American Marten Reintroduction and Management Plan for Pennsylvania

2024-2033

American Marten Reintroduction and Management Plan for Pennsylvania

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Executive Summary

Once a common native species, the American marten (*Martes americana*) was extirpated from Pennsylvania in the early 1900's due to habitat loss and unregulated harvest. Reforestation and harvest regulations have resulted in many other species that shared the marten's fate being reintroduced. Although past considerations of marten reintroduction were not given serious attention, with available resources and interest in feasibility, assessing reintroduction was added to the Pennsylvania Game Commission's strategic plan for 2020-2023. Subsequently, managers developed a *Feasibility Assessment for the Reintroduction of American Marten to Pennsylvania* in 2022. This assessment determined through habitat suitability analyses that the state has suitable habitat in quantity, quality, and connectivity. It also predicts minimal impacts would occur to species of concern and from other predators within Pennsylvania. Past efforts throughout North America to reintroduce marten in other regions are numerous (N=40) with the majority ending in success. Justification provided within the assessment included ecological restoration, arguments for increasing biodiversity, and cultural considerations for Indigenous peoples. Other points centered on the positive effect on the outdoor recreation economy, as demonstrated by other reintroductions, and Pennsylvania's long-standing legacy of working to restore wildlife species and habitat through the generations. The assessment recommended the reintroduction of the marten to Pennsylvania.

Following Board of Commissioner direction, staff developed the *American Marten Reintroduction and Management Plan for Pennsylvania: 2024-2033* (this document). Designed to provide a 10-year road map for reintroduction, this plan describes a variety of considerations for a successful restoration effort. Following basic ecology for this species, the plan assesses historic and current forest conditions prior to providing habitat suitability analyses. Public opinion survey work is discussed as well as considerations for success before evaluating past marten reintroductions in North America and keys to success. The translocation portion covers source populations, multi-agency coordination, capture techniques, transportation, holding requirements, and release methodology. The importance of research and monitoring is highlighted with a variety of techniques to be executed post-release. A communication and education strategy is outlined in detail followed by partner coordination and resource availability. Costs for this project have been estimated over the next decade, including translocation, research, monitoring, and management. Finally, a timeline is provided to help guide managers for the duration of the project.

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Project Mission: Reintroduce the American marten to suitable habitat within Pennsylvania and manage populations for the benefit of all Pennsylvanians in perpetuity.

To realize this mission, the following goals and associated objectives, strategies, and actions are presented.

Management Goals, Objectives, Strategies, and Actions

Goal 1 – Translocation: Translocate wild American marten into multiple release locations within Pennsylvania.

Objective 1.1 Establish source locations, partner agencies, and logistics for translocation efforts.

Strategy 1.1.1 Send formal requests to source states and provinces for confirmation.

Strategy 1.1.2 Develop resource requirements and responsibility assessments for cooperating source states and provinces.

Strategy 1.1.3 Establish formal translocation agreements with cooperating source states and provinces.

Objective 1.2 Complete final translocation planning.

Strategy 1.2.1 Identify trapping resources and personnel for individual cooperating source states and provinces.

Strategy 1.2.2 Develop detailed plans for each trapping location and communicate with source trapping coordinator.

Strategy 1.2.3 Develop detailed transportation plan for shipping and receiving for each state and province.

Objective 1.3 Conduct translocation following plan and guidelines.

Strategy 1.3.1 Coordinate trapping efforts across all locations with cooperating agencies.

Strategy 1.3.2 Coordinate transportation including holding, shipment, and receiving of translocated martens.

Strategy 1.3.3 Coordinate holding and care of captured marten after arrival in Pennsylvania with local partners.

Strategy 1.3.4 Coordinate health screening, testing, and treatment with approved staff and partners.

Strategy 1.3.5 Complete data collection, genetic sampling, and marking of each individual to prepare for release.

Strategy 1.3.6 Coordinate release in designated release locations in partnership with public landholder agencies and managers.

Goal 2 – Research and Monitoring: Evaluate marten population dynamics including establishment, survival, and reproduction.

Objective 2.1 Conduct research and monitoring to estimate survival and source of mortality.

Strategy 2.1.1 Measure survival using GPS-collared founder individuals annually.

Strategy 2.1.2 Measure survival of future generations of individuals through capture and GPS collaring.

Strategy 2.1.3 Locate and collect individuals post-mortem and conduct necropsies to identify causes of mortality.

Objective 2.2 Conduct research and monitoring on movement.

Strategy 2.2.1 Monitor movements of martens prior to home-range establishment.

Strategy 2.2.2 Quantify home range establishment.

Strategy 2.2.3 Monitor transitory behavior of founding population.

Strategy 2.2.4 Use capture-and-mark or genetic analyses to monitor dispersal of young.

Objective 2.3 Quantify habitat selection within home ranges.

Strategy 2.3.1 Analyze habitat within home ranges at multiple scales.

Strategy 2.3.2 Assess differential habitat use within home ranges by sex.

Strategy 2.3.3 Revise habitat suitability model based on results of habitat selection findings.

Objective 2.4 Evaluate fecundity in reintroduced populations.

Strategy 2.4.1 Document natural reproduction using appropriate techniques.

Strategy 2.4.2 Gather additional data on reproduction including sex ratio, litter size, and kit health through capture or intensive camera monitoring.

Objective 2.5 Evaluate diet of released individuals and future generations.

Strategy 2.5.1 Evaluate marten diet through analyses of scat or stomach contents from mortalities on founder population.

Strategy 2.5.2 Conduct diet research through scat collection or stomach contents from mortalities on successive generation populations.

Objective 2.6 Estimate population size and occupancy.

Strategy 2.6.1 Conduct passive genetic sampling paired with PIT tag readers with established methods.

Strategy 2.6.2 Conduct camera surveys to determine detection probabilities and occupancy.

Strategy 2.6.3 Document incidental observations through survey work utilizing staff and external partners.

Strategy 2.6.4 Conduct snow-track transect or track-plate surveys to measure relative abundance of marten.

Objective 2.7 Monitor other species populations in relation to marten reintroduction

Strategy 2.7.1 In coordination with species experts, monitor species of interest in relation to marten reintroduction efforts if warranted.

Goal 3 – Information and Education: Assess and improve the public's knowledge, awareness, and understanding of American marten restoration and management in Pennsylvania and promote marten conservation efforts to a diverse audience.

Objective 3.1 Increase knowledge and awareness to all audiences in consideration of the American marten, its background, and its reintroduction to Pennsylvania.

Strategy 3.1.1- Develop print and electronic materials with key messaging for distribution.

Action 3.1.1.1 – Develop a short summaries of the *American Marten Reintroduction Feasibility Assessment for Pennsylvania*

Action 3.1.1.2 – Develop a printable Wildlife Note for American marten.

Action 3.1.1.3 – Develop a single or series for Facebook Live, YouTube Live, or webinar(s) on American marten and reintroduction.

Action 3.1.1.4 – Develop a story map for American marten.

Action 3.1.1.5 – Produce a feature length documentary of the reintroduction process.

Action 3.1.1.6 – Develop articles for Game News and other suitable outlets.

Action 3.1.1.7 – Develop talking points for Pennsylvania Game Commission (PGC) staff who work directly with the public (Board of Commissioners, Information and Education Supervisors (IESs), Dispatch, Administrative Assistants, etc.)

Action 3.1.1.8 – Use PGC email 'blasts' to provide important information and point towards additional upcoming or established resources.

Action 3.1.1.9 – Produce a podcast with PGC Call of the Outdoors on marten and the results of the assessment, plan development, and forthcoming activities.

Action 3.1.1.10 – Develop a 'Questions and Answers' document focusing on the most-asked questions and most common misperceptions about marten.

Action 3.1.1.11 – Develop a brochure with relevant information from the feasibility assessment.

Action 3.1.1.11 – Develop a short summary of the *American Marten Reintroduction and Management Plan for Pennsylvania: 2024-2033*.

Strategy 3.1.2 – Develop social media materials and release on a regular schedule.

Action 3.1.2.1 – Develop Facebook posts to be released bi-monthly including a photo and fact about marten.

Action 3.1.2.2 – Develop Instagram posts to be released monthly with high-quality photographs and links to additional information.

Action 3.1.2.3 – Develop Twitter posts to bring attention to other communication opportunities or marten-related information (i.e., presentations, webinars, or live events).

Action 3.1.2.4 – Respond to misinformation posted on Game Commission social media platforms with facts.

Strategy 3.1.3 – Develop and update agency website with relevant information for American marten.

Action 3.1.3.1 – Develop links that point towards other research, reintroduction benefits, etc.

Action 3.1.3.2 – Update American marten webpage with information relevant to Pennsylvania's efforts.

Action 3.1.3.3 – Use marten webpage as landing for blog posts, recorded events, articles, etc.

Strategy 3.1.4 – Provide presentations to audiences throughout the state.

Action 3.1.4.1 – Provide an open house within each region in coordination with region IES.

Action 3.1.4.2 – Solicit partners for time within annual meetings to provide an update on the marten project (U.S. Forest Service [USFS], Pennsylvania Trappers Association [PTA], Pennsylvania Department of Conservation and Natural Resources [DCNR], National Wild Turkey Federation [NWTF], Ruffed Grouse Society [RGS], Audubon, etc.).

Action 3.1.4.3 – Provide targeted meetings/presentations within potential area of focus for release.

Strategy 3.1.5 – Develop a separate email resource account for American Marten that can be used to field questions, comments, concerns, as well as disseminate information.

Action 3.1.5.1 – Develop monthly internal emails for staff highlighting marten ecology, assessment results, and reintroduction planning.

Strategy 3.1.6 – Solicit internal, external, and partner organizations to present information on podcasts.

Strategy 3.1.7 – Provide information to a dedicated cooperator base.

Action 3.1.7.1 – Solicit interest in becoming a furbearer management cooperator and develop a list for information dissemination.

Action 3.1.7.2 – Publish an annual Furbearer Management newsletter (electronic) that can be distributed to cooperators and provides up to date information on the marten project.

Objective 3.2: Increase support for American marten reintroduction within Pennsylvania across diverse constituencies.

Strategy 3.2.1 – Establish and maintain collaborations within the PGC critical to the project.

Action 3.2.1.1 – Provide regular updates to Senior staff, Executive staff, and Board of Commissioners on project progress through meetings or reports.

Action 3.2.1.2 – Provide regular updates and close coordination with region staff (Region Directors [RDs], Wildlife Management Supervisors [WMSs], Region Foresters [RFs]) through meetings or reports.

Action 3.2.1.3 – Provide regular updates and content to Bureau of Marketing and Strategic Communications and Bureau of Information and Education staff through meetings or email updates.

Strategy 3.2.2 – Establish and maintain collaborations with Non-governmental Organizations (NGOs) that have a vested interest in reintroduction.

Action 3.2.2.1 – Provide regular updates and solicit feedback throughout the project.

Action 3.2.2.2 – Provide education and information materials to NGOs for distribution to members and other stakeholders.

Strategy 3.2.3 - Establish and maintain collaborations with other state and federal agencies and recognized Indigenous groups that have a vested interest in reintroduction.

Action 3.2.3.1 – Provide regular updates and solicit feedback throughout the project.

Strategy 3.2.4 – Provide factual and transparent information to the public.

Action 3.2.4.1 – Provide prompt responses to written comments or concerns directed to the PGC by the public.

Action 3.2.4.2 – Provide prompt responses to emails, telephone calls, and in--person interactions.

Goal 4 – Cooperative Partnerships: Establish, maintain, and enhance partnerships to support American marten restoration efforts within Pennsylvania.

Objective 4.1 Establish, maintain, and enhance new and existing partnerships across a diversity of organizations.

Strategy 4.1.1 Establish, maintain, and enhance partnerships with public land managers.

Strategy 4.1.2 Establish, maintain, and enhance partnerships with source state and provincial government agencies.

Strategy 4.1.3 Establish, maintain, and enhance partnerships with research partners.

Strategy 4.1.4 Establish, maintain, and enhance partnerships with stakeholder partners.

Strategy 4.1.5 Develop a Marten Reintroduction Team to include a variety of partners to assist in adaptive management decision making.

Strategy 4.1.6 Provide monthly or bimonthly project updates to all partners.

Goal 5 – Population Management: Maintain marten populations in perpetuity.

Objective 5.1 Develop long-term strategies for monitoring population trends and occupancy.

Strategy 5.1.1 Develop and conduct annual population abundance surveys based on research and results on effective long-term monitoring strategies.

Strategy 5.1.2 Develop and conduct annual population occupancy surveys using established methodology.

Strategy 5.1.3 Monitor populations through annual staff surveys, an index to relative abundance, within release districts and expansion areas.

Objective 5.2 Use regulated harvest as a tool for management if populations reach sustainable levels within the future.

Strategy 5.2.1 Analyze habitat availability, carrying capacity, population trends, and occupancy to develop a season and regulations for harvest.

Strategy 5.2.2 Begin harvest with a conservative season length and required permit with targets based on population sustainability.

Strategy 5.2.3 Require mandatory harvest reporting and carcass collection (not including pelt) for important data collection needed for additional management.

Objective 5.3 Manage human – wildlife conflict as it pertains to martens.

Strategy 5.3.1 – If marten nuisance complaints arise, develop a Standard Operating Procedure (SOP) to define reporting and classification procedures. When a conflict is reported to provide support to dispatchers and region staff as needed.

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Introduction

When a species has been absent for over 120 years from a place, it tends to be forgotten. Several generations of humans have come and gone during that absence, and those memories of the American marten have drifted away on the winds of time, out of the collective conscience of today's Pennsylvanians. Not only has the species been lost over time, but the important services that it provides within a complex ecological system have been lost. This is a system which humans often separate themselves from through wood, metal, glass, and plastic. The reality, however, is that humans remain an important aspect of this community and benefit greatly when the system functions to its potential. Although humans in Pennsylvania drastically altered the system during the settlement of the Commonwealth, Pennsylvanians have placed significant value on their natural resources and over the last 100 years have diligently worked to restore wildlife communities and their habitat.

Historic wildlife translocations began soon after the turn into the 20th century with white-tailed deer and elk reintroductions. Wild turkey and beaver followed soon after with turkeys translocated in state and beaver coming in from a variety of states and provinces as well as local in-state translocations. River otter, peregrine falcon, osprey, and bald eagle were brought in following the nation's bicentennial. Managers will soon be preparing to trap and transfer the first wild bobwhite quail back into the state. Three generations of Pennsylvanians have been working tirelessly to restore the natural association and processes of the state. Their work has benefited the successive generations, and those benefits have been multiplied to each one in turn.

As Pennsylvania contemplates the reintroduction of yet another lost member of the wildlife community, the careful consideration of what this might entail is of utmost importance. The Pennsylvania Game Commission, in partnership with many other agencies and organizations, developed a multi-year process to evaluate marten reintroduction. Initially elevated to a goal within the agency's *2020-2023 Strategic Plan* (Pennsylvania Game Commission [PGC] 2020), the *American Marten Reintroduction Feasibility Assessment* (Keller 2022a) was completed in July of 2022. Following direction from the Board of Commissioners, staff developed this document to provide a comprehensive, long-term management plan to guide reintroduction efforts. Public review and comment are integral parts of wildlife management because wildlife indeed belongs to all Pennsylvanians (Commonwealth of Pennsylvania [COP] 1971). Following this process to completion, over two years of careful research and review will have taken place to assist the decision-making process. Wildlife management is challenging, but thorough examination of historic and current research along with social science and analysis provide decision makers with requisite information.

Historic Background of Martens in Pennsylvania

The American marten was known to exist throughout much of the northwest, northcentral and northeast regions of the state

(Rhoads 1895, Williams 1928, Luttringer 1931, Richmond and Roslund 1949, Roslund 1951, Grimm and Whitebread 1952, Cunningham 1985, Williams et al. 1985, Merritt 1987, Heppenstall and Doutt et al. 1998, Whitaker and Hamilton 1998). Surprisingly, however, only one prehistoric record exists from a location in Bedford County, near the town of New Paris, titled the Number 4 Sinkhole (Guilday et al 1964). Skeletal remains from a single individual were found here during excavation dating to 11,300 Before Present. Williams et al. (1985) hypothesized that this may be due to the martens 'arboreal nature', or climbing ability, that would have prevented it from being trapped within similar sites. This site was studied extensively, whereas other locations within the state have not received the same attention, therefore possibly explaining the lack of other prehistoric evidence. Others postulated that native Americans may have considered the marten sacred and not utilized its pelt or meat. Although it's not clear if native tribes in Pennsylvania held the marten in a place of protection, we know other tribes from the Upper Mid-west and Northwest coast, such as the Mi'kmaq, Ottawa, Wabanaki, Kootenai, Ojibwe, Tlingit, Menominee, Innu, and Abenaki all developed legends or stories about the marten or used the marten as a representative clan animal (Native Languages of the Americas [NLA] 2020).

Although marten range was thought to extend as far south as Tennessee and North Carolina (Krohn 2012), historical accounts in Pennsylvania documented by Rhodes (1903) and Williams et al. (1985) focus primarily within the counties of Clinton, Potter, Cameron, and McKean (Fig. 1). There are also records from Crawford, Elk, Forest, Luzerne, Tioga, Wayne, Wyoming, Pike, Monroe, Columbia, and Sullivan counties. The earliest record comes from McKean and Warren counties in 1821 and they continue throughout the marten's range within the state until the early 1900s. Although it's largely believed that extirpation occurred by the turn of the 20th century, several records have occurred in later years, three from the 1950s-60s in Potter and Wayne counties as well as a skull collected in Mercer County in 1970. More recently, some publications (Merritt 1987) list marten as having uncertain occurrence, hinting at natural reestablishment, but no other reports have been collected since 1970.

This extirpation follows the progressive European settlement of Pennsylvania, beginning in the mid-1600s and continuing through the late 1800s (Florin 1977). This is not unlike other documented extirpation for martens within North America (Krohn 2012). By the beginning of the 20th century, very few uncut forested areas remained in the state (Rhodes 1903), and only a handful of small patches clung to the

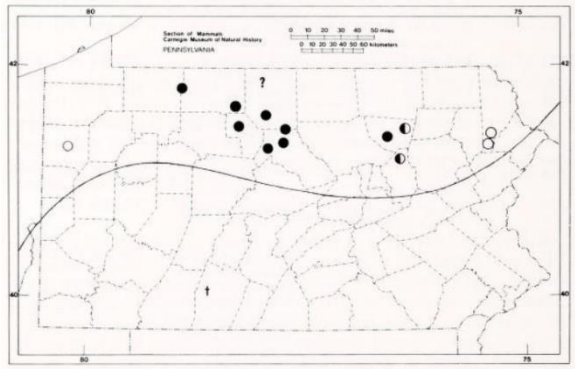

Figure 1. Estimated historic range (North of line) by late 1800's with historical record locations. Solid black dots represent historical records of marten captured or killed. Open dots represent museum collection specimens without associated written historical records. Half dots represent specimens with written records. The cross represents record from archeological site, while the (?) represents sight records without the animal being acquired (Williams et al. 1985).

landscape in the northern tier, holding out in the steeper and more inaccessible hollows and mountain folds (Smith 1989). This same period was prior to regulated harvest within the state. Although we don't know whether unregulated take contributed to decline and eventual extirpation, it is likely, coupled with the extreme loss of habitat, to have played some part (Allen 1942), and it is clear overall harvest within the U.S. decreased dramatically coming into the early 1900s (Obbard et al. 1987). Although it is very difficult to know the exact timing of extirpation, it can be assumed that by the early 1900s most martens were absent from their historic range in Pennsylvania. The later sightings may have occurred from transient individuals dispersing from populations in New York.

American marten is currently classified as a furbearer within the Pennsylvania Game and Wildlife Code (Pennsylvania General Assembly [PGA] 1986a) even though extirpated. There is no open season for martens, and they are not considered a Species of Greatest Conservation Need (SGCN; Pennsylvania Game Commission and Pennsylvania Fish and Boat Commission [PGC-PFBC] 2015), threatened or endangered (Pa. Code 58 § 133.41). Dr. Thomas Serfass completed a reintroduction feasibility assessment in 2002 that was funded by the Pennsylvania Wild Resource Conservation Fund (Serfass et al. 2002). This assessment determined there was justification for a reintroduction, providing specific locations for release and citing likely habitat suitability but cautioned against expecting results like those experienced with fisher and otter reintroductions. At the time (2003), Pennsylvania Game Commission staff did not feel that this assessment addressed habitat suitability within the state adequately, and thus chose not to move forward with reintroduction efforts until further habitat evaluations occurred.

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Ecology and Habitat

Taxonomy

The American marten is known by many names including the American pine marten, American sable, and Apistanewj by the Mi'kmaq tribe. Martens are considered similar in size to the American mink (*Neovison vison*) and smaller than the fisher (*Pekania pennanti*). Martens are derived from the Order Carnivora, Family Mustelidae, and genus *Martes*. Of the eight 'true' marten species, not including fisher, wolverine (*Gulo gulo*), and tayra (*Eira barbara*), *Martes americana* falls within a sub-group called the 'boreal forest martens,' which are found across the circumboreal zone (Buskirk and Ruggiero 1994; Buskirk 1992) and largely do not overlap amongst species east to west. Fourteen subspecies were at one time recognized throughout the Old and New worlds (Hall and Kelson 1959)

but more recently only eight have been widely accepted (Clark et al. 1987), and of those eight, only five are considered 'true' boreal forest martens, to include the American marten.

General Characteristics

American martens measure between 500 and 680 mm (19.7 – 26.8 in.) from nose to tip of tail with adults weighing between 500 g and 1400 g (1.1 – 3.1 lb.; Buskirk and Ruggiero 1994). Sexual dimorphism within this species is evident with males being up to 65% heavier and 15% longer than females (Clark et al. 1987). The coat is made up of dense fur with long soft guard hair and coloration varies among individuals. Light brown to black hair covers the top of the head, running down the back, continuing onto the tail and stretching down each leg. In winter, a pale, whitish gray color stretches from the ears down under the chin whereas in summer this area is chocolate brown. A yellowish orange bib covers the throat and can stretch down to the chest. Like most furbearing animals, the coat thins substantially throughout spring and summer (Clark et al. 1987, Soutiere and Steventon 1981).

Having digitigrade, five-toed feet with semi-retractable claws, these animals can move vertically through the canopy as quickly as horizontally on the ground surface. Their thickly furred, large feet allow for efficient weight disbursement on snow (Krohn et al. 2005, Jensen and Humphries 2019). Martens have a typical weasel body shape, which is long and thin with relatively short legs. These attributes allow them to use burrows and subnivean spaces efficiently. Combined with other attributes including a pointy snout with long whiskers for optimal hunting in tight, narrow locations such as tree cavities, dense understory, or within subnivean (under snow) abscesses.

Distribution

Current range (Fig. 2) of the American marten extends from the far northeast of North America in Newfoundland, across the northern forest boundary in Canada, stretching up into Alaska. The western edge of the range encompasses British Columbia down through parts of the Pacific northwest and into northern California following the Cascades and the Sierra Nevada ranges. It should be noted that these western martens are often considered Pacific marten (*Martes caurina*), although there's still question as to where the transition zone is between Pacific and American marten. Populations stretch down through the Rocky Mountains as far south as New Mexico. Following the forested landscape, the range retreats up into mid-Alberta, Saskatchewan, and Manitoba before again coming south into Minnesota and the upper peninsula of Michigan. Within New England, some populations exist as far south as the Adirondacks of New York and further north into Vermont (Moruzzi et al. 2003),

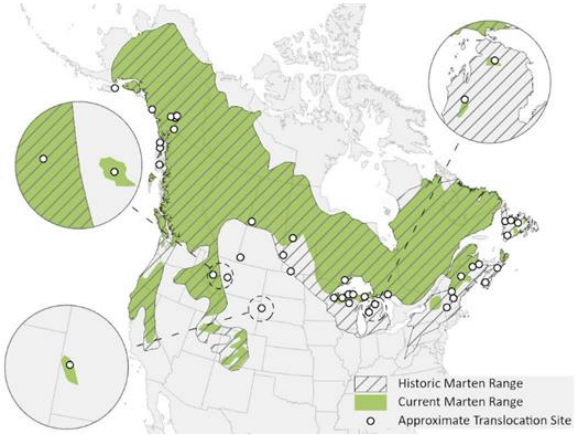

Figure 2. Historic and current distribution of American and Pacific martens in North America with historic translocations shown. E. Clees, 2022 (Data from Williams et al. 2007, Powell et al. 2012 and Pauli et al. 2022).

Maine and then back into Canada as far northeast as Prince Edward Island (Clark et al. 1987; Hall 1981; Buskirk and Ruggiero 1994).

Historic southern range within the mid-West and East would have encompassed northeastern North Dakota, down through the entirety of Wisconsin, Michigan, continuing as far south as southeastern Ohio, northern West Virginia, and the northern two thirds of Pennsylvania, finally running north through all of New England. Fossil records to the east indicate *Martes americana* as far south as Tennessee as well as in Virginia, West Virginia, and Pennsylvania. To the west, fossils have been found in sites in the Yukon Territory, Idaho, Wyoming, and Colorado (Clark et al. 1987).

Multiple reintroduction projects have been conducted throughout the current and historic range (Fig. 2) to include Maine, Vermont (Moruzzi et al., 2003), Wisconsin (Williams et al., 2007), the Upper and Lower peninsulas of Michigan (Hiller et al. 2011; Williams et al. 2007), South Dakota (Buskirk and Ruggiero 1994), Montana (MFWP 2020), Idaho, New Hampshire, Wyoming, several Alaskan islands, and throughout Canada (Burris and McKnight- 1973). Further details on previous reintroductions are provided in *Marten Reintroduction Efforts* section under *Reintroduction and Translocation*.

Reproduction

Both male and female martens are polygamous (Proulx and Aubry 2017). Breeding season averages 35 days and generally occurs within the months of July and August but can begin as early as late June in Alaska and end as late as early September in more southern locales (Clark et al. 1987; Buskirk and Ruggiero 1994). Following fertilization, delayed implantation of the blastocysts occurs for anywhere between 190-250 days (Clark et al. 1987; Hamilton 1943). After implantation, gestation lasts 27 days prior to birth. Between 1-5 kits (avg. 2.85; Strickland and Douglas 1987) are born altricial between March through May weighing an average of 28 g (Strickland et al. 1982, Buskirk and Ruggiero 1994). Young are weaned by day 42 (Mead 1994, Buskirk and Ruggiero 1994) and are actively moving out of the maternal den by day 46 (Clark et al. 1987). At 15 months, marten reach sexual maturity, with some females producing first time litters at 24 months (Strickland et al. 1982, Buskirk and Zielinski 1997). Fecundity and recruitment can vary widely (Clark et al. 1987) and is thought to potentially be driven by food availability or environmental stress (Thompson and Colgan 1987, Buskirk and Zielinski 1997).

Dispersal, Home Range and Minimum Population Viability

After accompanying the adult female outside of the den during late spring through summer, young martens disperse from late summer through early winter (Buskirk and Zielinski 1997, Buskirk and Ruggiero 1994, Clark et al. 1987). Dispersal distances vary between location and are likely a result of habitat quality and pre-existing territories. The average dispersal distance reported included 33.3 km in Oregon (Bull and Heater 2001) and 5.13 km in Ontario (Broquet et al. 2006) while unpublished data from Minnesota (M. J. Joyce, University of Minnesota, unpublished data) was 4.3 km for males and 6.4 km for females. Pauli et al. (2012) found a range of 15-40 km from research that looked at both American and Pacific marten in southeastern Alaska and northern British

Columbia. Although not typical, martens can disperse long distances and have been reported traveling over 200 km in several instances (Johnson et al. 2009, Moruzzi et al. 2003).

Martens, like most mustelids, exhibit what is called intrasexual territories where territories are closely defended within the same sex, but where overlap occurs between sexes (Powell 1979, Buskirk and Ruggiero 1994). Home range size for males is larger than for females in most cases, although some research has shown comparable sized ranges between sexes (Smith and Schaefer 2002). This study compiled historical data and showed the wide variation between 15 study sites with female marten home ranges from 2-27.6 km² and males from 2.6-45 km². In northern Wisconsin, Dumyahn et al. (2007), found an average winter home range size of 3.29 km² (males=4.25 km², females=2.32 km²). Another Wisconsin project, centered on translocation of martens from Minnesota (Woodford et al. 2013), compared not only sex but age, with adult males=16.19 km², adult females=4.81 km², juvenile males=11.57 km² and juvenile females=10.27 km². This research showed martens traveling an average of 4.6 km over an 18-day period before establishing territory as these were translocated individuals. Kujawa (2018), when researching home range of martens in a reintroduced population in the northern Lower Peninsula of Michigan, found a mean of 12.4 km². Home range variability seems to be driven by a variety of factors, to include habitat quality, typing, connectivity, and availability as well as prey abundance (Buskirk and Ruggiero 1994, Thompson and Colgan 1987, Soutiere 1979). Variability amongst documented home ranges can also depend on monitoring and relocation methodology. It must be understood that making comparisons between reported results that may be measuring home range during differing seasons or using a variety of methods can be difficult.

Minimum Viable Population (MVP) can be an important aspect of a species long-term survival and management. Genetics become a critical part of this estimation, particularly within populations that are isolated or experience little to no gene flow. Slough (1994) recommended that MVP for American marten is 50 breeding individuals for short-term genetic success, while long-term goals may reach upwards of 500 individuals. At 50 individuals, however, genetic fitness can be maintained. He recommended, based on research from Strickland et al. (1982), a stable population of 50 individuals would require an area ranging from 42-125 km² of contiguous habitat. Population viability modeling work on populations in Michigan found that when habitat carrying capacity of marten exceeded 100 individuals, loss of marten genetic heterozygosity was minimal over a 100-year period, whereas below that threshold, it decreased substantially (Hillman 2014, Hillman et al. 2017). Research within Wisconsin (Grauer et al. 2019) explored two separate reintroduced populations and how immigration proved critical to preventing extinction over time. This research demonstrated the critical importance of maintaining genetic diversity in an isolated, reintroduced population.

Diet

Martens are considered a facultative generalist, feeding on a large variety of available food types by season (Zhou et al. 2011). Martens are both active predators as

well as opportunistic scavengers. Martens have been documented to feed on animals both larger than and smaller than themselves, including small mammals, reptiles and amphibians, birds and bird eggs, insects, both hard and soft mast, earthworms, and carrion (Clark et al. 1987, Buskirk and Ruggiero 1994). As is seen in other mustelids such as fisher (McNeil et al. 2017), martens also exhibit intraspecific consumption (Thompson and Colgan 1990, Carlson et al. 2014, Zielinski et al. 1983). Marten have even been observed feeding at sap wells of maple trees (*Acer spp.*) created by yellow-bellied sapsuckers (*Sphyrapicus varius*) as reported by Kitching and Tozer (2010).

Prior diet study comparisons (Buskirk and Ruggerio 1994) as well as a comparison of 13 historic diet studies (Appx. 1) compiled in this assessment, paints a very clear picture of not only the diversity of food items but also preference. Small mammals (voles, mice, and shrews) make up the bulk of the marten diet (>68% frequency of occurrence [FO]). Within this group, and as most literature states, the red-backed vole (*Myodes gapperi*) is the most common prey item (26.1% FO) throughout the marten range (Martin 1994, Clark et al. 1987, Bull 2000, Thompson and Colgan 1987 and 1990, Cumberland et al. 2001, Hales et al. 2008). The *Microtus* genus makes up another large portion (24.2% FO) followed by the *Peromyscus* genus (13.5% FO), *Blarina* genus (11.9% FO), and *Sorex* genus (10.7% FO).

The percent frequency equals the number of occurrences of a prey item divided by total number of stomachs, intestines, and/or fecal samples multiplied by 100. Note that percent frequency of occurrence is the most common measurement of diet composition and sums to more than 100% in most cases.

Plant materials make up the next largest FO at 21.7%, with a major percentage coming from soft mast (e.g., berries) and the rest from a variety of grasses, leaves, lichen, etc. The bird class has a FO of 12.3%, with ruffed grouse (*Bonasa umbellus*) at 4.6% FO and 'Other Birds' at 7.4% FO. The *Sciurids* (squirrel grouping) have a FO of 11.5% with members ranging from 1.5% (*Glaucomys spp.*) to 6.7% (*Tamiasciurus hudsonicus*). *Lagomorphs* (rabbits and hares) follow with a FO of 9.3%, the majority reflected solely by snowshoe hare (*Lepus americanus*). The m*ustelid* grouping had a FO of 2.7%, with American martens comprising 1.62 %. Within the 'Other' category (23.3% FO), insects led with 17.8% followed by cervid carrion at 6.9 % FO. This category also included fish, amphibians, reptiles, and a western woodrat species (*Neotoma cinerea)*.

Diet can be dictated by seasonality, prey abundance, or prey access (Zielinski et al. 1983, Weckwerth and Hawley 1962, Buskirk and Ruggiero 1994). Use of items such as soft mast or insects peak in late summer through early fall while winter sees marten diet heavily skewed towards mammals (Thompson and Colgan 1990, Buskirk and Ruggiero 1994, Raine 1981). Thompson and Colgan (1990) found that marten in Ontario expanded their diet niche during years when common prey species were less abundant. With the effect of mast production on prey abundance, several researchers have found important ties to marten harvest in relation to mast availability (Jensen et al. 2012, Jakubas et al. 2004). Martens have also been considered an

important species for seed dispersal given their penchant for a large variety of fruits and their large home range sizes or dispersal distances (Willson 1993). It should be noted that although most diet research is reported as percentage frequency of occurrence, Cumberland et al. (2001) suggested that assessment of prey availability should rather focus on the importance of those species (i.e., hare, grouse, and squirrel) with the highest caloric value, measured instead in overall biomass. This doesn't negate the fact that small mammals still make up most of the marten's diet or that martens can persist on small mammals, only that in some areas of their range, larger prey makes up a larger portion of their caloric intake depending on time of year.

Mortality

Sources of mortality for martens varies between natural predation, human-caused (harvest or roadkill), as well as disease and parasites. As with other species, exposure (Bull and Heater 2001) and starvation (Hearn 2007) occur within marten populations and has been documented as causes of mortality for this species. Toxoplasmosis, Aleutian disease, and plague (western populations) have all been detected in marten at various rates, although were not found to have population-level impacts (Strickland et al. 1982, Zielinski 1984, Buskirk and Ruggiero 1994). Fredrickson (1990) found that canine distemper can cause high mortality as it spreads throughout an area. Martens host a large variety of ectoparasites and several endoparasites (Clark et al. 1987, Strickland and Douglas 1987); however, none have been shown to cause negative impacts on populations. A detailed study on serosurvey, hematology and causes of mortality relating to a reintroduced population of marten in Michigan (Spriggs et al. 2018) found that although martens contained antibodies for several viruses and even a high percentage with verminous or granulomatous pneumonia, the primary natural cause of mortality was predation followed closely by trapping, where legal.

Reported mammalian species predating marten include bobcat (*Lynx rufus*; Bull and Heater 2001), fisher (Payer and Harrison 1999, McCann et al. 2010), coyote (*Canis latrans*; Woodford et al. 2013), red fox (*Vulpes vulpes*; Buskirk and Ruggiero 1994, Hearn 2007), and other martens (Bull and Heater 2001, Thompson 1986, Thompson and Colgan 1990, Carlson et al. 2014, Zielinski et al. 1983). The most common raptor species to take martens are the great-horned owl (*Bubo virginianus*; Baker 1992, Buskirk and Ruggiero 1994), eagles (*Accipitridae spp.*) and the northern goshawk (*Accipiter gentilis*; Bull and Heater 2001, Squires 2000). Clark et al. (1987) reported that none of these species poses a significant threat to marten populations. More recent research (Jensen et al. 2019, Pauli et al. 2022) points to the increased potential of predation from larger mammalian predators in the absence of suitable habitat and abiotic conditions. Most mammalian predation occurred during winter, while raptors, although infrequent, took marten during the summer kit-rearing period (McCann et al. 2010, Woodford et al. 2013)

Survival

In captivity, martens can live 15 years and even some wild-caught martens were aged to 14.5 years (Strickland and Douglas 1987,

Buskirk and Zielinski 1997), however, average age is likely much less, although there is surprisingly little information available. Harvest records from research within the Upper Peninsula of Michigan found that within a trapped population, the majority of the harvest was yearlings while 1.5-year-olds followed closely behind, and very few individuals lived past 5.5 years (Skalski et al. 2011). Woodford et al. (2013) compared survival of two release methods for translocation in northern Wisconsin: quick release after transport (Survival = 0.80) and a 14-day conditioning period slow-release (Survival = 0.67). This study also estimated survival after the slow-release reintroduction with variation among sex (F=0.71, M=0.79) and age (J=0.66, A=0.84). Another northern Wisconsin project (McCann et al. 2010) found overall adult annual survival to be 0.81 with adult females at 0.77 and adult males at 0.85. There was no estimate of juvenile survival. Hodgman et al.'s (1994) survival results from northcentral Maine show a wide gap between sexes regardless of age with males (JM=0.64, AM=0.56) significantly less than females (JF=0.73, AF=0.76), likely a result of a larger home range and increased opportunity to encounter a trap set. Bull and Heater (2001) conducting research in northeast Oregon found a relatively low annual survival of 0.63, while Slough (1989) found some of the highest recorded, within the Yukon Territory, at 0.88 and 0.91 for females and males, respectively.

Martens are susceptible to human-caused mortality (i.e., harvest or roadkill), which can reduce overall density, skew sex ratio towards females, and change age structure (Buskirk and Ruggiero 1994, Powell 1994, Strickland and Douglas 1987, Hodgman et al. 1994). Payer and Harrison (1999) found in Maine comparing adult marten survival within an untrapped forest reserve (F=0.62, M=0.95), a trapped industrial forest (F=0.66, M=0.59), and an untrapped industrial forest (F=0.82, M=0.84). It should be noted, however, that density and age structure can fluctuate dramatically within unharvested populations (Thompson and Colgan 1987, Wekwerth and Hawley 1962, Buskirk and Ruggiero 1994). and regulated harvest provides a tool to decrease these swings in density helping to stabilize populations for ease of management (Powell 1994).

Habitat

The subject of marten habitat has been researched extensively throughout their range and there is a wide variety of literature available. What was historically generally agreed upon was that martens are a species of mature forest, with strong ties to conifers, favoring a diverse and complex structure from forest floor to canopy crown (Strickland and Douglas 1987, Clark et al. 1987, Buskirk and Ruggiero 1994, Buskirk and Powell 1994, Buskirk and Zielinski 1997, Gilbert et al. 2017). Originally thought of as a species specifically inhabiting 'old-growth' coniferous forests, much research has shown that the marten can inhabit a large variety of forested habitat types if abundant prey and cover are available.

Historical records describing habitat within Pennsylvania (Rhodes 1903) reflect a difference in habitat preference from northern populations. Rhodes says, "My correspondents agree in saying that deciduous, hardwood timber is preferred by this species in PA. This seems at variance with its preferred resorts in Canada." Martens

prefer mesic over xeric forests as is reported by Buskirk and Powell (1994). Several habitat-based models have been developed (Bowman and Robitaille 2005) but none are referenced more than the model Arthur Allen developed in 1984 (Allen 1984). Allen described the two most limiting factors for suitability of winter habitat were percent tree canopy closure (>30%) and stand successional stage (pole size or larger). The two additional factors that Allen (1984) stressed were having conifers, primarily fir or spruce, as a portion of the overstory (>25%) as well as the importance of downed woody debris and stumps covering the forest floor. This complex structure at ground level provides important prey habitat and access to the subnivean spaces for both hunting and thermal regulation as well as protection from predators (Buskirk and Powell 1994, Buskirk and Ruggiero 1994, Corn and Raphael 1992). Basal area of partially cut stands also plays an important role in use and Fuller and Harrison (2005) recommend retention of >18m²/ha which provides for both cover and food abundance needs.

It is well documented that martens avoid large open areas such as new clear cuts, burns or fields that lack canopy cover (Hawley and Newby 1957, Koehler and Hornocker 1977, Soutiere 1979, Allen 1984, Buskirk and Powell 1994); however, if alternate suitable cover is available (e.g., thick early successional growth, rock or talus fields, heavy slash, or an open subnivean environment) martens have been shown to utilize non-high canopied areas (Streeter and Braun 1968, Soutiere 1979, Allen 1984, Buskirk and Powell 1994). Seasonal differences in relation to young forest openings are evident, where marten avoid openings during the winter, purportedly due to predator avoidance, while their use of these areas may expand during the summertime if early succession provides a low, dense canopy (Koehler and Hornocker 1977, Soutiere 1979, Buskirk and Powell 1994). These authors also point out that research results vary on marten use of edges, although it appears that the edge composition itself dictates use.

Research from Maine found that many of the historical pillars of marten habitat including mature coniferous forests with a high percentage of canopy closure may not be accurate after all (Chapin et al. 1997). Within study areas, marten preferred the structural complexity resulting from insect mortality and thus <30% canopy closure, utilizing the 10-20 year early successional growth on the forest floor as well as available snags and coarse woody debris. Results pointed towards the importance of vertical and horizontal structure rather than stand age or species composition within the overstory, a well-documented thesis (Buskirk and Powell 1994, Buskirk and Ruggiero 1994, Katnik 1992). Chapin et al. (1997) recommend focusing on creating the structural habitat needs within both managed and unmanaged stands regardless of overstory canopy, stand age, or stand composition.

Another research project from Maine found that marten selected for primarily deciduous habitat with strong structural complexity at ground level shying away from mature coniferous stands, while they readily used early successional stands <20 years having dense vegetative growth and ample course woody debris (Potvin et al. 2000). These combinations not only provide the necessary protective cover from terrestrial

and avian predation, but also increased prey abundance.

Of all aspects of habitat, structural complexity is likely the most important for the American marten, according to the literature review. Denning and resting sites are an important part of this complexity and having a mixture of tree cavities, exposed branches, ground-based sites such as holes, dens, rock outcrops, downed woody debris, and of course access to all of these during periods of prolonged snow is critical (Buskirk and Powell 1994, Joyce et al. 2017, Sanders and Cornman 2017). The overall volume and percent cover of coarse woody debris provides greater access to subnivean spaces during winter (Corn and Raphael 1992) and speaks to the importance of this complex horizontal structure. Joyce et al. (2017) found several key observations when conducting a literature review focusing on resting microsite use. Their findings showed that a.) during winter, marten utilized sites within the subnivean layer more often than outside of it, b.) severe winter climates saw an increase in ground microsite use by martens and c.) marten used ground microsites more often than fishers. Sanders and Cornman's (2017) research, within the Lower Peninsula of Michigan, found different results with most winter (97.4%) resting sites within larger diameter at breast height (DBH), elevated cavities (64.9%), branches (12.9%), or nests (19.6%), while summer sites (97%) focused on these same three characteristics (39.3%, 41.8%, 15.9%, respectively), with oak being the predominant tree species selected. This likely falls in line with Joyce et al.'s (2017) conclusion that within areas experiencing mild winters, marten may not require subnivean rest sites as frequently. Current research in Michigan has shown that martens using cavities within these areas are not showing a significantly higher energetic cost (M. J. Joyce, University of Minnesota, unpublished data). Denning sites from research in Michigan were found most often in live trees with large basal area (Nichols 2016).

The study of habitat fragmentation and its effects on marten populations, especially relating to connectivity between populations is evolving. Understanding what habitat fragmentation means is often interpreted differently by researchers and managers worldwide. Henrik Andren (1994) breaks fragmentation down into three primary parts, those being forfeiture of original habitat, decrease of habitat patch size, and the further seclusion of patch size. Fragmentation can occur through a variety of natural occurrences such as succession, fire, or windfall, but the most often cited is human land use at large scale (Andren 1994).

When considering landscape connectivity, D'Eon et al. (2002) found martens to have moderate vagility in comparison to fellow old-growth associates with both high (northern goshawk) and low (northern flying squirrel) vagility. At the local (or home range) scale, Potvin et al. (2000) recommended keeping fragmentation below 30% over a 30-year period. Research in northeastern Utah developed recommendations that timber harvests (new harvest in combination with natural openings) remain less than 25% of landscapes ≥9 km², and if possible cutting outwards from a single patch vs. the same area, but in well distributed smaller patches, in order to maximize contiguous mature forest (Hargis et al. 1999). Payer and

Harrison (1999) recommended timber harvests less than 20% of landscapes from research conducted in Maine. Proulx (2001) conducted research on the use of connectivity corridors in British Columbia, within a highly fragmented landscape, finding that it appears marten can persist, but population viability is uncertain pending further study. Research points towards a variety of factors, including forest cover, slope, elevation, and land development that affect regional gene flow (Aylward et al. 2020), an important consideration for future persistence of a population.

Importance of Snow

As noted previously within the habitat needs of American marten, snow cover during winter can act as an important aspect in providing thermal protection and offer a competitive edge to marten over other meso-carnivores (Raine 1981, Krohn et al. 2005) such as fisher, bobcat, and coyotes, by giving them access to winter food resources within the subnivean space (Buskirk and Powell 1994). The reported minimum snow depth for subnivean establishment varies from 10 cm (Thompson et al. 2018) to 20 cm (Pruitt 2005) and will provide suitable stabilized temperatures. Snow depth can vary based on forest structure, particularly canopy cover (Varhola et al. 2010) as well as a variety of landscape characteristics such as latitude and topography (Thompson et al. 2018). Much subnivean research has also focused on the importance of additional abiotic conditions such as snowpack, which constitutes density, persistence, surface hardness, compaction (Pauli et al. 2022, Berteaux et al. 2017), elevation, and temperature (Jensen and Humphries 2019). This combination of factors determines a marten's ability to access the subnivean, the length of time it is available, and the fisher's ability to compete over the winter season (see *Interspecific Competition* section).

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Habitat in Pennsylvania

Historic Forest Composition

The pre-European settlement northern forests of Pennsylvania consisted of large diameter, old growth conifers, primarily white pine (*Pinus strobus)* and Eastern hemlock (*Tsuga canadensis*), as well as a mix of hardwoods such as black cherry (*Prunus serotina*), various oaks (*Quercus spp.*), hickories (*Carya spp.*), white ash (*Fraxinus americana*), American beech (*Fagus grandifolia*) and American chestnut (*Castanea dentata*) (Hough and Forbes 1943, Nowacki and Abrams 1994). Disturbance at this time occurred from a variety of natural sources including windfall, insect outbreaks, ice glazing, as well as both natural and anthropogenic fire (Black and Abrams 2005). It's estimated that prior to settlement, forest land in Pennsylvania equaled 28.6 million acres (Albright et al. 2017). Following the intense logging of the 19th century, forest composition changed throughout the state. By the turn of the 20th century, it was

estimated that just over 9 million acres (32%) remained (Rothrock 1894). This change was dictated through the species value at the time of cutting, seed tree removal, intensive fires within standing slash, and increased herbivory of new growth from species lacking natural predators such as white-tailed deer (*Odocoileus virginianus*) (Tilghman 1989) and porcupine (*Erethizon dorsatum*) (Hough and Forbes 1943). Previous white pine dominated stands saw an increase in white oak, red maple (*Acer rubrum*) and chestnut during second and third growth. Hardwood-hemlock stands saw an increase in beech, maple (*Acer spp.*) and birch (*Betula spp.*) species (Hough and Forbes 1943) during their second and third growth. Since that time, species such as beech, ash, and hemlock continue to face threats from Beech Bark Disease (*Neonectria spp.*; Held and Jones-Held 2014), Beech Leaf Disease (*Litylenchus crenatae mccannii*), Emerald Ash Borer (*Agrilus planipennis*), and Hemlock Wooly Adelgid (*Adelges tsugae*; Cessna and Nielsen 2012) respectively. Other forest pests have wrought havoc on the forest in past years including the spongy moth (*Lymantria dispar*), where during the years 2006-2008, over 2 million acres of forest land were defoliated from infestation (Albright et al. 2017).

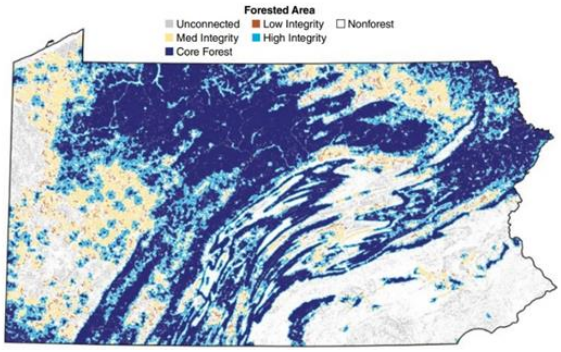


Figure 3. Core forest area within Pennsylvania. Albright et al. 2017.

Current Forest Composition

Pennsylvania currently contains approximately 16.7 million acres of forested land (U.S. Department of Agriculture [USDA] 2019), which makes up approximately 58% of the total land area. Development and agriculture continue to be the two primary reasons for loss of forested area, although more forest was gained than lost between 2009 and 2014 (Albright et al. 2017). Albright et al. (2017) also reported that currently 56% of forest land is considered 'core' forest (minimum patch size of 1,544 ac.) while 24% has 'high integrity' when it comes to determining fragmentation (Fig. 3). Public (30%) vs. private (70%) ownership (Fig. 4) is important to consider for the state's forest lands and how they are managed. Of the 30% of publicly owned forest land, 27% is owned by state and local governments (USDA 2019).

The most recent Forest Inventory Assessment (FIA) data showed Pennsylvania as having a very diverse forest, with 101 tree species and 16 forest-type groups. The most common FIA 'groups' across the northern tier regions were oak/hickory, maple/beech/birch, followed by white

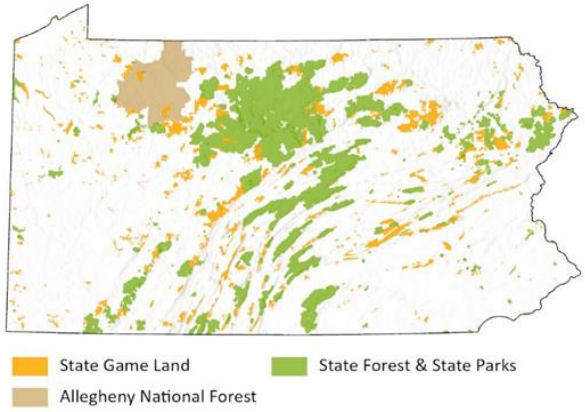


Figure 4. Public land ownership in Pennsylvania. E. Clees 2022.

pine/red pine/hemlock. Large diameter classes are dominated by oak, red maple, black cherry, sugar maple (*Acer saccharum*) and hemlock. Albright et al. (2017) found that both stand age by percent and area are currently highest within the late successional stages with 29% within the 61–80-year class and 28% within the 81-100-year class. Also, 67% of forestlands are considered as having large diameter stands (hardwoods ≥ 11" dbh and softwoods ≥ 9" dbh) with the majority moderate to fully stocked (35-100%). Average annual mortality rate for Pennsylvania trees was 0.9% during this study, with lowest rates in the northcentral region. Health risks for today's forests include disease, insects, invasive plant competition, herbivory, and fragmentation. Impacts from these stressors have contributed towards the shift in composition and lower regeneration of the forest. Fortunately, managers on public lands have developed plans to address many of these issues through critical partnerships (Johnson et al. 2014, 2016), whether that's managing disease and forest pests through pesticide application, reducing fuel load and increasing regeneration for fire dependent species through prescribed fire (Pennsylvania Department of Conservation and Natural Resources [DCNR] 2020) or reducing herbivory through increased deer harvest (Rosenberry et al. 2009).

Snowfall in Pennsylvania

Average annual snowfall in Pennsylvania varies widely throughout the state ranging from below 50.8 cm in the southeast to over 264 cm in the northwest (Fig. 5; National Oceanic and Atmospheric Administration [NOAA] 2022). Snowfall in the state is largely dependent on latitude, elevation, and lake effect snow from Lake Erie. Latitudinally, the Commonwealth sits between 42.269°N at its northernmost point (Erie County) and 39.721°N at its most southern (Greene County). Elevations within the state range from a low at sea level within the Delaware River in the southeast to a high of 979.3 above MSL at Mt. Davis, in Somerset County in the southwest. Within much of the large, contiguous forested areas of the state found in the northern tier, elevation ranges from 426 above MSL to over 670 above MSL. Much of the potential habitat for marten in the state lies within several different physiographic provinces, including the High Plateau, Deep Valleys, Pittsburgh Low Plateau, and Glaciated High Plateau sections (DCNR 2018). Average annual snowfall across these sections varies from 91 cm to over 243 cm (NOAA 2022). Variables that account for snowpack within the state are challenging to determine and national research conducted on this metric has a large resolution in comparison to the scale of the Pennsylvania specific habitat model (see *Habitat Modeling* section).

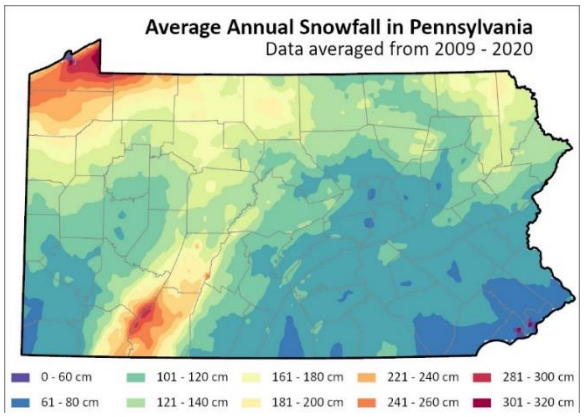


Figure 5. Average annual snowfall in Pennsylvania. E. Clees 2022.

Predictive Climate and Forest Composition Models

An important part of any assessment of this magnitude is understanding how things may change in light of past and current trends. Predicting the future is a challenging, if not impossible, proposition, but managers can take what information is available and draw conclusions on differing potential outcomes. One way this is commonly achieved is through theoretical statistical modeling. To quote the late George E. P. Box, an honored statistician, "All models are wrong, but some are useful." The last decade has seen a large volume of models predicting changes in climate as well as how this may affect characteristics of the landscape including forest composition. Several papers speak specifically to marten within their ranges throughout the country predicting both range expansion (Baltensperger et al. 2017) as well as contraction (Wasserman et al. 2012).

On a region scale (central-eastern North America), Notaro et al. (2014) predicted a decline in snowfall, delayed onset of snow season, reduced persistence of snowpack, and less common but more intense snow events within the next century. Research focusing on the northern Appalachian Mountain range, specifically in regard to marten and lynx impact, predicted a 40% decline in marten populations by 2055 (Carroll 2007). In contrast to a declining snowfall model, albeit on a specific regional scale, Burnett et al. (2003) predicted increasing lake-effect snowfall on the leeward side of the Great Lakes, which would include the northwestern portion of Pennsylvania. Specific to the mid-Atlantic region, Butler-Leopold et al. (2018) predicted increasing temperature and precipitation as well as more extreme temperature shoulders on the year. This could potentially lead to an increase in intensive wildfire, tree mortality, forest pests and invasive species. An overall loss of forest land (10%) is predicted within the state within the next 50 years (Albright et al. 2017). Forest composition within the Commonwealth is predicted to shift with declines for species such as black cherry, maples, American beech and eastern hemlock, while oak species, hickory and black gum will expand their range (Union of Concerned Scientists [UCS] 2008, Albright et al. 2017, Butler-Leopold et al. 2018). For martens in New England, as well as other locations within their southern range, potential for a warming climate to increase interspecific competition (Jensen and Humphries 2019, Pauli et al. 2022) as well as reduce gene flow among populations has also been predicted (Aylward et al. 2020).

Certainly, according to predictions, the outlook of forests and climate within Pennsylvania, and the greater mid-Atlantic region, will change, providing both positive and negative impacts to our current suite of species. This is crucial to keep in mind when managing forests for the future. It is also important to note that most of the research cited within this section provides caveats that read "…scenarios should be interpreted cautiously" (Carroll 2007) or "These studies suggest inaccurate modeling in areas with complex topography and rapid elevation change" (Butler-Leopold et al. 2018). Albright et al. (2017) said it best in that "…predictions are future possibilities, not future truths." This is not included to be dismissive, but only to highlight several important factors. A change in forest composition does not equal a negative scenario for marten habitat and the northern tier of Pennsylvania has both complex topography and rapid elevation change.

Habitat Modeling

The International Union for Conservation of Nature (IUCN) guidelines for reintroduction (IUCN/SSC 2013) stress the importance of ensuring that the cause of previous extinction has since been identified and rectified. In the case of the marten, ensuring that habitat exists within the Commonwealth is perhaps the most important aspect of determining feasibility. Understanding that habitat loss was the primary cause of extirpation for this species, it's imperative that managers properly assess current habitat conditions, including quantity, quality, and connectivity. Much of Pennsylvania's forest has regrown, and age classes within many public lands are well within the late-succession stage (61-100 years), soon approaching old growth (Albright et al. 2017). Note that age class may not always represent suitable marten habitat in complexity which is highly dependent on past management practices. It's also critical to mention that climatic conditions and how they affected composition may have been different prior to extirpation. Modeling habitat across large landscapes provides many challenges, but with advances in remote sensing technology such as airborne Light Detection and Ranging (LiDAR; Vierling et al. 2008), satellite imagery, and other detailed imaging software, there has not been a better time to combine the available resources and use this tool for determining habitat suitability.

Several non-spatial (not using Geographic Information Systems) habitat models have been developed for marten (Allen 1984, Bowman and Robitaille 2005, Fecske et al. 2002). Multiple spatially driven models have also been developed (Schulz and Joyce 1992, Kirk and Zielinski 2009, Rustigian-Romsos and Spencer 2010) with some models specific to reintroduction feasibility (Kolbe et al. 2020). Joyce (2018) proved that high pulse LiDAR can measure fine scale habitat structure, such as coarse woody debris, and brought to light the potential of this technology for use in modeling for structural complexity. Modern spatial models are generally built on existing data from that state or province and therefore have limited use for Pennsylvania.

Of all the habitat suitability models referenced within the large majority of marten habitat related literature, Arthur Allen's Habitat Suitability Index (HSI) Model developed in 1984 has been tested across multiple study areas and appears to describe marten habitat well. This model is effective because it can be used across a wide variety of locations throughout the marten's range. It has proved it is still applicable today, even competing with more modern models (Bowman and Robitaille 2005). Its limitation is the requirement of coarse woody debris, and this is a difficult category to measure. We decided to utilize the basic structure of this model to develop an HSI model that could use available spatial information to drive a geospatial model.

We originally selected 5 categories for analysis to include Land Cover, Snow Cover, Percent Canopy Cover, Stand Age, and Coarse Woody Debris. Land Cover data was used to look at forest type (coniferous, deciduous, mixed, etc.) and drew from the National Land Cover Database (U.S. Geological Survey [USGS] 2019). Snow cover data came from the National Weather Service (NOAA 2021) and was given specific values for annual snowfall attributes averaged over the past 30 years which is critical to understand snow condition over time and in the present period. Percent Canopy Cover data came from the LANDFIRE database (U.S. Department of

Agriculture and U.S. Fish and Wildlife Service [USDA/USFWS] 2022) and was assigned 5 categorical values. Tree Height data also came from LANDFIRE and was used as a surrogate for stand age (Bowman and Robitaille 2005, Maltamo et al. 2020, Xu et al. 2018, Racine et al. 2014) due to the extensive scale of the model. It also had 5 attributes of values. It should be noted that tree height is not always an indicator of stand age, particularly within mixed stands. This can also hold true for high elevation, xeric ridgetop sites with poor soil quality (Smith et al. 1997). We did attempt to incorporate Coarse Woody Debris, but unfortunately, we were not able to do so on the multi-state scale this model was developed for. Although LiDAR data exists for the study area, there are concerns about the pulse rate accurately depicting ground cover (M. J. Joyce, University of Minnesota, pers. comm.), lack of GIS methods for this process, and lack of time and resources to complete the necessary processes to compute this layer (Joyce et al. 2019).

Attributes within each of the 4 categories' raster datasets (Fig. 6) were reclassified with the original cell value changed to the corresponding HSI value with a range from 0 to 100. The reclassified raster datasets were added together to determine the final suitability value with a value of 400 being the highest suitability. Any cell with a HSI value of 0 was excluded. Focal statistics (ESRI 2022), a method of averaging surrounding cells, was then used on the final suitability raster to determine the mean suitability within the average home range of a marten (8.37 km²; derived from historical averages from 5 projects in MI, MN, NY and WI). A moving window with a radius of 1,631 m within the averaging process using the neighborhood circle method.

This process determined specific areas that might be of high value. Public lands were also overlaid across the map to determine where optimal habitat coincided. We based our study area on nearest known populations of martens with Maine, Michigan, New Hampshire, New York, and Vermont included with Pennsylvania in order to test the model against existing populations (Fig. 7).

Finally, this model was tested and ground-truthed using known locations of

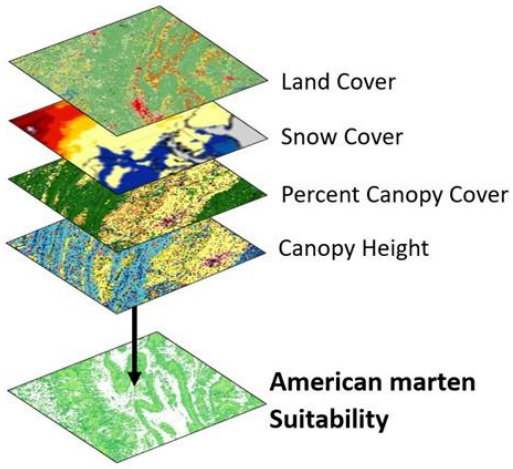


Figure 6. Categories used to develop an American marten habitat suitability model. E. Clees 2022.

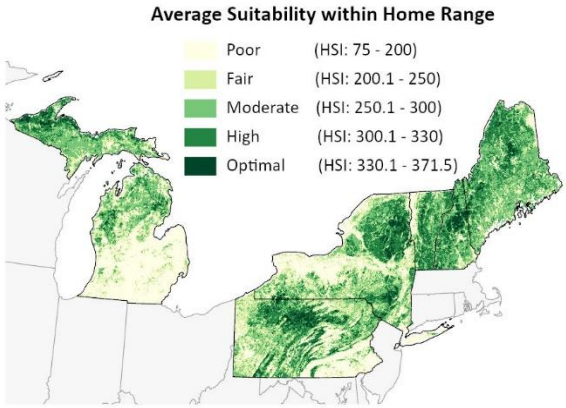


Figure 7. American marten habitat suitability across study area. E. Clees 2022.

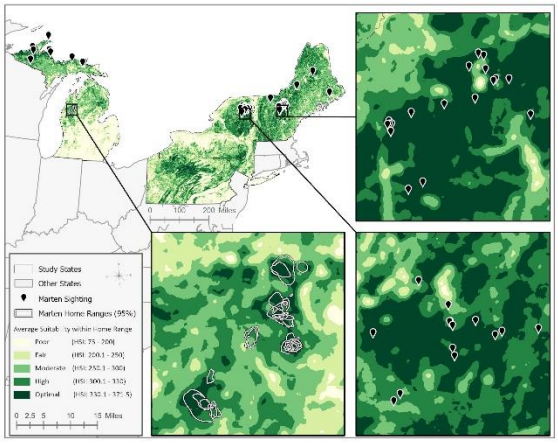


Figure 8. Locations of known marten and habitat suitability used to test model. E. Clees 2022.

marten within the study area utilizing two methods (Fig. 8). 'Research' grade American marten observations through iNaturalist (iNaturalist contributors 2022) were exported and overlapped with the focal statistic HSI layer (figure 9). The iNaturalist points were given the HSI value for the corresponding raster cell at each point. Values were then averaged across samples to determine overall average of HSI across the study area. The other method to determine suitability thresholds was using home range data from known populations within the northern Lower Peninsula of Michigan (A. M. Kujawa, LRBOI, unpublished data). Twenty-six home ranges, estimated at 95% fixed kernel density, were analyzed by averaging each 30 m² HSI cell within the home ranges prior to running the focal statistic. This result yielded an average HSI within each of the polygon home ranges. The HSI values for each home range were averaged to determine the average HSI value within this study area. Home range HSI values were then averaged to find an overall average HSI value for the project area. Values for both HSI estimation methods were averaged to obtain overall thresholds for ranking suitability (Clees 2022).

Results show that Pennsylvania does indeed have comparable habitat for the American marten to other states with extant marten populations (Fig. 9), with the large majority of suitable habitat occurring within the northern tier which was considered their historical range. Most optimal habitat falls within public land boundaries (Fig. 10), which are a combination of National Forest, State Forest, and State Game Lands. Not only is there high-quality habitat in large measure, but there is also good connectivity within this area. Our model identified habitat within other parts of the state such as the Laurel Highlands and Ridge and Valley sections, however, fragmentation by non-forest land uses is a concern with many of these areas.

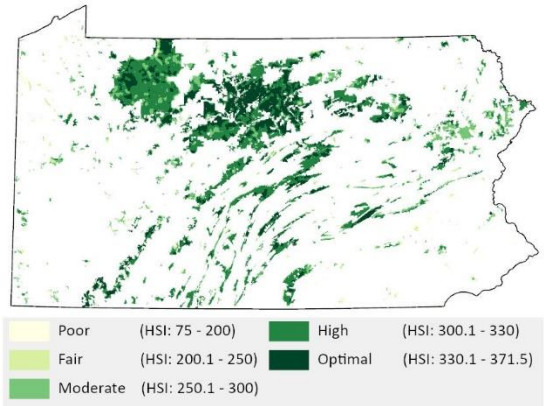


Figure 10. Suitable American marten habitat within Pennsylvania public lands. E. Clees 2022.

Revisiting the MVP suggested by Slough (1994) based on research from Strickland et al. (1982) of requiring a contiguous area of 42-125 km² to support a stable population consisting of 50 individuals, Pennsylvania meets those requirements. After analysis, 4,427.3 km² of the 6,306 km² of Optimal habitat and 24,719 km² of the 27,780 km² of Optimal and High combined is considered contiguous when analyzed at the threshold of 42 km² and above. Taking these values, dividing by 42

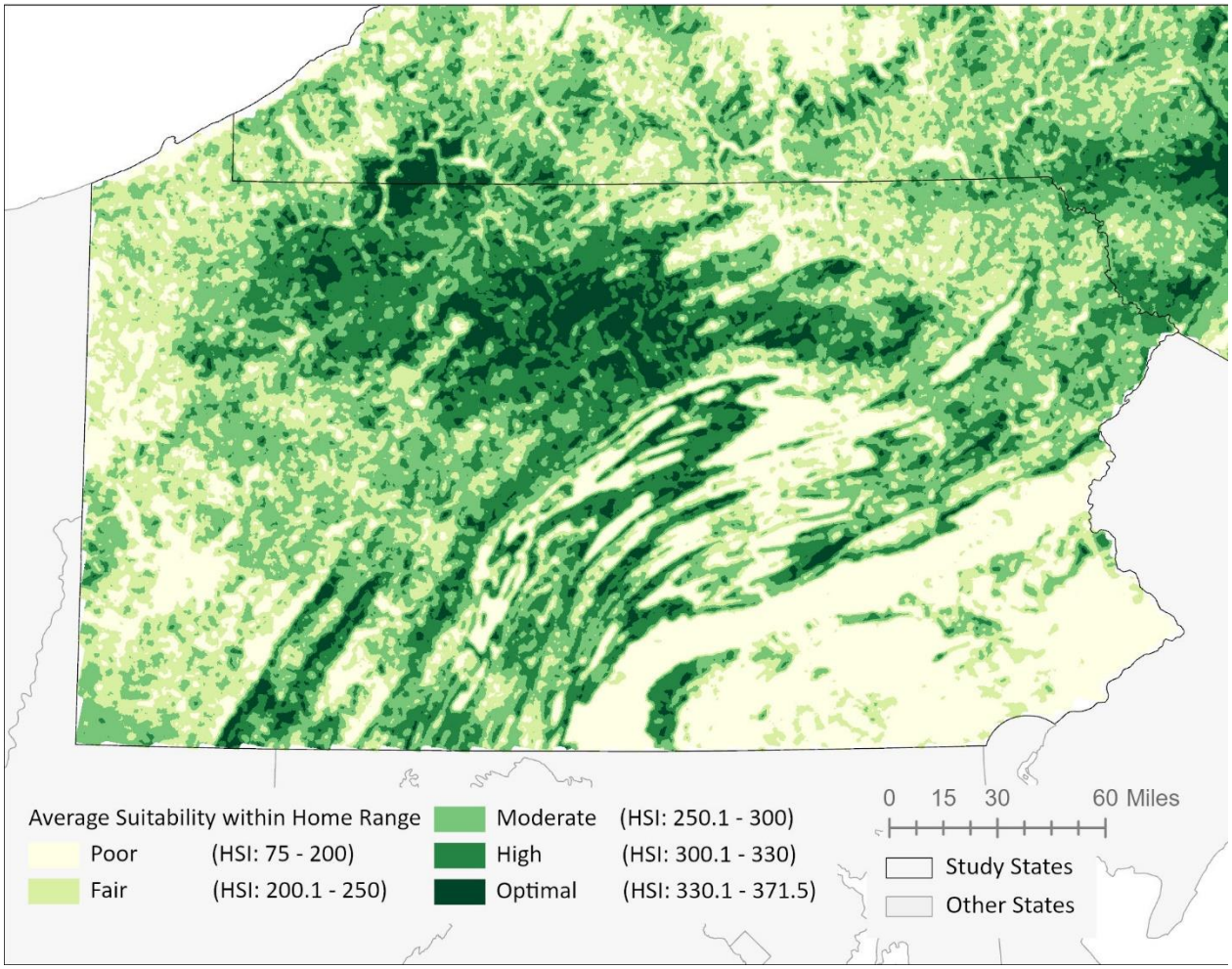


Figure 9. American marten habitat suitability results for Pennsylvania. E. Clees 2022.

and multiplying by 50 (stable population) gives us a rough estimate of how many martens Pennsylvania could potentially support based on habitat suitability modeling results.

There are potential limitations to this model, being that equal weighting of all categories has the potential to over-estimate suitable habitat. Structural complexity, which is critical to marten, is extremely difficult to determine without having appropriate data on coarse woody debris. Finally, this model does not account for climatic conditions or resulting abiotic-productivity-intraguild interactions or relationships that ultimately dictate the presence and persistence of marten populations. These interactions will be addressed further on within this document.

Field Assessment

In 2021, the Pennsylvania Marten Reintroduction Assessment Working Group decided to invite American marten specialists to Pennsylvania from across the northeast and Upper Mid-west to tour and provide feedback concerning Pennsylvania's current state of habitat suitability for marten. Unfortunately, due to the COVID pandemic, restricted travel, and a relatively short timeline, only 4 biologists representing Michigan and Minnesota were able to attend, but their combined experience paired with a strong knowledge base of marten life history

and habitat needs proved invaluable during their time in the Commonwealth. This field assessment occurred over three days (1-3 November 2021), with the intention of focusing on Pennsylvania's northern tier (i.e., High Allegheny Plateau ecoregion), and the variety of forested habitat types it exhibits. The tour started within the Allegheny National Forest (ANF) Marienville Ranger Station, where we met with representatives from the U. S. Forest Service, Pennsylvania Game Commission (PGC) Northwest region biologists, and members of the Working Group who represent the Pennsylvania Department of Conservation and Natural Resources (DCNR) as well as two bureaus within PGC (Wildlife Habitat Management and Wildlife Management).

From ANF, the tour continued eastward along Route 6, traversing what is largely privately held forest before passing through Susquehannock State Forest and arriving at State Game Lands (SGL) 208. Here, the team met with a PGC land manager, wildlife management supervisor, geospatial specialist, and forester, as well as a DCNR forester from the local district. Stops included a timber management area on SGL 208 and a late succession drainage area on Tioga State Forest. After spending the night in Williamsport, the team toured the Loyalsock State Forest, meeting with DCNR district managers and foresters, and then traveled through Ricketts Glen State Park and State Game Lands 13 before arriving at State Game Lands 57 (Fig. 11), where the team met with PGC land managers, biologists, game wardens, and senior staff. All told, this tour covered 20 counties traveling close to 600 miles through a large portion of Pennsylvania's northern forested areas. This also allowed for a diversity of partner agency personnel to ask questions, raise concerns, and hear directly from experts in the field of marten ecology and marten reintroduction.

Figure 11. The habitat assessment team pauses for a photograph at State Game Lands 57. T. Graziano 2021.

Overall impressions from species experts were extremely positive. The primary takeaway messages were (M. J. Joyce, University of Minnesota, pers. comm.):

- There appears to be an abundance of adequate ground complexity which is critical resting and foraging habitat as well as access to the subnivean layer over winter.
- There appeared to be an abundance of adequate cavities suitable to martens for both resting and denning sites.
- There is adequate high canopy cover, appropriate for marten habitat.
- Both conifer and mixed stands were of high quality for marten at all elevations with hemlock and white pine, the predominant conifer species.
- The forested landscape has high overall connectivity for marten with minimal fragmentation from rural development, harvest, roads, and energy development.
- Based on habitat complexity and historic local research, prey abundance and diversity should be adequate for marten.

Reviewers also provided several recommendations. Concerning the habitat model, accounting for annual snowfall and persistence would be key to assessing the subnivean potential, as well as analyzing the habitat quality at the home range scale. Primary concern focused on intraguild and interspecific competition, mainly between marten, fisher, and bobcat. They suggested that snow depth might be an important factor in reducing potential conflict, but also noted that fisher and marten co-occur throughout their range in Minnesota and Michigan's Upper Peninsula. Other concerns centered on future climate unknowns and how that may affect forest composition and structure. None were overly concerned with potential negative impacts to possible prey species of conservation citing their generalist diet. All told, these experts were very pleased with habitat quantity, quality, and connectivity and on several occasions remarked that specific locations possessed higher quality habitat than some occupied ranges within their own states.

Kahlan Fuhrer, Grade 12, Bangor, PA

Public Opinion

Successful wildlife management relies primarily on sound scientific methods and data, but also considers social aspects. As the state agency responsible for the management of 480 species of wild birds and mammals in Pennsylvania, held in trust for the citizens of this state (COP 1971), the PGC must gauge interest or support for such a project.

Pennsylvania State University Survey

The Center for Survey Research (CSR) at Penn State, an unbiased third party, administered two statewide surveys, one completed in 2022 and then replicated a year later in 2023 (Fig. 12). The survey instrument used was a Qualtrics™ online survey. The CSR contracted Marketing Systems Group to survey respondents from across Pennsylvania. The survey was designed to eliminate bias towards location, age, or gender. Respondents were adults who chose to participate as part of a panel. Two questions concerning American marten reintroduction were included within a larger survey. (See Appx. 2)

2022 Results – In 2022, 72,707 Pennsylvania residents were invited to participate, with a total of 1,047 respondents, representing 63 of the 67 counties. Participation rate was 1.8% and survey margin of error was +/-3.0%. **Support of marten reintroduction averaged 92% across categories; opposed averaged 8%**. These did not vary significantly across or within categories (i.e., gender, age, identity as a hunter) (Appendix 2).

2023 Results – In 2023, 60,760 Pennsylvania residents were invited to participate, with a

total of 1,045 respondents, representing 61 of the 67 counties. Participation rate was 2.5% and survey margin of error was +/-3.0%/ O**verall support of marten reintroduction averaged 91% across categories and opposed averaged 9%**. These results did not vary significantly across or within categories (Appendix 2).

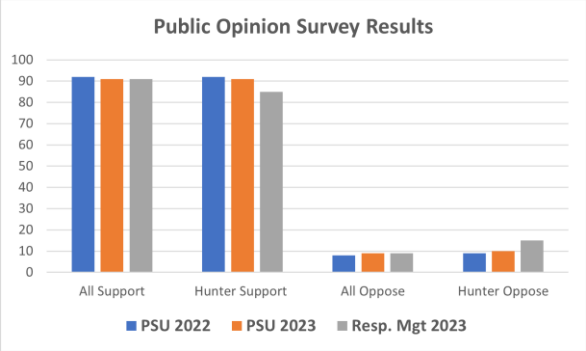


Figure 12. Public opinion survey results from 2022 and 2023.

Responsive Management

A survey was conducted in the spring of 2023 by Responsive Management, an unbiased third party, and was a telephone survey to randomly selected Pennsylvania residents. A sample goal of 150 residents from each of the 22 state Wildlife Management Units (WMUs) was completed totaling 3,300 resident respondents statewide. Although this survey asked questions relating to a wide and diverse set of issues and species, several questions were dedicated to marten reintroduction within one of the 'splits'. In total, 850 respondents provided their opinion on martens, representing 66 of 67 counties. Results had a confidence interval of 95% with a margin of +/- 4%. The first question focused on feelings towards reintroducing extirpated species to Pennsylvania that were once native. The second question asked whether residents were familiar with the American marten (formerly pine marten). This question was followed with basic information concerning the marten, its former status in Pennsylvania, its diet and habitat, as well as when and why it disappeared from the state. Additional information was available if prompted including its size, its current range, and additional information on diet and habitat. The third question relating to marten asked residents about whether they support or oppose reintroduction of the American marten to Pennsylvania. If they answered 'opposed,', a follow up question asking why they were opposed was asked. These answers were then categorized by the interviewer.

Results found that of those surveyed, 73% supported extirpated species restoration while 11% opposed (16% were 'neither' or 'didn't know'). It found that 38% of residents were familiar with the American marten while 61% were not (2% 'didn't know'). Of all Pennsylvania residents surveyed, 80% supported while 8% opposed (11% 'neither' or 'don't know') and of all hunters surveyed, 76% supported while 13% opposed. When censoring 'neither' and 'don't know' in order to make a direct comparison with the Penn State surveys, **91% of all Pennsylvania respondents with an opinion supported marten reintroduction while 9% opposed. Doing the same for hunters, 85% supported and 15% opposed** (Fig 12)**.** Of those opposed, the most common reasons were wildlife predation concerns (31%), turkey predation concerns (14%), and livestock predation concerns (14%).

Addressing Concerns for Reintroduction

Reintroduction of a missing piece to the ecosystem can potentially create changes that are difficult to anticipate, so ensuring these changes are considered is important when making management decisions on this scale. Concerns within Pennsylvania likely center around how marten could negatively impact a variety of both game and non-game species, how other predators might negatively impact reintroduced marten and their survival, and how an unknown change in climate could affect marten long-term survival within the state. Several other concerns have been identified throughout the review process as well including incidental harvest, long-term genetic viability, and the potential for future litigation.

Impacts to Other Species

With any predator species reintroduction, there is much trepidation from both wildlife managers as well as the public with concern to how this might impact their species or community of interest (Serfass et al. 2003). Some modeling work has been done for large, keystone predators such as wolves (Baker et al. 2016) to predict changes, but little for species such as the marten. Concerns considering direct mortality to other species should first be addressed through prior diet studies to determine if any one species, or group of species is at risk. A total of 664 (SGCN) have been identified within the *2015-2025 Pennsylvania Wildlife Action Plan* (PGC-PFBC 2015), with 68% invertebrates, 14% birds, 10% fish, 3% reptiles, 3% mammals, and 2% amphibians.

Of these species that share a similar habitat and space use type, a variety of birds, several mammals, and a select few reptiles and amphibians have the potential to be impacted by marten reintroduction. Understanding how marten could impact invertebrates is difficult to measure, particularly with the lack of research, but we do know that insects can make up a significant portion of their diet (17.8% FO) depending on time of year. Avian and mammalian species identified as potential species of impact (PSOI) from this list are the northern goshawk, blackpoll warbler (*Dendoica striata*), yellow-bellied flycatcher (*Empidonax flaviventris*), ruffed grouse, northern flying squirrel (*Glaucomys sabrinus macrotis*), Allegheny woodrat (*Neotoma magister*), Appalachian cottontail (*Sylvilagus obscurus*), and several shrew species (*Sorex spp.*). Additional species that are not included within the Action Plan that have been identified as PSOI are snowshoe hare, and wild turkey (*Maleagris gallipavo*). There may be other species that a variety of groups and individuals might also consider as PSOI.

The Western Pennsylvania Conservancy was contracted to provide a spatial analysis of SGCN, identifying occurrence locations (Western Pennsylvania Conservancy [WPC] 2022). The six species that were targeted were goshawk, grouse, woodrat, northern flying squirrel, Appalachian cottontail, and rock vole (*Microtus chrotorrhinus*). Within the designated study area, based on available habitat, they detected 3,441 occurrence features throughout. These data were derived from the Conservation Opportunity Area Tool (PGC-PFBC 2019) and included occurrences from a variety of sources from 1983 – 2021. These data can provide important information on both individual locations of PSOI as well as high-density areas. The report recommended further evaluation of highly sensitive occurrence areas as well as long-term monitoring of these in the case of a reintroduction effort

(WPC 2022).

It is important to again stress the fact that martens are highly adaptive dietary generalists (Zhou et al. 2011). No research has pointed towards selectivity, only an opportunistic approach to hunting and feeding within a relatively large home range (see *Diet* section above). Martens don't control prey species excepting potentially rodents (Anderson and Erlinge 1977), but rather in some cases are controlled by fluctuations in prey species (Thompson and Colgan 1987, Fryxell 1999). This large diversity of prey has been well documented through an extensive sample of diet research from across their range in North America (Fig. 13). When diet composition is broken into 7 basic categories, it's easy to identify not only how diverse their diet is, but what prey group makes up the large majority of their diet. Small mammals (68.2% FO) are by far and away the highest, while the 'other' (23.3% FO) category, which includes insects, cervid carrion, fish, amphibians, reptiles and a species of western woodrat is second, plants (21.7% FO) are third, birds (12.3% FO) are fourth, squirrels (11.5% FO) fifth, lagomorphs (9.3% FO) sixth, and mustelids (2.7% FO) are seventh. Of course, without having Pennsylvania specific data we can only speculate that this would remain true here. We can, however, examine the fisher in Pennsylvania, and find a similar diversity of prey items. Diet research from McNeil et al. (2017) found only one of the previously listed PSOI, that being the Allegheny woodrat (cottontail spp. are not separated between Appalachian and eastern), within fisher stomach contents. We can assume that a smaller mustelid species that shares a significant portion of diet range with fisher would have a similar range of diet.

Species such as ruffed grouse and snowshoe hare are currently experiencing declines within Pennsylvania due to disease (Stauffer et al. 2018, Nemeth 2021) and habitat loss (Diefenbach et al. 2016, Dessecker and McAuley 2001). Wild turkey populations within the state are generally stable to increasing excepting 3 WMUs, however, turkey have not been identified within diet research for marten. The Allegheny woodrat also struggles with habitat loss (Balcom and Yahner 1996) and disease threats (LoGiudice 2000), while many other avian species considered SGCN face continued habitat loss as well as pesticide concerns (Rosenberg et al. 2019).

With very few records of breeding northern goshawk within the state, there has been some concern voiced of a threat from marten reintroduction. Goshawk are considered one of the primary avian predators for the marten (Bull and Heater 2001, Squires 2000: see *Mortality* section). One specific instance of a marten predating a goshawk could be found in the literature (Paragi and Wholecheese 1994). Personal communications with a researcher conducting telemetry work with marten in Michigan found a telemetry collar from a marten underneath the predated nest of a goshawk (R. Sanders, MI DNR, pers. comm.). Much could be assumed from this instance such as marten predation of a nest and goshawk predation of a marten. In an evaluation on the decline of goshawks, Reynolds et al. (2006) noted that marten are potential predators for the species, however, predation is unlikely a major contributing factor to population dynamics, instead pointing towards forest structure and food availability.

Based on extensive prior diet research

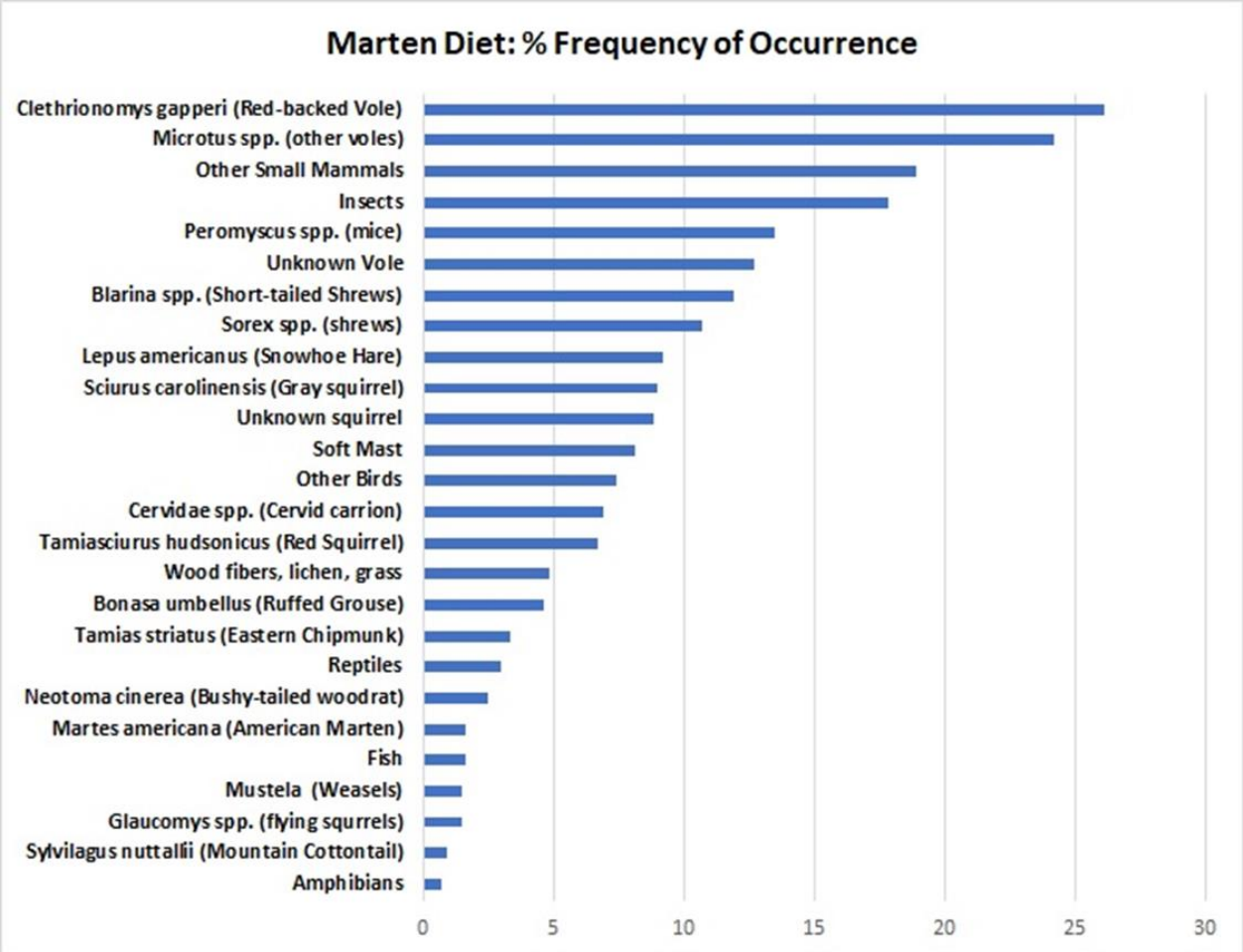


Figure 13. An average of 13 American marten diet studies throughout the marten range by % frequency of occurrence and species. See Appendix 1 for additional details.

(Fig. 13), marten predation on these 'rare' species having low abundance should be minimal and have little to no impact on overall species populations. It is recommended, however, that pre- and post-release monitoring of PSOI species within release areas be conducted to measure any significant impact that may occur. It's important to note there are many examples of locations where PSOI species ranges overlap with marten and populations of both are healthy and abundant. A project such as this has the potential to benefit this suite of species that share similar habitat through an influx of resources towards improving a structurally diverse habitat on the landscape, increased education, and monitoring of a community based on a single umbrella or flagship species such as the marten (Roberge and Angelstam 2004). Forest heterogeneity (described in *Interspecific Competition*) having structural complexity benefit many of the PSOI species identified, and efforts such as Dynamic Forest Restoration Blocks (Maryland Department of Natural Resources [MDNR] 2022, Ruffed Grouse Society [RGS] 2022) being promoted by the Dynamic Forest Partnership and the Ruffed Grouse Society fit well into the habitat needs of marten by providing these important characteristics. As managers from state, federal, tribal, and local government

organizations as well as NGO's dedicated to species conservation through habitat management face continued challenges whether that be limited resources, disease risks, or invasive species, its critical to partner with each other to advance species diversity and needed habitat for these large suites of species. Collaboration rather than isolation and competition is so much more effective and impactful for the resource. This project offers that opportunity by working together for the forest community.

Climate Impacts

The impact of climate and its potential for change over time is an important consideration for how a species reintroduction may succeed in future years. Review of literature concerning climate impacts, specifically for marten, provided mixed results on whether they would be positive or negative with predictions for snowfall changes variable within the state; while the future of forest composition within Pennsylvania could see both loses and gains of important species for marten habitat (see *Predictive Climate and Forest Composition Models* section). Many of the large-scale, Northeast region predictions, unfortunately, spell challenge for most current communities, including marten within their southern ranges (Pauli et al. 2022, Lawler et al. 2012).

Fortunately, it appears that the historic range of marten within Pennsylvania (and the current area of existing habitat), the northern tier, possesses some attributes that may allow this area to persist as landscapes with suitable conditions for marten even with predictions of changing snowfall and forest composition. With increased variation in topography at higher elevations (Jensen and Humphries 2019), what is considered 'mountainous refugia' (Carroll 2007), and the potential for increased snowfall within northwestern Pennsylvania from lake effect (Burnett et al. 2003) downwind of the Great Lakes as referenced, some biotic and abiotic conditions may help insulate negative impacts to marten within the Commonwealth. There is also some evidence that both passive (reduced fragmentation and overstory removal: Steventon and Daust 2009) and active habitat management strategies (anthropogenic refugia development: Morelli et al. 2012, Zielinski et al. 2017) can be employed. The Resilient Land Mapping Tool from The Nature Conservancy shows strong resilience (climatic diversity that increases persistence and retention of biodiversity), flow (ability for populations to move in response to changing climate) and biodiversity value overlapping current habitat for martens in Pennsylvania (Anderson et al. 2016, Fig. 14).

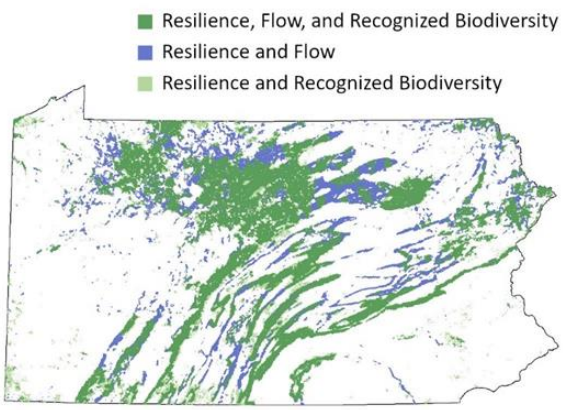


Figure 14. Resilience, flow and recognized biodiversity of Pennsylvania. E. Clees (data from Anderson et al. 2016).

Research from California focusing on niche overlap between marten (*M. americana* and *M. caurina*) and fisher found that martens were expanding their range into lower elevations with warmer temperatures and reduced snowpack (Zielinski et al. 2017),

potentially highlighting adaptability to a warmer climate. Although there is much unknown behind how climate might change, the severity of change, and its impact on the landscape, managers should embrace adaptive management strategies that promote continued habitat diversity, structural complexity, and connectivity.

Interspecific Competition

The relationship between marten and other predator species that share both diet and space, in particular the fisher, is one of the most widely researched aspects of marten biology besides habitat (Pauli et al. 2022, Jensen and Humphries 2017, Zielinski et al. 2017, Manlick et al. 2017, Fisher et al. 2013, McCann 2011). Regardless of the variety of research, this exact relationship continues to prove somewhat elusive (see *Interspecific Competition* section). It is, however, a major concern for a reintroduction project within Pennsylvania as competitor species such as fisher, bobcat and coyote continue to show stable to increasing populations over the long-term (Keller 2022b). There are several factors identified within literature that appear to allow for sympatry and minimize interspecific competition.

Size of various food items can allow for sympatry through diet partitioning, with larger competitors preferring larger prey, especially during winter, such as deer carrion (Raine 1981, Jensen and Humphries 2019 Pauli et al. 2022). Each year, approximately 30% of white-tailed deer mortalities do not involve deer hunting (Rosenberry et al. 2009). The 300,000 to 400,000 white-tailed deer taken by deer hunters each year (PGC 2022) represent the remaining 70% of mortalities. As a result, tens of thousands of potential deer carcasses are available to predators/scavengers throughout Pennsylvania each year. Prey abundance and diversity is high within the state (WPC 2022), providing opportunity for diet partitioning throughout the year and lessening competition for a specific prey species.

Another important factor is the presence of a subnivean space throughout winter from which marten can hunt with very little competition (Buskirk and Powell 1994) from larger predators, as well as find safe refugia for resting locations (Joyce et al. 2017, Krohn et al. 1995, 1997, 2005; Raine 1981). With minimum snow depth for subnivean establishment at 10 cm (Thompson et al. 2018), Pennsylvania's marten habitat within the northern tier, paired with variability of elevation and topography, and matched with this region's average annual snowfall ranging from 76-280 cm (NOAA 2022), should provide adequate subnivean space for marten throughout the winter.

The concept of habitat and spatial heterogeneity has also been identified as an important factor for coexistence (Fisher et al. 2013, Manlick et al. 2020, Pauli et al. 2022). Marten habitat identified in Pennsylvania falls within very diverse, and contiguous sections of forest that have extremely low anthropogenic development and fragmentation (Albright et al. 2017). This area also occurs within a region of higher elevation and variation in topography, two additional factors that can contribute to niche or habitat partitioning between competitors (Pauli et al. 2022, Zielinski et al. 2017, Rosenzweig 1966, Raine 1981). Pauli et al. (2022) postulate that where segregation occurs, densities for both species increase, while areas of coexistence see lower marten densities. This is an important aspect to keep

in mind, that should marten be reintroduced, they may remain at a lower density but at a self-sustaining level as is seen in other parts of their range. Although Pennsylvania would be considered on the very southern range of marten within the east, many of the factors that contribute to increased interspecific competition are negated due to the current biotic and abiotic conditions, providing for an increase in partitioning and in the likelihood of successful reintroduction.

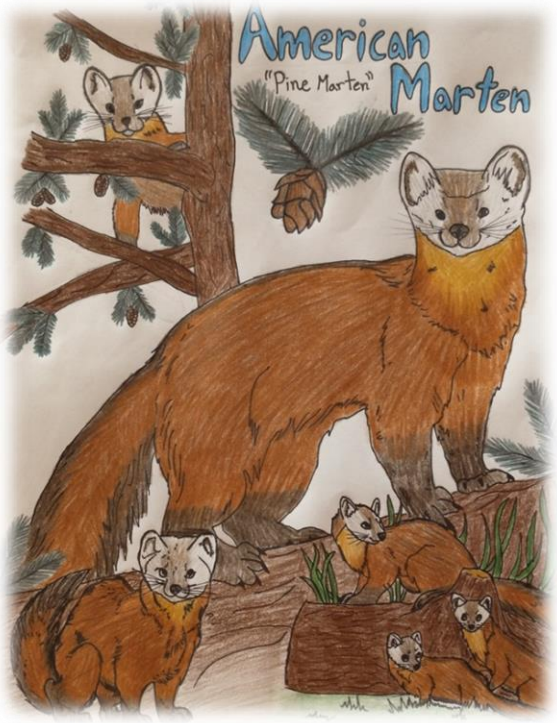
Other Concerns

Incidental Capture - Concern from incidental trapping has been expressed from experts throughout the Mid-West and Northeast where some reintroduction efforts have experienced this. Although valid, due to the susceptibility of marten to trapping, unlike these states, Pennsylvania does not allow the use of conibears outside of an established watercourse, waterway, marsh, pond, or dam (PGA 1986b). This would not preclude marten from becoming captured within foothold traps set on land for a variety of other species but would potentially allow any captured marten to be released unharmed if no serious damage occurs while in a trap. An important aspect of this concern will be working with trappers to educate on the importance of selectivity and avoidance within areas that marten would inhabit.

Population Persistence - Another valid concern from experts is population resilience and persistence, specifically maintaining genetic heterozygosity over the long-term. Although a reintroduction in Pennsylvania would be considered an 'isolated' population on the southern extent of their range within the east (Aylward et al. 2020), there are currently many other examples of 'isolated' self-sustaining populations on a much smaller scale of available habitat than what the Commonwealth can provide. States such as South Dakota (Fecske 2003), Montana (MFWP 2020), and Michigan (Gehring et al. 2019) have all conducted successful reintroduction efforts creating 'isolated' populations. Martens continue to persist on islands within Lake Superior (Smith et al. 2021) and the Gulf of Alaska (Small et al. 2002) with little to no genetic ingress/egress. Regardless, genetic monitoring should play an important role throughout the process of a reintroduction, from how and where animals are sourced, to what genetic diversity looks like into the future of a population (see *Conservation Genetics* section).

Litigation - Lastly, a concern from partners that are making great strides for SGCN species within the state sharing similar habitat needs to the marten is that of possible litigation that could arise with the return of the American marten. Prior lawsuits from environmental groups in Wisconsin (ELPC 2020, USDA 2009) and California (SLS 2015) have halted state and federal agency plans for habitat management or development. Two of these cases specifically named the marten as a reason for concern. What should be noted, however, is that within these three cases, all species were considered either state and/or federally listed as threatened or endangered. Of course, public agencies encounter restrictions within Pennsylvania with listed species when it comes to forestry or energy extraction and must fall within the bounds of laws and regulations in place. In the case of the potential reintroduction of the American marten to Pennsylvania, it would be classified as an 'experimental' species. This was done for many other reintroduced species and does not afford those species any additional regulatory protection as does

classification as threatened, endangered, or even SGCN. This would therefore not restrict timber management or energy extraction within the state, and prevent the marten being used within a lawsuit against state and federal agencies trying to manage lands for wildlife habitat.



Mackenzie Howles, Grade 10, Saegertown, PA

Reintroduction

Objectives of Reintroduction

Translocation, the intentional movement of a species from one location to another, has been conducted throughout the world over a broad spectrum of species. The three common objectives of translocation are to establish, reestablish or augment a species population (Griffith et al. 1989). International Union for Conservation of Nature/ Species Survival Commission (IUCN/SSC) (2013) defines reintroduction as "the intentional movement and release of an organism inside its indigenous range from which it has disappeared." Regarding what characterizes a successful translocation or reintroduction effort, the primary goal is a self-sustaining wild population (Seddon et al. 2014, Griffith et al. 1989). Prior to conducting a reintroduction effort, a variety of factors should be considered. Defining the need for a project of this scope is critical. Developing a feasibility assessment (Keller 2022a) that encompasses pertinent biological and non-biological factors ensures that the decision is not made lightly or without thought. Biologically, this includes general life history information that can speak to how a species fits within the community as well as important habitat needs, general diet information, and climate considerations. Non-biologically, it is important to consider the social aspects of a reintroduction effort, specifically how this project might affect the surrounding community, stakeholder support, opposition from individuals and groups, economic impacts, and cultural considerations (IUCN/SSC 2013). A significant portion of the feasibility evaluation addressed proper risk assessment, to include disease/parasite risk to other extant species, risk to both potential prey species as well as competitors, risk to the translocated species welfare, and social risks as mentioned previously (Keller 2022a).

A History of Reintroduction in Pennsylvania

Pennsylvania has a robust historic record of successful species reintroduction efforts. Following post-settlement anthropogenic induced habitat loss, many species, primarily habitat specialists, were extirpated. What species remained were considered generalists

or retreated into the remaining habitat that was largely inaccessible to humans. As forests regrew, water quality improved, and regulated harvest or protections were put into place. State agencies in partnership with universities, NGOs, and individuals began to pursue reintroduction as a tool to restore native species back to the Commonwealth. Culturally important game species such as white-tailed deer (*Odocoileus virginianus*) and wild turkey (*Meleagris gallopavo*) were some of the first to see reintroduction efforts, followed by Elk (*Cervus canadensis*). Bald eagles (*Haliaeetus leucocephalus*), peregrine falcons (*Falco peregrinus*), and osprey (*Pandion haliaetus*) all returned to the state through intensive reintroduction efforts following pesticide related declines (Kosack 1995). Aquatic species such as American eel (*Anguilla rostrata*; Newhard et al 2021), northern riffleshell (*Epioblasma rangiana*), clubshell (*Pleurobema clava*; Tiemann et al. 2013) and invertebrates like the regal fritillary (*Speyeria idalia*; Becker 2016) have all seen successful population expansion through reintroduction or are in the midst of promising reintroduction efforts. Of all species groups, furbearers have seen extraordinary success within Pennsylvania through reintroduction. Beavers (*Castor canadensis*) were extirpated by the end of the 19th century as well as fisher, while river otter (*Lontra canadensis*) were driven to near extirpation during this time with very few individuals remaining in the isolated wetlands of the northeast region. Translocation projects beginning in the early 1900s for beaver, 1982-2004 for river otter, and mid 1990s for fisher, were all successful in returning these iconic species to the forests and waterways of the state (Kosack 1995). Today, many of these species continue to expand their ranges throughout Pennsylvania through dispersal into existing habitat. Currently, the Commission is working towards restoring bobwhite quail (*Colinus virginianus*) through habitat management and translocation efforts proving that this technique is still relevant for returning native species to the community. That's not to say that reintroduction has always been successful, but many past failures have been the result of no prior assessment, poorly established habitat, and a lack of planning.

Marten Reintroduction Efforts

American marten may be one of the most frequently translocated furbearing species to date in North America. Past translocation efforts are a rich source of information in assisting with developing a robust plan and learning from both successes and failures. Fifty-two translocations have been conducted for American marten, with 40 of those being reintroductions, while the remainder were augmentations within an existing population or original introductions (Powell et. al. 2012, J. Kolbe, personal communication). These occurred within 9 states and 7 Canadian provinces (Fig. 2). Thirty-nine of these reintroductions have already occurred while one effort in Montana is in progress (Kolbe et al. 2020). Of the past 39 reintroductions, 20 succeeded, 9 failed and 10 had uncertain outcomes (Powell et al. 2012). Since Powell et al. 2012, the reintroduction project from Vermont's Green Mountains has been deemed a success with the newly discovered establishment of a population (O'Brien et al. 2018), changing success rate to 54% and failure rate to 21% (25% unknown). Because Vermont's reintroduction commenced in 1991, but was not quantifiably successful until 2018, it demonstrates that marten populations are resilient and can go unnoticed without careful monitoring.

Although the majority of marten reintroduction efforts have had success, those that have failed generally were thought to have been the result of too few founding individuals, or release into poor or unsuitable habitat (Powell et. al. 2012). Powell et al. (2012) developed important modeling based on biological information and data gained from a variety of similar Mustelidae species reintroductions to help predict reasons for success or failure. Primary findings focused on several important aspects, including sex ratio, number of total females, number of adult females, and number of release sites. The model showed that as the number of adult females and number of release sites increase, success also increases. Speaking specifically to the total number of martens at a release site, ≥60 individuals could increase success. Previous reintroductions have spanned anywhere from 1-8 years, but number of years did not impact success within the model. Another important question is that of proximity to the source populations. In other species, reintroducing a species such as quail is thought to have high importance with proximity of source to release due to local adaptations to habitats, food sources, climate, and predators (Martin et al. 2017). Unlike quail, proximity did not play a role with marten reintroduction success. Although further research is needed, the idea of having multiple sources to increase genetic diversity and avoid bottleneck often is thought to be important in reintroduction efforts (Serfass et al. 2003, Powell et al. 2012). Another variable that did have an effect in reintroductions was protection (i.e., harvest restriction). Some reintroductions did not provide protection, which did not appear to factor into success or failure.

Translocation

Requirements for a Self-Sustaining Population

Number of Individuals - Minimum requirements for a self-sustaining population have been covered previously (see *Dispersal, Home Range, and Minimum Population Viability* section) and although differences of opinion exist on starting number for a translocation, the differentiation likely is due to the difference in resource availability within release sites. Powell et al. (2012), Strickland et al. (1986), Slough (1992), and most recently Kolbe et al. (2020) have recommended 50-60 founding marten for long-term persistence. Pennsylvania's American marten reintroduction will target a minimum of 60 individuals for each release location, although this number may increase within a given release location if additional animals are readily available.

Alaina Boswell, Grade 7, Cranberry Township, PA

Sex Ratio - Much of the past research also recommend a female--biased sex ratio, and some consider adult females to be an important aspect (Powell et al. 2012). The number of juvenile females did not influence

success. It was found that a sex ratio of 1:4 (males: females) greatly influenced success and has been recommended. What was difficult to determine based on research from Powell (2012) was how many 'effective' breeding males are available. This could mean that more males are necessary than the 1:4 ratio recommended if some males are juveniles and non-breeders at the time of release. With this consideration in mind, this project will attempt to bias founders toward females, if possible, and at the least will ensure a minimum 1:1 ratio of males to females. Animal age is notoriously difficult to determine within a reasonable amount of time during a translocation process. Managers will do their best to estimate age (see *Biologic Data* section below) and track this throughout the process but will not weight this factor heavily during the project.

Translocation Dispersal – As with most reintroduction efforts, a certain number of animals will disperse out of the release area. This is common with many historic carnivore reintroduction efforts including marten (Davis 1983, Fritts et al. 1984, Proulx et al. 1994, Spinola et al. 2008, Woodford et al. 2013, Day et al. 2021). With the understanding of marten spacing and population density, the idea that some martens are transitory (Powell 1994, Slough 1994) will contribute to potential dispersal as well. This underscores the importance of the number of individuals released, but also how animal release points are distributed within a release area (see *Release* section).

Project Scale - Literature provides some guidance on the distance between locations and states that for release sites to be 'independent,' or not of the same site, they should be at least 50 km from the next location (Slough 1994, Powell et. al. 2012). Evaluating the release locations in Pennsylvania, the shortest distance between adjacent prospective release sites is 35 km while the longest is 207 km and average is approximately 47 km.

Release Location Selection

The foremost consideration for reintroducing a habitat specialist like marten is to choose large, contiguous, and well-connected areas of highly suitable habitat. Using the habitat suitability model (see *Habitat Modeling* section) developed for this project, most of the best-suited areas for re-establishment are within the northern tier (Fig. 9). Special consideration is given to contiguous areas of at least 125 km² (Fig. 15) where potential restoration success is highest (see *Dispersal, Home Range and Minimum Viable Population* section). Public land areas will be critical when it comes to providing core areas of persistent habitat through time (Fig. 10). With long-term management plans in place for most public lands (PGC 2021, DCNR 2016 and 2020, USFS 2007), loss of habitat due to natural resource markets and land conversion is of lesser concern than on privately held lands. Recent reintroduction efforts for pheasant on private lands within Pennsylvania have proven difficult largely due to agricultural commodities providing greater perceived financial benefit to private landowners compared to long-term federal subsidy programs that kept important warm-season grass plantings and other habitat practices in place (Klinger and Keller 2019). Public ownership and long-term plans also prevent mass deforestation, which was one of the two primary causes of extirpation of American marten in Pennsylvania.

Habitat fragmentation and presence of natural refugia can be significant when

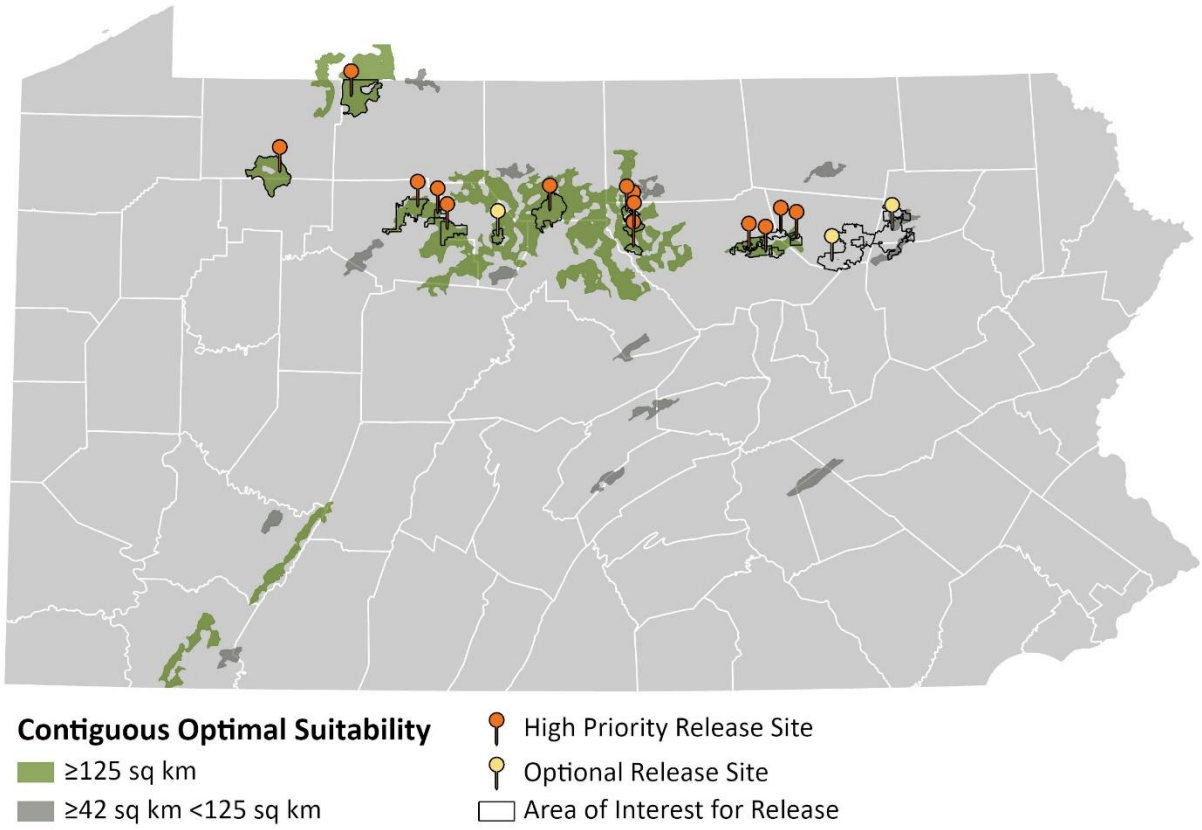


Figure 15. American marten primary and optional release areas and locations with contiguous suitable habitat.

selecting release locations (see *Habitat* section). Fragmentation from features such as highways and utility corridors can act as major barriers to population growth through dispersal and occupancy of available habitat (Gehring et al. 2019). Marten can be very susceptible to trapping, even incidentally, with males and juveniles having a higher probability of encountering traps during dispersal or within larger home ranges (Clark et. al 1987, Strickland and Douglas 1987). Powell et al (2012) found when evaluating successful translocation efforts within the *Martes* clade that one of the keys to success was protecting populations from harvest. The idea of providing 'refuge' type areas where harvest, or incidental capture, could be minimized has played an important role in ensuring continued healthy marten populations (De Vos 1951, Lensink 1953, Van Zyll de Jong 1969, Strickland and Douglas 1987, Strickland 1994). In the event of a potential for sustainable harvest, focusing on areas of natural refugia rather than closing specific areas to harvest may be an important aspect of management in the future. Working to educate and partner with trappers within release areas will be of higher benefit rather than placing additional restrictions on trapping.

As has occurred with other successful mustelid releases in Pennsylvania (Serfass et al. 1999 and 2003, Hardisky 2001), multiple reintroduction sites have been selected to develop sub-populations. Five primary release areas with multiple sites within have been selected in optimal and highly suitable

habitat having high connectivity (Fig. 15). These prioritized release areas allow for natural dispersal to begin connecting these areas as the project progresses. Release sites are found within a combination of DCNR-, USFS-, and PGC-owned lands within the northern tier of the state. These locations were selected in close collaboration with partner agencies (see *Public Land Management Partners* section below).

Hammersley Wild Area – Located in Potter and Clinton counties (Fig.16), this 30,253-acre (12,243 ha) tract is managed by the DCNR Susquehannock State Forest district.

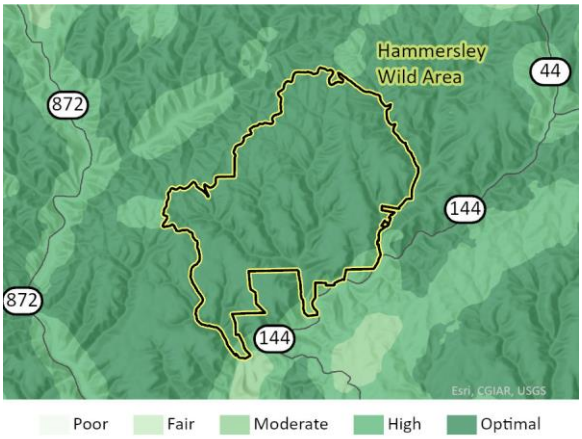


Figure 16. Hammersley Wild Area. E. Clees 2023.

Historically this site was home to logging camps from the 1800s as timber was removed from the deep valleys and tall ridges that make up the diverse topography. The DCNR defines a Wild Area as "…an extensive area which the general public will be permitted to see, use and enjoy for such activities as hiking, hunting, fishing, and the pursuit of peace and solitude" (DCNR 2016b). No motorized vehicle access is permitted, and timber management is prohibited with few exceptions. Gas and mineral rights belong to DCNR. The Hammersley Wild Area is prioritized as the best release location due to its overall size, its remoteness, the entirety of the area falls within optimal habitat, and its central geographic location within a large, contiguous block of suitable habitat within the state. This area presents challenges such as releasing animals within the interior and research or monitoring work. Even so, it appears to provide the keys to a successful translocation effort considering the previously mentioned reasons.

State Game Lands Complex 25, 293, 14 – State Game Lands (SGL) 25 (24,117 acres), SGL 293 (5,472 acres), and SGL 14 (14,947 acres) make up a large tract of public land located in Elk and Cameron counties (Fig. 17). Totaling 44,536 acres, with each parcel connected to state forest lands managed by the Elk State Forest district, this complex provides forested habitat that falls into optimal suitability managed specifically for wildlife habitat. Private parcels do exist between each of the SGLs, although they too largely fall into the optimal habitat category. Long-term game lands plans provide for a mixture of both late succession and early succession management over the next 100 years.

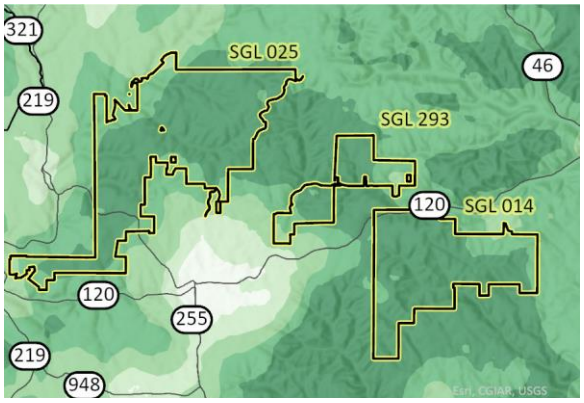


Figure 17. State Game Lands complex of 25, 293, & 14. E. Clees 2023.

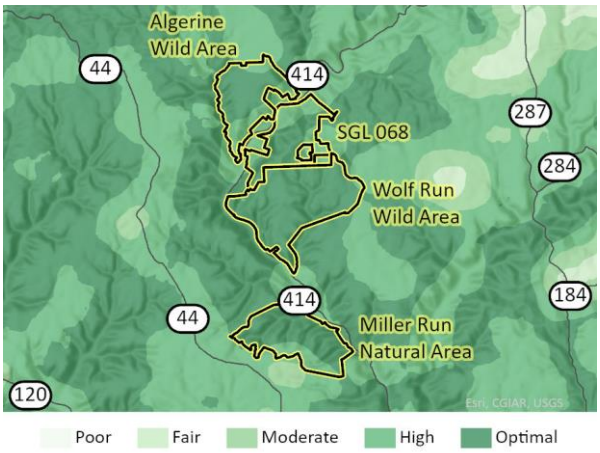


Figure 18. Wolf Run complex. E. Clees 2023.

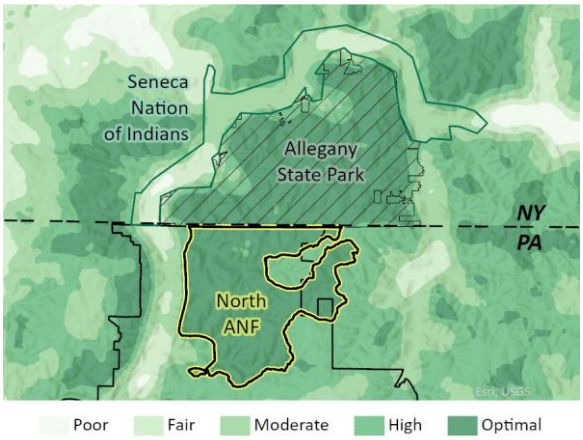


Figure 19. The North ANF potential release site, found within the Tracy Ridge Recreation Area. E. Clees 2023.

Wolf Run Wild Area Complex – The Wolf Run Wild Area, encompassing 6,900 acres, is one part of a series of remote public land holdings. To the north lies the Algerine Wild Area (3,700 acres) and to the south lies the Miller Run Natural Area (4,992 acres) with SGL 68 (3,921 acres) adjoining both Wolf Run and Miller Run. Altogether, this complex includes 19,513 acres in Lycoming County (Fig. 18). With DCNR lands managed by the Tiadaghton State Forest district, this complex offers a unique multi-agency management approach to the forest and its wildlife resources. DCNR Natural Areas "are set aside to provide locations for scientific observation of natural systems, to protect examples of typical and unique plant and animal communities, and to protect outstanding examples of natural interest and beauty" (DCNR 2016b). Natural areas have similar restrictions to Wild Areas to allow long-term natural succession to occur, promoting a natural, undisturbed system to operate.

Allegheny National Forest (ANF) – Within the ANF, there are two tracts of considerable importance. The first (Fig. 19), what is referred to as the Tracy Ridge Recreation Area is a 39,483-acre tract in the northern portion of the forest bordering New York State. This area in McKean and Warren counties provides a remote portion of the forest with optimal habitat suitability, which extends over into New York's Allegheny State Park and onto Seneca Nation Tribal lands. There is a unique opportunity for managers from both states and the Seneca Nation to establish a new marten population straddling the state line. With this in mind, the Seneca Nation and New York State should be consulted on whether they might be willing to consider this as a benefit and potentially partner with the Pennsylvania effort, if only to monitor occupancy into the future.

The second tract under consideration (Fig. 20) is referred to as the Hearts Content Recreation Area. This area has 37,122 acres and includes the Hickory Creek Wilderness Area (8,663 acres) and is directly adjacent to SGL 29 (9,800 acres). Located in Warren County, this area has optimal suitability and is surrounded by highly suitable habitat within the remainder of the National Forest (513,175 acres). The USFS describes Wilderness Areas as "A wilderness, in contrast with those areas where man and his works dominate the landscape, is hereby

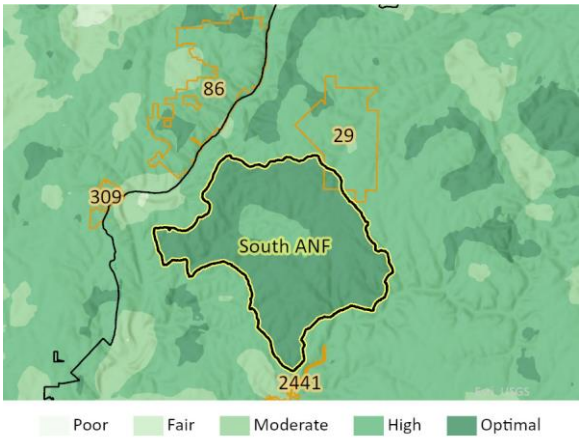


Figure 20. The South ANF potential release location found within the Hearts Content Recreation Area. E. Clees 2023.

recognized as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain" (USDA 1964). Only one of the ANF tracts will be chosen for release due to their proximity to each other.

Loyalsock State Forest – On the southern portion of this 114,552-acre state forest lies an area of 22,609 acres of optimal suitable habitat for marten containing several important areas (Fig. 21). Both the Kettle Creek Wild Area (2,600 acres) and the Kettle Creek Gorge Natural Area (774 acres) are contained within the State Forest boundary managed by the Loyalsock State Forest district. Intermixed within state forest lands

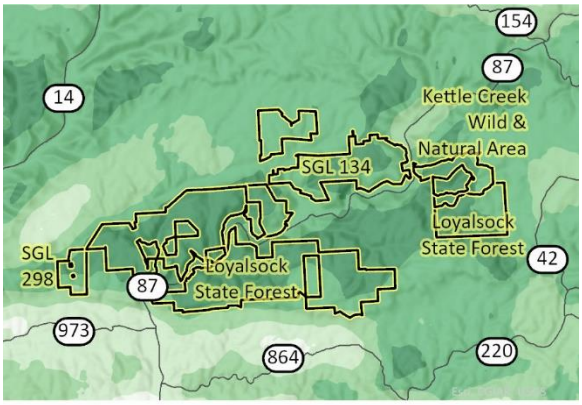


Figure 21. Loyalsock State Forest and associated State Game Lands. E. Clees 2023.

are SGLs 134 (8,365 acres) and 298 (1,140 acres).

Other Release Locations for Future Consideration – Although these primary 5 release locations are situated within an appropriate distance from each other and within optimal habitat (Fig. 15), there are several other locations within the state that may provide for the needs of a translocated population and should be considered for future releases or as alternate release sites. The complex of SGLs 57 (45,986 acres), 13 (50,744 acres), and Ricketts Glen State Park (13,193 acres) contains a large tract of unbroken public lands with a diversity of habitat types including one of the last remnant boreal red spruce forests within the state (Fig. 22).

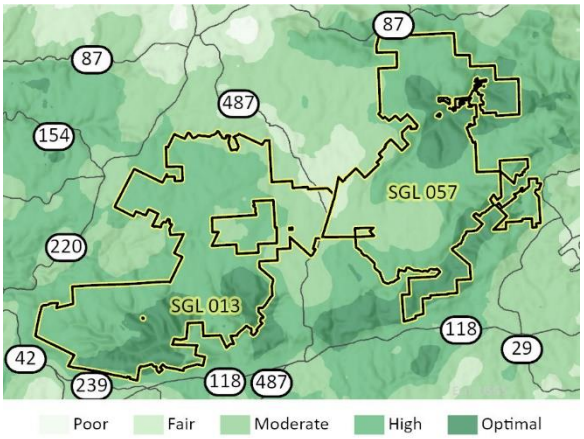


Figure 22. State Game Lands 13 & 57 complex. E. Clees 2023.

Another consideration is the Square Timber Wild Area (Fig. 23) in Elk County, an 8,461-acre forested area bordering the Sinnemahoning River. This includes the Bucktail State Park Natural Area and contains a series of steep valleys feeding into the river. The Square Timber Wild Area is situated between the Hammersley Wild Area and the State Game Lands Complex of 25, 293, and 14. This has the advantage of

providing a steppingstone between these areas.

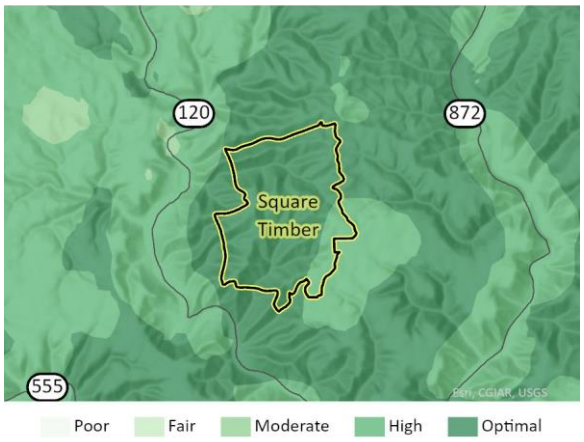


Figure 23. Square Timber Wild Area. E. Clees 2023.

Source

Wild vs. Captive Reared Source - Captive rearing of species occurs frequently, especially within those considered threatened or endangered. Reintroductions have occurred with success with reintroducing other captive-reared species, but in the case of mustelids, most experience very high mortality (Biggins et al. 2011, Powell et al. 2012). All successful efforts for marten reintroduction were from wild sources. Most researchers and managers recommend wild-caught marten (Griffith et al. 1989, Slough 1994, Moruszzi 2003) and there has been strong evidence of a much higher success rate with wild translocations versus captive bred of many species (Fischer and Lindenmayer 2000, Seddon et al. 2014). Captive rearing is expensive due to additional and long-term animal care. This practice also poorly prepares an individual for the many challenges it will experience within the wild and likely would impact its survival.

Source Population Selection - Selecting proper sources for reintroducing species can have several important considerations. The first is how close the source population should be. In other species such as quail, the proximity of the source population to the release sites is thought to be of high importance due to local adaptations to food, climate, and predators (Meffe 1987, IUCN 2019). According to Powell et al. (2012), proximity did not play a role with marten reintroduction success. The second consideration is whether a source population should be a single dedicated population or multiple populations from potentially one or many political boundaries. Although further research is needed, the idea of having multiple sources to increase genetic diversity and avoid bottlenecks is important in reintroduction efforts (Slough 1994, Powell et al. 2012).

A third consideration is how much removal can a source population withstand. In their *Management and Conservation Plan for Martens in Wisconsin* (WIDNR 2011), the Wisconsin Department of Natural Resources recommends that source populations have at least 400 individuals before removal is considered. Because translocating from a source is much likened to harvesting, utilizing historic harvest data along with long-term population indices may be most beneficial in answering this question.

For reintroduction into Pennsylvania, source populations have several considerations. This effort will require a minimum of 300 marten (with the potential for more if the effort is expanded or there is a need for augmentation), and we recognize that this is a heavy lift for any one source population. This target satisfies the minimum population referenced by Powell (2011) and individual sites have had success

in past efforts in reaching these goals (Powell et al. 2012). By working with a variety of sources, whether that be within a state or province, or more than likely with several states and provinces, this eases the burden on the source populations. Another consideration is assessing potential health threats from source populations. It would be unwise to reintroduce from a source population that are known to carry a disease or parasite that is not common or endemic to Pennsylvania. This is why pre-assessment (see *Health Evaluations and Pre-release Treatment* section) is important prior to translocation. Another important reason for using multiple source locations is if the likelihood of natural immigration into the reintroduced population is low or zero, multiple sources will provide a strong genetic diversity within the founding population, preventing inbreeding within the immediate future. This, of course, doesn't come without some potential risks.

Conservation Genetics – An important consideration with the reintroduction and establishment of a population is the genetic diversity of the population and how this may impact the success of the project. The field of conservation genetics is ever-expanding and increasing with research showing that genetic variability has great influence on population health and fitness. For reintroduced populations without expected immigration such as the American marten in Pennsylvania, genetic diversity can be a major concern. Population persistence can be assumed in direct relation to genetic variability as a general rule of conservation genetics (Ouborg et al. 2010a, b; Schwartz et al. 2012). Inbreeding and genetic drift can lead to various negative impacts on a population over time and should be addressed during any effort to restore a species. If left unaddressed, these bottlenecks lead to a reduction in fitness, inability to cope with diseases, and failure to adapt to environmental changes (Lacy 1997, Keller and Waller 2002, Jamieson 2011). Within two isolated marten reintroduction efforts in the Lower Peninsula of Michigan, small population sizes and lack of genetic flow are leading to a loss in genetic diversity (Hillman et al. 2017).

To combat this impact, there have been several ideas postulated within the literature. Beyond genetic management, habitat development and preservation, removing exotic species competition, and keeping harvest at a minimum until establishment are potential drivers (Lacy 1997). Habitat can certainly play an important role in either promoting or inhibiting genetic flow among populations or within a population (Koen et al. 2012). Alyward and Kilpatrick (2020) found that at multiple spatial scales, developed land cover negatively impacted gene flow for marten. Considering genetic management, research indicates a variety of methods to address inbreeding depression. Although contested by Williams and Scribner (2007), Swanson et al. (2006) found no bottleneck in the populations reintroduced to Michigan's Upper Peninsula and attributed this to multiple reintroduction efforts as well as in-state translocations.

The idea of 'genetic rescue' through introducing individuals from other source populations is important to maximize genetic diversity (Frankham et al. 2017, Ralls et al. 2020). Frankham et al. (2017) provided guidance for the genetic management of populations following continued monitoring of the genetic structure. When considering the American marten having multiple

populations of one distinct species, thus primarily avoiding outbreeding depression (Hedrick and Miller 1992), augmentation may be the best way to overcome a genetic bottleneck. Grauer et al. (2019) modeled two reintroduced populations of American marten in Wisconsin. One population in the study was stable to increasing, likely due to immigration, while the other was declining towards extinction due primarily to isolation. Using population modeling they found that with modest immigration (1 female/year) they could effectively reduce the stable populations opportunity for extinction to 1% and reduce the declining populations extinction opportunity by 30%. They also cite the critical importance of having connectivity between populations for immigration and emigration.

The question of whether founding populations should be sourced from a single population, with high genetic heterozygosity, or multiple populations to increase genetic diversity still seems to remain unanswered. This is reflected within the IUCN Reintroduction Guidelines (2013) where several considerations are highlighted. While recommendations revolve around attempting to source a genetically diverse founding population from as close to the release site as possible, there may be a situation that requires mixing multiple founding populations. Recent research from Day et al (2021) provides additional considerations such as the negative effects of assortative mating, a poorly understood phenomena within the *Martes* genus, but found to impact other species such as songbirds (Bradley et al 2014) and fishes (Weise 2020).

Although there is potential to measure genetic diversity from potential sourcing locations ahead of a translocation effort, Pennsylvania's situation is somewhat unique. With complete extirpation of marten from the state, and the nearest population found over 130 km to the north in the Adirondack Mountains surrounded by non-habitat, there is no realistic hope for natural colonization. With that in mind and considering the need for at least 300 individuals to source at least 5 release locations, this effort will need to rely on the partnership of multiple states and provinces. This is important for several reasons. A single source population is not being depleted to the point where it suffers negative impacts from the removal of individuals and lightening the burden on any one government. It also provides the opportunity to mix several founding populations from the start into one starting population, increasing genetic diversity immediately and reducing the chance for inbreeding depression during the initial population growth (Powell et al. 2012). Another potential positive is the ability to conduct important research; answering questions such as: 1) Do we truly see strong genetic diversity with mixed founder populations? 2) Which founder populations show high survival and fecundity? or 3) How does genetic structure change over time as sub-populations come together and begin interbreeding?

Trapping Effort Coordination

Capture of a species for translocation begins long before the first trap is set. Coordinating such an effort requires strong communication between all partners, in some cases several years beforehand. Leadership roles must be established throughout the many facets of the project including the source agencies, the receiving state agency, release location agencies, wildlife health partners, research

partners, non-governmental organization (NGO) partners, and other partners.

Important roles to be established:

- Pennsylvania Project Leader (Pennsylvania Game Commission)
- Pennsylvania Public Lands Release Location Leaders (Department of Conservation and Natural Resources, U. S. Forest Service, Pennsylvania Game Commission)
- Pennsylvania Wildlife Health Coordinator (Pennsylvania Game Commission)
- Source Location Project Leader (State and Provincial Government Agency Staff)
- Source Location Project Wildlife Health Coordinator (State and Provincial Government Agency Staff)
- Source Location Project Trapping Coordinator (Agency Staff or Contractor)
- Research Partner Leader (TBD)
- NGO Partner Leaders (TBD)

These roles should work closely together within a working group that meets regularly and stays in constant communication on all aspects of the effort. Once this has been established, the Pennsylvania Project Leader position will begin coordinating all facets, ensuring each part is well supported and informed.

Coordinating a Multi-Agency Reintroduction

Once open communications have been made between all partners, setting appropriate expectations for each role mentioned previously will be vital. These expectations should be agreed upon by the partnership and integrated into a document that will facilitate working through the process of achieving project goals. This will look different for each role. While some partnerships will need to form binding documentation such as research agreements, or contracts, others will not find this necessary. An important aspect, however, is flexibility knowing that this is a wildlife-centric project and needs to remain adaptable.

Questions for Source Partners when Planning for Capture

Several important questions that need to be addressed prior to moving forward with capture are:

- What are the appropriate contacts within the source location to coordinate with?
- Who or what group will be coordinating capture efforts?
- Who will be executing the capture of marten within the source location?
- Who will be coordinating with trappers to facilitate collection?
- How and where will martens be held, cared for, and prepped for shipment?
- Will payment be made to trappers for effort and if so, how much?
- Will payment be made to source agencies for marten and, if so, how much?
- How many martens are realistic to capture and move from a source location within a single year?
- How many martens is that source population willing to provide for the effort?
- What are specific requirements from source governments to allow for export of wild marten?

These questions, although important, cannot be answered until the decision has been made

to reintroduce. Following a decision, this plan can help using past efforts as a guide.

A Guide for Capture

After agreement between partners, source agencies should assess their available populations of martens to determine where trapping should take place and how many individuals can be removed from each location without negative impacts. Once that is determined, source locations will decide on who will be conducting the trapping effort in the field. Past reintroduction efforts have employed agency staff from the source state, agency staff from the receiving state, NGO staff (Klinger and Keller 2019), or most commonly, by local trappers (Serfass et al. 2003, J. Kolbe, personal communication). With most wildlife agencies underfunded and understaffed, it is recommended trappers be the primary source for trapping marten. Trappers have always been some of the leading supporters of furbearer conservation throughout North America, and this offers them an opportunity to once again prove the value of trapping to conserve a species (Kuglin 2021).

The Montana and Washington Models - Since 2020, Montana has been conducting marten translocations in the Little Belt Mountain range (Kolbe et al. 2020). Managers have built upon decades of reintroductions to develop a successful system of trapping, handling, transfer, and release (J. Kolbe personal communication). Following this model, source agencies can identify historically successful marten trappers from within their boundaries as well as work with the state or provincial trappers' association (J. Kolbe, personal communication, Kuglin 2021). Source location project leaders can directly work with or assign a coordinator to work with individual trappers. During Washington's fisher reintroduction into Olympic National Park, managers hired trapping coordinators within each source location who coordinated all trapping efforts with local trappers. Responsibilities also included supplying traps and holding boxes, bait and lure, as well as holding and transport of animals. The delegation of these responsibilities should be left up to the source state or province.

Capture Seasonality - Most past marten translocations occurred during seasons outside of summer, primarily in the fall or winter months. Two reintroductions were completed during summer months, one with some success. Some research suggests that allowing individuals to explore territory, establish home ranges, and adapt to a new environment prior to parturition can lead to greater success of reintroduction (Powell et al. 2012). Summer capture and release, however, will likely be much more costly and potentially more difficult. Working with trappers during the season (Kuglin 2021) allows trappers to also pursue other animals concurrently and is conducted at a time of the year when food abundance is limited, therefore increasing the chance of successful capture through use of bait and lure. Montana reintroduction managers found that female capture rate was higher during the fall than winter, which may be important when considering the importance of sex ratio (see *Sex Ratio* section). Slough (1994) recommended release occur between October and January to avoid timing of dispersal and encourage establishing home ranges near the release location. Other considerations may be weather conditions and the challenges that they present.

Equipment - Trappers will be supplied with live traps with custom fit holding boxes (Seglund 1995, J. Kolbe personal communication, Appx. 4 and 5) that can be detached and replaced with a fresh box in the event of a capture. Live, or cage traps, (Tomahawk™ model 108.1 Havahart™ model 1085) will be utilized to prevent injury and hold marten until traps can be checked. Bait and lure will also be supplied by the project. Trappers should be supplied with as many traps as they have availability to set and check responsibly.

Trapping Procedure – Trappers will target marten from their normal target areas where they have good experience with, where marten travel, and have had success in the past. Trapping will take place in the late fall/winter coinciding with harvest season. Trappers will receive training ahead of the season specific to safe capture, holding, and transport. Traps should be set with consideration to weather, and under some cover. Trap placement should also consider protection from flooding or extreme snowfall. Traps should be properly baited and lured as selected by the individual trapper from experience. Holding boxes should be securely fastened to the trap and have dry polyfill placed inside to provide warmth for captured martens. Traps should be tested to ensure proper function prior to setting and should be stabilized to prevent rolling from marten or other species. Traps will be checked within every 36 hours, and sooner if possible.

Capture and Transfer Procedure – Once a marten has been captured, the trapper should complete a visual assessment for any major injuries or life-threatening wounds. In the case of one of these two instances, euthanasia for harvest may be the most ethical consideration. Managers should provide trappers with guidance on decision making prior to the season. If relatively healthy, the trapper will slide in the metal door once the marten has gone into the holding box and latched securely. The box can then be unattached from the trap and a new holding box secured to the trap before being rebaited and reset. Once the marten is secured, it should be transported to a designated holding facility to await transport. If the transportation time is extended (i.e., >12 hours), a specially designed holding cage with food (raw meat or cat food) and water can be attached to the holding box and the door opened for access. Marten should be removed from the trap and transported to a holding facility as soon as possible to avoid potential injury.

Holding at the Source – A designated holding facility should be established before trapping begins with appropriate equipment ready. Separate holding pens that prevent marten from coming in contact will be important to prevent injury. The trapping coordinator at the source will be responsible for selecting and setting up this facility as well as proper animal care. This facility can range anywhere from as simple as a barn or outbuilding with proper cover to a zoo but should have the ability to house up to 20 individual martens. Pens should be designed to allow the marten to enter from the holding box and have branches for chewing or scratching. The design will allow for the cage or the box to be closed off for cleaning. Fresh polyfill should be kept within the holding box. Food and water should be available each day within tip proof containers, and the individual monitored for health concerns.

Tentatively, marten will not be shipped until 10 have been captured so there is the

possibility that some marten may be held for several weeks not to exceed 3 weeks. The trapping coordinator will work closely with animal care specialists as well as veterinarians for treatment or certification as needed. While in captivity, marten should be fed 200-250 grams of meat once a day as well as always have water available. Meat source can vary, but for cost efficiency road killed deer sourced from local wildlife officers or beaver carcasses sourced from local trappers may be pieced out and provided. Other protein sources are acceptable as well as nutritional supplements with the intent to allow martens to gain weight while in captivity. Managers should consider developing a standardized commercially available raw meat diet and providing this to source and Pennsylvania holding facilities if possible.

Health Evaluations, Pre-Release Treatment and Marking

Pre-capture Population Evaluations – Prior to a capture effort within a source population, managers can conduct a cursory evaluation of the population's overall health. This should be conducted within a 3-year window prior to the trapping effort and utilize trapper-harvested carcasses for assessment. Working closely with source population managers and trappers, the project coordinator will work to collect a minimum of 30 carcasses from each potential source location. These carcasses will be shipped to the project coordinator in Pennsylvania and working with the PGC Veterinarian, Wildlife Futures (WF) Veterinarians, and WF health specialists, marten will be analyzed for a variety of diseases or parasites of concern. These carcasses can also provide important genetic information that could inform managers on the overall genetic diversity of the population in question. Prior to trapping, a list of known diseases and parasites of *Martes* in North America will be generated from a literature review and expert knowledge. A disease risk analysis process will then be used to assess the likelihood and consequence of the diseases and parasites listed in order to generate a priority list for testing

Post-Capture Evaluation Process - Following capture, individual marten will be transported to a holding facility to await shipment. During this time, observational health evaluations should begin. Responsible staff can continually monitor for any overt symptoms of disease, stress, or injury. If immediate action would be needed prior to transport, the local source project wildlife health coordinator can contact the designated local partnering veterinarian to proceed with treatment after assessment.

Barring any immediate action, once transport is completed (see *Transport* section) and marten arrive in Pennsylvania, they should be moved into a temporary holding facility (see *Holding* section) to await in-depth health evaluations. In preparation for scheduled release, each marten will be anesthetized, attempting to limit immobilization to one instance.

Chemical Immobilization - Anesthetization should be performed by a qualified staff member using one of several effective techniques. Chemical immobilization of marten has been successful using a mixture of Ketamine/Xylazine in a 5:1 mixture with a dosage of 8.5 mg/kg (Bull et al. 1996). This mixture rendered the individual unconscious for approximately 10-20 minutes. Telazol has also seen success with a dosage of 8 mg/kg,

although atropine was utilized at 3 mg/kg for controlling convulsions and to speed recovery (Bull et al. 1996). Overall recovery was estimated at an hour with this method. Isoflurane has also been successfully utilized with marten immobilization by way of a continuous 0.5-5% flow (Spriggs et al. 2017). Following the termination of flow, martens are able to be released within 15 minutes. There is some concern, however with hypothermia and hyperthermia when using this method so temperature should be monitored when in use. Most recently, and likely the most effective method due to fewer complications and efficiency, is using the mixture of Butorphanol, Azaperone, and Medetomidine, commonly referred to as BAM. Montana biologists are currently reintroducing martens within the state using this anesthetic combination with great success (J. Kolbe, personal communication). This protocol also has the advantage of using reversal agents Naltrexone and Atipamezole, so that animals quickly and safely recover from anesthesia.). During immobilization, ophthalmic ointment should be applied to the eyes and vital signs such as temperature, breathing, and capillary refill should all be monitored closely with equipment and supplies on hand to react to an emergency.

Biologic Data - Following immobilization, martens should be weighed, sexed, and aged. Although techniques for sexing marten postmortem are well developed (Poole et al. 1994, Belant 2011), it can be especially challenging when alive. Some evidence has been given to comparing sagittal crest width and length in adults (Strickland and Douglas 1987), but this has proven difficult at best even for experienced handlers. Total skull measurement or assessment of temporal muscle coalescence has also been found to be accurate (Flynn and Schumacher 2016), but like other methods, these are tested following mortality and without pelage. Sex can be determined in adult mustelids by palpation of an os penis (baculum) in males. For any animals where results of palpation are equivocal, radiography can be performed as the calcification of the baculum can be detected on a radiographic image. Radiography or ultrasound may also be used to determine pregnancy or reproductive status; although some pregnancies may be difficult to detect if at an early phase including delayed implantation.

Age can be determined by premolar extraction for cementum annuli analysis, tooth wear patterns, or sagittal crest development. Tooth extraction has been recommended against by managers (J. Kolbe personal communication) because of potential damage during extraction. Additional morphological measurements will be collected including total length, tail length, hind foot length, ear width, and neck circumference. Photos will be collected of each individual with particular attention given to chest and neck coloration patterns.

A general health examination should include a search for wounds, evidence of ectoparasite loading or damage, abnormalities, and past or current disease impacts. Special attention should be paid to past or recent tooth damage, broken bones, missing limbs or digits, or nasal/ocular discharge. Managers should reference the *American Marten Health Evaluation Form* (Appx. 5) for a complete checklist when working through this process pre-release.

Following pre-capture health evaluations, if certain concerns are identified, additional health assessments should be considered pre-release. Endoparasite loading

can be evaluated through fecal sampling, including a direct smear, flotation, sedimentation and the Baermann test, while disease exposure and overall biological condition can be evaluated through blood analysis (complete blood counts, biochemistries and antibody titers), and various molecular techniques.

Pre-release Treatments – Other successful mustelid reintroduction efforts have provided both reactive and proactive medical treatments while individuals are within human care prior to release (Serfass et al. 1993, Lewis 2006). This approach enhances the potential for reintroduction success. Priority should be given to the treatment of open wounds or injuries while infections should also be treated with appropriate care as determined by a veterinarian. All individuals should receive vaccination for rabies (Imrab-3) and canine distemper (purevax ferret vaccine; Lewis 2006). Internal and External parasite load will be evaluated for each animal; treatment may be warranted based on parasite load, risk to the individual animal, risk to the population, or risk for introduction to Pennsylvania. This will be evaluated on a case-by-case basis, with veterinary-approved treatment as prescribed.

Sampling and Marking - In addition to treatments, genetic sampling will occur to conduct DNA analysis for each individual. A variety of methods are available to collect genetic samples to include hair, tissue (ear punch), or blood sample (ear prick) on Whatman card. This will be critical for future population monitoring.

Marking will occur for all individuals through the insertion of Passive Integrated Transponder devices, commonly referred to as PIT tags. These devices will be inserted through injection between the shoulder blades (Kujawa 2018) of the animal. Each tag will be programmed with a pre-selected unique identification number that will be assigned to an individual. This tagging method is more reliable and less invasive than many historic tagging options and can provide important population vitals for a wildlife species (Gibbons and Andrews 2004).

Telemetry will be used as a part of this project to answer questions relating to survival, mortality, dispersal, home range, habitat preference, and to gather a variety of other important information. Due to the marten's solitary nature, large home range, and ability to disperse long-distances, GPS telemetry should be the primary method for this project. Although costly, a small sub-sample based on sex and age from each source location within each release location will be transmittered. Collars will be used carefully due to potential snagging that have been documented in the past (A, Kujawa, personal communication, J. Kolbe, personal communication). Kujawa (2018) utilized the model M1555 from Advanced Telemetry Systems with success for her work in Michigan. Several different options exist for collars on the market, but with technological advances in telemetry occurring quickly, a collar system should be investigated and selected closer to deployment.

Exportation and Importation Health Requirements and Certifications – With the potential to source marten from several Canadian provinces, there are additional needs to consider moving wildlife across international boundaries. These needs have been previously addressed by Lewis (2006) as part of the implementation plan to

reintroduce fishers into Washington state from British Columbia and much of this section draws directly from the Washington effort.). Other Provinces may require an export permit to lawfully export live marten (Aaron Walpole, Ontario Ministry of Natural Resources and Forestry, personal communication). It's important to note that American marten are not considered a species that falls within the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES). A licensed veterinarian in participating provinces will inspect all marten captured and prepped for export prior to crossing into the United States. This may be completed in transit or at holding facility prior to transport. Both an assigned health certificate and possession/export permit are required by the provincial wildlife authority (Lewis 2006, CFIA 2022). Importation requirements into Pennsylvania are regulated by the Pennsylvania Game Commission. A Certificate of Veterinary Inspection (CVI) will be required from the state or province of origination. A USDA accredited veterinarian, preferably a state or provincial staff vet, is required to complete the CVI. Upholding the current Pennsylvania standards of wildlife import (PGA 1953), managers should obtain a Wildlife Special Use Permit from the Pennsylvania Game Commission prior to project start.

Transportation

International Transport - As previously mentioned under Exportation Requirements, proper certification will be needed prior to moving marten across international boundaries (i.e., Canada). On the U.S. side of importation, the U.S. Fish and Wildlife Service (USFWS) is the governing agency with regulatory authority. Managers will also be working with both the Canada Border Services Agency (CBSA) and the U.S. Customs and Border Protection (USCBP) to safely transport martens across the border (USCBP 2023).

When preparing to export a shipment of martens across the border, the trapping coordinator will need to notify CBSA and USCBP well ahead of time to allow for agents to conduct inspections, review paperwork, and question personnel traveling with the animals on both sides of the border during crossing (Lewis 2006). The USFWS will require both the Declarations Form 3-177 (USFWS 2021) and pre-notification of port of entry, which in this case will require the Designated Port Exception Permit Form 3-200-2 (USFWS 2000) as currently no authorized ports of entry are reasonable for this project.

Domestic Transport - There may be exportation considerations from domestic translocations within the U.S. Most state wildlife agencies are the point of contact for pursuing this process and will be contacted very early on prior to a translocation to ensure all permitting requirements are met. This will likely be different from state to state and managers from the receiving state (Pennsylvania) will communicate with those from the source state long before traps are set.

Air vs. Ground - Two primary methods of transportation have been employed by managers in the past when moving species. Vehicular ground transportation has been used most commonly, but shipment by air has occurred as well. Both options present unique challenges with ground transportation taking up a significant portion of staff time while air transport involves moving live animals through a populated airport setting as well as

a period of no access. Because in temporary captivity martens appear to have low stress and high survival (J. Kolbe, personal communication), either air or ground transport should be sufficient. Ground transport has the advantage of constant contact with animals to continually assess health, provide food and water, and address emergencies. Air travel may be much faster however and should be considered for travel from Canadian provinces or states further than a single day's drive. Depending on distance, relay driving may be the best option to avoid driver fatigue. Managers moving martens across the international border will require a valid passport.

Whether air or ground travel, marten should be kept separated and within their holding boxes. If holding cages are attached, dividers should be provided to prevent disease transmission or potential harm from other martens. Water and food should continue to be supplied as available during transport following holding recommendations. When transporting during the warmer months managers should keep holding boxes in a cool place to avoid overheating. A box trailer outfitted with necessary shelving to secure holding boxes as well as house supplies is likely the best option for transporting larger numbers of martens. For smaller numbers a pickup truck with cap and tie offs for securing holding boxes will be important. Organization will be key for border agents to easily assess animal care and cargo when crossing the border.

Air Shipping - If shipping through air transport, early communications with airlines to identify which carriers are best suited for this project will be important. Dependent upon flights and holding facilities in Pennsylvania, several nearby airports should provide the ability to receive these shipment types including Philadelphia, Pittsburgh, Baltimore, and potentially Harrisburg. Considerations for air transport include appropriate paperwork in full, making reservations, following container regulations as well as proper labeling. It is the responsibility of the shipper to provide detailed instructions for care and feeding during transport if necessary. Coordination from the source trapping coordinator to the receiving agency coordinator should include all necessary paperwork and itinerary to ensure martens are promptly in receipt of the appropriate individual after landing. Martens should then be immediately moved to their holding location.

Holding

Following transport from source to Pennsylvania, martens will be transferred to the care of a holding facility. Pennsylvania is fortunate to have two primary partners willing to act as holding facilities, the Elmwood Park Zoo in Norristown, PA and Hershey's ZooAmerica in Hershey, PA. These facilities are accredited by the Association of Zoos and Aquariums (AZA). Other potential cooperators for holding may be academic or research institutions such as the Pennsylvania State University as was done with the river otter reintroduction (Serfass et al. 1993).

Holding facilities will have the ability to provide a higher level of care for marten as well as temperature-controlled areas with ample room for storage of 20 holding boxes and cages. Cage designs vary, but holding cages used for black-footed ferret (*Mustela nigripes*) present a suitable option for martens in temporary captivity (USFWS 2017). Facilities will have a clean indoor

location to conduct treatment and sampling, as well as emergency treatment capabilities and any necessary tools for proper animal care. Facilities will have exam tables, gas anesthesia equipment, radiograph generators, emergency treatment units and digital radiography. Staff at holding facilities should have sufficient training in animal care and will be trained on specific care concerns for marten.

Captive marten will continue to be always provided with water and food/nutritional supplements as was provided in holding at the source location (see *Holding at Source* section). Holding times may vary depending on the care needed or if additional sampling and testing are required. In the event of long-term holding needs (i.e., >3 weeks), both preventative health and enrichment plans may be needed. Should additional disease or parasite testing be needed, longer term care may be required. Holding facilities should work closely with PGC staff if additional supplies are needed prior to or during care of animals.

Release

As timing of release approaches, managers should ensure that all marten in holding appear healthy exhibiting normal behavior. Transport from holding to release will follow similar recommendations as was stated previously in the *Transportation* section.

Release Type - A variety of different methods of release have been utilized for marten reintroduction efforts. Generally, they fit into one of two categories labeled 'hard' or 'soft' releases (Mengak 2018). Hard releases are often thought of as the release of an individual as quickly as is possible after capture and directly into the environment with little to no period of adjustment to factors like food, climate, vegetation, or habitat. A soft release is one where individuals are kept within an enclosure inside of the release location and allowed time to adjust to available food resources, habitat, climate, etc. In some cases, soft releases provide additional food resources or cover post-release as well. This of course is a spectrum, with some hard releases happening same day, documented soft releases taking a matter of months, and a wide variation in between. Powell et al. (2012) did not determine whether release type had an impact on success. Powell et al. (2012) noted that soft releases had 100% success while hard releases had 77%, but the discrepancy with hard release had the confounding factor of number of individuals released, with all failures having very few individuals. Slough (1994) recommended short handling and transport periods to reduce stress and disorientation. Although hard releases are generally favored, specifically for species that do not tolerate acute or chronic stress (i.e., game birds), in some cases soft releases are necessary for mammals. In this case, managers will attempt hard releases directly from the holding facility into the release site. Hard releases were used for both otter (Serfass 1996) and fisher (Hardisky 2001) successfully.

Release Coordination and Access - Communications will be important with all partners ahead of a release. Pennsylvania Game Commission coordinators should work closely with DCNR headquarters and district staff, USFS staff and PGC region staff well in advance of a release to pinpoint exact locations, mode of transportation, and route of entry. Certain release sites may have additional restrictions on access or entry so they should be evaluated prior to arrival. Working with local land managers before and

during a release will head off unforeseen problems that would otherwise arise without local knowledge.

With most release sites being remote and often difficult to access, releases may pose a challenge to staff. Releases should be completed by trained personnel and coordinated by the PGC furbearer specialist. Many releases may involve backpacking marten in by trail to reach targeted release locations. Other's may be available to access by unimproved or improved roads. Snow cover may preclude 4 wheeled vehicle travel and necessitate the use of snowmobiles. Managers should ensure that vehicles of all types are prepared and ready for use prior to any release. Partners may have specialized equipment available to assist the release team as needed.

Release Timing – Slough (1989, 1994) reported that home ranges can shift or change between the months of February and September. This is also thought to be the time for dispersal. He recommended avoiding this period for release and instead targeting between October and January, which may encourage newly liberated animals to establish home ranges near the release location. This timing would coincide with most trapping seasons and agree with a plan to utilize trappers during the open harvest season within source locations. Winter translocation would not negatively impact pregnant females and would likely improve results assuming that most females will contribute to recruitment within 6 months of release. Releases should occur during stable weather patterns and not just prior to major weather events that could negatively impact an individual that is unfamiliar with a location. Releases should also occur no less than two hours prior to nightfall to allow an individual time to locate cover if needed and prevent mortality from owls. When releasing in a designated location, Montana researchers released in small clusters (5) with several at the same location and then traveling up to 15 miles to release another cluster. It was highly dependent on the availability and location of the most suitable habitat but generally managers attempted to place throughout the entirety of the area with females well distributed (J. Kolbe, personal communication).

Release Structure - Releasing the optimal number of individuals for a self-sustaining population within all selected release locations in a single year would be best case scenario. Unfortunately, this is highly unlikely knowing that many factors such as source population abundance, weather conditions, trapping success, and trapping participation can vary from year to year and influence the number of available martens for translocation. Translocation efforts within Pennsylvania have ranged from 4 years for 192 fishers (Hardisky 2001) and 6 years for 2,328 ring-necked pheasants (*Phasianus colchicus*; Klinger and Keller 2019) to over 20 years for 153 river otters (Serfass et al. 2003). This project will focus on one release site at a time, attempting to fulfill the minimum founder population target within a given year. If additional marten become available a second release location can begin releases. With this target in mind, release goal would be over a 5-year period, although it should be understood it may take longer to reach target numbers within each location.

Public Release Opportunities – Building public support prior to a reintroduction effort is key but maintaining it during an effort is just as important. Part of our approach is to provide opportunities for the public to

experience the release process, which is often considered the most gratifying portion of a reintroduction program. This can be accomplished by working with press and holding several opportunities to conduct a small release within an area of easy access. The challenge is not compromising the survival or establishment potential for the animals while at the same time providing an experience for the public to 'join' the effort and take ownership. Providing opportunities for contributing partners is also invaluable in allowing them to experience a part of what they've worked toward. These can often be invitations to assist or accompany biologists and researchers into release areas when releasing and won't be as challenging as press events. Both are critical to the continued support of this project.

Techniques for Encouraging Establishment – Some consideration has been given to attempt to prevent marten from dispersing an extended distance from a release area. Recommendations for European pine marten (*Martes martes*) described using feces, urine, and anal scent within an area prior to release to encourage martens to settle within that location believing that other martens are or were there recently (Pulliainen 1982, Slough 1994). This same idea of an already established social system attracting and holding newly released animals could potentially be developed through multiple releases over time in a specific area.

Augmentation – Although briefly covered throughout other sections, there is the potential recommendation for future augmentation releases. This has the advantage of injecting additional genetic diversity and has been found to be helpful in both marten and other species experiencing genetic structure impacts (Smyser et al. 2013). Montana's marten reintroduction managers plan to augment every 5-10 years with up to 10 individuals (J. Kolbe, personal communication). This will be a continual consideration for this project but should only be utilized as needed based on genetic sampling to determine population heterozygosity which should occur periodically.

Jackson Strickler, Grade 10, Myerstown, PA

Research and Monitoring

The monitoring of a reintroduction effort is important in measuring success or failure. It also presents a secondary objective, which is to inform adaptative management practices should they be needed throughout the translocation process (Lewis 2006). Early historic translocations used a variety of passive methods to monitor efforts. Slough (1994) references winter track counts, snow tracking, live trapping, fur harvest returns, and anecdotes used in the 1960s and -70s (van Zyll de Jong 1969, Schupbach 1977). Telemetry became common in later research, but most monitoring was focused within year one, and little occurred past year three post reintroduction.

Monitoring should focus on several important factors that are imperative to understand when measuring success. When conducting fisher reintroduction in Washington, Lewis (2006) chose to focus on survival, reproduction, movement, and home range establishment. He also referenced recruitment and population expansion, two key aspects of successful reintroductions. Research and monitoring should also focus on factors such as diet, dispersal, and associated species of concern. Monitoring should begin with the first released individuals and continue indefinitely, albeit at a lesser intensity. The assumed failure of reintroduction in Vermont in 1991 (Moruzzi et al. 2003) was based on several years of limited monitoring and proved a success over 25 years later following additional monitoring after anecdotal evidence surfaced that marten persisted over time (O'brien et al. 2018). Marten populations grow slowly because of their limited reproduction potential based on sexual maturity and small litter size (Slough 1994) and require close monitoring over long-periods to achieve a true assessment.

This project will replicate other reintroduction efforts (Lewis 2006) and establish a marten recovery team to develop appropriate monitoring techniques and make adaptive management decisions while evaluating reintroduction success. This group should include PGC species specialists, PGC veterinarian, release location agency representatives, academic research partners, NGO partners, and others who will contribute to monitoring and research focus.

Survival and Mortality

Survival is an important aspect of understanding population establishment. Modern survival estimation techniques primarily rely on telemetry. Ensuring that females can survive to reproduction and successful completion of the next generation is critical. Survival should be monitored throughout the year to measure seasonal impacts, and individuals may need to be recaptured to have their collars replaced over the long-term. Once mortality occurs, researchers can promptly locate and attempt to determine cause of mortality (Bull and Heater 2001). Following a necropsy, identification of mammalian or raptor predators, and affliction by injury, diseases or parasites can be determined (McCann et al. 2010).

Movement

Post-release movements of animals can provide insight into a variety of behaviors of the reintroduced animals. As martens are released, most will first attempt to locate suitable habitat in which to establish a home range. Using telemetry, home ranges can be mapped, and when established, provide data on resource use. Estimating home range size through telemetry also can provide indications of habitat quality and indirectly assess the suitability of a release area. Some individuals may travel long distances prior to establishing a home range (see *Dispersal* section) or may remain transitory without a home range for some time. With GPS-capable collars, these instances will provide information on how these animals use the landscape, and what habitat features may be used to facilitate dispersal and are selected during these movements. Dispersal also should be researched post-reproduction.

Whether capturing and marking young or using genetic analyses, learning about dispersal distances and overland movements of young as they seek to establish territory is important to future management.

Habitat Selection

As marten establish home ranges, managers will need to determine what specific habitat characteristics they are selecting in Pennsylvania. This may be critical early to make adaptive decisions on future release locations and ensure appropriate habitat management. Habitat selection at a variety of scales is important whether that be at rest-site selection up to landscape scale or in between with forest stand scale. Using telemetry-based home range estimation will be the basis for analyzing habitat selection through large scale GIS based modeling (Chapin et al. 1997, Potvin et al. 2000) or finer-scale traditional vegetation surveys (Sanders et al. 2017). Sex-specific habitat selection data should be analyzed. Results may better inform the habitat suitability model designed for Pennsylvania as part of the Feasibility Assessment.

Reproduction

Documentation of natural reproduction is an important goal within a reintroduction effort. A variety of methods can be used to document reintroduction and recruitment within a population. Telemetry data will allow managers to identify denning locations of pregnant females. Once a denning location has been identified, in-person kit sightings, vocalizations, PIT tag readers, or remote camera detections (Kujawa et al. 2014, Bull and Heater 2001) will be used to determine if reproduction has occurred. Capture of females with evidence of lactation or capture of kits also confirms reproduction and provides information on litter size, sex ratio, health, etc. Other evidence of reproduction can be gathered by genetic analysis of hair, unmarked individuals incidentally captured or found dead, or photographic evidence of unmarked animals (Lewis 2006).

Diet

Many diet studies have been conducted (see *Diet* section) across marten range, however monitoring marten diet in Pennsylvania is very important. This has implications about where marten have the most abundant and highest quality resources and if these resources vary seasonally. Diet research will investigate both the founder population and successive generations to understand if diet changes generationally after establishment. Researchers should use scat sampling, located through telemetry or detection dogs (Kelly et al. 2012) if readily available, and stomach contents from recovered mortalities. In addition, tick specific surveys can be completed, assessing how marten influence transmission of tick-borne diseases through preying on intermediate hosts presents important research for Pennsylvania (Ostfeld and Holt 2004).

Other Species Monitoring

Pending concern or interest and in consultation with colleagues, additional surveys may be completed focusing on other species as warranted. These surveys will follow guidance from species specialists and tested methodology. Species of Greatest Conservation Need should be given priority.

Monitoring Tools and Techniques

Telemetry - Modern tracking techniques primarily use telemetry, specifically Global Positioning System (GPS) technology. Historically, successful marten research

often relied on Very High Frequency (VHF) telemetry units (Thompson et al. 2001). The limitations of ground-based and aerial VHF include an immense cost associated with staff time in remote locations, flight time, and fuel. Although GPS telemetry systems have a high initial cost, GPS units are programmable to collect specific required data, they require less labor to collect and retrieve data, and they have been used successfully on marten in other research (Moriarty and Epps 2015, Doster et al. 2015, Martin et al. 2019, Thompson et al. 2001). Considering survival, incorporating a mortality signal function with the programming will be essential. Telemetry is critical for almost all aspects of monitoring and research including survival, home range establishment, dispersal, and habitat use.

Genomics - Genetic monitoring will be an important component used for this project. It enables analyses of population dynamics through genetic markers, keying in on spatio-temporal dynamics, and providing critical testing of genetic diversity at release and into the future (Foran et al. 1997, Schwartz et al. 2012). Each translocated marten will have a genetic sample collected during anesthetization (see *Sampling and Marking* section). This provides a library of individual genetics representing the founder population. During release and post-release periods, passive genetic monitoring techniques such as hair snares (Pauli et al. 2008) can be used in a standardized DNA mark-recapture method (Boulanger et al. 2008) to estimate occupancy, calculate population estimates (Mowat and Paetkau 2002), understand reproduction including parentage of and mate selection for an individual, and quantify dispersal and movements (Lewis 2006).

Capture and Marking – Recapture of founder individuals and capture of unmarked individuals can provide important information on reintroduction. Telemetry collars and PIT tags will be the primary tracking methods, in addition to the genetic sampling. Montana researchers are using a unique approach of installing PIT tag readers in combination with hair snares with a bait attractant to lure an individual over the reader (J. Kolbe, personal communication). Whenever animals are in hand, opportunities for additional sampling and measuring can take place.

Camera Surveys – The use of remote cameras is an increasingly popular and important aspect of passive monitoring and research for marten (Moriarty et al. 2018, Raphael 1994, Kelly et al. 2012). Remote camera surveys offer a reliable and effective method for detecting marten (Evans et al. 2019) and determining occupancy (Fuller et al. 2016). Cameras also are important for assessing recruitment by allowing us to determine if detected individuals have been previously marked.

Observational and Incidental Surveys – Confirmed sightings can act as an important tool to know whether marten persist within an area or have occupied new areas. Soliciting sightings from the public can be an option and a sighting tool could be developed to assist with collection and analysis. Similar methods already being used by the PGC are the annual State Game Warden Furbearer Survey and the Furtakers Survey (Keller 2022b). These reach both wardens and trappers inquiring about incidental captures and general population trends of marten within their game warden districts and Wildlife Management Units.

Track Surveys – Snow track transects have long been used as a technique to measure relative abundance with marten (Douglas and Strickland 1987, Raphael 1994). A similar method used for many carnivores is the sooted track plate survey, which can be used when snow cover isn't present (Barrett 1983, Raphael 1994). Track surveys can provide data on habitat use during winter.

Measuring Success

Most previous translocation efforts are considered successful when a self-sustaining population persists in the long-term. While few have set a particular population goal, Vermont and Wisconsin's reintroductions efforts set goals of 300 individuals (Gieck 1986, DiStefano et al. 1989) over several years. In some cases, harvest was considered a goal, while in others there was no intention for future harvest. Other studies cited maintaining the genetic diversity of the founding population as a measure of success (Slough 1994). For Pennsylvania, success will follow the same path as many other efforts, seeking long-term persistence of a self-sustaining population. An important aspect of that, however, does consider genetics, and sampling should continue through the distant future. Should populations reach a harvestable level, a limited opportunity to harvest will be considered as an important aspect of management. Please note that although sustainable harvest should be considered in the future, it is unlikely to occur within this 10-year plan.

Communications, Education, and Information

The social aspects of wildlife management have always held importance but are arguably becoming more significant, especially regarding reintroductions and specifically of carnivores. Past efforts have seen great success or perceived failure due primarily to effective communications, or the lack thereof, when reintroducing predatory species (Serfass et al. 2014, Serfass et al. 2003, Bath 2008). With human tolerance and public perception of predators still somewhat of a challenge to overcome for carnivore conservation (Treves and Bruskotter 2014, Treves et al. 2017), intensive communication efforts are needed to educate and inform.

Madison Robbins, Grade 12, Dallas, PA

Target Audience

Prior to embarking on an education campaign, managers should first identify who should receive the information, and if and where there are specific groups that may be especially in need of outreach efforts. These may be groups the agency has a history of working or that have been identified as potentially benefiting from outreach and education. For this project, groups were selected with the assumption that they may have specific concerns or questions regarding

other species or domestic animals and impacts from a marten reintroduction.

- Legislators and gubernatorial staff – local/statewide
- Game Commission staff and Board of Commissioners
- Other State and Federal Agency staff
- General Public, more specifically:
  - Resident and non-resident hunters
  - Resident and non-resident trappers
  - Livestock growers -specifically poultry and backyard flock raisers
  - Hunter-trapper education instructors and students
  - Conservation groups and non-profit wildlife organizations
  - Sportsmen's clubs
  - Landowners-specifically Forest owners within the northern tier
  - Naturalists (nature enthusiasts)
  - Zoo visitors
- Media:
  - Newspapers – key local and regional
  - Outdoor reporters
  - Editorial boards
  - Bloggers and focused websites (where appropriate)
  - Local television outlets
  - Local radio outlets

Stakeholder and Partner Organizations

As with all projects where partnership is key, providing regular communication and updated information to interested stakeholders and potential partners should be a top priority. During the development of the Feasibility Assessment and this current plan, many of these organizations were either a part of the working group, solicited for information or feedback, or provided with information throughout the process. These will continue to be important moving forward with the development and review of this plan, and if this project moves forward towards reintroduction. It should be noted that this list is not exhaustive.

- Pennsylvania Department of Conservation and Natural Resources
- U.S. Forest Service
- U.S. Fish and Wildlife Service
- Pennsylvania Fish and Boat Commission
- Seneca Nation of Indians
- Pennsylvania Federation of Sportsmen and Conservationists
- Pennsylvania Trappers Association
- The Wildlife Society, Pennsylvania Chapter
- The Mammal Technical Committee of the PA Biological Survey
- Western Pennsylvania Conservancy
- Wildlife Futures Program
- Audubon Pennsylvania
- National Wild Turkey Federation
- Ruffed Grouse Society/American Woodcock Society
- Elmwood Park Zoo
- Hershey ZooAmerica
- Hawk Mountain Sanctuary
- Indiana University of Pennsylvania
- University of Minnesota Duluth
- New York State Department of Environmental Conservation
- Vermont Fish and Wildlife
- Maine Department of Inland Fisheries and Wildlife
- Michigan Department of Natural Resources
- Wisconsin Department of Natural Resources
- Minnesota Department of Natural Resources

- Ontario Ministry of Natural Resources and Forestry
- Quebec Ministry of Natural Resources
- New Brunswick Natural Resources and Energy Development
- Canadian Wildlife Service

Education Needs

Several strategies can be employed to better understand what messaging is most important when developing an education campaign. Evaluating feedback through online or in-person question and answer sessions will be important sources for developing a list of frequently asked questions. Focus groups or individual interviews through a third party have also solicited excellent feedback. Through these processes and others, several recurring concerns or questions arose and assisted in identifying the primary education needs regarding this project.

- Physical description primarily focusing on size
- General diet
- Potential impacts to other species (primarily wild turkey and ruffed grouse)
- Threat to livestock (domestic chickens)
- Potential impacts to land management practices and fossil fuel extraction
- Additional trapping restrictions

Resource Development

As part of an education campaign, well established resources should be developed and maintained within accessible locations for both target audiences, staff, and partners. Core documents like feasibility assessments and reintroduction plans are important but often only referenced by a few due to their complexity and overall length. Resources that are to the point and provide a summary or quickly share the important information to the general reader are just as important when communicating about the issue. These resources should be developed prior to engagement with the public if possible. A variety of important resources already exist as a part of this project and can be found within the strategies below. To view many of these visit the project StoryMap through the QR code (Fig. 24).

Figure 24. A QR code developed to direct the public towards the PA marten Story Map for more information. M. Weaver 2023.

Focus Group – To better understand the concerns of turkey hunters within Pennsylvania and how to communicate more effectively about this project, the PGC partnered with The Center for Survey Research (CSR) at The Pennsylvania State University, Harrisburg. The CSR completed an in-person focus group and ten in-depth interviews with individual turkey hunters. Successful turkey hunters were selected both from the core potential marten release area of Pennsylvania for the independent interviews, while ten others were selected from the Harrisburg area to participate in the focus group. Of the ten selected, only eight participated in the focus group. Question topics covered turkey hunting, turkey

population management, species reintroduction, and marten reintroduction.

Key findings were as follows:

- Hunters differed on current state of the turkey population based on regions.
- Hunters greatest concern for turkey population impacts was predators.
- Hunters cautiously supported species reintroduction for ecosystem balance.
- Hunters either had strong knowledge of marten, or little to no knowledge (no middle-ground)
- Hunters that supported reintroduction cited increasing diversity, minimal consequences, and returning a native species as justification.
- Hunters that opposed reintroduction cited a distrust of the PGC and thus the information relating to the project.
- Hunters requested a synthesized form of the feasibility assessment be made available through print and digital media to a wide range of hunters.

Statewide Information and Education Campaign

Beginning in 2022, the PGC furbearer specialist began presenting information on the project to the public through a variety of methods. A presentation was developed focusing on the history of wildlife loss in Pennsylvania, its recovery to date, results from the American marten feasibility assessment, and the decision-making process to reintroduce. Each formal presentation concluded by reviewing the FAQ's developed for the project and then a question-and-answer session. Unless a time constraint was in place (i.e., another speaker) all questions and concerns were addressed. Between June 2022 through September 2023, over 80 public presentations and open houses were given throughout the state reaching at least 5,500 people in person (Fig. 25) and 40 organizations (Appx. 9). Although an intensive amount of work, this strategy was critical in helping to dispel misinformation in many communities and offer all Pennsylvanian's an opportunity to learn more in person and ask questions or provide comments/concerns.

Other strategies were employed including 20 interviews for print and radio, 8 articles written for popular print, 4 podcasts, social media posts, a project highlight video, a webinar, a GIS Story Map, project brochure with associated informationals, wildlife note, marten webpage, and email resource account. In addition, an art contest was held for all middle and high school students within Pennsylvania to help increase awareness of the project and encourage wildlife art and conservation. That artwork fills this document.

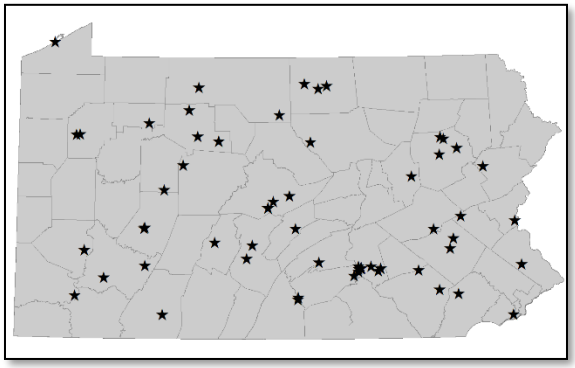


Figure 25. Information and Education Campaign stops throughout Pennsylvania in 2022 and 2023. T. Keller.

Cooperative Partnerships

Public Land Management Partners

Reintroduction efforts often hinge on maintaining the needed habitat for the reintroduced species in the long-term. Many public land agencies have management plans

that extend upwards of 100 years or more and these plans focus on enduring sustainability of our natural resources (DCNR 2016, 2020, PGC 2020, USFS 2007). Pennsylvania is fortunate to have an extensive number of public lands with over 4.5 million acres owned by the DCNR, USFS, and PGC alone. Much of the forested landcover within the state considered public is owned and managed by these agencies. Although primary goals can differ for each agency, many are similar including topics such as forest health, recreation, and wildlife habitat management (PGC 2020, DCNR 2020, USFS 2007).

Unlike humans, wildlife is not bounded by political lines drawn on a map and therefore, it's critical for public land agencies to work together for the good of natural resources as they represent stewards of these resources for the people within the Public Trust (COP 1971). As the PGC worked through the feasibility assessment and planning process, agencies like the USFS and DCNR were invited to engage throughout the process as allies in managing Pennsylvania's wildlife and habitats. With much of the highly suitable habitat falling within these agencies' borders, it was important to ensure that concerns from each agency were addressed early on and that a project such as this aligns with the overall mission and goals of said agencies. In April of 2023, both DCNR and USFS drafted formal letters of support for the project and cemented their dedication to this partnership working towards restoration of an extirpated species (Appx. 6). Throughout the continued planning process and if approved for executing this plan, these partners will continue to be critical in forging ahead.

Halie Krieg, Grade 8, Lake City, PA

Source Partners

When a species is extirpated from its native home, only two forms of re-establishment are possible, those being immigration from dispersal and natural range expansion or human-assisted translocation. The nearest extant marten population is found in the Adirondack Mountains of New York State. Natural expansion of marten into Pennsylvania from the Adirondack population is highly unlikely due to the roughly 209 km of unsuitable habitat in between. This unsuitable habitat is driven primarily by agriculture, residential, and commercial development. This expanse of unsuitable habitat has been solidified as modern agricultural practices have been adopted and the human population continues to grow. If natural recolonization of marten into Pennsylvania from the Adirondacks were to have occurred, it would have likely happened in the past 100 years and the

absence of marten in Pennsylvania show that non-forested areas and transportation corridors serve as barriers to marten dispersal. Therefore, if we aim to have a self-sustaining population of marten in Pennsylvania, human assisted translocation is the only option.

Identifying a source for translocation has a variety of considerations. Source locations should have an abundant population from which to draw from ensuring that removal of individuals would not negatively impact the long-term local population (IUCN 2019). Managers should consider a cursory evaluation of health for source populations to promote a strong founder population as well as prevent disease spread post-release. As presented in the *Source Population* section, having a multitude of source partners has great benefits in order to ease the burden rather than place it on a single partner.

Building these partnerships started early, prior to the completion of the Feasibility Assessment. Talking with state and provincial biologists and managers was an important part of the Assessment as well as asking for their professional review. Following this, providing regular updates on the project has been important and having an informal conversation concerning the general feelings or attitudes towards partnership was critical. For states or provinces that were interested in pursuing a partnership, a formal request letter was drafted. Both parties reviewed the language at the biologist level prior to moving up through the chain of command within the Pennsylvania Game Commission, ultimately signed and sent from the Executive Director. The letter was sent to the similar level of authority within the potential source partners wildlife agency, requesting a show of support if interested in partnering.

As of this draft, six letters requesting support have been mailed, and discussions are continuing for an additional four letters to potentially go out in the future. Three letters indicating interest in potential partnership pending the approval of this plan have returned, those coming from Michigan Department of Natural Resources, Maine Department of Inland Fisheries and Wildlife, and New York State Department of Environmental Conservation (Appx. 7). Having support prior to the acceptance of this plan is invaluable knowing that if the plan would move forward, source populations are available, and partners are willing to consider working together.

Research Partners

As with any reintroduction effort, research and monitoring is imperative. It not only evaluates the overall success of the project and informs managers on needed changes as necessary, but it also adds to the overall collective knowledge for current and future generations. There is significant opportunity with an effort like this. Understanding basic biologic vitals such as survival, fecundity, recruitment, mortality, and population estimation will be critical when assessing establishment. Additional research can also target questions pertaining to habitat preference, source population strength, genetic diversity, and a variety of other important factors.

The PGC is limited on its ability to conduct research as needed due to staff availability and the plethora of other responsibilities that encompass staff time. This necessitates the need for research partners, and fortunately, the agency has

always worked in tandem with academic professionals from across the globe. This could mean anything from undergraduate projects, masters student thesis projects, PhD candidate dissertations, or post-doctoral work. This project has the potential to provide research opportunities to partnering academia, and being a reintroduction, will likely be extremely attractive to many.

Pennsylvania is fortunate to have many academic institutions in state or within bordering states that have a well-developed relationship. These partnerships have led to many strong research projects within the past and have well-developed understandings of partner requirements. The PGC will likely pursue research interest from current partners initially, but knowing the inherent importance of this project, will be looking to find the right fit with proper experience for this effort. Research partners will be identified should the plan be accepted.

Stakeholder Partners

As the process of developing the Feasibility Assessment and this plan have moved forward, so has the engagement of many key stakeholders within Pennsylvania. This was an important aspect of the communications planning and continues to be as we have solicited review of the management plan. Several key stakeholders have provided support for the project, much of it in helping to communicate the process and educate/inform their constituency and the public. Others have pledged financial support or services support in the case of animal care and health assessments (Appx. 8). If this project were to move ahead, partnerships with key stakeholders throughout the state and abroad will be instrumental in making progress and seeing reintroduction through to a successful conclusion.

Plan Management

Adaptive Management

Success of any reintroduction is highly dependent on the adaptability of the plan and the staff involved. Making course corrections along the journey can mean the difference between failure and success. Although plans are meant to be followed, it should be stated that this plan will have fluidity and provides a guidance document that can be altered as necessary. Much of what is learned as the process unfolds will inform deviations from this plan if needed. The marten reintroduction team will play an important role in evaluating and making those decisions and regularly updating the plan as necessary. This plan was sent to 64 individuals for review representing a diverse group of stakeholders and partners, content experts and colleagues from across the country and within Pennsylvania.

Long-term Management

If the project realizes success with the eventual establishment of the American marten in Pennsylvania, this plan will be transitioned from a reintroduction plan to a management plan. This follows the track PGC has taken with the reintroduction of fisher, bald eagle, elk, and river otter. Annual monitoring programs would be established utilizing some of the same methods that other successfully reintroduced species have adopted. Developing annual population indices will be important to track changes in population over time and measures of occupancy will provide updated information to managers on how these populations are faring on the landscape. Similar methods will

likely be used as other furbearers have (Keller 2022b; see *Observational and Incidental Surveys*).

Harvest - As with other furbearer species that have had successful reintroductions to Pennsylvania, including river otter, fisher, and beaver, providing harvest opportunity will likely be an important aspect of long-term management and should be considered once populations reach a level able to sustain harvest. In some cases, population stabilization can be achieved through harvest (Strickland 1994), and managers have the ability to more easily manipulate stable populations because harvest presents a tool to better understand small changes over time (Powell 1994). Sustainable harvest presents many benefits to a population because it allows for important data collection within that population. Trappers have always played a critical role in managing furbearing species within Pennsylvania by partnering with the PGC and providing information on trapping effort as well as incidental capture, and carcass collection.

Harvest management must consider many factors including population density and occupancy across the landscape, habitat suitability and related carrying capacity, as well as social aspects that come into play. Few examples exist of states or provinces providing targets for a sustainable population for a harvest. Maine provides one of the more detailed explanations of how they've set harvest targets (Strickland 1994, Maine Department of Inland Fisheries and Wildlife [MDIFW] 2020) through a population estimate based on habitat availability, followed by a maximum allowable harvest at one marten per square mile. This was assuming that carrying capacity had been reached within core habitat (MDIFW 2020). Maine's biologists monitor a variety of trapping indices (harvest, rate of success, and effort) and habitat availability to set seasons and bag limits. Current harvest objectives are 3,000 martens, which is approximately 17% of their estimated marten population in 1990.

Following this example, Pennsylvania would need to collect data on carrying capacity within the state to develop a framework for harvest. Based on current habitat suitability modeling for Pennsylvania and high and optimal contiguous habitat (see *Habitat Modeling* section), models suggest that Pennsylvania could potentially support an estimated 29,427 martens, although this is not a current goal or estimate needed for harvest. If Pennsylvania followed Maine's example of 17% (MDIFW 2020), over 4,600 martens could be harvested sustainably. Despite the estimates presented here, more accurate habitat availability and carrying capacity estimates would be needed using data collected from research and monitoring efforts during the reintroduction. Like other furbearers that have been reintroduced, Pennsylvania would likely take a very conservative approach to harvest through a limited number of permits to begin with, an abbreviated season, a limit of 1 marten per permit per year, or assigning permits through lottery. If research shows that additional animals can be harvested sustainably, managers would likely slowly open harvest opportunities as PGC has done with fisher and river otter. Regulations should include mandatory harvest reporting, and carcass surrender following the removal of the pelt for the first several years to collect needed data for management.

Conflict Management

Conflict management with all species is an important aspect of social considerations. The marten is a secretive species that resides in the core of the forest and wilderness areas throughout its range, so opportunity for conflict with humans or property (including livestock) are few. Should conflict arise, PGC staff should be notified and respond accordingly. During the period of population establishment, responding staff should attempt to resolve the conflict in a manner that will preserve the life of the offending animal. This may mean relocation as with problematic bears in the state, or assisting landowners with education, information, or additional resources as needed. If conflicts arise, staff should first contact the PGC furbearer specialist for additional support and instructions.

Resources and Support

Resources

Reintroduction efforts are herculean in scale and require significant resources to ensure success. Fortunately, the Pennsylvania Game Commission in partnership with supporting agencies and organizations finds now to be an appropriate time to move forward with such a consideration.

Staffing - The PGC is fully staffed and has more staff resources available to it now than ever. Regions now have additional biological staff throughout the state and additional support from bio-aides and seasonal internships that assist permanent staff with research and monitoring.

Wildlife Health - The Agency has a strong partnership with The University of Pennsylvania's PennVet Wildlife Futures Program, providing the ability to monitor and manage wildlife diseases statewide. With Futures staff housed within every region and Harrisburg headquarters, the PGC is uniquely positioned to work with the Wildlife Futures staff on health and disease concerns relating to marten reintroduction.

Research - The PGC continues to be a dedicated partner with the Pennsylvania Cooperative Fish and Wildlife Research Unit at the Pennsylvania State University, and commonly partners with other academic institutions in state such as Indiana University of Pennsylvania, Delaware Valley University, Shippensburg University, Juniata College, Pennsylvania Western University, and a variety of others.

External Partnerships – The PGC works collaboratively with many NGOs throughout the state on a large variety of projects. Habitat focuses on wetlands management (Ducks Unlimited), grassland management (Pheasants/Quail Forever), forest management (American Bird Conservancy, Ruffed Grouse Society), or a combination (National Wild Turkey Federation). Organizations like Audubon and Hawk Mountain Sanctuary partner on non-game bird research and management while land trusts like Western Pennsylvania Conservancy partner on both land acquisition and wildlife research through the Natural Heritage Program partnership. The list of external partners is long and growing, driving ingenuity and a diversity of projects in wildlife management.

Funding – Currently, the PGC has reached new levels of financial surplus. At the end of this past fiscal year (FY22), the Game Fund balance exceeded $253 million dollars, an increase from the previous year of over $110

million. There has never been a better time financially to pursue a project such as this. A reintroduction effort would neither pull money away from other research projects, nor from much needed habitat management projects within the state for species in decline.

Support – Reintroduction efforts are completely dependent on support from both the public and partners. Fortunately, this project has strong public support (see *Public Opinion* section), which has always been critical (Serfass et al. 2003, Watkins et al. 2021) in carnivore reintroductions. Support has also come from the primary public land holders within Pennsylvania, including the DCNR, USFS, and internally at PGC. Support has come from zoo facilities within the state willing to partner as a part of this effort. Support has come from the Pennsylvania chapter of The Wildlife Society, The Pennsylvania Trappers Association, and the Keystone Trails Association. Support has also come from other states to include Maine and Michigan in partnering as potential source locations.

Budget

Cost of a project has always been an important consideration within a reintroduction effort such as this. What should be made clear, is that the Pennsylvania Game Commission will provide the funding for all aspects of this project as needed. If partner agencies and organizations are interested in financially supporting this effort it would be welcomed, but total cost can be covered by the agency.

The budget provides individual line items (Appx. 9) as well as a 10-year overview (Table 1) for the life of the plan.

Year	One Time Cost	Translocation Cost	Long-term Monitoring
2024	$289,400	$63,179	
2025		$308,601	
2026		$308,601	
2027		$308,601	
2028		$308,601	
2029		$308,601	
2030			$60,000
2031			$60,000
2032			$60,000
2033			$60,000
Total	**$184,400**	**$1,606,184**	**$240,000**
10-Year Project Total = $2,030,584			

Table 1. Proposed 10-year budget for American marten reintroduction to Pennsylvania.

The total cost is reflective of a decade of needed resources to reintroduce a species. Much of these data were modeled after Lewis (2006). For a detailed annual budget with individual line-items see Appendix 10.

Timeline

For the success of any long-term management plan, a timeline should be developed. This allows managers to carefully track the completion of strategies and action items, ensuring each is addressed at the appropriate time within the extent of the plan. For a detailed timeline corresponds to the project goals, objectives, strategies, and action items see Appendix 11.

Conclusion

The value of wildlife in Pennsylvania has never been questioned by its residents. Over the past 100 years, Pennsylvania has led the nation in re-wilding efforts by reintroducing white-tailed deer, elk, bald eagles and wild turkeys to the forests and fields of this great state. Today's generation has benefited from the forethought of past managers and administrators making decisions to restore

species and habitat to the land years before they were born. Youth of today may take for granted herds of deer and flocks of turkeys spread across the landscape and barely give notice to a bald eagle riding the thermals overhead. Older generations don't take these things for granted however, as they remember a time without these animals. They remember when Cameron County did not have elk bugling in September. They remember when peregrine falcons were not seen winging through the towering buildings of Pittsburgh, and when beaver tails didn't break the silence of an early morning on the West Branch of the Susquehanna. If not for the wise decisions of a few, some who didn't see the end result but were only thinking of the future, the Pennsylvania wilds would be much less wild, and as a people, Pennsylvanians would be all the poorer for it. The essence of conservation is comprehending the wise decisions of yesterday having influenced the plenty of today while grasping the significance of tomorrow.

The American marten is one of the great icons of wilderness throughout North America. An opportunity to restore such a significant species to the wilderness of Pennsylvania comes along very seldomly. With the support of Pennsylvanians throughout the state, strong partnerships from within and outside of its borders, and clear feasibility, this plan provides a comprehensive science-based path forward. Whether a hunter, birder, trapper or hiker; a conservationist understands that the value of wilderness is not what can be extracted from it, but rather what can be returned to it.

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Aaron West, Grade 7, York PA

Appendix 1. A comparison of 13 American marten diet studies showing percent frequency of occurrence.

	ON[1]	WI[2]	MI[3]	OR[4]	NB[5]	MI[6]	ME[7]	CA[8]	MT[9]	AK[10]	ID[11]	MB[12]	CO[13]	Avg.
Small Mammals	**68.0%**	**64.3%**	**77.9%**	**80.1%**	**46.2%**	**100.0%**	**87.1%**	**24.6%**	**60.3%**	**58.0%**	**100.0%**	**20.5%**	**100.0%**	**68.2%**
Myodes gapperi (Red-backed Vole)	30.5	15.7	34.2	24.6			38.4		20.5	58	36	8.4	81	26.1
Microtus spp. (other voles)	8.8			27.4	26.4	31	38.1	16.1	39.1		30	10.2		24.2
Unknown Vole				12.7										12.7
Peromyscus spp. (mice)	21.2	10	19.9	7.8	4	59	3.6	6.3	0.7		2			13.5
Sorex spp. (shrews)	3.6	38.6	7.4	4.7	15.8		7	2.2			1	1.9	42	10.7
Blarina spp. (Short-tailed Shrews)	1.3		16.4			18								11.9
Other Small Mammals	2.6			2.9		27					43			18.9
Lagomorphs (Hare/Rabbits)	**13.0%**	**1.4%**	**0.9%**	**2.4%**	**8.0%**		**1.7%**	**4.9%**	**2.9%**		**2.0%**	**58.9%**	**6.0%**	**9.3%**
Lepus americanus (Snowhoe Hare)	13.0	1.4	0.9	1.4	8		1.7	4.9	2.9		2	58.9	6	9.2
Sylvilagus nuttallii (Mountain Cottontail)				0.9										0.9
Sciurids (Squirrels)	**1.7%**	**11.4%**	**15.7%**	**27.6%**	**11.2%**	**24.0%**	**7.3%**	**3.0%**	**4.5%**		**7.0%**	**15.9%**	**9.0%**	**11.5%**
Tamiasciurus hudsonicus (Red Squirrel)	0.8	10	5.5	3.3	10.8	3	6.6		4		5	15.9	9	6.7
Glaucomys spp. (flying squrrels)	0.5	1.4		4.3	0.4		0.5	3	0.2		2			1.5
Sciurus carolinensis (Gray squirrel)			6			12								9
Tamias striatus (Eastern Chipmunk)	0.4		4.2	2.7		9	0.2							3.3
Unknown squirrel				17.3					0.3					8.8
Birds	**1.8%**	**15.7%**	**5.5%**	**19.5%**	**14.8%**	**22.0%**	**18.0%**	**8.8%**	**12.0%**	**10.0%**	**5.0%**	**17.8%**	**9.0%**	**12.3%**
Bonasa umbellus (Ruffed Grouse)	1.6	4.3	0.2		12.2							4.7		4.6
Other Birds	0.2	11.4	5.3		2.6				12			13.1		7.4
Mustelids	**2.9%**	**4.3%**		**0.8%**	**0.9%**	**3.0%**		**2.2%**	**0.1%**				**7.5%**	**2.7%**
Martes americana (American Marten)	0.7	1.4			0.8	3		2.2						1.62
Mustela erminea (Short-tailed Weasel)	2.1	2.9		0.8	0.1									1.5
Mustela nivalis (Least Weasel)	0.2													
Other	**3.1%**	**31.4%**		**27.1%**	**4.1%**	**84.0%**	**9.2%**	**9.4%**	**26.1%**		**9.0%**		**29.5%**	**23.3%**
Neotoma cinerea (Bushy-tailed woodrat)				2.5										2.5
Cervidae spp. (Cervid carrion)		30		2	2.4		0.7	1.2	4.7				7	6.9
Insects	3.1	1.4		22.4	0.7	81	8.3	8	21.4		9		15.5	17.8
Fish				0.2	0.3		0.2	0.2					7	1.6
Amphibians					0.7									0.7
Reptiles						3								3
Plants	**9.5%**			**13.3%**	**2.4%**	**90.0%**	**11.5%**	**7.6%**	**39.7%**	**17.0%**	**12.0%**	**21.4%**	**14.0%**	**21.7%**
Soft Mast	9.5			8.5	2.4						12			8.1
Wood fibers, lichen, grass				4.8										4.8

[1]Thompson & Colgan (1990) Manitouwadge, Ontario
[2]Carlson et al. (2014) Northern Wisconsin
[3]Hales et al. (2008) Upper Peninsula of Michigan
[4]Bull (2000) Northeastern Oregon
[5]Cumberland et al. (2001) New Brunswick
[6]Kujawa et al. (2014) Lower Peninsula of Michigan
[7]Soutiere (1979) North-central Maine
[8]Zielinski et al. (1983) North-east California
[9]Weckwerth and Hawley (1962) North-west Montana
[10]Lensink et al. (1955) Interior Alaska
[11]Koehler and Hornocker (1977) Northern Idaho
[12]Raine (1981) South-eastern Manitoba
[13]Gordon (1986) North-central Colorado

Appendix 2. Penn State public opinion survey results for 2022 & 2023 and related questions.

		Gender					
		Man		Woman		Total	
		Count	Column N %	Count	Column N %	Count	Column N %
2022	Oppose	34	**7.4%**	35	**7.5%**	69	**7.5%**
	Support	423	**92.6%**	434	**92.5%**	857	**92.5%**
2023	Oppose	38	**8.2%**	48	**10.3%**	86	**9.3%**
	Support	424	**91.8%**	417	**89.7%**	841	**90.7%**
		Age - Recode - Broad Categories					
		18-34		35-64		65 and older	
		Count	Column N %	Count	Column N %	Count	Column N %
2022	Oppose	19	**6.9%**	34	**7.7%**	16	**7.7%**
	Support	257	**93.1%**	407	**92.3%**	193	**92.3%**
2023	Oppose	18	**6.9%**	41	**9.1%**	27	**9.3%**
	Support	244	**93.1%**	412	**90.9%**	185	**90.8%**
		Do you consider yourself a hunter?					
		Yes		No		Total	
		Count	Column N %	Count	Column N %	Count	Column N %
2022	Oppose	10	**8.5%**	59	**7.4%**	69	**7.5%**
	Support	108	**91.5%**	741	**92.6%**	849	**92.5%**
2023	Oppose	10	**10.4%**	76	**9.2%**	86	**9.3%**
	Support	86	**89.6%**	749	**90.8%**	835	**90.7%**

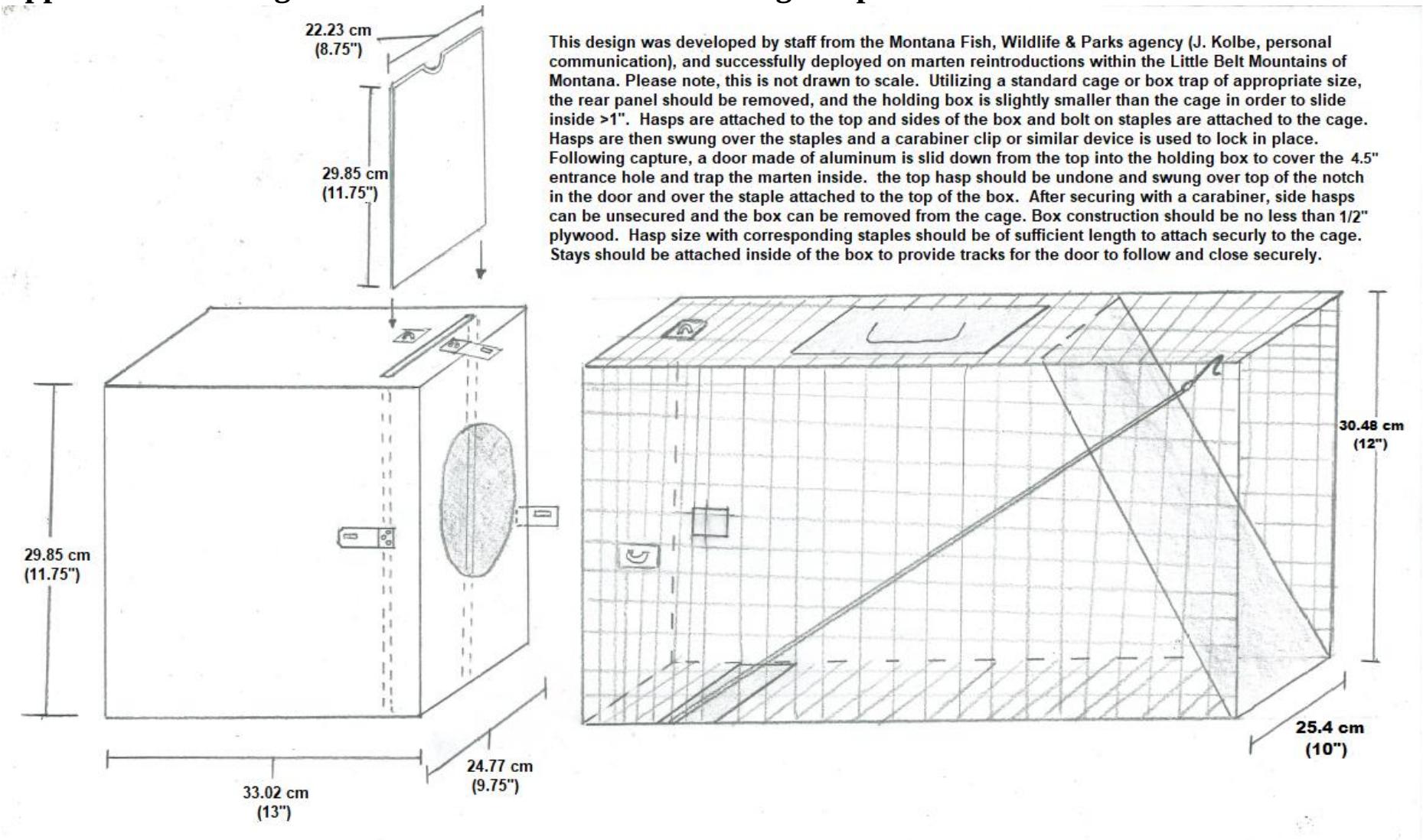
The below information occurred following the first question regardless of answer. It occurs directly before question 2.

Marten_Description. Please read the following information about the American marten carefully. The American marten is a small mammal that weighs about 1 to 3 pounds and measures 20 to 26 inches from its nose to the tip of its tail. Once native to Pennsylvania, it has disappeared from the state due to losing forest habitat in the late 1800s and early 1900s. There are still active populations in New York and other parts of the United States and Canada. It eats small animals, including squirrels, rodents, and birds, in addition to insects, fruits and nuts. Marten typically live in mature forested areas away from human development. This is a photo of an American marten.

Photo Credit. Robert Sanders

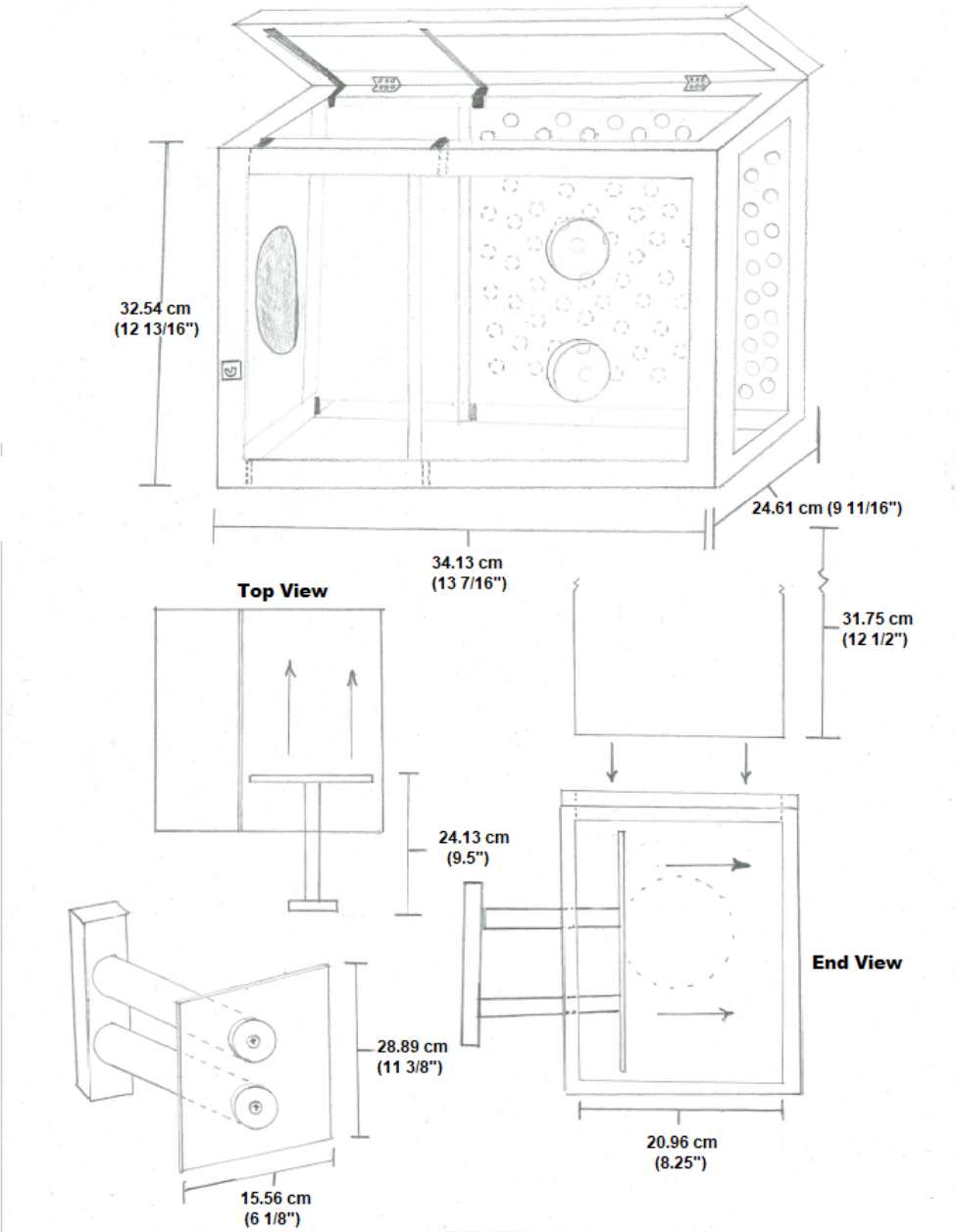
Marten Establish. The Pennsylvania Game Commission is looking at whether it might be possible to reintroduce the American marten in Pennsylvania.

Appendix 3. Holding box attachment for commercial cage trap.



Schematics drawn by T. Keller, 2023

Appendix 4. Handling box for American marten.



This design was developed by staff from the Montana Fish, Wildlife & Parks agency (J. Kolbe, personal communication), and successfully deployed on marten reintroduction within the Little Belt Mountains of Montana. Please note, this is not drawn to scale.

This handling box is designed to attach directly to the holding box through the use of the two side hasps attached to the holding box and the bolt on staples attached to the sides of the handling box. Utilize carabiners for a secure attachment. After attachment, the aluminum door on the holding box can be raised and allow the marten to move into the handling box. Once inside, an aluminum door can be slid down inside the handling box in the slot nearest the opening hole and trap the marten inside of the handling box.

Once inside the handling box, the marten can be trapped even further by inserting a second aluminum door through the lid and into the second slot nearest the plunger. The plunger can then be utilized to squeeze the marten into the opposite side wall that is covered with 3/8" sized holes to allow for injection if needed.

Construction of the primary structure is wooden framing with 1/4" plexiglass walls and lid excepting the entrance hole and floor which are 1/2" plywood. Two aluminum doors are needed for the handling box. Two sets of wooden stays are utilized on the inside to provide tracks for the door to follow and close securely.

The plunger is contructed of a plexiglass rectangle attached to 2 - 1.25"dowels with wood screws. Two 1" washers should be used opposite the dowels when attaching to the plexiglass to avoid fracture when tightening screws. Plexiglass should be pre-drilled for screw holes. Opposite the plexiglass rectangle, a simple block handle is attached and used to manipulate the plunger.

Plunger handle holes for dowel should be 1 3/8" to 1 1/2" through plexiglass and centers should match centers of dowels to prevent binding.

Entrance hole in handling box should match size and center of entrance hole in holding box (approximately 5" diameter).

Lid is hinged on side opposite plunger and two hasps (not pictured) are attached to the plunger side meeting with two staples attached to the uppor portion of the frame (not pictured) on the same side allowing for a secure latch with carabiners prior to allowing marten into the handling box. Once the animal is anesthetized, the hasps can be unlatched and the lid opened to retrieve.

Schematics drawn by T. Keller, 2023.

Appendix 5. American Marten Health Evaluation Form

Pre-Treatment Information

Marten ID Number: _____ Staff Name(s): _____

Capture Date: _____ Capture Location (State/Province: _____

Behavioral Notes Pre-Immobilization: _____

Anesthetics

Chemical Immobilization Method: _____

Drug 1: _____ Drug 2: _____ Drug 3: _____

Mixture: _____ Dosage: _____

Administered by (staff): _____ Injection Location: _____

Injection Type: IM SubQ IV ID

Vital Rates

Pulse: _____ Temperature: _____

Respiration: _____ Capillary Refill Time: _____

Morphological Information

Sex: M F Unk Age Method: Tooth Collection Tooth Wear Sagittal Crest

Approximate Age: Juvenile Yearling Adult Unknown

Weight (g): _____ Overall Length (cm): _____ Tail Length: (cm): _____

Rear Foot Length (cm): _____ Neck Circumference (cm): _____ Ear Length (cm): _____

Evaluation Checks

Broken Bones	Y / N	Wounds/Injuries	Y / N	All Canines Present	Y / N
Missing Limbs	Y / N	Missing Digits	Y / N	Disability	Y / N
Underweight	Y / N	Excessive tooth wear	Y / N	Diarrhea	Y / N
Hair Loss	Y / N	Parasite Infestation	Y / N	Eye/Nose Discharge	Y / N

Other: _____

Treatment

Injury 1: _____ Treatment: _____

Injury 2: _____ Treatment: _____

Injury 3: _____ Treatment: _____

Rabies Vaccination ☐ Distemper Vaccination ☐ Ectoparasite Treatment ☐

Endoparasite Treatment ☐

Sample Collection

DNA Sample Collection Method: Hair Tissue Blood Sample Labeled w/ID: ☐

Photographs (Chest markings, Overall Body, Injuries/Wounds, etc.) ☐

Following As Needed:

Blood Sample (Serum or Whole Blood): ☐ Fecal Sample (Endoparasite Loading): ☐

Ectoparasites (As Needed): ☐

Marking

PIT Tag ID: _____ PIT Tag Insertion Location: Between Shoulders Behind Ear

Collar Attached: Y / N Collar ID: _____ Collar Frequency: _____ Collar Test: ☐

Post-Treatment Care

Reversal Administered: Y / N Reversal: _____ Dosage: _____

Reactions Observed: Y / N Vitals Stable through Recovery: Y / N Full Recovery: Y / N

Notes:

Appendix 6. Letters of support from public landowner agencies.

pennsylvania
DEPARTMENT OF CONSERVATION
AND NATURAL RESOURCES

March 24, 2023

Pennsylvania Game Commission
Bureau of Wildlife Management
2001 Elmerton Ave
Harrisburg, PA 17110

Attn: Support for American Marten (*Martes americana*) Reintroduction in Pennsylvania

The Pennsylvania Department of Conservation and Natural Resources mission is to conserve and sustain Pennsylvania's natural resources for present and future generations' use and enjoyment. DCNR lands provide habitats that support healthy populations of wildlife and resilient ecosystems. Managing resilient ecosystems may include restoring species lost from a system.

DCNR has appreciated being part of the Pennsylvania Game Commission's process regarding the appropriateness of a reintroduction of a mammal into the state. The assessments so far have taken into account many considerations and concerns. Through this process DCNR recognizes that martens could be very important to Pennsylvania forest biology. The reintroduction into the forests may help increase forest health through stabilizing rodent populations and dispersing seeds of a variety of plants to enhance ecosystem processes. We also see the need for monitoring following reintroduction to ensure the impact of marten to other native species, particularly rare or declining species, is minimal.

DCNR considers the reintroduction as beneficial to the state and we support the initiative to bring the American marten back to the Pennsylvania landscape.

The Department is looking forward to working with PGC as this plan develops and reintroduction sites are potentially identified. We are willing and committed to working with the PGC on the future management of this important species.

Sincerely,

Cindy Adams Dunn
Secretary

Office of the Secretary
Rachel Carson State Office Building | P.O. Box 8767 | Harrisburg, PA 17105-8767 | 717.772.9084 | F 717.772.9106 | www.dcnr.pa.gov

United States Department of Agriculture
Forest Service
Allegheny National Forest Supervisor's Office
4 Farm Colony Drive
Warren, PA 16365
814-723-5150
Fax: 814-726-1465

File Code: 2600
Date: April 5, 2023

Bryan Burhans
Executive Director
Pennsylvania Game Commission
Bureau of Wildlife Management
2001 Elmerton Ave
Harrisburg PA, 17110

Mr. Burhans,

This letter serves as a formal show of support for the Pennsylvania Game Commission's (PGC) American Marten Reintroduction and Management Plan.

The Allegheny National Forest (ANF) is approximately 517,000 acres and includes land in Elk, Forest, McKean, and Warren counties in the northwest corner of the State. In the late 1800s and early 1900s this area was profoundly transformed by industrialization and unregulated logging. The once extensive forest was almost completely logged, leaving barren, brush covered hillsides. Deer and other mammals were almost eliminated due to unregulated hunting and loss of habitat. We recognize that the subsequent recovery of animal populations, e.g., white-tailed deer, wild turkey, river otter, fisher, black bear, and elk, is largely a product of reintroductions and the PGC's approach to scientifically based wildlife management.

The ANF supports the reintroduction of the American marten—a once common native species—and we are committed to working with the PGC on the future management of the species. We ask that you continue to communicate with Linda D. Ordiway (linda.ordiway@usda.gov) regarding all drafts and updates during plan development, and that you make these available for formal comment prior to submission for official approval.

Sincerely,

(for) JAMIE DAVIDSON
Forest Supervisor

cc: joshua.w.hanson@usda.gov, linda.ordiway@usda.gov, thkeller@pa.gov

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Appendix 7. Letters of support from potential source agencies.

STATE OF MAINE
DEPARTMENT OF
INLAND FISHERIES & WILDLIFE
353 WATER STREET
41 STATE HOUSE STATION
AUGUSTA, ME 04333-0041

JANET T. MILLS
GOVERNOR

JUDITH CAMUSO
COMMISSIONER

May 2, 2023

Bryan J. Burhans
Executive Director
Pennsylvania Game Commission
2001 Elmerton Avenue
Harrisburg, PA 17110-9797

Dear Mr. Burhans:

Thank you for the invitation to partner with the state of Maine as part of the marten reintroduction plan in Pennsylvania. I applaud your effort to solicit feedback from other states early in the process as well as gathering public input, habitat and prey availability, and considering a wide array of other factors that would impact the success of reintroduction. We are proud to have a healthy and abundant marten population in Maine and have supported other wildlife reintroduction efforts across the country.

We support the general concept of the proposed marten reintroduction and would be happy for staff to discuss more details pending approval of the Plan. Please keep the Department informed on the progress and approval of the Plan.

Sincerely,

Judith Camuso
Commissioner

PHONE: (207) 287-8000

FISH AND WILDLIFE ON THE WEB:
www.maine.gov/ifw

EMAIL ADDRESS:
ifw.webmaster@maine.gov

STATE OF MICHIGAN
DEPARTMENT OF NATURAL RESOURCES
LANSING

GRETCHEN WHITMER
GOVERNOR

SHANNON LOTT
ACTING DIRECTOR

March 30, 2023

Mr. Bryan J. Burhans
Executive Director
Pennsylvania Game Commission
2001 Elmerton Avenue
Harrisburg, Pennsylvania 17110-9797

Dear Mr. Burhans:

Thank you for your letter of March 6, 2023, to initiate a partnership between the Pennsylvania Game Commission and Michigan Department of Natural Resources (MDNR) to assist with the reestablishment of American martens in Pennsylvania. As you mentioned, martens are a valuable resource to the State of Michigan and its residents. Habitat degradation, high fur prices, and unregulated trapping led to the extirpation of martens from Michigan by 1939. Several reintroduction efforts were undertaken during 1955-57, 1969-70, 1979-81, and 1985-86 to reestablish our marten population, and those efforts would not have been possible without support from the Ontario Ministry of Natural Resources in sourcing martens for those efforts.

Due to the history associated with martens extirpation and successful reestablishment in Michigan, we recognize the significance of reintroducing martens to portions of their historical range, as well as the Pennsylvania Game Commission's desire to once again provide this important resource to the people of the Commonwealth. We are also confident that approaches exist in which we can support your agency's efforts by sourcing martens from Michigan without negatively impacting our state's marten population. As such, the MDNR formally offers our support and partnership to the Pennsylvania Game Commission toward efforts to bring back extirpated martens to Pennsylvania.

I look forward to further developing our partnership. If you have questions in the meantime, please feel free to contact Mr. Cody Norton at 906-202-3023 or nortonc3@michigan.gov.

Sincerely,

Shannon Lott

Shannon Lott
Acting Director
517-284-6367

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Division of Fish and Wildlife, Bureau of Wildlife
625 Broadway, 5th Floor, Albany, NY 12233-4754
P: (518) 402-8883 F: (518) 402-8925
www.dec.ny.gov

June 8, 2023

Bryan J. Burhans
Executive Director
Pennsylvania Game Commission
2001 Elmerton Avenue
Harrisburg, PA 17110-9797

Dear Mr. Burhans,

New York State Department of Environmental Conservation (Department) received your invitation to partner with the Pennsylvania Game Commission on the proposed reintroduction of American marten to Pennsylvania. The American marten is one of New York's most valued furbearers, and we are proud to have a robust population within the Adirondack Park. The prospect of marten returning to a neighboring state is an exciting one, and the Department supports such an effort.

The Department commends the work completed by the Pennsylvania Game Commission to lay the foundation for a successful reintroduction program. The effort to solicit feedback from potentially affected nearby states, model habitat suitability, and conduct public outreach is admirable. We look forward to further discussing how the Department can best support and assist this reintroduction effort, pending approval of the Pennsylvania *American Marten Reintroduction and Management Plan*. Please keep us informed on the progress of the Plan and direct any questions or communications to Mandy Watson at 518-402-8859 or mandy.watson@dec.ny.gov.

Sincerely,

Jacqueline M. Lendrum
Division Director
Division of Fish and Wildlife

cc: James Farquhar, Bureau Chief, Bureau of Wildlife
Mandy Watson, Game Management Section, Bureau of Wildlife

NEW YORK STATE | Department of Environmental Conservation

Appendix 8. Letters of support from stakeholders.

Seneca Nation of Indians

Fish & Wildlife Department

3689 Center Rd, Salamanca, NY, 14779 PH: 716-945-2779

DATE: 7/5/2023

Bryan Burhans
Executive Director
Pennsylvania Game Commission
Bureau of Wildlife Management
2001 Elmerton Ave.
Harrisburg PA, 17110

Mr. Burhans,

Please except this letter as a formal show of support for the Pennsylvania Game Commission's proposed American Marten Reintroduction and Management Plan. The restoration of the American Marten to its former home range in the state of Pennsylvania is the essence of conservation. The Seneca Nation is excited to learn that it sits atop of one of the optimal relocation sites. The possibility of the Pine Marten returning within such proximity is thrilling.

The Seneca Nation Fully supports the Pennsylvania Game Commission 's reintroduction of the American Pine Marten and its Management Plan. Pending approval, we look forward to further discussions to determine how the Seneca Nation can best assist and support the Pennsylvania Game Commission and its effort's.

Sincerely,

Shane M. Titus
Seneca Nation Fish and Wildlife Director

ELMWOOD PARK ZOO

May 3, 2023

2023
Board of Directors

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President

Dohn Millard
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Morgan DeNicola
Richard M. Gallo
Brian Johnson
Kevin Johnson
Crandall Jones
John R. Maxwell, DVM
Kym Ramsey
Erik Sims

Albert J. Zone
Executive Director & CEO

Thomas Keller
Pennsylvania Game Commission
Bureau of Wildlife Management
2001 Elmerton Avenue
Harrisburg, PA 17110

Dear Tom-

We are excited to be writing to you to express our interest in partnering with the Pennsylvania Game Commission to assist with your plans to reintroduce this iconic species back into the native Pennsylvania landscape. We are currently building a 17,000 square foot Veterinary Hospital and animal Quarantine Facility that will be part of the zoo's new Welcome Center. The hospital is scheduled to open in fall of 2024. To highlight transparency in animal care, there will be large public viewing windows into both our Animal Treatment and Animal Commissary rooms so that guests have a unique opportunity to directly see the work that goes into providing a high standard of care to all the animals at the zoo.

The mission of the Elmwood Park Zoo is to foster an appreciation for wildlife and the environment that will inspire active participation in conservation. What better way to advance the mission of our organization than to participate in a local conservation project to help reestablish an extirpated species throughout its historic range. Our unique facilities and staff expertise can greatly benefit this project:

- State-of-the-art Veterinary facilities for new animal intake examinations and sample collection including on-site laboratory and radiology equipment
- Dedicated quarantine and isolation facility for short-term animal holding prior to translocation
- Veterinarian knowledge of surgical placement of internal transmitters in other species
- Animal staff knowledge in the husbandry and nutrition of related species, including black-footed ferret and North American river otter
- Public viewable treatment space allows for direct communication with stakeholders about the Marten Reintroduction project by agency personnel
- Long-term partnership opportunities including direct guest education and messaging through the addition of an American Marten display exhibit as part of the Elmwood Park Zoo's North American expansion project

We look forward to learning more about this exciting project and how the Elmwood Park Zoo can get more involved!

Sincerely,

Albert J. Zone, Executive Director and CEO

Michele Goodman

Michele Goodman, VMD, Director of Animal Care

Elmwood Park Zoo's mission is to foster an appreciation for wildlife and the environment that will inspire active participation in conservation.

1661 Harding Blvd • Norristown, PA 19401 **610.277.3825** **www.elmwoodparkzoo.org**

The official registration and financial information of the Norristown Zoological Society, which operates the Elmwood Park Zoo, may be obtained from the Pennsylvania Department of State by calling toll free, within Pennsylvania, 800.732.0999. Registration does not imply endorsement.

ZOOAMERICA
NORTH AMERICAN WILDLIFE PARK

100 West Hersheypark Drive • Hershey, PA • 17033 • (717) 534-3860 • Fax (717) 534-3151

June 6, 2023

Pennsylvania Game Commission
2001 Elmerton Avenue
Harrisburg, PA 17110

ZooAmerica Wildlife Park would be interested in partnering with the Pennsylvania Game Commission and other partners to work towards the restoration of the American Marten back into Pennsylvania's lands. Our vision statement is to create lasting memories to inspire conservation of North American wildlife and wild places. Working on this project is directly in line with both our vision and our mission. Bringing back a once common native species will replace a missing piece of our native habitat.

ZooAmerica has appreciated being able to be part of the process to date and in this letter we wish to state our intent to continue to partner with the Game Commission should the project move forward. Our facility is able to offer holding capabilities as well as an exam room in which to provide health assessments, and attach monitoring equipment prior to release. The ZooAmerica staff are professional and well trained in modern animal care and welfare techniques. Most of all they are very excited and interested in committing to work with you and this species. At ZooAmerica we concentrate solely on North American Wildlife. We currently house the only two American Marten in Pennsylvania. and have cared for them on site since 2008. The staff is excited to be able to add this to our list of local conservation efforts. Our current efforts include working with numerous partners to formulate new colonies of regal fritillary butterflies throughout the state, working on barn owl, kestrel and prothonotary warbler nest boxes locally. To date we have been able to provide access to the state employees who have been able to photograph and video these charismatic weasels for use in many of the reintroduction effort publications and we hosted Mr. Keller at our Party for the Planet Earth day celebration.

I feel the ZooAmerica staff has great interest in, and an excellent knowledge of working with American martens. We have facilities located rather close to your main office so it makes good sense for us to be able to partner with you on this project.

Sincerely
Dale Snyder

Dale Snyder

Assistant Director, Animal Care and Operations

ACCREDITED BY THE ASSOCIATION OF ZOOS & AQUARIUMS

THE WILDLIFE SOCIETY
Pennsylvania Chapter

To: Pennsylvania Game Commission

2001 Elmerton Avenue
Harrisburg, PA 17110-9797

Attn: Support for American marten (*Martes americana*) Reintroduction in Pennsylvania

I am writing on behalf of the Pennsylvania Chapter of the Wildlife Society (PATWS) to express support for reintroduction of the American marten (*Martes americana*) into the state of Pennsylvania. We believe that bringing martens back to Pennsylvania will replace a missing piece of the ecosystem for the northern forests of the commonwealth.

The American marten was once a common native species within northern Pennsylvania, but with deforestation and unregulated harvest, martens disappeared from the state. We recognize that martens are still important within the Pennsylvania forest biological community. The reintroduction of martens into the forests of the state may help increase forest health through stabilizing rodent populations and dispersing the seeds of a variety of plants to enhance ecosystem processes. Based on historic diet analysis, prey abundance estimates, habitat modeling, and assessment of marten ecological needs, the impact of marten reintroduction to other native Pennsylvania fauna should be relatively minimal. That said, the American marten has been proven to serve as a 'flagship' species for the conservation of northern temperate forests in the United States, with multiple other forest taxa benefiting from the management and conservation of marten habitat.

Pennsylvania has led the nation in returning extirpated species to the wild, such as the elk, otter, and fisher. The chance to reintroduce martens into the Commonwealth would continue the legacy of leaving the next generation with a better natural world than when we found it. As with previous successful reintroductions, managers have been able to monitor populations and provide consumptive use opportunities as specific population thresholds of reintroduced species were reached.

Overall, the PATWS considers marten reintroduction as beneficial to the state and to the cultures of the first nations people. We believe the Pennsylvania Game Commission should take the initiative and bring the marten back to the people of the Commonwealth.

I thank you for your time and I welcome any questions you may have.

Sincerely,

Dr. Aaron Haines

Certified Wildlife Biologist
President and representative of the Pennsylvania State Chapter of the Wildlife Society
Aaron.haines@millersville.edu
PAChapterTWS@gmail.com

PENNSYLVANIA TRAPPERS ASSOCIATION

"Our Image is Our Future"

Established 1937 - Chartered 1948
www.patrappers.com

Affiliated With
The National Trappers Association
Fur Takers of America

Associated With
Pennsylvania Federation of Sportsmen & Conservationists
United States Sportsmen's Alliance
Pennsylvania Outdoor Writers Association

A NON-PROFIT ORGANIZATION OF TRAPPERS, FUR HUNTERS & BUYERS DEDICATED TO THE CONSERVATION OF FURBEARING ANIMALS AND THE PROMOTION OF PROPER FUR LAWS

Dear Pennsylvania Game Commission Board of Commissioners & Executive Staff,

As a representative of Pennsylvania Trapper's Association, I am writing today to indicate our support for the reintroduction of the American marten to Pennsylvania. Knowing that the marten was once a common native species within the Commonwealth, we recognize that it still has importance within the ecological community from which it is missing. There are many other important reasons as to why the marten should be returned to the forests of the state, whether to increase biodiversity, increase forest health, or recognize its cultural importance. Pennsylvania has led the nation in returning extirpated species to the wild, and reintroducing those that were on the brink. This is a chance to continue that legacy, leaving the next generation with a better natural world than when we found it.

As trappers, we have supported the conservation and management of the state's furbearers above any other entity or group. We have worked closely with the Pennsylvania Game Commission on not only past furbearer reintroduction efforts, but in gathering data on species vital statistics which are used annually to make management decisions on population health as well as harvest opportunity. We have also continued to source samples for important disease monitoring like the most recent rodenticide research which looked at the prevalence of these chemicals within our fisher, bobcat, and otter populations throughout the state. Please understand, like the hunter who cherishes the game, or the birder who treasures the avian assemblage, trappers care deeply for the furbearing species, and have always worked diligently to conserve them.

Trappers are also a critical part of any reintroduction effort when considering a furbearing species. It was trappers from Wisconsin, Louisiana, New York and many other states and provinces that live-captured river otter, fisher, and beaver to restore and repopulate Pennsylvania. Even today, the Montana Trappers Association is playing a major role in assisting with the American marten reintroduction in that state. We're writing to state that we are in full support of this project moving forward and would be available to provide assistance when needed in the future.

Respectfully,

Keystone Trail Association
46 E. Main Street
Mechanicsburg, PA 17055
(717) 766-9690
www.Kta-hike.org

May 31, 2023

Mr. Bryan Burhans
Executive Director
Pennsylvania Game Commission
2001 Elmerton Avenue
Harrisburg, PA 17110

Dear Mr. Burhans:

Keystone Trails Association (KTA) is pleased to communicate its support for American marten ***(Martes americana)*** reintroduction in Pennsylvania.

With a mission to provide, protect, preserve, and promote recreational hiking trails and hiking opportunities in Pennsylvania, the organization facilitates exploration of the commonwealth's great outdoors. Wildlife viewing is part of what makes those experiences special. Spotting an American marten would surely enrich anyone's adventure and expand their appreciation of the natural world. Attendees at our recent Spring Hiking Weekend in Wellsboro were mesmerized by the marten program presented by PGC biologist, Tom Keller. Their response is likely indicative of the excitement bound to be exhibited by lucky hikers who might get to see martens in the wild.

Based on the Game Commission's research and diligence, it seems there are minimal risks, but many benefits to bringing this species back to the state. It will add to the diversity of wildlife found in Pennsylvania without comprising existing wildlife populations.

KTA envisions a variety of ways to partner with the Commission in their reintroduction efforts. Perhaps our members could help with releases, in concert with outings or trail projects. The organization could enlist hikers to help monitor marten populations by reporting sightings. Marten news could be shared via our communication channels.

In any case, it's obvious that we are excited about this endeavor, and hope reintroduction becomes a reality. We consider it a form of hiking enrichment and wish you much success.

Sincerely,

Brook Lenker
Executive Director

Appendix 9. Organizations reached through statewide information and education campaign.

- Somerset Sportsmen's League
- Sporting Dog Owners
- Minktoberfest
- Tuscarora Camp Owners Association
- Youngwood Sportsmen's Association
- Pittsburgh Sports Show
- Jaffa Sports Show
- Northeast Furbearer Resources Technical Committee
- Wildwood Wetlands Festival

Appendix 10. Proposed annual budget for American marten translocation to Pennsylvania.

Item	Amount	Cost/Unit	One Time Cost	Annual Cost
Source Trapping Coordinator ($25/hour X 2 locations)				
Trapper coordination and preparation	65			$3,250
Marten transfers	165			$8,250
Set up holding facility and tear down	40			$2,000
Husbandry: feeding, care, maintenance	360			$18,000
Documentation and final report	40			$2,000
Transportation of marten to Pennsylvania	40			$2,000
Marten Holding Expenses (X 2 locations)				
Equipment (boxes, runs, stands; $300/unit)	25	$300	$15,000	
Supplies (food, litter, bedding)				$400
Facility rental - 3 months @ $450/month				$2,700
Liability Ins. For housing facility (1 yr. min.)				$2,000
Veterinarian at source: time, travel, supplies				$2,000
Holding facilities in PA staff time ($35/hr)	80			$5,600
Holding facilities in PA supplies/equipment				$6,000
Trapping Expenses				
Tomahawk Cage Traps (model 108.1)	200	$100	$20,000	
Holding Box (materials)	250	$50	$12,500	
Trapper payments ($250/marten)	300			$15,000
Transportation ($0.58/mi x 2 locations)				
Equipment transport to source	4800			$5,568
Marten transport from trapper to source holding ($0.58/mi.)	5000			$5,800
Marten transport from source to Pennsylvania holding	9,600			$11,136
Marten transport from PA holding to release location	4500			$5,220
Permitting and processing expenses				$500
Veterinarian at source: time, travel, supplies				$2,000
Lodging & Per diem ($150)	16 days			$4,800
Salary ($33/hr)	16 days			$8,448
Research & Monitoring Equipment				
GPS Collars	100	$1,200	$120,000	
Pit Tag Readers	50	$200	$10,000	
Pit Tags	300	$13	$3,900	
GPS collar subscription				$250
Misc. field gear (backcountry gear)			$3,000	
Monitoring Expenses				
Graduate student ($150k/student)	2			$75,000
PGC Wildlife Biologist 2				$63,179
Veterinarian ($55/hr.)	300			$16,500
Bio-aide				$35,000
Genetic analysis ($50/marten)	600	$50		$6,000
			One Time Total	**Annual Total**
Translocation and Initial Monitoring Total			**$184,400**	**$308,601**

Appendix 11. Project Timeline

	By End of Fiscal Year (exp. FY2024 = July 1, 2024 - June 30, 2025)									
	2024	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**
Goal 1: Translocation										
Objective 1.1 Establish source locations & logistics										
Strategy 1.1.1 Send official requests source locations	•									
Strategy 1.1.2 Develop resource requirements	•	•								
Strategy 1.1.3 Establish official translocation agreements	•	•								
Objective 1.2 Complete final translocation planning										
Strategy 1.2.1 Identify trapping resources and personnel	•	•								
Strategy 1.2.2 Develop plans for trapping locations	•	•								
Strategy 1.2.3 Develop detailed transportation plan	•	•								
Objective 1.3 Conduct translocation										
Strategy 1.3.1 Coordinate trapping efforts		•	•	•	•	•				
Strategy 1.3.2 Coordinate transportation		•	•	•	•	•				
Strategy 1.3.3 Coordinate holding and care		•	•	•	•	•				
Strategy 1.3.4 Coordinate health screening and testing		•	•	•	•	•				
Strategy 1.3.5 Complete data collection and marking		•	•	•	•	•				
Strategy 1.3.6 Coordinate release		•	•	•	•	•				
Goal 2 – Research & Monitoring										
Objective 2.1 Conduct research and monitoring										
Strategy 2.1.1 Measure survival of founders		•	•	•	•	•	•			
Strategy 2.1.2 Measure survival of future generations			•	•	•	•	•	•		
Strategy 2.1.3 Identify cause of mortality		•	•	•	•	•	•	•		
Objective 2.2 Conduct research on movement										
Strategy 2.2.1 Monitor general movement		•	•	•	•	•	•	•		
Strategy 2.2.2 Monitor home range establishment		•	•	•	•	•	•	•		
Strategy 2.2.3 Monitor transitory behavior		•	•	•	•	•	•	•		

	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Strategy 2.2.4 Monitor dispersal of young		•	•	•	•					
Objective 2.3 Conduct research on habitat selection										
Strategy 2.3.1 Analyze habitat within home ranges		•	•	•						
Strategy 2.3.2 Analyze habitat in relation to sex		•	•	•						
Strategy 2.3.3 Revise habitat suitability model					•					
Objective 2.4 Conduct research on reproduction										
Strategy 2.4.1 Document natural reproduction		•	•	•						
Strategy 2.4.2 Record sex ratio, litter size, and kit health		•	•	•						
Objective 2.5 Conduct research on diet										
Strategy 2.5.1 Conduct diet research on founders		•	•	•						
Strategy 2.5.2 Conduct diet research on 2nd generations			•	•	•					
Objective 2.6 Estimate population and occupancy										
Strategy 2.6.1 Conduct passive genetic sampling		•	•	•					•	•
Strategy 2.6.2 Conduct camera surveys		•	•	•					•	•
Strategy 2.6.3 Conduct SGW & furtaker surveys	•	•	•	•	•	•	•	•	•	•
Strategy 2.6.4 Conduct snow track transect surveys			•							•
Objective 2.7 Monitor other species populations										
Strategy 2.7.1 Monitor other species as warranted	•	•	•	•	•	•	•	•	•	•
Goal 3 – Information & Education										
Objective 3.1: Increase knowledge and awareness										
Strategy 3.1.1- Develop print and electronic materials										
Action 3.1.1.1 – Develop summary of *Feasibility Assessment*	•									
Action 3.1.1.2 – Develop Wildlife Note	•									
Action 3.1.1.3 – Develop Facebook Live or webinar	•									
Action 3.1.1.4 – Develop a story map	•									
Action 3.1.1.5 – Produce a feature length documentary	•	•	•	•	•	•	•	•	•	•

	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Action 3.1.1.6 – Develop articles for popular print	•	•	•	•	•	•	•	•	•	•
Action 3.1.1.7 – Develop talking points for PGC staff	•									
Action 3.1.1.8 – Utilize PGC email 'blasts'	•									
Action 3.1.1.9 – Produce a podcast with PGC COTO	•					•				•
Action 3.1.1.10 – Develop a Q&A	•									
Action 3.1.1.11 – Develop a 3-fold brochure	•									
Action 3.1.1.11 – Develop a summary of Plan	•									
Strategy 3.1.2 – Develop social media materials										
Action 3.1.2.1 – Develop Facebook posts	•	•	•	•	•	•	•	•	•	•
Action 3.1.2.2 – Develop Instagram posts	•	•	•	•	•	•	•	•	•	•
Action 3.1.2.3 – Develop Twitter posts	•	•	•	•	•	•	•	•	•	•
Action 3.1.2.4 – Continually address misinformation on SM	•	•	•	•	•	•	•	•	•	•
Strategy 3.1.3 – Develop and update agency website	•	•	•	•	•	•	•	•	•	•
Action 3.1.3.1 – Develop additional links	•									
Action 3.1.3.2 – Update American marten webpage	•	•	•	•	•	•	•	•	•	•
Action 3.1.3.3 – Utilize webpage as landing for information	•	•	•	•	•	•	•	•	•	•
Strategy 3.1.4 – Provide speaking engagements statewide										
Action 3.1.4.1 – Provide an open house in all regions**	•									
Action 3.1.4.2 – Provide annual updates to partners	•	•	•	•	•	•	•	•	•	•
Action 3.1.4.3 – Provide targeted meetings/presentations	•									
Strategy 3.1.5 – Develop email resource account for marten	•									
Action 3.1.5.1 – Develop monthly internal emails for staff	•									
Strategy 3.1.6 – Conduct external podcasts	•									
Strategy 3.1.7 – Provide information to cooperators	•	•	•	•	•	•	•	•	•	•
Action 3.1.7.1 – Develop furbearer management cooperators	•									
Action 3.1.7.2 – Publish an annual cooperator newsletter	•	•	•	•	•	•	•	•	•	•

	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Objective 3.2: Increase support for reintroduction										
Strategy 3.2.1 – Establish internal collaboration										
Action 3.2.1.1 – Provide updates to BOC	•	•	•	•	•	•	•	•	•	•
Action 3.2.1.2 – Provide updates to regions	•	•	•	•	•	•	•	•	•	•
Action 3.2.1.3 – Provide regular updates to BMSC & BI&E	•	•	•	•	•	•	•	•	•	•
Strategy 3.2.2 – Establish collaborations with NGOs										
Action 3.2.2.1 – Provide updates to NGOs	•	•	•	•	•	•	•	•	•	•
Action 3.2.2.2 – Provide I&E materials to NGOs	•									
Strategy 3.2.3 - Establish collaborations with Gov/Tribes										
Action 3.2.3.1 – Provide updates to states/feds/provinces	•	•	•	•	•	•	•	•	•	•
Strategy 3.2.4 – Provide information to the public										
Action 3.2.4.1 – Provide responses to public comments	•	•	•	•	•	•	•	•	•	•
Action 3.2.4.2 – Provide responses to public calls	•	•	•	•	•	•	•	•	•	•
Goal 4 – Cooperative Partnerships										
Objective 4.1 Establish partnerships										
Strategy 4.1.1 Establish public land partnerships	•									
Strategy 4.1.2 Establish partnerships with source locations	•	•								
Strategy 4.1.3 Establish partnerships research partners	•	•								
Strategy 4.1.4 Establish partnerships with stakeholders	•									
Strategy 4.1.5 Develop a Marten Reintroduction Team	•									
Strategy 4.1.6 Provide project updates to all partners	•	•	•	•	•	•	•	•	•	•
Goal 5 – Population Management										
Objective 5.1 Monitor abundance and occupancy										
Strategy 5.1.1 Conduct annual population abundance surveys	•	•	•	•	•	•	•	•	•	•
Strategy 5.1.2 Conduct annual population occupancy surveys	•	•	•	•	•	•	•	•	•	•
Strategy 5.1.3 Monitor population indices SGW survey	•	•	•	•	•	•	•	•	•	•

	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Objective 5.2 Utilize harvest as a tool for management* **										
Strategy 5.2.1 Develop a season and regulations for harvest***										•
Strategy 5.2.2 Begin conservative harvest***										•
Strategy 5.2.3 Require harvest reporting and collect carcass***										•
Objective 5.3 Manage human – wildlife conflict										
Strategy 5.3.1 – Develop a marten conflict SOP		•								

* Survey dependent on pre-release occupancy of species.

** Open houses were completed in 2023 and will only be completed in the future if needed.

*** Harvest will only occur should the population reach a population that can sustain harvest. Harvest will be evaluated (not instituted) in 2033.

Appendix 12. Summary of public comment.