Activity Patterns of American Martens, *Martes americana*, Snowshoe Hares, *Lepus americanus*, and Red Squirrels, *Tamiasciurus hudsonicus*, in Westcentral Montana

KERRY R. FORESMAN and D. E. PEARSON

Division of Biological Sciences, University of Montana, Missoula, Montana 59812, USA
USDA Forest Service, Intermountain Research Station, Missoula, Montana 59807, USA

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We investigated winter activity patterns of American Martens, *Martes americana*, Snowshoe Hares, *Lepus americanus*, and Red Squirrels, *Tamiasciurus hudsonicus*, in westcentral Montana between November 1994 and March 1995 using dual-sensor remote cameras. One hundred percent of Snowshoe Hare (n = 25) observations occurred at night while Martens (n = 85) exhibited random activity during diel and nocturnal hours and Red Squirrels (n = 22) were diurnal. Marten activity coincided with the nocturnal and diurnal microtines and diurnal Red Squirrels though they could take advantage of the strictly nocturnal Snowshoe Hares.

Key Words: Marten, *Martes americana*, Snowshoe Hare, *Lepus americana*, Red Squirrel, *Tamiasciurus hudsonicus*, activity patterns, remote cameras, Montana.

Four species of mid-level forest carnivore, American Marten (*Martes americana*), Fisher (*Martes pennanti*), Lynx (*Lynx lynx*), and Wolverine (*Gulo gulo*) are currently thought to be threatened by the loss of late-successional forests (Ruggiero et al. 1994). As such, they have become the focus of attention in an effort to accurately determine their status across the continent and, in doing so, establish baseline levels of occurrence to which future survey results can be compared (Ruggiero et al. 1994; Zielinski and Kucera 1995). Previous studies have addressed regional questions and have provided limited data on distributions (Raphael and Barrett 1981; Barrett 1983; Thompson et al. 1989; Bull et al. 1992; Kucera and Barrett 1993; Fowler and Golightly 1994; Zielinski and Stauffer 1996). However, only recently have efforts been made to coordinate and standardize sampling methods in order to develop a comparable database across a large region (Zielinski and Kucera 1995).

We used remote sensing cameras between November 1994 and March 1995 in westcentral Montana to obtain information on activity patterns of Martens and two species of their prey: Snowshoe Hares (*Lepus americanus*) and Red Squirrels (*Tamiasciurus hudsonicus*).

Study Area

The study was conducted within the Bitterroot Mountains on the Bitterroot National Forest of westcentral Montana (46°30′N, 114°15′W). Four drainages running east to west and spaced approximately 5 km apart were used. These drainages lie within narrow, steep canyons which exhibit an elevational gradient from approximately 1200 m at the floor to over 2500 m at the surrounding peaks. The overstory is characterized by Douglas Fir (*Pseudotsuga menziesii*), Western Larch (*Larix occidentalis*), and Lodgepole Pine (*Pinus contorta*), with Western Red Cedar (*Thuja plicata*) in riparian zones.

Methods

This study was initiated on 30 November 1994 and concluded on 28 March 1995. Remote sensing cameras were employed as described by Foresman and Pearson (1995*, 1998) following the suggested protocols of Kucera et al. (1995). Two dual-sensor remote cameras were placed in adjacent 6.44 km^2 sampling units in four separate drainages, totaling 16 camera stations. Manley camera units (Tim Manley, Kalispell, Montana) mounted 2-3 m above the ground were baited with commercial trapping scents and deer quarters in a "non-reward" manner as per Kucera et al. (1995). Visual observations of Snowshoe Hares and Red Squirrels were recorded while camera units were set and checked.

Camera sets were run continually until 30 days of active camera time was accumulated. Camera sets were checked two days after establishment and at four to seven day intervals to retrieve film and monitor battery life.

Activity patterns for all species detected were determined by categorizing observed occurrences as detections either during nighttime (nocturnal) or day-

*See Documents Cited section.

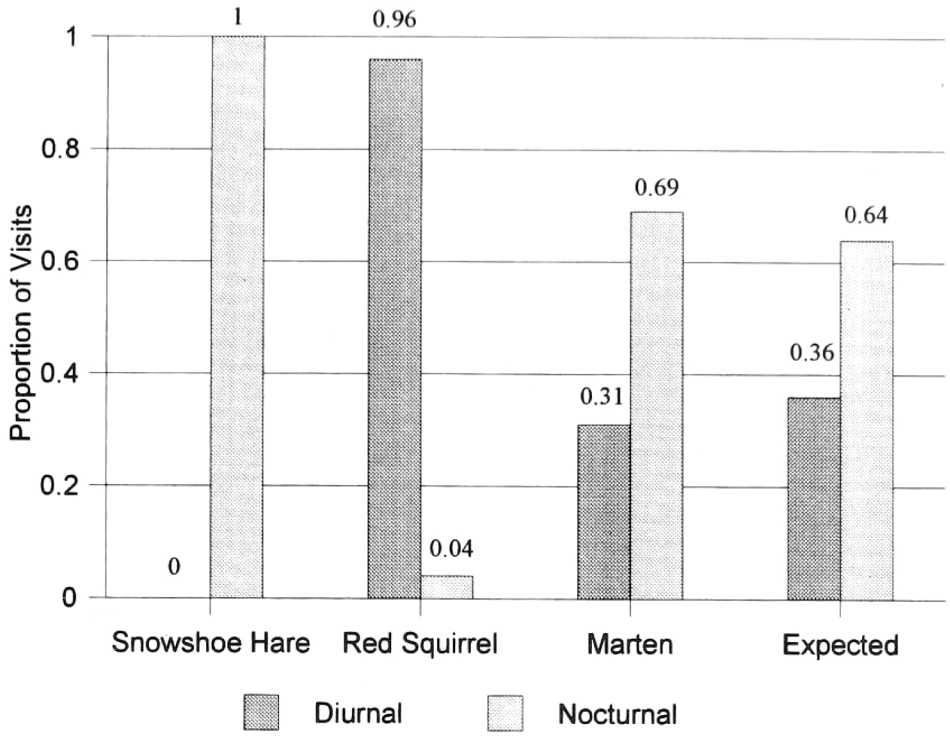

FIGURE 1. Observed nocturnal versus diurnal visitation to remote camera stations for American Martens, Snowshoe Hares, and Red Squirrels compared to expected values based upon median day length for the survey period in the Bitterroot mountains of western Montana, November 1994 to March 1995.

light (diurnal) hours. Nighttime/daylight periods were determined by adding or subtracting 0.5 h respectively to National Weather Service sunrise/sunset time tables. A chi-square goodness-of-fit test with Yates correction for continuity was used to compare observed versus expected values (Zar 1974). Expected values were obtained by using the median day length for the camera survey period. Observations recorded by each camera were treated as independent occurrences when one photograph was obtained separated by 1 h. Thus if individual animals remained at a site creating multiple exposures in a short period of time, such observations would be treated as a single occurrence.

Results

We obtained 85 Marten observations, and we detected Wolverine on two occasions. Eleven additional observations were made on another target species, Fisher (*Martes pennanti*), but since seven were of the same individual during one time period the overall sample size was too small for inclusion in these analyses. Other prey species recorded were Red-backed Voles (*Clethrionomys gapperi*), Deer Mice (*Peromyscus maniculatus*), Red-tailed Chipmunks (*Tamias ruficaudus*), Northern Flying Squirrels (*Glaucomys sabrinus*), Bushy-tailed Woodrats (*Neotoma cinerea*), and Western Jumping Mice (*Zapus princeps*).

Expected values for the chi-square analyses were 8.8 h daylight and 15.3 h nighttime during the study period. Marten activity patterns did not differ from expected ($n = 85$, $\chi^2 = 0.858$, df = 1, $P < 0.280$) while Hares ($n = 25$, $\chi^2 = 12.81$, df = 1, $P < 0.001$) were significantly nocturnal as all observations occurred at night (Figure 1). Red Squirrel observations were diurnal (91%; $n = 22$, $\chi^2 = 30.56$, df = 1, $P < 0.001$). Both observations of Wolverine occurred during the day.

Discussion

Remote camera observations indicated Marten activity was random with respect to diel and nocturnal periods, whereas Red Squirrels, an important prey species of Marten (Weckwerth and Hawley 1962; Gordon 1986), were diurnal. Snowshoe Hares were nocturnal.

Wild Martens have been described as being diurnal in Alberta (More 1978) and nocturnal in Idaho (Marshall 1942) and California (Zielinski et al. 1983) during winter. Zielinski et al. (1983) found a poor correlation between Marten activity patterns and ambient temperatures and suggested that Marten activity patterns in the Sagehen Creek area reflected a synchronization of activity with prey availability rather than an attempt to achieve thermoneutrality.

The primary prey of Marten in the Rocky Mountains is the Red-backed Vole (Koehler and

Hornocker 1977; Weckwerth and Hawley 1962; Cowan and Mackay 1950), but Red Squirrels are an important dietary component reported in 10-12% of scats analyzed in several studies (Gordon 1986; Koehler and Hornocker 1977; Weckwerth and Hawley 1962). Activity patterns of Marten in this study appear to coincide with those reported for microtine rodents much more closely than those of Red Squirrels. Microtines are active throughout the day and night (Hamilton 1937; Davis 1936), while we found Red Squirrels to be almost strictly diurnal. Martens are considered to be generalist predators (Buskirk and Ruggiero 1994) and, therefore, might be expected to exhibit a fairly random activity pattern in foraging for a wide variety of prey.

Snowshoe Hares were strictly nocturnal during winter and, as such, would have been readily available to Marten. Additionally, although the sample size of Fisher detections during this study was too small for statistical analysis, all observations were also made at night. This finding is consistent with observations by deVos (1952) in Ontario, and Coulter (1966) and Arthur and Krohn (1991) in Maine who also found Fishers to be primarily nocturnal [but see Powell (1977) who found Fisher activity random with respect to time of day]. If Fishers synchronize their activity patterns with those of their primary prey (see Curio 1976), Snowshoe Hare activity patterns could largely explain the activity patterns of Fishers in this region.

Our data must be viewed in the context of the time-frame analyzed. Activity patterns of both predator and prey species may vary seasonally. Both Marten (Marshall 1942; Zielinski et al. 1983) and Fisher (Arthur and Krohn 1991) have been shown to alter their activity patterns from winter to summer becoming more diurnal with increasing day length. Recent camera studies conducted between 21 February 1996 and 23 June 1996 support these findings; greater diurnal activity was observed by both Marten and Fisher (37% and 53%, respectively; Foresman and Maples 1996*) than observed in the present study.

In the present study, Snowshoe Hares were not observed during daylight during winter (this pattern was confirmed by camera observations as well), but as spring came and animals began to shed their winter pelts, we began to see animals during the day. Diurnal activity in Snowshoe Hares was recorded 10% of the time in our recent Spring/Summer camera studies. Mech et al. (1966) found that Snowshoe Hares in Minnesota were entirely nocturnal during winter, but during spring and summer months they became largely crepuscular. A switch from crepuscular-diurnal activity during the non-winter period to nocturnal activity in winter is particularly interesting in a species that takes on a white coat in winter presumably for camouflage.

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