



Recovery Plan

American marten (*Martes americana atrata*) in Newfoundland

Prepared by the Newfoundland Marten Recovery Team

Department of Environment & Conservation

Wildlife Division



What is the *Endangered Species Act*?

The *Endangered Species Act* was enacted in 2001 to ensure that species at risk of extinction in Newfoundland and Labrador, as well as their residence and habitat critical to their survival and recovery, receive protection. Furthermore, the *Endangered Species Act* ensures that efforts to recover these species are initiated. This legislation applies to species, sub-species and populations that are native to the province, but does not include marine fish, bacteria, or viruses. It also does not apply to introduced species, except in extraordinary circumstances. The *Endangered Species Act* fulfills the province's commitments to the *Accord for the Protection of Species at Risk*. The *Species at Risk Act*, was enacted in June 2003 as the federal government's contributing piece of legislation to the Accord.

What is recovery?

For species at risk of continued population decline or extinction, such as those listed in the *Endangered Species Act* as endangered, threatened, or vulnerable, recovery is the process by which its population decline is stopped, stabilized, and reversed. This occurs when a threat to the whole population or individuals is removed or reduced. A species is not considered to be recovered, and thereby removed from the *Endangered Species Act*, until its long-term persistence in the wild is secured. It is possible that a species will always be considered rare. This typically occurs when the species is restricted to an extremely unique or uncommon habitat or habitat loss has been extensive. For each species listed as endangered or threatened a recovery team is put in place to oversee the recovery process and write a recovery plan. For each species listed as vulnerable a management plan is written to guide the recovery process.

What is a recovery plan?

A recovery plan outlines the goals and actions deemed necessary by the recovery team to protect and recover the species and it identifies the main threats to the species' recovery. Section 23 of the *Endangered Species Act* outlines the required content of and the process for developing recovery plans. It states that a recovery plan will identify the necessary measures for the recovery of a species, a species' critical and recovery habitat (if appropriate), and a schedule for the implementation of the plan. Depending on the status of the species, a recovery plan has to be developed within one to two years after the species is designated under the *Endangered Species Act*. These recovery plans are reviewed regularly and updated approximately every five years.

What's the next step?

Implementing the plan! Many people work towards implementing the recovery actions outlined in a recovery plan, including the recovery team itself, who meet regularly to discuss the recovery of the species. Approximately 100 people participate on recovery teams and working groups around the province, and act as provincial representatives on national recovery teams. These volunteers come from municipal, provincial, and federal governments, aboriginal groups, industry, universities, interest groups, and local communities. Each play a significant role in recovery implementation. Success in species recovery depends on the commitment and cooperation of many different people and requires all responsible jurisdictions, as well as all Newfoundlanders and Labradoreans, work together to support and implement recovery plans.

Disclaimer

A species listed as endangered or threatened under the Newfoundland and Labrador *Endangered Species Act* requires the development of a recovery plan. These recovery plans are prepared in cooperation with jurisdictions responsible for the species and the responsible recovery team. Implementation of the goals and actions identified in this document ultimately depends on the ongoing program priorities and budgetary constraints of the participating jurisdictions and organizations. The goals and actions identified in a recovery plan are based on the best existing knowledge and are subject to modifications resulting from new findings and revised objectives. It does not necessarily represent the official positions of the governmental or non-governmental organizations, or individuals, involved.

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COVER PHOTOGRAPH

American Marten in Newfoundland, by Emily Herdman

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RESPONSIBLE JURISDICTIONS

Government of Newfoundland and Labrador
Environment Canada (Canadian Wildlife Service)
Parks Canada Agency

EXECUTIVE SUMMARY

The marten (*Martes americana atrata*) on the island of Newfoundland are a genetically and geographically distinct population of the more widely distributed American marten found across the boreal region of North America. Marten were historically distributed throughout most areas of productive forest on the island; however, the cumulative impacts of habitat alteration, forest harvest, and incidental mortality associated with snaring and trapping limited their abundance and distribution resulting in their designation as threatened under both Federal and Provincial endangered species legislation. A recent (2007) estimate of population size suggests that there are between 286 to 556 adult, breeding individuals remaining on the island and that most of these reside in the Little Grand Lake, Red Indian Lake, Georges Lake/Pinchgut Lake and Main River regions of western Newfoundland, and the Terra Nova National Park and surrounding region of eastern Newfoundland.

Similar to most other North American populations, American marten in Newfoundland are strongly associated with forested habitats. Forest structure provides critical resources required for survival including concealment and escape routes from predators, denning and resting sites, and access to prey. Recent studies have demonstrated that marten will use forests across a range of height and canopy closure conditions, including areas disturbed by forest insects and mid-successional forest. The Newfoundland and Labrador *Endangered Species Act* allows for the identification and protection of critical and recovery habitat for a species at risk. Critical habitat for the American marten in Newfoundland was determined by combining marten occurrence data and information on habitat quality. The area meeting the selected criteria was 6208 km²; figures depicting the occurrence of critical habitat across the island are provided in this document.

The recovery goal for American marten in Newfoundland is to have and maintain a viable, wild population that is not at risk. The following seven objectives have been identified as important in achieving this goal:

- 1) Maintain and/or enhance existing populations and support natural dispersal within the species' historical range;
- 2) Identify and update the spatial distribution of critical and recovery habitat;
- 3) Manage critical and recovery habitat for the survival and recovery of marten through the implementation of forestry and wildlife management strategies;
- 4) Reduce incidental mortality by implementing appropriate mitigations to reduce incidental snaring and trapping;
- 5) Continue to refine our understanding of marten ecology to facilitate effective habitat and population management;
- 6) Continue long-term, standardized population monitoring to assess the success of recovery relative to our population goal; and
- 7) Obtain broad stakeholder support and involvement to facilitate the recovery of the species.

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SPECIES INFORMATION

ASSESSMENT AND LEGAL STATUS

Common names: American marten, Newfoundland marten, Marten cat, Pine marten		Scientific name: <i>Martes americana atrata</i>	
Provincial Listing (ESA): Threatened		Federal listing (SARA): Threatened	
Global: G5T1 Critically imperiled (NatureServe) Least Concern (IUCN Red List)	National: N4: Secure (General Status) Newfoundland: N1 Critically imperiled (NatureServe) Remainder of Canada: N5 Secure (NatureServe)		Provincial: S4: Secure (General Status) Newfoundland: S1 Critically imperiled (NatureServe) Labrador: S5 Secure (NatureServe)
SSAC assessment date: N/A		COSEWIC assessment date: 2007	
SSAC assessment history: N/A		COSEWIC assessment history: Not at risk (1979), Threatened (1986), Endangered (1996), Endangered (2000), Threatened (2007)	
Reason for designation: American marten in Newfoundland have declined substantially over the last century. The current population consists of 286-556 mature marten in five subpopulations. Marten in Newfoundland are still at risk because of incidental mortality related to snaring and trapping outside of protected areas and because of forest harvesting. A small decrease in population size would likely result in consideration for Endangered status. The marten is one of only a few land mammals native to Newfoundland and the subspecies is endemic to Canada.			
Newfoundland and Labrador occurrence: The global distribution of this threatened population is restricted to the island of Newfoundland, Canada.			
Canadian occurrence: The Newfoundland population of American marten is a genetically and geographically distinct population of the subspecies <i>Martes americana atrata</i> , which is otherwise only found in Labrador.			
Current legal protection: <i>Endangered Species Act</i> (NL), <i>Species at Risk Act</i> (Federal)			

SPECIES DESCRIPTION

The Newfoundland population of American marten is a genetically (Kyle and Strobeck 2003) and geographically distinct population of the subspecies *Martes americana atrata*, which is otherwise only found in Labrador. This subspecies is one of five subspecies of American marten that are distributed across most boreal regions of North America. Taxonomically, marten belong to the Order *Carnivora*, Family *Mustelidae* and are related to fishers, mink, otters, and wolverines. Martens have dark brown fur except for an orange/yellow patch on the throat (Figure 1). Their bodies are elongated and males on average weigh 1275 g; females are noticeably smaller and weigh on average 772 g (Hearn 2007).

DISTRIBUTION

The global distribution of this threatened population is restricted to the island of Newfoundland, Canada. American marten in Newfoundland were historically distributed throughout most areas of productive forest on the island (Figure 2; Bergerud 1969). Ongoing population monitoring has confirmed that breeding populations of American marten remain in western Newfoundland (Little Grand Lake, Red Indian Lake, Georges Lake/Pinchgut Lake), the Northern Peninsula (Main River), and eastern Newfoundland (Terra Nova National Park, northern portion of the Bay du Nord Wilderness area) (Figure 3).

POPULATION TRENDS

Early accounts from explorers and settlers dating from the early 1600s to the late 1800s suggest that the historical distribution of American marten on the island was greater than that of today and included the Avalon Peninsula and south-central Newfoundland (Howley 1915, Cormack 1928, and Marshall 1996). In 1763 English trappers caught approximately 480 marten and the French, Micmac, and Montagnais trappers were said to have taken approximately another 3100 pelts (Marshall 1996). By 1934, marten were reportedly scarce and the commercial harvest of this species ended. In the following decades, despite the imposed harvest restriction, numbers appeared to continue to decline. By 1960, Bergerud (1969) reported that the distribution of American marten on the island was no longer continuous and that marten were absent from large areas in central Newfoundland (Figure 2). The majority of sightings and incidental captures reported to the Government of Newfoundland and Labrador, Wildlife Division since the late 1960s are from western Newfoundland.

In 1985, Snyder and Hancock used data from live-trapping studies, the locations of incidentally trapped animals, and habitat availability to estimate that there were 630 to 875 American marten in Newfoundland. In 1995, a re-evaluation of the abundance of marten using a similar approach and updated data suggested that < 300 breeding adults remained. More recently, Schmelzer (Government of Newfoundland and

Labrador, Wildlife Division unpublished report, 2007) combined information on the distribution of marten, area-specific densities, and the probabilities of occupancy for different habitat types (Hearn et al. 2005, Fuller et al. 2006) to estimate the effective population size (i.e., breeding individuals) at 286 to 556 individuals; mean densities ranged from 0.04 to 0.08 marten/km². Although these recent populations estimates imply an increase in the abundance of marten, these assessments (1985, 1995, and 2007) did not use comparable methods. The 2007 estimate is based on improved demographic and habitat information and is likely more accurate than previous estimates.



Figure 1. American marten in Newfoundland wearing radio-telemetry collars (photo credit: E. Herdman).

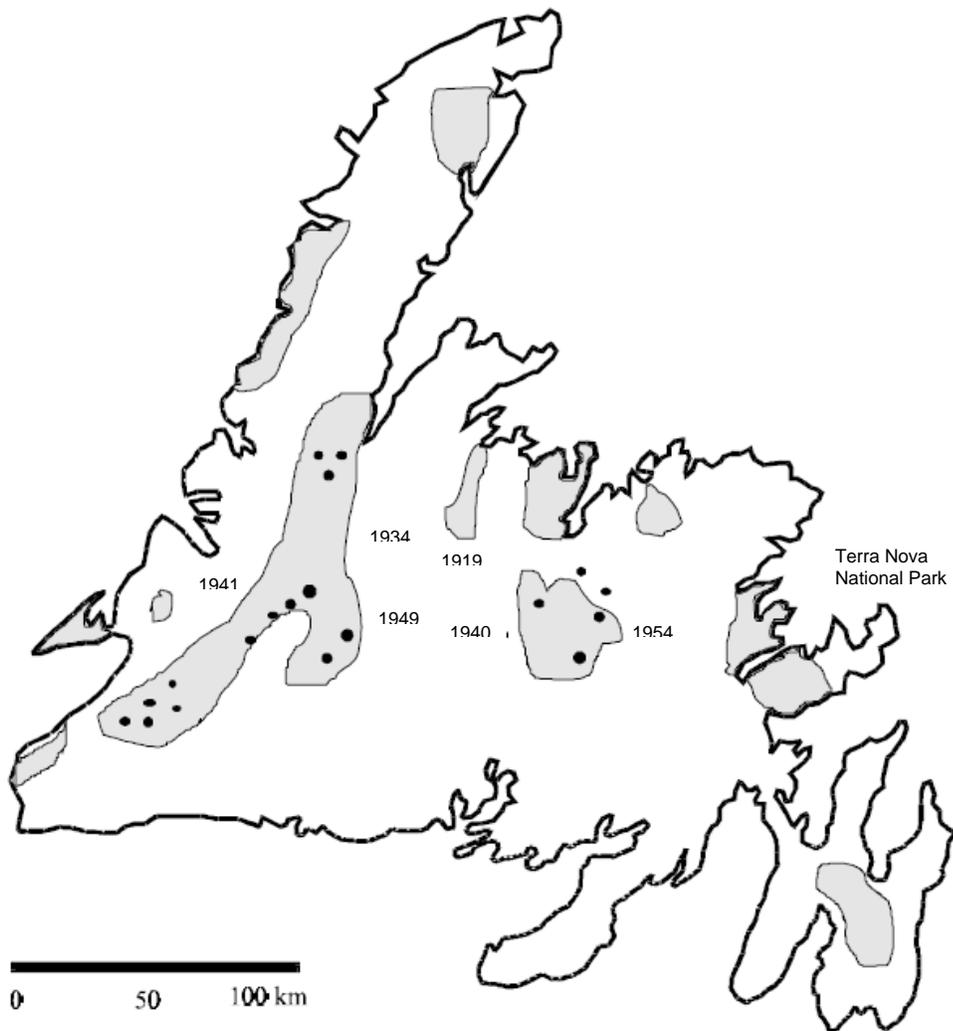


Figure 2. Distribution of Newfoundland population of American marten (*Martes americana atrata*) between 1950 and 1960 based on the reports of wildlife officers (black dots) compared to their potential range based on distribution of mature forest (grey areas). The years represent the approximate time of marten disappearance from that area. (adapted from Bergerud, 1969)

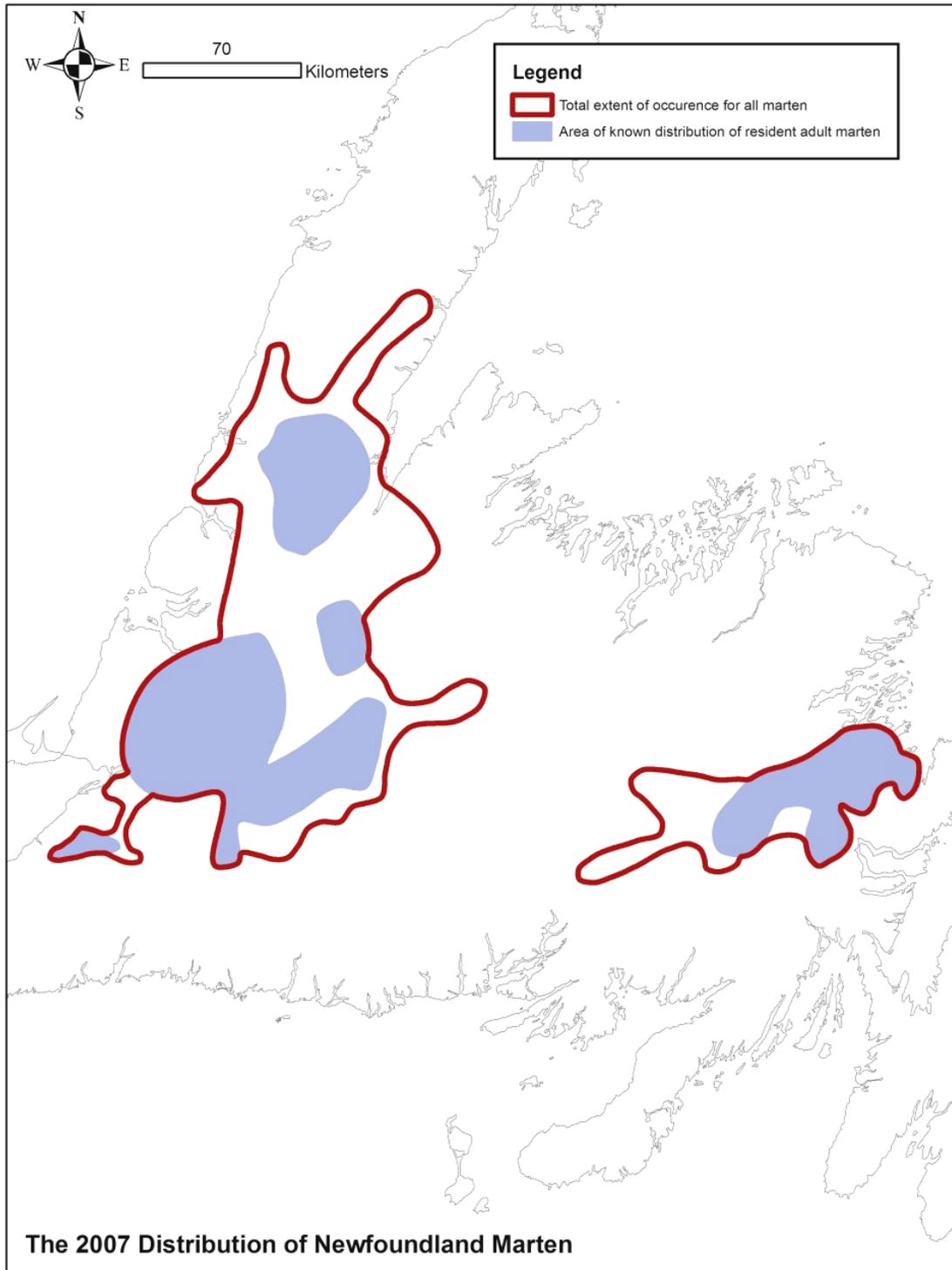


Figure 3. Current distribution of Newfoundland population of American marten (*Martes americana atrata*), including the known occurrence of resident adult marten and the total extent of occurrence of all marten, including young and dispersing animals.

BIOLOGICAL NEEDS AND ECOLOGICAL ROLE

American marten are described as a forest-dependent species since most of the resources required for their survival are found within forested environments. American marten in Newfoundland have exceptionally large home range areas (Bateman 1986, Gosse et al. 2005, Hearn et al. 2005) when compared to mainland populations (Buskirk and Macdonald 1989) and consequently require greater spatial area to support viable populations. This creates a greater challenge for recovering populations of marten on landscapes where forest harvesting and other forms of development occur.

American marten are known to have a low reproductive output; females produce three kits per year on average but may abandon reproduction when food resources are scarce (Thompson and Colgan 1987). This low reproductive rate likely limits their ability to numerically respond to improved habitat conditions or to re-occupy areas from which they were extirpated. Fecundity of marten in Newfoundland is not well documented but may be particularly low due to the reduced diversity and abundance of prey that historically occurred on the island. Meadow voles were the only small mammal species available to marten in Newfoundland until recently when a number of small mammal species (e.g. southern red-backed voles (*Clethrionomys gapperi*), deer mice (*Peromyscus maniculatus*), masked shrew (*Sorex cinereus*)) and snowshoe hare (*Lepus americanus*) were introduced (Hearn et al. 2006). Snowshoe hare are an important component of the winter diet of marten in Newfoundland (Gosse and Hearn 2005) but fluctuate in availability due to their cyclic nature. Red-backed voles are an important prey item for American marten across much of their North American range (Martin 1994); however, the demographic effect of this new prey source on the Newfoundland population is unknown. It has been speculated that the extinction of the Newfoundland wolf (*Canis lupus beothucus*) by the 1930s negatively impacted marten populations by reducing the amount of caribou carrion available (Gosse and Hearn 2005).

HABITAT

Similar to other North American populations, the American marten of Newfoundland are strongly associated with forested habitats. Forests provide the resources required by marten for concealment and escape routes from predators (Hargis and McCullough 1984, Hodgman et al. 1994, Thompson and Harestad 1994), provision of suitable denning and resting sites (Buskirk et al. 1989, Bull and Heater 2000), and access to prey (Sherburne and Bissonette 1994, Andruskiw et al. 2008). Studies of habitat associations of American marten in Newfoundland have found that they are dependent on old-growth or overmature (>80-years-old) forests due to a depauperate prey base which restricts marten to older forests where prey are accessible (Drew 1995, Thompson and Curran 1995, Bissonette et al. 1997, Sturtevant and Bissonette 1997, Andruskiw et al. 2008). However, recent studies in Newfoundland suggest that marten will use a wide variety of habitat types, including immature regenerating forests, pre-commercially thinned forests, areas disturbed by forest insects, and areas of mature

and overmature forests (Gosse et al. 2005, Hearn et al. 2005). Based on the current habitat associations described by Hearn et al. (2005), Fuller et al. (2006) developed a predictive habitat model to describe the declining probability of home-range occupancy with decreasing amounts of suitable habitat in home-range size landscapes. Although a variety of forest landscapes may be capable of supporting marten, incidental mortality likely limits the expansion of marten into otherwise suitable areas (Hearn 2007).

Residence

American marten in Newfoundland are known to have one type of residence - a den, which is protected under the Newfoundland and Labrador *Endangered Species Act* and the federal *Species at Risk Act* (Government of Canada 2009). Marten are known to use rock piles, squirrel middens, and tree cavities for their den sites (Mayo and Greene 1985). Parturition occurs in natal dens; however, marten may occupy several maternal den sites throughout the kit-rearing period (Ruggiero et. al. 1998). Physical damage to dens can be caused by a range of sources; including domestic and commercial timber harvest, road construction, all-terrain vehicle use, snowmobile use, domestic animal activity, and site excavation (Government of Canada 2009). Exact parturition dates for marten in Newfoundland (outside of captivity) are not known, but likely fall between April and May (Mayo and Greene 1985, M. Pitcher pers. comm.). Marten kits are born blind, deaf, and without fur, and are weaned at approximately 42 days of age (Powell 2003). It is recommended that natal and maternal dens be protected from April 1 to June 30 annually - a period of approximately 90 days (Government of Canada 2009).

Identification of critical habitat

The provincial *Endangered Species Act* allow for the protection of critical habitat for species at risk to ensure their survival. Critical habitat for the American marten in Newfoundland was determined by combining marten occurrence data and information on habitat quality. The area meeting the selected criteria was 6208 km². Areas recommended as critical habitat (areas of suitable habitat known to have resident adult marten; Figures 4 and 5) are a subset of the known distribution of American marten in Newfoundland (Figure 3; Newfoundland Marten Recovery Team 2005). These recommendations are based on the best information available on marten distribution and suitable habitat and will be updated as new information on marten distribution and habitat requirements is obtained.

The current critical habitat identification process (Newfoundland Marten Recovery Team 2005) does not yet explicitly link critical habitat with a population goal, and it is inadvisable to include a numerical population goal if no defensible targets exist. As a proxy, it is possible to calculate the approximate number of marten an area can support by estimating the total number of potential home ranges. Currently, Hearn et al. (unpublished data) are estimating the total number of marten that can be supported in each of the 18 Forest Management Districts on the island at various levels of probability. This project will provide results that can be used to establish defensible population goals. In the interim, the precautionary principle dictates that areas that currently support reproducing populations of marten should be conserved, as marten

population levels and distribution are well below historical levels (Figure 2; Bergerud 1969).

Recovery habitat

The Newfoundland and Labrador *Endangered Species Act* defines recovery habitat as the habitat necessary for the recovery of the species. Recovery habitat has not yet been identified for marten but will be identified and mapped as part of the island-wide habitat modelling exercise (see recovery actions). Marten recovery habitat will likely include: 1) unoccupied, suitable habitat adjacent to areas of critical habitat; 2) areas where marten have been released but breeding has not been confirmed; 3) areas where marten have been caught but breeding has not been confirmed; and, 4) areas identified by the Newfoundland Marten Recovery Team and/or the Wildlife Division, in consultation with land users as suitable in meeting recovery habitat requirements. Ultimately recovery habitat will be linked with a population goal, take into account the dynamic nature of the forest, integrated with resource management planning, and managed to minimize the mortality of marten from recreational snaring and trapping.

Existing and recommended approaches to habitat protection

In order to identify which areas protect American marten and its habitat, the current status of lands proposed as critical habitat was assessed. Fully protected areas are defined as those in which commercial forestry harvest, all land-based traps, all land-based locking neck snares, and small game snares are legally prohibited. They include National Parks, Provincial Parks, Public and Ecological Reserves (including Provisional), and Wildlife Reserves. A total of 1779 km² (29%) of critical habitat was identified as fully protected (Group 1, Figure 6). Critical habitat within federal properties, such as the Gros Morne and Terra Nova National Parks, are also protected under the federal *Species at Risk Act*.

There are also a number of areas that offer partial protection to American marten and its habitat (Group 2, 3, 4, and 5 Figure 6). Group 2 includes areas that manage development and forest harvest through the *Environmental Protection Act* and the land-use and resource planning process, but where all land-based traps, all land-based locking neck snares, and where small game snares are legally prohibited. These areas include the Pine Marten Study Area and the Main River Study Area. A total of 1263 km² (20%) of critical habitat is protected to this degree. Group 3 includes areas that also manage development and forest harvest through the *Environmental Protection Act* and the land-use and resource planning process, but where only land-based traps are prohibited. Fox, coyote, or lynx killing neck snares are allowed. A total of 1644 km² (26%) of critical habitat is partially protected in this manner. Group 4, includes areas of the Middle Ridge Wildlife Reserve and Bay du Nord Wilderness Reserve, which allows snaring and trapping but where forest harvest is legally prohibited. A total of 122 km² (2%) is protected within these reserves. These snaring and trapping guidelines were developed in 2007 to reduce the capture of non-target species, including American marten (Newfoundland and Labrador Hunting and Trapping Guide 2009-2010, Furbearing Animals Trapping and Shooting Order, 2009-2010).

In addition to snaring and trapping closed areas, six-strand picture cord and 22 gauge brass wire replaced stainless steel wire in 2008 as the only legally approved snare wire for small-game harvest in Newfoundland (Newfoundland and Labrador Hunting and Trapping Guide 2009-2010). These changes were implemented across the island of Newfoundland to assist with ongoing efforts to mitigate the incidental capture of American marten and other non-target species in snares (Newfoundland and Labrador Hunting and Trapping Guide 2009-2010). As a result, the remainder of American marten critical habitat not protected by one of the previous categories (1400 km² (23%)), as well as all potential recovery habitat, is partial protected as development and forest harvest are managed through the *Environmental Protection Act* and the land-use and resource planning process and the only legally approved snare wire for small-game harvest is effective in releasing most incidentally captured American marten (Group 5, Figure 6). Therefore, in total, 100% of critical habitat for American marten in Newfoundland has at least a partial form of legal protection.

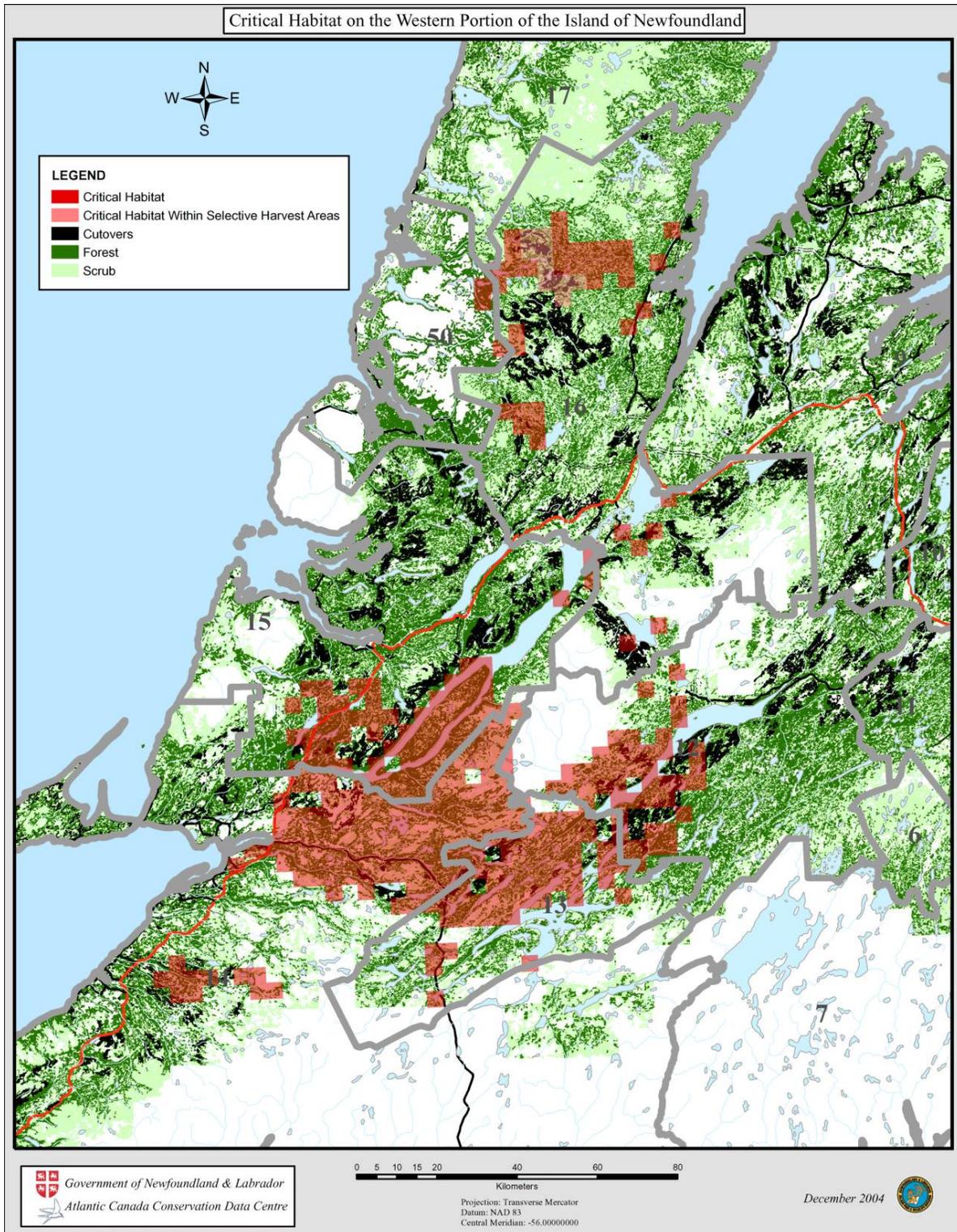


Figure 4. Proposed critical habitat (in red) for the American marten in western and northern Newfoundland. Also shown are mature forest, recently harvested areas (in black) and Forest Management district boundaries (in grey).

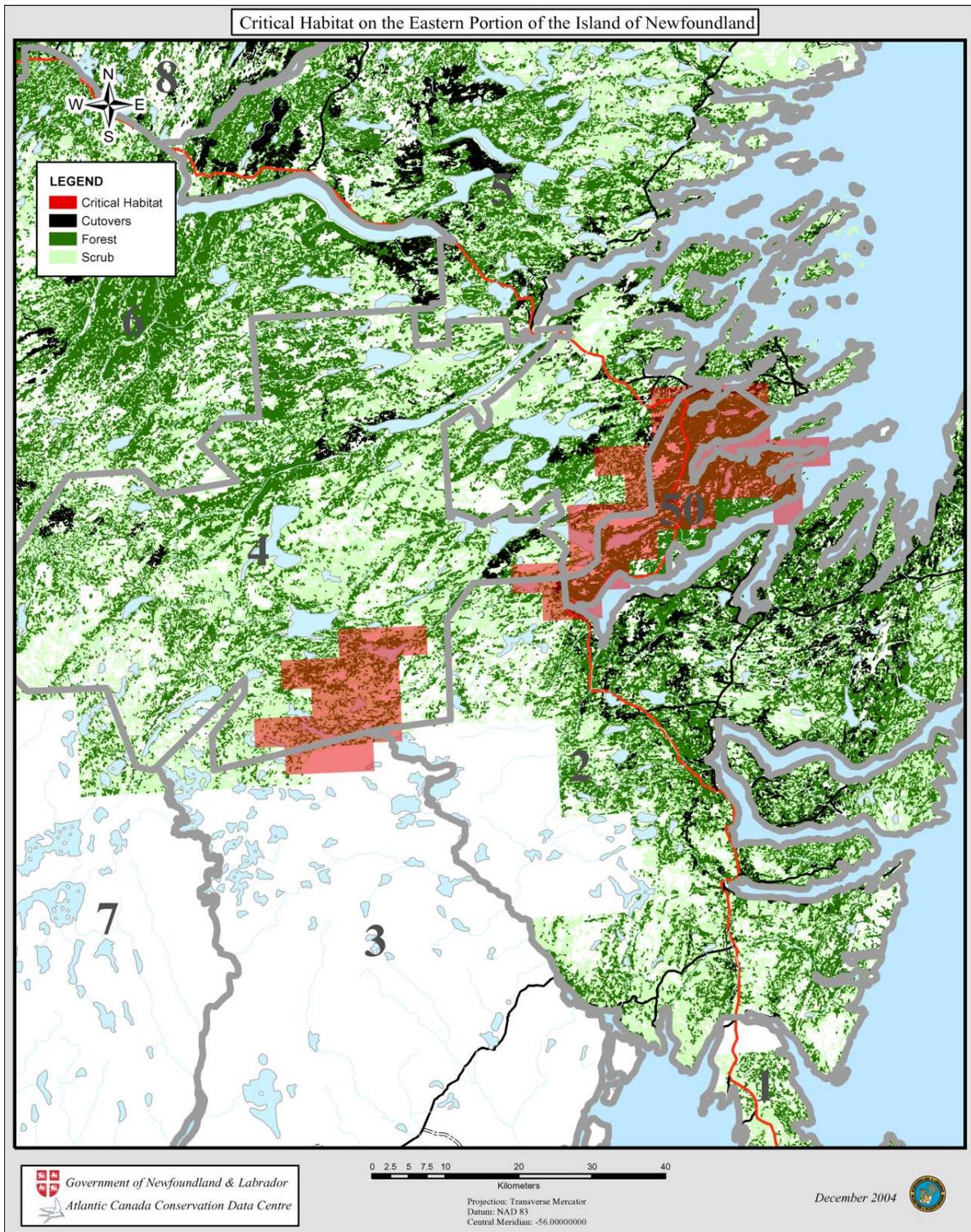


Figure 5. Proposed critical habitat (in red) for the American marten in Eastern Newfoundland centered on Terra Nova National Park. Also shown are mature forest, recently harvested areas (in black) and Forest Management district boundaries (in grey).

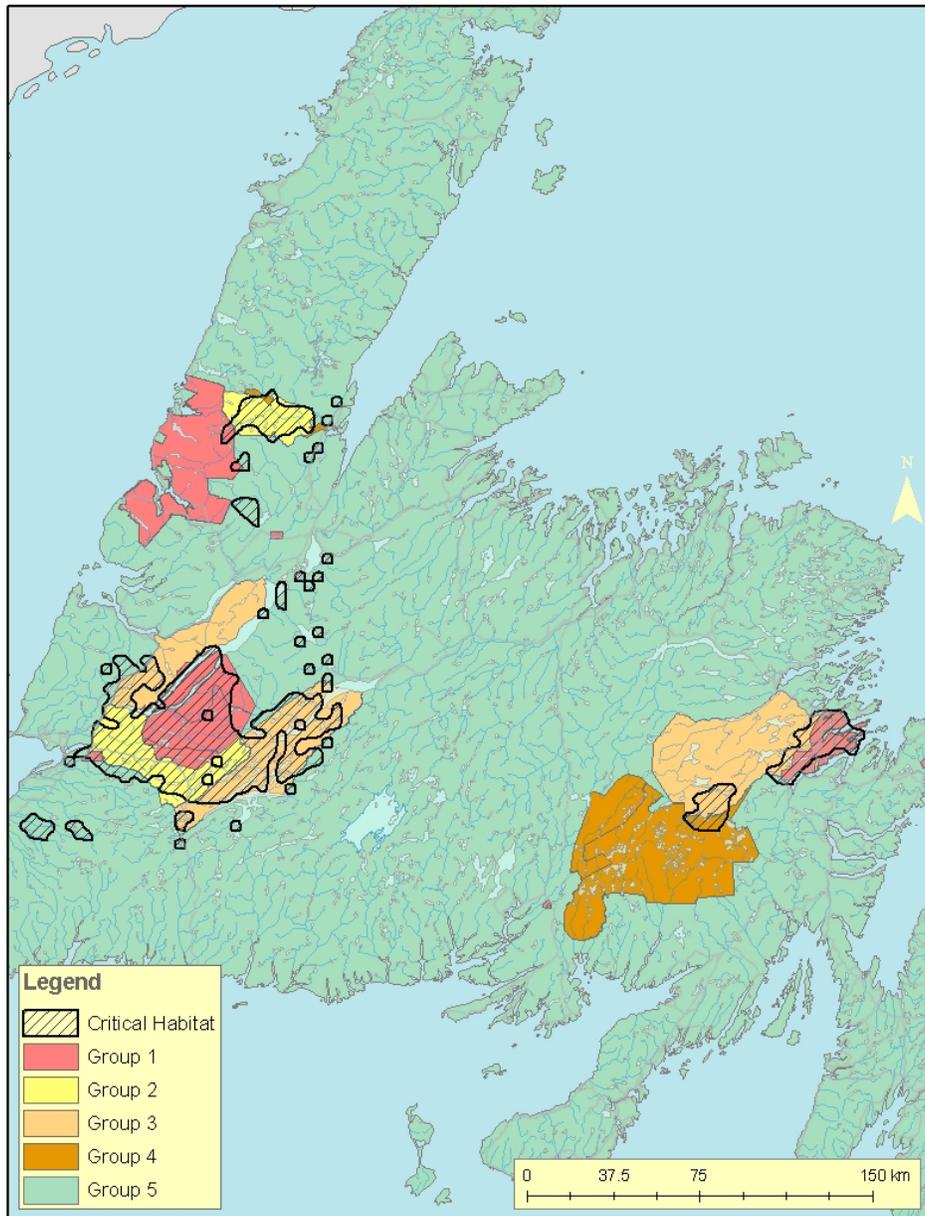


Figure 6. Location of areas providing full to partial protection of the critical habitat of American marten in Newfoundland. In group 1 areas forestry harvest, development, land-based traps, land-based locking neck snares, and small game snares are prohibited. In group 2 areas forest harvest and development are managed and land-based traps, land-based locking neck snares, and small game snares are prohibited. In group 3 areas forest harvest and development are managed and only land-based traps are prohibited, as fox, coyote, or lynx killing neck snares and approved snare wire for small-game harvest is permitted. In group 4 areas forest harvest is prohibited but snaring and trapping using approved snare wire is permitted. In group 5 areas (remainder of the island) forest harvest and development are managed and only approved snare wire for small-game harvest is permitted.

THREATS

Habitat loss

American marten are a forest-dependent species thus loss of forest cover from resource extraction activities (e.g., forestry), community development, or natural disturbance (e.g., forest fire, insect damage) have a direct influence on the capacity of an area to support them by removing denning/resting sites, foraging habitat, or breeding habitat (Fuller et al. 2006, Godbout and Ouellet, 2008). Marten are known to tolerate forest openings caused by both natural and anthropogenic disturbances within their home ranges; however, removal of habitat beyond a threshold will reduce the probability of occupancy of an area by marten (Hearn et al. 2005, Fuller et al. 2006, Godbout and Ouellet, 2008). In Newfoundland, commercial forest harvesting is the dominant source of habitat loss and fragmentation across the landscape. In other regions of North America where the impacts of forest harvesting on marten populations have been evaluated, studies have documented larger home ranges in areas where extensive harvesting has occurred (Payer 1999, Potvin and Breton 1997, Fuller and Harrison 2005). Payer (1999) suggested that heightened energetic demands associated with defending larger territories, as well as an increased risk of predation and lower foraging success in early successional stands probably reduces the capacity of extensively clearcut landscapes to support marten.

Critical habitat will be compromised if forest cover within these areas is removed beyond thresholds tolerated by marten (Fuller 2006). Habitat loss could occur through forest harvesting, agricultural development, mining operations, flooding from hydro projects, expansion of existing towns or cottage development areas, or the construction of roads and utility corridors. Depending on the form of anthropogenic development, habitat loss may be relatively short-lived (e.g., forest harvesting), or may persist indefinitely (flooding, expansion of towns etc.).

Mortality from snaring and trapping

American marten were once an important fur species for trappers across Newfoundland. Although the legal trapping season for marten was closed in 1934, the species has continued to be impacted by non-targeted (incidental) mortality caused by legal snaring and trapping of furbearing species (Forsey et al. 1995). Between 1995-2000, Hearn (2007) radio-collared and monitored 94 marten (27 juvenile and 67 adult) in an area open to snaring and trapping near Red Indian Lake in western Newfoundland. Incidental capture in furbearer traps and in snares set for snowshoe hares caused 92% of the juvenile mortality (n = 11 mortalities) and 58% of the adult mortality (n = 19 mortalities). The overall impact of incidental mortality was likely underestimated in this study because trapping pressure on the study area was low (Hearn 2007). In addition, since 1970, carcasses of American marten incidentally captured and subsequently returned to the Government of Newfoundland and Labrador Wildlife Division indicate that this problem is pervasive and occurs across the entire range of marten on the island (Table 3; Forsey et al. 1995, Government of Newfoundland and Labrador, unpublished data). Measures to reduce the incidental capture of marten have included; 1) the elimination of trapping and snaring in some of the core areas where marten occur and 2) use of

approved snaring and trapping techniques (e.g.: 22 gage brass and 6-strand picture cord snare wire) on the remainder of the island of Newfoundland.

Table 3: Reported trap-related American marten mortality between 1970-2003 in Newfoundland (Government of Newfoundland and Labrador, Wildlife Division, Incidental Capture Database).

Trap Type	Target Animal(s)	No. of trap-killed marten	% of trap-killed marten
Foothold / conibear traps set on dry land	Mink, Weasel, Fox, Lynx, and Coyote	79	56.4%
Locking snares set on dry land	Coyote, Fox, and Lynx	13	9.3%
Rabbit Snares	Snowshoe hare	48	34.3%

Other Threats

Other threats to marten survival and recovery include disease and mortality caused by competitors and the introduction of red-backed voles. Marten may be susceptible to diseases carried by farmed mink or other mustelids and able to contract diseases from domestic animals. It is unlikely that these diseases will be prevalent enough to significantly impact population size or recovery. The direct and indirect effects of the introduction of the red-backed vole to the forest ecosystems of Newfoundland are unknown (Hearn et al. 2007); however, this introduction will likely impact the demographics of predators including fox, coyote, and raptors, which are all known to kill marten and animals (i.e., mink and weasel) which compete with marten for food and den sites (Drew 1995, Hearn 2007).

IMPORTANCE TO PEOPLE

Historical literature abounds with references of marten in Newfoundland and its importance to both aboriginal peoples and early European trappers. In a series of referenced extracts, Captain John Whitbourne describes “a traffic with the savages for their furs of beaver, martin, seale, otter ...” (Whitbourne 1620, Howley 1915). Henry Crout, a resident of Cupids, indicated that the trapping of muskrat, fox, otter and marten occurred between 1612 and 1613 (Marshall 1996). Archeological work has unearthed evidence of marten use by Beothuk people, demonstrating the presence of marten on the Island prior to European contact. In the 1700s marten first appear in records of furs traded to the English (Marshall 1996). More recently marten have become an indicator of forest health (Thompson 1991, Thompson and Curran 1995), and as one of only 14 native mammals on the island, they have come to symbolize the plight of species at risk within the province.

KNOWLEDGE GAPS

To help achieve species recovery additional information is required on the distribution and abundance of American marten in Newfoundland, the numbers and distribution required to achieve long-term population viability, the effect of threats on the population viability of marten, sub-stand level habitat requirements, and the demographic response of marten to the increase in small mammal diversity and revised snaring and trapping policies and regulations.

RECOVERY GOALS, OBJECTIVES, AND ACTIONS

RECOVERY GOAL

To have and maintain a stable wild population of American marten in Newfoundland. The population goal identified in the 1995 National Recovery Plan - to establish a population of 1000 individuals - will be maintained. Numerical estimates of potential population size and spatial distribution are being prepared and will be used to refine this goal.

RECOVERY OBJECTIVES

It is necessary to meet the following seven recovery objectives in order to achieve the recovery goal:

- 1) Maintain and/or enhance existing populations and support natural dispersal within the species historical range;
 - (a) To maintain areas currently occupied by marten;
 - (b) To establish marten in areas adjacent to known populations where the potential for occupancy is high (e.g., east of Victoria River, Red Indian Lake north to Birchy Lake, Lake St. John north to Gander Lake);
- 2) Identify and update the spatial distribution of critical and recovery habitat;
- 3) Manage critical and recovery habitat for the survival and recovery of marten by implementing forestry and wildlife management strategies;
- 4) Reduce incidental mortality by implementing appropriate mitigations to snaring and trapping;
- 5) Continue to refine our understanding of marten ecology to facilitate effective habitat and population management;
- 6) Continue long-term, standardized population monitoring to assess the success of recovery relative to the population goal; and
- 7) Obtain broad stakeholder support and involvement to facilitate the recovery of the species.

RECOVERY ACTIONS

The following recovery actions are considered important to complete in order to achieve the recovery goal and objectives and are summarized with their implementation schedule in Table 4. These build on previously completed recovery objectives which are summarized in Table 5.

Population Monitoring

1. Establish a long-term monitoring program

Monitoring the distribution and abundance of American marten in Newfoundland is critical to determine the effectiveness of recovery initiatives and the status of populations relative to targets. A long-term monitoring program will be established that incorporates a systematic and strategic approach to assess the status of established populations and the reestablishment of marten back into historical range (Figure 2, 3).

2. Implement cost-effective population monitoring techniques

Given that traditional sampling methods (i.e. live-trapping and mark-recapture approaches) are generally labour intensive and difficult to implement over large areas, researchers will expand the use of rapid, inexpensive techniques for estimating the occurrence and abundance of marten. The use of genetic material obtained from hair samples has been accepted as a useful technique for monitoring populations over large geographic areas (McGowan et al 1999, Mowat and Paetkau 2002, M. McGrath, pers. comm.).

Habitat Protection

3. Conduct an island-wide habitat assessment

An assessment of existing and projected marten habitat is currently being conducted using a probability based marten occupancy model (MOM; Fuller et al. 2006). This model uses habitat selection indices derived from an intensive five-year radio telemetry study of American marten in southwestern Newfoundland (Hearn 2007) and utilizes the provincial forest inventory to provide base landcover information for areas under assessment. Work is also being conducted to map the island using a revised version of the MOM model (Fuller et al. 2006) which utilizes remotely sensed (satellite) landcover images. Landcover maps generated using remote sensing images will complement the provincial forest inventory (aerial photography) and allow application of marten habitat models for areas of the province where forest inventories are outdated or incomplete (i.e., portions of the Bay du Nord Wilderness reserve, Burin Peninsula). An assessment of marten habitat using these approaches will be completed by 2011 and will be used to update the current distribution of critical and recovery habitat.

4. Assess the occurrence of marten in areas predicted by habitat models

Habitat models are useful for assessing the potential of landscapes to support marten, however, field validation is required to determine the actual presence or absence of marten since factors other than the extent and configuration of forest cover are known to influence the occupancy of landscapes by marten (Chapin et al. 1998, Hargis et al. 1999, Potvin et al. 2000, Godbout and Ouellet, 2008). Areas where monitoring is

required will be prioritized by the Recovery Team and systematic, standardized approaches will be implemented. Population monitoring is critical to assess species recovery relative to targets and to assess the effectiveness of management actions.

5. Develop area-specific population goals

Following the island-wide assessment of marten habitat and its verification, area-specific population goals will be developed based on the availability of suitable habitat.

6. Continue to support initiatives to minimize incidental mortality

Incidental mortality of marten from snowshoe hare snaring and furbearer trapping has been identified as a major factor limiting the recovery of the species on the island. Snaring and trapping are important recreational activities for many residents and have been valued aspects of their lifestyle for generations. Approximately 29% of critical habitat is fully protected (closed to snaring and all trapping methods that are likely to capture marten and forest harvest); however, complete closure of areas to all snaring and trapping activity is not the preferred management approach. Less stringent protections have been put in place which protect an additional 46% of critical habitat by requiring trapping methods that will minimize accidental marten mortality. Finally, snare wire types have been limited island-wide (including all areas of critical habitat) to those which release most captured marten (Fisher et al. 2005). This approach was designed to ensure that the incidence of incidental mortality will be negligible within the critical habitat of American marten and its historical range (Figure 2, 3, 5) and needs to be continued to be implemented to ensure marten recovery throughout their historic range. Snaring and furbearer harvests will be maintained, and the understanding and acceptance of recovery initiatives by resource users will continue to be promoted.

7. Update critical and recovery habitat maps

Critical habitat maps will be modified based on updated or new information on the spatial extent of suitable habitat and the distribution of American marten. Critical habitat maps will be reviewed and updated every five years, or as required. Recovery habitat will be identified and mapped as part of the island-wide habitat modelling exercise (#3 above) and will help identify regional population goals and targets.

8. Manage critical and recovery habitat

The Recovery Team and responsible jurisdictions will provide advice to resource managers as to the appropriate protection measures for critical and recovery habitat. The identification of appropriate protection will take into account the degree of threat(s), the success or failure of past protection measures, public support, numbers of animals and size of area to be affected, and current and future land use practices. Appropriate protection measures may include modified or closed snaring and trapping zones, protected areas, stewardship agreements, legal prohibitions, and habitat protection through the forest management planning processes. Habitat models (Fuller et al. 2006, Hearn 2007) for marten should be used throughout the forest management planning process to help develop a strategic, spatial plan to maintain adequate levels of marten habitat on the landscape in different regions through time, and include decisions

regarding timber harvest schedules, road construction, or other forms of development that may reduce the quality or quantity of habitat available for marten.

9. Support the establishment of protected areas

A number of reserves (including Ecological, Wilderness, Wildlife, and Public Reserves as well as Provincial Parks) have been established in Newfoundland to protect a range of ecological features and biodiversity, including the American marten. In reserves where marten are known to occur or potentially occur, activities that may influence the persistence of marten in these areas will be assessed and managed to maintain marten on the landscape. One of the primary reasons for establishing the Little Grand Lake Provisional Ecological Reserve was to protect American marten and marten habitat. The process of establishing Little Grand Lake Provisional Ecological Reserve as a full status Ecological Reserve requires approval by Cabinet and adoption of a reserve management plan under the *Wilderness and Ecological Reserves Act*. The management plan will outline strategies to protect reserve values, including American marten. The transfer of the Little Grand Lake Provisional Ecological Reserve to full Reserve status and the adoption of a management plan for Little Grand Lake Ecological Reserve is considered important to the recovery of the American marten. It is recommended by the Newfoundland Marten Recovery Team as a recovery action. In addition, a plan for the renewal of the Glover Island Public Reserve, or for another form of long-term protection of that area, must be in place prior to expiry of the reserve in 2012.

Population Enhancement

10. Assess the need for re-introduction of American marten to parts of its historic range

Once populations are reduced to a few breeding individuals, they are highly subjective to the effects of demographic, environmental, and genetic stochasticity (Caughley and Gunn 1995). Small populations may persist for a number of years but have an increased probability of extinction compared with larger populations. Animal translocations are commonly carried out to support dispersal and augment established populations with additional breeders to expedite population growth. One of the goals outlined in this document is to establish a number of sub-populations of American marten through out its historic range (Figure 2). Establishing geographically separate populations will lessen the probability of a large-scale catastrophic event affecting all areas where American marten occur. Two formerly extirpated populations (Main River and Terra Nova) have been re-established following a series of reintroductions that began in the early 1980s. The need for further translocations will be evaluated; however, an emphasis will continue to be placed on minimizing incidental mortality and planning for landscape scale connectivity via dispersal from disjunct populations.

Ecological Research

11. Investigate the implications of an increasing southern red back vole population on marten demographics

The 1995 Newfoundland Marten Recovery Plan (Foresy et al. 1995) refers to the possibility of introducing red-backed voles (*Clethrionomys gapperi*) to the island as a means of increasing the low diversity and biomass of prey and improving recruitment

and population growth of marten. Though an introduction was not endorsed by the Recovery Team, red-backed voles have since been recorded in western Newfoundland and their distribution is expanding (Hearn et al. 2005). Because red-backed voles are a major food item of marten populations across their North American range (Soutiere 1979, Thompson and Colgan 1987, Simon et al. 1999), the colonization of this species on the island could have implications on marten ecology, including increased population density, smaller home ranges, and higher ovulation rates (Thompson and Colgan 1987)

Marten populations may respond to this new food source, however the magnitude of this response is unknown (Hearn et al. 2005). On-going small mammal research in the Red Indian Lake area, conducted each fall since 1999 by the Canadian Forest Service in cooperation with the College of the North Atlantic, has documented the arrival and irruption of red-backed voles in areas where marten have been studied. Small mammal inventories and monitoring as part of a province wide small mammal monitoring network has documented similar results (Rodrigues 2008). Future research should be initiated to investigate the influence of red-backed voles on marten demography and ecology. Research over the next several years should focus on monitoring the distribution and density of red-backed voles across the island, possibly through the continued support of the provincial small mammal monitoring network (Rodrigues 2008); continuing scat collections from ongoing marten research and future studies to allow a comparison of marten diet before and after the establishment of southern red-backed voles; and continuing population monitoring to investigate potential demographic shifts following the stabilization of southern red-backed vole populations.

12. Population dynamics of prey species

American marten are known to respond numerically to shifts in prey abundance through changes in their reproduction performance, thus, it is important to understand the distribution and relative densities of prey in landscapes where marten occur. This may be particularly important on the island of Newfoundland as prey communities are changing in response to recent introductions (southern red-backed voles and deer mice) and the long-term demographic consequences of this changing food base to marten are unknown. We recommend that standardized methods for measuring the abundance of known important prey be identified, such as those used in the province wide small mammal monitoring network (Rodrigues 2008), expanded to include snowshoe hare, and applied as a long-term monitoring initiative.

13. Investigate the impacts of anthropogenic development on marten

Habitat availability and incidental snare and trap mortality are currently viewed as the two factors most strongly impacting the recovery of American marten in Newfoundland. However, the impact of snaring and trapping on marten populations and the response of marten to timber harvest have not been measured. To tackle some of these questions, a study area has been set-up around Georges, Pinchgut, and Stag Lakes which includes sections with modified trapping and sections scheduled for harvest in the next 2-5 years. Up to 40 animals will be fitted with radio collars and their movements will be monitored to document survival, space use, and dispersal of marten in areas under different combinations of harvest and snaring/trapping pressure. Outcomes of this

research will be used to shape future forest harvesting plans and to evaluate the relative impact of snaring/trapping on marten recovery.

Stewardship and Education

14. Develop public support for recovery actions

A comprehensive communication strategy for the purpose of building support of recovery initiatives through effective and relevant education programs and messages will be initiated, based on work done to date. This strategy will be reviewed annually and will provide opportunities for public involvement. Previous social sciences research (Bath 2002, 2003, and 2004) described the attitudes, values and knowledge levels of local residents on marten related issues and this data will be incorporated into the communication strategy and act as a baseline for evaluating public knowledge in the future. New education programs will complement and support existing programs (e.g., school programs, television ads, website etc.)

15. Establish strong partnerships with stakeholders

The mortality of American marten in Newfoundland from incidental snaring and trapping continues to impact the rate of species survival and recovery; therefore it is imperative that understanding of recovery issues is increased in the snaring and trapping community and that they be encouraged to participate in recovery initiatives. The Red Indian Lake Stewardship Program resulted in an increased awareness of marten and an improvement in the proper use of approved snare wire (Wayne Barney, pers. comm.). This interactive approach should be continued. Maintaining an adequate supply and spatial distribution of forest cover on the landscape is also fundamental to American marten recovery in Newfoundland. It is critical that partnerships are strengthened between the provincial and federal agencies responsible for wildlife and forest management, industrial forest companies, academic institutions, etc. to ensure that effective conservation measures are implemented.

RECOVERY ACTION IMPLEMENTATION SCHEDULE

Table 4. Implementation schedule of the recovery actions required to meet recovery objectives for the American marten in Newfoundland during the next five years (2010-2014).

Recovery Action	Objective	Priority	Responsibility or Lead ⁱ	Implementation schedule				
				2010	2011	2012	2013	2014
Population Monitoring								
Establish a long-term monitoring program	1, 6	Urgent	WD	X	X	X	X	X
Implement cost-effective population monitoring techniques	1, 6	Urgent	CFS, DNR, WD	X	X	X	X	X
Habitat Protection								
Conduct an island-wide habitat assessment	2	Urgent	CFS, DNR, WD	X	X			
Assess the occurrence of marten in areas predicted by habitat models	2	Necessary	WD		X	X	X	X
Develop area-specific population goals	1	Necessary	RT					X
Continue to support initiatives to minimize incidental mortality	4	Urgent	WD	X	X	X	X	X
Update critical and recovery habitat maps	2	Necessary	WD			X	X	
Manage critical and recovery habitat	3	Necessary	WD, DNR, PC, PNAD	X	X	X	X	X
Support the establishment of protected areas	1, 3	Necessary	RT	X	X	X	X	X
Population Enhancement								
Assess the need for re-introduction of American marten to parts of its historic range	1	Necessary	RT	X	X			
Ecological Research								
Investigate the implications of an increasing southern red-backed vole population on marten demographics	5	Beneficial	CFS, WD	X	X	X	X	X
Measure population dynamics of prey species	5	Beneficial	WD	X	X	X	X	X
Investigate the impacts of anthropogenic development on marten	5	Urgent	CBPPL, CFS, WD	X	X	X	X	X
Stewardship and Education								
Develop public support for recovery actions	7	Necessary	WD, NLTA	X	X	X	X	X
Establish strong partnerships with stakeholders	7	Necessary	WD	X	X	X	X	X

ⁱ CBPPL - Corner Brook Pulp and Paper Limited, CFS - Canadian Forest Service, NLTA - Newfoundland and Labrador Trappers Association, WD - Government of Newfoundland and Labrador Wildlife Division, PC - Parks Canada, PNAD - Government of Newfoundland and Labrador Parks and Natural Areas Division, and RT - Newfoundland Marten Recovery Team

COMPLETED RECOVERY ACTIONS

Table 5. Recovery actions for the Newfoundland population of American marten that have been completed or currently in progress.

Category	Recovery Action
Population Monitoring	<ol style="list-style-type: none"> 1. Determined distribution using live-trapping, bait station, and snow-tracking 2. Established a monitoring program using genetic tagging 3. Monitored American marten using radio telemetry (Gosse et al. 2005, Hearn et al. 2005, Hearn 2007)
Habitat Protection	<ol style="list-style-type: none"> 4. Targeted American marten trapping was closed on the island in 1934. 5. Established the Pine Marten Study Area in 1973 6. Snaring and trapping closed in the Pine Marten Study Area, Main River Study Area, Little Grand Lake Ecological Provisional Ecological Reserve and Wildlife Reserve, and on the Glover Island Public Reserve 7. Modified snare zones established in the Northwest Shore Grand Lake and the Red Indian Lake, Terra Nova and Charlottetown enclaves 8. Provincial protected areas created at Little Grand Lake, Glover Island, and Main River watershed 9. Integrated marten habitat management guidelines into forest management planning 10. Developed landscape habitat suitability models (Knox et al. 2000, Adair 2003, Fuller et al. 2006) 11. Defined and mapped critical and recovery habitat 12. Critical habitat maps submitted to the Government of Newfoundland and Labrador
Population Enhancement	<ol style="list-style-type: none"> 13. Developed captive breeding techniques (Heath et al. 2001) 14. Reintroduced marten to eastern Newfoundland and the Main River watershed
Ecological Research	<ol style="list-style-type: none"> 15. Monitored prey populations in the Red Indian Lake and Terra Nova regions and investigated their effect on marten population dynamics 16. Studied marten demographics and habitat selection (Gosse et al. 2005, Hearn et al. 2005, Fuller 2006, Hearn 2007) 17. Analyzed the relative importance of different food items to the diet of marten (Gosse and Hearn 2005) 18. Researched alternate hare snaring wires for reducing marten mortality (Proulx et. al. 1994, Fisher and Twitchell 2004, Fisher et al. 2005) 19. Determined the response of American marten to modified harvesting designs 20. Assessed the genetic distinctiveness of American marten in Newfoundland (Hicks and Carr 1992, McGowan et al. 1999, Kyle and Strobeck 2003) 21. Establishment of a province wide small mammal monitoring network (Rodrigues, 2008)
Stewardship	<ol style="list-style-type: none"> 22. Determined public attitude to American marten (Bath 2002, 2003, 2004) 23. Developed communication and education products for elementary school students, the general public, trappers, and snowshoe hare snarers 24. Implemented stewardship initiatives targeting recreational snarers and trappers (i.e.: Distribution of legal snare wire (22 gage brass and 6-strand picture cord) free of charge) 25. Implemented snaring and trapping information programs in four areas 26. Released to the media information regarding ongoing American marten-related activities

EFFECTS OF RECOVERY ON OTHER SPECIES AND ECOLOGICAL PROCESSES

The Newfoundland population of American marten is part of the natural biological diversity of forested environments in Newfoundland and should be recovered. The ecological role of the marten is not completely understood; however, it does function as both a predator and prey species and undoubtedly contributes to other processes including seed dispersal and nutrient cycling. Re-establishment of marten into former parts of its range is unlikely to have a significant effect on prey or competitors (e.g. fox and coyotes) considering the very low densities at which marten occur. Maintenance of forested areas suitable for marten would undoubtedly benefit other forest dependent wildlife species (e.g. the endangered Red Crossbill (*Loxia curvirostra percna*)).

LITERATURE CITED

- Adair, W.A. 2003. Modeling habitat quality for American martens in western Newfoundland, Canada. Ph. D. thesis. Utah State University, Logan, USA.
- Andruskiw, M., J.M. Fryxell, I.D. Thompson, and J.A. Baker. 2008. Habitat mediated variation in predation risk by the American marten. *Ecology* 89: 2273-2280.
- Bateman, M.C. 1986. Winter habitat use and home range size of the marten, *Martes americana*, in Western Newfoundland. *Canadian Field Naturalist* 100:58-62.
- Bath, A.J. 2002. Resident attitudes toward and knowledge about Newfoundland marten and marten recovery in TNNP and Newfoundland. Report submitted to Terra Nova National Park, Parks Canada, St. John's, Canada. 125 pp.
- Bath, A.J. 2003. Western Newfoundland resident attitudes toward and knowledge about the Newfoundland marten and marten recovery on the island. Report submitted to Terra Nova National Park, Parks Canada, St. John's, Canada. 133 pp.
- Bath, A.J. 2004. Central Newfoundland resident attitudes toward and knowledge about Newfoundland marten and marten recovery on the island. Report submitted to Terra Nova National Park, Parks Canada, St. John's, Canada. 124 pp.
- Bergerud, A.T. 1969. The status of pine marten in Newfoundland. *Canadian Field Naturalist* 83:128- 131.
- Bissonette, J.A., D.J. Harrison, C.D. Hargis, and T.G. Chapin. 1997. The influence of spatial scale and scale-sensitive properties on habitat selection by American marten. Pages 368-385 in *Wildlife and Landscape Ecology*. Edited by J.A. Bissonette. Springer-Verlag, New York, USA.
- Bull, E.L. and T.W. Heater. 2000. Resting and denning sites of American martens in northeastern Oregon. *Northwest Science* 74:179-185.
- Buskirk, S.W., S.C. Forrest, M.G. Raphael, and H.J. Harlow. 1989. Winter resting site ecology of marten in the central Rocky Mountains. *Journal of Wildlife Management* 53:191-196.
- Buskirk, S.W. and L.L. McDonald. 1989. Analysis of variability in home range size of the American marten. *Journal of Wildlife Management* 53: 997-1004.
- Chapin, T.G., D.J. Harrison, and D.D. Katnik. 1998. Influence of landscape pattern on habitat use by American marten in an industrial forest. *Conservation Biology* 12: 1327-1337.

- Cormack, W.E. 1928. Narrative of a Journey Across the Island of Newfoundland in 1822. (Centenary Issue) 138 pp. *Edited by* F.A. Bruton. Longmans, Green and Co. Ltd. London, England.
- Caughley, G. and A. Gunn. 1995. Conservation Biology in Theory and Practice. Blackwell Science. Cambridge, Massachusetts, USA.
- Drew, G.S. 1995. Winter habitat selection by American marten (*Martes Americana*) in Newfoundland: Why old growth? Thesis, Utah State University, Logan, USA.
- Fisher, J.T. and C. Twitchell. 2004. Assessing the abilities of experimental snare wires to release American marten (*Martes americana*). Final report, Alberta Research Council Inc., Sustainable Ecosystems Unit, Vegreville, Canada. 13 pp.
- Fisher, J.T., C. Twitchell, W. Barney, E. Jensen, and J. Sharpe. 2005. Utilizing behavioural biophysics to mitigate mortality of snared endangered Newfoundland marten. *Journal of Wildlife Management* 69:1743-1746
- Forsey, O., J. Bissonette, J. Brazil, K. Curnew, J. Lemon, L. Mayo, I. Thompson, L. Bateman, and L. O'Driscoll. 1995. National Recovery Plan for the Newfoundland Marten. Rep. No. 14, Recovery of Nationally Endangered Wildlife Committee, Ottawa, Canada.
- Fuller, A.K. and D.J. Harrison. 2005. Influence of partial timber harvesting on American martens in north-central Maine. *Journal of Wildlife Management* 69: 710 -722.
- Fuller, A.K., D.J. Harrison, B.J. Hearn, and J.A. Hepinstall. 2006. Landscape thresholds, occupancy models, and responses to habitat loss and fragmentation in Newfoundland and Maine, Final Contract Report. Wildlife Division, Department of Environment and Conservation, Government of Newfoundland and Labrador, Corner Brook, Canada.
- Fuller, A.K. 2006. Multi-scalar responses of forest carnivores to habitat and spatial pattern: case studies with Canada lynx and American martens. Thesis, University of Maine, Orono, USA.
- Furbearing Animals Trapping and Shooting Order. 2009. Wild Life Regulations and Wild Life Act, Statutes of Newfoundland and Labrador. Queen's Printer, St. John's, Canada.
- Godbout, G. and J.P. Ouellet. 2008. Habitat selection of American marten in a logged landscape at the southern fringe of the boreal forest. *Ecoscience* 15: 332-342.
- Gosse, J.W., R. Cox, and S.W. Avery. 2005. Home range characteristics and habitat use by American martens in eastern Newfoundland. *Journal of Mammalogy* 86: 1156-1163.

- Gosse, J.W. and B.J. Hearn. 2005. Seasonal diets of Newfoundland Marten, *Martes americana atrata*. Canadian Field Naturalist 119: 43-47.
- Government of Canada. Species at Risk Act Public Registry. Residence Descriptions. Description of residence for American marten, Newfoundland population (*Martes americana atrata*) in Canada. http://www.sararegistry.gc.ca/virtual_sara/files/rd_newfoundland_marten_final_807_e1.pdf. (Access November 2009).
- Hargis, C.D. and D.R. McCullough. 1984. Winter diet and habitat selection of marten in Yosemite National Park. Journal of Wildlife Management 48:140-146.
- Hargis, C.D., J.A. Bissonette, and D.L. Turner. 1999. The influence of forest fragmentation and landscape pattern on American martens. Journal of Applied Ecology 36:157-172.
- Hearn, B.J., D.J. Harrison, C. Lundrigan, W.J. Curran, and A.K. Fuller. 2005. Scale dependent habitat selection by Newfoundland marten, Final Contract Report. , Wildlife Division, Department of Environment and Conservation, Government of Newfoundland and Labrador, Corner Brook, Canada.
- Hearn, B.J., J. Neville, W. Curran, and D.P. Snow. 2006. First record of the Southern red-backed vole in Newfoundland, *Clethrionomys gapperi*: Implications for the endangered Newfoundland marten, *Martes americana atrata*. Canadian Field Naturalist 120: 50-56.
- Hearn, B.J. 2007. Factors affecting habitat selection and population characteristics of American marten (*Martes americana atrata*) in Newfoundland. Ph.D. Dissertation, University of Maine, Orono, USA.
- Heath, J.P., D.W. McKay, M.O. Pitcher, and A.E. Storey. 2001. Changes in reproductive behaviour of the endangered Newfoundland marten (*Martes americana atrata*): implications for captive breeding programs. Canadian Journal of Zoology 79: 149-153.
- Hicks, S.A. and S.M. Carr. 1992. Genetic analysis of a threatened subspecies, the Newfoundland pine marten (*Martes americana atrata*). Pages 287-290 in Science and Management in Protected Areas. Edited by J. H.M. Willison, S. Bondrup Nielsen, C. Drysdale, T. B. Herman, N. W. P. Munro, and T. L. Pollock. Elsevier Press, Amsterdam, Netherlands.
- Hodgman, T.P., D.J. Harrison, D.D., Katnik, and K.D. Elowe. 1994. Survival in an intensively trapped marten population in Maine. Journal of Wildlife Management 58: 593-600.

- Howley, J.P. 1915. The Beothucks or Red Indians. Cambridge Univ. Press. Cambridge, England.
- Knox, K., B.J. Hearn, J. Brazil, and J. Pond. 2000. American marten habitat Modelling in Newfoundland. Presentation and published abstract. 3rd International Martes Symposium, 13-16 August 2000. Corner Brook, Canada.
- Kyle, C. J. and Strobeck, C. 2003. Genetic homogeneity of Canadian mainland marten populations underscores the distinctiveness of Newfoundland pine martens (*Martes americana atrata*). Canadian Journal of Zoology 81: 57-66.
- Marshall, I. 1996. A History and Ethnography of the Beothuk. McGill-Queen's University Press. Montreal, Canada.
- Martin, S.K. 1994. Feeding ecology of American martens and fishers. Pages 297-315 in Martens, sables, and fishers: Biology and Conservation. Edited by S. W. Buskirk, A. S. Harestad, M. G. Raphael, and R. A. Powell. Cornell University Press, Ithaca, USA.
- Mayo, L. and Greene, B. 1985. Pine marten denning/natality behaviour and resting sites at Little Grand Lake, Newfoundland – internal report. Wildlife Division, Department of Environment and Conservation, Government of Newfoundland and Labrador, Corner Brook, Canada.
- McGowan, C., L.A. Howes, and W.S. Davidson. 1999. Genetic analysis of an endangered pine marten (*Martes americana*) population from Newfoundland using randomly amplified polymorphic DNA markers. Canadian Journal of Zoology 77: 661-666.
- Mowat, G. and D. Paetkau. 2002. Estimating marten *Martes Americana* population size using hair capture and genetic tagging. Wildlife Biology 8: 201-209.
- Newfoundland and Labrador Hunting and Trapping Guide. 2009. Wildlife Division, Department of Environment and Conservation, Government of Newfoundland and Labrador, Corner Brook, Canada.
- Newfoundland Marten Recovery Team. 2005. Designation of critical habitat for the Newfoundland marten – internal report. Wildlife Division, Department of Environment and Conservation, Government of Newfoundland and Labrador, Corner Brook, Canada.
- Payer, D.C. 1999. Influences of timber harvesting and trapping on habitat selection and demographic characteristics of American marten. Ph.D. dissertation, University of Maine, Orono, USA.
- Potvin, F. and L. Breton. 1997. Short-term effects of clearcutting on marten and their

- prey in the boreal forest of western Quebec. Pp. 452-474 in *Martes: taxonomy, ecology, techniques, and management*. Edited by G. Proulx, H. N. Bryant, and P. M. Woodward. Provincial Museum of Alberta, Canada.
- Powell, R.A., S.W. Buskirk, and W.J. Zielinski. 2003. Fisher and marten. Pp. 635-649 in *Wild Mammals of North America*, 2nd edition. Edited by G.A. Feldhamer, B.C. Thompson, and J.A. Chapman. John Hopkins University Press, Baltimore, USA.
- Proulx, G., A.J. Kolenosky, M.J. Badry, P.J. Cole, and R. K. Drescher. 1994. A snowshoe hare snare system to minimize capture of marten. *Wildlife Society Bulletin*. 22: 639-643.
- Rodrigues, B. 2008. Newfoundland and Labrador small mammal monitoring network 2008 seasonal report – internal report. Wildlife Division, Department of Environment and Conservation, Government of Newfoundland and Labrador, Corner Brook, Canada.
- Ruggiero, L.F., D.E. Pearson, and S.E. Henry. 1998. Characteristics of American marten den sites in Wyoming. *Journal of Wildlife Management* 62: 663-673.
- Sherburne, S.S., and J.A. Bissonette. 1994. Marten subnivean access point use: response to subnivean prey levels. *Journal of Wildlife Management* 58:400-405.
- Simon, N.P., F.E. Schwab, M.I. LeCoure, and F.E. Phillips. 1999. Fall and winter diet of martens, *Martes americana*, in central Labrador related to small mammal densities. *Canadian Field-Naturalist* 113: 678-680.
- Soutiere, E.C. 1979. Effects of timber harvesting on marten in Maine. *Journal of Wildlife Management* 43: 850-860.
- Snyder, J.E. and J. Hancock. 1985. Newfoundland pine marten population estimate. Internal report. Wildlife Division, Department of Environment and Conservation, Government of Newfoundland and Labrador, Corner Brook, Canada.
- Sturtevant, B. J., and J. A. Bissonette. 1997. Stand structure and microtine abundance in Newfoundland: implications for marten. Pages 182–198 in *Martes: taxonomy, ecology, techniques, and management*. Edited by G. Proulx, H. N. Bryant, and P. M. Woodard, editors. Provincial Museum of Alberta, Edmonton, Canada.
- Thompson, I.D. 1991. Could marten become the spotted owl of eastern Canada? *Forestry Chronicle* 67: 136-140.
- Thompson, I.D. and P.W. Colgan. 1987. Numerical responses of marten to food shortage in northcentral Ontario. *Journal of Wildlife Management* 51:824-855.

Thompson, I.D. and W.J. Curran. 1995. Habitat suitability for marten of second growth balsam fir forests in Newfoundland. *Canadian Journal of Zoology* 73: 2059-2064.

Thompson, I.D. and A.S. Harestad. 1994. Effects of logging on American martens, and models for habitat management. Pp. 335-367 *in* Martens, sables and fishers: biology and conservation. *Edited by* S. W. Buskirk, A. S. Harestad, M. G. Raphael, and R. A. Powell. Cornell University Press, Ithaca, USA.

Whitbourne, R. 1620. A discourse and discovery of New-found-land. Felix Kyngston for William Barret, London, England.

APPENDIX A

RECOVERY TEAM MEMBERS

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