DETECTIONS OF PACIFIC FISHER AROUND SHASTA LAKE IN NORTHERN CALIFORNIA

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Abstract: As part of a field investigation related to a proposal to raise Shasta Dam and expand Shasta Lake, forest carnivore surveys were performed to determine the presence of Pacific fisher (*Martes pennanti pacifica*) within the study area. The investigation began with a pilot survey in 2003, followed by 2 larger surveys in 2004 and 2005. Eighty-five baited remote camera stations were used across a 53-sample unit survey grid in the 549 km^2 study area. Pacific fishers were detected at 13 locations throughout much of the region around Shasta Lake. They occurred in areas generally not considered to be suitable habitat in California, including open second-growth conifer, hardwood-conifer, and hardwood habitats that had extensive chaparral components in the study area. Three detections occurred in areas that were barren and semi-barren 50–60 years ago as a result of copper smelting. There were detections near residential and industrial development areas. These results provide additional information on habitat use and distribution of the Pacific fisher in northern California that may help conservation efforts.

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Key words: distribution, habitat, *Martes pennanti pacifica*, northern California, Pacific fisher, remote camera surveys, Shasta Lake.

The Pacific fisher (*Martes pennanti pacifica*) is a forest carnivore that is a member of the family Mustelidae and the largest member of the genus *Martes.* Recently, the west coast distinct population segment of this species has been proposed for listing under the federal Endangered Species Act and is currently considered a candidate for federal listing (U.S. Fish and Wildlife Service 2004). Reasons for the listing proposal included a reduction of the current known range relative to the species' historical range, habitat loss and fragmentation resulting from various land uses and management, and reduction in populations from historical trapping activities (U. S. Fish and Wildlife Service 2004).

To support biological resource inventory and related reservoir management planning, surveys were conducted for Pacific fisher within the region encompassing Shasta Lake, Shasta County, California. Surveys were conducted to determine the presence, distribution, and habitat associations of Pacific fisher in the Shasta Lake area. Approximately 103 km^2 were surveyed during winter and early spring 2003, and 549 km^2 were surveyed during winter and early spring 2004 and 2005.

STUDY AREA

Shasta Lake is located approximately 16 km north of Redding, Shasta County, California (Fig. 1). The lake consists of the main body and 5 primary arms comprising Big Backbone and Squaw Creeks, and the Sacramento, McCloud, and Pit Rivers. Shasta Lake has a surface area of 121 km^2 and 676 km of shoreline. The study area for the Pacific fisher survey project was 549 km^2 and comprised Shasta Lake and the surrounding vicinity.

The study area has a variety of vegetation types typical of transitional mixed woodland and low-elevation forest habitats in the lower Klamath/Cascade Mountains. Habitats within the study area comprised Sierran mixed conifer, ponderosa pine (*Pinus ponderosa),* closed-cone pine cypress, montane hardwood-conifer, montane hardwood, blue oak (*Quercus douglasii*) woodland, blue oak–foothill pine (*P. sabiniana*), montane riparian, mixed chaparral, annual grassland, fresh emergent wetland, lacustrine, riverine, barren, and urban as classified using the California Wildlife Habitat Relationship system (Mayer and Laudenslayer 1988). Dominant plant species and the composition of vegetation in all these habitats vary, and dramatic changes in species composition occur in relation to aspect, slope,

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geologic substrate, or juxtaposition with other habitats. Although the climate is Mediterranean, the size and geographic location of Shasta Lake influences local meteorological conditions. The average annual precipitation is 156 cm, and average annual temperatures range from 10°C in winter to 32°C in summer. Elevations within the study area range between 326–366 m, and the terrain is moderate to steep.

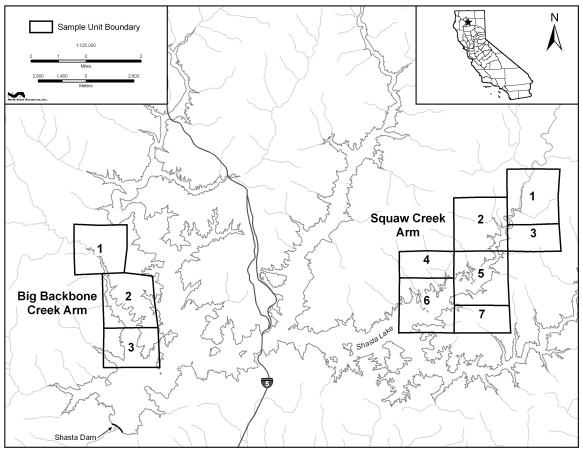

Fig. 1. Big Backbone Creek and Squaw Creek sample units used in 2003 for a study of Pacific fishers at Shasta Lake, California, USA.

METHODS

Pacific fisher surveys were conducted following Zielinski and Kucera (1995), which describes techniques currently used by many researchers and natural resource agencies for surveys of forest carnivores. Surveys were conducted within sample units designed during pre-survey project planning. Generally, a sample unit was a 10.4 km^2 area aligned with section boundaries (although smaller sample units were used when boundaries extended beyond the project area), contained <10.4 km^2 of land, or extended onto Shasta Lake. Two photographic bait stations were located within each sample unit (n = 32), although 1 photographic station was used in smaller sample units (n = 21). Fifty-three sample units, consisting of 85 stations, were used during the survey effort.

The photographic surveys were conducted using Wildlife Pro cameras (Camtrak South Inc., Watkinsville, Georgia, USA). These cameras use a passive heat and motion sensor system to activate a Yashica T4 Super D or a Kyocera Super Zoom 35-mm camera in a self-contained weatherproof case. The cameras use Zeiss camera optics. During the survey effort, each unit was set in continuous mode with a 3-min delay between photo events. Camera stations were placed in forest stands within the sample units. Within the units, stations were located based on study area boundaries, habitat suitability, access constraints, and to separate stations by ≥1.6 km. Each camera was mounted onto a tree and aligned with an adjacent tree with bait so that the camera triggered when an animal activated the beam or sensor when investigating the bait. Small-size or exposed trees were generally avoided for camera stations to prevent camera triggering from tree movement resulting from wind. Distances between the camera and bait trees were 3–6 m to maximize the effectiveness of the camera unit. Cameras had north or south orientations to avoid long shadows and direct sunlight. Survey stations were baited with 4.5 kg of raw, whole chicken. Galvanized aviary wire "bait baskets" held the bait to the tree. Each basket was secured to the tree and aligned with the camera. Additionally, approximately 15 ml of "Gusto" scent (Caven's Lures, Minnesota Trapline Products, Pennock, Minnesota, USA) was used as an additional attractant.

All stations were operated for a 28-day period. Each station was checked every 7 days during the 28-day period. At the beginning of each check, the station was visually examined for activity. After the initial examination, the camera frame number was recorded and test photos were taken to check camera alignment and functioning. Film and/or batteries were changed as needed, and the bait tree was checked, rebaited, scented, and repaired as necessary. The surveys were conducted between 2003 and 2005. During 2003, pilot studies were done in the Big Backbone Creek and Squaw Creek arms of the study area (Fig. 1) with two 28-day survey periods in January–February and March–April. The survey effort was expanded to include the entire region surrounding Shasta Lake during 2004 and 2005 (Fig. 2), and one 28-day survey period was done April–May 2004 and March–April 2005.

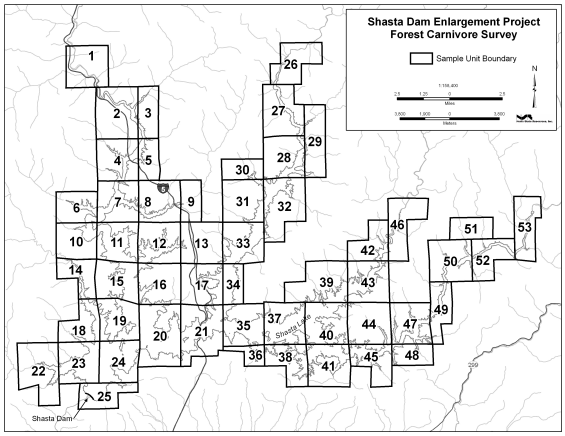

Fig. 2. Forest carnivore survey sample units used to survey for Pacific fishers in 2004 and 2005 at Shasta Lake, California, USA.

RESULTS

In 2003, Pacific fishers were detected in 1 sample unit at 1 station each in the Big Backbone Creek and Squaw Creek study areas. The first detection in Big Backbone Creek occurred 7 days into the second 28-day survey period, while the first detection in Squaw Creek occurred 16 days into the second 28-day survey period. Pacific fisher detections occurred during 2004 in 9 sample units at 9 stations: 1 location in Big Backbone Creek; new detections in the Sacramento River and Pit River arms; and the southwestern portion of the main body of Shasta Lake. There were Pacific fisher detections in 7 sample units during 2005 at 7 stations, but 5 were at the same sample units and stations as those in the 2004 surveys. No detections occurred within Big Backbone Creek, but a new detection in that sample unit was at a station in the adjacent Little Backbone Creek inlet. There were no detections in the Pit River, although there was 1 detection at a station in a new sample unit along the eastern portion of the main body of Shasta Lake. The average latency to detection of Pacific fishers was 8.8 days in 2004 and 10.5 days in 2005 (Table 1).

Collectively, Pacific fishers were detected in 11 sample units at 13 stations within the main body of Shasta Lake and the arms of Big Backbone Creek, Sacramento River, Squaw Creek, and Pit River (Fig. 3). No detections occurred within the McCloud River arm, and no additional detections occurred in the Squaw Creek arm after 2003. The 13 detections were located throughout the entire region surrounding Shasta Lake except for a large portion of the north–central part of the lake.

Table 1. Number of baited remote camera stations and sample units for Pacific fisher surveys at Shasta Lake, California, USA, during 2004 and 2005.

Year	Survey effort (sample units)	Sample units with detections	Average latency (days) to detection (range)
2004	85 (53)	9	8.8 (0.5– 25)
2005	85 (53)	7	10.5 (2– 23)

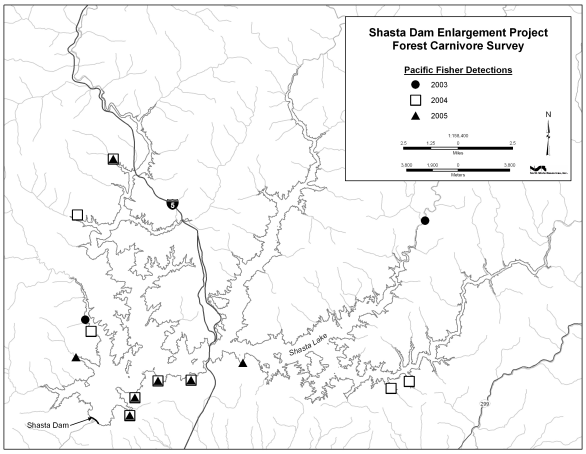

Fig. 3. Detection locations of Pacific fishers between 2003 and 2005 at Shasta Lake, California, USA.

DISCUSSION

The 2003 studies confirmed that Pacific fisher occurred at the western and eastern portions of the study area, and the 2004 and 2005 surveys provided additional distribution information that showed Pacific fisher occurring throughout most of the study area except the McCloud River arm. Pacific fishers were previously reported from the McCloud River arm because a dead animal was found at Hirtz Bay in May 2001 (J. Zustak, U.S. Forest Service, personnel communication). No

Pacific fishers were detected in this same area during our surveys but detections occurred in the adjacent drainages to the west and east.

Habitats in the study area mainly consisted of remote areas but also included various human development and infrastructure. Stations were located in remote settings and near human development features based on habitats present in each sample unit. Three Pacific fisher detections around Shasta Lake occurred near human population centers and other development. One detection was <0.8 km from residential development, while another detection was approximately 2.4 km from residential development and <0.8 km from a boat marina. A third Pacific fisher detection occurred 1.6 km from a large resort, boat marina, and a large industrial development. Ten Pacific fisher detections occurred at stations in remote locations. Pacific fisher detections also occurred on both sides of the Interstate 5 and Union Pacific Railroad corridors.

Surveys detected Pacific fishers in areas where they were suspected to occur, however, no detections occurred during the first 28-day survey period in 2003. Zielinski and Kucera (1995) suggested one 28-day survey period with baited camera stations is generally sufficient to determine the presence of Pacific fishers; however, fishers were not detected until the second 28-day survey period in 2003. Without the 2003 detections, surveys may not have been done in 2004 and 2005. This suggests that one 28-day survey may be insufficient for all situations despite it being widely used by resource professionals to survey for fishers and other sensitive forest carnivores.

Regionally, these results provide new information on Pacific fisher distribution in California. Pacific fisher were previously known from the upper Clear Creek watershed, which is 9.7 km west of the study area (D. H. Weinberg, U.S. Bureau of Land Management, unpublished data; North State Resources. 2002. Buckhorn Grade improvement project forest carnivore surveys, Redding, California, USA) and from scattered sites in the upper Sacramento River watershed (S. Self and S. Kerns. 2001. Pacific fisher use of a managed forest landscape in northern California. Sierra Pacific Industries, Redding, California, USA) including a site 11.3 km north of the study area (S. Self, Sierra Pacific Industries, personal communication). There are no recent confirmed sites east of the study area, and the nearest known sites to the south are located in the southern Sierra Nevada (Zielinski and Barrett 1995, U. S. Fish and Wildlife Service 2004). These results expand the current known range of Pacific fisher in northern California by 32 km to the south and 29 km to the southeast based on the distribution map in Zielinski and Barrett (1995). Because the northern Central Valley is immediately south of Shasta Lake, it is highly unlikely that Pacific fishers occur farther south from these locations and at lower elevations in interior northern California.

These results also provide additional information on habitat use by Pacific fishers in California. Most descriptions of habitat associations for Pacific fishers in the western U.S. state that they occur predominately in mature or late-successional conifer forests (Jones 1991, Buck et al. 1994, Powell and Zielinski 1994, Wier and Harestad 2003, U.S. Fish and Wildlife Service 2004, Zielinski et al. 2004). Using the Mayer and Laudenslayer (1988) habitat classification system, habitats at Pacific fisher detection sites at Shasta Lake were classified as predominately montane hardwood-conifer stands juxtaposed among ponderosa pine, montane hardwood, blue oak–foothill pine, and mixed chaparral. Tree habitats were generally open- to moderate-canopied hardwood-conifer stands dominated by California black oak (*Q. kelloggii*), canyon live oak (*Q. chrysolepis*), ponderosa pine, and occasional Douglas-fir (*Pseudotsuga menziesii*). Many of these habitats had dense shrubs including whiteleaf manzanita (*Arctostaphylos viscida*), poison-oak (*Toxicodendron diversilobum*), snowdrop bush (*Styrax officinalis*), western redbud (*Cercis occidentalis*), and birch-leaf mountain mahogany (*Cercocarpus betuloides*). Hardwood and chaparral habitats were dominated by evergreen and deciduous tree and shrub species such as California black oak, canyon live oak, whiteleaf manzanita, buck brush (*Ceanothus cuneatus*), and brewer oak (*Q. garryana breweri*). Blue oak–foothill pine habitats occurred as small inclusions of blue oak, interior live oak (*Q. wislizenii*), and foothill pine. Although uncommon, there were scattered patches of dense-canopy conifer and mixed-conifer stands in addition to large trees, downed woody debris, and conifer and hardwood snags in the study area. These habitat elements are

important to Pacific fishers in California (Zielinski et al. 2004) and most likely provide the structural complexity required by Pacific fishers within the study area, even though the habitats where Pacific fishers were detected at Shasta Lake are generally not characterized as the traditional conifer-dominated habitats they are known to use in California.

Pacific fisher detections at the western portion of Shasta Lake are useful when considering the translocation of fishers. Pacific fishers were consistently detected between 2003 and 2005 in Big Backbone and Little Backbone Creeks. Much of the western portions of Shasta Lake, including these 2 drainages, are in an area that was heavily affected by copper smelting and related mining between the late 1800s and early 1900s (Kristofors 1973). These activities denuded most of the vegetation for a 725-km^2 area, including much of what is now the western portion of Shasta Lake. Revegetation and erosion control work began here in the early 1930s and continued into the early 1960s (Kristofors 1973). Given these timelines, and following review of historical aerial photographs and other vegetation data, the earliest period that conifers were most likely present in this area was during the mid-1950s, and the habitats would probably have had sparse canopy closure and pole-size trees at the beginning of regeneration. Based on these results, this suggests that Pacific fishers can occupy or reoccupy newly suitable habitats in ≤50 years. The survey did not include formal habitat analysis or attempt to determine Pacific fisher population size in the study area. Further studies investigating habitat use and selection by Pacific fishers in the Shasta Lake area and elsewhere should be conducted to understand the suitability and potential value of similar habitats for population reintroduction and/or establishment.

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