California Fish and Game Commission

NOTICE OF FINDINGS
Humboldt Marten
(*Martes caurina humboldtensis*)

NOTICE IS HEREBY GIVEN that the California Fish and Game Commission (Commission), at a meeting in Fortuna, California on August 23, 2018, found pursuant to Fish and Game Code Section 2075.5, that the information contained in the petition to list Humboldt marten (*Martes caurina humboldtensis*) and other information in the record before the Commission, warrants adding the Humboldt marten to the list of endangered species under the California Endangered Species Act (CESA) (Fish & G. Code, § 2050 et seq.). (see also Cal. Code Regs., tit. 14, § 670.1, subsec. (i).).

NOTICE IS ALSO GIVEN that, at its December 13, 2018 meeting in Oceanside, California, the Commission adopted the following findings outlining the reasons for its determination.

I. Background and Procedural History

Petition History

The Environmental Protection Information Center and the Center for Biological Diversity, as joint petitioners, submitted a "Petition to List Humboldt Marten (*Martes caurina humboldtensis*) as an Endangered Species under the California Endangered Species Act" (Petition) to the Commission on June 8, 2015. 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).

On November 11, 2015, the Department transmitted to the Commission 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" (petition evaluation). The Commission formally received the Department's petition evaluation at a meeting on December 10, 2015 in San Diego, California (Fish & G. Code, §§ 2073.5 & 2074.2; Cal. Code Regs., tit. 14, § 670.1, subsec. (d) & (e)). At its 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 determined that sufficient information existed to indicate the petitioned action may be warranted and accepted the petition for consideration. Upon publication of the Commission's notice of its findings, the 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 as a candidate species triggered the Department's process for conducting a status review to inform the Commission's decision on whether to list the species. At its scheduled public meeting on February 8, 2017, in Rohnert Park, California, the Commission granted the Department a six-month extension to complete the status review and facilitate external peer review. The Department transmitted to the

Commission the Department's report to the Commission titled "A Status Review of Humboldt Marten *(Martes caurina humboldtensis*) in California" (Status Review) on June 20, 2018. And on June 21, 2018, the Commission formally received the Department's Status Review. On August 23, 2018, in Fortuna, California, the Commission found that the information contained in the petition to list the Humboldt marten and the other information in the record before the Commission warrants listing the Humboldt marten as an endangered species under the California Endangered Species Act.

Species Description

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 kilograms (0.88-2.76 pounds). 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 kilometers (9.3 miles). Available information suggests that home ranges of Humboldt martens fall within the Sierra marten home range sizes in California of 70 – 733 hectares (173 – 1,811 acres).

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 (*Lynx rufus*), coyotes (*Canis latrans*), foxes (*Vulpes vulpes*), fishers (*Pekania pennanti*), and great-horned owls (*Bubo virginianus*), 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 (*Pseudotsuga menziesii*), 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 denning, resting, escape cover, and shelter structures. 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.

II. Statutory and Legal Framework

The Commission, as established by the California Constitution, has exclusive statutory authority under California law to designate endangered, threatened, and candidate species under CESA. (Cal. Const., art. IV, § 20, subd. (b); Fish & G. Code, § 2070.) The CESA listing process for the Humboldt marten began in the present case with the Petitioners' submittal of the petition to the Commission on June 8, 2015. The regulatory and legal process that ensued is described in some detail in the preceding section above, along with related references to the Fish and Game Code and controlling regulation. The CESA listing process generally is also described in some detail in published appellate case law in California, including:

- *Mountain Lion Foundation v. California Fish and Game Commission* (1997) 16 Cal.4th 105, 114-116;
- *California Forestry Association v. California Fish and Game Commission* (2007) 156 Cal.App.4th 1535, 1541-1542;
- *Center for Biological Diversity v. California Fish and Game Commission* (2008) 166 Cal.App.4th 597, 600;
- *Natural Resources Defense Council v. California Fish and Game Commission* (1994) 28 Cal.App.4th 1104, 1111-1116;
- *Central Coast Forest Association v. California Fish and Game Commission* (2017), 2 Cal. 5th 594, 597-598; and
- *Central Coast Forest Association v. California Fish and Game Commission* (2018) 18 Cal. App. 5th 1191, 1196-1197.

The "is warranted" determination at issue here for Humboldt marten stems from Commission obligations established by Fish and Game Code Section 2075.5. Under this provision, the Commission is required to make one of two findings for a candidate species at the end of the CESA listing process; namely, whether listing a species is warranted or is not warranted. Here, with respect to the Humboldt marten, the Commission made the finding under Section 2075.5(e)(2) that listing the species as endangered is warranted.

The Commission was guided in making these determinations by statutory provisions and other controlling law. The Fish and Game Code, for example, defines an endangered species under CESA as "a native species or subspecies of a bird, mammal, fish, amphibian, reptile or plant 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 & G. Code, § 2062.) Similarly, the Fish and Game Code defines a threatened species under CESA as "a native species or subspecies of a bird, mammal, fish, amphibian, reptile or plant 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 this chapter." (*Id*., § 2067.)

The Commission also considered Title 14, Section 670.1, subsection. (i)(1)(A), of the California Code of Regulations in making its determination regarding Humboldt marten. This provision provides, in pertinent part, that a species shall be listed as endangered or threatened under CESA if the Commission determines that the species' continued existence is in serious danger or is threatened by any one or any combination of six 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.

Fish and Game Code Section 2070 provides similar guidance. This section provides that the Commission shall add or remove species from the list of endangered and threatened species under CESA only upon receipt of sufficient scientific information that the action is warranted. Similarly, CESA provides policy direction not specific to the Commission per se, indicating that all state agencies, boards, and commissions shall seek to conserve endangered and threatened species and shall utilize their authority in furtherance of the purposes of CESA. (Fish & G. Code, § 2055.) This policy direction does not compel a particular determination by the Commission in the CESA listing context. Nevertheless, "'[l]aws providing for the conservation of natural resources' such as the CESA 'are of great remedial and public importance and thus should be construed liberally." (*California Forestry Association v. California Fish and Game Commission*, supra, 156 Cal. App.4th at pp. 1545-1546, citing *San Bernardino Valley Audubon Society v. City of Moreno Valley* (1996) 44 Cal.App.4th 593, 601; Fish & G. Code, §§ 2051, 2052.)

Finally, in considering these factors, CESA and controlling regulations require the Commission to actively seek and consider related input from the public and any interested party. (See, e.g., Id., §§ 2071, 2074.4, 2078; Cal. Code Regs., tit. 14, § 670.1, subsec. (h).) The related notice obligations and public hearing opportunities before the Commission are also considerable. (Fish & G. Code, §§ 2073.3, 2074, 2074.2, 2075, 2075.5, 2078; Cal. Code Regs., tit. 14, § 670.1, subsec. (c), (e), (g), (i); see also Gov. Code, § 11120 et seq.) All of these obligations are in addition to the requirements prescribed for the Department in the CESA listing process, including an initial evaluation of the petition and a related recommendation regarding candidacy, and a review of the candidate species' status culminating with a report and recommendation to the Commission as to whether listing is warranted based on the best available science. (Fish & G. Code, §§ 2073.4, 2073.5, 2074.4, 2074.6; Cal. Code Regs., tit. 14, § 670.1, subsec. (d), (f), (h).)

III. Factual and Scientific Bases for the Commission's Final Determination

The factual and scientific bases for the Commission's determination that designating the Humboldt marten as an endangered species under CESA is warranted are set forth in detail in the Commission's record of proceedings including the Petition, the Department's Petition Evaluation Report, the Department's status review, written and oral comments received from members of the public, the regulated community, tribal entities, the scientific community and other evidence included in the Commission's record of proceedings.

The Commission determines that the continued existence of the Humboldt marten in the State of California is in serious danger or threatened by one or a combination of six factors as required by the California Code of Regulations Title 14, Section 670.1, subsection (i)(1)(A):

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 Commission also determines that the information in the Commission's record constitutes the best scientific information available and establishes that designating the Humboldt marten as an endangered species under CESA is warranted. Similarly, the Commission determines that the Humboldt marten, 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.

The items highlighted here and detailed in the following section represent only a portion of the complex issues aired and considered by the Commission during the CESA listing process for the Humboldt marten. Similarly, the issues addressed in these findings represent some, but not all of the evidence, issues, and considerations affecting the Commission's final determination. Other issues aired before and considered by the Commission are addressed in detail in the record before the Commission, which record is incorporated herein by reference.

Background

The Commission bases its "is warranted" finding for the Humboldt marten most fundamentally on the fact that 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 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.

Threats

Present or Threatened Modification or Destruction of Habitat

Modification to the structure and landscape configuration of Humboldt marten habitat can negatively impact survival, reproduction, and population connectivity of the species (CDFW Status Review 2018). 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 (CDFW Status Review 2018). 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 (CDFW Status Review 2018). It is estimated that the area of old growth conifer forest in the Pacific Northwest has been reduced by 72 percent since European settlement (Strittholt et al. 2006), and only 10 percent 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 percent of remaining old forest on federal lands in the Northwest Forest Plan area is fully protected from harvest, and 80 percent 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 (CDFW Status Review 2018). Harvest on federal lands declined sharply following implementation of the Northwest Forest Plan in 1994 (Strittholt et al. 2006). The area of older forests (OGSI-200) on federal lands in the coastal and Klamath mountains of northwestern California declined 8.4 percent from 1993-2012, largely due to wildfires, while the area of older forests on non-federal lands increased 1.3 percent, 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 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 percent loss of old forest habitat over the period of 1993-2012 despite gains from forest succession; this loss was primarily attributed to wildfires (Davis et al. 2015). 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 hectares (566,829 acres) and the 2017 Chetco Bar Fire burned an additional contiguous 77,346 hectares (191,125 acres) between the southern Oregon Humboldt marten population and the California – Oregon border population, perhaps functionally isolating the two populations from one another (CDFW Status Review 2018).

Vegetation management activities designed to reduce the risk of wildland fire by removing shrubs, reducing canopy cover, and removing snags and logs impact 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).

Thinning and fuel reduction management can fragment and degrade Humboldt marten habitat; however, severe wildfires can also substantially fragment and degrade marten habitat (CDFW Status Review 2018). Implementing fuel reduction treatments (mechanical or prescribed fire) on as little as 10-20 percent of the landscape significantly reduced the probability of Pacific marten habitat loss from wildfires (Moriarty et al. 2017). Modelling has shown that prescribed fire and mechanical thinning fuel reduction treatments in and surrounding marten habitat would limit the spread of large wildfires; treating only the landscape outside of predicted marten habitat was shown to be equally as effective as conducting fuel reduction treatments in marten habitat, so long as at least 30 percent of the landscape is available for treatment (Credo 2017). 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 (CDFW Status Review 2018). 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 hectares [40 acres])(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 result in the loss of mature forest habitat favored by martens, but human occupancy likely renders such areas unsuitable for martens (CDFW Status Review 2018). 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 (CDFW Status Review 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 (CDFW Status Review 2018). The impact these new laws will have on the conversion of forests for the production of cannabis is uncertain (CDFW Status Review 2018). A recent study found the majority of cannabis cultivation sites in Humboldt County were located >500 meters (1,640 feet) 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 percent 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.

Large Tree Structures and Tree and Shrub Canopy Cover

Both large tree structures and tree and shrub canopy cover are requisite Humboldt marten habitat features (CDFW Status Review 2018). These requisite features are likely particularly at risk from habitat loss and degradation resulting from the above activities (CDFW Status Review 2018).

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 (CDFW Status Review 2018). 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).

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 Practice 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 hectares (40 acres). In practice, openings in Green Diamond Resources Company even-aged harvest units average approximately 6 hectares (15 acres) (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 (CDFW Status Review 2018).

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 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 (CDFW Status Review 2018).

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 percent of thinned stands were observed with a fruiting or flowering shrub component, compared to fruiting or flowering in 100 percent 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 threatens Humboldt marten individuals and populations (CDFW Status Review 2018). Male and female Pacific martens in the Sierra Nevada avoided crossing open ski runs between forest patches wider than 18 meters (60 feet) and 13 meters (43 feet) 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 energy 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 (CDFW Status Review 2018). 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 hectares (5,000 acres) in area, with most patches less than 40 hectares (100 acres) 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. 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 (CDFW Status Review 2018). American marten dispersal distances were found to decrease by approximately 50 percent in intensively logged forests in Ontario compared to unlogged forests, and the percent of juveniles successfully dispersing and establishing new territories declined from 49 percent in unlogged forests to 25 percent in logged forests (Johnson et al. 2009). Thompson (1994) found daily survival rates in recently harvested (3- to 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 percent of camera detections of generalist carnivores such as gray fox and bobcats were on roads, while 80 percent 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 to 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 (CDFW Status Review 2018). 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 (CDFW Status Review 2018).

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 (CDFW Status Review 2018). 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 (CDFW Status Review 2018). Therefore, the continued existence of the Humboldt marten in California is threatened by present or threatened modification or destruction of its habitat.

Overexploitation

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 (CDFW Status Review 2018). 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 less 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.* Fish & G. Code § 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 records from 2007 to 2016 indicates that as many as nine Humboldt martens may have been trapped in Oregon (CDFW Status Review 2018). Linnell et al. (2017) 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 (CDFW Status Review 2018). 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 (CDFW Status Review 2018). Despite the past impact that trapping had on the species, due to changes in trapping laws and practices, overexploitation no longer threatens the species in California (CDFW Status Review 2018).

Predation

Predation is a major cause of Humboldt marten mortality in California populations (CDFW Status Review 2018). 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 kilometers (3.1 miles) 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 percent of the known marten stations (CDFW Status Review 2018). Bobcats, black bears, and domestic dogs were detected near 26 percent, 23 percent, and 11 percent of the known marten stations, respectively (CDFW Status Review 2018). Detections of coyotes, domestic cats, and mountain lion were less frequent, ranging from two to four percent (CDFW Status Review 2018).

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 percent), raptors (22 percent), coyotes (11 percent), and other martens[1] (22 percent). The martens killed by predators accounted for 51 percent 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 percent, mostly from coyotes and bobcats). In a Humboldt marten dispersal study in California (Slauson et al. 2014), nine martens (39 percent 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. An inverse relationship between bobcat occupancy and marten occupancy almost certainly exists as well as a direct relationship between bobcat occupancy and marten predation rates (CDFW Status Review 2018).

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 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 2007). 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 2007).

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

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[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.

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 hectares (124-247 acres) (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). Humboldt martens in northwestern California showed the strongest preference for stands with ≥80 percent shrub cover, and avoided stands with <60 percent shrub cover, while fishers and foxes avoided stands with ≥80 percent shrub cover and used stands with <60 percent 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 kilometers squared (154 miles squared) northeastern Oregon Pacific marten study area included a relatively small area (53 kilometers squared) (20 miles squared) of uncut forest surrounded by an area “extensively harvested for timber (approximately 80 percent) and fragmented by partial cuts, regeneration cuts, and roads.” More than 90 percent 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). 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 percent of camera detections of generalist carnivores such as fisher, gray fox, and bobcats were on roads while 80 percent 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, 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.

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 (CDFW Status Review 2018). 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 (CDFW Status Review 2018). 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 (CDFW Status Review 2018). Therefore, the continued existence of the Humboldt marten in the State of California is in serious danger or threatened by predation.

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 kilometers (3.1 miles) of historical marten detections (reported as percent of camera trap sample units with detections): spotted skunk (*Spilogale gracilis*) at 41 percent of stations, opossum (*Didelphis viriginiana*) at 25 percent of stations, and short-tailed weasel at 8 percent 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 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 (Wiens et al. 2014).

There is significant overlap in the prey species of Humboldt martens and barred owls (*Strix varia*); including Douglas' squirrels, flying squirrels, voles, deer mice, and songbirds (Wiens et al. 2014). The dietary overlap and shared habitat affinities suggest the two species may be resource competitors (Holm et al. 2016). 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). If barred owl populations continue to increase in northern California, prey species used by Humboldt martens 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).

Disease

In its 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 data) 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 percent) had antibodies to parvovirus, and 14 (74 percent) 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 (CDFW Status Review 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 (CDFW Status Review 2018). 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 (CDFW Status Review 2018).

Other Natural Events or Human-Related Activities

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, far below the population size experts believe to be required to ensure long-term viability of a species (CDFW Status Review 2018; 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 (CDFW Status Review 2018).

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 percent 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 become 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 (CDFW Status Review 2018). 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 (CDFW Status Review 2018).

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 (CDFW Status Review 2018). A well-planned conservation strategy can substantially mitigate risks associated with small populations (CDFW Status Review 2018). 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 (CDFW Status Review 2018).

Wildland Fires

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 (CDFW Status Review 2018). 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 percent to 70 percent 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 percent 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 2,800 hectares (7,000 acres) 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 meters (60 feet) (Slauson 2017). The 2002 Biscuit Complex Fire and the 2017 Chetco Bar burned a combined 306,733 hectares (757,954 acres), with some overlap, in the area between the southern Oregon Humboldt marten population and the California-Oregon border population, likely preventing the exchange of individuals and genes between the two populations (CDFW Status Review 2018).

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). 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 (CDFW Status Review 2018). Therefore, habitat loss from wildland fire is a threat to the 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 celsius (1.2 fahrenheit) warmer over the past 30 years compared to the period 1895-2016, and is projected to further increase to 1.4 celsius (2.5 fahrenheit) 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 – 4.1 celsius (2.8 – 7.3 fahrenheit) warmer based on low emissions scenarios, to 3.2 – 6.6 celsius (5.8 – 11.9 fahrenheit) warmer under high emissions scenarios (Vose et al. 2017).

In northwestern California annual precipitation levels have been 10-15 percent 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 celsius ± 0.7 celsius (4.9 fahrenheit ±1.3 fahrenheit) (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 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 percent loss of suitable locations), but 77 percent 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.

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 (CDFW Status Review 2018). 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 (CDFW Status Review 2018). 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 is a threat to the long-term persistence of the Humboldt marten population in California.

Toxicants

The control of animals perceived as pests through poisoning was historically common in the western states (CDFW Status Review 2018). 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 percent of northern spotted owls (n=10) and 40 percent 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 percent 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.

The documented continued use of highly toxic anticoagulant rodenticides and other pesticides within the California range coupled with the known impacts to the fisher demonstrates that toxicant exposure threatens the Humboldt marten in California.

IV. Final Determination by the Commission

The Commission has weighed and evaluated the information for and against designating the Humboldt marten as an endangered species under CESA. This information includes scientific and other general evidence in the Petition; the Department's Petition Evaluation Report; the Department's status review; the Department's related recommendations; written and oral comments received from members of the public, the regulated community, various public agencies, and the scientific community; and other evidence included in the Commission's record of proceedings.

Based upon the evidence in the record the Commission has determined that the best scientific information available indicates that the continued existence of the Humboldt marten is in serious danger or threatened by present or threatened modifications or destruction of the species' habitat, predation, competition, disease, or other natural occurrences or human-related activities, where such factors are considered individually or in combination. (See generally Cal. Code Regs., tit. 14, § 670.1, subsec. (i)(1)(A); Fish & G. Code, §§ 2062, 2067.) The Commission determines that there is sufficient scientific information to indicate that designating the Humboldt marten as an endangered species under CESA is warranted at this time and that with adoption and publication of these findings the Humboldt marten for purposes of its legal status under CESA and further proceedings under the California Administrative Procedure Act, shall be listed as endangered.

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