Interagency Pacific Marten (*Martes caurina*) Distribution Study On the Olympic Peninsula, Washington

Final Interagency Special Status/Sensitive Species (ISSSSP) Report for the Field Season of November 1, 2015–October 10, 2016

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Pacific Marten photographed in Olympic National Park, August 10, 2016

Introduction

In 2001, a summary of historical and recent observations of Pacific martens (*Martes caurina*) in the Pacific States indicated that martens were apparently absent from much of their historical range in California and 'also may have declined in on the Olympic Peninsula of Washington' (Zielinski et al. 2001). These results suggested the need to augment inventories of Pacific martens to better evaluate their current population status. In northern California and Oregon, the coastal subspecies of the Pacific marten (*Martes caurina humboldtensis*) was petitioned for listing as Federally Threatened in 2010, although a 12-month review of the subspecies distribution, abundance and environmental threats led the U.S. Fish and Wildlife Service to conclude that Federal listing was not warranted at that time. The enduring lack of reliable information on the current distribution and status of coastal marten populations in Washington State, however, represents a significant impediment to making informed decisions about their conservation. This concern has also elevated the coastal marten to an ISSSSP Top 10% Priority Species for the Olympic National Forest (ONF) on Washington's Olympic Peninsula.

The primary objective of this study was to determine if the Pacific marten still occurs on the Olympic Peninsula in Washington. Secondarily, we hoped to obtain detections of other carnivores, including fisher (*Pekania pennanti*), a Forest Service TRACS (Terrestrial Restoration and Conservation Strategy) Priority Species for the Pacific Northwest Coast Ecoregion, as well as spotted skunk (*Spilogale gracilis*), a Washington Department of Fish & Wildlife Species of Greatest Conservation Need.

Background

The Pacific marten is a medium-sized, semi-arboreal carnivore in the family Mustelidae (weasels) that once occurred throughout coniferous forest habitats in the Pacific coastal states (Zielinski et al. 2001). Historically, Pacific marten populations in Washington occurred primarily in 2 disjunct areas, the Cascade Range and the coastal mountains, which were separated by apparently unsuitable habitat in the Puget Trough (Dalquest 1948). Cascade populations occur primarily in true fir forests at high elevations where deep snowpacks form during the winter and populations appear to be relatively stable (Zielinski et al. 2001). In contrast, coastal marten populations occupied a much broader elevational range, including low-elevation coniferous forest habitats near sea level (Bailey 1936; Hagmeier 1956).

Trapping records suggest that martens may have been relatively common at one time on the Olympic Peninsula—in the 1940s, 83 martens were legally trapped in Clallam, Jefferson, and Mason counties, 3 of the 4 counties that comprise the Olympic Peninsula (cited in Zielinski et al. 2001). However, marten trapping records on the Olympic Peninsula declined precipitously after that time; only 2 martens were harvested in the 1950s and 9 in the 1960s. Surprisingly, 4 martens were reportedly trapped in Pacific County (located south of the Olympic Peninsula along the coast) in the 1970s, but no martens have been legally trapped on the Peninsula or along the southwest coast of Washington since that time. As of 2001, coastal marten populations in all 3 of the Pacific states had declined or been extirpated (Zielinski et al. 2001).

From 1991 to 2015, 5 separate remote-camera surveys were conducted in mid- to high-elevation coniferous forest habitats on the Olympic Peninsula to document the presence of carnivores, specifically martens or fishers. A sixth study used remote cameras and track plates to document mesocarnivore distributions in riparian forest habitats along the Elwha River on the Olympic Peninsula (Jenkins et al. 2015). One verifiable detection of a Pacific marten was obtained from these six survey efforts.

Summer 1991: Remote-camera surveys were conducted in the Cascade Range, Puget Trough, and Olympic Peninsula. Thirty-nine photos (out of 260 taken) were judged at the time to be martens with only one from the Peninsula (Jones and Raphael 1991). We have subsequently reexamined this photo in detail, however, and now believe it is not diagnostic of a marten; rather, it appears to be a long-tailed weasel (*Mustela frenata*).

March–October 1992: Approximately 50 remote cameras were deployed in the Hoh, Dosewallips, Duckabush, Hamma Hamma, and Gold Creek drainages on the Olympic Peninsula; 1 photo of a marten was reportedly taken near the Dosewallips River (Sheets 1993). However, this photograph is not available for examination and cannot be verified.

Winters of 2001–2002 and 2002–2003: Extensive camera surveys targeting forest carnivores were conducted in ONP. Among the 1,270 photos that were obtained during this effort, none were of martens (Happe et al. 2005).

Summers 2006–2008: Remote camera and track-plate surveys were conducted in the riparian zone of the Elwha River to document mesocarnivore distributions before dam removal. No martens were detected in over 1,500 camera-trap nights and 8,000 trackplate-nights of effort (Jenkins et al. 2015).

Summers 2009–2015: Remote-camera surveys were conducted on the ONF and in ONP to monitor the distribution of fishers reintroduced to the Olympic Peninsula in 2008, and to document subsequent reproduction. One marten was detected in the Upper Hoh watershed during ~16,380 camera-trap nights (Figure 1).

Winters 2013–2014: We directed camera surveys targeting martens along the east side of the Olympic Mountains, where all recent verifiable records of martens had been obtained through 2014 (Figure 2) but, again, no martens were detected during ~1,400 camera-trap nights.

If martens are present, they have a very high probability of detection at baited camera stations during the winter (Zielinski et al. 2015). This was verified during the winters of 2001–2003, when similar carnivore surveys were conducted in Mount Rainier, North Cascades, and Olympic National Parks simultaneously. Martens were commonly detected in the Cascade Range but were not detected at all in the Olympic Mountains. The detection of only 1 marten from all these surveys considered collectively raises substantial concerns about the conservation status of martens on the Olympic Peninsula.

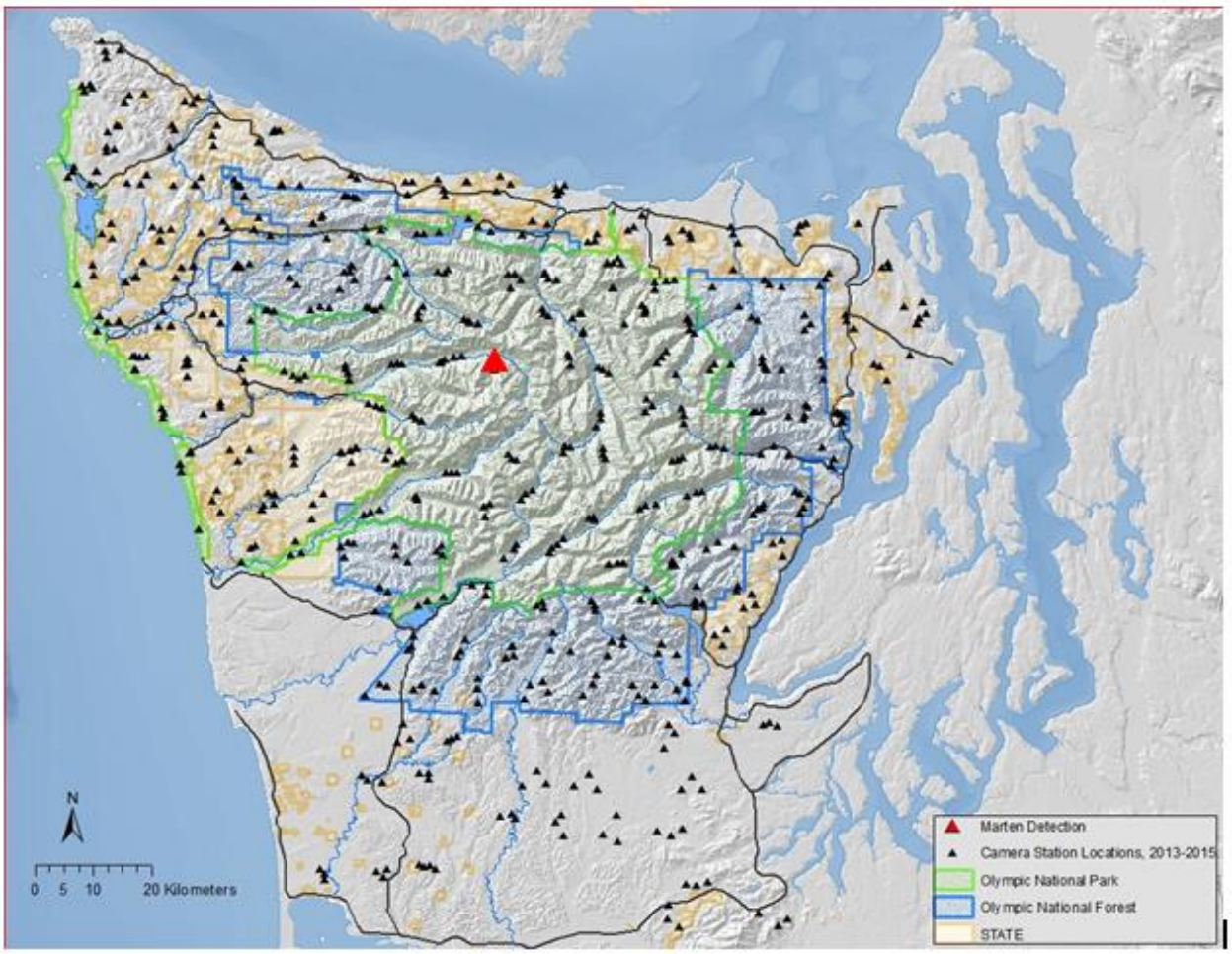

Figure 1; Fisher camera stations installed for about six weeks each on the Olympic Peninsula, Washington, from 2013–2015 (Happe et al. 2015); the one marten detection from the Upper Hoh is denoted in red.

Recent occurrence records of the Pacific marten that were obtained opportunistically on the east side of the Olympic Peninsula, however, suggest that the species is still present (Figure 2). In 1988, a marten was photographed at close range in The Brothers Wilderness (K. Aubry, unpubl. data). In 1990, researchers reportedly live-trapped and released 2 martens near the Dosewallips River during a northern spotted owl (*Strix occidentalis caurina*) prey-base study (B. Biswell, PNW Research Station, pers. comm.). Although neither of these specimens was collected and this record is not verifiable, the researchers were experienced mammalogists and had the animals "in hand," which gives strong credence to these records. Recently, a third and unequivocal record was the discovery of a dead juvenile marten on the trail to Mt. Rose in the southeast corner of the Olympic Peninsula in 2008; the specimen was deposited in the Burke Museum at the University of Washington. This record is particularly important, because it demonstrates that martens were present and reproducing on the Peninsula as recently as 2008. Finally, in June 2015, an additional record of a marten was confirmed (Figure 2), at the summit of Mt. Cruiser on

the border of ONP and ONF. This record is a photograph taken by a rock climber (Figure 3). The records from 2015 brought the total to 5 reliable observations of martens on the Olympic Peninsula between 1988 and 2015, before the 2016 survey effort.

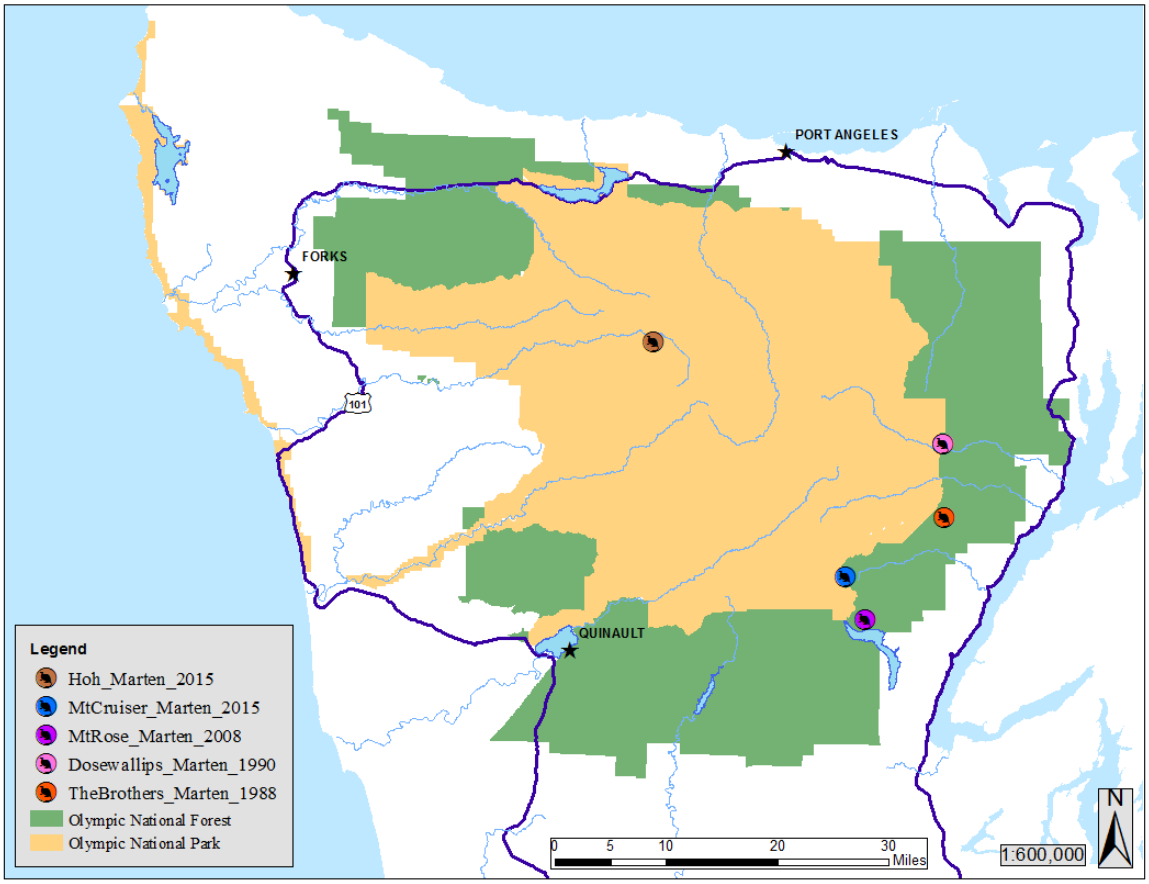

Figure 2; Highly reliable records of Pacific martens on the Olympic Peninsula, Washington, 1988–2015

Figure 3; Pacific marten on Mt. Cruiser, June 2015. Photo by Shemuel Harding

Extensive survey efforts have been directed at martens and fishers in the Olympic Mountains during the last decade. The scarcity of verifiable records of martens obtained during these surveys demonstrates that there is considerable uncertainty regarding the future viability of the marten population on the Olympic Peninsula. In response to the poor performance of previous surveys to detect martens, we identified two regions of the Peninsula that warranted additional surveys: coastal habitats and high-elevation habitats.

Study Area

Previous survey efforts targeting Pacific martens on the Olympic Peninsula were focused at mid- to high elevations in the areas where the 1988–2008 records were located, but were limited in scope due to budget and personnel constraints. The two June 2015 sightings were located at higher elevations, suggesting additional sampling at high elevations was warranted. Recent survey work in the Coast Range of Oregon has also documented the presence of martens <1 km from the ocean (Moriarty et al. 2016). Given these recent findings from the Oregon coast, we speculated that remnant marten populations on the Olympic Peninsula most likely occurred either in coastal areas at low elevations in relatively dense, shrub-dominated habitats, as they do in Oregon and northern California, or at high elevations, perhaps above the areas where other predators reach their highest densities. Therefore, these 2015–2016 surveys focused both in coastal areas in ONP from Lake Ozette to the Quinault Indian Reservation, and high-elevation areas in ONP and ONF near the areas of the five historic records (Figure 4).

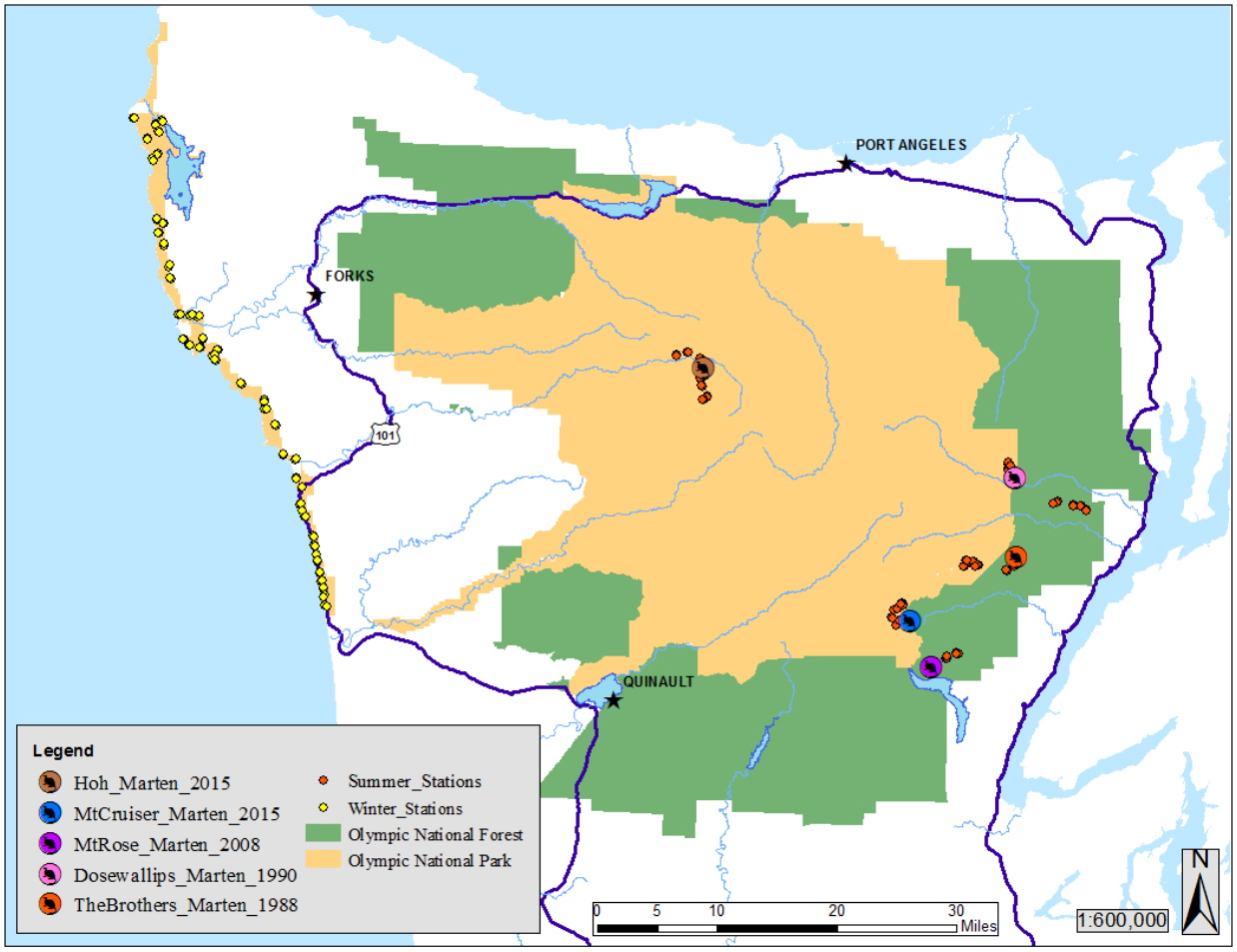

Figure 4; We surveyed 108 camera stations during the winter of 2015–16 and 85 camera stations during the summer of 2016. Marten survey stations on ONP and ONF were funded by ISSSSP and PNW, with support from ONP and ONF.

Methods

We focused sampling at low-elevation sites along the coast during winter (November 2015–March 2016) and at high-elevation sites near treeline during summer (July–September 2016). Although camera trapping success is generally greater during winter than summer (Zielinskis et al. 2015), we focused high-elevation sampling during the summer because due to deep snow and winter weather these wilderness areas are not safely accessible during winter. For both targeted areas, we identified potential sample units (i.e., independent sampling sites with 2 camera stations per unit) for camera deployment using a stratified random design and by buffering trails by 750-m within focal polygons. We identified potential sample units for both winter and summer surveys randomly with a minimum of 750-m spacing between sample units within the study area using Geospatial Modeling Environment (Beyer 2012). Our strategy was to use more cameras and at increased densities than had been used previously on the Peninsula.

Sample units consisted of two baited remote camera stations placed no closer than 100-m apart. Placement of the second station was determined by random compass direction from the first randomly selected point at a distance of 100–300 m, working within the constraints of avoiding infrastructure (trails and campsites) and unsafe terrain. We placed the camera and bait low to the ground in micro-sites with dense shrub cover (>50%). Low sets may increase effectiveness, because smaller carnivores may use dense cover disproportionately (Linnell et al. In press). We baited each station with 1 chicken leg and 1 can (156g) of fish-flavored cat food. We applied 30 ml of commercial scent lure (Gusto, Minnesota Trapline Products, Pennock, Minnesota, USA) mixed with glycerin in a 4:1 ratio to each station. For longevity through the winter we placed the lure mixture in a punctured film canister with a 2 cm^2 piece of sponge.

We sampled the coastal sites during winter in the coastal strip in ONP (Figure 5). We restricted surveys to within 250-m of a road, highway, trail, or the coastline. We created 250 random points and 86 locations fit our criteria. Field crews abandoned sample units if the slope was >45 degrees or if they had to cross a large body of water.

We sampled high-elevation sites during summer within 6 focal areas (e.g., regions surrounding mountain or lakes) where martens had been observed historically. The focal areas were variable in size and shape, but each encompassed a specific mountain complex or basin that was accessible by trails. Each focal area was associated with a verifiable detection (Figure 3) or a sighting record from a reliable field biologist. We identified 75 potential sample units within the focal areas by randomly selecting independent points at least 750-m from one another and within the defined 750-m buffer around trails. We established at least 4 sample units (8 cameras) in each focal area, with a maximum of 9 sample units (18 cameras) at each. The number of sample units per focal area depended both on the size of the focal area, the available trail network at high elevations (>1,500 m), and the distribution of safe access routes. We surveyed a total of 43 sample units based on these safety and logistical considerations.

Similar to winter, we placed the camera and bait low to the ground in micro-sites with dense shrub cover (>50%) and baited each station with 1 chicken leg and 1 can (156g) of fish-flavored cat food. We did not mix glycerin, but applied 10 mL commercial scent lure (Gusto, Minnesota Trapline Products, Pennock, Minnesota, USA) on sponges which hung above the station. All stations were >200 m from campsites and lakes, >50 m from trails, and out of sight from trails or campsites. For both winter and summer, after the initial deployment, a subset of stations was checked to make sure the equipment was functioning properly, and then were left for a range of 57–111 days depending on access and seasonal weather considerations (Table 1).

Results

Combining both the winter and summer survey efforts, we established a total of 193 survey stations in 97 sample units (Table 1), resulting in 17,897 camera-nights of sampling effort. We surveyed 108 camera stations and 54 sample units during winter, and 85 camera stations and 43 sample units during summer. For the winter sampling season, camera stations were set by a crew of 4 from November 19 to December 16, 2015 when weather was permitting, and were removed by a crew of 2 from February 5 to March 9, 2016. Cameras were in the field for a minimum of 60 days and collected a minimum of 77,300 photographs. During the summer sampling season,

cameras were set by a crew of 3 from July 12 to August 2, 2016 and were removed by a crew of 2 from September 17 to 27, 2016. Cameras were in the field for a minimum of 57 days and collected a minimum of 319,749 photographs.

We have not completed the determination of all species captured in the digital imagery. Field crews examined each of the images in the field looking for martens and fishers, and recording up to three other incidental species detected. Hence, at this time we have completed the tally of only martens and fishers; we still need to go through the images in the office to obtain a final tally of all species detected. Based on cursory field examination of the images, we detected a minimum of 20 species or taxonomic groupings of wildlife including (in approximate descending order of frequency reported) mice, birds, chipmunks (*Tamias spp.*), northern flying squirrels (*Glaucomys sabrinus*), fishers, spotted skunks, short-tailed weasel (*Mustela erminea*), black-tailed deer (*Odocoileus hemionus columbianus*), Douglas' squirrel (*Tamiasciurus douglasii*), bobcat (*Lynx rufus*), bushy-tailed woodrat (*Neotoma cinerea*), raccoon (*Procyon lotor*), mountain lion (*Puma concolor*), black bear *Ursus americanus*), long-tailed weasel, opossum (*Didelphis virginiana*) coyote (*Canis latrans*), snowshoe hare (*Lepus americanus*), and marten. We detected fishers at 44% of the stations sampled during winter in the coastal strip of Olympic National Park (Figure 5), while none were detected during the summer effort. We detected martens at only one site during the summer sampling season at a high-elevation site in Olympic National Park (Figure 6). Additionally, we detected spotted skunks at 39 stations, 33 during the winter effort and 6 during the summer. We will complete the tally of other species and provide a full reporting of relative frequencies and distributions of other species' detections in an upcoming publication.

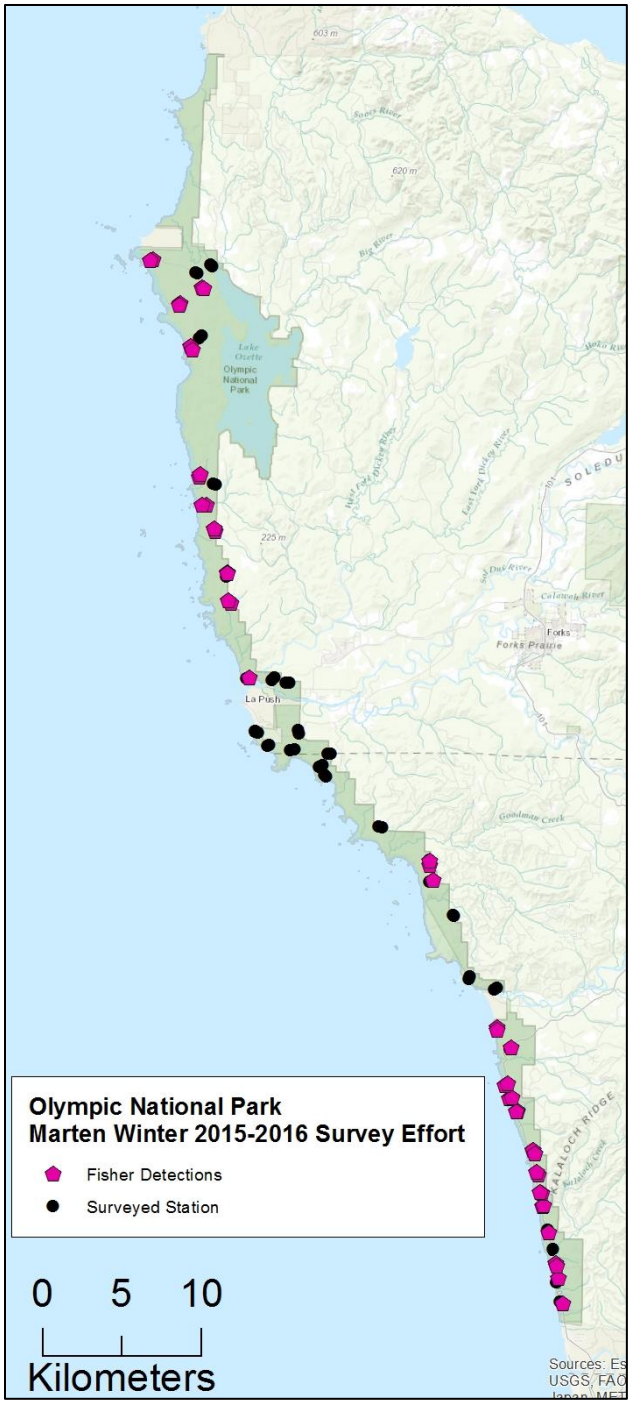

Figure 5; Location of 108 camera stations distributed among 54 sample units in Olympic National Park November 19, 2015–March 9, 2016. Cameras were in the field for a minimum of 60 days. Fishers were detected at 48 stations (44% of stations) throughout the survey area (pink pentagons) but no martens were detected.

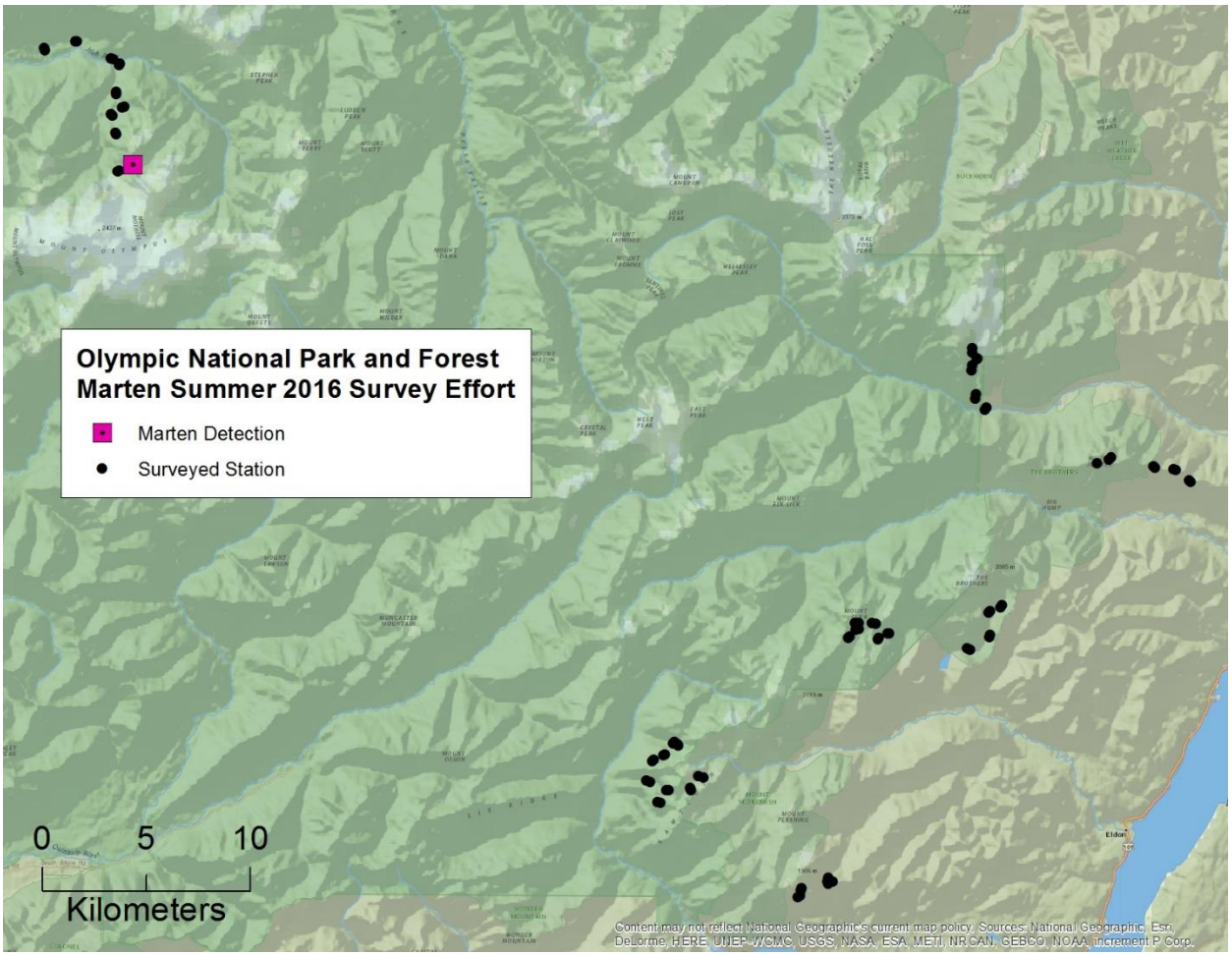

Figure 6; Location of 85 camera stations and one marten detection distributed among 43 sample units in Olympic National Park and Olympic National Forest.

Table 1. Summary of survey effort within the coastal strip of Olympic National Park and the 6 focal areas in the montane region in Olympic National Park and Olympic National Forest.

Survey Region/Focal Area	Number Sample Units	Number Camera Stations	Setup Entry Date	Setup Exit Date	Check Entry Date	Check Exit Date	Pull Entry Date	Pull Exit Date	Approx. Days Deployed	Number Survey Nights	Number Photographs
Coastal strip region	54	108	19-Nov 2015	16-Dec 2015			5-Feb 2016	9-Mar 2016	111	11988	77,300
Montane region/	43	85	12-Jul 2016	2-Aug 2016			17-Sep 2016	10-Oct 2016	435	5909	319,749
(1) Mt Ellinor - Mt Washington	4	8	12-Jul	12-Jul	8-Aug	8-Aug	17-Sep	18-Sep	68	544	
(2) Mt Jupiter	5	9	13-Jul	14-Jul	12-Aug	12-Aug	10-Oct	10-Oct	89	801	
(3) Lake Constance	5	10	14-Jul	14-Jul	7-Aug	7-Aug	3-Oct	10-Oct	88	880	
(4) Mt Cruiser - Staircase – Flapjack	10	20	18-Jul	19-Jul	9-Aug	10-Aug	29-Sep	1-Oct	75	1500	
(5) Brothers - Lena Lake	9	18	25-Jul	27-Jul	11-Aug	15-Aug	20-Sep	21-Sep	58	1044	
(6) Upper Hoh - Elk Lake	10	20	1-Aug	2-Aug			26-Sep	27-Sep	57	1140	
Total Effort	**97**	**193**							**546**	**17897**	**397,049**

Discussion

Based on available evidence, Pacific martens appear to be very limited in distribution and at critically low numbers throughout most of their former range on the Olympic Peninsula in Washington. We detected only 1 individual marten during this extensive marten-specific survey effort. In addition, there were 2 martens detected during 2015, resulting in 6 verifiable marten detections since 1988 (i.e., in 28 years). Because two detections of martens in the Hoh watershed of the Park (in 2015 and 2016), were only 4-km apart, these could be the same individual. Hence, we conclude there is direct evidence of the presence of only 2 or 3 martens on the Olympic Peninsula from all sources since 2013—1 or 2 martens in the upper Hoh and 1 marten near Mt. Cruiser. Our survey efforts build on previous broad-scale endeavors by the National Park Service and their collaborators (Figure 1) and the Forest Service, that resulted in 34,000 survey nights at both broad (Figures 1 and 4) and fine spatial scales (Figures 5 and 6). The paucity of observations of martens in both low- and high-elevation habitats where the subspecies is more commonly observed elsewhere, raises some concern over the long-term viability of martens on the Peninsula.

We suspect the population size of martens on the Olympic Peninsula is small, and also that it may exist as small and isolated subpopulations, which if true may put martens at risk of extirpation. Potential risks to remaining populations include demographic risks associated with small population size, which may be exacerbated by environmental influences. Martens are typically associated with montane environments and dense snow cover, where it has been hypothesized they find seasonal refugia from predators (Moriarty et al. 2015). However, climatic changes may increasingly threaten the viability of this snow-dependent species (Dawson et al. 2011; Pauli et al. 2013). In addition, there may be other factors contributing to the apparent population decline of martens, including competition with other carnivores, predation, overtrapping, and/or disease (e.g., Holm et al. 2016). Further, the use of anticoagulant poisons to control rodents has recently emerged as a significant concern for non-target wildlife, including forest carnivores (Gabriel et al. 2012). None of these plausible explanations for the decline and scarcity of Pacific martens, however, is currently testable without a much better understanding of the nature and status of remnant populations.

The population status and genetic affinities of Pacific martens on the Olympic Peninsula is unknown, but an evaluation is in progress. The USDA Forest Service National Genomics Laboratory is evaluating the genetic origins of this population, attempting to address questions such as relatedness to populations in the Cascades and those in coastal Oregon. Dr. Aubry obtained historical samples from the Olympic Peninsula that will be combined with a rich data set obtained from recent research on extant populations. Until the results of these analyses are available, it is prudent to assume that this population is either genetically unique (possibly containing localized adaptations to this region) or closely related to nearby populations. This ongoing research should shed light on whether recent and continued habitat fragmentation, urbanization, and agricultural land uses in the Puget Sound and Chehalis river lowlands may have contributed to genetic isolation and potential limitations to the Olympic population.

We have no recent evidence that martens are persisting at lower elevations on the Olympic Peninsula where they were once readily trapped. Although we focused our effort in coastal areas similar to where martens were detected in California and Oregon, we detected none. We cannot rule out the possibility that martens occur farther inland along the coast. Other camera-trapping efforts, however, distributed more broadly and systematically throughout the coastal lowlands targeting fishers, have also not detected any martens (Figure 1). Causes for the absence of martens at low elevation are not known, but we speculate it could be related to predation and competition from generalist carnivores such as bobcats, coyotes, or barred owls, which have been shown to limit distributions (e.g., Wiens et al. 2014, Holm et al. 2016). Alternatively, martens may have been trapped out in lower elevation forests that were most easily accessed, and have not yet dispersed from montane regions back to these forests. Further, the potential impact of rodenticide poisons on marten population status in the forested lowlands of the peninsula warrants additional research focus.

Martens on the Olympic Peninsula appear to occur at critically low population densities, with all reports of the species in the past 20 years occurring in wilderness (National Forest or National Park). As a next step, we suggest additional distributional surveys that involve noninvasive collection of DNA to better quantify the geographic extent and genetic diversity of the current population, or to definitively demonstrate the species absence from this segment of its former range. We believe it would be useful to continue efforts to document marten occurrence in high-elevation wilderness areas of Olympic National Park and Forest. Because of logistical constraints working in wilderness, and because the efficiency of detecting martens is generally greatest in winter (Zielinski et al. 2015), it may be useful to deploy the latest innovation—pairing camera stations with long-lasting scent lure dispensers (R. Long, Woodland Park Zoo, pers. comm.) for longer periods of time (i.e., over winter) in remote reaches of the Olympic Mountains. These scent-dispensers dispense a few milliliters of potent scent lures daily, thereby maintaining maximum attractant efficiency over several months. Secondly, because preliminary findings indicate that scat-sniffing dogs are likely more successful than camera surveys at detecting martens during summer in coastal Oregon (Moriarty et al. In prep), we also recommend exploring the use of dog teams to detect martens on the Olympic Peninsula during summer. Using dog teams may present some operational challenges in wilderness areas, particularly in Olympic National Park, where dogs are prohibited from Park trails. However, the use of this technique may be feasible in Olympic National Forest, and would permit more exhaustive and definitive searches for martens than has been possible using cameras. Lastly, because there is so little information on the genetic characteristics of extant martens on the Olympic Peninsula, hair-snare devices could be distributed throughout areas where martens have been detected. Such efforts would help managers make informed decisions for marten conservation in the region, while also promoting broader goals of maintaining biological diversity and contributing to species recovery on public lands.

Acknowledgments

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