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Diet of Kit-Rearing Female Martens in Northern Michigan

Angela Kujawa
Grand Valley State University

Paul Keenlance
Grand Valley State University

Joseph Jacquot
Grand Valley State University

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Angela Kujawa, Paul Keenlance, and Joseph Jacquot

Student Summer Scholars Program

Grand Valley State University, Biology Department, 1 Campus Drive, Allendale, MI 49401

Abstract

The American marten (*Martes americana*) is a small, slender-bodied, carnivorous mammal found throughout the northern portion of North America. Our study focused on the populations in the Manistee National Forest in Michigan's Lower Peninsula and the Hiawatha National Forest in Michigan's Upper Peninsula. Food availability is a large limiting factor to American marten populations due to their high metabolism and low fat storage. This can be especially important for lactating females that may have up to five kits to sustain. Kit-rearing female martens were fitted with radio collars and radio telemetry was used to track them to den sites. Scat, prey remains and remotely-triggered cameras were used to identify diet components. We sought to obtain an understanding of reproducing female marten diets in order to maintain optimal marten habitat. We observed martens behaving as generalists, consuming many types of prey. Small prey were consumed more often, but large prey provided the majority of their caloric intake. Gray squirrels were especially important prey for lactating females. We documented consumption of eastern moles and the delivery of multiple prey to the den at the same time, both previously unreported for this species. This is novel research that can be used by the Little River Band of Ottawa Indians, the Sault Sainte Marie Tribe of Chippewa Indians, the United States Forest Service and the Michigan Department of Natural Resources to manage for marten habitat in Michigan.

Introduction

The American marten (*Martes americana*) is a small, slender-bodied, carnivorous mammal found throughout the northern portion of North America, which historically included Michigan. Optimal habitat for marten includes old growth coniferous or mixed forests, high canopy cover and large amounts of coarse woody debris (Clark et al., 1987). Marten were extirpated from Michigan due to logging, fire and fur trapping in the early 1900s and reintroduction efforts began in 1955 (Williams et al. 2007). In order to manage for a healthy marten population it is vital to understand their dietary needs and manage for their prey populations as well (Bull, 2000). In the past, marten have been observed to behave as generalist predators, often utilizing voles as a significant food source (Bull, 2000; Clark et al., 1987; Zielinski et al., 1983). Their lean-bodied nature, high metabolic needs and limited fat reserves cause marten to be highly impacted by available food (Buskirk and Harlow, 1989). Due to the increased demands associated with

raising kits and the importance of reproducing females to a healthy population, this study sought to delineate the diet of kit-rearing female marten. We hope to gain insight into marten diet preferences and contribute management recommendations to the Little River Band of Ottawa Indians, Sault Sainte Marie Tribe of Chippewa Indians, United States Forest Service and the Michigan Department of Natural Resources. Our efforts were focused on the Manistee National Forest in Michigan's Lower Peninsula and the Hiawatha National Forest in Michigan's Upper Peninsula.

Field Methods

We live trapped marten in the Manistee National Forest, MI in May 2014. Traps were baited with smoked pork and scented with "Gusto," a potent lure (Minnesota Trap Line, Pennock, MN). Leaf and bark debris was used to cover each trap to provide bedding and protection against the elements. Each trap was marked using flagging and GPS locations were recorded. Traps were checked every morning and re-baited and lured as needed. When we captured a target animal, the trap was covered with a canvas tarp, to reduce stress, and moved to the back of a truck equipped with handling gear. We secured a denim cone (Desmarchelier et al., 2007) around the trap door and opened it using metal poles. When the marten entered the cone, it was gently secured by hand and its snout covered with a breathing apparatus that delivered isoflurane and oxygen to anesthetize the animal. Once anesthetized, the marten was removed from the cone and fitted with a radio collar. The collar was tested and the unique frequency number recorded. Temperature, heart rate and respiratory rate were monitored throughout the handling process. We then placed the marten in a recovery box until effects of the anesthesia wore off and the animal could be safely released. Collared females were tracked using radio telemetry every other day, unless they were found away from a den or we were unable to locate them, then multiple attempts in a day were made. When we found a female at a possible den, we placed remotely-triggered cameras around the site and collected scat and prey remains. We used the presence of latrine areas and prey remains, kit sightings or vocalizations, and photos from the cameras to confirm locations as dens. Any samples collected were labeled with the female's identification number, date found and the UTM coordinates of the den.

In order to increase our sample size, we tracked previously collared females in the Hiawatha National Forest, MI in June 2014. Confirmed mothers were tracked every day and

methods to confirm dens and collect samples were the same as those used in the Manistee National Forest.

Lab Methods

All scat samples were assigned a number and their volume determined by water displacement. If there was a large quantity of scat collected in one sample, one easily identifiable scat was taken. The scat was then placed in fine mesh nylon bags with a number tag and let sit in soapy water for 24 hours. After soaking, samples were agitated for 10 minutes and then rinsed on a 500 µm sieve following the methods of Zielinski et al. (1999) and Zielinski and Duncan (2004). The samples were then examined under a dissecting microscope and separated into bone and other components. The other category consisted of vegetation, insect, parasite and any additional distinguishable material. Samples with identifiable bones were classified to species, while those unidentifiable fell into the broader category of small mammals. We made no attempt to further identify bird, insect or vegetation components at this time. All prey remains collected outside dens were identified to the lowest taxonomic level possible. All photos from den cameras were observed and when possible prey identified; unidentifiable items were classified as unknown. Percent occurrence for all sampling methods was determined by dividing the number of times a prey type occurred into the total number of scats, prey remains or den photos. We calculated caloric value of prey by multiplying the number of times a prey type occurred by the amount of kilocalories (kcals) an individual of that species typically provides (values derived from Cumberland et al., 2001), divided by the total amount of kcals found for each sampling method.

Results

We were able to radio collar and track four kit-rearing female martens. There were no mortalities due to trapping or handling, but one due to predation and one from unknown causes.

A total of 22 scats, 11 prey remains and 36 photographed incidents of prey brought back to den sites were used to delineate maternal diet. The percent occurrences of 14 different diet components were determined for these three sampling methods. When using scatology, vegetation was the highest occurring component, followed by insects, white-footed mice, voles, eastern moles, birds, short-tailed shrews, gray squirrels, chipmunks, red squirrels, snakes and martens. Vegetation occurred in over 90% of scats, insects over 80% and mice just under 60%

(Figure 1). Of the prey remains, gray squirrels were the highest, occurring 27% of the time. Red squirrels and eastern moles were found 18% of the time and star-nosed moles, chipmunks, birds and snakes remains occurred less than 10% of the time (Figure 2). White-footed mice appeared most often in photographs of prey returned to the den, occurring in just over 30% of all pictures. Eastern mole, vegetation, rabbit/hare, vole, bird and short-tailed shrew kills were also seen (Figure 3). Females were also captured on camera bringing back two white-footed mice and two hatchlings birds at once. This was observed in 8% of den photos.

Gray squirrels were found to provide the greatest amount of energy of prey identified in scats and prey remains, contributing 62% and 72%, respectively. Eastern mole (13%) and red squirrel (8%) provided the second and third most energy of prey found in scat samples (Figure 4). Among prey remains, red squirrels were second with 18% of the calories consumed, followed by eastern moles with 5% (Figure 5). Rabbits/hares provided the highest amount of calories from prey identified in den photos, attributing 50%. The eastern mole was next with 38% and then the white-footed mouse with 10% (Figure 6).

Discussion

Female kit-rearing martens in northern Michigan exhibited generalist feeding behavior. They were observed to utilize a variety of available prey ranging from smooth green snakes to gray squirrels. The large occurrence of vegetation found in scats was likely due to incidental consumption. Photos showed martens taking vegetation into dens, presumably for bedding. The marten component found in scat was a single claw, likely from grooming activities. No past studies reported observing martens carrying multiple prey items simultaneously back to den structures. One mother was observed carrying two adult white-footed mice and a different female carrying two hatchling birds.

We also did not see martens making special use of voles as reported in several other studies (Bull, 2000; Zielinski and Duncan, 2004; Zielinski et al., 1983). Voles appeared most when sampling via scats, but were absent in prey remains and occurred in less than 5% of den pictures. Across the range of martens, red-backed voles (*Myodes gapperi*) are important prey (Kurta, 1995), however we have not trapped them in the Manistee National Forest (Keenlance and Jacquot, personal communication). The only vole species martens are likely to encounter in

the MNF are woodland voles (*Microtus pinetorum*), which are semi-fossorial and tend to be a low-density (Smolen, 1981).

Most prey remains found had larger bones that the martens had thoroughly eaten around. This would also explain the low occurrence of larger prey in scats, suggesting that gray squirrels and red squirrels may be underrepresented by this sampling method. Prey remains of these species generally contained larger bones striped of meat. Larger prey items provide larger percentages of digestible protein which cannot be seen when using scatology (Zielinski et al., 1983).

White-footed mice were a popular prey item; they were found in nearly 60% of scats and were the highest occurring prey choice observed on den cameras. The absence of mice in prey remains can be explained by the relative ease in which a marten can break smaller bones and consume a mouse whole.

When calculating kcals, vegetation, insect and marten components were excluded due to their consumption most likely being incidental. Gray squirrels were found to contribute the majority of calories when sampling via scat and prey remains. Their lack of presence on camera could be due to the limited range of visibility provided by stationary cameras. Instead rabbits/hares were found to be the largest caloric contributor when using den photos. Eastern moles were also a leading contributor to caloric intake of lactating females, being among the top three in all sampling methods. The significance of moles in marten diet has not been seen in past studies (Murie, 1961; Bull, 2000; Thompson and Colgan, 1990).

Although martens may consume smaller prey, such as white-footed mice, more frequently, larger prey, such as squirrels, provide the bulk of their caloric needs. Thompson and Colgan (1990) provide one possible explanation for this, suggesting that martens continuously hunt for large prey but come across small prey more often and are easily able to subdue them.

Each sampling method provided different results, suggesting the importance of using multiple sampling methods to achieve a more comprehensive view of marten diet. Using percent occurrence acknowledges presence or absence; calculating caloric contributions of each component give a better understanding of energy provided by each prey type (Cumberland et al., 2001). This study had a limited sample size of four reproductive females, also limiting the

quantity of scats collected. This increases the likelihood of sampling error. However, since marten are generalists, their diets include a greater prey diversity which reduces the amount of scats needed to accurately reflect diet (Trites and Joy, 2005). The severe winter of 2013-2014 was a possible explanation for the low number of female marten captured in our study area during the 2014 field season.

Based on our findings, it is important to manage for mature or mixed forests with coarse woody debris to support adequate prey populations for healthy marten populations. Old growth forests provide canopy cover and coarse woody debris that martens use for protection and foraging (Clark et al., 2000; Steventon and Major, 1982). Young stands with adequate coarse woody debris to provide small mammal habitat have also been found to support marten populations (Buskirk, 1992). Coarse woody debris is an important component to manage for because it provides habitat for prey which is essential to providing optimal marten habitat.

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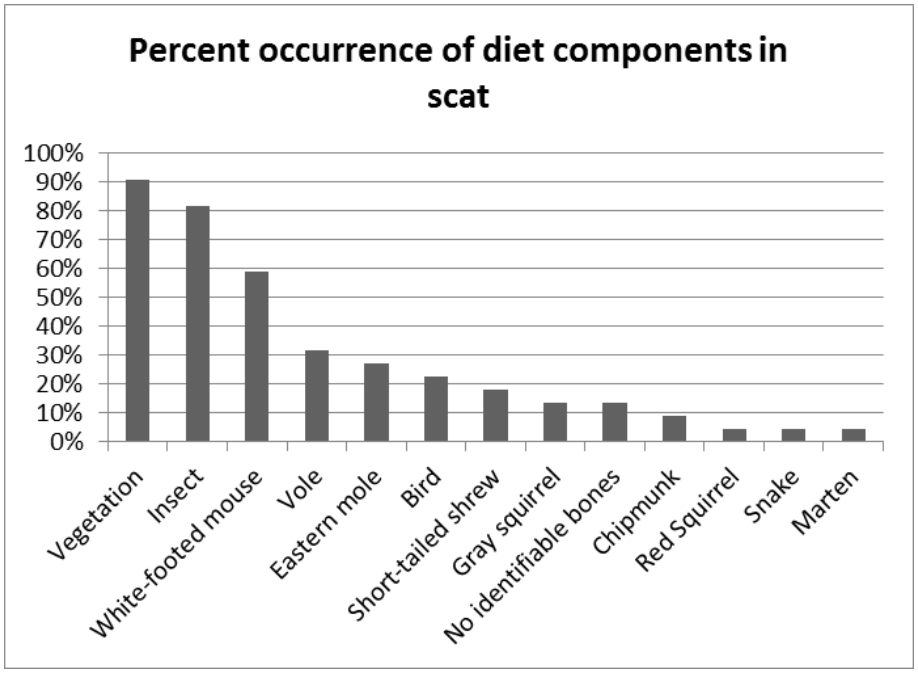

Figure 1. Percent occurrences of diet components found in 22 marten scats from four female marten.

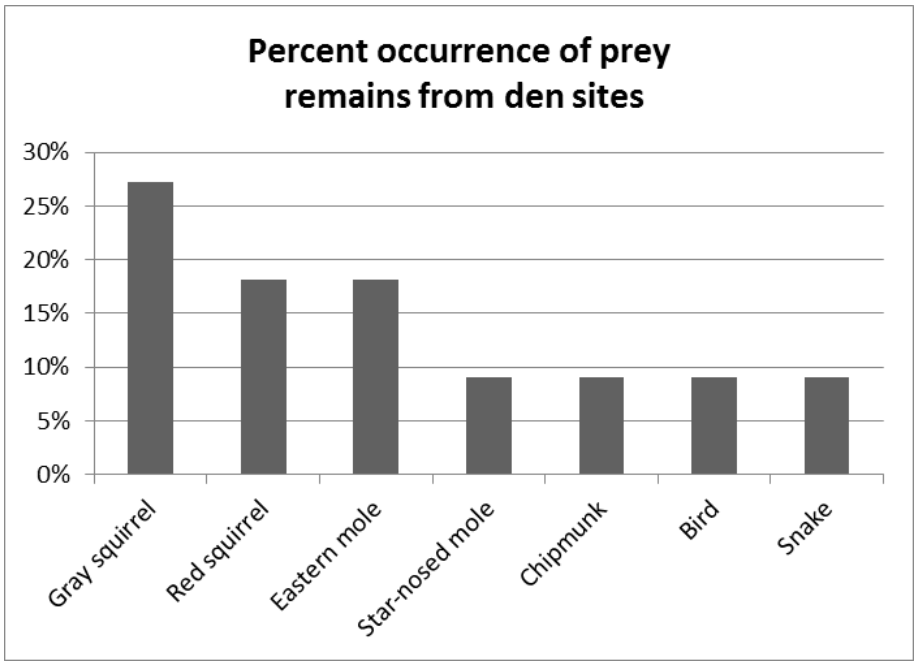

Figure 2. Percent occurrences of 11 prey remains found near female marten denning sites.

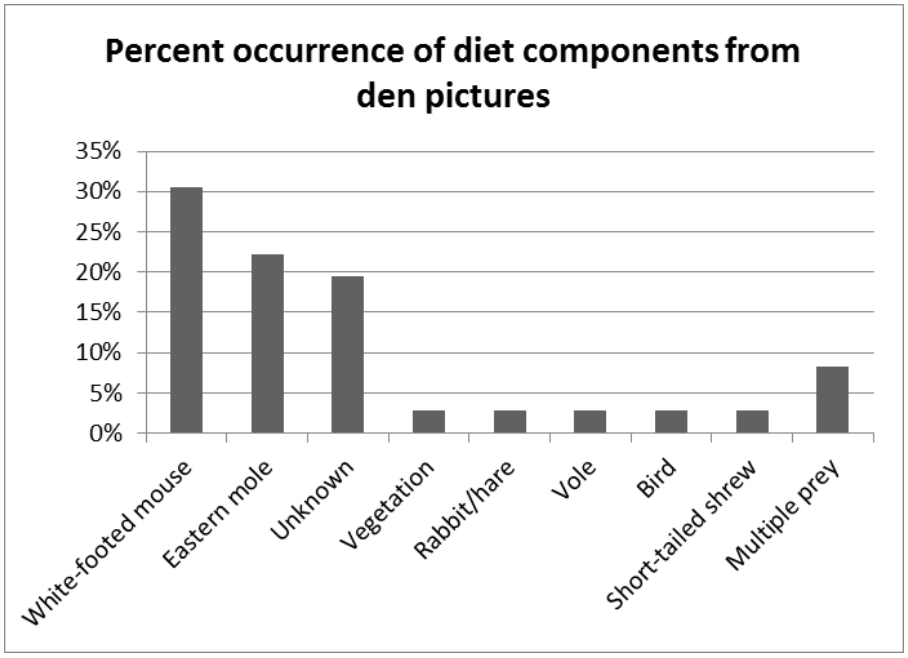

Figure 3. Percent occurrences of prey brought to the den by female marten. A total of 36 photographed incidents were documented.

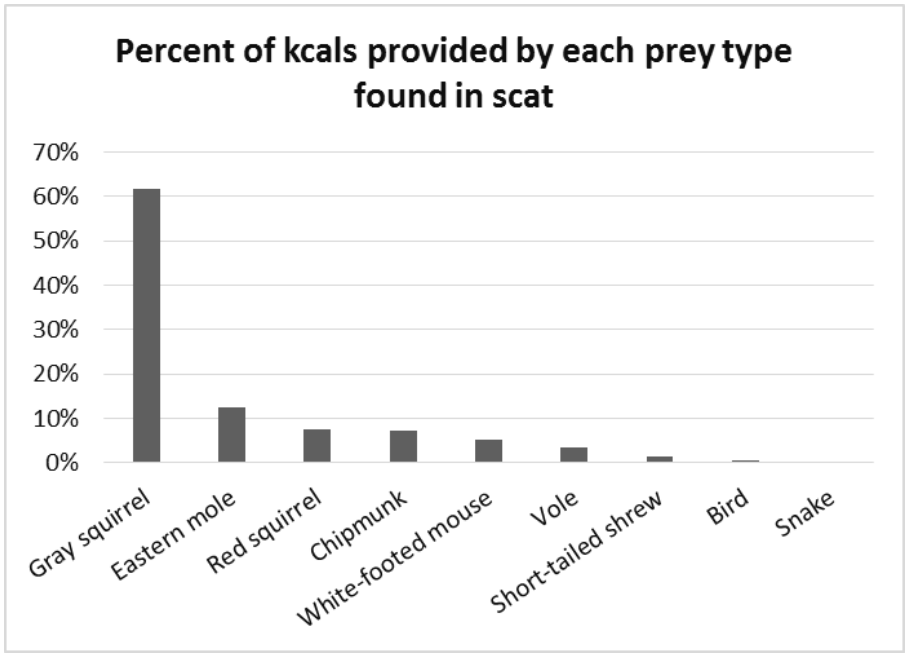

Figure 4. Percent of total kcals provided by each prey type found in 22 marten scats.

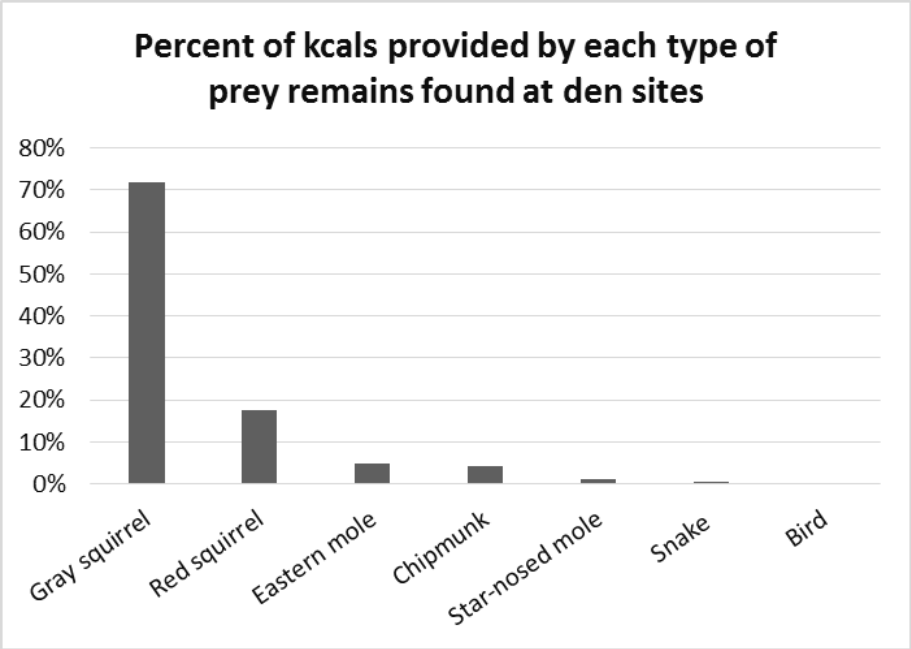

Figure 5. Percent of total kcals provided by prey remains found outside female den sites. Eleven prey remains were collected.

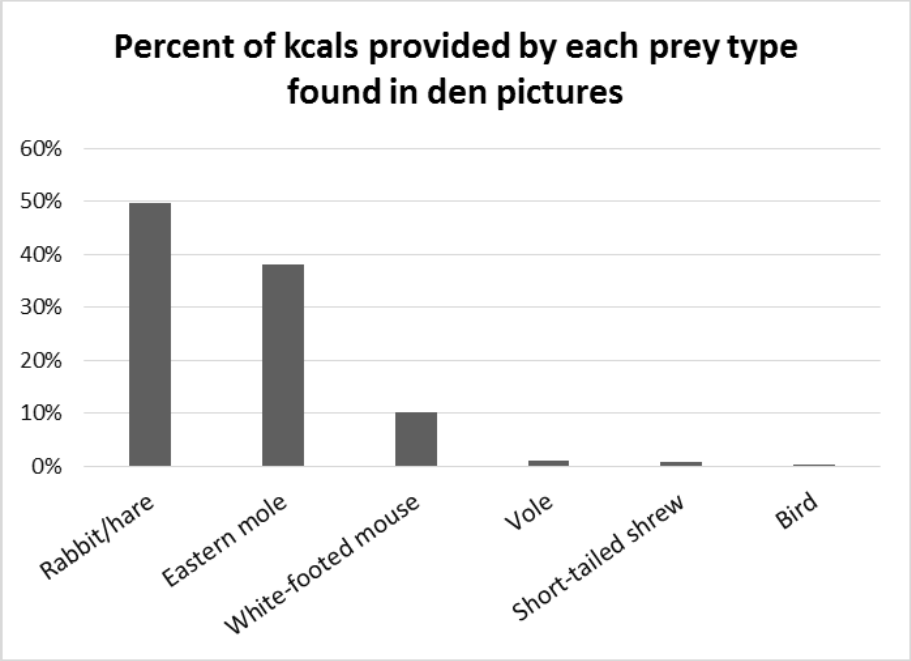

Figure 6. Percent of total kcals provided by prey brought to the den by female marten. A total of 36 photographed incidents were documented.

Table 1. Estimated average body mass of each prey type found in female marten diet and estimated energy (kilocalories) from that prey type (kcal values from Cumberland et al., 2001). We used average body mass from prey species in the museum records of GVSU as a proxy for the mass of prey consumed by marten. No body mass is shown for birds since the species was unknown, but presumed to be small passerine. No records were available for snakes. Kcal values in bold and italics did not have known values and were interpolated from their closest relative in Cumberland et al. (2001). Snakes were assigned a kcal value because no accurate way to determine the snake's length and body mass weight.

Prey type	**Average body mass**	**Kcals per individual**
White-footed mouse	18.0	25
Vole	26.8	30
Eastern mole	93.3	***129***
Bird	N/A	5
Short-tailed shrew	15.5	***21***
Gray squirrel	490.9	***1267***
Chipmunk	85.9	***221***
Red squirrel	182.1	470
Snake	N/A	***20***
Rabbit	925.3	1350
Hare	1345.5	1350
Star-nosed mole	39.8	***54***