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Habitat Selection by the American Marten in Northeastern Oregon

Abstract

Habitat used by 20 adult radiocollared American martens was investigated in northeastern Oregon between 1993 and 1997 to provide land managers with information on habitat management for this species. Martens showed a strong preference for old-structure, unlogged stands in subalpine fir and spruce forests with canopy closures ≥50%, a high density of dead trees and logs, and in close proximity to water. Martens avoided harvested stands, dry forest types, early structural classes, and areas with low densities of dead trees. Factors such as disturbance patterns, tree diseases, forest structure, prey base, and predators are important considerations in a management plan for martens.

Introduction

The American marten (*Martes americana*) is a management indicator species in the western United States and thus must be considered in any activities that may impact their habitat. Results from numerous marten studies describing habitat use are highly variable, thus indicating some ecotypic variation in the species. For example, research in Maine (Katnik 1992, Lachowski 1997, Chapin et al. 1997) has shown that martens do not require a dense coniferous overstory, select for stands defoliated by spruce budworm (*Choristoneura fumiferana*) in summer, and select for vertical and horizontal structural components more than tree age or species composition in the overstory. In contrast, studies in the western United States indicate a strong association with older, coniferous forests and their associated dense overstories and large-structure components (Buskirk and Ruggiero 1994; Raphael and Jones 1997; Ruggiero et al. 1998). Consequently, specific results from one geographic area may not apply to other areas (Sturtevant and Bissonette 1997).

Reduced distribution of the marten in certain areas of North America has caused concern among managers. Habitat destruction, primarily by logging late-successional conifer forests, has been listed as the primary cause of the population decline in areas where martens are currently threatened or have become extinct (Yeager 1950, Archibald and Jessup 1984, Thompson and Harestad 1994). Zielinski et al. (2001) consider the marten a serious conservation problem that requires immediate attention if martens are to persist in forest communities of the Pacific coast as marten populations have declined in California and the Olympic Peninsula of Washington since 1900. Information on habitat use is particularly critical for the development and implementation of management plans that conserve habitat for viable populations. Our objectives were to describe habitat used by adult American marten and compare it with available and unoccupied habitats.

Study Area

The study area encompassed about 400 km^2 in the Blue Mountains in northeastern Oregon. The center of the study area was in the La Grande Municipal Watershed (referred to as Watershed), which contained about 53 km^2 of predominantly unmanaged forest. The area in a 6-km radius outside the Watershed comprised the remainder of the study area and was managed forest.

The Watershed consisted of 83% unmanaged forest and 17% regenerating stands that had been salvaged after a 1960 wildfire. The predominant feature was the continuous forest covering 90% of the Watershed with wet meadows adjacent to the drainages. Forest types within the Watershed were: 55% lodgepole pine (*Pinus contorta*), 19% subalpine fir (*Abies lasiocarpa*), 16% grand fir (*Abies grandis*), and 10% Douglas-fir (*Pseudotsuga menziesii*). Of the forested area in the Watershed, 44% contained trees 25-51 cm dbh, 37% contained

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trees 5-25 cm dbh, and 19% contained trees >51 cm dbh. The road density was 0.54 km/km^2, and roads occurred primarily on the periphery of the Watershed.

The portion of the study area outside the Watershed was predominantly managed, fragmented, and roaded. About 80% of this area had been harvested, were a mixture of forest types, and contained a road density range of 1.85-3.70 km/km^2. Grand fir and subalpine fir predominated; the lodgepole pine forest type was less abundant than within the Watershed. Harvest activities were a mixture of regeneration, partial, and selection cuts. The area outside the Watershed had a similar proportion of trees in the 5-51 cm dbh classes, but fewer trees > 51 cm dbh, and a higher percentage of seedling/sapling structure (< 5 cm dbh).

The topography consisted of moderately steep mountains dissected by drainages with abundant permanent water in the form of springs and streams. The elevation ranged from 1,320 to 1,980 m. Daytime maxima in summer normally exceeded 24°C, and winter low temperatures were typically below freezing with extremes of -15°C being common. Annual precipitation averaged 78 cm with about 60% falling as snow depending on the elevation. At the highest elevation, snow was on the ground from November through April each year with maximum depths of 1.5 m. At the lowest elevation, snow was on the ground from December until March, with maximum depths of 0.5 m.

Methods

Habitat selection was determined by monitoring 20 radiocollared martens from December 1993 to October 1997. Martens were captured in live traps during December-March and September of each year, immobilized, and fitted with a radiocollar (Holohil Inc., Ontario, Canada) using methods described in Bull et al. (1996). Martens were trapped along roads and trails that were accessible to ATVs and snowmobiles throughout the study area, although most of the Watershed was inaccessible to trapping because only 5 km of roads and 2 km of trails were accessible in the winter and summer. Traps were set 5 days each week during the winter in forested habitat or wherever marten tracks were found. We replaced collars on martens in September each year so traps were set only in the proximity of radiocollared martens. Martens were classified as kits (dependent on the female), juveniles (independent of the female but ≤16 months old), or adults (>16 months) based on tooth wear and analysis of cementum annuli.

To characterize plots in locations actually used by martens, we located radiocollared martens an average of once per week in winter and twice per week in summer. Stationary martens or the specific structure (i.e., live or dead tree, log, platform) being used were located on the ground visually. Martens were actually seen 24% of the time (Bull and Heater 2000). If the marten was moving, we followed it > 300 m and until we thought we were within 100 m of the animal, based on the strength of its signal (i.e., the number of MHz above the marten's radio frequency). Based on sightings of 30 traveling martens, we determined we were always within 100 m of a marten if we could detect the signal 0.020 MHz above the actual transmitter frequency. By following the moving martens >300 m, we were confident our plots occurred in habitat though which the marten had traveled.

For each location that martens were observed using or traversing, we recorded date, habitat characteristics, and UTM (Universal Transverse Mercator) coordinates. Stand characteristics were recorded in a 0.05-ha circular plot centered on the marten's location or estimated location if the marten was moving. Forest stands were classified by plant series into six forest types: ponderosa pine (*Pinus ponderosa*), Douglas-fir, grand fir, lodgepole pine, subalpine fir, and Engelmann spruce (*Picea engelmannii*; Johnson and Hall 1990). Structural classes were defined as early (seedlings/saplings), mid-early (trees 5-25 cm dbh), late (trees 26-51 cm), and old (>40 trees/ha that were >51 cm dbh) based on a modification of Oliver (1992). Old stands were multilayered and had ≥50% canopy closure. If stands contained trees >51 cm dbh but fewer in number than defined for old stands, we classified them as remnant. Logging activity were classified as unharvested, selection harvest, partial overstory removal, or regeneration harvests. Selection harvest in the 1960s and 1970s had removed a portion of the large-diameter western larch (*Larix occidentalis*) or Douglas-fir; other tree species were retained, and the stand structure was largely unchanged. Partial overstory removal included salvage, sanitation, and commercial thinning harvests from the 1960s through the 1990s. Regeneration harvests included clearcuts, shelterwoods, and seed tree cuts done in the 1980s and early 1990s.

We estimated the percentage of canopy closure and the number of canopy layers comprising >10% of the canopy closure in the 0.5-ha surrounding the marten. The landform (ridge, upper half of slope, lower half of slope, drainage), slope aspect, and slope gradient were recorded. Distance to water and distance to an opening >1 ha in size were recorded while on site if possible; otherwise distances were calculated from orthophoto quadrant maps.

In a 0.05-ha circular plot, we recorded the number of live and dead stems <5 cm dbh (saplings), 5-25 cm dbh (poles), 26-51 cm dbh (medium-sized trees), and >51 cm dbh (large trees). Tree species in the plot were recorded in order of abundance, and percent shrub cover was estimated. The number of logs ≥3 m in length were recorded in two size categories: 8-25 cm and >25 cm in large-end diameter.

To ascertain preferences in a marten's use of habitat, we compared habitat plots in which radiocollared martens were observed (used), to systematically selected plots within the home range (available), and to systematically selected plots outside the home ranges (unoccupied). We defined the home range of each marten (100% minimum convex polygon) monitored >6 months and with >50 locations; home ranges averaged 2,717 ha for adult males (n = 10) and 1,416 ha for adult females (n = 9; Bull and Heater 2001a). Available habitat within the home ranges was quantified with plots using the same habitat variables described above, at 50 points systematically located by placing a 0.5-km grid over a map of each home range. In addition, we recorded the number of potential rest sites (trees with cavities or platforms and hollow logs) within each plot. Specific habitat plots did not overlap in used, available, or unoccupied habitats, even though there was 3% overlap in home ranges of all females and 13% for all males (Bull and Heater 2001a).

To determine differences between unoccupied (outside the home ranges) habitat and used and available habitat within home ranges, we recorded habitat in 20 areas within 10-40 km of the study area that were not occupied by martens. Juvenile martens from the Watershed dispersed up to 43 km (Bull and Heater 2001a), so all the unoccupied areas were within a distance that a marten could disperse. This comparison with unoccupied areas provides information to managers in determining what is not appropriate habitat for martens. We selected the unoccupied areas based on our knowledge that martens were not present and the similarity to the study area. The areas consisted of predominantly mixed coniferous forest with some grand fir stands present, were within the same elevation range (1,320-1,980 m) as the study area, and had moderate to steep topography. All 20 unoccupied areas were in managed forests with a high density of roads. The absence of martens was based on winter track surveys conducted by the La Grande Ranger District from 1991-97 and based on previous research activity. Other research projects had been conducted for 1-2 winters (weekly visits) in nine of the areas with no evidence of martens (Bull and Holthausen 1993). In the other 11 areas, 2-5 track surveys were conducted each winter for 3-4 winters with no martens detected. We measured the same habitat characteristics previously described at 50 points in each unused area. The spacial distribution of the 50 points was identical to those used for the plots in each marten's home range.

Statistical Analyses

Statistical analyses were conducted on habitat data collected within the home ranges delineated for 20 adults that survived >6 months. For all 20 martens combined, we compared used, available, and unoccupied habitat with MANOVA. All continuous variables were log transformed except percent canopy closure which was negatively skewed and therefore squared (Zar 1999). Categorical variables were compared using chi-square analyses among plot types. The number of potential rest sites in cavities and brooms were compared between available and unoccupied habitat using chi-square analyses as they exhibited a non-normal distribution. A significance level of 0.05 was used in assessing all analyses.

Results

Twenty adult martens monitored for > 6 months were located 1,558 times between December 1993 and October 1997. MANOVA showed that there was an overall difference among the used, available, and unoccupied habitat ($P < 0.01$) when aggregated by individual marten. All habitat characteristics, except percent shrub cover, differed significantly among the 1,558 plots used by martens, the 1,000 plots within available home ranges, and the 1,000 plots in unoccupied habitat when each group of

TABLE 1. Means (SE) of habitat characteristics in plots used by 20 martens (used, n = 1,558 plots), in plots of available habitat within the 20 home ranges (available, n = 1,000 plots), and in plots in 20 areas that were not occupied by martens (unoccupied, n = 1,000 plots) in northeastern Oregon, 1993-1997. All comparisons among used, available, and unoccupied habitats were significantly different at P < 0.01.

Characteristic	Used	Available	Unoccupied
Snags 25-51 cm dbh/0.05 ha (no.)	1.1 (0.16)	0.8 (0.09)	0.4 (0.06)
Snags >51 cm dbh/0.05 ha (no.)	0.5 (0.07)	0.3 (0.02)	0.1 (0.02)
Saplings/0.05 ha (no.)	23.3 (2.68)	62.0 (7.16)	44.5 (7.44)
Poles/0.05 ha (no.)	28.4 (1.57)	31.5 (2.24)	16.6 (1.65)
Trees 25-51 cm dbh/0.05 ha (no.)	5.3 (0.21)	4.5 (0.29)	3.8 (0.34)
Trees >51 cm dbh/0.05 ha (no.)	2.3 (0.17)	1.2 (0.07)	0.7 (0.7)
Canopy closure (%)	63.1 (0.97)	57.7 (2.71)	47.9 (1.54)
Slope Gradient (%)	20.2 (1.16)	22.7 (1.02)	17.9 (1.04)
Distance to water (m)	104.2 (11.04)	249.1 (16.67)	415.9 (24.93)
Distance to an opening (m)	276.1 (40.46)	316.8 (52.44)	186.8 (25.43)
Logs 8-25 cm diam./0.05 ha (no.)	10.2 (1.20)	16.8 (1.48)	7.9 (0.92)
Logs >25 cm diam./0.05 ha (no.)	2.5 (0.22)	2.6 (0.28)	1.3 (0.13)

plot types was aggregated by marten home range (P < 0.01; Table 1).

Stands where martens were observed had higher densities of snags >51 cm dbh, trees >25 cm dbh, and logs <25 cm in diameter than systematically selected plots available within the home range. There was a lower density of saplings in plots in which marten were observed than available in systematically selected plots within the home ranges. The mean distance from plots where marten were located to water was less than half the mean distance between systematically selected plots and water (Table 1). Martens were located more in subalpine fir and spruce forest types than expected based on availability. All other forest types were used less than expected based on availability ($P <$ 0.01; Figure 1A). Old-structure stands were used more, and the early and mid-early structural stages were used less than expected based on availability ($P < 0.01$) (Figure 1B). Stands with no harvesting were used more, and stands with any harvesting activity were used less than expected based on availability ($P < 0.01$; Figure 1C). Stands with 50-74% canopy closure were used more, and stands with <50% canopy closure were used less than expected ($P < 0.01$; Figure 1D). Northern aspects were used more and southern aspects used less than expected in comparison to available habitat ($P < 0.01$). Upper slopes and drainages were used more, and lower slopes and ridges used less than expected ($P < 0.01$).

In a comparison of habitat characteristics between 1,558 plots where martens were found and 1,000 plots in 20 unoccupied areas outside the marten home range, stands used by martens had a higher density of snags, trees >25 cm dbh, logs, and higher percentage canopy closure than stands in areas without martens. Stands in which martens were observed had more canopy layers, a longer distance to an opening, and one-fourth the distance to water compared to plots in areas not occupied by martens. Areas not occupied by martens had a higher percentage of stands in ponderosa pine and Douglas-fir forest types, in early and mid-early structural stages, with harvest activities, and on ridges than did stands with martens. Martens were observed more on northern and eastern aspects and less on southern and western aspects ($P < 0.01$) than those aspects occurred in systematically selected plots in unoccupied areas.

The density of potential rest sites was significantly higher ($P < 0.01$) in available marten home ranges than in unoccupied areas with an average density (no./ ha) of 2.7 versus 1.0 trees with cavities, 2.7 versus 1.3 hollow logs, and 13.6 versus 7.3 trees with platforms.

Discussion

A combination of landscape attributes best describes suitable marten habitat in northeastern

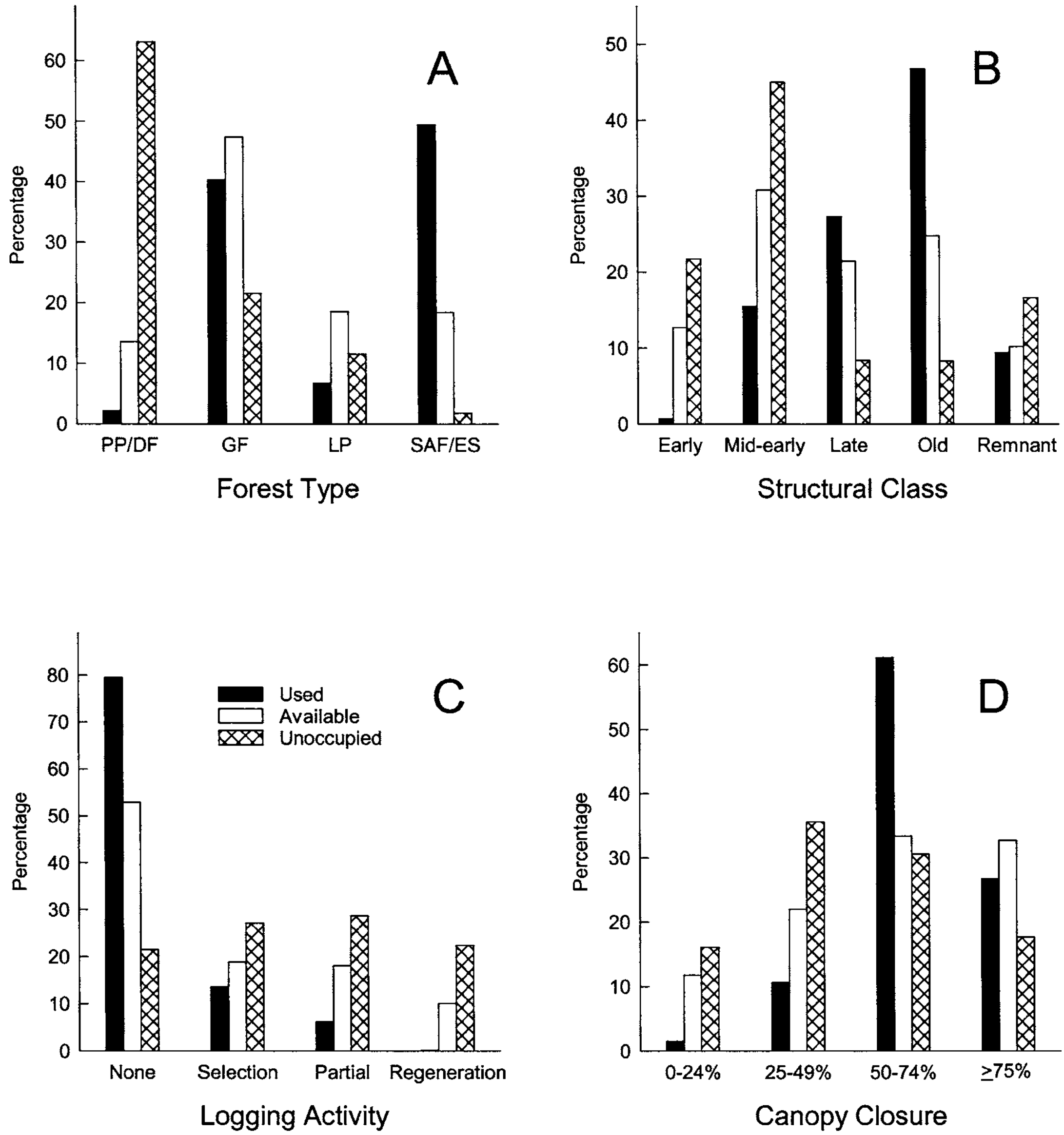

Figure 1. Distribution of forest type (A), structural class (B), logging activity (C), and canopy closure (D) by habitat that 20 resident martens were observed using in their home ranges (used), habitat available within their 20 home ranges (available), and habitat in 20 areas that were not occupied by martens (unoccupied) in northeastern Oregon, 1993-97. Forest types are ponderosa pine and Douglas-fir (PP/DF), grand fir (GF), lodgepole pine (LP), and subalpine fir and Engelmann spruce (SAF/ES).

Oregon. The preference for late- and old-structure stands we observed has been reported by many authors (Koehler et al. 1990, Spencer et al. 1983, Wynne and Sherburne 1984, Snyder and Bissonette 1987, Raphael and Jones 1997, and Lofroth 1993). The abundance of large-diameter trees, both live and dead, and hollow logs in late- and old-structure forests of subalpine fir and spruce provides rest and den sites, protection from avian and mammalian predators, and foraging sites. The abundance of down wood can provide rest sites, hunting areas, and access to subnivean spaces in the winter (Thompson 1986, Bissonette and Sherburne 1993, Sherburne and Bissonette 1994).

Closed canopies and multiple canopy layers characteristic of older subalpine fir and spruce forests provide cover from predators, as well as structure for prey species. Within the marten home ranges in northeastern Oregon, the martens selected for specific sites with denser canopy, more canopy layers, larger diameter live and dead trees, larger logs, and closer proximity to water compared to available habitat (Table 1). Close proximity of martens to streams may be due to the cooler temperatures in the drainages, access to water, or increased prey availability, particularly during the summer. Unoccupied habitat either lacked these features or contained them in lower densities and may explain the lack of martens in these areas (Table 1). This information may help managers recognize which areas are suitable for martens.

Our findings are consistent with others that report martens avoid recent clearcuts (i.e., regeneration cuts) and will not cross large areas with low canopy closure (Thompson and Harestad 1994). In Utah, martens responded negatively to low levels of habitat fragmentation and were rarely detected in sites with > 25% open areas (Hargis et al. 1999). In Yellowstone National Park, martens did not readily cross open areas wider than 100 m (Bissonette and Sherburne 1993). Hargis and McCullough (1984) suggested >50% canopy closure was required by martens in California, which is consistent with our findings. Predation was intense in our study area (Bull and Heater 2001b), so martens may have avoided areas in early structural stages or with <50% canopy closure because their vulnerability increased in these stands. In Maine, habitat used by martens had taller trees, higher live-tree basal areas, and greater snag volumes than unused areas which were 13-21 year-old regenerating clearcuts (Payer and Harrison 2003).

Although many wildlife species use a particular physical structure without regard to tree species, martens in northeastern Oregon appear to depend on particular tree species for resting and denning structures. Some pathogens typically attack a specific tree species and create particular structures which provide marten rest and den sites. For example, broom rust attacks Engelmann spruce and subalpine fir in our study area, creating the broom structures martens use as rest sites (Parks and Bull 1997). Most of the large-diameter hollow trees used by martens as den and rest sites were in grand fir as Indian paint fungus (*Echinodontium tinctorium*), a heart-rot fungi, was prevalent in this tree species. Typically, managed stands do not provide many of the structural attributes preferred by martens that result from tree diseases (Bull et al. 1997). Some consideration needs to be given to recognizing the value of tree diseases (e.g., heart-rot fungi, brooms) in creating valuable habitat for martens and other wildlife.

Our results suggest that tailoring management recommendations to the habitat requirements of the local population and specific forest types may be essential for managing marten populations. Habitat recommendations from other areas might be inadequate in providing appropriate habitat for martens in northeastern Oregon. Local factors including climate, prey base, predation, disease and insect agents, disturbance patterns, forest structure, and population demography should be considered in any management plan for this species.

Acknowledgements

Gale Culver and Dave Wyland assisted with field work. Additional support was provided by Arlene Blumton, Mark Henjum, Larry Jones, Barb Wales, and Mike Wisdom. Funding was provided by the Pacific Northwest Research Station, National Wildlife Federation, National Audubon Society, Oregon Department of Fish and Wildlife, La Grande Ranger District, and Forest Service, Pacific Northwest Region, Fish and Wildlife.

Literature Cited

Archibald, W. R., and R. H. Jessup. 1984. Population dynamics of the pine marten (*Martes americana*) in the Yukon Territory. Pages 81-97 *In* R. Olsen, F. Geddes, and R. Hastings (editors), Northern Ecology and Resource Management. University of Alberta Press, Edmonton, Alberta.

Bissonette, J. A., and S. S. Sherburne. 1993. Habitat preferences of unexploited pine marten (*Martes americana*) populations in Yellowstone National Park. Final report. Utah Cooperative Fish and Wildlife Research Unit, Utah State University, Logan, Utah.

Bull, E. L., and T. W. Heater. 2000. Resting and denning sites of American marten in northeastern Oregon. Northwest Science 74:179-185.

Bull, E. L., and T. W. Heater. 2001a. Home range and dispersal of the American marten in northeastern Oregon. Northwestern Naturalist 82:7-11.

Bull, E. L., and T. W. Heater. 2001b. Survival, causes of mortality, and reproduction in the American marten in northeastern Oregon. Northwestern Naturalist 82:1-6.

Bull, E. L., T. W. Heater, and F. G. Culver. 1996. Live-trapping and immobilizing American martens. Wildlife Society Bulletin 24:555-558.

Bull, E. L., and R. S. Holthausen. 1993. Habitat use and management of pileated woodpeckers in northeastern Oregon. Journal of Wildlife Managment 57:335-345.

Bull, E. L., C. G. Parks, and T. R. Torgersen. 1997. Trees and logs important to wildlife in the interior Columbia River basin. USDA Forest Service General Technical Report PNW-391. Pacific Northwest Research Station, Portland, Oregon.

Buskirk, S. W., and L. F. Ruggiero. 1994. American marten. Pages 7-37 *In* L. F. Ruggiero, K. B. Aubrey, S. W. Buskirk, L. J. Lyon, and W. J. Zielinski (editors), The Scientific Basis for Conserving Forest Carnivores: American Marten, Fisher, Lynx, and Wolverine in the Western United States. USDA Forest Service General Technical Report RM-254. Rocky Mountain Research Station, Fort Collins, Colorado.

Chapin, T. G., D. J. Harrison, and D. M. Phillips. 1997. Seasonal habitat selection by marten in an untrapped forest preserve. Journal of Wildlife Management 61:707-717.

Hargis, C. D., J. A. Bissonette, and D. L. Turner. 1999. The influence of forest fragmentation and landscape pattern on American martens. Journal of Applied Ecology 36:157-172.

Hargis, C. D., and D. R. McCullough. 1984. Winter diet and habitat selection of marten in Yosemite National Park. Journal of Wildlife Management 48:140-146.

Johnson, C.G., Jr., and F. Hall. 1990. Plant associations of the Blue Mountains. USDA Forest Service, R6-Ecol. Area 3.

Katnik, D. D. 1992. Spatial use, territoriality, and summer-autumn selection of habitat in an intensively harvested population of martens on commercial forest land in Maine. M.S. Thesis, University of Maine, Orono, Maine.

Koehler, G. M., J. A. Blakesley, and T. W. Koehler. 1990. Marten use of successional forest stages during winter in north-central Washington. Northwestern Naturalist 71:1-4.

Lachowski, H. J. 1997. Relationships among prey abundance, habitat, and American marten in northern Maine. M.S. Thesis, University of Maine, Orono, Maine.

Lofroth, E. C. 1993. Scale dependent analyses of habitat selection by marten in the sub-boreal spruce biogeoclimatic zone, British Columbia. M.S. Thesis, Simon Fraser University, Victoria, British Columbia.

Oliver, C. D. 1992. A landscape approach—achieving and maintaining biodiversity and economic productivity. Journal of Forestry 90:20-25.

Parks, C. G., and E. L. Bull. 1997. American marten use of rest and dwarf mistletoe brooms in northeastern Oregon. Western Journal of Applied Forestry 12:131-133.

Payer, D. C., and D. J. Harrison. 2003. Influence of forest structure on habitat use by American marten in an industrial forest. Forest Ecology and Management 179:145-156.

Raphael, M. G., and L. L. C. Jones. 1997. Characteristics of resting and denning sites of American marten in central Oregon and western Washington. Pages 146-165 *In* G. Proulx, H. N. Bryant, and P. M. Woodard (editors), *Martes*: Taxonomy, Ecology, Techniques, and Management. Provincial Museum of Alberta, Edmonton, Alberta.

Ruggiero, L. F., D. E. Pearson, and S. E. Henry. 1998. Characteristics of American marten den sites in Wyoming. Journal of Wildlife Management 62:663-673.

Sherburne, S. S., and J. A. Bissonette. 1994. Marten subnivean access point use: response to subnivean prey levels. Journal of Wildlife Management 58:400-405.

Snyder, J. E., and J. A. Bissonette. 1987. Marten use of clear-cuttings and residual forest stands in western Newfoundland. Canadian Journal of Zoology 65:169-174.

Spencer, W. D., R. H. Barrett, and W. J. Zielinski. 1983. Marten habitat preferences in the northern Sierra Nevada. Journal of Wildlife Management 47:1181-1186.

Sturtevant, B. R., and J. A. Bissonette. 1997. Stand structure and microtine abundance in Newfoundland: implications for marten. Pages 182-198 *In* G. Proulx, H. N. Bryant, and P. M. Woodard (editors) *Martes*: Taxonomy, Ecology, Techniques, and Management. Provincial Museum of Alberta, Edmonton, Alberta.

Thompson, I. D. 1986. Diet choice, hunting behavior, activity patterns, and ecological energetics of marten in natural and logged areas. Ph.D. Thesis, Queen's University, Kingston, Ontario.

Thompson, I. D. and A. S. Harestad. 1994. Effects of logging on American martens, and models for habitat management. Pages 355-367 *In* S. W. Buskirk, A. S. Harestad, M. G. Raphael, and R. A. Powell (editors), Martens, Sables, and Fishers: Biology and Conservation. Cornell University Press, Ithaca, New York.

Wynne, K. M., and J. A. Sherburne. 1984. Summer home range use by adult marten in northwestern Maine. Canadian Journal of Zoology 62:941-943.

Yeager, L. E. 1950. Implications of some harvest and habitat factors on pine marten management. Transactions of North American Wildlife Conference 15:319-334.

Zar, J. H. 1999. Biostatistical analysis. 4th ed. Prentice Hall, Upper Saddle River, New Jersey. 663 p.

Zielinski, W. J., K. M. Slauson, C. R. Carroll, C. J. Kent, and D. G. Kudrna. 2001. Status of American martens in coastal forests of the Pacific States. Journal of Mammalogy 82:478-490.

Received 26 December 2003
Accepted for publication 15 December 2004