCR §1052).

While thinning and fuel reduction management can fragment and degrade Humboldt marten habitat, it is important to note that severe wildfires can also substantially fragment and degrade marten habitat. However, Moriarty et al. (2017) found that implementing fuel reduction treatments (mechanical or prescribed fire) on as little as 10-20% of the landscape significantly reduced the probability of marten habitat loss from wildfires. Management for the creation and conservation of resilient Humboldt marten habitat will require land managers to carefully plan for both habitat patches and fuel reduction zones over the landscape over time.

The amount of Humboldt marten habitat in California has been substantially reduced since the species' range was first described by early naturalists, primarily as a result of past timber harvesting and timber production practices which removed the large tree structures and dense shrub layers martens require for denning and protection from predators. Although the rate of timber harvesting appears to have decreased in recent years, it will take centuries recruit large tree structures to replace what has been lost. Wildfire, conversion of land to urban and agricultural uses, and cannabis cultivation have also contributed to habitat loss and degradation. Where habitat remains, degraded conditions and fragmentation caused by roads, timber harvesting, cannabis cultivation, and other land use practices can limit its usefulness to the marten population. Degraded and fragmented habitats may allow larger carnivores to colonize traditional Humboldt marten habitat resulting in increased rates of predation on martens. Because historical habitat loss and degradation severely limits the spatial extent of suitable habitat available to the population, it continues to pose a potentially significant threat to Humboldt

Commented [CW6]: Is this redundant?

martens. However, increases in the extent of mature coastal forest from recruitment of large tree and shrub structure and reductions in habitat fragmentation could significantly contribute to the recovery of Humboldt martens in California.

Predation

Predation can significantly limit marten populations in the wild (Hodgman et al. 1997, Bull and Heater 2001, McCann et al. 2010, Slauson et al 2017). Known or expected predators of Humboldt martens include bobcats, gray foxes (*Urocyon cinereoargenteus*), coyotes, mountain lions (*Puma concolor*), great horned owls, goshawks (*Accipiter gentilis*), and Pacific fishers (Buskirk and Ruggiero 1994, Bull and Heater 2001, Slauson et al. 2009b, Woodford et al. 2013). Moriarty et al. (2017) detected the following potential predators at camera traps within 5 km (3.1 mi.) of known Humboldt marten detections: black bear (*Ursus americana*), bobcat, gray fox, domestic dog (*Canis familiaris*), domestic cat (*Felis catus*), coyote, and mountain lion. Gray fox was the most frequently observed species with detections near 29% of the known marten stations. Bobcat, black bear, and domestic dogs were detected near 26%, 23%, and 11% of the known marten stations, respectively. Detections of coyote, domestic cat, and mountains lions were lower, ranging from two to four percent.

Commented [CW7]: I think it's clear that predation can limit marten populations, but I think that the primary take home message here is that based on past knowledge of populations (ie. sizeable past population) marten were doing okay, but current known rates of predation on marten seem to indicate that predation is very likely CURRENTLY limiting marten populations. Recorded predation rates seem unsustainable given known reproductive rates.

Bull and Heater (2001) documented 22 mortalities in their northeastern Oregon Pacific marten radio telemetry study; of these, 18 were attributed to predation by bobcats (44%), raptors (22%), coyotes (11%), and other martens (22%)[1]. The martens killed by predators accounted for 51% of the collared population over their four year study (Bull and Heater 2001). In Raphael's (2004 *in* Slauson et al. 2017) study of Pacific martens in the Oregon Cascades, 21 of 28 marten mortalities were attributed to predation (bobcats and coyotes), which constituted 18% of the monitored population. In a Humboldt marten dispersal study in California (Slauson et al. 2014), nine martens (39% of collared martens) were killed by predation over the course of less than one year. All nine of these predation events were from bobcats. Comparing the effect of varying levels of bobcat occupancy in different watersheds in the California range of the Humboldt marten, Slauson (unpublished presentation 2017) showed an inverse relationship between bobcat occupancy and marten occupancy, and a direct relationship between bobcat occupancy and marten predation rates.

Predator – Vegetative Community Interactions

Coastal forest ecosystems are complex, with tree, shrub, and herbaceous plant layers creating multiple structural layers. Historically, dense continuous shrub understories were common in mature forests in the redwood region (Morgan 1953, Allgood 1996, Slauson and Zielinski 2007). These shrub understories have been drastically reduced and modified through a century of logging and related forest management such as burning, mechanical clearing, road building, and planting dense stands of trees which compete for sunlight with shrubs and herbs (Slauson and Zielinski 2007). The time period over which shrub layer extent, density, and species composition drastically changed corresponds with observed reductions in Humboldt marten distribution and the observed expansion of generalist mesocarnivore (mid-sized carnivores) distributions in the redwood region.

Martens appear to require dense shrub stand patches of >50-100 ha (124-247 ac.) (Slauson et al. 2007). Where shrub layers have been removed or reduced, fishers and gray foxes - both potential marten predators, have expanded their historic ranges into the previously unoccupied redwood region (Slauson and Zielinski 2007). Conversely, in the remaining old tree conifer stands with intact dense shrub layers

[1] The four marten deaths attributed to other martens were all males, including two juveniles. The carcasses were not eaten, but showed trauma suggestive of fighting. The authors surmised resident male martens engaged in territorial defense were responsible for these mortalities.

that Humboldt martens select as preferred habitat, fishers and gray foxes are rarely detected (Slauson 2003, Slauson and Zielinski 2007). Martens showed the strongest preference for stands with ≥80% shrub cover, and avoided stands with <60% shrub cover, while fishers and foxes avoided stands with ≥80% shrub cover and used stands with <60% shrub cover in proportion to their availability (Slauson 2003).

The high predation rates noted in the Pacific marten and Humboldt marten studies above occurred in areas that included intensively-managed forests. Raphael (2004 *in* Slauson et al. 2017) described his study as a "high-harvest" area. Bull and Heater's (2001) 400 km^2 (154 mi^2) study area included a relatively small area (53 km^2) (20 mi^2) of uncut forest surrounded by an area "extensively harvested for timber (approximately 80%) and… fragmented by partial cuts, regeneration cuts, and roads." More than 90% of the Slauson et al. (2014) Humboldt marten dispersal study area had been previously harvested. Managed forests with open overstories, less dense shrub layers, and high road density appear to favor larger-bodied generalist predators such a bobcats, gray foxes, and fishers, which may prey on or kill Humboldt martens (Slauson and Zielinksi 2007, Slauson et al. 2010, Slauson unpublished presentation 2017). Fragmentation of dense shrub stands by roads also appears to confer a competitive advantage to generalist carnivores like fishers, bobcats, and gray foxes, which compete with and prey upon martens. Slauson et al. (2010) found that 80% of camera detections of generalist carnivores such as fisher, gray fox, and bobcats were on roads while 80% of marten detections came from off road areas. Because roads favor generalist predators, crossing roads to move between fragmented patches of habitat means martens are much more likely to encounter a predator than they would be if they were able to remain in dense shrub habitat (Slauson et al. 2010).

A landscape-scale habitat shift has occurred within the Humboldt marten's geographic range since the advent of industrial logging in the 20th century; from large, contiguous old forest stands with extensive dense shrub layers to a more patchy landscape of younger stands with degraded shrub layers divided by road systems. It is thought that small-bodied martens have a competitive advantage over the larger bodied carnivores when foraging and moving through dense shrub stands (Slauson and Zielinski 2007), so this shift in habitat can disadvantage marten while simultaneously favoring larger-bodied generalist carnivores such as bobcats, fishers, and gray foxes. These changes, along with the increased density of roads in the area, have allowed generalist predators to expand their distributions into areas they did not traditionally occupy and prey upon martens at higher rates. Although it is unknown whether predation alone threatens the existence of Humboldt martens in California, adult survival rates are known to be the most influential parameters in marten population growth models (Slauson et al. 2017). Predation rates therefore likely have a potentially significant effect on population growth and abundance.

Commented [CW8]: Of course there are other factors at play; however, given the models presented by Slauson and what I know of the landscape in our region, I am somewhat surprised that marten have persisted at all.

Competition

No data or studies were identified that assess the impacts of competition between Humboldt martens and other species. The USFWS Humboldt marten species report (2015) does not identify competition as a significant stressor on Humboldt martens. Additionally, species with very specific habitat associations, such as Humboldt marten would be expected have a competitive advantage within their preferred habitat over habitat generalist species in the same area (Ricklefs 1990, Zabala et al. 2009). Further, carnivore species typically select prey species of a certain size as a function of the predator's own mass, effectively limiting competition with smaller and larger carnivores in the same community (Sinclair et al. 2003, Owen-Smith and Mills 2008). In coastal Oregon, Moriarty et al. (2016) detected the following potential competitor predators at camera traps within 5 km (3.1 mi.) of historical marten detections (reported as percent of camera trap sample units with detections): spotted skunk (*Spilogale gracilis*) at 41% of stations, opossum (*Didelphis viriginiana*) at 25% of stations, and short-tailed weasel at 8% of stations. Of these, only the spotted skunk is similar in size to Humboldt martens (Maser et al. 1981) and it is a habitat generalist, and therefore unlikely to be a significant competitor.

Toxicants

The control of predators and other animals perceived as pests through poisoning was historically common in the western states. Two former methods had the potential to kill non-target predators such as the Humboldt marten: poisoning livestock carcasses and aerial broadcast of poisoned baits. In one report, dead fishers and martens were observed in the vicinity of poisoned ungulate carcasses in Washington State (Zielinski et al. 2001). While such practices had largely ceased by the 1970s, the historical impact on Humboldt marten population size and distribution is unknown but potentially significant. Recently the use of rodenticides and other toxicants at illegal cannabis plantations has been observed to be a widespread practice (Gabriel et al. 2018). Anticoagulant rodenticides detected near cannabis plantations in northwestern California include brodifacoum, bromodiolone, chlorophacinone, diphacinone, and warfarin. Brodifacoum and bromodiolone are considered second-generation anticoagulant rodenticides which were introduced when rodents developed resistance to first-generation compounds in the 1970s (Gabriel et al. 2012, 2013, Thompson et al. 2014). First-generation compounds generally require several doses to cause intoxication, while second-generation anticoagulant rodenticides, which are more acutely toxic, often require only a single dose to cause intoxication or death and persist in tissues and in the environment (Gabriel et al. 2012). Additionally, other highly toxic pesticides, some of which are banned in the United States, have been found at illegal cannabis grow sites (Thompson et al. 2014).

A recent study conducted on Green Diamond Resource Company lands in Humboldt and Del Norte Counties detected anticoagulant rodenticide exposure in the tissues of 70% of northern spotted owls (n=10) and 40% of barred owls (*Strix varia*, n=84) examined, although none of the 36 rodent livers examined had traces of rodenticides (Gabriel et al. 2018). The authors hypothesized a recent increase in cannabis cultivation sites in the study area may have led to the increased use of anticoagulant rodenticides in the area. In an earlier study, Gabriel et al. (2015) detected the presence of anticoagulant rodenticides in the tissues of >85% of the dead fishers tested in California. Within their northern California study area (i.e., Hoopa Valley Indian Reservation) 52 fishers were tested for anticoagulant rodenticide exposure. Seven fishers were confirmed to have died from anticoagulant rodenticide poisoning, all of which had trespass marijuana grows within their home ranges (Gabriel et al. 2015). Because fisher and martens have similar foraging habits and diets, rodenticide exposure likely also poses a significant threat to the Humboldt marten population in California (Slauson et al. 2017). In recent necropsies of deceased Humboldt martens, one out of six carcasses examined showed traces of rodenticides in its tissues (Slauson et al. 2014). Although exposure to rodenticides was not necessarily the cause of death of the exposed animals, the acute toxicity of these compounds makes it likely that the salvaged animals were either directly killed by rodenticides or negatively affected to the extent that death from other causes such as exposure, predation, or starvation became more likely.

Deleted:

Disease

In their Humboldt marten species report (2015), the UFSWS noted: “The outbreak of a lethal pathogen within one of the three coastal marten populations could result in a rapid reduction in population size and distribution, likely resulting in a reduced probability of population persistence, given the small size of these populations.” North American martens are known to be susceptible to a variety of diseases, including: rabies, plague, distemper, toxoplasmosis, leptospirosis, trichinosis, sarcoptic mange, canine adenovirus, parvovirus, herpes virus, West Nile virus, and Aleutian disease (Strickland et al. 1982, Zielinski 1984, Williams et al. 1988, Banci 1989, Brown et al. 2008, Green et al. 2008). Although

Strickland et al. (1982) found that American martens in their central Ontario study tested positive for toxoplasmosis, Aleutian disease (a carnivore parvovirus), and leptospirosis; none of the diseases was considered to be a significant mortality factor for martens. Similarly, although Zielinski (1984) discovered antibodies to plague (*Yersinia pestis*) in four of 13 Sierra martens in the Sierra Nevada, he noted martens only appear to show transient clinical signs of the disease. Gray foxes within the current range of Humboldt martens in California are known to have been exposed to canine distemper, parvovirus, toxoplasmosis, West Nile Virus, and rabies, all of which are transmittable to martens (Brown et al. 2008, Gabriel et al. 2012). In their Hoopa Valley Reservation Study, Brown et al. (2008) found dead fisher within the range of Humboldt marten had been exposed to canine parvovirus and canine distemper which is known to cause high rates of mortality in mustelids (Deem et al. 2000). Because several potentially lethal diseases are known from the environment, a disease outbreak in one or both of the remaining Humboldt marten population areas in California should be considered a potential threat to the species. Although it is not known if this threat alone imperils the persistence of the species in California, when combined with the more serious threat of small, isolated populations, habitat loss from wildland fire, cannabis cultivation, timber management, and other threats, the possibility of a catastrophic disease outbreak further reduces the certainty that the Humboldt marten population will persist into the foreseeable future.

Wildland Fire

Slauson (2003) states that stochastic events such as wildfire present a major challenge to the persistence of Humboldt marten, and Slauson et al. (2017) classified wildfires as a serious threat over a large area of the extant population area in California and Oregon. In the more coastal areas occupied by Humboldt martens, conditions that promote the ignition and spread of wildfire rarely exist due to the typically wet winters and foggy summers of the local climate. However, fires become more frequent in the extant Humboldt marten range with distance inland from the coast (Oneal et al. 2006). By examining the size of recent fires in the extant range, Slauson et al. (2017) concluded that a single large fire could affect 31-70% of the currently occupied suitable habitat in California. Others have concluded that a single wildfire could burn an entire core population area (USFWS 2015). The effects of fires varies with the intensity of the burn and the severity of the impact on the vegetative community; ranging from high severity burns which can kill and consume most vegetation, including large tree structures, to low severity burns which consume only the ground level vegetation, leaving shrub and tree layers largely unaffected (USFWS 2015). Slauson et al. (2017) state that even a low severity burn would be likely to reduce Humboldt marten habitat suitability by reducing shrub cover; however, when a fire burned through approximately 25% of a studied Humboldt marten population area in the interval between surveys in 2008 and 2012, no change in marten occupancy post-fire was detected, indicating that any fire-related impacts the population were slight and/or short lived (Slauson et al. 2017). More recently in the summer of 2015, the Nickowitz fire burned approximately 2,800ha (7,000 ac.) in and adjacent to the current known range of Humboldt martens in Del Norte County, but the impact has not been assessed (InciWeb 2015).

Commented [CW9]: This could indicate imminent threat of extirpation.

Miller et al. (2012) reported that the annual number of fires, mean fire size, maximum fire size, and area burned all increased in northwestern California over the period of 1910-2008. Miller et al. (2012) also noted that high severity fires tended to be clustered in years when region-wide lighting strikes caused multiple ignitions, indicating that weather conditions in some years are conducive to widespread high severity fires in northwestern California. The effects of wildland fire on the landscape are difficult to predict due to variations in ignition frequency and burn severity based on vegetation type, geography, and weather patterns. However, it is clear that fires have the potential to degrade or destroy Humboldt marten habitat over entire population areas, further reducing the carrying capacity of the landscape and fragmenting populations. Therefore, habitat loss from wildland fire should be considered a potentially significant threat to persistence of the California Humboldt marten population.

Climate Change

The North American continent has already experienced the climatic effects of human-mediated increases in greenhouse gas emissions (USGCRP 2017). The annual average temperature in the contiguous United States has been 0.7°C (1.2°F) warmer over the past 30 years compared to the period 1895-2016, and is projected to further increase to 1.4°C (2.5°F) warmer over the period 2021-2050 (Vose et al. 2017). By the end of the century annual average temperatures are projected to be 1.6°C – 4.1°C (2.8°F – 7.3°F) warmer based on low emissions scenarios, to 3.2°C – 6.6°C (5.8°F – 11.9°F) warmer under high emissions scenarios (Vose et al. 2017).

In northwestern California annual precipitation levels have been 10-15% lower in the last three decades compared to the period 1901-1960 (Easterling et al. 2017). While future precipitation levels in this region are not projected to change radically, the frequency of drought events is projected to increase due to increased evapotranspiration resulting from increasing temperatures (Easterling et al. 2017). Additionally, projected warming of ocean surface temperatures 2.7°C ± 0.7°C (4.9°F ±1.3°F) (Jewett and Romanou 2017) will likely result in reduced daily coastal fog formation.

The Humboldt marten's coastal redwood and Douglas-fir forest ecosystem is characterized by moderate temperatures, high annual precipitation, and summer fog which supports dense conifer tree and shrub cover (Slauson et al. 2007, USFWS 2015). This ecosystem is currently limited in spatial extent to near coastal Oregon and northern California. Climate projections suggest that the coastal zone where precipitation is frequent will narrow in the future (PRBO 2011). The intrusion of coastal fog into inland forests has already been observed to be decreasing in frequency (Johnstone and Dawson 2010), though whether this pattern will continue into the future is unclear (PRBO 2011). Less extensive coastal precipitation, reduced fog intrusion, and globally increasing temperatures together could cause the southern extent of mesic coastal forest to retract northward, further reducing the amount of suitable habitat available to Humboldt martens (USFWS 2015, Slauson et al. 2017). These climatic changes could cause a shift from current conifer dominated vegetative communities to hardwood forests unsuitable to martens, and the dense, shade-tolerant shrub layer required by marten may be lost (USFWS 2015). These vegetation transitions could create conditions more favorable to marten predators and could further fragment the remaining patches of suitable habitat (USFWS 2015). Under moderate emissions scenarios the bioclimatic conditions that support Humboldt marten habitat are projected to reliably occur only in Del Norte County and northern Humboldt County (DellaSalla 2013).

Projected climatic changes could further impact Humboldt martens by changing the fire regime in the range of the subspecies. Miller et al. (2012) reported the number of fires per year, mean fire size, maximum fire size, and area burned all increased in northwestern California over the period 1910-2008 and that observed changes in the local climate explained much of the fire trends. This research demonstrates that the effects of a changing climate may already be impacting Humboldt marten habitat and highlights the link between climate patterns and wildfire trends in northwestern California forests. In the summer of 2015 the Nickowitz fire burned approximately 2,800 ha (7,000 ac.) in and adjacent to the current known range of Humboldt martens (InciWeb 2015). In addition to wildfire-mediated habitat changes resulting from changes in climate, other studies have projected climate-related changes in forest disease, insect damage, and other disturbance events which could affect marten habitat quality or availability (USFWS 2015). Finally, Lawler et al. (2012) suggested that martens (all North American species) will be highly sensitive to climate change and will likely experience the greatest impacts at the southernmost latitudes and lowest elevations within their range.

Commented [CW10]: This synergy with the previously mentioned wildfire threat is frightening for the marten.

22

In a recent modeling study, Stewart et al. (2016) assessed climate change vulnerability to 20 of California's terrestrial mammals, including the Humboldt marten. Their study included three components of climate change vulnerability for each taxon. The first component is the taxon's projected response to future climate change, which is the percent of climatically suitable potential habitat projected to be lost (or added) due to climate change. It is based on the climatic conditions within the historical range and projections of those conditions in future climate scenarios. The second vulnerability component is exposure/niche breadth. This component scores the projected amount of change in climate within the taxon's range, and is expressed as percent change compared to current conditions within the historical range of the taxon. The final component is based on an assessment of the taxon's physical, behavioral, and physiological characteristics that affect its sensitivity and adaptive capacity to respond to climate change. Overall climate change vulnerability was assessed by combining the scores for the three components. Two emission scenarios (high, low) and two global climate models (hot/dry and warm/wet) were used to project four future climates. Overall vulnerability scores were partitioned into five categories, ranging from "may benefit" through "less", "moderately", "highly", and "extremely" vulnerable to future climate change impacts.

Depending on the scenario, the Humboldt marten's vulnerability was assessed to be either less vulnerable (low emission, warm/wet scenario), moderately vulnerable (low emission, hot/dry scenario and high emission, warm/wet scenarios), or highly vulnerable (high emission, hot/dry scenario). By the end of the century, projected habitat conditions at the locations Humboldt martens have been detected to date would remain largely suitable under the low emission, warm/wet scenario (only about 1% loss of suitable locations), but 77% of the locations would become unsuitable under the high emission, hot/dry scenario. The following excerpt from Stewart et al. (2016) summarizes the results from the models:

> Distribution models suggest that the Humboldt marten would benefit (increase area of climatically suitable habitat) under wet climate scenarios, but would be adversely impacted (decrease area of climatically suitable habitat) under drier future climate scenarios. Under the wet scenarios, suitable habitat is projected to increase in extent around the currently suitable areas in the southern portion of its coastal range. Under the hot dry scenarios, suitable habitat on the coast is projected to retract into the core area currently known to be occupied by the subspecies. Distribution models map large areas of suitable climate where the Humboldt marten is not currently known to occur. These include areas in the southern coastal part of the Humboldt marten's presumed historical range, as well as areas within the geographic range of the Sierran subspecies of the Pacific marten (*Martes caurina sierra*). Given the current understanding of Humboldt marten's requirements for forest structure (large decadent trees with cavities for denning, dense shrub layers) that do not occur in much of the coastal forests of northern California, it is not surprising that the species does not currently occur in a large proportion of the coastal area predicted as currently climatically suitable.

In summary, there is relatively high certainty that temperatures will continue to increase within the range of Humboldt martens, which is likely to increase the frequency drought events due to increased evapotranspiration. Although there is less confidence in projected changes in total precipitation, fire regimes, and the distribution of vegetative communities, it is apparent that significant changes are possible within the century. Changes in the distribution and abundance of preferred Humboldt marten habitat could significantly impact the existing Humboldt marten population and limit opportunities for population expansion. Therefore, climate change should be considered a threat to the long-term persistence of the Humboldt marten population in California.

Vehicle Strikes

Mortalities resulting from collisions with vehicles is a documented threat to Humboldt martens, with 17 road kills documented in coastal Oregon by Moriarty et al. (2016). Vehicle strikes were the greatest source of mortality in their Oregon study, although the authors speculated that the impact to the population may be trivial compared to predation, disease, and exposure to poisons, particularly given their small, isolated populations. There have been no recorded roadkill Humboldt martens in California since 1980 (USFWS 2015); however, Highway 101 is a high speed, multi-lane road which transects potentially suitable Humboldt marten habitat in places, and likely would pose a risk to martens attempting to cross (S. Prokop and B. Silver 6/29/2016 letter to CDFW). Slauson et al. (2017) classified the impact of vehicle collisions on Humboldt marten populations as extremely severe, but limited in scope to a few areas where frequently traveled roads intersect marten population areas. The impact of vehicle strikes on the overall Humboldt marten population is unknown. Mortalities from collisions, although apparently not spatially extensive, may combine with mortality from predation, toxicants, and other sources to exceed recruitment rates, at least in localized areas, and limit population viability (USFWS 2015).

Small Populations

Small, isolated populations are inherently vulnerable to extinction due to loss of genetic variability; inbreeding depression and genetic drift; reduced genetic capacity to respond to changes in the environment; as well as through demographic stochasticity (changes in age and sex ratios resulting in less than optimal breeding opportunities) due to random variation in birth and death rates (Primack 1993, Reed and Frankham 2003). In studied wildlife populations, genetic diversity is strongly correlated with population fitness (increased survival and reproduction rates) and decreased extinction risk (Hedrick and Kalinowski 2000, Reed and Frankham 2003). The smaller the population size, the more likely other threats will drive it to extinction (Primack 2010).

Commented [CW11]: Considering that most threat categories seem to provide additional risk to martens, I think there must be serious consideration of stochastic risk, both demographically and environmentally. Yet another big deal.

The only estimate of the Humboldt marten population is that less than 100 individuals exist in California (Slauson et al. 2009b), far below the population size experts believe to be required to ensure long-term viability of a species (Traill et al. 2007, Traill et al. 2010, Flather et al. 2011). The loss of genetic diversity inherent to small, isolated populations can be expected to increase their risk of extinction because small and inbred populations have reduced ability to adapt with changing environments due to diminished pools of potentially adaptive heritable phenotypes (Frankham 2005). Populations of at least several hundred reproductive individuals are believed to be required to ensure the long term viability of vertebrate species, with several thousand individuals being the goal (Primack 1993). However, observations of wild populations indicate that it is possible for small populations to persist, at least in the short term, in the face of genetic challenges, but these observations do not inform the probability or durability of recovery (Harding et al. 2016).

Commented [CW12]: Does this indicate a mammal in danger of going extinct in a significant portion of its range? Do you consider the portion of the range in Oregon as part of this review, or examine CA in a bubble? Unsure how this works for CESA as most of my experience is with ESA.

In wild populations, reproductive output and survival vary amongst individuals and from year to year. In large populations this variance averages out, but in small populations this variation, termed demographic stochasticity, can cause the population size to fluctuate randomly up or down (Primack 1993). The smaller the population size the more pronounced the effect. Once a population size drops, its next generation is even more susceptible to further stochasticity and random inequalities in the sex ratio resulting in fewer mating opportunities and a declining birth rate (Primack 1993). Due to their small population size, Humboldt martens may be vulnerable to these effects; however, Slauson et al.

(2017) believe any negative impacts associated with demographic stochasticity would likely be spatially limited in Humboldt martens.

Unpredictable changes in the natural environment and biological communities can cause the size of small populations to vary dramatically where larger, more widely distributed populations would remain more stable because these changes normally occur in localized areas (Primack 1993). For example, unpredictable changes in a species' prey or predator populations, climate, vegetative community, or disease and parasite exposure can cause the size of a small, isolated population to fluctuate wildly, and possibly lead to extinction (Primack 1993). Additionally, natural disasters such as droughts, fires, earthquakes, and severe storms can lead to dramatic population changes if the population is small and localized such that the disaster impacts all or most of the individuals. Although the probability of such events is generally rare in any given year, over the course of generations the probability becomes much greater (Primack 1993). Ecological modeling studies have demonstrated that the influence of random environmental stochasticity has a greater influence on extinction probability than demographic stochasticity (Primack 1993). Environmental and genetic effects can work in concert with each other to seriously threaten small populations. As populations get smaller they become more vulnerable to demographic variation, environmental variations, genetic drift, and inbreeding depression. Each of these effects can amplify the impact of the other effects, further reducing population size and accelerating the species towards extinction in what has been termed an extinction vortex (Primack 1993).

Small populations, and populations that have experienced periods of low population numbers in the past lose genetic diversity and may suffer the effects of inbreeding depression - the concentration of deleterious alleles (maladaptive genes) in the population from the mating of closely related individuals resulting in offspring with reduced fitness (Frankham 2005, Harding et al. 2016). Closely related to inbreeding depression is genetic drift, or the accumulation and fixation of detrimental alleles in in the population due to a limited breeding pool (Hedrick and Kalinowski 2000). In large populations maladaptive genes do not accumulate in the population due to random mate pairings and the elimination of less fit offspring through natural selection. However, in small, isolated populations natural selection can have less of an effect on the population genotype than genetic drift. When this happens deleterious genes can become fixed in the population's genotype resulting in decreased reproductive fitness in all individuals, and potentially negative population growth (Hedrick and Kalinowski 2000, Frankham 2005).

The influence of inbreeding depression on fitness-related traits appears variable across populations, heritable traits, and environments (Hedrick and Kalinowski 2000). Inbreeding depression affects nearly every well studied wildlife species, and contributes to extinction risk in most wild populations of naturally outbreeding species (Frankham 2005). It is uncertain whether inbreeding depression occurs within the California Humboldt marten population, but the small population size and apparent period of isolation from other populations make it likely that significant genetic diversity has been lost (Slauson et al. 2017).

The loss of genetic diversity and the accumulation of deleterious genes can largely be mitigated by the exchange of breeding individuals between population centers (Primack 1993). When individuals migrate from their natal population to new population areas, the novel genes they introduce can balance the effects of genetic drift and inbreeding depression. As few as one migrant per generation in a population of 120 individuals could negate the effects of genetic drift (Primack 2010). Consequently, habitat fragmentation can seriously increase the genetic risks to isolated subpopulations, and habitat connectivity between populations can substantially mitigate these risks.

While the genetic risks associated with small populations may significantly increase a population's risk of extinction, it is important to note that a small population size alone is not necessarily predictive of population viability over time. A well planned conservation strategy can substantially mitigate risks associated with small populations. A comprehensive plan for long term viability should include the principles of representation, resiliency, and redundancy (Shaffer and Stein 2000, Wolf et al. 2015). These principles require recovered species be present in multiple large populations across the entire spectrum of habitats used by the species, and these populations must also be resilient to environmental changes, identified threats, and genetic threats (Wolf et al. 2015). The California Humboldt marten population, numbering less than 100 individuals, is currently highly exposed to the environmental and genetic risks inherent to small populations; however, a carefully designed program of habitat protection, connection, as well as the possibility of facilitated translocations could connect isolated breeding populations, increase the number of populations, and decrease these risks.

Commented [CW13]: Yes, it could if all things go well. However, don't count your martens before they hatch. Discussions are occurring, but no such actions are REALLY in place yet.

Research and Handling

Wildlife research in California is regulated through the state's Scientific Collecting Permit program (Fish & Game Code § 1002 et seq.). The program requires researchers to disclose their study design, wild animal handling protocols, and demonstrate their professional experience with the species of interest. Notwithstanding this oversight, mortalities are a risk of any wildlife research that requires the capture and handling of live animals. In early 2016, a Humboldt marten in California died of exposure in a trap set by researchers when a pre-baited trap was inadvertently left open and not checked again for several days. This incident is the only documented research-related Humboldt marten mortality in California despite the fact that dozens of martens have been captured and fitted with radio collars to date. Additionally, species experts believe it is unlikely that research would be conducted on more than 10% of the Humboldt marten population at any one time (Slauson et al. 2017). Therefore, it is unlikely that research and handling presents a significant threat to the population.

Commented [CW14]: I heard that another female with kits died from a collar getting hung up within a denning tree in June 2016. The kits subsequently died also. GDR researchers contacted Yurok and we had biologists present to witness the tree climbing. Contact GDR for information and please pass along to me if you get it. I only just heard a couple of weeks ago that it was due to the radio-collar snagging. I had thought it was a natural mortality with resulting abandoned kits.

EXISTING MANAGEMENT

Land Ownership within the California Range

In California, the majority of the land within the Humboldt marten's range is owned and managed by the U.S. Forest Service, with smaller portions owned and managed by the Yurok Tribe, Green Diamond Resource Company, and State and National Redwood Parks (Figure 7). Land management strategies and practices vary across and within ownerships.

National Forest Lands

The U.S. Forest Service manages the majority of the land within the marten's range on the Six Rivers and Klamath National Forests. As mentioned in the Conservation Status Section, on Forest Service lands in Region 5 (California), the Humboldt marten is designated as a Sensitive Species. Management projects subject to the National Environmental Policy Act (NEPA) must analyze impacts to the Sensitive Species; however, there is no requirement to minimize or mitigate project impacts to the species. National Forest lands in northern California are managed under the Northwest Forest Plan (USDA and USDI 1994) which sets land management guidelines according to seven allocations: Congressionally Reserved Areas, Late Successional Reserves, Managed Late Successional Areas, Adaptive Management Areas, Administratively Withdrawn Areas, Riparian Reserves, and Matrix lands. Matrix lands units are intended for timber harvest, yet Slauson (2003) detected Humboldt marten on Matrix lands in 8 out of 31 sample units, and 20% of Slauson et al.'s (2007) analysis area was designated as Matrix land available for logging with 16% of the Matrix land previously logged. Late Successional Reserves (LSR) are intended to support viable populations of late successional and old-growth dependent species such as spotted owls and Humboldt martens. However, logging is not prohibited in this land allocation class, and not all LSRs are currently in a late successional condition, but rather managed to grow into late successional habitat and therefore may not currently provide Humboldt marten habitat. Forty percent of Slauson et al.'s (2007) study area was designated LSR, with martens detected in 13 of 66 sample units in LSR; 13% of the land designated LSR in the marten's range has been logged (Slauson et al. 2007). The Humboldt marten was given only a 67% likelihood of remaining well distributed within the range of the northern spotted owl (*Strix occidentalis caurina*) by the Northwest Forest Plan scientific analysis team (USDA and USDI 1994). Slauson et al. (2009b) concluded that the Northwest Forest Plan does not completely protect the extant population, with 38% of the Humboldt marten distribution occurring outside of NWFP reserves.

Commented [CW15]: I had no idea! There just isn't much late seral left. I thought designated LSR land was fully protected and managed as "fully protected" LSR.

Forest management on individual national forests is governed by Land and Resources Management Plans (LRMP). The LRMP for the Six Rivers National Forest, where much of the extant Humboldt marten population is located, includes provisions to protect known active Pacific marten den sites and the surrounding habitat within 152 m (500 ft.) from disturbance and land-altering activities. However, there is no requirement to conduct pre-project surveys for martens, so there is little probability that active marten dens would be detected and subsequently protected, leaving denning martens and their habitat outside of protected land allocations vulnerable to disturbance and destruction (Six Rivers National Forest 1996).

A small portion of the Humboldt marten range is contained within the Siskiyou Wilderness Area, and only a portion of the wilderness area is composed of vegetation suitable for martens. Slauson (2003) detected martens on only 3 out of 23 sample units located in Siskiyou Wilderness. The U.S. Forest Service also manages the Smith River National Recreation Area (SRNRA), which covers a small portion of the marten's range. The SRNRA is not vulnerable to logging, but management of the area prioritizes recreation over wildlife values.

Redwood National and State Parks Management

State and National Park Service land in the Humboldt marten range includes the Redwood National Parks Complex consisting of Redwood National Park, Prairie Creek Redwoods State Park, Jedediah Smith Redwoods State Park, and Del Norte Coast Redwoods State Park. These parks are managed by the National Parks Service and California Department of Parks and Recreation (California State Parks) and total over 53,412 ha. (131,983 ac.) in northwestern California, of which approximately 30% is currently composed of old-growth forest. Forests in state and national parks are not subject to harvest, except where younger stands are managed to more rapidly develop old-growth characteristics (Slauson et al. 2017). The General Plan/General Management Plan governing the management of the parks does not identify specific management actions for Humboldt martens. Approximately 33% of the Park lands are managed as primitive zones where no development or facilities construction occurs and visitor use is limited to foot traffic on existing trails. An additional, 55.4% of the Park lands are managed as backcountry zones where the preservation and restoration of the natural environment is emphasized, and modification of the environment related to visitor use is limited. Where suitable marten habitat exists within these management zones, it is likely maintained and protected from significant modification and degradation (USDI NPS and California State Parks 2000).

As of 2010, State and National parks had removed over 350 km of roads and thinned 4-6% of the second growth stands within their boundaries (Slauson et al. 2010). Prairie Creek Redwoods State Park had at least one Humboldt marten detection each year from 2009-2013, and again in 2017, although it does not appear to currently support a viable reproducing marten population (K. Slauson pers. comm. 10/10/2017).

Private and Tribal Lands

The largest private land owner within the contemporary Humboldt marten range is the Green Diamond Resource Company, which manages approximately 151,000 ha (373,000 ac) primarily in Humboldt and Del Norte Counties, California (Green Diamond Resource Company 2017). Although only a small fraction of the ownership is within the contemporary range of the Humboldt marten, an important portion lies between the core population area and potentially suitable coastal habitat in the Redwood State and National Parks (Figure 7), although much of this area was recently transferred to the Yurok Tribe. Green Diamond lands are dominated by redwood forest in coastal and low elevation areas and by Douglas-fir as elevation and distance from the coast increase. Hardwoods are common in all forest types and in places compose the majority of the stand (Green Diamond Resource Company 2012). Most of the ownership has been logged at least once over the last century and now consists of second and third growth stands from recently harvested to 120 years old (Hamm et al. 2012). Small old growth forest areas which have never been logged are scattered throughout the ownership and total 150 acres of redwood and 300 acres of Douglas-fir, comprising less than 2% of Green Diamond Resource Company land. Green Diamond operates under a Maximum Sustained Production Plan approved pursuant to a provision of California Code of Regulations, Title 14, Section 913.11 subdivision (a) ("Option A") filed with the CAL FIRE. The Option A plan is intended to balance forest growth and timber harvest over a 100 year period. With some exceptions, Green Diamond plans to practice even-aged silviculture management on the ownership using clear-cutting as the primary harvest/regeneration method. Conifer stands are typically thinned 10-20 years after planting, again after 30 years, and harvested at or after 45 years in clear cuts of 16 ha (40 ac.) or less. Streamside zones, steep slopes, and special habitat areas are managed differently, including single tree selection harvest and retention for wildlife values (Green Diamond Resource Company 2012). At least 10% of the pre-harvest basal area is typically retained in streamside zones, habitat areas, and scattered trees to retain forest structural elements through the harvest rotation. Regeneration involves prescribed burning, mechanical slash treatment, tree planting, and the control of competing vegetation with herbicides (Green Diamond Resource Company 2012).

Green Diamond has periodically surveyed their lands for the presence of fishers and martens, including surveys in 1994-1995 and 2011-2012 (Hamm et al. 2012). No Humboldt martens were detected in the earliest surveys (1994-1995); however, in a repeat survey in 2004-2005 a marten was detected on Green Diamond land west of a known Humboldt marten population on public lands, and detected again in 2006. In 2010-2011 camera station surveys on Green Diamond lands detected martens at 14 stations, some co-occurring with fishers. This series of surveys indicates that martens are a persistent presence on Green Diamond lands (Hamm et al. 2012). Green Diamond has partnered with the United States Department of Agriculture's Forest Service Redwood Sciences Lab to conduct research on the species since 2012 (K. Hamm pes. Comm. Oct. 24, 2017). As of 2016, 33 Humboldt martens have been captured, and 24 fitted with radio collars to study habitat use and den site characteristics in this joint study (Early et al. 2016). Most of the land covered by these surveys and studies was recently acquired by the Yurok Tribe through land purchases in 2011 and 2018.

Green Diamond Resource Company manages most of its land under the conditions of two federally-approved Habitat Conservation Plans (HCPs), one for the northern spotted owl and the other for anadromous salmonid fish. The HCPs allow for incidental take of listed species and may deviate from Forest Practice Rule guidelines for species covered under the HCPs. Under Section 10(a) of the ESA, incidental take, defined as take that is incidental to, and not the purpose of an otherwise lawful activity, may be authorized for federally threatened and endangered species covered under an approved HCP. For both HCPs, the Department has determined that the federal Incidental Take Statement is consistent with CESA pursuant to Fish and Game Code section 2080.1. Although neither HCP specifically covers Humboldt marten, the plans are designed, in part, to retain and recruit larger tree structure which may improve marten habitat suitability on company lands over time. During development of the northern spotted owl HCP Green Diamond prepared a 30-year timber stand age-class forecast model. The age-class forecast covered 1991 through 2021, and assumed timber harvest would occur at an annual rate of 3,000-6,000 acres. Results indicated that second-growth stands in the 46+ year age-class would more than double, the 31-45 year age-class would increase by approximately 50,000 acres in first 10 years then return to 1991 levels, and the 8-30 year age-class would generally decrease over time.

Fish and Game Code sections 2089.2 through 2089.26 allow the Department to authorize incidental take of a species listed as endangered, threatened, candidate, or a rare plant, through a Safe Harbor Agreement (SHA) if implementation of the agreement is reasonably expected to provide a net conservation benefit to the species, among other provisions. SHAs are intended to encourage landowners to voluntarily manage their lands to benefit CESA-listed species without subjecting those landowners to additional regulatory restrictions as a result of their conservation efforts. In addition, at the end of the agreement period, participants may return the enrolled property to the baseline conditions that existed at the beginning of the SHA. Green Diamond Resource Company has voluntarily applied for a Humboldt marten SHA; however, until the SHA is approved, it is not possible to describe or quantify the benefits to the Humboldt marten population that will result from the agreement.

The other significant land owner within the range of the Humboldt marten is the Yurok tribe which owns approximately 23,876 ha (59,000 ac.) of land in or near the Humboldt marten range. The Tribe also manages an additional 1,528 ha (3,776 ac.) of federal land held in trust for the Tribe (Yurok Tribal Information Services website accessed October 25, 2017).

Yurok Tribal objectives for the management of Tribal lands include: Establishment of a regular, periodic, long term sustained yield of timber products, generation of Tribal income and employment from timber sales, limiting the use of clear cutting and eliminating the use of herbicides, protecting and enhancing areas considered culturally significant, acquisition of lands (including cutover lands) to increase the Tribal land base, protection and enhancement of fisheries, use of prescribed burning when possible, generating Tribal income from the sale of carbon credits, and providing oversight and professional expertise on the best way to utilize Tribal forestland for non-timber use. To achieve these goals, the Yurok primarily use uneven-aged silviculture practices (harvest of individually selected trees and small groups rather than large clear cuts) (Yurok Tribal Forestry 2012). A specific goal of Yurok Tribal forest management is the protection of Humboldt marten dens and large tree and brush cover habitat across the landscape (E. Mann pers. comm. 10/25/2017).

Commented [CW16]: I'm sure Ed told you of Yurok plans to put 14,790 acres of our most recent acquisition from GDRC into a sanctuary targeting late seral forest conditions.

Both Green Diamond Resource Company lands and Yurok Tribe fee lands are subject to the Z'berg – Nejedly Forest Practices Act of 1973 (Pub. Resources Code, § 4511 et seq.) and the California Forest Practice Rules (chapters 4, 4.5, and 10, Title 14, CCR), which are administrated by the California Department of Forestry and Fire Protection (CAL FIRE). The California Forest Practice Rules specify that an objective of forest management is the maintenance of functional wildlife habitat in sufficient condition for continued use by the existing wildlife community within planning watersheds (§ 897(b)(1)(B), Title 14, CCR). This language may result in actions on private lands beneficial to martens. Nevertheless, specific guidelines to retain habitat for martens are not provided in the Forest Practice

Rules. Further, this guidance would at best conserve habitat where Humboldt martens are known to exist, but would not be expected to result in the creation of additional habitat. Additionally, section 919.16 of the Forest Practice Rules requires landowners to provide CAL FIRE with information when late successional forest stands are proposed for harvesting if the harvest will "significantly reduce the amount and distribution of late successional forest stands or their functional wildlife value so that it constitutes a significant adverse impact on the environment". However, this rule does not specify protective or mitigation measures to offset potentially significant impacts associated with late successional forest loss.

Habitat suitable for martens may be retained within Watercourse and Lake Protection Zones (§ 916 et seq., Title 14, CCR) on private timberlands. Watercourse and Lake Protection Zones are defined areas along streams where the Forest Practice Rules limit the amount of timber harvested in order to protect in-stream habitat quality for fish and other resources. Harvest restrictions and retention standards vary according to the presence of anadromous and other fish species, as well as other aquatic life forms. These zones may encompass 15-45 m (50-150 ft.) on each side of a watercourse, 30-91 m (100-300 ft.) in total width depending on side slope, location in the state, and the watercourse's classification. Within Watercourse and Lake Protection Zones, the prescriptions vary by watercourse classification. For fish bearing streams (Class I watercourses), the retention standards vary from 50- 80 % overstory canopy (depending on distance to the watercourse) and include leaving a multi-storied stand composed of a diversity of species similar to that found before the start of timber operations. For watersheds that fall within Anadromous Salmonid Protection rules (§§ 916.9, 936.9, and 956.9, Title 14, CCR), the 13 largest trees per acre (live or dead) must also be retained within Class I Watercourse and Lake Protection Zone. For non-fish bearing streams (Class II watercourses), Watercourse and Lake Protection Zone retention standards vary from 50 % total canopy to 80% overstory canopy depending on the type and location of the watercourse.

MANAGEMENT RECOMMENDATIONS

The Department has evaluated existing management recommendations and available literature applicable to the management and conservation of the Humboldt martens to arrive at the following recommendations. The recommendations largely derive from *The Humboldt Marten Conservation Assessment and Strategy* (Slauson et al. 2017). The Department recognizes the scientific expertise and judgement of the Executive Team that developed the Strategy, and deems the information provided a reliable synthesis of current scientific literature on the species, thus constituting the best available science.

Habitat Protection, Management, and Restoration

Given the many conservation challenges identified for the Humboldt marten, achieving the goal of recovering and maintaining sustainable reproductive marten populations in California necessitates cooperation and support among government and private land managers. Achieving the overarching goal of Humboldt marten population recovery and persistence necessitates managing the landscape toward habitat conditions suitable for marten occupancy within much of their historic range. Specific management objectives can be further refined within the following Conservation Emphasis Areas (CEAs) from Slauson et al. (2017) (Figure 4).

Extant Population Areas (EPA)

EPAs are areas where five or more Humboldt marten detections have been documented since 1980 that are no more than 5 km (3.1 mi.) from the nearest neighboring detection. These clusters of detections are then buffered to include 2 km (1.24 mi.) of the surrounding landscape.

1. Design land management activities in and adjacent to EPAs to maintain conditions characterized as highly suitable marten habitat[2], and where feasible, improve habitat conditions in areas of moderate and low suitability

2. The current extent of the two California EPAs is 81,182 ha (202,162 ac.), which is 3.9% of the historic range; however, a habitat suitability model developed by Slauson et al. (in press) classifies 15,566 ha (38,464 ac.) of this extent as currently unsuitable for marten occupancy. Assess areas classified as unsuitable habitat within EPAs for their potential to be managed toward conditions characterized as high suitability marten habitat.

3. Continue surveys for the Humboldt marten where large patches of suitable habitat exist within their historical range, and as new detections are documented, EPAs should be re-assessed periodically to include new detections, following methods described in the Conservation Strategy (Slauson et al. 2017).

4. Identify high priority areas for restoration within EPAs based on their potential for connecting fragmented suitable habitat patches.

5. Evaluate whether major roads within EPAs fragment suitable habitat patches, create major barriers to marten movement, or pose a substantial collision risk to crossing martens. Consider installation of wildlife crossing structures where appropriate.

6. Protect currently suitable resting and denning structures within EPAs (i.e. large snags and downed logs) and manage forest stands to ensure continual recruitment of structures.

7. Protect current dense shrub layers within EPAs, and plan for the regeneration of shrub layers when it can benefit marten habitat suitability, particularly if required after a low intensity fire event.

Population Re-establishment Areas (PRA)

PRAs are areas within the Humboldt marten historical range which currently do not contain self-sustaining populations, and where recovery actions are required to accelerate the recolonization of self-sustaining marten populations. For a PRA to support a self-sustaining population, the amount of contiguous suitable marten habitat should be greater than 1,500 ha (3,707 ac.), which corresponds to the estimated area capable of supporting five or more female home ranges. Based on these criteria, Slauson et al. (2017) identified four potential PRAs within California (Figure 4), which should be considered for immediate Humboldt marten population recovery.

[2] Briefly, areas with high precipitation levels and a high Old Growth Structural Index (many large trees and snags and high tree size diversity), or serpentine soils (see Slauson et al. in press for details).

8. Manage habitat with the PRAs towards a landscape condition that is suitable to sustain Humboldt martens.

9. Where major roads (e.g. highways 101, 199, and 299) separate PRAs from EPAs and may act as barriers to marten dispersal, evaluate the availability of existing structures such as bridges, large culverts, and overpasses which could be used by martens to safely cross. Where such structures are limited, work with state and federal highway agencies to plan and install state of the art wildlife crossing structures.

10. Once a PRA is determined to have a sufficient amount of suitable habitat, assess it to determine if population recolonization would require human assisted dispersal, or whether natural dispersal of animals is a reliable means for recolonizing the PRA.

Landscape Connectivity Areas (LCA)

Providing dispersal habitat that Humboldt martens may use to move safely between an EPA to restored habitat in a PRA is critical for recolonizing newly restored habitat, and within a metapopulation context, provides essential connectivity for gene flow to occur between extant marten populations. LCAs are characterized by low potential to develop suitable reproductive marten habitat but capacity to provide functional dispersal zones. Currently, only one LCA has been identified in California, and it lies in a critically important dispersal zone between the southernmost EPA and the restorable 1,430 km^2 (552 $mi.^2$) Redwood-Prairie Creek PRA extending into Humboldt County (Figure 4). Unfortunately, suitable habitat conditions for an LCA are poorly understood, and additional research is needed to better understand functional dispersal habitat requirements for the Humboldt Marten.

11. Avoid actions within the LCAs which could permanently restrict the ability of Humboldt martens to move between EPAs and PRAs.

Wildland Fire

Given that the current distribution of extant Humboldt marten populations in California is limited to two relatively small EPAs occupying < 5% of the species' historical geographic range, large catastrophic fires have the potential to severely impact up to 70% of occupied suitable habitat in California over the next 15 years (Slauson et al. 2017). Moriarty et al. (2017) found that treating as little as 10-20% of the landscape with mechanical or prescribed fire fuel reduction treatments can significantly reduce the risk of Pacific marten habitat loss.

12. Design and implement fuel management prescriptions to reduce the wildfire risk to EPAs and PRAs. Prescriptions should preserve important Humboldt marten habitat elements like dense shrub understories, abundant large snags, dead and dying trees and downed logs in occupied habitat to the greatest degree possible while achieving risk reduction goals.

13. Expand the range and increase the resiliency of Humboldt marten populations in California, including managing for multiple large EPAs connected by LCAs to reduce the risk of a substantial loss of the current extant marten population due to a single catastrophic fire.

Research, Surveys, and Monitoring

14. Research is needed to determine whether the Humboldt marten's small population size has resulted in a loss of genetic diversity, and whether the subspecies is at risk of population declines due to

reduced fitness affecting their ability to evolve and adapt to environment changes due to climate change and other causes.

15. Determine the extent to which Humboldt marten populations in California and Oregon interbreed and quantify the genetic contribution to California populations from animals dispersing from Oregon.

16. Conduct surveys to determine if Humboldt martens occur in shore pine habitat in California, as found in Oregon.

17. Develop and implement consistent survey and monitoring strategies that reliably produce metrics on population size, distribution, and trends.

18. Develop a better understanding of specific silvicultural practices that result in high suitability habitat for the Humboldt marten and its prey species.

19. Study and develop siliviculture techniques in early seral stands which discourage occupancy by marten predators while recently harvested or burned stands are regenerating.

20. Study the lethal and sub lethal effects of rodenticides and other toxicants on Humboldt martens, model potential population effects, and work to reduce sources of exposure.

21. Identify the impact diseases have on Humboldt marten fitness and mortality, and work to reduce sources for exposure.

22. Continue to collect demographic parameters of extant marten populations, and identify key parameters affecting population growth and persistence.

23. Study habitat relationships of the primary marten predators (i.e. bobcats), and identify management options that reduce predator abundance and distribution within marten habitat (e.g. restorative thinning to stimulate shrub growth and road removal).

SUMMARY OF LISTING FACTORS

CESA directs the Department to prepare this report regarding the status of the Humboldt marten based upon the best scientific information available to the Department. CESA's implementing regulations identify key factors that are relevant to the Department's analyses. Specifically, a "species shall be listed as endangered or threatened ... if the Commission determines that its continued existence is in serious danger or is threatened by any one or any combination of the following factors: (1) present or threatened modification or destruction of its habitat; (2) overexploitation; (3) predation; (4) competition; (5) disease; or (6) other natural occurrences or human-related activities." (§ 670.1(i)(1)(A), Title 14, CCR.). The definitions of endangered and threatened species in the Fish and Game Code provide key guidance to the Department's scientific determination. An endangered species under CESA is one "which is in serious danger of becoming extinct throughout all, or a significant portion, of its range due to one or more causes, including loss of habitat, change in habitat, over exploitation, predation, competition, or disease." (Fish & Game Code, § 2062.) A threatened species under CESA is one "that, although not presently threatened with extinction, is likely to become an endangered species in the foreseeable future in the absence of special protection and management efforts required by [CESA]."

(*Id.*, § 2067). The following summarizes the Department's determination regarding the factors to be considered by the Commission in making its decision on whether to list the Humboldt marten. This summary is based on the best available scientific information, as presented in the foregoing sections of the report.

Present or Threatened Modification or Destruction of Habitat

The geographic range of the Humboldt marten has retracted to less than five percent of the extent documented by naturalists in the early 20th Century. Although historical trapping pressure is implicated in the initial decline of the species in the state, today the species population is limited by the amount, distribution, and quality of its remaining preferred habitat. Historical and ongoing management for timber production threatens the species by removing, degrading, and fragmenting the dense shrub layers and large tree structures the species is dependent upon for cover, denning, and foraging. Some portions of the remaining occupied habitat are protected by wilderness and other land use designations, but large areas remain vulnerable to continued timber harvesting and other uses which can fail to retain required habitat elements on the landscape. Until additional areas of suitable forest habitat are allowed to develop with careful management and the passage of time, the limited extent of suitable habitat will continue to prevent recovery of the California Humboldt marten population and this limited extent exposes martens to potentially high levels of threat due to both demographic and environmental stochasticity.

Commented [CW17]: Very little of this area is in "good" late seral condition or even resilient enough to be resistant to catastrophic wildfire. I think this paints a rosier picture than exists.

Overexploitation

Intensive trapping pressure during the late 19th and first half of the 20th centuries appears to have significantly reduced the Humboldt marten population and the species' distribution in the state. However, due to changes in trapping laws and practices, overexploitation no longer threatens the species in California.

Predation

Predation is a significant cause of Humboldt marten mortality in California populations. While predation is natural in wildlife communities, predation rates by larger predators may be elevated in landscapes managed for timber production. It is uncertain how predation rates relate to reproductive rates of Humboldt marten on managed landscapes. Whether predation by larger predators may constitute a primary threat to Humboldt marten populations on managed landscapes is a hypothesis that warrants examination with further research.

Commented [CW18]: I think that Slauson et al have provided ample evidence of this. I disagree with your interpretation here. 51% of study animals by Bull and Heater predated in 3 years. Raphael had 75% of mortality events due to predation. Slauson had 39% of monitored animals predated in less than a year. I think it's pretty clear how high predation rates affect reproductive rates. If animals are getting hammered on the landscape, encounter rates decline and in turn reproductive rates decline. Unless we know that production is replacing mortality, and I am not sure that we know that. Slauson could probably crunch those numbers for you.

Competition

There is no indication in the available information to indicate that competition poses a substantial threat to Humboldt marten populations in California.

Disease

Although there is little available information on disease rates and associated mortality in Humboldt marten populations, the presence of highly virulent diseases has been documented in the occupied range. Because Humboldt marten populations are small and isolated, a virulent disease outbreak in one or more core population area could seriously threaten the statewide population. However, the probability of such an outbreak is difficult to predict.

Other Natural Events or Human-Related Activities

Small Populations

In California the Humboldt marten population is believed to be less than 100 individuals distributed in two core population areas. Populations of this size are vulnerable to inherent genetic and environmental threats including, inbreeding depression, demographic stochasticity, environmental stochasticity, and loss of genetic diversity. These effects can result in decreased reproductive output, inability to adapt to changing environmental conditions, concentration of maladaptive genetic traits, and other deleterious effects. Small, isolated populations are also at inherently at greater risk of extinction due to environmental events such as wildfires and disease outbreaks. Small population effects can interact with other threats (such as disease, toxicants, climate change, and others) synergistically to amplify the negative impacts on the Humboldt marten population. While these small population effects almost certainly impact the California Humboldt marten population, research would be required to quantify the degree to which these effects threaten the persistence of the population.

Wildland Fires

Because the California Humboldt marten population is small, and isolated to a small geographic range, a single catastrophic wildfire has the potential to significantly impact the population size and range. Fires can destroy the dense shrub understories and large tree structures martens depend on for cover, denning, and foraging. Additionally, fires have the potential to further fragment the remaining habitat. Although it is impossible to predict the timing and location of wildfires, it is likely that fires will impact Humboldt marten habitat in northwestern California in the foreseeable future. The degree to which wildland fires threaten the persistence of the California Humboldt marten population is unknown.

Climate Change

Past and ongoing changes to the north coast climate such as rising temperatures, declining precipitation, and decreased daily fog will likely result in long term changes to the vegetative community in the region. How these changes will impact the preferred habitat of Humboldt martens is difficult to predict, but some modeling studies indicate that the geographic extent of suitable marten habitat is likely to retract northward in California. While there is a high degree of confidence in projected warming trends, and less certainty in projected precipitation changes, the degree to which these changes will threaten Humboldt martens in the foreseeable future is unknown.

Toxicants

Although there is little available information on Humboldt marten exposure to toxicants, the presence of highly toxic anticoagulant rodenticides and other pesticides is well documented within the California range. These compounds are known to frequently kill closely related fishers in northwestern California; however, the degree to which toxicant exposure threatens the Humboldt marten population is unknown.

LISTING RECOMMENDATION

CESA directs the Department to prepare this report regarding the status of the Humboldt marten in California based upon the best scientific information. CESA also directs the Department, based on its analysis, to indicate in the status report whether the petitioned action is warranted. (Fish & Game Code, § 2074.6; § 670.1(f), Title 14, CCR). In addition to evaluating whether the petitioned action (i.e., listing as endangered) was warranted, the Department considered whether listing as threatened under CESA was warranted. The Department includes and makes its recommendation in its status report as submitted to the Commission in an advisory capacity based on the best available science. In consideration of the scientific information contained herein, the Department has determined that historic and ongoing habitat loss, fragmentation and associated elevated predation rates, coupled with unquantified, but potentially significant ongoing impacts to the species from a small population size, disease, toxicants, wildfire, and climate change, warrants listing the Humboldt marten as threatened under CESA.

Protection Afforded by Listing

It is the policy of the State to conserve, protect, restore and enhance any endangered or threatened species and its habitat (Fish & Game Code § 2052). The conservation, protection, and enhancement of listed species and their habitat is of statewide concern (Fish & Game Code § 2051(c)). CESA prohibits the import, export, take, possession, purchase or sale of any species the Commission determines is endangered or threatened (Fish & Game Code, § 2080 et seq.). CESA defines "take" as hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill (Fish & Game Code, § 86). The Fish and Game Code authorizes the Department to allow "take" of species listed as threatened or endangered under certain circumstances through incidental take permits, memoranda of understanding, natural community conservation plans, safe harbor agreements, or other plans or agreements approved by or entered into by the Department (Fish & Game Code, §§ 2081, 2081.1, 2086, 2087, 2089.2, and 2835).

If the Humboldt marten is listed under CESA, impacts of take caused by activities authorized through incidental take permits must be minimized and fully mitigated according to state standards. These standards typically include protection of the land in perpetuity with an easement, development and implementation of a species-specific adaptive management plan, and funding through an endowment to pay for long-term monitoring and maintenance to ensure the mitigation land meets performance criteria. Additionally, the Department is prohibited from approving incidental take permits which could jeopardize the continued existence of the species in the state (Fish & Game Code, § 2081(b)(4)). Obtaining an incidental take permit is voluntary. The Department cannot force compliance; however, any person violating the take prohibition may be punishable under state law.

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

Although the protections afforded listed species by CESA do not apply to the actions of federal management agencies on federal lands, CESA listing may prompt increased interagency coordination and the likelihood that state and federal land and resource management agencies will allocate funds toward protection and recovery actions. In the case of the Humboldt marten, the Humboldt Marten Working Group signatory agencies already meet and coordinate regularly, but a state listing could result in increased availability of conservation funds.

Economic Considerations

The Department is not required to prepare an analysis of economic impacts (Fish & Game Code, § 2074.6).

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Personal Communications

Derek J. Broman, Furbearer Coordinator, Oregon Department of Fish and Wildlife. March 17, 2017

Keith Hamm, Wildlife Biologist, Green Diamond Resource Company. October 24, 2017.

Edward Mann, Yurok Tribal Forestry Director. October 25, 2017.

Stephan Prokop, Redwood National Park Superintendent, and Brett Silver, Redwood State Parks Superintendent. Letter to Daniel Applebee, California Department of Fish and Wildlife. June 29, 2016.

Keith M. Slauson, Research Ecologist, USDA Forest Service Redwood Sciences Lab. November 10, 2017.

Keith M. Slauson, Research Ecologist, USDA Forest Service Redwood Sciences Lab. E-mail exchange with Scott Osborn and Daniel Applebee, CDFW. November 17, 2017.

LIST OF FIGURES

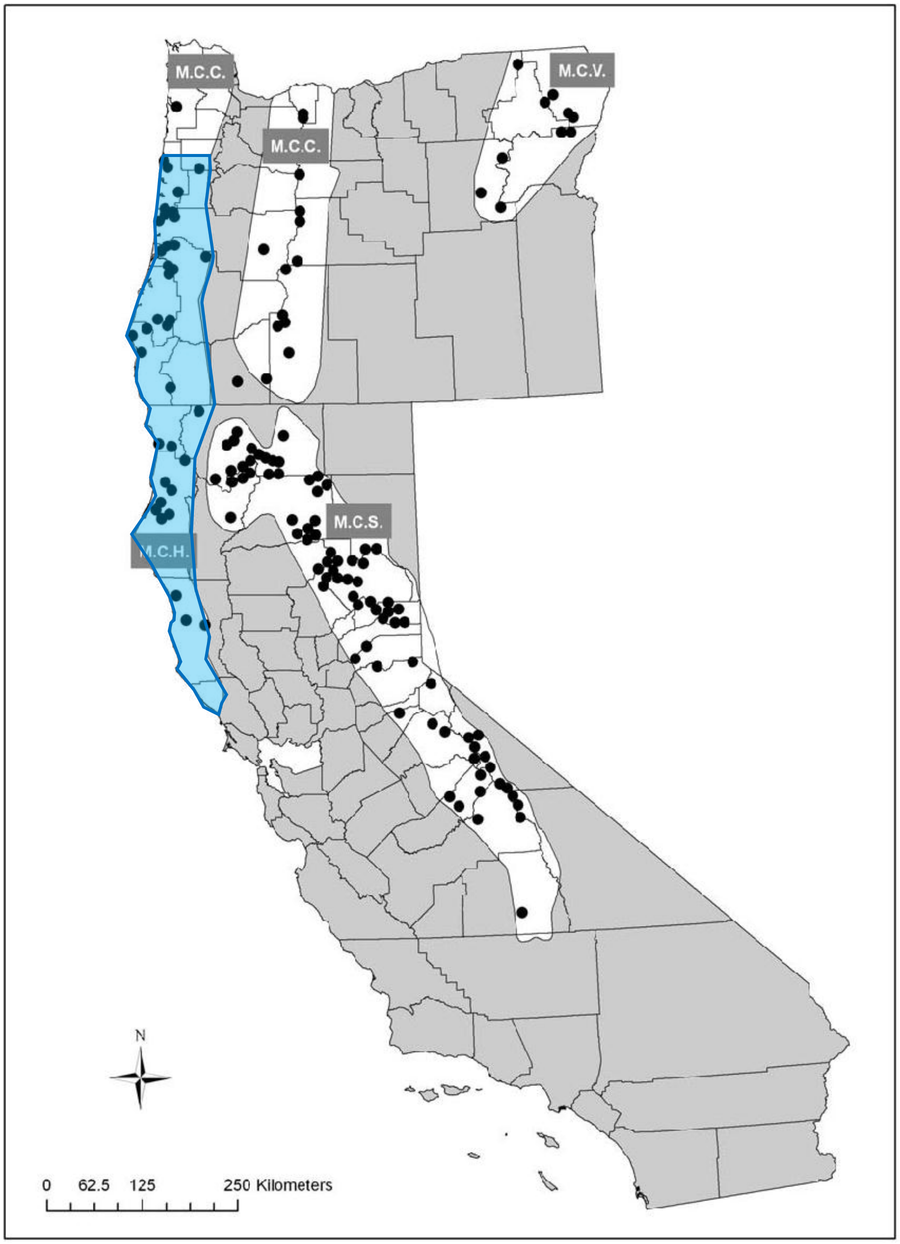

Figure 1.

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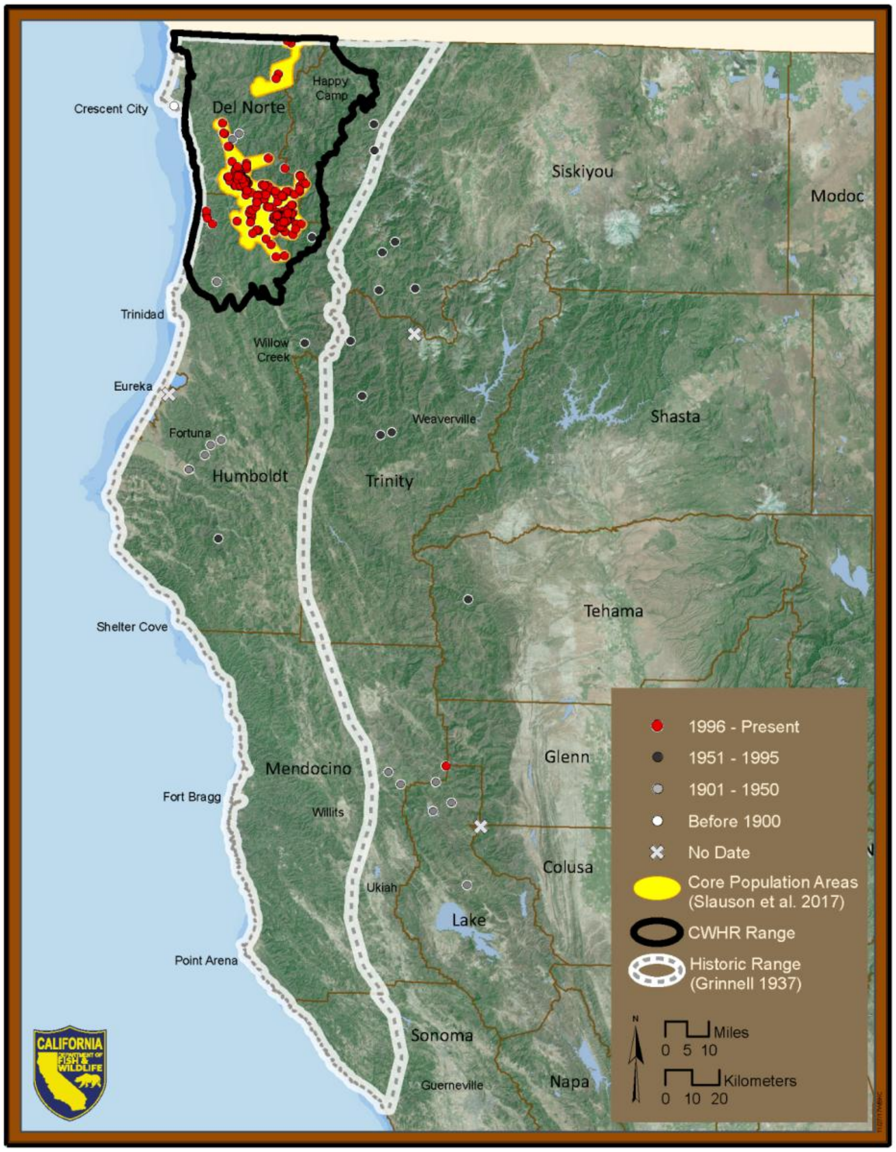
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Shelter Cove
Tehama
Mendocino
Fort Bragg
Willits
Glenn
Colusa
Ukiah
Lake
Point Arena
Sonoma
Guerneville
Napa
1996 - Present
1951 - 1995
1901 - 1950
Before 1900
No Date
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Figure 2.

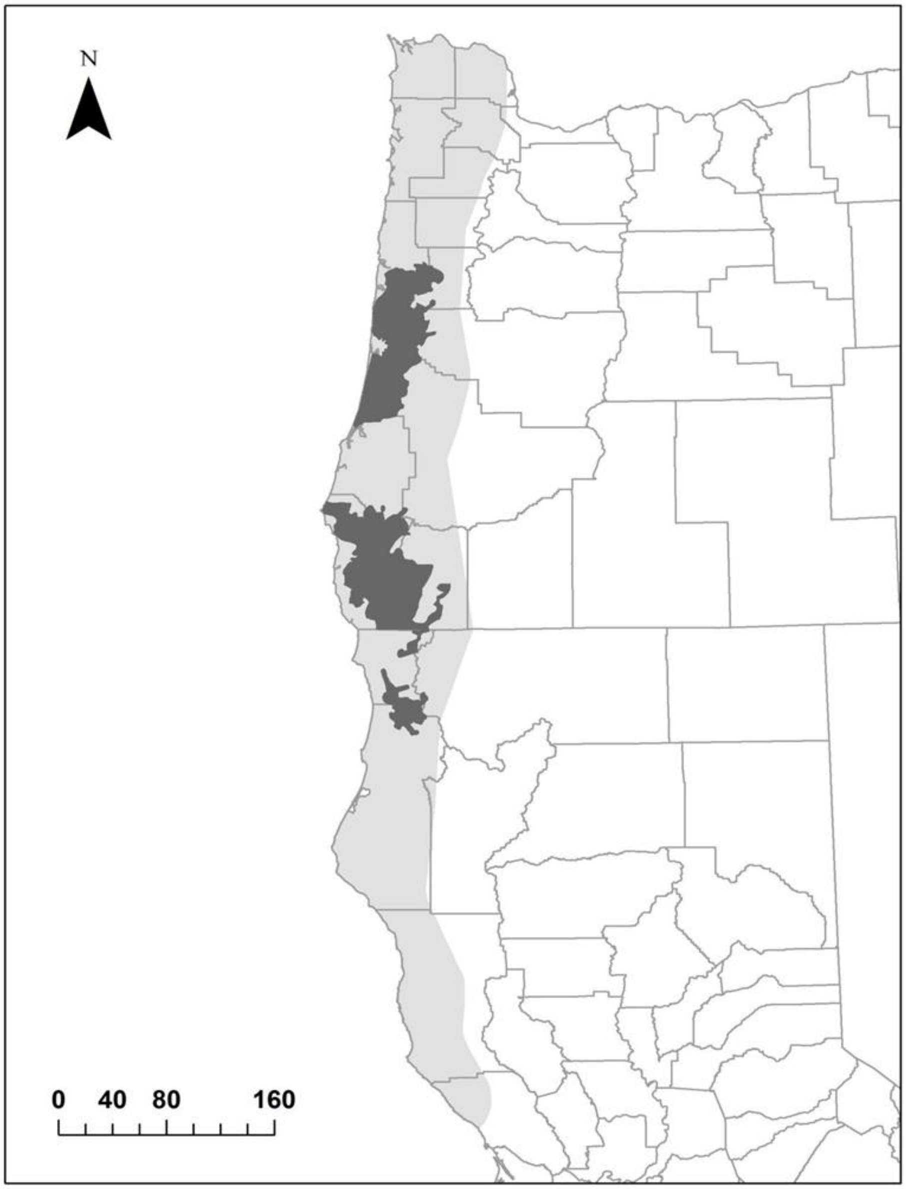

Figure 3.

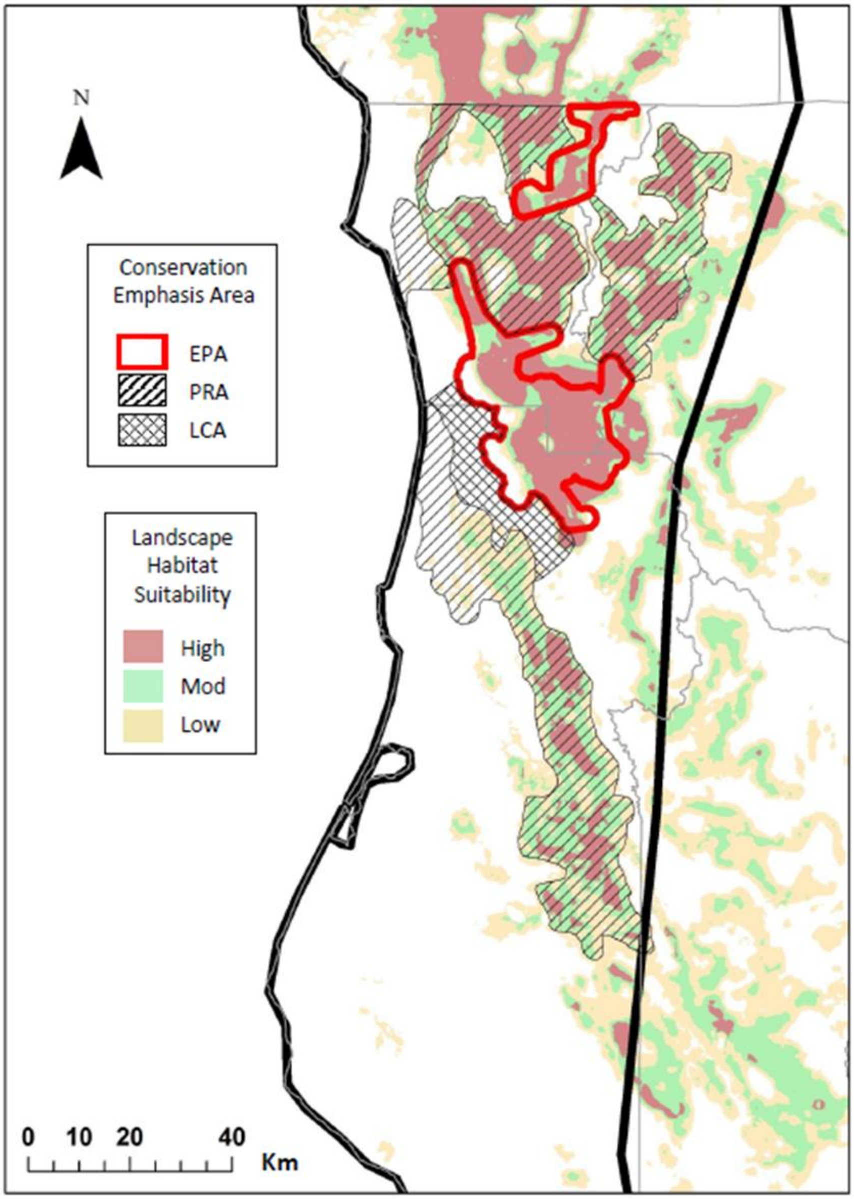

Figure 4.

Commented [CW20]: Legend in the chart with acronyms and some explanation would be good, unless its inserted into text at appropriate spot to be relevant.

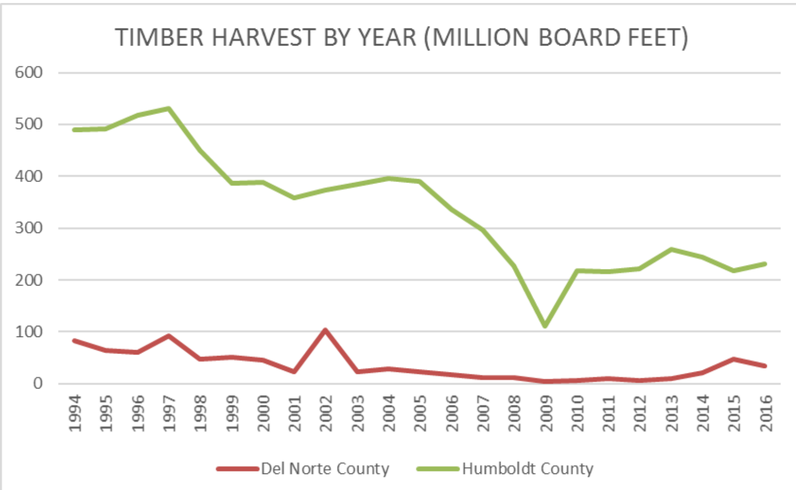

Figure 5.

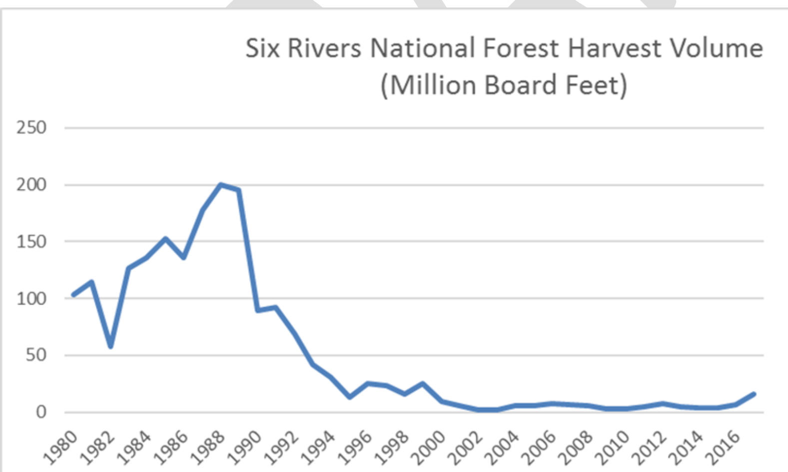

Figure 6.

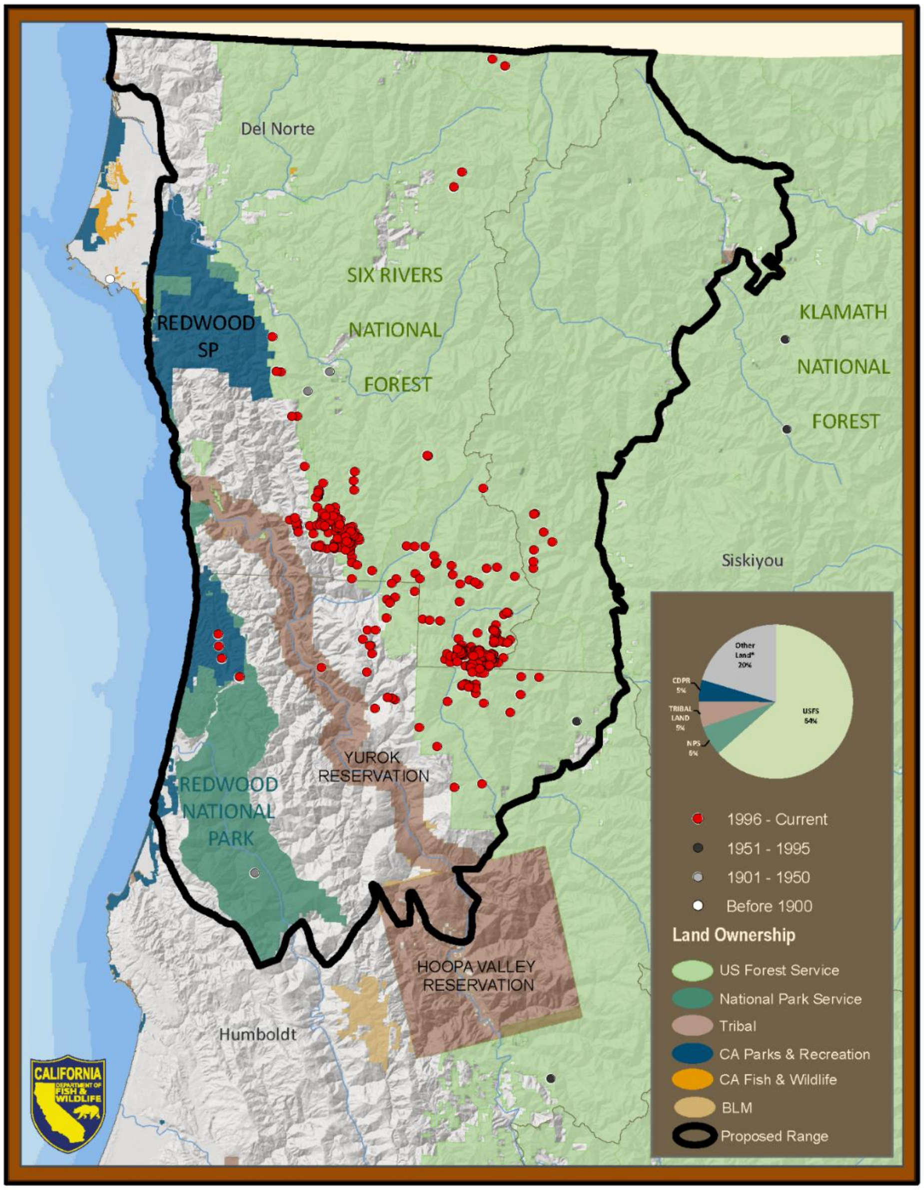

Figure 7.

Commented [CW21]: Is the pie chart of land ownership for the map or just for the Proposed Range?

Dan,

Here are my (incomplete) comments on your document. I was able to get as far as the "Small Populations" section before I ran out of time. Overall it is a well written document that considers most of the relevant information – specific to California. I think more of the info from Oregon needs to be referenced here, in that population processes in Oregon are likely to have some impact on California populations. Perhaps that is not your charge, or that this topic was considered in one of the latter sections of the doc. I liked how you were able to cite the conservation assessment and strategy so often; that was the basis for compiling the information by many authors from a multi-stakeholder group (i.e. the HMCG). We had hoped it would be of value to managers/decision makers/policy makers and it looks like it already has proven its utility.

Anyway, well done and thanks for soliciting my opinion.

Bill
William J. Zielinski
USDA Forest Service
Pacific SW Res Station
1700 Bayview Drive
Arcata, CA 95521
[redacted]

BZ: comments and edits (incomplete) – 13 April 2018

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State of California
Natural Resources Agency
Department of Fish and Wildlife

DRAFT REPORT TO THE FISH AND GAME COMMISSION
A STATUS REVIEW OF THE
HUMBOLDT MARTEN
(*Martes caurina humboldtensis*)
IN CALIFORNIA

Keith Slauson photo used with permission

CHARLTON H. BONHAM, DIRECTOR
CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE
March 20, 2018

Contents

ACKNOWLEDGMENTS

EXECUTIVE SUMMARY

(Section will be written following peer review)

REGULATORY SETTING

A "Petition to List the Humboldt Marten (*Martes caurina humboldtensis*) as an Endangered Species under the California Endangered Species Act" (Petition) was submitted to the Fish and Game Commission (Commission) on June 8, 2015, by the Environmental Protection Information Center and the Center for Biological Diversity (Petitioners). Commission staff transmitted the Petition to the Department of Fish and Wildlife (Department) pursuant to Fish and Game Code section 2073 on June 18, 2015, and published a formal notice of receipt of the Petition on July 24, 2015 (Cal. Reg. Notice Register 2015, No. 30-Z, p. 1237). The Department serves in an advisory capacity to the Commission by providing scientific reviews of petitions.

On November 11, 2015, the Department provided the Commission with its evaluation of the Petition, "Evaluation of the Petition from the Environmental Protection Information Center and the Center for Biological Diversity to List the Humboldt Marten (*Martes caurina humboldtensis*) as Endangered Under the California Endangered Species Act," to assist the Commission in making a determination as to whether the petitioned action may be warranted based on the sufficiency of scientific information. (Fish & G. Code, §§ 2073.5 & 2074.2; Cal. Code Regs., tit. 14, § 670.1, subds. (d) & (e).) Focusing on the information available to it relating to each of the relevant categories, the Department recommended to the Commission that the Petition be accepted.

At its scheduled public meeting on February 11, 2016, in Sacramento, California, the Commission considered the Petition, the Department's petition evaluation and recommendation, and comments received. The Commission found that sufficient information existed to indicate the petitioned action may be warranted and accepted the Petition for consideration. Upon publication of the Commission's notice of its findings, the Humboldt marten was designated a candidate species on February 26, 2016 (Cal. Reg. Notice Register 2016, No. 9-Z, p. 290).

Status Review Overview

The Commission's action designating the Humboldt marten a candidate species triggered the Department's process for conducting a status review intended to inform the Commission's decision on whether listing the species is warranted. At its scheduled public meeting on February 8, 2017, in Rohnert Park, California, the Commission granted the Department a six-month extension to facilitate external peer review.

This written status review report, based upon the best scientific information available and including independent peer review of the draft report by scientists with expertise relevant to the Humboldt marten, is intended to provide the Commission with the most current information available on the

Humboldt marten and to serve as the basis for the Department's recommendation to the Commission on whether the petitioned action is warranted. The status review report also identifies habitat that may be essential to the continued existence of the species and provides management recommendations for recovery of the species. (Fish & G. Code, § 2074.6.). Receipt of this report is to be placed on the agenda for the next available meeting of the Commission after delivery. Additionally, the report will be made available to the public for a minimum of 30 days prior to the Commission taking any action on the Petition.

Concurrent Federal Petition

Humboldt marten populations in northwestern California and coastal Oregon are currently under review for potential listing under the federal Endangered Species Act of 1973 (ESA) (16 U.S.C. § 1531 et seq.) in response to a 2010 petition also submitted by the Environmental Protection Information Center and the Center for Biological Diversity. The petitioned populations include the entire Humboldt marten range in California, as well as two populations of coastal Oregon Humboldt martens. In 2015, the USFWS released a 12-Month Finding that listing the Humboldt marten was not warranted. The federal petitioners challenged the finding in federal court, specifically challenging the USFWS conclusion that Humboldt marten populations were not in danger of extinction due to the risks associated with small, isolated populations. The court issued a summary judgement in favor of the Petitioners' claim that Humboldt marten populations in northwestern California are threatened by small, isolated populations (*Center for Biological Diversity v. U.S. Fish and Wildlife*. 15-cv-05754-JST, (N.D. Cal. Mar. 28, 2017). As a result, the USFWS is currently reevaluating the status of Humboldt martens in California and Oregon. An important difference between the ESA and CESA is that the ESA requires USFWS to assess whether species are threatened or endangered in the United States, while CESA directs the Department to assess a species' status only within California.

BIOLOGY AND ECOLOGY

Systematics

The Humboldt marten is a carnivorous mammal (order Carnivora, family Mustelidae), classified as a subspecies of Pacific marten (*Martes caurina*), a species occurring west of the Rocky Mountain Divide which was recently split from the American marten (*Martes americana*, Dawson and Cook 2012). The taxonomy of martens in the Pacific Northwest is currently unsettled. Historically the range of Humboldt martens was described as entirely within the north coastal portion of California (Grinnell and Dixon 1926, Grinnell et al. 1937); however, recent genetic evidence suggests Humboldt martens and martens in coastal Oregon (currently classified as *M. caurina caurina*) are diagnosably distinct from other western martens and are one phylogenetic lineage. Consequently experts now believe martens in northwestern California and coastal Oregon should collectively be classified as Humboldt martens (*M. caurina humboldtensis*) (Slauson et al. 2009a, USFWS 2015, Moriarty et al. 2016, Schwartz and Pilgrim 2017).

California is also home to the closely related Sierra marten (*M. caurina sierra*), which is traditionally considered to range throughout the Sierra Nevada and northern interior mountains. The Sierra marten is not the subject of this Petition (Figure 1). Within this report references to North American martens may refer to any species or subspecies of marten occurring in the North America (i.e. *M. americana, M. caurina, M. caurina sierrae, M. caurina caurina,* and/or *M. caurina humboldtensis*), and references to Pacific martens include any or all subspecies of *M. caurina* (including Sierra, Humboldt, *M. caurina vulpina*, and other subspecies).

Species Description

Martens have elongated and low-to-the-ground bodies, as do other members of the weasel family. Martens are intermediate in size among North American mustelid species. Martens are larger and stockier than long-tailed weasels (*Mustela frenata*) and short-tailed weasels (*Mustela erminea*), and have longer tail and body fur than the similarly sized minks (*Neovison vison*). They are noticeably smaller and more slender than the larger mustelids of North America, including wolverines (*Gulo gulo*), river otters (*Lontra canadensis*), and American badger (*Taxidea taxus*). Martens are typically smaller than fishers (*Pekania pennanti*), though there is some overlap in size between male martens and female fishers.

Marten pelage (fur) is brown (varying from yellowish buff to nearly black), with a contrasting lighter patch on the throat and chest. The marten's bushy tail constitutes more than one-third of the overall body length. Overall body lengths range from 45-70 cm (18-28 in.) and body mass ranges from 0.4-1.25 kg (0.88-2.76 lbs.), with males averaging 15% longer and up to 65% heavier than females (Clark et al. 1987, Powell et al. 2003). Humboldt martens generally differ from the Sierra martens by having darker, richer golden fur; smaller throat patch, more extensive dark fur on the feet, legs, and tail; smaller skulls, narrower faces (rostra), and differences in dentition (Grinnell and Dixon 1926, Grinnell et al. 1937, USFWS 2015).

Geographic Range and Distribution

Within California, Humboldt martens historically occupied the coastal mountains from Sonoma County north to the Oregon border from sea level to 915 m (3,000 ft.) within 35 km (22 mi.) of the coast (Grinnell and Dixon 1926, Zielinski et al. 2001, USFWS 2015). The current distribution within the state is limited to areas of Del Norte, northern Humboldt, and western Siskiyou counties and encompasses less than 5% of the probable historical range in the state (Slauson et al. 2009b, Slauson et al. 2017). The majority of contemporary California marten detections are from a 812 km^2 (313 mi^2) core area which includes the South Fork of the Smith River, Blue Creek, Bluff Creek, Camp Creek, Cappell Creek, Pecwan Creek, Slate Creek, and Rock Creek watersheds (USFWS 2015). An additional population exists east of U.S. Highway 199 near the California-Oregon border in northeastern Del Norte County, and a few Humboldt martens have recently been detected west of the core area in Prairie Creek Redwoods State Park (USFWS 2015, K. Slauson pers. comm. 10/10/2017, [Figure 2]). These extant population areas are currently isolated from one another by substantial areas of currently suboptimal habitat. East and south of the core population elevation and precipitation rapidly declines in the canyon of the Klamath River. The drier climatic conditions of the river canyon do not support the dense tree and shrub cover that characterize the habitat of Humboldt martens (Slauson et al. 2007). West of the core population lies an 8-16 km (5-10 mi.) wide band of industrial timberlands between the core population and presumably high quality redwood forest habitat in State and National Parks where a few martens have been detected periodically in the last decade. These industrial timberlands are typically harvested every 40-60 years, and in this zone dense tree and mature shrub cover is less extensive. Where mature shrub cover exists it is fragmented by roads and recent timber harvests. This more open and fragmented cover may favor carnivore species that prey on or compete with Humboldt martens (this topic is discussed below in the Threats section).

Within coastal Oregon, Humboldt martens have been detected from the California border through Lincoln County (Moriarty et al. 2016). Recent survey efforts and road kill records indicate Humboldt martens currently occupy 3-4 core population areas in the two states. The degree to which the smaller California-Oregon border population area may be effectively connected to marten populations in southern Oregon is unknown.

The Department develops species range maps using the established convention of including the USDA Forest Service Ecological Subregions of California (https://map.dfg.ca.gov/bios/) that encompass species detections from the last 20 years, and when necessary modifying the boundaries along geological features (California Interagency Wildlife Task Group 2014). For the Humboldt marten range used in Figures 2 and 7, the ecological subregions were cut along the Klamath River and the Redwood Creek watershed boundary to omit large areas where no contemporary Humboldt marten detections have occurred, and the urban area surrounding Crescent City was omitted. It is recognized that this convention can result in the inclusion of substantial unoccupied areas within the range bounds. Humboldt martens are distributed unevenly within the bounds of their range, with only a minority of the area containing the requisite tree and shrub cover to support marten populations.

Habitat Associations and Use

Generally, Humboldt martens are strongly associated with two distinct habitat types: late successional conifer forests with dense mature shrub layers where abundant live and dead standing and downed tree structures are used for resting, denning, and escape cover; and serpentine soil forest communities of various seral stages with variable tree cover, dense shrubs, and rock piles and rock outcrops used for resting, denning, and escape cover (Slauson et al. 2007, Slauson et al. 2017, Slauson et al. in review). Large patches (>50 ha [>124 ac.]) of late successional conifer forests or serpentine soil formations appear necessary for supporting sustainable Humboldt marten populations (Slauson et al. 2007, K. Slauson pers. comm. 11/10/2017). While Humboldt marten territories and dens have also been found in younger, previously harvested stands adjacent to late successional stands which retain some large trees, snags, and logs, populations in these areas may not be sustainable in the absence of individuals dispersing from nearby late successional stands (Slauson pers. com. 11/10/2017). In coastal central Oregon, Humboldt martens have recently been discovered occupying a third habitat type: shore pine (*PInus contorta* subsp. *contorta*) forests with extensive dense shrub understories (Slauson et al. 2017).

Commented [ZB-1]: Make sure that somewhere in the description of habitat is the essential distinction between the importance of mature dense evergreen shrubs that occur in gaps in mature forest conditions and classic early-seral shrubs that follow disturbance (e.g. Ceanothus).

Humboldt martens appear to select habitat at three scales (micro-habitat, stand, and home range scales), and populations of martens are affected by the arrangement of habitat at a fourth scale, the landscape. The following outline of habitat use is taken largely from Slauson et al. (2017). It should be noted that the best available information specific to Humboldt marten is presented here, but in some cases, information from other subspecies or from the American marten is referenced.

At the micro-habitat scale (the locations at which martens feed, rest, and den), North American martens rest or den in structures that provide cover for thermoregulation and protection from predators, and they forage in locations where prey is abundant and available (Andruskiuw et al 20XX,Taylor and Buskirk 1994). Humboldt marten prey species are associated with late-successional conifer forest stands characterized by abundant large logs, snags, and decadent live trees; with extensive, dense stands of ericaceous shrubs (i.e. evergreen huckleberry [*Vaccinium ovatum*], salal [*Gaultheria shallon*], and rhododendron (*Rhododendron macrophyllum*] [Allgood 1996, Slauson et al. 2017]). Den sites of North American martens are used by females to give birth to their young (natal dens) and to rear young until weaning and independence (maternal dens). Martens tend to be highly selective in their choice of denning sites, favoring large trees and snags with cavities that prevent larger predators from entering (Payer and Harrison 2003, Fuller and Harrison 2005, Thompson et al. 2012). The available data on Humboldt marten den sites (Slauson and Zielinski 2009, Slauson et al. unpublished data, Green Diamond Resource Company unpublished data) are consistent with the general North American marten pattern. A study of Humboldt marten denning ecology on managed timberlands in northern California categorized the type of substrate used for 34 identified dens (Table 1. Data from Early et al. unpublished presentation 2016):

Table 1. Humboldt marten dens by structure type and marten use from Early et al. 2016.

			Structure Type		
Den Type	Live Tree	Snag	Log or Rock Pile	Artificial Nest Box	Underground
Natal	5	0	2	0	1
Maternal	19	4	1	2	0

Trees and snags used for denning in the study were typically large, averaging 91 cm diameter at breast height (dbh, [36 in. dbh]), ranging from 46-183 cm dbh (18-72 in. dbh). Den trees typically had complex structural features such as broken tops, dead tops, large limbs, complex branching, basal hollows, and cavities.

Rest structures, used between periods of foraging by both male and female martens, include the kinds of sites used for denning as well as other sites that are less protective and less insulated than cavities or hollows, such as large tree limbs (Slauson et al. 2017). Martens typically select the largest available structures for resting and denning (Spencer 1987, Gilbert et al. 1997). Rest structures used by Humboldt martens in largely unmanaged forests averaged 95 cm (37 in.) dbh for snags, 88 cm (35 in.) large-end diameter for downed logs, and 94 cm (37 in.) dbh for live trees. Structures on average exceeded 300 years of age (Slauson and Zielinski 2009). Preliminary data on Humboldt marten rest structures from more intensively managed lands indicate a similar pattern of use of large-diameter conifer structures, with 70 percent of structures >70 cm (>28 in.) dbh (Slauson et al., unpublished data). Most resting locations (i.e., the actual resting place in the structure) were in tree cavities (33%), on platforms in broken-top snags or on large live branches (33%), or in chambers within log piles or rock outcrops (28%) (Slauson and Zielinski 2009). Rest structures which provide cavities or chambers likely become especially important during the late fall through the late spring, when wet rainy conditions are common.

At the stand scale of habitat selection (forest patches used for foraging, denning, and resting), Humboldt martens are found in forest stands that provide abundant structures suitable for resting and denning, as well as good foraging habitat, which includes both abundant prey and overhead cover to reduce predation risk (Slauson et al. 2017). In non-serpentine soil areas, Humboldt martens have been shown to preferentially use late seral forest stands and to avoid use of early successional stands (Slauson et al. 2007). The preferred late seral stands were Douglas-fir dominated, but also included mature tanoak (*Notholithocarpus densiflorus*) or chinquapin (*Chrysolepis chrysophylla*) understories. As mentioned above, late successional forest stands with dense shrub layers and abundant habitat elements such as large snags, tree cavities, large downed logs and woody debris, as well as serpentine soil forest stands with abundant rock cover appear to provide the best combination of habitat features at the stand scale.

Where Humboldt martens have been tracked on managed timberlands with younger tree age distributions, they have been associated with second-growth stands several decades old, which provide substantial overhead cover. Importantly, these younger stands retained abundant late successional habitat elements such as large old trees, snags, and logs through earlier harvests. It is likely that these retained old growth structural elements provide the micro-scale habitat features needed by martens for resting, denning, and foraging (Slauson et al. 2014, Slauson et al. 2017).

Humboldt martens have also been found in forest stands growing in serpentine soils in near proximity (less than 30 km) of the coast (Slauson and Zielinski 2001). Serpentine soils are characterized by having low plant productivity due to naturally low concentration of essential nutrients (and in some areas naturally high heavy metal concentrations). Serpentine stands used by the Humboldt marten are dominated by a variety of conifers, including lodgepole pine (*Pinus contorta*), western white pine (*Pinus monticola*), and Douglas-fir (*Pseudotsuga menziesii*) in dense to sparse overstories (Slauson et al. 2007).

Humboldt marten resting sites in serpentine stands are strongly associated with the presence of dense shrub cover and the abundant rock outcrops in serpentine stands, which are used for resting cover (Slauson and Zielinski 2009).

Serpentine habitat areas appear to support lower proportions of female martens than late successional forest stands on non-serpentine soils. Population monitoring suggests marten occupancy is less stable in serpentine habitats than in old forest habitat. Therefore, the serpentine habitat areas may have less value to Humboldt marten population persistence than old forest habitat (Slauson et al. in review).

Dense shrub layers (>70% cover) of salal, evergreen huckleberry, rhododendron, shrub oak (*Quercus vaccinifolia*), and tanoak is an important component of stands selected by Humboldt martens (Slauson et al. 2007). Slauson et al. (2010) modeled Humboldt marten habitat occupancy probability based on several habitat variables measured at the stand scale and found that marten occupancy was most strongly influenced by the percent of the landscape with ≥50% shrub cover. Importantly, the shrub community favored by Humboldt martens does not include the shade-intolerant, short-lived shrub species such as *Ceanothus* spp. that occupy more xeric (dry) sites, and dominate sites following logging and other disturbances (Slauson et al. 2010).

Commented [ZB-2]: Good, glad you made this clear.

Dense shrub layers may play an important role in excluding marten predators. Most North American martens occupy areas where deep snow accumulates which effectively excludes larger carnivores with higher body mass to foot surface area ratios. It rarely snows in the coastal forests occupied by Humboldt martens, but it is thought that extensive, extremely dense shrub layers effectively exclude larger bodied carnivores and provide a niche for Humboldt martens to exploit (Slauson et al. 2010). Humboldt martens, with the smallest body size of North American marten subspecies (Hagmeier 1961), are adapted to the dense foliage and stems found near ground level in coastal forest ecosystems, allowing them to move quickly through the dense cover and successfully capture prey.

At the home range scale, Humboldt martens appear to select areas with a high proportion of late succession forests stands. The limited information available on Humboldt marten home ranges (n=3) indicates they are on the order of 300 - 500 ha (750 - 1250 ac.), (Slauson et al. 2017). Habitat selection analysis of radio-telemetered Humboldt martens indicates that home ranges typically include ≥70% stand-scale suitable habitat arranged in large patches (≥150 ha [>370 ac.] in area) (Slauson et al. 2007, Slauson et al. 2017). Humboldt martens have also been found reproducing in younger conifer stands (40-50 years post-harvest) in the Pecwan Creek watershed and surrounding areas on the western margin of the core population area. While these stands are not considered late successional nor old growth, the average tree size is greater than 61 cm (24 in.) dbh, and stands retain abundant large tree, snag, and log structures as a legacy of historical individual tree and small group selection silviculture no longer typical for the region (K. Slauson pers. comm. 10/10/2017). Although reproducing martens have been found in these younger conifer stands, mortality rates are high, particularly from bobcat predation. It is unlikely that native reproduction rates offset the high mortality rates to sustain the population. Male-skewed sex ratios, and an age structure skewed to younger individuals in these areas suggests that a large proportion of the population occupying younger conifer stands consists of animals dispersing from the adjacent core population area (K. Slauson pers. comm. 10/10/2017).

At the landscape scale, Humboldt martens appear to select areas of occupancy based on the amount of old forest structure or serpentine habitat present in areas which receive abundant annual precipitation. Slauson et al. (in review) developed a landscape scale Humboldt marten habitat selection model to predict which regions of the historical range contain suitable marten habitat. The model was developed by relating field survey results to the environmental and habitat attributes hypothesized to influence marten distribution. The models that best correlated with observed landscape scale habitat selection each included: (1) measures of old growth structural index (a combination of stand age indices and the number of large trees >100cm [39 in.] dbh, (2) the number of large snags >50 cm [20 in.] dbh and >15 m [49 ft.] tall, (3) the volume of large snags, (4) a tree size diversity index measured at the 1-km [0.62 mi.] scale), (5) serpentine habitat measured at the 3 km [1.89 mi.] scale, and (6) annual precipitation measured at the 3 km [1.89 mi.] scale.

Growth, Reproduction, and Survival

Humboldt martens are assumed to be polygynous, like American martens and other Pacific martens, where one male breeds with multiple females. The following information is based on general characteristics of American and Pacific martens. Martens generally produce one litter per year (Calder 1984), and mating occurs mostly in summer, with a peak in July (Markley and Bassett 1942). The fertilized embryo does not implant in the endometrium for seven or eight months (Ashbrook and Hanson 1927). Active pregnancy begins upon implantation in mid-winter (February). Parturition typically occurs in March or April, after 27 days of gestation (Jonkel and Weckwerth 1963). In a radio-telemetry study of Humboldt martens (Early et al. unpublished presentation 2016), adult females reduced their daily movements from mid-March through early April, consistent with near-term pregnancy and immediate post-parturition. Typical litter size is two or three young (Strickland et al. 1982) and ranges from one to five young (Strickland and Douglas 1987).

Young are born with little fur, ears and eyes closed, and have a body mass at birth of about 28 g (1 oz.), (Brassard and Bernard 1939). The ears open at about 24 days, eyes at 39 days, and by 7 to 8 weeks of age they are active enough for the mother to move them to another den (or succession of dens) for subsequent rearing (Ruggiero et al. 1998). Male parents do not provide care for the young, though by excluding other males from their territories, they may indirectly increase prey availability for the females and their young (Clark et al. 1987). Young are typically weaned at 18 weeks of age (Strickland and Douglas 1987), and may begin dispersing from the natal area as early as August, continuing through the following summer (USFWS 2015).

Females may mate as early as 15 months of age and, because of delayed implantation, may first give birth at about 24 months of age (Strickland et al. 1982). The proportion of adult females that may attempt breeding is likely related to environmental conditions (severity of winter and availability of prey). In a Canadian population of the American marten only about 50% of adult females became pregnant in environmentally stressful years (Thompson and Colgan 1987); however, it is possible the relatively mild conditions within the Humboldt marten's geographic range may mean that a higher proportion of females may be pregnant each year (Slauson et al. 2017). Although data for Humboldt martens are lacking, in other martens females achieved highest reproductive potential between 3 and 5 years of age (Mead 1994, Fortin and Cantin 2004).

In a radio telemetry study of Humboldt martens in northwestern California (Early et al. unpublished presentation 2016), 11 females were collared, and over the course of the three-year study 16 female territories were monitored continuously for at least a full year, with some territories being monitored in multiple years. There were 12 reproduction attempts amongst the 16 monitored females (75%). All but one of these attempts produced kits (94%). Of the 20 kits produced, 17 survived to weaning (Early et al. unpublished presentation 2016).

Humboldt marten survival rates between age classes for males and females are not known. In California, Pacific martens seldom survive longer than 5 years in the wild (USFWS 2015). Building upon the population model for martens developed by Buskirk et al. (2012), Slauson et al. (2017) posited age-class specific survival rates for Humboldt marten of 0.50 for juveniles (i.e., from birth to age 1 year) and 0.70 for all adult age classes (from age 1 year to age 2 years, age 2 to 3 years, 3 to 4 years, etc.). The model indicates that population persistence is dependent on relatively high adult survival rates. Therefore higher rates of adult marten mortality, as from predation, would have large impacts on population size, trend, and rates of recovery after population decrease (Slauson et al. 2017).

Diet and Food Habits

North American martens require 15-25% of their body mass in prey daily to meet their energetic requirements (Slauson and Zielinski in press). The diet of Humboldt martens consists primarily of small mammals and birds, along with lesser amounts of reptiles, insects, and berries. Humboldt marten diets shift seasonally, with berries consumed more frequently in the summer and fall than other times of the year (Slauson et al. 2007).

Commented [ZB-3]: Use the primary literature reference instead. Keith and I did not do any primary bioenergetics work.

A recent investigation of the Humboldt marten's diet estimated the proportion of metabolizable energy (PME) contributed to the marten diet from various prey items(Slauson and Zielinski in press). Using the results of scat analysis, an average of 72% of Humboldt martens' metabolizable energy came from mammals, 22% from birds, 7% from reptiles, 5.3% from insects, and 2.6% from plant material, primarily fruits. Mammals were the most important food source by PME in all seasons. Although 17 different mammal taxa were evident in the analyzed scats, the vast majority of energy was derived from a few rodent taxa: 42% of PME attributed to mammals was composed of squirrels and chipmunks and 21% of voles and mice. Chipmunks (*Tamias* spp.), red-backed voles (*Myode*s *californicus*), Douglas's squirrels (*Tamiasciurus douglasii*) and flying squirrels (*Glaucomys sabrinus*) constituted the majority of year round biomass of mammalian prey. Red-backed voles, Douglas's squirrels, and flying squirrels reach their highest densities in late successional conifer forest stands where the foods they specialize on (conifer seeds and truffles) can be found, while chipmunks, flying squirrels, and overall small mammal abundance are positively correlated with ericaceous shrub density (Slauson et al. 2017).

The only significant insect food consumed appeared to be the adults and larvae of wasps and bees. Berries constituted 98.5% of the plant matter consumed, primarily salal, evergreen huckleberry, California red huckleberry (*Vaccinium. parviflora*), and manzanita (*Arctostaphylos sp*.) fruits. Berries were consumed most often in summer and fall (Slauson and Zielinski in press). Although reptiles composed a relatively small proportion of the diet, they were more important in the spring and summer (12% and 10% of diet respectively), when predation on mammals was lowest.

No major differences were observed between the diets of males and females nor between adult and subadult diets (Slauson and Zielinski in press). Compared to the studied diets of other North American martens, the Humboldt marten has a more diverse diet, depends less on voles, and includes more birds. (Slauson and Zielinski in press).

Surprisingly, dusky-footed woodrats (*Neotoma fuscipes*) appeared in only one of the scat samples analyzed by Slauson and Zielinski (in press). Woodrats are a widespread and often abundant small mammal in coastal redwood forests. They are especially abundant in regenerating (<20 year-old) stands in managed forests (Hamm and Diller 2009). Although woodrats would seem to be ideal prey for martens based on their size and microhabitat use, it may be that bobcat (*Felis rufus*) prevalence in younger forests effectively precludes martens from taking them. Woodrats (and brush rabbits, another herbivore found in young forest stands) are the dominant prey of bobcats (Slauson unpublished presentation 2017). It is likely the risk of predation from, and competition with, bobcats effectively precludes Humboldt martens from utilizing this abundant prey resource (K. Slauson pers. comm. 10/17/2017).

Predators (see also Threats below)

Known predators of martens in western North America include coyote (*Canis latrans*), red fox (*Vulpes vulpes*), bobcat, and great horned owl (*Bubo virginianus*) (Thompson 1994, Bull and Heater 2001). Fishers are also known to kill martens, and the distribution of fisher populations may limit the distribution of marten (Krohn et al. 2004, USFWS 2015). In a recent study of radio-telemetered Humboldt martens (Slauson et al. 2014), nine mortalities of martens were observed (including eight collared martens and one uncollared marten) over the course of two years. All nine of the martens that died were either confirmed or determined likely to have been killed by bobcats (Slauson et al. 2014). Slauson reviewed several North American marten research projects (Thompson 1994, Hodgman et al. 1997, Ellis 1998, Bull and Heater 2001, Raphael 2004, and McCann et al. 2010) which found predation to be an important source of mortality in monitored marten populations. Among these studies, Slauson (Slauson et al. 2017, and K. Slauson unpublished presentation 2017) noticed a correlation between the intensity of timber harvest in the study areas and the proportion of marten mortality attributed to predation by generalist carnivores, including bobcats. In the three study sites located in areas with high timber harvest rates and a mosaic of young forest stands and edge habitat, bobcats were the predominant predator.

Home Range and Territoriality

Martens are intrasexually territorial—adults exclude members of the same sex from their home ranges, but not members of the opposite sex (Powell 1994, Powell et al. 2003). Intrasexual territoriality is believed to benefit adult females energetically by reducing direct competition from other females for prey, and adult males by providing exclusive reproductive access to females within their home ranges.

Pacific marten home ranges in the Sierra Nevada vary from 170 to 733 ha (420–1,811 ac.) for males and from 70 to 580 ha (173–1,433 ac.) for females (Buskirk and Zielinski 1997). The limited available information from three collared male Humboldt martens in California indicates home ranges are similar in size to Sierra marten, in the range of 300–400 ha (Slauson et al. 2017). Moriarty et al. (2016) estimated the average fall home range areas in coastal Oregon to be 280 ha (692 ac.) for three males and 65 ha (160 ac.) for eight females. There appears to be an inverse relationship between habitat quality and home range size, with the larger marten home ranges in coastal California and Oregon occupying more intensively managed landscapes (USFWS 2015, Moriarty et al. 2016, Slauson et al. 2017).

Dispersal

Humboldt marten kits begin dispersing from their maternal home range as early as August and dispersal continues through at least the following summer (Slauson et al. 2017). Although dispersal distances in excess of 70 km (43.5 mi) have been reported, the average dispersal distance of North American martens is typically less than 15 km (9.3 mi) (USFWS 2015, Slauson et al. 2017).

CONSERVATION STATUS

Regulatory Status

The Humboldt marten is not currently listed as threatened or endangered in California under the CESA or the ESA. However, California Fish and Game Code section 2085 extends all of the protections afforded threatened and endangered species to those species under review in response to accepted petitions. Accordingly, during the current candidacy period the legal protections of the CESA are in place for the Humboldt marten until the Commission adopts findings either formally listing the species or rejecting the petitioned action.

The Humboldt marten is designated as a Species of Special Concern by the Department (CDFW 2017). Species of Special Concern (SSC) are species, subspecies, or distinct populations of vertebrate animals native to California that have been extirpated from the state, are ESA (but not CESA) listed as Threatened or Endangered, have naturally small populations or are experiencing serious population or range declines that could qualify them for Threatened or Endangered status. SSC is an administrative designation that conveys no formal legal status or protection. The intent of SSC status is to focus attention on animals at conservation risk, stimulate research on poorly known species, and achieve conservation and recovery of these animals before they meet criteria for listing as threatened or endangered under the CESA (CDFW Species of Special Concern website accessible at https://www.wildlife.ca.gov/Conservation/SSC).

On United States Forest Service (USFS) lands in Region 5 (which encompasses all of California), the Humboldt marten is designated a Sensitive Species and a Priority Species. Its Sensitive Species status requires management projects subject to the National Environmental Policy Act (NEPA) to analyze impacts to the species; however, this obligation carries no attendant requirement to minimize or mitigate impacts to the species.

Habitat Essential for the Continued Existence of the Species (FGC § 2074.6)

The Department considers all currently occupied Humboldt marten habitat (Extant Population Areas, see discussion below) essential for the continued existence of the species in California. Additionally, suitable but apparently unoccupied habitat near the currently occupied habitat (Population Re-establishment Areas, see below) is also considered essential for species. Further, additional habitat that is not currently suitable but which could be restored to suitability within the near term should also be considered essential.

This determination is based on analysis of information provided by Slauson (2003) and Slauson et al. (2017). For example, Slauson (2003) summarized the condition and management of the currently occupied Humboldt marten range by stating:

> A significant number of marten detections (38%) occurred on lands (private industrial timberlands and USFS matrix lands) that are available for logging currently and lack strategies to maintain suitable marten habitat ... Both martens and their habitat are patchily distributed in the area, and further loss or degradation of limited suitable habitat could decrease the chances for the persistence of this remnant population. A conservation strategy based solely on measures to maintain current conditions for this population is unlikely to ensure its long-term persistence. The two major challenges for persistence and restoration of the coastal California marten population are: 1) the longer a population remains small, the greater the chance that it will lose its genetic variation (Nei et al. 1975) or that it will be eliminated due to stochastic demographic or environmental events (e.g., wildfire)(Fager 1991), and 2) restoration of forest habitats with the structural characteristics necessary to be suitable for martens may take many decades.

Based on figures in Slauson et al. (2017), approximately 81,000 ha (200,155 ac.) of currently suitable or recruitable habitat exist in two Extant Populations Areas (“EPAs”, [the geographic range of the known extant reproductive population based on verified Humboldt marten detections and a 2 km-wide (1.24 mi.) buffer of the surrounding suitable habitat]) in California (Figure 4). If fully occupied, and assuming a female home range size of 350 ha, which is intermediate to those reported for Sierra martens (Buskirk and Zielinski 1997), the EPAs could support approximately 231 females. The four Population Reestablishment Areas (PRAs, areas of modeled suitable habitat in patches large enough to support at least five female marten home ranges which are currently unoccupied or support fewer than five females) identified in Slauson et al. (2017) encompass 198,713 ha (491.031 ac.), which could theoretically support a maximum of an additional 568 female martens. Therefore existing habitat in California, if fully occupied, could be expected to support 800 or fewer adult females. These estimates should be considered unrealistically high because: (1) a species rarely occupies all the habitat that is suitable, and (2) the estimate assumes an optimal spatial arrangement of the home ranges within suitable habitat. Additionally, the PRAs are currently thought to be unoccupied. Establishment of populations within these areas may require active translocation of individuals.

Forest management within areas essential to the continued existence of the Humboldt marten would not necessarily need to be precluded to promote the development of quality Humboldt marten habitat. For example, areas which are not currently suitable habitat could be thinned to open canopies for the promotion of dense shrub layers and the recruitment of large tree structures. Additionally, landscape-scale planning and management would be required to balance the promotion and retention of large patches of high quality habitat with the risk of catastrophic habitat loss from wildfire. All six areas, especially the four PRAs, are a mix of suitable and unsuitable habitat conditions. Management actions aimed at increasing suitability (availability of structural elements, dense shrub layer, and closed overstory canopy) could increase the number of marten home ranges supported over current conditions and reduce the threats associated with fragmented habitat in these areas.

Even if suitable habitat in these six areas were fully developed and fully occupied, Humboldt martens would number no more than 800 adult females, and only an approximate 20% of the historical geographic range in California would be occupied (Slauson et al. 2017). This number (added to the number of adult male martens that would also occupy the area) is at or below the theoretical minimum viable population size thresholds for mammal populations of several thousand individuals (Traill et al. 2007). Therefore, additional areas within or adjacent to the historical range would need be examined for the potential to recruit large patches of suitable habitat and support a larger marten population more resilient to extinction. Evaluations of potentially recruitable habitat would need to consider the distribution and composition of forest stands in future climate scenarios. Absent the protection and recruitment of suitable habitat, Humboldt martens are likely to remain at risk of extirpation in California in the foreseeable future due to one or a combination of the threat factors discussed in this report, including high rates of predation, effects of small population size, and impacts from stochastic (random, unpredictable) events such as wildfire.

Range and Distribution Trends

Historically, Humboldt martens ranged from the coastal forests of northwestern Sonoma County north to Curry County Oregon within the narrow humid coastal zone ≤35 km (22 mi.) from the coast (Grinnell et al. 1937, Kucera 1998, Zielinski et al. 2001, Slauson et al. 2017, [Figure 2]). In California, records of occurrence exist from Colusa, Del Norte, Glenn, Humboldt, Lake, Mendocino, Siskiyou, Tehama, and Trinity Counties (California Natural Diversity Database accessed October 23, 2017), but when the habitat affinities of Humboldt and Sierra martens are considered along with recent genetic research (Schwartz and Pilgrim 2017), marten records from Colusa, Glenn, Lake, and Tehama Counties should be attributed to the Sierra marten subspecies rather than Humboldt marten.

The historical range described by Grinnell et al. (1937) was roughly 22,000 km^2 (8,500 mi^2), although not all of the habitat within the bounds of the historical range would have been suitable or occupied.

Commented [ZB-4]: Precluded from what?

Commented [ZB-5]: Unclear; rewrite.

Commented [ZB-6]: Keeping in mind the long timelines, of course.

Commented [ZB-7]: At what point do you acknowledge the possible contribution to California viability of the pops in SW and coastal Oregon?

Commented [ZB-8]: Yes, this is an important – but often overlooked –relationship which requires an understanding of the diff btwn the "area of occupancy" and "extent of occurrence" and how each has/or is expected to change over time (I think the fundamentals are in Gaston's book on geographic ranges). We do not, for example know how historical areas of occupancy occurred relative to the distribution of habitat defined as suitable.

Within the historical range, the distribution of marten record locations is uneven, with concentrations of records from northern Lake and east-central Mendocino County, an area southeast of Eureka, and near the intersection of Del Norte, Humboldt, and Siskiyou counties (fig. 2). By the 1940s, a significant decline in Humboldt marten trapping returns and a retraction of the southern end of the range had been noted (Anonymous 1920, Twining and Hensley 1947). Zielinski et al. (2001) conducted an exhaustive review of historical coastal marten records from California, Oregon, and Washington including published reports, museum specimens, unpublished notes of naturalists and trappers, and interviews of tribal members and others. Based on their review they concluded that a significant reduction in occupied range has occurred.

The Department is aware of Humboldt marten records only from Del Norte, northern Humboldt, and extreme western Siskiyou Counties in the last 25 years (California Natural Diversity Database query October 22, 2017) despite the fact that surveys during that period covered a much larger portion of the historical range (USFWS 2015). The occupied range (as of year 2008) as circumscribed by a minimum convex polygon drawn around detection locations was found to be 627 km^2 (242 mi^2) by Slauson et al. (2009b). Since that time, the known occupied range has expanded slightly with two detections of Humboldt martens a few kilometers from the coast in Prairie Creek Redwoods State Park, first in 2013 and most recently in 2017 (CDFW 2014, K. Slauson pers. comm. 10/10/2017); and additional detections near the Oregon border (Slauson et al. 2017). The martens detected in Prairie Creek Redwoods State Park were not detected during rigorous surveys in the same area in 2002, thus they likely represent a recent range expansion (Slauson et al. 2010). Despite these recent expansions in the known range, Humboldt martens appear to have been extirpated from 95% of their historic range in California (Slauson et al. 2009b, Slauson et al. 2017).

Although martens were historically distributed throughout the coastal regions of Oregon, there are currently just two disjunct coastal populations of Humboldt martens (Grinnell et al. 1937, Moriarty et al. 2016, [Figure 3]). The southern population is possibly contiguous with the northernmost populations in California. In Oregon, the range appears to have remained unchanged since 2001; however, there are no indications that the population is expanding (Moriarty et al. 2016).

Commented [ZB-9]: What about the subject of how the Oregon populations may contribute to overall Hummarten population persistence? Is that discussed somewhere?

Population Size and Trend

From 1945-1995 Humboldt martens were virtually undetected in California, leading some to speculate that the species had gone extinct until they were again detected in 1996 (Kucera and Zielinski 1995, Zielinski and Golightly 1996, Slauson et al. 2009b, Slauson and Zielinski 2004). Based on surveys in the modern era the population appears to have declined by over 40% over the period 2000-2008, and then remained unchanged during the period 2008-2012 (Slauson et al. 2009b, USFWS 2015). In the only contemporary population estimate Slauson et al. (2009b), estimated the extant Humboldt marten population in California consisted of less than 100 individuals. Although it is not known if Oregon populations are in contact with California populations, Moriarty et al. (2016) detected a minimum of 28 unique Humboldt martens in coastal Oregon during surveys in 2015, and concluded “martens in coastal forests are rare and likely limited by unknown factors, especially compared to their former range.”

Historically Humboldt martens appear to have been more common and widespread. Grinnell et al. (1937) stated that Humboldt martens were “fairly numerous” in “earlier years”, though apparent declines in the Humboldt marten population, at least locally, were noted as early as the 1920s. The authors report a tale of one trapper capturing 50 Humboldt martens in a single winter near Fortuna, California. While no rigorous historical population estimate exists, one can reasonably infer from the recorded anecdotal information that the number of martens present at that time was larger than the population present in the 1990s when no detections of the species had been recorded for the previous 50 years (Zielinski and Golightly 1996).

THREATS

Trapping

Early trapping of Humboldt marten was intensive, with accounts of individual trappers taking 35-50 martens in a single winter (Grinnell et al. 1937). By the early 1900s annual harvest of Humboldt martens was already declining, prompting Joseph Dixon to call for closing the trapping season in California to prevent an extirpation; however, marten harvest continued until a partial closure was enacted in northwestern California in 1946, depleting populations and likely reducing genetic variation within the remaining population (Dixon 1925, Zielinski et al. 2001).

Today trapping of all martens is prohibited statewide (§ 460, Title 14, California Code of Regulations (CCR)). Although it is possible that Humboldt martens could be inadvertently taken by trappers pursuing other fur bearers or nongame mammals that may be legally harvested for recreation, commerce in fur, or depredation. Trapping in California is highly regulated, and trappers must pass a Department examination demonstrating their skills and knowledge of laws and regulations prior to obtaining a license (Fish & Game Code § 4005). Additionally, only live-traps may be used to take furbearers or nongame mammals for recreation or commerce in fur; trappers are required to check traps daily and release non-target animals (*Id*. §§ 3003.1, 4004, and, 4152 and § 465.5, Title 14, CCR). With the passage of Proposition 4 in 1998, body-gripping traps (including snares and leg-hold traps) were banned in California for commerce in fur and recreational trapping (*Id.* § 3003.1). However, some body-gripping traps may be used by licensed trappers for purposes unrelated to recreation or commerce in fur, including protection of property or by government employees, or their authorized agents, while acting in their official capacities (*Id.* § 3003.1 and § 465.5, Title 14, CCR). Martens incidentally captured by trappers must be immediately released § 465.5(g)(1), Title 14, CCR).

Trapping of Humboldt martens remains legal in neighboring Oregon where trappers are required to obtain a trapping license and take an educational course (Hiller 2011). In recent years very few trappers reported pursuing martens in Oregon (4-8 trappers per year [Hiller 2011]), and only three Humboldt martens were reported taken in 2013 (USFWS 2015). Oregon trapping records are organized by county making it difficult to determine if reported trapped martens were coastal Humboldt martens or interior *Martes caurina caurina*. Review of trapping record from 2007-2016 indicates that as many as nine Humboldt martens may have been trapped in Oregon and one roadkill Humboldt marten was recovered (D. Broman pers. comm. 3/17/2017).

Commented [ZB-10]: So, how then are you making the assessment that *X* number of martens trapped in these counties are M M c. h. (i.e., trapped in the coastal portion of the counties)?

Trapping pressure on Humboldt martens was intense during the late 1800s and early 1900s, and very likely resulted in significant declines in population size as well as a dramatic reduction in range. There have been no studies on the population level effects of Humboldt marten trapping, but the loss of even a few adult martens, especially when combined with other mortality sources, could reduce the likelihood of long-term population viability (USFWS 2015). However, it is unlikely that trapping continues to threaten Humboldt martens in California due to the ban on trapping martens, restrictions on the types of traps that may be used for other species, as well as requirements that licensed trappers check traps daily and release non-target animals.

Commented [ZB-11]: Might be good here to find data on the number of licensed trappers that live within the general range (?). Can you get access to that information?

Habitat Loss and Degradation

Changes in the structure and landscape configuration of Humboldt marten habitat can negatively impact survival, reproduction, and population connectivity of the species. In particular, timber harvest and other silvicultural treatments of older forests, salvage logging, development of coastal forests for human settlement, as well as the clearing of forests for the cultivation of cannabis can all lead to loss, degradation, and fragmentation of Humboldt marten habitat. The USFWS (2015) Humboldt marten species report concluded habitat loss and degradation from historical and current logging is the most plausible reason the marten is absent from much of its historical range, noting most of the remaining suitable habitat is located on federally owned land (Zielinski et al. 2001).

Forest conditions in the range of the Humboldt marten today are largely shaped by a legacy of over 100 years of logging and timber management. It is estimated that the area of old growth conifer forest in the Pacific Northwest has been reduced by 72% since European settlement (Strittholt et al. 2006), and only 10% of the historical range of redwood forests remains in old growth stands (Fox 1996). While timber harvest continues in the area, the logging of old growth forest stands on private and public lands has dramatically slowed from peaks in the second half of the 20th Century. Today, 33% of remaining old forest on federal lands in the Northwest Forest Plan area is fully protected from harvest, and 80% is afforded some level of management protection (Strittholt et al. 2006). The rate of timber harvest on private lands in the area has declined in recent decades due to more restrictive regulations and market conditions (Figure 5). Harvest on federal lands declined sharply following implementation of the Northwest Forest Plan in 1994 (Strittholt et al. 2006) (Figure 6.). The area of older forests (OGSI-2000) on federal lands in the coastal and Klamath mountains of northwestern California declined 8.4% from 1993-2012, largely due to wildfires, while the area of older forests on non-federal lands increased 1.3%, despite losses to timber harvest (Davis et al. 2015). While recent losses of old forest stands in the Humboldt marten range have been relatively small, forest stands degraded and fragmented from historical logging will take decades to recover dense ericaceous shrub layers and centuries to recruit the large tree structures needed to restore high quality Humboldt marten habitat conditions (Slauson et al. 2010, Slauson et al. 2017).

Habitat loss and degradation from human settlement and residential development rapidly increased in the 1850s when pioneers of European descent began harvesting lumber, farming, mining, and fishing along California's north coast (Del Norte County Community Development Department 2003). Since that time minor portions of the historical range have been converted from forests to urban areas, primarily in and around Crescent City, Humboldt Bay, Fortuna, Fort Bragg, and Willits; and much of the historical range south of Del Norte County has been parceled and occupied by very low density housing (≤1 housing unit/16 ha [40 ac.])(Cal Fire 2010). However, the core population area currently occupied by Humboldt martens is almost entirely unoccupied by humans, with the exception of some areas adjacent to the Klamath River on Yurok Tribal lands (Cal Fire 2010). Low-density human occupancy does not necessarily equate with the loss of mature forest habitat favored by martens but human occupancy likely renders such areas unsuitable for martens. Impacts from the presence of humans, livestock, and pets, the construction and use of rural roads, and the use of household pesticides can frighten wildlife away, introduce novel predators, diseases, and toxicants, deplete prey populations, and degrade and fragment habitat (Merenlender et al. 2009). While further human development of the historical range will likely continue into the future, a modeled analysis of future land conversions under several human population growth scenarios found the probability of significant conversions to urban and agricultural uses in the northwest California coast region to be very low for the remainder of this century (Sleeter et al. 2017).

Large-scale marijuana cultivation in remote forests throughout California has increased since the mid-1990s, coinciding with the 1996 passage of Proposition 215, the Compassionate Use Act of 1996 (Health & Safety Code, § 11362.5), which allowed the legal use and growth of marijuana for certain medical purposes (Bauer et al. 2015). Humboldt and Del Norte counties are known centers of legal and illegal cannabis cultivation in California due to the remote and rugged nature of the land and abundant water sources (National Drug Intelligence Center 2007, Bauer et al. 2015). The recent passage of California Proposition 64, the Control, Regulate and Tax Adult Use of Marijuana Act, further decriminalized the adult use of cannabis for recreational use beginning in January 2018. In 2017, the California Legislature approved the Medical and Adult Use of Cannabis Regulation and Safety Act which provides state and local governments the authority to regulate the production and processing of cannabis products, including regulation of the environmental impacts from growing cannabis. It remains to be seen what effect these new laws will have on the conversion of forests for the production of cannabis. A recent study (citation?) found the majority of cannabis cultivation sites in Humboldt County were located >500 m (1,640 ft.) from the nearest road, indicating cultivation may contribute to landscape fragmentation, although the amount of land area under cannabis cultivation was found to be minor at less than 1% of the land under organic crop cultivation (Bustic and Brenner 2016). The extent to which land clearing for legal and illegal cannabis cultivation contributes to Humboldt marten habitat loss and degradation is unknown.

The habitat characteristics of Humboldt martens that may be particularly at risk from these activities can be considered at the four scales of habitat selection described in the BIOLOGY AND ECOLOGY section on Habitat Associations and Use above.

Large Tree Structures

At the micro-habitat scale, the large tree structures used by Humboldt martens for resting and denning were typically removed during timber harvests, both during initial harvests of original-growth forests as well as through harvest of "residual" old growth trees in subsequent entries in second-growth forests (Slauson et al. 2010, USFWS 2015). Large diameter trees, snags, and downed logs with cavities and platforms used as resting and denning structures by Humboldt martens are significantly reduced in second-growth forest stands compared to the old growth stands (Slauson et al. 2003, Slauson et al. 2010). In second-growth stands it is estimated that it could take more than 200 years to recruit such structures (Slauson et al. 2010). The minimum age of live and dead tree structures used for resting by martens in north coastal California was 176 and 254 years, respectively (Slauson and Zielinski 2009).

Other silvicultural treatments also reduce marten habitat structures. For example thinned stands (n=26) have been found to have significantly fewer potential resting and denning structures than Humboldt marten-occupied stands (n=7); although large cull logs from previous harvests in recently thinned stands can provide similar densities of large log structure to marten occupied stands (Slauson et al. 2010).

Commented [ZB-12]: Reminder to reference Matt Delhiemer thesis that also addressed diffs in marten occupied and non-occupied areas; as well as the value of rest boxes to help restore resting habitat in young stands.

Tree and Shrub Canopy Cover

At the stand scale of habitat selection, Humboldt marten habitat suitability is reduced under most of the commonly used timber harvest methods, both through overstory canopy cover reduction and through loss of dense ericaceous shrub layers (USFWS 2015). Shrub layers can be destroyed or degraded through conifer stand management which favors trees over shrubs (such as mechanical brush clearing and application of herbicides that target brush species), and through the competitive exclusion of densely planted conifers which shade out understory shrubs (Slauson et al. 2010). Typical even-aged silvicultural methods employed on industrial timberlands completely eliminate post-harvest canopy cover in clear cuts over areas of up to 40 acres. Such conditions, unsuitable for marten use, persist for years until the regenerated stand achieves suitable canopy closure. Shrub cover is more patchily distributed in thinned stands than in old growth stands (Slauson et al. 2010). Dense regenerating conifer stands that were thinned were found to regenerate moderately dense shade-tolerant native species shrub layers within 15-30 years following thinning; however, shrub cover remained significantly lower than levels found in the old growth redwood stands used by Humboldt martens (Slauson et al. 2010). Given relatively short harvest rotations, typically less than 60 years (USDA 1992, Green Diamond Resource Company 2012, Yurok Tribal Forestry 2012) in the coastal forests of northern California, overstory conditions suitable for martens may only exist on a small proportion of the intensively managed landscape at any given time.

Slauson et al. (2010) found that shrub flowering and fruiting are greatly reduced in stands thinned ≤30 years prior to harvest compared to stands occupied by martens: Only 38% of thinned stands were observed with a fruiting or flowering shrub component, compared to 100% of old forest stands occupied by Humboldt martens. In addition to directly providing food for martens, fruiting shrubs support greater densities of marten prey animals such as small mammals, hornets and migratory birds.

Vegetation management activities designed to efficiently produce timber and reduce the risk of wildland fire by removing shrubs, reducing canopy cover, and removing snags and logs may negatively impact martens by removing required habitat structures and by removing shrub cover which can reduce prey abundance and improve access for competitors and larger-bodied predators such as bobcats and gray foxes.

Fragmentation

At the home range and landscape scale, forest fragmentation poses threats to Humboldt marten individuals and populations. Individuals may be forced to move over greater distances to acquire food in fragmented landscapes, increasing their energetic costs and exposing them to more predators. Populations may be impacted by reducing the ease of juvenile dispersal and ability of breeding individuals to move between population areas. Fragmented habitat conditions exist throughout much of the Humboldt marten's historical and current range and the four extant marten populations in coastal California and Oregon appear to be isolated from one another by unsuitable habitat degraded by logging, severe wildfire, and urbanization (Slauson et al. 2017). Fragmentation of habitat can also be detrimental at finer scales, where fragments of habitat may not be large enough to support a single marten territory. For example, the Redwood National and State Parks complex contains only three patches of late successional forest greater than 2,023 ha (5,000 ac.) in area, with most patches less than 40 ha (100 ac.) in area (USFWS 2015).

Slauson et al. (2017) concluded that early trapping combined with the extensive habitat loss and fragmentation from unregulated timber harvesting were the two factors most responsible for the decline in distribution and abundance of Humboldt martens. Similarly, Moriarty et al. (2016) suggested habitat fragmentation (both natural and anthropogenic) is the most serious threat to martens in coastal Oregon (Moriarty et al. 2016):

> Habitat fragmentation through natural and anthropogenic alterations likely poses the largest threat to marten conservation. Marten populations decline with as little as 30% of the forest cover removed (Hargis and others 1999; Potvin and others 2000), and fuel reduction treatments typically decreased cover and connectivity in the Sierra Nevada (Moriarty and others 2015). Martens were deterred by low-canopy-cover openings,

Commented [ZB-13]: Although Linnell et al (2018) focused on the impact of human mortality via roads as a significant factor.

16

seldom moving 17 m (56 ft.) beyond cover (Cushman and others 2011), and most often moving 50 m (164 ft.) within forest patches to avoid such openings (Moriarty and others 2015).

Commented [ZB-14]: Keith also, in his PhD diss., identified some distance thresholds that appeared to discourage movement across openings, and that these differed by sex.

Degraded landscapes may lack obvious barriers to marten movement while acting as functional barriers to movement by decreasing the likelihood of daily survival and successful dispersal. American marten dispersal distances were found to decrease by approximately 50% in intensively logged forests in Ontario compared to unlogged forests, and the percent of juveniles successfully dispersing and establishing new territories declined from 49% in unlogged forests to 25% in logged forests (Johnson et al. 2009). Thompson (1994) found daily survival rates in recently harvested (3-40 year old) forest stands in Ontario were nearly five times lower than in uncut forests. Where habitat conditions result in decreased dispersal distances and lower survivorship of dispersing animals, habitat is functionally fragmented.

Commented [ZB-15]: Increased? ..due to inability to find a home range area the meets the requirements in terms of level of frag or patch sizes.

Because roads favor generalist predators that prey on martens, crossing roads to move between fragmented patches of habitat means martens are more likely to encounter a predator than if they were able to remain in dense shrub habitat (Slauson et al. 2010). Fragmentation of dense shrub stands by roads also appears to confer a competitive advantage to generalist carnivores like fishers, gray foxes, and bobcats, which compete with and prey upon martens. Slauson et al. (2010) found that 80% of camera detections of generalist carnivores such as fisher, gray fox, and bobcats were on roads while 80% of marten detections came from areas away from roads. In northwestern California Highway 101, which is a four lane highway in some sections, may constitute a significant barrier to marten movement (S. Prokop and B. Silver 6/29/2016 letter to CDFW).

Commented [ZB-16]: What about the more likely role of the Klamath River as a barrier; do you discuss this important issue elsewhere?

Wildfires and associated salvage logging of damaged trees can threaten the already small Humboldt marten population by reducing and fragmenting the remaining habitat (Slauson and Zielinski 2004). Vegetation management activities designed to reduce the risk of wildland fire by removing shrubs, reducing canopy cover, and removing snags and logs impacts martens by removing required habitat structures and shrub cover which can reduce prey abundance and improve access for competitors (USFWS 2015). On federal lands, salvage logging and fuels management activities can occur on all land allocation categories except for wilderness areas (Hamlin et al. 2010), and on private lands salvage logging plans are exempt from normal review procedures and are automatically approved by the California Department of Forestry and Fire Protection (CAL FIRE) through a ministerial process if all applicable Forest Practice Rules are abided (Title 14, CCR §1052).

While thinning and fuel reduction management can fragment and degrade Humboldt marten habitat, it is important to note that severe wildfires can also substantially fragment and degrade marten habitat. However, Moriarty et al. (2017) found that implementing fuel reduction treatments (mechanical or prescribed fire) on as little as 10-20% of the landscape significantly reduced the probability of marten habitat loss from wildfires. Management for the creation and conservation of resilient Humboldt marten habitat will require land managers to carefully plan for both habitat patches and fuel reduction zones over the landscape over time.

The amount of Humboldt marten habitat in California has been substantially reduced since the species' range was first described by early naturalists, primarily as a result of past timber harvesting and timber production practices which removed the large tree structures and dense shrub layers martens require for denning and protection from predators. Although the rate of timber harvesting appears to have decreased in recent years, it will take centuries recruit large tree structures to replace what has been lost. Wildfire, conversion of land to urban and agricultural uses, and cannabis cultivation have also contributed to habitat loss and degradation. Where habitat remains, degraded conditions and fragmentation caused by roads, timber harvesting, cannabis cultivation, and other land use practices can limit its usefulness to the marten population. Degraded and fragmented habitats may allow larger carnivores to colonize traditional Humboldt marten habitat resulting in increased rates of predation on martens. Because historical habitat loss and degradation severely limits the spatial extent of suitable habitat available to the population, it continues to pose a potentially significant threat to Humboldt martens. However, increases in the extent of mature coastal forest from recruitment of large tree and shrub structure and reductions in habitat fragmentation could significantly contribute to the recovery of Humboldt martens in California.

Predation

Predation can significantly limit marten populations in the wild (Hodgman et al. 1997, Bull and Heater 2001, McCann et al. 2010, Slauson et al 2017). Known or expected predators of Humboldt martens include bobcats, gray foxes (*Urocyon cinereoargenteus*), coyotes, mountain lions (*Puma concolor*), great horned owls, goshawks (*Accipiter gentilis*), and Pacific fishers (Buskirk and Ruggiero 1994, Bull and Heater 2001, Slauson et al. 2009b, Woodford et al. 2013). Moriarty et al. (2017) detected the following potential predators at camera traps within 5 km (3.1 mi.) of known Humboldt marten detections: black bear (*Ursus americana*), bobcat, gray fox, domestic dog (*Canis familiaris*), domestic cat (*Felis catus*), coyote, and mountain lion. Gray fox was the most frequently observed species with detections near 29% of the known marten stations. Bobcat, black bear, and domestic dogs were detected near 26%, 23%, and 11% of the known marten stations, respectively. Detections of coyote, domestic cat, and mountain lions were lower, ranging from two to four percent.

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Bull and Heater (2001) documented 22 mortalities in their northeastern Oregon Pacific marten radio telemetry study; of these, 18 were attributed to predation by bobcats, raptors, coyotes, and other martens[1]. The martens killed by predators accounted for 51% of the collared population over their four year study (Bull and Heater 2001). In Raphael's (2004 *in* Slauson et al. 2017) study of Pacific martens in the Oregon Cascades, 21 of 28 marten mortalities were attributed to predation (bobcats and coyotes), which constituted 18% of the monitored population. In a Humboldt marten dispersal study in California (Slauson et al. 2014), nine martens (39% of collared martens) were killed by predation over the course of less than one year. All nine of these predation events were from bobcats. Comparing the effect of varying levels of bobcat occupancy in different watersheds in the California range of the Humboldt marten, Slauson (unpublished presentation 2017) showed an inverse relationship between bobcat occupancy and marten occupancy, and a direct relationship between bobcat occupancy and marten predation rates.

Predator – Vegetative Community Interactions

Coastal forest ecosystems are complex, with tree, shrub, and herbaceous plant layers creating multiple structural layers. Historically, dense continuous shrub understories were common in mature forests in the redwood region (Morgan 1953, Allgood 1996, Slauson and Zielinski 2007). These shrub understories have been drastically reduced and modified through a century of logging and related forest management such as burning, mechanical clearing, road building, and planting dense stands of trees which compete for sunlight with shrubs and herbs (Slauson and Zielinski 2007). The time period over which shrub layer extent, density, and species composition drastically changed corresponds with

[1] The four marten deaths attributed to other martens were all males, including two juveniles. The carcasses were not eaten, but showed trauma suggestive of fighting. The authors surmised resident male martens engaged in territorial defense were responsible for these mortalities.

observed reductions in Humboldt marten distribution and the observed expansion of generalist mesocarnivore (mid-sized carnivores) distributions in the redwood region.

Humboldt martens appear to require dense shrub stand patches of >50-100 ha (124-247 ac.) (Slauson et al. 2007). Where shrub layers have been removed or reduced, fishers and gray foxes - both potential marten predators, have expanded their historic ranges into the previously unoccupied redwood region (Slauson and Zielinski 2007). Conversely, in the remaining old tree conifer stands with intact dense shrub layers that Humboldt martens select as preferred habitat, fishers and gray foxes are rarely detected (Slauson 2003, Slauson and Zielinski 2007). Martens showed the strongest preference for stands with ≥80% shrub cover, and avoided stands with <60% shrub cover, while fishers and foxes avoided stands with ≥80% shrub cover and used stands with <60% shrub cover in proportion to their availability (Slauson 2003).

The high predation rates noted in the Pacific marten and Humboldt marten studies above occurred in areas that included intensively-managed forests. Raphael (2004 *in* Slauson et al. 2017) described his study as a "high-harvest" area. Bull and Heater's (2001) 400 km^2 (154 mi^2) study area included a relatively small area (53 km^2) (20 mi^2) of uncut forest surrounded by an area "extensively harvested for timber (approximately 80%) and… fragmented by partial cuts, regeneration cuts, and roads." More than 90% of the Slauson et al. (2014) Humboldt marten dispersal study area had been previously harvested. Managed forests with open overstories, less dense shrub layers, and high road density appear to favor larger-bodied generalist predators such a bobcats, gray foxes, and fishers, which may prey on or kill Humboldt martens (Slauson and Zielinski 2007, Slauson et al. 2010, Slauson unpublished presentation 2017). Fragmentation of dense shrub stands by roads also appears to confer a competitive advantage to generalist carnivores like fishers, bobcats, and gray foxes, which compete with and prey upon martens. Slauson et al. (2010) found that 80% of camera detections of generalist carnivores such as fisher, gray fox, and bobcats were on roads while 80% of marten detections came from off road areas. Because roads favor generalist predators, crossing roads to move between fragmented patches of habitat means martens are much more likely to encounter a predator than they would be if they were able to remain in dense shrub habitat (Slauson et al. 2010).

A landscape-scale habitat shift has occurred within the Humboldt marten's geographic range since the advent of industrial logging in the 20th century; from large, contiguous old forest stands with extensive dense shrub layers to a more patchy landscape of younger stands with degraded shrub layers divided by road systems. It is thought that small-bodied martens have a competitive advantage over the larger bodied carnivores when foraging and moving through dense shrub stands (Slauson and Zielinski 2007), so this shift in habitat can disadvantage marten while simultaneously favoring larger-bodied generalist carnivores such as bobcats, fishers, and gray foxes. These changes, along with the increased density of roads in the area, have allowed generalist predators to expand their distributions into areas they did not traditionally occupy and prey upon martens at higher rates. Although it is unknown whether predation alone threatens the existence of Humboldt martens in California, adult survival rates are known to be the most influential parameters in marten population growth models (Slauson et al. 2017). Predation rates therefore likely have a potentially significant effect on population growth and abundance.

Competition

No data or studies were identified that assess the impacts of competition between Humboldt martens and other species. The USFWS Humboldt marten species report (2015) does not identify competition as a significant stressor on Humboldt martens. Additionally, species with very specific habitat associations, such as Humboldt marten would be expected have a competitive advantage within their preferred habitat over habitat generalist species in the same area (Ricklefs 1990, Zabala et al. 2009). Further, carnivore species typically select prey species of a certain size as a function of the predator's own mass, effectively limiting competition with smaller and larger carnivores in the same community (Sinclair et al. 2003, Owen-Smith and Mills 2008). In coastal Oregon, Moriarty et al. (2016) detected the following potential competitor predators at camera traps within 5 km (3.1 mi.) of historical marten detections (reported as percent of camera trap sample units with detections): spotted skunk (*Spilogale gracilis*) at 41% of stations, opossum (*Didelphis viriginiana*) at 25% of stations, and short-tailed weasel at 8% of stations. Of these, only the spotted skunk is similar in size to Humboldt martens (Maser et al. 1981) and it is a habitat generalist, and therefore unlikely to be a significant competitor.

Toxicants

The control of predators and other animals perceived as pests through poisoning was historically common in the western states. Two former methods had the potential to kill non-target predators such as the Humboldt marten: poisoning livestock carcasses and aerial broadcast of poisoned baits. In one report, dead fishers and martens were observed in the vicinity of poisoned ungulate carcasses in Washington State (Zielinski et al. 2001). While such practices had largely ceased by the 1970s, the historical impact on Humboldt marten population size and distribution is unknown but potentially significant. Recently the use of rodenticides and other toxicants at illegal cannabis plantations has been observed to be a widespread practice (Gabriel et al. 2018). Anticoagulant rodenticides detected near cannabis plantations in northwestern California include brodifacoum, bromodiolone, chlorophacinone, diphacinone, and warfarin. Brodifacoum and bromodiolone are considered second-generation anticoagulant rodenticides which were introduced when rodents developed resistance to first-generation compounds in the 1970s (Gabriel et al. 2012, 2013, Thompson et al. 2014). First-generation compounds generally require several doses to cause intoxication, while second-generation anticoagulant rodenticides, which are more acutely toxic, often require only a single dose to cause intoxication or death and persist in tissues and in the environment (Gabriel et al. 2012). Additionally, other highly toxic pesticides, some of which are banned in the United States, have been found at illegal cannabis grow sites (Thompson et al. 2014).

A recent study conducted on Green Diamond Resource Company lands in Humboldt and Del Norte Counties detected anticoagulant rodenticide exposure in the tissues of 70% of northern spotted owls (n=10) and 40% of barred owls (*Strix varia*, n=84) examined, although none of 36 rodent livers examined had traces of rodenticides (Gabriel et al. 2018). The authors hypothesized a recent increase in cannabis cultivation sites in the study area may have led to the increased use of anticoagulant rodenticides in the area. In an earlier study, Gabriel et al. (2015) detected the presence of anticoagulant rodenticides in the tissues of >85% of the dead fishers tested in California. Within their northern California study area (i.e., Hoopa Valley Indian Reservation) 52 fishers were tested for anticoagulant rodenticide exposure. Seven fishers were confirmed to have died from anticoagulant rodenticide poisoning, all of which had trespass marijuana grows within their home ranges (Gabriel et al. 2015). Because fisher and martens have similar foraging habits and diets, rodenticide exposure likely also poses a significant threat to the Humboldt marten population in California (Slauson et al. 2017). In recent necropsies of deceased Humboldt martens, one out of six carcasses examined showed traces of rodenticides in its tissues (Slauson et al. 2014). Although exposure to rodenticides was not necessarily the cause of death of the exposed animals, the acute toxicity of these compounds makes it likely that the salvaged animals were either directly killed by rodenticides or negatively affected to the extent that death from other causes such as exposure, predation, or starvation became more likely.

Disease

In their Humboldt marten species report (2015), the UFSWS noted: "The outbreak of a lethal pathogen within one of the three coastal marten populations could result in a rapid reduction in population size and distribution, likely resulting in a reduced probability of population persistence, given the small size of these populations." North American martens are known to be susceptible to a variety of diseases, including: rabies, plague, distemper, toxoplasmosis, leptospirosis, trichinosis, sarcoptic mange, canine adenovirus, parvovirus, herpes virus, West Nile virus, and Aleutian disease (Strickland et al. 1982, Zielinski 1984, Williams et al. 1988, Banci 1989, Brown et al. 2008, Green et al. 2008). Although Strickland et al. (1982) found that American martens in their central Ontario study tested positive for toxoplasmosis, Aleutian disease (a carnivore parvovirus), and leptospirosis; none of the diseases was considered to be a significant mortality factor for martens. Similarly, although Zielinski (1984) discovered antibodies to plague (*Yersinia pestis*) in four of 13 Sierra martens in the Sierra Nevada, he noted martens only appear to show transient clinical signs of the disease. Gray foxes within the current range of Humboldt martens in California are known to have been exposed to canine distemper, parvovirus, toxoplasmosis, West Nile Virus, and rabies, all of which are transmittable to martens (Brown et al. 2008, Gabriel et al. 2012). In their Hoopa Valley Reservation Study, Brown et al. (2008) found dead fisher within the range of Humboldt marten had been exposed to canine parvovirus and canine distemper which is known to cause high rates of mortality in mustelids (Deem et al. 2000). Because several potentially lethal diseases are known from the environment, a disease outbreak in one or both of the remaining Humboldt marten population areas in California should be considered a potential threat to the species. Although it is not known if this threat alone imperils the persistence of the species in California, when combined with the more serious threat of small, isolated populations, habitat loss from wildland fire, cannabis cultivation, timber management, and other threats, the possibility of a catastrophic disease outbreak further reduces the certainty that the Humboldt marten population will persist into the foreseeable future.

Wildland Fire

Slauson (2003) states that stochastic events such as wildfire present a major challenge to the persistence of Humboldt marten, and Slauson et al. (2017) classified wildfires as a serious threat over a large area of the extant population area in California and Oregon. In the more coastal areas occupied by Humboldt martens, conditions that promote the ignition and spread of wildfire rarely exist due to the typically wet winters and foggy summers of the local climate. However, fires become more frequent in the extant Humboldt marten range with distance inland from the coast (Oneal et al. 2006). By examining the size of recent fires in the extant range, Slauson et al. (2017) concluded that a single large fire could affect 31-70% of the currently occupied suitable habitat in California. Others have concluded that a single wildfire could burn an entire core population area (USFWS 2015). The effects of fires varies with the intensity of the burn and the severity of the impact on the vegetative community; ranging from high severity burns which can kill and consume most vegetation, including large tree structures, to low severity burns which consume only the ground level vegetation, leaving shrub and tree layers largely unaffected (USFWS 2015). Slauson et al. (2017) state that even a low severity burn would be likely to reduce Humboldt marten habitat suitability by reducing shrub cover; however, when a fire burned through approximately 25% of a studied Humboldt marten population area in the interval between surveys in 2008 and 2012, no change in marten occupancy post-fire was detected, indicating that any fire-related impacts the population were slight and/or short lived (Slauson et al. 2017). More recently in the summer of 2015, the Nickowitz fire burned approximately 2,800ha (7,000 ac.) in and adjacent to the current known range of Humboldt martens in Del Norte County, but the impact has not been assessed (InciWeb 2015).

Miller et al. (2012) reported that the annual number of fires, mean fire size, maximum fire size, and area burned all increased in northwestern California over the period of 1910-2008. Miller et al. (2012) also noted that high severity fires tended to be clustered in years when region-wide lighting strikes caused multiple ignitions, indicating that weather conditions in some years are conducive to widespread high severity fires in northwestern California. The effects of wildland fire on the landscape are difficult to predict due to variations in ignition frequency and burn severity based on vegetation type, geography, and weather patterns. However, it is clear that fires have the potential to degrade or destroy Humboldt marten habitat over entire population areas, further reducing the carrying capacity of the landscape and fragmenting populations. Therefore, habitat loss from wildland fire should be considered a potentially significant threat to persistence of the California Humboldt marten population.

Climate Change

The North American continent has already experienced the climatic effects of human-mediated increases in greenhouse gas emissions (USGCRP 2017). The annual average temperature in the contiguous United States has been 0.7°C (1.2°F) warmer over the past 30 years compared to the period 1895-2016, and is projected to further increase to 1.4°C (2.5°F) warmer over the period 2021-2050 (Vose et al. 2017). By the end of the century annual average temperatures are projected to be 1.6°C – 4.1°C (2.8°F – 7.3°F) warmer based on low emissions scenarios, to 3.2°C – 6.6°C (5.8°F – 11.9°F) warmer under high emissions scenarios (Vose et al. 2017).

In northwestern California annual precipitation levels have been 10-15% lower in the last three decades compared to the period 1901-1960 (Easterling et al. 2017). While future precipitation levels in this region are not projected to change radically, the frequency of drought events is projected to increase due to increased evapotranspiration resulting from increasing temperatures (Easterling et al. 2017). Additionally, projected warming of ocean surface temperatures 2.7°C ± 0.7°C (4.9°F ±1.3°F) (Jewett and Romanou 2017) will likely result in reduced daily coastal fog formation.

The Humboldt marten's coastal redwood and Douglas-fir forest ecosystem is characterized by moderate temperatures, high annual precipitation, and summer fog which supports dense conifer tree and shrub cover (Slauson et al. 2007, USFWS 2015). This ecosystem is currently limited in spatial extent to near coastal Oregon and northern California. Climate projections suggest that the coastal zone where precipitation is frequent will narrow in the future (PRBO 2011). The intrusion of coastal fog into inland forests has already been observed to be decreasing in frequency (Johnstone and Dawson 2010), though whether this pattern will continue into the future is unclear (PRBO 2011). Less extensive coastal precipitation, reduced fog intrusion, and globally increasing temperatures together could cause the southern extent of mesic coastal forest to retract northward, further reducing the amount of suitable habitat available to Humboldt martens (USFWS 2015, Slauson et al. 2017). These climatic changes could cause a shift from current conifer dominated vegetative communities to hardwood forests unsuitable to martens, and the dense, shade-tolerant shrub layer required by marten may be lost (USFWS 2015). These vegetation transitions could create conditions more favorable to marten predators and could further fragment the remaining patches of suitable habitat (USFWS 2015). Under moderate emissions scenarios the bioclimatic conditions that support Humboldt marten habitat are projected to reliably occur only in Del Norte County and northern Humboldt County (DellaSalla 2013).

Projected climatic changes could further impact Humboldt martens by changing the fire regime in the range of the subspecies. Miller et al. (2012) reported the number of fires per year, mean fire size, maximum fire size, and area burned all increased in northwestern California over the period 1910-2008 and that observed changes in the local climate explained much of the fire trends. This research demonstrates that the effects of a changing climate may already be impacting Humboldt marten habitat and highlights the link between climate patterns and wildfire trends in northwestern California forests. In the summer of 2015 the Nickowitz fire burned approximately 2,800 ha (7,000 ac.) in and adjacent to the current known range of Humboldt martens (InciWeb 2015). In addition to wildfire-mediated habitat changes resulting from changes in climate, other studies have projected climate-related changes in forest disease, insect damage, and other disturbance events which could affect marten habitat quality or availability (USFWS 2015). Finally, Lawler et al. (2012) suggested that martens (all North American species) will be highly sensitive to climate change and will likely experience the greatest impacts at the southernmost latitudes and lowest elevations within their range.

In a recent modeling study, Stewart et al. (2016) assessed climate change vulnerability to 20 of California's terrestrial mammals, including the Humboldt marten. Their study included three components of climate change vulnerability for each taxon. The first component is the taxon's projected response to future climate change, which is the percent of climatically suitable potential habitat projected to be lost (or added) due to climate change. It is based on the climatic conditions within the historical range and projections of those conditions in future climate scenarios. The second vulnerability component is exposure/niche breadth. This component scores the projected amount of change in climate within the taxon's range, and is expressed as percent change compared to current conditions within the historical range of the taxon. The final component is based on an assessment of the taxon's physical, behavioral, and physiological characteristics that affect its sensitivity and adaptive capacity to respond to climate change. Overall climate change vulnerability was assessed by combining the scores for the three components. Two emission scenarios (high, low) and two global climate models (hot/dry and warm/wet) were used to project four future climates. Overall vulnerability scores were partitioned into five categories, ranging from "may benefit" through "less", "moderately", "highly", and "extremely" vulnerable to future climate change impacts.

Depending on the scenario, the Humboldt marten's vulnerability was assessed to be either less vulnerable (low emission, warm/wet scenario), moderately vulnerable (low emission, hot/dry scenario and high emission, warm/wet scenarios), or highly vulnerable (high emission, hot/dry scenario). By the end of the century, projected habitat conditions at the locations Humboldt martens have been detected to date would remain largely suitable under the low emission, warm/wet scenario (only about 1% loss of suitable locations), but 77% of the locations would become unsuitable under the high emission, hot/dry scenario. The following excerpt from Stewart et al. (2016) summarizes the results from the models:

> Distribution models suggest that the Humboldt marten would benefit (increase area of climatically suitable habitat) under wet climate scenarios, but would be adversely impacted (decrease area of climatically suitable habitat) under drier future climate scenarios. Under the wet scenarios, suitable habitat is projected to increase in extent around the currently suitable areas in the southern portion of its coastal range. Under the hot dry scenarios, suitable habitat on the coast is projected to retract into the core area currently known to be occupied by the subspecies. Distribution models map large areas of suitable climate where the Humboldt marten is not currently known to occur. These include areas in the southern coastal part of the Humboldt marten's presumed historical range, as well as areas within the geographic range of the Sierran subspecies of the Pacific marten (*Martes caurina sierra*). Given the current understanding of Humboldt marten's requirements for forest structure (large decadent trees with cavities for denning, dense shrub layers) that do not occur in much of the coastal forests of northern California, it is not surprising that the species does not currently occur in a large proportion of the coastal area predicted as currently climatically suitable.

In summary, there is relatively high certainty that temperatures will continue to increase within the range of Humboldt martens, which is likely to increase the frequency drought events due to increased evapotranspiration. Although there is less confidence in projected changes in total precipitation, fire regimes, and the distribution of vegetative communities, it is apparent that significant changes are possible within the century. Changes in the distribution and abundance of preferred Humboldt marten habitat could significantly impact the existing Humboldt marten population and limit opportunities for population expansion. Therefore, climate change should be considered a threat to the long-term persistence of the Humboldt marten population in California.

Vehicle Strikes

Mortalities resulting from collisions with vehicles is a documented threat to Humboldt martens, with 17 road kills documented in coastal Oregon by Moriarty et al. (2016). Vehicle strikes were the greatest source of mortality in their Oregon study, although the authors speculated that the impact to the population may be trivial compared to predation, disease, and exposure to poisons, particularly given their small, isolated populations. There have been no recorded roadkill Humboldt martens in California since 1980 (USFWS 2015); however, Highway 101 is a high speed, multi-lane road in places which transects potentially suitable Humboldt marten habitat in places, and likely would pose a risk to martens attempting to cross (S. Prokop and B. Silver 6/29/2016 letter to CDFW). Slauson et al. (2017) classified the impact of vehicle collisions on Humboldt marten populations as extremely severe, but limited in scope to a few areas where frequently traveled roads intersect marten population areas. The impact of vehicle strikes on the overall Humboldt marten population is unknown. Mortalities from collisions, although apparently not spatially extensive, may combine with mortality from predation, toxicants, and other sources to exceed recruitment rates, at least in localized areas, and limit population viability (USFWS 2015).

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Commented [ZB-18]: .. but will certainly be more severe if this mortality occurs in spring and summer and affects adult females who are rearing dependent young. In these cases the adult female is lost as are the kits she was caring for. This is actually true of any mortality factor: it will be magnified insofar as it preferentially affects survival of adult females, especially during the breeding season.

Small Populations

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Small, isolated populations are inherently vulnerable to extinction due to loss of genetic variability; inbreeding depression and genetic drift; reduced genetic capacity to respond to changes in the environment; as well as through demographic stochasticity (changes in age and sex ratios resulting in less than optimal breeding opportunities) due to random variation in birth and death rates (Primack 1993, Reed and Frankham 2003). In studied wildlife populations, genetic diversity is strongly correlated with population fitness (increased survival and reproduction rates) and decreased extinction risk (Hedrick and Kalinowski 2000, Reed and Frankham 2003). The smaller the population size, the more likely other threats will drive it to extinction (Primack 2010).

The only estimate of the Humboldt marten population is that less than 100 individuals exist in California (Slauson et al. 2009b), far below the population size experts believe to be required to ensure long-term viability of a species (Traill et al. 2007, Traill et al. 2010, Flather et al. 2011). The loss of genetic diversity inherent to small, isolated populations can be expected to increase their risk of extinction because small and inbred populations have reduced ability to adapt with changing environments due to diminished pools of potentially adaptive heritable phenotypes (Frankham 2005). Populations of at least several hundred reproductive individuals are believed to be required to ensure the long term viability of vertebrate species, with several thousand individuals being the goal (Primack 1993). However, observations of wild populations indicate that it is possible for small populations to persist, at least in the short term, in the face of genetic challenges, but these observations do not inform the probability or durability of recovery (Harding et al. 2016).

In wild populations, reproductive output and survival vary amongst individuals and from year to year. In large populations this variance averages out, but in small populations this variation, termed demographic stochasticity, can cause the population size to fluctuate randomly up or down (Primack 1993). The smaller the population size the more pronounced the effect. Once a population size drops, its next generation is even more susceptible to further stochasticity and random inequalities in the sex ratio resulting in fewer mating opportunities and a declining birth rate (Primack 1993). Due to their small population size, Humboldt martens may be vulnerable to these effects; however, Slauson et al. (2017) believe any negative impacts associated with demographic stochasticity would likely be spatially limited in Humboldt martens.

Unpredictable changes in the natural environment and biological communities can cause the size of small populations to vary dramatically where larger, more widely distributed populations would remain more stable because these changes normally occur in localized areas (Primack 1993). For example, unpredictable changes in a species' prey or predator populations, climate, vegetative community, or disease and parasite exposure can cause the size of a small, isolated population to fluctuate wildly, and possibly lead to extinction (Primack 1993). Additionally, natural disasters such as droughts, fires, earthquakes, and severe storms can lead to dramatic population changes if the population is small and localized such that the disaster impacts all or most of the individuals. Although the probability of such events is generally rare in any given year, over the course of generations the probability becomes much greater (Primack 1993). Ecological modeling studies have demonstrated that the influence of random environmental stochasticity has a greater influence on extinction probability than demographic stochasticity (Primack 1993). Environmental and genetic effects can work in concert with each other to seriously threaten small populations. As populations get smaller they become more vulnerable to demographic variation, environmental variations, genetic drift, and inbreeding depression. Each of these effects can amplify the impact of the other effects, further reducing population size and accelerating the species towards extinction in what has been termed an extinction vortex (Primack 1993).

Small populations, and populations that have experienced periods of low population numbers in the past lose genetic diversity and may suffer the effects of inbreeding depression - the concentration of deleterious alleles (maladaptive genes) in the population from the mating of closely related individuals resulting in offspring with reduced fitness (Frankham 2005, Harding et al. 2016). Closely related to inbreeding depression is genetic drift, or the accumulation and fixation of detrimental alleles in in the population due to a limited breeding pool (Hedrick and Kalinowski 2000). In large populations maladaptive genes do not accumulate in the population due to random mate pairings and the elimination of less fit offspring through natural selection. However, in small, isolated populations natural selection can have less of an effect on the population genotype than genetic drift. When this happens deleterious genes can become fixed in the population's genotype resulting in decreased reproductive fitness in all individuals, and potentially negative population growth (Hedrick and Kalinowski 2000, Frankham 2005).

The influence of inbreeding depression on fitness-related traits appears variable across populations, heritable traits, and environments (Hedrick and Kalinowski 2000). Inbreeding depression affects nearly every well studied wildlife species, and contributes to extinction risk in most wild populations of naturally outbreeding species (Frankham 2005). It is uncertain whether inbreeding depression occurs within the California Humboldt marten population, but the small population size and apparent period of isolation from other populations make it likely that significant genetic diversity has been lost (Slauson et al. 2017).

The loss of genetic diversity and the accumulation of deleterious genes can largely be mitigated by the exchange of breeding individuals between population centers (Primack 1993). When individuals migrate from their natal population to new population areas, the novel genes they introduce can balance the effects of genetic drift and inbreeding depression. As few as one migrant per generation in a population of 120 individuals could negate the effects of genetic drift (Primack 2010). Consequently, habitat fragmentation can seriously increase the genetic risks to isolated subpopulations, and habitat connectivity between populations can substantially mitigate these risks.

While the genetic risks associated with small populations may significantly increase a population's risk of extinction, it is important to note that a small population size alone is not necessarily predictive of population viability over time. A well planned conservation strategy can substantially mitigate risks associated with small populations. A comprehensive plan for long term viability should include the principles of representation, resiliency, and redundancy (Shaffer and Stein 2000, Wolf et al. 2015). These principles require recovered species be present in multiple large populations across the entire spectrum of habitats used by the species, and these populations must also be resilient to environmental changes, identified threats, and genetic threats (Wolf et al. 2015). The California Humboldt marten population, numbering less than 100 individuals, is currently highly exposed to the environmental and genetic risks inherent to small populations; however, a carefully designed program of habitat protection, connection, as well as the possibility of facilitated translocations could connect isolated breeding populations, increase the number of populations, and decrease these risks.

Research and Handling

Wildlife research in California is regulated through the state's Scientific Collecting Permit program (Fish & Game Code § 1002 et seq.). The program requires researchers to disclose their study design, wild animal handling protocols, and demonstrate their professional experience with the species of interest. Notwithstanding this oversight, mortalities are a risk of any wildlife research that requires the capture and handling of live animals. In early 2016, a Humboldt marten in California died of exposure in a trap set by researchers when a pre-baited trap was inadvertently left open and not checked again for several days. This incident is the only documented research-related Humboldt marten mortality in California despite the fact that dozens of martens have been captured and fitted with radio collars to date. Additionally, species experts believe it is unlikely that research would be conducted on more than 10% of the Humboldt marten population at any one time (Slauson et al. 2017). Therefore, it is unlikely that research and handling presents a significant threat to the population.

EXISTING MANAGEMENT

Land Ownership within the California Range

In California, the majority of the land within the Humboldt marten's range is owned and managed by the U.S. Forest Service, with smaller portions owned and managed by the Yurok Tribe, Green Diamond Resource Company, and State and National Redwood Parks (Figure 7). Land management strategies and practices vary across and within ownerships.

National Forest Lands

The U.S. Forest Service manages the majority of the land within the marten's range on the Six Rivers and Klamath National Forests. As mentioned in the Conservation Status Section, on Forest Service lands in Region 5 (California), the Humboldt marten is designated as a Sensitive Species. Management projects subject to the National Environmental Policy Act (NEPA) must analyze impacts to the Sensitive Species;

however, there is no requirement to minimize or mitigate project impacts to the species. National Forest lands in northern California are managed under the Northwest Forest Plan (USDA and USDI 1994) which sets land management guidelines according to seven allocations: Congressionally Reserved Areas, Late Successional Reserves, Managed Late Successional Areas, Adaptive Management Areas, Administratively Withdrawn Areas, Riparian Reserves, and Matrix lands. Matrix lands units are intended for timber harvest, yet Slauson (2003) detected Humboldt marten on Matrix lands in 8 out of 31 sample units, and 20% of Slauson et al.'s (2007) analysis area was designated as Matrix land available for logging with 16% of the Matrix land previously logged. Late Successional Reserves (LSR) are intended to support viable populations of late successional and old-growth dependent species such as spotted owls and Humboldt martens. However, logging is not prohibited in this land allocation class, and not all LSRs are currently in a late successional condition, but rather managed to grow into late successional habitat and therefore may not currently provide Humboldt marten habitat. Forty percent of Slauson et al.'s (2007) study area was designated LSR, with martens detected in 13 of 66 sample units in LSR; 13% of the land designated LSR in the marten's range has been logged (Slauson et al. 2007). The Humboldt marten was given only a 67% likelihood of remaining well distributed within the range of the northern spotted owl (*Strix occidentalis caurina*) by the Northwest Forest Plan scientific analysis team (USDA and USDI 1994). Slauson et al. (2009b) concluded that the Northwest Forest Plan does not completely protect the extant population, with 38% of the Humboldt marten distribution occurring outside of NWFP reserves.

Forest management on individual national forests is governed by Land and Resources Management Plans (LRMP). The LRMP for the Six Rivers National Forest, where much of the extant Humboldt marten population is located, includes provisions to protect known active Pacific marten den sites and the surrounding habitat within 152 m (500 ft.) from disturbance and land-altering activities. However, there is no requirement to conduct pre-project surveys for martens, so there is little probability that active marten dens would be detected and subsequently protected, leaving denning martens and their habitat outside of protected land allocations vulnerable to disturbance and destruction (Six Rivers National Forest 1996).

A small portion of the Humboldt marten range is contained within the Siskiyou Wilderness Area, and only a portion of the wilderness area is composed of vegetation suitable for martens. Slauson (2003) detected martens on only 3 out of 23 sample units located in Siskiyou Wilderness. The U.S. Forest Service also manages the Smith River National Recreation Area (SRNRA), which covers a small portion of the marten's range. The SRNRA is not vulnerable to logging, but management of the area prioritizes recreation over wildlife values.

Redwood National and State Parks Management

State and National Park Service land in the Humboldt marten range includes the Redwood National Parks Complex consisting of Redwood National Park, Prairie Creek Redwoods State Park, Jedediah Smith Redwoods State Park, and Del Norte Coast Redwoods State Park. These parks are managed by the National Parks Service and California Department of Parks and Recreation (California State Parks) and total over 53,412 ha. (131,983 ac.) in northwestern California, of which approximately 30% is currently composed of old-growth forest. Forests in state and national parks are not subject to harvest, except where younger stands are managed to more rapidly develop old-growth characteristics (Slauson et al. 2017). The General Plan/General Management Plan governing the management of the parks does not identify specific management actions for Humboldt martens. Approximately 33% of the Park lands are managed as primitive zones where no development or facilities construction occurs and visitor use is limited to foot traffic on existing trails. An additional, 55.4% of the Park lands are managed as backcountry zones where the preservation and restoration of the natural environment is emphasized, and modification of the environment related to visitor use is limited. Where suitable marten habitat exists within these management zones, it is likely maintained and protected from significant modification and degradation (USDI NPS and California State Parks 2000).

As of 2010, State and National parks had removed over 350 km of roads and thinned 4-6% of the second growth stands within their boundaries (Slauson et al. 2010). Prairie Creek Redwoods State Park had at least one Humboldt marten detection each year from 2009-2013, and again in 2017, although it does not appear to currently support a viable reproducing marten population (K. Slauson pers. comm. 10/10/2017).

Private and Tribal Lands

The largest private land owner within the contemporary Humboldt marten range is the Green Diamond Resource Company, which manages approximately 151,000 ha (373,000 ac) primarily in Humboldt and Del Norte Counties, California (Green Diamond Resource Company 2017). Although only a small fraction of the ownership is within the contemporary range of the Humboldt marten, an important portion lies between the core population area and potentially suitable coastal habitat in the Redwood State and National Parks (Figure 7), although much of this area was recently transferred to the Yurok Tribe. Green Diamond lands are dominated by redwood forest in coastal and low elevation areas and by Douglas-fir as elevation and distance from the coast increase. Hardwoods are common in all forest types and in places compose the majority of the stand (Green Diamond Resource Company 2012). Most of the ownership has been logged at least once over the last century and now consists of second and third growth stands from recently harvested to 120 years old (Hamm et al. 2012). Small old growth forest areas which have never been logged are scattered throughout the ownership and total 150 acres of redwood and 300 acres of Douglas-fir, comprising less than 2% of Green Diamond Resource Company land. Green Diamond operates under a Maximum Sustained Production Plan approved pursuant to a provision of California Code of Regulations, Title 14, Section 913.11 subdivision (a) ("Option A") filed with the CAL FIRE. The Option A plan is intended to balance forest growth and timber harvest over a 100 year period. With some exceptions, Green Diamond plans to practice even-aged silviculture management on the ownership using clear-cutting as the primary harvest/regeneration method. Conifer stands are typically thinned 10-20 years after planting, again after 30 years, and harvested at or after 45 years in clear cuts of 16 ha (40 ac.) or less. Streamside zones, steep slopes, and special habitat areas are managed differently, including single tree selection harvest and retention for wildlife values (Green Diamond Resource Company 2012). At least 10% of the pre-harvest basal area is typically retained in streamside zones, habitat areas, and scattered trees to retain forest structural elements through the harvest rotation. Regeneration involves prescribed burning, mechanical slash treatment, tree planting, and the control of competing vegetation with herbicides (Green Diamond Resource Company 2012).

Green Diamond has periodically surveyed their lands for the presence of fishers and martens, including surveys in 1994-1995 and 2011-2012 (Hamm et al. 2012). No Humboldt martens were detected in the earliest surveys (1994-1995); however, in a repeat survey in 2004-2005 a marten was detected on Green Diamond land west of a known Humboldt marten population on public lands, and detected again in 2006. In 2010-2011 camera station surveys on Green Diamond lands detected martens at 14 stations, some co-occurring with fishers. This series of surveys indicates that martens are a persistent presence on Green Diamond lands (Hamm et al. 2012). Green Diamond has partnered with the United States Department of Agriculture's Forest Service Redwood Sciences Lab to conduct research on the species since 2012 (K. Hamm pes. Comm. Oct. 24, 2017). As of 2016, 33 Humboldt martens have been captured, and 24 fitted with radio collars to study habitat use and den site characteristics in this joint study (Early et al. 2016). Most of the land covered by these surveys and studies was recently acquired by the Yurok Tribe through land purchases in 2011 and 2018.

Green Diamond Resource Company manages most of its land under the conditions of two federally-approved Habitat Conservation Plans (HCPs), one for the northern spotted owl and the other for anadromous salmonid fish. The HCPs allow for incidental take of listed species and may deviate from Forest Practice Rule guidelines for species covered under the HCPs. Under Section 10(a) of the ESA, incidental take, defined as take that is incidental to, and not the purpose of an otherwise lawful activity, may be authorized for federally threatened and endangered species covered under an approved HCP. For both HCPs, the Department has determined that the federal Incidental Take Statement is consistent with CESA pursuant to Fish and Game Code section 2080.1. Although neither HCP specifically covers Humboldt marten, the plans are designed, in part, to retain and recruit larger tree structure which may improve marten habitat suitability on company lands over time. During development of the northern spotted owl HCP Green Diamond prepared a 30-year timber stand age-class forecast model. The age-class forecast covered 1991 through 2021, and assumed timber harvest would occur at an annual rate of 3,000-6,000 acres. Results indicated that second-growth stands in the 46+ year age-class would more than double, the 31-45 year age-class would increase by approximately 50,000 acres in first 10 years then return to 1991 levels, and the 8-30 year age-class would generally decrease over time.

Fish and Game Code sections 2089.2 through 2089.26 allow the Department to authorize incidental take of a species listed as endangered, threatened, candidate, or a rare plant, through a Safe Harbor Agreement (SHA) if implementation of the agreement is reasonably expected to provide a net conservation benefit to the species, among other provisions. SHAs are intended to encourage landowners to voluntarily manage their lands to benefit CESA-listed species without subjecting those landowners to additional regulatory restrictions as a result of their conservation efforts. In addition, at the end of the agreement period, participants may return the enrolled property to the baseline conditions that existed at the beginning of the SHA. Green Diamond Resource Company has voluntarily applied for a Humboldt marten SHA; however, until the SHA is approved, it is not possible to describe or quantify the benefits to the Humboldt marten population that will result from the agreement.

The other significant land owner within the range of the Humboldt marten is the Yurok tribe which owns approximately 23,876 ha (59,000 ac.) of land in or near the Humboldt marten range. The Tribe also manages an additional 1,528 ha (3,776 ac.) of federal land held in trust for the Tribe (Yurok Tribal Information Services website accessed October 25, 2017).

Yurok Tribal objectives for the management of Tribal lands include: Establishment of a regular, periodic, long term sustained yield of timber products, generation of Tribal income and employment from timber sales, limiting the use of clear cutting and eliminating the use of herbicides, protecting and enhancing areas considered culturally significant, acquisition of lands (including cutover lands) to increase the Tribal land base, protection and enhancement of fisheries, use of prescribed burning when possible, generating Tribal income from the sale of carbon credits, and providing oversight and professional expertise on the best way to utilize Tribal forestland for non-timber use. To achieve these goals, the Yurok primarily use uneven-aged silviculture practices (harvest of individually selected trees and small groups rather than large clear cuts) (Yurok Tribal Forestry 2012). A specific goal of Yurok Tribal forest management is the protection of Humboldt marten dens and large tree and brush cover habitat across the landscape (E. Mann pers. comm. 10/25/2017).

Both Green Diamond Resource Company lands and Yurok Tribe fee lands are subject to the Z'berg – Nejedly Forest Practices Act of 1973 (Pub. Resources Code, § 4511 et seq.) and the California Forest Practice Rules (chapters 4, 4.5, and 10, Title 14, CCR), which are administrated by the California Department of Forestry and Fire Protection (CAL FIRE). The California Forest Practice Rules specify that an objective of forest management is the maintenance of functional wildlife habitat in sufficient condition for continued use by the existing wildlife community within planning watersheds (§ 897(b)(1)(B), Title 14, CCR). This language may result in actions on private lands beneficial to martens. Nevertheless, specific guidelines to retain habitat for martens are not provided in the Forest Practice Rules. Further, this guidance would at best conserve habitat where Humboldt martens are known to exist, but would not be expected to result in the creation of additional habitat. Additionally, section 919.16 of the Forest Practice Rules requires landowners to provide CAL FIRE with information when late successional forest stands are proposed for harvesting if the harvest will "significantly reduce the amount and distribution of late successional forest stands or their functional wildlife value so that it constitutes a significant adverse impact on the environment". However, this rule does not specify protective or mitigation measures to offset potentially significant impacts associated with late successional forest loss.

Habitat suitable for martens may be retained within Watercourse and Lake Protection Zones (§ 916 et seq., Title 14, CCR) on private timberlands. Watercourse and Lake Protection Zones are defined areas along streams where the Forest Practice Rules limit the amount of timber harvested in order to protect in-stream habitat quality for fish and other resources. Harvest restrictions and retention standards vary according to the presence of anadromous and other fish species, as well as other aquatic life forms. These zones may encompass 15-45 m (50-150 ft.) on each side of a watercourse, 30-91 m (100-300 ft.) in total width depending on side slope, location in the state, and the watercourse's classification. Within Watercourse and Lake Protection Zones, the prescriptions vary by watercourse classification. For fish bearing streams (Class I watercourses), the retention standards vary from 50- 80 % overstory canopy (depending on distance to the watercourse) and include leaving a multi-storied stand composed of a diversity of species similar to that found before the start of timber operations. For watersheds that fall within Anadromous Salmonid Protection rules (§§ 916.9, 936.9, and 956.9, Title 14, CCR), the 13 largest trees per acre (live or dead) must also be retained within Class I Watercourse and Lake Protection Zone. For non-fish bearing streams (Class II watercourses), Watercourse and Lake Protection Zone retention standards vary from 50 % total canopy to 80% overstory canopy depending on the type and location of the watercourse.

MANAGEMENT RECOMMENDATIONS

The Department has evaluated existing management recommendations and available literature applicable to the management and conservation of the Humboldt martens to arrive at the following recommendations. The recommendations largely derive from *The Humboldt Marten Conservation Assessment and Strategy* (Slauson et al. 2017). The Department recognizes the scientific expertise and judgement of the Executive Team that developed the Strategy, and deems the information provided a reliable synthesis of current scientific literature on the species, thus constituting the best available science.

Habitat Protection, Management, and Restoration

Given the many conservation challenges identified for the Humboldt marten, achieving the goal of recovering and maintaining sustainable reproductive marten populations in California necessitates cooperation and support among government and private land managers. Achieving the overarching goal of Humboldt marten population recovery and persistence necessitates managing the landscape toward habitat conditions suitable for marten occupancy within much of their historic range. Specific management objectives can be further refined within the following Conservation Emphasis Areas (CEAs) from Slauson et al. (2017) (Figure 4).

Extant Population Areas (EPA)

EPAs are areas where five or more Humboldt marten detections have been documented since 1980 that are no more than 5 km (3.1 mi.) from the nearest neighboring detection. These clusters of detections are then buffered to include 2 km (1.24 mi.) of the surrounding landscape.

1. Design land management activities in and adjacent to EPAs to maintain conditions characterized as highly suitable marten habitat[2], and where feasible, improve habitat conditions in areas of moderate and low suitability

2. The current extent of the two California EPAs is 81,182 ha (202,162 ac.), which is 3.9% of the historic range; however, a habitat suitability model developed by Slauson et al. (in press) classifies 15,566 ha (38,464 ac.) of this extent as currently unsuitable for marten occupancy. Assess areas classified as unsuitable habitat within EPAs for their potential to be managed toward conditions characterized as high suitability marten habitat.

3. Continue surveys for the Humboldt marten where large patches of suitable habitat exist within their historical range, and as new detections are documented, EPAs should be re-assessed periodically to include new detections, following methods described in the Conservation Strategy (Slauson et al. 2017).

4. Identify high priority areas for restoration within EPAs based on their potential for connecting fragmented suitable habitat patches.

5. Evaluate whether major roads within EPAs fragment suitable habitat patches, create major barriers to marten movement, or pose a substantial collision risk to crossing martens. Consider installation of wildlife crossing structures where appropriate.

6. Protect currently suitable resting and denning structures within EPAs (i.e. large snags and downed logs) and manage forest stands to ensure continual recruitment of structures.

7. Protect current dense shrub layers within EPAs, and plan for the regeneration of shrub layers when it can benefit marten habitat suitability, particularly if required after a low intensity fire event.

Population Re-establishment Areas (PRA)

PRAs are areas within the Humboldt marten historical range which currently do not contain self-sustaining populations, and where recovery actions are required to accelerate the recolonization of self-sustaining marten populations. For a PRA to support a self-sustaining population, the amount of

[2] Briefly, areas with high precipitation levels and a high Old Growth Structural Index (many large trees and snags and high tree size diversity), or serpentine soils (see Slauson et al. in press for details).

contiguous suitable marten habitat should be greater than 1,500 ha (3,707 ac.), which corresponds to the estimated area capable of supporting five or more female home ranges. Based on these criteria, Slauson et al. (2017) identified four potential PRAs within California (Figure 4), which should be considered for immediate Humboldt marten population recovery.

8. Manage habitat with the PRAs towards a landscape condition that is suitable to sustain Humboldt martens.

9. Where major roads (e.g. highways 101, 199, and 299) separate PRAs from EPAs and may act as barriers to marten dispersal, evaluate the availability of existing structures such as bridges, large culverts, and overpasses which could be used by martens to safely cross. Where such structures are limited, work with state and federal highway agencies to plan and install state of the art wildlife crossing structures.

10. Once a PRA is determined to have a sufficient amount of suitable habitat, assess it to determine if population recolonization would require human assisted dispersal, or whether natural dispersal of animals is a reliable means for recolonizing the PRA.

Landscape Connectivity Areas (LCA)
Providing dispersal habitat that Humboldt martens may use to move safely between an EPA to restored habitat in a PRA is critical for recolonizing newly restored habitat, and within a metapopulation context, provides essential connectivity for gene flow to occur between extant marten populations. LCAs are characterized by low potential to develop suitable reproductive marten habitat but capacity to provide functional dispersal zones. Currently, only one LCA has been identified in California, and it lies in a critically important dispersal zone between the southernmost EPA and the restorable 1,430 km^2 (552 $mi.^2$) Redwood-Prairie Creek PRA extending into Humboldt County (Figure 4). Unfortunately, suitable habitat conditions for an LCA are poorly understood, and additional research is needed to better understand functional dispersal habitat requirements for the Humboldt Marten.

11. Avoid actions within the LCAs which could permanently restrict the ability of Humboldt martens to move between EPAs and PRAs.

Wildland Fire
Given that the current distribution of extant Humboldt marten populations in California is limited to two relatively small EPAs occupying < 5% of the species' historical geographic range, large catastrophic fires have the potential to severely impact up to 70% of occupied suitable habitat in California over the next 15 years (Slauson et al. 2017). Moriarty et al. (2017) found that treating as little as 10-20% of the landscape with mechanical or prescribed fire fuel reduction treatments can significantly reduce the risk of Pacific marten habitat loss.

12. Design and implement fuel management prescriptions to reduce the wildfire risk to EPAs and PRAs. Prescriptions should preserve important Humboldt marten habitat elements like dense shrub understories, abundant large snags, dead and dying trees and downed logs in occupied habitat to the greatest degree possible while achieving risk reduction goals.

13. Expand the range and increase the resiliency of Humboldt marten populations in California, including managing for multiple large EPAs connected by LCAs to reduce the risk of a substantial loss of the current extant marten population due to a single catastrophic fire.

Research, Surveys, and Monitoring

14. Research is needed to determine whether the Humboldt marten's small population size has resulted in a loss of genetic diversity, and whether the subspecies is at risk of population declines due to reduced fitness affecting their ability to evolve and adapt to environment changes due to climate change and other causes.

15. Determine the extent to which Humboldt marten populations in California and Oregon interbreed and quantify the genetic contribution to California populations from animals dispersing from Oregon.

16. Conduct surveys to determine if Humboldt martens occur in shore pine habitat in California, as found in Oregon.

17. Develop and implement consistent survey and monitoring strategies that reliably produce metrics on population size, distribution, and trends.

18. Develop a better understanding of specific silvicultural practices that result in high suitability habitat for the Humboldt marten and its prey species.

19. Study and develop siliviculture techniques in early seral stands which discourage occupancy by marten predators while recently harvested or burned stands are regenerating.

20. Study the lethal and sub lethal effects of rodenticides and other toxicants on Humboldt martens, model potential population effects, and work to reduce sources of exposure.

21. Identify the impact diseases have on Humboldt marten fitness and mortality, and work to reduce sources for exposure.

22. Continue to collect demographic parameters of extant marten populations, and identify key parameters affecting population growth and persistence.

23. Study habitat relationships of the primary marten predators (i.e. bobcats), and identify management options that reduce predator abundance and distribution within marten habitat (e.g. restorative thinning to stimulate shrub growth and road removal).

SUMMARY OF LISTING FACTORS

CESA directs the Department to prepare this report regarding the status of the Humboldt marten based upon the best scientific information available to the Department. CESA's implementing regulations identify key factors that are relevant to the Department's analyses. Specifically, a "species shall be listed as endangered or threatened ... if the Commission determines that its continued existence is in serious danger or is threatened by any one or any combination of the following factors: (1) present or threatened modification or destruction of its habitat; (2) overexploitation; (3) predation; (4) competition; (5) disease; or (6) other natural occurrences or human-related activities." (§ 670.1(i)(1)(A), Title 14, CCR.). The definitions of endangered and threatened species in the Fish and Game Code provide key guidance to the Department's scientific determination. An endangered species under CESA is one "which is in serious danger of becoming extinct throughout all, or a significant portion, of its range due to one or more causes, including loss of habitat, change in habitat, over exploitation, predation, competition, or disease." (Fish & Game Code, § 2062.) A threatened species under CESA is one "that, although not presently threatened with extinction, is likely to become an endangered species in the foreseeable future in the absence of special protection and management efforts required by [CESA]." (*Id.*, § 2067). The following summarizes the Department's determination regarding the factors to be considered by the Commission in making its decision on whether to list the Humboldt marten. This summary is based on the best available scientific information, as presented in the foregoing sections of the report.

Present or Threatened Modification or Destruction of Habitat

The geographic range of the Humboldt marten has retracted to less than five percent of the extent documented by naturalists in the early 20th Century. Although historical trapping pressure is implicated in the initial decline of the species in the state, today the species population is limited by the amount, distribution, and quality of its remaining preferred habitat. Historical and ongoing management for timber production threatens the species by removing, degrading, and fragmenting the dense shrub layers and large tree structures the species is dependent upon for cover, denning, and foraging. Some portions of the remaining occupied habitat are protected by wilderness and other land use designations, but large areas remain vulnerable to continued timber harvesting and other uses which can fail to retain required habitat elements on the landscape. Until additional areas of suitable forest habitat are allowed to develop with careful management and the passage of time, the limited extent of suitable habitat will continue to prevent recovery of the California Humboldt marten population.

Overexploitation

Intensive trapping pressure during the late 19th and first half of the 20th centuries appears to have significantly reduced the Humboldt marten population and the species' distribution in the state. However, due to changes in trapping laws and practices, overexploitation no longer threatens the species in California.

Predation

Predation is a significant cause of Humboldt marten mortality in California populations. While predation is natural in wildlife communities, predation rates by larger predators may be elevated in landscapes managed for timber production. It is uncertain how predation rates relate to reproductive rates of Humboldt marten on managed landscapes. Whether predation by larger predators may constitute a primary threat to Humboldt marten populations on managed landscapes is a hypothesis that warrants examination with further research.

Competition

There is no indication in the available information to indicate that competition poses a substantial threat to Humboldt marten populations in California.

Disease

Although there is little available information on disease rates and associated mortality in Humboldt marten populations, the presence of highly virulent diseases has been documented in the occupied range. Because Humboldt marten populations are small and isolated, a virulent disease outbreak in one or more core population area could seriously threaten the statewide population. However, the probability of such an outbreak is difficult to predict.

Other Natural Events or Human-Related Activities

Small Populations

In California the Humboldt marten population is believed to be less than 100 individuals distributed in two core population areas. Populations of this size are vulnerable to inherent genetic and environmental threats including, inbreeding depression, demographic stochasticity, environmental stochasticity, and loss of genetic diversity. These effects can result in decreased reproductive output, inability to adapt to changing environmental conditions, concentration of maladaptive genetic traits, and other deleterious effects. Small, isolated populations are also at inherently at greater risk of extinction due to environmental events such as wildfires and disease outbreaks. Small population effects can interact with other threats (such as disease, toxicants, climate change, and others) synergistically to amplify the negative impacts on the Humboldt marten population. While these small population effects almost certainly impact the California Humboldt marten population, research would be required to quantify the degree to which these effects threaten the persistence of the population.

Wildland Fires

Because the California Humboldt marten population is small, and isolated to a small geographic range, a single catastrophic wildfire has the potential to significantly impact the population size and range. Fires can destroy the dense shrub understories and large tree structures martens depend on for cover, denning, and foraging. Additionally, fires have the potential to further fragment the remaining habitat. Although it is impossible to predict the timing and location of wildfires, it is likely that fires will impact Humboldt marten habitat in northwestern California in the foreseeable future. The degree to which wildland fires threaten the persistence of the California Humboldt marten population is unknown.

Climate Change

Past and ongoing changes to the north coast climate such as rising temperatures, declining precipitation, and decreased daily fog will likely result in long term changes to the vegetative community in the region. How these changes will impact the preferred habitat of Humboldt martens is difficult to predict, but some modeling studies indicate that the geographic extent of suitable marten habitat is likely to retract northward in California. While there is a high degree of confidence in projected warming trends, and less certainty in projected precipitation changes, the degree to which these changes will threaten Humboldt martens in the foreseeable future is unknown.

Toxicants

Although there is little available information on Humboldt marten exposure to toxicants, the presence of highly toxic anticoagulant rodenticides and other pesticides is well documented within the California range. These compounds are known to frequently kill closely related fishers in northwestern California; however, the degree to which toxicant exposure threatens the Humboldt marten population is unknown.

LISTING RECOMMENDATION

CESA directs the Department to prepare this report regarding the status of the Humboldt marten in California based upon the best scientific information. CESA also directs the Department, based on its analysis, to indicate in the status report whether the petitioned action is warranted. (Fish & Game Code,

§ 2074.6; § 670.1(f), Title 14, CCR). In addition to evaluating whether the petitioned action (i.e., listing as endangered) was warranted, the Department considered whether listing as threatened under CESA was warranted. The Department includes and makes its recommendation in its status report as submitted to the Commission in an advisory capacity based on the best available science. In consideration of the scientific information contained herein, the Department has determined that historic and ongoing habitat loss, fragmentation and associated elevated predation rates, coupled with unquantified, but potentially significant ongoing impacts to the species from a small population size, disease, toxicants, wildfire, and climate change, warrants listing the Humboldt marten as threatened under CESA.

Protection Afforded by Listing

It is the policy of the State to conserve, protect, restore and enhance any endangered or threatened species and its habitat (Fish & Game Code § 2052). The conservation, protection, and enhancement of listed species and their habitat is of statewide concern (Fish & Game Code § 2051(c)). CESA prohibits the import, export, take, possession, purchase or sale of any species the Commission determines is endangered or threatened (Fish & Game Code, § 2080 et seq.). CESA defines "take" as hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill (Fish & Game Code, § 86). The Fish and Game Code authorizes the Department to allow "take" of species listed as threatened or endangered under certain circumstances through incidental take permits, memoranda of understanding, natural community conservation plans, safe harbor agreements, or other plans or agreements approved by or entered into by the Department (Fish & Game Code, §§ 2081, 2081.1, 2086, 2087, 2089.2, and 2835).

If the Humboldt marten is listed under CESA, impacts of take caused by activities authorized through incidental take permits must be minimized and fully mitigated according to state standards. These standards typically include protection of the land in perpetuity with an easement, development and implementation of a species-specific adaptive management plan, and funding through an endowment to pay for long-term monitoring and maintenance to ensure the mitigation land meets performance criteria. Additionally, the Department is prohibited from approving incidental take permits which could jeopardize the continued existence of the species in the state (Fish & Game Code, § 2081(b)(4)). Obtaining an incidental take permit is voluntary. The Department cannot force compliance; however, any person violating the take prohibition may be punishable under state law.

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

Although the protections afforded listed species by CESA do not apply to the actions of federal management agencies on federal lands, CESA listing may prompt increased interagency coordination and the likelihood that state and federal land and resource management agencies will allocate funds toward protection and recovery actions. In the case of the Humboldt marten, the Humboldt Marten

Working Group signatory agencies already meet and coordinate regularly, but a state listing could result in increased availability of conservation funds.

Economic Considerations

The Department is not required to prepare an analysis of economic impacts (Fish & Game Code, § 2074.6).

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Derek J. Broman, Furbearer Coordinator, Oregon Department of Fish and Wildlife. March 17, 2017

Keith Hamm, Wildlife Biologist, Green Diamond Resource Company. October 24, 2017.

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Keith M. Slauson, Research Ecologist, USDA Forest Service Redwood Sciences Lab. November 10, 2017.

Keith M. Slauson, Research Ecologist, USDA Forest Service Redwood Sciences Lab. E-mail exchange with Scott Osborn and Daniel Applebee, CDFW. November 17, 2017.

LIST OF FIGURES

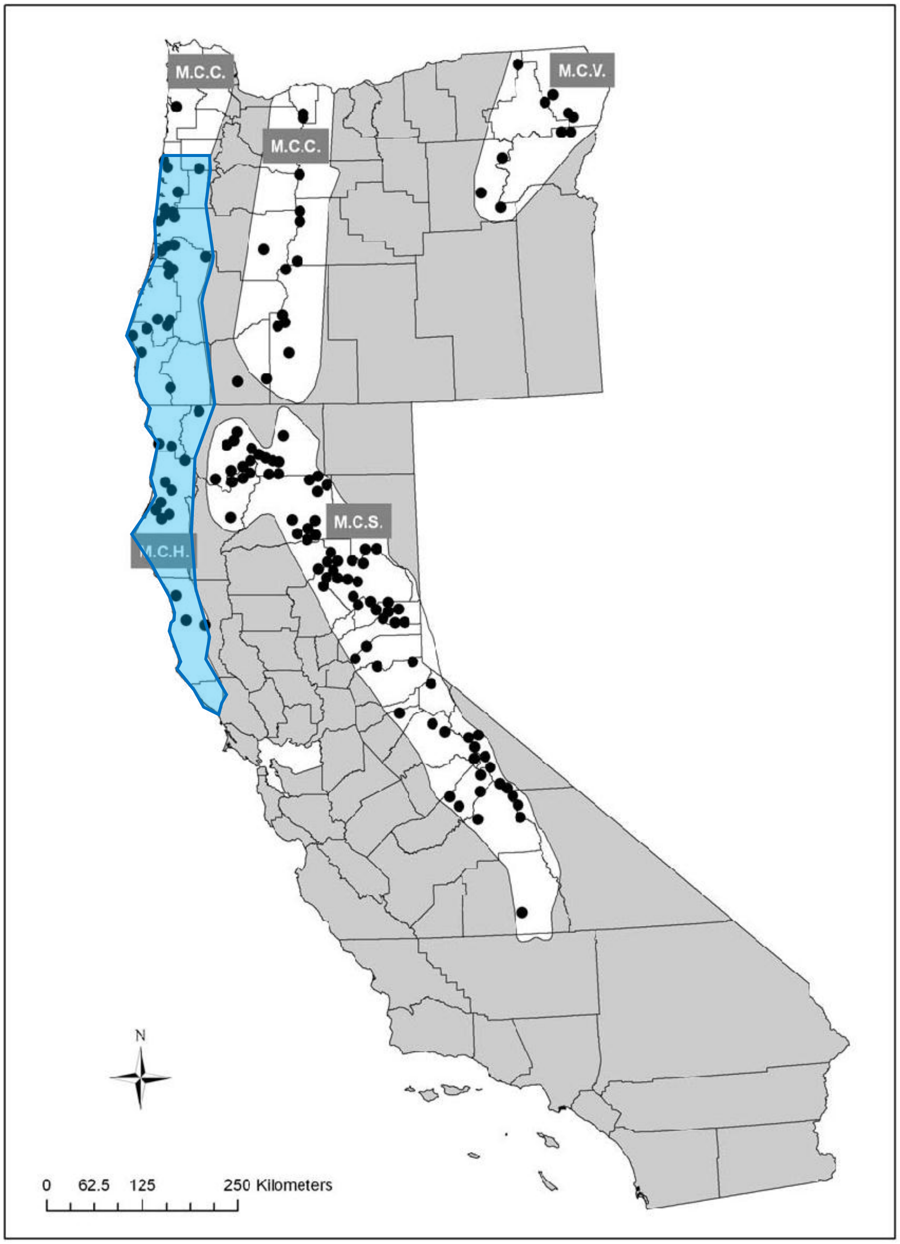
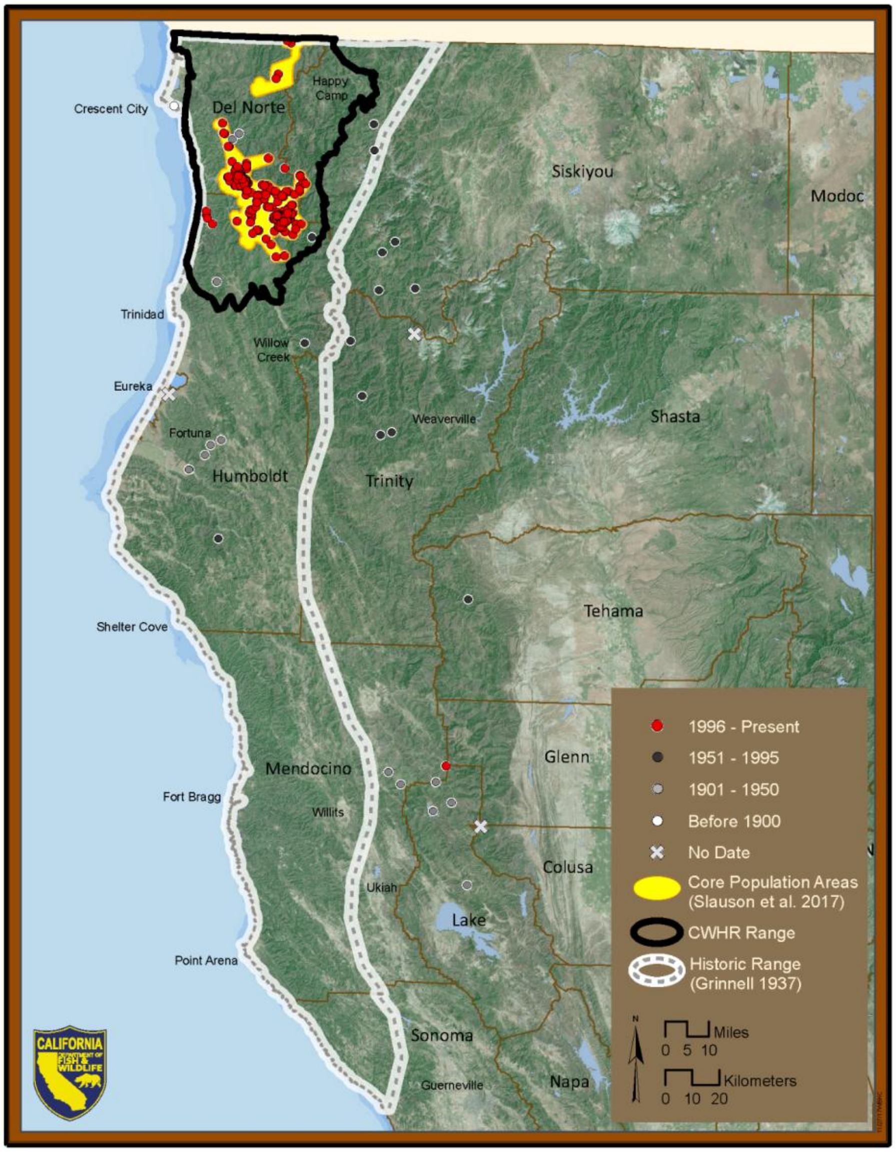


Figure 1.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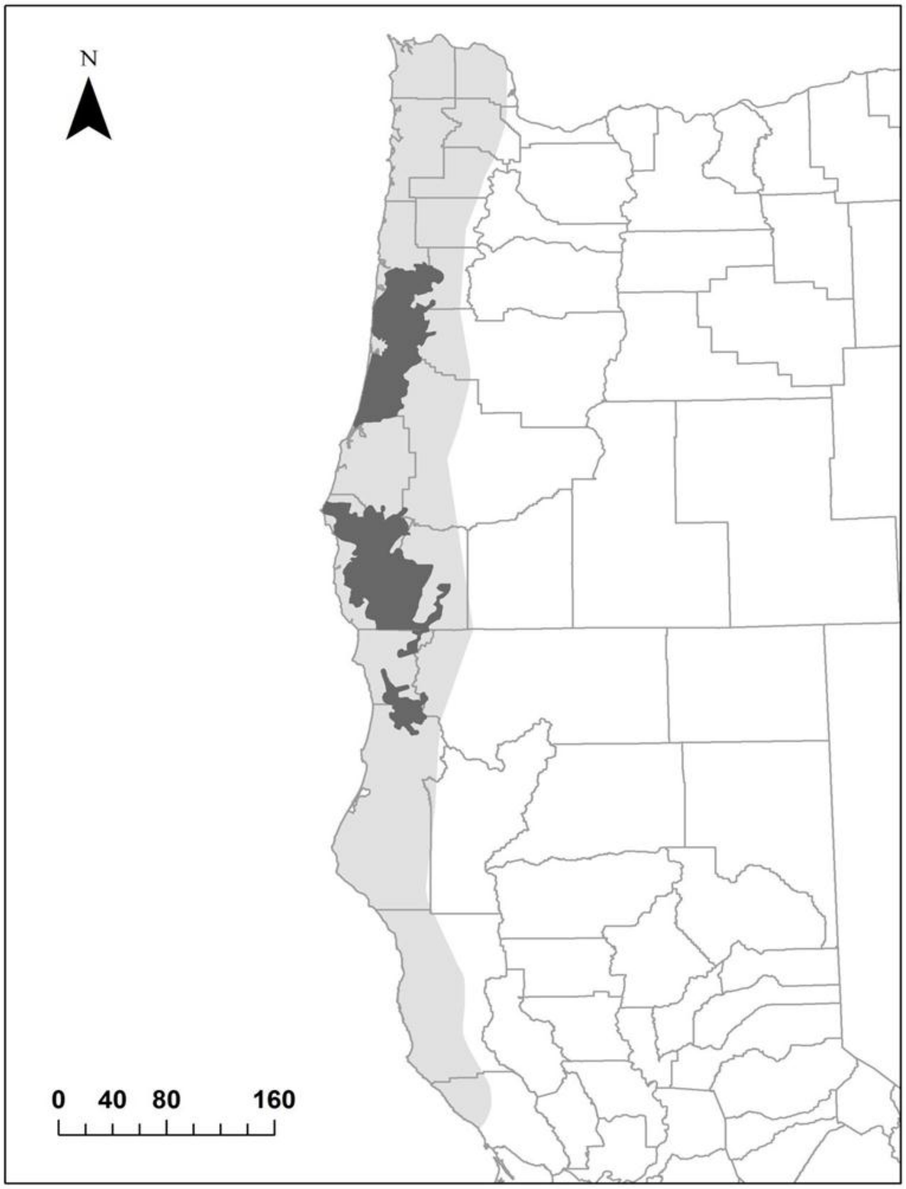
Del Norte
Happy Camp
Siskiyou
Modoc
Trinidad
Willow Creek
Eureka
Fortuna
Humboldt
Weaverville
Trinity
Shasta
Tehama
Shelter Cove
Mendocino
Fort Bragg
Willits
Glenn
Colusa
Ukiah
Lake
Point Arena
Sonoma
Guerneville
Napa
1996 - Present
1951 - 1995
1901 - 1950
Before 1900
No Date
Core Population Areas (Slauson et al. 2017)
CWHR Range
Historic Range (Grinnell 1937)
Miles
0 5 10
Kilometers
0 10 20

Figure 2.



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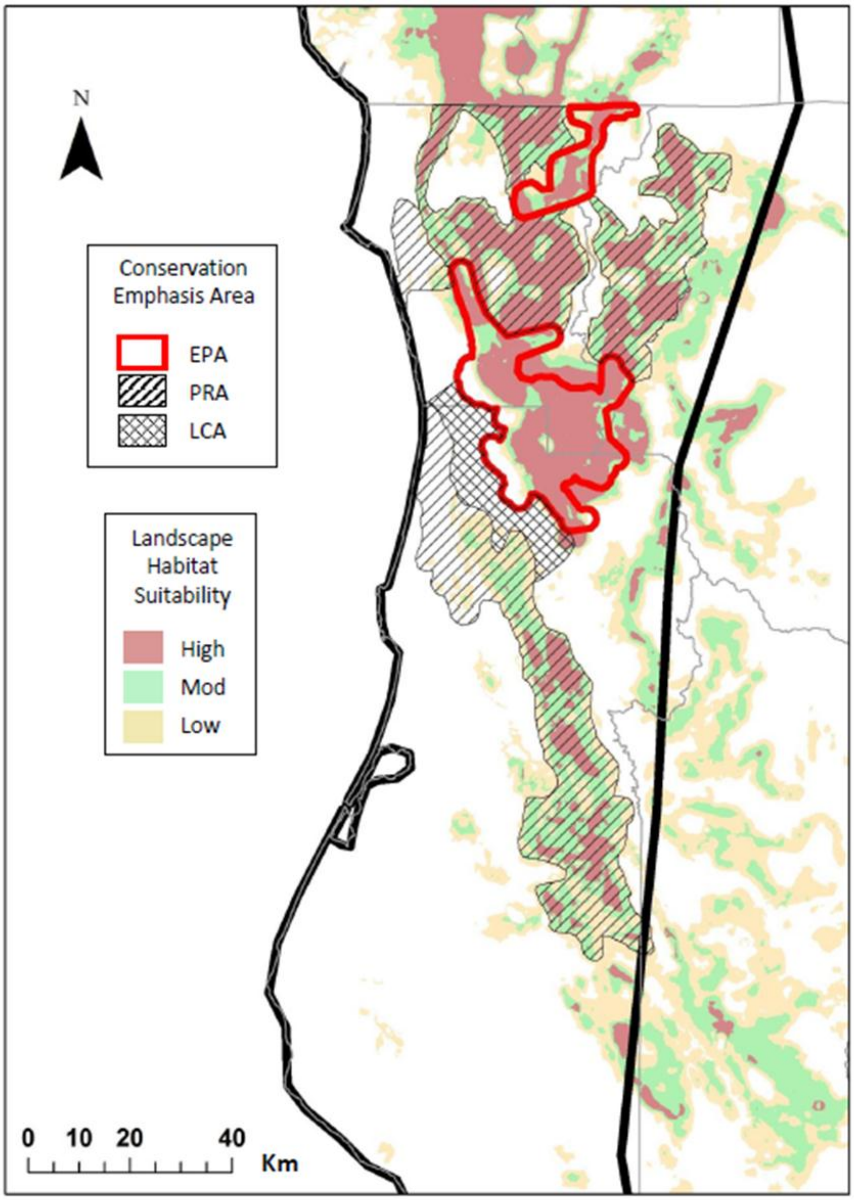
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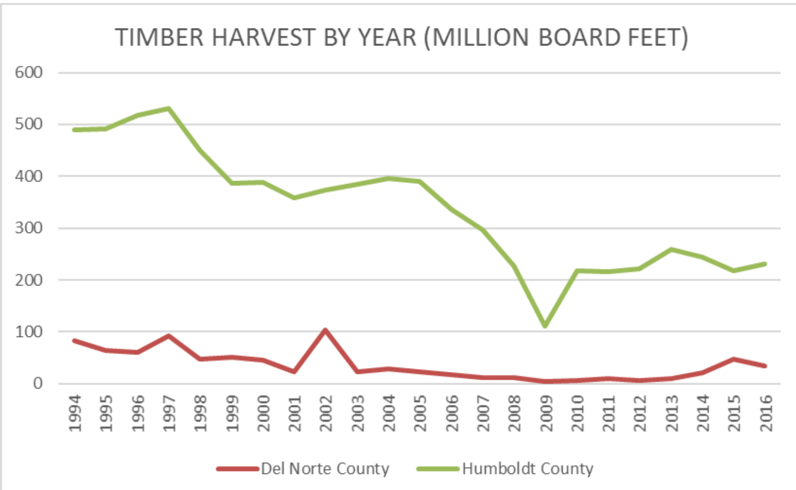
Conservation Emphasis Area
EPA
PRA
LCA
Landscape Habitat Suitability
High
Mod
Low
0 10 20 40
Km

Figure 4.



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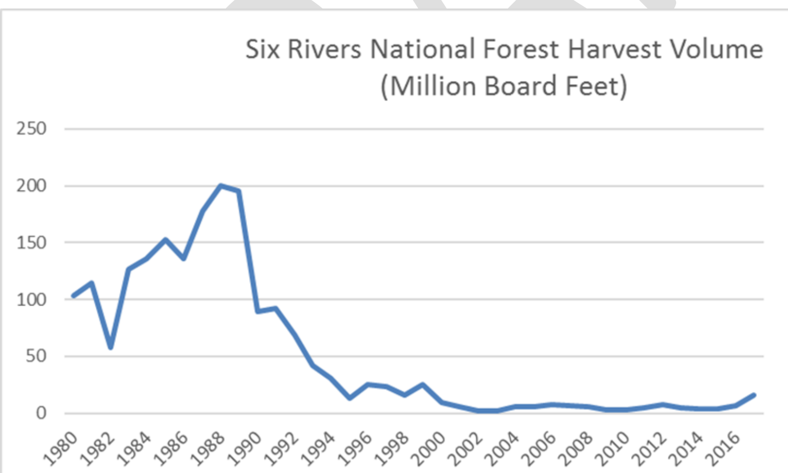

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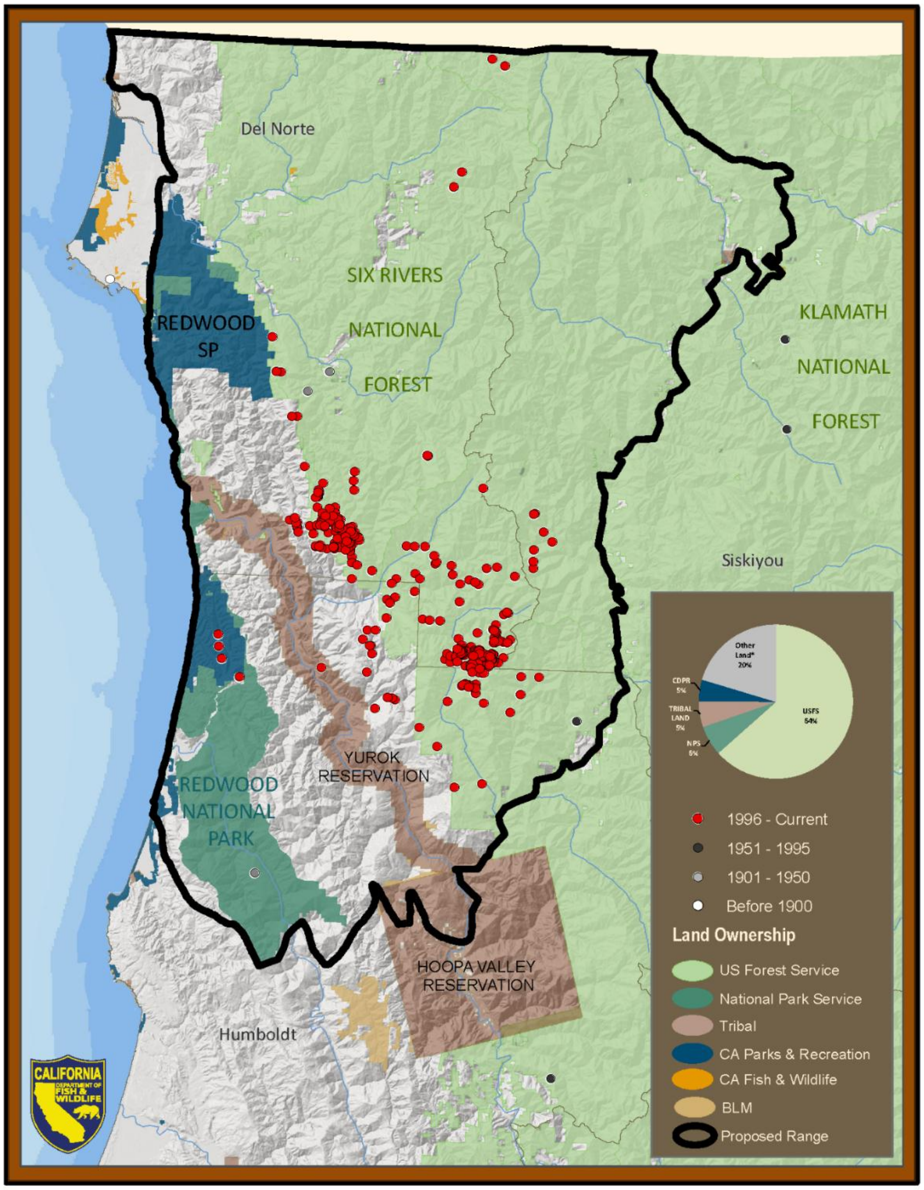
Del Norte
SIX RIVERS
NATIONAL
FOREST
REDWOOD
SP
KLAMATH
NATIONAL
FOREST
Siskiyou
YUROK
RESERVATION
REDWOOD
NATIONAL
PARK
HOOPA VALLEY
RESERVATION
Humboldt
Other
Land*
20%
CDPR
5%
TRIBAL
LAND
5%
NPS
6%
USFS
64%
1996 - Current
1951 - 1995
1901 - 1950
Before 1900
Land Ownership
US Forest Service
National Park Service
Tribal
CA Parks & Recreation
CA Fish & Wildlife
BLM
Proposed Range
CALIFORNIA
DEPARTMENT OF
FISH & WILDLIFE

Figure 7.