Ecological Characteristics of Fishers (*Martes pennanti*) in the Southern Oregon Cascade Range

Update: July 2006








USDA Forest Service—Pacific Northwest Research Station
Olympia Forestry Sciences Laboratory, Olympia, WA

PREFACE

The following is an update on the Rogue River Fisher Study being conducted by Keith B. Aubry (Principal Investigator) and Catherine M. Raley (Lead Wildlife Biologist) with the Wildlife Ecology Team, USDA Forest Service, Pacific Northwest Research Station, Olympia Forestry Sciences Laboratory, 3625 93rd Ave. SW, Olympia, WA 98512.

The report and data summaries were prepared by Catherine Raley. For more information contact:

Keith Aubry	**or**	Catherine Raley
360-753-7686		360-753-7686
kaubry@fs.fed.us		craley@fs.fed.us

This report can also be found on the Olympia Forestry Sciences Laboratory's website under Ecology, Management, and Conservation of Sensitive Wildlife Species: http://www.fs.fed.us/pnw/olympia/wet/team-research.

A key to the photographs on the front cover is provided on the last page of this report.

Ecological Characteristics of Fishers (*Martes pennanti*) in the Southern Oregon Cascade Range

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Keith B. Aubry (Principal Investigator) and **Catherine M. Raley** (Lead Wildlife Biologist). USDA Forest Service, Pacific Northwest Research Station, Olympia, Washington.

STATUS OF CURRENT RESEARCH

We initiated a radio-telemetry study on the ecology of fishers in the southern Oregon Cascade Range in the spring of 1995 and completed the field-work phase of the research in April 2002. In 2004, we completed the identification of prey remains and food items in fisher scats that we collected at den and rest sites. Also in 2004, and in collaboration with several genetic research labs, we completed genetic analyses of tissue samples collected from our study animals. Analyses of fisher habitat relations at various spatial scales is ongoing. The purpose of this report is to provide a summary of the data we collected during our radio-telemetry study and an update on various completed and continuing analyses.

STUDY OBJECTIVES

Conduct a radio-telemetry study to investigate the ecological relations of fishers in the southern Oregon Cascades, with emphasis on determining:

- natal and maternal den site characteristics and associated habitats,
- rest site characteristics and associated habitats,
- effects of stand and landscape composition on habitat use and home range size and shape, and
- food habits.

Determine whether fishers occurring in the southern Oregon Cascade Range represent a reintroduced or native population.

Determine the current distribution and conservation status of fishers in Oregon.

POTENTIAL BENEFIT OF THE STUDY

Fisher populations in the Pacific States have been petitioned twice in the past 15 years for listing under the Endangered Species Act. A third petition was delivered to the U.S. Fish and Wildlife Service in November 2000 to list the West Coast distinct population segment (DPS) of the fisher. In April 2004, the U.S. Fish and Wildlife Service announced a 12-month finding that the petitioned action for the West Coast DPS was warranted but precluded by higher priorities and placed the fisher on their candidate species list. The Forest Service's Conservation Assessment for Forest Carnivores (Ruggiero et al. 1994) identifies the Pacific Northwest as an area for which our knowledge of the ecological relations of fishers is almost totally lacking. Additionally, during the FEMAT/FSEIS process, the fisher was one of 4 mammal species (excluding bats) that was predicted to have <80% likelihood of maintaining long-term population viability under the Northwest Forest Plan. The few radio-telemetry studies that have been conducted on fishers in California indicate that fishers use large snags, live trees, and logs for birthing, denning, and resting, and are associated with dense-canopied, late-successional forests at relatively low elevations (<1200 m). This study represents the only research conducted on fishers in either Oregon or Washington. Because of its rarity and apparent sensitivity to the effects of timber harvesting, the fisher is of significant concern to forest managers in this region. Information on the effects of forest management on fisher habitat at multiple spatial scales will contribute to regional conservation and management strategies for this species.

STUDY AREA

Our study area was located primarily in the Upper Rogue River drainage basin on the west slope of the Cascade Range in southern Oregon and was about 2,437 km^2 in extent (941 mi^2; Figure 1). Lands within our study area were managed by the Prospect and Butte Falls Ranger Districts of the Rogue River National Forest, Crater Lake National Park, the Butte Falls Resource Area of the Bureau of Land Management, Boise Cascade Corporation, PacifiCorp, and other private land-owners on the west slope of the Cascade Range, and the Winema National Forest and Oregon Department of Forestry on the east slope of the Cascade Range. The elevation ranged from about 610-2,134 m (2,000-7,000 ft) with a few higher peaks in the Sky Lakes Wilderness Area along the Cascade crest. Precipitation varied depending on the elevation and primarily occurred between October and April as rain at the lower elevations and snow at the higher elevations. The average annual precipitation at 782 m near Prospect, OR was about 107 cm (National Climatic Data). Snow persisted throughout the winter above about 1,219 m (4,000 ft). The southern part of our study area was a little warmer and drier (average annual precipitation ~92 cm at Butte Falls, OR; National Climatic Data).

Our study area was primarily within the Mixed-Conifer Zone as described by Franklin and Dyrness (1988). The predominant tree species in this zone were Douglas-fir (*Pseudotsuga menziesii*), true fir (*Abies concolor - A. grandis* species complex), Ponderosa and sugar pines (*Pinus ponderosa, P. lambertiana*), and incense cedar (*Calocedrus decurrens*), although the pines typically occurred as scattered trees (Franklin and Dyrness 1988). Other common species included western hemlock (*Tsuga heterophylla*), western white pine (*P. monticola*), and golden chinquapin (*Castanopsis chrysophylla*). Shasta red fir (*Abies magnifica*), mountain hemlock (*Tsuga mertensiana*), and Engelmann spruce (*Picea engelmannii*) were typically found at elevations >1524 m; scattered lodgepole pine (*Pinus contorta*) also occurred at some of the higher elevations especially in the northern part of the study area near Crater Lake National Park. Brushfields that included *Ceanothus* spp. and *Arctostaphylos* spp. were characteristic in areas that had been harvested or burned (Franklin and Dyrness 1988).

On the west slope of the Cascades our study area included five 5th-level watersheds that ranged in size from 15,000-104,800 ha (USDA Forest Service, unpublished data): Upper Rogue River, South Fork Rogue River, Rogue River-Lost Creek, Big Butte Creek, and Elk Creek-Rogue River. PacifiCorp operated a hydroelectric project near Prospect that included 3 diversion dams (1 each on Red Blanket Creek and the Middle and North Forks of the Rogue River), 3 powerhouses, and about a 9-mile water conveyance system (canals and flumes). At various locations along the length of the system, water was either transported in a surface canal enclosed along both sides by cyclone fencing or in an elevated flume supported by trestles. Wildlife overpasses were constructed at several sites along the canal; animals could cross freely underneath the elevated trestle sections.

Two 2-lane highways and 1 county road crossed our study area (Figure 1). Highway 62/230 ran parallel to the Rogue River for the entire length of our study area and was a major year-round transportation route along the west slope of the Cascades. At the junction of Highway 62 and 230, 62 turned east and crossed the Cascade Range on the south side of Crater Lake National Park. This was a primary route for summer tourism to Crater Lake and for traveling to areas on the east side of the Cascades; however, during the winter the highway was closed at the Park to east-bound traffic. Prospect was the only developed community within our study area (population <600); however, Butte Falls (population <500) was <2 km from the southwest boundary of the study area. There were some small-scale agricultural activities on private lands in the study area, and cattle grazing occurred on National Forest, BLM, and state-owned lands. There were several developed campgrounds and a small resort development along the Rogue River–Highway 62 corridor. Additionally, there were many other developed and undeveloped campgrounds on federal lands throughout the study area. Other recreational activities in the study area included hunting and OHVs (summer and winter). Several snowmobile trails were maintained on the Rogue River and Winema National Forests.

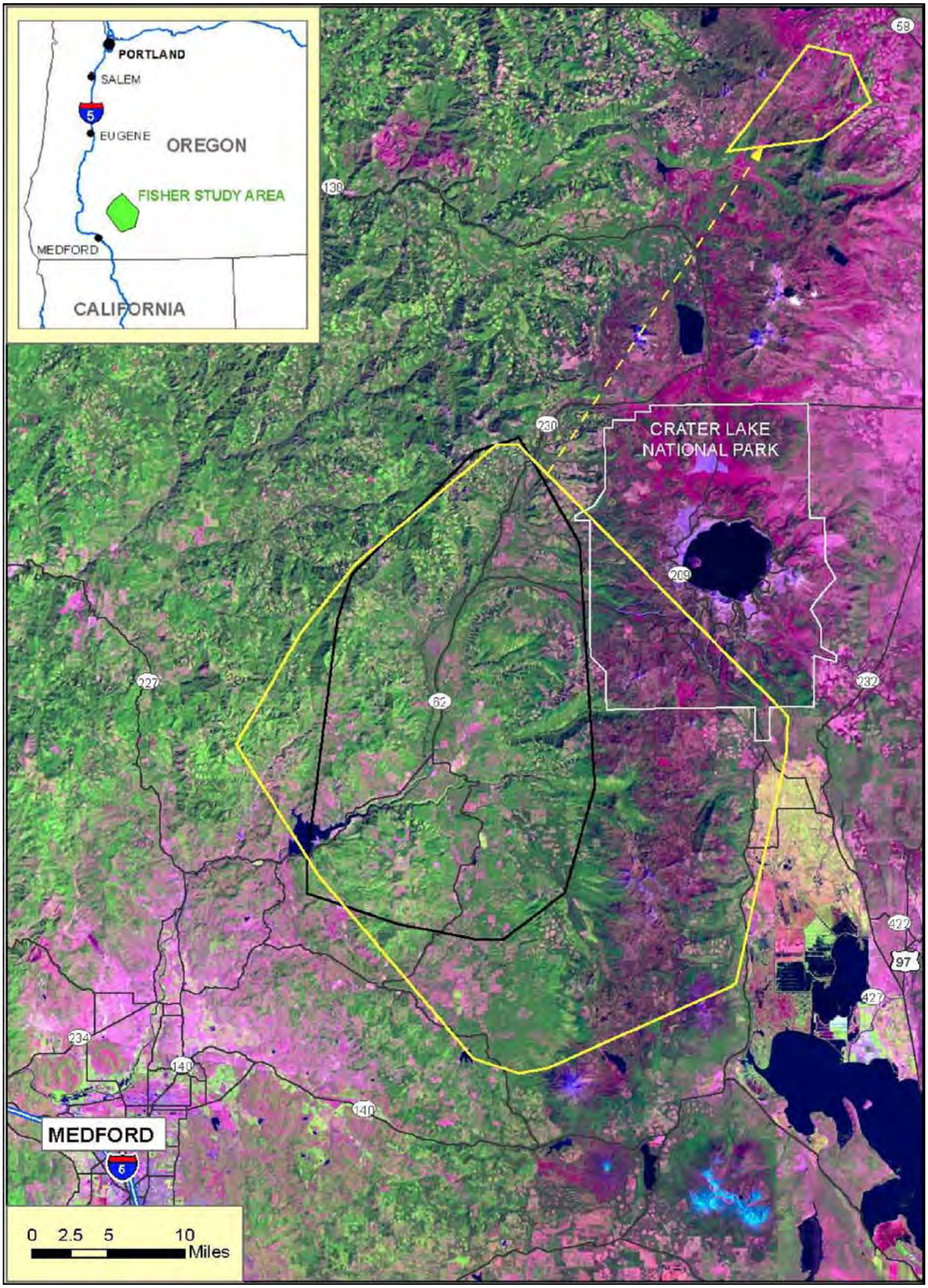

Figure 1. Mosaic of Landsat TM5 satellite images (bands 3-5, summer 2000) for the Rogue River Fisher Study Area in the southern Oregon Cascade Range. The large polygon (solid yellow line; 2,437 km^2 [941 mi^2]) is the geographic extent of telemetry locations for 19 fishers that were radio-tracked between 1995-2001. One juvenile male dispersed ~55 km (dashed yellow line) to the Big Marsh area on the Deschutes National Forest (small polygon outlined in solid yellow). We collected habitat availability data within our core study area (polygon outlined in solid black; 1,210 km^2 [467 mi^2]). Figure prepared by H. Beyer, GIS Analyst, Pacific Northwest Research Station.

RESEARCH METHODS

Capturing and Radio-collaring Fishers

We used raccoon-size live traps (Tomahawk 108) with an attached wooden nest-box to capture fishers within our core study area. We trapped in areas where remote camera surveys conducted by biologists on the Rogue River National Forest had detected fishers, as well as in areas where there had been recent sighting reports of fishers or tracks in snow. We used a mixture of Ketamine and Valium (5 mg Valium per 1,000 mg Ketamine) to anesthetize captured animals and fit them with radio-collars. Except for the initial year of the study when we used several radio-collars manufactured by Telonics, we fitted each captured fisher with a 42-gram Holohil Systems VHF radio-collar equipped with an 18-month battery. We ear-tagged all animals and during the process collected a small sample of ear tissue for genetic analyses. Additionally, we weighed each animal, took standard body measurements, examined tooth condition (wear and tartar), examined the skin for ectoparasites and injuries, and assessed reproductive status (i.e., enlarged teats or testes, length of baculum) and overall physical condition. We differentiated adults from juveniles based on the extent of wear and tartar build-up on teeth, differences in body measurements and weight, and the presence (adult) or absence (juvenile) of a pronounced sagittal crest. Although these characteristics were reliable for separating juveniles from adults (fishers >1 year of age), we could not use them to determine various age groups among adults. However, if we captured a reproductive female (i.e., a lactating female or subsequent telemetry locations revealed she had kits) we knew that female was ≥2 years (i.e., female fishers are not capable of giving birth to kits until they are 2 years of age).

Tracking Radio-collared Fishers

We tracked radio-collared fishers year-round using ground-based telemetry methods and attempted to relocate each individual 2 times/week. We did not use triangulation methods to determine animal locations; rather, we located resting animals by walking-in and isolating their signal to a specific structure (e.g., tree, log). We tracked active animals by walking-in and circling around their signal until we could pinpoint their location to an area ≤0.4 ha (1 acre) in size. Using these methods we were able to collect detailed information on structures used for resting and gather information on the habitat types used for resting, hunting, and traveling. We used aerial telemetry only to collect data on long-distance movements by dispersing juveniles and adult males during the breeding season and, on occasion, to locate an animal we could not find using ground-based telemetry.

To locate den sites, we increased our monitoring of adult females in early March from twice a week to 3-4 times/week. When we located an adult female in a potential den structure (i.e., live tree or snag with natural or woodpecker cavities), we monitored her for several days to determine whether she remained in or returned frequently to that structure. Once we confirmed repeated use of a structure, we installed a remotely-triggered video camera system at the site to determine which cavity the female was using and to document female activity during the denning period (camera was attached to a nearby tree with the lens and sensors focused on the den structure and potential cavity opening). To minimize disturbance at den sites, we only installed remote video cameras when the adult female was away from the den.

We defined natal dens as the structures where females give birth to kits and nurse them until weaning at about 8-10 weeks of age (Powell [1993] observed that hand-reared kits began taking some solid food at 8 weeks and were completely weaned at 10 weeks). We defined maternal dens as the structures used by adult females and kits during the period when kits are still dependant on the female for food, which appeared to last until late August or early September in our study area, when the kits are about 5 months old. However, by August we observed that kits were becoming more independent and may have been catching prey on their own. Thus, we used the following criteria to distinguish between maternal dens and rest sites: (1) from the time a female moved her kits from the natal den through July 31, we classified the structure used as a maternal den if the female exhibited site fidelity for ≥2 days, kits were seen or heard, or we found multiple scats and prey items at the site indicating prolonged use; 2) after July 31, we classified the structures used by a female and her kits as rest sites.

Collecting Habitat Data at Fisher Den and Rest Sites

At a later date, we returned to all den sites and a subset of the rest structures we located for each fisher and collected detailed data on both the structure and surrounding habitat conditions. To describe den and rest sites, we recorded the type of structure used (e.g., live tree, snag, natural log, cull log, slash pile, etc.), growth form of live trees (e.g., straight bole with intact top, broken top, forked trunk, etc.), decay condition of snags and logs, tree species, size (diameter, height or length) and, if known, the micro-site used (e.g., natural cavity, woodpecker cavity, mistletoe broom, hollow in log, etc.). Using the den or rest structure as the center of a 0.1-ha (0.25 acre) circular plot, we counted logs (average diameter >25 cm), cut stumps (>25 cm at the cut), and live trees (10-100 cm dbh). For more accurate estimates of very large trees (>100 cm dbh) and snags (>25 cm dbh), we counted all such structures within a 0.4-ha (1 acre) circular plot. For all structures counted, we also recorded tree species, diameter class, length or height, and decay condition (for logs and snags). We collected 5 canopy cover measurements using a concave spherical densiometer: 1 measurement in each of the 4 cardinal directions at a distance of 9 m from plot-center, and 1 measurement at plot-center. Additionally, we collected general site characteristics including elevation, slope, aspect, and visual estimates of percent ground and shrub cover.

Collecting Habitat Availability Data

To describe the availability of potential denning and resting structures, we used ArcInfo GIS software to randomly place a grid of 2.6-km^2 (1-mi^2) cells over our core study area (see Figure 1). Then we generated UTM coordinates for the center of each 2.6-km^2 cell in our core study area that was ≤ 1,554 m in elevation (373 points). We masked out areas above 1,554 m (5,100 ft) in elevation because our telemetry data indicated that fishers rarely used higher elevations. In the field, we used Rockwell PLGR GPS units to navigate to each point and collected data on available live trees, snags, logs, and canopy closure. At each random point (i.e., plot-center), we located the nearest 3 live trees, nearest 3 snags, and nearest 3 logs that met the following criteria:

Live trees
- 26-50 cm dbh, 51-100 cm dbh, and >100 cm dbh

Snags (decay condition classes 1, 2, 3, and 4 only)
- 26-50 cm dbh, 51-100 cm dbh, and >100 cm dbh

Logs (≥3 m in length and decay condition classes 1, 2, and 3 only)
- 26-50 cm, 51-100 cm, >100 cm

If we could not find a structure(s) that met our criteria within a 50-m radius (0.79 hectares; 1.95 acres) of the plot-center, we recorded 'NONE' for that specific structure and size-class. For each structure that did meet our criteria, we recorded tree species, size, decay condition, and the presence of potential micro-sites (e.g., mistletoe broom, limb cluster or platform branch, rodent nest, natural cavity, woodpecker cavity, etc.). We also recorded elevation, slope, and aspect and collected 5 canopy cover measurements using a concave spherical densiometer as described previously.

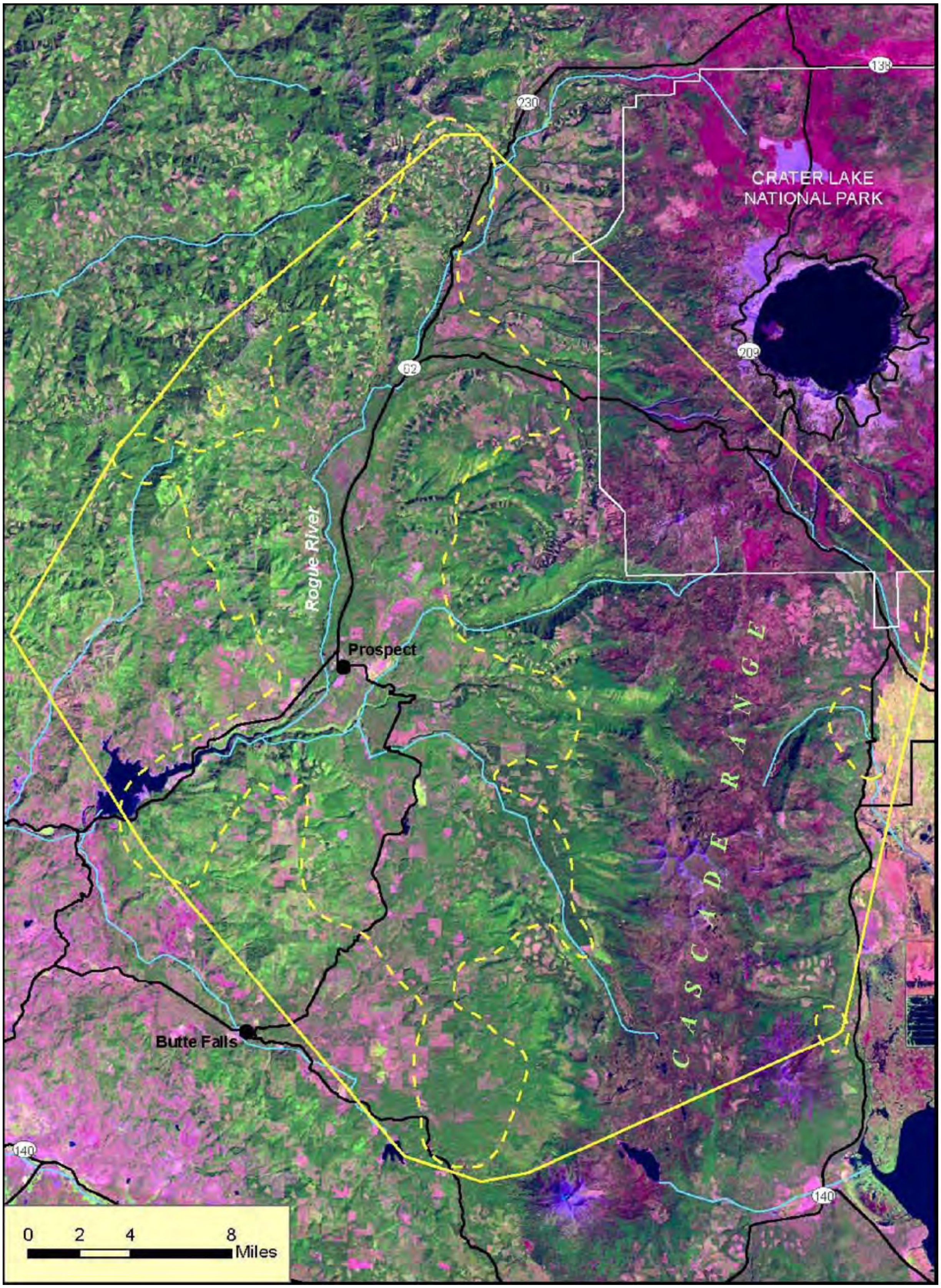

Figure 2. Minimum convex polygon encompassing all the telemetry locations of 19 fishers that were radio-tracked between 1995-2001 in the southern Oregon Cascade Range (solid yellow line; 2,437 km^2). Radio-collared fishers primarily used forested areas on the west slope of the Cascade Range <1,525 m in elevation (dashed yellow line = 95% kernel distribution). Figure prepared by H. Beyer, GIS Analyst, Pacific Northwest Research Station.

SUMMARY OF RESEARCH FINDINGS

The Study Population

We captured 22 fishers from 1995 to 2001: 13 females (8 adults and 5 juveniles) and 9 males (6 adults and 3 juveniles). We radio-collared 21 fishers and were able to collect telemetry location data for 20: 1 juvenile female slipped her collar before we could collect any location data, and we did not collar 1 adult male because he was captured near the end of the study. Similar to other mustelids, male fishers are larger than female fishers. The average weight of adults captured during our study was 5.9 kg for males and 2.85 kg for females ($n = 7$ and $n = 9$, respectively). Juvenile females appeared to reach adult size and weight sooner than juvenile males. The average weight of 7-9 month old juvenile females (2.58 kg, $n = 4$) was only 0.27 kg less than an adult female, whereas the average weight of 8-month old juvenile males (4.38 kg, $n = 2$) was 1.52 kg less than an adult male. Even at 11 months of age, juvenile males still weighed about 1 kg less than an average adult male (4.95 kg, $n = 2$).

We obtained >1,600 telemetry locations: 51% at rest structures, 6% at den structures, 32% active locations, and 11% aerial locations. The 100% minimum convex polygon (MCP) of all telemetry locations (except those of 1 juvenile male who dispersed out of the study area) was 2,437 km^2 (941 mi^2; Figure 2). The landscape used by our study animals included both the west and east slopes of the Cascade Range; however, most radio-telemetry locations were on the west slope in forested areas <1,525 m (Figure 2). Although the Rogue River and Highway 62 appeared to influence spatial use by fishers (i.e., an individual home range was either on one side of this corridor or the other), resident females occasionally crossed these features and adult males regularly crossed them during the breeding season. Additionally, these features did not appear to impede the movements of dispersing juveniles.

Demographics of the Study Population

We monitored 2-4 adult females ($\geq$2 years of age) each breeding season from 1995 to 2001 and determined females to be reproductive if we observed: (1) denning behavior (i.e., if an adult female repeatedly used a single structure in March or early April and spent long periods of time each day at the structure); (2) evidence of lactation when captured (i.e., teats enlarged and nuzzle-marks evident); or (3) kits with an adult female. Using these methods, we determined that on average 59.4% of adult females gave birth to kits each year; however, the average annual reproductive success rate was only 44% (Table 1). Several females gave birth to kits but died before the kits were weaned; thus, we concluded that a female was reproductively successful only if she and $\geq$1 kit survived into June (i.e., when kits were >2 months old). It was not possible for us to reliably determine survival of kits beyond this time because the kits became more mobile and difficult to observe. Footage from remote video cameras and field observations at natal and maternal dens revealed litter sizes of 1–3 kits (average of 1.9 kits/female, $n = 8$). However, we only observed 1 litter of 3 and not all of the kits survived beyond ~2 months of age.

The average annual survival rate of fishers $\geq$1 year of age in our study area was 82% (Table 2). Although our samples sizes were small, it appeared that males had a slightly greater survival rate

(85%) than females (78%; Table 2). Survival rates of radio-collared juveniles in our study area appeared to be high. From 1995 to 2000, we captured 6 juveniles that were 7-9 months of age. All of these juveniles survived until they were >1 year of age. One juvenile female (captured in 1995) and 1 juvenile male (captured in 1998) established home ranges within our core study area and we tracked both animals until the end of the study when they were 6 and 3 years of age, respectively. The remaining juveniles either dispersed out of our study area (1 male that we monitored until he was >20 months old and then his collar failed), remained within our study area but the telemetry work ended before they reached reproductive age (2 females), or we lost their radio-signal (1 female's collar apparently failed when she was about 15 months old). We captured a 7th juvenile in March 2001(a male that was ~11 months old), and although we were able to collect data on his dispersal movements, he was not radio-collared long enough to include in estimates of survival.

Table 1. Annual reproductive rates for radio-collared adult female fishers (≥2 years of age) in the southern Oregon Cascade Range 1995-2001. Reproductive rates are based on data from 9 adult females that were monitored at various times during the study (i.e., not all females were radio-collared at the same time).

	Breeding season						
	1995	1996	1997	1998	1999	2000	2001
Adult females that gave birth to kits	2/2	2/2	1/3	2/4	1/3	1/2	2/4
Adult females with kits that survived into June	2/2	1/2	1/3	2/4	0/3	1/2	1/4

Table 2. Number of radio-collared fishers ≥1 year of age surviving from 1 April of the first year to 1 April of the following year in the southern Oregon Cascade Range 1995-2001. The approximate birth date of fishers in our study area was 1 April. Survival rates are based on data from 19 fishers that were monitored at various times during the study (i.e., not all fishers were radio-collared at the same time).

	Time period						Average annual survival rate
	1995-1996	1996-1997	1997-1998	1998-1999	1999-2000	2000-2001	
Females	2/2	4/5	4/5	3/4	1/3	4/4	0.78
Males	1/1	3/4	2/3	2/2	4/4	2/3	0.85
All fishers	3/3	7/9	6/8	5/6	5/7	6/7	0.82

All radio-collared fishers that died during our study were necropsied by Dr. Stanley Snyder the Director of the Oregon State University Diagnostic Veterinarian Laboratory. Of the 6 adult females that died during the course of our 6½-year study, 1 was shot, 2 were killed by predators (1 potentially by a cougar, the other possibly by a coyote), 1 died from starvation and other complications most likely related to old age (her teeth were completely worn down to the gum line and it was apparent she had not been able to masticate food for some time), 1 appeared to have drowned in a creek, and 1 died from unknown causes. Three adult males died during our study; 2 from natural causes and 1 was euthanized. One male died from acute pleuritis, and although the source of the bacterial infection was unknown, the veterinarian speculated that perhaps it was from one of several porcupine quills that were embedded in the thoracic region. Another male ($\geq$7 years old) died from malignant testicular cancer with metastases. In 1998, we euthanized 1 male after he sustained a trap-related injury (he broke most of his teeth chewing on the trap door). However, we also noticed that he had numerous porcupine quills on the left side of his face and shoulder and one in his mouth (upper inside lip area). Additionally, the necropsy revealed that he had a large subcutaneous abscess and bacterial infection in his left scapular area associated with an embedded piece of porcupine quill. We initially captured and radio-collared this male in 1996, and then we captured and re-collared him again in 1997. On both of these occasions, the male appeared to be in excellent health and he did not incur any trap-related injuries. Although we can not be certain as to the cause of the 1998 trap-related injury, we speculated that perhaps the porcupine quills were irritating him or another male fisher approached the trap causing a confrontation (other researchers conducting a radio-telemetry study on pine martens observed such a confrontation between 2 male martens; L. Jones pers. comm.).

Seasonal Activities and Movements

Because we monitored adult and juvenile fishers year-round using radio-telemetry, we were able to document the timing of various activities associated with reproduction and juvenile dispersal (Figure 3). The timing and duration of the natal-denning period was relatively consistent among the adult females we monitored. Adult females appeared to give birth to kits from about 17 March to 5 April (based on the earliest dates we observed adult females establishing natal den sites), and the natal-denning period lasted until late-May or the beginning of June. As an example, 1 female established a natal den by the 26th of March and did not move her kits from the den cavity until the 6th of June. Another female established a natal den by the 24th of March and moved her kits on May 23rd. Once adult females moved their kits from the natal den, subsequent use of maternal dens (i.e., sites used $\geq$2 days) was variable and appeared to be related to the number of kits. Females that had only 1 kit appeared to be relatively mobile and we found few maternal dens. In contrast, we regularly found maternal dens when an adult female had $\geq$2 kits, and at least some of these dens were used for extended periods of time (e.g., >2 weeks). Footage from remote video cameras placed at maternal den sites indicated that at 3-4 months of age fisher kits were learning to climb trees and handle prey. On several occasions, 2 kits were observed climbing in small trees near the maternal den (their movements were still somewhat uncoordinated) and 'playing' with prey remains that the adult female had brought to the den site. The adult female frequently left the kits alone at the maternal den; sometimes the kits would remain in the den cavity and other times they would explore the immediate vicinity around the den tree. On one occasion, the adult female appeared to become very agitated when a coyote was in the vicinity and kept the 2 kits in the den (a cavity in the base of a large live tree). We documented coyotes near the maternal den on several occasions and a bobcat investigated the base of the den tree on one occasion.

In early February of each year, adult males became more active and started to move longer distances, sometimes moving well beyond their non-breeding season home ranges presumably to find reproductive females. One adult male, who resided on the east slope of the Cascades during the non-breeding season, traveled about 30 km across the Cascade crest to our core study area on the west slope during 3 successive breeding seasons (1996-1998; see Aubry et al. 2004). From early February to late April 2001, we used fixed-wing aircraft to monitor the breeding season movements of a 3-yr old male and a 6-yr old male. The younger male covered 22,618 ha (226.18 km^2; 100% MCP) and made excursions far to the south of his non-breeding season territory. The older male covered 10,060 ha (100.6 km^2; 100% MCP) and moved primarily within his non-breeding season territory with some excursions beyond his usual activity areas. The maximum distance between successive locations (i.e., straight-line mapping distance which was less than the actual distance traveled) was 17.6 km for the younger male and 22.2 km for the older male. In both cases, these movements were made within 48 hours. Telemetry data and field observations indicated that mating was probably occurring within a week or two after the adult females established a natal den (i.e., about 1-2 weeks after the kits were born). On several occasions, we documented adult males close to the natal dens of radio-collared females. On one occasion, we bumped a male fisher who had been bedded down under a small tree <5 meters from the base of a natal den tree (adult female was in the natal den cavity). By the end of April, most of the adult males had settled back into their non-breeding season home ranges.

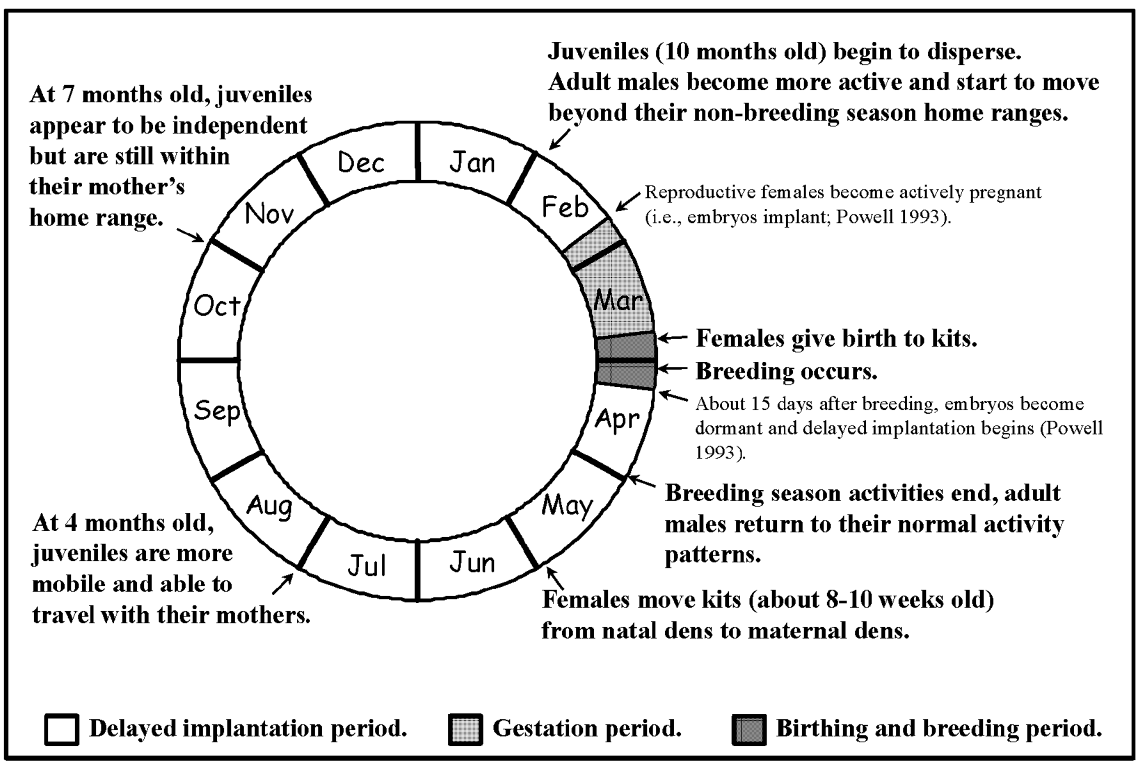

Figure 3. Seasonal activity of fishers in the southern Oregon Cascade Range. Timing of events is based on field observations of radio-collared adult and juvenile fishers from 1995-2001; length of gestation and delayed implantation periods are from Powell (1993).

We documented 7 juvenile dispersals (4 females and 3 males). Juveniles appeared to stay within or close to their mother's home-range through their first fall and began to make exploratory movements in early February. By about the end of May, most 1-year-old fishers had settled into the areas where they eventually established a home range. Juvenile males dispersed further (mean = 29 km; range 7-55 km) than juvenile females (mean = 6 km; range 0-17 km), supporting the hypothesis of male-biased dispersal in fishers (see Aubry et al. 2004). Two of the 4 juvenile females did not disperse from their natal areas; these females appeared to establish home ranges adjacent to and slightly overlapping their mother's home range. Dispersing juveniles crossed or traveled around various landscape features including the Cascade crest (1 male), the Rogue River and its tributaries, 2-lane highways, a 9-mile long water canal system, and the small rural community of Prospect.

Home Range Estimates

We used the computer program CALHOME to calculate 95% minimum convex polygon (MCP) home ranges for adult male and female fishers. Our estimates of home range size are preliminary and will change if we use a different estimator in future analyses (e.g., adaptive or fixed kernel estimator) or different time periods.

In our study area, fishers began to exhibit breeding behavior in February (Figure 3); thus, we considered 1 February thru 31 January of the following year to represent the annual breeding cycle. However, because adult males typically ranged over a much greater area during the breeding season (presumably in search of receptive females), we used different criteria to describe the home ranges of adult males and females. We calculated female home ranges on an annual basis (1 February-31 January), whereas we split male annual home ranges into breeding (1 February-30 April) and non-breeding (1 May-31 January) seasons. The average 95% MCP annual home range size for females was ~25 km^2 ($n = 7$). Male home ranges were substantially larger: ~147 km^2 ($n = 3$) during the breeding season, and ~62 km^2 ($n = 4$) during the non-breeding season.

We did not include 3 adult fishers (2 males and 1 female) in estimates of home range size. Two males captured during the breeding season of 1996 did not have home ranges within the core study area. One of the males (#05) resided on the east side of the Cascade crest during the non-breeding season and returned to our core study area each breeding season from 1996 to 1998. The second male (#06) resided to the southeast of our core study area and used areas on both the west and east-side of the Crest during the non-breeding season. Because of their wide-ranging movements beyond our core study area, we did not collect enough data to calculate reliable estimates of home range size for those individuals. An adult female captured in December 2000 did not appear to have an established home range. We suspect that she may have been displaced and was exploring areas in an effort to establish a new home range. She traveled as far as 15 km north of her capture location and by late March 2001 settled in an area ~8 km south of her original capture site.

The main stem of the Rogue River and Highway 62 appeared to influence spatial use by fishers, and individuals in that part of our study area primarily maintained home ranges on one side or the other of that corridor, crossing it only occasionally and during the breeding season (males).

However, other landscape features (e.g., smaller rivers, creeks, paved county roads, etc.) in our study area did not appear to substantially influence where fishers established their home ranges. One adult male's home range was located on the outskirts of Prospect and encompassed portions of the 9-mile long water canal system. Additionally, he frequently crossed the Middle Fork and South Fork of the Rogue River.

General Forest Conditions at Telemetry Locations of Radio-collared Fishers

Each time an animal was located at a den, rest, or active site, observers made a visual determination of forest conditions within 0.4 ha (1 acre) around the animal's location. We did not include aerial telemetry locations in any assessment of habitat use. Overall, females were found in patches of unmanaged forest more frequently than males (Table 3). Males appeared to use a wider array of habitat conditions when resting or active compared to females.

Table 3. Assessment of general habitat conditions within 0.4-ha (1 acre) plots around radio-telemetry locations of 12 female and 8 male fishers in the southern Oregon Cascade Range, 1995-2001.

	Females			Males	
Habitat category	Den locations *n* = 32	Resting locations *n* = 489	Active locations *n* = 274	Resting locations *n* = 342	Active locations *n* = 260
Unmanaged forest [1]	56%	63%	40%	25%	25%
Managed forest: [2]					
1-33% of overstory trees removed	13%	8%	6%	5%	8%
34-66% of overstory trees removed	13%	6%	9%	7%	6%
>66 overstory trees removed	12%	8%	17%	14%	13%
Managed second-growth forest: [3]					
10-25 cm dbh trees	3%	4%	5%	23%	6%
26-50 cm dbh trees	3%	10%	21%	23%	36%
51-75 cm dbh trees	0	<1%	1%	1%	0
Non-forested habitats [4]	0	1%	1%	2%	6%

[1] No evidence of any past timber harvesting within a 0.4-ha area around location.
[2] Some timber harvesting has occurred but the original forest has not yet been completely replaced.
[3] Areas that have a longer history of timber management and the original forest has been replaced.
[4] Includes wet meadows and upland shrub habitat conditions.

The category "unmanaged forest" only indicates that there was no evidence of timber harvesting and does not represent any particular age of forest. Additionally, these data represent use of general habitat categories at a small scale (0.4 ha), and should not be interpreted to indicate habitat selection at larger spatial scales. For example, we rarely located fishers in patches of managed second-growth forest with trees 51-75 cm dbh. However, we know that these habitat conditions are uncommon in our study area, therefore lack of use by fishers may merely reflect the scarcity of such patches. Likewise, frequent locations of female fishers in unmanaged patches may simply reflect the abundance of this habitat condition within their home ranges. We will be conducting analyses of habitat selection at various spatial scales using classified satellite imagery at a later date.

Characteristics of Den Structures

We located 13 natal dens and 18 maternal dens. For natal dens, adult female fishers typically used live trees (*n* = 7) or snags (*n* = 6) with openings that accessed hollows created by heartwood decay. Most of the openings used appeared to have been excavated by pileated woodpeckers (8/13); natural openings included small knot holes and narrow cracks in the bole. Although the tree cavity may have been large, footage from remote video cameras revealed that adult females typically used cavity openings that were just large enough for them to fit through. The size of the opening may be important for excluding potential predators and perhaps, male fishers.

Natal den trees need to be fairly large to accommodate a cavity large enough for an adult female and kits. The average dbh and height of live trees used for natal dens was 92 cm (range = 62-138 cm) and 40 m (range = 25-54 m), respectively. The average dbh and height of snags was 89 cm (range = 61-136 cm) and 26 m (range = 10-52 m), respectively. Most of the snags were relatively hard (decay class 1-3); however, 1 natal den was in a large decay-class 4 snag. Height of the cavity-opening may also be important for protection from potential predators; the average height of cavity-openings was 16.2 m (range = 4-47 m; *n* = 10). The most commonly used tree species were incense cedar, true fir, and western white pine (Table 4).

Table 4. Tree species used for denning by 6 female fishers in the southern Oregon Cascade Range, 1995-2002.

	Natal dens *n* = 13		Maternal dens *n* = 18		
	live trees	snags	live trees	snags	logs
Douglas-fir	1		5	2	2
Incense cedar	3	1	2	1	2
True fir	1	2	1	2	1
Western white pine	1	2			
Golden chinquapin	1	1			

Structures used for maternal dens were more variable than those used for natal dens, and included cavities in the bole or butt of large live trees and snags, and large hollow logs (Table 5). The average dbh and height of live trees used for maternal dens was 97 cm (range = 35-137 cm) and 38 m (range = 19-57 m), respectively. Females used relatively hard (decay class 2 and 3) snags and logs for maternal dens. The average dbh and height of snags was 132 cm (range = 90-250 cm) and 16 m (range = 3-27 m), respectively. The average diameter at the wide end and length of logs was 105 cm (range = 56-166 cm) and 15 m (range = 5-27 m), respectively. Three of the 5 logs used as maternal den sites had $\geq$1 cut end (i.e., cull trees from past harvest or thinning operations that were felled and left in place). We identified 2 additional sites used by adult females and kits in August and September, but we classified these as rest sites, not maternal dens. Tree species commonly used for maternal dens included Douglas-fir, incense cedar, and true firs (Table 4).

The large size and species of various structures used by female fishers for natal and maternal dens was most likely related to the species of live trees in our study area that were most susceptible to infection by heart-rot decay fungi. Hollows in live trees, snags, and logs are the result of a long decay process that begins when a living tree is infected by heart-rot fungi (Bull et al. 1997). Injuries to the top or bole of a tree (e.g., top or limb breakage, lightening strikes, frost cracks, etc.) provide infections courts for the airborne spores of heart-rot decay fungi (Bull et al. 1997). Typically, older (thus larger diameter), suppressed, or otherwise stressed trees are less capable of resisting infection by heart-rot fungi than younger or healthier trees (Manion 1991).

Table 5. Characteristics of 18 maternal dens used by 4 female fishers in the southern Oregon Cascade Range, 1995-2001.

	Structure used		
Micro-site used	Live tree $n = 8$	Snag $n = 5$	Log $n = 5$
Woodpecker cavity	2	1	
Natural cavity	3	3	5
Cavity formed between bole of tree and sloughing bark		1	
Mistletoe broom	2		
Rodent nest	1		

Characteristics of Rest Structures

When fishers were not hunting or traveling, they used a variety of structures for 'resting'. Field observations suggested that such sites may serve multiple functions, including a secure location for resting (i.e., protection from potential predators), a secure location for consuming prey (i.e., to reduce harassment by other carnivores and the potential risk of having larger prey items stolen), and thermal regulation (i.e., relief from heat in the summer, protection from extreme moisture or cold in the winter). Additionally, our radio-telemetry monitoring indicated that fishers remained at rest sites for several hours to >24 hours, and occasionally re-used structures.

We located 641 different resting structures used by 7 males and 12 females from 1995 to 2001. Fourteen percent (86/641) of the rest structures were reused by the same animal on $\geq$1 occasion (range = 1-7 reuses). Three percent (18/641) of the rest structures were used by another radio-collared fisher at some point during the study, and 1 structure was used by 3 different fishers. In most cases (12/19) reuse was by a member of the opposite sex. Thus, including reuse of structures by a member of the opposite sex, we identified 378 different resting structures used by females and 275 different structures used by males. Both female and male fishers primarily used live trees for resting (225/378 and 195/275, respectively; Table 6). Use of logs and cull piles by females and males was similar; however, females used a greater proportion of snags for resting (76/378) than males (17/275; Table 6).

In live trees, both female and male fishers used mistletoe brooms as resting platforms more than any other micro-site (Table 7). We verified use (animal was seen) of mistletoe brooms as resting platforms for 31% and 21% of the live trees used by females and males, respectively. We suspected use of mistletoe brooms (animal was not seen but mistletoe brooms were the only possible micro-site) for an additional 44% and 33% of the live trees used by females and males, respectively (Table 7). Rust brooms (caused by rust fungi) were not common in our study area; however, we documented 1 use of a rust broom in a live red fir. We verified use of rodent nests as resting platforms in 24% of the live trees used by male fishers, and suspected use in another 3%. A few of the rodent nests used by fishers were supported by mistletoe-deformed branches; we included these micro-sites in the count for rodent nests rest sites and did not include them in the count for mistletoe broom rest sites. Although 5 different males used rodent nests as resting platforms, 1 male accounted for >50% of the observations. Additionally, only 4% of the micro-sites used by females in live trees were rodent nests, suggesting that use of rodent nests may be related to specific habitat conditions occurring within the home ranges of 1-2 males. Limb clusters or platform branches, especially those that are characteristic of older Douglas-fir trees, were the next most commonly used micro-site by both females and males (Table 7). We did not document males using cavities in live trees; however, females used such cavities about 7% of the time.

Table 6. Structures identified as resting sites for female (n= 12) and male (n=7) fishers in the southern Oregon Cascade Range, 1995-2001.

	% of rest structures by sex					Number of structures
	Live tree	Snag	Log	Cull pile	Miscellaneous [1]	
Females	60	20	16	2	2	378
Males	71	6	16	3	4	275

[1] Includes dense brush, natural debris pile, rock outcrop, and unknown structure under snow.

Table 7. Species of live trees and the micro-sites used for resting by 12 female and 7 male fishers in the southern Oregon Cascade Range 1995-2001. Percentages in parentheses represent trees where animals were not seen but use of a specific type of micro-site was suspected (based on visual inspection of all potential micro-sites).

	% of live tree rest structures by sex					
Micro-site used	Douglas-fir	Western hemlock	True fir[1]	Incense cedar	Other species[2]	Number of structures
Females						
Mistletoe broom	24 (36)	6 (7)	1 (1)			167
Limb cluster or platform branch	5 (1)	1	<1 (<1)		<1	19
Rodent nest	1 (1)	<1	1		<1	8
Cavity	1		<1	2 (1)	1 (<1)	15
Other[3]	4		1 (1)		1	16
Males						
Mistletoe broom	5 (15)	9 (15)	5 (2)		2 (1)	104
Limb cluster or platform branch	8 (2)	<1 (<1)	1 (<1)			24
Rodent nest	4 (<1)	5 (<1)	13 (2)		2	52
Cavity	<1					1
Other[3]	4	(<1)	1 (<1)		2	14

[1] Primarily white-grand fir species complex but also includes red fir (1).
[2] Includes lodgepole (2), Pondersosa (8), and white pine (1), Engelmann spruce (1), golden chinquapin (4), madrone (1), and Pacific yew (1).
[3] Other types of micro-sites include non-platform branches, raptor nests, rust brooms, unknown.

Although a variety of live tree species were used for resting by fishers (Table 7), most (57%) were Douglas-fir, 21% were western hemlock, and 15 % were true fir. Use of different tree species for resting was probably related to the presence and characteristics of potential micro-sites. For example, mistletoe infections in Douglas-fir and western hemlock cause branch swelling and produce dense masses of deformed branch growth (i.e., 'witches' brooms; K. Mallams, USFS Pathologist) which provide broad platforms or dense cave-like structures. Conversely, mistletoe infections in incense cedar create rather small pendant clumps of shoots (K. Mallams, Pathologist, U.S. Forest Service).

The average diameter of live trees used by females for resting was slightly greater than those used by males: 88 cm dbh (range = 26-185; *n* = 138) versus 64 cm dbh (range = 18-201; *n* = 121). Although cavities and limb clusters or platform branches were typically associated with large-diameter (>50 cm dbh) trees, we observed mistletoe brooms in both small and large live trees.

Fishers used relatively large snags and logs for resting; the average sizes of snags and logs used by females for resting were similar to those used by males (Table 8). When resting in snags and logs, both sexes typically used cavities or hollows that had been created by advanced stages of heartwood decay. Similar to results for den structures, use of various species of snags and logs (Table 8) by fishers for resting was probably related to the live tree species in our study area that were most susceptible to infection by heart-rot decay fungi.

Both sexes occasionally used cull piles for resting (i.e., debris piles created during timber harvest operations). The average length and width of 11 cull piles used by fishers was 19.3 m (14.2-31.5) and 13.1 m (7.8-18.2), respectively. The height of cull piles varied from 1.5-4.0 m (mean = 2.5 m). On average, cull piles were comprised of small woody debris <10 cm in diameter (41%), logs 10-50 cm in diameter (43%), logs >51 cm in diameter (15%), and stumps, soil and boulders (1%).

Table 8. Characteristics of snags and logs used for resting by 12 female and 7 male fishers in the southern Oregon Cascade Range, 1995-2001.

	% of snag and log rest structures by sex								
Type of structure	Douglas-fir	Western hemlock	True fir[1]	Incense cedar	Sugar pine	Other species[2]	*n*	Mean diameter[3, 4] (range)	Mean height or length[4] (range)
Snag:									
Females	33	3	32	14	14	4	76	114 cm (29-196) *n* = 47	16 m (1-60) *n* = 47
Males	65	6	12	6		11	17	121cm (62-196) *n* = 7	21m (8-62) *n* = 7
Log:									
Females	36	4	23	13	11	13	53	105cm (48-182) *n* = 43	21m (4-52) *n* = 43
Males	40		21	21	7	11	43	108 cm (52-160) *n* = 32	21m (5-46) *n* = 32

1 Primarily white-grand fir species complex but also includes red fir (3 logs).
2 Includes Ponderosa (2 snags and 2 logs) and western white pine (1 snag and 2 logs), Engelmann spruce (1 snag), golden chinquapin (3 logs), and unidentified species due to advanced decay conditions.
3 Dbh for snags, and diameter at the large end for logs.
4 Because of the great number of rest structures we located, we only collected measurements on a subset.

Availability of Potential Denning and Resting Structures

Within our core study area, we sampled 373 random points and measured 875 live trees, 650 snags, and 826 logs in 3 size classes: medium (26-50 cm dbh or diameter), large (51-100 cm dbh or diameter), and very large (>100 cm dbh or diameter). The average canopy cover at random sampling points was 67% and, within the elevation range we sampled (i.e., <1554), the average elevation was 1,126 m.

We did not find any large or very large live trees at 12 and 51% of the random sampling points, respectively (i.e., there were no trees in these size classes within a 50-m radius (0.8 ha) of the sampling point). However, most (97%) of the random points had medium live trees. Most (45%) of the available live trees were Douglas-fir; 26% were true firs, 8% incense cedar, 7% western hemlock, 11% ponderosa, sugar and white pine, and 3% other species. Although most of the rest sites used by both sexes were mistletoe brooms in live trees, ≤12 % of the available live trees we sampled had these types of micro-sites (Table 9).

We did not find any medium snags at 20% of the random points, and large and very large snags were absent at 35 and 71% of the random points, respectively. Species composition of available snags was similar to that of live trees; 40% were Douglas-fir, 25% true fir, 5% incense cedar, 4% western hemlock, 13% ponderosa, sugar and white pine, and 13% other species or unknown (bark decayed or burned). Woodpecker and natural cavities were uncommon in snags <51 cm dbh and were more prevalent in large snags, especially those >100 cm dbh (Table 9).

We found medium logs at most (95%) of the random points; however, large and very large logs were absent at 12 and 62% of the random sampling points, respectively. Thirty-five percent of the available logs were Douglas-fir, 14% true fir, 6% incense cedar, 3% western hemlock, 7% ponderosa, sugar and white pine, 4% other species, and 31% unknown (bark decayed or burned). Few logs <51 cm in diameter were hollow or had natural cavities (Table 9). However, a greater proportion of large-diameter logs, especially those with an average diameter >100 cm, were hollow or had natural cavities than did smaller-diameter logs (Table 9).

These results suggest that in our study area, live trees, snags, and logs with the types of micro-sites used by fishers for resting, or used by female fishers for denning, were relatively uncommon. However, larger structures (especially those >100 cm dbh or diameter) had more potential micro-sites than smaller structures.

Table 9. Percent of available live trees, snags, and logs measured at 373 random sampling points in the southern Oregon Cascade Range that had potential micro-sites that fishers could use for denning or resting.

Structure	% of available structures with various micro-sites[1]					Number of structures
	Mistletoe broom[2]	Limb cluster or platform branch[2]	Rodent nest	Cavity[3]	Hollow[4]	
Live tree						
26-50 cm dbh	6	6	0	0	--	362
51-100 cm dbh	10	17	0	<1	--	330
>100 cm dbh	12	55	0	4	--	183
Snag						
26-50 cm dbh	1	1	0	10	--	299
51-100 cm dbh	1	2	<1	19	--	242
>100 cm dbh	1	9	2	33	--	109
Log						
26-50 cm diameter	--	--	--	6	6	356
51-100 cm diameter	--	--	--	17	20	328
>100 cm diameter	--	--	--	27	23	142

[1] Each structure could have >1 type of micro-site.
[2] Structures that were large enough to support a female fisher (e.g., a few live trees had evidence of mistletoe infections, however, brooms had not developed).
[3] Woodpecker or natural cavity with an opening large enough for a fisher to access. For logs that were hollow at 1 or both ends, these were additional openings present along the length of the log.
[4] Hollow at ≥1 end of the log.

Habitat Conditions at Den and Rest Sites

We collected detailed habitat data at all den sites and at a subset of the rest sites located for each radio-collared fisher. We defined sites as the immediate area or patch around a den or rest site within which we sampled live trees, snags, logs, canopy cover and other habitat conditions. The average canopy cover at sites used by fishers for denning (females) and resting (females and males) was ≥80% (Table 10). Sites used by males for resting were lower in elevation than sites used by females for resting or denning (Table 10). We identified 15 evergreen and 14 deciduous tree species in 0.1-ha plots around fisher den and rest sites; however, the average number of species per plot was about 5 (range = 1-9; Table 10). Dominant species included true fir, Douglas-fir, western hemlock, incense cedar, Ponderosa pine, sugar pine, white pine, and golden chinquapin. Incense cedar, pines, and golden chinquapin occurred most frequently as scattered trees and were rarely the dominant species in a plot. Common understory species included California hazel (*Corylus cornuta*), Pacific dogwood (*Cornus nuttalli*), and vine maple (*Acer circinatum*).

For most of the habitat characteristics we measured, there did not appear to be any substantial differences between den sites and sites used by females for resting (Table 10). However, the density of snags was about 1.5 times greater at den sites than at rest sites. Because females use cavities in dead or dying trees for denning, they may use areas that have an abundance of potential structures to select from. Additionally, due to the ecological processes that cause tree decadence and mortality (e.g., heart-rot fungi, bark beetles, and other insect and disease agents), snags typically occur in patches.

There appeared to be some differences in the habitat characteristics between sites used by females for resting and those used by males for resting. Although basal area of deciduous trees was relatively low at all sites used by both sexes, it was greater at male rest sites than at female rest sites (Table 10). Also, the average basal area of evergreen trees ≤50 cm dbh was about 1.3 times greater at male rest sites than at those of females. In contrast, the average basal area of large (51-100 cm dbh) and very large (>100 cm dbh) evergreen trees was >1.5 and >2 times greater, respectively, at female rest sites than at male rest sites (Table 10). Additionally, the average densities of all size classes of snags and all size classes of logs were greater at female rest sites than at male rest sites (Table 10). Because females use cavities in large live trees, snags, and logs for denning, their home ranges may include areas that have greater densities of such structures than male home ranges. Additionally, some of the radio-collared males had home ranges that encompassed relatively low-elevation second-growth forests (primarily on private timber lands near Prospect). Typically, these forests had higher overall stem densities, smaller diameter live trees, and fewer snags than other forested habitats in our study area.

These data represent preliminary summaries of some of the detailed habitat data that were collected at den and rest sites. Additionally, we collected similar data at 79 of the 373 random sampling points: 36 points in the northern part of our core study area that overlapped but did not encompass the home ranges of 2 adult females and 1 adult male, and 43 points located in the south-central part of our core study area that overlapped but did not encompass the home ranges of 1 adult female and 2 adult males. At each of the random points, we collected the same habitat data as described previously for fisher den and rest sites. In future analyses, we will be investigating potential differences in habitat conditions at den and rest sites vs. random sampling points.

Table 10. Habitat conditions (mean values and standard deviation in parentheses) measured at natal and maternal den sites and sites used for resting by 12 female and 7 male fishers in the southern Oregon Cascade Range, 1995-2001.

Site or habitat characteristic	Natal dens *n* = 13	Maternal dens *n* = 18	Female rest sites *n* = 130	Male rest sites *n* = 88
Elevation (m)	1,253 (161)	1,211 (108)	1,182 (198) *n* = 237[1]	1,061 (232) *n* = 172[1]
Canopy cover	80% (22)	88% (11)	84% (16) *n* = 235[1]	82% (20) *n* = 171[1]
Mean # of live tree species	4.9 (1.5)	4.4 (1.2)	4.5 (1.4)	5.1 (1.8)
Basal area of deciduous trees (m^2 / ha)	0.02 (0.07)	0.23 (0.80)	0.23 (0.93)	1.57 (3.11)
Basal area of live evergreen trees 10-50 cm dbh (m^2 / ha)	17.58 (9.81)	22.70 (16.01)	19.04 (12.44)	24.65 (13.92)
Basal area of live evergreen trees 51-100 cm dbh (m^2 / ha)	21.59 (22.45)	16.83 (15.01)	19.41 (15.73)	12.27 (10.46)
Basal area of live evergreen trees >100 cm dbh (m^2 / ha)	9.84 (11.19)	11.28 (13.52)	10.07 (9.85)	4.99 (8.00)
Density of snags 26-50 cm dbh and in DC 1-4 (ha)	19.04 (15.73)	23.06 (23.27)	13.85 (11.93)	11.05 (10.93)
Density of snags ≥51 cm dbh and in DC 1-4 (ha)	15.19 (14.88)	15.28 (9.74)	10.19 (9.28)	6.53 (7.32)
Density of logs averaging 26-50 cm in diameter and in DC 1-3 (ha)	51.54 (38.91)	68.89 (33.94)	54.57 (51.22)	38.47 (42.55)
Density of logs averaging ≥51 cm in diameter and in DC 1-3 (ha)	31.54 (28.24)	27.22 (28.03)	33.33 (31.36)	26.71 (30.25)

[1] We collected data on canopy closure and elevation at more rest sites than we did detailed habitat data.

Food Habits

While radio-tracking fishers, we identified a variety of prey remains at den, rest, and active sites. The bird prey remains we identified included: Steller's jay (*Cyanocitta stelleri*), pileated woodpecker (*Dryocopus pileatus*), hairy woodpecker (*Picoides villosus*), northern flicker (*Colaptes auratus*), ruffed (*Bonasa umbellus*) and dusky grouse (*Dendragapus obscurus*), mountain quail (*Oreortyx pictus*), and western screech owl (*Megascops kennicottii*). Mammal prey remains included: California ground squirrel (*Spermophilus beecheyi*), Douglas' squirrel (*Tamiasciurus douglasii*), northern flying squirrel (*Glaucomys sabrinus*), brush rabbit (*Sylvilagus bachmani*), snowshoe hare (*Lepus americanus*), and ungulate carrion (deer [*Odocoileus hemionus*] and elk [*Cervus elaphus*]). Additionally, one adult female killed a turkey (*Meleagris gallopavo*), and we found a garter snake (*Thamnophis* spp.) and a torn-up wasp nest at the rest sites of 2 other females. We found remains of striped skunks (*Mephitis mephitis*) at several male fisher rest and active sites, as well as porcupine (*Erethizon dorsatum*), opossum (*Didelphis virginiana*; 1 occasion), and bobcat (*Lynx rufus*; 1 occasion). Although prey remains provide insights about the diet of fishers in our study area, they were opportunistic observations and probably biased towards larger prey items.

To more accurately describe fisher diets, we collected 303 scats from 11 females and 84 scats from 8 males (Table 11). Although we collected scats year-round, 89% of female scats and 62% of male scats were collected between March and September. Additionally, 59% of the female scats we collected were from den sites. We air-dried and stored scats in paper bags and then contracted Neil Duncan (presently with the American Museum of Natural History, New York) to clean, sort, and identify all food items.

Table 11. Number of scats collected when trapping and tracking radio-collared fishers in the southern Oregon Cascade Range from 1995-2001.

	Sites where scats were collected				
	Den	Rest	Active	Trap	Total
Females (*n* = 11)	179	90	16	18	303
Males (*n* = 8)	--	51	14	19	84

Eight-three percent of all fisher scats contained mammal prey items, 28% contained birds, 26% arthropods, 14% plants, and 7% reptiles. The frequency of occurrence of these 5 major taxa was similar in female and male scats (Table 12). However, there appeared to be differences in the frequency of occurrence of several mammal taxa. A greater percentage of female scats contained Sciurids (35%) and Leporids (27%) than did male scats (10% and 7%, respectively; Table 13). In contrast, a greater percentage of male scats contained skunk (10%) and porcupine (8%) than did female scats (1% and 0, respectively). Additionally, muskrat occurred more frequently in male scats than in female scats (Table 13).

Table 12. Percent (number) of female and male fisher scats in which the 5 major taxa of food items were identified.

Taxa	Females *n* = 303	Males *n* = 84
Mammalia	85 (256)	76 (64)
Aves	28 (86)	27 (23)
Reptilia	7 (21)	5 (4)
Insecta	25 (76)	27 (23)
Planta	14 (42)	13 (11)

Table 13. Percent (number) of 303 female and 84 male fisher scats containing mammalian prey items. Frequency of occurrence of mammals is non-overlapping among taxonomic levels (i.e., some prey items could only be identified as mammalian, others could only be identified to order, family, or genus).

Taxa	Females %	Females #	Males %	Males #
Insectivora; unknown insectivore	1	(3)	1	(1)
Soricidae (shrews)	1	(3)		---
Talpidae (moles)	2	(5)		---
Neurotrichus gibbsii (shrew-mole)	3	(8)		---
Rodentia; unknown rodent	4	(12)	5	(4)
Sciuridae (squirrels, chipmunks)	7	(21)	4	(3)
Spermophilus beecheyi (Califronia ground squirrel)	14	(43)		---
Spermophilus lateralis (golden-mantled ground squirrel)	3	(9)	1	(1)
Spermophilus spp. (ground squirrels)	3	(8)	1	(1)
Sciurus griseus (western gray squirrel)	<1	(1)		---
Tamiasciurus douglasii (Douglas' squirrel)	3	(9)	1	(1)
Tamias spp. (chipmunks)	3	(10)	1	(1)
Glaucomys sabrinus (northern flying squirrel)	2	(6)	1	(1)
Geomyidae; *Thomomys* spp. (pocket gophers)	1	(2)		---
Muridae; *Peromyscus* spp. (deer mice)		---	2	(2)
Neotoma spp. (woodrats)	<1	(1)		---
Clethrionomys spp. (red-backed voles)	<1	(1)		---
Microtus spp. (voles)		---	2	(2)
Ondatra zibethicus (muskrat)	1	(4)	6	(5)
Zapodidae; *Zapus* sp. (jumping mouse)	<1	(1)		---
Erethizontidae; *Erethizon dorsatum* (porcupine)		---	8	(7)
Lagomorpha; unknown lagomorph		---	1	(1)
Ochotonidae; *Ochotona princeps* (American pika)	<1	(1)		---
Leporidae (hares and rabbits)	27	(81)	7	(6)
Carnivora; Mustelidae; *Mephitis mephitis* or *Spilogale gracilis* (skunk)	1	(2)	10	(8)
Artiodactyla; Cervidae (cervids)	9	(27)	7	(6)
Mammalia; unknown mammal	13	(38)	24	(20)

Although our sample of male scats is small, our results suggest that female fishers were capturing smaller-bodied prey more frequently than larger-bodied prey, and male fishers were capturing larger-bodied prey more frequently. Combining results of scat analyses with our observations of prey remains at den, rest, and active sites provides additional evidence of these potential dietary differences between female and male fishers. For example, we identified skunk in 8 scats from 3 different male fishers and found skunk prey remains at rest or kill sites for 3 additional males. In contrast, we identified skunks in only 2/303 scats from 2 different females and we never found skunk remains at female den or rest sites. Although all scats that contained porcupine remains were from 1 male fisher (but on different occasions), we identified fresh porcupine kills by 3 additional males. Additionally, when capturing and radio-collaring fishers, 6 males had porcupine quills embedded in their skin. In contrast, we did not find any evidence that female fishers were preying on porcupines: no porcupine were found in 303 scats, no remains at den, rest or active sites, and no observations of embedded porcupine quills when we examined captured females. In our study area, adult male fishers weighed twice as much as adult females (mean = 5.90 and 2.85 kg, respectively). Thus, perhaps male fishers were more effective at capturing and killing larger prey than females. Alternatively, because most of the female scats we collected were from den sites, perhaps females focused on relatively smaller prey items that were easier to transport back to den sites and easier for kits to process.

Although we identified Steller's jay and northern flicker in some of the fisher scats, most of the bird remains could not be identified to species. Fifteen percent of male scats and 8% of female scats contained wasps (Family Vespidae), and 6% of both male and female scats contained Lepidoptera larvae (Family Tortricidae). Several species in this family occurred in our study area including the Modoc budworm (*Choristoneura viridis*) which attacks true fir (D. Overhulser, Forest Entomologist, Oregon Department of Forestry). However, we do not know yet if the remains we found in scats can be identified to species (we will be contacting entomologists who specialize in this family to determine if further identification is possible). Most of the reptile remains in scats could not be identified to species; however, we found alligator lizards (*Elgaria* spp.) in the scats of 2 females and 1 male. The most common plant food we identified in fisher scats were Pacific blackberry (*Rubus ursinus*; 8% of both female and male scats) and mast (4% of female scats).

In future analyses, we will investigate whether there are seasonal differences in the frequency of occurrence of various prey remains in fisher scats. Additionally, we will conduct separate analyses on scats collected at den sites and those collected at rest, active, and trap sites.

<u>Genetic Analyses</u>

In collaboration with Drs. Samantha Wisely and Steven Buskirk of the University of Wyoming, we conducted genetic analysis of tissue samples collected from 18 of our study animals (5 adult and 3 juvenile males, and 6 adult and 4 juvenile females) and 2 adult males that were trapped incidentally in the northern Siskiyou Mountains of southwestern Oregon (about 75 km southwest of our study area). We screened non-coding (microsatellite) DNA for polymorphic loci using PCR (polymerase chain reaction) on 19 primers developed for American marten, mink, ermine, badger, and black bear; 9 loci were polymorphic for our sample of fishers.
Previous analyses of historical records, distribution patterns, and haplotype frequencies in

mitochondrial DNA showed that fishers in the southern Oregon Cascade Range (our study area) represented a reintroduced population that may be geographically isolated from fishers occurring in the northern Siskiyou Mountains (for details, see Aubry and Lewis 2003 and Drew et al. 2003). Our microsatellite analyses showed that fishers in these 2 areas were genetically distinct: the 2 male fishers from the Siskiyou Mountains in southwestern Oregon were homozygous at 2 loci for alleles that did not occur among fishers from the Oregon Cascade Range, and at a third locus, were homozygous for an allele that was rare among fishers from our study area (Table 14; for details, see Aubry et al. 2004).

We used microsatellite genotypes to examine all potential parental relationships among the adult animals captured during our study. There was only 1 possible parent-offspring relationship among the adult males in our study area; in contrast, many potential parental relationships were possible among adult females. These results, along with our telemetry data on juvenile dispersal, provide evidence of male-biased juvenile dispersal and female philopatry in fishers; i.e., females are more likely to be related than males because they are more likely to establish home ranges in proximity to their close relatives and breed with them (for details, see Aubry et al. 2004).

Table 14. Allele lengths and combinations present at 3 loci in tissue samples collected from 18 fishers in the southern Oregon Cascade Range study area and 2 fishers incidentally trapped in the northern Siskiyou Mountains of southwestern Oregon.

	Locus		
	Mvis 002[1]	Mvi 39[2]	Mer 041[1]
Southern Oregon Cascade Range	220-220	142-144	175-177
	220-228	144-144	177-177
	228-228		177-179
			177-181
Northern Siskiyou Mountains	224-224	152-152	181-181

[1] Primers developed for *Mustela vison* (Mvis002) and *Mustela erminea* (Mer041) by Fleming et al. (1999).
[2] Primer developed for *Mustela vison* by O'Connell et al. (1996).

Additional genetic analyses were conducted using tissue samples from 21 of our study animals and >90 animals from British Columbia and California to investigate genetic diversity and structure of fisher populations in the western portion of their geographic range (for details, see Wisely et al. 2004).

Acknowledgments

This study was funded by the U.S. Forest Service, Pacific Northwest Research Station. We received additional funds in some years from the Center for Wildlife Conservation, Boise Cascade Corporation, PacifiCorp, and the U.S. Fish and Wildlife Service. Additionally, we gratefully acknowledge the following organizations for their many substantial contributions to the success of this study:

The Rogue River National Forest for assistance with administrative services, aviation planning, equipment and field work, GIS needs, housing of field crews, and office space.

The Oregon Department of Fish and Wildlife for loan of telemetry receivers and other equipment.

The Butte Falls Resource Area of the Bureau of Land Management for assistance with field maps and the purchase of some field equipment.

The Chemult Ranger District of the Winema National Forest and the Crescent Ranger District of the Deschutes National Forest for their cooperation and assistance in locating and monitoring a juvenile male fisher that dispersed from our study area in 1999.

Publications associated with research on fishers in the southern Oregon Cascade Range:

Aubry, K.B. and J.C. Lewis. 2003. Extirpation and reintroduction of fishers (*Martes pennanti*) in Oregon: implications for their conservation in the Pacific states. Biological Conservation 114:79-90.

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Key to photographs on cover page.

Adult female fisher resting in the top of a large snag. Photo by T. Catton, PNW Research Station.

Natal den cavity (old pileated woodpecker cavity) in a western white pine snag used by and an adult female fisher for 5 weeks. Photo by C. Raley, PNW Research Station.

A fisher kit that was orphaned after the adult female was illegally shot. Photo by C. Raley, PNW Research Station.

Adult male fisher that has been immobilized; note embedded porcupine quill in his lower jaw area. Photo by PNW Research Station.

Radio-collaring an immobilized fisher. Photo by PNW Research Station.

Fisher scat (full of blackberry seeds) at a rest site. Photo by PNW Research Station.

Rogue River Fisher Study Area: view is of the Middle Fork of the Rogue River and Red Blanket Creek drainages. Photo by PNW Research Station.

Snow tracks of a male fisher traveling along a log. Photo by PNW Research Station.