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Job Progress Report

PINE MARTEN ECOLOGY

Study I: Pine Marten Ecology

Job 1: Habitat use and harvest effects

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ABSTRACT

Thirty-nine martens have been captured since 1994. Nine "new" and 2 previously captured pine marten (Martes americana) were captured and radio-collared during June-July 1996. Five (3 males and 2 females) of these martens died, apparently from starvation or sickness. Telemetry indicates that inter-sexual home ranges are not exclusive, whereas intra-sexual home ranges were much more so. More than 500 radio locations from 20 martens are being used to evaluate habitat use patterns. Visual inspection of scats indicates that martens are feeding on small mammals, huckleberries (Vaccinium globulare), and yellowjackets and hornets. We also trapped small mammals to assess prey abundance. A final report will be submitted during FY97.

INTRODUCTION

The distribution of the American marten (Martes americana) in North America has been dramatically impacted by fur harvesting (Yeager 1950, Marshall 1951) and habitat loss due to fire (Koehler et al. 1975, Soutiere 1979) and logging (Yeager 1950, Dodds and Martell 1971, Koehler et al. 1975, Soutiere 1979). Historically, martens occurred from the tundra/taiga ecotone south to the northern Appalachians, upper Great Lake states, and Rocky Mountains and from the Atlantic to the Pacific Ocean (Hagmeier 1956). The marten is absent from historic range in Illinois, Michigan, New Hampshire, Ohio, Pennsylvania, Vermont, Virginia, and Wisconsin (Deblaay 1980). The Rocky Mountain Region of the western U.S. still supports marten populations in many forested habitats. Martens occur in the southeastern portion of Idaho, as well as north and east of the Snake River Valley (Leptich 1990).

Forest Service compliance with the National Forest Management Act necessitates selection of Management Indicator Species (MIS) within planning areas. The selected species serve as barometers allowing the Forest Service to gauge impacts of management activities. The marten was chosen as an indicator for old-growth habitats on many Northern Region forests, including the Kaniksu National Forest in northern Idaho (U.S.D.A. Forest Service 1987). Old-growth forest communities have been substantially impacted by logging and are in further danger of exploitation (Harris 1984). Fragmentation of old-growth forests may present a serious threat to
the marten, and other species; however, evidence of marten dependence on old-growth is still inconclusive. Furthermore, old-growth habitats are poorly defined. The potential value of the marten as an old-growth MIS may be marginal due to this confusion concerning old-growth, in association with an incomplete understanding of marten ecology. Improved knowledge of marten ecology in northern Idaho may help prevent further population declines of marten and other old-growth-dependent species in the region. This approach blends well with ecosystem management and aims to avoid the species-by-species management practices of the past.

This study was initiated in 1994 to determine: 1) marten habitat use patterns in relation to forest age and structure; 2) spatial and temporal changes in marten activity and habitat use; and 3) which variables influence home range size.

STUDY AREA

The study site is located on the Sandpoint Ranger District of the Kaniksu National Forest in northern Idaho. This area marks the western boundary of the Cabinet Mountains. Elevation ranges from 2,100 feet at the shore of Lake Pend Orielle to nearly 7,000 feet at the peaks (U.S.D.A. Forest Service 1987). The climate is influenced by maritime air masses. Topography also has a strong effect on temperature and precipitation. Precipitation at higher elevations, over three-fourths of which falls as snow, approaches 80 inches annually. Lower elevation forests receive approximately 30 inches (U.S.D.A. Forest Service 1987).

Vegetative communities in the study area are relatively diverse. Western red cedar-hemlock (Thuja plicata\Tsuga heterophylla) habitat types dominate lower elevations. Grand fir (Abies grandis) habitat types are interspersed on the drier aspects at these elevations. At higher elevations spruce-subalpine fir (Picea engelmannii\Abies lasiocarpa) forests dominate. These forests are typified by dense understory shrub communities of menziesia (Menziesia ferruginea), alder (Alnus sinuata), and huckleberry (Vaccinium spp.). Talus and alpine meadows are found in association with the high elevation spruce-fir forests.

METHODS

Marten Capture

Trapping sites were selected within the study area on the basis of forest age, structure, species composition, accessibility, and previous documentation of marten occurrence. Martens were captured in Tomahawk live traps baited with putrid chicken. The majority of trapping was conducted in spruce-fir community types. We also trapped in late successional cedar-hemlock forests with large quantities of coarse woody debris. Most trap sites were within 400 m of primary roads.

Traps were checked daily. Ketamine hydrochloride (10mg/ml.) and xylazine (.05 cc) was administered with a hand-held syringe to immobilize the animals. Immobilized martens were then weighed, measured, sexed, and examined to determine overall physical condition. The first
upper premolar was extracted with a tooth elevator for later aging by cementum annuli analysis (Matson and Matson 1993). Prior to release, most animals were fitted with a 52-g radio collar (ATS Corp.). In addition, a numbered ear tag was affixed to each ear. Upon completion of handling, the animals were returned to the traps and were released upon full recovery from anesthesia.

Telemetry

Radio-collared martens were located from the ground using a hand held, three-element Yagi or a directional ‘H’ antenna. Both triangulation and walk-in monitoring was conducted. A minimum of 3 azimuths from known locations (G.P.S. verified) within the study area were used in triangulations. Signal strength and correspondence of several azimuths were critically evaluated. Topography, vegetation, and the potential of a marten to be at ground level, above ground level, or below ground level increases the potential for telemetry errors dramatically. Azimuths were plotted in the field to allow for determination of potential error. Walk-ins were conducted on resting martens to gather specific habitat information. Plots were taken only when a visual was obtained on the marten or when a strong signal was obtained with the antenna and cable disconnected from the receiver. Field testing indicated the collar is within 50 m when such a signal is obtained. Locations from strong, nondeflected signals and walk-ins were plotted on U.S.G.S. 7.5 minute topographic maps. UTM coordinates of these locations were later added into a computer data base.

Increases in error polygons occur due to: 1) increased distance from the receiver to the transmitter, and 2) departure of tracking angle from 90 degrees (Kenward 1987). These factors were considered to avoid incorrect assumptions concerning macrohabitat use. In addition, error polygon size is currently being documented through field testing of telemetry equipment as described by Hupp and Ratti (1983).

Habitat Analysis

To evaluate habitat variables at use and random locations, a modified U.S. Forest Service stand exam technique was employed (U.S.D.A. Forest Service, 1985). Some aspects of this procedure are similar to methods used by Jones (1988) to study the fisher (Martes pennanti). Use plots were conducted at areas where: 1) martens were visually observed; and 2) walk-ins resulted in a rest site approximation by close range triangulation. The concentric, nested plot arrangement consists of a plot center, a 1/300-acre plot, a 1/30-acre plot, and a variable plot. The variable plot is determined by a 20 basal area factor reading taken from plot center. Habitat data was collected at use locations and at a paired replicate plot for use in microhabitat selection analysis. The replicate plots were determined by traveling at a random azimuth and distance of 50 m from the use plot. Habitat data were collected in each plot pair during the season in which the marten was located at the use plot for that pair.

A step-wise discriminate function analysis (Pielou 1984) will be used to determine statistical significance of habitat variables. Comparison of used and available habitats will indicate
macrohabitat preference. Furthermore, analysis of the data from replicate plots and use plots will show if martens are selecting for specific microhabitats. A chi-square heterogeneity test (Zar 1984) will be used to detect differences in habitat use based on individual or season. This test will also be used to determine if data from different replicates can be pooled for analysis.

Prey Distribution

To determine if martens are selecting for habitats with higher abundance of small mammals, snap trap transects and grids have been used. This procedure provides an index of small mammal abundance across different habitats. Transects and, more frequently, grids were laid out in paired arrangements. Forested areas known to be used by marten and adjacent cutting units or clearings comprise the pairs. Traps were placed at 5 m intervals along transects of 20 traps. Traps in grids of 25 traps (5x5) were also separated by 5 m. All trapping to date has been conducted with snap traps. Live traps are logistically impractical in this study setting. Traps were checked and baited every 24 hours. Data will be analyzed using a chi-square goodness of fit test (Zar 1984) to determine if marten use areas within the home range contain higher abundance of small mammals than nonuse areas.

Home Range Analysis

Estimates of home range were determined using the adaptive kernel and minimum convex polygon techniques from the program CALHOME. Radio locations used in home range analyses are separated by sufficient time to allow for independence (Swihart and Slade 1985). Although no optimal time has been determined for the marten, 8 hours has been used in previous studies on similar species (Jones 1988). To date, only summer locations have been obtained. According to Heinemeyer (1993) 12 locations are the minimum needed to estimate the home range of fisher using the adaptive kernel method. To assure this minimum is attained, an effort has been made to locate each marten twice per week.

RESULTS AND DISCUSSION

Study Animals and Trapping

Marten trapping has been conducted over 4 separate periods during this study. Trapping from June 14 to August 19, 1994 resulted in 21 individual marten captures (15M, 6F) in 885 trap nights. The period from November 4 through December 8, 1994 accounted for 2 new male captures and 2 recaptures in 127 trap nights. A subadult female fisher was also captured in November 1994. In 1995, 520 trap nights occurred between June 20 and August 11. The majority of this trapping took place in areas trapped in 1994. Five previously uncaptured individuals (3M, 2F) were radio marked during this period. In addition, collars were placed on 3 previously captured male martens that had not been collared in 1994. Four individuals (2M, 2F) monitored during 1994 were also captured. A new collar was placed on 1 of these individuals (F6494). During the final trapping period, June 6 to July 17, 1996, we captured and collared 9 new martens (6M, 3F) in 180 total trap nights. Two previously collared martens were also
captured. One of these animals, M7994, was fitted with a new transmitter. See Table 1 for capture data.

A total of 39 (27M, 12F) individuals were captured in 1,712 trap nights. Many of these individuals have been captured more than once (Table 1). The overall capture rate (recaptures included) is 4.26 martens per 100 trap nights. The success rate for new individuals captured varied by year. During the 1994 summer, we documented 2.37 new captures/100 nights. Winter success was similar with 2.36 new captures/100 nights. In the summer of 1995, success dropped to 1.15 new captures/100 nights. Conversely, the 1996 summer showed a marked increase with 5 new captures/100 trap nights. Although many factors may affect trapping success, the increase in 1996 captures may be linked to a decline in the small mammal prey base.

Marten captures are skewed in terms of sex ratio (2.3M:1F). This occurrence is well documented in previous marten studies. The highly skewed sex ratio of this study, as well as the low incidence of juvenile captures, may be due in part to the season (summer) during which trapping has been concentrated.

Nontarget captures were infrequent. Red squirrel (*Tamiasciurus hudsonicus*, n = 7), Colombian ground squirrel (*Spermophilus columbianus*, n = 2), northern flying squirrel (*Glaucomys sabrinus*, n = 1), and a fisher (n = 1) accounted for all nontarget captures. One of the red squirrels was partially consumed while in the trap. Three other red squirrels and the flying squirrel did not survive capture. The surviving small mammals were released without handling. The fisher was immobilized, sexed, measured and ear tagged. She was released upon recovery.

**Study Animal Mortality**

Eighteen known mortalities have occurred to date (7F, 13M). At least 6 of these mortalities involved a predation episode in which the skull and/or body of the marten was punctured by the teeth of a fairly large animal. Only 3 of these martens were fed upon. The other 5 individuals that were preyed upon were located on the ground intact. Four collars emitting mortality signals were recovered upon return to the field in May and June 1996. The status of 3 of the 4 martens in question is uncertain. Hair and bone fragments were found near 1 of these collars (M3195) making predation or winter kill (and subsequent scavenging) the possible cause of death. In the remaining 3 cases, no remains were found with the collars. One collar (M9795) was located approximately 100 m from an active coyote den. Predation is likely in this case. The collars of M8894 and F9494 may have been shed. However, in past cases involving shed collars, the collar strap was broken. These 2 collars were intact. Predation or natural mortality is suspected in these cases as well.

Five mortalities are associated with the capture, handling, or radio tagging of study animals. All but 1 of these mortalities occurred during the 1994 field season. M45 was captured 4 times during the summer of 1994. Captures 3 and 4 occurred on consecutive days. On the fourth capture this marten was unresponsive in the trap. He was transported in the trap to the field station. The marten consumed a small quantity of food and drank water readily the evening of
capture but remained somewhat lethargic. He died the following morning. F3738 was captured once during the course of the study. She did not recover from the standard injection of ketamine\xyllazine. Inspection of the teeth and pelage of this animal suggests she was very old and in poor condition. M9794 was initially captured and collared in July 1994. Upon his second capture in November 1994 he was given the standard injection of ketamine\xyllazine. The intent was to replace his ear tags and remove the radio collar for the winter. Although this animal initially showed the signs of normal recovery, he did not fully regain consciousness. He was transported to the field station where he died approximately 4 hours after capture. F6194 was initially captured in July 1994. She shed her collar in late November 1994. On June 21, 1995, she was recaptured and fitted with a new collar. Her condition seemed good at this time. On June 26, 1995, she was found dead in a trap. The cause of death was apparently trap stress. M4546 was collared in late July 1994. He was found dead in late October 1994, presumably due to an infection caused by a poorly-fitted collar.

Of the 13 known natural mortalities, 8 took place after June 1996. As previously stated, 9 new martens were captured in 1996. Five of these animals (3M, 2F) have been killed or have died of starvation or sickness. The field-determined age (sagittal crest and tooth wear) of all these martens is 1 year. The 3 males are assumed to be dispersers, as they moved long distances during monitoring. M6196 and M6496 moved approximately 6 miles from their initial capture location in a period of 2 weeks or less. Both of these martens were found dead on the ground. Starvation or disease is suspected in the deaths of these animals, as they were found huddled in areas of cover. Furthermore, their bodies were not contorted and they did not appear to have undergone a struggle. M9196 was captured 3 times in less than a month. This marten appeared to be in a weakened condition upon release from the final capture. Approximately 1 week after this capture we received a mortality signal from M9196. He was located in an open clearcut the following day and appeared to have undergone a struggle, as his body was contorted and the neck was likely broken. The body was not fed upon. F5596 and F3596 were recovered less than 24 hours after a mortality signal was received. F3596 was definitely killed by a predator, as her body and head had several puncture wounds and dried blood was present in her ears. The body was not fed upon. The cause of death of F5596 is uncertain. No fresh wounds were evident upon external examination of the marten’s body; however, the body was found in a contorted position in a relatively open area. The marten was not fed upon.

M7994 and M7095 were captured and collared in 1994 and 1995 respectively. Both animals were found dead less than 24 hours after a mortality signal was received in July 1996. M7994 was approximately 12 miles from the location of his original capture. His body was heavily fed upon and predation is suspected. M7095 was found within his usual home range. The body was not fed upon but was in a contorted position. Predation is the most likely cause of death in this case. F6795 was captured and collared in 1995. We recovered her body less than 24 hours after receiving a mortality signal in August 1996. The body cavity of this marten was slightly fed upon by a relatively small animal. Predation is the likely cause of death in this case. It is probable that M5596 was feeding on this animal, as he was located within 300 m of the carcass just prior to its recovery.
Four shed radio collars were recovered in 1994-95. The design of 1994 collars was somewhat faulty in that the head of the fastening screw could eventually pull through the leather collar. This was the case with all collars recovered in 1994-95 and it is assumed the animals were alive at the time the collar broke free. One of these animals (F6194) was captured several months after her initial collar was shed. F6196 shed her collar several days after it was fitted in the summer of 1996. The collar was located in a hollow log approximately 12 hours after it began emitting a mortality signal. We assume the marten was able to slip free of the collar in this case. No remains were found with the collar. See Table 1 for marten mortality/survival.

Home Range

During the summer of 1994, >12 locations were obtained on 9 martens (5M, 4F) resulting in a total of 160 locations for these martens (Table 2). Excluding M8594, a juvenile, average home range size for adult male martens as estimated by the minimum convex polygon (MCP) 100% contour was 178 ha. Adult female home range (100% MCP) was 155 ha based on data from 4 females. In 1995, 218 relocations were made on 9 martens (8M, 1F). Two of these martens were monitored in 1994 as well (M5294, M8894). Each animal had at least 20 relocations during this period. Average home range size for males during this period was 184 ha (MCP 100%). F6795 had a 251 ha home range (MCP 100%) during 1995. The summer of 1996 resulted in 125 relocations on 9 martens (7M, 2F). Of these animals, 4 were also monitored in 1995 and one (M5294) was monitored in 1994 and 1995. Twelve or more relocations were recorded for each of these individuals. The average home range for males in 1996 was 193 ha while the 2 monitored females had an average home range size of 82 ha (MCP 100%). It must be assumed that these figures underestimate actual home range size due to the low number of locations on some animals. In addition, some attempts at locating certain martens are unsuccessful, suggesting that unrecorded, long-range movements may occur. See Table 2 for home range data.

Both triangulation and walk-in telemetry indicate that intersexual home range territories are not exclusive. Female home ranges have been shown to be used by at least one male during the periods of monitoring. On several instances a male and female have been located near each other. This proximity has been documented in October and November, well past the breeding season. Males appear to infrequently venture into the territories of other males. Male home ranges plotted on topographic maps demonstrate fairly definite boundaries and two males are rarely found near one another. However, the home range overlap of juvenile M8594 and adult M5294 in 1994 was quite apparent. This suggests that adult male territoriality may be reduced toward juvenile males.

Trapping has not been extensive enough to estimate marten density across the entire study area. In the northern portion of the study area, however, trapping has been conducted intensively for 3 seasons. As previously stated, only 5 new individuals were captured in 1995. Three of these individuals were captured in areas not trapped in 1994. In 1996, capture of new individuals was high in a relatively small area. This fact, in association with the estimated age of the animals captured, suggests that natality and juvenile survival during the spring of 1995 was high. In
1995, 10 collared martens (8M, 2F) occupied an area of approximately 26 km². Male home ranges in this area seemed to be rather tightly spaced. This spacing suggests that all males in this area may have been collared. The possibility exists that 1 or more females in this area were not captured. At any rate, the minimal density for this area can be estimated at one marten per 2.6 km² in 1995. Fairly large sections of this area consist of nonforested clearcuts which martens seem to avoid. Thus, these 10 martens were actually utilizing an area substantially smaller than 26 km². During the 1996 summer, 15 collared martens occupied this 26 km² area for a short time. Dispersal and mortality reduced the number of collared individuals within this area to 7 by mid-August. Several factors, including reduced small mammal density, home range shifts by adult martens, large dispersal distances, and high mortality of young animals, indicate that the carrying capacity for marten in the northern portion of the study area diminished from 1995 to 1996.

Habitat Use

To date 500 total relocations have been recorded on 20 martens. Approximately 40 of these locations were walk-ins at marten rest sites. On 35 occasions the resting martens were seen or remained unflushed allowing for determination of the precise resting location. Rest sites have been located in live trees, snags, talus slopes, beneath the ground, and on the ground in dense vegetation (Fig. 1). Plots have been taken at most of these sites and will be conducted at those remaining. This data will be analyzed to evaluate marten microsite habitat selection. Many of these sites are in proximity to streams and are characterized by a large degree of structural complexity near the ground. Deciduous shrub canopy cover is often greater than 70% and coarse woody debris >5-inch diameter is usually present to abundant. Two martens have been found using talus slopes void of canopy cover. These animals were resting under large boulders and did not flush at my presence. No rest sites have been documented in open cutting units or other sparsely vegetated areas.

Analysis is pending on the triangulation locations obtained thus far. At least 12 relocations have been recorded for 20 martens (14M, 6F) over the course of this study. All locations occurred between June 1 and October 31 during the respective years. The average number of locations per marten is 25. Some animals have more than 40 locations due to monitoring for consecutive years. A GIS utilizing Pamap GIS software is nearly complete. This system will incorporate preexisting forest service data with marten relocations to evaluate marten habitat use.

Food Habits

No detailed laboratory analysis of scats has been conducted. Visual inspection of scats indicates that the diet of martens in this region is variable. This correlates with past studies which have shown the marten to be an opportunist rather than a strict carnivore (Murie 1961, Weckwirth and Hawley 1962). In late spring and early summer the majority of marten scats are composed of small mammal hair, bones, and teeth. Vegetation is also sometimes present. Huckleberries are a primary component of scats during mid- to late summer. This fact is not surprising, as these
berries are abundant throughout the study area. Yellowjackets and hornets (Order Hymenoptera) were also observed in the marten scats during summer months.

Prey Abundance and Distribution

Small mammal trapping was conducted primarily in the 1995 and 1996 field seasons. During 1994, a pilot trapping exercise was conducted. This exercise involved transects of 20 snap traps in a forested area and an adjacent shrub field (old cutting unit). These respective transects were run on consecutive nights in late August. The forested transect resulted in capture of 13 red-backed voles (Clethrionomys gapperi) and 2 shrews (Sorex spp.) In contrast, 5 red-backed voles, 5 deer mice (Peromyscus maniculatus), and 1 yellow pine chipmunk (Tamias ameonus) were captured in the shrub field. In 1995-96, trapping grids of 25 traps were deployed in a pairwise design. Two forested areas known to be used by martens were selected on the basis of proximity to a nonforested area. Grids were run in these paired habitat types for 3 consecutive nights during the months of July and August in both 1995 and 1996. A total of 150 trap nights (25 traps x 3 nights x 2 periods) were conducted at each grid location for both 1995 and 1996. A total of 92 small mammals were captured in the forest habitats in 1995 (trap nights = 300). The same forest grids resulted in only 47 small mammal captures in 1996 (trap nights = 300). The clearcut grids exhibit less annual variation. In 1995, 23 captures were recorded in 300 trap nights. In 1996 clearcut trapping resulted in 29 small mammal captures in 300 trap nights. No statistical analysis has been conducted on these data to date. Casual inspection indicates a rather dramatic decline in forest small mammals from 1995 to 1996.

LITERATURE CITED


Figure 1. Marten rest site locations, west Cabinet Mountains, Idaho, 1994-96
Table 1. Capture data for martens in the west Cabinet Mountains, Idaho, 1994-96.

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Table 2. Home range sizes for martens in the west Cabinet Mountains, Idaho, 1994-96.

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