Final Progress Report

Forest Carnivore Research in the Northern Cascades of Oregon

(Oct 2012–May 2013, Oct 2013–Jun 2014)

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One of several red foxes detected in the northern Cascades of Oregon.

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Habitat for American marten (*Martes americana*)[4] typically includes late successional coniferous and mixed forests with >30% canopy cover (see Clark et al. 1987, Strickland and Douglas 1987). The Pacific Northwest has experienced intensive logging during the past century and the distribution of martens in this region is largely discontinuous because of fragmented patches of forest cover (Gibilisco 1994). Based on state agency harvest data, the average annual number of martens harvested in the Oregon Cascades (and statewide) has decreased substantially during recent decades, but disentangling the potential factors (e.g., decreasing abundance, decreasing harvest effort) attributed to changes in harvest levels continues to prove difficult (Hiller 2011, Hiller et al. 2011).

Two indigenous subspecies of Red Fox (*Vulpes vulpes*) occupy Oregon, but non-native Red Foxes also exist in Oregon. The native Rocky Mountain Red Fox (*V. v. macroura*) is distributed in montane systems within many Rocky Mountain states, and extends into the Wallowa Mountains in northeastern Oregon (Ables 1975). In Oregon, the native Sierra Nevada Red Fox (*V. v. necator*) was lumped with the Cascades subspecies (*V. v. cascadensis*) of Washington until recent evidence suggested the current classification based on their closer phylogenic relationship with Sierra Nevada Red Fox in California (Sacks et al. 2010). This montane subspecies was once widespread throughout high-elevation areas of California in the southern Cascades and the Sierra Nevada, but its distribution in Oregon is largely unknown. In California, there are only 2 known populations with total numbers estimated to be <50 individuals (Statham and others 2012). The Sierra Nevada Red Fox was petitioned for listing under the federal Endangered Species Act (ESA) during 2011, with a listing determination currently under review (US Fish and Wildlife Service 2011).

In 1936, the wolverine (*Gulo gulo*) was thought to have been extirpated from Oregon; however, there has been at least 1 record per decade during 1960–1999 based on information collected by the Oregon Department of Fish and Wildlife (Hiller 2011). Three individuals were detected in the Eagle Cap Wilderness during a 2011–2012 survey in northeastern Oregon, but there was no evidence confirming any of these as female (Magoun et al. 2013). Wolverines have been protected in Oregon since 1967, were listed as threatened under the Oregon ESA in 1987 and at the time of this writing, were under consideration for listing as threatened in the contiguous U.S. under the federal ESA (U.S. Fish and Wildlife Service 2014).

We implemented a 2-year non-invasive survey to collect data on forest carnivores in the northern Cascades of Oregon. We concentrated our efforts in wilderness areas and specifically to collect data on American martens, red fox, and wolverines (if present). Our objective was to describe our detections of forest carnivores and we will submit ≥1 manuscript to peer-reviewed scientific journals to provide more detailed information.

STUDY AREA

Our study was conducted in the Willamette (about 6,900 km^2) and Deschutes National Forests (about 7,300 km^2) in the northern Cascade Mountain Range of Oregon, USA (Fig. 1). This included the Mt. Jefferson, Mt. Washington, and Three Sisters wilderness areas. Forests on our study area were dominated by Douglas-fir (*Pseudotsuga menziesii*) on the west slope of the Cascades, and ponderosa pine (*Pinus ponderosa*) on the east slope of the Cascades; other vegetation included silver fir (*Abies amabilis*), sub-alpine fir (*Abies lasiocarpa*), mountain hemlock (*Tsuga mertensiana*), western hemlock (*Tsuga heterophylla*), lodgepole pine (*Pinus*

[4] See Dawson and Cook (2012) for proposed recognition of two North American species of martens.

contorta), and alpine meadows. Santiam Pass (1,468 m in elevation), between the Mt. Jefferson and Mt. Washington wilderness areas, generally experiences snowfall during 10 months of each year, with a monthly peak of 262 cm of snow depth during March (Western Regional Climate Center 2013); snowfall and snow depth typically increase with increasing elevation in the study area. Average minimum (−6.9 °C) and maximum (22.8 °C) daily temperatures occur during January and July, respectively (Western Regional Climate Center 2013).

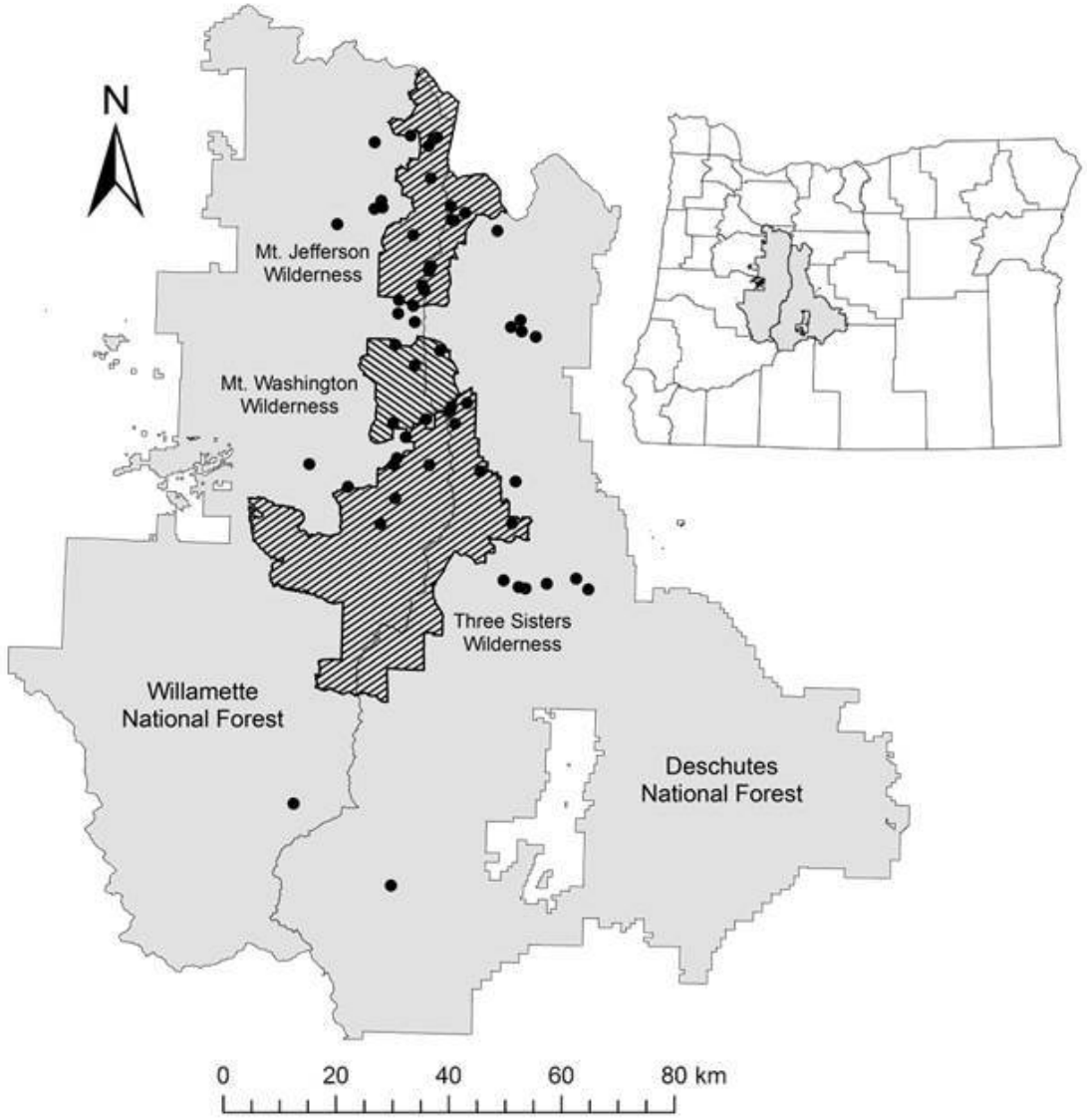

Fig. 1. Locations of baited camera stations (solid circles) implemented as part of a non-invasive survey of forest carnivores in three U.S. Forest Service wilderness areas and adjacent areas in the Deschutes and Willamette National Forests, Cascade Mountain Range, Oregon, USA, during October 2012–May 2013 and October 2013–June 2014.

METHODS

Our study was conducted during October 2012–May 2013 and October 2013–June 2014 using non-invasive survey methods primarily to collect data (e.g., presence, distribution) on forest carnivores within the study area. We used two types of baited camera stations (elevated, ground), a subset of which had hair-snagging devices specifically designed to collect samples from either wolverines (Magoun et al. 2011) or red fox (California Department of Fish and Game, unpublished report). We defined station as a site with bait and camera during a season, so for our purposes, a bait and camera at the same location during each of our 2 field seasons was considered 2 stations. Some stations consisted of both elevated baits and ground baits, which we refer to as ground stations based on access by more wildlife species than elevated stations. We selected station locations based on topographical and ecological features (e.g., avalanche chutes, presence of mountain goats [*Oreamnos americanus*]), winter access, and historical detections and current detections or reported sightings of carnivores, particularly wolverines and red fox.

We used infrared (e.g., Bushnell Trophy Cam HD, Overland Park, Kansas, USA) and non-infrared (e.g., Trail Watcher model 2035 and 2040, Monticello, Georgia, USA) motion-sensing digital cameras at stations using bait that typically consisted of 5–20-kg portions of salvaged deer (*Odocoileus hemionus*), elk (*Cervus canadensis*), or American beaver (*Castor canadensis*), depending on site location, station design, and availability of bait. We also used a skunk-essence based lure (Gusto, Minnesota Trapline Products, Pennock, MN) as an attractant applied 2–3 m aboveground on nearby trees. We recorded location (UTM) and elevation of each station using a handheld GPS unit. Bait and equipment were transported by non-mechanical means (e.g., horse, human) within wilderness areas. We attempted to monitor stations every 2–6 weeks, depending on weather conditions, avalanche risk, and other factors. Using digital images, we attempted to identify every mammalian species that visited each station, but we did not identify non-Carnivora mammals smaller than squirrels. We pooled squirrels into 3 groups (northern flying [*Glaucomys sabrinus*], tree (Subfamily Sciurini other than northern flying], and ground [Subfamily Xerinae]) based on physical characteristics.

RESULTS AND DISCUSSION

We collected a total of 111,148 digital images from 21 elevated and 39 ground stations over 3,555 camera-days during both field seasons. During the second field season, 5 stations were located ≤400 m from the nearest station active during the first field season. One camera collected only digital videos, which we used to identify species detected at that station. Cameras were active at stations for an average of 59.3 days (SE = 6.9, range = 2–212). Elevation of stations ranged from 586 to 2,237 m (Fig. 2).

At least 17 different mammalian species, of which 12 were of the Order Carnivora, were detected during our study (Table 1, Fig. 3). We detected American marten at 63% (38 of 60; elevation range = 1,252–2,237 m) of all stations, and red fox at 23% (9 of 39; elevation range = 1,545–1,988 m) of ground stations (Table 1). Unusual detections included a raccoon at an elevated station at 1,814 m of elevation in Three Sisters Wilderness during January 2013, and striped (*Mephitis mephitis*) and western spotted (*Spilogale gracilis*) skunks (elevation = 1,559 and 1,475 m, respectively) at ground stations about 7.9 km south of Camp Sherman during November 2013; all three species were detected at elevations much higher than expected.

Although our study did not focus on avian species, detections included American crow (*Corvus brachyrhynchos*), common raven (*Corvus corax*), bald eagle (*Haliaeetus leucocephalus*), red-tailed hawk (*Buteo jamaicensis*), turkey vulture (*Cathartes aura*), gray jay (*Perisoreus canadensis*), Steller's jay (*Cyanocitta stelleri*), Clark's nutcracker (*Nucifraga columbiana*), and other species.

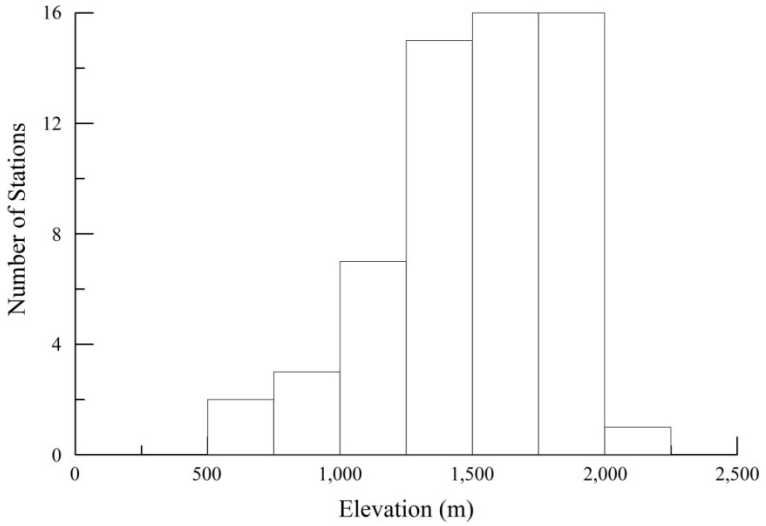

Fig. 2. Distribution of elevations of baited camera stations implemented as part of a non-invasive survey of forest carnivores in the Deschutes and Willamette National Forests, Cascade Mountain Range, Oregon, USA, during October 2012–May 2013 and October 2013–June 2014.

Martens seemed well distributed on our study area based on the majority of stations resulting in detections (Table 1). Farrell et al. (1995) had detections (evidence based on camera pictures or tracks) at 19 of 58 (33%) stations in the Umpqua National Forest, southwestern Oregon, during winter 1994–1995, much lower than our 63% detection rate, although they had detections over a lower range of elevations (732–1,868 m). Martens typically avoid large, open expanses (e.g., resulting from clearcuts or stand-replacing fires), but such areas may be traversed or serve as sink habitat and become increasingly used about 15 years post-disturbance (Soutiere 1979, Slough 1989, Paragi et al. 1996, Gosse et al. 2005). We had detections of martens at 3 of 4 stations contained within the area of B & B Complex burns (36,733 ha between Mt. Jefferson and Cache Mountain; summer 2003) and 2 of 3 stations contained within the area of the Pole Creek burn (10,570 ha in northeast portion of Three Sisters Wilderness and extending east outside of wilderness area; summer 2012). Both were stand-replacement burns with relatively little cover during our study.

Our study resulted in numerous detections of red foxes, including near areas of high human use (e.g., Mt. Bachelor), and of each of the three primary pelage colorations (silver, cross, red). Of the 5 ground stations located in previous stand-replacing burns, 2 stations located in the Pole Creek burn resulted in detection of ≥1 red fox. Coyotes (*Canis latrans*) were detected at 4 of the ground stations that also detected red fox, including the ground stations located in the Pole Creek burn. Preliminary genetic analysis provided additional evidence to suggest that montane red foxes on our study area are the indigenous Sierra Nevada subspecies. Additional research on red foxes in the Oregon Cascades will be critical to ascertain distribution, abundance, habitat

requirements, potential hybridization with non-native subspecies, and assess ecological relationships with coyotes to make informed conservation and management decisions.

Table 1. Wildlife species detected using non-invasive survey methods (2 types of baited camera stations), northern Cascades of Oregon, USA, October 2012–May 2013 and October 2013–June 2014.

Order Species	Number of Elevated Stations (n = 21)	Number of Ground Stations[a] (n = 39)
Carnivora		
American marten (*Martes americana*)	19	19
Red fox (*Vulpes vulpes*)	0	9
American mink (*Neovison vison*)	0	1
Long-tailed weasel (*Mustela frenata*)	0	2
Short-tailed weasel (*Mustela erminea*)	0	2
American black bear (*Ursus americanus*)	2	5
Coyote (*Canis latrans*)	3	9
Bobcat (*Lynx rufus*)	3	8
Northern raccoon (*Procyon lotor*)	1	0
Mountain lion (*Puma concolor*)	0	1
Striped skunk (*Mephitis mephitis*)	0	1
Western spotted skunk (*Spilogale gracilis*)	0	2
Rodentia		
Northern flying squirrel (*Glaucomys sabrinus*)	6	20
Tree squirrel (Subfamily Sciurini)	3	24
Ground squirrel (Subfamily Xerinae)	0	8
Lagomorpha		
Snowshoe hare (*Lepus americanus*)	0	9
Artiodactyla		
Mule or black-tailed deer (*Odocoileus hemionus*)	0	4

[a]All ground stations had bait generally accessible to terrestrial mammals, but a subset of ground stations also had elevated baits.

During our study, we did not detect any wolverines, fishers (*Martes pennanti*)[5], gray wolves (*Canis lupus*) or Canada lynx (*Lynx canadensis*), the latter of which included only 17 records statewide during 1897–1993 (Hiller 2011). Verts and Carraway (1998) considered wolverine observations in Oregon to be associated with "extreme dispersal events of individuals" and not representative of self-sustaining populations. Despite several efforts, no wolverines have been confirmed in Oregon since 1992 until Magoun et al. (2013) in northeastern Oregon. A wolverine was confirmed in northern California during 2008, with evidence suggesting it was of

[5] See Sato et al. (2012) for proposed recognition as *Pekania pennanti*.

Rocky Mountain origin, but no evidence confirming whether it dispersed, and if so, its dispersal path (Moriarty 2009). We had no evidence of wolverines occurring within the northern Cascades of Oregon during our study, although the Cascades may at minimum have served historically as a dispersal corridor based on documentation of individuals during past decades in California and Oregon (Aubry et al. 2007).

Several species of forest carnivores in the Pacific Northwest (e.g., OR, WA) are considered sensitive in that population viability is a concern based on evidence related to significant current or predicted decreasing trends in population abundance or in existing distribution of the species of interest (U.S. Forest Service 2005). Factors considered detrimental to many forest carnivore species include forest fragmentation through clear-cutting, landscape-scale wildfires, and climate change (e.g., Ruggiero et al. 1994, McKelvey et al. 2011). We recommend periodic continued monitoring of forest carnivores in the Oregon Cascades to assess changes in species distribution and composition, particularly related to potential effects associated with climate change and changes in predator communities (e.g., re-colonization of gray wolves [*Canis lupus*]).

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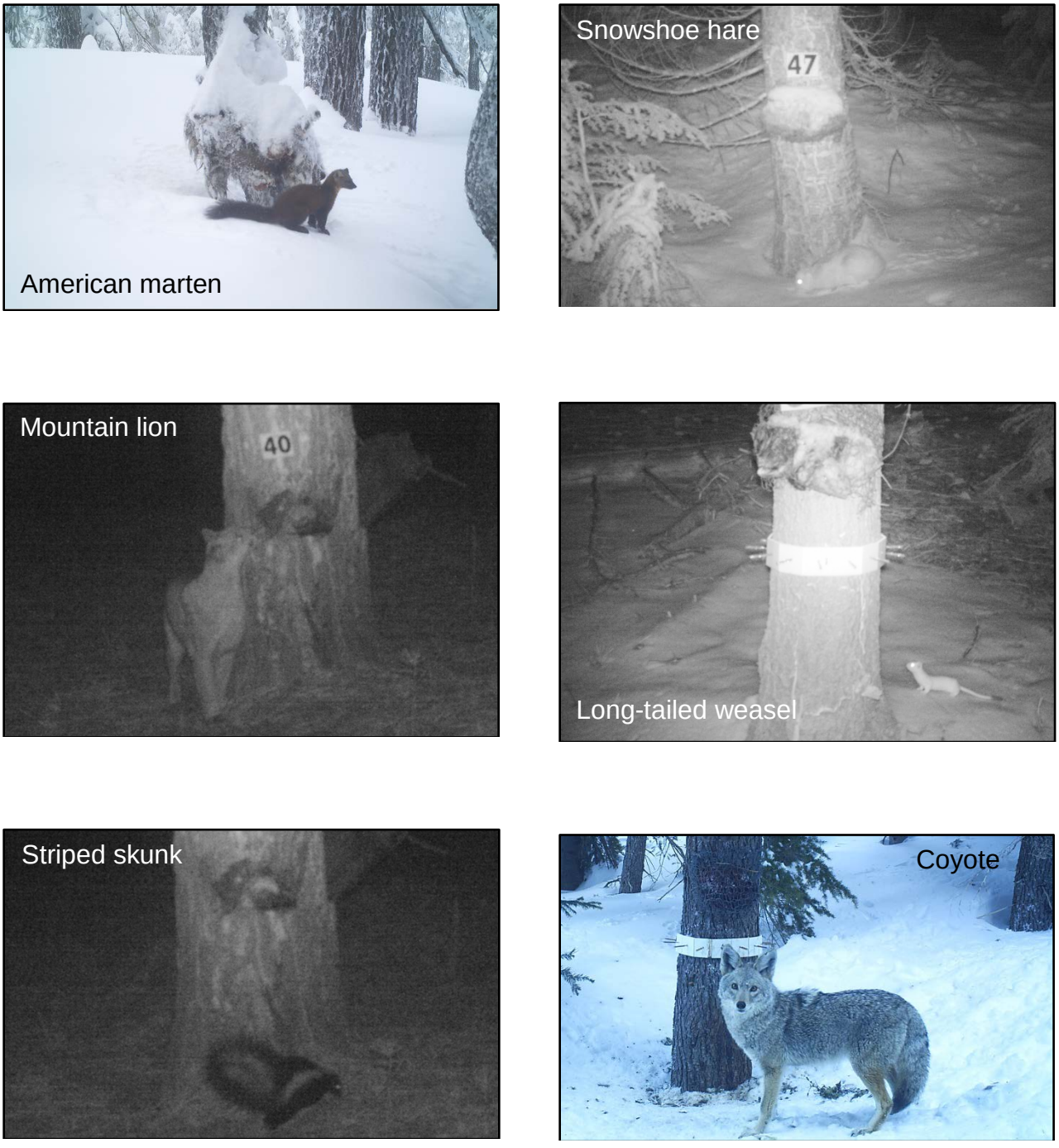

Fig. 2. Selected images of mammalian species detected during non-invasive survey of forest carnivores in the Deschutes and Willamette National Forests, Cascade Mountain Range, Oregon, USA, October 2012–May 2013 and October 2013–June 2014.

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