FISHER AND MARTEN DEMOGRAPHY AND HABITAT USE IN MINNESOTA

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SUMMARY OF FINDINGS

During winter 2007-08, we began work on a study of fisher (*Martes pennanti*) and marten (*Martes americana*) ecology in northern Minnesota. The primary goal this winter was to radiocollar a sample of animals to allow us to evaluate various field methods. A total of 18 martens (11M, 7F) were captured. Five martens (1M, 4F) appear to have slipped their collars in the first 6 weeks after capture. Of the remaining 13 martens, 3 (2M, 1F) were killed by raptors, 1 female dispersed, traversing ~ 15 miles (now missing), and 9 are currently being monitored. We radiocollared 9 fishers (2M, 7F), but 3 collars, all on females, fell off after the collar material broke (1 was later re-collared). Prior to the collar breaking, 1 female fisher dispersed 13 miles. Of the 7 fishers that remained collared, 1 female appears to have been accidentally or illegally trapped after the season closed, 1 female is missing, and 5 are currently being monitored. Only 2 of the currently monitored animals (1 fisher, 1 marten) are suspected to be adult females, but neither appears to have established a den and given birth. During winter, we opportunistically located 5 winter resting sites used by marten, including 1 in a rock pile, 1 in a slash/debris pile, and 3 in underground tunnels in the mossy substrate of lowland conifer forest. Since spring, we have also documented 2 above-ground marten rest sites, both in tree cavities. During winter, we also opportunistically located 5 fisher resting sites, including 2 in tree cavities, 1 in a slash pile, 1 in a beaver (*Castor canadensis*) dam, and 1 in an abandoned muskrat (*Ondatra zibethicus*) or beaver bank den. Since spring, 2 additional fisher rest sites were located, 1 in a red squirrel (*Tamiasciurus hudsonicus*) nest and 1 in a tree cavity. We have begun establishing prey sampling transects in the study areas, and are preparing to measure vegetative characteristics in animal home ranges. Full-scale trapping and collaring will begin in winter 2008-09.

INTRODUCTION

American marten and fisher are native to Minnesota, but reliable documentation of their historic distribution is limited. Undoubtedly, northeastern Minnesota was a stronghold for the marten population, though notable numbers likely occurred in the northern border counties as far west as Roseau county. Limited information suggests they occurred as far south and west as Crow Wing and Polk counties. As a result of over-harvesting, marten were considered rare in Minnesota by 1900, and extensive logging and burning around the turn of the century further contributed to the near extirpation of marten from Minnesota by the 1930s (Swanson et al. 1945). Fishers in Minnesota appear to have historically occupied a larger geographic area than martens, extending further south and west into the hardwood dominated transition zone, and also into southeast Minnesota (Swanson et al. 1945, Balser and Longley 1966). The impacts of over-harvest and habitat alteration were equally as detrimental to fisher, with populations substantially reduced by the 1930s.

Legally, fisher and marten were unprotected in Minnesota prior to 1917, after which harvest season length restrictions were implemented. These protections were removed in the mid-1920s, and remained so until all harvest was prohibited in 1929. Seasons remained closed until 1977 for fisher and 1985 for marten, when limited harvests were reinstated. Since then, trapping zones and quotas have periodically increased to the current combined quota of 5 fisher/marten per trapper. Recent harvest levels have been near 3,500 and 2,500 for marten and fisher, respectively. While harvest is legal in ~ the northern 50% of the state, most marten harvest occurs in counties bordering Canada, particularly in northeast and north-central Minnesota. Fisher harvest occurs in most of the northern 50% of the state, though harvest is comparatively low in extreme northeast Minnesota (Lake and Cook counties), and rare, though perhaps increasing, in the Red River Valley (western Minnesota) and the highly fragmented transitional forests in central Minnesota.

While both species appear to have naturally re-colonized a significant portion of their historic range, Minnesota-specific information on species biology and ecology is limited. Except for carcass data obtained from harvested fisher and marten, we are aware of only 1 published field study in Minnesota. Specifically, Mech and Rogers (1977) opportunistically radiocollared 4 marten and reported survival and home range information for those animals. This information is now nearly 30 years old, and based on a very limited sample size. While fisher and marten populations appear to be 'healthy' based on current occupied range and recent harvest levels, their lower reproductive potential, lower density, and comparatively narrow habitat requirements make them more susceptible to over-harvest and the negative effects of human development and habitat alteration.

The primary objectives of this study are to: (1) estimate survival rates and causes of mortality for fisher and marten in Minnesota; (2) describe and quantify features of natal den sites used by females; (3) directly estimate parturition rates and, if possible, litter sizes of radio-marked females; (4) evaluate how survival or reproduction varies as a function of forest attributes, prey abundance and weather conditions; and (5) to evaluate the design of winter track surveys.

Winter 2007-08 marked the pilot year of the study, with efforts focused on evaluating trapping and handling methods, radiocollar designs, aerial relocation efficacy, and den confirmation and inspection methods. Herein we present only those methods and results pertinent to field methods employed during the pilot year. Other objective-specific methods will be detailed in future years as results become available.

STUDY AREA

Marten research is focused on 1 study area located in northeastern Minnesota (Figure 1; Area 1). The area (~ 700 km^2) is composed of ~ 69% mixed forest, 15% lowland conifer or bog, 5% upland coniferous forest, 4% gravel pits and open mines, 3% regenerating forest (deciduous and coniferous), 2% shrubby grassland, 1% marsh and fen, 1% open water, and 0.4% deciduous forest. The area is ~ 90% public ownership, including portions of the Superior National Forest and state and county lands. Fishers are also present in this area at low to moderate density.

Fisher research will take place in 3 areas (Figure 1; Areas 1, 2, and 3), though the study in Area 3, a collaborative effort between Camp Ripley Military Reservation, Central Lakes Community College, and the Minnesota Department of Natural Resources, is not discussed in detail in this report. Area 2 (1075 km^2), our primary fisher study area, is composed of ~ 74% deciduous forest, 11% open water, 5% lowland conifer or bog, 5% marsh and fen, 2% regenerating forest (deciduous and coniferous), 1% coniferous forest, 1% grassland, and 1% mixed forest. Area 2 is ~ 67% public ownership, including portions of the Chippewa National Forest and State and county lands. Extremely few martens occupy Area 2.

METHODS

Our goal the first winter was to capture 15 martens and 15 fishers to evaluate numerous field techniques. We used cage traps to capture both fishers (Tomahawk Model 108) and martens (Tomahawk Model 106 or 108) during winter. Traps were baited with either deer or beaver meat, with commercial lure placed in or above the traps. We enclosed traps inside white plastic 'feed sacks' or burlap bags and further covered traps with snow or vegetation. All traps were checked daily.

To immobilize animals, we used metal 'combs' to restrict the animal to a small portion of the trap, or restrained the animal against the side of the trap by pulling its tail through the cage mesh. Animals were injected with a hand-syringe using a 10:1 mixture of ketamine and xylazine (fisher: 30 mg/kg ketamine and 3 mg/kg xylazine; marten: 20 mg/kg ketamine, 2 mg/kg xylazine) (Kreeger et al. 2002). After processing, the xylazine was reversed with yohimbine at a dosage of 0.1 mg/kg (marten) or 0.15 mg/kg (fisher). We ear-tagged fisher with a monel # 3 tag in one ear (National Band and Tag Co., Newport, KY) and a 2-piece plastic mini-tag (Dalton I.D. Systems, UK) in the other ear. Marten were ear-tagged with a monel #1 tag (National Band and Tag Co., Newport, KY) in each ear. Passive Integrated Transponder (PIT) tags or lip tattoos may be used in the future if ear-tag retention is low.

During processing, animals were placed on either chemical hand warmers or heating pads connected to a power inverter and 12 volt battery. We monitored respiration, pulse, and rectal temperature during anesthesia. We weighed and sexed animals and removed a first pre-molar for aging. Morphological measurements taken included body length, tail length, hind foot length, and chest, neck, and head circumference. We removed guard hair samples for subsequent genotyping, and for evaluating the use of stable isotope analysis for deciphering food habits (Ben-David et al. 1997). To determine which females were pregnant in mid-winter, and eventually the percent of those that failed to produce a litter in spring, we planned to draw blood samples from either the jugular or femoral vein to measure serum progesterone levels (Frost et al. 1997). We were unsuccessful at drawing blood, but hope additional experience or training will allow us to do so in the future. Antibiotics were administered subcutaneously to all animals prior to release.

During the pilot year, we deployed several radiocollar models to compare overall performance. Fishers were collared with an ATS M1585 zip-tie collar (~ 43 g), an ATS M1930 collar (~ 38 g; deployed on females only) with a 16on/8off duty cycle, or a Lotec SMRC-3 collar (~ 61 g; deployed on adult males only). Martens were collared with an ATS M1565 zip-tie collar (~ 32 g), an ATS M1930 collar (~ 38 g; deployed on males only) with a 16on/8off duty cycle, or a Holohil MI-2 collar (~ 31 g). All radiolocations, except for some taken during the den-monitoring period, will be obtained from fixed-wing aircraft at approximately weekly intervals. During the pilot year, and periodically thereafter, we will test the accuracy of aerial radiolocations by placing transmitters in known locations of varying forest structure, and compute the mean distance between known and estimated locations. Detailed information on radiolocation methods and analysis will be presented in future years.

While data is absent for Minnesota, nearly all reported fisher natal dens have been in elevated tree cavities (Powell et al. 2003). Marten natal dens are also frequently in tree cavities (Gilbert et al. 1997), but may occur in more varied features (e.g., under-ground burrows, exposed root masses of trees, rock piles, large downed logs; Ruggiero et al. 1998). Confirmation of parturition and den location can often be accomplished by monitoring female movements and behavior. When necessary to help confirm exact den location, and to monitor female den attendance and kit emergence, we will also utilize remotely triggered cameras positioned near suspected dens (Jones et al. 1997). After den locations are confirmed, we will wait ~ 2 weeks and attempt to obtain counts of litter size using video inspection equipment. For viewing underground and tree cavity dens, we are evaluating use of a modified Aqua-Vu Scout SRT black and white video camera (Nature Vision Inc., Brainerd, MN), or an MVC2120-WP color video camera (Micro Video Products, Bobcaygeon, Ontario) connected to a laptop computer. Dens will only be examined when radio-marked females are not present. After initial den and litter confirmation, we will re-examine dens at 30-day intervals (up to 120 days) to determine which females recruit at least 1 offspring to the fall population.

RESULTS AND DISCUSSION

A total of 18 martens (11M, 7F) and 9 fishers (2M, 7F) were radiocollared during the first winter (Table 1). Tooth aging has not yet been completed. Of the 18 martens collared, 3 individuals (1M, 2F) were able to subsequently slip the collars off. Two additional females are presumed to have slipped their collars as well, but we have not yet been able to access the collar location to confirm (1 in a rock pile, 1 in a white pine tree cavity). No fishers have slipped their collars, but 3 females lost collars when the collar attachments broke (ATS M1585 zip-tie attachment collars). One female was recaptured shortly thereafter, and a new collar was attached.

While we have yet to compute the number of captures per trap night, capture rate was considered high for marten in Area 1, with 18 individuals, plus 1 fisher, being captured in approximately 12 days of trapping by 1 trapping crew. While additional fisher captures would likely have occurred in Area 1, trapping was terminated after reaching our goal for marten capture. Fisher capture success was low in Area 2, with only 7 fisher being captured over ~ 10 weeks of trapping. While the low capture success appears due in part to a recent decline in fisher numbers, we believe it is also attributable to our decision to utilize only 1 trapping crew this first winter, which necessitated moving traps more frequently than desired in an attempt to examine or trap all portions of both study areas.

Three marten mortalities have been confirmed, all from raptor predation. Two males were killed within ~ 100 m of each other, but neither were consumed. Both were found along a forest edge (open power line corridor) and appeared to have escaped the initial attack, but puncture wounds penetrating the heart or lungs caused death shortly thereafter. One female marten was killed, likely carried a distance to a perch, and ‘plucked’, with only the head, fur, and collar remaining at the site. No human-related marten mortalities have been documented, but radiocollaring efforts began after the close of the harvest season. Only 1 fisher death has been documented, a female that appears to have been accidentally or illegally trapped after the harvest season closed.

One female fisher, we suspect a juvenile, dispersed 13 miles before her collar attachment broke and fell off. One female marten traversed ~ 15 miles since capture, though the maximum distance she was ever located from her original location center was ~ 6 miles. She is currently missing. Two other martens, both males, have moved 4-6 miles from their original location.

Of the 7 female martens captured, 4 slipped collars and 1 was killed by a raptor. For the remaining 2, 1 suspected juvenile is missing and 1 suspected adult does not appear to have established a natal den. Of the 7 female fishers captured, 3 lost collars when the collar attachment broke (1 was subsequently re-collared), 1 was accidentally or illegally trapped, and 1 is missing. For the 3 females currently collared, only 1 was suspected as being an adult, and she does not appear to have established a natal den.

Because no natal dens were confirmed, we have been unable to fully evaluate our video and camera methods for confirming dens, ascertaining litter size, or monitoring den attendance by females. However, as part of collar retrieval and ground checks on potentially denned females, we have had opportunity to document and examine various resting/den sites. Throughout winter, all resting sites we located for marten were either on or below ground, including 1 in a rock pile, 1 in an old slash/debris pile, and 3 underground in the mossy substrate of lowland conifer stands. During spring, we have also confirmed 2 marten resting sites in above ground tree cavities (1 in a live white pine, 1 in a black spruce snag), and another resting site in a slash/debris pile. While this sparse and opportunistic sample of resting sites is inadequate to draw any strong conclusions, it appears that martens may primarily use on- or below-ground dens in winter, with increasing use of above-ground sites in other seasons.

We confirmed 5 fisher resting sites used in winter, including 2 in tree cavities in large-diameter snags (1 trembling aspen (*Populus tremuloides*), 1 sugar maple (*Acer saccharum*)), 1 in a slash pile, 1 in a beaver dam, and 1 in an abandoned muskrat or beaver bank burrow on the edge of an old beaver pond. During spring, 1 collared female fisher has also been located in a red squirrel nest, and 1 non-radioed animal was followed to a tree cavity in a sugar maple snag.

Both video systems we are evaluating appear adequate for viewing details inside tree cavities and underground dens. Numerous slipped or broken collars were observed in such dens with the use of the portable video systems. We continue to experiment with improved (sufficiently sturdy, yet lightweight) poles for elevating the video probe to higher tree cavity entrances, and better underground attachments that are sufficiently sturdy to advance the video probe into the den, yet flexible and maneuverable enough for turning in more complex dens.

We also deployed a Reconyx PC85 remotely triggered camera (Reconyx LLP, Holmen, Wisconsin) at several potential natal den sites. While we did obtain pictures of a fisher near a suspected den site, we did not confirm repeated fisher or marten use at any of the monitored locations (i.e., they were not natal dens). Cameras also captured activity of other species, including squirrels, raccoons (*Procyon lotor*), and white-tailed deer (*Odocoileus virginianus*), and the cameras obtained sufficiently rapid sequences of pictures (~ 1 per second) necessary to detect quick movements to and from potential den sites.

FUTURE PLANS

Full-scale radiocollaring of fishers and martens will begin in December 2008, with a goal of annually collaring 40 martens (Area 1) and 30-40 fishers (~ 10 fisher in Area 1, 20 in Area 2, and 5-10 in Area 3). The project is currently planned as a 6-year study. Throughout this summer and fall, prey and vegetation sampling will commence, as will establishment of weather monitoring locations. More detailed description of these methods will be presented in subsequent years. Here, we outline basic sampling plans.

Prey sampling transects are being established in both study areas. Transects (n = 200 in each study area) will consist of 10 sampling locations spaced 20m apart, distributed in various cover types throughout the study area. Transects will generally be oriented perpendicular to roads or trails, with the first plot 30m off the trail. In spring, we will count snowshoe hare (*Lepus americanus*) pellets in a 1-m^2 plot at each sampling station (McCann et al. 2008). During fall, small mammal snap-trapping will occur for 2 consecutive days at the same sampling stations, similar to protocol used on an existing small mammal survey in Minnesota (Olson 2006). During both spring (hare pellet sampling) and fall (small mammal trapping), we will also count the number of red squirrels observed or heard along each transect. Rather than using 10-min point counts (Mattson and Reinhart 1996, Bayne and Hobson 2000), with our small mammal/hare pellet stations as the sampling points, we will simply record the number of unique squirrels observed/heard along each transect while checking pellet plots and small mammal traps. Information on white-tailed deer and ruffed grouse (*Bonasa umbellus*) populations may be available from existing surveys or population models.

Throughout summer, we will collect vegetative information from individual fisher and marten home ranges. Sampling will occur in randomly located plots, stratified by cover type within each home range. We will collect quantitative data on: (1) tree DBH and height, and ultimately basal area and volume of trees, by species; (2) % canopy cover (deciduous and coniferous); (3) sapling density; (4) understory cover density; (5) density and volume of snags; (6) density, volume, and other characteristics of coarse woody debris; and (7) density and volume of exposed root masses.

Weather sampling stations will be established within different cover types throughout the study area. At each station we will monitor daily temperature throughout the year, and weekly snow depth and snow density from ~ December 1 – May 1. Depending on the amount of spatial variability in temperature and snow conditions within a study area, we will either assign a study area specific average to all animals, or assign home-range specific results based on data from the nearest cover type appropriate stations.

Prey sampling data will be summarized by cover type, and, along with vegetative data from home ranges and pertinent weather information, will be used to help elucidate any observed differences in survival and reproduction across individuals or years, and to evaluate the reliability or applicability of existing fisher or marten habitat models/recommendations developed elsewhere (e.g., Allen 1982, 1983, Carroll et al. 1999, Naylor et al. 1999, Payer and Harrison 2004, Fuller and Harrison 2005, Bowman and Robitaille 2005, Zielinski et al. 2006). We will also continue to collect tissue samples from prey species to quantify species-specific stable isotope ratios. If prey-specific chemical signatures are sufficiently distinct, it may be possible to describe late-summer/fall food habits for fisher and marten based on chemical analysis of guard hair samples. In addition, we will examine whether animal-specific isotope ratios are correlated with home range habitat characteristics (e.g., cover type) or prey population indices, and whether there is any correlation between isotope ratios (food habits) and survival or reproductive success.

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Table 1. Sex, weight, and status of fishers and martens radiocollared during winter 2007-08.

Study Area	Species	ID	Sex	Weight (kg)	Status
Area 1	fisher	F08-304	F	2.50	Alive
Area 1	marten	M08-140	F	0.65	Alive
Area 1	marten	M08-162	F	0.60	Disperser, now missing
Area 1	marten	M08-206	F	0.61	Raptor predation
Area 1	marten	M08-202	F	0.50	Slipped collar
Area 1	marten	M08-188	F	0.62	Presumed slipped collar – not yet retrieved
Area 1	marten	M08-138	F	0.52	Slipped collar
Area 1	marten	M08-213	F	0.61	Presumed slipped collar – not yet retrieved
Area 1	marten	M08-161	M	0.82	Alive
Area 1	marten	M08-184	M	0.89	Alive
Area 1	marten	M08-136	M	0.79	Alive
Area 1	marten	M08-134	M	0.89	Alive
Area 1	marten	M08-204	M	0.82	Alive
Area 1	marten	M08-215	M	1.07	Alive
Area 1	marten	M08-217	M	1.06	Alive
Area 1	marten	M08-219	M	0.81	Alive
Area 1	marten	M08-211	M	1.05	Raptor predation
Area 1	marten	M08-209	M	0.90	Raptor predation
Area 1	marten	M08-132	M	0.71	Slipped collar
Area 2	fisher	F08-375	F	2.70	Collar attachment broke, re-collared, now missing
Area 2	fisher	F08-353	F	2.95	Alive
Area 2	fisher	F08-351	F	2.70	Accidentally or illegally trapped
Area 2	fisher	F07-002	F	2.60	Collar attachment broke
Area 2	fisher	F08-374	F	2.70	Collar attachment broke
Area 2	fisher	F08-077	M	2.50	Alive
Area 2	fisher	F08-373	M	4.70	Alive
Area 3	fisher	F07-326	F	2.7	Alive

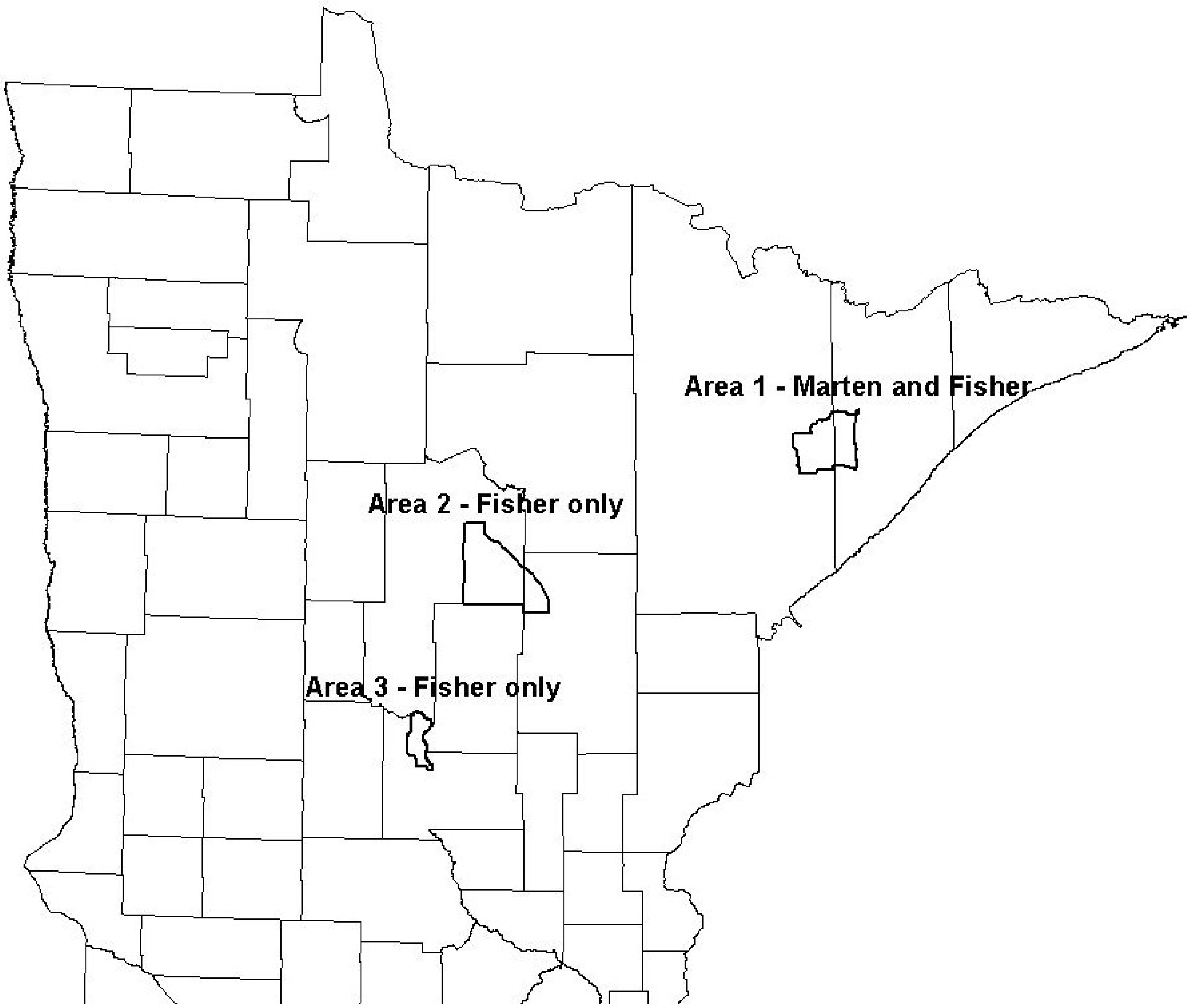

Figure 1. Fisher and marten study areas.