Assessing an American Marten, *Martes americana*, Reintroduction in Vermont

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During October-December 1989-1991, biologists from the Vermont Fish and Wildlife Department and the USDA Forest Service reintroduced 115 (88 male, 27 female) American Martens (*Martes americana*) into the southern half of the Green Mountain National Forest. During the years of release, brief radio-contact was made with 9 of the 13 (8 male, 5 female) radio-collared animals, and several of these may have established residency. Results of winter track count surveys suggested the presence of at least four Martens in 1990. During winter 1994-1995, Trailmaster® cameras and boxed camera systems detected Martens at two, and Fishers (*Martes pennanti*) at 11, of 20 sites. During winter 1997-1998, Fishers were detected at 37 of 47 boxed camera sites, but no Martens were detected. During summer 1997 and 1998, no Marten photos were recorded at 285 pressure-plate camera stations in a larger area that included all Marten release sites. Although post-release monitoring may have been insufficient to definitively confirm Marten presence, results from the 1997 and 1998 camera surveys indicate that a viable population of Martens was not established in southern Vermont, perhaps due to competition with Fishers.

Key Words: Fisher, *Martes pennanti*, American Marten, *Martes americana*, carnivores, reintroduction, camera, survey, Vermont.

Beginning in the 1600s, American Martens (*Martes americana*) largely were extirpated from their southern ranges, particularly east and south of the Great Lakes (Gibilisco 1994). In response, numerous Marten reintroductions to former habitats (n = 38) and introductions to new range (n = 7) have occurred since 1934 (Slough 1994). Though many of these were deemed "successful", at least seven were failures, mostly due to small numbers of animals involved (Slough 1994).

Historically, Martens also occurred throughout Vermont, but extensive deforestation and unregulated trapping from the late 1800s through the early 1900s led to their decline and eventual extirpation (DiStefano et al. 1990*). Because Martens are classified as endangered by the Vermont Fish and Wildlife Department (VFWD), a recovery plan was implemented by the VFWD and the US Forest Service (USFS) to restore at least two viable populations in suitable habitats within the State (DiStefano et al. 1990*). If these populations became established (>300 individuals/population), their legal status could be changed from endangered to threatened (DiStefano et al. 1990*).

Initially, wild-trapped Martens from Maine and New York were to be translocated to northeastern and southern areas in Vermont, but the northeastern site was abandoned due to local political pressure. During October-December 1989-1991, the VFWD and the USFS reintroduced Martens at two sites in the southern portion of the Green Mountain National Forest (GMNF) in southern Vermont (Royar 1992*). This paper reviews the attempts made during 1989-1995 to assess the success of the Marten reintroduction, presents new information on extensive remote-camera surveys conducted during winter 1997-1998 and summers 1997 and 1998, and gives an overall assessment of the likelihood of a viable population of Martens occurring in southern Vermont.

Marten Releases

In each of the three release years, 31-40 Martens were released near Manchester, Vermont (Figure 1; 43°N, 73°W) using either a quick or slow release method (Table 1). All Martens (n = 115; 88 male, 27 female; 104 from Maine, 11 from New York) were tagged in each ear with individually numbered tags, and 13 (8 male, 5 female) of them also were fitted with radiocollars. In November 1989, five other unmarked male Martens escaped from their transport cages 25 km east of the release site. Relocation efforts ended in 1991 after the total number of females released (n = 27) neared the original goal of 30 (Trombulak and Royar 2001).

All releases occurred at relatively high elevations within the Green Mountains (~650 m and ~785 m in the northern and southern release areas, respectively) where Fishers were less likely to be encountered (Kelly

* See Documents Cited Section.

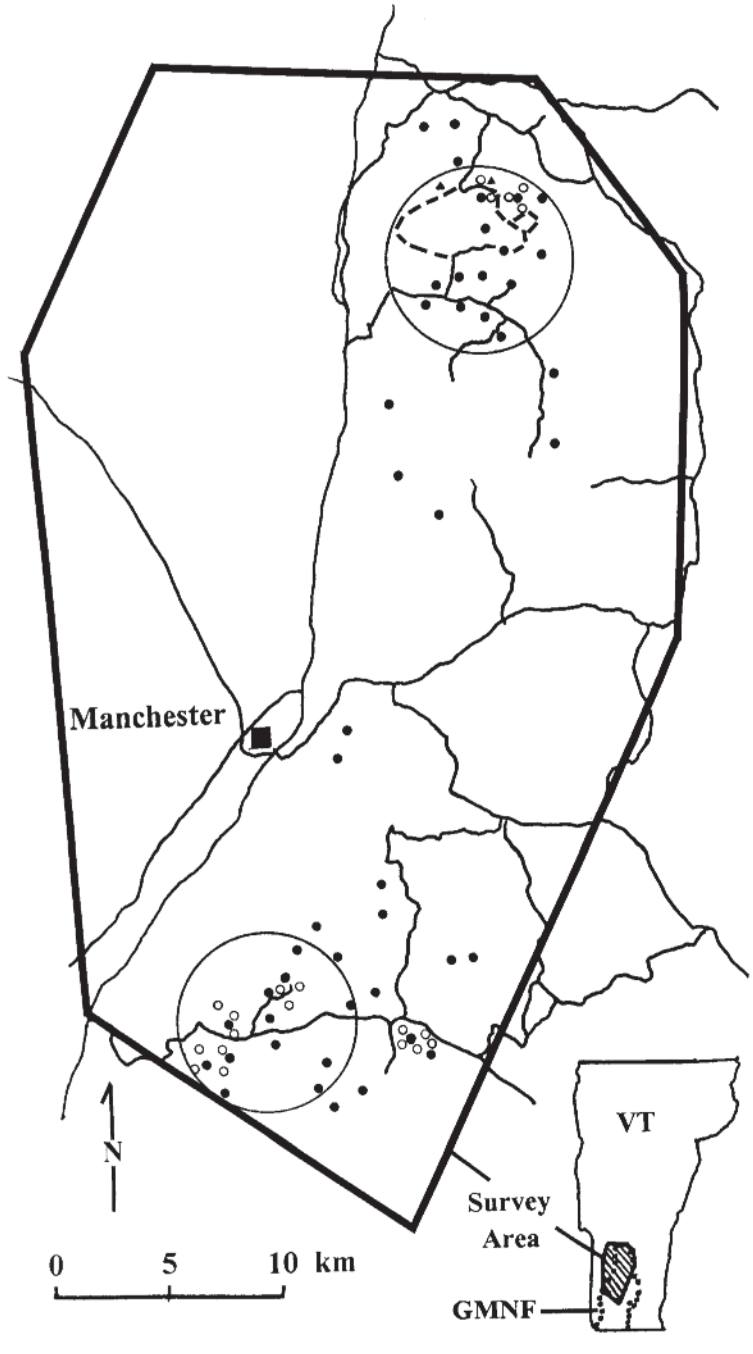

FIGURE 1. Location of two areas where Martens were released during October-December 1989-1991 (circled areas); Marten track count transects, January-March 1990 (dashed lines); track plates, 1990 (triangles); camera stations winter 1994-1995 (open circles); camera stations winter 1997-1998 (closed circles), and extent of the area surveyed with camera stations during summers 1997 and 1998 (heavy solid line) in and near the Green Mountain National Forest and the town of Manchester, southern Vermont.

TABLE 1. Ratios of adult and juvenile male and female Martens that were released during reintroduction attempts in the Green Mountain National Forest, southern Vermont (Royar 1992*).

Ratio	1989	1990	1991	Total
Adult:Juvenile	35:5	26:5	30:14	91:24
Male:Female	29:11	25:6	34:10	88:27
Slow:Quick [a]	12:28	8:23	20:24	40:75
Total	40(6)[b]	31(7)	44(0)	115(13)

[a] Quick release method involved releasing Martens as soon as they were transported to the release site; slow release involved keeping Martens in holding boxes for several days at the site before release.
[b] Number of Martens wearing radio collars.

1977) in predominantly spruce and fir cover types. Northern hardwoods were also common in the area, but little cleared land or herbaceous cover occurred at the release site locations (Royar 1992*). Monthly (December-March) snow depth averaged about 37 cm during 1990-1998 at a 510-m elevation site within southern GMNF (Northeast Regional Climate Center, Ithaca, New York).

In December each year, a two-week trapping season for Fishers was open in the study area, and all pelts and carcasses were required to be registered. The density of drivable roads and trails in the eastern half of the study area was about 0.9 km/km^2 vs. 1.6 km/km^2 in the west.

Assessment

Telemetry monitoring

In winter 1989-1990 radio contact was made with three of six radio-collared Martens, but actual locations of individuals were not identified due to time and accessibility constraints (Royar 1992*). In 1990-1991, six of seven radio-collared Martens were located from the ground and the air one to six times each, and though four individuals seemed to settle and perhaps establish home ranges near the release sites, the others were never located within 10 km of the release area. On 31 March 1991 efforts to locate lost animals using aerial telemetry were unsuccessful, and telemetry efforts were terminated.

Snow tracking and sooted track plates

Snow tracking conditions during January-February 1990 surveys (Figure 1) ranged from excellent to very poor, although tracks of 1-2 Martens and those of 0-2 individuals of other carnivores were observed on each survey (Table 2). No more than four Martens could be accounted for at any one time on the three different transects (two on Transect 1, and one each on Transects 2 and 3). Two sooted track plates were set out for two weeks during December 1992 (Figure 1), but no Martens (or any other species) were detected because snow hardened on top of the track plates before any animal walked on them.

Initial remote camera surveys

During October 1994-January 1995, 20 remotely triggered Trailmaster® (TM) cameras were paired (≥30 m apart) with 20 camera boxes and set out near four former release sites (Figure 1) in an attempt to definitively identify any Marten in the area (Brooks 1996). TM camera systems tripped by animals breaking an infrared beam (Kucera and Barrett 1993) were attached to wooden frames anchored 2 m above the ground on a convenient tree bole, and aimed at a climbing pole baited with skunk-essence lure and a meat bait. Automatic cameras in 81×23×23-cm wooden boxes tripped by animals stepping on an aluminum treadle at the entrance (cf., Danielson et al. 1996) were set 2 m above the ground and attached to a tree bole. Camera boxes were baited with Beaver (*Castor canadensis*) meat, Marten gland lure, and a skunk essence lure. Cameras were operational for 60-75 days.

One photo of a Marten was taken at a camera box at one site; photos of Martens also were taken at another site 9.6 km away at both the paired TM and camera-box stations (Brooks 1996). Photos of Fishers were taken by both camera box and TM cameras at six and nine of the stations, respectively (Table 3), and at a total of 11 different sites.

Remote camera survey, winter 1997-1998

During January-March 1998, 47 baited camera boxes were placed a minimum of 1 km apart within 8 km of Marten release sites (Figure 1), and above 550 m

TABLE 2. Tracks of Martens and other carnivores observed in snow on surveys conducted during winter 1990 in the Green Mountain National Forest, southern Vermont (Royar 1992*).

Transect	Length (km)	Date	Tracking conditions	Time since last snowfall	Number of individual Martens identified	Number of individuals of other species identified
1	12.9	3 January	excellent	thawed and refrozen 48 hrs prior to survey	2	1 Fisher
		8 February	poor	96 h	1	
		22 February	excellent-poor	48 h	2	
2	9.7	25 January	fair-poor	24 h; rained during survey	1	1 Fisher
3	1.6	22 February	very poor	60 h since 50-cm snowfall; started snowing during survey	1	1 Bobcat 2 Coyote 1 Red Fox

TABLE 3. Proportion of remote Trailmaster® (TM) camera and camera box (BOX) stations at which various species were photographed during winter in the Green Mountain National Forest, southern Vermont. In 1994-1995, paired TM and BOX cameras were located within ≤30m of one another (Brooks 1996 and unpublished data).

	1994-1995 (n = 20)[a]		1998 (n = 47)[b]
Species	TM	BOX	BOX
Fisher (*Martes pennanti*)	0.45	0.30	0.79
American Marten (*Martes americana*)	0.05	0.10	0.00
Bobcat (*Lynx rufus*)	0.00	0.00	0.04
Long-tailed Weasel (*Mustela frenata*)	0.00	0.00	0.02
Ermine (*Mustela erminea*)	0.05	0.00	0.00
Black Bear (*Ursus americanus*)	0.00	0.00	0.02
Raccoon (*Procyon lotor*)	0.00	0.00	0.02
Flying Squirrel (*Glaucomys* spp.)	0.60	0.15	0.00
Red Squirrel (*Tamiasciurus hudsonicus*)	0.50	0.05	0.00
Blue Jay (*Cyanocitta cristata*)	0.15	0.00	0.00
Peromyscus spp.	0.05	0.00	0.00
Human	0.00	0.00	0.06

[a] Cameras set for 60-80 days each.
[b] Cameras set for 45-70 days each.

elevation where Fishers purportedly were less likely to be encountered (Kelly 1977). Camera locations included all areas surveyed by Brooks (1996) in 1995, plus additional sites in the Forest. Camera boxes were operational for 40-65 days.

No Martens were detected, but Fishers were photographed at 37 of the 47 camera sites (Table 3). During winter 1998, Fishers were detected in every area surveyed during the 1995 study, and in the areas where Martens were detected during 1995. Several other carnivore species were photographed during 1998, as well.

Remote camera survey, summer 1997 and 1998

During the summers of 1997 and 1998, a broader carnivore distribution study using remote cameras was conducted in a 1032-km^2 area in and immediately adjacent to the Green Mountain National Forest (Figure 1; Moruzzi et al. 2002). Cameras were placed at 1-km intervals at 131 and 154 baited trap stations in 1997 and 1998, respectively. We photographed Martens at no stations, but Fishers at 47 stations, during the two summers.

Other reports

A report from Candia, New Hampshire confirmed that a Marten released seven months earlier (i.e., with appropriate ear tags) was road-killed there in June 1990 — 145 km east of its release site. Another released in November 1989 was trapped in a Fisher set in December 1990 in Shrewsbury, Vermont — 15 km north of its release site. A third marked Marten was road-killed in nearby (15 km) Winhall, Vermont in 1991, and a fourth near Bakersville, Connecticut in June 1992 — 160 km south of its 1990 release site. A fifth marked Marten was trapped in Rangeley, Maine in November 1997 — 245 km northeast of its 1989 release site.

Discussion

The goal of the Marten reintroduction project was to establish at least two viable populations of Martens in Vermont. Despite the release of 115 animals, track count surveys in 1990 suggested the presence of no more than four Martens (Royar 1992*), and photos taken in winter 1994-95 confirmed the presence of no more than two (Brooks 1996). In addition, our more extensive camera surveys during winter 1997-1998 and summers of 1997 and 1998 failed to detect any Martens. Given the data that were collected, there is no evidence that Martens have established a viable population in the area.

The success of Marten reintroduction efforts, as well as those of other carnivores, appears to depend on several factors (Berg 1982; Slough 1994; Reading and Clark 1996; Breitenmoser et al. 2001). In the Vermont reintroduction, many of these factors do not seem to be responsible for the apparent failure of the project. First, an adequate number of individuals is essential. In Vermont, relatively few females were released each year, but the final total (27) was near the target number of 30 (cf., Slough 1994), and this was more than were released in at least 15 successful reintroductions or introductions. Also, releases conducted over several years, such as was done in Vermont, versus a single release seem preferable (Slough 1994). Additionally, a male-biased sex ratio may increase the likelihood of establishing a normal spacing pattern and maximize reproductive success (Slough 1994); again, this was the case in Vermont. Martens also should be wild-caught and from areas similar to the area to which animals are moved (Slough 1994); animals moved to Vermont were from nearby New York and Maine. Martens also should be protected from trapping, but even though Fisher trapping was allowed in the area for a short period each winter, the small

number of Martens reported trapped over a large area over many years indicates that trapping was not an important mortality factor.

Habitat suitability might strongly influence translocation success of Martens. Prior to the release in Vermont, GMNF stand inventory data were compared with Marten-specific habitat suitability models (e.g., Allen 1982), and some fieldwork was conducted to assess percent softwood, tree size class, and dead and downed material (Trombulak and Royar 2001). These efforts suggested that the proportion of softwood canopy closure might have been relatively low, but there is no particular reason to believe that these vegetation characteristics would limit Marten survival (Chapin et al. 1997:715). However, such stand-level attributes might not be nearly as relevant as landscape level configuration (Chapin et al. 1998, Hargis et al. 1999). Although no such landscape evaluation has been carried out, most such concerns focus on the effects of extensively logging on habitat fragmentation. Since levels of logging in the GMNF have been very low for the past 20 years, we do not suspect that such considerations affected Marten populations.

Another factor that might limit Marten reintroduction success is interspecific competition, particularly with Fishers (Slough 1994). Abundance of the two species often has been reported to be inversely proportional, perhaps reflecting the dynamics of food competition and/or predation by Fishers on Martens (Krohn et al. 1995, 1997). In Vermont, all releases occurred at relatively high elevations where Fishers were thought to be less abundant. Still, the high rate of Fisher photos, in particular, that we obtained suggested that they had become more common in the area than previously believed. Fisher pelt prices and corresponding trapper effort dropped significantly in the late 1980s, likely resulting in a statewide increase in Fisher numbers (K. Royar, unpublished data). Also, deep and frequent snowfalls apparently limit Fisher abundance and distribution (Krohn et al. 1995, 1997). In our area, long periods of thick snow typical of the study area previous to the translocation (mean number of days snow thicker than 46 cm during December-March 1979-1988 = 34) was less common in the years immediately following the release (mean number of days snow deeper than 46 cm during December-March 1989-1998 = 23; Vermont Department of Fish and Wildlife). Thus, a general increase in Fisher numbers because of reduced trapping pressure and in Fisher distribution in the Marten release area because of reduced snowfall may have limited the success of the Marten reintroduction, albeit by unknown means.

Conclusions

While the initial attempts to assess the success of the Marten reintroduction in southern Vermont were limited, the results of our most recent winter survey suggest that few if any individuals survived to establish a viable population. The reasons for this outcome are not clear, but undocumented competition with Fishers seems to be the most workable one.

It seems clear that the previous surveys were inadequate to document the occurrence of resident Martens in Vermont. In any future attempt to restore Martens in Vermont, a landscape level analysis of habitat seems prudent. When Martens are released, more extensive and definitive winter track count and track plate surveys should be conducted, and additional camera stations (Bull et al. 1992; Jones and Raphael 1993; Raphael 1994) should be set in and near sighting areas to provide definitive evidence of Marten presence. Perhaps most importantly, more radiomarked animals should be monitored intensively and extensively, as well, especially to monitor the fates of Martens and to keep up with widely moving individuals. Concomitantly, a more intensive effort to monitor Fisher abundance, distribution, and interactions with Martens is necessary. Apparently no Marten translocations have been carried out in areas with high Fisher densities, and the actual mechanisms by which Fishers might limit Martens have not been documented.

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