Predator Conservation Alliance

Saving a Place for America's Predators

Predator Conservation Alliance's Literature Summary —

Draft — February 21, 2001 — Draft

Conservation Status and Needs of the Pine Marten (*Martes americana*)

Part I. Conservation status of the marten

A. Current and historic marten distribution and numbers across the American West

B. Protected status of the marten

Part II. Ecological factors limiting the survival and recovery of martens in North America

Part III. Science-based policies needed to protect and restore the marten and its habitat throughout the U.S. lower 48.

A. Maintain and restore large areas of late-successional forested habitat

B. Protect martens from unsustainable human-caused mortality

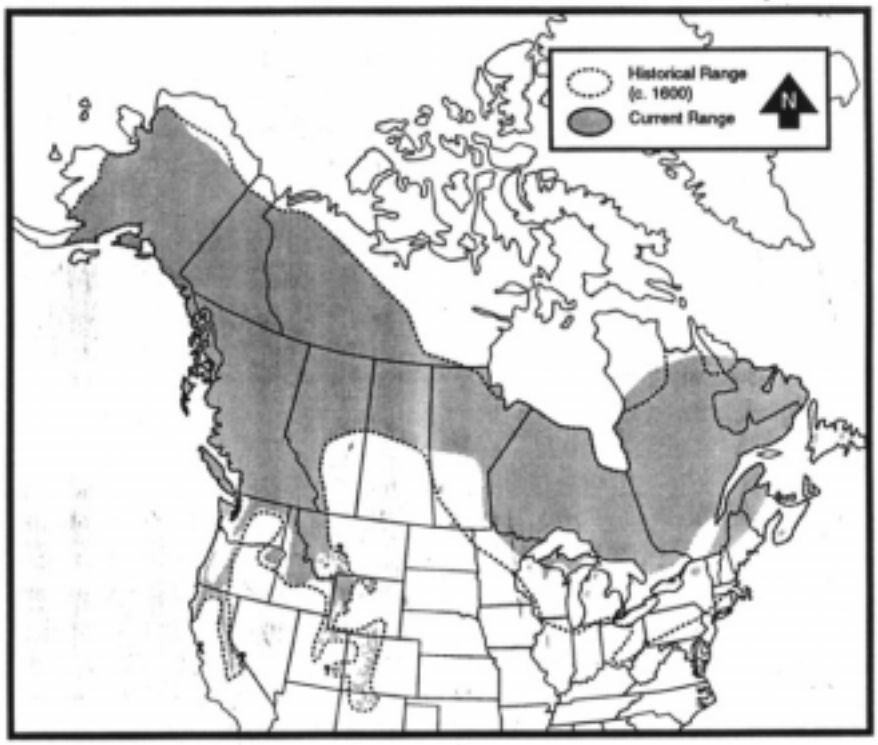
C. Maintain connectivity between marten sub-populations

Part I. Conservation status of the marten

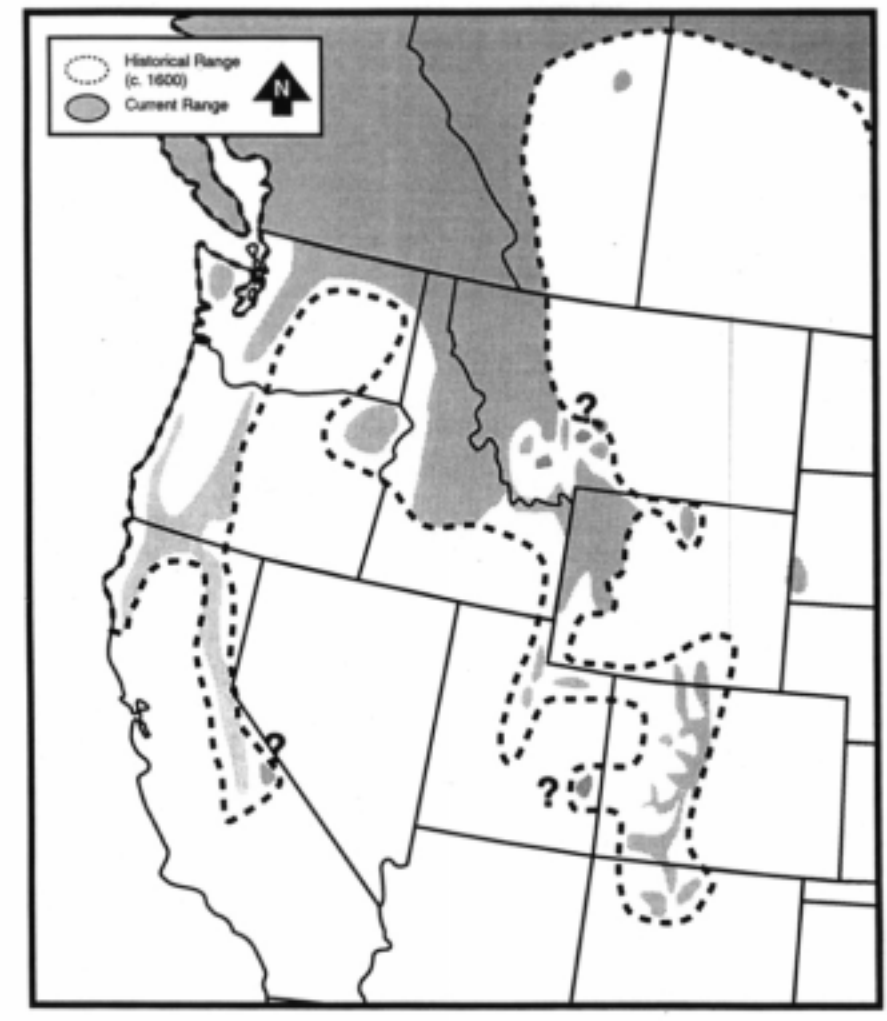
Marten range in North America— past and current (Gibilisco 1994)

P.O. Box 6733 ♦ Bozeman, MT 59771 ♦ 406-587-3389 ♦ fax: 406-587-3178

pca@predatorconservation.org ♦ *www.predatorconservation.org*


Historical Range
(c. 1600)
Current Range
N

Marten range in the western U.S. — past and current (Gibilisco 1994)



A. Current and historic marten distribution and numbers nationwide

Buskirk and Ruggiero 1994

"The American marten is broadly distributed. It extends from the spruce-fir forests of northern New Mexico to the northern limit of trees in arctic Alaska and Canada, and from the southern Sierra Nevadas of California to Newfoundland Island... in the western contiguous United States, its distribution is limited to mountain ranges that provide preferred habitat." (p. 7)

"On balance, the American marten has a smaller distribution now than in presettlement historical times (Gibilisco 1994); the total area of its geographic range appears similar to early this century, when it was at its historical low." (p. 10)

"Changes in patterns of distribution and abundance of martens indicate that this species is not secure throughout its range. In areas where populations appear to have been isolated by human actions, or where already isolated populations have had the carrying capacity of the habitat reduced, immediate measures to ensure persistence appear prudent..." (p. 29)

Gibilisco 1994

The distribution of marten in northwestern N. America appears to be relatively stable. Coastal marten in northern California eliminated around the turn of the century. Prognosis for marten on Olympic Peninsula is poor. In eastern N. America reoccupying much of historical range. Likely extinct on Cape Breton, Nova Scotia. Threatened in Newfoundland. Absent from historical range south and east of Great Lakes.

B. Protected Status of the Marten

1. Federal protections

Listed by the Forest Service as a "Management Indicator Species" in much of Region 1, 2, and 4; "Sensitive" throughout the West except in Montana and Idaho, and in Oregon and Washington where it is listed as a "Management Requirement" species (Macfarlane 1994).

2. State protections

The marten is listed as "endangered" in New Mexico, a "species of special" concern in Utah, "sensitive" in Oregon, and is trapped as a "furbearer" elsewhere except in Nevada (Macfarlane 1994).

3. Canada protections ???

Part II. Ecological factors limiting the survival and recovery of martens in North America

Buskirk and Ruggiero 1994

"The reproductive rates of martens are low, and longevity is high, by mammalian standards. This suggests that, for a 1-kg mammal, martens are slow to recover from population-level impacts." (p. 16)

Home ranges were recorded as large as 15.7 km2 (Mech and Rogers 1977)...
"... home ranges of American martens are 3-4 times larger than predicted for a 1-kg terrestrial carnivoran, and about 30 times that predicted for an herbivorous mammal of that size... home ranges in clearcut areas [have been reported at] 1.5-3.1 times the size of those in uncut areas." (p. 27)

"The marten is predisposed by several attributes to impacts from human activities. These attributes include its habitat specialization for mesic, structurally complex forests; its low population densities; its low reproductive rate for an animal its size; and its vulnerability to trapping…" (p. 29)

Clark et al., 1989

Home Range Size
Male 2.33 square kilometers (sd=2.03, range 0.02-6.63)
Female 1.10 square kilometers (sd=0.83, range 0.10-3.82)

"No seasonal differences in ranges were found. The martens studied showed spatial use patterns similar to that found for martens elsewhere" (Abstract, p. 423)

Part III. Science-based policies needed to protect and restore the marten and its habitat throughout the U.S. lower-48 states

A. Maintain and restore large areas of late-successional forested habitat

IDFG 1995

"The primary threat to continued population viability of martens in Idaho is habitat loss and fragmentation through harvesting of late successional forests. Marten are dependent on structural diversity associated with late successional or mature stands for denning, resting, and foraging habitat, thermal and escape cover, and gaining access to subnivean sites for resting and foraging during winter. Martens are susceptible to habitat fragmentation because of their large area requirements, specialized habitat needs, low dispersal abilities, and low biotic potential. Fragmentation of marten habitat through timber harvest activities can geographically and demographically isolate populations and lower population viability by disrupting dispersal and emigration/immigration processes." (p. 9)

Buskirk and Ruggiero 1994

"American martens... associate closely with late-successional stands of mesic conifers, especially those with complex physical structure near the ground..." (p. 7)

"... studies have generally shown that martens make little absolute or relative use of clearcuts for several decades and that marten populations decline after clearcut logging... studies showed consistent use/availability ratios <1 in shrub, sapling, and pole stages. Only when succession reached the "mature" stage did use/availability ratios begin to exceed one, and only "overmature" stands were constantly preferred." (p. 24)

"The mechanisms by which martens are impacted by timber cutting are the removal of overhead cover, the removal of large-diameter coarse woody debris, and, in the case of clearcutting, the conversion of mesic sites to xeric sites, with associated changes in prey communities..." (p. 25)

"In the western United States, the marten has undergone major reductions in distribution... The reduction and fragmentation of the geographic range of martens has resulted primarily from the loss of habitat due to timber cutting...

Buskirk and Powell 1994

In general martens prefer:

A) mesic forests over xeric forests:
    (1) In Rocky Mountains, high elevation stands dominated by spruce/fir
    (2) In temperate latitudes, riparian forests
B) structurally complex stands over simple stands
    (1) low and closed canopies
    (2) avoidance of open areas
C) late successional over early successional

Edge Effects:

In general martens prefer:

A) forest/meadow edges
B) Patches of preferred habitat that are interconnected by other forest types are used by marten but patches of preferred habitat that are separated by open areas of sufficient size are not likely to be used at all.

Seasonality: During winter, martens prefer conifer dominated over hardwood dominated forests and of conifer dominated stands over young ones. Even where limited use of non-forest cover in summer, avoid non-forested areas completely in winter.

Demography: Juveniles are less selective with respect to habitat preference than adults.

Life needs and habitat use:
(1) May need more cover to avoid predation; large amounts of Coarse Woody Debris may substitute for cover if available
(2) Access to subnivean spaces for prey
(3) Access to subnivean spaces for thermoneutral resting
(4) Prey must be predictable; therefore "catchability" of prey is critical and probably related to forest structure and prey abundance and behavior.

Managememt Recommendations: "Distributional losses of marten…populations in response to habitat change provide evidence that populations require the habitats that individuals, especially reproductive adults, behaviorally prefer." Thus, authors believe that martens require certain stand types such as old-growth conifers to survive.

Coffin 1994

"What makes these areas attractive to marten most likely depends on the size, amount, and placement of structural elements across the landscape in addition to their association with prey items." (p. 73)

"Presence of marten in southwest Montana is not contingent on abundant quantities of contiguous old growth forest, as marten are not restricted to old growth. Marten do seem to prefer traits associated with more mature timber stands such as larger diameter trees and downed woody material." (p. 73)

"Prey availability must influence habitat selection in pine marten. Because the marten is in many ways maladapted to harsh winter climates, it must have access to a reasonably constant food supply to survive. Cover types favored by marten tended to have more, or more vulnerable, red-backed voles and deer mice than less favored cover types. Habitat structure as well as species composition influenced prey availability." (p. 73-4)

Thompson and Harestad 1994

Critical habitat: Old forests. Reasons: predator avoidance (mature canopy), coarse woody debris (CWD), large diameter downfall, prey abundance – foraging success 21-119% greater in old-forest stands compared with successional forest.

Assumptions about habitat characteristics:
"(1) American martens will use forest with a canopy of at least 30% -- and prefer a canopy of 50-75%--in which more than half is provided by mature or old softwood trees.
(2) American martens prefer large-diameter downed wood for winter dens and as habitat for their major prey species….
(3) American martens require large-diameter standing old or dead trees for natal denning….
(4) American martens prefer forest with a complex understory or forest with fine-grained patches (gaps).

(5) In the short term, large cutovers (contiguous cuts over a 40-year period of 2 km2/year) eliminate American marten habitat. The more highly fragmented the mature forest becomes, the lower will be its carrying capacity for American martens.
(6) Carrying capacity of an even-aged mature conifer forest could be improved in thew short term by evenly dispersing a harvest of 20-25% of the stem basal area in 0.5 to 3.0 ha patches……
(7) Selective logging, including using a shelterwood system, will not reduce a habitat's carrying capacity for American martens if removals are kept below 30% of the stem basal area every 50 years in boreal and montane forests, or every 100 years in temperate rain forests."

For boreal coniferous and mixed-wood forest, 20% of the forest should be mature and old at any time. In Ontario, approximately 600 km2 of old forest habitat is necessary to maintain MVP of 237 American marten.

Buskirk 1992

"... habitat is the main concern involving martens and the fisher (*Martes pennanti*), especially in the northwestern United States" (p. 318)

"Most conservation concerns presented at the symposium revolved around population-level impacts on boreal forest martens and the fisher. The boreal forest martens show consistent close associations with mesic coniferous forests that have complex physical structure, most often in old, uneven-aged stands. In winter, when they are energetically limited, sables and American martens (Buskirk et al. 1998) specialize on small bird or mammal prey and rest in sites beneath the snow, often in association with coarse woody debris. They survive winter by highly selective use of stand ages and types, preferring those with dense and complex structure near the forest floor. This structure, including living branches, logs, and other coarse woody debris, is important because it provides protection from predators, access to spaces beneath the snow where prey animals live, and protected sites where martens can minimize energetic costs while resting. Where complex physical structure is lacking, either at the scale of the stand or the landscape, boreal forest martens and fishers tend to be scarce or absent. Major retrogressional habitat change, especially cutting of temperate and boreal coniferous forests, has interfered with natural forest dynamics, especially structural and vegetational heterogeneity. Intensive wood-production programs involving short rotation times generally provide little of either." (p. 318)

"Some have characterized the fisher and American marten as among the most climax-dependent of North American mammals (see Harris 1984:61). And the habitat area requirements of both species are enormous; home ranges of the American marten and fisher are about 50 times that predicted on the basis of body size (Buskirk and McDonald 1989; Powell, in press). Thus, their huge areal requirements may make martens and fishers useful umbrella species for the protection of temperate coniferous forests; habitat loss limited to that which can be tolerated by these species should provide protection for virtually all other vertebrates." (p. 319)

Buskirk et al. 1989

Critical habitat: Access to the subnivean (under snow) surface appeared from this study to be critical for marten survival.

Coarse woody debris (CWD): Established animals maintained home ranges in the areas with the highest density of CWD. Forty nine percent of sites and 63% of episodes were associated with subnivean CWD (logs and stumps).

Management Recommendations: "Resting site requirements of marten illustrate thermoregulatory adaptations and help explain the reported association of this forest carnivore with old growth forest during the cold season."

Mature spruce-fir forests have important implications for management of marten in the central Rocky Mountains due to the prevalence of CWD in these stand types. Retention of spruce-fir old growth is indicated.

1. Protect old growth and mature forest habitat for denning

Buskirk and Ruggiero 1994

"In virtually all cases involving standing trees, logs, and snags, dens were found in large structures that are characteristic of late-successional forests... Given the importance of natal dens to recruitment, the availability of structurally complex sites could have important implications for conservation." (p. 17)

Thompson and Harestad 1994

Management Recommendations:
(1) For areas where martens occupy limited areas of old forest: maintain as much old forest as possible for as long as possible. Even aged management not an option. Program should have following components:
"an improved database that refines information for individual stands, including age information more specific than pooling 20- to 40-year age groups; some measure of decadence, site type, and predicted regeneration trajectory; a carefully designed integrated pest management program to protect against outbreak of insect pests; a harvesting strategy to remove only the most decadent stands in small patches and in a manner that maintains connectivity among uncut areas,……retention of coarse woody debris during logging; GIS mapping of surrounding landscape to project future stand development……and monitoring of American marten populations and their habitat."
(2) Where habitat supply not immediately critical: ecosystem supply analysis…provide enough ecosystem availability to provide adequate habitat over time.

2. Limit clearcuts

Potvin et al. 2000

Clearcuts: Martens in this study were "intolerant of habitat fragmentation and cannot tolerate more than 30-35% cutovers in its home range"

Management Recommendations: Greater than 50% uncut forest should be preserved inside 10 km2 units and less than 30% of area should be clearcut over a 30 year period. "Uncut forest patches should be large (>100 ha) to maximize core area and minimize edge with open cutovers.

Chapin et al. 1998

Clearcuts: "Isolation of residual patches interacts with patch size to influence the spatial distribution of marten in landscapes with extensive clearcutting." No marten occupied a range with over 40% regenerating forest. Residual forest patches within clearcut landscape contained 82% of locations..96% of locations were within telemetry error of residual patches. Patches used by resident marten were 18 times larger (median = 27 ha) than patches with no use and were closer to adjacent forest preserves.

Management Recommendations: "Despite different spatial requirements, both males and females tolerated a median of only 20% regenerating clearcuts in their home ranges." "Long term planning to maximize residual patch area and minimize distance between large residual forest patches is recommended…."

Hargis and Bissonette 1997

Clearcuts: Captures of individual marten declined to zero when openings occupied over 25% of the landscape.

IDFG 1995

"Studies show clearcuts provide poor quality habitat and support lower density populations with highter mortality rates for at least 45 years after logging. Thompson and Harestad (1994) summarized findings of 10 habitat selection studies in relation to successional stage. They found marten consistently avoided "pole" or younger seral stages, used "mature" stages either in proportion to or greater than their availability, and consistently preferred "overmature" stages. Soutiere (1979) found marten densities reduced by 66% (0.40 resident adults/ square kilometer) in fragmented landscapes composed of 50% clearcut, 25% selectively cut, and 25% uncut habitat patches, compared with unfragmented landscapes; and found little use of 0-15 year old clearcuts. Thompson (1994) reported martens in 10-40 year old clear cuts experienced high mortality rates from predation and trapping, and Thompson and Harestad (1994) concluded that marten population levels in 0-45 year old regenerating clearcuts were 0-33% of those adjacent to uncut forest." (p. 17)

Buskirk and Ruggiero 1994

"... Robinson (1953) found that martens avoided traveling >23 m from forest edges in Colorado... [five other studies] have reported complete or partial avoidance of nonforested habitats. The size of openings that martens have been observed to cross have varied from 10 m ... to 40 m... to 100 m... In most cases, these are the largest openings that the authors observed to be crossed during their respective studies." (p. 26)

"Clearcutting, the most common timer harvesting practice in the northwestern United States in the last 20 years, is generally deleterious to marten populations. Regenerating clearcuts have little or no value as marten habitat for several decades... consistent preference is not shown by martens until stands reach the 'mature' or 'overmature' stage." (p. 29)

Thompson and Colgan 1994

Clearcuts: 90% reduction in numbers of American martens where more than 90% of timber removed.

Thompson and Harestad 1994

Clearcuts: Less than 20% canopy cover is seldom used by martens…uncut stands usually have around 50% canopy cover in winter. Successional forests after clearcutting (<45 yr after clear-cut) supported 0-33% of nearby uncut forest, depending on type of regeneration and amount of original forest removed. Where young forests used, marten subjected to high predation rates, were mostly young animals, and no reproduction.

Bissonette et al. 1989

"It is unknown how many years are needed after clear-cutting a site to regenerate adequately for marten, but data show that greater than 23 years are needed in Newfoundland (Snyder 1984)." (91)

"Clearly, marten prefer residual forest over clear-cut and regenerating areas, and will use patches of residual forest if greater than 15 ha. The clear implication is that interior, or core area is required. Our recommendations suggested a change in logging operations from large-scale clear-cuttings to much smaller-scale patch cuts." (93)

"[Marten] movements showed strong avoidance of clear-cut areas. Throughout the study, adult marten were found in clear-cuts in only 7 of 324 locations (2.2 percent)." (94)

Steventon 1982

“Soutiere (1979) reported that marten populations were reduced by two-thirds on an area of extensive commercial clear-cutting as compared to adjacent uncut or partially cut areas.” (p. 175)

“Our methods also gave insight into marten activities within the different habitats. Hunting, as indicated by a search pattern of circling and zig-zagging about a localized area, was associated with uncut and partially cut stands. Clear-cuts may have been underused because of poor hunting conditions for marten in this habitat. Our observations and other studies (Marshall 1951, Campbell 1979) have shown that marten use leaning trees, fallen logs, and other debris protruding above the snow for below-snow access while searching for prey in winter. The structure of slash resulting from clear-cutting may differ substantially from that resulting from natural tree mortality in an uncut forest. The generally smaller-diameter material protruding out of the snow in clear-cuts may not provide adequate access.” (p. 181)

Soutiere 1979

Clearcuts: Removal of 60% of timber resulted in population reduction of 67%.

3. Maintain coarse woody debris on the forest floor.

Potvin et al. 2000

"The most important structural elements for marten habitat in winter are coarse woody debris and coniferous saplings." In mature black spruce stands, CWD was lower in older stands, thus no structural advantage to mature black spruce forests, opposed to western North America. Dense coniferous cover not required; more structure dependent."

Buskirk and Ruggiero 1994

“Coarse woody debris, especially in the form of large-diameter tree boles, can address many of the needs that martens have for physical structure: predator avoidance, access to subnivean spaces..., and thermal protection...” (p. 25)

Corn and Raphael 1992

Important because it provides breaks in the snow for martens to reach below the snow surface. Downed logs were the most frequently used structure of CWD.

"CWD is an important component of marten winter habitat, and its provision and maintenance in marten habitat in managed forests of the central Rocky Mountains likely will require specific management efforts."

B. Protect martens from human-caused mortality

Buskirk and Ruggiero 1994

“Early season trapping tends to selectively remove juveniles, but seasons that extend into late winter or spring begin to remove more adults. Likewise, early trapping tends to selectively remove males, but trapping after the onset of gestation shifts toward selective removal of females.” p. 15)

“For over 40 years, researchers have emphasized the importance of refugia to the conservation of American martens.” (p. 26)

"... trapping may adversely affect some marten populations and may have contributed to or hastened local extinctions, especially where habitat quality was poor..." (p. 29)

C. Maintain connectivity between marten populations

Buskirk and Ruggiero 1994

"... biologists are generally agreed that over 5 kilometers of treeless land below the lower elevational limit of trees acts as a complete barrier to dispersal (Gibilisco 1994; Hawley and Newby 1957)." (p. 12)

"Several marten populations are known or hypothesized to have been isolated by human-caused habitat change. The genetic and stochastic processes that predispose small populations to extinction likely are acting on these remnants..." (p. 29)

1. Because of their wide range, marten conservation and management requires a regional perspective. Priority habitats for martens should be identified and protected, as well as areas of connection between these areas.

IDFG 1995

"Marten home ranges are large by mammalian standards and home range size is dependent on habitat quality and forage availability (Buskirk and McDonald 1989, reviewed by Buskirk and Ruggiero 1994)" (p. 12)

Gibilisco 1994

Author discusses disjunct nature of montane islands through most of range below Canada and implications for persistence and reoccupancy of martens in this habitat. No recorded martens for Snowy Mountains (Montana) of 733 km2 and 78 km from nearest population; recorded, persistent populations in Crazy Mountains (932 km2; 36 km from nearest population); and historic, but not present populations in the Tobacco Root Mountains (1120 km2; 18-20 miles from nearest population—the last likely due to human disturbance patterns.

"Marten biologists are nearly unanimous in believing that a distance of more than 5 km of unforested land below the conifer zone is a complete barrier to dispersal."

Managememt Recommendations: "In western areas, naturally isolated populations of American martens in particular are being further subjected to increasing human pressures and land-use changes."

Coffin 1994

"Marten home range size and movements are likely tied to site quality and prey availability. Marten during my study were very mobile. Gravel roads, paved highways, groomed snowmobile trails, or small streams did not inhibit movements." (p. 72-3)

2. Highways threaten martens due to direct mortality and especially because they may pose a barrier to movement, thereby isolating marten populations and areas of suitable habitat across the Rocky Mountains of the U.S. and Canada.

Bill Ruediger, Threatened, Endangered and Sensitive Species Program Leader for the Northern Region of the U.S. Forest Service, describes the current threat to the marten and other forest predators due to landscape fragmentation:

Ruediger et al. 1999

"As the highway system (and railroad) grows in size, traffic volume and total miles, its impacts on wildlife will grow. The impacts on low density carnivores like grizzly bears, wolves, lynx, wolverine and fisher will be more severe than most other wildlife species. This is due to their large home ranges, relatively low fecundity, and low natural population density. The adverse effects of highways to rare carnivores and other wildlife include serious habitat fragmentation, mortality, direct loss of habitat, displacement from noise and human activity and secondary loss of habitat due to human sprawl. (p.2)

"When traffic volume increases, there is an evolution of highways from gravel roads to paved two lane roads, and from two lane highways to more problematic four land highways and "super highways" like the Interstate system. The eventual result of such a progression in the highway system on rare carnivores is the slow strangulation of viability due to population isolation, loss of habitat, mortality of individuals and a decline in potential population size. All of these factors are primary causative agents in the decline and extirpation of wildlife worldwide. (p.2)

Ruediger et al. (1999) assesses the current landscape fragmentation problem in Montana and Idaho specifically:

"… The [land] ownership pattern is particularly problematic in western Montana, where mountain ranges are largely National Forest land, but the surrounding valley bottoms are mostly private lands. The private land is increasingly subject to subdivision, suburban sprawl and other uses incompatible to the long-term maintenance of wildlife habitat connectivity. Once the private lands are fully developed, western Montana will have only three large areas of carnivore refugia (Greater Yellowstone Area, Selway-Bitterroot Mountains and the Bob Marshall Wilderness-Glacier Park areas), with the remaining public land habitat in between these areas existing as "island" mountain ranges surrounded by developed private land. (p.5)

"… In northern Idaho from Coeur d'Alene north, key linkage areas between the Selkirk Mountains, Cabinet Mountains and the Bitterroot Mountains are at risk and will require restoration. In western Idaho, linkage to the Wallowa and Blue Mountains in Oregon and Washington is at risk or absent. In eastern Idaho, Interstate 15 provides a formidable barrier between the Greater Yellowstone area and Bitterroot Mountains. (p.6)

Other marten science "summary" documents:

- "Marten" *in* Scientific Basis for Conserving Forest Carnivores (Buskirk and Ruggiero 1994);
- "Habitat ecology of fishers and American martens" *in* Martens, Sables and Fishers: Biology and Conservation (Buskirk and Powell 1994);
- "A literature review for management of the marten and fisher on national forests in California" (Freel 1991);
- "Marten" *in* Wild Furbearer Management and Conservation in North America (Strickland and Douglas 1987).

Literature Cited

Berg, W., D. Kuen. 1994. Demography and range of fishers and American martens in a changing Minnesota landscape. Pp. 262-271 in S.W. Buskirk, A.S. Harestad, M.G. Raphael, and R.A. Powell (eds.). Martens, Sables, and Fishers: Biology and Conservation. Cornell University Press.

Bissonette, John, Richard Fredrickson, Brian Tucker. 1989. American marten: a case for landscape-level management. Trans. 54th N.A. Wildl. & Nat. Res. Conf.:89-100.

Burnett, Gary W. 1981. Movements and habitat use of American marten in Glacier National Park, Montana. Masters Thesis, University of Montana, Missoula.

Buskirk, Steven. 1994. Introduction to the Genus Martes. Pp. 1-10 in S.W. Buskirk, A.S. Harestad, M.G. Raphael, and R.A. Powell (eds.) Martens, Sables, and Fishers: Biology and Conservation. Cornell University Press.

Buskirk, Steven. 1992. Conserving circumboreal forests for martens and fishers. Conservation Biology 6(3):318-320.

Buskirk, Steven W., Steven C. Forrest, Martin G. Raphael, Henry J. Harlow. 1989. Winter resting site ecology of marten in the central Rocky Mountains. J. Wildlife Management 53(1):191-196.

Buskirk, S., R. Powell. 1994. Habitat ecology of fishers and American martens. Pp. 283-296 in S.W. Buskirk, A.S. Harestad, M.G. Raphael, and R.A. Powell (eds.). Martens, Sables, and Fishers: Biology and Conservation. Cornell University Press.

Buskirk, Steven W., Leonard F. Ruggiero. 1994. American Marten. Pp. 7-37 in L.F. Ruggiero, K.B. Aubry, S.W. Buskirk, L.J. Lyon, and W.J. Zielinski, tech eds. The scientific basis for conserving forest carnivores: American marten, fisher, lynx, and wolverine in the western United States. U.S. Dept. of Agriculture, Forest Service, Gen. Tech. Rep. RM-254.

Chapin, T.G., D.J. Harrison, D.D. Katnik. 1998. Influence of landscape pattern on habitat use by American marten in an industrial forest. Conservation Biology 12(6):1327-1337.

Clark, Tim W., Marc Bekoff, Tom M. Campbell, Tedd Hauptman, Bay D. Roberts. 1989. American Marten, Martes americana, home ranges in Grand Teton National Park, Wyoming. The Canadian Field Naturalist 103:423-425.

Clark, Tim W., Thomas M. Campbell III, Tedd N. Hauptman. 1989. Demographic characteristics of American marten populations in Jackson Hole, Wyoming. Great Basin Naturalist 49(4):587-596.

Coffin, Kenneth W. 1994. Population characteristics and winter habitat selection by pine marten in Southwest Montana Masters thesis, Montana State University, Bozeman, Montana, 93 pp.

Corn, J.G., M.G. Raphael.. 1992. Habitat characteristics at marten subnivean access sites. J. Wildlife Mgmt. 56(3):442-448.

Fager, Craig W. 1991. Harvest dynamics and winter habitat use of the pine marten in Southwest Montana Masters Thesis, Montana State University, Bozeman, 73 pp, September 1991.

Freel, Maeton. 1991. A literature review for management of the marten and fisher on national forests in California. U.S. Dept. of Agriculture, Forest Service, Pacific Southwest Region, Los Padres National Forest, July 1991.

Gibilisco, Charles G. 1994. Distributional dynamics of modern Martes in North America. Pp. 59-70 in S.W. Buskirk, A.S. Harestad, M.G. Raphael, and R.A. Powell (eds.). Martens, Sables, and Fishers: Biology and Conservation. Cornell University Press.

Hargis, C.D., J.A. Bissonette. 1997. Effects of forest fragmentation on populations of American marten in the intermountain West. Pp. 437-451 in G. Proulx, H.N. Bryant, and P.M. Woodard, editors. Martes: taxonomy, ecology, techniques and management. Provincial Museum of Alberta, Edmonton, Canada.

Hawley, Vernon D., Fletcher E. Newby. 1957. Marten home ranges and population fluctuations. Journal of Mammalogy 38(2):174-183.

IDFG. 1995. The American marten (Martes americana) in Idaho: habitat conservation assessment (HCA). Saving all the Pieces, The Idaho State Conservation Effort, Idaho Dept. of Fish and Game et al., draft dated Feb. 20, 1995.

Jones, Lawrence, Martin G. Raphael. 1990. Ecology and management of marten in fragmented habitats of the Pacific Northwest. Progress report: Fiscal Year 1990, U.S. Dept. of Agriculture, Forest Service, Pacific Northwest Research Station: Forestry Sciences Laboratory, 44 pp.

Koehler, Gary M., Maurice G. Hornocker. 1977. Fire effects on marten habitat in the Selway-Bitterroot Wilderness. J. Wildl. Manage. 41(3):500-505.

Kujala, Quentin J. 1992. Winter habitat selection and habitat status of pine marten in southwest Montana. State Wildlife Program, Furbearers and Predators, MT Dept. of Fish, Wildlife and Parks, USDA Forest Service, Montana State, Bozeman.

Lacy, Robert C., Tim W. Clark. 1993. Simulation modeling of American marten populations: vulnerability to extinction. Great Basin Naturalist, 53 (3):282-292.

Macfarlane, Diane. 1994. National Forest System status information. Appendix C (pp. 176-184) *in* L.F. Ruggiero, K.B. Aubry, S.W. Buskirk, L.J. Lyon, and W.J. Zielinski, tech eds. The scientific basis for conserving forest carnivores: American marten, fisher, lynx, and wolverine in the western United States. U.S. Dept. of Agriculture, Forest Service, Gen. Tech. Rep. RM-254.

Marshall, David. 1993. Status of the American Marten in Oregon and Washington. Draft unpublished report, Audubon Society of Portland, Oregon, 46 pp., June 1, 1993.

Martin, Sandra, Reginald Barrett. 1983. The importance of snags to pine marten habitat in the northern Sierra Nevada. Pp. 114-116 In Proceedings, Snag Management Symposium, Northern Arizona University, Flagstaff, Arizona, June 7-9, 1983.

More, Gavin. 1978. Ecological aspects of food selection in pine marten (Martes americana). Masters Thesis, University of Alberta, Edmonton, Spring 1978.

Potvin, F., L. Bélanger , K. Lowell. 2000. Marten habitat selection in a clearcut boreal landscape. Conservation Biology, 14(3):844-857.

Proulx, Gilbert, Harold N. Bryant, Paul M. Woodard (eds.). 1997. Martes: taxonomy, ecology, ecology, techniques, and management. Proceedings of the second international Martes symposium, The Provincial Museum of Alberta, Edmonton, Canada.

Snyder, J.E. 1984. Marten use of clearcuts and residual forest stands in western Newfoundland. MS Thesis. University of Maine, Orono.

Soukkala, Arthur M. 1983. The effects of trapping on marten populations in Maine. Masters Thesis, University of Maie, Orono, 41 pp., May 1993.

Soutiere, E.C. 1979. Effects of timber harvesting on marten in Maine. J. Wildlife Management, 43:850-860.

Spencer, Wayne D., Reginald H.,Barrett, William J. Zielinski. 1983. Marten habitat preferences in the northern Sierra Nevada. J Wildl Manage. 47(4):1181-6.

Steventon, J. 1982. Marten use of habitat in a commercially clear-cut forest. J Wildl Manage. 46(1):175-82.

Strickland, Marjorie A., Carman W. Douglas. 1987. Marten. Pp. 531-546 In M. Novak et al., eds. Wild furbearer management and conservation in North America. Pp. 683-694. Toronto, Ontario: Ontario Trappers Association and Ministry of Natural Resources.

Thompson, Ian D., Patrick W. Colgan. 1994. Marten activity in uncut and logged boreal forests in Ontario. J. Wildl. Manage. 58:279-288.

Thompson, D., A.S. Harestad. 1994. Effects of Logging on American Martens, and Models for Habitat Management. Pp. 355-367 in Martens, Sables, and Fishers: Biology and Conservation. S.W. Buskirk, A.S. Harestad, M.G. Raphael and R.A. Powell (eds.), Cornell University Press.

USDA. 1990. The effects of timber harvest on wildlife: Maverick Study. U.S. Dept. of Agriculture, Forest Service, Pacific Northwest Region, Forestry Sciences Lab, Wenatchee National Forest, Lake Wenatchee Ranger District, 10 pp.

White, Marshall. 1992. Declaration of the effects of the Land and Resource Management Plan of the Winema National Forest, Oregon, on the marten and its habitat. Unpublished report, 11 April 1992, 24 pp.

Zielinski, W., R. Barrett. 1997. Southern Sierra Nevada fisher and marten study: progress report IV, 15 May 1994 - 2 October 1996. Progress Report IV, USDA Forest Service, Pacific Southwest Research Station, University of California, 24 March 1997.