RECOVERY MEASURES FOR THE STATE ENDANGERED AMERICAN MARTEN: AN INTERNSHIP WITH TWO WISCONSIN NATURAL RESOURCE AGENCIES

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ABSTRACT

RECOVERY MEASURES FOR THE STATE ENDANGERED AMERICAN MARTEN: AN INTERNSHIP WITH TWO WISCONSIN NATURAL RESOURCE AGENCIES

by Sarah Lynn Harvey

I completed a six-month internship to meet the requirements for a Master of Environmental Science degree. The objective of my internship agreement with the Endangered Resources Bureau of the Wisconsin Department of Natural Resources was to write an updated recovery plan for the American marten, *Martes americana*. Utilizing literature, interviews, and previous Wisconsin reports, I completed a draft that is now awaiting approval from the Wisconsin Marten Committee. In addition, I assisted with a marten trapping study and developed updated educational materials. For part of my internship I worked with the U.S. Forest Service North Central Research Station. I developed the idea for a marten habitat guide and created a presentation and pamphlet. I photographed known marten rest sites, foraging sites, and maternal den sites. The habitat guide provided forest features important for marten persistence. This internship required working with multiple agencies interested in marten recovery and forest management.

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ACKNOWLEDGEMENTS

I would like to thank my advisor, Dr. David Berg, for his continual help during my internship. Thanks also to Dr. Vincent Hand and Dr. Adolph Greenberg for their time reading and commenting on my report. Thanks to the Institute of Environmental Sciences for generating an atmosphere of opportunity. Thanks to all of my Miami professors who changed the way I view the world. A gracious thanks to Betty Haven and Chris Ingham who helped me through my two years in the IES program. Thanks to Adrian Wydeven and Jim Woodford for a wonderful experience at the Wisconsin Department of Natural Resources. Thanks also to Jane Wiedenhoeft, John Olson, and Bruce Kohn who contributed to my projects at the WDNR. I thank Pat Zollner who allowed me the means to create. Thanks to Jon Gilbert, Dan Eklund, and Tom Matthiae who collaborated on the habitat guide. And I am eternally grateful to Joe Dumyahn.

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CHAPTER 1

Introduction

I chose to complete a six-month internship to meet the requirements for the Master of Environmental Science degree from the Institute of Environmental Sciences, Miami University, Oxford, Ohio. My concentration of study was Biological Conservation. I am especially interested in endangered species issues, and hoped to find an internship that provided experience dealing with endangered species and their habitats. The Institute of Environmental Sciences program has one year of core courses and the rest of the classes are chosen based on the student's concentration. To fulfill the requirements for my Biological Conservation concentration, I enrolled in graduate courses in ecology, conservation, and plant community ecology that provided a strong background for my internship.

Conservation biology is a discipline that developed from the loss of biodiversity mainly due to human activities (Meffe and Carroll 1997). One of the goals of this field is to manage biodiversity and protect it from extinction. This requires a multidisciplinary approach that accounts for the many aspects of conservation, such as biological, social, ecological, political, and economical influences. Conservation biology has three guiding principles; one of these is, "The human presence must be included in conservation planning" (Meffe and Carroll 1997). As humans continue to fragment and reduce species habitat, more animals become endangered. I hoped to learn about endangered species recovery measures and their application to mitigate the effects of humans.

I learned about the American marten, *Martes americana*, while volunteering with the U.S. Forest Service North Central Research Station (NCRS) in Wisconsin during

summer and winter 2002, and winter 2003. I helped with small mammal trapping to identify prey densities in American marten home ranges. I was also able to set and check traps targeting martens that were not yet radio-collared and recorded marten activity paths within different cover types. While doing research on this intriguing animal, I learned that it was a state endangered species. I was curious about the management actions being taken to conserve the species.

I contacted the Wisconsin Department of Natural Resources (WDNR) Bureau of Endangered Resources, the agency and division responsible for managing and monitoring state listed species, to complete my internship with them. The original marten recovery plan was written in 1986 (Gieck) and needed updating. Adrian Wydeven, an ecologist with the WDNR Endangered Resources Bureau, asked me to assist with this effort. My internship goal with the WDNR was to write an updated American marten management plan for the state of Wisconsin. In order to meet the first goal, I compiled literature and monitoring data, conducted interviews, and provided recommendations for future management and monitoring strategies. Drafts of the plan were revised by my two internship supervisors. I completed the draft for the American marten recovery and management plan, which will now be reviewed by the Wisconsin Marten Committee before publication. In addition, I participated in a marten population study that will provide essential information for the recovery plan. I also created and updated American marten educational materials.

I collaborated with the U.S. Forest Service North Central Research Station (NCRS), Great Lakes Indian Fish and Wildlife Commission (GLIFWC), and the Chequamegon-Nicolet National Forest (CNNF) on the second aspect of my internship.

While working on the American marten recovery plan, I realized that the majority of the marten population is on the CNNF. The U.S. Forest Service is responsible for managing the forest for timber, recreation, wildlife, and ecosystem health. I was interested in learning about how the Forest was managed for American marten habitat requirements. I developed the idea for a marten habitat guide to describe forest features that should be conserved. Using previously collected marten locations from the NCRS and GLIFWC, I photographed features found at each site. The formats for the habitat guide were a Power Point presentation and a laminated brochure that were reviewed by biologists and researchers from collaborating agencies. The presentation and handout provide a visual tool for timber markers, silviculturists, and other Forest Service or natural resource agency personnel that need to understand marten habitat needs.

CHAPTER 2

Wisconsin Department of Natural Resources

Introduction

The American marten, *Martes americana*, is a member of the weasel family, *Mustelidae*. Martens are about the size of a small house cat and have furry bodies and tails (Fig. 1). They range in color from golden to rust to brown, with darker brown legs and tail. They have a large chin- or throat-patch that is cream-to-rust colored. Martens are sexually dimorphic with the males being larger (0.6-1.0 kg) than females (0.4-0.7 kg) (Powell et al. 2003).

Figure 1. Marten climbing a tree after being released from a box trap in Wisconsin. (photograph by J. Dumyahn)

Martens have experienced declines in population size and distribution across North America. The conspecific Eurasian pine marten, *Martes martes*, has experienced similar declines. Marten distribution is from the tree line in the north to the boreal transition in the south, but follows the Sierra Nevada and Rocky Mountain ranges even farther south. The marten is currently extirpated from seven states in which it historically occurred: New Jersey, Pennsylvania, West Virginia, Ohio, Indiana, Illinois, and North Dakota. Today eight states do not permit marten trapping, reflecting the spatial decline of the species (Table 1). In Canada, it is now absent in southern Manitoba and Prince Edward Island, and restricted in range on Newfoundland and Cape Breton Island.

Table 1. Current marten status and management in the United States.

State	Status	Management
EAST		
Maine		Trapping- 25 marten/ trapper
New Hampshire	Threatened	Recovery measures
New York		Trapping- 6 marten/ trapper
Vermont	Endangered	Recovery measures

N. CENTRAL		
Michigan		Trapping in UP- 1 marten/ trapper
Minnesota		Trapping- 5 marten/ trapper
Wisconsin	Endangered	Recovery measures
South Dakota		No trapping
WEST		
Colorado		No trapping
Idaho		Trapping
Montana		Trapping
Nevada		No Trapping
New Mexico	Threatened	Recovery measures
Utah		Trapping- limited areas
Wyoming		Trapping
PACIFIC NW		
Alaska		Trapping
California	*M.a. humboldtensis* Special Concern	No trapping
Oregon		Trapping
Washington		Trapping

Martens have a unique role in the ecosystem. They are considered mesocarnivores, since other carnivores will prey on them. Martens help to cycle nutrients through the forest food web. Martens preferentially prey on voles (*Clethrionomys* spp. and *Microtus* spp.), and respond to changes in these species' populations. During the summer, marten disperse seeds when they eat berries. Marten are considered forest-dependent species, and are affected by changes to their surroundings. The USDA Forest Service refers to them as a Regional Forester Sensitive Species, which must be accounted for in their forest management plans (USDA Forest Service 2004). Since they are so closely tied to the forest, marten are used as an ecological indicator of forest health (Buskirk and Ruggiero 1994). Martens are also culturally and aesthetically important resources (Powell et al. 2003).

The WDNR Bureau of Endangered Resources is responsible for coordinating the recovery of its state-endangered and state-threatened species. Currently, the state has

only two listed mammals: the state-protected and federally threatened gray wolf, *Canis lupus*, and the state-endangered American marten. In 1925, martens were considered extirpated in Wisconsin (Jackson 1961). At the time, unregulated furbearer trapping and habitat changes from logging, agriculture, and wildfires led to the extirpation of martens. An initial reintroduction took place in 1953, when five Montana martens were released on Stockton Island, one of the Apostle Islands in Lake Superior. Twenty years later only one marten was observed there, and the reintroduction was considered a failure. The marten was listed as a state-endangered species in 1972.

Two other reintroductions have taken place in Wisconsin. From 1975-1983, the WDNR and the U.S. Forest Service released 172 marten in the Nicolet side of the Chequamegon-Nicolet National Forest (CNNF) in northeastern WI (Table 2; Fig. 2). From 1987 to 1990, 139 martens were released within the Chequamegon side of the National Forest in northwestern WI (Table 2; Fig. 2).

Table 2. Marten reintroductions in the Nicolet and Chequamegon National Forest (Kohn and Eckstein 1987; Kohn, unpublished).

Year	Total Released	Male	Female	Unknown	Source
Nicolet					
1975-1976	124	97	27		Ontario
1980-1981	19	9	10		Colorado
1981 March	18	9	9		Ontario
1981-1982	4	2	2		Colorado
1982-1983	7	3	3	1	Colorado
	172	120	51	1	
Chequamegon					
1987	31	27	4		Minnesota
1988	21	13	8		Minnesota
1989	42	28	14		Minnesota
1990	41	25	16		Minnesota
	139	93	42		

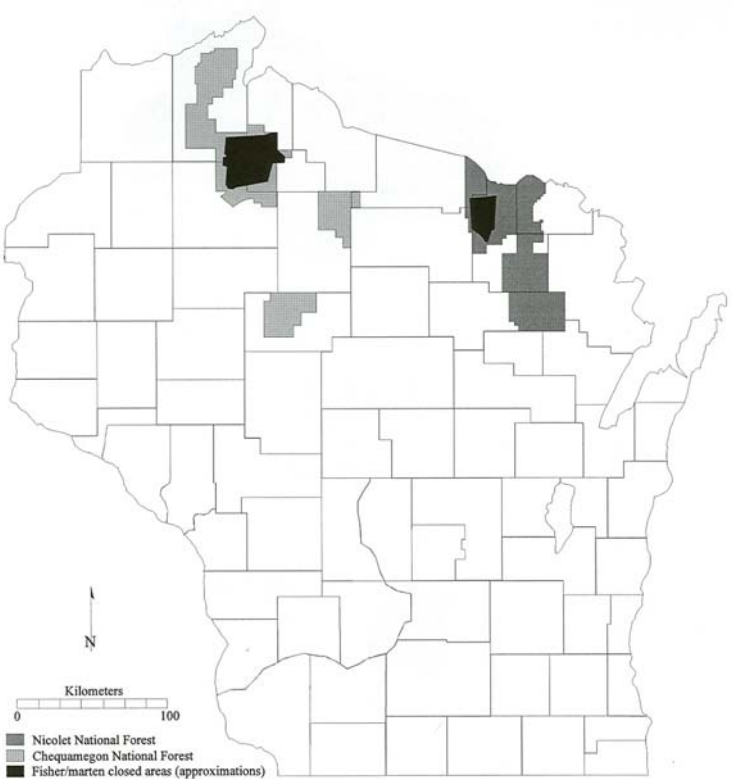

Figure 2. Nicolet and Chequamegon National Forests with locations of the Marten Recovery Areas darkened (Wright 1999).

The first marten recovery plan was written in 1986 (Geick 1986) and has not been updated. Since the plan's publication, the second marten reintroduction on the Chequamegon portion of the National Forest has been completed, new research has been conducted, and more organizations are involved in recovery efforts. A new plan was needed to address the changes. The 1986 plan's goal of 300 marten on the Nicolet side and 100 on the Chequamegon side of the National Forest is considered accomplished based on snow track surveys. However, there is insufficient research and monitoring to validate this claim. An updated plan would outline the need to estimate populations and improve monitoring efforts.

Internship Responsibilities

My internship was principally supervised by Adrian Wydeven, the mammalian ecologist for the Bureau of Endangered Resources. Jim Woodford, a researcher with the WDNR Bureau of Integrated Sciences, was my secondary supervisor. The primary goal for my internship was to complete a draft of the recovery and management plan for the American marten, *Martes americana*, in Wisconsin. Adrian Wydeven stated some of the objectives needed to meet this goal in my internship agreement. Researching literature, obtaining DNR reports, interviewing biologists, researchers, and managers, and analyzing survey information were all used to complete the plan.

I became aware of some of the challenges I would face at the Marten Committee Meeting on May 19, 2004, in Wausau, Wisconsin. Recovery and management of a species is not the interest of just one agency, but several. Committee members represented a broad range of scientific advisors; from the WDNR alone, employees from the Bureau of Endangered Species, the Bureau of Integrated Science, and the Bureau of Wildlife Management were present. Other committee members included a U.S. Forest Service District Wildlife Biologist, U.S. Forest Service NCRS researchers, a GLIFWC biologist, a Wisconsin Trappers Association member, and a professor and graduate student from the University of Wisconsin at Stevens Point (UWSP). Many points of view on, and ideas for, marten recovery were discussed at the meeting. I realized that I would have to incorporate the views of multiple constituencies into the document.

Another hurdle I faced was the lack of research and information on the two marten populations. While sitting at the meeting, I was astounded that the WDNR had not conducted a population estimate for the Nicolet population since 1985, and had never

done one for the Chequamegon population. I was not sure how I was going to write a recovery and management plan with so little information.

Luckily, as the meeting progressed, I learned that the WDNR and the University of Wisconsin at Stevens Point (UWSP) had a study planned for early fall of this year. The study would provide a much-needed marten population estimate for the Nicolet side. I was able to assist with the study by checking traps. Other internship responsibilities that evolved were creating and updating educational and informational materials about the Wisconsin marten.

Recovery plans are created to identify goals and criteria for recovery of a species. Plans include available knowledge about the species and input from stakeholders to develop the best recovery actions. The recovery plans that I used as references (Pine Marten Recovery Plan 1986, Wisconsin Wolf Management Plan 1999, Marten Recovery Plan for Vermont 1990) had two main parts. The first part of the plan contains species status, distribution, life history information. It compiles the data on the species for the state, and includes a population estimate and current monitoring results. This information is useful for the second part of the plan, which outlines recovery strategies. The second part of the plan states a population goal for the state. Then, it provides multiple measures for how to recover and manage the species and its habitat.

Part One of the Recovery Plan: Available Knowledge

The first half of the recovery plan emphasizes current knowledge about the Wisconsin marten. Using available monitoring and study results from the WDNR and other agencies, I constructed the Current Distribution and Status sections of the plan. Life history information (physical description, reproduction, mortality, habitat

requirements, and food) was obtained from literature searches. Specific Wisconsin habitat requirements and limiting factors were identified mostly through interviews and by examination of research done in the state. Current management and research portions were based on interviews and management plans. The format for Part One of the recovery plan followed the first plan (Geick 1986) and the Wolf Management Plan (WI Wolf Advisory Committee 1999). The final draft of the Wisconsin American Marten Recovery and Management Plan can be found in Appendix A.

Current distribution and status information of Wisconsin marten are limited to one population study completed in 1985, annual snow track counts, and a small ongoing study on the Chequamegon portion of the population. These studies suggest that the marten population is still centered on the release sites. When the marten were reintroduced into the state, the Fisher Management Units within the Chequamegon-Nicolet National Forest were used as the release sites (Fig. 2). The FMU's were created when the once extirpated fisher, *Martes pennanti*, was reintroduced in the 1950's and 1960's to Wisconsin. The Nicolet unit is 484 km^2 and the Chequamegon unit is 890 km^2. These areas have been designated as Marten Recovery Areas (MRA). They are closed to upland or dry trapping of furbearers. This ensures that the marten have decreased pressure from incidental trapping in the core release areas.

A trap-recapture and track-count study was conducted from 1983-1985 to estimate the marten population and distribution after the reintroduction (Kohn and Eckstein 1987). Eighteen marten were captured; none of them were the ear-tagged or tattooed individuals from the reintroductions. This provided the first evidence that the

population was reproducing. Ten of the captured animals were juveniles and only three of the eighteen were females.

Trapping was not successful enough to provide a population estimate, but using the track counts (1983-1984= 15.8/100 miles; 1984-1985= 37.5/100 miles) Kohn and Eckstein (1987) estimated that 100 to 150 marten were in the area. The distribution of the new marten population was still within the MRA; 89% of the observations were within 12 miles of the release sites. The WDNR began annual winter track count surveys in 1981 through the Nicolet (Fig. 3). These snow track counts continue to provide presence and distribution data (Fig. 4).

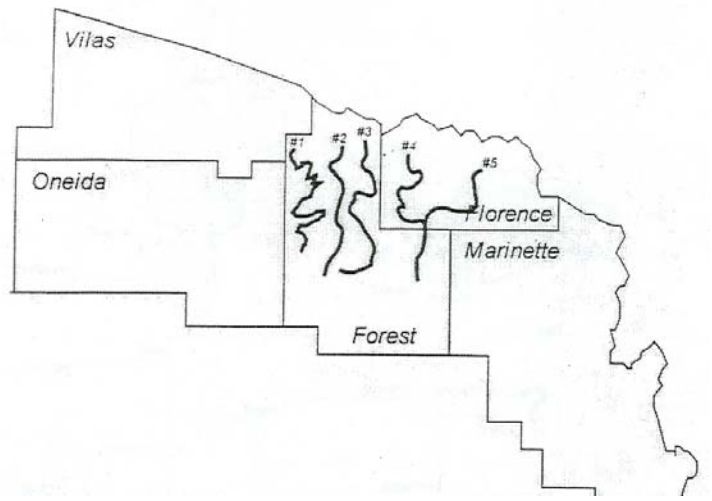

Figure 3. Furbearer track count transects in the Nicolet side of the CNNF (Wydeven et al. 2002).

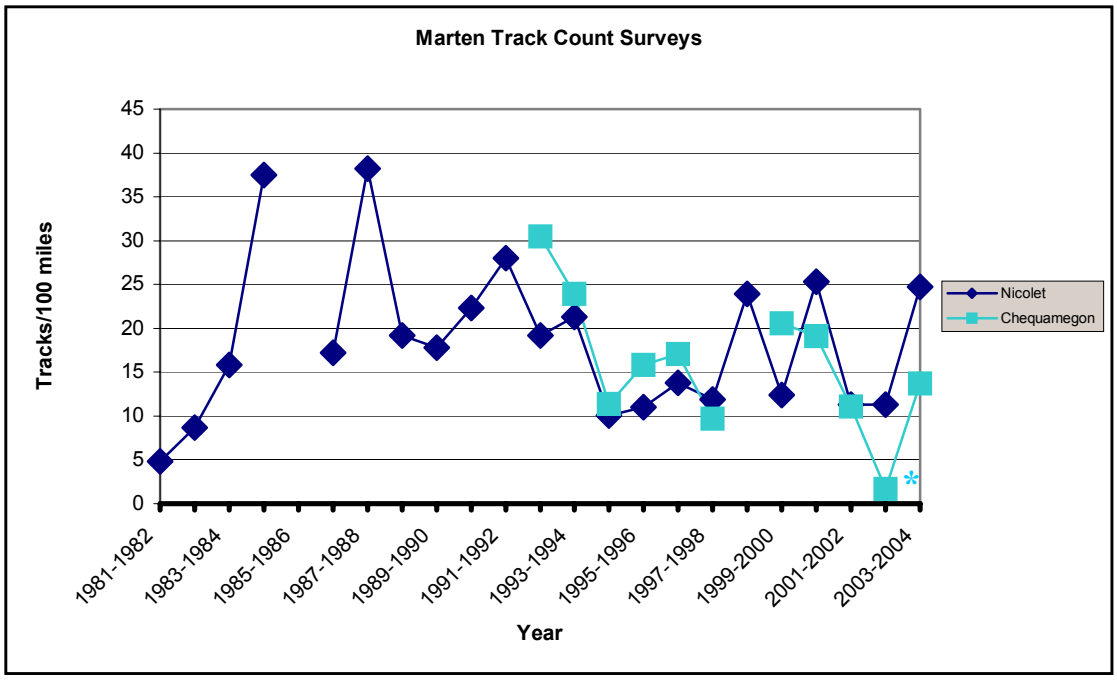

Figure 4. Marten track count survey results from 1981-1982 to 2003-2004 (Kohn and Eckstein 1987; Ashbrenner 1994; Wydeven and Wiedenhoeft 2004).
* Poor tracking conditions were reported.

The reintroduction on the Chequamegon portion of the National Forest (n=139) took place from 1987 to 1990 (Table 2). No studies have been completed to assess the results of the reintroduction. The WDNR did establish transects in and around Chequamegon MRA for snow track count surveys (Fig. 5) to monitor for presence and distribution of the marten beginning in 1992-1993 (Fig. 4). The only study on the Chequamegon side of the National Forest is by GLIFWC (1990-present). John Gilbert, the Wildlife Section Leader with GLIFWC, focuses his study within the MRA. The mark-recapture study has collected information on marten home ranges, diet, and habitat use.

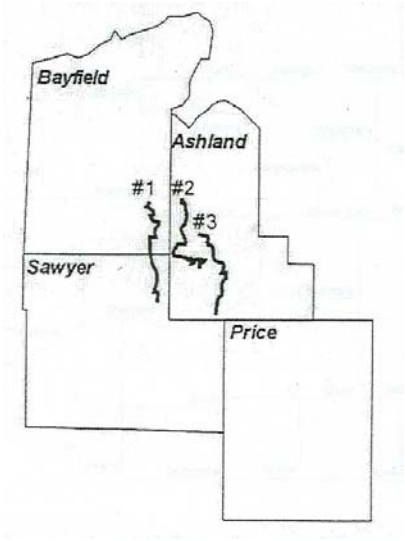

Figure 5. Furbearer track count transects in the Chequamegon side of the CNNF (Wydeven et al. 2002).

The annual winter furbearer track counts and reports from field biologists were used by J. Woodford (unpublished) to create distribution maps from the past 16 years. The resulting maps revealed that the marten ranges expanded during the first ten years after reintroduction. The 1996 to 2001 map suggested that the Nicolet side population was decreasing in range size (Fig. 6). Woodford (unpublished) stated that the snow track methods provided limited estimates of distribution and abundance due to observer variability. He claimed that additional objective assessments are needed.

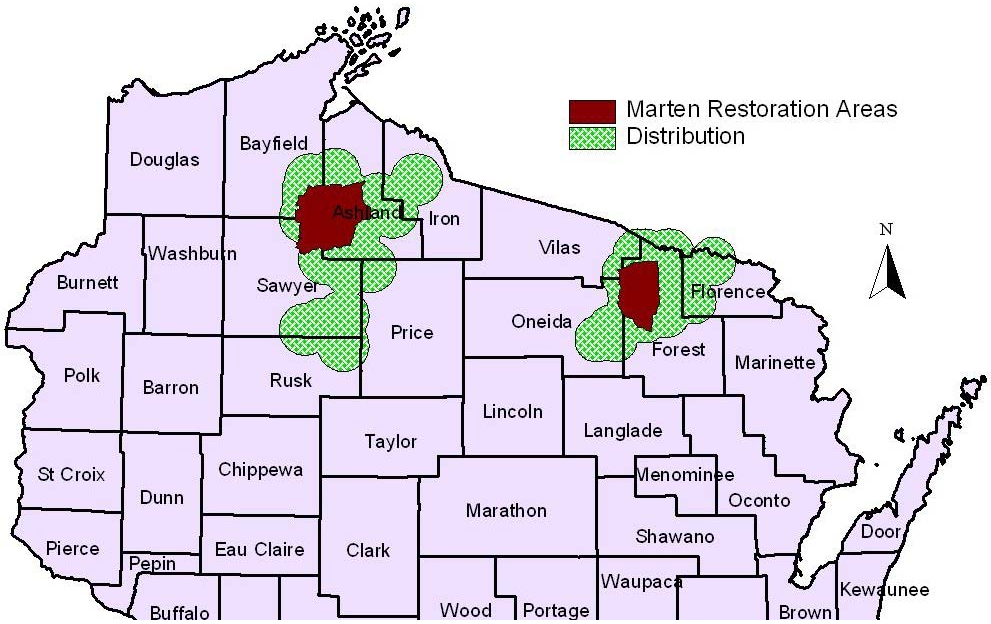

Figure 6. Estimated distribution of marten based on track surveys and observations from 1996 to 2001 (J. Woodford unpub. data).

The Wisconsin Habitat portion of the marten management plan required research that related specifically to WI marten. Habitat used by martens varies greatly across its east-to-west distribution. It was previously believed that marten relied solely on coniferous forest habitats. However, from literature searches I found that martens utilize mixed coniferous and deciduous, and deciduous forests. Martens do have more specific microhabitat needs, which include horizontal and vertical structure from woody debris. Landscape-scale needs are more general: continuous forest cover with little fragmentation. This background information explained why martens were able to succeed in Wisconsin's managed hardwood forests.

John Wright (1999) completed a study on radio-collared marten on the Nicolet side of the CNNF. Eighteen radio-collared marten provided home range estimates. The cover types that composed the home ranges were determined using USDA Forest Service compartment coverage, which includes tree types, stand diameter class, and stocking.

Wright (1999) found that the marten occupied predominantly mixed hardwood stands (sugar maple, American basswood, white ash, and paper birch). J. Gilbert (pers. comm., GLIFWC) described marten maternal den sites as standing, live trees with an entrance hole in the stem approximately 3 inches in diameter. He listed the favorite tree species used for maternal dens as yellow birch, white cedar, sugar maple, and paper birch. The mixed hardwood stands comprised 42% of the study area. The martens avoided non-forested areas. The stand pole and saw size classes (>12.7 cm dbh & <22.9 cm, >22.9 cm, respectively) were used preferentially over the seedling size class (<12.7 cm dbh).

At locations of marten activity and rest sites, both Wright (1999) and Gilbert et al. (1997) found that dead woody material was present in greater quantities than in reference plots. Dead and downed woody material can consist of fallen trees, stumps, root tip-up mounds, and branches. The correlation between marten foraging activity and downed woody debris (DWD) is that prey may be locally concentrated in these areas. In the winter, DWD provides access to the snow-ground interface where prey are present. Thus, it is more energy efficient for marten to search for prey in areas with snow lofted by DWD, than it is for them to dig for prey in random locations. I elaborate on the importance of DWD in Chapter 3.

A section in the first part of the management plan addressed factors that could be limiting the success of the Wisconsin marten. Martens' specific habitat requirements, described above and in Chapter 3, make habitat availability limiting. Another factor that limits marten success is prey availability. Several studies have demonstrated that prey population fluctuations positively correlate with marten population fluctuations (Thompson and Colgan 1987; Weckwerth and Hawley 1962). Predation is another

potential limitation, but little information exists for predation rates on Wisconsin marten (Fig. 7). Fishers, coyotes (*Canis latrans*), red foxes (*Vulpes vulpes*), bobcats (*Lynx rufus*), great horned owls (*Bubo virginianus*), and northern goshawks (*Accipiter gentilis*) are some of the possible predators in Wisconsin. Indirect competition from fishers could limit marten success; fishers eat small rodents, inhabit similar habitat, and use similar maternal dens and rest sites. Humans are another predator. Although trapping marten is illegal in Wisconsin, marten are still accidentally captured (Table 3). I doubt that all of the incidental captures are reported, but it does not seem to be a significant source of mortality.

Figure 7. A female marten killed by a raptor in 2003 (photo by J. Dumyahn)

Table 3. Incidental marten seizures reported to conservation wardens from 1996 to 2003

YEAR	Martens
1996	1
1997	3*
1998	0
1999	1*
2000	2
2001	0
2002	1
2003	0

(*Reported by Wydeven and Boles 1998; Wydeven and Weidenhoeft 2000)

Some of the limiting factors are being addressed through current research and management efforts within Wisconsin. Information about studies being done by the WDNR, UWSP, NCRS, GLIFWC, and forest management efforts by the U.S. Forest Service and WDNR Division of Forestry are described in the Management and Research section of the plan.

Part Two of the Recovery Plan: Recovery Strategies

Part Two of the Wisconsin American Marten Recovery and Management Plan focuses on different recovery and management strategies. This part of the plan still required literature searches, but also involved providing recommendations. First, I determined what objectives were needed for improved marten management. I developed four basic objectives:

1. Identify the size of the two known marten populations on the Chequamegon-Nicolet National Forest
2. Determine if additional recovery measures or down-listing are required for the Wisconsin marten
3. Identify ways to improve state monitoring efforts of marten populations and distributions
4. Continue to fund Wisconsin marten research and management projects

The four objectives are described within the various sections of Part Two (Background, Population Management Strategies, Habitat Management Strategies, Marten Research

Needs, Interagency Cooperation and Coordination, Education, and Marten Budget). The outline for Part Two was derived from the Wisconsin Wolf Management Plan (WWAC 1999), Pine Marten Recovery Plan (Geick 1986), and National Recovery Plan for the Newfoundland Marten (Forsey et al. 1995). The final draft of the Wisconsin American Marten Recovery and Management Plan can be found in Appendix A.

The background section addressed the method for determining listing and delisting criteria for Wisconsin marten. Establishing recovery goals for the American marten proved difficult for me. The 1986 Wisconsin marten plan and Vermont's marten plan (DiStephano et al. 1990) cited 300 marten in each of the two reserve areas as the states' population goals. It is not certain if the goal of 300 individuals was validated by a population viability analysis or a carrying capacity estimate. By determining the carrying capacity of the two sections of the National Forest in northern Wisconsin, a population goal could be estimated. The amount of suitable habitat for marten in the Chequamegon-Nicolet National Forest (CNNF) needed to be estimated in order to do this.

Wright (1999) reported habitat use by radio-collared marten in the Nicolet portion of the National Forest. The cover types were divided into three categories: high use, moderate use, and low use (Table 4). Using the same categories as Wright (1999), the amount of high use habitat available in the CNNF was estimated (Table 5). The USDA Forest Service in Wisconsin supplied the cover type data. The NCRS helped with the use of geographic information systems to categorize the cover types and size classes for the different uses. Polygon areas were then calculated for the different cover types. To estimate carrying capacity, the larger male home range area (2.7 km^2) was used to approximate how many male marten could reside within suitable habitat in the CNNF. A

range of estimates was needed to account for the varying percentage (0-100%) of overlapping female home ranges (1.7 km^2). High-use cover type areas could support approximately 700 to 1400 marten. If marten also utilize the moderate and low use cover types, then 1350 to 2700 marten could inhabit the CNNF.

Table 4. Marten relative use of cover types and size classes and the availability of those cover types (km^2) within the CNNF.

Cover Type and Size Class	High Use	Moderate Use	Low Use
Aspen birch pole			583.9
Aspen birch saw			182.6
Lowland conifer pole			390.8
Lowland conifer saw			114.1
Lowland hardwood pole	139.6		
Lowland hardwood saw	16.6		
Oak pole	105.2		
Oak saw	66.5		
Pine oak pole		3.8	
Pine oak saw		2.3	
Upland conifer pole		297.3	
Upland conifer saw		403.3	
Upland hardwood pole	1100.8		
Upland hardwood saw	689.2		
Total	2117.9	706.7	1226.0

Table 5. Marten cover type use and availability (km^2) in each National Forest.

National Forest	High Use	Moderate Use	Low Use	Total
Chequamegon	1088.7	360.2	701.3	2150.2
Nicolet	1029.2	346.5	524.7	1900.4
Total	2117.9	706.7	1226.0	4050.6

Several *caveats* exist with the carrying capacity estimates. First, not all of the high-use areas may provide the conditions needed for marten success (downed woody material, den sites, and a high percentage (>30%) of canopy closure). Second, the carrying capacity only represents area within the national forest. A similar analysis is needed for state forests, which comprise a large area of northern Wisconsin, to have a

more accurate estimate of the overall carrying capacity. Finally, the carrying capacity estimate may not reflect the goal of creating a viable population.

A population viability analysis was attempted using VORTEX version 7.1 (Lacy et al. 1995). The MS-DOS based program is a Monte Carlo simulation that models the effects of deterministic forces, as well as stochastic demographic, genetic, and environmental events. Since the two populations are small, inbreeding was one major concern which VORTEX could simulate. I tried to determine the extinction probability of the Wisconsin marten using known parameter values and the newly estimated carrying capacity. However, too many of the parameters were unknown to make sense of the results. Some of the unknown parameters were percent standard deviation (SD) of the carrying capacity due to environmental variation, percent SD in mortality due to environmental variation, and percent SD in percent producing litters due to environmental variation. After trying various values, I realized that this model would not provide an understandable population goal. I went back to the literature.

Schneider and Yodzis (1994) produced a marten population dynamics model based on data from Canadian furbearer harvests and a number of studies that provided demographic values. The study found that populations of 75 to 125 females did not go extinct during the 500-year model runs for most of the parameter combinations. When incorporating environmental stochasticity, the populations had to be 26% larger in order to persist. Using Schneider and Yodzis' values, approximately 190 to 315 martens in each of the populations are needed for long-term survival.

The Wisconsin and Vermont marten plans have goals of 300 marten in each refuge, which is very similar to the values found by Schneider and Yodzis (1994). I

decided to use 300 as the minimum population estimate for down-listing to threatened status. Adrian Wydeven considered this estimate to be too small, and suggested that I use my carrying capacity of high use habitat, approximately 1000 martens, as a minimum population. The marten is a smaller carnivore than the wolf and should occur in greater numbers in the same amount of area. The wolf management goal is 350 individuals for Wisconsin. I also contacted the Minnesota and Michigan Upper Penninsula DNR to find out what their goal populations were before beginning a harvest. Neither of the states had a population goal or a management plan for the marten when managers decided to allow a trapping season (Richard Earle Michigan DNR, Bill Berg Minnesota DNR, and John Erb Minnesota DNR, pers. comm.). With the data collected from the harvests, population modeling is possible. The estimated population from modeling in Minnesota is approximately 13,700 marten, and their state status is considered "good" (J. Erb, pers. comm.).

I decided to use Wisconsin's fisher population goals as a guide. Fishers were reintroduced into the state from 1956 to 1967. The reintroductions were considered a success, and currently fishers are distributed throughout northern Wisconsin. A fisher trapping season was conducted in 1985 with a very conservative number of permits and a time limit (Kohn et al. 1993). The population was estimated to be over 4000 in 1985 based on snow track counts and modeling. Today the fisher population sustains larger harvests, and it is still increasing.

Using the cumulative background information, I developed the listing and delisting criteria for marten (Table 6). Less than 1000 individuals present in the state means the marten maintains its endangered status. This equates to 500 marten within

each of the two populations assuming equal distribution. Other distributions (700/300) could be acceptable. However, a limit to how out of balance the two populations needs to be established. Once an estimated 4000 marten are present in the state, the marten can be down-listed to a protected species, or the Wisconsin Marten Recovery Committee can decide on allowing a trapping season. I included in Population Management Strategies the stipulations for additional reintroductions based on Schneider and Yodzis (1994); if one of the two populations should fall to 75 individuals, an immediate augmentation should be planned. The population estimates must be met over a five-year period, which leads to the discussion of more involved monitoring.

Table 6. Listing and delisting criteria for Wisconsin marten.

Marten Population	**State Listing**
Less than 1000	Endangered
>1000 for 5 years	Threatened
>2000 for 5 years	Delisted and Protected
4000 or greater	Protected or Furbearer
Less than 2000 for 5 years	Reclassify as Threatened
Less than 1000 for 1 year	Reclassify as Endangered

One of the greatest concerns about the Wisconsin marten is the lack of information about their status and limiting factors. The snow track surveys produce unreliable results due to observer variability and low densities of marten (Fig. 4). It is difficult to differentiate marten tracks from fisher or mink (*Mustela vison*) tracks. A new, more accurate monitoring method is needed. I suggested in the recovery plan that a trial study on the effectiveness of hair snares, soot plates, or camera stations (Zielinski et al. 1997; Belant 2003) be conducted. The three alternative methods are proven to provide more reliable detection results. Camera stations can be expensive and finicky in cold weather, and soot plate stations can be ruined by rain or snow. A multi-agency team

decided to use hair snares for a trial detection survey this winter. Two possible snare types are available to try: a modified box trap with a currycomb attached or PVC pipes with glue plates mounted inside of them.

Another shortcoming of snow track counts is that they are not designed to estimate population size. A mark-recapture study is necessary to determine the marten population in Wisconsin. Marten population sizes must be monitored while they are a state endangered species. The two populations should be estimated every five years, until they are delisted. The Nicolet side population will be estimated by winter 2005. A similar study is needed for the Chequamegon population. In addition to population estimates, other research is needed to better manage the marten.

Marten ecology is still little studied in Wisconsin. Filling in the research gaps will provide new directions for marten recovery measures and management. Basic research needs include population estimates and distribution. Habitat use and availability in northern Wisconsin needs to be investigated further. Demographic data for Wisconsin marten are needed for population modeling. Demographic data on the survivorship of marten at each age class, fecundity, and amounts of immigration and emigration will aid in modeling population viability of marten. Genetic diversity estimates of the Wisconsin marten populations are required for appropriate management (McGowan et al. 1999). DNA samples should be collected from martens during research, from incidentally trapped marten, hair snares, and other found specimens. Genetic diversity of the population is important for long-term success.

Prey availability and predator abundance are other limiting factors for martens that need to be understood. Prey population monitoring could provide an index for

marten success. Thompson and Colgan (1987) reported evidence of prey cycles influencing marten population size. Minnesota has noted that red-backed vole population fluctuations coincide with marten population changes (J. Erb, pers. comm.). Mammalian and avian predation may also limit marten success. Research on generalist predator (red fox, coyote, and great-horned owls) abundance and predation rates in known marten areas could determine how predation affects marten survival and behavior. Martens may also compete with fishers for resources, such as prey or den sites. Fishers are also known to prey on marten, but the mortality rates are unknown.

The marten recovery and management plan states that a revised budget is needed to fund the additional monitoring and research. Annual average state expenditures for the Wisconsin timber wolf recovery program are approximately $20,000. This figure does not include the compensation payments for wolf damages paid by the WDNR Endangered Resources Fund. The gray wolf is currently being federally delisted, and state recovery expenses will decrease. In the new marten recovery plan, an increased budget of $10-20,000 is suggested. If the research and monitoring provide valuable information for improving marten status, increased funding should be supported.

Marten Monitoring and Research

I participated in the joint WDNR and UWSP mark-recapture marten study from September through October. The goal of the study is to estimate the marten population on the Nicolet, identify juvenile dispersal paths and limitations, and assess home ranges as they relate to cover type. The study design divided the Nicolet side of the National Forest into four areas. The 140 trap locations were randomly selected in a variety of different cover types in the Nicolet. Access by road to these locations was an important

consideration. Two areas were trapped for two weeks with seventy traps each, and then the other two areas were trapped for two weeks. To increase trapping effort, the areas were then trapped again. In order to effectively estimate population size, the study will repeat in fall 2005.

To volunteer with the WDNR-UWSP marten research project, I attended a mandatory trap-training day. Jim Woodford described the project and how a typical day would proceed. The group went to a forested area and practiced setting the live, or box traps. The traps were baited with raw chicken or other meat scraps, which were placed in the back of the trap. Marten lure was used the second month of the study and placed on a twig near the trap. The trap was covered with bark, logs, balsam sprigs, or moss, referred to now as a cubby set (Fig.8). Procedures for handling a trapped marten were also discussed. The marten was injected with the anesthetic ketamine xylazine in its rear flank, weighed, measured, aged, a premolar was removed, and if it was a juvenile or female, a radio collar was put on the animal (Figure 9). The study eventually collared all martens captured if a collar was available.

Figure 8. Typical marten cubby set. (photo by J. Dumyahn)


Figure 9. Anesthetized marten with a radio-collar. (photo by J. Dumyahn)

September yielded six marten captures and five of them were collared. Bruce Kohn, the primary DNR mammalian biologist during the 1987-1990 marten reintroductions, and Jim Woodford had anticipated a higher rate of captures, closer to one marten per day during the thirty trap days. The weather was very mild during September, providing enough food for marten without entering traps. However, there were many incidental captures of skunks and raccoons. Bears also frequently visited traps and attempted to get the bait. Based on the results of the first month, a weeklong break was taken before trapping again. The results from trapping in October proved slightly more successful; all previously captured martens were recaptured and new martens were trapped and collared, as well. In total, seventeen martens were captured over sixty days. Using telemetry, their movements and home ranges are being recorded.

One of the differences that I noticed about the DNR trap line compared to the GLIFWC and Forest Research Station trap line was the proximity to roads. Often we would have to hike a distance in from an access road to get to the trap. The habitat

quality was also different. GLIFWC targets high quality marten habitat for trap placement. However, both of these differences can be explained by the different study designs.

The WDNR-UWSP study design is a stratified random sample of trap site locations, which means that different cover types are included in the trap line. Incorporating less suitable cover types ensures that detection effort is high. The sample was non-systematic random sampling due to the necessity for road access in order to check all the traps. Previous trapping experiences have had a much lower trap effort with fewer traps set and fewer trap nights. GLIFWC placed traps in high quality habitat only, aiming to capture the greatest number of martens in the shortest time. I found it beneficial to learn about the importance of detection effort in less suitable habitat.

Educational Materials

One of the many requirements for marten recovery is an increased awareness of the species' presence in Wisconsin. The draft for the marten plan calls for the creation of educational materials, and Adrian Wydeven felt that I could contribute to meeting this goal. Many of the personnel in the WDNR and the U.S. Forest Service spend a lot of time in the CNNF. The personnel may not be able to identify a marten, or those who can, may not be aware that they should report sightings and locations to the Endangered Resources Bureau. I wanted to educate agency personnel and the public about the marten, its habitat needs, and its status in Wisconsin. I decided the best way to do this would be visually.

In order to create a marten poster, I needed a marten picture. John Olson, a furbearer specialist for the WDNR, informed me that an artist was selling a print of a

marten painting through the Wisconsin Trappers Association (WTA). John Olson discussed using the print for a poster with the WTA and the artist. WTA and the artist agreed, if the contact information for obtaining a numbered print was available on the back of the poster. Making this multicolor, large sized poster would be expensive; I decided to seek donations. I wrote to 100 conservation organizations in counties in or around the CNNF asking for donations to the Endangered Resource Bureau (Appendix B). I received no donations, but the poster was still created (Appendix C).

Other educational materials needed to be updated. The WDNR marten website (http://dnr.wi.gov/org/land/er/factsheets/mammals/marten.htm) did not have information about the Chequamegon reintroduction. The Word document was sent to Madison, the WDNR central office, for web publishing. A marten pamphlet that was available for the public at WDNR stations was also very outdated. I provided additional text, revisions, and a new marten picture for the pamphlet. Production and distribution of the copies to the WDNR service stations is pending due to budget restrictions.

Discussion

Writing the marten recovery plan was a wonderful challenge. I enjoyed the process of writing a species recovery plan. The elements involved with marten recovery can be applied to many other endangered species. In the case of the Wisconsin American marten, improved monitoring and an updated population estimate are crucial. Other research information that can be collected during these studies includes: habitat characteristics, juvenile dispersal, predation rates, demographic data, and genetic information. With a broader knowledge base, improved recovery measures can be made.

To write the first part of the marten plan, I did extensive literature searches. The literature was used for general marten information. Wisconsin Department of Natural Resources data, Wisconsin marten studies, and interviews were needed for specific Wisconsin marten needs. Acquiring feedback for the various drafts of the plan was also a unique experience. Comments from my two supervisors and the Marten Committee members provided many avenues to explore. I was never short of things to research or investigate.

I also had the initiative to fulfill some of the suggested recovery measures. Marten educational and informational materials were as outdated as the first marten recovery plan. I enjoyed creating the poster and pamphlet. While I did not receive funding from my mailing effort, I at least learned about the procedure. The web updates afford many people the opportunity to learn about the current management and status of the marten. I became interested in forest management impacts on marten habitat while working on the recovery plan. In the next chapter, I describe the habitat guide I created in response to that concern.

While I learned a profuse amount about the American marten, I also learned about the challenges of interagency coordination. The Marten Committee meeting provided insight to the multiple agendas that surrounded the small carnivore. Composing a plan that includes these agendas was not an easy task. I made certain that the plan focused on the recovery goals and the means of meeting them. Additional suggestions were worked into the plan if they supported marten recovery and appropriate management. Garnering support for additional monitoring methods, other than snow tracking, was simple. Chequamegon-Nicolet National Forest Service, NCRS, and GLIFWC are working on the

new hair snare technique. Hopefully, the WDNR will be included in this effort, since the two supervisors I worked with at the WDNR have additional funds and volunteers that would be willing to participate in checking hair snare transects. Politics exist in the natural resource agencies, too. It seems strange that marten recovery is the common goal, but coordinating the effort is so difficult.

The first year of the joint WDNR-UWSP study, personnel managed to capture seventeen martens after very intensive trapping effort. The same area was trapped in 1983-1984 capturing the same number of martens. Even if the 2004 results represent only 10% of the population, a conservative estimate, then approximately 170 martens are present on the Nicolet side of the CNNF. From 1975 to 1983, 172 martens were reintroduced into that area, suggesting that the marten population has not increased in size. If the trapped martens represent 50-100% of the population, another reintroduction should be considered to augment the population. The second year of trapping will give a more accurate population estimate. According to the new management plan, martens will not be down-listed to threatened status until the two populations exceed 1000 individuals for five years. Improved research and monitoring will provided information on the factors limiting marten success. I hope the new Wisconsin marten plan can guide the recovery of this species.

CHAPTER 3

USDA Forest Service, North Central Research Station

Introduction

While working on the American marten management plan, I wondered what actions could be taken to limit the effects humans have on the marten. The greater part of

Wisconsin's two marten populations is found on the Chequamegon-Nicolet National Forest (CNNF). The Forest is managed by the USDA Forest Service according to their 2004 Land and Resource Management Plan. The plan outlines general management guidelines for the various forest types. The American marten is cited as a Regional Forester Sensitive Species based on its limited population and habitat. CNNF management guidelines for areas occupied by marten are:

1. Leave 15-25% of potential timber salvage unharvested following large disturbance events (greater than 100 acres) except in salvage situations determined high risk to human safety and/or forest health.
2. Incorporate Management Area 2B Reserve Tree Guidelines relative to tree numbers and diameters to even and uneven-age managed stands, where existing tree diameters allow.
    - Reserve 4 to 9 live trees per acre larger than 11 inches. Focus on the largest trees
    - Develop and retain trees over 24 inches in diameter to increase the probability of natural gap formation and tip-up mounds. The number of reserve trees over 24 inches in diameter should be included within the 4-9 reserve live tree total. Large (over 24 inches) basswood, ash, yellow birch, and red oak are preferred for retention.

The silviculturists and timber markers translate the general management guidelines into action by harvesting a stand to meet the future goals. The silviculturist for a forest district writes the stand prescription for timber harvests. Then tree markers render the prescription into existence by marking the trees to be cut. I was curious if the goals of the CNNF management plan, the goals for each forest stand, and the goals for the American marten could be combined. I hoped that a greater understanding of forest management through timber harvesting would provide a way to merge the goals.

John Gilbert, the Chief Biologist for GLIFWC, organized a trip to the planned Cayuga cut, within the Chequamegon portion of the National Forest. Interested biologists, researchers, and Forest Service personnel were invited to learn about timber

marking. Attending the trip were USDA Forest Service district biologists, tree marking crew leaders, a silviculturist, and NCRS researchers. Logging within the Cayuga cut has not commenced due to an ongoing lawsuit about the impacts of the cut. The planned harvest was within prime marten habitat, currently occupied by a female marten.

The Cayuga site was an upland hardwood saw and pole stand with some pockets of conifer. The trees were marked with blue paint on the stems if they were to be harvested. One thing I was amazed to learn from the Forest Service timber cruisers was the copious number of considerations for selecting trees to be cut. Many considerations, such as wildlife, waterways, recreation, timber value, and safety are involved in forest management. I realized that a visual reference guide of marten habitat characteristics would be useful for the timber markers and silviculturists to help incorporate marten needs into timber selection methods.

American martens are used as indicators of forest health (Buskirk and Ruggiero 1994). Typically dependent on late successional forests, marten densities can reflect the quality of habitat. Soutiere (1979) found that marten density was lower in clearcut forests than in undisturbed forests in Maine, 0.4 marten/km^2 and 1.22/km^2, respectively. Mature forests provide structure in the form of increased canopy cover, downed logs, and other downed woody debris that marten rely on for foraging, rest, and maternal den sites. Many of these habitat features are needed by other animals, as well. If marten habitat needs are integrated into forest harvests, more than just the marten will benefit.

Internship Responsibilities

The habitat guide was discussed during a conference call on August 18 attended by Pat Zollner, an Ecologist with the NCRS, John Gilbert, the Wildlife Section Leader

with GLIFWC, Dan Eklund and Tom Matthiae, Forest Biologists with the US Forest Service. During the call, we established that a visual habitat guide would be a useful tool and elaborated on ways to develop it. Marten winter rest sites, prey kill sites, maternal dens, and central activity areas within marten home ranges were known from previous marten tracking studies and telemetry information. These data provided locations for photographing the forest characteristics and points of structural interest. I went to thirty-six sites while the leaves were on the trees. I also revisited some of the sites to get leaf-off photographs to emphasize certain habitat characteristics. A second meeting with the same participants was held to discuss the format of the guide. I was to create a Power Point presentation, a three-page brochure (Appendix D), and a detailed catalogue on CD of the sites visited. The guide and brochure explain the importance of forest structure to martens. In order to drive a Forest Service vehicle to the marten sites, I had to pass an online defensive driving class.

American Marten Habitat Guide

The Great Lakes Indian Fish and Wildlife Commission, along with the NCRS, has been trapping and studying martens since 1996 in the Clam Lake marten study area on the Chequamegon side of the CNNF (Fig. 10). Marten locations were identified by two different methods. Telemetry-based points were determined from radio-collared martens that utilized the same area two to three times. Foraging areas and winter rest sites were located from backtracked martens' daily activity paths. The locations were recorded using a GPS and then mapped (Fig. 11). All of the points were entered into the GPS so that I could navigate to them. Additionally, I was provided a topographic map with the

points for a reference with the Forest Service roads. I visited maternal dens and additional rest sites with Jon Gilbert, the GLIFWC biologist.

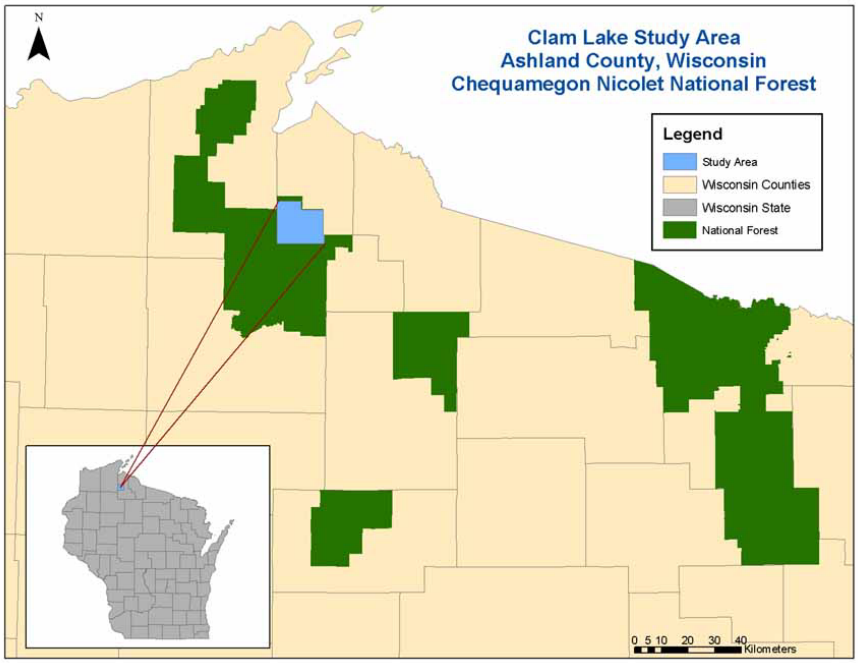

Figure 10. Clam Lake study area on the Chequamegon side of the CNNF.

At every location, I photographed the canopy, stem, and ground from each of the cardinal directions. Next, I photographed surrounding structural characteristics of interest. Features, such as large logs, branch piles, tree root mounds, rotting stumps, conifer species within the hardwood stands, live trees with small holes, and red squirrel middens were found at many of the sites. The structural components of a forest provide martens with places to forage, thermally efficient rest sites, maternal den sites, and protection from predators. By emphasizing the importance of forest structure within the habitat guide, forest managers would understand the importance of leaving or creating certain features.

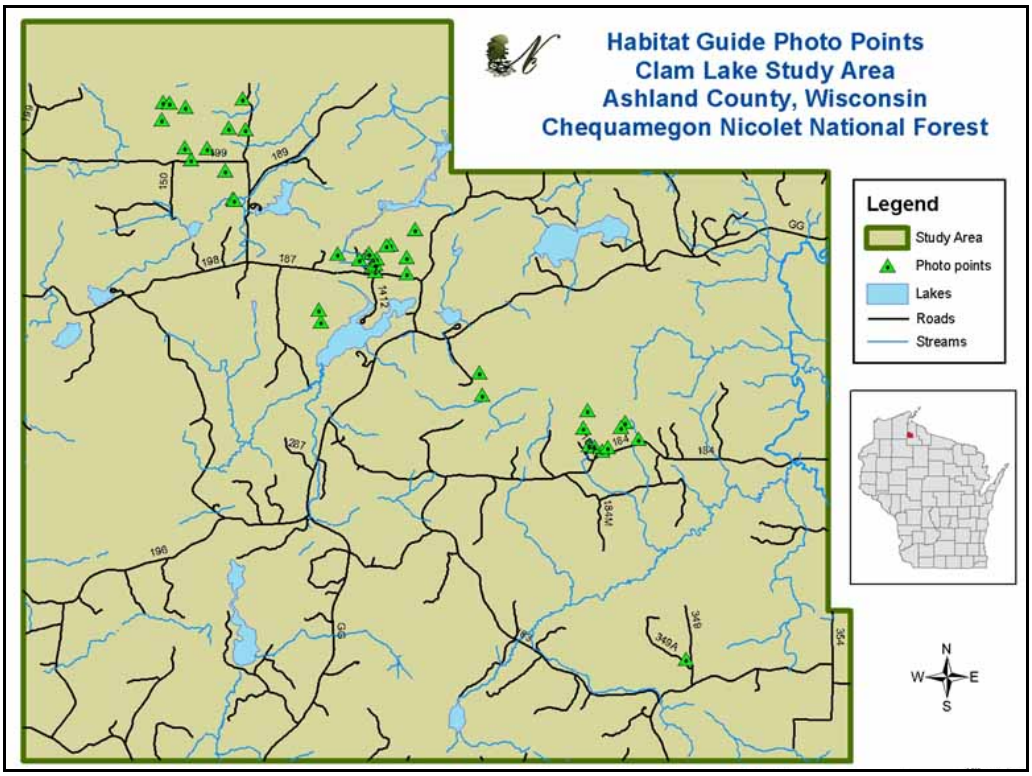

Figure 11. Marten foraging sites, winter rest sites, and maternal den sites photographed for the habitat guide.

Martens are often associated with mature coniferous and mixed deciduous/coniferous forests that naturally provide the structural components they use (Koehler et al. 1975). Martens in western North America select late-successional, coniferous forests. In the eastern part of their range, martens utilize mixed or deciduous stands (Chapin et al. 1997; Poole et al. 2004). The variety of forest communities utilized by martens suggests that species composition is not as important as other forest characteristics (Buskirk and Powell 1994; Buskirk and Ruggiero 1994; Chapin et al. 1997).

Greater canopy cover is characteristic of late successional forests. The standardized canopy photos were designed to capture the types of forest stands that marten inhabit. The closed canopy may provide a lower risk of predation than open areas

(Thompson 1994; Latour et al. 1994). Feske et al. (2002) and Allen (1982) used 50% or greater as the most suitable canopy cover percentage for marten habitat models. Other researchers have suggested 30% as the minimum acceptable canopy cover (Hargis and Bissonett 1995; Koehler and Hornocker 1977; Spencer et al. 1983). The amount of non-forested area present in the landscape may determine marten home range selection and movement. An upper limit of 25-30% of open area is tolerated by marten (Chapin et al. 1998; Hargis et al. 1999; Potvin et al. 2000).

Martens are more closely tied to coniferous and structurally complex areas in the winter. During snowfall, woody debris penetrates the surface making subnivean prey and rest sites accessible (Buskirk et al. 1989; Corn and Raphael 1992). Large woody debris (LWD), such as stumps, root tip-up mounds, and large logs (greater than or equal to 7.6 cm dbh), are important components in marten winter habitat that aid in thermoregulation (Allen 1982). Spencer (1987) found that during periods of 100% snow cover, all rest sites were subnivean, with cavities in decaying wood preferred. Gilbert et al. (1997) found that winter resting sites are selected based on volume of LWD. Most of the winter rest sites were located under tree fall mounds or in the subnivean cavities of other types of LWD. Allen's (1982) Habitat Suitability Index for martens cites an optimum ground cover of downfall as 20-50% of the surface area. Thirty of the thirty-six locations had LWD features near the center of the site.

Another structural feature at many of the locations was understory conifers. These small balsams, hemlocks, or spruces provide overhead cover from predators for martens while they travel and forage during the winter (Hargis and McCullough 1984; Thompson 1994). Low branches of conifers loft snow, enabling marten to access

subnivean prey at the snow-ground interface. Thirty of the sites I photographed had either a coniferous understory or canopy.

Maternal den sites are also an important component of habitat. Ruggiero et al. (1998) stated that live trees with cavities, usually formed by woodpeckers, are common den sites. Martens in Wyoming selected dens in late-successional forests with greater LWD and canopy cover than random sites (Ruggiero et al. 1998). Marten maternal dens can be found in a variety of tree species, but the features around the den sites share structural characteristics. Tree species used for the maternal den sites were yellow birch, sugar maple, and white cedar. All were live saw-sized trees (greater than 22.9 cm dbh). The entrances to the den site were also much smaller than would be expected, averaging about three inches in diameter. The entrance may be located at the base of the tree, a few feet above the ground, or very high up the tree.

The same four individuals who helped organize the project are reviewing the Habitat Guide Presentation. The presentation was designed to emphasize visually the site features that are used by martens. Each slide has a large picture of the feature being discussed and an explanation of its importance to martens. There are one to three slides for each characteristic. Especially important features, such as a coniferous understory, will be targeted for leaf-off photos, when their importance to martens is greater. The brochure was created in conjunction with the habitat guide presentation (Appendix D). Tree markers, or other forest managers, can carry the visual aid with them as a reminder of features to retain or create. For instance, dead trees and snags that would be harvested for safety reasons could be marked to knock over and leave in the stand. A CD, with the

habitat guide presentation and brochure that can be printed out, will be distributed to the Forest Service and other agencies.

A detailed catalogue of the site photographs was created for people who want to pursue the topic in detail. Each site has a folder with the canopy, stem, and ground photos and site features of interest. The catalogue also includes references about woody debris, maternal dens, and rest sites. Not everyone who views the habitat guide presentation would want the catalogue CD, but it will be available for those interested.

Discussion

As a conservationist, I am aware that species conservation is dependent upon habitat conservation. If an endangered species is to survive, enough suitable habitat is required. The American marten was reintroduced into the CNNF, a now-managed forest, which may or may not be similar to the pre-logged Wisconsin forest. It is uncertain if the marten population is stable or decreasing, but it is most likely not increasing. This is based on the distribution estimates show that the marten has not expanded its range from the initial reintroduction sites and the WDNR-UWSP study results thus far. Many factors could be affecting marten success in Wisconsin, and habitat quality could be one of them.

I hoped that by gaining a better understanding of marten habitat requirements, I could provide a means to improve the Wisconsin habitat for martens. The habitat guide presentation will give forest managers a practical way to incorporate marten needs into forest planning. Ground structure from woody debris can be created from timber slash. Logs and branch piles left from the harvesting provide foraging areas and rest sites. Features that are not easy to recreate, such as rotting stumps, should be preserved during

the timber extraction process. In addition, understory and canopy conifers should be preserved to the greatest degree possible. Large (>22.9 cm dbh) trees with holes approximately three inches in diameter should be left. Timber markers typically leave den trees within a stand for wildlife, but the trees selected have holes that are too large to be selected by martens for maternal dens. Selective cuts should still > 30% canopy cover.

Landscape features were not addressed in the habitat guide, however, they are important for quality marten habitat, as well. Researchers have suggested that contiguous suitable habitat aids marten dispersal (Hargis and Bissonette 1997; Spencer et al. 1983; Koehler and Hornocker 1977). Habitat corridors between suitable patches could provide a means for dispersal and additional colonization of an area. This is an especially important consideration for the Wisconsin martens, since two separate populations exist. Sources of marten from the Michigan Upper Peninsula could contribute to the Nicolet population size and genetic diversity. Home ranges appear to be selected at the coarsest scale based on adequate forest cover (Chapin et al. 1998). Since martens do not appear to use open areas during the winter, non-forested areas should not dominate the landscape. In order to maintain large blocks of optimal habitat, future harvests should be located near existing cut or open areas.

I believe that the CNNF forest management goals and marten recovery can coincide. Areas with known martens should have special precautions while timber harvesting. Timber road creation and marked trees should be selected carefully with the mentioned habitat features considered. Selectively cut hardwood stands should still contain large trees, conifers, and woody debris after a harvest. Marten typically move out

of an area undergoing a harvest due to the noise and human activity. However, afterwards a logged stand could still provide features that martens need.

CHAPTER 4

Reflection on the Internships and IES

From this internship experience, I gained knowledge about endangered species recovery and management. My education from the Institute of Environmental Sciences (IES), Miami University allowed me to pursue my interest in Biological Conservation. The IES core courses established a background for confronting environmental issues. I learned various environmental measurements and methods for solving questions. Methods for approaching environmental questions were emphasized while completing a team Public Service Project. My team PSP was with the Three Valley Conservation Trust, which works to preserve riparian areas to protect green space and water quality. The Trust needed a complete inventory of a watershed's ecological, geographical, and social components. This project provided experience solving a problem, lack of information. I gained leadership, writing, and presentation skills from working with my PSP team and Three Valley Conservation Trust. All of these skills were useful during my internship.

My greatest reward from the internship was the ability to work with so many other organizations. I am a proponent of involving many stakeholders for species recovery. During my internship I sought the input of relevant individuals. United States Forest Service personnel will be using the habitat guide; by collaborating with the CNNF I ensured that it would be useful to them. If a program is not supported, it will not be

successful. Additionally, the support for a program may be available, but the funding for it may not be. Many of the needed monitoring changes and research projects could not happen until grants and other resources are obtained.

I enjoyed having an internship where my interest and initiative was utilized. Creating the additional educational materials mentioned in the recovery plan was very satisfying. As well, producing the habitat guide project when I realized the need was rewarding. The WDNR and the Forest Service NCRS provided me with the support and materials I needed. Constructive criticism was also provided, helping to improve the recovery plan and habitat guide. I learned much from my two WDNR supervisors and the collaborators with the habitat guide. I am looking forward to working with them on other marten projects this winter.

Conservation biology requires a multidisciplinary approach to deriving a solution. I learned how multiple agencies cooperate for species recovery. Humans caused the martens' extirpation in Wisconsin due to unregulated logging and trapping. The multiple use nature of the National Forest, on which the martens now reside, integrates timber management, species management, ecosystem management, recreation, and aesthetics. Without taking all of these aspects into consideration, a solution to biodiversity loss within the Chequamegon-Nicolet National Forest would not be reached. Utilizing scientific research for management actions only addresses part of the issue. Conservation must incorporate the human viewpoint; otherwise, recovery measures are not likely to be supported. Knowing these challenges, I hope that this internship is just the beginning of my future conserving biodiversity.

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APPENDIX A

Wisconsin American Marten

Recovery and Management Plan

2004

Wisconsin Department of Natural Resources

TABLE OF CONTENTS

PART I. Distribution, Status, and Life History

A. INTRODUCTION

The American marten (*Martes americana*) is currently listed as a state endangered species in Wisconsin. The goal of this plan is to emphasize the need for improved monitoring and management for the marten. Interagency coordination and cooperation are integral for these improvements to manifest themselves. After two successful reintroductions, the American marten is reestablished in the Chequamegon-Nicolet National Forest. The last population study for the Nicolet side of the marten was in 1986, and a new research study by the Department of Natural Resources and the University of Wisconsin at Stevens Point will provide a population estimate in 2005. A similar study is needed for the Chequamegon portion of the population. Winter snow track counts are providing annual distributions of marten in northern Wisconsin. However, a more accurate and comprehensive monitoring method is needed to reliably assess marten distribution. In addition, better understanding of current marten population status and ecology are required to ensure recovery and long-term survival in Wisconsin. Continued research and funding are necessary to gain this fundamental information for sound management decisions.

B. DISTRIBUTION AND STATUS

North America

1. Former Range

Historically, marten distribution followed the boreal forest zones east to west with the northern limit extending to tree line (Powell et al. 2003). Canada and Alaska formed the greatest proportion of the marten range. The Sierra Nevada and Rocky Mountain ranges form fingers of habitat stretching southward in the western United States. Generally, marten were found in the northeastern, Great Lakes, and northwestern United States.

2. Current Range

Marten have been extirpated from seven states in which it historically occurred: New Jersey, Pennsylvania, West Virginia, Ohio, Indiana, Illinois, and North Dakota (Buskirk and Ruggiero 1994). Marten populations are also declining in areas of northeastern Canada. Today, eight states do not permit the trapping of marten reflecting the continued population and spatial decline of the species (Table 1).

Table 1. Current marten status and management in the United States.

State	Status	Management
EAST		
Maine		Trapping- 25 marten/ trapper
New Hampshire	Threatened	Recovery

New York		Trapping- 6 marten/ trapper
Vermont	Endangered	Recovery
N. CENTRAL		
Michigan		Trapping in UP- 1 marten/ trapper
Minnesota		Trapping- 5 marten/ trapper
Wisconsin	Endangered	Recovery
South Dakota		No trapping
WEST		
Colorado		No trapping
Idaho		Trapping
Montana		Trapping
Nevada		No Trapping
New Mexico	Threatened	Recovery
Utah		Trapping- limited areas
Wyoming		Trapping
PACIFIC NW		
Alaska		Trapping
California	*M.a. humboldtensis* Special Concern	No trapping of *M. americana*
Oregon		Trapping
Washington		Trapping

Wisconsin

3. Former Numbers and Distribution

Marten were found throughout most of the forested regions of Wisconsin, but as unregulated trapping, forest harvest, and subsequent wildfires occurred, the population declined. Jackson (1961) estimated that in the 1800's northern Wisconsin's mixed conifer and hardwood forests supported one marten per square mile. Even though marten trapping ceased in 1921, they were considered extirpated in 1925 (Jackson 1961). The marten was listed as a state endangered species in 1972.

Three reintroduction efforts have been made in Wisconsin. The first attempt in 1953 released 5 Montana marten onto Stockton Island, one of the Apostle Islands, in Ashland County. One marten was observed there in 1972, but the reintroduction was considered a failure (Kohn and Eckstein 1987). Kohn and Eckstein (1987), and Davis (1983) documented the second release, which was made in the Nicolet National Forest (n=172) from 1975 through 1983 (Table 2). The marten were released within the Fisher Management Unit, a 484-km^2 area that prohibits upland trapping, near the town of Argonne (Fig 1). The third release took place from 1987 through 1990, reintroducing 139 marten into the Chequamegon National Forest (Table 2). Once again, an existing Fisher Management Unit (890-km^2) within the Forest was utilized as the release site (Fig. 1) (Wright 1999).

A trapping and track count study was conducted from 1983 to 1985 in and around the Nicolet Marten and Fisher Management Unit (MFMU) in order to estimate the marten population and distribution after the reintroductions (Kohn and Eckstein 1987). Eighteen marten were captured during this time; none were the marked, reintroduced marten. This provided evidence that the population was reproducing. A disproportionately small number of females were captured (n=3), and over half of the captures were juveniles (n=10). Track counts within the Nicolet MFMU increased from 1983-1984 to 1984-1985 (Fig. 2). The study found that 89% of the observations taken from 1982 to 1985 were within 20-km of the release sites. The authors estimated the marten population to be 100-150 individuals within the Nicolet MFMU (Kohn and Eckstein 1987). The Chequamegon MFMU still lacks a marten population estimate.

Table 2. Marten reintroductions in the Nicolet and Chequamegon National Forest (Kohn and Eckstein 1987; Kohn, unpublished).

Year	Total Released	Male	Female	Unknown	Source
Nicolet					
1975-1976	124	97	27		Ontario
1980-1981	19	9	10		Colorado
1981 March	18	9	9		Ontario
1981-1982	4	2	2		Colorado
1982-1983	7	3	3	1	Colorado
	172	120	51	1	
Chequamegon					
1987	31	27	4		Minnesota
1988	21	13	8		Minnesota
1989	42	28	14		Minnesota
1990	41	25	16		Minnesota
	139	93	42		

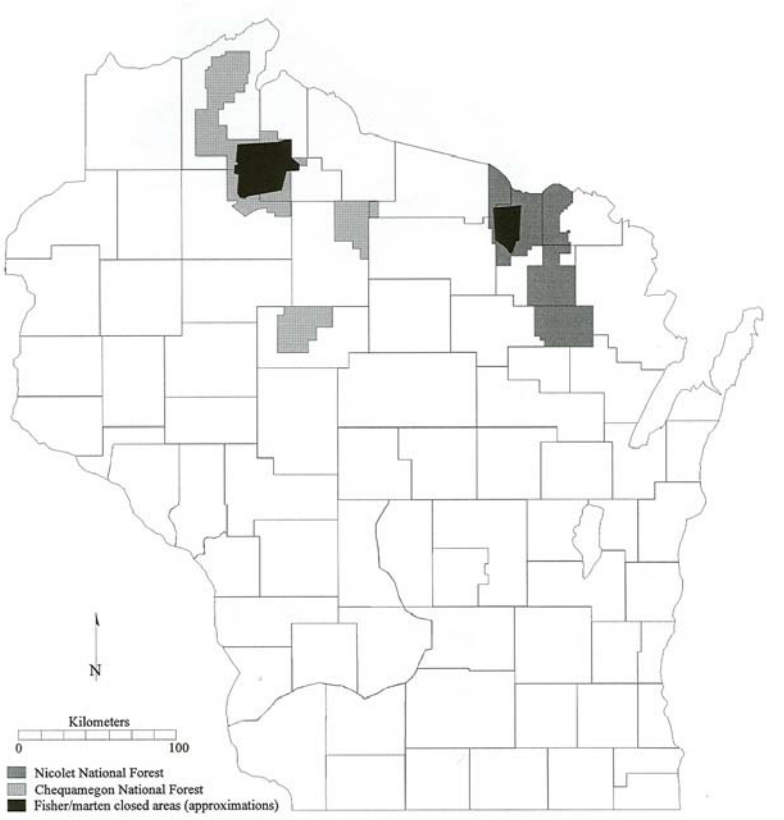

Figure 1. Nicolet and Chequamegon National Forests with locations of the Marten and Fisher Management Units darkened (Wright 1999).

4. Current Numbers and Distribution

The Nicolet and Chequamegon marten populations have continued to be monitored via winter track count surveys (Fig. 2). The surveys have not yielded any consistent trends, but have provided an estimated distribution (Fig. 3). Locations of tracks and observations from 1996 to 2001 were buffered using the mean winter home range radius of 1,085 meters reported by Wright (1999) (J. Woodford unpub. data).

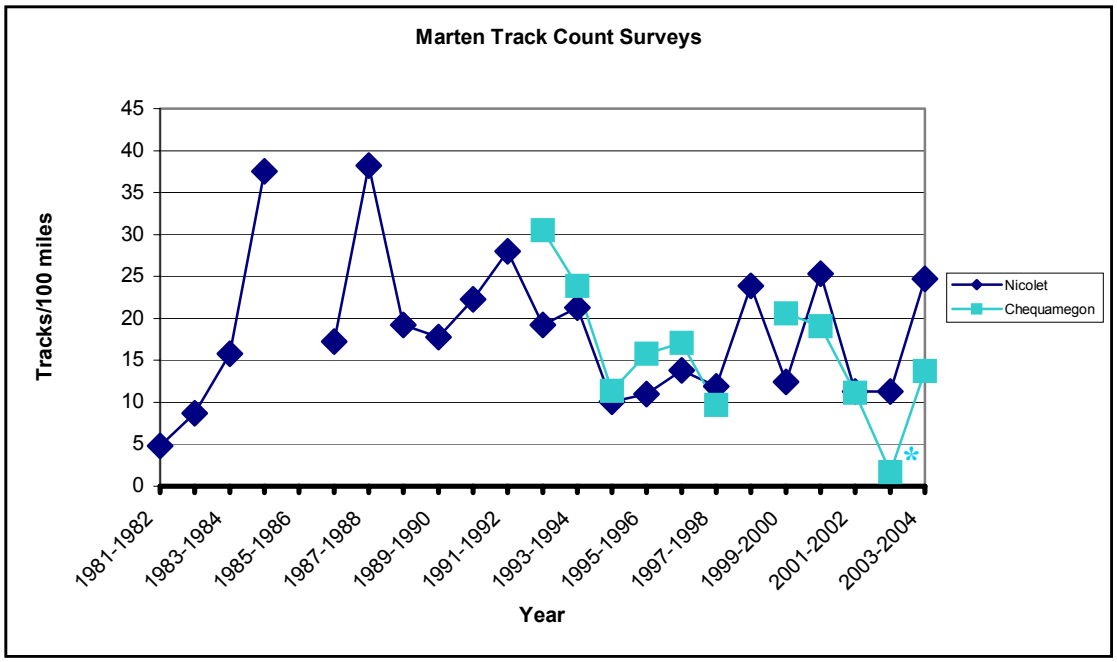

Figure 2. Marten track count survey results from 1981-1982 to 2003-2004 (Kohn and Eckstein 1987; Ashbrenner 1994; Wydeven et al. 2003).
*Poor tracking conditions were reported.

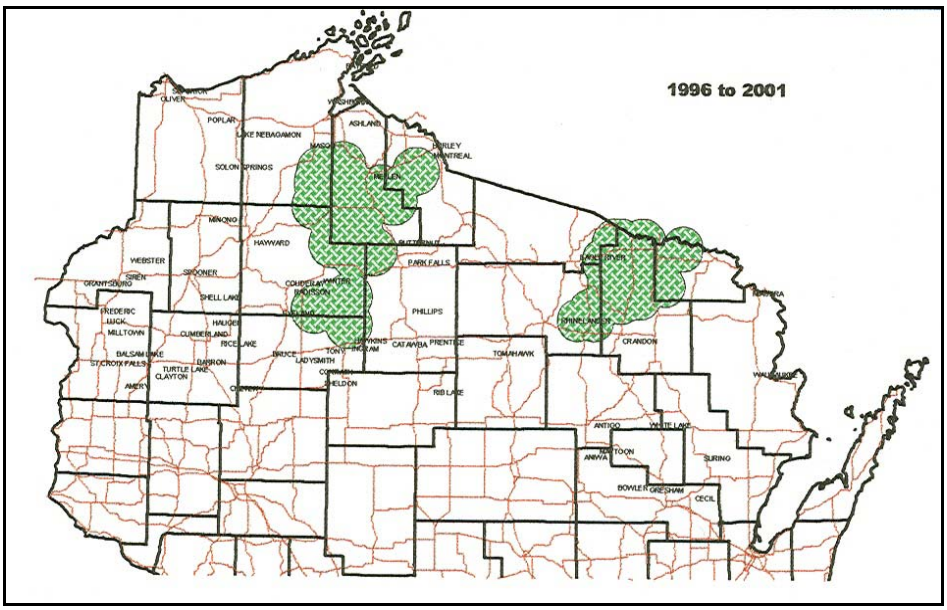

Figure 3. Estimated distribution of marten based on track surveys and observations from 1996 to 2001 (J. Woodford unpub. data).

C. LIFE HISTORY

1. Description

The American marten is in the Family Mustelidae and possesses the characteristic long, slender body. Martens are about the size of a small house cat with males being larger than females (Strickland and Douglas 1987). Adult length and weight measurements range from 49 to 68 cm and 500 to 1400 g, depending on sex and geographic location (Buskirk and McDonald 1989). The tail is also long and well furred. Pelage coloration is typically brown, but can vary from tan to brownish red to a dark black-brown. Winter coats are thicker with essentially the same coloration. Annual shedding to the summer coat is completed by mid-June. The head and dorsal are usually a paler color, and the legs and tail are darker. There is a characteristic buff to orange throat or neck patch. Marten have a pointed face with small, curved ears. The eyes are small and black, and a vertical eye bar extends from the inside corner of the eyes. Marten paws have five toes, all of which touch the ground. Mean male foot length taken from the most anterior toe to the most posterior interdigital pad segment is 4 cm; female foot length is 3.4 cm. Mean male and female width is 3.5 and 3.4 cm, respectively (Zielinski and Truex 1995). The claws are semi-retractable, which aid in climbing trees.

2. Reproduction

The breeding season is from July to August (Strickland et al. 1982). Marten can successfully breed at the age of fifteen months with females being polyandrous or selective. The fertilized blastocyst implantation is delayed until midwinter, 6-8 months later. Litters are born mid-March to late April in a natal den, usually a tree cavity, prepared by the female. The average litter size is 2.9 kits, and the sex ratio at birth is 1:1 (Strickland and Douglas 1987). The young weigh about 28 g at birth, and are blind and altricial. Males do not directly participate in care of the young, but by excluding other martens from the territory, foraging may improve for the female. The young are weaned by six weeks, become more active and are moved to a ground-level den in week 7-8. The young reach adult length, but not weight, by three months. Young start to disperse from the parents' territory by late summer or early fall (Francis and Stephenson 1972).

3. Mortality

Marten are vulnerable to fluctuations in prey populations. When food is scarce, females and juveniles are more negatively impacted than males due to higher energy demands (Hawley and Newby 1957; Powell et al. 2003). Females have reduced reproduction and juvenile survival is lower during times of decreased prey abundance (Weckworth and Hawly 1962).

Marten are reportedly preyed on by fishers (*Martes pennanti*), lynx (*Lynx canadensis*), moutain lions (*Puma concolor*), coyotes (*Canis latrans*), red fox (*Vulpes vulpes*), golden eagle (*Aquila chrysaetos*), bald eagle (*Haliaeetus leucocephalus*), and great horned owls (*Bubo virginianus*) (Strickland and Douglas 1987). In Wisconsin, fishers have successfully reestablished populations (Kohn et al. 1993). Fishers, if not directly consuming marten, may be competing with them for territory, prey, or den sites.

Competitive interactions involving limiting resources have not been conclusively reported (Gilbert 1995; Buskirk and Ruggiero 1994).

Humans are another marten predator. Marten are trapped for their pelts, which are in its prime November to December (Powell et al. 2003). Trapping regulations are different across the marten range and vary in time, length of season, numbers of licensed trappers, and quotas. Marten are curious, and are susceptible to trapping mortality even in areas that prohibit marten trapping. In Wisconsin, road killed martens are another form of human-induced mortality (Wydeven and Wiedenhoeft 2004).

4. Habitat Requirements

Martens are often associated with mature coniferous and mixed deciduous/coniferous forests and are used as climax forest indicator species (Koehler et al. 1975). Martens in western North America select late-successional, coniferous forests. In the eastern part of the range, martens will utilize mixed or deciduous stands (Chapin et al. 1997; Poole et al. 2004). The variety of forest communities utilized by martens suggests that species composition is not as important as other forest features (Buskirk and Powell 1994; Buskirk and Ruggiero 1994; Chapin et al. 1997).

Canopy coverage is an important habitat feature that mature forests provide (Buskirk and Powell 1994). The closed canopy may provide a lower risk of predation than open areas (Thompson 1994; Latour et al. 1994). Feske et al. (2002) and Allen (1982) used 50% or greater as the most suitable canopy cover percentage for marten habitat models. Other researchers have suggested 30% as the minimum acceptable canopy cover (Hargis and Bissonett 1995; Koehler and Hornocker 1977; Spencer et al. 1983). The amount of non-forested area present in the landscape may determine marten home range selection and movement. An upper limit of 25-30% of open area is tolerated by marten (Chapin et al. 1998; Hargis et al. 1999; Potvin et al. 2000). However, canopy coverage can be a very subjective measure.

Marten are more closely tied to coniferous and structurally complex areas in the winter. During snowfall, woody debris penetrates the surface making subnivean prey and rest sites accessible (Buskirk et al. 1989; Corn and Raphael 1992). Large woody debris (LWD), such as stumps, root tip-ups, and large logs, is an important component in marten winter habitat that aid in thermoregulation. Allen's (1982) Habitat Suitability Index for marten cites an optimum ground cover of downfall as 20-50% of the surface area. The LWD can include snags, tree fall mounds, stumps, and fallen logs (greater than or equal to 7.6 cm in diameter) (Allen 1982). A coniferous or shrub understory can provide overhead structure to avoid predators while traveling and foraging during the winter (Hargis and McCullough 1984; Thompson 1994)

Maternal den sites are also an important component of habitat. Ruggiero et al. (1998) state that live trees with cavities, usually formed by woodpeckers, are common den sites. Marten in Wyoming selected dens in late-successional forests with greater LWD and canopy cover than random sites (Ruggiero et al. 1998). Other den sites have been found

in rock crevices, squirrel middens, and logs (Corn and Raphael 1992). Snags and live trees were used as rest sites most frequently during times of less than 100% snow cover (Spencer 1987). Spencer (1987) found that during periods of 100% snow cover all rest sites were subnivean, with squirrel middens and other cavities in decaying wood preferred.

Home ranges of marten can vary widely. Male home ranges are typically larger than female home ranges, ranging from 2-27 km^2 and 0.6-17 km^2 respectively (Powell 1994). A study by Buskirk and McDonald (1989) report that the variability found did not relate to geographic latitude. Density of marten is correlated to prey availability and habitat suitability (Soutiere 1979; Francis and Stephenson 1972). Soutiere (1979) found that marten density was lower in clearcut forests than in undisturbed forests in Maine, 0.4 marten/km^2 and 1.22/km^2, respectively. Francis and Stephenson (1972) found a similar density of 1.5/km^2 in southern Ontario.

5. Food

A typical marten diet consists of small mammals, birds, bird eggs, insects, plant matter, reptiles, and carrion. The variation in diet reflects the marten's opportunistic foraging behavior. However, voles (*Microtus* and *Clethrionomys* spp.) were found to be the principle component of many marten diets (Buskirk and MacDonald 1984; Ben-David et al. 1997; Douglass et al. 1983). In the winter, marten may consume more snowshoe hares (*Lepus americanus*) (Thompson and Colgan 1987), but this may be a function of prey availability rather than preference.

D. WISCONSIN HABITAT

1. Critical Habitat

Wisconsin's managed forests provide different forest cover types than other more boreal or montane regions of marten habitat. Wright (1999) found that home ranges of marten from the Nicolet side of the Chequamegon-Nicolet National Forest are in predominantly mixed hardwood forests in pole class diameter (12.7-22.9 cm dbh). Male marten selected red pine cover more than expected, and avoided aspen/aspen-spruce/fir, swamp conifer, and non-forested cover. Females selected mixed hardwoods, and avoided the same cover types as males, but also avoided red pine forest types. The pole size forest diameter class was selected for by marten. Male marten also selected saw size stands (>22.9 cm dbh). Females were reported to use the saw size stands in proportion to its availability. Large woody debris was identified to be more important than cover type or stand class for determining marten preferred habitat. In addition, LWD influenced activity centers, dens, and rest sites.

Wright (1999) found the average male marten (n=15) home range was 4.7 km^2 using a 95% kernel estimator or 2.7 km^2 using minimum convex polygon. The average female marten (n=6) home range was 2.7 km^2 or 1.7 km^2 using the kernel and minimum convex polygon estimators, respectively. Gilbert (1995) found a similar size for male martens home ranges in the summer, 2.59 km^2, but in the winter, it increased to 4.56 km^2. The marten density estimate was 0.6 marten/km^2 (Wright 1999).

2. Maternal Dens and Resting Sites

Maternal den sites are usually found in standing, live trees that are greater than 50 cm in diameter (Gilbert et al. 1997). The favorite tree species, in descending order, used by Wisconsin marten for dens are yellow birch (*Betula alleghaniensis*), white cedar (*Thuja occidentalis*), sugar maple (*Acer saccharum*), and aspen (*Populus* spp.) (J. Gilbert, pers. comm.). The entry holes are usually small, less than three inches in diameter. Den sites do not appear to be used more than once (J. Gilbert, pers. comm.). Gilbert et al. (1997) found that winter resting sites are selected based on volume of LWD. Most of the winter rest sites were located under tree fall mounds or other types of LWD in the subnivean cavities. Rest site characteristics are typical of late-succession forests. Marten spring resting sites are mainly live-trees or snags, and are not selected by presence of LWD. Rest sites may be used in subsequent years.

E. LIMITING FACTORS

Prey availability may cause marten population fluctuations. A study by Thompson and Colgan (1987) found that prey scarcity resulted in population decline.

Predation may also limit marten populations. Predation by raptors accounted for four of the seven recorded predator-related marten deaths in the Chequamegon NF from 1997-2002 (J. Gilbert unpub. data). Two fisher-caused mortalities and one unknown predator accounted for the other three marten mortalities during those years. Populations of red fox in northern Wisconsin could impact the marten.

In Wisconsin, there is not a marten-trapping season. However, dry land trapping of fishers and other furbearers is permitted outside of the MFMU. Some incidental trapping is recorded (Table 3). The extent of unreported seizures is unknown.

Table 3. Incidental marten seizures reported to conservation wardens from 1996 to 2003

YEAR	Martens
1996	1
1997	3*
1998	0
1999	1*
2000	2
2001	0
2002	1
2003	0

*Reported by Wydeven and Boles 1998; Wydeven and Weidenhoeft 2000.

The Wisconsin marten population may be limited by availability of suitable habitat areas. The effects may be indirect as related to adequate cover from predators or ability to find prey. Some forest management strategies are harmful to the success of marten. Many studies demonstrate the negative impact of clear cutting or forest openings on marten,

represented by increased predation and decreased presence of marten in the area (Steventon and Major 1982; Soutiere 1979; Potvin and Breton 1997).

F. MANAGEMENT AND RESEARCH

Current monitoring by the Wisconsin Department of Natural Resources is via annual snow track surveys. The WDNR and the University of Wisconsin Stevens Point are planning an extensive study on the Nicolet marten population. The study will use a mark-recapture method over two consecutive years to estimate the population size. Radio tracking the collared animals will help to describe juvenile dispersal, as well as habitat use.

The USDA Forest Service North Central Research Station and the Great Lakes Indian Fish and Wildlife Commission cooperatively researched three aspects of marten ecology. The research utilized radio-collared marten near the town of Clam Lake in the Chequamegon NF. Energetic constraints were determined by establishing field metabolic rates, daily activity patterns, and small mammal densities. Predation risk was the second ecological aspect researched, which identified terrestrial predator relative abundance in marten primary habitat types. Third, marten movement in various habitat types was established by backtracking radio-collared marten. The North Central Research Station is developing a marten simulation model based on these aspects to predict how marten move through landscapes (P. Zollner unpub.data). Additional cooperative research includes: home range estimates, genetic analysis, teeth aging, necropsies of dead marten, and scat sampling.

The USDA Forest Service has recently updated its Land Resource and Management Plan for the Chequamegon-Nicolet National Forest (2004). The plan identifies the marten as a Regional Forester's Sensitive Species (RFSS). Forest management guidelines in marten habitat describe leaving "15-25% of potential timber salvage unharvested following large disturbance events (greater than 100 acres)" (pg2-22). Uneven-aged northern hardwood stand guidelines are supportive of marten habitat needs by maintaining old-growth characteristics, leaving larger trees to eventually create tree fall mounds, snags, and large woody debris. The plan also calls for the retention of all dead snags or den trees (up to 10/acre) emphasizing the largest of den trees and snags available.

PART II. Recovery and Management Strategies

A. MANAGEMENT GOAL AND CRITERIA FOR DETERMINING ENDANGERED, THREATENED, OR DELISTED STATUS

The management goal is to establish and maintain a viable population of at least 4,000 martens within Wisconsin. Martens could be delisted at that level and managed as a protected or furbearer species (Table 1). This will require more intensive and improved monitoring efforts, determination of the need for additional reintroductions, and continued protection.

Management Objectives:

1. Identify the size of the two known marten populations on the Chequamegon-Nicolet National Forest
2. Determine if additional recovery measures or down-listing are required for the Wisconsin marten
3. Identify ways to improve state monitoring efforts of marten population and distribution
4. Continue to fund Wisconsin marten research and management projects

Table 1. Listing and delisting criteria for Wisconsin marten.

Marten Population	**State Listing**
Less than 1000	Endangered
>1000 for 5 years	Threatened
>2000 for 5 years	Delisted and Protected
4000 or greater	Protected or Furbearer
Less than 2000 for 5 years	Reclassify as Threatened
Less than 1000 for 1 year	Reclassify as Endangered

1. Background

The Wisconsin Marten Committee and the Wisconsin DNR propose to maintain the endangered status of marten until a population estimate of 1000 or more is achieved in the state. This will provide a population of approximately 500 marten for each of the two core areas on the Chequamegon-Nicolet National Forest. Schneider and Yodzis (1994) modeled population viability for *Martes americana* and found that populations with 75-150 females or less faced extinction. The transition to extinction usually resulted from decreased habitat size or carrying capacity. Populations that persisted despite environmental and demographic stochasticity were generally 26% larger, 95-189 females. If the total population is considered, then 190-378 individuals should be present to guard against possible extinction. Once the population exceeds 1000 individuals for five years, the Marten Committee can begin down-listing the marten to threatened status.

Concern about the amount of available habitat for the marten within the Chequamegon-Nicolet National Forest led to a habitat assessment using a Geographic Information System (GIS). Wright (1999) studied marten use in different cover types (for explanations of cover type use see section III A). High use cover types within the CNNF

provide 2117.9 km^2 of habitat (Table 2). Male marten home range estimates were approximately 3 km^2. The smaller female home ranges were approximately 2 km^2 and can overlap male home ranges completely or not at all (Wright 1999). Based on the male home range estimates and the span of female overlapping home ranges, the CNNF could support 700 to 1400 marten. If marten could also utilize moderate and low use areas, then 1350 to 2700 marten could live in the CNNF. According to the range of carrying capacity values, a minimum population of 500 marten in each core habitat area of the CNNF could be feasible. However, habitat is not the only limiting factor for marten success, and even the high use areas may not provide ideal conditions. Prey availability was cited as influencing marten population fluctuations (Thompson and Colgan 1987). Therefore, 700 marten is a reasonable upper limit of carrying capacity for the National Forests with each containing approximately 350 marten. In order to reach delisted status, marten will need to occupy other forested areas in the state.

Long-term viability of marten populations is another concern. The CNNF populations are spatially separate, and martens may not be able to travel between them. Martens from Minnesota and the Upper Peninsula of Michigan may be supplementing the two populations, but no evidence is available. Until then, the two populations should be considered isolated.

B. POPULATION MANAGEMENT STRATEGIES

1. Identify Suitable and Potential Habitat

In order to manage the Wisconsin marten population, a better understanding of habitat use and characteristics is required. Several of the habitat needs of marten are at a site-specific scale and are not available on USDA Forest Service Geographic Information System database. However, many of the site features that provide quality habitat can be found in pole and saw stands of different cover types. Wright (1999) identified suitable marten habitat based on cover types present within the home ranges on the Nicolet side of the CNNF. High, moderate, and low use cover types were designated from the research findings (Table 2). Hardwood pole and saw was designated as high use cover types providing 2117.9 km^2 of habitat. An assessment of the amount of suitable habitat on state, county, tribal, and private land is needed. The carrying capacity for the state can then be estimated.

Table 2. Marten relative use of cover types and size classes and the availability of those cover types (km^2) within the CNNF.

Cover Type and Size Class	High Use	Moderate Use	Low Use
Aspen birch pole			583.9
Aspen birch saw			182.6
Lowland conifer pole			390.8
Lowland conifer saw			114.1
Lowland hardwood pole	139.6		
Lowland hardwood saw	16.6		
Oak pole	105.2		
Oak saw	66.5		
Pine oak pole		3.8	
Pine oak saw		2.3	
Upland conifer pole		297.3	
Upland conifer saw		403.3	
Upland hardwood pole	1100.8		
Upland hardwood saw	689.2		
Total	2117.9	706.7	1226.0

Table 3. Marten cover type use and availability (km^2) in each National Forest.

National Forest	High Use	Moderate Use	Low Use	Total
Chequamegon	1088.7	360.2	701.3	2150.2
Nicolet	1029.2	346.5	524.7	1900.4
Total	2117.9	706.7	1226.0	4050.6

2. Population Monitoring

Accurate population counts are needed to determine the status of marten. The WDNR and the University of Wisconsin- Stevens Point are currently conducting a two-year (2004-2005) mark-recapture and telemetry study on the Nicolet core area marten population. The findings should provide an accurate population estimate. A similar study on the Chequamegon population needs to be initiated for the following two years (2006-2007). The research will determine the status of marten and further management needs. The Wisconsin Marten Committee should plan to complete an intensive population study for both the Chequamegon and Nicolet populations every five years until marten are delisted.

A trial study on the effectiveness of soot plates, camera stations, or hair snares for determining marten distribution and changes in occurrence should be conducted by the WDNR, GLIFWC, and the U.S. Forest Service (Zielinski et al. 1997; Raphael 1994; Belant 2003). The results of the study should be compared to the current monitoring method of snow track counts. Currently, annual winter snow track counts are used to identify marten presence and distribution. The snow track survey should continue annually by experienced DNR personnel, unless one of the tested methods is found to be more effective.

Other surveys that will provide continued information on marten population trends include:

a. Furbearer track counts that consist of two ten-mile survey sections per county that are conducted by wildlife managers. Winter track counts have been conducted since 1978, providing distribution data and long-term population trends.
b. Rare mammal reports that consist of marten observations from agency personnel and the public will continue to be collected. Locations from observations can guide winter surveys.

3. Evaluate the Need for Additional Reintroductions

Should the marten population remain endangered, the Wisconsin Marten Committee should make plans to augment the population by additional reintroductions into suitable habitat. The findings from the WDNR and University of Wisconsin-Stevens Point study on the Nicolet marten population will provide a valid population estimate. If less than 500 marten are found within each core area, the Marten Committee can decide whether a reintroduction is necessary. If either of the populations is found to be less than 75 individuals, then the Marten Committee should make plans for a reintroduction in 2006 (Schneider and Yodzis 1994).

The following points should be considered for all future reintroductions:

a. The reintroduction should occur at the first suitable time. Trapping martens from the source population should not be done during April or May, as females may be rearing litters. Release of marten should be before harsh winter weather limits activity and prey abundance.
b. The methods for restocking the population can follow the previous reintroduction efforts in Wisconsin (Davis 1983). The number of marten to restock the population can be determined by the Marten Committee. Marten should be obtained from a viable source with adequate genetic diversity. The Chequamegon reintroduction (1987-1990) obtained marten from Minnesota. The ideal sex ratio to reintroduce is an equal number of males to females to increase reproductive opportunities. A DNA sample should be collected from each marten for future testing. It can be decided if blood samples are necessary. Pertinent vaccinations can be administered before release. The martens should be marked using the best method available (e.g. tattoo, ear-tag, or PIT tag). Selected marten should be radio-collared to track dispersal, survival, and home ranges.
c. The Marten Recovery Areas can be used as release locations. Ideal sites can be selected within the MRA to release the marten. Gentle-release methods should be used to reduce post-release movements (Davis 1983). In addition, by providing several days worth of food in the area, marten movements can be reduced.
d. Appropriate funding should be in place to monitor the success of the restocking. Telemetry data should be collected on the collared individuals

until each radio-collar is off the air. Sound monitoring efforts should be planned as a follow up to the restocking.

4. Maintain Marten Restoration Areas

The continued existence of Marten Restoration Areas (MRAs) is a critical factor for marten recovery. Previously referred to as Marten/ Fisher Closed Areas, the MRAs are closed to upland trapping, minimizing the incidental captures of marten. The two MRAs are found within the CNNF (Part 1, Fig.1). The marten reintroductions took place on the MRAs, and evidence from snow track surveys suggests that the marten populations are still centered within these areas (Part 1, Fig. 3). Upland trapping in the MRAs should continue to be illegal while the marten is listed. Once the population is no longer protected, the Marten Committee can determine if the MRAs can be opened to trapping.

Until the marten are delisted, the MRAs should continue to be closed to upland trapping or restricted to live capture with box traps (e.g. Havahart and Tomahawk) that allow for the safe release of captured marten. Enforcement of the law relies on the WDNR Conservation Wardens, trapper education, and the public. DNR wardens can be contacted for incidental trapping reports and poaching reports at 1-800-TIP-WDNR. The fine for trapping in Marten Restoration Areas is $280.40.

C. HABITAT MANAGEMENT STRATEGIES

1. Forest Management

Marten distribution is predominantly on the CNNF. It is expected that the USDA Forest Service in Wisconsin will manage the CNNF according to the 2004 Land and Resource Management Plan. The following considerations for forest management for marten should be applied to national, state, county, tribal, and private forests.

Marten populations are denser in undisturbed areas with little fragmentation (Bissonette and Broekhuizen 1995; Snyder and Bissonette 1987). Large tracts of late successional forests should be maintained, especially in areas with known populations of marten. Marten do not appear to use open areas during the winter, therefore non-forested areas should not dominate the landscape. In order to maintain large blocks of optimal habitat, future harvests should be located near existing cut or open areas. Selective cuts should still provide greater than 30% canopy cover (Hargis and Bissonette 1997; Spencer et al. 1983; Koehler and Hornocker 1977). Connectivity of suitable habitats should also be considered. Marten dispersal is aided by providing corridors between suitable habitat patches.

Forests with dead and downed woody material provide the structural complexity that marten need during the winter. Efforts should be made to preserve large stumps, root mounds, logs, and snags. Conifer species within the hardwood stand should also be preserved. When cutting in known or suitable marten habitat, dead or unsafe trees with no market value can be knocked over and left on site. Other cutting debris (i.e., slash) should be left in the area.

Marten maternal den trees should also be preserved. Den openings are small (three inches or less in diameter). These openings may be hard to identify, since they can occur high up on the trunk. Den trees of Wisconsin marten are usually found in standing, live trees that are 50 cm in diameter (Gilbert et al. 1997). Common den trees used by Wisconsin marten are yellow birch (*Betula alleghaniensis*), white cedar (*Thuja occidentalis*), sugar maple (*Acer saccharum*), and aspen (*Populus* spp.) (J. Gilbert, pers. comm.).

D. MARTEN RESEARCH NEEDS

1. Determine Population Status and Distribution

An accurate population estimate is needed for each of the suspected marten populations. The WDNR and the University of Wisconsin- Stevens Point are starting a 2-year mark-recapture and telemetry study on the Nicolet side of the CNNF, which should provide a population estimate for 2004-2005. The Chequamegon population and surrounding area need to be inventoried as well. Methods that will provide reliable distribution or presence/absence data should be tested and then implemented.

2. Identify Marten Habitat Requirements

Very little is known about the habitat requirements of marten in Wisconsin. Continued research on marten habitat use and additional habitat areas within Wisconsin is needed. Identification of other suitable habitat areas will be useful for future reintroductions or monitoring for marten presence. Marten home range areas and densities in different habitat types need to be studied. This information can provide a more accurate population goal for the state. The use of different habitat types during juvenile dispersal should be identified. A study on the effects of various cutting methods on resident marten is also needed to determine the impact of forest harvest.

3. Demographic Survey

Demographic data for Wisconsin marten is needed for population modeling. Data for the survivorship of marten at each age class, fecundity, and rates of immigration and emigration will aid in predicting the population viability of marten.

4. Community Interactions

Prey population monitoring will also provide an index for marten success. Thompson and Colgan (1987) reported evidence of prey cycles influencing marten population size. Annual or regular prey density estimates would be useful in determining how prey limits Wisconsin marten. Mammalian and avian predation may also be limiting marten success. Research on generalist predator (red fox, coyote, and great-horned owls) abundance and predation rates in known marten areas could determine how predation affects marten survival and behavior. Habitat types and alteration may be a factor in predation rates on marten. Marten may also compete with fishers for resources, such as prey or den sites. Fishers are also a predator, but the rates of marten mortality due to fishers are unknown. Once competition or predation from fishers is established to be a significant source of pressure against marten success, a fisher removal experiment can be designed by the Marten Committee.

5. Genetic Database

Genetic diversity estimates of the Wisconsin marten populations are required for appropriate management (McGowan et al. 1999). DNA samples should be collected from martens during research, from incidentally trapped marten, and other specimens found. Genetic variation within the population and among other populations can be assessed. Diversity of the population is important for long-term success.

E. INTERAGENCY COOPERATION AND COORDINATION

1. Marten Committee Communication

The annual Marten Committee meetings should continue. It is critical for marten survival that new research findings be shared among the group. The information gathered from the DNR-UWSP study on the CNNF populations and GLIFWC on the Chequmegon population will be essential in directing future conservation and management measures. Communication with the US Forest Service is needed as new information on locations of marten habitat areas, habitat needs, or collaborative survey opportunities arise.

2. Annual Comprehensive Marten Report

The Marten Committee also needs to prepare an annual, comprehensive report on marten distribution, completed surveys, and reported marten fatalities. The Conservation Warden seizure reports for marten need to be obtained by the Marten Committee. An efficient system of communication should be developed to inform a Marten Committee member or members of reported seizures, observations, or road kills. The annual marten report should reflect collaboration between all agencies involved with marten or marten habitat. The report will guide the ideas for future research and management needs.

3. Marten Specimen and DNA Management

A system of maintaining and organizing marten DNA samples and specimens should be created. The Marten Committee can decide upon the location for the database of samples and specimens. Funding for genetic testing of the samples can be acquired at a date specified by the Marten Committee. An analysis of genetic diversity can be done to compare the relatedness of Wisconsin martens, and diversity compared to other marten populations. This will enable the Marten Committee to protect against inbreeding depression.

4. Interstate Communication

The Wisconsin DNR Bureau of Endangered Resources is responsible for communicating with marten biologists in Minnesota and Michigan. Issues with marten dispersal across state lines can be addressed. Marten from Michigan and Minnesota may serve as a source population for Wisconsin. These two states already identify the marten as a furbearer species, and a trapping season is in place. Once Wisconsin marten are delisted, trapping regulations could follow Minnesota or Michigan's initial harvest limits. Other possible management suggestions can come from these neighboring states.

F. EDUCATION

1. Marten Education Materials

The WDNR needs to provide information about this endangered mammal to the general public, interested organizations, trappers, and agencies involved with marten management.

a. Create a marten poster that provides a physical description, life history information, and the contact information if one is seen.
b. Develop an updated pamphlet on the marten for the general public.
c. Update the WDNR marten web site as new information becomes available.
d. Continue to have marten information and the locations of MRAs in the Trapper Regulations brochure.

2. Provide Training

a. Trapper education courses need to discuss marten ecology and current state protection. The location and regulated trapping within Marten Restoration Areas also needs to be covered.
b. Marten tracks and signs need to be taught to agency personnel conducting mammal surveys. Ability of the individual to accurately distinguish marten tracks should be confirmed.
c. University personnel conducting marten research should be provided with suggested techniques for trapping. Previous DNR studies should also be provided, to ensure that research is not duplicated. Findings from both entities should be shared.
d. U.S. Forest Service and State Forest silviculturists and tree marking crews should be provided with research findings on marten habitat needs and guidelines for incorporating them into stand prescriptions.

G. MARTEN BUDGET

1. Current Marten Spending

The Wisconsin DNR Bureau of Endangered Resources has not provided specific budgets for marten monitoring in recent years, but funding has come from general appropriations for all endangered and threatened wildlife. Annual spending is based on project proposals and known monitoring needs (Table 4). The increased spending in 2004 is due to the marten research project with the WDNR and UWSP.

Table 4. Marten spending by WDNR Endangered Resources for fiscal years 2003 and 2004.

Expenditures	**FY 2003**	**FY 2004**
Permanent Salaries	~ $1250	~ $2400
LTE Salaries	~ $500	~ $900
Supplies and Travel	~ $350	~ $800
Total	$2102.40	$4131.05

2. Proposed Marten Budget

A specific marten budget should be created to account for improved monitoring, estimating population every five years, population modeling, and other efforts. In order to address these concerns adequately, an annual budget of $10,000 to $20,000 may be necessary. A more expensive monitoring program is more likely to survive budget cuts, if benefits such as an understanding of habitat associations, are emphasized.

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APPENDIX B

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

Jim Doyle, Governor
Scott Hassett, Secretary

875 S. 4th Ave.
Park Falls, WI
54552
Phone: 715-762-4684
Fax: 715-762-4348

August 19, 2004

Dear Conservation Organization:

The purpose of this letter is to ask for financial assistance for the recovery and management of the state endangered American marten, *Martes americana*. The Department of Natural Resources Bureau of Endangered Resources has helped oversee the recovery of this small, carnivorous mammal since its reintroduction began in 1975. Before I tell you how your donation will be used, let me give you a brief history of the marten recovery efforts by the WDNR.

Following the first reintroduction of 172 marten on the Nicolet side of the Chequamegon-Nicolet National Forest, an intensive survey was conducted estimating that in 1985 approximately 100-150 marten were still present in the Forest. In 1987, another reintroduction began, releasing 139 marten on the Chequamegon side of the Forest. This population has never been extensively surveyed. Annual winter snow track counts continue to be done by the WDNR to assess the distribution of marten and provide a rough population estimate. However, marten tracks can be difficult to distinguish from their close relatives the fisher and mink, which are doing well in Wisconsin. The WDNR has a two year (2004-2006) study planned for the marten population on the Nicolet section. Currently, an updated recovery and management plan is being developed for the marten, but it will rely on future research to improve the marten status.

We are looking for monetary donations to help fund the following variety of recovery and management projects. A population study is needed for the marten population on the Chequamegon side, which would use live-trap and recapture methods to estimate the numbers of marten in the area. An improved marten detection survey is needed for stronger evidence of marten distribution. For this effort camera stations, track plates, or other techniques are being considered. In addition, we are developing an informational poster on the marten for various agencies and the public. The purpose of this poster will be to make people more aware of the presence of marten in the state, to provide education on the importance of marten to the forest ecosystem, and to encourage people to report marten sightings to the DNR.

If you have questions about the American marten projects or donations, you can contact Sarah Harvey via email at harveysl@muohio.edu. You can make checks payable to the Bureau of Endangered Resources. Checks can be mailed to Marten Research, Department of Natural Resources, 875 S. 4th Avenue, Park Falls, WI, 54552.

Thank you very much for considering supporting the American marten recovery effort.

Sincerely,

APPENDIX C


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Wisconsin martens inhabit hardwood and coniferous forests with downed woody debris, such as logs, stumps and root mounds.
For more information visit the following WDNR website: http://dnr.wi.gov/org/land/er/factsheets/mammals/marten.htm
American Marten
Martes americana
Wisconsin Endangered Species
To report sightings call 715-762-4684 ext 107 or visit this website: http://dnr.wi.gov/org/land/er/forms/raremammal.asp
The Wisconsin Department of Natural Resources provides equal opportunity in its employment, programs, services, and functions under an Affirmative Action Plan. If you have any questions, please write to Equal Opportunity Office, Department of Interior, Washington, D.C. 20240.

Appendix D