American Marten (*Martes Americana*)
Species Assessment

Prepared for the
Grand Mesa, Uncompahgre, and Gunnison National Forest
September 2005

Prepared by **Matt Vasquez**[1] with contributions by **Leslie Spicer**[1], 2005

[1] Biological Science Technician (Wildlife), Gunnison Ranger District

Reviewed and Edited by Clay Speas, Forest Fisheries Biologist and Tom Holland, Forest Wildlife Biologist

Cover photos taken by remote cameras at track plate and bait stations on the Gunnison Ranger District, Grand Mesa, Uncompahgre, and Gunnison National Forest.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

The American Marten is a focus of an assessment because it is a Management Indicator Species (MIS) on the Grand Mesa, Uncompahgre, and Gunnison National Forest (Forest), in addition to multiple National Forests in Region 2. The American marten is also categorized as a sensitive species by the USFS in Region 2. As a MIS, the American Marten serves as a barometer for species viability at the forest level. MIS have a dual functionality: 1) to estimate the effects of planning alternatives on fish and wildlife populations (36 CFR 219.19 (a) (1)) and 2) to monitor the effects of management activities on species via changes in population trends (36 CFR 219.19 (a) (6)).

In 2005, the Forest amended the Forest Plan for MIS and selected American marten (from here on referred to as marten) as an MIS to assess potential affects of Forest Management on spruce-fir and lodgepole pine cover types. In the 1991 Amended Land and Resource Management Plan for the Forest (USDA Forest Service 1991), martens were identified as an MIS for old growth spruce-fir forests (Table II-15, page II-42). Because martens utilize both spruce-fir and lodgepole pine forests, marten were selected to represent both cover types in the 2005 Amendment. Marten's significance as an indicator species is reflected by their special habitat needs in terms of coarse woody debris, closed over-stories, and interior old growth (Table II-16, page II-43).

A technical conservation assessment on the marten has not been prepared for Region 2 (USDA Forest Service, Rocky Mountain Region) through the Rocky Mountain Region's Species Conservation Project, although Buskirk (2002) has written a Conservation Assessment for the American Marten in the Black Hills National Forest, South Dakota and Wyoming, within Region 2. In addition, a Species Assessment was prepared for the marten on the Forest in 2001 and is included in the 2001 MIS Assessment for the Forest (USDA Forest Service 2001). Detailed information on the species management status and natural history, biology, distribution, abundance, habitat, and ecology on the Forest levels are included in these reports and summarized in the current report.

This report supplements the 2001 Species Assessment for the marten and incorporates new information that can be used for forest-level and project-level planning. The biology and conservation status of the marten on the Forest is addressed. The goal of this assessment is to summarize historical and current literature on the marten to provide land managers and the public with an objective overview of this species within the Forest. Peer reviewed scientific literature and summarized data are the primary information sources used in this report. Local data sources (District wildlife biologists and technicians) were used to provide information on distribution, localized abundance, and habitat condition for the Forest.

SUMMARY OF KEY FINDINGS

Many literature sources report that marten prefer and depend on mature late successional mesic conifer and mixed conifer stands containing intermediate canopies (30-70%). Martens have also been found strongly associated with stream and riparian corridors that are adjacent to conifer stands. Vertical and horizontal structural diversity in terms of abundant coarse woody debris and snags are important key habitat components, especially for den and rest sites, thermal regulation, and hunting.

The Forest is well within the range of this species and appears to support viable populations of martens. To date, martens have not been reported on the Uncompahgre Plateau, which may be attributed to a lack optimal habitat conditions in addition to a lack of connectivity between the Uncompahgre Plateau and other forested areas on the Forest. The Gunnison Basin Geographic Area, North Fork Valley Geographic Area, Grand Mesa Geographic Area, and the San Juan Geographic Area comprise the majority of primary marten habitat (578,386 acres) on the Forest and contain the current known distribution of martens on the Forest. The Uncompahgre Plateau Geographic Area comprises only 6% (34,596 acres) of primary marten habitat. Total potential habitat, consisting of all secondary and primary marten habitat conditions, encompasses approximately 1,076,568 acres.

Currently, neither the marten nor any of its local populations are listed under the Endangered Species Act. In Colorado, martens have been protected by state regulation since 1996, which specifies that martens cannot be legally taken at any time. Prior to 1996 trapping was the only legal means of taking martens.

Survey protocols used for marten on the Forest include snowtracking, sooted track plates, and photographic bait stations based on methodologies described by Zielinski and Kucera (1995). Twenty-eight marten territories are known to occur on the Forest. Territory identification is based on known marten distribution across the Forest. Less than 1% of suitable marten habitat has been surveyed on the Forest and therefore the number of documented territories may be substantially less than actual number of territories existing on the Forest. All suitable habitats surveyed resulted in marten detections. Survey methods have focused primarily on presence/absence, distribution, and habitat inventory. Survey results have provided distribution information and insight on general habitat characteristics and habitat quality.

The effects of management activities on martens generally depend on their intensity, extent, and duration. Management activities most likely have the greatest affect on population viability when intensive management, particularly timber harvest, occurs in the best-quality habitats. Specifically, intensive management that causes reductions in canopy cover, removal of coarse woody debris, loss of future recruitment of coarse woody debris, reductions in size of future coarse woody debris, and increases in road densities affects habitat use, habitat preference, or habitat quality for martens (Buskirk 2002). Forest stands that have reached a stage where mortality of larger trees has occurred are important key habitat components of marten habitat.

HABITAT CRITERIA USED IN FOREST-WIDE HABITAT EVALUATION

2001 MIS Habitat Criteria

In 2001, potential suitable habitat for the American marten was modeled using existing vegetation data (Figure 1) from the Forest Integrated Resource Inventory (CVU-covering 77% of the Forest). Additionally, GAP Vegetation data produced by the Colorado Division of Wildlife was utilized for areas where forest vegetation data was not available (23% of the Forest). Queries were based on vegetation cover type and habitat structural stage. Spruce-fir was identified as the primary habitat cover type with habitat structural stages consisting of mature closed canopy 4B and 4C. Secondary habitat cover types were lodgepole pine and Douglas-fir in the 4B and 4C habitat structural stages.

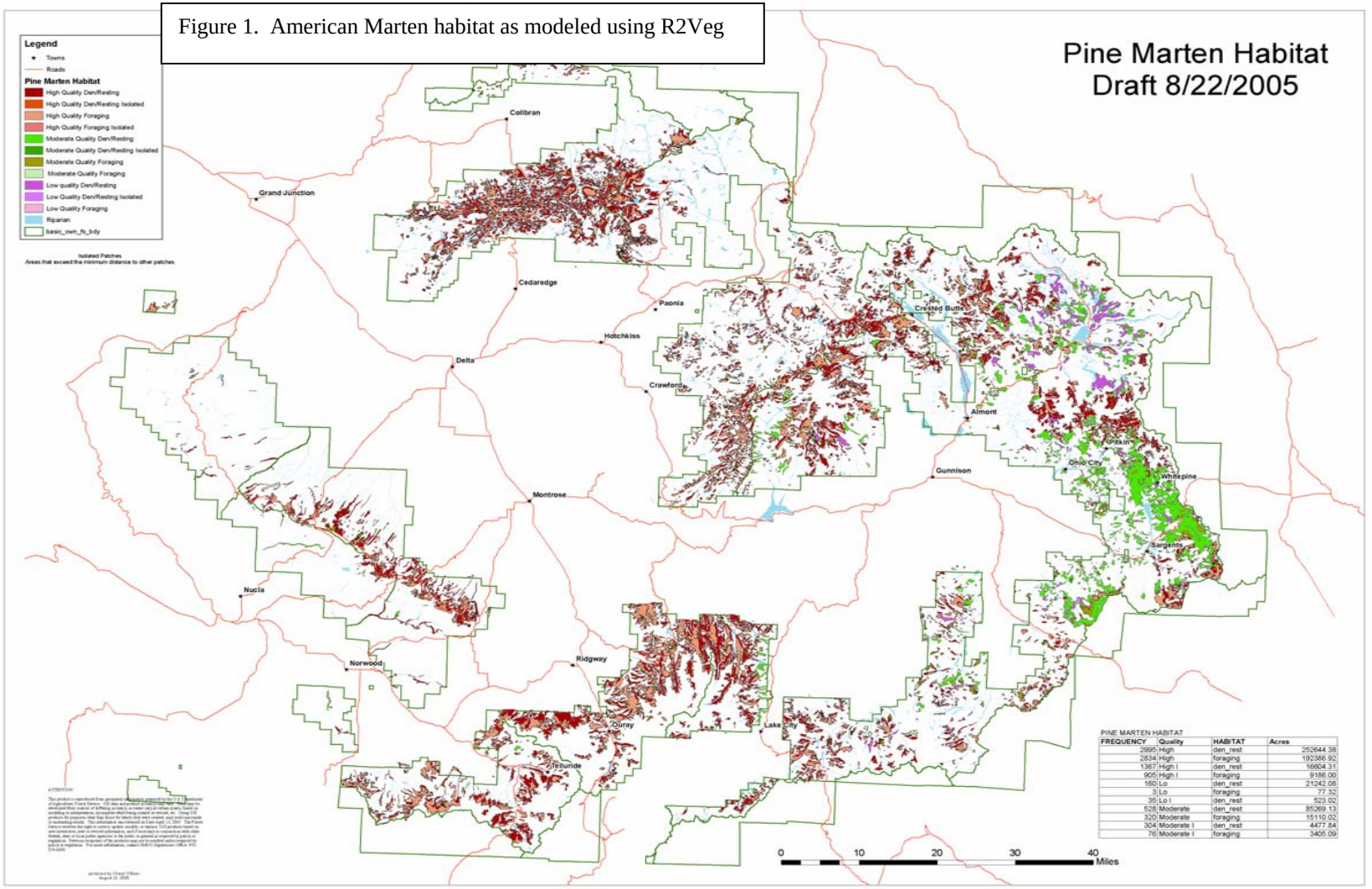
Rationale

Currently, approximately 22% (748,058 acres) of the Forest is spruce-fir, lodgepole pine occupies 8% (280,290 acres) of the Forest, and Douglas-fir and blue spruce encompass less than 2% (48,238 acres) of the Forest. Marten use of forest stand types may be dependent on spatial availability; consequently, martens likely occupy stand types in proportion to spatial availability. Since the spruce-fir cover type encompasses the largest portion of the Forest, marten use of this cover type is likely greater than other conifer cover types.

2005 MIS Habitat Criteria

Following publication of the 2001 MIS Assessment, vegetation data (CVU R2-Veg) now exists for all areas of the Forest and is continuously being updated. This should result in mapping that more reliably depicts suitable marten habitat on the Forest. Queries were based on vegetation cover type, habitat structural stage, tree size class, and tree condition. Spruce-fir and lodgepole pine with habitat structural stages consisting of mature 4B and 4C (canopy closure 30 – 70%) were considered primary marten habitat. Additionally, high elevation riparian within a specified elevation range (excluding pinyon-juniper and ponderosa pine, the elevation range included the elevation occurrence of coniferous forest cover types within the forest boundary) was mapped as primary habitat within 4B and 4C spruce-fir, lodgepole pine, Douglas-fir, and blue spruce cover types. Primary habitat designations excluded the 4A habitat structural stage because 4A stands (0 – 40% Canopy Cover) may not provide adequate canopy cover for marten during winter. All habitat structural stages of Douglas-fir and blue spruce, in addition to spruce-fir and lodgepole pine associations with habitat structural stages of 1, 2, 3A, 3B, 3C, and 4A, were considered secondary habitat in

Figure 1. American Marten habitat as modeled using R2Veg



that they provide connectivity between mature conifer stands and foraging opportunities. Martens may utilize the edges of small openings (less than 300 feet wide) for foraging. Marten use of forest openings is limited to openings that contain escape cover such as overhead vegetation, rocks, or coarse woody debris. Due to the coarse grain nature of the CVU R2-Veg GIS layer, we are unable to map small meadows (less than 5 acres in size) containing a width of less than 300 feet. By mapping all habitat structural stages depicting primary and secondary habitat of spruce-fir, lodgepole pine, high elevation riparian, Douglas-fir, and blue spruce, small forest openings that meet the habitat requirements for marten will likely be included within those cover types.

Additional habitat attributes supporting primary and secondary habitat designation included the presence of abundant coarse woody debris, snags in various decay classes, and high vertical and horizontal diversity. Habitat queries utilizing the tree size class attribute focused on categories L (large tree size of 9.0 – 15.9 inch DBH) and V (very large tree size of 16.0 DBH or greater). Habitat queries utilizing the tree condition attribute focused on categories P (declining crowns or scattered dead trees present), S (Significant amount of dead trees present), and D (dead present). Primary and secondary habitat was also categorized as high, moderate, or low quality habitat based on its suitability for martens and the likelihood of marten occurrence within those areas. Habitat parameters for modeling marten habitat are summarized in Table 1. Table 2 reflects modeled acres of denning, resting, and foraging habitat by habitat quality using these criteria.

Table 1. Habitat parameters for modeling Marten habitat.

	Primary Habitat		Secondary Habitat
Habitat Parameter	**High Quality (Optimum)**	**Moderate Quality (Suitable)**	**Low Quality (Marginal)**
1. Foraging Requirements	4b, 4c, 5 stands containing > 50% spruce-fir, primarily multiple canopy layers, interspersed with small (<0.5 ac) openings containing good ground cover (rocks, talus slopes, logs, stumps, abundant herbaceous vegetation Dense high elevation riparian corridors w/in 4b, 4c, 5 spruce-fir stands	4b, 4c, 5 stands containing > 50% lodgepole pine, primarily multiple canopy layers, interspersed with small (0.5-2ac) openings containing good ground cover Dense high elevation riparian corridors w/in 4b, 4c, 5 lodgepole pine, Douglas-fir, and blue spruce stands	1, 2, 3a, 3b, 3c, 4a spruce-fir and lodgepole pine stands and dense high elevation riparian corridors w/in these stands* 1, 2, 3a, 3b, 3c, 4a, 4b, 4c, 5 Douglas-fir and blue spruce stands* Dense high elevation riparian corridors w/in 1, 2, 3a, 3b, 3c, 4a Douglas-fir and blue spruce stands* Single canopy becoming more prominent then multiple canopy layers > 25% of forest stands should be in mature conditions
2. Cover Requirements	4b, 4c, 5 stands containing > 50% spruce-fir, primarily multiple canopy layers Dense high elevation riparian corridors w/in 4b, 4c, 5 spruce-fir stands	4b, 4c, 5 stands containing > 50% lodgepole pine, primarily multiple canopy layers Dense high elevation riparian corridors w/in 4b, 4c, 5 lodgepole pine stands	3b, 3c, 4a spruce-fir, lodgepole pine, Douglas-fir, and high elevation riparian Single Canopy becoming more prominent than multiple canopy layers > 25% of forest stands should be in mature conditions
3. Denning/Resting Habitat	4b, 4c, 5 stands containing > 50% spruce-fir, primarily multiple canopy layers Dense high elevation riparian corridors w/in 4b, 4c, 5 spruce-fir stands	4b, 4c, 5 stands containing > 50% lodgepole pine, primarily multiple canopy layers Dense high elevation riparian corridors w/in 4b, 4c, 5 lodgepole pine stands	4a spruce-fir and lodgepole pine, single canopy becoming more prominent than multiple canopy layers Dense high elevation riparian corridors w/in 4a spruce-fir and lodgepole pine stands
4. High Elevation Riparian Proximity to Denning and Resting Stands	< or = 0.25 mi	> 0.25-0.5 mi	0.5-1 mi
5. Denning, Resting, Winter Habitat Canopy Closure	> 70%	50-70%	30-49%
6. Forest Canopy Height	> or = 49 ft	33-48 ft	16-32 ft
7. Minimum Size of Isolated Habitat Patches	> or = 37 acres	> or = 37 acres	< 37 acres
8. Distance of Isolated Habitat Patches to Nearest Habitat Patches	< 100 ft	100-199 ft	200-300 ft
9. Core Habitat Area Size	12 - 19 square miles or greater Minimum of 7,680 ac	12 - 19 square miles or greater Minimum of 7,680 ac	> 19 square miles*** Minimum of 12,160 ac
10. Core Habitat Area Stand Structure	> 75% (> 5,760 ac) should be comprised of optimal to suitable marten habitat specified above under forage and cover requirements > 4,176 ac required for foraging > 1,584 ac required for cover	> 75% (> 5,760 ac) should be comprised of at least suitable marten habitat specified above under forage and cover requirements > 4,176 ac required for foraging > 1,584 ac required for cover	> 75% (> 9,120 ac) should be comprised of suitable to marginal marten habitat specified above under forage and cover requirements > 6,612 ac required for foraging > 2,508 ac required for cover
11. Habitat Spacing Distance Between Core Habitat Areas**	< 0.6 mi	< 0.6 mi	0.6 - 1.2 mi
12. Travel Corridor Width	> 300 ft within mature stands > 600 ft if corridor is adjacent to openings or areas of no canopy	150-299 ft within mature stands 300-599 ft if corridor is adjacent to openings or areas of no canopy	100-149 ft within mature stands 200-299 ft if corridor is adjacent to openings or areas of no canopy

	Primary Habitat		Secondary Habitat
Habitat Parameter	**High Quality (Optimum)**	**Moderate Quality (Suitable)**	**Low Quality (Marginal)**
13. Travel Corridor Canopy Closure	> 50-70%	> 50-70%	30-50%
14. Size of Openings	< 0.5 ac each	> = 0.5-2 ac each	> 2-3 ac each
15. Coarse Woody Debris Densities	> 20 per ac that are > or = 15 inches dbh and at least 15 ft in length Intermediate decay classes preferred	10-19 per ac that are > or = 15 inches dbh and at least 15 ft in length Intermediate decay classes preferred	5-9 per ac that are > or = 15 inches dbh and at least 15 ft in length Intermediate decay classes preferred
16. Snag Densities	at least 6 per acre, at least 2 with a minimum dbh of 12 inches	at least 6 per acre, at least 2 with a minimum dbh of 12 inches	< 6 per acre, with 2 or less with a minimum dbh of 12 inches
17. Road Densities	< 1 mi per square mi	1-2 mi per square mi	> 2-3 mi per square mi

^ Habitat parameters for marten are based on literature reviews documented in the 2005 American marten MIS assessment and distribution of habitat and marten detections on the Forest

* Habitat structural stages 1 and 2 need to conform to minimum sizes of openings specified under habitat parameter # 14

** Core habitat areas should be connected by riparian reserves and other unharvested forests. Connectivity between core habitat areas does not need to be continuous, but gap distance should conform to minimum distances specified under habitat parameter # 11

*** Core habitat areas comprised primarily of secondary habitat characteristics will need to be larger to provide the habitat requirements necessary to support martens

Table 2. Acres of marten habitat on the Forest based on habitat parameters and habitat quality.

	Habitat Quality			
Habitat Parameter	**Primary**		**Secondary**	
	High	**Moderate**	**Low**	**Total**
Denning/resting	269,248	89,747	21,765	380,760
Foraging	201,573	15,110	77	220,165
Total	470,821	104,857	21,842	600,925

Rationale

Forest-wide, marten habitat use will likely occur primarily in spruce-fir associations. However, 20% of the Forest within the Gunnison Basin Geographic Area is comprised of lodgepole pine. Consequently, martens will likely utilize lodgepole pine associations in the Gunnison Basin G.A. to a much greater extent compared to the other geographic areas on the Forest.

The habitat capability model (Habcap) is a computerized tool for quantitative habitat analysis. It provides estimates of the capability of habitats to support wildlife species based on the mix of vegetation cover types and structure present in an area. This model was developed for application at the planning area and project area analysis levels for Forest Plan implementation and is utilized as one of the tools for determining criteria to model marten habitat. The model generates a Habitat Capability Index (HCI) value that is a measure of overall habitat value of an area based on forage and cover quantity and quality. An HCI value of 1.0 represents optimum habitat. The cover types and habitat structural stages described as primary and secondary habitat for marten are given the highest coefficient values for both cover and forage habitat for marten in the Habcap model. Habcap provides lower coefficient values for habitat structural stages 1-4A for the proposed primary and secondary habitat cover types. Habcap coefficients for marten cover and foraging habitat are provided in tables 3 and 4. A value of 1.0 is optimal habitat and 0 is considered unsuitable.

Table 3. Cover structural stage values from Habcap for American Marten

Cover Type	**1**	**2**	**3A**	**3B**	**3C**	**4A**	**4B**	**4C**	**5**
Spruce-fir	0.1	0.2	0.2	0.2	0.3	0.5	0.8	0.9	1
Lodgepole Pine	0.1	0.1	0.1	0.2	0.3	0.3	0.8	0.8	0.8
High Elevation Riparian	0.1	0.2	0.2	0.2	0.3	0.5	1	1	1

Douglas fir	0.1	0.1	0.1	0.2	0.2	0.3	0.5	0.7	1

Table 4. Feeding structural stage values from Habcap for American Marten

Cover Type	1	2	3A	3B	3C	4A	4B	4C	5
Spruce-fir	0.1	0.2	0.3	0.5	0.3	0.5	0.8	0.7	1
Lodgepole Pine	0.1	0.1	0.1	0.2	0.2	0.3	0.6	0.7	0.8
High Elevation Riparian	0.6	0.5	0.5	0.5	0.3	0.5	0.8	0.7	1
Douglas fir	0.1	0.1	0.1	0.2	0.2	0.3	0.5	0.5	0.7

HCI values of 1 represent optimum habitat, HCI values of 0.5 represent marginal habitat, and HCI values near 0 represent low quality habitat.

MANAGEMENT STATUS AND NATURAL HISTORY

Management Status

- **USDA Forest Service:** Regions 2 and 5 have designated the marten as a sensitive species, one for which population viability is a concern, as evidenced by a current or predicted downward trend in population numbers or habitat (Forest Service Manual 2670.5). In addition to being a Forest Service Sensitive Species, the Forest classifies the marten as a Management Indicator Species.
- **USDI Fish and Wildlife Service:** The marten is not listed under the Endangered Species Act.
- **Colorado Division of Wildlife:** The marten is classified as a furbearer, but the hunting season has been closed. In Colorado, trapping, the only legal means of taking martens was banned by referendum in 1996 (Andelt et al. 1999).

Existing Regulatory Mechanisms, Management Plans, and Conservation Strategies

Buskirk (2002) lists 9 species assessments, management plans, or conservation strategies for the American marten (refer to Literature Cited for full citations):

- Bennett and Samson 1984
- Beaudette 1991
- Biological Staff 1996
- Forsey et al. 1995
- Marshall 1994
- Patton and Escano 1990
- Rodrick and Milner (eds.) 1991
- Ruggiero et al. 1994
- Watt et al. 1996

The marten is considered a furbearer in Colorado and has been protected against "take" by the Colorado Division of Wildlife since 1996. The USFS Rocky Mountain Region includes the marten on the Regional Forester's sensitive species list. Under Region 2's sensitive species policy (http://www.fs.fed.us/im/directives/field/r2/fsm/2600/2670.doc), conservation strategies are to be developed and implemented for sensitive species and their habitats, in coordination with other USFS units, managing agencies, and landowners (USDA 2003). The Forest has incorporated recommendations into management direction for the marten (Table 5) set forth in the Amended Land and Resource Management Plan for the Forest (USDA Forest Service 1991). The Forest has implemented survey protocols for the marten following methodologies outlined by Zielinski and Kucera (1995).

Table 5. 1991 Amended Land and Resource Management Plan standards and guidelines for the marten.

Management Activities	General Direction	Standards and Guidelines
Aquatic and Terrestrial Habitat Management	Manage for habitat needs of indicator species (FP III-24).	b. Pine Marten (old growth spruce-fir): Created openings should be less than 300 ft in width. Provide diversity of forest communities.
	Manage habitat for viable population of all existing vertebrate wildlife species (FP III-26).	a. Maintain habitat capability at a level at least 40% of potential capability[1]
Diversity on National Forests and National Grasslands	Maintain structural diversity of vegetation on units of land 5,000 to 20,000 acres in size, or fourth-order watersheds that are dominated by forest ecosystems.	c. In forested areas of a unit, 5-12% or more will (where biologically feasible) be in an old growth forest classification and must occur in irregular shaped patches. Designated spruce-fir and mixed conifer old growth patches shall be no smaller than 30 acres in size and should average 100-200 acres in size whenever possible…For every 10,000 acres of forest land capable of providing forest stands meeting old growth criteria, 500-1,200 acres of old growth will be evenly distributed throughout the unit. In addition, other stands within the same unit will be designated so that these stands will be managed on extended rotations in order to develop their old growth structure and values so that these stands will serve as old growth replacement stands.
	In forested diversity units, maintain an average of 200-300 snags (in all stages of development) per 100 acres, well distributed over the diversity unit (FP III-9b).	a. Snag dependent species must be maintained by providing habitat that will maintain minimum viable populations.
		b. Maintain 10-20 tons of logs and other down woody material per acre for species dependent on this material for their habitat.

[1] This standard and guideline varies with specific Management Area direction.

Biology and Ecology

Marten is a mink-sized member of the mustelid family with highly specialized habitat requirements. Their specialized habitat requirements may be influenced significantly by management practices resulting from land use allocations. They prefer mesic mature coniferous forests, with a complex physical structure near the ground (Watt et al. 1996). These features provide den sites, resting sites, thermal cover, and protection from predators. Den and resting sites are found in live trees, snags, logs and root balls depending on the season (Watt et al. 1996). A portion of these structures must be large enough for the rearing of young. In Maine, trees and logs of 40 cm dbh (15.7") were preferred by marten for the purpose of rearing young (Wynne and Sherburne 1984). Female marten are more restricted to mature forests due to the rearing of young (Sadoway 1986). Mature coniferous forests with a canopy cover of 30-70% reduce snow depth and moderates winter temperatures, which is important for marten survival (Watt 1996). Subnivean spaces created by coarse woody debris and exposed saplings are important for providing adequate hunting terrain and thermal cover in winter. Importantly, riparian and stream corridors are utilized for hunting and determining marten home ranges (Spencer et al. 1983, Jones and Raphael 1990).

Marten home ranges often overlap. Male home ranges in the Western United States have been found to be from 0.8 km^2 – 4.9km^2 (0.3 mi^2-1.8 mi^2) with female home ranges from 0.7km^2 – 3.4km^2 (.27 mi^2-1.3 mi^2) (Burnett 1981, Hawley and Newby 1957, Martin 1987, Spencer 1981), dependent upon prey quantities and cover. Adult females typically have home ranges approximately one-third to one-half the size of males. The home ranges of males are distinct; however, female home ranges often overlap with those of other females and males. The boundaries of marten home ranges often coincide with the edges of topographic or vegetative features such as open meadows, burns, and streams.

Martens are typically generalized carnivores preying upon a wide variety of species and not exhibiting a dependency upon one particular prey species. Marten diets vary according to the gender, season, prey availability, and geographic location. Food items include but are not limited to red backed voles, red squirrels, mice, snowshoe hare, bird eggs, nestlings, insects, fish, young mammals, berries, wood fiber, lichen and grass (Bull 2002). Larger prey items such as the snowshoe hare become more important during the winter months. The importance of these larger prey items increases as the winter progresses. (Raine 1987, Thompson and Colgan 1994). Martens will forage daily but tend to hunt during the night in summer

months and shift to daytime hunting activity in winter. Martens do not exhibit seasonal or altitudinal migrations although their home ranges shift in size depending on the season (Jones et al. 1990) and response to prey availability.

Female marten are sexually mature at 15 months of age. Marten have delayed implantation with the majority of mating activity occurring in June and July. Female marten produce 1 litter per year of 1-5 kits (Strickland and Douglas 1987). Kits are born in March through April and stay with their mother until September or October, when juveniles disperse. Juveniles can disperse up to 40 – 60+ km (Strickland and Douglas 1987).

Species-Habitat Relationships

Extensive literature sources document that marten prefer and depend on late successional mesic conifer and mixed conifer stands containing intermediate canopies (30-70%), which become increasingly important during winter months (Buskirk 2002, Witmer et al. 1998, Watt 1996, Lundrigan and Fillier 1995, Buskirk and Powell 1994). During winter, martens typically avoid conifer stands with less than 30% canopy cover (Koehler et. al. 1975). Vertical and horizontal structural diversity in terms of abundant coarse woody debris and snags are important habitat components necessary to meet the marten's life history requirements for den and rest sites, thermal regulation, and hunting opportunities (Wynne and Sherburne 1984). Snags are used primarily for resting and natal and maternal den sites (Wynne and Sherburne 1984, Jones and Rapheal 1990, Flynn and Schumacher 2001).

Martens are also associated with stream and riparian corridors that are adjacent to conifer stands. Conversely, Lundrigan and Fillier (1995) found that marten strongly avoided scrub and bog areas. Several studies have reported marten using open areas during the summer months (Dice 1921, Grinnell et al. 1937, Marshall 1951, Streeter and Braun 1968, Koehler and Hornocker 1977, Soutiere 1979). Spencer et al. (1983) found that marten in their study area avoided open areas year round. Others have found that marten use meadow edges heavily (Simon 1980). Spencer et.al. (1893) found that marten use lodgepole pine for foraging but still retreated to old growth stands for resting. This tendency was also observed for the use of riparian areas. Lodgepole pine stands overall are more useful to marten than meadows because they not only provide food but cover (Spencer et.al. 1983). Extremely dense stands, which reduce herbaceous cover, were avoided by marten (Koelher et. al 1975, Spencer et. al. 1983).

The extent and arrangement of forest fragmentation can have a negative affect on marten. Forest stands with greater than 25% of non-forest cover have been found nearly devoid of marten. Hargis (1999) reported that forested landscapes with less than 100 m between open patches "appeared unsuitable for marten", but he did not specify the size of open patches or what the concentration of open patches within an area would be that would compromise connectivity and render habitat unsuitable. Martens avoid large openings and clearcuts, especially in winter (Soutiere 1979, Clark and Cambell 1979; Stevenson and Majors 1982; Hargis and Mcullough 1984). Watt et al. (1996) suggests that to meet marten habitat needs "core habitat areas" should be 11.5-19 mi^2 (30-50 km^2) within which 75% of the core area contains suitable stands, and gaps of open areas between core areas should not exceed 0.6-1.2 miles (1-2 km.) across.

Vertical and horizontal structure may be more important in providing suitable marten habitat than forest age or forest composition (Buskirk and Powell 1994, Chapin et al. 1997, Takats et al. 1999). Coarse woody debris may not be a limiting factor for marten (Takats 1999) if marten are hunting prey species that occur above the subnivean zone such as snowshoe hares, or if there is an understory forest structure of conifer saplings that are also used commonly by martens as access structures (Corn and Raphael 1992, Takat 1999). Marten habitat use fluctuates depending on life history requirements. Martens are dependent on coarse woody debris and snags primarily during the winter and spring when the downed woody component provides denning habitat and subnivean access to prey. During the spring, summer, and fall, martens may be found in habitat types that lack coarse woody debris, particularly in late summer and early fall when juvenile martens begin dispersing. During the summer, non-forested areas such as rock piles, talus slopes, and forest openings may be used for foraging. However, research indicates that forest openings greater than 300 feet in width discourage use and may act as barriers to marten movements (Hoover and Wills 1984).

Available Habitat and Local Distribution

Marten are dependent on mature and old growth coniferous forests (Takats et al. 1999) associated with small openings and high elevation riparian habitat. The Forest currently supports approximately 600,925 acreas of denning, resting and foraging habitat for Marten (Table 7). This is approximately 18% of the land base of the Forest. Sixteen percent of the Forest is primary (moderate and high quality) denning/resting and foraging habitat that is contiguis to other suitable habitat. Approximately 30,268 acres of primary habitat that is greater than 37 acres in size is isolated from other suitable habitat. High quality habitat is composed of 4b, 4c, and 5 spruce fir stands with greater than 50% canopy cover. Moderate quality is lodgepole stands composed of 4b, 4c, or 5 structural with greater than 50% canopy cover.

Table 7. Acres of marten habitat on the Forest based on habitat parameters and habitat quality.

	Habitat Quality							
Habitat Parameter	**Primary**				**Secondary**			
	High	**High Isolated**	**Moderate**	**Moderate Isolated**	**Low**	**Low Isolated**		**Total**
Denning/resting	252,644	16,604	85,269	4,478	21,242	523		380,760
Foraging	192,387	9,186	15,110	0	77	0		220,165
Total	445,311	25,790	100,379	4,478	21,319	523		600,925

Martens, particularly juveniles, may use forest stand types in proportion to their availability (Buskirk et al. 1989) and marten distribution and habitat use across the Forest has been primarily in spruce-fir. On the Forest, there are 49 documented occurrences of marten in spruce-fir, 10 documented occurrences in lodgepole pine, eight detections in aspen, one observation in limber pine, and one observation at the edge of a grassland cover type. Documented occurrences of marten in lodgepole pine have been within the Gunnison Basin Geographic Area. These cover types with marten occurrences have typically been associated with large diameter downed wood, large diameter standing trees, leaning logs and trees, decayed or overturned stumps, snags and coarse woody debris in various decay stages, and large rocks, trees, or saplings. Where marten detections have occurred in aspen, spruce-fir has been a component of the tree species mix within those stands or spruce-fir stands were adjacent to those aspen stands. Marten detections within 1M – 3C habitat structural stages were adjacent to larger blocks of contiguous mature spruce-fir or lodgepole pine cover types. Marten detections by cover type and habitat structural stage is summarized in Table 8.

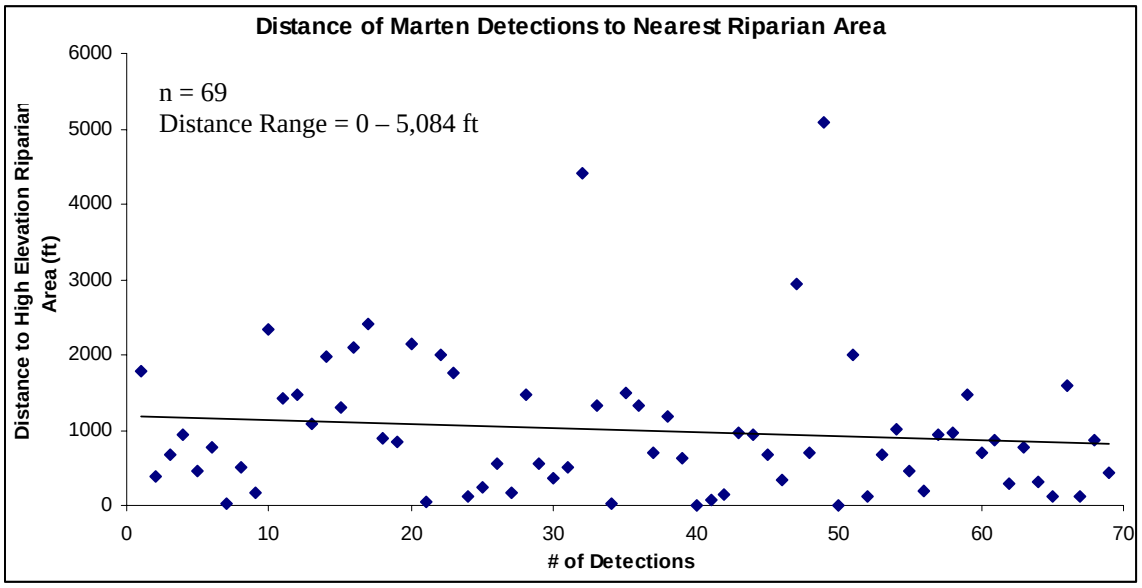
Table 8. Distribution of Marten detections by cover type and habitat structural stage on the Forest. [1]

Cover Type	**1M**	**3A**	**3B**	**3C**	**4A**	**4B**	**4C**	**Total**
TSF			6	1		21	21	49
TLP			2	2	1	1	4	10
TAA		1	2			2	3	8
TLI						1		1
GRA	1							1
Total	**1**	**1**	**10**	**3**	**1**	**25**	**28**	**69**

[1]Refer to Appendix A for marten habitat and detection distribution map.

Additionally, 50 marten detections have occurred within ¼ mile of a high elevation riparian area. Sixteen detections have occurred between ¼ mile and ½ mile from a high elevation riparian area, and 3 detections were greater than ½ mile from a riparian area. Overall, all marten detections are within 1 mile of a high elevation riparian area (Figure 2).

Figure 2. Marten detections in relation to riparian areas on the Forest.



There have been no documented occurrences of marten on the Uncompahgre Plateau. This is likely due to habitat isolation related to a lack of connectivity between forest cover on the Uncompahgre Plateau and other forested areas on the Forest. Approximately 12% (42,928 acres) of forested habitat on the Uncompahgre Plateau may be suitable for martens, but much of this habitat exists in forest stringers along drainages or occurs in small patches intermixed with other cover types typically not utilized by martens. Marten have been documented using small residual patches but require larger patches to support their home range (Chapin et al. 1998). To be considered suitable, isolated habitat patches should be 15 ha (37 acres) or larger (Snyder 1984) and should be near patches of larger contiguous habitat. Buskirk (2002) proposes that martens are believed to be behaviorally incapable of dispersing across non-forested habitats greater than 10 – 20 km (6 – 12 mi). Conifer forest habitats separated by just a few kilometers of shrubland or grassland can be completely isolated from each other over ecologically meaningful time periods (Buskirk 2002). This population insularity, in combination with small island size, leads to small, geographically closed populations, which are predisposed to stochastic and genetic processes that cause them to go extinct (Soule 1987, Buskirk 2002).

Suitable marten habitat on the Uncompahgre Plateau is isolated from other forested habitats on the Forest, and therefore may not be capable of supporting viable marten populations. Additionally, martens have been found absent from isolated mountain ranges containing less than 1,639 km^2 (633 mi^2) of coniferous forest habitat (Buskirk 2002). Coniferous forest habitat suitable for martens on the Uncompahgre Plateau is 42,928 acres, which is only 174 km^2 (67 mi^2). All forested cover types on the Uncompahgre Plateau encompasses approximately 382,733 acres, which is 1,549 km^2 (598 mi^2). Assuming a minimum viable population size of 10 individuals per population requiring a minimum of 4,000 acres (Hoover and Wills 1984), potentially suitable habitat on the Uncompahgre Plateau could support 10 or 11 populations (107 individuals). While martens have not been reported on the Uncompahgre Plateau, suitable marten habitat should be managed as if martens are present to support any possible marten in the area.

Population Information

Survey protocols used for marten on the Forest include snowtracking, sooted track plates, and photographic bait stations based on methodologies described by Zielinski and Kucera (1995). Twenty-eight marten territories are estimated to occur on the Forest. Less than 1% of suitable marten habitat has been surveyed; consequently number of known territories on the Forest should not be used to represent actual number of territories on the forest. All suitable habitats surveyed resulted in marten detections. In Colorado, trapping, the only legal means of taking martens was banned by referendum in 1996 (Andelt et al. 1999, Buskirk 2002). This eliminated or substantially reduced the mortality threat associated with trapping, leading to speculation that marten populations may be increasing. However, with the absence of harvest data and no

concerted effort in the state of Colorado to monitor populations, there are no data to support this speculation. Year-to-year fluctuations in population size of marten are common, and typically correlate with fluctuations in densities of small mammals (Weckwerth and Hawley 1962, Buskirk and Ruggeiro 1994, Fryxell et al. 1999). However, descriptions of long-term changes in densities are virtually absent from the literature (Buskirk 2002). Marten detections per survey effort on the Forest were relatively high in 2004. Anecdotal evidence suggests that this may correspond to an increase in prey availability compared to previous years' efforts (Gunnison Ranger District survey records). Since such a small percentage of the available marten habitat has been inventoried, population trends on the Forest cannot be determined. However, by assessing habitat suitability for relatively large forest landscapes using generalized species-habitat relationships and stand level vegetation inventory, approximate population size can be calculated by assuming linear habitat-population relationships (Takats et al. 1999). This can be done using a Habitat Suitability Index Model.

Habitat Suitability Index (HSI) models have been developed to predict the habitat suitability for marten in terms of forage and cover quality, specifically for winter habitat (Takats et al. 1999, Allen 1982). Winter habitat requirements of marten are more restrictive than habitat requirements during other seasons (Allen 1982), thus the model assumes that if adequate winter habitat is available, then potential den site and suitable summer and reproductive habitat will be met by the same parameters that provide essential winter food and cover (Takat et al. 1999). HSI models predict habitat suitability based on an assessment of habitat attributes such as habitat structure, habitat type, and spatial arrangements between features (Takats et al. 1999). The model provides HSI values of 0.0 to 1.0 for specific habitat variables; values near or at 1.0 represent optimal habitat. Based on Soutiere (1979) and Thompson (1994) the current estimate of the maximum number of marten per optimal hectare (2.47 acres) is 0.02 (Carrying Capacity). On the Forest, there are approximately 84,251 hectares (208,187 acres) of optimal (1.0) marten habitat. Optimal habitat variables used for the model are 4B and 4C/5 high elevation riparian habitat, and 4C/5 spruce-fir. Approximate population size of marten, based on potentially available optimal habitat is calculated below:

84,251 ha optimal habitat x 0.02 individuals/ha = 1,685 individuals (Carrying Capacity for optimal habitat)

This model does not provide accurate population density estimates nor does it provide accurate prediction of habitat suitability at the stand level (Takats et al. 1999). Rather, it estimates approximate population size and habitat suitability at the landscape scale.

Hoover and Wills (1984) estimate the minimum number of individuals necessary to maintain a viable population of marten is 10 individuals within a minimum habitat area of 4000 acres (2,900 acres required for feeding, 1,100 acres required for cover), or one individual per 400 acres. This estimate takes into account overlapping territories between male and female martens. Martens are intrasexually territorial which means that home ranges are exclusive within but not between sexes (Katnik et al. 1994). This scenario estimates approximate population size based on primary marten habitat on the Forest. Primary marten habitat considered in this analysis includes 4B and 4C/5 spruce-fir, 4B and 4C/5 lodgepole pine, and 4B and 4C/5 high elevation riparian habitat. Approximate population size of marten for the Forest based on minimum viable population criteria estimated by Hoover and Wills (1984), and potentially available primary habitat is calculated below:

612,982 acres primary habitat ÷ 4,000 acres/population = 153 populations, or 1,532 individuals*

*Assuming 10 individuals per minimum viable population

Similar to the HSI model described above, this scenario assumes a linear habitat-population relationship, does not take into consideration fluctuations in prey availability, and excludes effects of management activities. Additionally, this is a minimum population size estimate. The Forest should be able to support additional populations when considering secondary habitat and overlapping territories. Local marten populations are likely dynamic based on changes in prey availability, juvenile dispersal, and changes in habitat quality. Habitat quality may be influenced by habitat modification resulting from management activities.

CONSERVATION

Threats

A number of marten studies investigating the effects on individuals of local populations from management activities such as timber harvesting, fire, fuelwood gathering, and livestock grazing show that the effects generally depend on their intensity, extent, and duration. Management activities most likely have the greatest affect on population viability when intensive management, particularly timber harvest, occurs in the best-quality habitats. Specifically, intensive management that causes reductions in canopy cover, removal of coarse woody debris, loss of future recruitment of coarse woody debris, reductions in size of future coarse woody debris, and increases in road densities affects habitat use, habitat preference, or habitat quality for martens (Buskirk 2002). Several other factors could affect the population viability of marten on the Forest and their likely effects would depend on interactions among them. They include changes in road densities or intensity of road use, the occurrence of catastrophic fires in large areas of spruce-fir and lodgepole pine dominated stands, insect outbreaks that cause the death of a large number of trees, and the outbreak of a disease, such as canine distemper, that has a high virulence to martens (Fredrickson 1990). Roads can have a range of effects on martens, including mortalities from vehicle collisions, displacement of martens near active roads (Robitaille and Aubry 2000), facilitating human collection of fuel woods near roads, and increasing exposure of martens to pets and human foods (Buskirk 2002).

Timber Harvest

Timber harvest has been hypothesized to have variable effects on martens, depending on cutting intensity (Buskirk 2002). Importantly, cutting intensity influences the relative carrying capacity based on the percentage of forest cover removed and cut patch size. Thompson and Harestad (1994) predicted a linear decline in carrying capacity of 50 percent for marten associated with clearcuts greater than 3 ha (7.4 acres) that result in 50 percent forest removal. Conversely, timber harvesting resulting in forest removal of 25 percent or less may increase the carrying capacity for marten by about 25 percent, assuming that martens move short distances into small recently cut areas to exploit resources (Thompson and Harestad 1994, Buskirk 2002), and that connectivity is maintained between openings. On the Forest, timber harvesting is commonly implemented through partial harvesting methods. These methods include small group selection and shelterwood cuts that do not exceed two acres in size in spruce-fir forests, and normally average ¼ acre in size with most harvesting in spruce-fir resulting in small openings less than ¼ acre in size spaced 200 ft apart (Vermillion pers. comm. 2005). Partial harvesting of forest stands provides some opportunity to maintain marten populations in harvested forests (Watt et al. 1996) and to provide a mosaic of forest structural conditions.

To maintain population viability for marten, suitable marten habitat should be arranged in core habitat areas between 30 and 50 km^2 (12 – 19 mi^2) in size, with a minimum of 75 percent of core habitat areas comprised of suitable stands for marten (Watt et al. 1996). Stands that have reached a stage where mortality of larger trees has occurred are important components of core habitats, since younger stands are unlikely to provide the structurally diverse conditions, snags, and coarse woody debris preferred by martens (Watt et al. 1996). The literature reports that partial harvesting can occur in as much as 30 percent of the core habitat areas, provided it retains 50 percent of the original conifer basal area and a canopy closure of at least 50 percent (Watt et al. 1996). However, harvest methods that adversely affect habitat for red back voles can have an adverse affect on Marten as well as boreal owls, since voles are a primary prey item. Past harvest techniques used on the Grand Mesa in the past (i.e. 3-step shelter wood) may be affecting microhabitats of vole thereby reducing their abundance (Holland, pers. comm.).

Fire Suppression and Wildfire

Fire suppression involves actions intended to prevent and extinguish fires. In the short-term, fire suppression is beneficial to martens in that it provides longer fire-return intervals, more continuous vertical and horizontal distribution of woody debris, and increased densities of coarse woody debris (Buskirk 2002). In the long-term, fire suppression results in a higher likelihood of high-intensity fires, leading to an increased need for alternative forms of disturbance such as thinning and prescribed fire. Fire suppression increases the probability of catastrophic wildfires that could cause major reductions in marten habitats. The

effects of wildfire on martens depend on the size and fire intensity; stand type, fire frequency, and post-fire succession (Buskirk 2002). In Yellowstone National Park, martens made virtually no use of the 1988 burns, although martens passed through burns and rested on unburned islands (Fager 1991). In Idaho, martens were found utilizing a mosaic of burned and unburned moist stands, where the burned area composed about half of the study area and varied in fire intensity (Koehler and Hornocker 1977). In general, martens have evolved in association with fire over most of their western distribution, but they tend not to prefer forest types with a history of frequent fires, particularly dry forest types (Buskirk 2002).

Livestock Grazing

Marten habitats have not been studied relative to livestock grazing, and livestock grazing in forests has not been hypothesized to be an important influence on marten habitats (Buskirk 2002). To determine the effects of grazing on marten habitat, the specific grazing practices and the intensity of grazing would need to be addressed. If forests were managed to encourage forage production through timber harvesting methods, particularly within high elevation riparian areas near spruce-fir dominated stands, the effects on martens would be negative and most likely severe (Buskirk 2002). Since suitable rangeland typically does not exist in spruce-fir and lodgepole pine cover types due to the lack of productive grass and forb understory, effects on marten habitat quality or population numbers are probably minor (Buskirk 2002). Where forage production is sufficient to attract livestock grazing in forested areas, martens could be affected by physical alteration of the structure and standing crops of herbaceous plants, which in turn could affect small mammal populations in which marten rely (Buskirk 2002). Livestock grazing could have a positive affect on marten populations if grazing stimulates the growth of herbaceous plants in forested areas, which in turn could also stimulate increased densities of small mammals (Buskirk 2002).

Insect Outbreaks

Insect outbreaks are important in disturbance regimes of coniferous forests in the West (Veblen 2000). Insect outbreaks are potentially important to martens because they can cause the deaths of large numbers of trees, thereby altering stand age and physical structure, initiating stand replacement, and abruptly recruiting large numbers of snags or volumes of coarse woody debris (Buskirk 2002). Potvin et al. (2000) reported that in some parts of the Northeast, martens were found to prefer forests 30 – 50 years following outbreaks of spruce budworm (*Choristoneura fumiferana*) because of the complex physical structure near the ground contributed by insect-killed trees, and rapid regeneration of some conifers. In the short term, insect outbreaks causing massive tree death can be expected to reduce the habitat quality for martens due to a reduction in overstory (Buskirk 2002). The effects of insect outbreaks on marten populations on the Forest depend on sizes and proportions of trees killed, rates at which insect killed trees are incorporated into the coarse woody component on the ground, and rates of regeneration.

Recreation

Marten response to recreation activities has not been well documented in the literature, nor have predictions been proposed addressing how marten might respond to various types or intensities of recreation (Buskirk 2002). Hypothesized effects of recreation on marten include increased deaths caused by vehicle collisions, and facilitated movement of competitors of marten into snowy areas resulting from snow compaction by snowmobiles. A wide range of negative effects can be associated with increased numbers of forest users, including displacement caused by people or dogs, illegal trapping or shooting, and exposure to toxins or human foods. Martens may be at greater risk of exposure to toxins, human foods, and canine distemper if there is an increase in dispersed recreation within marten habitat. The potential risk of these factors associated with recreation and the extent to which they might affect marten populations is unknown.

LITERATURE CITED

Allen, A. W. 1982. Habitat suitability index models: Marten. U. S. D. I. Fish and Wildlife Service. FWS/OBS-82/10.11. 9 p.

Andelt, W. F., R. L. Phillips, R. H. Schmidt, and R. B. Gill. 1999. Trapping furbearers: an overview of the biological and social issues surrounding a public policy controversy. Wildlife Society Bulletin 27: 53-64.

Beaudette, D. 1991. Forest management planning for supply of mature coniferous forest habitat on New Brunswick Crown land. Unpublished report, New Brunswick Natural Resources and Energy, Fish and Wildlife Branch, Fredriction, New Brunswick. 25pp.

Bennett, L. A. and F. B. Samson. 1984. Marten ecology and habitat management in the central Rocky Mountains: problem analysis. Unpublished progress report to the U.S.D.A. Forest Service. Colorado Cooperative Wildlife Research Unit, Fort Collins, CO. 60pp.

Biological Staff. 1996. Marten conservation strategy: Draft – Revision 1. Huron-Manistee National Forests Lower Peninsula-Michigan. 34pp.

Bull, E.L. 2002. Seasonal and sexual differences in American marten diets in northeastern Oregon. Northwest Science, 74(3): 186-191.

Burnett, G. 1981. Movements and habitat use of American marten in Glacier National Park, Montana. Missoula, MT: University of Montana. 130p.M.S. thesis.

Buskirk, S. and R. Powell. 1994. Habitat ecology of fishers and American martens. *In:* Buskirk, S.; Harestad, A.; Raphael, M.; Powell, R., eds. Martens, sables, and fishers. Biology and conservation. Ithaca, NY: Cornell University Press: 283-296.

Buskirk, S.W., and L.F. Ruggiero. 1994. The American marten. Pages 7-37 *in* L.F. Ruggiero, K. B. Aubry, 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. U.S. Forest Service General Technical Report RM-254.

Buskirk, S. W. 2002. Conservation assessment for the American marten in the Black Hills National Forest, South Dakota and Wyoming. USDA Forest Service. Forestry Sciences Laboratory, Rocky Mountain Research Station. Missoula, MT. 50 pp.

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

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.

Clark, T.W. and T.M. Campbell. 1979. Population organization and regulatory mechanisms of pine marten in Grand Teton National Park. WY. Conference on Scientific Research in National Parks Vol. 1 (ed. R.M. Linn), pp. 293-295. National Park Transactions and Proceedings Series 5. National Park Service, Washington, D.C.

Corn, J. G. and M. G. Raphael. 1992. Habitat characteristics at marten subnivean access sites. Journal of Wildlife Management 56: 442-448.

Dice, L.R. 1921. Notes on mammals of interior Alaska. J. Mammal. 2:20-28.

Fager, C. W. 1991. Harvest dynamics and winter habitat use of the pine marten in southwest Montana. M. S. Thesis, Montana State University, Bozeman, Mont. 73pp.

Forsey, O., J. Bissonette, J. Brazil, K. Curnew, J. Lemon, L. Mayo, I. Thompson, L. Bateman, and L. O'Drscoll. 1995. National recovery plan for the Newfoundland marten. Report No. 14, Recovery of Nationally Endangered Wildlife Committee, Ottawa, Ontario, Canada. 29pp.

Fredrickson, R. J. 1990. The effects of disease, prey fluctuation, and clear-cutting on American marten in Newfoundland, Canada. M. S. Thesis, Utah State University, Logan. 76pp.

Fryxell, J.M., J.B. Falls, E.A. Falls, R.J. Brooks, L. Dix, and M.A. Strickland. 1999. Density dependence, prey dependence, and population dynamics of martens in Ontario. Ecology 80:1311-1321.

Grinnell, J., J.S. Dixon and J.M. Linsdale. 1937. Fur-bearing mammals of California. Univ. California Press. Berkeley. 57pp.

Hargis, C.D. 1999. The influence of forest fragmentation and landscape pattern on American martens. J. 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. J. Wildl. Manage. 48:140-146.

Hawley, V. and A. Baer. 1957. Marten home ranges and population fluctuations. Journal of Mammology. 38: 174-184.

Hoover, R. L., and D. L. Wills. 1984. Managing forested lands for wildlife. Colorado Division of Wildlife in cooperation with USDA Forest Service, Rocky Mountain Region, Denver, Colorado, 459 pp.

Jones, L.L., and M.G. Raphael. 1990. Ecology and Management of Marten in Fragmented Habitats of the Pacific Northwest. Pacific Northwest Research Station. Olympia, Washington. 4203.3-1

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

Koehler, G.M., W.R. Moore and A.R. Taylor. 1975. Preserving pine marten: management guidelines for western forests. Western Wildlands 2: 31-36.

Lundrigan, C. and D. Fillier. 1995. Pine Marten Baseline Component 1995 Annual Report. Western Newfoundland Model Forest. Report draft: June 1995.

Lofroth, E. C. and J. D. Steventon. 1990. Managing for marten winter habitat in interior forests of British Columbia. P. 67-75. *in* Chambers, A. ed. Symposium: a workshop on resource integration for wildlife and forest managers. Prince George, B. C. Forestry Canada.

Marshall, D. B. 1994. Status of the American marten in Oregon and Washington. Unpublished report, Audubon Society of Portland, Portland, OR. 38pp.

Marshall, W.H. 1951. Pine Marten as a forest product. J. For. 49:899-905.

Martin, S. 1987. The ecology of pine marten at Sagehen Creek, California. Berkley, CA: University of California. 223p. Ph.D. thesis.

Patton, T. and R. Escano. 1990. Marten habitat relationships. Unpublished. Pages 29-47 in N. M. Warren, editor. Old-growth habitats and associated wildlife species in the northern Rocky Mountains. U.S.D.A. Forest Service, Northern Region, R1-90-42.

Potvin, F., L. Belanger, and K. Lowell. 2000. Marten habitat selection in a clearcut boreal landscape. Conservation Biology 14: 844-857.

Raine, R.M. 1987. Winter food habits and foraging behavior of fishers (*Martes pennati*) and martens(*Martes Americana*) in southwest Manitoba. Can. J. Zool. 65:745-747.

Robitaille, J. -F. and K. Aubry. 2000. Occurrence and activity of American martens *Martes americana* in relation to roads and other routes. Acta Theriologica 45: 137-143.

Rodrick, E. and R. Milner, technical editors. 1991. Management recommendations for Washington's priority habitats and species. Washington Department of Wildlife, Olympia, Washington.

Ruggiero, L. F., K. B. Aubry, S. W. Buskirk, L. J. Lyon, and W. J. Zielinski. 1994. The scientific basis for conserving forest carnivores: American marten, fisher, lynx, and wolverine in the western United States. U.S.D.A. Forest Service, General Technical Report RM-254.

Sadoway, K.L., 1986. Effects of intensive forest management on non-ungulate mammals of Vancouver Island. Victoria: BC Ministry of Environment.

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

Soule, M. E. 1987. Viable populations for conservation. Cambridge University Press, Cambridge, U. K.

Soutiere, T.L. 1979. Effects of timber harvesting on marten in Maine. J. Wildl. Manage. 43:850-860.

Spencer, W.D. 1981. Pine marten habitat preferences at Sagehen Creek, California. Berkley, CA: University of California. 121p. M.S. thesis.

Spencer, W.D., R.H. Barrett, and W.J. Zielinski. 1983. Marten Habitat Preferences in the Northern Sierra Nevada. J. Wildl. Manage. 47(4):1181-1183.

Stevenson, J.D. and J.T. Major. 1982. Marten use of habitat in a commercially clear-cut forest. J. Wildl. Manage. 46: 175-182.

Streeter, R.G. and C.E. Braun. 1968. Occurrence of pine marten: *Martes Americana* (carnivora mustelidae), in Colorado alpines areas. Southwest. Nat. 13:449-451.

Strickland, M.A. and C.W. Douglas. 1987. p.531-546 *in* Novak, M., J.A. Baker, M.E. Obbard, and B. Malloch, eds. Wild furbearer management and conservation in North America. Ont. Trappers. Assoc. North Bay Ont.

Takats, L., R. Stewart, M. Todd, R. Bonar, J. Beck, B. Beck, and R. Quinlan. 1999. American marten winter habitat: Habitat suitability index model version 5. 8 pp.

Thompson, I. D. 1994. Marten populations in uncut and logged boreal forest in Ontario. Journal of Wildlife Management 58: 272-280.

Thompson, I. D., and A. S. Harestad. 1994. Effects of logging on American martens with 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, N. Y.

Thompson, I.D. and P.W. Cogan 1994. Marten activity in uncut and logged boreal forests in Ontario. J. Wildl. Manage. 58: 280-288.

USDA. 2003. Threatened, endangered, and sensitive plants and animals. Chapter 2670 in FSM 2600-2003-1, Forest Service Manual: wildlife, fish, and sensitive plant habitat management. USDA Forest Service Rocky Mountain Region (Region 2), Denver, CO. Available: http://www.fs.fed.us/im/directives/field/r2/fsm/2600/2670.doc

USDA Forest Service. 1991. Amended Land and Resource Management Plan for the Grand Mesa, Uncompahgre and Gunnison National Forests. Delta, CO.

USDA Forest Service. 2001. Management Indicator Species Assessment, Grand Mesa, Uncompahgre, and Gunnison National Forests. Version 1.0. Delta, CO. 130 pp. plus Appendices.

Veblen, T. T. 2000. Disturbance patterns in southern Rocky Mountain forests. Pages 31-54 *in* R. L. Knight, F. W. Smith, S. W. Buskirk, W. H. Romme, and W. L. Baker, editors. Forest fragmentation in the southern Rocky Mountains. University Press of Colorado, Boulder.

Vermillion, B. 2005. Personal communication. Silviculturist, Grand Mesa, Uncompahgre, and Gunnison National Forests, Gunnison Ranger District.

Watt, W.R., J.A. Baker, D.M. Hogg, J.G. McNicol, and B.J. Naylor. 1996. Forest Management Guidelines for the Provision of Marten Habitat. Version 1.0. Ontario Ministry of Natural Resources, Ottawa, Ontario, Canada. MNR#50908.

Weckwerth, R.P. and V.D. Hawley. 1962. Marten food habits and population fluctuations in Montana. Journal of Wildlife Management 26:55-74.

Witmer, G.W., S.K. Martin and R.D. Sayler. 1998. Forest Carnivore Conservation and Management in the Interior Columbia Basin: Issues and Environmental Correlates. U.S. Department of Agri. Gen. Tech. Report: PNW-GTR-420.

Wynne, J.M. and J.A. Sherbourne. 1984. Summer Home Range use by adult marten in northwestern Maine. Can. J. Zool. 62:941-943.

Zielinski, W. J., and T. E. Kucera, technical editors. 1995. American marten, fisher, lynx, and wolverine: survey methods for their detection. Gen. Tech. Rep. PSW-GTR-157. Albany, CA: Pacific Southwest Research Station, Forest Service, U. S. Department of Agriculture; 163 p.

Appendix A

Potentially Suitable American Marten Habitat and Distribution of Detections on the Grand Mesa, Uncompahgre, and Gunnison N.F.