DISTRIBUTION AND STATUS OF THE FISHER (*MARTES PENNANTI*) IN WASHINGTON

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ABSTRACT—We determined the current distribution of fishers (*Martes pennanti*) in Washington using sighting and trapping records, and evaluated their occurrence in relation to major vegetation and elevation zones. We obtained 137 records dating from 1894–1991. *Martes pennanti* still occurs in the Cascade Range and Olympic Mountains and in portions of the Okanogan Highlands, but is apparently very rare. We found no records from the eastern edge of Puget Sound, the Kitsap Peninsula, the southern Coast Range, or the Blue Mountains. Records of *M. pennanti* west of the Cascade crest were strongly skewed toward low to mid-elevations: 87% were at <1000 m and the remainder were at <1800 m. In contrast, only 30% of records east of the crest were at <1000 m, and 18% were from 1800–2200 m. These patterns may result from deeper, softer snowpacks at high elevations on the west side, which restrict the movements of *M. pennanti* in winter. Most western records (54%) were from the Western hemlock (*Tsuga heterophylla*) forest zone; remaining records were from the Pacific silver fir (*Abies amabilis*) zone (26%) and the Sitka spruce (*Picea sitchensis*) zone (20%). Most eastern records (53%) were from the Subalpine fir (*Abies lasiocarpa*) zone; others were from the Grand fir (*Abies grandis*)/Douglas-fir (*Pseudotsuga menziesii*) (37%) and Timberline/Alpine zones (10%). We predict that available habitat for fishers would be enhanced by minimizing forest fragmentation, maintaining high forest-floor structural diversity, preserving snags and live trees with dead tops, and protecting swamps and other forested wetlands.

Intensive timber harvesting activities in the Pacific Northwest during the past half-century have resulted in striking changes to the structure, composition, and landscape context of a large proportion of Washington's 6.8×10^6 ha of commercial timberland (Morrison 1988). The magnitude of these changes has prompted recent concern about the population status of wildlife species that may be associated with late-successional forests (*e.g.*, Thomas et al. 1990; Ruggiero et al. 1991), including the fisher (*Martes pennanti*).

In 1990, the northern spotted owl (*Strix occidentalis caurina*), a species closely associated with old-growth forests, was listed by the U.S. Fish and Wildlife Service as a threatened species under the Endangered Species Act of 1973. The marbled murrelet (*Brachyramphus marmoratus*), another old-growth species, was granted threatened status in 1992. Due to similar concerns over the loss or alteration of old-growth forests, a petition was submitted in May 1990 to list *M. pennanti* as endangered in the Pacific States (Central Sierra Audubon Society et al. 1990). This petition was denied by the Fish and Wildlife Service (USFWS 1991), however, because insufficient information was available on the past and present distribution, status, and ecological relationships of *M. pennanti* in that region to warrant listing.

Historically, *M. pennanti* occurred throughout densely forested areas in Washington. According to Suckley and Cooper (1860), *M. pennanti* was plentiful in forested habitats both east and west of the Cascades in the mid-19th century. By the early 20th century, they "... seem[ed] to be concentrated chiefly in the wild and roadless portions of the Olympic Mountains, but [had] been reported along the Cascades and as far east as the Okanogan Valley" (Scheffer 1938). Dalquest (1948) claimed that "in Washington more fishers live in the Olympic Peninsula and the northern Cascade Mountains than else-

where." Although records are scant, *M. pennanti* was trapped heavily in some areas into the 20th century; in the Olympic Mountains, 37 *M. pennanti* were reportedly taken on the Queets River in 1920 and 20 were trapped on the East Fork of the Quinault River in 1921 (Scheffer 1949). The trapping season for *M. pennanti* has been closed in Washington since 1933 (Payne and Taber 1974).

Previous reports on the status of *M. pennanti* in Washington are few and have been very limited in scope. Yocum and McCollum (1973) obtained nine records of *M. pennanti* in Washington from the files of State and Federal agencies dating from 1955–1973. They considered the animal to be rare statewide and possibly absent from the southern and eastern portions. Payne and Taber (1974) gathered 12 reliable records of *M. pennanti* from the west-central Cascades dating from 1964–1974, and concluded that *M. pennanti* numbers were very low. No comprehensive attempt has been made to document the distribution of *M. pennanti* in Washington nor to evaluate the extent to which the species may be associated with particular habitats.

Our objectives are to determine the current (1980–1991) distribution and status of *M. pennanti* in Washington using sighting and trapping records, to evaluate the extent to which their distribution may have changed from the recent past (1955–1979), and to examine *M. pennanti* occurrence in relation to major vegetation and elevation zones.

Methods

To document the distributional history of *M. pennanti* in Washington, we gathered all records from the Washington Department of Wildlife; Olympic, Mount Rainier, and North Cascades National Parks; and all Ranger District offices in Olympic, Mt. Baker/Snoqualmie, Gifford Pinchot, Wenatchee, Okanogan, Colville, Kaniksu, and Umatilla National Forests. We also sent questionnaires to members of the State Trappers Association and to field biologists with the Washington Department of Wildlife. Most reports are unverified in the sense that no subsequent effort was made by professional biologists to revisit areas where sightings or trappings occurred. In many cases, however, we contacted observers to obtain additional information. We also compiled historical records of *M. pennanti* from published accounts and museum collections (Appendix).

Recognizing that data of this nature should be interpreted with caution, we screened each report and ranked its reliability as follows: (1) specimen or photo, (2) first-person trapping report (no specimen available), (3) detailed sighting by experienced observer, (4) sighting by observer with undetermined or limited qualifications, (5) tracks, (6) record containing insufficient or questionable description or locality data. The complete database may be obtained from the authors, and is on file with the Washington Department of Wildlife's Nongame Data Base in Olympia, Washington.

To determine if the distribution of *M. pennanti* is associated with major patterns of variation in available habitats within Washington, we plotted our records onto a map of the vegetation zones described by Franklin and Dyrness (1973). Forested habitats differ substantially east and west of the Cascade crest (Fig. 1); consequently, we evaluated the distribution of records dating from 1955–1991 among habitat types and elevation zones from each region separately. Because of the coarse scale at which these vegetation zones are delineated, we deleted records from the habitat analysis that were within 1.6 km of a zone boundary. We analyzed the elevational distribution of *M. pennanti* records by pooling them into 100-m elevation zones.

Results

We obtained 137 records of *M. pennanti* dating from 1894 to October 1991 (Table 1). Each record represents a report of occurrence by one observer at a particular locality. Thus, reports of several animals being seen or trapped in one locality represent one record. Locality data for the 22 records dating from 1894–1925 were generally too vague to be reliably mapped, but museum specimens collected during this period (Appendix) verify the presence of *M. pennanti* in both the Cascade Range and Olympic Mountains before extensive human alteration of forested landscapes. We found no records dating from 1926–1954. Among the 115 records dating from 1955–1991, only five represent captured animals: two museum specimens (reliability 1) and three reports of *M. pennanti* being caught by trappers, but with no associated specimen (reliability 2). Sightings of

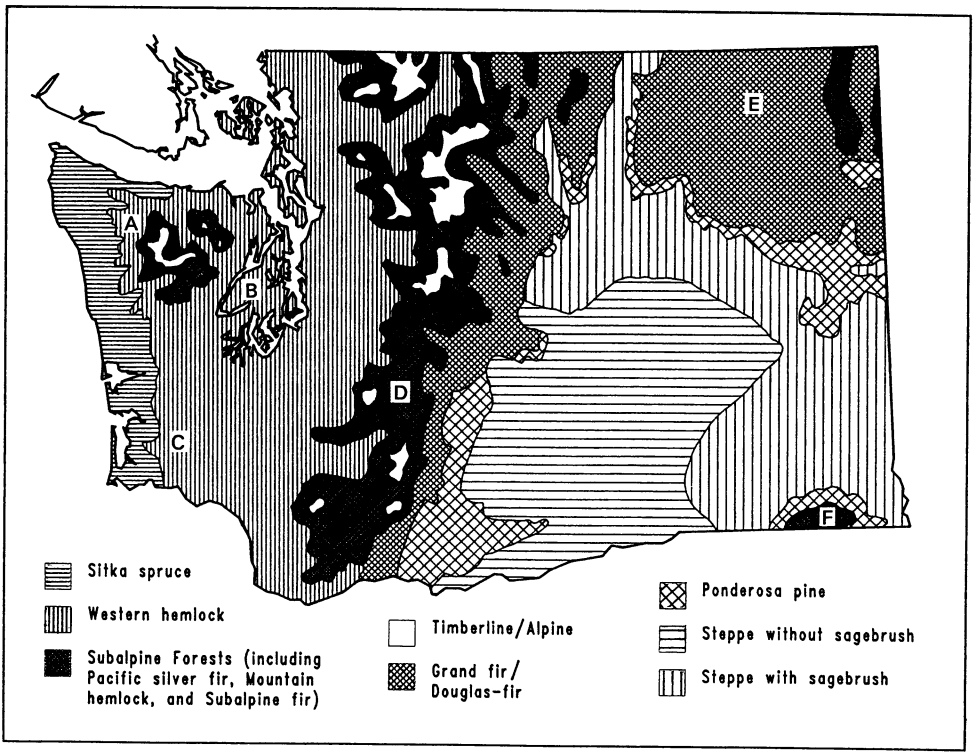

FIGURE 1. Major vegetation zones in Washington State (from Franklin and Dyrness 1973). Major physiographic featuers are designated as follows: A. Olympic Mountains. B. Kitsap Peninsula. C. Coast Range. D. Cascade Range. E. Okanogan Highlands. F. Blue Mountains.

reliability 3 and 4 totalled 17 and 66 records, respectively. We deleted the 27 records of tracks or questionable sightings (reliability 5 and 6), and used only the remaining 88 records in our analyses.

The two recent museum specimens (Fig. 2) are a female (weight 2.65 kg, length 87.0 cm) taken near Lilliwaup Swamp in Mason Co. in 1969 (UWBM #37530, see Appendix) and a female (weight 2.5 kg, length 83.5 cm) trapped in a swamp near Orting in Pierce Co. in December 1990 (UPSMNH #14784). The three trapping records (Fig. 2) represent individuals taken in Winter 1971 near Sultan in Snohomish Co. (released by trapper), December 1975 near Moses Mountain in Okanogan Co. (disposition unknown), and Autumn 1987 near Morton in Lewis Co. (released by trapper).

We removed a second lower premolar from the specimen collected at Lilliwaup in 1969. Examination of the dental cementum layers showed that she was 2 yr old at death

TABLE 1. Records of *M. pennanti* by reliability rating for Washington State, 1894–1991.

	Reliability rating[a]						
Period	1	2	3	4	5	6	Total
1894–1925	14	6	2	0	0	0	22
1926–1954	0	0	0	0	0	0	0
1955–1979	1	2	6	32	5	4	50
1980–1991	1	1	11	34	7	11	65
Total	16	9	19	66	12	15	137

[a] (1) Specimen or photo, (2) first person trapping report (no specimen available), (3) detailed sighting by experienced observer, (4) sighting by observer with undetermined or limited qualifications, (5) tracks, (6) record containing insufficient or questionable description or locality data.

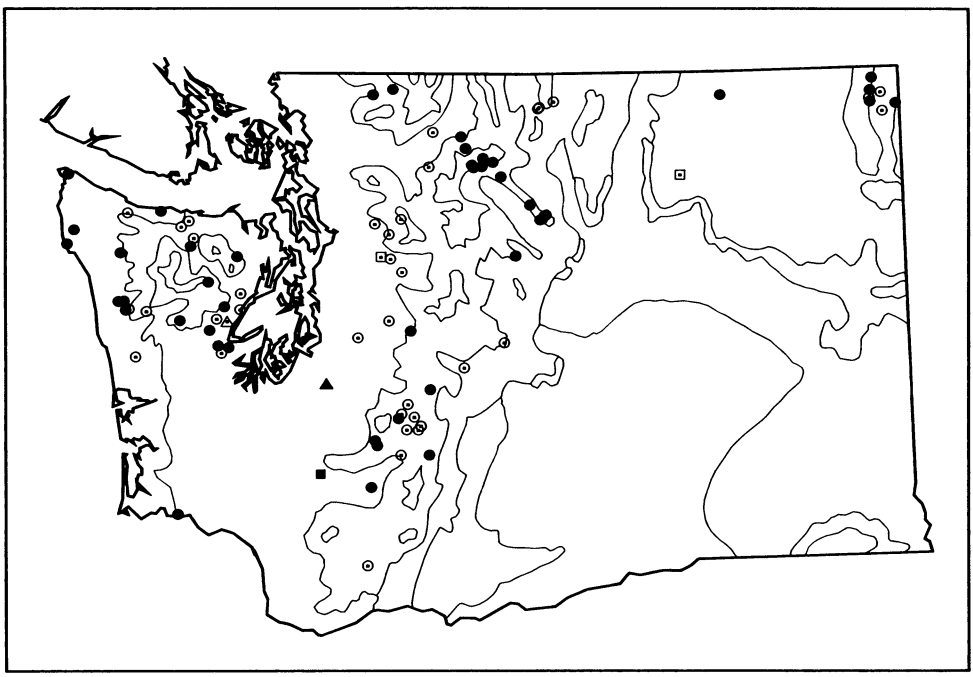

FIGURE 2. Locations of 88 records of *M. pennanti* in Washington State from 1955–1991. Solid symbols represent records dating from 1980 to 1991, and open symbols with dots represent records dating from 1955–1979. Circles are sighting reports; squares, trapping reports with no associated specimen; triangles, museum specimens. Lines indicate major vegetation zones described by Franklin and Dyrness (1973) presented in Fig. 1.

(Matson's Laboratory, Milltown, Montana 59851). This age determination is important because an adult female *M. pennanti*, at least 4 yr of age (L. Beebe, Olympic Game Farm, Sequim, Washington 98382, pers. comm.), escaped from the Olympic Game Farm, about 70 km north of Lilliwaup, in Spring 1969. Based upon this age determination, the animal from Lilliwaup could not have been the escapee.

Cementum annuli counts from the specimen collected in December 1990 near Orting indicated that she was 8 yr old. She was not pregnant; the ovaries contained no corpora lutea and the endometrium showed no signs of growth or glandular development (M. J. Erpino, Dept. of Biology, Chico State Univ., Chico, California 95926, pers. comm.). Morphological evidence indicated that she has been living in the wild and was not a recent escapee from captivity. We found few fat deposits in the body cavity, and the teeth did not have the heavy tartar accumulations typically found in *M. pennanti* subsisting on commercial food (R. A. Powell, Dept. of Zoology, North Carolina State Univ., Raleigh, North Carolina 27695, pers. comm.). In addition, raising *M. pennanti* in captivity for commercial purposes is illegal in Washington and no escapes were reported from animal parks maintaining the species in captivity.

Our interpretation of the current (1980–1991) distribution of *M. pennanti* is based on 47 records, and that of the recent past (1955–1979) is based on 41 records (Fig. 2). During both periods, the broad pattern of distribution indicated by sighting records of relatively low credibility (reliability 4) was similar to that indicated by records for which we had a high degree of confidence (reliability 1–3). Consequently, we combined all records of reliability 1–4 in our analyses.

There were 65 records of *M. pennanti* that could be assigned to a habitat zone (Table 2). Among 46 records from western Washington, 25 (54%) were from the Western hemlock

TABLE 2. Records of *M. pennanti* by vegetation zone for Washington State 1955-1991.[a]

Vegetation zone	West side	East side
Sitka spruce	9	—[b]
Western hemlock	25	—
Subalpine forest, including:		
Pacific silver fir	12	—
Mountain hemlock	0	—
Subalpine fir	—	10
Timberline/Alpine	0	2
Ponderosa pine	—	0
Grand fir/Douglas-fir	—	7
Steppe without sagebrush	—	0
Steppe with sagebrush	—	0
Total	46	19

[a] Records within 1.6 km of any zone boundary were deleted from this analysis (see text).
[b] Vegetation zone does not occur in this region.

(*Tsuga heterophylla*) zone, 9 (20%) from the Sitka spruce (*Picea sitchensis*) zone, and the remaining 12 (26%) from subalpine forests. All 12 records of *M. pennanti* in subalpine forests in western Washington were from the Pacific silver fir (*Abies amabilis*) zone. Among 19 records from the east side, 10 (53%) were from the Subalpine fir (*Abies lasiocarpa*) zone, 7 (37%) were from the Grand fir (*Abies grandis*)/Douglas-fir (*Pseudotsuga menziesii*) zone, and 2 (10%) were from the Timberline/Alpine zone; none occurred in the Ponderosa pine (*Pinus ponderosa*) zone.

All 88 records with reliability ratings of 1-4 contained sufficient information to classify each into a 100-m elevation zone. Results differed markedly east and west of the crest (Fig. 3). The 55 records from the west side were strongly skewed toward low to mid-elevations; 87% were at less than 1000 m and none was reported from elevations over 1800 m. In contrast, among 33 records from the east side, only 30% occurred at elevations less than 1000 m and 18% were at elevations from 1800-2200 m.

DISCUSSION

Distribution

Few striking changes are evident in the geographic distribution of *M. pennanti* reports in Washington between 1955-1979 and 1980-1991. *Martes pennanti* still occur in the Cascade Range and Okanogan Highlands, and are probably still present in the Olympic Mountains, although the last report of one being trapped there was in 1969. *Martes pennanti* appears to be absent from forests along the eastern edge of Puget Sound, the Kitsap Peninsula, the southern Coast Range, and the Blue Mountains (Figs. 1, 2).

In the northern Cascade Range, however, changes appear to have occurred both east and west of the crest. In that region, only recent records are available from the eastern slope of the Cascades. Although this may simply reflect the establishment of North Cascades National Park in 1968 and subsequent development of their wildlife data base, we cannot exclude the possibility that these records reflect actual patterns of distribution and the refugial nature of habitats contained in and adjacent to the Park. Records from west of the crest, where the converse appears to be occurring, provide support for this hypothesis. Among 15 records from Whatcom, Skagit, Snohomish, and King Cos., only five were current (Fig. 2). The 10 records dated prior to 1980 were from a variety of ownerships including six from private timerlands, two from Mt. Baker/Snoqualmie National Forest, one from North Cascades National Park, and one from state forest lands, at elevations ranging from 100-1750 m. All five of the current records, however, occurred in Mt. Baker/Snoqualmie National Forest or North Cascades National Park at elevations greater than 750 m.

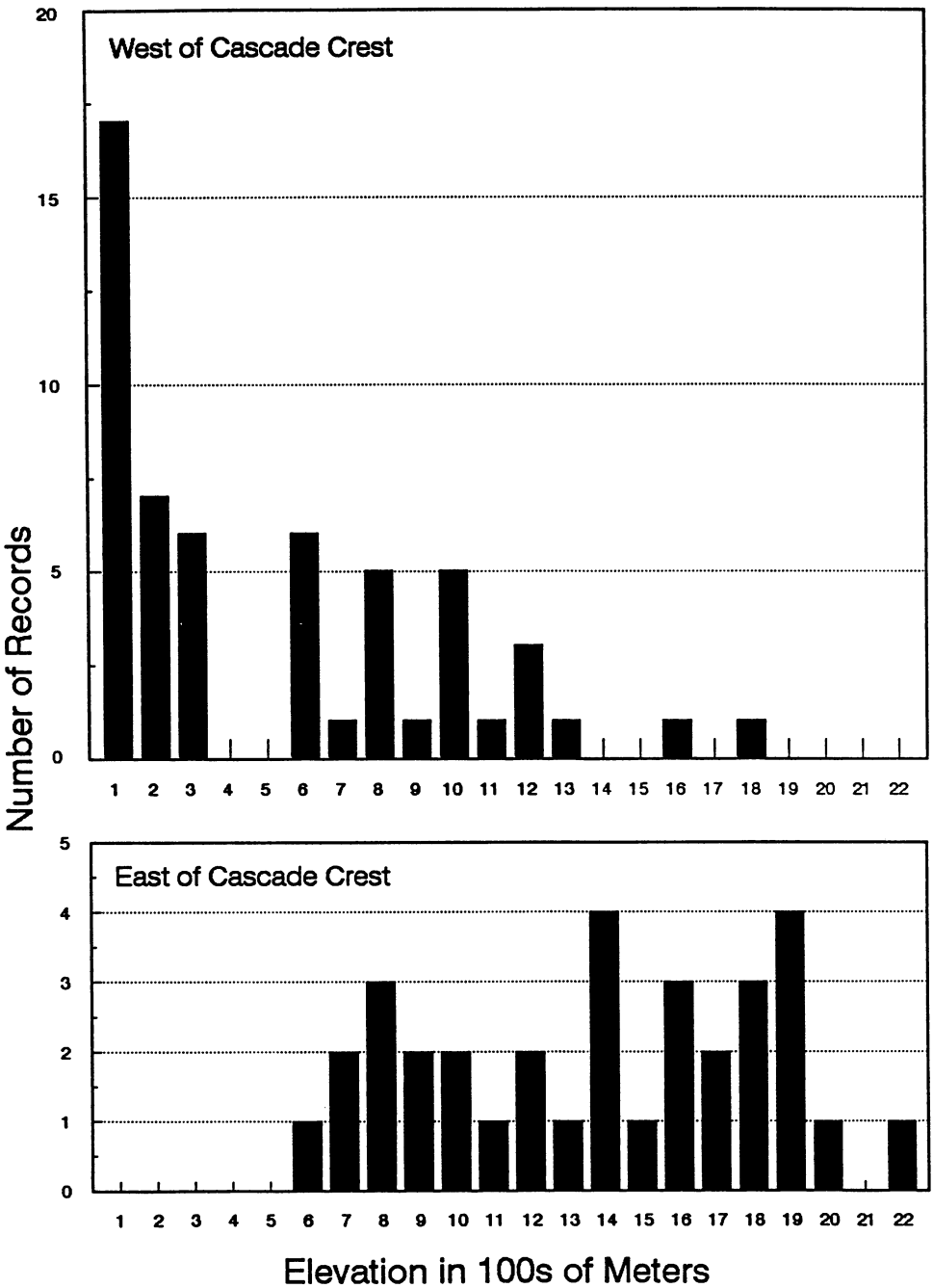

FIGURE 3. Elevational distribution of 88 records of *M. pennanti* in Washington State from 1955–1991 east and west of the crest of the Cascade Range.

Martes pennanti occurs in a wide variety of forested habitats in North America (Strickland et al. 1982), but clearly prefers dense, lowland forests with an extensive, continuous canopy (Powell 1982). The harvesting of old-growth forests in the northwestern Cascades has been most intensive on state and private timberlands, and at elevations below about

600 m on the Mt. Baker/Snoqualmie National Forest (Morrison 1988; Morrison et al. 1990). Our data suggest that widespread clearcut logging, which resulted in the removal or fragmentation of once-extensive forest canopies at lower elevations, may have reduced or eliminated suitable habitat for *M. pennanti* in the northwestern Cascade Range.

We cannot determine the status of extant populations, beyond noting that the species is apparently very rare. The overall similarity in distribution patterns between 1955–1979 and 1980–1991 could be interpreted to mean that *M. pennanti* is not declining in numbers. However, these records only provide evidence for the continued presence of *M. pennanti* in broad areas that were occupied in the recent past. Large areas of late-successional forest at low elevations have since been harvested (Morrison 1988), potentially reducing the suitability of forested habitats for *M. pennanti* throughout Washington (Central Sierra Audubon Society et al. 1990). Thus, our findings should not be interpreted to mean that *M. pennanti* populations are stable. The scarcity of recent sighting reports and, in particular, of incidental trappings of *M. pennanti* in sets made for other furbearers strongly suggest that densities are precariously low in Washington.

We noted that in certain localized areas, a number of sightings were made by different individuals over time. This was particularly evident near Sullivan Lake in Pend Oreille Co. in the Okanogan Highlands; east of Lake Chelan near Bryan Butte in Chelan and Okanogan Cos. in the northern Cascade Range; and in the Quinault, Queets, Skokomish, and Hamma Hamma River drainages in the Olympic Mountains. Multiple sightings over long periods of time reduce the uncertainty inherent in any single sighting report and provide strong evidence that *M. pennanti* is present. We recommend that future field studies be located in these areas.

Patterns of Habitat Use

Our habitat analysis generally agrees with studies conducted elsewhere in North America (see reviews in Allen 1983; Bianchi 1989; Powell 1982; Strickland et al. 1982), which indicate that *M. pennanti* occupies a wide variety of densely forested habitats at low to mid-elevations. *Martes pennanti* is restricted in its movements, however, by soft, thick snow (de Vos 1952; Leonard 1980; Raine 1982, 1983). Leonard (1980) estimated that *M. pennanti* uses 54% more energy to travel in soft snow compared to hard snow. The absence of records from the Mountain hemlock zone in western Washington may be related to depth of snowpack. The mid-elevation (about 750–1300 m) Pacific silver fir zone has snowpacks ranging from 1–3 m in depth. In contrast, forests in the upper elevation (about 1300–1800 m) Mountain hemlock zone may accumulate snowpacks up to 7.5 m deep that can last for 6–8 mo (Franklin and Dyrness 1973). Similarly, lower precipitation due to rain shadow effects on the east side of the crest probably accounts for the large number of *M. pennanti* records there at elevations over 1400 m.

Although *M. pennanti* occupies a variety of forested habitats, its presence is often associated with wetland forests and riparian zones (Bianchi 1989; Powell 1982; Strickland et al. 1982), presumably because such habitats generally have dense canopies and abundant prey. It is noteworthy that both museum specimens collected in Washington during the last 25 years were trapped in swamps. In addition, many of our sighting reports were also from swamps or other forested riparian areas. Because riparian zones in the Pacific Northwest have generally been provided with some degree of protection during timber harvesting operations (see Raedeke 1988:191–220), they may provide critical habitat for *M. pennanti* in areas where upland forests have been extensively logged.

Management Implications and Research Needs

Clearcut logging practices typically involve the removal of large amounts of woody debris from the site for wood fiber, improved regeneration, or fire control (Spies and Cline 1988). This process greatly reduces structural diversity on the forest floor in intensively managed plantations compared to unmanaged forests. Thinning also results in

more open conditions within the forest. *Martes pennanti* prefers forests with a continuous canopy and complex physical structure near the forest floor (Powell 1991). This structure may include fallen logs, leaning live trees, trunks, and low branches. Intensively managed forest plantations generally provide few of these habitat components. In addition, there is evidence suggesting that older and larger forest stands are preferred by *M. pennanti* in this region. In Douglas-fir/hardwood forests in northern California, *M. pennanti* was detected on smoked aluminum tracking plates more frequently as stand age increased (Raphael 1984). The percentage of plots with *M. pennanti* detections was about 2 and 3 times higher in old-growth (>250 yr) compared to sawtimber (<150 yr) and mature (150–250 yr) stands, respectively. Landscape-scale analyses of the data (Rosenberg and Raphael 1986) also indicated that *M. pennanti* was sensitive to the effects of forest fragmentation. Detection rates increased with stand area and decreased with increasing stand insularity (percentage of stand perimeter consisting of clearcut edge).

Snags are typically removed during clearcutting and, under short rotations, will not be replaced. Relatively few natal dens of *M. pennanti* have been described, but all have been located in cavities in either dead or living trees at heights generally exceeding 6 m (Powell 1982; Paragi 1990). The only natal den ever described in the Pacific States was in northwestern California and was located about 11 m from the ground in a nearly limbless pine snag 89 cm in d.b.h. (Buck et al. 1983). The mean d.b.h. of 32 natal den trees found in southcentral Maine, of which 30 were hardwoods, was 51 cm (Paragi 1990). Adult female *M. pennanti* weigh 2.0–2.5 kg, are 75–95 cm in total length, and have an average litter size of three kits (Strickland et al. 1982). Obviously, only relatively large trees can provide cavities of adequate size for a female *M. pennanti* and her kits.

Detailed information on the ecological relationships and habitat requirements of *M. pennanti* in the Pacific Northwest is lacking. Based on the results of our survey and on research conducted elsewhere, however, we predict that habitat for *M. pennanti* in this region would be enhanced by the following strategies: minimizing forest fragmentation, both in remaining old-growth and in second-growth forests; maintaining a high degree of forest-floor structural diversity in intensively managed plantations; preserving large snags and live trees with dead tops; maintaining continuous canopies in riparian zones; and protecting swamps and other forested wetlands.

Although we have attempted to restrict our analysis to reliable records, a survey based primarily on unverified sightings is no substitute for the intensive field work that will be required to quantitatively determine the habitat requirements and population status of *M. pennanti* in Washington. A study of 20 radio-collared animals in the Trinity Alps of northern California in the late 1970's (Buck et al. 1983, in press) is the only field study of *M. pennanti* using radio-telemetry ever conducted in the Pacific States; no comparable research has been done in either Washington or Oregon. If we are to adequately evaluate the extent to which *M. pennanti* populations may be threatened in the Pacific Northwest and effectively provide suitable habitat through management, radio-telemetry studies designed to gather detailed information on the habitat relationships of *M. pennanti* in this region will be essential.

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information on the history of fishers on the Olympic Peninsula. Roger Powell, Martin Raphael, David Marshall, and an anonymous reviewer provided helpful comments on a previous draft of the manuscript.

[Note: After this manuscript was completed, we received two additional sighting reports of fishers from the Olympic Mountains. Johnson and Johnson (1952) stated that they had seen a fisher on the Hoh River near the coast, but did not include further details. According to field notes obtained from M. L. Johnson, the sighting occurred on 2 August 1949 on the Hoh River road ". . . about 1 mile above store." The second sighting was made by A. L. Larson, a long-term resident and trapper in the southern Olympic Mountains, who saw a fisher on 8 and 10 January 1992 near Matlock in Mason Co. We consider both sightings to be of reliability 3.]

LITERATURE CITED

ALLEN, A. W. 1983. Habitat suitability index models: fisher. USDI Fish and Wildl. Serv. FWS/OBS-82/10.45. 19 pp.

BIANCHI, V. 1989. A fisher management strategy for British Columbia. B.C. Min. Env., Wildl. Branch, Wildl. Bull. No. B-63. 117 pp.

BUCK, S. G., C. MULLIS, AND A. S. MOSSMAN. 1983. Corral Bottom-Hayfork Bally fisher study. Final Rep. to USDA For. Serv., Pacific Southwest Region, San Francisco, CA 94111. 102 pp.

BUCK, S. G., C. MULLIS, AND A. S. MOSSMAN. In press. Fisher habitat utilization in adjoining heavily and lightly harvested forest. *In:* S. W. Buskirk, A. S. Harestad, M. G. Raphael, and R. A. Powell (eds.), Biology and conservation of martens, sables, and fishers. Cornell Univ. Press, Ithaca, NY.

CENTRAL SIERRA AUDUBON SOCIETY ET AL. 1990. Petition for a rule to list the fisher as endangered. On file at the USDA For. Serv., Pacific Northwest Res. Sta., Olympia, WA 98512. 26 pp.

DALQUEST, W. W. 1948. Mammals of Washington. Univ. Kans. Publ. Nat. Hist., 2. 444 pp.

DE VOS, A. 1952. Ecology and management of fisher and marten in Ontario. Ontario Dept. of Lands and For., Tech. Bull., Wildl. Ser. 1. 90 pp.

FRANKLIN, J. F., AND C. T. DYRNESS. 1973. Natural vegetation of Oregon and Washington. USDA For. Serv. Gen. Tech. Rep. PNW-8. 417 pp.

JOHNSON, M. L., AND S. JOHNSON. 1952. Check list of mammals of the Olympic Peninsula. Murrelet 33:32–37.

LEONARD, R. D. 1980. The winter activity and movements, winter diet and breeding biology of the fisher (*Martes pennanti*) in southeastern Manitoba. Unpubl. M.S. thesis, Univ. of Manitoba, Winnipeg. 181 pp.

MORRISON, P. H. 1988. Old growth in the Pacific Northwest: a status report. The Wilderness Society, Washington, DC. 46 pp.

MORRISON, P. H., D. KLOEPFER, D. A. LEVERSEE, C. M. MILNER, AND D. L. FERBER. 1990. Ancient forests on the Mount Baker-Snoqualmie National Forest: analysis of forest conditions. The Wilderness Society, Washington, DC. 18 pp.

PARAGI, T. F. 1990. Reproductive biology of female fishers in southcentral Maine. Unpubl. M.S. thesis, Univ. of Maine, Orono. 106 pp.

PAYNE, N. F., AND R. D. TABER. 1974. Current status of 10 uncommon birds and mammals in Snoqualmie National Forest and vicinity. Unpubl. Rep., Coll. of Forest Resources, Univ. Washington, Seattle. 73 pp.

POWELL, R. A. 1982. The fisher: life history, ecology, and behavior. Univ. Minnesota Press, Minneapolis. 217 pp.

POWELL, R. A. 1991. Thoughts on fishers and forests on the Olympic Peninsula. Final Rep. to USDA For. Serv., Pacific Northwest Res. Sta., Olympia, WA 98512. 3 pp.

RAEDEKE, K. J. (ed.). 1988. Streamside management: riparian wildlife and forestry interactions. Univ. of Washington, Seattle, Inst. For. Res., Cont. No. 59. 277 pp.

RAINE, R. M. 1982. Ranges of juvenile fisher, *Martes pennanti*, and marten, *Martes americana*, in southeastern Manitoba. Can. Field-Nat. 96:431–438.

RAINE, R. M. 1983. Winter habitat use and responses to snow cover of fisher (*Martes pennanti*) and marten (*Martes americana*) in southeastern Manitoba. Can. J. Zool. 61:25–34.

RAPHAEL, M. G. 1984. Wildlife diversity and abundance in relation to stand age and area in Douglas-fir forests of northwestern California, pp. 259–274. *In:* W. R. Meehan, T. R. Merrell, Jr., and

T. A. Hanley (eds.), Fish and wildlife relationships in old-growth forests. Sympos. Proc., Amer. Inst. Fish. Res. Biol. 425 pp.

ROSENBERG, K. V., AND M. G. RAPHAEL. 1986. Effects of forest fragmentation on vertebrates in Douglas-fir forests, pp. 263–272. *In:* J. Verner, M. L. Morrison, and C. J. Ralph (eds.), Wildlife 2000: modeling habitat relationships of terrestrial vertebrates. Univ. Wisconsin Press, Madison. 470 pp.

RUGGIERO, L. F., K. B. AUBRY, A. B. CAREY, AND M. H. HUFF (tech. coords.). 1991. Wildlife and vegetation of unmanaged Douglas-fir forests. USDA For. Serv. Gen. Tech. Rep. PNW-GTR-285. 533 pp.

SCHEFFER, V. B. 1938. Notes on wolverine and fisher in the State of Washington. Murrelet 19:8–10.

SCHEFFER, V. B. 1949. Mammals of the Olympic Peninsula, Washington. Unpubl. Rep. to USDI Fish and Wildl. Serv. On file at Olympic Natl. Park, Port Angeles, WA 98362. 248 pp.

SPIES, T. A., AND S. P. CLINE. 1988. Coarse woody debris in forests and plantations of coastal Oregon, pp. 1–23. *In:* C. Maser, R. F. Tarrant, J. M. Trappe, and J. F. Franklin (eds.), From the forest to the sea: a story of fallen trees. USDA For. Serv. Gen. Tech. Rep. PNW-GTR-229. 153 pp.

STRICKLAND, M. A., C. W. DOUGLAS, M. NOVAK, AND N. P. HUNZIGER. 1982. Fisher, pp. 586–598. *In:* J. A. Chapman and G. A. Feldhamer (eds.), Wild mammals of North America: biology, management, and economics. Johns Hopkins Univ. Press, Baltimore. 1147 pp.

SUCKLEY, G., AND J. G. COOPER. 1860. The natural history of Washington and Oregon territory. Bailliere Brothers, New York. 399 pp.

THOMAS, J. W., E. D. FORSMAN, J. B. LINT, E. C. MESLOW, B. R. NOON, AND J. VERNER. 1990. A conservation strategy for the northern spotted owl. Report of the Interagency Scientific Committee to Address the Conservation of the Northern Spotted Owl. On file at USDA Forest Service, Pacific Northwest Region, Portland, OR 97208. 427 pp.

U.S. FISH AND WILDLIFE SERVICE. 1991. Notice of petition finding: 90-day petition finding for the Pacific fisher. Fed. Reg. 58:1159–1161.

YOCUM, C. F., AND M. T. MCCOLLUM. 1973. Status of fisher in northern California, Oregon and Washington. Cal. Fish and Game 59:305–309.

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APPENDIX

Museum specimens of Martes pennanti *from Washington State*

University of Washington Burke Museum, Seattle: UWBM 37530, Pierce Co., about 3 mi west of Orting, T19N R4E NE ¼ of S34, 11 Dec. 1990, D. Robertson.

University of Puget Sound Museum of Natural History, Tacoma, Washington: UPSMNH 14784, Mason Co., Melbourne Lake (near Lilliwaup Swamp), 1969, G. Gray.

Field Museum of Natural History, Chicago, Illinois: FMNH 6341, Clallam Co., Olympic Mountains, Solduck Trail, 9 Oct. 1898, D. G. Elliot; FMNH 6342, Clallam Co., Olympic Mountains, Barnes Cr., Lake Crescent, 13 Oct. 1898, D. G. Elliot.

National Museum of Natural History, Washington, D.C.: USNM 241949, Jefferson Co., Olympic Ranger Station, Glacier Cr., 2 mi SE of Hoh River, Dec. 1919, W. P. Taylor; USNM 63907, Klickitat Co., S. base of Mount Adams, near Trout Lake, 1894, C. M. Wegstein; USNM 63908, Klickitat Co., S. base of Mount Adams, near Trout Lake, 1894, C. M. Wegstein; USNM 64758, Klickitat Co., Mount Adams, Trout Lake, 1894, C. M. Wegstein; USNM 64759, Klickitat Co., Mount Adams, Trout Lake, 1894, C. M. Wegstein; USNM 69972, Klickitat Co., S. base of Mount Adams, near Trout Lake, 11 Dec. 1894, D. N. Kaegi; USNM 70541, Klickitat Co., S. base of Mount Adams, near Trout Lake, 17 Jan. 1895, D. N. Kaegi; USNM 70927, Klickitat Co., S. base of Mount Adams, near Trout Lake, Feb. 1895, D. N. Kaegi; USNM 70928, Klickitat Co., S. base of Mount Adams, near Trout Lake, 2 March 1895, D. N. Kaegi; USNM 76615, Klickitat Co., Mount Adams, Trout Lake, 2 Jan. 1896, D. N. Kaegi; USNM 76616, Klickitat Co., Mount Adams, Trout Lake, 22 Dec. 1895, D. N. Kaegi; USNM 77873,

Klickitat Co., Mount Adams, Trout Lake, 23 March 1896, D. N. Kaegi; USNM 81843, Klickitat Co., Mount Adams, Trout Lake, 5 Dec. 1896, P. Schmid; USNM 81951, Klickitat Co., Mount Adams, Trout Lake, 29 Dec. 1896, P. Schmid; USNM 87084, Klickitat Co., Mount Adams, Trout Lake, 15 Jan. 1897, P. Schmid; USNM 92113, Klickitat Co., Mount Adams, Trout Lake, 31 Dec. 1897, P. Schmid; USNM 92770, Klickitat Co., Mount Adams, Trout Lake, 17 Jan. 1898, P. Schmid; USNM 99457, Klickitat Co., Mount Adams, Trout Lake, 20 Jan. 1900, P. Schmid; USNM 99652, Klickitat Co., Mount Adams, Trout Lake, 10 March 1900, P. Schmid; USNM 107624, Klickitat Co., Mount Adams, Trout Lake, 26 Jan. 1901, P. Schmid; USNM 108213, Klickitat Co., Mount Adams, Trout Lake, 8 March 1901, P. Schmid; USNM 116480, Klickitat Co., Mount Adams, Trout Lake, 24 Feb. 1902, P. Schmid; USNM 116481, Klickitat Co., Mount Adams, Trout Lake, 25 Feb. 1902, P. Schmid; USNM 116766, Klickitat Co., Mount Adams, Trout Lake, 12 Apr. 1902, P. Schmid; USNM 78410, Mason Co., Lake Cushman, 18 Jan. 1896, T. Hayes; USNM 96580, Mason Co., Lake Cushman, 9 Feb. 1899, T. Hayes; USNM 96581, Mason Co., Lake Cushman, 20 Jan. 1899, T. Hayes; USNM 96582, Mason Co., Lake Cushman, 17 Feb. 1899, T. Hayes; USNM 116653, Mason Co., Hoodsport, 6 May 1901, H. Finch; USNM 119957, Mason Co., Olympic Mountains, Skokomish River, 28 March 1902, G. K. Robbins; USNM 119958, Mason Co., Olympic Mountains, Skokomish River, 19 March 1902, G. K. Robbins; USNM 119959, Mason Co., Olympic Mountains, Skokomish River, 20 Apr. 1902, G. K. Robbins; USNM 119960, Mason Co., Olympic Mountains, Skokomish River, 9 March 1902, G. K. Robbins; USNM 119961, Mason Co., Olympic Mountains, Skokomish River, 22 Nov. 1902, G. K. Robbins; USNM 170606–170609, Mason Co., Hoodsport, March 1907, T. W. Rule; USNM 170610, Mason Co., Hoodsport, 5 Dec. 1909, T. W. Rule; USNM 170611, Mason Co., Hoodsport, 16 Dec. 1909, T. W. Rule; USNM 170612, Mason Co., Hoodsport, 30 Dec. 1909, T. W. Rule; USNM 170613, Mason Co., Hoodsport, 22 Jan. 1910, T. W. Rule; USNM 170614, Mason Co., Hoodsport, 29 Jan. 1910, T. W. Rule; USNM 170615, Mason Co., Hoodsport, 10 Feb. 1910, T. W. Rule; USNM 170616, Mason Co., Hoodsport, 24 March 1910, T. W. Rule; USNM 268769, Mason Co., Olympic Peninsula, Lake Cushman region, 1895, R. F. Harps; USNM 243790, Skamania Co., Vance, 27 mi. SW of Iron Cr., 5 Sept. 1923, W. Scalf; USNM 3379, Thurston Co., Olympia, date unknown, G. Gibbs.