Coastal Oregon and Northern Coastal California Populations of the Pacific Marten (*Martes caurina*)

Species Report

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1. INTRODUCTION

This report reviews the biology and status of Pacific marten (*Martes caurina*) populations in coastal Oregon and northern coastal California, and the stressors that may be impacting those populations. Currently, the two extant Pacific marten populations in coastal Oregon are considered to be a separate subspecies (*M. c. caurina*) from the single extant population in northern coastal California (*M. c. humboldtensis*; "Humboldt marten"). However, recent genetic research suggests that these three populations represent a single evolutionary unit (or "clade"), indicating a single taxon (refer to the **TAXONOMY** section below for details). Throughout this report we refer to the combined populations of the Pacific marten occurring within coastal Oregon and northern coastal California as the "coastal marten." When information only applies to one or more of the three extant coastal marten populations, or to martens that occur outside of coastal Oregon and California, it will be noted as such. We refer to the coastal marten population in northwestern California as the northern coastal California population; however, on occasion, we maintained the use of the common name "Humboldt marten" when citing published sources that used that common name for martens occurring in northern coastal California. We refer to the two coastal Oregon populations by their geographic locations; the central coastal Oregon population and the southern coastal Oregon population (refer to the **Delineation of Extant Population Areas** section for details).

Research on the ecology of coastal populations of the Pacific marten began in 2000, with an emphasis on the single population found in northern coastal California. Thus, more information is available for the northern coastal California population than the coastal Oregon populations. Regardless, we use all available data, published and unpublished, for Pacific martens within coastal Oregon and northern coastal California. Where information gaps exist, we rely on Pacific marten information from outside these coastal areas and use published information that appears to best characterize aspects of marten biology that are consistent across the range of the species. Unpublished data from outside these coastal areas are used only in cases where these data fill gaps in the published literature. Finally, biological information from research on the other North American marten species, the American marten (*Martes americana*), was used to fill information gaps, when applicable to the coastal marten (*Martes caurina* spp.).

Much of the information in this report was originally compiled by the Humboldt Marten Conservation Group (HMCG) as part of a conservation assessment and strategy document currently under development (i.e., Slauson et al. *In prep.*(a)). The HMCG was founded in 2011 and includes representatives from private and public entities in coastal Oregon and northern coastal California committed to the conservation and recovery of Pacific marten populations and habitat in coastal Oregon and northern coastal California.

2. ANALYSIS AREA

We delineated the 56,705-square-kilometer (km^2) (21,894-square-mile (mi^2)) coastal marten analysis area (Figure 2.1) using the generalized published historical extent of the distribution of the Pacific marten in coastal Oregon and northern coastal California (Grinnell and Dixon 1926, p. 415; Bailey 1936, p. 296; Grinnell et al. 1937, pp. 190, 207, 209; Zielinski and Golightly

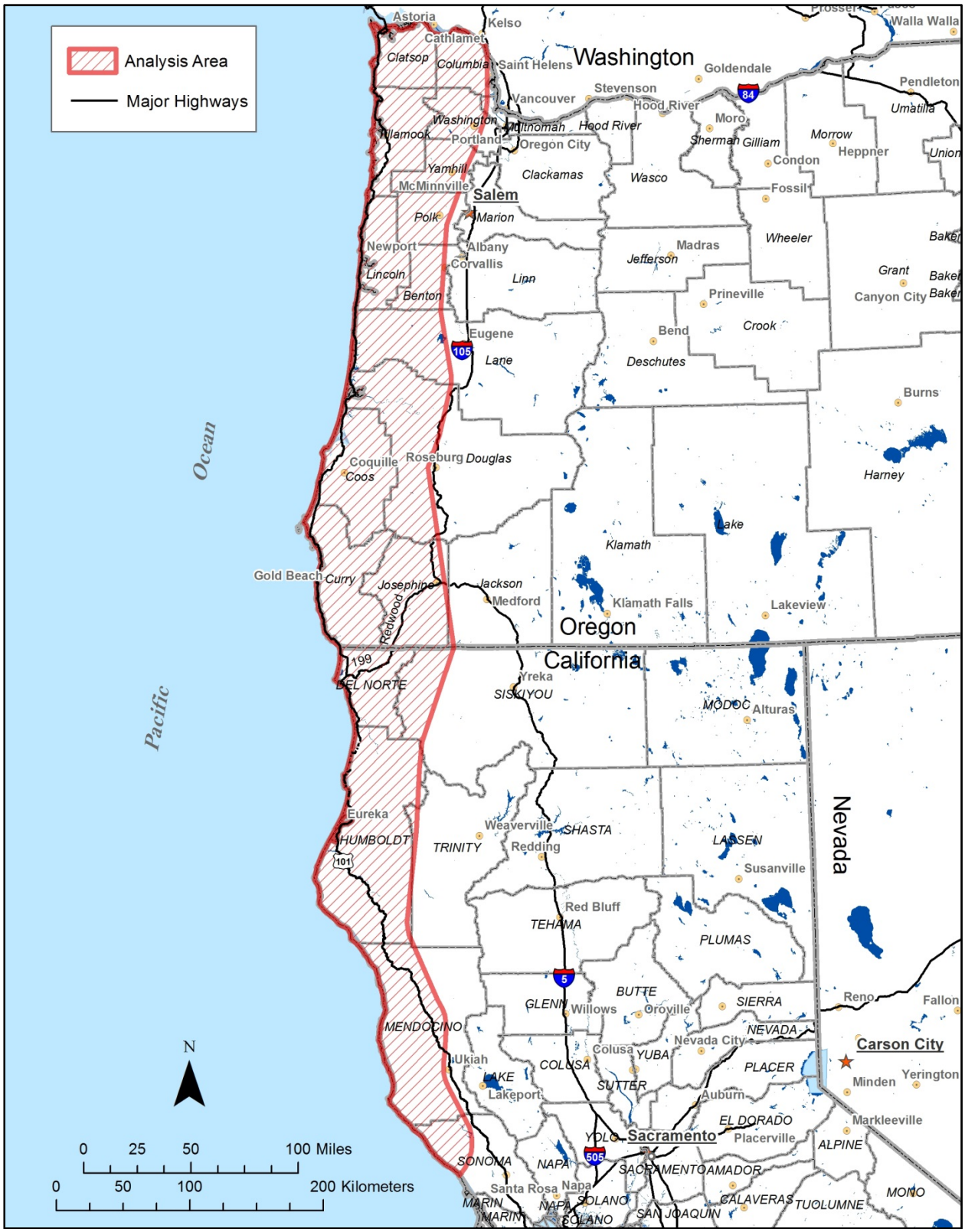

Figure 2.1. Analysis area (aka historical range) for coastal Oregon and northern coastal California populations of the Pacific marten (*Martes caurina*).

1996, p. 115; Zielinski et al. 2001, p. 480; Slauson et al. *In prep.*(a)), broad-scale ecological criteria (Ricketts et al. 1999, entire), and natural biophysical features. The 36,348-km^2 (14,034 mi^2) Oregon portion of the analysis area includes all counties west of the Willamette Valley, the Coast Range portions of Lane and Douglas counties, and Coos, Curry, and Josephine counties in the south coast (Figure 2.1).The 20,747-km^2 (8,010 mi^2) California portion of the analysis area includes all or portions of Sonoma, Mendocino, Trinity, Humboldt, Siskiyou, and Del Norte counties (Figure 2.1).

3. SPECIES DESCRIPTION

Two species of marten, divided into 14 total subspecies, inhabit North America. Collectively, North American martens are characterized by the long and narrow body type typical of the mustelid family (Mustelidae; e.g., weasels, minks, otters and fishers), overall brown pelage (i.e., fur) with distinctive coloration on the throat and upper chest that varies from orange to yellow to cream, large and distinctly triangular ears, and a bushy tail that is proportionally equivalent to about 75 percent of the body length (Clark et al. 1987, p. 2; Powell et al. 2003, p. 636). The Humboldt marten shares most of these physical characteristics with other subspecies of North American martens, but differs slightly in pelage color and the size and coloration of the throat patch (Figure 3.1). Compared to the Sierra subspecies (*M. c. sierrae*) of the Pacific marten in northern interior California and the Sierra Nevada Mountains, the Humboldt marten subspecies is darker, with a richer golden tone to the under fur, a patchy and smaller throat patch that is more cream colored than orange and yellow (Figure 3.1), a smaller skull, smaller and less crowded premolars, and a more narrow rostrum (Grinnell and Dixon 1926, p. 411).

To the best of our knowledge, no comparison of pelage characteristics and morphological measurements between coastal martens in northern coastal California and coastal Oregon or the Oregon Cascades has been made. Grinnell and Dixon (1926, p. 411) compared pelage coloration and skull and tooth morphology between *M. c. humboldtensis* in northwestern California and *M. c. caurina*; however, the *M. c. caurina* specimen used for the comparison was from central coastal Washington, not coastal Oregon or the Oregon Cascades. Recent genetic analyses suggest that martens from coastal Washington (currently *M. c. caurina*) are genetically distinct from martens in coastal Oregon (also currently *M. c. caurina*) and martens in northern coastal California (currently *M. c. humboldtensis*; Schwartz et al. *In prep*.).

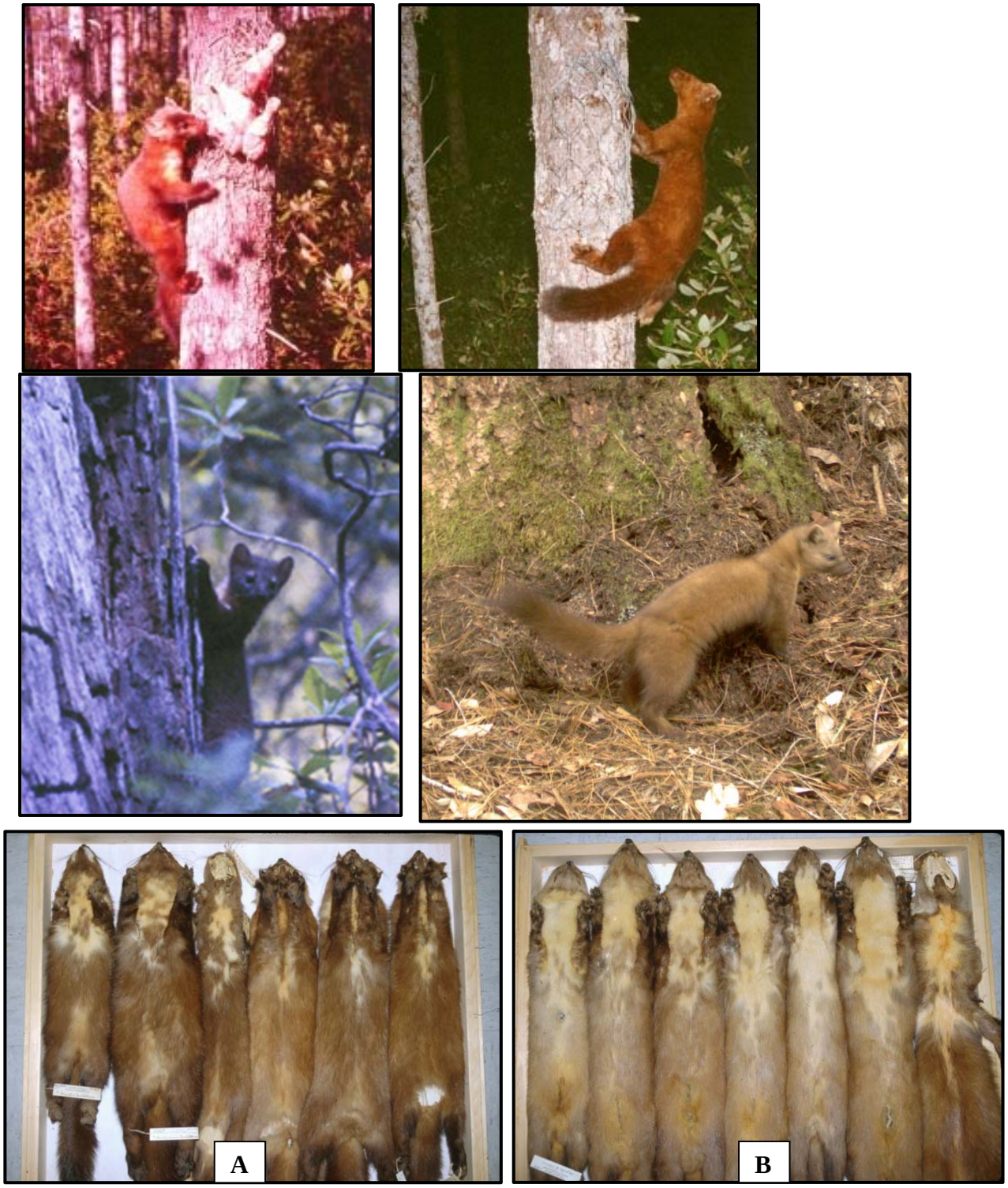

Figure 3.1. Coastal marten photographs from southern coastal Oregon (top row) and northern coastal California (middle row). Bottom row: comparison of overall pelage coloration and extent of the gular patch on typical historical museum specimens of the coastal marten from northern coastal California (A) and the Sierra marten (B). Specimens are from the Museum of Vertebrate Zoology, University of California-Berkeley, Berkeley, CA, USA.

4. TAXONOMY

A single species of marten, the American marten (*Martes americana*), was historically recognized as occurring across a broad range in North America, including the boreal forest region, montane coniferous forests, and Atlantic and Pacific coastal forested regions of North America (Gibilisco 1994, entire). The Pacific marten (*M. caurina*) was recently split from the American marten based on genetic and morphological differences (Dawson and Cook 2012, entire). The Pacific marten occurs largely in montane and coastal coniferous forests west of the Rocky mountain crest in North America, while the American marten occurs to the north and east of the Rocky mountain crest. The genetic split between these two species of martens is thought to have originated from the persistence of marten populations in two disjunct glacial refugia during the last glacial period (Dawson and Cook 2012, entire). Throughout this report we adopt the new species-level nomenclature for the Pacific marten (i.e., *Martes caurina*), but maintain previously described (e.g., Hall 1981, pp. 981–985) subspecies epithets (e.g., *Martes americana humboldtensis* is now referred to as *Martes caurina humboldtensis*).

In Oregon, two subspecies of martens have been historically recognized, with *M. caurina caurina* occurring in the Coast Range and Cascades Mountains of central and western Oregon and *M. c. vulpina* occurring in the Blue Mountains of northeastern Oregon (Figure 4.1; Hall 1981, pp 983–985). Two subspecies of Pacific marten occur in California. The Humboldt marten (*M. c. humboldtensis*) occurs along the northern coast, whereas the Sierra marten (*M. c. sierrae*), is found in the interior mountains of northwestern California, the Cascade Mountains in northern central California, and the Sierra Nevada Mountains of eastern California (Figure 4.1; Grinnell and Dixon 1926, entire; Grinnell et al. 1937, entire).

The Humboldt marten was historically distributed throughout the coastal coniferous forests of northern California from northwestern Sonoma County northward to the Oregon border (Grinnell et al. 1937, pp. 207–210). Recent phylogenetic analyses using mitochondrial DNA (mtDNA) support the distinctiveness of the Humboldt marten subspecies, based on the presence of distinct haplotypes shared by historical museum specimens and martens currently occupying portions of the historical range in northern coastal California (Slauson et al. 2009a, entire). Marten populations in coastal Oregon, which were historically described as *M. c. caurina*, also share these haplotypes, leading Slauson et al. (2009a, pp. 1338–1339) to suggest that martens in the Coast Range of Oregon may also be *M. c. humboldtensis.* Furthermore, preliminary results of a subspecific genetic evaluation of the Pacific marten by Schwartz et al. (*In prep.*)—using nuclear DNA (nDNA) and samples from substantially more martens than used by Slauson et al. (2009a)––also indicate that coastal Oregon and northern coastal California marten populations represent a single evolutionary clade calling into question the separation of the original subspecies range boundaries (i.e., *M. c. humboldtensis* in northern coastal California and *M. c. caurina* in coastal Oregon) at the California-Oregon border.

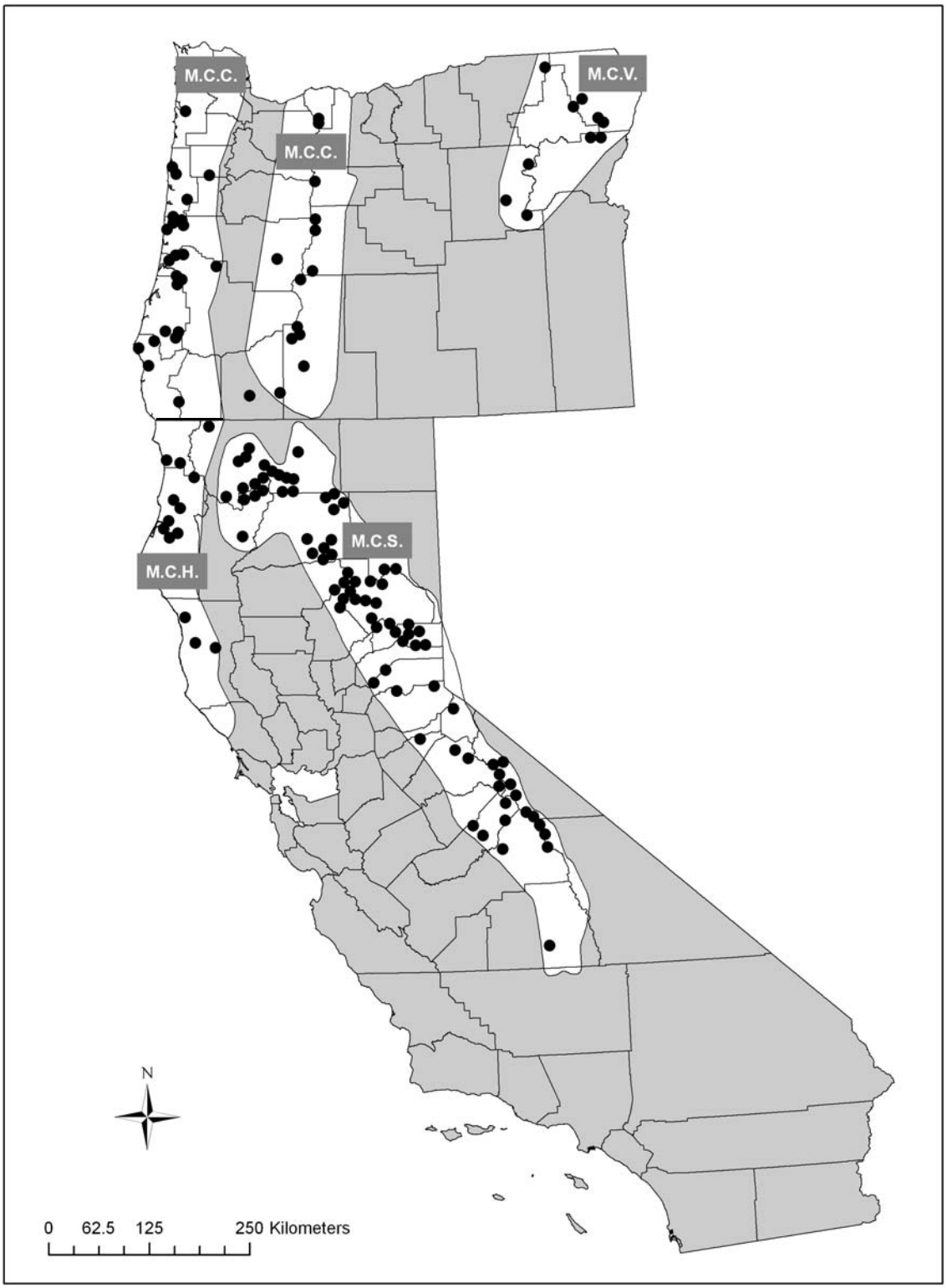

Figure 4.1. Historical range and distribution for the four Pacific marten subspecies occurring in Oregon and California. Range boundaries (white polygons) and historical records of occurrence (black circles) are modified from Zielinski et al. (2001, p. 480). Subspecies: *M. c. humboldtensis* (M.C.H.), *M. c. sierra* (M.C.S.), *M. c. caurina* (M.C.C.), *M. c. vulpina* (M.C.V.).

5. LIFE HISTORY

5.1 TERRITORIALITY

Martens exhibit intrasexual territoriality, with males excluding males and females excluding females from their home ranges (Katnik 1992, p. 48; Powell 1994, pp. 111–121). However, Archibald and Jessup (1984, entire) reported that juvenile and adult martens of the same sex sometimes had overlapping home ranges. For juvenile females it is unclear whether this is a strategy to improve female offspring survival during the early dispersal period or a way to ensure that high quality reproductive habitat is passed on through matrilines (i.e., descent through the maternal line), or both. Male and female home ranges typically overlap, with dominant males maintaining home ranges that encompass one or more female's home range (Powell 1994, p. 111).

5.2 ACTIVITY PATTERNS

Martens are active year-round and appear to seasonally adjust their activity patterns to synchronize with those of their key prey species (Zielinski et al. 1983, pp. 387–388). Accordingly, martens can be active at any time of the day. Peak diurnal activity typically occurs during the summer when ground dwelling sciurids (i.e., squirrels) and young birds are key prey, and peak nocturnal activity typically occurs in the winter when nocturnal species such as flying squirrels (*Glaucomys sabrinus*) or snowshoe hares (*Lepus americanus*) become more important (Zielinski et al. 1983, p. 389; Zielinski et al. 2008, p. 1567).

5.3 FOOD HABITS AND HABITAT-PREY RELATIONSHIPS

North American marten species (i.e., the Pacific marten and American marten) are considered dietary generalists; however, as mentioned above, their diet changes with seasonal prey availability, and during particular seasons they may become specialists on a few prey species (Zielinski et al. 1983, pp. 390–391; Martin 1994, pp. 303–304). Overall, the diet of North American marten species is dominated by mammals, but birds, insects, and fruits are seasonally important (Martin 1994, pp. 298–301). Diet analysis for the coastal marten is currently limited to scats collected from the northern coastal California population from July to November. In this sample of 420 scats, mammals occurred in 93 percent of the scats, berries in 85 percent, birds in 21 percent, insects in 20 percent, and reptiles in 7 percent (Slauson and Zielinski *In prep.*(a)). Sciurid and cricetid (i.e., New World rats and mice) rodents dominated the diet, with the most frequent prey species being chipmunks (*Tamias* sp.) and red-backed voles (*Myode*s *californicus*). The relative biomass contributed by chipmunks, red-backed voles, and Douglas's squirrels (*Tamiasciurus douglasii*) and flying squirrels represented 85 percent of the total mammalian biomass consumed in the summer-fall period (Slauson and Zielinski *In prep.*(a)). The frequency of berries in summer and fall scats from northern coastal California martens was higher than previously reported in other North American marten subspecies (Martin 1994, p. 298) and was dominated by salal (*Gaultheria shallon*; 33 percent), evergreen huckleberry (*Vaccinium ovatum*; 26 percent), and California red huckleberry (*Vaccinium parviflora*; 23 percent) (Slauson and Zielinski *In prep.*(a)).

The availability of prey species to the coastal marten, such as voles, pocket gophers, and moles, varies seasonally. Due to the lack of significant snowpack in areas where coastal martens occur, prey are probably more available to coastal martens during the winter than for other North American martens (Slauson et al. *In prep*.(a)). Furthermore, an important winter prey species found throughout much of the range of North American martens, the snowshoe hare, occurs only within the central and northern coastal Oregon portions of the historical range of the coastal marten (Verts and Carraway 1998, p. 142). Therefore, other typical winter prey species, such as Douglas's and flying squirrels, and species otherwise unavailable where snow cover occurs, may play a more important role in the winter diet of the coastal marten.

Many of the key prey species of the Humboldt marten reach their highest densities in forest stands with old-growth structural features (e.g., Hayes and Cross 1987, p. 543; Carey 1991, entire; Rosenberg et al. 1994, pp. 267–268; Carey and Johnson 1995, pp. 340–343; Waters and Zabel 1995, pp. 861–863) where their key food resources—conifer seed crops and fruiting bodies of ectomycorrhizal fungi—reach their greatest abundances (Smith et al. 2002, pp. 190–197; Luoma et al. 2003, pp. 346–347). The density of ericaceous (i.e., members of the plant family Ericaceae or heather family) shrub layers has also been shown to be positively correlated with chipmunk density in coastal Oregon (Hayes et al. 1995, pp. 69–70). Physical complexity on or near the forest floor, typically provided by coarse woody debris, is directly related to predation success for martens; when this complexity is reduced (e.g., by logging), predation success declines due in part to the increased vigilance prey exhibit when physical complexity is reduced (Andruskiw et al. 2008, pp. 2275–2277).

5.4 Reproduction

North American martens are polygamous with females solely responsible for raising young. Mating is largely known from the behavior of captive animals, and occurs from late June to early August, with a peak in July (Markley and Bassett 1942, pp. 606–607). Females typically give birth in March and April (Strickland et al. 1982, p. 602). Females do not mate until 15 months of age and, due to delayed implantation, will not produce their first litters until they are at least 24 months old (Strickland et al. 1982, p. 601). However, not all yearling females produce ova. Thompson and Colgan (1987, p. 831) reported less than 25 percent of yearlings produced ova, and Fortin and Cantin (2004, pp. 224–229) reported a range of 44–75 percent for greater than 4,000 martens over a decade. Not all females ≥2 years of age give birth in any given year. Thompson and Colgan (1987, p. 831) reported a 50 percent pregnancy rate during years of environmental stress. However, in the Sierra Nevada Mountains of California, from 2009–2011, of 20 females that were at least 2 years old, all were lactating annually, indicating that they were all actively involved in attempting to raise litters (Slauson and Zielinski *In prep*.(b)). The 3 years of reproductive activity monitoring included both mild and severe winters, including 2011, which was one of the top ten snowfall years in the Sierra Nevada Mountains over the last century (Slauson and Zielinski *In prep*.(b)). This suggests that in marten populations in the Sierra Nevada Mountains of California, adult females attempt to produce litters annually, regardless of winter conditions and its effects on prey populations. However, these variables may still be an important determinant in population growth if kit survival is directly influenced by annual variation in environmental conditions and prey populations.

Female martens are capable of producing from 1 to 5 kits per litter, but the modal average is 2–3 (Strickland et al. 1982, p. 602; Mead 1994, p. 410). There is also evidence suggesting age related fecundity in martens, with the number of kits produced highest for 3–5 year olds and lowest for inexperienced first year breeders and for senescent females greater than 5 years old (Mead 1994, pp. 405–406; Fortin and Cantin 2004, p. 228). Despite the importance of recruitment to understanding population growth and persistence, no data exist on the average number of young raised to weaning or the average number of young recruited into the population per female. These data, as well as the effects of annual variation in environmental conditions and prey populations on kit survival, are important information gaps for all species and subspecies of North American martens.

5.5 Survivorship and Longevity

Minimal information is available on marten longevity and age structure. Longevity in North American martens is not well understood because most studies of longevity are from trapped populations where the age structure is truncated and captures are biased towards younger individuals, and because few studies of un-trapped populations report age structure. Captive martens are known to reach 15 years of age (Clark et al. 1987, p. 3). However, in the Algonquin Region of Ontario, Canada, of 2,076 females trapped, approximately 10 percent were more than 5 years old (Strickland and Douglas 1987, p. 535). Furthermore, of 22 martens in northeastern Oregon, all were less than 5 years old (Bull and Heater 2001a, p. 4). With regards to age structure of martens, data are available for Pacific martens in the Sierra Nevada Mountains (i.e., *Martes caurina sierrae*) of eastern California. Over a 3-year period, age structure in an un-trapped population of 96 Pacific martens in the Sierra Nevada Mountains maintained relatively consistent proportions of yearling and adult age classes, with only a single female observed that was greater than 4 years of age (Slauson et al. *In prep.*(a)). Therefore, it appears that in the wild, most North American martens, and presumably coastal martens, live less than 5 years.

Factors influencing survival of un-trapped populations of coastal martens are poorly understood. Coastal martens coexist in forested ecosystems with larger bodied mammalian and avian predators that occasionally prey on them. Therefore, predator avoidance has likely been an important factor shaping their evolution and led coastal martens to select for highly complex forest structure and avoid areas lacking overhead and escape cover (Slauson et al. *In prep.*(a)). By specializing on structurally complex forests, coastal martens minimize their distributional overlap with predators that use more diverse habitats (Slauson et al. *In prep.*(a)).

5.6 Parasites and Disease

Little information is available on disease or parasite prevalence in the Pacific marten. Zielinski (1984, entire) discovered antibodies to plague (*Yersinia pestis*) in four of 13 Sierra martens in the northern Sierra Nevada Mountains, and also found that the chipmunk flea (*Monopsyllus ciliatus*) was the most common ectoparasite, and a probable source of plague transmission. Ticks are commonly encountered on trapped martens, especially on the nape and in the ears during the spring and summer (Slauson per obs.). Ticks are potential vectors of disease transmission to martens (Gabriel et al. 2012a, pp. 158–159).

Sympatric populations of gray foxes (*Urocyon cinereoargenteus*) and Pacific fishers (*Pekania pennanti pacifica*) are known to have been exposed to viral and parasitic diseases, such as canine distemper virus (CDV; *Morbillovirus* spp.), parvovirus, toxoplasmosis, West Nile virus, and rabies, which are also known to be transmittable to martens (Brown et al. 2008, pp. 5–6). Mustelids are among the species most susceptible to CDV (Deem et al. 2000, p. 443). Much of our knowledge about the course of CDV outbreaks in mustelid populations comes from black-footed ferrets (*Mustela nigripes*) in the wild (Williams et al. 1988, entire), and captive domestic ferrets (*Mustela putorius furo*) (e.g., Marini et al. 2002, pp. 498–499). Canine distemper virus outbreaks move rapidly through wild and un-inoculated captive ferret populations. The mortality rate in CDV-infected individual ferrets approaches 100% (Williams et al. 1988, p. 393; Marini et al. 2002, p 498).

5.7 Dispersal and Recruitment

In the American marten, juvenile dispersal is generally thought to occur as early as August, although fall, winter, and spring (the year after birth) dispersal periods have been reported (Clark and Campbell 1976, p. 294; Slough 1989, p. 993). Juvenile dispersal in Humboldt and Sierra martens has been observed to occur as early as August and continue at least until the following summer season (Slauson and Zielinski, unpublished data). No information is available regarding the timing of juvenile dispersal for coastal martens in Oregon, although we expect it to be similar to that of coastal martens in northern coastal California.

Dispersal has been divided into three phases to understand the decisions faced by juveniles or adults and the potential factors influencing those decisions: 1) whether to disperse from the natal area or home range, 2) search behavior, and 3) factors important to settlement (Stamps 2001, entire). Linking the social or habitat-related influences on each phase of the dispersal process is critical to understanding how these factors influence the outcome of dispersal events (Bowler and Benton 2005, entire).

While reports that some adult male and female martens left their home ranges during periods of low prey densities (Thompson and Colgan 1987, pp. 830–831), overall the prevalence of adults leaving their established home ranges in most studies is low. Search behavior and the distance juvenile and adult coastal martens can travel are critical to understanding how landscape pattern can affect dispersal (Slauson et al. *In prep.*(a)). While dispersal distances of more than 70 km (43 mi) have been reported for martens (e.g., Fecske and Jenks 2002, p. 310), most studies find that the majority of juvenile martens in both logged and unlogged landscapes dispersed short distances (e.g., ≤5 km (3.1 mi), Broquet et al. 2006, p. 1694; <15 km (9.3 mi), Phillips 1994, pp. 73–75; $\bar{x} =$ 15.5 km [SE = 1.01] (9.6 mi), Pauli et al. 2012, p. 393). Furthermore, Johnson (2008, pp. 33–36) found that juvenile martens traveled slower, shorter distances, and suffered twice the mortality risk in logged versus unlogged landscapes. The unlogged landscape offered increased foraging efficiency for dispersers (Andruskiw et al. 2008, pp. 2275–2277), resulting in increased physical condition and thus facilitating longer dispersal distances and twice the success rate (25 percent in logged versus 49 percent in unlogged landscapes) of surviving to adulthood (Johnson et al. 2009, p. 3365). Therefore, the best available information suggests that landscape condition (e.g., the spatial distribution of unlogged and logged stands) has important effects on

dispersal dynamics, affecting both the distance dispersers can travel and the success rate they have in establishing home ranges and surviving to adulthood.

Annual recruitment rates of juvenile cohorts (i.e., the proportion of juveniles that survive to adulthood and become part of a population by establishing a home range) in un-trapped marten populations depend on three factors: (1) the number of young produced per female that survive to the dispersal stage; (2) the rate of success of dispersing juveniles establishing home ranges; and (3) the effects of annual environmental stochasticity on recruitment (Slauson et al. *In prep.*(a)). We have no information regarding annual juvenile recruitment rates for coastal marten populations; however, over a 3-year period in an un-trapped population of Pacific martens in the Sierra Nevada Mountains of California, annual juvenile recruitment represented approximately 40 percent of the total observed population size and was relatively constant over the 3-year period (Slauson and Zielinski *In prep.*(b)). Annual juvenile recruitment was estimated at 50 percent for the coastal marten (Slauson et al. *In prep.*(a)).

5.8 Population Biology and Dynamics

Understanding the relative importance of population processes and life stages to population growth is key to identifying management and conservation actions likely to benefit species persistence (Mills 2007, pp. 17–36). Slauson et al. (*In prep.*(a)) developed a re-parameterized version of the existing stage-structured population model for North American martens developed by Buskirk et al. (2012, entire); the re-parameterized version contains parameter estimates more realistic for the coastal marten in northern coastal California and researchers used these models to conduct sensitivity analyses to identify the relative effects age-related survival and fecundity have on coastal marten population growth.

To provide estimates of fecundity (i.e., the number of young produced) and survival by stage, Buskirk et al. (2012, pp. 85–92) used rates estimated from their review of reproductive and survival rates estimated by marten studies across North America. Most of these studies were from populations of martens that were accessible to trappers. Four stages were chosen, representing juveniles (Stage 1: 0 years old), yearlings (Stage 2: 1 year old), young adults (Stage 3: 2–3 years old), and older adults (Stage 4: >3 years old). Buskirk et al. (2012, p. 88) reported the stable age distribution as 53 percent juveniles, 13 percent yearlings, 9 percent 2–year olds, and 24 percent older animals. Changes in adult and juvenile survival were found to have a much larger relative impact on population growth rate than fecundity at any stage (Mills 2007, pp. 143–150; Buskirk et al. 2012, p. 88).

Buskirk et al.'s (2012) population modeling provided a crucial first step in evaluating the importance of key life stages on marten population growth, but Slauson et al. (*In prep.*(a)) identified several model parameters that may have been biased by the dominance of data from trapped populations. First, fecundity estimates for 1-year old martens were higher than those from un-trapped California populations in the Sierra Nevada Mountains. During a 3-year period (2009–2011), of 14 yearling Sierra marten females examined, only 3 (21 percent) showed signs of lactation (Slauson and Zielinski *In prep.*(b)). Moreover, first time breeding female American martens have been shown to have lower overall success rates in raising kits to dispersal

(Thompson and Colgan 1987, p. 831). Slauson et al. (*In prep.*(a)) re-parameterized yearling fecundity using a lower pregnancy rate of 0.18, resulting in a yearling fecundity rate of 0.16.

Second, the 25 percent juvenile survival rate used by Buskirk et al. (2012, pp. 87–88) did not agree with the 49 percent juvenile survival rate reported by Johnson et al. (2009, pp. 3365–3366) for American martens in unlogged forests of southeastern Alaska and northern British Columbia. While 25 percent of juveniles dispersing through intensively logged forest survived to establish a home range and become adults (Johnson et al. 2009, p. 3365); this rate likely underestimates the survivorship of juveniles in un-trapped populations in more intact forests. The only other estimate of juvenile survival in Buskirk et al.'s (2012, p. 82) review was 61 percent for American martens in western Québec in logged forests (Potvin and Breton 1997, p. 464). Slauson et al. (*In prep.*(a)) used a 50 percent juvenile survival rate for coastal martens to better represent the expected juvenile survival rate in more in-tact forests, similar to the 49 percent juvenile survival rate in unlogged forests reported by Johnson et al. (2009).

Third, age structures of wild populations rarely contain individuals >5 years of age. With all stages >0 years old with survival rates of 0.75, the final stage would have proportionally more individuals than would be expected based on field data of population age structures (Bull and Heater 2001a, pp. 3–4; Fortin and Cantin 2004, pp. 231–233; Slauson, unpublished data). To account for this Slauson et al. (*In prep.*(a)) chose a lower survival rate of 0.70 for all stages >0. Slauson et al. (*In prep.*(a)) believed these three changes create a more realistic model for un-trapped marten populations and, specifically, for the coastal marten population in northern coastal California.

Slauson et al. (*In prep.*(a)) reported the stable age distribution for the Humboldt marten as 42 percent juveniles, 20 percent yearlings, 13 percent 2-year olds, and 25 percent ≥ 3 years. Similar to Buskirk et al.'s (2012, p. 88) results, key transition rates were for adult (≥3 years), juvenile and yearling survival. The results of Slauson et al.'s (*In prep.*(a)) and Buskirk et al.'s (2012) matrix models suggest that variation in adult survival and survival across all stages have a much larger impact on population growth than variation in fecundity. The knowledge that marten population growth rates are strongly influenced by adult and juvenile survival (Buskirk et al. 2012, p. 98) has important management and conservation implications. Rather than expecting that marten populations will be capable of growing quickly in temporarily favorable environments, managers can expect that stable conditions and long time periods will be required for population growth and recovery (Buskirk et al. 2012, p. 91).

It is important to consider how each vital rate actually varies in nature or under management (Mills 2007, pp. 143–150). Johnson et al. (2009, entire) made a clear link between juvenile marten survival and the landscape level effect of clear-cut logging, demonstrating a nearly 50 percent reduction in juvenile survival in logged (25 percent survival rate) versus unlogged landscapes (49 percent survival rate). This magnitude of effect likely results in reduced population growth. Information on how survival is influenced by less intensive silvicultural practices as well as how other vital rates vary, and for what reasons, are important areas for future research. Given the current state of knowledge, coastal marten population growth is most significantly affected by changes in survival rates (Slauson et al. *In prep.*(a)).

5.9 INTRA-GUILD PREDATION AND INTERSPECIFIC COMPETITION

Intra-guild predation refers to killing and eating of species that use similar, often limiting, resources and are thus potential competitors (Polis et al. 1989, p. 297). In the Pacific states, intra-guild predation has been confirmed following predictable body size relationships, where species with intermediate differences in body size tended to participate more than expected in killing events, while species pairs with small and large differences in body size tended to do so less than expected (Donadio and Buskirk 2006, pp. 525). Martens are susceptible to predation by larger mammalian and avian predators, typically the habitat-generalist species, including coyote (*Canis latrans*), red fox (*Vulpes vulpes*), bobcat (*Felis rufus*), and great horned owl (*Bubo virginianus*) (Thompson 1994, p. 276; Lindstrom et al. 1995, entire; Bull and Heater 2001a, p. 4). Fishers have also been shown to kill martens (e.g., McCann et al. 2010, p. 11), and large populations of fishers may directly increase mortality of martens and ultimately affect their distribution (Krohn et al. 1995, entire)

The composition of marten predators may vary, depending on the quality of the habitat. For example, generalist carnivores, including bobcats and coyotes, were responsible for 71 percent (Bull and Heater 2001a, pp. 3–4) to 75 percent (Raphael 2004, abstract) of predation events in intensively logged forests versus 40 percent (Hodgman et al. 1997, p. 92) in a forest reserve. In addition, marten populations in highly altered forest landscapes show higher rates of predation by habitat generalist carnivores (and lower annual survival rates) than those in less-altered forest landscapes (Thompson 1994, p. 278). Minimizing risk of predation would be expected to influence both daily movement decisions of where to forage and rest as well as decisions during dispersal and home range establishment. Furthermore, because survival is the most influential population process on population growth, predation can have a meaningful effect on abundance and population growth rates.

Little information on kill site characteristics is available, but in two marten studies, kill sites were associated with areas of reduced escape cover, heavily-logged stands (Raphael 2004, abstract) or open shelterwood stands (Ellis 1998, pp. 41–49). Two studies on the ecologically similar fisher have revealed similar kill site patterns, with kills by larger-bodied generalists (e.g., bobcats) occurring in areas of reduced escape cover, including roads and brushy clearcuts (Buck et al. 1983, pp. 67–68; Higley et al. 2013a, pp. 24–27). Collectively, the results of these studies indicate that human-induced changes to landscape structure can indirectly increase predation risk for martens.

6. BIOPHYSICAL ENVIRONMENT

6.1 PHYSICAL ENVIRONMENT

From north to south the analysis area includes three forest ecoregions: Central Pacific Coastal forests of Oregon, the coastal edge of the Klamath-Siskiyou forests, and Northern California Coastal forests (Ricketts et al. 1999, pp. 238–244). The northern portion of the analysis area is bordered to the east by the non-forested Willamette Valley and in the central and southern portions by the distinctive transition from fog-influenced mesic forest communities to drier interior forest communities at approximately 30–40 kilometers (km) (18.6–24.9 miles (mi)) from

the coast in the Klamath mountains and 20–30 km (12.4–18.6 mi) from the coast farther south in the California Coast Range.

The topography of the analysis area is dominated by steep mountainous terrain dissected by multiple rivers and creeks draining to the Pacific Ocean. Elevation in the analysis area ranges from sea level to 1,524 meters (m) (5,000 feet (ft.)), with approximately 90 percent of the area lower than 914 m (3,000 ft.). The topographic diversity of the analysis area creates many microenvironments, which affect the distribution of vegetative composition and structure through their influence on elevation, aspect, and weather.

The climate of the analysis area is heavily influenced by its close proximity to the Pacific Ocean. Pacific storms in the winter and cloud cover or coastal fog in the summer produce largely persistent moist conditions year-round. Strong west-east gradients in climatic conditions create characteristic shifts in vegetative communities as conditions become drier with increasing distance from the coast. This distance from coast gradient becomes strongest in southern coastal Oregon and the California portions of the analysis area where especially cool and moist summer conditions become most constricted. In addition, temperatures across the analysis area are relatively mild with low magnitude shifts between summer highs (average 15 °Celsius (C) (60 °Fahrenheit (F))) and winter lows (average 5 °C (40 °F); PRISM undated). As a result of relatively mild winter temperatures, most precipitation falls as rain, with average rainfall totals ranging from 100 to 300 centimeters (cm) (39 to 188 inches (in.)), with the average generally increasing from south to north in the analysis area. Persistent snow typically occurs above 914 m (3,000 ft.), with persistent snow packs forming only in the northern Oregon Coast Range and along the eastern edge of the analysis area in southern coastal Oregon and northern coastal California. Summers are warm but moist, due to the presence of clouds and fog during the summer months, providing additional moisture during the driest portion of the year and helping shape the structure and composition of coastal forests.

6.2 PLANT COMMUNITIES

The analysis area is characterized by some of the most productive forests in the world, which in unmanaged late-seral stages are typically composed of long-lived, large trees, multi-layered canopy structure, substantial standing and down large woody debris, and abundant ferns, herbs, and shrubs on the forest floor (Sawyer et al. 2000, entire; Chappell et al. 2001, entire; Sawyer 2007, entire; DellaSala et al. 2011, entire). The forests of the analysis area are largely coniferous, and typically dominated by coast Douglas-fir (*Pseudotsuga menziesii menziesii*), western hemlock (*Tsuga heterophylla*), and Sitka spruce (*Picea sitchensis*) in Oregon, and redwood and coast Douglas-fir in California (Ricketts et al. 1999, entire; Sawyer 2007, entire). Sub-dominant conifers include western red cedar (*Thuja plicata*), Port Orford-cedar (*Chamaecyparis lawsoniana*), grand fir (*Abies grandis*), sugar pine (*Pinus lambertiana*), and white fir (*A. concolor*) at higher elevations (Chappell et al. 2001, entire; Sawyer 2007, entire). Hardwood dominated stands in the analysis area are uncommon, but hardwoods such as tanoak (*Notholithocarpus densiflorus*), golden chinquapin (*Chrysolepis chrysophylla*), and Pacific madrone (*Arbutus menziesii*) are common canopy subdominants. Red alder (*Alnus rubra*) can dominate as an early successional overstory dominant in some near-coast locations or post-logging sites. Riparian forests are dominated by broadleaf species such as red alder, black

cottonwood (*Populus trichocarpa*), bigleaf maple (*Acer macrophyllum*), and mesic shrub species such as vine maple (*A. circinatum*).

Dense herbaceous or shrub layers are characteristic structural components of the forest floor in unmanaged stands in the analysis area. Species presence and dominance is shaped largely by the combination of soil nutrients and moisture, with herbaceous species such as sword fern (*Polystichum munitum*) dominating on nitrogen rich or very moist sites, and evergreen shrubs such as Pacific rhododendron (*Rhododendron macrophyllum*) and salal dominating on nutrient poor or drier sites (Chappell and Kagan 2001, entire). Other dominant or co-dominant understory shrub species include evergreen huckleberry, salmonberry (*Rubus spectabilis*), red huckleberry, and in serpentine habitats (see description below) dwarf tanbark (*Notholithocarpus densiflorus* var. *echinoides*), and huckleberry oak (*Quercus vaccinifolia*; Jimerson et al. 1996, pp. A13–A15; Sawyer et al. 2000, entire; Chappell et al. 2001, entire). Many of the dominant shrub species are adapted to fire by having lignotubers, which are basal swellings at the interface between the roots and shoots usually just below the soil surface, allowing these species to quickly sprout after fire kills the shoots and thus maintain site dominance (Agee 1993, p. 133).

While other habitat types (e.g., grasslands) can be found in the analysis area, two additional, rare forest habitats of particular relevance to coastal martens also occur in the analysis area: coastal serpentine habitat and dune forest habitat distributed on coastal terraces. These two additional habitat types are discussed briefly here because of recent coastal marten detections. However, their overall importance should be balanced by their relative rarity compared to the more extensive dominant forest types that supported the majority of the historical marten distribution in coastal Oregon and northern coastal California. We use the term *serpentine* to refer to the environment influenced by the unique chemical composition of ultramafic rocks, serpentine, and serpentinized peridotite and the resulting plant community structure and species composition it supports (Jimerson et al. 1995, pp. A8–A31; Moores 2011, pp. 3–28).

Forests in serpentine habitats are typically open and rocky with stunted trees that contrast sharply with the dense, rapidly-growing stands on more productive, non-serpentine soils that surround these sites (Jimerson et al. 1995, pp. A8–A31). On the extreme coastal edge of the distribution of serpentine habitats within the analysis area, increased moisture and summer fog supports dense, spatially-extensive shrub layers. Coastal martens have been found in this type of serpentine habitat in both the southern coastal Oregon and northern coastal California portions of the analysis area, but not in the more extensive and drier interior serpentine habitats that are more open due to the absence or reduction in shrub cover. The serpentine communities used by coastal martens are composed of a variety of coniferous trees, such as Douglas-fir, sugar pine, lodgepole pine, western white pine (*Pinus monticola*), Jeffrey pine (*P. jeffreyi*), knobcone pine (*P. attenuatta*), and Port Orford-cedar, and are dominated by mast-producing shrubs such as dwarf tanbark, huckleberry oak, and red huckleberry (Jimerson et al. 1995, p. C1; Slauson 2003, pp. 5, 9, 13). Similar to the shrub community in stands used by coastal martens on more productive soil types, the shrub community in serpentine habitats is composed of long-lived, mast-producing species that maintain site dominance and are not an early-seral community that dominates only for short periods after disturbances.

We use the term coastal dune forest communities to describe the forest communities typically dominated by shore pine (*P. contorta contorta*), the coastal form of lodgepole pine, and in some areas co-dominated by Sitka spruce occurring in stabilized dunes on marine terraces, predominantly in coastal Oregon. The understory of these forest communities are typically dominated by salal and evergreen huckleberry (Chappell et al. 2001, p. 101).

6.3 LAND OWNERSHIP IN THE ANALYSIS AREA

Land ownership in the analysis area includes private (61 percent), U.S. Forest Service (Forest Service; 20 percent), Bureau of Land Management (BLM; 10 percent), Oregon Department of Forestry (ODF; 5 percent) and National Park Service (NPS), California Department of Parks and Recreation (CPR), and Tribal (1 percent each) (Figure 6.1).

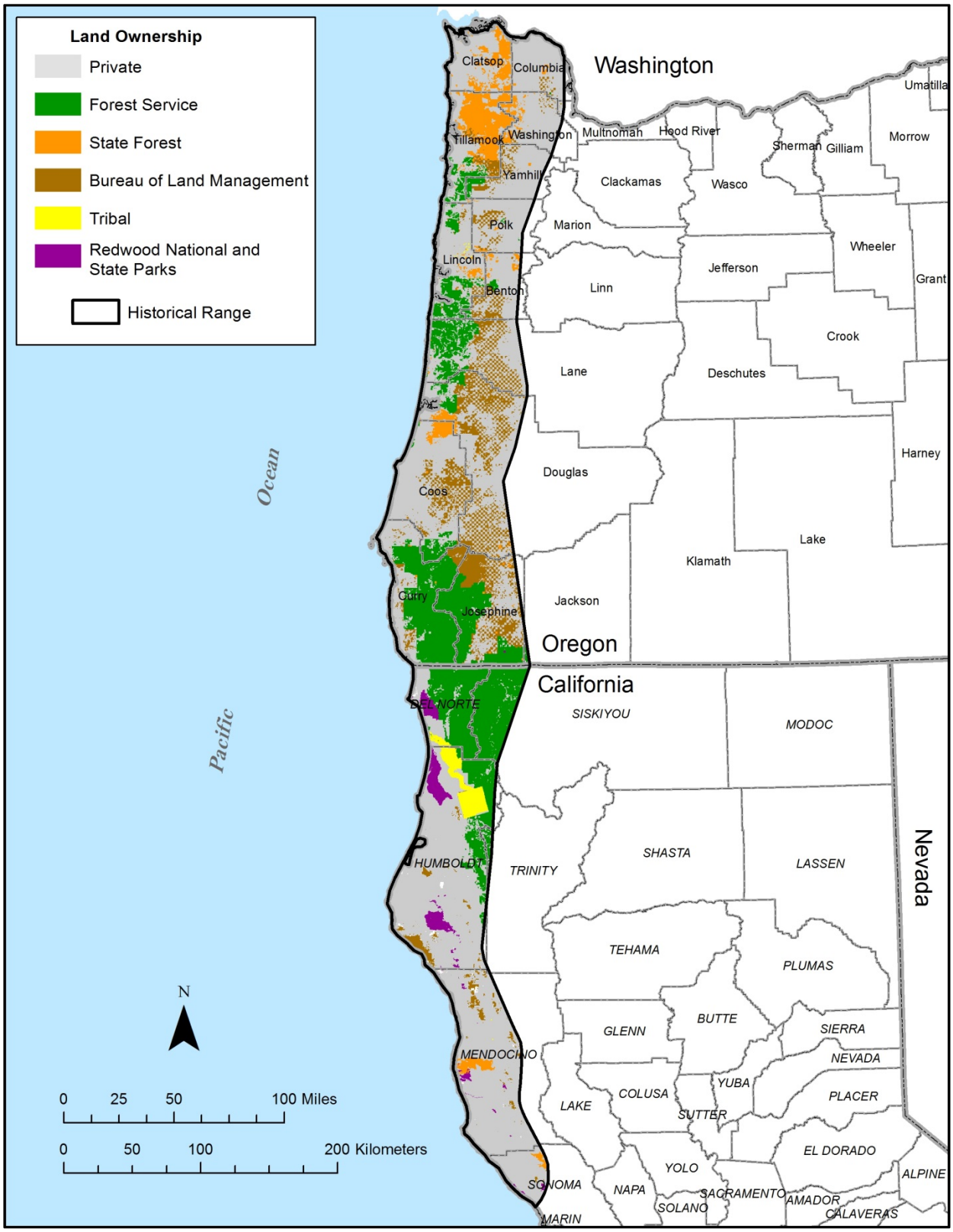

Figure 6.1. Land ownership within the analysis area (i.e., the historical range of the coastal marten).

7. HABITAT USE

Pacific and American martens select habitat at four primary spatial scales: micro-habitat, stand, home range, and landscape scales. At the micro-habitat scale, martens select specific structures to use for foraging or resting, such as large logs, which they run along searching for prey, or cavities in snags that provide thermal benefits (Taylor 1993, pp. 1–8) and reduce predation risk while resting. At the stand-scale, martens select stands with the structural features that provide for one or more life-history requirements (e.g., prey populations, foraging structures, resting structures). At the home-range scale, martens position their home ranges to include enough high quality habitat to provide for year round life history needs (e.g., seasonal prey bases, den sites) and access to mates, while avoiding same-sex conspecifics (Katnik et al. 1994, pp. 604–606; Powell 1994, entire). At the landscape-scale within populations, dispersing individuals select suitable portions of the landscape that are unoccupied by same-sex conspecifics to establish home ranges (Johnson 2008, pp. 14–16). At the landscape-scale between populations, dispersal maintains adjacent populations or meta-population structure, where it exists, and gene flow.

In a recent review of habitat selection by Pacific and American martens, Thompson et al. (2012) found that habitat selection appeared to be strongest at the home range-scale, with a consistent pattern of individual martens requiring at least 70 percent of home ranges composed of suitable habitat conditions; as the availability of these habitats declined at the landscape scale, either from wildfire or management, so did marten population density. Although martens generally prefer mature and old forests over young regenerating stands, marten habitat use varies across the continent, making generalities difficult to infer at the stand-scale. The variation in the preference for older forests appears to be linked to key aspects of Pacific and American marten ecology, including the abundance of primary prey species, predator distribution, and the development of structural complexity near the ground in different forest types (Thompson et al. 2012, pp. 212–221). Consequently, assumptions about stand-scale habitat relationships should be ecosystem-specific and not based on general understandings from throughout their ranges.

7.1 MICRO-SCALE HABITAT USE: RESTING AND DENNING HABITAT

Rest structures are used daily by martens between foraging bouts to provide thermoregulatory benefits and protection from predators (Taylor and Buskirk 1994, pp. 253–255). Reuse rates for individual rest structures are low and selection for structure type changes seasonally to meet thermoregulatory needs (e.g., Spencer 1987), such that multiple resting structures meeting seasonal requirements are required across the home range. Large-diameter live trees, snags, and logs provide the main types of resting structures for martens (Spencer et al. 1983, pp. 1182–1185; Schumacher 1999, pp. 26–58; Slauson and Zielinski 2009, pp. 41–42). Of 55 rest structures used by Humboldt martens in the summer and fall, 37 percent were snags, 23 percent downed logs, and 17 percent live trees (Figure 7.1; Slauson and Zielinski 2009, pp. 39–42). Martens typically select the largest available structures for resting and denning (Spencer et al. 1983, pp. 1182–1185; Gilbert et al. 1997, pp. 138–142). Rest structures used by Humboldt martens averaged 95 cm (37 in.) diameter-at-breast-height (dbh) for snags, 88 cm (35 in.) maximum diameter for downed logs, and 94 cm (37 in.) dbh for live trees (Slauson and Zielinski 2009, p. 40). These woody structures were found in the oldest forest development stages (Slauson and Zielinski 2009, p. 40). Most resting locations—the actual place in the structure the

marten used for resting—occurred in tree cavities (33 percent), on platforms (33 percent) created by broken top snags or large live branches, or in chambers (28 percent) created by log piles or rock outcrops (Figure 7.1; Slauson and Zielinski 2009, p. 39). In coastal Oregon and northern coastal California, rest structures providing cavities or chambers will likely become seasonally important during the rainy period of the year; late fall through late spring.

Denning structures used by female martens to give birth to kits are called natal dens, and the subsequent locations where they move their kits are referred to as maternal dens. Pacific and American martens appear to be more selective of habitat conditions at den sites than at resting sites (Thompson et al. 2012, p. 223). Ruggiero et al. (1998, pp. 665–669) found that both the characteristics of the den structures and the characteristics of the stands they were found in influenced den-site selection. This is likely due to the importance of high quality foraging habitat in close proximity to den sites, allowing females to simultaneously maximize the energy they gain from foraging during lactation and minimize the time spent away from kits, especially when they are dependent on their mothers for thermoregulation. The most common den structures used by Pacific and American martens are large diameter live and dead trees with cavities (Thompson et al. 2012, p. 223). No natal dens and only three maternal dens (all from the northern coastal California population) have been described for the coastal marten. Two of the maternal dens were cavities in the broken tops of a 66 cm (26 in.) dbh golden chinquapin and 113 cm (44 in.) dbh Douglas-fir, and the other was a cavity in a 115 cm (45 in.) dbh Douglas-fir snag (Slauson and Zielinski 2009, p. 40). All three maternal dens were located in the same old-growth, Douglas-fir dominated stand encompassing a creek and riparian habitat.

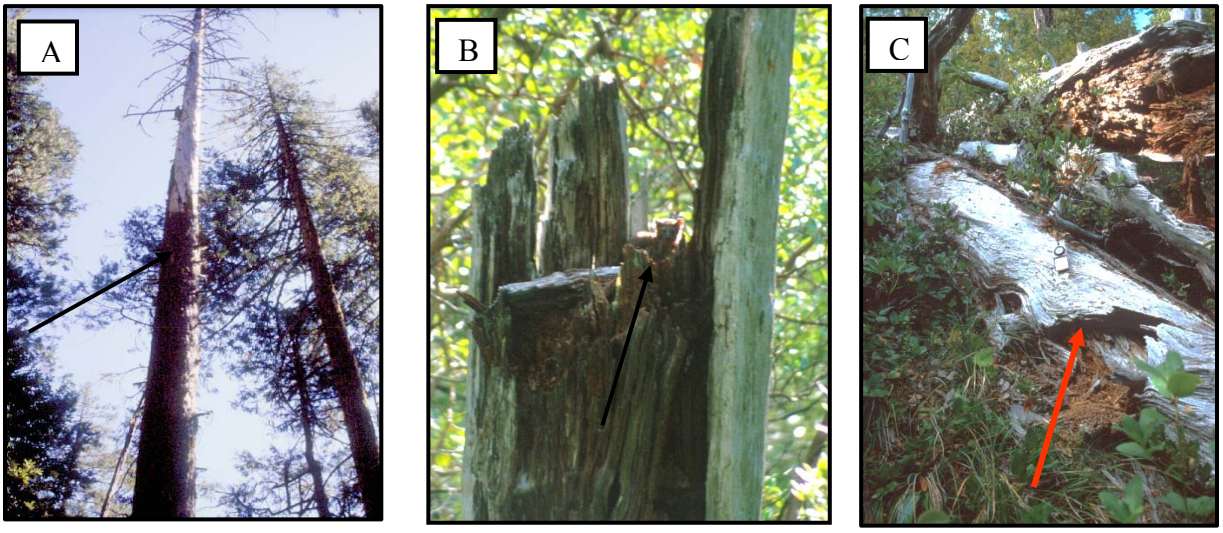

Figure 7.1. Examples of coastal marten resting structures in northern coastal California: **A**. Cavity in Douglas-fir snag. **B**. Platform on broken Douglas-fir snag. **C**. Cavity in downed Douglas-fir log. Red arrows identify the resting location in each structure.

7.2 STAND SCALE HABITAT USE

Martens select forest stands that provide habitat structure supporting one or more life history needs that include foraging, resting, or denning. In addition, stands that provide sufficient structure to reduce the risk of predation, such as dense overhead vegetation and vertical tree boles, are also important and affect marten survival. In general, the Pacific marten is associated with late-successional conifer stands (Powell et al. 2003, pp. 641–642) characterized by an abundance of large downed logs, and large, decadent live trees and snags (Buskirk and Ruggiero 1994, pp. 21–22). Many of the key prey species exhibit their highest densities in forest stands with old-growth structural features (e.g., red-backed vole: Hayes and Cross 1987, pp. 544–545; flying squirrel: Waters and Zabel 1995, pp. 861–862; Douglas's squirrel: Carey 1991, pp. 14–15) and dense shrub layers (e.g., chipmunks; Hayes et al. 1995, p. 69). Physical complexity on or near the forest floor, typically provided by coarse woody debris, is directly related to predation success for martens; when this complexity is reduced (e.g., from logging), so is predation success (Andruskiw et al. 2008, pp. 2275–2277).

Coastal martens in California most strongly selected stands of old-growth, conifer-dominated forests with dense, ericaceous shrub layers (Figure 7.2; Slauson et al. 2007, pp. 464–465). Other than the late-mature developmental stage, which was used in proportion to its availability, stands in earlier developmental stages were selected against (Slauson et al. 2007, pp. 462–464). These old-growth and late mature stands most often were dominated by Douglas-fir over stories, but also had mature hardwood understories composed of either tanoak or golden chinquapin. Shrub layers were dense (greater than 70 percent cover), spatially extensive, and dominated by evergreen huckleberry, salal, and rhododendron (Figure 7.2; Slauson et al. 2007, p. 465). The majority of detections of coastal martens in southern coastal Oregon share these same stand characteristics (Zielinski et al. 2001, p. 485).

In addition to old-growth stands in highly productive soils, coastal martens have used forest and shrub dominated habitats occurring on less productive serpentine soils, hereafter called serpentine habitats. These habitats include conifer-dominated tree overstories, with dominants including lodgepole pine, western white pine, and Douglas-fir, but also including dense (greater than 70 percent cover) shrub layers dominated by huckleberry oak, dwarf tanbark, and California red huckleberry (Figure 7.2; Zielinski et al. 2001, p. 485; Slauson et al. 2007, p. 462). In contrast to the dense old-growth stand structure used by martens on productive soils, stands used in serpentine soils can include any seral stage and more variable tree overstory canopy closure ranging from sparse to dense (Figure 7.3; Zielinski et al. 2001, pp. 485, 488; Slauson et al. 2007, p. 462). Serpentine habitats used by martens also contain dense shrub layers and abundant rocky outcrops, providing chambers that martens use as resting structures because large woody structures are rare in serpentine habitat (Slauson and Zielinski 2009, pp. 39–40). While the distribution of serpentine soils is extensive in southwestern Oregon and northwestern California, martens have only been found in serpentine habitats in the fog influenced portions of their distribution near (less than 30 km (18.6 mi)) the coast, where the shrub component is dense enough to meet marten needs.

Figure 7.2. Habitat structure within typical coastal marten occupied stands in northern coastal California. Note conifer dominated overstory, dense shrub layers and presence of large diameter dead standing and downed wood.

Figure 7.3. Typical stand structures within serpentine habitat occupied by martens in northern coastal California and southern coastal Oregon.

Coastal martens in central coastal Oregon have been detected and found as road kills in and adjacent to shore pine and transitional shore pine-Douglas-fir-hemlock forests at the Oregon Dunes National Recreation Area (Zielinski et al. 2001, p. 484). Shore pine forests in the vicinities of these detections and road kills share many of the same characteristics with serpentine habitats, specifically variable tree over-story with dense, spatially extensive ericaceous shrub understories (Chappell and Kagan 2001, pp. 25, 27, 95, 100).

7.3 HOME RANGE HABITAT USE

Pacific and American martens exhibit strong habitat selection at the home range scale, suggesting that this scale of selection most directly influences an individual's fitness (Thompson et al. 2012, p. 210). Martens establish home ranges to encompass their year-round resource needs as well as, during the breeding season, access to members of the opposite sex. Theoretically, home range size for a predator is a function of prey density and habitat quality; smaller home ranges typically represent better habitat conditions. Marten home ranges are often positioned to maximize the composition of high quality habitat and minimize low quality habitat (Figure 7.3; Phillips 1994, pp. 59–60). Individual Pacific and American marten home ranges typically include a high proportion (≥70 percent) of high quality late-successional forest habitat (reviewed in Thompson et al. 2012, p. 218). Females, due to their solitary role raising young, have unique needs and must have access to reliable and nearby prey resources to support the energetic demands of lactation and providing food for kits. In northern coastal California, 97 percent (38 of 39) of a typical female's within-home range resting and active locations occurred in the core old-growth and late-mature riparian habitat patches (Figure 7.4; Slauson and Zielinski, unpublished data). For males, 30 of 39 (77 percent) within-home range resting and active locations occurred in the core old-growth and late-mature riparian habitat patches (Figure 7.4; Slauson and Zielinski, unpublished data).

There is an inverse relationship between the amount of high quality habitat and marten home range size. As the amount of low quality habitat (e.g., recent clear-cuts or partial harvests) increases, home range size increases (Thompson 1994, p. 276; Potvin and Breton 1997, p. 462; Fuller and Harrison 2005, pp. 715–719). Accordingly, in our review of home range area studies of Pacific martens in California and Oregon, the largest home ranges we encountered (i.e., greater than 10 km^2 (3.9 mi^2)) were from individuals occupying intensively logged landscapes (Ellis 1998, pp. 35–41; Bull and Heater 2001b, p. 9; Self and Kerns 2001, p. 5).

Home ranges of Pacific martens in the Sierra Nevada Mountains of California in largely unlogged forest landscapes averaged 3–5 km^2 (1.2–1.9 mi^2) for males and 3–4 km^2 (1.2–1.5 mi^2) for females (Simon 1980, p. 97; Spencer et al. 2011, p. 798). Limited telemetry data from coastal martens suggests that home ranges for adult males (n =3) are of similar size (3–4 km^2; 1.2–1.5 mi^2) (Slauson, unpublished data). Telemetry data and habitat selection analysis at coastal marten detection sites reveal that home ranges include large patches (median >1.5 km^2 (0.6 mi^2)) of the most favored habitat: old-growth, old-growth and late-mature, and serpentine habitat (Figures 7.4, 7.5.; Slauson 2003, pp. 49–54; Slauson et al. 2007, pp. 462–463).

7.4 LANDSCAPE SCALE HABITAT USE: FACILITATING MOVEMENT, OCCUPANCY AND POPULATION DYNAMICS

The pattern and composition of habitat at the landscape scale affects the ability of martens to successfully disperse and find suitable home ranges, affects marten survival and spatial occupancy dynamics, and ultimately affects population size and persistence. The amount and spatial arrangement of high quality habitat capable of supporting one to multiple home ranges, their distances from adjacent patches, and the quality of the intervening habitat are key factors at the landscape scale (Chapin et al. 1998, pp. 1334–1336; Hargis et al. 1999, pp. 162–169; Kirk and Zielinski 2009, pp. 765–771).

Compared to other species closely associated with late-successional forest, American and Pacific marten populations, including the coastal marten, are very sensitive to the loss or fragmentation of high quality habitat at the landscape scale. Martens exhibit a progression of responses to timber harvest as the proportion of habitat affected by intensive logging practices increases, including (but not limited to) activities such as clear cutting (see review in Thompson et al. 2012), partial harvest (Potvin et al. 2000, pp. 851–854; Fuller and Harrison 2005, pp. 715–716; Godbout and Ouellet 2008, pp. 336–338), and shelterwood cutting (Ellis 1998, p. 41–49). The combination of habitat loss and fragmentation of remnant suitable habitat effectively lowers the density of martens by reducing the number of home ranges that can be supported (Thompson 1994, p. 276).

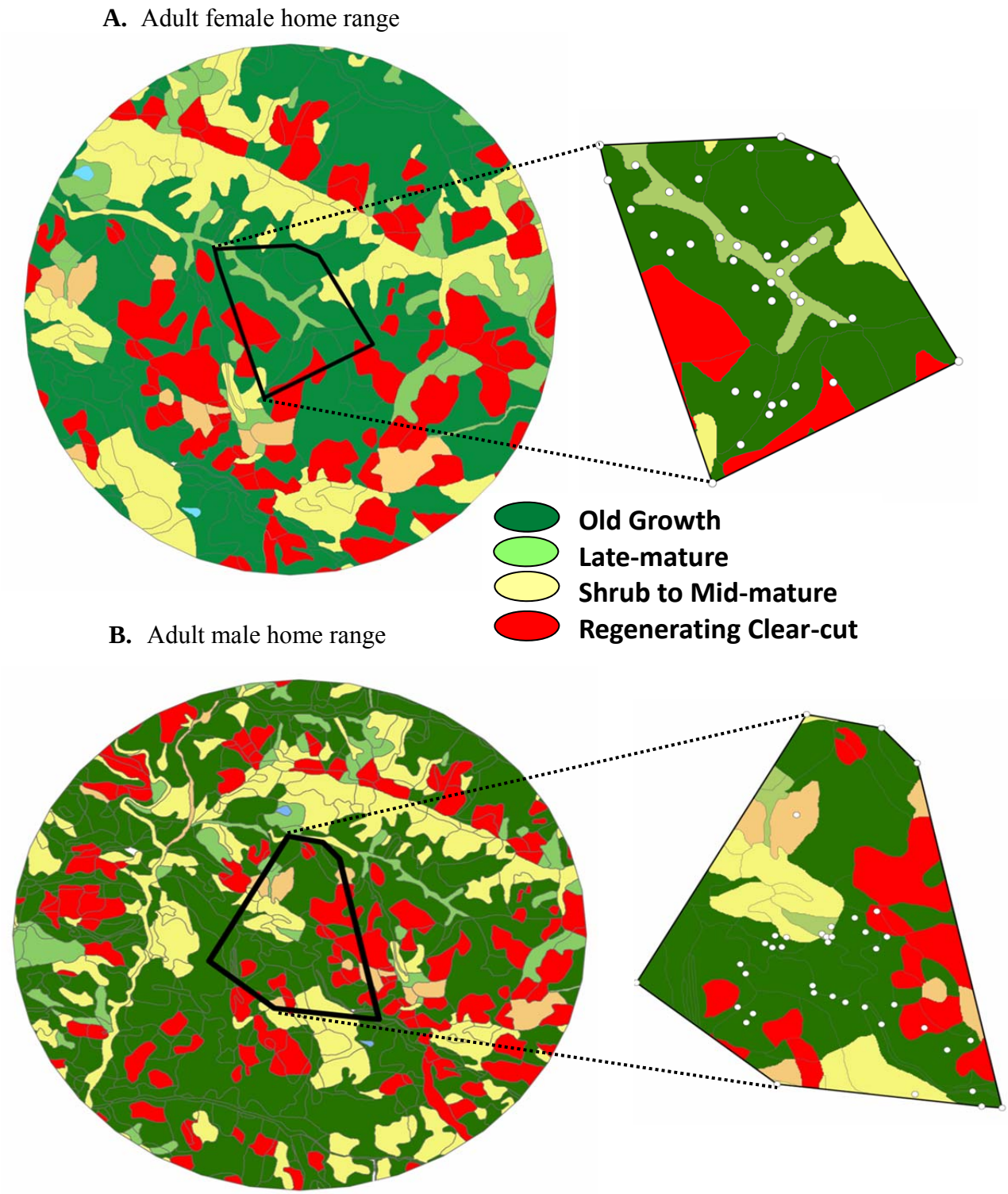

Figure 7.4. Home range position in the landscape, habitat composition, and within-home range habitat use by: (**A**) a typical adult female, and (**B**) a typical adult male coastal marten in non-serpentine habitat in northern coastal California. Home ranges represents 100 percent minimum convex polygon in non-serpentine forest habitat. Small white circles on inset maps represent rest sites and "active" sites located by radio telemetry. Source: Slauson et al. *In prep.*(a).

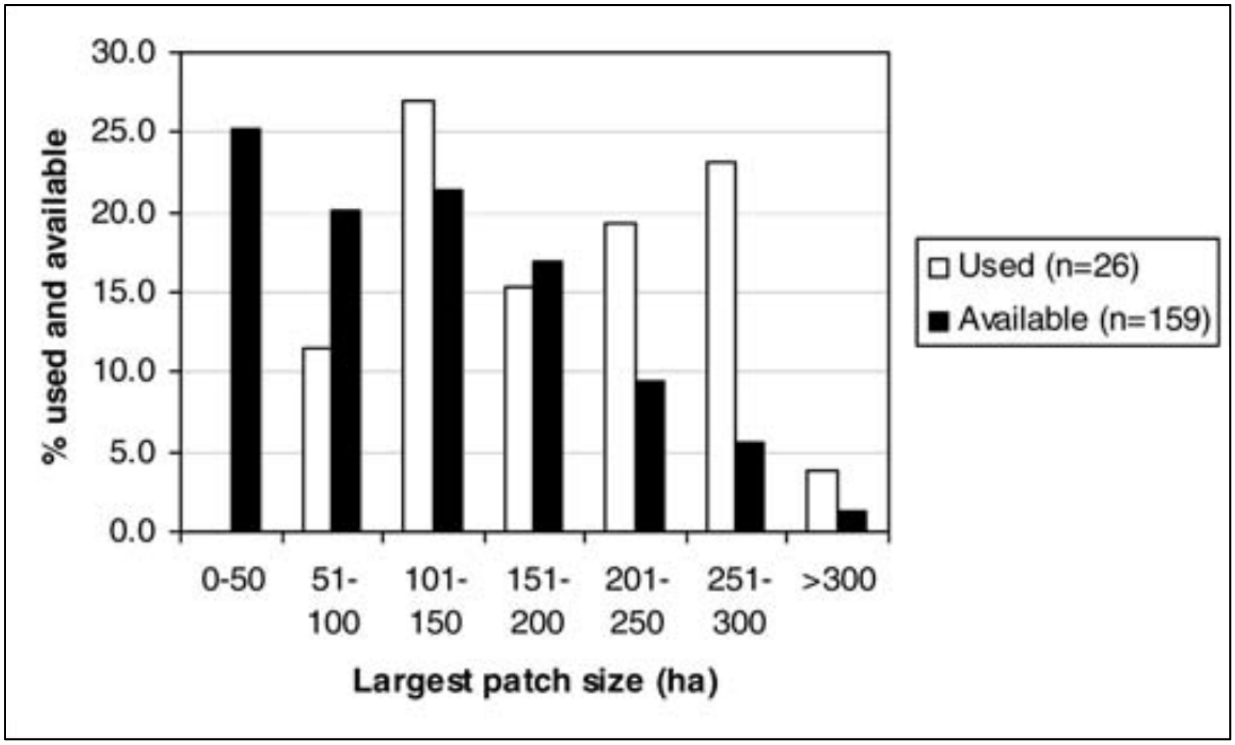

Figure 7.5. Use and availability of the largest contiguous patch of old-growth, old-growth plus late-mature, or serpentine habitat within a 1-km (0.62 mi) radius that encompassed locations occupied by the coastal marten in northern coastal California (Slauson et al. 2007, p. 464).

Martens occupying the remnant suitable portions of landscapes fragmented by logging experience increased predation rates and lower survival rates compared with martens occurring in more contiguous, unlogged landscapes (Thompson 1994, pp. 276–278; Potvin and Breton 1997, p. 464; Raphael 2004, abstract). Finally, occupancy by American martens across forested landscape declines when 25–30 percent of the landscape is regenerating following timber harvesting (Chapin et al. 1998, pp. 1334–1336; Hargis et al. 1999, p. 158; Potvin et al. 2000, pp. 849–854; Fuller and Harrison 2005, p. 716; reviewed by Thompson et al. 2012, p. 217) or wildfire (Paragi et al. 1996, pp. 2231–2233).

Dispersal is the means by which marten populations maintain and expand their distribution. However, successful dispersal requires the existence of functional habitat connectivity between patches of habitat suitable for reproduction to maintain or expand population size and distribution. Dispersal is also essential to maintain viable meta-populations, if populations are structured as meta-populations. Johnson et al. (2009, p. 59) found that in intensively logged landscapes, both the daily and total dispersal distance were reduced on average approximately 50 percent and that the success rate of juvenile martens dispersing to establish home ranges had been reduced from 49 percent to 25 percent. The combined effects of reduced foraging efficiency in logged stands (Andruskiw et al. 2008, pp. 2275–2277) and likely increased predation risk in post-logging early seral habitat may pose significant impediments for dispersing martens.

During dispersal, martens use a search strategy that is not random or linear, suggesting they are responding to habitat cues and that landscape pattern likely influences movement trajectories (Johnson 2008, pp. 27–29, 36–39). Given the energetic demands of dispersal, habitats with high or low quality foraging opportunities are likely to influence movement. For example, a dispersing juvenile female Humboldt marten moved from her natal area along a peninsula of unmanaged stands of various seral stages, but showed repeated use of a small (less than 0.5 km^2 (0.2 mi^2) old-growth stand prior to returning to her natal area (Slauson and Zielinski, unpublished data). Marten search behavior during dispersal often involves sharp turning angles to avoid barriers or low quality habitat and reversing direction to return to familiar areas (Johnson 2008, pp. 33–38).

7.5 CURRENT LANDSCAPE HABITAT SUITABILITY

Slauson et al. (*In prep.*(b)) developed a landscape habitat suitability model that we used for the analysis area in this report (Figure 7.6). The model was developed by identifying the combination of environmental, topographic, disturbance history, and vegetation variables that best described the distribution of marten detection/non-detection survey data. Variables were assessed using "moving windows" with 500, 1,000 and 3,000 m (1640, 3281, 9843 ft.) radii to assign each 30 x 30 m (98 x 98 ft.) pixel a variable value representing the variable characteristics within the window and vicinity. The top models (i.e., those candidate models that best "fit" the data set) contained a combination of four base variables based on the 1,000 m and 3,000 m (3281 and 9,843 ft.)) radius windows: (1) old-growth structural index (OGSI), (2) serpentine habitat, (3) precipitation, and (4) adjusted elevation (Slauson et al. *In prep.*(b)). Less important variables included recent timber harvest and stream density. The final averaged model reveals three significant regional habitat areas: two in Oregon, one on the central coast and one on the southern coast, and one in northwestern California that supports the only known population for the state (Figure 7.6). The model predicts some potential habitat connectivity between the northern coastal California and southern coastal Oregon populations, but suggests there is little habitat connectivity between the central and southern coastal Oregon populations.

The old-growth structural index is a composite index based on stand age, density of large conifers, diversity of tree sizes, density of large snags, and volume of down wood (Spies et al. 2007a, p. 10). The OGSI was one of the 4 variables included in all top landscape habitat suitability models (Slauson et al. *In prep.*(b)) but was less valued at lower elevations most likely due to the legacy of intensive forest management at lower elevations versus a biological relationship with martens. The old-growth structural index will help identify areas that have strong potential for future marten reproduction.

The habitat suitability map derived from model results is based on a suitability index scale from 0 = "not habitat" to 1 = "habitat of high suitability"; based on the probability of coastal marten occurrence. The habitat suitability index was split into three suitability classes or bins (low, moderate, high) representing the relative probability of marten occurrence at the landscape scale. Approximately 11 percent of the analysis area consists of coastal marten habitat of high suitability; 12 percent of moderate suitability; 18 percent of low suitability; and 59 percent unsuitable (Slauson et al. *In prep.*(b); Figure 7.6).

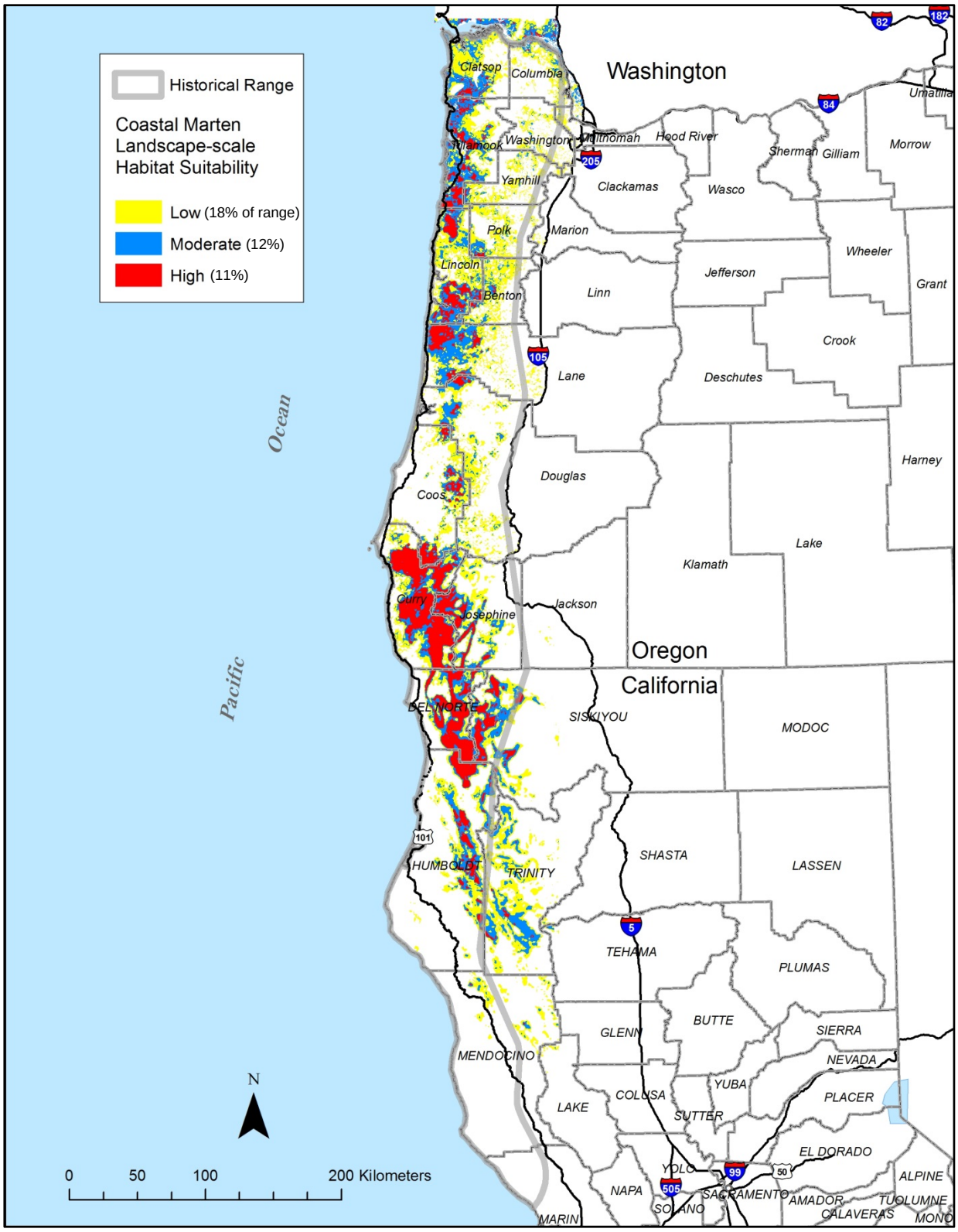

Figure 7.6. Current landscape habitat suitability for coastal martens throughout their historical range (Slauson et al. *In prep.*(b)). Coastal dune forest habitat in northern Coos County, Douglas County, and Lane County, Oregon are considered suitable, but were excluded by the model.

8. SPECIES STATUS

8.1 SPECIES DISTRIBUTION

8.1.1 Historical Distribution (pre-1980)

Zielinski et al. (2001, entire) compiled all available verifiable marten detections in coastal Oregon and California. Verifiable detections include records with physical evidence such as tracks, photographs, and carcasses (mainly roadkill mortalities and martens trapped for fur), and reliable reports of martens captured and released by trappers. Zielinski et al. (2001, entire) selected 1980 as a dividing year between historical and current marten records primarily because all verifiable detections at that time in central coastal Oregon (in this case in the form of road kills) were from 1980 to 1998, with earlier verifiable detections going back to the 1950s (trapping records); with no verifiable detections in the intervening years. Unverifiable marten detections, mainly visual observations from inexperienced observers, have occurred within the analysis area from the 1950s to 1980, but were excluded from Zielinski et al.'s (2001, entire) compilation and this report.

To delineate the historical distribution of martens in coastal Oregon and northern coastal California we used locations of verifiable detections (museum specimens, trapping records) and pre-1950s published interviews with trappers, that were collected during the late 19th century and the early and mid-20th century, as summarized by Zielinski et al. (2001, p. 480).We modified the historical range boundary in northern coastal California to exclude several historical trapping records in eastern Mendocino County and northern Lake County because of imprecise locational data or information indicating unsuitable habitat conditions (i.e., dry, interior forest with inadequate shrub cover) for the coastal marten based on recent field site visits (Zielinski, unpublished data). In addition, trapping records in northern coastal Oregon counties were used to delineate the historical range boundary in coastal Oregon, but were excluded from verifiable detection maps since they did not contain precise locational data (i.e., only to the nearest county)(Figure 8.1; Zielinski et al. 2001, p. 480; Slauson et al. *In prep.*(a)).

Within northern coastal California, the currently described Humboldt marten subspecies was historically known to occur within 80 km (50 mi) of the coast, "north through the humid coast belt from the vicinity of old Fort Ross, Sonoma County, into Oregon" (Grinnell and Dixon 1926, p. 413). The historical range of the Humboldt marten subspecies in California was described on the basis of 43 martens trapped at 14 locations from 1919 to 1924 (Figure 8.1; Grinnell et al. 1937, p. 210). Twining and Hensley (1947, pp. 133, 136) described the range of the Humboldt marten subspecies as the northern coast ranges of California, noting that Humboldt martens had not been trapped in Lake or Sonoma counties for many years and records were scarce for Mendocino County. Hemphill (1952, p. 146) stated that martens still occurred on the Mendocino National Forest (which stretches north-south along the eastern boundary of Mendocino County, the northern portion of Lake County, as well as other inland counties) as of 1948, but provided no data to support his assertion.

Of the 24 historical verifiable detections (trapping records and museum specimens) of Humboldt marten in northern coastal California that contained precise locational data, 20 (83 percent)

occurred in redwood and Douglas-fir forests less than 25 km (15 mi) from the coast and no records occurred greater than 35 km (22 mi) from the coast (Figure 8.1; Slauson and Zielinski 2007, p. 241).

The historical distribution of martens in coastal Oregon includes "…the humid mixed zones of the coast and Coast Ranges."(Bailey 1936, p. 296), extending from the Columbia River south through the coastal portions of the Klamath-Siskiyou mountains to the California border (Figure 8.1; Zielinski et al. 2001, p. 480). Museum or trapping records for martens exist for every county within their historical range in coastal Oregon (Marshall 1994, p. 1; Zielinski et al. 2001, p. 483). In northern coastal Oregon, historical records are sparse, but early trapping records verify occurrence of martens in Benton, Clatsop, Columbia, Lincoln, Polk, Tillamook, Washington, and Yamhill counties (Zielinski et al. 2001, p. 483). Similar to the pattern of distribution of northern coastal California historical records, historical records of marten in coastal Oregon predominantly (>90 percent) occur closer to the coast than in the interior portions of the historical range (Figures 4.1 and 8.1).

8.1.2 Current Distribution (1980 to present)

To describe the current distribution of martens in coastal Oregon and northern coastal California, we compiled verifiable marten detections from surveys (track plate stations, photographic bait stations, snow-track surveys), roadkill mortality locations, locations of martens legally trapped (Oregon only), live-capture locations (from research projects), and locations derived using radio telemetry (research projects). Pre-2005 survey efforts and results were summarized by Zielinski et al. (2001, pp. 483, 484) and Slauson and Zielinski (2004, p. 62), and post-2005 survey efforts and results were summarized from published sources (Slauson et al. 2009b; Hamm et al. 2012) and unpublished sources (BLM, California State Parks, Green Diamond Resource Company, Hoopa Tribe, Humboldt Redwoods Company, Mendocino Redwoods Company, Pacific Southwest Research Station, Redwood National Park, Yurok Tribe of the Yurok Reservation [Yurok Tribe]). In central and north coastal Oregon, where survey efforts have been sparse (Figure 8.2), we relied on the locations of carcasses from road killed individuals and the recent locations where martens have been legally trapped.

The Humboldt marten subspecies from northern coastal California was considered to be extremely rare or extinct (Zielinski and Golightly 1996, entire) until 1996, when a single population was rediscovered on the Six Rivers National Forest in Del Norte County, California (Zielinski et al. 2001, p. 487). Zielinski and Golightly (1996, p. 117) could not document a single verifiable detection within the historical range in the 50 years prior to 1995. Therefore, detections of Humboldt martens in 1996 represented the first verified presence of martens within the range of the Humboldt marten subspecies in 50 years (Zielinski et al. 2001, p. 487).

Despite surveys occurring at greater than 3,000 locations and representing greater than 50,000 days of effort throughout northern coastal California, martens were detected in a small geographical area in the extreme northern portion of the historical range in California, representing less than five percent of the historical range of the currently described Humboldt marten subspecies (Figure 8.2). In 2008, this remnant marten population occupied a 100 percent minimum convex polygon area of 627 km^2 (242 mi^2) (Slauson et al. 2009b, p. 9). Currently, both

martens and suitable marten habitat are patchily distributed throughout this area (Figure 7.6). Since 1996, over 600 verifiable marten detections have been documented within the remnant population area mentioned above plus areas in the vicinity of the remnant population area (Table 8.1; Figures 8.2, 8.3).

The current distributions of the two known marten populations in coastal Oregon are not well understood due to insufficient survey effort. Recent surveys (i.e., since the early 1990s) capable of detecting martens in coastal Oregon have primarily occurred in the southern portion of the state (Figure 8.2). Systematic surveys to aid in the delineation of current marten distribution in central and southern coastal Oregon began in the summer of 2014 (Slauson 2014, unpublished survey design and field protocol). The 2014 surveys covered approximately 175 km^2 (67.6 mi^2; 96 survey stations) in central coastal Oregon, and approximately 48 km^2 (18.5 mi^2; 29 survey stations) in southern coastal Oregon. A marten was detected at only one station, approximately 11 km south of Reedsport, Oregon, and 0.5 km west of U.S. Highway 101 in Coos County (< 1 km south of the Douglas County border). In coastal Oregon, verifiable marten detections are located in two distinct areas; on or adjacent to the Rogue River-Siskiyou National Forest in southern coastal Oregon (35 detections), and on or adjacent to the Siuslaw National Forest in central coastal Oregon (19 detections) (Figure 8.2). The verifiable marten detections in central coastal Oregon consist of 14 roadkill mortality locations (along U.S. Highway 101 on or in the immediate vicinity of the Siuslaw National Forest and Oregon Dunes National Recreation Area along the central Oregon coast), 3 recent (2013) trapping records, and 2 survey detections (one of which was from the 2104 survey effort) (Figure 8.2; Table 8.1). Verifiable marten detections in southern coastal Oregon were from track plate stations, photographic bait stations, and snow-track surveys.

Despite limited survey effort in central and northern coastal Oregon, and relatively few current verifiable detections, the landscape habitat suitability model suggests that suitable conditions exist to support a marten population on and in the immediate vicinity of the Siuslaw National Forest (Figure 7.6).

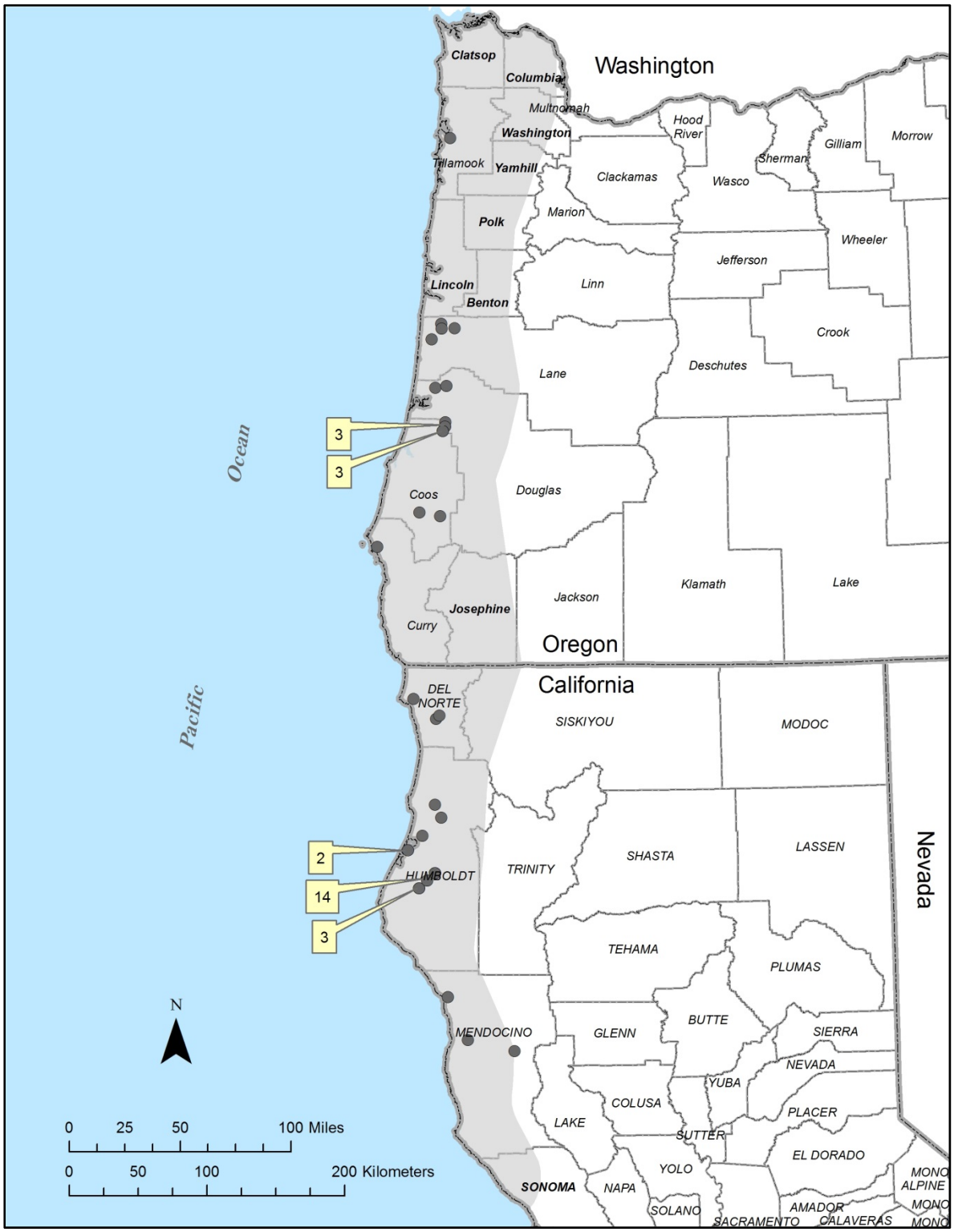

Figure 8.1. Historical (pre-1980) verifiable marten detections (dark gray circles) within the historical range (light gray shading) of the coastal marten. Each circle represents a single detection unless otherwise noted (numbers in boxes). Counties with bold labels have one or more historical trapping and\or museum records, but lacked precise locational data for mapping.

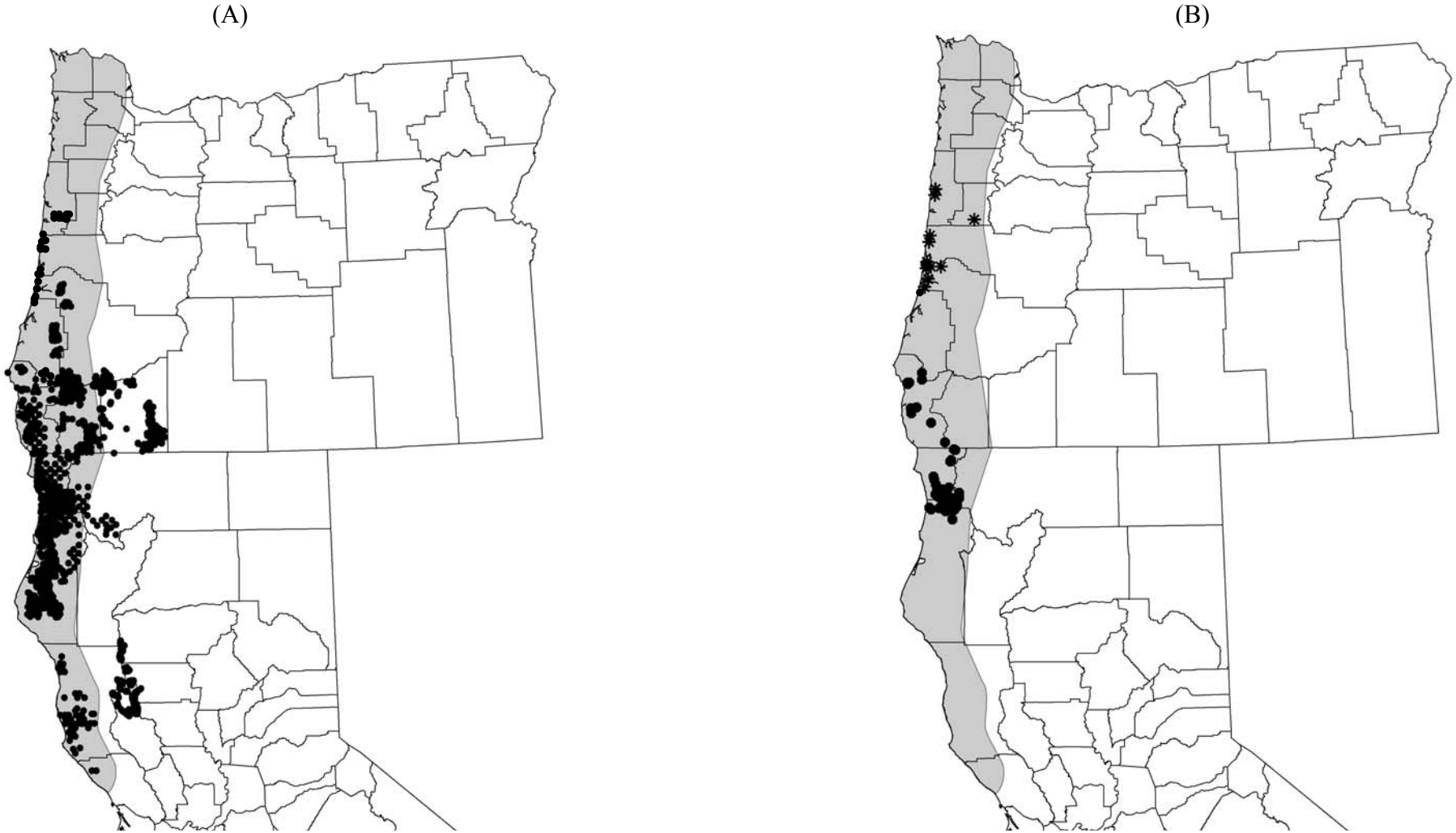

Figure 8.2. (A) Distribution of current survey effort, and (B) current verifiable marten detections from surveys (circles), and road kill mortalities (n = 14) or trapped (n = 3) individuals (asterisks; central coastal Oregon) in the analysis area.

8.2 POPULATION STATUS

8.2.1 Delineation of Extant Population Areas

All current (since 1980) verifiable marten detections described above and suitable marten habitat were used to delineate extant population areas (EPAs) within the analysis area. The number of verifiable marten detections available to guide the delineation of the boundaries of the extant populations varied considerably across the analysis area. Marten detection locations were buffered by 2 km (1.2 mi) and connected to create a preliminary "population area". A 2-km buffer distance was used because most coastal marten survey and monitoring grids use a 2-km grid spacing, thus to feel confident about where animals do not occur, one would need to get to the next grid point without detections (Slauson 2014a, pers. comm.). Suitable marten habitat around each population area extending 2 km (1.2 mi) out from peripheral marten records was also used to delineate each EPA. Suitable habitat was identified using the aforementioned landscape habitat suitability model (see **Current Landscape Habitat Suitability** section). Adjacent marten records (less than 5 km (3 mi) apart; representing a typical marten dispersal distance; see **Dispersal and Recruitment** section), were connected using the shortest direct line. However, if the shortest direct line crossed unsuitable habitat, then the shortest path through suitable habitat was used. If the total number of verifiable detections in an area was less than 5 or they were separated by greater than 5 km (3 mi) from other verifiable detections, the combined detections were not designated as an extant population area due to the insufficient level of information to suggest a likely self-sustaining population.

Based on the distributions of current verifiable marten detections and adjacent suitable habitat, we identified three extant population areas within coastal Oregon and northern coastal California (Figure 8.3):

1) Central Coastal Oregon Extant Population Area (CCO_EPA)
2) Southern Coastal Oregon Extant Population Area (SCO_EPA)
3) Northern Coastal California Extant Population Area (CA_EPA)

8.2.1.1 Central Coastal Oregon Extant Population Area (CCO_EPA)

The CCO_EPA has received the least survey effort of the three EPAs. Therefore, this EPA was delineated using largely the distribution of suitable habitat and 19 verifiable marten detections available for this area, which include 14 roadkill mortality locations, 3 recent (2013) trapping records, and 2 survey detections (Figure 8.3; Table 8.1). At the landscape scale, the CCO_EPA consists of approximately 20 percent of coastal marten habitat of high suitability; 36 percent of moderate suitability; 22 percent of low suitability; and 21 percent unsuitable (Figure 7.6; Table 8.2; Slauson et al. *In prep.*(b)). Coastal dune forest within the CCO_EPA was not considered suitable by the landscape habitat suitability model, despite being considered suitable based on visual observations (Slauson 2014b, pers. comm.) and the presence of several verifiable marten detections (Figure 8.3). The amount of coastal dune forest within the CCO_EPA is relatively small, occurring as a narrow coastal strip. Coastal areas within southern Oregon and northern coastal California were also excluded by the habitat model, but considered suitable in certain

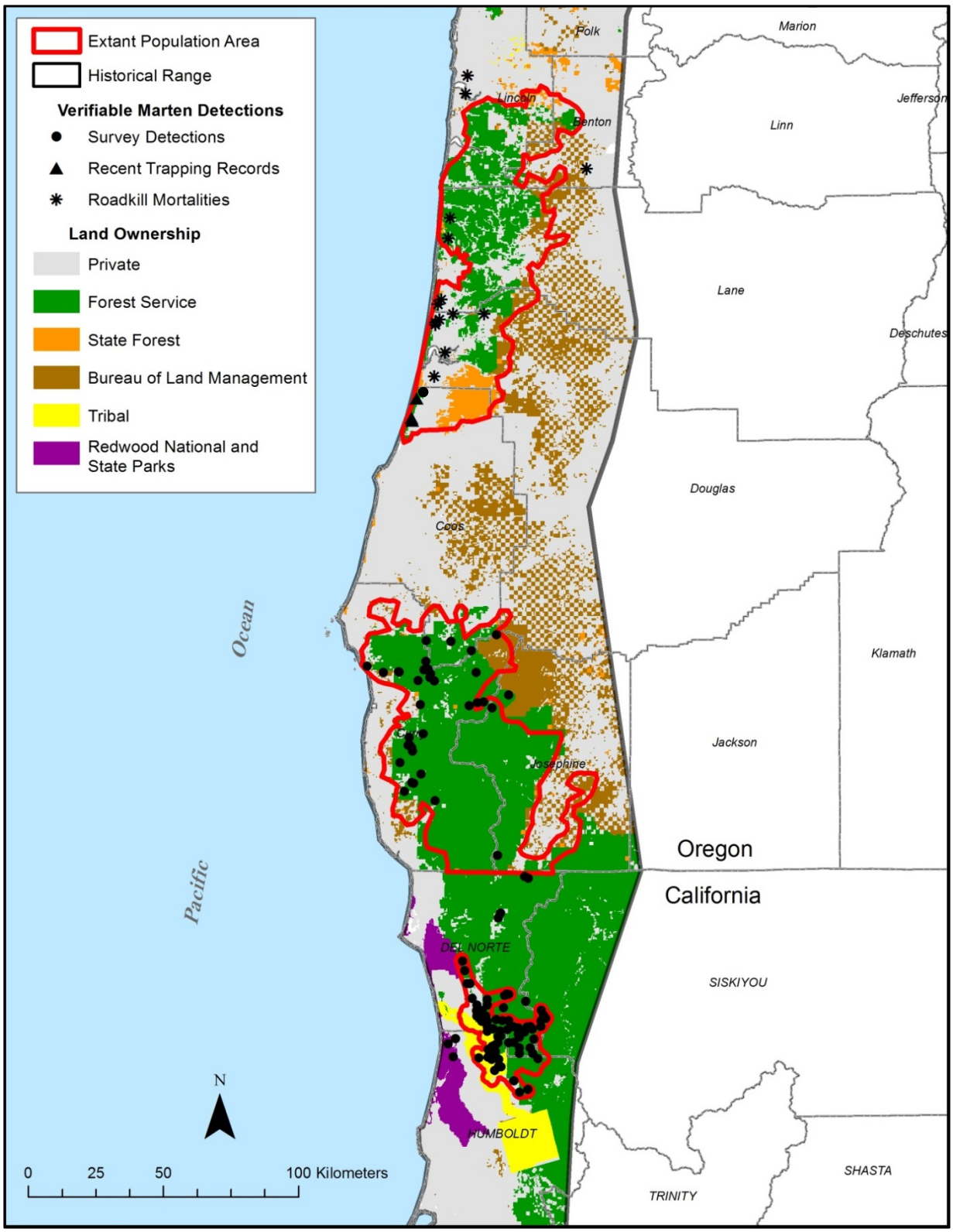

Figure 8.3. Coastal marten extant population areas. Central coastal Oregon (CCO_EPA; top), southern coastal Oregon (SCO_EPA; middle), and northern coastal California (CA_EPA; bottom).

Table 8.1. Current (since 1980) verifiable marten detections used to delineate the three extant population areas (EPAs) within the range of the Pacific marten in coastal Oregon and northern coastal California. Data sources: Zielinski et al. (2001); Slauson and Zielinski (2004); Slauson et al. 2009b; Hamm et al. 2012, Humboldt Marten Conservation Assessment and Strategy (Slauson et al. *In prep.*(a)), and unpublished sources.

Population	Source of Detections	No. of Detections	Counties	Land Owners (percent of EPA)
Central Coastal Oregon	• Road kill mortalities • Trapping records • Track plate stations	19	Lincoln, Benton, Lane Douglas, Coos	• Forest Service (41) • Private (40) • BLM (10) • Oregon Department of Forestry and Oregon State Parks, combined (9)
Southern Coastal Oregon	• Track plate stations • Photographic bait stations • Snow-track surveys	35	Coos, Douglas, Curry, Josephine	• Forest Service (78) • Private (13) • BLM (8) • Oregon Department of Forestry (<1)
Northern Coastal California	• Track plate stations • Photographic bait stations • Live-captures • Radio-telemetry	>600	Del Norte, Humboldt, Siskiyou	• Forest Service (65) • Yurok Tribe (23) • Private (11) • Redwood National and State Parks (1)

locales, especially within state- or federally-owned areas (Slauson et al. *In prep.*(a)). At this time, neither the SCO_EPA nor the CA_EPA currently includes these coastal areas (Figure 8.3).

The 4,150 km^2 (1,602 mi^2) CCO_EPA includes all coastal draining watersheds from the Umpqua River north to the Yaquina River in Lincoln, Benton, western Lane, western Douglas, and northwestern Coos counties. The principal land managers in the CCO_EPA include the BLM, Siuslaw National Forest, and ODF. Most of the private land is assumed to be owned by private industrial timber companies.

8.2.1.2 Southern Coastal Oregon Extant Population Area (SCO_EPA)

Approximately 52 percent of the 4,696 km^2 (1,813 mi^2) SCO_EPA consists of coastal marten habitat of high suitability; 26 percent of moderate suitability; 17 percent of low suitability; and 5 percent unsuitable (Figure 7.6; Table 8.2; Slauson et al. *In prep.*(b)). This EPA was delineated using only detections from surveys, which were mostly patchily distributed across the landscape. Currently, we consider this EPA to exist largely within the Siskiyou National Forest and immediately adjacent lands.

The SCO_EPA includes the Chetco River, Pistol River, South Fork Rough and Ready Creek, North Fork Smith River watersheds in Curry, western Josephine, and southern Coos counties. The principal land managers in the SCO_EPA include the BLM and Rogue River-Siskiyou National Forest. Most of the private land is assumed to be owned by private industrial timber companies.

8.2.1.3 Northern Coastal California Extant Population Area (CA_EPA)

More than 600 verifiable marten detections were used to delineate the 812 km^2 (313 mi^2) CA_EPA (Figure 8.3, Table 8.1). At the landscape scale, approximately 67 percent of the CA_EPA consists of coastal marten habitat of high suitability; 14 percent of moderate suitability; 7 percent of low suitability; and 12 percent unsuitable (Figure 7.6; Table 8.2; Slauson et al. *In prep.*(b)). The CA_EPA includes the South Fork of the Smith River, Blue Creek, Bluff Creek, Camp Creek, Cappell Creek, Pecwan Creek, Slate Creek, and Rock Creek (Siskiyou County, north of Orleans, California) watersheds in Del Norte, northern Humboldt, and western Siskiyou counties. The principal land managers include the Green Diamond Resource Company, Klamath National Forest, Six Rivers National Forest, and the Yurok Tribe.

Two areas within the vicinity of the CA_EPA had verifiable marten detections, but were excluded from the CA_EPA because they did not meet the criteria described above: (1) Prairie Creek Redwoods State Park and, (2) the area just east of U.S. Highway 199 near the California-Oregon border in northeastern Del Norte County (Figure 8.3). To the west of the EPA, one or two marten detections have occurred annually in the same general area of Prairie Creek Redwoods State Park from 2009 to 2013. However, these detections are approximately10 km (6.2 mi) from the nearest marten detection to the east (within the CA_EPA) and were insufficient in number to be considered a population. In addition, little suitable marten habitat exists between these marten records and the CA_EPA to the east. To the north of the CA_EPA, from 2012–2013 four detections of martens occurred just east of U.S. Highway 199 near the Oregon border (Figure 8.3). It is unclear whether these detections represent a portion of the distribution of this extant population. However, using the criteria above the number of detections did not warrant designation as a separate EPA. Additional surveys are required to determine the distributional extent and number of individual martens present in this portion of the analysis area.

Table 8.2. Amount (km^2) and percent of total area of coastal marten habitat within each extant population area by suitability class and land ownership. Values for the entire analysis area include all three extant population areas and all areas within the historical range of the coastal marten outside the three EPAs. All values rounded to the nearest whole number.

Extant Population Area	Habitat Suitability Class	All Land Owners Combined		Land Owner							
				Federal		State		Private		Tribal	
		Area (km^2)	Percent of total	Area (km^2)	Percent of total	Area (km^2)	Percent of total	Area (km^2)	Percent of total	Area (km^2)	Percent of total
Central Coastal Oregon (CCO_EPA)	Low	931	22	341	16	144	37	441	27	-	-
	Moderate	1509	36	1,005	48	109	28	393	24	-	-
	High	839	20	653	31	49	13	137	8	-	-
	Unsuitable	871	21	96	5	86	22	676	41	-	-
	Total Area	4150 km^2		2,096 km^2		388 km^2		1,647 km^2		0 km^2	
Southern Coastal Oregon (SCO_EPA)	Low	803	17	556	14	5	17	242	38	-	-
	Moderate	1213	26	971	24	7	26	235	37	-	-
	High	2428	52	2,301	57	13	51	113	18	-	-
	Unsuitable	252	5	201	5	2	6	49	8	-	-
	Total Area	4696 km^2		4,029 km^2		26 km^2		640 km^2		0 km^2	
Northern Coastal California (CA_EPA)	Low	54	7	16	3	<1	<1	11	13	27	14
	Moderate	116	14	72	14	<1	9	23	26	21	11
	High	540	67	431	82	7	91	48	54	54	28
	Unsuitable	102	13	5	1	0	0	7	8	89	49
	Total Area	812 km^2		525 km^2		8 km^2		90 km^2		191 km^2	
Entire Analysis Area	Low	10,308	18	3,240	18	800	24	6,110	18	115	16
	Moderate	7,018	12	3,654	21	549	16	2,725	8	63	9
	High	6,002	11	4,913	28	232	7	760	2	88	12
	Unsuitable	33,377	59	5,774	33	1,827	54	24,872	72	456	63
	Total Area	56,705 km^2		17,582 km^2		3,408 km^2		34,467 km^2		722 km^2	

8.3 POPULATION ABUNDANCE AND TREND

Zielinski and Golightly (1996, entire) reviewed all published and unpublished historical information on the coastal marten in northern coastal California (i.e., currently classified as the Humboldt marten subspecies), and results of recent (1989–1995) field surveys conducted within its historical range, to determine the status of the subspecies in the redwood zone of California. They concluded that martens in the northern Coast Ranges of California were relatively common in the late 19th century and early 20th century, but declined significantly starting in the late 1920s, and that the last verifiable marten detection (a trapping record from the 1940s) was 50 years old, (at the time of their analysis) suggesting the subspecies was very rare, if not extinct (Zielinski and Golightly 1996, pp. 115, 117). The population decline was noted by Grinnell et al. (1937, pp. 209–210) when they summarized that the Humboldt marten is "…of rather sparse occurrence, though in earlier years it was more generally distributed and fairly numerous." For example, one trapper captured 50 martens in one winter in the early 1920s within a few miles of the coast in central Humboldt County, California (Grinnell et al. 1937, p. 210). Declining trapping harvests led to the closure of the marten trapping season in northwestern California in 1946 (Zielinski et al. 2001, p. 479).

As described above, martens in coastal Oregon are currently known from two populations; one in central coastal Oregon and one in southern coastal Oregon. Slauson et al. (2009a, p. 1340; citing Zielinski et al. 2001 and Slauson 2003) stated that these two populations are small and isolated due to natural distribution of suitable habitat, historical and contemporary effects of timber harvest, and historical effects of fur trapping. Further, Slauson and Zielinski (2009, p. 35) stated that marten populations in coastal Oregon and California have declined. Zielinski et al. (2001, pp. 482) reported that the number of martens harvested in coastal Oregon counties has declined since the 1940s. By the 1970s, martens were considered very rare along the Oregon coast (Mace 1970, pp. 13–14; Maser et al. 1981, pp. 293–294). Abundance estimates for the two coastal Oregon populations are not available. Marten surveys in unsurveyed portions of coastal Oregon began in mid-2014, but the area surveyed to date represents a small amount of the currently available suitable habitat found within the CCO_EPA and SCO_EPA. Additional presence\absences surveys are required to accurately delineate the distribution of these two populations, and grid-based surveys are required to estimate abundance. Because U.S. Highway 101 runs the entire length of the range of martens in coastal Oregon and northern coastal California, scientists expect densities of road kills to reflect the abundance of martens (Zielinski et al. 2001, p. 487). The best available data indicate an absence of reported marten road kills along coastal U.S. Highway 101 in northern coastal Oregon, southern coastal Oregon, and northern coastal California, suggesting low numbers of martens, at least within coastal habitat in the vicinity of U.S. Highway 101 in those regions (Zielinski et al. 2001, p. 487). Thus, the overall limited number of roadkill records, a reduction in trapping records in coastal Oregon since the 1940s (Zielinski et al. 2001, p. 482), and the fact that the two extant populations in coastal Oregon and single population in northern coastal California are considered to be small and isolated has led species experts (Slauson et al. 2009a, p. 1340) to have serious concerns about the viability of coastal marten populations.

In 2009, the size of the coastal marten population in northern coastal California was estimated using data from systematic surveys conducted in 2000–2001 and again in 2008 using the multi-

state occupancy method (Slauson et al. 2009b, p. 11). Slauson et al. (2009b, p. 11) estimated 31.5 coastal martens (95 percent confidence interval = 24–40) in 2000–2001 and 20.2 martens (95 percent confidence interval = 11–30) in 2008. The change between 2000–2001 and 2008 marks a significant decline in site occupancy, representing a change in occupancy rate $\lambda = 0.58$ (standard error = 0.13, 95 percent confidence interval = 0.31 to 0.81) or a 42 percent decline in occupancy over the 7-year period (Slauson et al. 2009b, p. 10). In 2012, all locations sampled in 2008 were resampled (Slauson et al. *In prep.*(a)). Preliminary occupancy estimates for the 2012 sampling were similar to results from 2008 (Slauson et al. *In prep.*(a)), suggesting that marten population abundance in northern coastal California did not change over that time period. Slauson et al. (2009b, p. 13) stated that the population estimates should be considered minimum estimates because the sampling area did not fully cover all potentially occupied habitats. As a result, Slauson et al. (2009b, p. 13) suggested more realistic population estimates to be double these population estimates; that is, a population estimate of 60 coastal martens in 2000–2001 and 40 in 2008. Slauson et al. (2009b, p. 13) concluded that it is likely the entire coastal marten population in northern coastal California contains fewer than 100 individuals (Table 8.3), which we consider to be the current population estimate for California.

Table 8.3. Distribution, abundance, and trend for the three extant population areas (EPAs) of the coastal marten in coastal Oregon and northern coastal California.

Extant Population[1]	Total Area of EPA	Percent of Entire Historical Range	Land Ownership	Abundance Estimate	Population Trend	Source for Estimates
Central Coastal Oregon (CCO_EPA)	4150 km^2 (1,602 mi^2)	7	• U.S. Forest Service (41 percent) • Private (40 percent) • BLM (10 percent) • Oregon Department of Forestry and State Parks (9 percent)	No estimates exist	Presumed to be in decline[2]	Zielinski et al. 2001, p. 482; Slauson and Zielinski 2009, p. 35
Southern Coastal Oregon (SCO_EPA)	4696 km^2 (1,813 mi^2)	8	• U.S. Forest Service (78 percent) • Private (13 percent) • BLM (8 percent) • Oregon Department of Forestry (<1 percent)	No estimates exist	Presumed to be in decline[2]	Zielinski et al. 2001, p. 482; Slauson and Zielinski 2009, p. 35
Northern Coastal California (CA_EPA)	812 km^2 (313 mi^2)	1.4	• U.S. Forest Service (65 percent) • Yurok Tribe (23 percent) • Private (11 percent) • Redwood National and State Parks (1 percent)	<100 individuals	Declining 2001–2008; unchanged 2008–2012[3]	Slauson et al. 2009b, pp. 10, 11, 13

[1]All three marten populations in coastal California and Oregon are native. No known marten reintroductions have occurred in the analysis area.
[2]Both populations are believed to be in decline based mainly on a reduction in the number of martens legally trapped and anecdotal sightings over time. However, current population numbers are unknown.
[3]The population declined by approximately 42 percent between 2001 and 2008, based on a comparison of occupancy estimates from systematic grid-based surveys conducted in 2000–2001 and 2008. Preliminary occupancy estimates from 2012 are similar to 2008 values (Slauson, unpublished data).

9. STRESSORS ON COASTAL MARTEN POPULATIONS AND HABITAT

In this section we review and evaluate past, current, and future stressors potentially affecting coastal marten populations or their habitat within the analysis area. To identify stressors, we reviewed the best available scientific and commercial information presented in this species report, as well as information from an earlier Humboldt marten species assessment (USDI FWS 2010, entire), information from a draft Humboldt marten conservation assessment and strategy (Slauson et al. *In prep.*(a), entire), and relevant literature for other species and subspecies of martens in North America. We define a stressor as any human-caused or natural activity or process that has caused, is causing, or may cause in the near future, negative effects resulting in:

1. A further decline of coastal marten populations.
2. A further decline in the amount of suitable coastal marten habitat.
3. An impediment to restoration of coastal marten populations or habitat.

9.1 CLASSIFYING STRESSORS

We separated stressors into two categories: (1) activities and processes potentially affecting marten populations; and (2) activities and processes potentially leading to the loss, degradation, or fragmentation of suitable marten habitat. We identified the following stressors on coastal marten populations or suitable habitat:

Activities and processes potentially affecting marten populations:

1. Trapping
2. Predation
3. Disease
4. Collision with vehicles
5. Exposure to toxicants

Activities and processes potentially leading to the loss, degradation, or fragmentation of suitable marten habitat:

1. Wildfire
2. Climate change
3. Vegetation management
4. Development

For each stressor we identified the *timing*, estimated the *scope* and evaluated the potential *impact* of the stressor on each of the three extant populations in the analysis area, and when appropriate, for the entire analysis area or a portion (e.g., California vs. Oregon) of the analysis area. We considered existing and future conditions for all stressors except for climate change, where we only considered future conditions (i.e., over the next 40–50 years).

Timing refers to whether the stressor occurred only in the past, is ongoing, or may occur in the future. To provide a biologically relevant means to assess timing for coastal martens, we calculated marten generation time. Female martens typically first give birth to young at 2 years

of age (Mead 1994). Buskirk et al. (2012) reviewed published studies on marten survival across North America and estimated that adult (>2 years old) annual survival was 0.75 for all adult ages. Using these numbers for age at first reproduction (α) and adult survival (s), marten generation time (T) was calculated as $T = \alpha + [s/(1-s)]$ or $T = 2 + [0.75/(1–0.75)] = 2 + 3$. Thus marten generation time (T) = 5 years. To provide a temporal extent for assessing the impact of stressors to marten populations and habitat, we chose 3 marten generations (as recommended by the International Union for Conservation of Nature (IUCN) 2014, pp. 14–21) or 15 years, with the exception of the climate change and wildfire stressors. To assess the stressor of wildfire, we used a longer period of 30 years based on the availability of wildfire data (for the 28-year period 1984–2012) for the entire analysis area. As mentioned above, we considered potential impacts of climate change over the next 40–50 years, due to the long-term nature of climate change models.

The *scope* of a stressor refers to the estimated proportion of suitable coastal marten habitat within each extant population area or the analysis area (for habitat stressors), or the proportion of a coastal marten population (for population stressors), that can reasonably be expected to be affected by a stressor based on the best available information. The *impact* of a stressor refers to the expected degree of decline it may cause to one or more of the three extant coastal marten populations or by the amount of suitable habitat lost, degraded, or fragmented based on the best available information. We considered only the moderate and high habitat suitability classes (Figure 7.6) of coastal marten habitat as "suitable habitat" in our scope estimates and impact assessments. A classification analysis to determine the proportion of coastal marten verifiable detections occurring in each habitat suitability class has not yet been conducted (Slauson 2014b, pers. comm.). However, we excluded the low habitat suitability class from our estimates because of the low probability of marten occurrence within this habitat suitability class (Slauson 2014b, pers. comm.).

For each stressor, we summarized the best available scientific information relating to its potential direct (e.g., mortality) and indirect (e.g., habitat effects) impacts on coastal marten populations. When significant information gaps existed, resulting in high levels of uncertainty in determining the scope and impact for particular stressors, we used expert opinion. When the scale for available information differed from extant population areas or the analysis area, we derived the values by extrapolating or interpolating available information from smaller or larger scales, respectively. Finally, for one stressor, exposure to toxicants, little information was available for martens; therefore, we used information from the closely related fisher as a surrogate. Besides being a close relative of the coastal marten, the fisher is the only forest carnivore within the analysis area that has been widely tested for exposure to toxicants, especially in California.

We used three impact level classes–low, medium, and high–to represent the likely impact of stressors on marten habitat or populations. We define the impact level classes as follows:

1. Low-level impact:
    a. Stressor is impacting individual martens within one or more populations, but does not likely result in a population-level impact, or
    b. Stressor is resulting in a minimal loss, degradation, or fragmentation of suitable habitat.

2. Medium-level impact:
    a. Stressor is impacting individual coastal martens within one or more populations, and likely resulting in a moderate population-level impact, or
    b. Stressor is resulting in a moderate loss, degradation, or fragmentation of suitable habitat.

3. High-level impact:
    a. Stressor is impacting individual martens within one or more populations, and likely resulting in a significant population-level impact.
    b. Stressor is likely resulting in a significant loss, degradation, or fragmentation of suitable habitat.

Estimated impact levels for all potential stressors on marten habitat or populations are summarized in Table 9.1.

9.2 REVIEW OF STRESSORS

9.2.1 Small and Isolated Population Effects

Population size and trend are the best predictors of extinction risk for vertebrate taxa (O'Grady et al. 2004, p. 516). In general, populations of at least several hundred reproductive individuals are needed to ensure the long-term viability of vertebrates with several thousand individuals being a desirable goal for many vertebrate species (Primack 1993, pp. 335–336). Small, isolated populations are vulnerable to extinction for the following four main reasons (Primack 1993, p. 255):

1. Genetic problems due to loss of genetic variability, inbreeding, loss of heterozygosity, and genetic drift;
2. Demographic fluctuations due to random variations in birth and death rates;
3. Environmental fluctuations due to variation in predation, competition, disease, and food supply; and
4. Natural catastrophes resulting from single events that occur at irregular intervals, such as wildfires, storms, or droughts.

The smaller a population becomes the more likely stressors will reduce the population size even more and drive the population to extinction (Primack 1993, p. 274). The marten population in northern coastal California has been estimated to contain fewer than 100 individuals (Slauson et al. 2009b, p. 13). There are no known population size estimates for the two extant populations in coastal Oregon, but researchers consider both populations likely to be relatively small (Zielinski et al. 2001, p. 478; Slauson and Zielinski 2009, p. 36). The three known extant coastal marten populations are separated from one another by distances 2 to 4 times greater than juvenile dispersal distance reported for American martens (i.e., <15 km (9.3 mi) Phillips 1994, pp. 93–94), suggesting that all three extant populations are functionally isolated from one another. Negative results from surveys conducted between the northern coastal California population and the southern coastal Oregon population confirmed that these two populations are functionally isolated from one another. Less survey effort between the two coastal Oregon populations makes

it more difficult to determine whether those populations are isolated from each other, although the limited amount of suitable habitat between the two populations (Figure 7.6) suggests they are.

For a mammal their size, martens have low reproductive rates suggesting a slow recovery from population-level impacts (Buskirk and Ruggiero 1994, p. 16). Species with low rates of population increase are often unable to rebuild their populations fast enough to avoid extinction following habitat destruction (Primack 1993, p. 102). The potential impacts to coastal marten suitable habitat and populations from the stressors we review below may be exacerbated by small population size and isolation from other populations. For example, a chance event, such as a large wildfire or an outbreak of a lethal pathogen, could potentially impact a large portion of, or an entire, extant population area and its habitat; this (i.e., the occurrence of large wildfires) has occurred recently in both the SCO_EPA and the CA_EPA. The predicted future increase in temperature and reduction in annual rainfall from climate change (refer to the **Climate Change** section below) throughout the majority of the analysis area will probably increase the frequency, size, and severity of future wildfires, which may in turn affect the continued existence of the extant coastal marten populations, especially the SCO_EPA and CA_EPA. Isolated populations are especially at risk from random events, since there is little or no possibility of recolonization if the event affects an entire population that is isolated from other populations.

Based on the current information suggesting that population sizes in Oregon and California are likely relatively small, and considering the current impacts and future potential impacts of other stressors (see sections 9.2.2 and 9.2.3 below), small and isolated population impacts have the potential to affect coastal marten population viability into the future.

9.2.2 Activities and Processes Potentially Affecting Marten Populations

In this section we estimate the scope and impact for those activities and processes that are potential stressors to marten populations currently and in the future. For each stressor, we estimate the scope and impact only within the three extant population areas and not the remaining portions of the analysis area of the coastal marten in coastal Oregon and northern coastal California, where martens are presumed to be extremely rare or extirpated. However, the impact of these stressors would likely apply to individual martens that occur in areas outside of the current EPAs, but with a very low probability of occurrence due to extremely small numbers of marten that are presumed to occupy areas outside the three EPAs. We considered potential impacts of recreational activities on marten populations, but concluded that due to the remote location of the three extant coastal marten populations, low human population density within the three EPAs, and the dense shrub layer preferred by coastal martens, use of suitable coastal marten habitat by humans for recreational activities was rare and thus the potential impact to marten populations to be discountable. Zielinski et al. (2008, p. 1564) found no effect of off-highway-vehicle (OHV) use on Sierra marten occupancy, suggesting that noise-generating recreational activities such as OHV use within occupied habitat have little or no impact on marten populations.

9.2.2.1 Trapping

Extensive unregulated fur trapping conducted over a long period of time can lead to a species range reduction, the extirpation of populations, or extinction of the species. Unregulated coastal marten fur trapping beginning in the late 1800s led to a marked reduction in the species distribution across coastal Oregon and northern coastal California by the late 1920s (see details below). Localized trapping may also negatively affect populations through removal of individual coastal martens that are vital to the long-term viability of the population (e.g., reproductive adult females). Population level effects of coastal marten trapping have not been studied, but coastal marten population growth is most significantly affected by a reduction in marten survival rates (see **Population Biology and Dynamics** section above). Therefore, for small coastal marten populations, the loss of only a few adult martens each trapping season could reduce the likelihood of long-term population viability into the future, especially when combined with mortalities from other sources such as roadkill, disease, predation, and exposure to toxicants. Annual juvenile recruitment (estimated at 50 percent for the coastal marten; Slauson et al. *In prep.*(a)) may offset losses due to legal trapping. However, annual mortality rates from other sources are either unknown (e.g., roadkill, disease, exposure to toxicants) or derived from a relatively small area and small sample size of martens (predation within the CA_EPA; refer to the **Predation** section below for details).

We considered the potential impacts of live-trapping and handling for research purposes on coastal marten populations as discountable due to the limited distribution (currently only a single project in the western half of the CA_EPA where no martens were injured or killed during live-trapping) of marten research projects in the three extant population areas and due to the strict trapping and handling protocols that must be adhered to by coastal marten researchers to ensure the safety of study animals. We do not have information to suggest that there would be any change to the level of anticipated impacts of live-trapping and handling for research purposes over the next 15 years, and we expect continued strict trapping and handling protocols.

Historically, coastal marten were first trapped by Native Americans in California and Oregon for use as tribal ceremonial regalia and later by European settlers for fur. The long-use of ceremonial regalia by Tribes suggests that martens were not trapped for these purposes at levels that would significantly affect marten populations. By the late 1800s and early 1900s, European settlers began trapping for the fur trade industry (Anonymous 1914, p. 20; Grinnell et al. 1937, pp. 5–10). By the early 1900s, annual harvest totals of martens in the analysis area were already in decline, signaling stress on populations from trapping (Dixon 1925, pp. 23–25; Zielinski et al. 2001, pp. 482–483). Accounts of individual trappers taking 35 and 50 martens in single winters within the California portion of the analysis area indicate the impact individual trappers had on marten populations (Grinnell et al. 1937, p. 205). The sharp decline in annual harvest rates prompted Dixon (1925, p. 25) to call for the closing of the marten trapping season in California for fear of their extirpation. However, marten trapping continued and further reduced populations, resulting in excessive harvest of coastal marten populations that will take many years to recover and likely resulting in the loss of genetic variation (Strickland 1994, p. 151).

The number of martens harvested in coastal Oregon counties has declined since the 1940s (Zielinski et al. 2001, p. 482), and by the 1970s martens were considered very rare along the

Oregon coast (Mace 1970, pp. 13–14; Maser et al. 1981, pp. 293–294; Zielinski et al. 2001, p. 483). Historical trapping of coastal martens for fur is considered by researchers as the likely cause of the marked contraction in coastal marten distribution and reduction in population size that was observed in coastal Oregon and northern coastal California in the early 20th century (e.g., Zielinski et al. 2001, p. 486; Slauson 2003, pp. 1–9). The trapping season for martens was closed in 1946 in the California portion of the analysis area; however, decades of protection from trapping have not resulted in the recovery of coastal marten populations in northern coastal California (Slauson and Zielinski 2004, p. 61).

Currently, trapping for martens is illegal in California. However, it is legal to trap other mammals that may occur within occupied coastal marten habitat in northern coastal California (e.g., bobcat, gray fox). Because body-gripping traps are illegal in California, we expect that coastal martens that are incidentally captured in "live-traps" set for other species would be released unharmed. Therefore, we consider the population level impacts from mortalities associated with incidental capture of martens in the CA_EPA as discountable both currently and over the next 15 years assuming marten trapping remains illegal in California. Furthermore, the scarcity of coastal martens in northern coastal California outside the CA_EPA suggests that incidental trapping-related injury to or mortality of coastal martens in those areas has a very low probability of occurrence.

In contrast to California, trapping of coastal marten for their fur is currently legal in Oregon. Coastal marten trapping records for the Oregon portion of the analysis area peaked in the 1940s and in no decade since have coastal marten harvest levels reached ≥15 percent of the 1940s total coastal marten harvest (Zielinski et al. 2001, p. 482). Currently, the harvest of marten in the Oregon Coast range is rare (Hiller 2011, p. 17). For example, three coastal marten were trapped within the entire Oregon portion of the analysis area (and area of 36,348-km^2 (14,034 mi^2)) during the 2013 trapping season (Oregon Department of Fish and Wildlife, unpublished data). A total of 36 martens (mean = 2.7 harvested per year; range = 0–5; standard deviation = 1.90) were harvested within coastal Oregon counties between 1969 and 1995 (Verts and Carraway 1998, p. 409). We excluded martens harvested from 1969 to 1995 in Lane (310 martens harvested) and Douglas counties (167 harvested) since both of these counties extend from the coast to the Oregon Cascades. Although most martens harvested in those two counties were likely from the Oregon Cascades, the actual proportion harvested within the Coast Range is unknown, but expected to be similar to the small number harvested in other coastal counties during that time frame.

The low number of coastal marten trapped in the Oregon portion of the analysis area in the recent past could be due to low marten densities in the two extant population areas in coastal Oregon, or possibly due to low trapping effort. Few Oregon trappers (4 to 8) have pursued marten in recent years, with most marten captures occurring in the Cascade Range of interior Oregon (Hiller 2011, p. 17), which is outside the historical range of the coastal marten. The three coastal martens (two males and one female) harvested during the 2013 trapping season were all captured within 2 km (1.2 mi.) of the coast between 8 and 17 km (5 and 11 mi) north of Coos Bay, Coos County, Oregon (Oregon Department of Fish and Wildlife, unpublished data). The proximity of all three harvested coastal marten to one of the more heavily [human] populated areas (i.e., Coos Bay, Oregon) in the CCO_EPA suggests that trapping activity might be more

prevalent near human population areas that are readily accessible by vehicles, such as via U.S. Highway 101 that traverses the CCO_EPA north to south near the coastline.

The legal marten harvest season in Oregon is open only during the winter (November 1 to January 31), but can occur throughout the entire Oregon portion of the analysis area. We estimated the scope of legal trapping by calculating the amount of moderate and high suitability coastal marten habitat within each coastal Oregon EPA. We presumed that all moderate and high suitability habitat within each extant population area was accessible to fur trappers. We estimated the scope of legal trapping at 57 percent of the 4,178-km^2 (1,613 mi^2) CCO_EPA and 78 percent of the 4,696-km^2 (1,813 mi^2) SCO_EPA.

Population level impacts of legal coastal marten trapping within the two Oregon EPAs have not been studied. Further, the impact of trapping on a marten population requires an estimate of population abundance, which is currently unavailable for both EPAs in coastal Oregon. Therefore, the population level impact of removing three martens from the CCO_EPA in 2013 is unknown. If the three trapped martens represent a small percentage of the overall population, the impact would likely be low, provided the loss of these martens is offset by recruitment of juvenile martens into the population. If the CCO_EPA population is similar in size to the population in northern coastal California (i.e., <100 individuals), then removal of three martens per year, especially reproductive females, could potentially affect population viability over time. Future survey efforts to estimate the distribution and abundance of coastal martens within the two EPAs in coastal Oregon may allow for estimates of the population level impacts of legal trapping. Slauson et al.'s (*In prep.*(a)) juvenile coastal marten annual survival rate estimate of 50 percent suggests that annual juvenile recruitment would offset the annual loss of three adults from the population due to legal trapping. Mortality of martens from other sources such as roadkill mortality, disease, and predation, combined with losses due to legal trapping could reduce population viability if these combined losses are greater than juvenile recruitment rates and occur annually into the future.

We consider the legal trapping of coastal marten for fur as having no impact to the population in northern coastal California and a low to medium level of impact to the two extant populations in coastal Oregon currently and over the next 15 years, assuming trapping continues in Oregon and remains illegal in California. The low to medium level impact addresses only losses of martens from trapping and not the other mortality sources mentioned in this report. Also, for California we expect that nearly all coastal martens that are accidentally captured in live traps set for other furbearer species or that are live-trapped for research purposes, will be released unharmed. Although no martens were legally trapped within the SCO_EPA in 2013, future trapping may result in captures within that EPA. At this time, we do not have information to suggest that trapping would not continue in Oregon over the next 15 years.

9.2.2.2 Predation

Predation is a natural ongoing source of mortality for the coastal marten and would not be expected to negatively impact the viability of the three coastal marten populations in coastal Oregon and northern coastal California, unless annual predation rates, combined with all other mortality sources, exceed annual juvenile coastal marten recruitment rates (estimated at 50

percent for the coastal marten; Slauson et al. *In prep.*(a)). However, little is currently known about coastal marten predation rates (see estimate below) or mortality rates from other sources. Strickland et al. (1982, p. 607) summarized reports of American martens being preyed upon by coyotes, fishers, red foxes, cougars, eagles (*Aquila chrysaetos*, *Haliaeetus leucocephalus*), and great horned owls. Bull and Heater (2001a, p. 3) in their northeastern Oregon study area documented 18 martens (i.e., *Martes caurina vulpina*) killed by predators: 44 percent by bobcats, 22 percent by raptors, 22 percent by other martens, and 11 percent by coyotes. The only documented coastal marten predator is the bobcat (see details below).

Historical coastal marten predation rates are unknown. Although the historical assemblage of coastal marten predator species was likely similar to the current assemblage, human-caused changes in vegetation composition and distribution and extensive road building over time likely increased predator densities and distribution within the analysis area. For example, the distributions of several mesocarnivores (i.e., "mid-sized" carnivores such as bobcat, fisher, and gray fox) in redwood forests, which are potential predators of the coastal marten, have changed over the last 80 years (Slauson and Zielinski 2007, p. 242). In northern coastal California, fisher and gray fox have not only maintained their interior distributions but also appear to have expanded their distributions in coastal redwood forest habitat concurrently with the dramatic decline in the distribution of coastal martens (Slauson and Zielinski 2007, p. 242). These distribution changes have occurred in areas where past logging of coastal forest has reduced the complexity of the shrub and herb layers due to various factors such as mechanical treatments, prescribed burning, herbicides, and densely stocked conifer stands (Slauson and Zielinski 2007, p. 241). Fishers and gray foxes typically occupy forest types where shrub densities are naturally lower and are rarely detected in coastal forest with spatially extensive shrub cover (Slauson and Zielinski 2007, p. 242), the latter of which is typically preferred by small-bodied coastal martens where they can have an advantage over other larger-bodied carnivores (Slauson et al. 2007, p. 466). Another recent study within northern coastal California suggests that bobcats and gray foxes frequent roads in forests dominated by redwoods (Slauson and Zielinski 2010, pp. 77–78); the same is likely true for other forest types throughout the analysis area in coastal Oregon and northern coastal California, but has not been confirmed. Slauson and Zielinski (2010, pp. 77–78) indicate that roads may be facilitating the presence and abundance of these predator species in dense-shrub landscapes, and increasing the risk of intraguild predation (i.e., the killing and eating of potential competitors) for coastal martens. Therefore, based on current habitat conditions (i.e., reduced complexity of herb and shrub layers), past logging practices in combination with existing roads may have facilitated an increase in the distribution of mesocarnivores in the analysis area and increased the likelihood that coastal martens will encounter a mesocarnivore predator. We expect the same to be true for the SCO_EPA and the CCO_EPA in coastal Oregon, but lack sufficient information from which to draw a conclusion.

Predation of coastal martens has only recently begun to be studied. Since the fall of 2012, researchers have radio-tracked up to 23 coastal martens within the western portion of the CA_EPA to determine survival rates and cause of death. To date, a total of nine coastal martens have been found dead (Slauson et al., unpublished data). The cause of death for all nine coastal martens was determined to be predation by bobcats (Slauson et al., unpublished data). As stated in the **Population Status** section above, the coastal marten population within the CA_EPA was estimated to have undergone a 42 percent decline in occupancy between 2000 and 2008 (Slauson

et al. 2009b, p. 11). Slauson et al. (2009b, pp. 9–12) hypothesized that intraguild predation was a possible cause of this decline. The decline in coastal marten occupancy in the CA_EPA appears to be more pronounced in serpentine habitats on the western edge of the CA_EPA, which is also an area containing fragmented old-growth forest (Slauson et al. 2009b, p. 12) that is adjacent to intensively-managed private industrial timber lands where larger-bodied mesocarnivores are more abundant (Slauson et al. 2009b, p. 12). All nine dead coastal martens from the current study occupied the aforementioned areas within the western portion of the CA_EPA where bobcats are considered more abundant. Within these same portions of the CA_EPA, fishers have recently been photographed visiting the same bait stations as coastal martens, but none of the recent coastal marten deaths were attributed to fisher predation. Predation of coastal martens within the two extant populations in coastal Oregon has not been studied, but we expect that coastal martens within these two populations are exposed to bobcats and other predators, such as gray fox and fishers (in the SCO_EPA only; fishers currently do not occur within the CCO_EPA), especially where extensive logging and road building within suitable coastal marten habitat has occurred.

The scope of this ongoing stressor is 100 percent for all extant populations, since all coastal martens in a population are likely exposed to predators during their lifetime. The only available estimate of coastal marten predation rates was made using the recent known predation events from the CA_EPA mentioned above. Nine of 23 (39 percent) radio-collared martens were found dead within the CA_EPA since the fall of 2012. However, because several of the dead martens were tracked for more than a year as part of a dispersal study, the annual estimated mortality rate was lower than the 39 percent mentioned above. Within the dispersal study area, the current Kaplan-Meier cumulative survival estimate for males and females combined is 0.674 (Slauson, unpublished data) or a 33 percent annual mortality rate from predation. Whether this predation rate also applies to the remainder of the CA_EPA or the SCO_EPA and CCO_EPA in coastal Oregon is unknown. Additional research is needed to determine a mean annual predation rate for the CA_EPA.

Predation is a natural stressor (i.e., part of the natural condition in which the coastal marten has evolved), but human activities such as vegetation management and road building may increase the abundance and distribution of predators within coastal marten home ranges. Of interest, the preliminary home ranges of all nine dead coastal martens mentioned above contained relatively large amounts of recently logged forest, compared with the home ranges of radio-collared coastal martens that are still alive (Slauson 2014c, pers. comm.). In addition, all nine dead coastal martens were found within 100 m (328 ft.) of a road. As described in the **Population Biology and Dynamics** section above, Slauson et al. (*In prep.*(a)) estimated annual juvenile coastal marten survival at 50 percent, which suggests that a 33 percent annual mortality rate from predation may be sustainable. However, mortalities from other sources such as roadkill, disease, trapping, and exposure to toxicants, combined with mortality from predation may decrease annual juvenile survival rates below 50 percent.

The population level impact of predation within the three extant population areas is currently unknown. However, the best scientific and commercial information available indicates that predation is currently occurring, and it is reasonable to assume that some unknown level of predation will continue over the next 15 years. Further research into predation rates and juvenile

recruitment rates is required to determine whether there are population level impacts from predation.

When considered alone, we expect that a 33 percent annual predation rate is sustainable when compared with an annual juvenile coastal marten survival rate of 50 percent, and thus predation alone would not likely result in a population level impact. However, over the next 15 years, annual predation rates and annual juvenile coastal marten survival rates may change; if that change is negative for the coastal marten, population-level impacts for one or more of the three extant coastal marten populations are possible. Therefore, based on the information currently available, we consider the predation stressor as having a low level population impact for all three extant coastal marten populations over the next 15 years.

9.2.2.3 Disease

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. Further, because the three extant coastal marten populations are functionally isolated from one another, recolonization of areas affected by the outbreak is unlikely. Ironically, the fact that the three extant populations are isolated suggests that natural transfer of a lethal pathogen between populations would be unlikely. Numerous pathogens are known to cause severe disease in mustelids (Brown et al. 2008, pp. 5–6), but disease exposure in the coastal marten has not been studied. However, disease exposure has been studied in the closely-related American marten and the Sierra subspecies of the Pacific marten. Strickland et al. (1982, p. 607) noted that American martens in their study area in central Ontario, Canada, tested positive for toxoplasmosis, Aleutian disease (a carnivore parvovirus), and leptospirosis; however, none of these was considered to be a significant mortality factor for martens. Zielinski (1984, pp. 171–172) discovered antibodies to plague (*Yersinia pestis*) in four of 13 Sierra martens (*M. c. sierrae*) in the Sierra Nevada Mountains of California; though martens and many other carnivores seem to be either resistant to plague (Williams et al. 1988, p. 386) or show only transient clinical signs (Zielinski 1984, p. 170). Additionally, plague can substantially reduce local populations of susceptible marten prey species such as rodents and rabbits. Mustelids are especially susceptible to infection by canine distemper virus. Fatal canine distemper virus outbreaks have been observed in black-footed ferrets, martens (*Martes* sp.), polecats (*Mustela putorius*), Eurasian badgers (*Meles meles*), American mink (*Neovison vison*), American badgers (*Taxidea taxus*), European otters (*Lutra lutra*), weasels (*Mustela* sp.), and ferret-badgers (*Melogale* sp.) (Cunningham et al. 2009, pp. 1150–1157).

Brown et al. (2008, entire) determined rates of pathogen exposure for the closely-related fisher in northwestern California on the Hoopa Valley Indian Reservation—located less than 9 km (5.6 mi) south of the nearest coastal marten verifiable detection within the CA_EPA—and demonstrated that fishers were exposed to several serious pathogens including canine distemper virus, canine parvovirus, and West Nile virus. Of the 15 radio-collared fishers found dead on the Hoopa Valley Indian Reservation during the pathogen study, two had been exposed to canine distemper virus and six to canine parvovirus (Brown et al. 2008, p. 3). Evidence of canine distemper virus infection has been reported in all families of terrestrial carnivores (Deem et al.

2000, p. 441) and mustelids are among the species most susceptible to canine distemper disease (Deem et al. 2000, p. 443). For example, the mortality rate of individuals infected with canine distemper in a wild population of black-footed ferrets from Wyoming was 100 percent (Williams et al. 1988, p. 393). Because canine distemper is highly contagious, and viral shedding may follow infection for 60–90 days (Greene and Appel 1990, p. 27), it is reasonable to expect that infected fishers on the Hoopa Valley Indian Reservation, especially dispersing juveniles, could infect the nearby coastal marten population (i.e., martens within the CA_EPA). Even at low exposure rates, canine distemper virus has the potential to greatly reduce the size and distribution of one or more of the small extant coastal marten populations. The estimated size of the marten population within the CA_EPA is small (<100), so an outbreak of canine distemper virus or other lethal carnivore disease could have a population level impact even if a small subset of martens survive the outbreak. Again, the three extant coastal marten populations are geographically isolated from one another, which should reduce the probability of a lethal pathogen spreading naturally from one population to another. However, fur trappers could unintentionally transfer lethal pathogens into and between extant populations via contaminated traps. Similarily, marten researchers could spread a lethal pathogen from one population to another if live traps or track-plate equipment are not disinfected before being moved to another EPA. Infected domestic dogs that are allowed to roam within an extant coastal marten population area could also expose martens to lethal pathogens.

We estimated the scope of this ongoing stressor as close to 100 percent for all three extant population areas; small numbers of coastal martens within a population may be somewhat isolated from other members of the population, and thus may not be exposed during an outbreak. Because the prevalence of lethal diseases within the three extant populations has not been studied, the level of past exposure to these populations is unknown. However, several carnivore species (e.g., fisher, gray fox, bobcat) known to be susceptible to these same lethal diseases, with the fisher known to be recently exposed, share habitat with the coastal marten and could potentially infect martens. For example, if one of the predator species listed above is infected with a lethal canine disease and attacks a healthy marten, even if the marten survives the attack it may be exposed to the pathogen, which it could then spread to other martens in the population, potentially causing a widespread outbreak and loss of a significant portion of the population.

Estimating the probability of an outbreak of a lethal pathogen over the next 15 years within one or more of the three extant coastal marten populations is difficult without further information on the current prevalence of antibodies to lethal pathogens (i.e., a serosurvey) within these populations to estimate past exposure rates. In the absence of seroprevalence data for the coastal marten we are uncertain whether or not a population has been exposed to a particular lethal pathogen in the past and, if exposed, the proportion of the population that was exposed, but survived.

The best available scientific and commercial information indicates that the probability of a lethal pathogen outbreak in one or more of the three extant coastal marten populations within any given year is unknown, but likely low both currently and over the next 15 years. However, if an outbreak does occur, an entire population could be infected, resulting in a significant population decline. We considered the disease stressor as having a low level population impact for all three extant populations over the next 15 years based on our supposition that an outbreak of a lethal

pathogen has a low probability of occurrence within that timeframe. A serosurvey of all three extant populations is required to determine past exposure to pathogens. The presence of antibodies to one or more lethal pathogens indicates that at least a subset of individuals within a population survived exposure to the pathogen in the recent past.

9.2.2.4 Collision with Vehicles

Collision with vehicles is a known source of mortality for the coastal marten currently and expected to continue into the future given the presence of roads within the range of the species. Collisions with vehicles may negatively affect the viability of the three coastal marten populations if annual roadkill mortality rates, in combination with all other sources of mortality, exceed annual juvenile recruitment rates. Based on their small body size, we expect that nearly all coastal martens struck by vehicles will either die immediately from blunt force trauma, or soon thereafter from severe injuries. A small proportion of coastal martens may survive a vehicle strike, but would likely be physically impaired, potentially increasing the probability of mortality from another source such as predation, disease, or starvation. For example, a broken limb from a vehicle strike would reduce the foraging capability of a coastal marten, which relies on swift movements to catch highly mobile prey through rugged terrain and into trees. If the injured coastal marten is an adult female that is caring for dependent kits, her reduced ability to acquire adequate prey may lead to one or more of the kits starving.

Historically, when coastal martens were more widely distributed in coastal coniferous forests in coastal Oregon and northern coastal California, vehicle collisions may have been more common. However, the historical incidence of roadkill mortality of the coastal marten is unknown. Although historical coastal marten population abundance and distribution was greater than at present, historical human population density within the analysis area was also lower, fewer roads and cars existed, and vehicle speeds were lower, suggesting that the incidence of roadkill mortality was historically low. As mentioned above in the **Trapping** section, coastal marten distribution was reduced by unregulated trapping by the late 1920s, when private car ownership was relatively uncommon (Walsh 2004, p. 1). Private car ownership increased little during the economically-depressed 1930s and did not increase significantly until the 1950s (Walsh 2004, p. 1) when coastal marten population size and distribution were already considered to be greatly reduced from historical levels. Finally, historical vehicle speed limits were lower than at present, suggesting that coastal martens had a better chance of evading an oncoming vehicle in the past than at present. For example, the national speed limit during World War II (after mid-1942) was only 35 miles per hour (Walsh 2004, p. 1).

No coastal marten roadkill mortalities have been reported recently (since 1980) in the CA_EPA, SCO_EPA, or in the northern coastal Oregon portions of the analysis area. The 14 documented coastal marten mortalities from vehicle collision since 1980 have all occurred within or near the CCO_EPA in central coastal Oregon (Figure 8.3). Most of these roadkill mortalities occurred on U.S. Highway 101, which traverses the entire CCO_EPA within a few miles of the coast. The impact of roadkill mortalities on the CCO_EPA marten population has not been studied, but 14 mortalities over a 34-year period suggests a low population level impact. Of the nine martens found dead in the CA_EPA the past two years (2012–2014) as part of a dispersal ecology study, none died from vehicle collision (Slauson et al., unpublished data). Although there are no

reported roadkill mortalities for U.S. Highway 101 outside of central coastal Oregon, the predominance of industrial timberlands in these areas and relatively few recent verifiable coastal marten detections likely result in few martens being exposed to vehicle traffic along this highway. Further, no roads with high speed (i.e., >45 m.p.h.) and heavy traffic, such as U.S. Highway 101, exist in the CA_EPA, and only a short segment of U.S. Highway 101 (approximately 5 km (3 mi)) intersects the SCO_EPA, which likely explains the lack of roadkill mortality records for those two EPAs. Alternatively, the SCO_EPA and CA_EPA are more remote than the CCO_EPA; therefore, the probability of a coastal marten carcass being found by a human within the SCO_EPA or the CA_EPA is less likely than within the CCO_EPA. As mentioned above, we expect that nearly all martens that are struck by moving vehicles die immediately from their injuries or move off the road into vegetation and die soon after the collision. Therefore, we suspect that some road killed coastal martens are never recovered. Additionally, post-collision removal of coastal marten carcasses by scavengers also likely occurs. Finally, human passers-by may remove coastal marten carcasses from roadways and do not report the incident to state or Federal wildlife management agencies.

Estimating the scope of this ongoing stressor requires knowledge of home range locations for coastal martens within the vicinity of roads, especially paved highways with heavy traffic volume that travels at high speeds, such as U.S. Highway 101. We assume that the greater the traffic volume and vehicle speed, the higher the likelihood that resident martens could be struck by a vehicle during daily movements within their home range (all else remaining equal). However, coastal marten distributional data and home range size estimates within the CCO_EPA and SCO_EPA are not available. Home range size has been estimated for several coastal martens within certain portions of the CA_EPA, but that EPA does not contain paved highways with heavy traffic traveling at high speed. U.S. Highway 101 with heavy traffic traverses much of the coastal edge of the CCO_EPA within suitable marten habitat, increasing the likelihood that resident martens may come into contact with vehicles during their daily movements. As mentioned above, nearly all known roadkill mortalities within the CCO_EPA occurred within the U.S. Highway 101 corridor (Figures 8.2, 8.3), and no roadkill mortalities are known from the SCO_EPA or the CA_EPA, which contain either no segments of U.S. Highway 101, similar highways (CA_EPA), or only short segments of U.S. Highway 101 (SCO_EPA). An accurate estimate of annual mortality rates from vehicle collision for the three extant coastal marten populations will require further research.

Based on the best available information presented above, we consider the collision with vehicles stressor as having a low level impact on all three coastal marten populations both currently and over the next 15 years. Roadkill mortalities have only been reported for the central coastal Oregon extant population, but with 14 mortalities over the past 34 years, we consider that even this population has been minimally impacted by this stressor. However, determining whether there is a population level impact from collision with vehicles for this population would require an estimate of current population size, which is not available. Although no roadkill mortalities have been reported for the southern coastal Oregon or the northern coastal California extant populations, we predict that over the next 15 years, a small but unknown number of coastal martens from these two populations may be struck by vehicles, especially dispersing juvenile coastal martens that must traverse one or more highways, with heavy traffic traveling at high speeds, to reach unoccupied suitable habitat for establishment of a home range.

9.2.2.5 Exposure to Toxicants

An emerging stressor is the widespread use of anticoagulant rodenticides (ARs) and other pesticides at illegal marijuana grow sites and the potential individual and population level impacts to coastal martens that are exposed to toxicants at these grow sites. Recent efforts to determine the prevalence of ARs in carnivore populations have focused on fisher populations in California due to the conservation status of that species and because the majority of illegal marijuana grow sites occur within California. The majority of information presented below pertains directly to the fisher. However, because of similarities in geographic distribution, habitat use patterns, reproductive biology, prey species, and physiology between the fisher and the closely related coastal marten, most of the information below should also apply to the coastal marten.

Anticoagulant rodenticides were created to kill mammals, including commensal rodents such as house mice (*Mus musculus*), Norway rats (*Rattus norvegicus*), and black rats (*R. rattus*) in and around residences, agricultural buildings, and industrial facilities, and agricultural pests such as prairie dogs (*Cynomys* sp.) and ground squirrels (*Spermophilus* sp.) in rangeland and agricultural areas. Anticoagulant rodenticides bind to enzymes responsible for recycling vitamin K, thus impairing the animal's ability to produce several key blood clotting factors (Berny 2007, p. 97; Roberts and Reigart 2013, pp. 173–174). Anticoagulant rodenticide exposure is manifested by such conditions as bleeding nose and gums, extensive bruises, anemia, fatigue, and difficulty breathing. Anticoagulants also damage the small blood vessels, resulting in spontaneous and widespread hemorrhaging. There is often a lag time of several days between ingestion and death (Berny 2007, pp. 97–98; Roberts and Reigart 2013, pp. 174–175).

Exposure to ARs, resulting in death in some cases, has been documented in many mammalian predators, including fishers (Gabriel et al. 2012b, p. 6), stoats (*Mustela erminea*), ferrets (*Mustela furo*), and house cats (*Felis cattus*)(Alterio 1996, entire); polecats; Shore et al. 1999, p. 202); American black bears (*Ursus americanus*; Schmidt 2012, pers. comm.); bobcats and mountain lions (*Felis concolor*; Riley et al. 2007, p. 1877); Sierra Nevada red foxes (*Vulpes vulpes necator*; Clifford, unpublished data); American badgers (*Taxidea taxus*; Quinn et al. 2012, pp. 468, 471); and San Joaquin kit foxes (*Vulpes macrotis mutica*; McMillin et al. 2008, p. 165).

In California, the majority (65 of 77: 84 percent) of fishers tested for the presence of ARs were positive (Gabriel et al. 2012b, p. 5; Thompson et al. 2013, p. 6), and several fishers have recently been confirmed to have died from acute poisoning from ARs on the Hoopa Valley Indian Reservation (Gabriel et al. 2012b), which is located less than 9 km (5.6 mi) south of the CA_EPA. Numerous fishers have been tested for AR exposure the past few years. In contrast, to date, six coastal martens have been tested for AR exposure, and of the six tested (all from the CA_EPA) one tested positive (Gabriel, unpublished data), with a sublethal concentration of a single second-generation AR (e.g., brodifacoum, bromadiolone, difenacoum, difethialone). However, that particular coastal marten was killed by a bobcat. Whether the sublethal dose of a second-generation AR predisposed that marten to predation is unknown.

9.2.2.5.1 Sources of Toxicants in the Environment

9.2.2.5.1.1 Legal Applications of Anticoagulant Rodenticides - Labeled (Registered) Uses

The best available information indicates that legal uses of ARs may pose risks to coastal martens in some parts of their range both currently and over the next 15 years. Anticoagulant rodenticides have a long history of use in forestry and crop agriculture. The aerial application of 1080 (sodium fluoroacetate) was once standard practice on both public and private forestry lands (Cone 1967, p. 133; Radwan 1970, p.78). The risks to coastal martens from direct poisoning through the application of ARs around conifer seedlings in clearcut areas may be negligible since coastal martens avoid open areas such as clearcuts. By the early 1970s, 1080 was being replaced by the two first generation ARs, diphacinone and chlorophacinone, which were aerially broadcast over large areas in northern California (Passof 1974, pp. 128–129). Queries to the BLM and USFS in Oregon confirm that these agencies currently apply very little if any AR on their ownerships (Standley 2013, pers. comm.; Bautista 2013, pers. comm.), but information on the use of ARs on private lands is not available.

The State of California requires that all agricultural pesticide use be reported monthly to county agricultural commissioners. The state maintains a broad definition of "agricultural use" so as to include applications to parks, golf courses, cemeteries, rangeland, pastures, and along roadside and railroad rights-of-way. The primary exceptions to the reporting requirements are that home-and-garden use, and most industrial (including private industrial timber lands) and institutional uses are not required to be reported. Therefore, we conclude that data pertaining to forest habitats (including habitat supporting coastal martens) is not captured adequately in these statistics, nor does this reporting requirement represent the best source of data for assessing the potential effects on coastal martens from the use of ARs.

9.2.2.5.1.2 Illegal Applications of Anticoagulant Rodenticides - Marijuana Cultivation Sites

With respect to fishers, although the sources of AR exposure have not been conclusively determined, large quantities of ARs have been found at illegal marijuana cultivation sites within occupied fisher habitat on public, private, and tribal lands in California (Gabriel et al. 2012b, p. 12; Thompson et al. 2013, pp. 7–8); ARs are found in significant amounts scattered around young marijuana plants to discourage herbivory and along plastic irrigation lines to poison rodents that might chew on them. The large number of marijuana cultivation sites within and near fisher populations in California and Oregon (Figures 9.1 and 9.2, respectively) and the lack of other probable sources of ARs within occupied fisher habitat have led researchers to implicate illegal marijuana cultivation sites as the source of AR exposure in fishers (Gabriel et al. 2012b, p. 12; Thompson et al. 2013, pp. 7–8), although Thompson (2014, p. 98) notes the association between illegal marijuana cultivation sites, ARs and other pesticide exposure, and fisher mortality, although strong, is still speculative.

Marijuana cultivation was first detected on national forest lands (in southern California) in 1995 and by 2011 had expanded to 20 states and 67 national forests (US Senate, Statement of Senator Feinstein, December 7, 2011, p. 1). The number of plants removed from national forests increased dramatically each year from 2005 to 2010, reaching a new record for eradication in

2010 of over 3.5 million plants from 59 national forests (USDOJ 2011, p 30). However, an apparent increase in illegal marijuana cultivation based solely on the number of plants eradicated each year may be misleading due to marked differences in eradication efforts between years. These national forests also account for the largest increase in the number of eradicated plants on public lands, which is due in part to intensified outdoor eradication operations (USDOJ 2011, p 30). Outdoor marijuana cultivation in California, Hawaii, Oregon, and Washington exceeds outdoor cultivation in all other areas of the country combined (US Senate, Statement of Senator Feinstein, December 7, 2011, p. 1), and national forests in California account for the largest plant eradication total from public lands in any region (USDOJ 2011, p 30). The National Marijuana Initiative estimates that 60–70 percent of national marijuana seizures come from California and of these, 60 percent come from public lands (Gabriel et al. 2013a, p. 48). As an example of the magnitude of illegal marijuana cultivation on national forests, more than 600 large-scale marijuana cultivation sites have been found on just two of California's 17 national forests (Gabriel et al. 2013a, p. 48). Over 65 percent of the CA_EPA and the SCO_EPA consists of public lands (primarily USDA Forest Service lands) and large numbers of illegal marijuana grows have been found on these lands. Approximately 40 percent of the CCO_EPA consists of USDA Forest Service lands.

9.2.2.5.2 Anticoagulant Rodenticides and other Pesticides Detected in Fishers

Among the pesticides found at marijuana grow sites, ARs are the primary type of pesticide that has been analyzed in fisher tissue. They are persistent in liver tissue and sublethal exposure to one or more AR (especially the more toxic second-generation ARs that are commonly used within illegal marijuana grow sites) will allow detection in liver tissue for several months following exposure. In contrast, some other pesticides that have been documented at grow sites would be more likely to cause immediate mortality and are less persistent in tissue, making their recovery from carcasses less likely. However, fishers have only been screened for a select few of these potential pesticides. If these materials are found in forms attractive to fishers (for example, via flavorizors or food intentionally laced with poison to attract rodents and other pests), it is likely that coastal martens are also being exposed to them.

To date, non-AR pesticides such as organophosphates, carbamates, or organochlorines have been found in one fisher found dead immediately adjacent to (10 m; 33 ft.) a grow site on the Six Rivers National Forest in northwestern California. This male fisher was confirmed to have ingested a hot dog intentionally laced with a carbamate (methomyl) (Gabriel et al. 2013b, entire). Another male fisher from the Northern California-Southwestern Oregon Population (same geographic area as the CA_EPA and SCO_EPA marten populations) was suspected of succumbing to bromethalin toxicosis having exhibited neurological symptoms including ataxia, lethargy, and seizures (Gabriel 2013a, p. 127). This fisher carcass was discovered near a trespass marijuana grow site where bromethalin, carbamate insecticides, and numerous other organophosphates were documented. However, no toxicants were found in the gastrointestinal tract and no additional tissues had any detectable toxicants. All other potential mechanisms for this fisher's clinical signs were ruled out leading this case to be classified as suspected toxicosis.

9.2.2.5.3 Effects of Anticoagulant Rodenticide Exposure on Individual Coastal Martens and Coastal Marten Populations

The effects of AR exposure on individual coastal martens and coastal marten populations have not been studied. However, in the closely related fisher, AR exposure has been determined as the direct cause of death for 4 of 58 individuals in California (Gabriel et al. 2012b, p. 6). The degree to which exposure of fishers to ARs increases the probability of mortality from other causes (e.g., roadkill, disease, predation) is not known. However, evidence from laboratory and field studies for several other species suggest that pesticide exposure: (1) reduces immune system function (Repetto and Baliga 1996, pp. 17–37; Li and Kawada 2006, entire; Zabrodskii et al. 2012, p. 1); (2) is associated with a higher prevalence of infectious disease (Riley et al. 2007, pp. 1878, 1882; Vidal et al. 2009, p. 270); and, (3) causes transient hypothermia (Ahdaya et al. 1976, entire; Gordon 1984, p. 432; Grue et al. 1991, pp. 158–159), which may contribute to an increase in mortality rates (Martin and Solomon 1991, pp. 122,126).

Additionally, multiple studies have demonstrated that sublethal exposure to ARs or organophosphates (OPs) may impair an animal's ability to recover from physical injury. A sublethal dose of AR can produce significant clotting abnormalities and hemorrhaging (Berny 2007, p. 98), and has been shown to reduce blood-clotting activity in golden eagles (Savarie et al. 1979, p. 77), screech owls (Rattner et al. 2012, p. 837), barn owls (Webster 2009, p. 70), rats (Bailey et al. 2005, p. 15), and weasels (Townsend et al. 1984, p. 630). Raptors with liver concentrations of ARs as low as 0.03 parts per million have died as a result of excessive bleeding from minor wounds inflicted by prey (Erickson and Urban 2004, pp. 90, 100, 184, 188, 190–191). AR-exposed coastal martens may be at risk of prolonged bleeding if wounded when pursuing or killing prey, escaping or fighting predators, or by conspecifics (for example, during mating). Sublethal AR exposure may also combine with other potential stressors (e.g., disease) to have additive or synergistic adverse effects. For example, 6 percent of study rats died after 5 days of exposure to an anticoagulant compound (dicoumarol), but 50 percent died when exposed to the anticoagulant and additional stressors (Jaques 1959, p. 851; Erickson and Urban 2004, p. 99). Exposure to ARs can result in changes to an animals' behavior, which makes them more susceptible to environmental stressors, such as adverse weather conditions, food shortages, and predation (LaVoie 1990, p. 29; Cox and Smith 1992, p.169; Brakes and Smith 2005, p. 121). Finally, sublethal levels of ARs might predispose individuals to death from other causes (for example, collisions with automobiles, starvation) or may reduce the chance of recovery from injury (Littin et al. 2000, pp. 311–313). That said, there can be wide variability in lethal and sublethal effects among and within taxonomic groups (Gabriel et al. 2012b, p. 11).

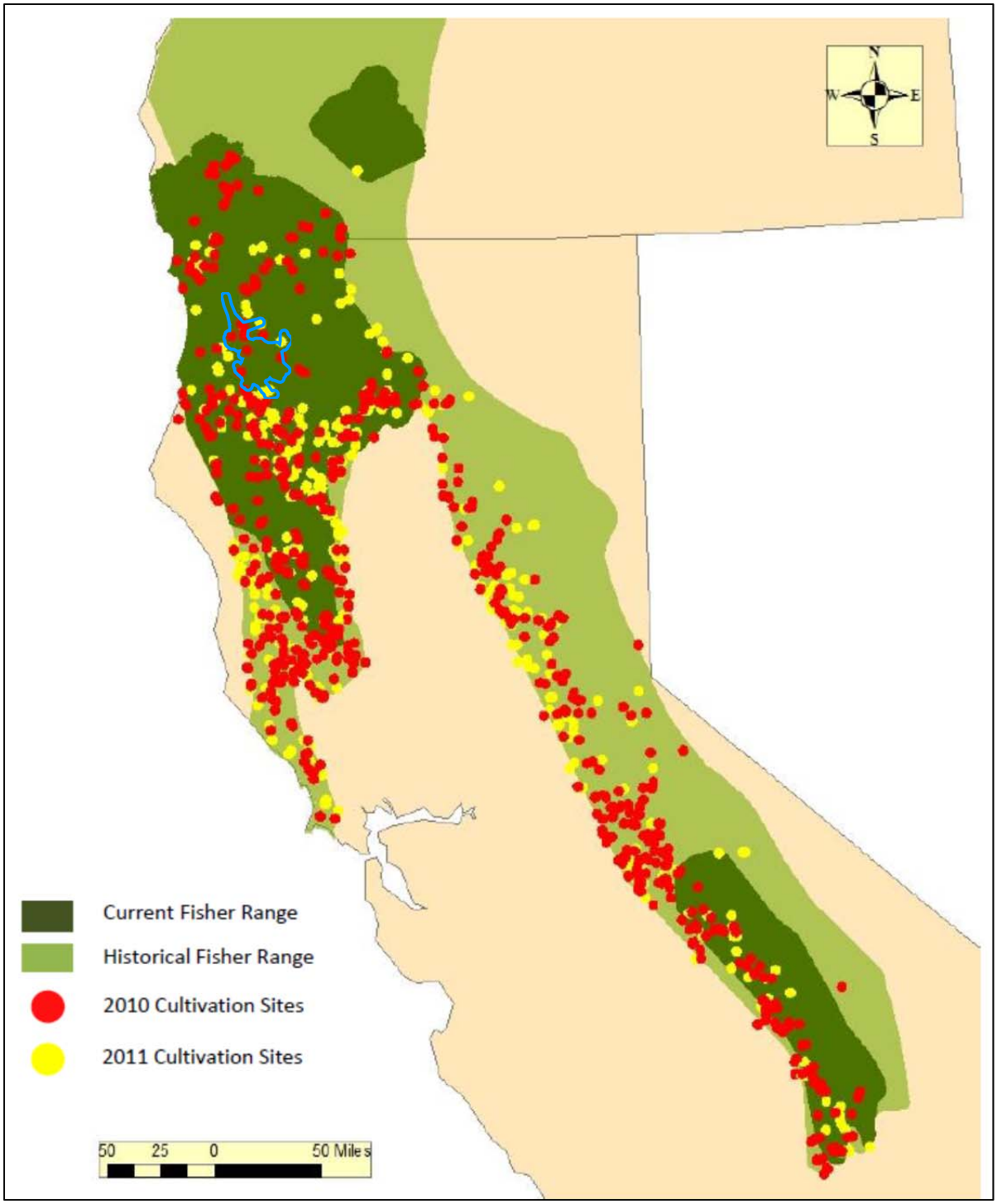

Figure 9.1. Marijuana cultivation sites eradicated on public, private, and tribal lands during 2010 and 2011 within both historical and current ranges of the fisher in California and southwestern Oregon, in comparison to the approximate location of the CA_EPA (blue polygon). Although the map is specific to fishers, it is meant to show the distribution of marijuana sites in relationship to the coastal marten population in northern coastal California. The central location for each eradicated site is buffered by 4 km (2.5 mi) radius which approximates a hypothetical home range of a male fisher. Figure from Higley et al. 2013b, p. 2.

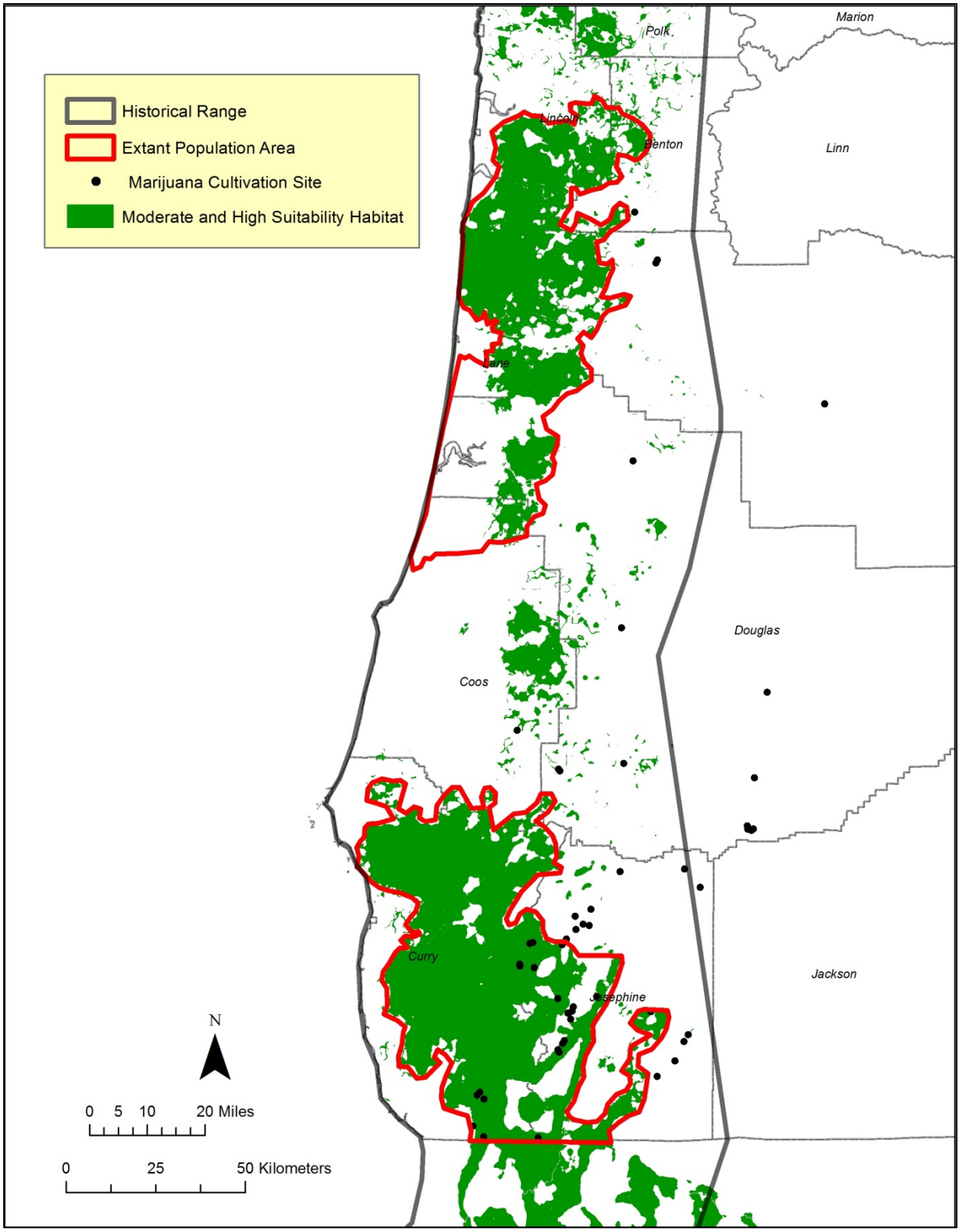

Figure 9.2. Marijuana cultivation sites eradicated between 2004 and 2012 in Oregon. Each site location (black circles) was buffered by a 1 km (0.62 mi) radius to approximate the size of a coastal marten home range. Cultivation site location data from ORHIDTA 2013.

Gabriel et al. (2012a, p. 10) emphasized that it is unknown if stressors or injuries from environmental, physiological, or even pathogenic factors could predispose fishers to elevated mortality rates with the added stressor of AR exposure. Potential impacts of sublethal AR exposure in fishers and coastal martens include impaired blood clotting, reduced reaction time, loss of appetite, impaired locomotion, thermoregulatory difficulties, increased susceptibility to diseases and parasites, and reduced reproductive potential through exposure of ARs to fetuses *in utero* or to kits from tertiary exposure through tainted milk. In turn, these conditions may increase the frequency of death from minor wounds or infections, roadkill mortalities, fetal miscarriages, hypothermia, disease or extreme parasitism, accidents, predation, and starvation.

A critical conservation question is whether AR exposure in individual coastal martens inhibits population growth or causes population declines by lowering population demographic vital rates such as survival and reproductive success. Thompson et al. (2013, p. 6) found that female fisher survival rates decreased with an increase in the number of illegal cultivation sites found within their home range areas in the southern Sierra Nevada Mountains. Small, isolated carnivore populations like the three coastal marten populations, are already vulnerable to stochastic events (Shaffer 1981, entire; Primack 1993, p. 255), thus any additional reduction in survivorship may decrease the probability of population persistence. Predictive modeling suggested that a 10–20 percent mortality rate increase in the southern Sierra Nevada fisher population may be enough to prevent population expansion even in the absence of dispersal barriers (Spencer et al. 2011, p. 796), and that high mortality rates may be limiting geographic expansion. Spencer et al.'s (2011, p. 796) model also showed that reductions in adult female survivorship resulted in disproportionately large declines in population size. If adult female survivorship is a major driver of demographic rates in the southern Sierra Nevada population and perhaps others, the observed reduction in adult female survivorship for females with higher numbers of marijuana cultivation sites within their home ranges (Thompson et al. 2013, p. 8–9) may result in significant population-level impacts in the near future.

A reduction in the density and distribution of potential mammalian prey from exposure to ARs at marijuana cultivation sites may result in additional negative impacts to coastal marten populations. Prey depletion has been associated with predator home range expansion and resultant increase in energetic demands, prey shifting, impaired reproduction, starvation, physiologic (hematologic, biochemical and endocrine) changes, and population declines in other species (Knick 1990, pp. 21, 32; Knick et al. 1993, entire; Karanth et al. 2004, p. 4858; Hayward et al. 2012, abstract). Small mammal mortality rates at marijuana cultivation sites have not been estimated. As a result, the best available data at this time indicates no direct evidence of AR-induced prey depletion and impacts to coastal marten populations.

The timing of AR use at cultivation sites (April–May) may also be important, because a reduction in rodent prey at this time coincides with increased energetic requirements of pregnant or lactating female coastal martens, increasing the likelihood of miscarriages due to inadequate nutrition or starvation of dependent kits due to reduced fitness of the adult female. Reduced fitness in male coastal martens during the early spring due to limited availability of prey could reduce the potential of mating with available female coastal martens. Finally, reduced prey density and distribution could decrease juvenile coastal marten survival rates if they attempt to

establish a home range that includes one or more marijuana cultivation sites that are using ARs to control rodents.

The uncontrolled use of ARs and other toxic chemicals in the illegal production of marijuana in the analysis area poses a potential risk to individual coastal martens and coastal marten populations. Conditions often used for marijuana grow operations, such as proximity to water sources with road access and recent timber harvest, are conditions that currently occur throughout the three extant marten populations in coastal Oregon and northern coastal California, and are expected to continue over the next 15 years. The relatively few illegal marijuana cultivation sites that have been found in the vicinity of the CCO_EPA compared with the SCO_EPA and CA_EPA (Figures 9.1, 9.2) suggests that the risk of AR exposure in coastal martens within the CCO_EPA is lower than in the other two EPAs; while the CCO_EPA is less remote and perhaps not as conducive to supporting illegal marijuana grows as the other marten population areas, the lower numbers of discovered plantations could also be a function of search effort. We estimated the scope of the exposure of toxicants for each extant coastal marten population area by visually estimating the proportion of each EPA containing known marijuana cultivation sites (Figures 9.1, 9.2). These estimates do not consider marijuana cultivation sites that were not found by law enforcement agencies and therefore likely underestimate the prevalence of AR exposure to coastal martens from this source. We estimated the scope at 5 percent, 25 percent, and 40 percent for the CCO_EPA, SCO_EPA, and CA_EPA, respectively. The rate of lethal and sublethal exposure of coastal martens to ARs is unknown and unstudied. Further research is needed before an accurate assessment of AR exposure rates and subsequent population-level impacts can be made. However, based solely on the density of recent known illegal marijuana sites (Figures 9.1, 9.2), coastal martens within the CA_EPA and SCO_EPA probably have a greater chance of encountering and consuming ARs or consuming prey that have consumed ARs, than martens within the CCO_EPA.

The rate of toxicant exposure for the two extant populations in coastal Oregon has not been studied. However, based on the relatively low prevalence of illegal marijuana grow sites within the CCO_EPA (occurring in approximately 5 percent of the total area), we consider the population level impact from this stressor to be low both currently and over the next 15 years. We estimate that approximately 25 percent of the SCO_EPA contains illegal marijuana grow sites and consider this stressor as having a low to medium impact on the SCO_EPA population both currently and over the next 15 years. Investigations of toxicant exposure in the CA_EPA began in 2014 with one of six martens testing positive with a sublethal dose of one second-generation AR. Given the relatively high occurrence (approximately 40 percent of the total area) of illegal marijuana grow sites within the CA_EPA, we consider this stressor as having a medium level impact on the CA_EPA population currently and over the next 15 years. We note some uncertainty overall as to the magnitude of impact that this stressor may have at the population- and range-wide levels given the minimal data available on impacts in the analysis area (i.e., only six coastal martens tested for AR exposure to date).

9.2.3 Activities and Processes Potentially Leading to Habitat Loss, Degradation, or Fragmentation

9.2.3.1 Wildfire

This section addresses potential impacts of wildfire on coastal marten moderate and high suitability habitat. Wildfires can threaten individual coastal martens directly through mortality, but we currently lack information on marten mortality rates from wildfire. We expect that the probability of direct mortality to be discountable since martens are capable of rapid evacuation from an approaching fire and adequate suitable habitat likely exists within their extant population area to establish a new home range; provided the majority of the suitable habitat within the extant population area isn't subjected to an extremely large wildfire of high severity.

Wildfire is a major coarse-scale disturbance force within the analysis area in all but the wettest coastal forests and can affect the composition and structural characteristics of the forest communities at multiple spatial and temporal scales. Fire severity is often expressed in categories of high, medium, or low severity. Low-severity fire burns at ground-level and does not kill most overstory trees, although it may consume understory vegetation and downed woody debris (Jain et al. 2012, p. 47). High severity fire, also called stand-replacing fire, kills all or nearly all vegetation within a stand and may extend across a landscape (Jain et al. 2012, p. 47). Moderate severity fire refers to fire that is intermediate in its effects between high-severity and low-severity fire; for example, a fire may kill scattered clumps of overstory trees within a stand. Mixed severity fire includes patches of low-severity fire and patches of high-severity fire (Jain et al. 2012, p. 47).

The effect of fire on coastal marten habitat varies from high-severity fires that consume much or all of the structural features (e.g., large trees, snags, logs) that are important elements of suitable coastal marten habitat, requiring centuries to regrow, to low-severity fires that burn only the dense, shade-tolerant shrub layer preferred by the coastal marten (Slauson et al. 2009b, p. 11). The shrub layer takes one to two decades to regrow to suitable size and density, depending on their fire resistance and adaptive response to disturbances (Slauson 2014c, pers. comm.). However, some low severity fires may burn ground cover without burning the dense, shade-tolerant shrub layer preferred by the coastal marten. Such low intensity fires may actually improve habitat suitability through increased site productivity and increased prey abundance. Wildfires within the analysis area often burn at mixed severities (LANDFIRE 2008a; LANDFIRE 2008b; LANDFIRE undated); with some areas within the fire perimeter burning at high severity resulting in stand replacement and other portions burning at low intensity resulting in the loss of only ground vegetation. Fire effects are complex; therefore, potential impacts of future wildfires on coastal marten suitable habitat are difficult to predict.

A fire regime is the product of the climate, ignition frequency, and the characteristic pattern in which fire interacts with the topography and vegetation structure within any region (Agee 1993, pp. 33–47). Within the range of the coastal marten, high levels of precipitation during the winter and cool moist summer conditions moderate the dry conditions that promote fire ignition and spread. Strong ocean-inland, and to a lesser degree north-south gradients exist in these climate driven moisture conditions across the range of the coastal marten. These regional gradients result

in non-anthropogenic fires occurring more frequently with increasing distance from the coast and farther south in the analysis area (Oneal et al. 2006, pp. 82–97). At finer scales, topographic characteristics, such as increasing slope position and aspect, strongly affect fire frequency and severity in the analysis area (Oneal et al. 2006, pp. 82–97). Despite climate change having the potential to affect historical fire regime patterns, we base the following analysis on the historical patterns mentioned above.

In the redwood region of northern coastal California, the incidence of fires from lightning ignitions is relatively uncommon (van Wagtendonk and Cayan 2008, pp. 40–44). Prior to European settlement, the majority of fires were probably initiated by Native Americans (Lorimer et al. 2009, pp. 1042–1043) to enhance mobility and access to their lands, and to manage the abundance and availability of harvestable plants and wildlife (Anderson 2006, pp. 417–425). The ecological imprint of Native American burning is evident today through oral accounts and empirical analyses of tree rings and fire scars. This record shows a centuries-long history of mostly low-severity surface fires occurring at return intervals ranging from < 5 years to 3–4 decades (e.g., Fritz 1932, pp. 2–3; Brown and Swetnam 1994, pp. 28–29; Stephens and Fry 2005, pp. 7–10; Norman 2007, pp. 10–11). However, this pattern of frequent, surface fire has been punctuated by intermediate-severity fires, causing moderate overstory mortality, with return intervals of 125–333 years (Veirs 1982, pp. 132–133); and by large, high-severity, stand-replacing fires with return intervals of 500–3,300 years (Oneal et al. 2006, pp. 82–91). We speculate that these intermediate- and high-severity fires could have originated when unusually intense lightning storms coincide with severe drought conditions.

Currently, within the analysis area, wildfires are largely caused by lightning strikes and anthropogenic sources. The lowest frequency of lightning strikes occurs in the northern and southern portions of the analysis area and the highest frequency occurs in the central interior portions of the analysis area along the western edge of the Klamath-Siskiyou ecoregion where the driest conditions combined with the highest mountains occur (Morris 1934, pp. 372–375; van Wagtendonk and Cayan 2008, pp. 41–44). The portion of the analysis area with the highest frequency of lightning strikes is coincident with the eastern two-thirds of the SCO_EPA in southern coastal Oregon and the eastern one-half of the CA_EPA in northern coastal California.

Lightning strikes in coastal forests are less likely to ignite due to the presence of coastal fog during the months of peak strike activity (reviewed in Lorimer et al. 2009, pp. 1041–1043). For example, lightning strikes in the redwood forests of the Northern California Coast ecoregion occur at the rate of 15–23 percent of that of more interior sites in the Klamath Mountains (van Wagtendonk and Cayan 2008, pp. 41–44). Furthermore, the redwood region is characterized by having a moderate severity fire regime, due to its ability to resist all but the most extreme fire events (Agee 1993, pp. 196–197). Non-anthropogenic fire frequency most likely varies along latitude and elevation gradients consistent with return intervals on the order of centuries in coastal locations, to several decades in upland locations where redwood forests border more fire prone habitats of the Klamath Mountains.

While redwood communities resist all but the most extreme fire events, the extant populations of the coastal marten in northern coastal California (i.e., the CA_EPA) and southern coastal Oregon (the SCO_EPA) occur primarily within Douglas fir-tanoak communities and thus are more

vulnerable to lightning-ignited fires. For example, the 2002 Biscuit Fire burned approximately 38 percent (1,788 km^2 (690 mi^2)) of the SCO_EPA; burning at mixed severities. Fifty percent of the Biscuit Fire area burned at high severities with more than 75 percent of the vegetation killed (Rogue River and Siskiyou National Forests 2003, p. 74). This fire also burned into extreme northern California and into suitable coastal marten habitat, but was nearly 20 km (12.4 mi) north of the CA_EPA, and over 9 km (5.6 mi) from the nearest [recent] verifiable marten detection in northern coastal California. In 1998, a 94.3 km^2 (36 mi^2) wildfire in and around the CA_EPA burned approximately 11 percent of that EPA, and in 2008, a complex of lightening fires burned approximately 773 km^2 (298 mi^2) on the Six Rivers and Klamath national forests and burned approximately 13 percent of the CA_EPA. Therefore, in just two fire seasons (1998 and 2008) nearly a quarter of the CA_EPA burned. Post-fire site visits to some of the areas burned in 2008 showed that the dense, shade-tolerant shrub layer was removed, likely reducing the suitability of these areas for martens over the short term (Slauson et al. 2009b, p. 11).

Large wildfires have the potential to burn an entire EPA in a single fire season, especially the smallest of the three EPAs, the CA_EPA. For example, in three separate years (1987, 2002, 2008), more area burned per year in Douglas-fir forest in the Klamath Ecoregion than occurs within the entire 812-km^2 CA_EPA: 875 km^2 (338 mi^2) burned in 1987; 2,023 km^2 (781 mi^2) burned in 2002; and 896 km^2 (346 mi^2) burned in 2008 (MTBS 2013). The same is true for the portions of the SCO_EPA occurring within drier interior forest (mainly the eastern two-thirds of that EPA) that also experiences frequent lightning strikes. The more mesic western (coastal) portion the SCO_EPA is less prone to wildfire. Effects of the 2008 fires may have contributed to the 42 percent decline in occupancy detected in the coastal marten population in northern coastal California between the 2000 and 2008 population survey periods (Slauson et al. 2009b, pp. 11–12). It is important to note that the aforementioned fires burned at mixed severity, with moderate and high suitability habitat remaining within the fire perimeter after the fires were out.

In the southern coastal Oregon and California portions of the analysis area, the fire regime described by LANDFIRE (2008a) shifts to a mix of low and mixed severity fires with 0–35 year and 35–200 year return intervals, respectively. The fire regime in central coastal Oregon is a mix of high and low severity fires with fairly long return intervals averaging >250 years (Impara 1997, p. 92; Long et al. 1998, p. 786; Long and Whitlock 2002, p. 223). In northern coastal Oregon, the fire regime is classified as stand replacing (i.e., high severity) with very infrequent (i.e., >200 year) return interval in the north, transitioning into a low and mixed severity with 35–200 year return intervals in the central region (LANDFIRE 2008a). Within these areas, the fire regime varies by forest type, with the moist Sitka spruce forests existing in the near coastal zone where climatic conditions limit both the frequency and intensity of naturally occurring fires (Agee 1993, pp. 189–191). Fires in Sitka spruce forests were very rare and burned under rare weather conditions where fires were driven into the coastal zone by dry winds from the interior (Agee 1993, p. 190). There is circumstantial evidence that many of the larger fires in coastal-interior western hemlock forests would have been naturally extinguished upon entering the moist temperate climate that is typical of coastal Sitka spruce forests (Agee 1993, p. 205). In moist western hemlock forests, fire intensity is often high under the conditions that allow fire spread and extensive stand-destroying fires can occur and are part of the historical record in coastal Oregon (Agee 1993, p. 209).). In the mid-1800s alone, three large fires, ranging from 1,214 to 3,237 km^2 (469 to 1,250 mi^2) were documented in the Oregon Coast Range (Morris 1934, pp.

317–322; Wimberly et al. 2000, p. 172). Starting in the mid-1800s, climate change, combined with European settlement, may have influenced the onset of large-scale fires (Weisberg and Swanson 2003, p. 25). Another complication in these wetter forests has been a pattern of multiple reburns that have occurred, at least since European settlement (e.g., the Tillamook burns of 1933, 1939, 1945, and 1951) (Pyne 1982, pp. 330–331; Agee 1993, p. 213). Reburns may or may not add large amounts of additional area to the original burn, but they have the potential to impede the development of the stand for decades (Agee 1993, p. 213), delaying the ultimate return to habitat suitable for martens.

Fire suppression organization and tactics have improved since the large fires of the last two centuries in the Oregon Coast Range, resulting in a reduction in fires (Wimberly et al. 2004, p. 153). Weisberg and Swanson (2003, p. 25), however, note that suppression success may have been influenced by the reduction in fuel accumulations that these extensive fires accomplished. Regardless, the intense, large, high-severity fires that can occur in the Oregon Coast Range are driven by severe weather events (droughts or east wind patterns) (Agee 1993, p. 154), conditions under which fire suppression is severely hampered at best and ineffectual at worst (Impara 1997, pp. 262–263).

In addition to forest type, fire exclusion (fire suppression contributes to fire exclusion) can also affect wildfire severity. For example, the potential for stand-replacing wildfire has increased in areas where fire suppression and regeneration timber harvest (with poor treatment of activity fuels) have played a role in raising fuel load to levels that place late-successional forest at increased risk (USDA FS and USDI BLM 1994a, pp. 3, 4–49). However, within northern coastal California and southern coastal Oregon, fire suppression has had little effect on altering the structure and composition of the dominant forest types and has not caused an increase in high severity fire compared to the historical patterns (Odion et al. 2004, pp. 933–935; Miller et al. 2012, p. 200). The period of fire suppression may not be long enough to accumulate such effects in coastal forest types where the return intervals for high-severity, stand-replacing fires are on the order of centuries (e.g., Veirs 1982, pp. 132–133; Oneal et al. 2006, pp. 82–87). Furthermore, in areas where fire return intervals are shorter, such as decades, forest structural change and subsequent wildfire have not produced burn conditions outside those expected based on the patterns of pre-suppression burning (Odion et al. 2004, pp. 933–935; Miller et al. 2012, p. 200).

We estimated the scope of the ongoing stressor of wildfire within the three extant population areas and within the remainder of the analysis area by calculating the proportion of moderate and high suitability coastal marten habitat within each EPA and the analysis area that was burned by wildfire between 1984 and 2012. Fire perimeter data used for the scope calculation were obtained from the National MTBS (Monitoring Trends in Burn Severity; MTBS 2013) burned area boundaries dataset, which contained data for the entire analysis area for 1984 to 2012. We expected that the incidence of wildfire in the future will be similar to 1984–2012. However, our scope estimates are likely biased low based on predictions of a warmer, drier analysis area projected by climate change models (refer to the **Climate Change** section below for details), which may increase the frequency and size of future wildfires within the analysis area; except perhaps within the central and northern coastal portions of Oregon. We also assumed that most wildfires of any intensity within coastal marten suitable habitat would result in the conversion of suitable habitat to unsuitable habitat for at least the next one to two decades since even low

intensity wildfires would eliminate the dense, shade-tolerant shrub layer, which requires a minimum of one to two decades to regrow.

To derive wildfire scope values, we overlaid the MTBS fire perimeter data from 1984 to 2012 (pre-1984, 2013, and 2014 fire perimeters were not yet available) on to each EPA boundary, and the entire analysis area (including all EPAs) in a GIS to calculate the total area burned within each area. We then overlaid the burned area polygons on to the coastal marten landscape-scale suitable habitat layer to calculate the amount of moderate and high suitability habitat that burned within each area. The resulting scope of the wildfire stressor for the extant population areas and the entire analysis area was:

1. CCO_EPA: 0 percent of all moderate and high suitability habitat;

2. SCO_EPA: 42 percent of all moderate and high suitability habitat combined (33 percent of all moderate suitability habitat; 47 percent of all high suitability habitat);

3. CA_EPA: 17 percent of all moderate and high suitability habitat combined (15 percent of all moderate suitability habitat; 17 percent of all high suitability habitat);

4. Analysis Area: 18 percent of all moderate and high suitability habitat combined (12 percent of all moderate suitability habitat; 25% of all high suitability habitat).

The CCO_EPA did experience many smaller (<1 ac) wildfires from 1984–2012, but these smaller fire perimeters are not included in the MTBS burned area boundaries dataset. The same is also true for the SCO_EPA and the CA_EPA, but the small fires within these EPAs are overshadowed by the larger wildfires that occurred within the drier interior forests found within these two EPAs. Relatively frequent, but small, fires would be expected for the more mesic central and northern coastal portions of Oregon, compared to southern coastal Oregon and northern coastal California. The relatively high proportion of burned suitable habitat within the SCO_EPA was primarily due to the 2002 Biscuit Fire. The probability of another large fire occurring in the SCO_EPA in the future is unknown, but fires as large as the 2002 Biscuit Fire are rare. The Biscuit Fire is by far the largest fire on record (since 1900 in Oregon, and 1878 in California) for the analysis area.

As mentioned above, approximately 12 percent of all moderate suitability habitat and 25 percent of all high suitability habitat within the analysis area burned between 1984 and 2012. The 2002 Biscuit Fire represented the majority of all suitable habitat burned within the entire analysis area and the Oregon portion of the analysis area. The 2008 Blue 2 Fire in northwestern California was the largest fire within the California portion of the analysis area between 1984 and 2012. The Blue 2 fire burned approximately 17 percent of all moderate and high suitability coastal marten habitat within the CA_EPA and approximately 9 percent of all moderate and high suitability coastal marten habitat within the California portion of the analysis area. Nearly two-thirds of the Blue 2 Fire burned to the immediate east of the CA_EPA. Had the fire continued burning to the west it had the potential of burning all suitable coastal marten habitat within the CA_EPA, but with mixed severity so some areas would have completely lost all suitable habitat while other areas would have only experienced loss of the shrub understory or even just the ground cover. If

wildfires result in the loss, degradation, or fragmentation of a significant portion of suitable habitat within any of the three extant population areas, limited adjacent suitable habitat is available for martens escaping the fires, potentially exposing surviving martens to an increased probability of mortality from other sources, such as predation, starvation, and disease. Due to small population size, the probability of population persistence could decrease if a large proportion of suitable habitat within an EPA is burned within any given year, especially for the CA_EPA and SCO_EPA, which are located in interior Douglas-fir forest within the fire-prone Klamath Ecoregion. Recolonization after a large fire from coastal martens occurring outside an EPA is unlikely since coastal marten numbers outside the EPAs are probably too low to act as a new founder population.

Based on the information presented above, we consider the ongoing wildfire stressor to have a medium to high impact on the loss, degradation, or fragmentation of suitable coastal marten habitat within the SCO_EPA and the CA_EPA, and a low level impact for the CCO_EPA. We assume these levels of impacts would continue into the future (approximately 30 years) based on the impact level estimates on the prevalence of wildfires within each EPA between 1984–2012 and our expectation that fire frequency, size, and severity in the future will be fairly similar (or slightly higher based on climate change projections). In general, within the analysis area, we consider wildfire as a low level impact to marten habitat within central and northern coastal Oregon, and a medium level impact in southern coastal Oregon and northern coastal California over the next 30 years.

9.2.3.2 Climate Change

Increased temperatures and decreased rainfall projected by climate change models within the analysis area in the short-term future (approximately 40–50 years) may result in loss, degradation, or fragmentation of suitable coastal marten habitat. Potential direct impacts to suitable coastal marten habitat include conversion of suitable forest types (i.e., moist coniferous or mixed conifer-hardwood forests) to unsuitable (for coastal martens) forest types, such as hardwood forests, and loss of the mesic, shade-tolerant shrub layer required by the coastal marten. Potential indirect impacts of climate change include the creation of an open understory due to the loss of the mesic shrub understory mentioned above, which is preferred by coastal marten predators such as gray fox and bobcat, and thus may increase predation rates. Another potential indirect impact of climate change is the effect of a warmer and drier climate on the frequency, size, and severity of future wildfires potentially resulting in the loss, degradation, or fragmentation of suitable habitat and possibly direct mortality of coastal martens when severe wildfires burn through extant population areas; especially the SCO_EPA and CA_EPA where fire frequency, size, and intensity are currently a stressor on coastal marten populations. As mentioned above, coastal marten populations are already small and isolated and suitable habitat is already fragmented and greatly reduced from historical levels. Therefore, further habitat loss, degradation, or fragmentation from climate change could threaten the future viability of coastal marten populations and reduce the likelihood of reestablishing connectivity between extant populations.

“Climate” refers to the mean and variability of weather conditions over time, with 30 years being a typical period for such measurements, although shorter or longer periods also may be used

(Intergovernmental Panel on Climate Change [IPCC] 2007, p. 78). The term "climate change" thus refers to a change in the mean or variability of one or more measures of climate (e.g., temperature or precipitation) that persists for an extended period, typically decades or longer, whether the change is due to natural variability, human activity, or both (IPCC 2007, p. 78). Scientific measurements spanning several decades demonstrate that changes in climate are occurring, and that the rate of change has been faster since the 1950s. Examples include warming of the global climate system, substantial increases in precipitation in some regions of the world, and decreases in precipitation in other regions (e.g., IPCC 2007, p. 30; and Solomon et al. 2007, pp. 35–54, 82–85.). Results of scientific analyses presented by the IPCC show that most of the observed increase in global average temperature since the mid-20th century cannot be explained by natural variability in climate, and is "very likely" (defined by the IPCC as 90 percent or higher probability) due to the observed increase in greenhouse gas (GHG) concentrations in the atmosphere as a result of human activities, particularly carbon dioxide emissions from use of fossil fuels (IPCC 2007, pp. 5–6 and figures SPM.3 and SPM.4; Solomon et al. 2007, pp. 21–35). Further confirmation of the role of GHGs comes from analyses by Huber and Knutti (2011, p. 4), who concluded that it is extremely likely that approximately 75 percent of global warming since 1950, has been caused by human activities.

Scientists use a variety of climate models, which include consideration of natural processes and variability, as well as various scenarios of potential levels and timing of GHG emissions, to evaluate the causes of changes already observed and to project future changes in temperature and other climate conditions (e.g., Meehl et al. 2007, entire; Ganguly et al. 2009, pp. 15555, 15558; Prinn et al. 2011, pp. 527, 529). All combinations of models and emissions scenarios yield very similar projections of increases in the most common measure of climate change, average global surface temperature (commonly known as global warming), until about 2030. Although projections of the magnitude and rate of warming differ after about 2030, the overall trajectory of all the projections is one of increased global warming through the end of this century, even for the projections based on scenarios that expect that GHG emissions will stabilize or decline. Thus, there is strong scientific support for projections that warming will continue through the 21st century, and that the magnitude and rate of change will be influenced substantially by the extent of GHG emissions (IPCC 2007, pp. 44–45; Meehl et al. 2007, pp. 760–764 and 797–811; Ganguly et al. 2009, pp. 15555–15558; Prinn et al. 2011, pp. 527, 529).

Changes in climate may have direct or indirect effects on species. These effects may be positive, neutral, or negative, and they may change over time, depending on the species and other relevant considerations, such as interactions of climate with other variables (e.g., habitat fragmentation, fire frequency) (IPCC 2007, pp. 8–14, 18–19). Identifying likely effects often involves aspects of climate change vulnerability analysis. Vulnerability refers to the degree to which a species (or system) is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the type, magnitude, and rate of climate change and variation to which a species is exposed, its sensitivity, and its adaptive capacity (IPCC 2007, p. 89; see also Glick et al. 2011, pp. 19–22). There is no single method for conducting such analyses that applies to all situations (Glick et al. 2011, p. 3). Expert judgment and appropriate analytical approaches are used to weigh relevant information, including uncertainty, in various aspects of climate change.

Global climate projections are informative, and in some cases, the only scientific information available. However, projected changes in climate and related impacts can vary substantially across and within different regions of the world (e.g., IPCC 2007, pp. 8–12). Therefore, we use "downscaled" projections when they are available, and have been developed through appropriate scientific procedures, because such projections provide higher resolution information that is more relevant to spatial scales used for analyses of a given species (see Glick et al. 2011, pp. 58–61, for a discussion of downscaling). With regard to our analysis area for the coastal marten, downscaled projections are available, as are some regional climate models that provide higher resolution projections using a modeling approach that differs from downscaling. The geographic region of the projections is the southern terminus of temperate rainforests of the North American continent, which encompasses the analysis area for the coastal marten.

Most reports discussing downscaled or regional projections of climate change for California and the Pacific Northwest use a suite of climate models along with a lower-emissions scenario and a medium- to high-emissions scenario. The differences between higher- and lower-emissions scenarios are minimal in the next few decades but become increasingly pronounced after the mid-21st century (Cayan et al. 2009, p. 7; Mote and Salathé 2010, p. 39). However, the current emissions trajectory is higher than any of the emissions scenarios used in climate projections for California and the Pacific Northwest (Hansen et al. 2013, pp. 1–2). Therefore, the projections we discuss here may underestimate the potential effects of climate change.

Climate change is projected to result in warmer temperatures for California and the Pacific Northwest. Increasing temperatures are projected across the analysis area during the 21st century, ranging from 1 ºC to 3 ºC (1.8 ºF to 5.4 ºF) by the mid-21th century and from 2 ºC to 5.8 ºC (3.6 ºF to 10.4 ºF) by the late 21st century (Hayhoe et al. 2004, p. 12423; Mote and Salathé 2010, p. 41; Halofsky et al. 2011, p. 14; Cayan et al. 2012, p. 4; Pierce et al. 2013a, p. 844). Some higher-emissions scenarios were not analyzed in these studies and would likely result in greater warming than reported above (Mote and Salathé 2010, p. 41). Summer temperatures are projected to increase more than winter temperatures (Mote and Salathé 2010, pp. 41–42; Salathé et al. 2010, pp. 65–66; Cayan et al. 2012, p. 8; Pierce et al. 2013a, p. 845). In addition, heat waves are projected to increase in intensity and duration, especially under higher-emissions scenarios (Hayhoe et al. 2004, p. 12423; Tebaldi et al. 2006, pp. 191–200; Salathé et al. 2010, p. 69; Cayan et al. 2012, p. 10; Pierce et al. 2013a, p. 848). Warmer temperatures are expected to result in drier conditions throughout the analysis area.

Future precipitation trends vary considerably (Pierce et al. 2013b, entire), but most simulations project a north to south gradient for total precipitation (with precipitation decreasing as you move from north to south) across the region, with an overall drying trend for California (Hayhoe et al. 2004, p. 1242; Christensen et al. 2007, p. 890; Littell et al. 2011, p. 74). Nearly all simulations show a strong decrease in summer precipitation across the entire region, and many show an increase in winter precipitation, especially in Oregon (Mote and Salathé 2010, pp. 42–43; Halofsky et al. 2011, p. 15; Cayan et al. 2012, pp. 13–20; Pierce et al. 2013a, p. 849). In California and southwestern Oregon, most simulations show a decrease in total yearly precipitation (Cayan et al. 2012, pp. 14–17), whereas in northern Oregon, simulations on average show little change in total yearly precipitation because drier summers are offset by wetter winters (Mote and Salathé 2010, p. 41; Halofsky et al. 2011, pp. 15, 24). In areas with stable or

increasing total precipitation, overall warmer temperatures are expected to result in a decreased snowpack (Hayhoe et al. 2004, p. 12423; Salathé et al. 2010, pp. 66–68; Littell et al. 2011, p. 60; Cayan et al. 2012, pp. 20–21). Ultimately, temperature and precipitation trends are projected to create drier conditions and an increased water deficit in the forests of California and the Pacific Northwest by the 2040s; that is, forests will lose more water to transpiration than they will gain from precipitation (Halofsky et al. 2011, p. 17–20; Littell et al. 2011, p. 62; Cayan et al. 2012, p. 20; Littell et al. 2013, p. 112).

Climate change resulting in hotter, drier conditions, and an increased water deficit throughout the analysis area is expected to increase fire frequency and area burned; decrease seedling establishment and tree growth; increase insect damage, forest disease, and tree mortality; and alter tree species distributions (Shafer et al. 2010, p. 183; Halofsky et al. 2011, p. 67; Lawler et al. 2012, pp. 386–388; Littell et al. 2013, p. 112). Other studies have projected the changes in fire frequency, forest disease, insect damage, and other disturbance events could affect marten habitat quality or availability (Shafer et al. 2010, p. 183; Halofsky et al. 2011, p. 67;Lawler et al. 2012, pp. 386–388). These disturbances are likely to alter important elements (e.g., denning sites) of marten habitat within forest stands, or even lead to a decrease in late-successional habitat (Lofroth et al. 2010, pp. 98–103). In Oregon, mountain pine beetle (*Dendroctonus ponderosae*) outbreaks are predicted to become more frequent and spread upward in elevation, leading to loss of climatically suitable range for one or more pine species (genus *Pinus*) (Littell et al. 2013, p. 114). Warmer temperatures also cause trees to become more susceptible to the fungal disease sudden oak death (*Phytophthora ramorum*), and this disease is expected to continue to spread northward in the Oregon Coast Range (Shafer et al. 2010, p. 185).

The disturbances resulting from climate change may have additive or even synergistic effects. For example, disease and insect outbreaks may facilitate increases in wildfire and in exotic species invasions (Whitlock et al. 2003, p. 15; Spies et al. 2010, pp. 1189, 1191; Halofsky et al. 2011, pp. 66–67). Expected changes in fire regime, frequency, and severity are likely to cause changes to the habitat elements that martens use, such as large trees, snags, coarse woody debris, and canopy cover, although how the various elements will change depends on future fire frequency and severity (Lawler et al. 2012, pp. 388–393). Ultimately, climate change is expected to increase forest disturbances, thus impacting forest structure and composition and the quality and availability of habitat where the coastal marten and its prey occur.

In northern coastal California and southwestern Oregon, climate projections within 50 years suggest that drier conditions will result in a narrower extent, greater fragmentation, and increasingly limited inland distribution of coastal forests (DellaSala 2013, entire). Refugial bioclimatic conditions, including year-round cool, moist conditions, and summer fog, for the redwood region were projected to only occur reliably in the current northern extent of the redwood's range in northern Humboldt and Del Norte counties of California under moderate emissions scenarios within 50 years (DellaSala 2013, entire). A decline in the frequency of summer fog has already been demonstrated and if continued, would reduce the inland and southern extent of coastal forest conditions (Johnstone and Dawson 2010, entire), potentially reducing the distribution of dense shrub layers that are an important component of coastal marten habitat. Conifer forests are projected to shift to hardwood-dominated mixed forests and woodlands, as well as shifts toward unsuitable habitat types such as woodland and chaparral,

accompanied by more frequent but less intense large fires, by the end of the 21st century (Lawler et al. 2012, pp. 385–386). Vegetation conversions to hardwood-dominated forest, woodland, and chaparral will likely result in a long-term or permanent loss of suitable marten habitat (Lofroth et al. 2010, pp. 81–121).

Climate change also is expected to result in shifts in the species composition of forests in coastal Oregon, although the extent and area affected varies between models. The range and area of Douglas-fir and conifer forest is projected to contract (Whitlock et al. 2003, p. 16; Littell et al. 2011, pp. 11–12; Littell et al. 2013, pp. 113–114), and mixed conifer-hardwood and deciduous forests are projected to increase (Rehfeldt et al. 2006, p. 1143; Lenihan et al. 2008, p. 20; Doppelt et al. 2009, p. 7; Shafer et al. 2010, pp. 180–181; Halofsky et al. 2011, pp. 68–73; Littell et al. 2013, p. 115). Vegetation conversions to deciduous forest will likely result in a long-term or permanent loss of suitable marten habitat, but mixed conifer-hardwood forest may still retain suitable habitat structural elements and prey for the coastal marten. We expect that changes between conifer forest types, or from conifer forest to mixed conifer-hardwood forest, will reduce suitability of habitat for the coastal marten, but will not result in a loss of habitat, unless the shade-tolerant shrub layer is lost in the forest type conversion. However, we also expect that changes from conifer forest to hardwood-dominated forest, woodland, chaparral, grassland, or other open vegetation communities will result in a permanent loss of suitable habitat for the coastal marten.

The scope of this short-term future stressor for coastal marten habitat within extant population areas and the analysis area as a whole is 100 percent. Fine-scale analyses of potential impacts to coastal marten suitable habitat from climate change are not available. However, Lawler et al. (2012, p. 371–372) suggested that, overall, martens will be highly sensitive to climate change and will likely experience the largest climate impacts at the southernmost latitudes and lowest elevations within their range. Lawler et al. (2102, p. 372) also asserted that several marten populations currently considered at risk of extirpation will likely experience future climates outside the range of current climatic conditions. How these predictions translate to the amount and distribution of lost, degraded, or fragmented suitable coastal marten habitat across the analysis area is unknown. However, it appears that future changes in climate within the analysis area will impact suitable habitat more in the southern portions of the analysis area (i.e., the CA_EPA and remainder of the analysis area in California, and the SCO_EPA in southern Oregon) than in the northern portions (i.e., the CCO_EPA and northern coastal Oregon). Currently, coastal marten populations are small and isolated and suitable habitat is fragmented and greatly reduced from historical levels. Therefore, further habitat loss, degradation, or fragmentation from climate change could threaten the future viability of coastal marten populations and reduce the likelihood of reestablishing connectivity between extant populations. The amount of suitable marten habitat lost, degraded, or fragmented due to climate change is difficult to predict as is the potential for an increase in fire frequency, size, and severity within the analysis area. Martens within the CA_EPA and portions of the SCO_EPA already occur within relatively dry interior Douglas-fir forests, which may become unsuitable for martens due to climate change, especially through the loss of the dense shrub layer. Suitable redwood habitat within coastal national and state parks to the west of the CA_EPA may remain suitable for coastal martens even with projected changes in climate. However, to reach this coastal redwood habitat, martens must traverse many kilometers of unsuitable industrial timberlands, potentially

exposing themselves to an increased risk of predation, disease, incidental capture, roadkill mortality, or other potential stressors to individual martens. Similarly, coastal martens occurring within the drier interior portions of the SCO_EPA could possibly migrate west into suitable habitat as climate change alters the more interior habitat; due to a lack of significant physical barriers to east-west movements within that EPA.

Although warmer temperatures seem likely to result in an overall habitat loss for coastal martens, it is still not certain how vegetation may specifically respond and how that may translate into marten habitat. For most plant species, we know relatively little about their response to projected climate changes, and species distribution models seldom incorporate ecological functions/processes that would influence species response to changing climate conditions (Shafer et al. 2010, pp. 193–194). Uncertainties are further compounded by the fact that climate modeling and projections are done at a large scale with effects to species (both vegetation and wildlife) being complex and unpredictable given the ecological interactions among biotic and abiotic factors (Lawler et al. 2012, p. 396). For example, climate data sets and subsequent predictions of vegetation changes do not capture fine-scale topography and the smaller-scale effects of slope, aspect, and elevation and how these may shape local climates and vegetation trends (Lawler et al. 2012, p. 385). Thus, interpretations of projected climate change effects on species must consider these uncertainties.

We currently lack sufficient information to estimate the future direct impacts of climate change on suitable coastal marten habitat through the conversion to unsuitable (for coastal martens) forest types. However, we expect that the amount and distribution of currently suitable marten habitat that will be converted (due to a warmer, drier climate) to unsuitable forest types within the next 50 years will be greater in southern coastal Oregon and northern coastal California (which includes the SCO_EPA and CA_EPA) than in central (including the CCO_EPA) and northern coastal Oregon. A rough estimate of the impact to suitable coastal marten habitat in the next 50 years includes a low level impact for the central and northern coastal Oregon portions of the analysis area, including the CCO_EPA, and a low to medium level impact for the southern coastal Oregon and northern coastal California portions of the analysis area (including the SCO_EPA and the CA_EPA).

These impact level estimates only refer to the loss, degradation, or fragmentation of suitable coastal marten habitat through the conversion from suitable forest types to unsuitable forest types, and not potential indirect impacts of climate change on other habitat stressors reviewed in this report. Potential indirect impacts of climate change to other habitat stressors include an increase in the frequency and size of wildfires due to a projected warmer and drier climate in the analysis area and an increase in predation rates in areas where the mesic shrub understory has been lost or fragmented.

9.2.3.3 Vegetation Management

Historically, in California, a primary reason for the range reduction of the coastal marten was likely the result of habitat loss due to logging of late-successional forests during the last century (e.g., Buskirk and Ruggiero 1994, p. 11; Proulx et al. 2004, p. 51). Redwood accounted for approximately 35 percent of the conifer forests in the historical range in California. Zielinski et al. (2001, p. 487) concluded that the effect of past and current timber harvest in the redwood region is the most plausible reason for the continued absence of the coastal marten throughout most of northern coastal California. Similar to northern coastal California, much of coastal Oregon is privately owned and the majority of late seral coastal forest stands have been harvested over the past century, especially in stands nearest to the coast. Little or no suitable marten habitat occurs in these privately owned areas adjacent to the coast. Most currently suitable coastal marten habitat near the coast in Oregon and California is federally owned.

Vegetation management, such as timber harvest, thinning, fuels reduction, and habitat restoration, can result in a temporary or permanent loss, degradation, or fragmentation of suitable coastal marten habitat. Once lost, structural elements found in suitable coastal marten habitat that are used for denning and resting, such as large diameter live trees, snags, and logs, require more than a century to develop (Slauson and Zielinski 2009, p. 43). Loss of the dense, shade-tolerant shrub layer required by the coastal marten would take one or two decades to regrow (Slauson 2014c, pers. comm.). In Wyoming, Ruggiero et al. (1998, p. 671) estimated that it would take 250 years or more to develop trees of sufficient size to be used by American martens as natal den structures. On private timberlands within the analysis area, habitat that is currently lacking suitable structural elements (such as large trees, snags, and logs) for the coastal marten is not expected to regenerate over the next several decades. Some vegetation management activities, such as thinning, fuels reduction projects, and habitat restoration have the potential to improve habitat suitability for the coastal marten in the long term by minimizing loss of late-successional stands due to wildfires and accelerating the development of late seral characteristics. These types of projects could ultimately increase the overall amount, distribution, and patch size of suitable coastal marten habitat. However, these same activities would likely result in a short-term degradation, loss, or fragmentation of suitable coastal marten habitat. For example, maintenance of the dense, shade-tolerant shrub layer during these activities would be difficult, but necessary, to avoid short-term negative impacts to suitable habitat. Carefully planned thinning, fuels reduction, and restoration projects could minimize the initial loss, degradation, or fragmentation of suitable habitat by minimizing impacts to the shrub layer.

Past large-scale timber harvest has fragmented suitable habitat, reduced patch size, and eliminated forest structural elements required by coastal martens, such as large trees, snags, and logs. Cooperrider et al. (2000, p. 163) found that the continued simplification of the structure of forests and their fragmentation into smaller, more isolated, patches is a potential threat facing the coastal marten within redwood forests. Patch size of late successional forest is especially important to coastal marten habitat suitability at the home range scale and has been affected by past timber harvest. For example, Slauson (2003, p. 67) found that the probability of detecting the coastal marten increases, as patch size of late-successional forest increases. Timber harvest has also affected forest structure and changed the suitability of habitat by removing overhead cover, large diameter trees and logs, the shrub layer, and resting and denning structures.

Clearcutting is especially detrimental to coastal marten suitable habitat and populations. Chapin et al. (1998, p. 1328) summarized studies of the effects of clearcutting on American martens, which included selection against clearcuts (Steventon and Major 1982, pp. 177–178; Snyder and Bissonette 1987 pp. 173–174; Fredrickson 1990, pp. 28–29; Katnik 1992, p. 97) and reduced density of American martens in logged landscapes (Soutiere 1979, p. 858; Philips 1994, p. 30; Thompson 1994, p. 278).

While substantial past timber harvest reduced habitat for the coastal marten, harvest has been substantially reduced on Federal lands in the analysis area with the onset of the Northwest Forest Plan in 1994, and remains lower than that occurring on private lands (Kennedy et al. 2012, p. 128). Changes to late-successional and old-growth habitat within the first 15 years of the NWFP have been tracked on Federal and non-Federal lands within the NWFP area (which contains all of the coastal marten analysis area) (Moeur et al. 2011, entire). Moeur et al.'s (2011, entire) report accounted for loss and recruitment of late-successional and old-growth habitat from 1994 to 2007 in California and 1996 to 2006 in Oregon, finding an overall net loss of late-successional and old-growth habitat of 1.9 percent. Amounts varied by province, but net changes were small relative to the sources of error and uncertainty in the estimates, limiting precise estimates of late-successional and old-growth habitat change (Moeur et al. 2011, p. i). Approximately two-thirds of all late-successional and old-growth habitat in the NWFP area is found on Federal lands. The vast majority of late-successional and old-growth habitat loss on Federal lands was from wildfire, with only 0.5 percent (approximately 32,000 acres NWFP-wide) of late-successional and old-growth habitat on Federal lands being harvested. In contrast, 13 percent (approximately 491,000 acres NWFP-wide) of late-successional and old-growth habitat on non-Federal lands was harvested during the same time frame (Moeur et al. 2011, p. 31). Although the definition of late-successional and old-growth habitat in the Moeur et al. (2011) report is not a precise definition of coastal marten habitat, the vast majority (94 percent) of its harvest across the NWFP area occurred on non-Federal land. As an indication of potential future habitat conditions for the coastal marten, within the coast range province of Oregon, more than 75 percent of the future tree harvest is expected to come from private timberlands (Johnson et al. 2007, p. 37; Spies et al. 2007b, p. 50) and modeling of future timber harvests over the next 50 years indicates that current harvest levels on private lands in Oregon can be maintained at that rate (Adams and Latta 2007, p. 13).

As mentioned above, some types of vegetation management can promote development of habitat structural elements that improve the suitability of habitat for coastal martens. For example, thinning or other silvicultural treatments in young stands can accelerate the development of late-successional forest structural elements. Carefully designed treatments in existing younger, even-aged stands can open up the canopy, thereby increasing diversity and accelerating the transition to a forest with mature characteristics (USDA FS and USDI BLM 1994b, p. C-12). Treatments of these stands could also be conducted to maintain and/or enhance the understory shrub layer preferred by coastal martens. Projects that have the dual goals of restoring the shrub understory in the short-term and increasing development of large trees, a multi-layered canopy, and recruitment of large snags and logs will likely benefit the coastal marten over the long-term (Slauson et al. 2007, p. 466). These types of projects would be consistent with the requirement to develop late-successional forest conditions in Late Successional Reserve (LSR) land allocations on BLM and Forest Service lands within the NWFP area.

Throughout their range, coastal martens are more likely to be detected in areas that have not been logged and that still contain large patches of late-successional coniferous forest (Slauson 2003, pp. 35–59). The largest patches of late-successional coniferous forest within the three EPAs occur on Forest Service lands. Northwest Forest Plan land allocations within Federal lands in the EPAs include matrix, congressionally-reserved (mostly wilderness areas and national parks and monuments), late-successional reserves, adaptive management areas, riparian reserves, and administratively withdrawn areas. Matrix lands are available for programmed future timber harvest, while wilderness, reserves and administratively withdrawn areas are not; although harvest can occur in some of these allocations to meet specific objectives such as late-successional forest development as mentioned above.

Currently, approximately 45 percent, 28 percent, and 40 percent of the CCO_EPA, SCO_EPA, and CA_EPA, respectively, consists of lands currently available or assumed to be available for programmed timber harvest; e.g., Forest Service matrix lands, private lands, tribal lands, and BLM matrix lands. Approximately 23 percent, 10 percent, and 11 percent of the moderate and high suitability coastal marten habitat within the CCO_EPA, SCO_EPA, and CA_EPA, respectively, is within private lands (Table 8.2), most of which we expect is managed for industrial timber production subject to ongoing and future timber harvest under short (40–60 year) rotation systems. An additional 11 percent of all moderate and high suitability coastal marten habitat within the CA_EPA is owned by the Yurok Tribe (Table 8.2), which was recently purchased from a private timber company. However, future vegetation management activities within these lands are currently unknown. Finally, approximately 27 percent of all moderate and high suitability coastal marten habitat within the entire analysis area (including the three extant population areas) are in private ownership (Table 8.2). Due to current and expected future intensive timber harvesting activities, private lands are not expected to support viable marten populations or maintain important habitat elements in the future. Therefore, the maintenance of suitable coastal marten habitat on Federal and State lands is important to the long-term viability of coastal marten populations, especially within the CCO_EPA, which contains the highest proportion of private lands of the three EPAs.

Other forest management activities, including fuels management, salvage logging, and hazard tree removal can also affect the suitability of habitat for the coastal marten. Fuels projects, designed to lower fire risks, such as prescribed burning and mechanical treatments may (ultimately) improve the suitability of habitat for the coastal marten and may be essential to reducing the potential for catastrophic wildfire, which can quickly destroy large amounts of coastal marten habitat. Conversely, in the short-term these same practices could reduce the suitability of coastal marten habitat by reducing important habitat features, such as shrub density and species composition, canopy cover, snags, or logs. Furthermore, prescribed burning is generally conducted in the more mesic spring, which coincides with the coastal marten breeding season, and thus may impact natal dens or displace coastal marten from areas used for breeding. Moreover, significant loss of the shrub layer due to fuels reduction projects may reduce habitat suitability, due to reduction in prey abundance or improved access by competitors (Slauson and Zielinski 2004, p. 63) or predators. Removal of key structural features that are valuable to martens (e.g., shrub layer, downed wood, snags) certainly degrades or removes suitable habitat. Yet, in an effort to reduce the risk of losing marten habitat to a large-scale fire, Zielinski (2013, p. 419–422) suggested that carefully applied fuel reduction treatments that retained understory

structural diversity in those parts of the landscape least likely to burn might provide adequate understory for the short term, although this approach (as advocated by North et al. 2009) is currently an untested assumption. We expect an increase in fuels reduction projects in the near future due to drought and climate change, which will likely increase the frequency, size, and severity of wildfires in the future.

The scope of this stressor is difficult to estimate. Public, private, and tribal land management plans may list vegetation management activities that may occur at some time in the future, but may not describe the amount or location where these activities will occur. Therefore, we had to expect that certain vegetation management activities were likely to occur in the future based purely on ownership. We expected that all private land owners would manage the majority of their forests under short (40–60 years) rotations for timber production and thus would not be considered suitable for coastal martens in the future; including those stands that are currently suitable for the coastal marten.

Given the information above we considered the scope of this stressor as the proportion of moderate and high suitability coastal marten habitat in private ownership (Table 8.2), and for Federal lands (Table 8.2), the proportion of moderate and high suitability habitat within NWFP land allocations that allow programmed timber harvest (i.e., matrix lands), and allocations that retain or develop suitable habitat (e.g., wilderness, LSRs, riparian reserves, national parks) as follows:

Entire Analysis Area (56,705 km^2):
- Total amount of suitable habitat: 13,020 km^2
  - Proportion in private ownership: 27 percent
  - Proportion in Federal ownership: 66 percent

CCO_EPA (4,150 km^2):
- Total amount of suitable habitat: 2,348 km^2
  - Proportion in private ownership: 23 percent
  - Proportion in Federal ownership: 71 percent
    - Federal Matrix: 27 percent of Federal ownership
    - Federal Reserves: 71 percent of Federal ownership

SCO_EPA (4,695 km^2):
- Total amount of suitable habitat: 3,641 km^2
  - Proportion in private ownership: 10 percent
  - Proportion in Federal ownership: 90 percent
    - Federal Matrix: 14 percent of Federal ownership
    - Federal Reserves: 79 percent of Federal ownership

CA_EPA (812 km^2):
- Total amount of suitable habitat: 656 km^2
  - Proportion in private ownership: 11 percent
  - Proportion in Federal ownership: 77 percent
    - Federal Matrix: 10 percent of Federal ownership
    - Federal Reserves: 90 percent of Federal ownership

Expected management activities within moderate and high suitability habitat:

Private Lands: We don't expect moderate and high suitability coastal marten habitat to be retained over the long term on most private ownerships. Based on the short rotation (40–60 year) used by most private timber companies in the analysis area, we expect that most or all currently suitable habitat will be harvested within the next 40 to 60 years.

Federal Matrix Lands: We expect that some moderate and high suitability habitat may be lost, degraded, or fragmented, but rotations are generally longer than on private lands and more structural features are retained.

Federal Reserve Lands: We expect that most moderate and high suitability habitat will be retained. Timber harvest may occur within reserves designed to develop late successional habitat characteristics; however, this will likely occur within stands that are currently unsuitable or of low suitability for coastal martens.

Based on the proportion of moderate and high suitability coastal marten habitat within Federal reserve lands within each EPA, over the next 15 years we consider the vegetation management stressor to have a low impact on the loss, degradation, or fragmentation of suitable coastal marten habitat within the SCO_EPA and the CA_EPA, but a medium level impact for the CCO_EPA. For the entire analysis area, we considered vegetation management as a low level impact on suitable marten habitat for Federal lands and a high level impact for private lands over the next 15 years.

9.2.3.4 Development

Development by humans could result in the loss, degradation, or fragmentation of coastal marten suitable habitat. Forms of development that could result in negative impacts to suitable habitat include road building, dam construction and creation of new reservoirs, conversion of forest habitat for agricultural use, development and expansion of recreational areas (e.g., golf courses, campgrounds, and trails), urban expansion, and rural development. Although no information is available regarding the potential effects of development by humans on coastal marten suitable habitat, we expect that development that occurs within suitable marten habitat has the potential to result in the permanent loss, degradation, or fragmentation of coastal marten habitat. The negative effects of development would be most evident in areas near or adjacent to extant marten populations. However, human population density in the entire analysis area, especially within the extant population areas, is relatively low, and the three extant coastal marten population areas are located in remote areas. In addition, most new development in the analysis area will likely occur on private lands that currently contain much less suitable coastal marten habitat than public lands.

Although the scope of the development stressor is unknown, we expect that the impact of this stressor on suitable coastal marten in all three extant population areas and within the analysis area as a whole to be minimal (e.g., <1 percent), with the majority of development occurring on private lands. Some forms of development within suitable coastal marten habitat would likely not result in a substantial loss, degradation, or fragmentation of suitable habitat such as trail building

and minor campground expansion, but we expect that nearly all future development within suitable coastal marten habitat would result in some loss of habitat.

As with the vegetation management stressor above, we expect that potential impacts to suitable coastal marten habitat from the development stressor would be greater for the CCO_EPA than either the SCO_EPA or the CA_EPA, because the CCO_EPA contains more private-owned (where development is more likely to occur in the future), suitable coastal marten habitat than the SCO_EPA and CA_EPA combined. However, we consider development as a low level impact on suitable coastal marten habitat in all three EPAs and for the entire analysis area both currently and over the next 15 years, primarily based on low human population densities in suitable habitat within the analysis area, and especially within suitable habitat in the three EPAs. Overall, for the three EPAs and the remainder of the analysis area in Oregon and California, development should have little impact on suitable marten habitat when compared to the potential stressors of wildfire, climate change, and vegetation management as described above.

9.3 EXISTING REGULATORY MECHANISMS AND OTHER MECHANISMS THAT MAY ADDRESS STRESSORS

Existing regulatory mechanisms and other mechanisms that affect coastal martens include laws and regulations promulgated by the Federal and individual State governments. Tribal governments, as sovereign entities, are not subject to these laws and regulations, but have their own system of laws and regulations on tribal lands. Principal stressors on martens for which governments may have regulatory control include injury or mortality due to trapping, habitat modification or loss, and legal uses of pesticides including anticoagulant rodenticides. These regulations differ among government entities and are explained in separate sections below. Although an identified stressor, illegal use of pesticides at marijuana cultivation sites are not analyzed here because existing regulatory mechanisms have little bearing on activities that intentionally disregard applicable laws.

9.3.1 Federal Laws, Regulations, and Policies

The three EPAs in coastal Oregon and northern coastal California occur predominantly on Forest Service lands, although the BLM also has lands in the two EPAs in coastal Oregon (Table 8.2; Figure 8.3). National Park Service lands do not occur within the extant population areas, but occur within the analysis area, especially in northern coastal California in the vicinity of the CA_EPA (Figure 8.3). Federal agencies are subject to the National Environmental Policy Act of 1969, as amended (42 U.S.C. §§ 4321 *et seq.*) (NEPA). Individual agencies also have specific legislation that directs their management, which are described for each individual agency below.

9.3.1.1 National Environmental Policy Act of 1969 (NEPA)

NEPA requires Federal agencies to formally document, consider, and publicly disclose the environmental impacts of major Federal actions and management decisions significantly affecting the human environment. The resulting documents are primarily disclosure documents and NEPA does not require or guide mitigation for impacts, including impacts to coastal marten populations or suitable habitat. In addition, projects that are covered by certain “categorical

Table 9.1. Estimated impact levels for stressors potentially affecting coastal marten populations or potentially leading to the loss, degradation, or fragmentation of suitable coastal marten habitat. Refer to the **Classifying Stressors** section for impact level definitions.

Stressor	Coastal Marten Population			Entire Analysis Area
	Central Coastal Oregon	Southern Coastal Oregon	Northern Coastal California	
Stressors Potentially Affecting Marten Populations				
Trapping	Low-Medium	Low-Medium	NA	NA
Predation	Low	Low	Low	NA
Disease	Low	Low	Low	NA
Collison with Vehicles	Low	Low	Low	NA
Exposure to toxicants	Low	Low-Medium	Medium	NA
Stressors Potentially Leading to Habitat Loss, Degradation, or Fragmentation				
Wildfire	Low	Medium–High	Medium–High	Low: central and northern coastal Oregon Medium: southern coastal Oregon & northern coastal California
Climate change: within ≤50 years	Low	Low-Medium	Low-Medium	Low: central and northern coastal Oregon Low-Medium: southern coastal Oregon & northern coastal California
Vegetation management	Medium	Low	Low	Low: Federal lands High: Private lands
Development	Low	Low	Low	Low

exclusions" are exempt from further NEPA environmental analysis because the agency has already determined these actions do not have a significant effect on the human environment. The USDA Forest Service and USDI BLM have revised their internal implementing procedures describing categorical exclusions under NEPA 68 FR 33813 (June 5, 2003). The joint notice of NEPA implementing procedures adds two categories of actions to the agency lists of categorical exclusions that could affect coastal marten habitat: (1) hazardous fuels reduction activities; and (2) rehabilitation activities for lands and infrastructure impacted by fires or fire suppression. These exclusions apply only to activities meeting certain criteria: mechanical hazardous fuels reduction projects up to 4 km^2 (1.5 mi^2) in size can be exempt and hazardous fuels reduction projects using fire can be exempt if less than 18 km^2 (7 mi^2). See 68 FR 33814 for other applicable criteria. Exempt post-fire rehabilitation activities may affect up to 17 km^2 (6.6 mi^2). Excluded fuels reduction activities would likely result in the removal of structural elements important to coastal martens, with the shrub layer being an element particularly important for the coastal marten, yet readily targeted in fuels reduction projects. Further, extensive shrub removal may reduce the effective suitable habitat patch size below the minimum (i.e., $\geq$1.8 km^2 (0.69 mi^2)) required by the coastal marten (Slauson 2003, p. 71). Depending on the extent and distribution of the habitat manipulation, a large proportion of currently occupied suitable habitat on Federal lands could be rendered unsuitable for the coastal marten even if other important structural elements of coastal marten suitable habitat (e.g., large standing and dead conifers, down woody debris) were not impacted by the activities. While these actions can occur without further environmental analysis, they could also occur after further environmental analysis required for other actions not covered by a categorical exclusion. This is because, as stated earlier, NEPA is not designed to prevent or reduce negative environmental effects, but to disclose those effects and allow for public participation in the decision-making.

9.3.1.2 National Forest Management Act

The National Forest Management Act (NFMA) requires the USDA Forest Service to incorporate standards and guidelines into Land and Resource Management Plans (LRMP), including provisions to support and manage plant and animal communities for diversity and for the long-term, range-wide viability of native species. For each national forest, the LRMP is the principal document that guides the decision making process. The LRMPs for National Forests in the analysis area were developed in the mid- to late 1980s under the 1982 Planning Rule (47 FR 43037, September 30, 1982), and subsequently amended by the Northwest Forest Plan in 1994 (USDA FS and USDI BLM 1994b, entire). The Forest Service has recently revised their NFMA planning rules (77 FR 21162, April 9, 2012), which will apply to future LRMPs. Current LRMPs were developed under the 1982 planning rule, which required the Forest Service to maintain viable populations of existing native and desired non-native vertebrate species in the planning area. The revised rule requires plans to use an ecosystem and species-specific approach to provide for the diversity of plant and animal communities and maintain the persistence of native species in the plan area. This would include contributing to the recovery of federally listed threatened and endangered species, conserving proposed and candidate species, and maintaining viable populations of species of conservation concern (77 FR at 21169–21272). Directives for implementing this rule have not been finalized, so it is unclear how this change will affect coastal martens and their habitat, but coastal martens may become a species of conservation concern under the new policy. While there is concern over the removal of the requirement to

maintain viable populations of vertebrate species, and the increase in discretionary language compared to the previous rule (Schultz et al. 2013, p. 442), the obligation to ensure that populations of native species persist remains in effect.

The current Six Rivers National Forest LRMP includes standards and guidelines to minimize disturbance and habitat alteration in the vicinity of known active American [=Pacific] marten dens, but there is no requirement to conduct pre-project surveys. Without pre-project surveys there is no way to determine whether the action area includes active marten dens. Therefore, marten den sites on the Six Rivers are only protected if they already occur in a land allocation where timber harvest or other habitat alteration is not allowed, or if inadvertently discovered through other activities. This is important because the majority of the current coastal marten extant population area in northern coastal California occurs on the Six Rivers National Forest. The Siuslaw and Rogue River-Siskiyou national forests in coastal Oregon had marten management areas prior to the NWFP, but were eliminated when NWFP late successional reserves (LSRs) were designated on both forests (Clayton, Rogue River-Siskiyou National Forest, pers. comm., and Williams, Siuslaw National Forest, pers. comm.).

9.3.1.3 Federal Land Policy and Management Act of 1976

Management of BLM lands is directed by the Federal Land Policy and Management Act of 1976, as amended (43 U.S.C. §§ 1704 *et seq.*) (FLPMA). This law provides direction for resource planning and establishes that BLM lands shall be managed under the principles of multiple use and sustained yield. This law directs development and implementation of resource management plans (RMPs), which guide management of BLM lands at the local level. RMPs are the basis for all actions and authorizations involving BLM-administered lands and resources. RMPs may contain specific direction regarding marten habitat, conservation, or management, but to date, none specifically address marten needs.

9.3.1.4 Forest Service and BLM Sensitive Species and rodenticide policy

The Forest Service's Sensitive Species Policy (FSSSP; Forest Service Manual [FSM] 2670.32) calls for National Forests to assist and coordinate with other Federal agencies and States to conserve species with viability concerns. The American [=Pacific] marten has been identified as a sensitive species by the Forest Service's Region 5 (Pacific Southwest Region) (USDA FS 2007), which covers the California portion of the analysis area. Management of sensitive species must not result in a loss of species viability or create significant trends toward federal listing (FSM 2670.32). It is not considered a sensitive species in Region 6 (Oregon portion of analysis area) (USDA FS 2011), nor does BLM in either Oregon or California consider it a sensitive species (USDI BLM 2008 and 2010).

BLM has a sensitive species program as well, directing the agency to initiate conservation measures that reduce or eliminate threats and minimize the likelihood of listing under the ESA (USDI BLM 2008, BLM Manual section 6840.02B). However, the marten is not listed as a sensitive species for BLM in either Oregon or California (USDI BLM 2010 and USDI BLM 2011).

9.3.1.5 Forest Service Rodenticide Policy

The Forest Service has extensive policy on the use of rodenticides. This policy is described in Forest Service Manual and Handbooks, which codify the agency's policy, practice, and procedure. Forest Service Manual (FSM) contains legal authorities, objectives, policies, responsibilities, instructions, and guidance needed on a continuing basis by Forest Service line officers and primary staff in more than one unit to plan and execute assigned programs and activities. Forest Service Manual, Chapter 2150.3 provides policy on the use of pesticides. It is Forest Service policy to:

1. Conduct all pesticide-use activities using an integrated pest management approach to improve overall treatment effectiveness and to reduce pesticide risk(s) for both humans and the environment.

2. Conduct all Forest Service pesticide-use activities in full compliance with applicable Federal laws, regulations, and other authorities including, but not limited to, the Federal Insecticide, Fungicide, and Rodenticide Act, the National Environmental Policy Act, and the Endangered Species Act. Relevant State and local laws pertaining to the use of pesticides will be followed when not in conflict with Forest Service management authorities and objectives.

3. Require that all pesticide-use activities conducted by non-Forest Service personnel on the National Forest System, or other areas administered by the Forest Service, be in compliance with applicable EPA pesticide label restrictions and other applicable Federal and State laws and regulations including the Federal and State laws and regulations that apply to personnel training and licensing.

4. Require that all Forest Service personnel who use any biopesticide or general-use chemical pesticide (other than household pesticides) on terrestrial or aquatic areas of the National Forest System be trained in the proper, safe, and effective use of the respective pesticides being applied for the management activity. Pesticide-use training and certification for Forest Service employees who use, or directly supervise the use of, restricted-use pesticides will be accomplished through an appropriate EPA-approved State program or a national Forest Service certification program.

5. Incorporate pertinent pesticide-use policy and related handbook guidance into all management activities on the National Forest System and other lands, waters, or facilities administered by the Forest Service; including but not limited to procurement activities, contracts, permits, leases, and agreements to foster the safe and effective use of pesticides.

6. Coordinate Forest Service pesticide-use activities, as appropriate, with Federal, State, Tribal, and local government agencies.

7. Use pesticides as part of an Integrated Pest Management (IPM) program within designated Wilderness, Research Natural Areas, and other special designation areas when necessary to protect native plant and animal populations and habitats, restore significant resource values or functions, or to protect public or private lands bordering these areas. All Forest Service-

sponsored pesticide-use activities implemented on private lands bordering designated Wilderness areas require planning, coordination, and written permission from the local landowner(s) prior to application activities.

8. Support pesticide-related research activities on evaluation and improvement of environmental and human safety, develop new and improved pesticide formulations and effective application methods, and transfer associated science and technology.

9. Provide technical assistance, when appropriate, to manufacturers, the EPA, or other agencies in evaluating or registering pesticides determined necessary for forestry, vegetation management, rangeland management, invasive species management, or other resource management activities.

9.3.1.6 Northwest Forest Plan (NWFP)

The NWFP was adopted in 1994 to guide the management of 97,124 km^2 (37,500 mi^2) Federal lands in portions of western Washington, Oregon, and northwestern California (i.e., within the range of the northern spotted owl [*Strix occidentalis caurina*]). The NWFP amends the management plans of National Forests and BLM Districts within the range of the northern spotted owl, representing a 100-year strategy intended to provide the basis for conservation of the northern spotted owl and other late-successional and old-growth forest associated species (USDA FS and USDI BLM 1994a, 1994b). All Forest Service and BLM lands within the analysis area are currently managed under the NWFP. Implementation of the NWFP is intended over time to provide a network of large blocks of late-successional forest habitat connected by riparian reserves. Implementation of the plan is expected to lead to a substantial improvement in current habitat conditions for the Pacific marten within the reserve network on Federal lands. The original assessment of NWFP implementation on martens within the plan area projected a 67 percent likelihood of achieving an outcome in which habitat is of sufficient quality, distribution and abundance to allow the Pacific marten population to stabilize and be well distributed across Federal lands (USDA, USDI, USDC, and USEPA 1993, p. IV-173). This analysis further determined a 27 percent likelihood that habitat was sufficient to allow marten populations to stabilize, but that there would be significant gaps in the species distribution on Federal lands; the principal concern was over the extremely low populations in coastal Oregon and Washington, casting doubt that marten populations would ever be well distributed throughout their range (USDA, USDI, USDC, and USEPA 1993, p. IV-172 to IV-174). Additional mitigation measures to improve habitat conditions in the matrix allocation were added to the final NWFP (specifically, increasing large woody debris retention amounts and increasing the size of riparian reserves), which resulted in an increase in the outcome for marten to 83 percent likelihood of well distributed habitats and populations, with a reduction to a 17 percent likelihood of a significant gap in the species distribution on Federal lands (USDA FS and USDI BLM 1994a, Appendix J2, pp. J2-54, J2-471 to J2-473). While the assessment determined that marten habitat would likely be sufficient to support martens throughout the NWFP area, it concluded that the low population levels of martens in coastal Oregon may limit distribution and recovery despite more favorable habitat conditions (USDA FS and USDI BLM 1994a, Appendix J2, p. J2-473).

The annual volume of timber offered for sale in the NWFP area has been greatly reduced since 1990, in part due to implementation of the NWFP. The annual probable sales quantity (PSQ or targeted timber volume) under the NWFP is just over 800 million board feet, only 18 percent of the volume annually offered in the 1980s by Federal agencies in the NWFP area (Grinspoon and Phillips 2011, pp. 3, 5). The actual effect on the ground is even less timber harvested because actual harvested timber sales from inception of the NWFP through 2008 have averaged 469 million board feet per year, or 58 percent of PSQ (Grinspoon 2012, pers. comm.). Thus, the potential for habitat loss from forest management activities on Federal lands within the NWFP area has been substantially reduced over the past two decades.

Even with the substantial reduction in timber harvest after NWFP implementation, timber harvest, fuels reduction projects, and road construction may continue to result in the loss, degradation, or fragmentation of suitable coastal marten. Fuels reduction projects can also occur on all non-matrix land allocations except wilderness. Timber harvest and fuels reduction projects can occur in late-successional reserves if proposed activities enhance late-successional conditions or reduce the risk of large-scale, stand-replacing fires. Although these projects may ultimately improve habitat quality for late-successional dependent species, such as the coastal marten, they likely would have the proximate negative effect of reducing habitat quality and quantity in the short term through the reduction of shade tolerant shrub cover, believed to be an important habitat element for the coastal marten. The loss of late-successional old-growth habitat, which is conducive to coastal marten habitat, in the analysis area primarily occurred outside of Federal lands, with more late-successional and old-growth loss of Federal lands occurring from fire than from timber harvest (Moeur et al. 2011, p. 31) (See ***Vegetation Management*** section above).

9.3.1.7 National Park Service (NPS) Lands

The NPS Organic Act of 1916 (39 Stat. 535, 16 U.S.C. 1, as amended), states that the NPS "shall promote and regulate the use of the Federal areas known as national parks, monuments, and reservations … to conserve the scenery and the national and historic objects and the wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." The General Management Plan/General Plan for Redwood National and State Parks (RNSP), which make up nearly all of National Park Service lands within the analysis area (the relatively small (2.3 km^2; 0.9 mi^2) Oregon Caves National Monument in southern Josephine County, Oregon is the only other national park or monument in the analysis area), does not contain any specific protective measures for coastal martens and does not require pre-project surveys (USDI NPS and California DPR 1999, entire). The protective measures afforded the federally listed northern spotted owl and marbled murrelet (*Brachyramphus marmoratus*) may not adequately protect habitat elements (especially the shade tolerant shrub layer) that may be critical for the viability of coastal marten populations. Biological assessments of proposed actions on NPS lands need not consider potential impacts to suitable coastal marten habitat. Therefore, it is possible that projects determined to have no significant impacts on listed species may negatively impact suitable coastal marten habitat. The extensive and contiguous suitable coastal marten habitat patches that occur on RNSP lands in northern coastal California are the most viable areas for the natural (i.e.,

through dispersal) or artificial (i.e., translocation) colonization of formerly occupied portions of the historical range of the coastal marten.

9.3.2 California State Laws, Regulations, and Policies

9.3.2.1 California Endangered Species Act (CESA)

The coastal marten is not listed under the California Endangered Species Act (CESA) or as a State "fully protected" species and thus does not receive protections available under those statutory provisions. The California Department of Fish and Wildlife (CDFW; formerly the California Department of Fish and Game (CDFG)) has identified the Pacific marten as a Species of Special Concern; however, this designation provides no legal status to protect habitat or prevent "take" (as defined under CESA) of martens. The State of California classifies the Pacific marten as a furbearing mammal that is protected from commercial harvest, which provides protection to martens in the form of minor fines for illegal trapping. The California Wildlife Action Plan (CDFG 2007, entire) does not identify any goals or objective for conservation specifically for martens in the State. The CDFW is currently updating and revising their "Mammalian Species of Special Concern" list and the Pacific marten is a nominee for evaluation during this process. In 1998, an update to CDFG's 1986 publication "Mammalian Species of Special Concern in California" was developed but never finalized. The draft document concluded that the Pacific [=American] marten appeared to meet CESA criteria for listing as Endangered in its historical range of Del Norte, Humboldt, Mendocino, and Sonoma counties (Bolster 1998, p. 141).

9.3.2.2 California State Park Lands

California Department of Parks and Recreation manages Prairie Creek Redwoods State Park. This 57 km^2 (22 mi^2) park was established in the 1920s to protect old-growth redwoods. Prairie Creek Redwoods, Del Norte Redwoods, and Jedediah Smith Redwoods State Parks are all co-administered with Redwood National Park and are managed under the General Management Plan for RNSP, which, as mentioned above, contains no specific protective measures for and does not require pre-project surveys for the coastal marten.

9.3.2.3 California Environmental Quality Act (CEQA)

CEQA requires disclosure of potential environmental impacts of public or private projects carried out or authorized by all non-Federal agencies in California. If significant effects are identified, the lead agency has the option of requiring mitigation through changes in the project or to decide that overriding considerations make mitigation infeasible (CEQA section 21002). Similar to the Federal NEPA, CEQA does not require that adverse impacts be fully mitigated, only that impacts be assessed and the analysis disclosed to the public. Therefore, protection of suitable coastal marten habitat or habitat elements is not required under the CEQA.

Protective measures disclosed under CEQA for federally listed species (e.g., northern spotted owl, marbled murrelet, and anadromous salmonids) may provide some general benefit for coastal martens; however, because these measures are not specific to coastal martens, they may be of

limited conservation benefit overall. For example, none of the above federally listed species depend on a dense layer of shade-tolerant shrubs.

9.3.2.4 California Forest Practice Rules (FPR)

In California, timber harvest activities on commercial (private and State) forestlands are regulated through a process that is a functional equivalent to CEQA. Under CEQA provisions, the State has established an independent regulatory program to oversee timber management activities on commercial forestlands, under the Z'berg-Nejedly Forest Practice Act of 1973 and the California Forest Practice Rules (California Department of Forestry and Fire Protection; CAL FIRE 2013). The California FPRs are administered by CAL FIRE, and apply to commercial harvesting operations for non-Federal and non-Tribal landowners of all sizes.

The California FPRs provide specific, enforceable protections for species listed as threatened or endangered under the Federal or California State endangered species acts, and for species identified by the California Board of Forestry (BOF) as "sensitive species;" however, the BOF has not classified the coastal marten as sensitive (i.e., the marten is not individually identified under the definition of "sensitive species" under 14 CCR 895.1). Therefore, proponents of State-permitted Timber Harvest Plans or Non-Industrial Timber Harvest Plans currently have no obligation to conduct coastal marten surveys, evaluate or disclose potential impacts to coastal martens, or to avoid, minimize, or mitigate any impacts to coastal martens. Furthermore, there is no mechanism for identifying cumulative impacts to the coastal marten or its habitat. Approximately 24 percent of the total area of the three EPAs, and 19 percent of the suitable marten habitat within the three EPAs, occurs on private timberlands and thus is subject to these unregulated and unquantified impacts.

While the California FPRs generally require that all snags within a logged area be retained to provide wildlife habitat, they also allow broad discretionary exceptions to this requirement for safety concerns, which greatly reduces the effectiveness of the snag retention requirement. The FPRs do not require the retention of downed woody material, making retention of these structural elements voluntary. Similarly, the California FPRs do not contain enforceable measures for protection of decadent or other large trees with structural features such as platforms, cavities, and basal hollows, which appear to be important components of coastal marten habitat. Some timber operations, such as salvage, fuel wood harvest, power line right-of-way clearing, and fire hazard reduction are exempt from timber harvest plan preparation and submission requirements.

The California FPRs provide for disclosure of impacts to late succession forest stands, in some cases. The rules require that information about late-successional stands be included in a timber harvest plan when late-successional stands over 0.08 km^2 (0.03 mi^2) in size are proposed for harvesting and such harvest will "significantly reduce the amount and distribution of late succession forest stands or their functional wildlife habitat value so that it constitutes a significant adverse impact on the environment" (FPR §919.16, 939.16, 959.16). If the harvest is found to result in "long-term significant adverse effects," feasible mitigation measures need to be incorporated in the timber harvest plan unless the adverse effects cannot be avoided or mitigated and then the plan will identify measures to reduce the effects.

9.3.3 Oregon State Laws, Regulations, and Policies

9.3.3.1 Oregon Department of Fish and Wildlife

In Oregon, the marten is classed as a furbearer, subject to regulated harvest statewide (OAR 635-050-0015 and 635-050-0110). Although marten can be legally trapped in Oregon, most of the marten trapping occurs in the Cascades, with harvest in the Coast Range extremely rare (Hiller 2011, p. 17).

The marten is also listed as a "Sensitive Species-Vulnerable Category" in the Oregon Coast Range, meaning the species faces one or more threats to their population or habitat in this area of the state, and not considered imperiled with extirpation, but could become so with continued or increased threats (ODFW 2008, pp. 2,13). The Sensitive Species list is not a regulatory mechanism and is not used as a "candidate" list for species to be considered for listing under the Oregon Threatened and Endangered Species rules. Rather, it is used to encourage voluntary actions that will improve the species' status and prevent species from declining to the point of qualifying for listing (ODFW 2008, p. 1).Within the Oregon Coast Range, the marten is also listed as a conservation strategy species in the Oregon Conservation Strategy (ODFW 2006, p. 320). The Oregon Conservation Strategy is a non-regulatory, overarching state strategy for conserving fish and wildlife and recommends voluntary actions to improve the efficiency and effectiveness of conservation in Oregon (ODFW 2006, p. i.). Based on identified low survival rates and fragmented forest habitats, the conservation strategy recommended minimization of fragmentation in core habitat, providing travel corridors between blocks of habitat, maintenance and creation of snags, and maintenance of downed wood.

State parks in coastal Oregon within the analysis area comprise 150 km^2 (62 mi^2), many of which may provide forested habitats suitable for marten. At the landscape scale, approximately 9 percent of state park lands consist of coastal marten habitat of high suitability; 23 percent of moderate suitability; 17 percent of low suitability; and 50 percent unsuitable. These parks are managed by the Oregon Parks and Recreation Department (OPRD), with a mission to "provide and protect outstanding natural, scenic, cultural, historic, and recreational sites for the enjoyment and education of present and future generations." (OPRD 2014, p.1). Most of the state parks are scattered small (a few square kilometers or less) parcels that provide mainly recreational opportunities such as camping and picnicking, with little benefit to coastal martens.

9.3.3.2 Oregon Forest Practice Rules

The Oregon Forest Practice Administrative Rules (OAR chapter 629, division 600) and Forest Practices Act (Oregon Revised Statutes (ORS) 527.610 to 527.770, 527.990(1) and 527.992) (ODF 2010a, entire) apply to all non-Federal and non-Tribal lands in Oregon, regulating activities that are part of the commercial growing and harvesting of trees, including timber harvesting, road construction and maintenance, slash treatment, reforestation, and pesticide and fertilizer use. The Oregon Administrative Rules (OAR) provide additional guidelines intended for conserving soils, water, fish and wildlife habitat, and specific wildlife species while engaging in tree growing and harvesting activities, but these rules do not directly protect the coastal marten or its habitat. Application of the rules may, however, retain some structural features (i.e., snags,

green trees, down wood) that contribute to marten habitat. For example, in regeneration harvest units that exceed 0.10 km^2 (0.04 mi^2), operations must retain two snags or two green trees, and two downed logs per acre (0.004 km^2; 0.002 mi^2). Green trees must be over 28 cm (11 in.) dbh and 9 m (30 ft.) in height, and down logs must be over 1.8 m (6 ft.) long and 0.28 m^3 (10 ft^3) in volume (ORS 527.676). These residuals, however, are substantially smaller than those typically selected by martens at resting sites.

Prohibition of timber harvest within a maximum of 6 m (20 ft.) of streams may provide some narrow, linear strips of older forests that may contain some structural features of benefit to martens. In addition, retention buffers are required on private lands around northern spotted owl nest sites (0.28 km^2 (0.11 mi^2) of suitable habitat) (OAR 629-665-0210), bald eagle nest sites (100-m (330-ft.) buffer) (OAR 629-665-0220), bald eagle roost sites (100-m (300-ft.) buffer) (OAR 629-665-0230), and great blue heron nest sites (91-m (300-ft.) buffer) (OAR 629-665-0120). Also, foraging trees used by bald eagles (OAR 629-665-0240) and osprey nest trees and associated key nest site trees (OAR 629-665-0110) are also protected from timber harvest. In all cases, protections of these sites are lifted when the site is no longer considered active (OAR 629-665-0010). These retention areas might provide some small pockets of mid- to late-successional habitat, and some old-forest structures that are desirable coastal marten habitat components may occur within these retention patches. However, with the exception of the no-cut riparian buffer, these are not intended to be retained long-term. Furthermore, these areas, at best, would only provide individual structures and small pockets of habitat in a landscape that is otherwise typically managed for industrial timber harvest with short rotations and limited opportunity to grow into suitable marten habitat.

9.3.3.3 Oregon Department of Forestry Lands

There are approximately 2,760 km^2 (1,066 mi^2) of State forestlands within the analysis area that are managed by the Oregon Department of Forestry (ODF). These lands include small scattered parcels, but most occur within one of three state forests, the largest being the Tillamook State Forest at 1,473 km^2 (569 mi^2). However, we have found only one confirmed overlap of State Forest lands with the CCO_EPA and one possible overlap. The confirmed overlap is in the Western Lane Administrative District (105.3 km^2; 40.7 mi^2; ODF, 2010, pp. 2–52) east of Mapleton, Oregon; the possible overlap is in Lincoln County in the southern portion of the West Oregon Administrative District, east of Newport, Oregon and south of State Route 20 (5.2 km^2; 2 mi^2; ODF 2010a, p. 2–52). Management of state forest lands are guided by forest management plans (e.g., ODF 2010a, entire). Pursuant to Oregon statutes (ORS 496.012) and administrative rules (OAR 635-100-0100 to 0130), the ODF has a species of concern policy for managing those species "at risk due to factors such as declining populations, limited range, or low quality or quantity of habitat". Only the Clatsop and Tillamook state forests in northwestern Oregon have identified their sensitive species so far, and the marten is on their lists (ODF 2009, p. 12).

State forests in western Oregon are managed for specific amounts of forest structural stages. The objective is to develop 15 to 25 percent of the landscape into older forest structure (81 cm (32 in.)) minimum diameter trees, multiple canopy layers, diverse structural features, and diverse understory) and 15 to 25 percent into layered structure (two canopy layers, diverse multi-species shrub layering, and greater than 46 cm (18 in.) diameter trees mixed with younger trees over the

long term (ODF 2010a, pp p. 4–48 and p. C-1 to C-24). State forests in northwest Oregon currently have 4 percent of their land base in forest age classes (>85 years) that are capable of supporting the layered and older forest structure categories, combined but the West Oregon and West Lane Administrative districts have 15.0 and 12.4 percent, respectively (ODF 2010a, pp. 2–82). The aforementioned marten landscape habitat suitability model (Figure 6.6) indicates that currently, approximately 8 percent of State Forest land is high suitability marten habitat, 19 percent is moderate suitability, 28 percent is in low suitability, and 45 percent is unsuitable habitat. Managing for the structural habitats as described should increase habitat for coastal martens on state forests.

Management plans for Oregon's State Forests do not provide specific provisions for conserving the marten or its habitat, although management for other species and resources may provide retention of some marten habitat elements and patches of marten habitat. Examples include 4 to 24 km^2-units (1.6 to 9.4 mi^2) of "anchor habitats" (e.g., ODF 2010a, pp. 4-82–4-83) designed to benefit species associated with older forest and interior habitat conditions in the short term, allowing them to persist and re-colonize new habitat created on the landscape over time (ODF 2010a, pp. 4-82–4-83; Dent 2013, pers. comm.). Northern spotted owl nest sites are protected by a 1 km^2 (0.4 mi^2) core, maintenance of 2 km^2 (0.8 mi^2) of suitable habitat within 1.1 km (0.7 mi) of the nest, and 40 percent of habitat within the provincial home range (ranging from 1.9 to 2.4 km (1.2 to 1.5 mi) radius of the nest, depending on what physiographic province the nest is in; ODF 2010a, p. A-10). Marbled murrelet management areas (MMMAs) are established around marbled murrelet occupied sites (ODF 2010b, Parts 3.16 and 3.17); management activities within MMMAs need to maintain habitat suitable for nesting and minimize disturbance of reproductive activities (ODF 2010b, Parts 3.18 and 3.20). Sizes of MMMAs vary with local conditions and habitat. In the northern Coast Range they total 25 km^2 (9.8 mi^2), averaging 0.6 km^2 (0.2 mi^2) in size (Weikel 2011, pers. comm.). In the south-central Coast Range on the Elliott State Forest, 14 km^2 (5.3 mi^2) of MMMAs are designated, with an additional 44 km^2 (17 mi^2) that overlap designated spotted owl protection areas (Dent 2013, pers. comm.). Many of these retention blocks are not large enough to support a coastal marten home range, but they may provide habitat patches that allow coastal martens to move across the landscape.

Retention of green trees and snags within harvest units differs among state forests, ranging from 2 to 4 live trees per acre on the Elliott State Forest to landscape-level targets of 5 trees per acre and 2 snags per acre elsewhere (Dent 2013, pers. comm.). Riparian buffers include a 7.6 m (25 ft.) no-cut area, with varying tree retention requirements out to 30 to 52 m (100 or 170 ft.), depending on the stream size, use, and whether or not fish are present (ODF 2010a, pp. J-7–J-10; Dent 2013, pers. comm.) These sites would not meet marten habitat needs post-harvest due to reduced stand densities and lack of crown continuity (e.g. ODF 2010a, pp. J-7–J-10). However, the retained trees would contribute to the development of the older forest and layered structural stages that the state is working to develop and that may provide future coastal marten habitat.

9.3.4 Tribal Lands

9.3.4.1 Oregon

None of the tribes in coastal Oregon specifically manage for coastal marten populations or habitat on their lands, and most of the reservations and other tribal lands in Oregon are outside of the range of the coastal marten.

The Confederated Tribes of Siletz Indians manage approximately 59 km^2 (23 mi^2) of tribal forest in Lincoln and Douglas Counties (Confederated Tribes of Siletz Indians 1999, pp. 1–3, 2-6, 2-7; Confederated Tribes of Siletz Indians 2010, p. 1-1; Kennedy 2013a, pers. comm.). Most of this land is managed for commercial timber harvest, but almost 17 km^2 (6.7 mi^2) were recently acquired as compensation for injuries to marbled murrelets as a result of a 1999 oil spill from the freighter vessel M/V New Carissa. The Tribes have entered into a conservation easement wherein the property will be managed as habitat for the marbled murrelet, with habitat protections to be sustained even if the marbled murrelet no longer is afforded protection under the Endangered Species Act. Existing habitat will be protected, while remaining property will be managed to move even-aged stands towards more diverse structure, providing for other late-successional forest species including the marten (Confederated Tribes of Siletz Indians 2010, pp. 1-1, 1-2, 3-1, 4-1, 4-2). Maintaining this area as murrelet habitat may also be beneficial for marten habitat because many of the forest structures and stand conditions found in murrelet habitat can benefit martens by providing rest and den sites, although martens are not known to occur in the area. Trapping is allowed on Siletz lands by tribal members and follows Oregon State trapping regulations (Kennedy 2013b, pers. comm.).

The Confederated Tribes of Grand Ronde manage approximately 40 km^2 (16 mi^2) of tribal forest in Yamhill County, Oregon, outside the known extant coastal marten population areas, but within its historical range in coastal Oregon. The tribal forest is managed for commercial timber harvest (Confederated Tribes of Grand Ronde 2012, pp. 3, 6–7). The forest is open to the public for hunting and fishing, but the tribe neither explicitly allows nor prohibits trapping; they currently have no trapping regulations and do not block access for trapping. Any trapping that does occur would have to abide by Oregon State fish and game regulations (Belonga 2013, pers. comm.).

The Coquille Indian Tribe manages the 22 km^2 (8.4 mi^2) of Coquille Forest located in Coos County. This land was formerly managed by the BLM, Coos Bay District, and is to be managed according to the standards and guidelines of the district's final resource management plan, as amended by the NWFP (Coquille Indian Tribe 1998, pp. 10–12). Although the Coquille Forest is managed in accordance with the NWFP, the land allocations on the forest are Matrix overlain by Riparian Reserves (Coquille Indian Tribe 1998, p. 17). Consequently, the only habitat components provided for coastal martens are structural features provided by green tree, snag, and down wood retention requirements within the NWFP matrix, and protection provisions of the NWFP riparian reserves. In addition to the Coquille Forest, the tribe manages another 4 km^2 (1.6 mi^2) of tribal trust lands on which operational forestry occurs (Robison 2013, pers. comm.). While canopy cover suitable for marten occupancy would likely not be maintained under the tribe's management, residual levels of resting structures and small patches of late-successional forest retention may facilitate coastal marten movements across the landscape between

surrounding Federal lands. Trapping on the Coquille tribal forest is managed by the State (James 2013, pers. comm.; Robison 2013, pers. comm.).

9.3.4.2 California

The Yurok Tribe manages roughly 206 km^2 (80 mi^2) of tribal land holdings, some areas held in trust by the Department of the Interior, and other areas are tribally held. Tribal lands include about 4 km^2 (1.6 mi^2) of late-successional redwood forest. The Yurok Tribe recently purchased 190 km^2 (73 mi^2; included in the collective holdings mentioned above) from the Green Diamond Resource Company (Western Rivers Conservancy 2010, p. 13; 2013, p. 7). With these newly acquired lands, the Yurok Tribe currently owns approximately 23 percent of the total area of the CA_EPA, on its western margin, most of which is currently occupied by coastal martens. The purchased lands will likely be used for a sustainable forestry operation and the portion within the lower Blue Creek watershed may be managed as a Yurok Tribal Park to protect cultural sites and develop heritage-based ecotourism (Yurok Tribe 2005, entire). However, proposed vegetation management activities within the purchased lands and the potential impacts to coastal martens are currently unknown. If the transferred lands are managed by the Tribe to accelerate the development of late-successional forest characteristics, they could eventually be suitable for the coastal marten and provide an important dispersal or functional corridor between public lands to the east and west of the transferred lands. Recent timber sales by the Yurok Tribe have targeted late-mature and old-growth stands for clear-cut harvest. For example, the proposed 2005 Bear Creek "A" Timber Harvest Plan proposed to remove at least 0.45 km^2 (0.18 mi^2) of suitable nesting habitat for northern spotted owl and marbled murrelet, much of which is likely suitable for the coastal marten. If similar management objectives were pursued on the newly purchased Green Diamond Resource Company lands, it would likely have negative effects on coastal marten habitat.

9.3.5 Other Mechanisms

9.3.5.1 Habitat Conservation Plans (HCPs)

Some non-Federal lands are managed under HCPs with strategies that conserve habitat for a variety of species. These HCPs may provide some incidental benefit to coastal martens, such as maintenance of late seral coniferous forest patches. The Green Diamond Resource Company's 1992 Northern Spotted Owl HCP is the only terrestrial species HCP within the current occupied range of the coastal marten. Green Diamond Resource Company planned to retain resource values that would provide core habitat for future northern spotted owl habitat. The northern spotted owl resource values listed in the HCP included the retention of: (1) hardwood and conifer "patches", (2) habitat structure along watercourses, (3) hard and soft snags, (4) standing "live culls", and (5) small areas of undisturbed brush. Details on the level and extent of resource retention were not provided. Because the coastal marten was not a covered species, the HCP contains no coastal marten-specific conservation measures. However, retention of only "small areas of undisturbed brush" is inadequate for the coastal marten. The lack of detailed size and density estimates for retained trees, snags, and habitat patches in harvest areas makes it difficult to determine whether the northern spotted owl conservation measures are adequate for the maintenance of coastal marten habitat.

Green Diamond Resource Company is currently developing a new HCP; however, the coastal marten is not a covered species. As mentioned above, approximately 11 percent of the CA_EPA occurs on private [Green Diamond Resource Company] timberlands. If conservation measures for the northern spotted owl are inadequate to conserve suitable coastal marten habitat, coastal marten population viability within the CA_EPA may be affected. Because private timberlands lie between large suitable tracks of public lands, a reduction in habitat quality and quantity may reduce the likelihood that the coastal martens can safely move between suitable public land segments (e.g., between Forest Service and RNSP lands in northern coastal California); with the intervening private lands acting as a population sink.

9.3.5.2 Rodenticide Regulations

The use of rodenticides is regulated under the Federal Insecticide, Fungicide, and Rodenticide Act of 1947, as amended (FIFRA) (7 U.S.C. §§ 136 *et seq*.) via the registration of labels by the U.S. Environmental Protection Agency (EPA). Each label describes the permitted use for an individual rodenticide product and must be supported by rigorously collected and analyzed efficacy and environmental safety data. The majority of registrations are sponsored by private manufacturers for large uses in commensal and agricultural settings, including forestry. In addition, there are a number of labels currently under registration to the U.S. Department of Agriculture (USDA) and state agencies for agricultural and wildlife damage control purposes. Eleven rodenticide compounds are currently registered with the EPA as solid baits for use against a number of vertebrate species. These are categorized by their mode of action: first generation anticoagulants (chlorophacinone, diphacinone, warfarin), second generation anticoagulants (SGARs) (brodifacoum, bromadiolone, difenacoum, difethialone), and non-anticoagulant/acute (bromethalin, cholecalciferol, zinc phosphide, strychnine).

The states have authority to regulate pesticides, implemented under laws and regulations unique to each state, but stepped down from FIFRA. They can register additional pesticide products at the state level as well as restrict or deny uses previously approved by the EPA. For California, the state Department of Pesticide Regulation is the regulatory authority which implements Title 3. (Food and Agriculture), Division 6 (Pesticides and Pest Control Operations) of the California Code of Regulations. Enforcement is carried out at the county level.

The EPA is required by multiple statutes [FIFRA, ESA, Migratory Bird Treaty Act of 1918, as amended (MBTA) (16 U.S.C. §§ 701-12), and Bald and Golden Eagle Protection Act of 1940, as amended (BGEPA) (16 U.S.C. §§ 668-668c)] to ensure that the use of a pesticide label does not result in mortality to non-target species. The process of registration of a pesticide with the EPA and the licensing of it for use at the state level must include a determination of what effects, if any, the proposed use would have on listed species. The EPA has conducted formal Section 7 consultations with the Service on the effects of rodenticides (e.g., USDI FWS 1993, entire; USDI FWS 2012a, entire; USDI FWS 2012b, entire), resulting in substantial changes to labels. Endangered Species Considerations are detailed for each listed species within the potential use area, with instructions to contact the nearest USFWS office, or the appropriate State Agency, for more information. At the user level, misuse of a pesticide resulting in take of a listed species can be prosecuted under the above statutes. However, the coastal marten is currently not a listed species.

The EPA's Endangered Species Protection Program Bulletins set forth geographically specific pesticide use limitations for the protection of endangered or threatened species and their designated critical habitat. When referenced on a pesticide label, Bulletins are enforceable use limitations under FIFRA.

The primary regulatory issue for rodenticides and coastal martens is the availability of large quantities of rodenticides that can be purchased under the guise of legal uses, which can then be used illegally in marijuana grows within coastal marten habitat. In 2008, after reviewing the scientific literature and reported nontarget exposures to children and wildlife, the EPA issued its Risk Mitigation Decision for Ten Rodenticides (USEPA 2008, entire), which evaluated the risk for all of the registered rodenticides except strychnine. In its Decision, EPA issued new legal requirements for how rodenticides could be labelled, packaged and sold, stating that the SGARs "…shall only be distributed to or sold in agricultural, farm and tractor stores or directly to PCOs [Pest Control Operators] and other professional applicators…" (USEPA 2008, p. 14). The Decision explains "...EPA has decided to use sale and distribution limitations – rather than restricted use classification – to minimize the use of second generation anticoagulants in settings where the risks outweigh the benefits (i.e., most residential settings)." (USEPA 2008, p. 15). Based on its concerns about the widespread exposure to SGARs in wildlife in California (CDPR 2013a, entire), the state of California proposed a change to existing regulations making all SGAR products in California-restricted, which limits their possession or use to those who are licensed applicators, or under a licensed applicator's direct supervision (CDPR 2013b, entire). Concern in particular about exposure to fishers is stated as one of the reasons for eliminating general consumer access to the second generation ARs: "By restricting the general users [sic] access to all SGARs, the opportunities for illegal marijuana growers to readily purchase and deliberately misuse SGARs would be significantly reduced" (CDPR 2013b, p. 9). This proposed rule change was finalized in March 2014, and became effective on July 1, 2014. It is premature to evaluate if this rule change will diminish the use of SGARs in illegal marijuana grows within the state. In addition, all ARs continue to be widely available and used by consumers, those with a certified pesticide applicator's license, and can be brought into California and the United States if purchased legally elsewhere (CDPR 2013a, entire; CDPR 2013b, entire).

9.3.6 Summary of Existing Regulatory Mechanisms and Other Mechanisms that may address Stressors

All of the Forest Service and BLM lands within the range of the coastal marten are managed under the Northwest Forest Plan (NWFP). This regional planning effort provides for retention and recruitment of older forests, and provides for spatial distribution of this type of habitat that will benefit late-successional forest dependent species such as the coastal marten. The adequacy of this plan is uncertain, but the amount of late successional coniferous habitat on Federal lands removed since implementation of the plan is substantially lower than pre-implementation levels. Even with this plan in place, timber harvest and thinning, fuels reduction treatments, and road construction may continue to result in the loss of habitat and habitat connectivity in areas, resulting in a negative impact on coastal marten distribution, abundance and recovery or recolonization of currently unoccupied habitat within their historical range. However, the future loss, degradation, or fragmentation of suitable coastal marten habitat on Federal lands from these

other activities is expected to be relatively low. In addition, forest management activities on Federal reserve lands designed to accelerate the development of late seral characteristics could ultimately increase the amount and distribution of suitable coastal marten habitat within the range of the species.

Forest practice rules vary greatly among the two states, with no explicitly stated coastal marten protections specified in California or Oregon. However, retention of some level of snags and green trees in harvest units is a ubiquitous requirement in managed forests throughout the analysis area, regardless of ownership. In many areas managed for commercial timber production however, these structures do not meet the minimum sizes typically used by coastal martens. Where they are large enough, they may provide future denning and resting sites provided they have the appropriate structural attributes (e.g. cavities, large limbs) and the surrounding forest is allowed to develop the necessary canopy cover, dense shrub understory, and prey base to support coastal martens in the long term. However, the short rotations of industrial forest management rarely allow this to happen. Conversely, where management is for longer rotations or designed to develop older stands (e.g., old-forest structure management on Oregon State Forests), retention of these legacy structures may facilitate coastal marten habitat development. In terms of effects to coastal marten habitat or incidental harm to coastal martens from timber harvesting or other types of land disturbing projects, California has regulations that act in combination to disclose, avoid, or mitigate environmental degradation. Cumulative effects analysis to listed and non-listed species is required in both CEQA and the California Forest Practice Rules.

The coastal marten is a Forest Service sensitive species in California, but is not a sensitive species on all BLM in the analysis area or on Forest Service lands in Oregon (and will likely become a species of conservation concern under revisions to the National Forest Management Act); however, protections afforded the coastal marten as a sensitive species largely depend on RMPs or LRMPs and on site-specific project analyses and implementation. Federal land management units have not developed coastal marten-specific guidelines in their management plans. Tribes may manage habitat in ways that benefit coastal marten without specifically mentioning them in their management plans. The coastal marten is not listed under the California Endangered Species Act (CESA) or as a State “fully protected” species and thus does not receive protections available under those statutory provisions.

Protection measures for riparian areas are also a widespread standard in managed forests lands, with larger buffers and more stringent retention requirements typically associated with Federal and State lands than on other ownerships. Retention areas to meet other management goals are also found across ownerships (e.g., anchor habitats on Oregon State Forests, occupied site buffers on multiple ownerships, Watercourse and Lake Protection Zones (WLPZ) on private land in California). Many of these retained areas are not large enough to support a coastal marten home range, but they may provide habitat patches that allow coastal marten to move across the landscape, providing connectivity to and facilitating dispersal between larger blocks of coastal marten habitat either within existing ownerships among neighboring ownerships.

Coastal martens may not be intentionally harvested for fur or otherwise killed in California, but injury or mortality may occur when coastal martens are incidentally captured in traps set for other species. The use of body gripping traps is prohibited and enforced in California, but injury

or mortality of coastal martens is likely to occur during illegal trapping using the banned body-gripping traps. In general, legal trapping (e.g., for research) is unlikely to result in injury or mortality to coastal martens because only use of live traps is allowed. The extent of illegal trapping and mortality to coastal martens in California is unknown.

Coastal martens can be legally trapped in Oregon. Coastal martens are listed by the Oregon Department of Fish and Wildlife as a sensitive species in the vulnerable category and as a species of conservation concern, but neither of these designations are regulatory mechanisms; rather, these designations are used to encourage voluntary actions to improve the species status or prevent population declines. The coastal marten is not a species that is explicitly managed for on State forest lands, or by regulation within the Oregon Forest Practices Act. Lands regulated by the Oregon Forest Practices Act may provide for some retention of habitat or components that may be used by marten, but they are not designed to protect martens and do not provide many marten den or rest sites or landscape conditions that are likely to support marten reproduction. Furthermore, lands managed as industrial forests, with short timber rotations, precludes forests from developing into marten habitat.

Management on Oregon state lands provides for retention of structural features and habitat blocks on the landscape. Many of these retention blocks are not large enough to support a marten home range, but they may provide habitat patches that allow marten to move across the landscape. This may be particularly valuable where State lands lie between large blocks of Federal lands managed as late-seral habitat. Because the State is managing to increase the development of layered and old-forest structural categories to 30–50 percent of their land base, these management goals may benefit martens in the future as surrounding stands are allowed to develop into a structural condition more suitable to martens.

None of the tribes in coastal Oregon specifically manage for coastal marten populations or habitat on their lands, and most of the reservations and other tribal lands in Oregon are outside of the range of the coastal marten. The Yurok Tribe currently owns approximately 23 percent of the total area of the CA_EPA, on its western margin, most of which is currently occupied by coastal martens. These Yurok lands will likely be used for a sustainable forestry operation and some portions will likely be managed as a Yurok Tribal Park to protect cultural sites and develop heritage-based ecotourism. However, proposed vegetation management activities within the Yurok lands and the potential impacts to coastal martens are currently unknown.

The use of rodenticides is regulated under the Federal Insecticide, Fungicide, and Rodenticide Act of 1947, via the registration of labels by the U.S. Environmental Protection Agency (EPA). Each label describes the permitted use for an individual rodenticide product and must be supported by rigorously collected and analyzed efficacy and environmental safety data. However, it is not clear how well those regulations prevent coastal martens from exposure to legal uses of these rodenticides. Coastal martens are also exposed to rodenticides used illegally. The Forest Service has extensive policy on the use of rodenticides. The Forest Service Manual contains legal authorities, objectives, policies, responsibilities, instructions, and guidance needed on a continuing basis by Forest Service line officers and primary staff in more than one unit to plan and execute assigned programs and activities.

Overall, the analysis area is comprised of approximately 31 percent federally managed lands and 5 percent State managed lands. Existing land use plans are available for Federal, State, and some tribal lands; none have specific standards and guidelines for managing coastal martens, although most address structural habitat features (e.g., snags or down wood retention) or limitations (e.g., Oregon Department of Forestry's no-cut riparian buffer, NWFP's protections of a network of late-successional forest habitat connected by riparian reserves) that contribute to the species' habitat. These land use plans are typically general in nature and afford relatively broad latitude to land managers, but with explicit sideboards for directing management activities.

Federal regulatory mechanisms have abated the large-scale loss of marten habitat. Much of the Federal ownership in the analysis area is managed for interconnected blocks of late-successional forests that are likely to benefit martens. Timber harvest has been substantially reduced on Forest Service and BLM lands within the NWFP area, and existing management is designed to increase the development of older forests that may provide marten habitat and aid in connecting populations. Timber management on non-Federal ownership affords fewer protections for martens. Management of State lands for scattered parcels of older forest or habitat retention for other late-successional species may facilitate marten movements across the landscape, or provide future habitat as some areas are allowed to develop into older stands. Outside of public ownership (State and Federal), forest practice rules provide no explicit protection for martens and limited protections for habitat of value to martens; while some structural retention and limited buffers may retain structural features desirable for martens, the short harvest rotation periods reduces the likelihood that the surrounding stand will develop to a condition that makes these features suitable for long-term use by martens.

9.4 Cumulative or Synergistic Effects of Stressors

For each stressor described above, we estimated the impact of that stressor acting alone on coastal marten populations or suitable habitat. However, marten populations and suitable habitat are affected by stressors acting together, and the combined effects of stressors likely impact populations and suitable habitat in an additive or synergistic manner. Any given stressor may only impact a portion of a population or available suitable habitat, and alone may not significantly impact populations or habitat (with the possible exception of a single large wildfire, an outbreak of a lethal disease, or similar event), but when all stressor impacts are combined, the effects may be substantial. Furthermore, some combinations of stressors may act together synergistically to cause effects greater than the sum of the individual effects of each stressor. These cumulative or synergistic effects may exacerbate the effects of another stressor, causing additional effects not accounted for in the analysis of each stressor in isolation, potentially decreasing the probability of population persistence and increasing the risk of extinction, especially for the coastal marten that currently occurs in three small, isolated populations. As mentioned above, small, isolated populations are vulnerable to extinction due to genetic problems, demographic and environmental fluctuations, and natural catastrophes.

Potential cumulative or synergistic effects from two or more coastal marten stressors acting together include: (1) A projected increase in the frequency and size of wildfires within the southern coastal Oregon and northern coastal California portions of the analysis area due to climate change model predictions of a warmer, drier climate in the future; (2) A potential

increase in marten mortality rates from predation, disease, trapping, collision with vehicles, and starvation from reduced ability to obtain prey, due to reduced marten fitness after sublethal exposure to toxicants found at illegal marijuana grow sites; (3) Increased coastal marten predation rates due to an increased abundance of intra-guild predators (e.g., bobcats, fishers) from vegetation management activities that improves habitat suitability for these marten predators by decreasing shrub densities; (4) Increased mortality from collision with vehicles, and disease contracted from domestic animals, due to an increase in human population densities from future development; and (5) Increased marten disease prevalence due to a warmer climate in the future, which favors disease transmission and outbreaks.

10. CONSERVATION EFFORTS

The Humboldt Marten Conservation Group (HMCG) was formed in 2011 with the primary goal of developing a conservation assessment and strategy for the Humboldt marten subspecies in northern coastal California. A Memorandum of Understanding (MOU) between the U.S. Fish and Wildlife Service, the Forest Service, Forest Service Pacific Southwest Research Station, National Park Service, California Department of Fish and Wildlife, California Department of Parks and Recreation, the Yurok Tribe, and the Green Diamond Resource Company was signed on September 26, 2012 (USDI FWS 2012c, entire). Each “party” above designated two or more staff members to provide input to the conservation assessment and strategy, and to guide future implementation of proposed conservation actions within their jurisdiction.

In January 2014, The HMCG expanded the group to include parties from coastal Oregon within the historical range of the coastal marten (i.e., Forest Service, BLM, U.S. Fish and Wildlife Service, Tribes, ODF, Oregon Department of Fish and Wildlife, and private timber companies). The Oregon parties are referred to as the “Oregon sub-group” of the HMCG, but are currently not signatories on the HMCG MOU. Parties from each state will independently determine which conservation actions are best suited for coastal marten populations and habitat within their state, implementation schedules, location of proposed conservation actions, and funding. However, some conservation actions may require a coordinated approach between parties from both states.

The parties agreed to work cooperatively to achieve mutual conservation goals through formation of the Humboldt Marten Conservation Group, and through the development and implementation of a conservation strategy for the marten. The conservation strategy will use strategic habitat conservation and adaptive management principles in its development and will identify necessary permits and compliance needs well in advance of the need for such authorization. Each party will seek input and support from scientific and technical support staff within each party and will consider this input for integration in overall planning, implementation, analysis and monitoring efforts to ensure that sound science practices are incorporated in conservation efforts. It is not the intent of the conservation strategy to supplant any ongoing and planned conservation efforts by the parties. Instead, the conservation strategy seeks opportunities to enhance those efforts. The HMCG holds quarterly meetings to facilitate preparation and implementation of the conservation strategy.

To the best of our knowledge there are no additional coastal marten conservation efforts in place or planned for the near future within the historical range in coastal Oregon and northern coastal California.

11. SUMMARY OF SPECIES STATUS AND STRESSOR IMPACTS

11.1 SUMMARY OF SPECIES STATUS

At the time of European settlement, the coastal marten occurred in all coastal Oregon counties and the northern coastal counties of California within late-successional coniferous forests. The majority of historical (pre-1980) verifiable marten detections occurred within fog-influenced coastal coniferous forest, but a few detections occurred within drier interior Douglas-fir dominated forests as far as 80 km (50 mi) from the coast.

Unregulated fur trapping throughout the coastal marten's historical range began in the late 1800s and by the late 1920s few marten were captured where they were once considered relatively abundant. A marked decline in the number of coastal marten harvested in northern coastal California led to the closure of marten trapping in northwestern California in 1946. In Oregon, marten fur trapping remains legal statewide. Historical fur trapping resulted in a significant contraction of coastal marten distribution and the extirpation of coastal martens from large portions of its historical range. The lack of available information on historical population size precludes an accurate assessment of the impact of unregulated trapping on coastal marten population abundance.

Extensive logging of old-growth redwood habitat in northern coastal California began in the late 1800s and coincided with unregulated fur trapping. Currently, less than 5 percent of the original redwood forests exist within the historical range of the coastal marten in northern coastal California (Save The Redwoods League 2015, no page number). Original late-successional coniferous forests in coastal Oregon were also extensively harvested in the early 1900s. Much of the coastal coniferous forest habitat in both states, especially within a few miles of the coast, is currently owned by private industrial timber companies and managed for timber production. Within the coastal marten's historical range, the majority of remaining late-successional coniferous forests suitable for the coastal marten are within national forests, and national and state parks. Currently, the largest contiguous block of suitable coastal marten habitat occurs within the Six Rivers National Forest in the extreme northern portion of the historical range in California, and in the adjacent Siskiyou portion of the Rogue River-Siskiyou National Forest in the southern portion of the historical range in Oregon. Large blocks of suitable habitat also occur in central coastal Oregon on the Siuslaw National Forest. Little suitable habitat is currently found in the southern half of the historical range in California, or within the northern coastal portion and the area between the Siskiyou and Siuslaw national forests in the historical range in Oregon.

Currently, the coastal marten occurs as three disjunct populations in: (1) central coastal Oregon (CCO_EPA); (2) southern coastal Oregon (SCO_EPA); and, (3) northern coastal California (CA_EPA). A few coastal marten verifiable detections occur outside these three EPAs, but these martens are currently not considered part of additional viable populations. No marten reintroductions have occurred within the historical range of the coastal marten. The lack of

marten survey detections within suitable habitat in much of the California portion of the historical range and suitable interior habitat in southwestern Oregon, suggests that the coastal marten has been extirpated from a large portion (over 95 percent) of its historical range in California and from interior portions of southern coastal Oregon. Minimal survey effort has occurred in southern and central coastal Oregon, and no surveys have occurred in northern coastal Oregon. The central coastal Oregon population was delineated using locations of recently (2013) trapped martens, road killed (records since 1980) martens, and detections at two survey stations (one from 2014). The two extant population areas in coastal Oregon combined occupy approximately 15 percent of the historical range of the Pacific marten in coastal Oregon.

The size of the northern coastal California population is estimated to contain fewer than 100 individuals, based on occupancy estimates from a population monitoring grid surveyed in 2000–2001. The same grid was resurveyed in 2008 and 2012. Between the 2000 and 2008 occupancy surveys, the population declined by 42 percent. The cause of this decline is unknown, but predation and loss of habitat from a 2008 wildfire have been suggested by marten researchers. The prevalence of exposure to lethal pathogens in the coastal marten has not been studied (refer to the **Disease** section above for details). However, a 33 percent annual mortality rate from predation was recently estimated for the coastal marten based on preliminary data from a marten dispersal ecology study within the western half of the extant population area in northern coastal California. The 2012 population estimate was similar to the 2008 estimate, suggesting the population size did not change since the 42 percent decline between 2000 and 2008.

No size estimates are available for the two extant populations in coastal Oregon. However, some researchers have suggested that both populations are small and isolated, based mainly on a reduction in the number of martens harvested (trapped) since the 1940s and a reduction in anecdotal sightings over time. The number of martens harvested in coastal Oregon counties has declined since the 1940s, and by the 1970s martens were considered very rare along the Oregon coast. Only three martens were harvested from coastal Oregon during the 2013 legal trapping season, all within the CCO_EPA, and few martens (≤5) were captured each year in coastal Oregon between 1969 and 1995. However, the number of trappers and the total area trapped within suitable marten habitat in coastal Oregon each year is unknown. Additional systematic marten surveys are required in coastal Oregon to further delineate extant populations and estimate current population sizes.

11.2 Summary of Stressor Impacts

11.2.1 Small and Isolated Population Effects

Small, isolated populations are vulnerable to extinction due to genetic problems, demographic and environmental fluctuations, and natural catastrophes. Populations of at least several hundred reproductive individuals are needed to ensure the long-term viability of vertebrates, with several thousand individuals being a desirable goal for many vertebrate species. The smaller a population becomes the more likely the above factors will reduce the population size even more and drive the population to extinction. The coastal marten population in northern coastal California has been estimated to contain fewer than 100 individuals. Population size estimates are unavailable for the two populations in coastal Oregon. Further, each of the three extant

coastal marten populations are likely to be functionally isolated from one another based either on marten survey results or limited habitat availability between the populations. Therefore, if one population is extirpated or significantly reduced in size and distribution so that it is effectively extirpated (i.e., because individuals would have difficulty locating one another for breeding), natural recolonization of the previously occupied area would be unlikely since few or no martens would be available to repopulate the area. The potential impacts to coastal marten suitable habitat and populations from the stressors we identified and review below are therefore likely exacerbated by small population size and isolation from other populations.

11.2.2 Trapping

Historical trapping of coastal martens for fur is considered by researchers as the likely cause of the marked contraction in coastal marten distribution and reduction in population size that was observed in coastal Oregon and northern coastal California in the early 20th century. Legal marten trapping in northern coastal California ended in 1946, but is still legal throughout Oregon. Currently, the number of martens legally harvested each trapping season in the Oregon portion of the analysis area is small, but the population-level impacts of removing even a few coastal martens from an extant population has not been studied. Further, population-level impacts from trapping within the two extant population areas in coastal Oregon are difficult to estimate without population size estimates, which are currently unavailable due to a lack of systematic marten surveys in both Oregon EPAs. Although no martens were legally trapped within the southern coastal Oregon extant population area in 2013, future trapping may result in captures within that EPA. If future population size estimates for the CCO_EPA are low, future legal trapping in that EPA may result in a greater impact to that population.

We consider the legal trapping of coastal marten for fur as having no impact to the population in northern coastal California and a low to medium level of impact to the two extant populations in coastal Oregon over the next 15 years. The low to medium level impact addresses only losses of martens from trapping and not the other mortality sources mentioned in this report. Also, for California we expect that nearly all coastal martens that are accidentally captured in live traps set for other furbearer species or that are live-trapped for research purposes, will be released unharmed.

11.2.3 Predation

Historical predation rates have not been estimated for marten populations in coastal Oregon and northern coastal California. Coastal martens were likely exposed to the same predators in the past as in the present, but changes in forest structure and composition from past large-scale vegetation management and development such as road building, may have increased the current distribution and abundance of marten predators such as gray fox and bobcats within all three EPAs, and fishers within the CA_EPA and SCO_EPA (fishers currently do not occur within the CCO_EPA). Despite the fact that the cause of death of all nine coastal martens found in the past two years were attributed to bobcats, it is currently unknown whether bobcat densities are currently relatively high within the western one-half of the CA_EPA, where the predation occurred. It is unknown whether the single estimate of adult survival rate in the analysis area applies to the remainder of the CA_EPA or the two coastal Oregon EPAs. However, vegetation

management and road building activities that have occurred within the CA_EPA have also occurred within the CCO_EPA and SCO_EPA, suggesting that the distribution and abundance of certain marten predators within the Oregon EPAs may have also increased over time.

Currently, it is unknown whether the 33 percent annual mortality rate from predation estimated for the CA_EPA would result in a population-level impact for the extant population in northern coastal California, and by extrapolation for the two extant populations in coastal Oregon. Additional research is needed to make accurate estimates of the impact of predation on coastal martens in the three extant population areas. However, an annual loss of 33 percent of adult martens in a population would require a relatively high annual recruitment rate of juveniles into the population to maintain a stable population. As described in the **Population Biology and Dynamics** section above, juvenile coastal marten survival was estimated at 50 percent, which suggests that a 33 percent annual mortality rate from predation may be sustainable. However, mortalities from other sources such as roadkill, disease, trapping, and exposure to toxicants, combined with mortality from predation may raise annual coastal marten mortality rates beyond the 50 percent juvenile survival rate, resulting in a negative population growth rate; all else remaining equal.

When considered alone, a 33 percent annual predation rate is expected to be sustainable when compared with an annual juvenile coastal marten survival of 50 percent, and thus predation alone would not likely result in a population level impact. However, annual predation rates and juvenile coastal marten survival rates may change in the future, potentially resulting in a population level impact for one or more of the three extant coastal marten populations. Therefore, we considered the predation stressor as having a low level population impact for all three extant coastal marten populations over the next 15 years.

11.2.4 Disease

The outbreak of a lethal pathogen within one of the three extant coastal marten populations could result in a rapid reduction in population size and distribution. Numerous pathogens are known to cause severe disease in mustelids, but serosurveys to determine the prevalence of past exposure to these pathogens have not been conducted on any of the three extant marten populations. Several serious pathogens have been detected in the related fisher less than 9 km (5.6 mi) from the nearest verifiable marten detection within the CA_EPA, suggesting that martens could be exposed by infected juvenile fishers that disperse from their natal area into the CA_EPA. Infected domestic dogs that are allowed to roam within an extant marten population area could also expose martens to lethal pathogens. Fur trappers could capture an infected carnivore (e.g., marten, fisher, gray fox, bobcat) and inadvertently spread the disease if martens encounter the contaminated trap. Marten researchers could also transfer lethal pathogens within and between extant population areas if traps and track-plate boxes are not disinfected after exposure to any carnivore species, including coastal martens.
The prevalence of past exposure to lethal pathogens within the CA_EPA marten population through a serosurvey has not been conducted for this population or the two extant populations in coastal Oregon. Vaccinating a subset of all three extant marten populations against the most virulent and lethal pathogens, such as the canine distemper virus, could reduce the spread of the disease within a population and reduce the likelihood that a population would be effectively

extirpated by the disease through loss of a significant portion of the breeding population. The probability of an outbreak of a lethal disease is likely low for all three coastal marten populations, but could result in the functional extirpation of a population if it occurs, due to the current small size of these populations.

We considered the disease stressor as having a low level population impact for all three extant populations over the next 15 years based on our supposition that an outbreak of a lethal pathogen has a low probability of occurrence. A serosurvey of all three extant populations is required to determine past exposure to pathogens. The presence of antibodies to one or more lethal pathogens indicates that at least a subset of individuals within a population survived exposure to the pathogen.

11.2.5 Collision with Vehicles

Collision with vehicles is a known source of mortality for coastal martens. Small coastal marten population sizes, limited coastal marten distribution, and a low density of roads with heavy traffic traveling at high speeds (e.g., >45 m.p.h.) within all three extant population areas, suggest that few martens die from vehicle collisions each year. Of the nine coastal martens found dead in the CA_EPA the past two years (2012–2014) as part of a dispersal ecology study, none died from vehicle collision. Although all 14 known coastal marten roadkill mortalities have occurred within or near the CCO_EPA, the carcasses were reported during a 34-year period (1980 to 2014), again, suggesting a low annual mortality rate from vehicle collisions. No roadkill coastal martens have been reported for the SCO_EPA or the CA_EPA, but neither EPA contains long segments of heavily-used highways (such as U.S. Hwy 101) through suitable marten habitat like the CCO_EPA. However, the relative remoteness of the CA_EPA and SCO_EPA suggest that roadkill marten may simply not be discovered by humans before being consumed as carrion. We consider collision with vehicles as having a minimal current impact on the coastal marten population within central coastal Oregon (where all current documented roadkill mortalities have occurred), and no current population level impact to coastal marten populations in southern coastal Oregon or northern coastal California. The population level impacts of collision with vehicles will need to be reassessed if human population density increases within the vicinity of these two EPAs or if large-scale road building (e.g., an extensive road bypass) or other forms of development (that would increase vehicle traffic) occurs within suitable and occupied coastal marten habitat.

Based on the information presented above, we consider the collision with vehicles stressor as having a low level impact on all three coastal marten populations currently and over the next 15 years. Although no roadkill mortalities have been reported for the southern coastal Oregon or the northern coastal California extant populations, we expect that in the future a small number of coastal martens from these two populations will be struck by vehicles, especially dispersing juvenile coastal martens that must traverse one or more highways, with heavy traffic traveling at high speeds, to reach unoccupied suitable habitat for establishment of a home range.

11.2.6 Exposure to Toxicants

The incidence of toxicant exposure and the population-level effects within the three extant coastal marten populations is currently unknown, and the testing of coastal martens for AR exposure began only recently (2014). To date, six coastal martens (all from the CA_EPA in 2014) have been tested for exposure to ARs; one tested positive, with a sublethal dose. As noted above, we estimated the scope and impact of this stressor using information from recent research on a surrogate species, the fisher, which is a close relative of the coastal marten with similarities in geographic distribution, habitat use patterns, reproductive biology, prey species, and physiology. The wide geographic distribution of known illegal marijuana cultivation sites within habitat considered suitable for the coastal marten and within areas currently occupied by coastal martens, suggest that coastal martens are being exposed to ARs and other pesticides at these grow sites. The ultimate cause of death for the coastal marten that tested positive for ARs was determined to be predation by a bobcat. Whether a sublethal dose of ARs predisposed this marten to predation is unknown. However, sublethal levels of ARs and other toxicants likely predispose individuals to death from other causes (for example, collisions with automobiles, disease, predation, or starvation) or may reduce the chance of recovery from common injuries. Secondary exposure through the consumption of AR-exposed prey is considered more likely than primary exposure from direct consumption. The physical and physiological manifestations of lethal AR exposure in rodents are fairly well known, but the minimum amount of AR required for sublethal or lethal poisoning in coastal martens is currently unknown. Coastal martens exposed to ARs likely become physically compromised, potentially leading to higher mortality rates, lower reproductive success, and ultimately to negative population growth and a reduced geographic distribution.

Based solely on the density of recent known illegal marijuana sites, coastal martens within the SCO_EPA and CA_EPA probably have a greater chance of encountering and consuming ARs or consuming prey that have been exposed to ARs, than coastal martens within the CCO_EPA. The rate of lethal and sublethal exposure of coastal martens to ARs is unknown and unstudied. Further research is needed before an accurate assessment of AR exposure rates and subsequent population-level impacts can be made.

The rate of toxicant exposure for the two extant populations in coastal Oregon has not been studied. However, based on the relatively low prevalence of illegal marijuana grow sites within the CCO_EPA (occurring in approximately 5 percent of the total area); we considered the population level impact from this stressor to be low over the next 15 years. We estimated that approximately 25 percent of the SCO_EPA contained illegal marijuana grow sites and considered this stressor as having a low to medium impact on the SCO_EPA population over the next 15 years. Finally, given the relatively high occurrence (approximately 40 percent of the total area) of illegal marijuana grow sites within the CA_EPA, we considered this stressor as having a medium level impact on the CA_EPA population over the next 15 years.

11.2.7 Wildfire

Within the analysis area, regional moisture gradients result in wildfires occurring more frequently with increasing distance from the coast and farther south in the analysis area. The

effect of fire on coastal marten habitat varies from high-severity fires that eliminate late-successional forest habitat, requiring centuries to regrow, to low-severity fires that burn only the dense shade-tolerant shrub layer preferred by the coastal marten. The shrub layer takes a minimum of one to two decades to regrow. Therefore, wildfire of any severity can result in the loss, degradation, or fragmentation of suitable coastal marten habitat. Historical fire records indicate that the CA_EPA and SCO_EPA have experienced larger and more severe wildfires than the CCO_EPA; which historically has experienced many, but small (less than an acre), fires. Historically, throughout the analysis area, the largest wildfires have occurred within the northern one-third of the California portion of the analysis area, and within the extreme southern one-quarter of the Oregon portion of the analysis area. The potential for severe, stand-replacing wildfire has increased in areas where fire suppression and regeneration timber harvest have played a role in raising fuel load to levels that place late-successional forest at increased risk. Although fire exclusion is known to contribute to the severity of fires in some areas, within northern coastal California and northern coastal Oregon, fire exclusion has had little effect on altering the structure and composition of the dominant forest types and has not caused an increase in high severity fire compared to the historical patterns.

Based on historical fire information and the more xeric nature of these areas, the future loss, degradation, or fragmentation of moderate and high suitability coastal marten habitat from wildfires will likely impact the CA_EPA and SCO_EPA populations to a much greater extent than the CCO_EPA population. Wildfires burned approximately 17 percent and 42 percent of the moderate and high suitability coastal marten habitat within the CA_EPA and SCO_EPA, respectively, between 1984 and 2012, with a few large fires responsible for the majority of burned suitable habitat. Based on recent fire history data, one or more large wildfires in a single year could potentially burn the entire CA_EPA or the entire interior (drier) portion of the SCO_EPA. In addition, fire frequency, size, and severity will likely increase in the future based on projected increases in temperature and decreased precipitation (see **Climate Change** section below) within southern coastal Oregon and northern coastal California. In contrast, very little moderate and high suitability coastal marten habitat has burned within the CCO_EPA and the remaining Oregon portions of the analysis area (excluding southern coastal Oregon) between 1984 and 2012. Large, stand-replacing fires do occur infrequently (>200–250 years) within central coastal Oregon, but is not reflected in Oregon fire history data, which begins in the late 1800s. If wildfires burn a significant portion of any of the three EPAs, limited adjacent suitable habitat is available for martens escaping the fires, which may expose surviving martens to an increased probability of mortality from other sources, such as predation, starvation, and disease. Due to small population size, the probability of population persistence could decrease if a large proportion of suitable habitat within an EPA is burned within any given year, especially for the CA_EPA and SCO_EPA, which are located in interior Douglas-fir forest within the fire-prone Klamath Ecoregion. Recolonization after a large fire from coastal martens occurring outside an EPA is unlikely since marten numbers outside the EPAs are probably too low to act as a new founder population.

We consider the wildfire stressor to have a medium to high impact on the loss, degradation, or fragmentation of suitable coastal marten habitat within the SCO_EPA and the CA_EPA, and a low level impact for the CCO_EPA over the next 15 years. We based our impact level estimates on the prevalence of wildfires within each EPA and our expectation that fire frequency, size, and

severity in the future will be fairly similar, or slightly higher based on climate change projections. For the entire analysis area, we consider wildfire as a low level impact to marten habitat within central and northern coastal Oregon, and a medium level impact in southern coastal Oregon and northern coastal California over the next 15 years.

11.2.8 Climate Change

Climate throughout the analysis area is projected to become warmer over the next century, and in particular summers will be hotter and drier, with more frequent heat waves. In the northern portion of the analysis area, winters will likely become wetter, but warmer temperatures will result in an overall water deficit. Throughout the analysis area, climate-related increases in disturbance from wildfire, insect damage, and disease are expected, and in coastal Oregon in particular, an increase in the areas affected by fungal diseases such as sudden oak death is anticipated. Throughout most of the analysis area, coastal marten habitat will be affected by climate change to some extent. We expect changes between conifer forest types, or from conifer forest to mixed conifer-hardwood forest, will reduce suitability of habitat for the coastal marten, but will not result in a loss of habitat, unless the shade-tolerant shrub layer is lost in the forest type conversion. However, we expect that changes from conifer forest to hardwood-dominated forest, woodland, chaparral, grassland, or other open vegetation communities will result in a permanent loss of suitable habitat for the coastal marten. In northern coastal California and southern coastal Oregon, nearly all models show shifts in future vegetation type from conifer forest to mixed-conifer hardwood forest, as well as shifts toward woodland and chaparral. In central and northern coastal Oregon, models project a shift from maritime conifer forest toward mixed conifer-hardwood and deciduous forests, although models differ in the extent of this change. Ultimately, the effects projected from climate change are expected to result in an unquantifiable loss of coastal marten habitat across its range. The general drying trend projected for the entire analysis area suggests that the dense shade-tolerant shrub layer preferred by the coastal marten may be lost even without climate-related conversion from a suitable forest type to an unsuitable forest type. However, it is not clear how finer-scale abiotic factors may shape local climates and influence local vegetation trends either to the benefit or detriment of martens.

Marten populations are already small and isolated and suitable habitat is already fragmented and greatly reduced from historical levels. Therefore, further habitat loss, degradation, or fragmentation from climate change could threaten the future viability of coastal marten populations and reduce the likelihood of reestablishing connectivity between extant populations. The amount of suitable marten habitat lost or degraded due to climate change is difficult to predict as is the potential for an increase in fire frequency within the analysis area. The effects of climate change will likely impact coastal marten suitable habitat in the CA_EPA and SCO_EPA to a greater extent than the more northern CCO_EPA, which is projected to increase in temperature, but maintain annual rainfall amounts. Marten populations within the CA_EPA and SCO_EPA are already threatened by future large wildfires, which will likely increase in frequency due to increased temperatures and reduced rainfall within these two areas. Coastal martens within the CA_EPA and portions of the SCO_EPA already occur within relatively dry interior Douglas-fir forests, which may become unsuitable for martens due to climate change, especially through the loss of the dense shrub layer. Suitable redwood habitat within coastal national and state parks to the west of the CA_EPA may remain suitable for coastal martens even

with projected changes in climate. However, to reach this coastal redwood habitat, martens must traverse many kilometers of unsuitable industrial timberlands, potentially exposing themselves to an increased risk of predation, disease, incidental capture, roadkill mortality, or other potential stressors to individual coastal martens. Martens occurring within the drier interior portions of the SCO_EPA could possibly migrate west into suitable habitat as climate change alters the more interior habitat; a westward migration is possible due to a lack of significant physical barriers to east-west movements within that EPA.

We currently lack sufficient information to estimate the future direct impacts of climate change on suitable coastal marten habitat through the conversion to unsuitable (for coastal martens) forest types. However, we expect that the amount and distribution of currently suitable marten habitat that will be converted (due to a warmer, drier climate) to unsuitable forest types within the next 50 years will be greater in southern coastal Oregon and northern coastal California (which includes the SCO_EPA and CA_EPA) than in central (including the CCO_EPA) and northern coastal Oregon. A rough estimate of the impact to suitable coastal marten in the next 50 years includes a low level impact for the central and northern coastal Oregon portions of the analysis area, including the CCO_EPA, and a low to medium level impact for the southern coastal Oregon and northern coastal California portions of the analysis area (including the SCO_EPA and the CA_EPA).

These impact level estimates only refer to the loss, degradation, or fragmentation of suitable coastal marten habitat through the conversion from suitable forest types to unsuitable forest types, and not potential indirect impacts of climate change on other habitat stressors reviewed in this report. Potential indirect impacts of climate change to other habitat stressors include an increase in the frequency and size of wildfires due to a projected warmer and drier climate in the analysis area and an increase in predation rates in areas where the mesic shrub understory was lost or fragmented. As with the direct impacts of climate change, we also lack sufficient information to estimate the potential future indirect impacts of climate change on suitable coastal marten habitat.

11.2.9 Vegetation Management

Vegetation management activities, especially historical large-scale harvest of late successional coniferous forest habitat, have reduced the amount and distribution of suitable coastal marten habitat, and are expected to continue to reduce and fragment suitable coastal marten habitat across the analysis area, especially on private lands. The past and current practice of managing coastal coniferous forests on a short rotation system (40–60 years) to maximize wood production has reduced the complexity of the shrub and herb layers, an important component of suitable marten habitat. These forest management practices preclude development of late-successional forest characteristics that are important to the coastal marten, such as large diameter logs, snags, and trees. Short rotation forestry is much more prevalent on private industrial timberlands than on Federal or State lands. Only a fraction of Forest Service lands (primarily “matrix” lands) in the analysis area are available for timber harvest. The loss of late seral coniferous forest habitat on Federal lands due to timber harvest has declined substantially since implementing the NWFP. The vast majority of the loss has been on private lands, while the loss on Federal lands has been relatively small, with most of the loss being attributable to wildfire. On private lands, little

habitat with the necessary structural characteristics for the coastal marten is expected to regenerate over the next several decades. Loss, degradation, or fragmentation of suitable coastal marten habitat due to short-rotation forestry is expected to impact suitable habitat within the CCO_EPA (23 percent of the moderate and high suitability coastal marten habitat in the EPA is privately owned) to a greater extent than in either the SCO_EPA (10 percent of the moderate and high suitability coastal marten habitat in private ownership) or the CA_EPA (11 percent of the moderate and high suitability coastal marten habitat in private ownership). Due to current and expected future intensive timber harvesting activities, private lands are not expected to support viable marten populations or maintain important habitat elements in the future. Therefore, the maintenance of suitable coastal marten habitat on Federal and State lands is important to the long-term viability of coastal marten populations, especially within the CCO_EPA. Further, maintenance of suitable coastal marten habitat outside the three extant population areas is important for future establishment of new marten populations within suitable, but unoccupied habitat and connectivity between extant populations to allow movement of marten between populations.

Some vegetation management activities, such as thinning, fuels reduction projects, and habitat restoration have the potential to improve habitat suitability for the coastal marten in the long term by minimizing loss of late-successional stands due to wildfires and accelerating the development of late seral characteristics, especially in thinned stands. However, these same activities would likely result in a short-term degradation, loss, or fragmentation of suitable coastal marten habitat. Maintenance of the dense shade-tolerant shrub layer during these activities would be difficult, but necessary, to avoid short-term negative impacts to suitable habitat. The effects of fuels reduction projects on suitable habitat will depend on the amount and type of fuel removed and the location of treated stands relative to suitable and occupied habitat. The short-term loss, degradation, or fragmentation of suitable habitat from these vegetation management activities may be outweighed by the potential long-term benefits, such as a reduction in the size and severity of future wildfires and the regrowth of habitat elements required by the coastal marten.

Based on the proportion of moderate and high suitability coastal marten habitat within Federal reserve lands within each EPA, we consider the ongoing vegetation management stressor to have a low impact on the loss, degradation, or fragmentation of suitable coastal marten habitat within the SCO_EPA and the CA_EPA, but a medium level impact for the CCO_EPA over the next 15 years. For the entire analysis area, we considered vegetation management as a low level impact on suitable marten habitat for Federal lands and a high level impact for private lands over the next 15 years.

11.2.10 Development

Development by humans in the analysis area is expected to result in the future loss, degradation, or fragmentation of a small amount of suitable coastal marten habitat within the analysis area. Forms of development that could result in negative impacts to suitable habitat include road building, dam construction and creation of new reservoirs, conversion of forest habitat for agricultural use, development and expansion of recreational areas (e.g., golf courses, campgrounds, and trails), urban expansion, and rural development. The future frequency of

occurrence and total area impacted by development activities is expected to be low, but when it does occur could result in the loss or degradation of nearly all suitable coastal marten habitat within the affected area. We expect that most future development will occur on private lands. As with the vegetation management stressor, we expect that potential impacts to suitable coastal marten habitat from the development stressor would be greater for the CCO_EPA than either the SCO_EPA or the CA_EPA, because the CCO_EPA contains more private-owned, suitable coastal marten habitat than the SCO_EPA and CA_EPA combined. However, we consider development as a low level impact on suitable coastal marten habitat in all three EPAs and for the entire analysis area over the next 15 years, primarily based on low human population densities in suitable habitat within the analysis area, and especially within suitable habitat in the three EPAs. Overall, for the three EPAs and the remainder of the analysis area in Oregon and California, development should have little impact on suitable marten habitat when compared to the potential stressors of wildfire, climate change, and vegetation management as described above.

11.3 OVERALL SUMMARY

Historical unregulated fur trapping and large-scale logging of late-successional coastal forests in coastal Oregon and northern coastal California have greatly reduced coastal marten abundance and distribution. Currently, the coastal marten occurs in three small and isolated populations; two in coastal Oregon and one in northern coastal California. When combined, the three marten populations occupy less than 17 percent of their historical range. Trapping of coastal martens for fur was banned in California in 1946, but the majority (96 percent) of their range in northern coastal California has not been recolonized since the ban, suggesting that other stressors are limiting the expansion of the small extant population in California to historically occupied suitable habitat. The coastal marten has a low reproductive rate that may explain the lack of expansion into unoccupied habitat, and fragmentation of suitable habitat likely has limited movements between suitable habitat patches or increased the mortality rate of dispersing martens. The California portion of the historical range currently contains little suitable coastal marten habitat south of the known population area in extreme northern California. Most current suitable marten habitat in northern California occurs on National Forest lands. Current suitable habitat in coastal Oregon occurs primarily within the two extant population areas in southern and central coastal Oregon, also mainly on National Forest lands. A relatively large patch of suitable habitat occurs in northern coastal Oregon on National Forest lands, but it is unknown whether this habitat patch contains coastal martens. Future planned surveys will determine whether this habitat patch is occupied by coastal martens.

The coastal marten population in northern coastal California has been estimated to contain fewer than 100 individuals. Populations of at least several hundred reproductive individuals are needed to ensure the long-term viability of vertebrates with several thousand individuals being a desirable goal for many vertebrate species. The current size of the two coastal Oregon populations is unknown. However, it has been suggested by researchers that both populations are small and have declined based on a marked reduction in the number of martens trapped (for fur) and anecdotal observations over time. Grid-based surveys in unsurveyed portions of coastal Oregon began in 2014, but covered a small proportion of unsurveyed area. Extensive surveys in the future are required to aid in further delineating the distribution of the two Oregon populations, to determine whether coastal martens occupy habitat outside the two known population areas, and to provide abundance estimates for extant populations.

Ongoing stressors that may impact one or more of the three coastal marten populations include fur trapping, predation, disease, collision with vehicles, and exposure to toxicants. We considered each of these stressors as having a low level impact on all three coastal marten populations when assessed individually. An exception is the potential impact of exposure to toxicants for the extant population in California, where the prevalence of illegal marijuana grow sites is higher than in the two Oregon population areas, and thus the probability of exposure is greater. The majority of fishers in northwestern California that were tested for toxicant exposure were positive for one or more anticoagulant rodenticides. A single coastal marten (from the northern coastal California population) has tested positive for an anticoagulant rodenticide, but only six have been tested to date, all from a relatively small geographic area within the northern coastal California extant population area. The high density of marijuana grow sites within suitable coastal marten habitat in northern coastal California suggests that future exposure of

coastal martens to toxicants is likely. Fewer grow sites have been found in the southern coastal Oregon extant population area and very few have been found within the central coastal Oregon extant population area, suggesting a lower probability of toxicant exposure for coastal martens in the two coastal Oregon populations.

Ongoing stressors that may result in the loss, degradation, or fragmentation of suitable marten habitat include wildfires, vegetation management activities, and development by humans. Wildfires have the potential to destroy or degrade large amounts of suitable habitat. If an exceptionally large wildfire burned a significant portion of suitable habitat within an extant population area, surviving martens have little suitable habitat in adjacent areas to recolonize, and few coastal martens outside the primary population area to replace individuals that died. Therefore, the wildfire stressor alone could effectively extirpate an extant population. Within the fire-prone southern coastal Oregon and northern coastal California portions of the coastal marten historical range, climate change models predict an increase in temperature and a reduction in rainfall in the next 50 years. A warmer and drier environment will likely increase the frequency and size of future wildfires exacerbating the impacts of wildfire on coastal marten habitat within the southern coastal Oregon and northern coastal California extant population areas. The impact of wildfire on the central coastal Oregon extant population and unoccupied suitable habitat in northern coastal Oregon is currently considered low, and will likely remain a low level impact on suitable coastal marten habitat in central and northern coastal Oregon in the future since the climate in these areas is expected to increase in temperature, but not in reduced rainfall. Ongoing vegetation management in suitable habitat on private timber lands will likely impact marten habitat because most private timber lands are currently managed using short-rotation (40–60 years) forestry that does not maintain the structural habitat elements (i.e., large trees, snags, and logs), large patches of late-successional habitat, or the dense shrub understory required by coastal martens. Conversely, vegetation management in suitable habitat on Federal lands will likely minimally impact suitable habitat since most Federal land within the three extant population areas is managed under the Northwest Forest Plan (NWFP), which promotes the maintenance and development of late-successional forest habitat that is generally suitable for martens. The southern coastal Oregon and northern coastal California extant population areas are comprised of mainly Forest Service lands, while the central coastal Oregon extant population area contains 40 percent private lands. Therefore, we expect that vegetation management activities would have a greater impact on marten suitable habitat within the central coastal Oregon extant population area than in the other two extant population areas. Finally, ongoing development will likely impact very little suitable marten habitat unless there is a significant increase in human population density in coastal Oregon and northern coastal California in the near future.

We estimated the impact of each stressor acting alone on coastal marten populations or suitable habitat. However, marten populations and suitable habitat are affected by stressors acting together, and the combined effects of stressors likely impact populations and suitable habitat in an additive or synergistic manner. Although the estimated impact level of several individual stressors on marten habitat and populations were considered low, the cumulative impacts of all stressors acting in concert could result in significant impacts to the three marten populations and suitable habitat within the extant population areas in the near future. The population in northern coastal California is especially vulnerable to extirpation due to its small size and very limited

distribution, its location within a fire-prone area, and the large number of illegal marijuana grows that likely occur within occupied suitable habitat potentially exposing martens and marten prey to anticoagulant rodenticides. The two coastal Oregon population areas (EPAs) are currently much larger than the California population area, but future surveys may indicate portions of the Oregon EPAs to be unoccupied, consequently reducing the area of occupied distribution of these two populations to a size comparable to the more highly surveyed California population area. If that is the case, potential impacts from stressors may be more pronounced in the two coastal Oregon population areas than discussed in this report.

If the coastal marten occurred as large, well distributed populations throughout coastal Oregon and northern coastal California, the estimated impact of individual stressors on suitable marten habitat and populations, and the cumulative or synergistic effects of two or more stressors acting in concert, would probably not result in the extirpation of one or more populations or extinction of the taxon. However, the current small and isolated populations are more vulnerable to extirpation and extinction from these same stressors.

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13. APPENDIX A. Substantive changes, corrections, and clarifications made to this report since release of an agency (Federal and State) review draft on November 4, 2014.

1. **Section 5.7 Dispersal and Recruitment**: We had described dispersal movements of martens as follows: "While dispersal distances of more than 70 km (43 mi) have been reported for martens (e.g., Fecske and Jenks 2002, p. 310), most studies find that the majority of juvenile martens in both logged and unlogged landscapes dispersed short distances (e.g., ≤5 km (3.1 mi), Broquet et al. 2006, p. 1694; <15 km (9.3 mi), Phillips 1994, pp. 73–75; $\bar{x} =$ 15.5 km [SE = 1.01] (9.6 mi), Pauli et al. 2012, p. 393)." To clarify, in terms of long distance movement capabilities, juvenile martens have been documented covering distances up to 82 km (50 mi) Broquet *et al.* (2006, p. 1695), and adult marten dispersal movements have been documented over distances up to 149 km (93 mi) or even 160 km (100 mi) (Slough 1989, p. 993; Kyle and Strobeck 2003, p. 61). Martens are therefore capable of moving relatively long distances. Such long distance movements are infrequent, however, and dispersal over much shorter distances is most common.

2. **Section 8.3 Population Abundance and Trend**: In the earlier version of the species report, we stated that "As described above, martens in coastal Oregon are currently known from two isolated populations—one in central coastal Oregon and one in southern coastal Oregon—both of which are believed to be in decline based mainly on a reduction in the number of martens trapped and anecdotal observations over time (Zielinski et al. 2001, p. 478; Slauson and Zielinski 2009, p. 36)." However, the references cited do not state that the populations are currently in decline, nor do they describe the populations as isolated (Slauson and Zielinski 2009, p. 36, use the term "disjunct"). This statement has now been modified to cite the correct reference and to more accurately reflect the language used by the authors as follows: "As described above, martens in coastal Oregon are currently known from two populations; one in central coastal Oregon and one in southern coastal Oregon. Slauson et al. (2009a, p. 1340; citing Zielinski et al. 2001 and Slauson 2003) stated that these two populations are small and isolated due to natural distribution of suitable habitat, historical and contemporary effects of timber harvest, and historical effects of fur trapping."

   We note that despite the stated opinions of the authors that the Oregon populations are small and isolated, to date we have no empirical data that would allow us to estimate population size for either of the known Oregon populations. Although Slauson et al. 2009a (p. 1340) cite to Zielinski et al. 2001 and Slauson 2003 as support for their statement, neither of the cited publications provide any population estimates for coastal Oregon marten populations. In addition, we do not have data sufficient to inform us as to the degree of isolation between populations. Detailed information is needed regarding the size and demographics of coastal marten populations and movements of individuals through the connecting areas of habitat in order to reliably estimate the degree of potential occasional interchange or functional isolation between populations.

   Throughout the Species Report we have referred to the populations of coastal martens as small and isolated, however the published literature has not presented data to support this

characterization. We conclude that the size of populations in coastal Oregon is unknown, as is the degree of functional isolation between them. Therefore, we cannot presume that all populations of coastal martens are small and isolated, which leads us to further clarify that we cannot presume synergistic or cumulative effects of small population size and isolation when combined with other stressors.

3. **Section 9.1: Review of Stressors**: To assess the stressor of wildfire, we used a longer period of 30 years (in the November 4, 2014 draft we used 15 years for this stressor) to estimate the scope and impact of the wildfire stressor on suitable coastal marten habitat, based on the availability of wildfire data (for the 28-year period 1984–2012) for the entire analysis area.

4. The following paragraph regarding potential impacts of recreational activities on marten populations was added to the end of the introductory section of **Section 9.2.2**:

> "We considered potential impacts of recreational activities on marten populations, but concluded that due to the remote location of the three extant coastal marten populations, low human population density within the three EPAs, and the dense shrub layer preferred by coastal martens, use of suitable coastal marten habitat by humans for recreational activities was rare and thus the potential impact to marten populations to be discountable. Zielinski et al. (2008, p. 1564) found no effect of off-highway-vehicle (OHV) use on Sierra marten occupancy, suggesting that noise-generating recreational activities such as OHV use within occupied habitat have little or no impact on marten populations."

5. **Section 9.2.3.2: Climate Change:** The November 4, 2014 draft species report assessed the scope and impact of climate change on coastal marten suitable habitat for short-term climate models (40–50 years into the future) <u>and</u> long-term models (100 years into the future). The final species report only used short-term climate models to assess the scope and impact of climate change on suitable coastal marten habitat.