American marten

American marten (*Martes americana*) are charismatic mammals in the weasel family. Clan members associated with marten are members of the Wabizhashi Dodem (Marten Clan), and are known as warriors, hunters, and gatherers. Marten are both ecologically and culturally significant to the Little River Band of Ottawa Indians (Little River) community and are a species of concern to Little River. Restoration and stewardship of native species, such as marten, is a high priority for Little River, as is the Native culture, harmony, and connectedness to the natural world.

Marten were once found throughout the Great Lakes Region, but were extirpated from Michigan during the early 20th century due to habitat loss and overharvest. In the late 20th century, marten were reintroduced to Michigan. Populations in the Upper Peninsula have thrived, but those in the Lower Peninsula have been less successful. Little River, in collaboration with other organizations, is researching marten to better understand the status of the reintroduced populations and enact proper management strategies to promote healthy marten populations in Michigan.

Marten in an oak tree.

Marten kit near its den.

Marten using a tree cavity for a resting site.

Remote camera image of radio-collared female marten with kit.

Collaborative research projects with Grand Valley State University

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Work-in-progress

Using occupancy modeling to estimate American marten distribution in Michigan's Lower Peninsula

Maria Weston, MS Student work-in-progress

Little River's Natural Resources Department (NRD) in, collaboration with Grand Valley State University (GVSU), is surveying the northern Lower Peninsula to model marten occupancy. This project will allow us to estimate marten distribution in Michigan and be better stewards.

In 2019, we began a three-year survey to look for marten, targeting areas predicted to have a high probability of use by marten. Surveying was limited to the northern Lower Peninsula because marten are forest-dwelling animals and southern

Michigan is largely agriculture and development. Each survey site consisted of two trail cameras, one facing north and one south, baited with salmon oil. A blue scale was painted on a tree within view of each cameras to help identify species with similar appearance, such as mink, marten, and fisher. Camera sets were deployed for four weeks and then the species within each image were identified.

In 2019, 138 sites were sampled, collecting 228,446 images of over 25 species. Marten were present at nine of these sites. In 2020, 102 sites were sampled, collecting 118,827 images. These images are still being processed, but currently marten have been detected at five new sites. No new species have been detected in 2020 that were not previously detected in 2019. Animals commonly found were white-tailed deer, black bears, various squirrel species, and raccoons. Less commonly found animals were elk, bobcat, badgers, and weasels.

Impacts of timber harvest and natural disturbance on American marten habitat

Anna Boes, MS Student work-in progress

Little River NRD and GVSU began live-trapping in areas where marten were known to occupy prior to timber management or large natural disturbance. Live trapped marten were fitted with GPS collars to collect fine-scale habitat data. Habitat use data from before and after management and disturbance events will be compared to determine how these landscape changes impact marten selection. Since October 2019, seven marten (3 female and 4 male) have been fitted with GPS collars.

Detection Probability of the American Marten (*Martes americana*) in Michigan's Lower Peninsula

Taylor Root, MS Student 2020

In order to accurately manage for the sustainability of wildlife populations, we must first determine how to locate individuals of a population with great consistency. Determining the efficiency of detection techniques is a challenge, especially when the

study species are scarce or elusive. Such is the case with the American marten *(Martes americana*), a small mustelid found across the Northern United States and Canada. In the lower peninsula of Michigan, the marten is considered a species of concern, and the full extent of its range remains largely unknown. Our goal was to test the efficacy of motion-triggered cameras for detecting the presence of a reintroduced population of American marten in the Manistee National Forest. Marten were live trapped (n=9), fitted with small radio collars, and tracked from May 2018 to September 2019 to determine the extent of their home ranges. We then set two baited, motion-triggered cameras within those home ranges for four weeks to test the probability of detection. Cameras were moved and rebaited after each four-week period and were deployed for a calendar year to test for any differences in detection rates due to seasonality or camera placement. Despite a hypothetical expectation of an approximately 1.0 detection probability, actual probabilities were much lower (0.625), supporting the idea that non-detections should not always be associated with an animal's absence. Additionally, we found that marten were more likely to be detected during the winter (Oct.-Mar. – 0.683, Apr.-Sept. – 0.561), when cameras were located near the core of the individuals home range (in core – 0.655, outside core – 0.546), and when camera locations were chosen instead of randomly placed (chosen – .692, random – .385). This study reveals that camera traps alone are not efficient enough to consistently confirm a martens' presence, even when the cameras are placed in the home range of at least one individual. We recommend high camera densities and selective camera placement, as well as additional detection techniques such as track and scat surveys for increasing the overall likelihood of detecting a martens' presence. This research should be used to strengthen any inferences made using camera trap studies in the future and will ideally provide wildlife managers and biologists with a framework for better detecting the American marten in Michigan's lower peninsula.

Characteristics of American marten habitat: A resource selection function for Michigan's northern Lower Peninsula

Angela Kujawa, MS student 2018

I sought to create a resource selection function for American marten (*Martes americana*) to predict areas in Michigan's northern Lower Peninsula marten have a higher probability of using. I used radio collar data to estimate 95% fixed kernel home-ranges for marten in the Manistee National Forest. Using ArcGIS, I measured characteristics potentially indicative of marten resource selection within the home-ranges marten selected and areas within the Manistee National Forest marten did not select. To validate my resource selection function I used cameras and credible sightings, which confirmed at least ten marten sightings in areas predicted to have a high probability of use and none in medium or low probability of use areas. My resource selection function predicted 37.6% of Michigan's northern Lower Peninsula had a high probability of use by marten.

Diets of kit-rearing female American martens in west Michigan: she ate what?

Cory Highway, Undergraduate student 2016

We studied the diet of kit-rearing female American martens due to the fact that their high metabolic rate makes caloric intake their largest limiting factor. Prey remains and scat were collected at den sites and remotely triggered cameras were deployed to collect data on preferred prey items. With this data we are able to understand the dietary needs of a female marten who is hunting for herself and up to 5 kits. The data shows that martens selected prey items that were easy to capture while still hunting for larger prey items which provided the bulk of their caloric intake. Gray squirrels (*Sciurus carolinensis*) were found to provide the most calories in the martens' diet but small mammals such as white-footed mice (*Peromyscus leucopus*) were found most frequently in the diet analysis.

American marten denning behavior in Michigan

Melissa Nichols, MS student 2016

For my Master's I explored female marten denning behavior in both the Upper and Lower Peninsulas. We used radio telemetry to track female marten to den sites where we analyzed both the den structures used and the habitat surrounding those den structures. Additionally, we set up trail cameras at den sites to estimate litter size and activity patterns. We found that den trees were significantly larger than the trees that surround the den, bigger litters used larger den structures, and the basal area around den structures was significantly higher than the basal area of paired, randomly selected plots.

A comparison of American marten habitat use from data collected using VHF radio telemetry versus GPS telemetry

Macy Doster, Undergraduate student 2015

Our study focused on home range size and habitat use of individuals in the Manistee National Forest in Michigan's Lower Peninsula. Marten home range sizes vary from animal to animal, as population density, climate, and food availability are all factors to consider (Smith et al. 2002). Our understanding of wildlife habitat use and selection, and therefore our efforts to create or manage suitable habitat are based almost exclusively on research conducted using very high frequency (VHF)-based radio telemetry. We compared the habitat use for each animal based on conventional VHF telemetry and Global Positioning System (GPS) telemetry. The habitat type in which each point was in was used as an indication of habitat preference. VHF-based radio telemetry generally allows the researcher to locate an animal once a day up to once a week. GPS-based telemetry allows the researcher to collect locations as often as once every half an hour, but the increased frequency comes with an increased cost of roughly ten times the cost of VHF transmitters. We conducted GPS telemetry by attaching GPS transmitters, small enough to use on an American marten, to a collar. The use of GPS collars increases the frequency of locations which will likely increase accuracy in our understanding of habitat selection. We evaluated whether the inferences regarding

marten habitat use vary between VHF and GPS derived data. We found that these inferences do vary, which justifies the increased cost of GPS transmitters.

Resting site characteristics of American marten in the northern Lower Peninsula of Michigan

Bob Sanders, MS student 2014

The purpose of my research was to determine habitat structures important to American martens, identify characteristics influencing resting site use within marten home ranges, and to provide forest management recommendations to maintain and improve marten habitat in Michigan's Norther Lower Peninsula. Twenty-five martens were monitored using radio telemetry to identify what types of resting sites structures were used. We identified 522 unique resting site structures; tree cavities (n = 255), branches (n = 162), and nests (n = 90) were the three most commonly observed structures being used. During the summer season (April-September) marten used more exposed tree branches (41.8%), while in the winter (October-March) they used more cavities (64.5%). Martens were observed using structures in live trees 86% of the time. Live trees used by marten included oak species (*Quercus spp*.), maple species (*Acer spp.),* and red pine (*Pinus resinosa*). Trees used as resting sites had significantly larger mean diameter at breast height (DBH) than the average DBH of non-resting site trees found at resting site locations. We also found that the average basal area in resting site plots was significantly larger than that found at control plots.

Genetic diversity of reintroduced American martens in Michigan's Lower Peninsula

Tamara Hillman, MS student 2014

My master's research focused on the genetic health of the reintroduced marten population in Michigan's Lower Peninsula. We genotyped marten from the two reintroduction sites, Manistee National Forest and Pigeon River Country State Forest, using 11 microsatellite loci. In particular we were interested in genetic diversity (measured through allelic richness), inbreeding, effective population size, and

population structure. We found low average allelic richness, moderate levels of inbreeding, significant heterozygote deficiencies at multiple loci, and small effective population size estimates. Our results indicate the Lower Peninsula populations have the potential to further lose genetic diversity and continue to diverge. My thesis research served to highlight the importance of long term genetic monitoring in reintroduced populations.

Diet of kit-rearing female martens in northern Michigan

Angela Kujawa, Undergraduate student 2014

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.

Den site characteristics and kit survival of American marten in Manistee National Forest Michigan

Rachel Hughart, Undergraduate student 2013

We tracked and documented the den sites and number of kits for three female American marten within Manistee National Forest from April through August 2013.

Kits were monitored using remote, motion-triggered trail cameras, and kit activity times were documented. The mothers were located two to three times per week using radio telemetry. A total of 7 kits documented with only 6 surviving into the rigorous tracking season and only 4 known survivors into mid-July. Nineteen unique den sites were documented in three different areas of marten use (Olga Lake, Pine River and Caberfae), and 12 of those had cavities at ground level. All of the den structures were in live trees (84.2%), snags (10.5%) and fallen logs (5.3%). The average diameter at breast height (DBH) of den trees in each area were: Olga Lake-61.95cm, Pine River- 38.88cm and Caberfae-47.58cm. When each was compared to a randomly chosen tree within a random plot in the same area a significant difference was found for all three areas indicating selection for trees with a larger diameter. Basal area was not found be significantly different and neither did a comparison of the DBH of trees surrounding the den tree in comparison to the random plot (Caberfae is the exception to the latter, a significant difference was found.) Kit survival may be limiting the population but denning sites do not; however, management for mature hardwoods and pine stands is recommended.

Den site characteristics and kit survival of American marten in west Michigan

Danielle Bradke, Undergraduate student 2012

We documented kit survival and identified den sites used by six female marten in the Manistee National Forest from April through August 2012. Dens were located with radio telemetry and kits were monitored using remotely triggered cameras. Den site attributes were compared to random sites at the local and landscape levels. We confirmed 28 unique den structures, including cavities in live trees (25), snags (2) and one down log. The mean diameter at breast height of den trees was approximately 55cm. Marten utilized dens within red pine stands significantly more than expected based on abundance. Kit survival does not appear to be limiting the population. However, we recommend maintaining large diameter hardwood trees with cavities and red pine stands as a management priority.

Status of reintroduced American marten in the Manistee National Forest within Michigan's northern Lower Peninsula

Julie Watkins, Undergraduate student 2011

We conducted a pilot study investigating the genetic structure of American marten (*Martes americana*) populations in Ward Hills and Caberfae in the Manistee National Forest. Using live traps, we captured 5 females and 6 males and drew blood samples for genetic analysis. Hair snares were also deployed in Caberfae resulting in samples from 17 red squirrels, 10 rodent and 8 possible marten. We extracted DNA from blood samples and amplified 5 microsatellite loci using the polymerase chain reaction. Using the program KINSHIP, we determined whether pairs of individuals were more likely to be parent-offspring, siblings or unrelated. We found 3 in Caberfae and 2 in Ward Hills who were likely to be parents and offspring, and 5 in Ward Hills that were more likely to be full-siblings. We calculated FST and found it was 0.14 with a p-value of 0.05, indicating that there was moderate genetic differentiation between the sites which suggests restricted dispersal and some loss of genetic diversity.