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Notes and Discussion Piece

Detection of Endangered American Martens (Martes americana) in Apostle Islands National Lakeshore, Wisconsin

ABSTRACT.—American martens (*Martes americana*) warrant concern in Wisconsin, U.S.A., for multiple reasons, including being the state's only endangered mammal and a clan animal of the Ojibwe tribes. American martens were once present throughout much of the state but were extirpated in the early 20th century through habitat loss and unregulated trapping. In the 1950s two reintroductions of martens to Stockton Island of the Apostle Islands archipelago were considered failures, with the last confirmed sighting in the archipelago in 1969. In the decades since the Stockton Island reintroduction efforts, anecdotal reports of martens have surfaced throughout the archipelago. In 2014–2016 we deployed 91 camera traps on 13 of the 21 Apostle Islands to survey the archipelago's extant carnivore species. We detected American martens at 28 of 87 functioning camera trap sites on 5 of 13 monitored islands and documented the existence of American martens in APIS in Wisconsin for the first time in over 50 y. We suggest continued research to evaluate the status of the APIS population and its potential origins to guide future conservation efforts.

INTRODUCTION

Understanding the distribution, trends, and abundance of wildlife populations is essential to wildlife management and conservation. For resource management agencies to have effective management efforts it is imperative to understand local distributions, especially for threatened or endangered species. American martens (*Martes americana*) warrant concern in Wisconsin, U.S.A., because they are the state's only endangered mammal (Woodford and Dumyahn, 2011), a habitat indicator species, susceptible to climate change, and a clan animal of the Ojibwe tribes. Although martens occurred throughout the state prior to European settlement, habitat loss and unregulated trapping led to population declines and range contraction in the early 20th century (Jackson, 1961; Kohn and Eckstein, 1987). Despite the closure of marten trapping seasons in 1921, the last confirmed sighting of a marten in Wisconsin occurred in 1925 in Douglas County (Jackson, 1961; Kohn and Eckstein, 1987).

Since being extirpated martens have been reintroduced in three areas of Wisconsin. Attempts to reintroduce martens in Wisconsin began in the Apostle Islands. Dr. A.W. Schoerger, of the University of Wisconsin, initiated the first reintroductions in 1953, which were implemented by the Wisconsin Department of Natural Resources (WDNR, called the Wisconsin Conservation Department at that time). In 1964 the state withdrew involvement in monitoring following a large live-trapping effort during which no martens were detected, and the reintroductions were considered a failure (Kohn and Eckstein, 1987). After being listed as a state-endangered mammal in 1972, efforts to reintroduce martens to mainland Wisconsin in the Chequamegon-Nicolet National Forest occurred from the 1970s through 2010 (Woodford *et al.*, 2013), and currently small breeding subpopulations of martens persist in Chequamegon-Nicolet National Forests (Woodford *et al.*, 2013; Manlick *et al.,* 2017).

Despite the reintroduction in the Apostle Islands being considered a failure, there have been anecdotal reports of martens on the Apostle Islands in the decades since. As a part of a larger study, we were interested in the veracity of these anecdotal reports of American martens in the Apostle Islands and, if present, wanted to determine their distribution in the archipelago. To meet this objective we deployed 91 camera traps over 2 y on 13 of the Apostle Islands with the goal of documenting the presence of carnivore species. This is the first study targeting presence of American martens in the Apostle Islands since last century's reintroduction.

MATERIALS AND METHODS

The Apostle Islands are an archipelago of sandstone islands located in southwestern Lake Superior, Wisconsin, U.S.A. (Fig. 1). The Apostle Islands National Lakeshore (APIS; 46°57′55″N 90°39′51″W) was established in 1970, protecting 21 of the 22 islands in the archipelago, with human use limited to recreational and land management activities (Busch, 2008). The islands are in the transition zone

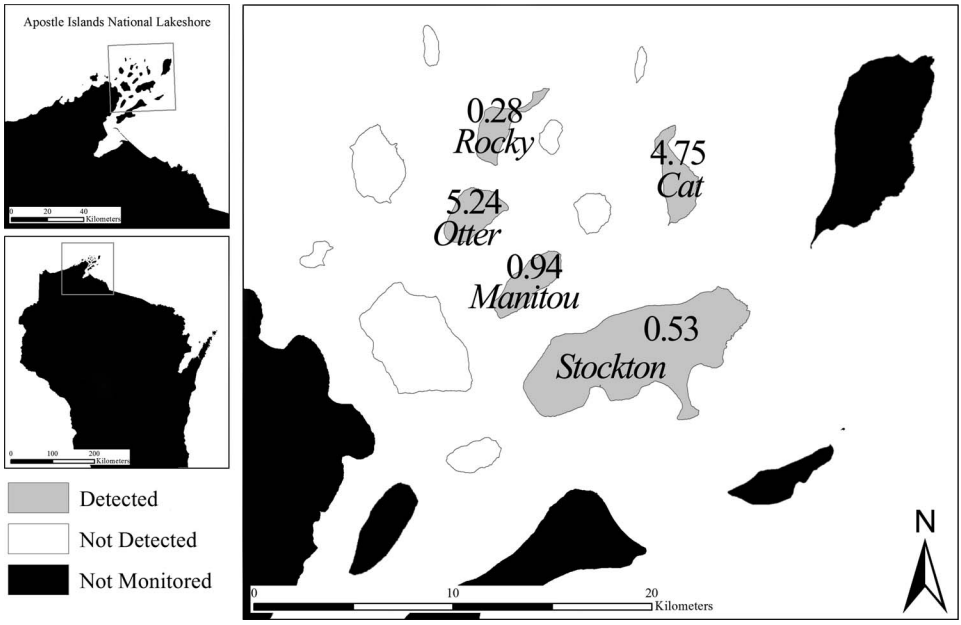

FIG. 1.—The detection and mean relative abundance (detections/100 trap nights) of American martens by island in the Apostle Islands National Lakeshore from September 2014 to June 2016

between northern boreal coniferous forest and deciduous forest (Craven and Lev, 1987). For full climate and ecological information see Allen *et al.* (2017).

We systematically deployed 91 camera traps (Hyperfire Model, Reconyx, Holmen, Wisconsin) on 13 islands from September 2014 to June 2016 in a 1 km^2 grid (*see* Allen *et al.*, 2017 for full procedure). We used standardized procedures for placing camera traps and targeted fine-scale landscape features to maximize detections of carnivores (*i.e.*, camera trap height, orientation, and distance to an unobstructed area that would facilitate movement of large animals) (O'Connell *et al.*, 2011). We returned to service each camera trap at approximately 6 mo intervals, with more frequent servicing not possible due to the logistical challenges of visiting the islands. On each island we randomly assigned half of the camera trap stations to receive a commercial predator trapping scent lure (Caven's Gusto, Minnesota Trapline Products Inc.) to improve detection probability of carnivores. During subsequent visits we rotated between lure or no lure at each camera trap station.

We defined a photo event as any series of photos triggered by a person or animal. To avoid pseudoreplication, we considered consecutive photo captures of the same species within 30 min to be the same event (Naing *et al.*, 2015; Wang *et al.*, 2015). We totaled the number of independent events (E) for each species and determined their relative abundance (RA) at each camera trap as:

$$RA = (E/TN) \times 100$$

where TN is the total number of trap nights that the camera trap was operational. To calculate total trap nights, we first determined when each camera trap was operational during its deployment. We assessed natural breaks in the distribution of d between capture events, and if a camera trap did not take a photo in >28 d, we assumed it malfunctioned due to low battery power or extreme temperatures, and these periods were excluded from our calculations.

RESULTS

We had 87 functioning camera traps that collected data across 18,761 trap nights. We documented 3592 events, including 1076 events documenting terrestrial carnivores. We detected a number of carnivore species (in order from most detections to least) including black bear (*Ursus americanus*), coyote (*Canis latrans*), American marten, red fox (*Vulpes vulpes*), bobcat (*Lynx rufus*), gray fox (Urycyon *cineorargentatus*), fisher (*Pekania pennanti*), gray wolf (Canis lupus), raccoon (*Procyon lotor*), and weasels (*Mustela spp.*).

We documented 88 American marten events, with detections at 28 of 87 camera traps (32.2%) and on five of 13 monitored islands (38.5%) (Fig. 1) (Cat, Manitou, Otter, Rocky, and Stockton Islands). The overall relative abundance of martens was 0.94 (±0.40 SE) detections/100 trap nights. The mean relative abundance of martens on islands where present ranged from 0.28 to 5.24 detections/100 trap nights (Fig. 1) and at camera trap sites where present ranged from 0.26 to 33.33 detections/100 trap nights (Fig. 1).

DISCUSSION

We confirmed the presence of American martens on five islands within the archipelago and martens were the third most frequently detected carnivore species, which suggests the presence of a population rather than a chance detection of a few individuals. This is surprising, considering martens are endangered in Wisconsin and reintroduction efforts in APIS in the 1950's after extirpation from the state were considered a failure (Kohn and Eckstein, 2007). These reintroduction efforts began in 1953, when five martens from Montana were reintroduced to Stockton Island, followed by an additional reintroduction in 1956 of five martens from a WDNR Experimental Game and Fur Farm (Jordahl, 1956; Brander, 1978). The source for the genetic stock in the 1956 reintroduction was from either Ontario (Jordahl, 1956) or British Columbia (Brander, 1978; sources disagree). Formal surveys for marten sign detected the presence of individuals on Stockton Island until 1960. From 1961–1964 no surveys were conducted because poor ice conditions limited travel to the islands. A conservation officer from the WDNR reported a marten sighting on the ice near Presque Isle Bay on Stockton Island in 1969, and there have been anecdotal sightings (including an opportunistically acquired photo in 2010 that was initially misidentified by APIS staff as a fisher until our study) occasionally in APIS since. Our study provides the first scientific documentation of martens in the archipelago in over 50 y.

Our findings indicate American martens were present on multiple islands in APIS but do not indicate from where the putative population originated. Understanding the origin could provide valuable information for conservation efforts. We pose three viable hypotheses, explaining the origin of martens in APIS: martens in APIS are (1) a relict population that survived state-wide extirpation (*e.g.*, martens of Isle Royale; Romanski and Belant, 2008), (2) undocumented progeny of 1950s reintroduction efforts, or (3) natural colonizers from nearby mainland populations. Because no rigorous survey efforts have been conducted in APIS until this project, the source of the observed martens and their relationship to mainland populations is uncertain. Carnivores can be particularly difficult to monitor due to their low population densities and cryptic behaviors (Harmsen *et al.*, 2010; Allen *et al.*, 2016), and this difficulty is exacerbated in areas that are remote and difficult to access when weather makes travel dangerous, such as in APIS. Camera trapping appears to be a viable tool for monitoring martens in APIS but may need to be supplemented with other methods (*e.g.*, hair snares; Manlick *et al.*, 2017) in order to fully understand the population.

Future research should also focus on factors affecting island- and site-specific variation in detection of American martens. Potential factors include available habitat or food, interaction with other carnivores, and the effects of island biogeography. Resources, such as available habitat and food, are important to wildlife populations, and, as a carnivore, the distribution of prey, including sciurids and lagomorphs, is likely to directly affect the distribution of martens (Carlson *et al.*, 2014). This may be especially important in APIS given the fact small mammal diversity on the islands is low relative to adjacent mainland (Belant and Van Stappen, 2002; Smith and Fawver, 2005). As a small carnivore, martens are also vulnerable to direct predation and suppression from larger carnivores (Ruggiero *et al.*, 1994) but could also be affected indirectly through cascading effects among carnivores (Levi and Wilmers, 2011; Allen *et al.*, 2015). Broader factors, such as island biogeography (*e.g.*, MacArthur and Wilson, 1967;

Belant and Van Stappen, 2002; Wilson, 2009), with the varying size and distance of islands, the ability and frequency of marten movement between islands, and how these factors affect marten prey or competitors could also affect the distribution of martens. Understanding the factors driving marten presence on the Apostle Islands will allow for effective management of both mainland and island populations.

The documentation of a putative population of a species in a segment of its former range is always of interest but particularly so with endangered species. The use of camera traps allowed us to document martens in APIS, a remote protected area that is difficult to access in summer and nearly impossible in winter. The origin of the population is currently unknown, but future genetic analyses could potentially determine the population source, as each source may have come from different subspecies. Efforts to reintroduce and augment martens have been underway in Wisconsin for over 60 y (Woodford *et al.*, 2013) but have had limited success (Manlick *et al.,* 2017), and our documentation of the martens in APIS may have important implications for conservation of martens in the state. Long-term monitoring could also help elucidate trends in carnivore community dynamics on the islands and reveal the stability of the current marten population and the mechanisms by which martens are affected by the rest of the carnivore community.

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