COSEWIC
Assessment and Status Report

on the

American Marten
Martes americana atrata

Newfoundland population

in Canada

SPECIAL CONCERN
2022

COSEWIC
Committee on the Status
of Endangered Wildlife
in Canada

COSEPAC
Comité sur la situation
des espèces en péril
au Canada

COSEWIC status reports are working documents used in assigning the status of wildlife species suspected of being at risk. This report may be cited as follows:

COSEWIC. 2022. COSEWIC assessment and status report on the the American marten (Newfoundland population) *Martes americana atrata* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xii + 42 pp. (https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html).

Previous report(s):

COSEWIC 2007. COSEWIC assessment and update status report on the American marten (Newfoundland population) *Martes americana atrata* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 26 pp. https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html).

COSEWIC 2000. COSEWIC assessment and update status report the Newfoundland marten *Martes americana atrata* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 9 pp. https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html).

Lemon, J. 1996. Update COSEWIC status report on the Newfoundland marten *Martes americana atrata* in Canada (Newfoundland population). Committee on the Status of Endangered Wildlife in Canada. Ottawa. 1-9 pp.

Skinner, W. R. 1979. COSEWIC status report on the Newfoundland pine marten *Martes americana atrata* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 14 pp.

Snyder, J. E. 1985. Update COSEWIC status report on the Newfoundland marten *Martes americana atrata* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 42 pp.

Production note:
COSEWIC acknowledges Brian G. Slough and Brian J. Hearn for writing the status report on American Marten, Newfoundland population, *Martes americana atrata*, in Canada, prepared under contract with Environment and Climate Change Canada. This status report was overseen and edited by Chris Johnson, Co-chair of the COSEWIC Terrestrial Mammals Specialist Subcommittee.

For additional copies contact:

COSEWIC Secretariat
c/o Canadian Wildlife Service
Environment and Climate Change Canada
Ottawa, ON
K1A 0H3

Tel.: 819-938-4125
Fax: 819-938-3984
E-mail: ec.cosepac-cosewic.ec@canada.ca
www.cosewic.ca

Également disponible en français sous le titre Évaluation et Rapport de situation du COSEPAC sur la Martre d'Amérique (*Martes americana atrata*) au Canada.

Cover illustration/photo:
American Marten — Photograph provided by authors.

Catalogue No. CW69-14/46-2022E-PDF
ISBN 978-0-660-44324-9

COSEWIC
Assessment Summary

Assessment Summary – May 2022

Common name
American Marten - Newfoundland population

Scientific name
Martes americana atrata

Status
Special Concern

Reason for designation
This species is a geographically isolated, and genetically and ecologically distinct population. This is one of only 14 mammal species endemic to the island of Newfoundland. The population decline began in the early 20th century and was largely the result of direct and incidental harvest. Current data and a recent population estimate suggest that distribution and abundance have increased since the last COSEWIC assessment in 2007. These increases are likely the result of underestimates of the number of marten, a reduction in harvest mortality, and more favourable ecological conditions for the species. The population no longer meets the criteria for Threatened, and is assessed as Special Concern as it would likely become Threatened if not managed effectively.

Occurrence
Newfoundland and Labrador

Status history
Designated Not at Risk in April 1979. Status re-examined and designated Threatened in April 1986. Status re-examined and designated Endangered in April 1996 and in May 2000. Status re-examined and designated Threatened in April 2007. Status re-examined and designated Special Concern in May 2022.

COSEWIC
Executive Summary

American Marten
Martes americana atrata

Newfoundland population

Wildlife Species Description and Significance

The Newfoundland population of American Marten (*Martes americana atrata*) is a geographically isolated and genetically and ecologically distinct designatable unit found only on the island of Newfoundland. Compared to other subspecies of marten, this population consists of animals that are larger and have darker pelage. Marten is one of only 14 mammals native to Newfoundland. The unique genetic characteristics and ecology of Newfoundland Marten make it an important component of biodiversity in Canada.

Distribution

The historical range of Newfoundland Marten is assumed to have coincided with forested ecosystems. The species' range contracted in the early 20th century and currently includes forested ecosystems across the island, particularly in southcentral and southwestern Newfoundland (Little Grand Lake/Red Indian Lake complex), Northern Peninsula (Main River Watershed), and on the east coast (Terra Nova area).

Habitat

Throughout the range, American Marten (*Martes americana*) is typically associated with mature conifer and mixed-wood forests. Older forests provide dense overhead cover, coarse woody debris, low-hanging branches, and shrub understory. Such habitat elements provide refuge from predators and maternal and natal dens, but are less restrictive to the distribution of marten in Newfoundland where the landscape is naturally fragmented and where there are fewer predators and competitors. In the past, mature forests were thought to be the primary requirement of marten habitat; recent studies revealed that marten used younger stands consisting of regenerating (<6 m) and precommercially thinned forest.

Biology

Newfoundland Marten is an opportunistic feeder with a broad diet. Previously, Meadow Vole was the critical food resource for this population. The introduced Southern Red-backed Vole was first documented in 1999 on the west coast of Newfoundland. Over the last 2 decades, Southern Red-backed Vole has expanded its range and now occurs

throughout the island. This species is a staple in the diet of other populations of American Marten in North America and is now consumed by Newfoundland Marten. The current diet has not been re-examined since Southern Red-backed Vole became widespread.

Population Sizes and Trends

The range and population size of Newfoundland Marten contracted throughout the 20th century, initially as a result of fur trapping and incidental mortality in snares and traps. The establishment of the forest industry during the early part of the 20th century had a compounding effect, accelerating habitat change via harvesting and simultaneously increasing human access and trapping.

In 1985, there were an estimated 630–875 Newfoundland Marten. A second and third estimate in 1995 and 2007 suggested 300 and 320–622 mature individuals. A fourth more comprehensive estimate was conducted in 2019 and suggested that the population had increased to 2,494–2,773 mature marten. The total, but still incomplete population estimate (~75% of the island with forest inventory data), is 2,558–2,837 when including approximately 64 mature individuals estimated for Terra Nova and Gros Morne National Parks. The apparent growth in the population resulted from a combination of two factors: 1) an actual increase in the number of marten; and 2) previous population assessments that were conservative and hampered by lack of empirical data.

The distribution of Newfoundland Marten has increased since the previous COSEWIC assessment (2007); marten now occur in at least 15 of the 18 designated forest management districts on the island as well as in both national parks. Marten are recolonizing parts of their historical range, notably in the Baie Verte Peninsula, Stephenville south area, and forested areas in southcentral Newfoundland. Marten may now be present on the Avalon Peninsula for the first time in over a century.

Threats and Limiting Factors

The most important threat for Newfoundland Marten is incidental harvest. However, a general decline in people participating in trapping and snaring, changes in regulations and gear, and the implementation of best management practices have reduced the incidental capture of Newfoundland Marten. Mortality from motor-vehicle collisions and habitat loss from forestry and utility corridors are lower impact threats to the species.

Protection, Status and Ranks

Newfoundland Marten is listed as Threatened under the provincial *Endangered Species Act* and federal *Species at Risk Act*. The global status of American Marten, as assessed by the IUCN, is Least Concern; neither the Newfoundland population or subspecies (*M. americana atrata*) was assessed. Using the NatureServe methodology, the province provided a provisional ranking for Newfoundland Marten of Vulnerable to Apparently Secure (S3S4).

Marten habitat is protected in reserves and parks. Critical habitat has been identified as part of the recovery planning process; as of 2010, 16% was protected from forestry, snaring, and trapping. Commercial trapping for marten in Newfoundland has been illegal since 1934. Marten are incidentally taken in snares and traps in areas of Newfoundland where such activities are not directly prohibited.

TECHNICAL SUMMARY

Martes americana atrata

American Marten - Newfoundland population

Martre d'Amérique - Population de Terre-Neuve

Range of occurrence in Canada: Newfoundland and Labrador

Demographic Information

Generation time (usually average age of parents in the population; indicate if another method of estimating generation time indicated in the IUCN guidelines (2011) is being used)	4–6 yrs
Is there an [observed, inferred, or projected] continuing decline in number of mature individuals?	No
Estimated percent of continuing decline in total number of mature individuals within [5 years or 2 generations]	Not applicable Newfoundland population is increasing.
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over the last [10 years, or 3 generations].	Estimated and suspected increase in total number of mature individuals, but rate unknown. Based on past two population estimates (2007 and 2019), broader definition of habitat, and reduction in threats.
[Projected or suspected] percent [reduction or increase] in total number of mature individuals over the next [10 years, or 3 generations].	Suspected increase in total number of mature individuals, but rate unknown. Based on past two population estimates (2007 and 2019), broader definition of habitat, and reduction in threats.
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over any [10 years, or 3 generations] period, over a time period including both the past and the future.	Estimated and suspected increase in total number of mature individuals, but rate unknown. Based on past two population estimates (2007 and 2019), broader definition of habitat, and reduction in threats.
Are the causes of the decline a. clearly reversible and b. understood and c. ceased?	a. Yes b. Yes c. Partially Incidental mortality of marten is continuing but at a reduced rate due to the introduction of improved trapping techniques; habitat loss due to forestry is occurring, but at a reduced rate.
Are there extreme fluctuations in number of mature individuals?	Unlikely

Extent and Occupancy Information

Estimated extent of occurrence	82,700 km²
Index of area of occupancy (IAO) (Always report 2x2 grid value).	4,692 km²
Is the population "severely fragmented" i.e., is >50% of its total area of occupancy is in habitat patches that are (a) smaller than would be required to support a viable population, and (b) separated from other habitat patches by a distance larger than the species can be expected to disperse?	a. No b. No
Number of "locations"* (use plausible range to reflect uncertainty if appropriate)	Not applicable No single threatening event would rapidly affect all individuals.
Is there an [observed, inferred, or projected] decline in extent of occurrence?	No Extent of occurrence is increasing (observed 18.5% since last status assessment in 2007).
Is there an [observed, inferred, or projected] decline in index of area of occupancy?	No Index of area of occupancy is increasing (observed 22.3% since last status assessment in 2007).
Is there an [observed, inferred, or projected] decline in number of subpopulations?	No. Subpopulation structure is declining with the increase in distribution.
Is there an [observed, inferred, or projected] decline in number of "locations"*?	Not applicable.
Is there an [observed, inferred, or projected] decline in [area, extent and/or quality] of habitat?	No Habitat quality (prey base) is likely increasing through the introduction of Southern Red-backed Vole.
Are there extreme fluctuations in number of subpopulations?	No.
Are there extreme fluctuations in number of "locations"*?	Not applicable.
Are there extreme fluctuations in extent of occurrence?	No
Are there extreme fluctuations in index of area of occupancy?	No

* See Definitions and Abbreviations on COSEWIC website and IUCN for more information on this term.

Number of Mature Individuals (in each subpopulation)

Subpopulations (give plausible ranges)	• Total estimate: 2,558–2,837 mature individuals • Majority of available habitat: 2,494–2,773 mature marten (75% of the island (83,020 km^2) with available forestry inventory • Terra Nova and Gros Morne National Parks: ~64 mature individuals (n=75; assuming 85% mature)

Quantitative Analysis

Probability of extinction in the wild.	Unknown No population viability analysis.

Threats (direct, from highest impact to least, as per IUCN Threats Calculator)

Was a threats calculator completed for this species? Yes

The assigned overall threat impact is *Medium-Low*, and the following contributing threats were identified, listed in decreasing order of impact:

5.0 Biological resource use (Medium – Low)
4.0 Transportation & service corridors (Low)

What additional limiting factors are relevant?
There are no exceptional natural limiting factors for this species.

Rescue Effect (immigration from outside Canada)

Status of outside population(s) most likely to provide immigrants to Canada.	No outside populations
Is immigration known or possible?	Not applicable
Would immigrants be adapted to survive in Canada?	Not applicable
Is there sufficient habitat for immigrants in Canada?	Not applicable
Are conditions deteriorating in Canada?[+]	Not applicable
Are conditions for the source population deteriorating?[+]	Not applicable
Is the Canadian population considered to be a sink?[+]	Not applicable
Is rescue from outside populations likely?	Not applicable

Data Sensitive Species

Is this a data sensitive species? No

[+] See Table 3 (Guidelines for modifying status assessment based on rescue effect).

Status History

COSEWIC: Designated Not at Risk in April 1979. Status re-examined and designated Threatened in April 1986. Status re-examined and designated Endangered in April 1996 and in May 2000. Status re-examined and designated Threatened in April 2007. Status re-examined and designated Special Concern in May 2022.

Status and Reasons for Designation

Status:	**Alpha-numeric codes:**
Special Concern	Not applicable
Reasons for designation: This species is a geographically isolated, and genetically and ecologically distinct population. This is one of only 14 mammal species endemic to the island of Newfoundland. The population decline began in the early 20th century and was largely the result of direct and incidental harvest. Current data and a recent population estimate suggest that distribution and abundance have increased since the last COSEWIC assessment in 2007. These increases are likely the result of underestimates of the number of marten, a reduction in harvest mortality, and more favourable ecological conditions for the species. The population no longer meets the criteria for Threatened, and is assessed as Special Concern as it would likely become Threatened if not managed effectively.	

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals): Does not meet criterion. The most current population estimate and observational data indicate that the population is increasing in distribution and abundance.
Criterion B (Small Distribution Range and Decline or Fluctuation): The population has an EOO (82,700 km^2) and IAO (4692 km^2) that exceed the thresholds for Criterion B.
Criterion C (Small and Declining Number of Mature Individuals): Does not meet criterion. The population has <10,000 mature individuals, but is not in rapid or continuing decline.
Criterion D (Very Small or Restricted Population): The population exceeds the criteria for very small population (>1000 mature individuals) and restricted distribution (>20 km^2) or number of locations (not applicable).
Criterion E (Quantitative Analysis): A quantitative population analysis was not conducted.

PREFACE

The Newfoundland population of American Marten was first assessed as Not at Risk in April 1979. The population was assessed as Endangered in April 1996 and May 2000 and was listed as Threatened following an updated status report in April 2007. Since that time, Newfoundland Marten has experienced a reduction in threats and demonstrated an increase in distribution and abundance.

The use of modified snare wire for the recreational harvest of Snowshoe Hare (*Lepus americanus*) and fewer harvesters has resulted in a reduction in the incidental catch of marten. Similarly, incidental bycatch in traps set for other species has decreased. Although the population is increasing in distribution and abundance, snaring, trapping, and road mortality may slow population growth and range expansion. The rate of habitat loss due to forest harvesting has decreased significantly over the last decade due to a decline in the activity of the forest industry in Newfoundland. Also, Newfoundland Marten is now known to use a wider range of habitats, including those areas that have disturbed or younger aged forests.

Recent surveys, incidental observations, and model-based estimates have revealed an increase in the abundance and distribution of Newfoundland Marten. Although methods and areas of study are not directly comparable, the most recent estimate of 2,558–2,837 adult marten represents an increase when compared to the 320–622 mature individuals estimated in 2007. Unpublished data from radio-collared marten collected a decade (circa 2010–2012) after the initial discovery of Southern Red-backed Vole indicated a decrease in the annual home-range of monitored individuals. Smaller home ranges likely correlate with an increase in the density of mature marten.

COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal entities (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government science members and the co-chairs of the species specialist subcommittees and the Aboriginal Traditional Knowledge subcommittee. The Committee meets to consider status reports on candidate species.

DEFINITIONS (2022)

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' risk of extinction.

* Formerly described as "Vulnerable" from 1990 to 1999, or "Rare" prior to 1990.

** Formerly described as "Not In Any Category", or "No Designation Required."

*** Formerly described as "Indeterminate" from 1994 to 1999 or "ISIBD" (insufficient scientific information on which to base a designation) prior to 1994. Definition of the (DD) category revised in 2006.

Environment and Climate Change Canada
Canadian Wildlife Service
Environnement et Changement climatique Canada
Service canadien de la faune
Canada

The Canadian Wildlife Service, Environment and Climate Change Canada, provides full administrative and financial support to the COSEWIC Secretariat.

COSEWIC Status Report

on the

American Marten

Martes americana atrata

Newfoundland population

in Canada

2022

TABLE OF CONTENTS

List of Figures

List of Tables

List of Annexes

WILDLIFE SPECIES DESCRIPTION AND SIGNIFICANCE

Name and Classification

Scientific name: *Martes americana atrata* (Bangs, 1897)

English name: American Marten, Newfoundland population, Newfoundland Marten

French name: martre d'Amérique, Population de Terre-Neuve

Classification: Class: Mammalia, Order: Carnivora, Family: Mustelidae

The classification of subspecies of American Marten (*Martes americana*) remains tentative and controversial. Hall (1981) distinguished 14 subspecies; including *M. americana atrata*, a subspecies endemic to Newfoundland. Other authors argued that the partitioning of subspecies was arbitrary and subject to error based on small sample sizes or samples biased by sex or variation in coat colour (Hagmeier 1958, 1961; Anderson 1970; Clark *et al.* 1987). Hagmeier (1958, 1961) and Clark *et al.* (1987) recognized *M. americana atrata* as the Newfoundland subspecies, but included *M. americana brumalis*, found in northern Quebec and Labrador, as a synonym. Kyle and Strobeck (2003) reported that *M. americana atrata* on the island of Newfoundland was genetically distinct and highly divergent from other subspecies and populations in North America. The taxonomic classification of American Marten requires review.

Morphological Description

American Marten is a long, slender, arboreal weasel with short limbs, broad feet, and semi-retractable claws used for climbing. The head is broad, tapering to a sharp nose, and the ears are large and rounded. The species' bushy tail is equal to about half the body length. The long, silky, dense fur varies from pale buff to dark brown dorsally. A bib on the throat and chest may be creamy to bright orange. Males are about 15% longer than females and up to 65% heavier.

Martes americana atrata, found in Newfoundland, southern Labrador, and northern Quebec is described as a large, dark subspecies (Hagmeier 1961) as compared with the small pale form found to the south and west (*M. americana americana*). Individuals found in Newfoundland are comparatively large among North American subspecies. Mean weights of males in Newfoundland were 1275 g (n=40) compared to 808 g (n=134) for marten in Maine (Hearn 2007).

Population Spatial Structure and Variability

Carr and Hicks (1997) analysed the cytochrome b gene of mitochondrial DNA and showed no divergence of Newfoundland Marten from most mainland populations of the *americana* group. More recent analyses of microsatellite DNA (Kyle and Strobeck 2003), and randomly amplified polymorphic DNA (McGowan *et al.* 1999) found that the Newfoundland population was genetically distinct and highly divergent from other populations of *Martes americana* (Kyle and Strobeck 2003). Low genetic diversity and

divergence from mainland populations are consistent with genetic drift and the absence of immigration as a result of biogeographic isolation since the last ice age.

Previous data suggested that Newfoundland Marten occurred within 4 to 5 geographic areas that may have represented subpopulations (COSEWIC 2007). An increase in the abundance and spatial distribution of marten, as indicated by contemporary location data, has resulted in relatively little subpopulation structure (Figure 1). Eastern and western subpopulations may still persist, but there are no data to test the COSEWIC definition of little demographic or genetic exchange (typically one successful migrant individual or gamete per year or less). The discrimination of core and peripheral subpopulations is becoming less meaningful as the population recolonizes former habitat and increases in distribution across the island.

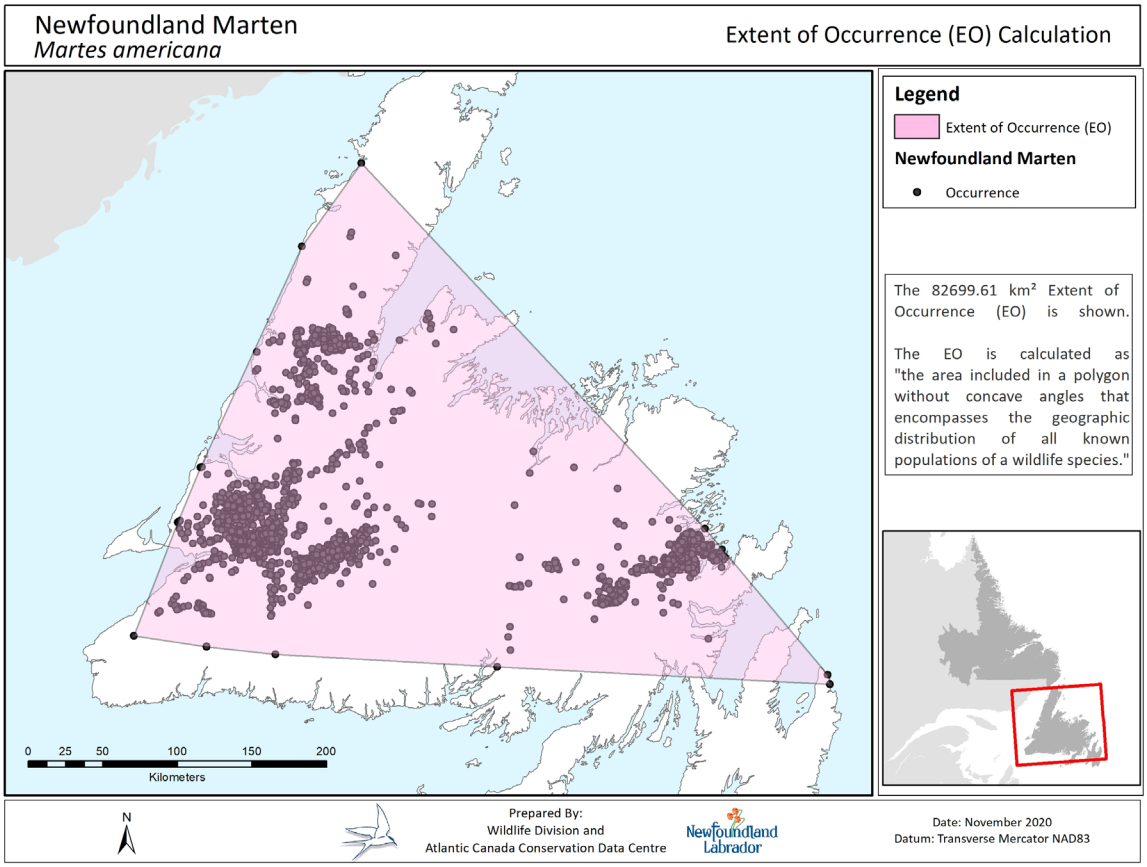

Figure 1. Extent of occurrence of the Newfoundland population of American Marten, Newfoundland, Canada. Occurrences of Marten were recorded between 1970–2018 (n=7,592).

Designatable Units

American Marten are found across much of Canada and demonstrate considerable differences in ecology and morphology. That variation has resulted in the identification of a maximum of 14 subspecies, although the taxonomic classification is uncertain (see Clark *et al.* 1987; Dawson and Cook 2012). Currently, COSEWIC recognizes the Newfoundland population of American Marten as one distinct designatable unit. The following section represents the available evidence supporting the recognition of that designatable unit as discrete and evolutionarily significant, when compared to other populations in Canada. Additional designatable units of American Marten may be recognized in the future.

Criterion 1 – Subspecies or varieties

COSEWIC recognizes a population as a designatable unit if it is a named subspecies or variety and meets the criteria for both Discreteness and Significance. Newfoundland Marten is an insular population that is restricted to the island of Newfoundland. That population was recognized as a unique subspecies (*M. americana atrata*; Hall 1983), but one revision of the taxonomy (Clark *et al.* 1987) now identifies *M. americana atrata* as occurring on the island and in Labrador and northern Quebec. Thus, taxonomic classification does not provide evidence of a designatable unit specific to the island of Newfoundland. There is insufficient evidence to determine if the mainland distribution of *M. americana atrata* would constitute an additional designatable unit.

Criterion 2 – Discrete and evolutionarily significant populations

COSEWIC recognizes a designatable unit if it has attributes that make it both "discrete" and "evolutionarily significant."

Discreteness

Criterion D1 – Evidence of heritable traits distinguishing the putative designatable unit from other designatable units

American Marten in Canada exhibit relatively little evidence of genetic distinctiveness based on nuclear microsatellites and mitochondrial DNA. However, the Newfoundland population demonstrates considerable divergence and is genetically distinct from a large number of other populations sampled from across the Canadian range (Kyle and Strobeck 2003).

Relative to the majority of the distribution of American Marten, the island of Newfoundland was historically depauperate of terrestrial mammals. That included both the prey, and the competitors and predators of Newfoundland Marten. Also, individuals of this population of marten are considerably larger in body size and darker in colour when compared to other mainland populations (Hearn 2007). The unique ecological and morphological characteristics of Newfoundland Marten suggest that the designatable unit has evolved unique heritable traits.

Criterion D2 – Natural geographic disjunction between putative designatable units

Newfoundland Marten is an insular population that has been restricted to the island of Newfoundland for approximately 7000 years (Hearn *et al.* 2006). Individuals of the population are known to engage in long-distance dispersal (>250 km). Although movement between the Labrador coast and the island (minimum width of 17 km) is not impossible it is highly unlikely. Thus, the Newfoundland population satisfies the criterion of natural disjunction between substantial portions of the species' geographic range.

In summary, evolutionary and ecological evidence suggests that the Newfoundland population meets one or more of the criteria for *discreteness*. What follows is an examination of the evidence for *significance*.

Evolutionary Significance

Criterion S1 – Evidence that the putative designatable unit has been on an independent evolutionary trajectory

The Newfoundland population of marten has been isolated from American Marten on Labrador for approximately 7000 years, the time since the retreat of the last continental ice sheet (Hearn *et al.* 2006). In agreement with that apparent geographic and reproductive isolation, genetic data suggest a high degree of divergence from other populations of American Marten in Canada. Also, this population has significantly less genetic variability when compared to other populations (H_E = 40.2 versus 62.6% averaged across all Canadian populations; see Kyle and Strobeck 2003). Historical population declines may have resulted in a greater rate of drift, further decreasing genetic variation on the island. Individuals of this population of marten are considerably larger in body and darker when compared to other mainland populations (Hearn 2007). Thus, there is strong evidence that Newfoundland Marten differs markedly from other populations in genetic characteristics that likely represent relatively deep intraspecific phylogenetic divergence.

Criterion S2 – Evidence that the putative designatable unit possesses adaptive, heritable traits, that cannot be practically reconstituted if lost

Historically, the Newfoundland population of marten existed in an ecological setting with relatively few terrestrial mammals. That setting may have resulted in adaptive strategies to accommodate few prey, in particular small mammals, and a unique morphology, ecology, and behaviour in response to few predators and competitors. Thus, there is evidence of persistence of the discrete population in an ecological setting unusual or unique to the species, such that we can infer adaptive heritable traits. Given the unique ecology of the island of Newfoundland, it is unlikely that those traits would be reconstituted by marten found within mainland populations.

In summary, current evidence suggests that the Newfoundland population of American Marten meets multiple criteria for discreteness and evolutionary significance (Table 1). Thus, there are a minimum of two designatable units of American Marten: Newfoundland population and the remaining population found across Canada.

Table 1. Summary of evidence supporting discreteness and evolutionarily significance criteria for designatable unit structure for the Newfoundland population of American Marten (*Martes americana atrata*). X = available data supported discreteness or significance. + = available data contributed some support.

	Discreteness		Significance	
	D1-Evidence of Heritable Traits	D2-Natural disjunction	S1-Independent Evolutionary Trajectory	S2-Adaptive Heritable Traits
Newfoundland population	+	X	X	+

Special Significance

Marten was once an important trapped furbearer species for the Indigenous people and early settlers of Newfoundland. However, legal trapping ended in 1934 (Newfoundland Marten Recovery Team 2010). This population is one of only 14 mammals native to Newfoundland (Dodds 1983). The unique genetic characteristics and ecology of Newfoundland Marten make it an important component of biodiversity in Canada.

DISTRIBUTION

Global Range

American Marten is distributed throughout the coniferous forests of the boreal and taiga zones of North America (Gibilisco 1994). The current distribution is less than was observed historically, particularly in central North America south of the Great Lakes region. Early declines and range contraction of American Marten were caused by overexploitation and habitat loss (Gibilisco 1994). Conservation efforts and forest succession have allowed some subpopulations to re-establish (Gibilisco 1994). The Canadian range of the subspecies *M. americana atrata* includes Newfoundland, Labrador, and northern Quebec. The genetically and ecologically distinct Newfoundland population occurs only on the island of Newfoundland.

Canadian Range

The historical range of Newfoundland Marten is assumed to have been contiguous within forested areas (Bergerud 1969). Range contraction during the early 20th century was primarily the result of overexploitation. The continued decline of marten followed a ban on regulated trapping in 1934. That decline corresponded with an expansion of the forest industry (habitat loss) in combination with increased human access into recently harvested areas. Successive publications and status reports by Bergerud (1969), Skinner (1979), Snyder (1985), Lemon (1996), and COSEWIC (2000) documented a trend in range reduction. The more recent evaluations (COSEWIC 2007; Hearn and Durocher In Prep) have reported increases in distribution across the historical range.

The most recent estimate of Newfoundland Marten reported a significant increase in the abundance of mature individuals and the distribution of the population (Hearn and Durocher In Prep). That included two records on the Avalon Peninsula (Figure 1). The discrimination of core and peripheral subpopulations is becoming less meaningful as the population recolonizes former habitat and increases in distribution across the island.

Extent of Occurrence and Area of Occupancy

The 2007 COSEWIC status assessment reported an extent of occurrence (EOO) for Newfoundland Marten of 68,700 km^2, and included an area with unoccupied range between the eastern and western subpopulations. The area of occupancy in 2007 was 23,383 km^2. This was a significant increase compared to the area occupied by marten in 1985 (13,356 km^2; Hancock *et al.* 1985) that was likely accelerated by the reestablishment of the species in the Main River and Terra Nova areas (Newfoundland Marten Recovery Team 2010). In 2007, the range of Newfoundland Marten included 23,383 km^2 of occupied habitat (see Figures 2 and 3 in COSEWIC 2007).

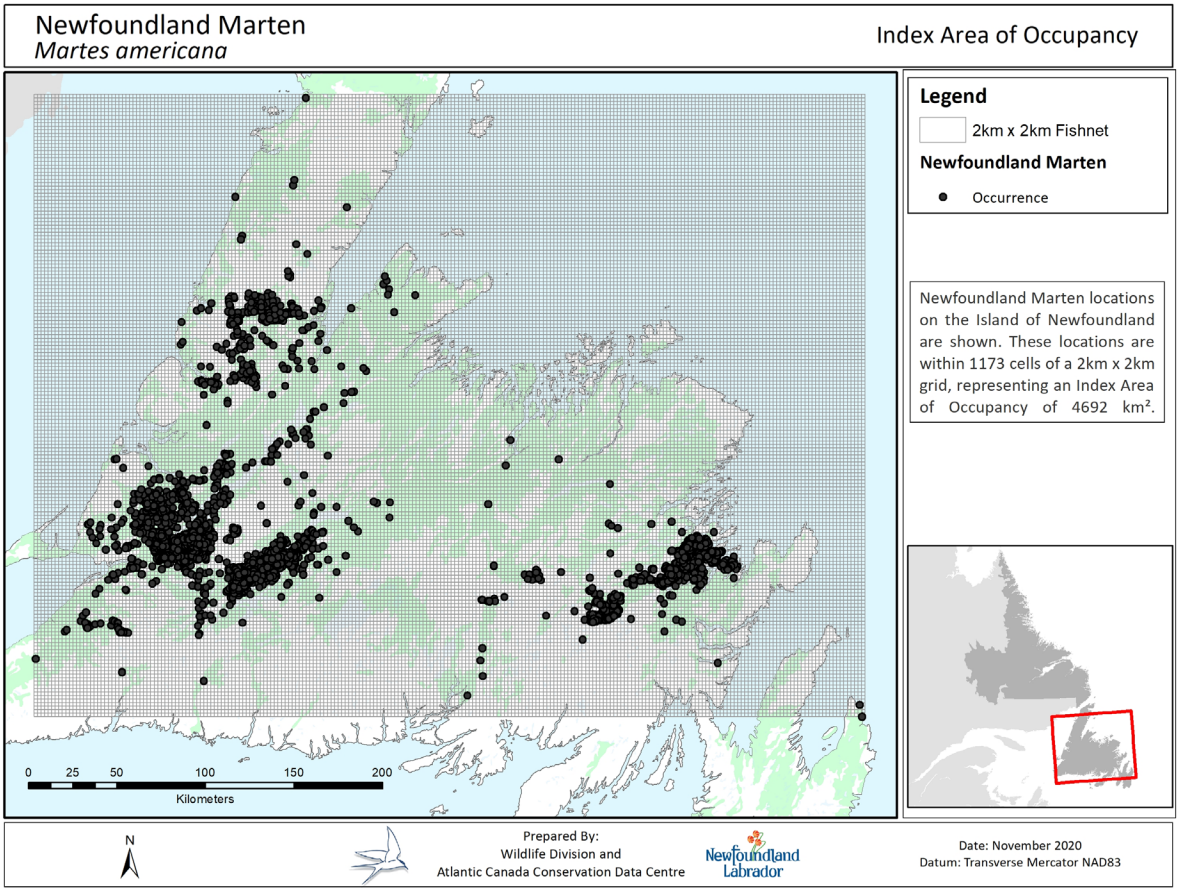

Figure 2. Index of area of occupancy of the Newfoundland population of American Marten, Newfoundland, Canada. The area of occupancy represents the number of 2x2-km cells with recorded occurrence of marten. Occurrences of Marten were recorded between 1970–2018 (n=7,592). Marten habitat with ≥ 60% probability of occupancy is indicated in green (after Hearn and Durocher In Prep).

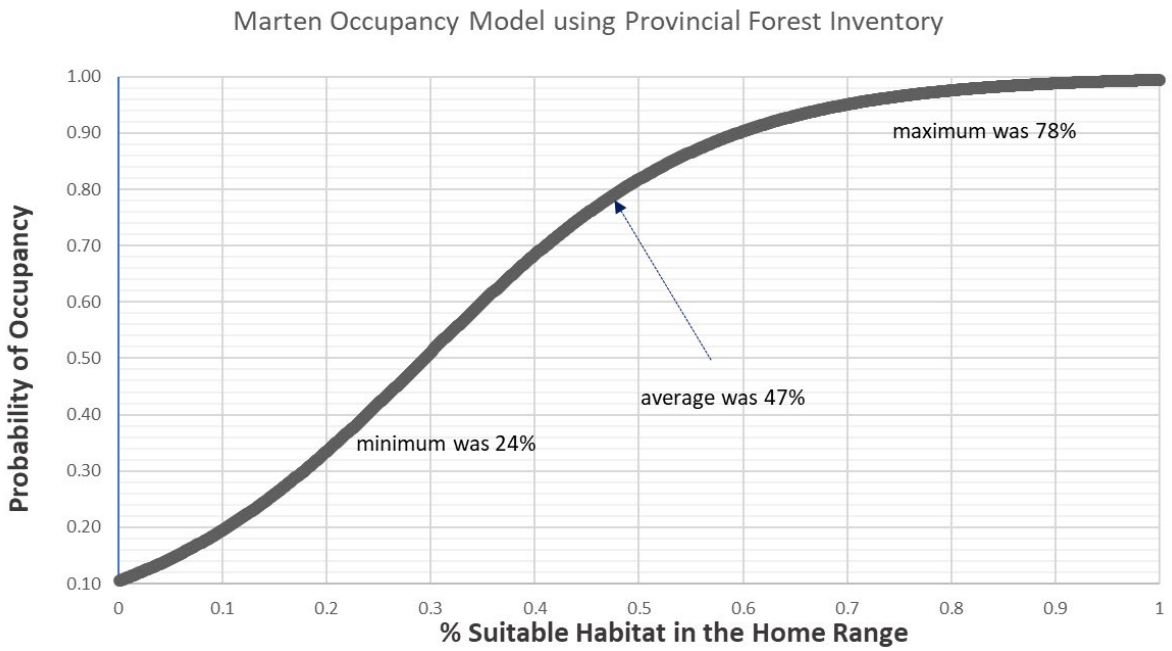

Figure 3. Probability of occurrence of marten as a function of the percent of suitable habitat in the home range. The logistic regression model was based on the amount of suitable habitat in home ranges of 84 adult resident marten (Fuller *et al*. 2005; Hearn *et al*. 2005) versus the habitat composition of home-range size areas not known to support a resident marten (Fuller 2006). Average amount of suitable habitat in these ranges was 47% (range=24–78%); 82% of marten had ≥35% suitable habitat; 18% of adult resident marten occupied home ranges that had between 24% and 34% suitable habitat. (From Hearn and Durocher In Prep.)

Past measures of area of occupancy differed in method from what is now used by COSEWIC (i.e., 2x2-km^2 grid). The 2007 COSEWIC status assessment reported four core areas in the Terra Nova (2,829 km^2), Main River (2,177 km^2), Little Grand Lake-Red Indian Lake (6,232 km^2), and St. George's areas (590 km^2), totalling 11,828 km^2. Isolated adult residents and juveniles or unconfirmed residents occupied an additional 11,555 km^2 of what was determined to be peripheral low-density habitat. One of these peripheral areas was judged a potential 5th core area of 260 km^2 in the Lobster House area. Marten were absent from the Avalon Peninsula and south-central Newfoundland in 2007.

Estimates of the potential versus actual size of the population of Newfoundland Marten (Hearn and Durocher In Prep) suggest that marten now occupy over half of the higher quality habitat on the island (habitat with a ≥60% probability of marten occurrence). The current confirmed EOO and index of area of occupancy (IAO) are 82,700 km^2 and 4,692 km^2, respectively; that is an increase of 18.5% and 22.3% according to the distribution data for marten used in the 2007 assessment (Figures 1, 2). For this report, each index was calculated using standard COSEWIC methods. Extent of occurrence was the area bounded by a minimum convex polygon drawn around all known occurrences of marten collected from 1970–2018. The IAO was the total area of 2x2-km^2 grid cells known to contain at least one confirmed occurrence of marten.

Currently, marten occur in at least 15 of the 18 forest management units distributed across the island. That includes the transplant and reestablishment of subpopulations in formerly unoccupied habitat, such as Main River and Terra Nova. Also, there is considerable evidence of natural recolonization of historical habitat. A hair-snagging study revealed a resident subpopulation of marten in Grasses Nature Reserve. The confirmed occurrence of these marten and the prevalence of tracks in the 25 km between the study area and the Trans-Canada Highway led Gosse (2014) to conclude that a subpopulation was established in the Robinson's River watershed. Two occurrences of Newfoundland Marten were recently observed with DNA-based hair snagging from the Avalon Peninsula (Figure 1). These records are > 80 km (straight-line distance) from the other easternmost marten records near the town of Clarenville.

Search Effort

The Newfoundland and Labrador Wildlife Division has maintained records of marten occurrence since the 1970s. These data are diverse and contain incidental captures (e.g., trap and snaring mortalities), verified incidental sightings, tracks, road mortalities, translocations, telemetry data, and other research and monitoring data. Efforts by provincial and federal biologists, the marten recovery team, and collaborating researchers have included extensive live trapping, collaring, and radio-telemetry work focused in core marten habitat in western Newfoundland as well as in eastern Newfoundland, including Terra Nova National Park. Notably, an ongoing hair snag project initiated in 2008 by provincial forestry and wildlife staff has been coordinated on a larger scale since 2011–2012 by a partnering environmental NGO (Intervale Associates Inc.), through funding from the federal Habitat Stewardship Program.

A broad network of volunteers, government employees, and Indigenous groups undertake monitoring. Search effort via hair snagging has increased during the last decade, and the volunteer program that began with 10 participants has grown to average more than 80 volunteers annually over the past five years. The genetics work has led to a better understanding of marten distribution, presence/absence in specific areas, abundance, habitat use, range size, and the expansion of the species into previously unoccupied habitats in the province.

HABITAT

Habitat Requirements

In many ecosystems, American Marten are associated with mature and overmature conifer and mixed-wood forests (Thompson and Harestad 1994; Payer and Harrison 2003; Thompson *et al.* 2012; Bridger *et al.* 2016). Structural characteristics of these forests include dense overhead cover, coarse woody debris, low-hanging branches, and shrub understory. These features provide protection from predators, subnivean access for hunting, denning and resting sites (also important for thermoregulation), and habitat for prey (Thompson and Harestad 1994).

Recent research suggests that resident adult marten occupy annual ranges that include a component of partially harvested stands, stands defoliated by insects, early successional forests regenerating after clearcutting (reviewed in Payer and Harrison 2000, 2003; Thompson *et al.* 2012; see also Potvin *et al.* 2000; Poole *et al.* 2004; Godbout and Ouellet 2008, 2010; Hearn *et al.* 2010), and burns and partial burns (Paragi *et al.* 1996). Marten in southwest Newfoundland selected an array of habitat types in proportion to availability including recent cuts ≤5 years old, regenerating forest <6 m in height, precommercially thinned stands, in aggregation with mature and overmature forests (Hearn *et al.* 2010). Across those disturbed landscapes, Newfoundland Marten likely have evolved to use a wider range of vegetation types, including early seral plant communities. That strategy may be the product of few predators and relatively little predation risk in open areas.

These more recent findings are in contrast with previous studies of Newfoundland Marten that documented the selection of old-growth forests, specifically mature Balsam Fir (*Abies balsamea*) (Snyder and Bissonette 1987; Bissonette *et al.* 1989; Thompson and Curran 1995; Forsey and Baggs 2001). However, the findings of those studies may have been biased by the selection of study area. Initial studies of Newfoundland Marten occurred across inaccessible portions of the island, where forest harvesting and trapping were limited or absent (Hearn 2007). The negative association between young forest and marten may have been the result of human access and resulting trapping and snaring effort, not an inherent requirement for marten to use old forest.

Meadow Vole (*Microtus pennsylvanicus*) was initially thought to be the required prey of marten in Newfoundland (Thompson and Curran 1995; Sturtevant *et al.* 1996; Sturtevant and Bissonette 1997). This close association (obligatory prey) was the basis for the marten's assumed reliance on old-growth habitat, as Meadow Vole are common in old forest types. Meadow Vole is consumed most frequently during the summer, 80% frequency occurrence in scats, but that declines to 47% in winter when the occurrence of Snowshoe Hare (*Lepus americanus*) increases 10-fold to 28% (Gosse and Hearn 2005). Snowshoe Hare are more abundant in 40-year-old second growth stands than in mature or overmature stands (Thompson and Curran 1995). Thus, the higher densities of hares in regenerating stands likely explains selection of these stands by Newfoundland Marten (Hearn *et al.* 2010).

Fuller *et al.* (2006) modelled habitat occupancy of Newfoundland Marten as a function of forest composition and other environmental variables. The percent suitable habitat in a home-range size area was the most important variable in determining habitat occupancy by marten. Only 47% of the area of annual home ranges of monitored Newfoundland Marten (n=84) was classified as suitable habitat. In contrast, 73% of the area of home ranges of marten in Maine contained suitable habitat. Fuller *et al.* (2006) hypothesized that the Newfoundland Marten has evolved in a naturally fragmented landscape where a large body size and larger home ranges allow it to use a broader range of habitat types. Also, lower predation risk allows Newfoundland Marten to use areas with less escape cover and greater prey density (Hearn 2007). Hearn *et al.* (2010) recommend that areas managed for

marten should include >24% mature and overmature forest, and that no more than 29% of younger aged forest be present within the annual home-range.

Habitat Trends

Recent studies of the habitat associations of Newfoundland Marten (Fuller *et al.* 2006; Hearn *et al.* 2010) have revealed that previous COSEWIC assessments were overly restrictive in describing and quantifying the area of habitat for the species. Similarly, past predictions of habitat shortages and extinction risks due to logging, natural forest mortality, and trapping and snaring were misleading or have now been addressed through management and conservation efforts (Thompson 1991; Schneider and Yodzis 1994; Schneider 1997). Given this new information, it would appear that forest management prescriptions (e.g., Thompson 1991; Thompson and Curran 1995; Sturtevant *et al.* 1996, 1997) designed to protect or maintain older forest types as marten habitat, were overly constraining (Gosse *et al.* 2005; Fuller *et al.* 2006, 2007). Nonetheless, old forest is still a recognized component of marten habitat and recently cut areas, with no overhead structure, are avoided (Fuller and Harrison 2005; Hearn *et al.* 2010).

Mature and overmature forest types are now being lost at a slower rate in Newfoundland, as harvest has decreased in conjunction with a downturn in the forest industry. The rate of forest harvest was approximately 200 km^2/year prior to 2006, but decreased by 65% to approximately 70 km^2/year by 2015 (National Forestry Database 2017). That decline followed the closure of two paper mills, one in 2005 and the second in 2009, and reduced harvest by the single paper mill remaining in the province. As a corollary to that trend, a reduction in the removal of old forest also means less area of recently cut and open habitat. However, the existing forest harvest now occurs in more isolated areas requiring greater road development. Although the habitat of Newfoundland Marten is not directly associated with old forest types, the decrease in forestry activities does maintain habitat and enhance recovery of the species.

BIOLOGY

Information presented in this section is derived primarily from studies of mainland subpopulations of *M. americana*, except where referenced as research focused on Newfoundland Marten. In some instances, the ecology of mainland marten differs from the Newfoundland population limiting the inference of those studies.

Life Cycle and Reproduction

Marten breed between June and early September (Strickland *et al.* 1982). The fertilized ovum develops into a blastocyst that remains in arrested development for 190–250 days, when implantation occurs and development proceeds. One to five young (mean of 2.85) are born from mid-March to late April (Clark *et al.* 1987). Yearlings of both sexes reach sexual maturity at 15 months of age, although not all yearlings breed. Strickland *et al.* (1982) found that 80% of yearlings and 93% of older females were pregnant, with a mean

fecundity of three kits per litter. Pregnancy rates may be reduced in response to food shortage. Females continue to breed throughout their lives (up to 14.5 years of age in the wild) and do not become reproductively senescent (Strickland *et al.* 1982). In the largest study of marten carcasses, from the Algonquin region of Ontario, 89.1% of non-juvenile marten (n=2,660) were ≤4 years of age. From these data, the minimum average age of reproduction was estimated at 2–3 years. The generation time of Newfoundland Marten is unknown and is presumed to vary across the continental distribution of American Marten. Buskirk *et al.* (2012) and Hillman (2014) estimated generation times of 5.1 and 4–6 years for trapped populations of American Marten. The general estimate of 4–6 years (Hillman 2014) was adopted for this report.

The median age of 76 adult (≥1-year old) females at first live capture was 2 years in both the untrapped Pine Marten Study Area (n=37) and the trapped area outside the reserve (n=39; Hearn 2007). Based on that work and other studies of American Marten, Hearn (2007) concluded that survival of adult and recruitment of juvenile female marten were the most limiting demographic factors for population growth.

Physiology and Adaptability

American Marten is a curious species; they are easily trapped, as they willingly investigate baits and scents. Juveniles are especially susceptible to traps, when they leave their maternal range in fall and winter in search of a suitable home range (Strickland and Douglas 1987). Transients make extensive movements leaving them vulnerable to traps, predation, and vehicle collisions.

American Marten are adaptable to a wide range of ecological and climatic conditions, as indicated by their broad distribution across North America and considerable variation in the size of the annual home range. Powell (1994) reported that marten in North America occupied home ranges that were on average 8.1 km^2 and 2.3 km^2 for males and females, respectively. Newfoundland Marten has the largest reported home range averaging 25.4 km^2 for males (n=15) and 15.2 km^2 for females (n=24) in northeastern Newfoundland. Similarly, Hearn (2007) reported large home ranges for marten from southwestern Newfoundland; median home-range area of adults was 27.6 km^2 (n=43) for males and 10.6 km^2 (n=49) for females. Those large home ranges are indicative of low prey diversity and abundance and a naturally fragmented landscape (Gosse *et al.* 2005). Following the introduction and spread of Southern Red-backed Vole (*Clethrionomys gapperi*), prey biomass has increased and the area of the home range of marten has decreased.

Dispersal and Migration

Dispersal and seasonal movement of marten have been poorly documented in the scientific literature (Buskirk and Ruggiero 1994) and most reports are anecdotal. Mean post-release movements by transplanted marten in Yukon averaged 13.4 km for males and 8.6 km for females with the longest recorded movement being 149 km (Slough 1989). Dispersing or transient marten commonly move <20 km from former ranges or capture and release sites (Slough 1989). Radio-collared marten from Newfoundland moved >60 km

(B.J. Hearn unpubl. data). One translocated radio-collared marten in eastern Newfoundland travelled >250 km when returning to its original capture site in the western portion of the island (J. Gosse unpubl. data). These findings suggest that genetic interchange occurs among groups of Newfoundland Marten even across areas previously thought to be unsuitable habitat (Bissonette *et al.* 1989).

Transient marten represent approximately 50% of the population with dispersal occurring primarily from mid-August to mid-October (Weckworth and Hawley 1962, Clark 1984). Those animals face a greater suite of limiting factors. For example, transient or dispersing marten may be unsuccessful in finding vacant areas of suitable habitats to establish a breeding area. Also, that segment of the population is more vulnerable to predation (Payer 1999) and other mortality factors such as vehicle collisions and incidental bycatch in traps or snares (Hearn 2007).

Interspecific Interactions

Fisher (*Pekania pennanti*), which are an important natural predator of marten (Hodgman *et al.* 1997; Krohn *et al.* 1995, 1997; Payer 1999), are absent on the island of Newfoundland (Dodds 1983). Potential avian predators include Great-horned Owl (*Bubo virginianus*) and Northern Hawk Owl (*Surnia ulula*); however, raptors are uncommon, relative to mainland North America, and there is little evidence of predation on marten (Gosse and Montevecchi 2001; Hearn 2007). Red Fox (*Vulpes vulpes*) is the most significant predator of marten in Newfoundland and accounted for over half (≥56.3%) of the predator mortalities (n=16) recorded by Hearn (2007) during his 5-year study. Other potential mammalian predators and competitors include Canada Lynx (*Lynx canadensis*) and Eastern Coyote (*Canis latrans*). Coyote became established in Newfoundland by crossing on ice from Nova Scotia, likely in 1985, and has spread throughout the island via natural range expansion (Parker 1995).

American Black Bear (*Ursus americanus*) are common throughout the island and are notably predatory on introduced Moose (*Alces americanus*) and the native Woodland Caribou (*Rangifer tarandus caribou*); however, bears have not been implicated in any mortalities of Newfoundland Marten. Newfoundland Wolf (*Canis lupus beothucus*) was extirpated in the early 1930s (Allen and Barbour 1937). Both bears and wolves (prior to their extirpation) might have provided a significant quantity of carrion for marten. Continuous, winter-long use of Moose and caribou carcasses by marten in Newfoundland has been documented (B.J. Hearn unpubl. data).

In 2012, the province's Wildlife Division confirmed occurrences of Grey Wolf (*Canis lupus*) of Labrador origin on the island of Newfoundland (from the Bonavista area) and subsequent testing confirmed a specimen captured in 2008. In addition, wolf-coyote hybrids have been reported. A provincial research program is continuing to study their distribution and population structure. It is too early to determine what effect the return of wolves or wolf-coyote hybrids may have on Newfoundland Marten.

The endemic prey base available to marten in Newfoundland is limited (Dodds 1983; Gosse and Hearn 2005; Hearn *et al.* 2006). Prior to 1864, Meadow Vole was the only small mammal prey. Bergerud (1967) suggested that Arctic Hare (*Lepus arcticus*) once ranged across Newfoundland in relatively high densities and that the introduction of the Snowshoe Hare indirectly led to a range contraction via an increase in Canada Lynx. However, a sequence of studies (Hearn *et al.* 1987; Barta *et al.* 1989; Fitzgerald and Keith 1990; Small *et al.* 1992) refuted Bergerud's (1967) hypothesis, concluding that Arctic Hare likely persisted at low densities throughout the island. The remains of Willow Ptarmigan (*Lagopus lagopus*) were identified in marten scats collected across southwestern Newfoundland during winter (Bateman 1986).

Over the last 150+ years, various other prey (or carrion) species have been deliberately or accidentally introduced to the island (Strong and Leroux 2014). Snowshoe Hare and Moose were introduced in 1864 and 1904, respectively (Dodds 1983). During the 1950s and 1960s, Masked Shrew (*Sorex cinereus*), Red Squirrel (*Tamiasciurus hudsonicus*), Eastern Chipmunk (*Tamias striatus*), and Deer Mouse (*Peromyscus maniculatus*) were introduced or became established (Gould and Pruitt 1969; Northcott *et al.* 1974; Dodds 1983). Southern Red-backed Vole were first recorded on the island, and in the diet of Newfoundland Marten, in 1999 (Gosse and Hearn 2005; Hearn *et al.* 2006). Southern Red-backed Vole is now distributed throughout the island (Rodrigues 2012; Rodrigues *et al.* 2013) and field data suggests it has significantly increased the biomass of small mammals (B.J. Hearn unpubl. data). Introduced avian prey include Spruce Grouse (*Falcipennis canadensis*) in 1964 and Ruffed Grouse (*Bonasa umbellus*) in 1956 (Tuck 1968).

Studies of American Marten have reported a diverse diet and opportunistic use of all locally available prey (Buskirk and MacDonald 1984; Nagorsen *et al.* 1989, 1991). Similarly, marten in Newfoundland consume all potential prey species available indicating a generalist hunting and scavenging strategy (Gosse and Hearn 2005). In 2005, Meadow Vole was the most frequent prey item throughout the year; during winter, consumption of Snowshoe Hare increased 10-fold and accounted for the vast majority of the caloric intake. Gosse and Hearn (2005) proposed that Snowshoe Hare was a critical food resource for Newfoundland Marten in winter, the most energetically stressful period annually (Thompson 1986; Buskirk *et al.* 1988). Insects and berries were consumed in summer when seasonally available.

Meadow Voles, normally associated with open habitat, have an expanded niche in Newfoundland, occupying old-growth coniferous forests (Thompson and Curran 1995; Sturtevant and Bissonette 1997). However, their distribution contracted following the introduction of Southern Red-backed Vole. Consumption of the vole by Newfoundland Marten is expected to increase, but there is some uncertainty about how community interactions between the two small mammals and the carnivore guild will change over time (Gosse and Hearn 2005). Southern Red-backed Vole may displace Meadow Vole and perhaps increase the density of Red Fox, a predator of Newfoundland Marten (Hearn *et al.* 2006; Strong and Leroux 2014). Andruskiw *et al.* (2008) reported that predation efficiency of marten on Southern Red-backed Vole in Ontario was greater in uncut forests, compared to

regenerating forests where vole densities were similar. They attributed this difference to voles in regenerating forests being cautious due to the lack of coarse woody debris and overhead cover.

Drew and Bissonette (1997) reported nocturnal behaviour of American Marten during winter when hunting Red Squirrel in subnivean middens or nocturnally active Snowshoe Hare. Alternatively, marten may have been nocturnally active to reduce predation risk by Red Fox which they speculated might be a less efficient predator at night. In colder climates, thermal constraints favour diurnal activity and the nocturnal use of subnivean resting sites. Hearn *et al.* (2010) suggested that given their ecological setting, predation risk is lower for Newfoundland Marten compared to mainland populations, allowing them a broader niche in terms of more open habitats with less overhead cover.

POPULATION SIZES AND TRENDS

Sampling Effort and Methods

There are four population estimates for Newfoundland Marten that are based on changing data and methods. Thus, the absolute estimates are not directly comparable.

In 1985, Snyder and Hancock (1985) used density estimates from live-trapping studies (Snyder 1984), occurrence data based on a trapper's questionnaire, sightings, and records of incidental trapping mortalities to produce the first population estimate of Newfoundland Marten across the island. Bissonette *et al.* (1988) followed with an estimate of the density of marten in the southwestern portion of the population's range. That estimate was based on the amount of suitable habitat within potential home range areas defined using a small sample of radio-tagged individuals. The definition of suitable habitat at that time was restricted to primarily overmature (≥80 yrs.) softwood. Thompson (reported in Forsey *et al.* 1995) used the density calculation of Bissonette *et al.* (1988) to generate the second, island-wide population estimate.

The third population estimate was reported in COSEWIC (2007) and used improved information of marten demography, distribution, and habitat. Distribution was based on all spatial data for marten collected between 1990 and 2006, and included live-trapping studies, accidental captures, radio-telemetry relocations, bait stations, and verified incidental sightings. A small number of records, distal from core and peripheral areas, were excluded as cases of vagrancy. Marten were classified as either adult, juvenile, or unknown. Core and peripheral areas of occurrence were delineated, where core areas enclosed regions occupied by animals confirmed as adult resident animals and peripheral areas contained juveniles or animals of unknown age, likely transients. Population density was calculated for the three largest core areas (95% of the total core area) by dividing the number of unique animals captured plus the number of radio-collared animals relocated within the area by the effective trapping area (ETA) for each region.

Using those data, two separate density values were calculated for each core area. The first estimate, a 'high density' value was based on the estimated population size within the ETA in 2006. The second 'mean density' value was based on the average density over all years of trapping at each site. Mean densities ranged from 0.04 to 0.08 and high densities from 0.09 to 0.14 marten/km^2. Densities in the peripheral areas were not calculated, but were assumed to be only 20% of those in the core areas, or 0.016 marten/km^2. A total population estimate was derived from an extrapolation of the density estimates across the area of suitable habitat for marten. Occupancy by adult resident marten was best predicted by the amount of suitable habitat present in a home-range size area (potential home range). More detailed descriptions of the methods and assumptions used in the third population estimate are provided in COSEWIC (2007).

The most recent population estimate for Newfoundland Marten differed in method from that reported in COSEWIC (2007). As the first step in that process, Hearn and Durocher (In Prep) used a habitat suitability model (Fuller *et al.* 2006, 2007) to generate a probabilistic habitat map for the portion of the island outside of the two national parks and for which reliable forest inventory was available (83,020 km^2; approximately 75% of the island). The second step in developing the population estimate required overlaying the probability map with a grid of 8-km^2 cells that represented the median annual home range of radio-collared female marten, after accounting for overlap. Each home-range cell was classified as occupied or not according to an average predicted probability of occupancy for the cell of ≥60% or ≥68%. The two probability values corresponded to a minimum of 35% or 40% suitable habitat within a home-range area (Figure 3). The average amount of suitable habitat in the ranges of radio-collared adult resident marten was 47% (range 24–78%; n=84); 82% of marten had ≥35% suitable habitat whereas 18% of adult resident marten occupied home ranges that had between 24% and 34% suitable habitat. Finally, the most recently collected (1990–2018) location data, buffered by 20 km, were used to exclude home-range cells that occurred outside the known occurrence of marten, even if the habitat was suitable. The number of home ranges (8 km^2) with sufficient suitable habitat, both at the ≥35% and ≥40% threshold, were counted and represented the estimate of resident, female marten. A doubling of the female marten resulted in a total population estimate, with the range in abundance defined by the counting of home-range cells that met the 35% or the lower carrying capacity threshold of 40% suitable habitat. This method resulted in a plausible estimate of the number of adult resident marten as defined by habitat suitability, the current distribution of the population, and the home range area of each individual. There were no data or alternative methods to validate the estimate of Hearn and Durocher (In Prep).

Abundance

The first population estimate was 630–875 Newfoundland Marten (Snyder and Hancock 1985). That estimate assumed there were no marten in the greater Terra Nova River area and that the 1982–83 translocations of marten in Terra Nova National Park (Slough 1994) had been unsuccessful. The total area of occupancy on the island was assumed to be 13,354 km^2, of which only 4,551 km^2 was considered to have a high-density of marten.

The second population estimate by Thompson (reported in Forsey *et al.* 1995) suggested that Newfoundland Marten had declined to 300 individuals across the island. That estimate was based on the extrapolation of marten density calculated by Bissonette *et al.* (1988). An assessment of habitat concluded that there was approximately 600 km^2 of prime habitat (≥80-yr-old softwood forest) remaining on the island.

The third estimate, presented in the most recent COSEWIC assessment (COSEWIC 2007), suggested 320–622 mature individuals. That estimate was based on substantially more empirical and modelling information and, thus, was not directly comparable to the two previous estimates.

The most recent model produced an estimate of between 2,494–2,773 mature individuals (Hearn and Durocher In Prep). That estimate applies to the majority of the island, but excludes the two national parks and regions without forest inventory information (approximately 25% of the island). Further, the analysis of Hearn and Durocher (In Prep) suggested that if marten were to occupy all available habitat (≥60% probability of occupancy) there is the potential to support a breeding population in excess of 4,000. Distribution of marten on the island has increased and is currently much more widespread than previously documented (Figure 1).

Recent (post-2007) population estimates are available for Gros Morne and Terra Nova National Parks. Marten were extirpated from Gros Morne National Park in the 20th century, consistent with the decrease in the species across Newfoundland. In 2001–2002, marten were observed along the eastern boundary of the park (n=~5). The subpopulation in the park was estimated at 15–20 individuals in 2012, with abundance increasing at a rate of >10% over the last 10 years (Parks Canada 2012). A recent hair snagging project in 2016–2017, along with other occurrence data, suggests that the marten subpopulation of the park may now be >30 individuals (S. Gerrow pers. comm. 2021). Recent habitat suitability modelling suggests that >38% of the park is suitable habitat for marten (Burton 2020; S. Gerrow pers. comm. 2021).

In 2011, Parks Canada (2011) estimated 25–30 individuals in or around Terra Nova National Park. Abundance was estimated to have increased >25% over the short term. Genotyping of hair identified 45 individual marten (11 female, 33 male, 1 unidentified; Pilgrim and Perry 2014). The most recent occurrence data (Figure 1) suggests that some of the suitable habitat in the southcentral portion of the province adjacent to Terra Nova National Park is now occupied by marten.

Fluctuations and Trends

Reports from explorers and settlers from the early 1700s to the late 1800s suggested that the historical distribution of marten included the Avalon Peninsula. Harvest records from 1763 reported 3,580 pelts suggesting that the marten population at that time was heavily exploited. Concern about the decline in marten on the island was noted by the early 1900s. This decline coincided with widespread overexploitation of American Marten and

Fisher populations throughout North America. A similar history of decline was documented for other game and furbearers in Newfoundland during this period: Newfoundland Wolf was extirpated between 1910 and 1923 (Allen and Barbour 1937) and Canadian Beaver (*Castor canadensis*) were nearly eliminated (Payne 1975). Further, Woodland Caribou, Canada Lynx, and River Otter (*Lontra canadensis*) populations were so severely reduced that the Newfoundland government closed the harvest seasons (Dodds 1983). Commercial harvest for marten was prohibited in 1934, but numbers continued to decline up to the 1990s (Forsey *et al.* 1995).

Previous population estimates for Newfoundland Marten (1985, 1995, 2007, 2019) did not use comparable methods, therefore, a population trend cannot be calculated. The latest population estimate (Hearn and Durocher In Prep) and the recent mapping of occurrence data (Figure 1) should be regarded as the most accurate and representative information. Those data suggest that the abundance and distribution of Newfoundland Marten has increased since the 2007 COSEWIC status assessment and that those increases are continuing. That includes the assisted (e.g., Terra Nova and Main River) and natural recolonization of historical range (e.g., Baie Verte Peninsula, Stephenville south area, Avalon Peninsula). Population growth is occurring under the current ecological and natural resource management regime; however, incidental mortality and habitat removal may slow marten recovery in localized areas.

Marten populations will fluctuate in abundance in response to the cycling dynamics of their primary prey small mammals and Snowshoe Hare. A broad prey base may dampen those fluctuations. For Newfoundland Marten that includes Red Squirrel, Southern Red-backed Vole, and Masked Shrew (Gosse and Hearn 2005). However, it is not known whether marten in Newfoundland are food limited and fluctuate with prey species (Gosse and Hearn 2005).

Earlier efforts to model extinction probability (Thompson 1991; Schneider and Yodzis 1994; Schneider 1995, 1997) used habitat associations (old-growth paradigm), home-range estimates, and dispersal distances that were inappropriate for Newfoundland Marten. Consequently, the extinction risk discussed in those previous studies should no longer be considered appropriate for Newfoundland Marten.

Rescue Effect

There is no possible rescue effect for this genetically and ecologically distinct population.

THREATS AND LIMITING FACTORS

Threats

Threats for Newfoundland Marten were assessed, organized, and based on the IUCN-CMP (World Conservation Union-Conservation Measures Partnership) unified threats classification system (Master *et al.* 2012) using definitions in Salafsky *et al.* (2008). Threats are defined as the proximate activities or processes that directly and negatively affect the population.

The primary immediate threats to Newfoundland Marten are unintended capture in traps and snares (Medium – Low), collisions with motor vehicles (Low), habitat loss associated with utility corridors (Low), and logging that results in forest openings (Low). The assigned overall threat impact was Medium – Low (Appendix 1).

Threat 5.1: Hunting and Collecting Terrestrial Animals – MEDIUM – LOW IMPACT

The incidental capture of marten in snares set for Snowshoe Hare and snares and traps set for furbearers is an important source of mortality for Newfoundland Marten (Forsey *et al.* 1995; Hearn 2007). In the past, this source of mortality was considered to be an impediment to marten dispersing from refuges to unprotected vacant habitats (Forsey *et al.* 1995; Thompson and Curran 1995).

Fisher and Twitchell (2003, 2004) introduced and tested a new snare that had sufficient torque and tension to hold hare, but release marten (Fisher *et al*. 2005). That type of snare wire has been mandatory across Newfoundland since 2008. Modifications to the snaring regulations, in addition to observed declines in snaring and trapping activity in recent years, has apparently reduced that source of mortality. However, the more recent degree of compliance of trappers in no-snaring and modified-snaring and trapping zones has not been adequately assessed.

Threat 4.1: Roads and Railways – LOW IMPACT

Roads are a direct source of mortality for Marten. Although the total exposure of marten to roads and the probability of being struck by a vehicle is uncertain, the Scope of that threat is likely limited (Small). Dispersing marten may be at greater risk of crossing a road and collision with a vehicle. With an increase in the abundance of the population, dispersal and road mortality are likely more common. Indirectly, roads provide access to trapping and snaring activities (reported in 5.1).

Threat 4.2: Utility and Service Lines – LOW IMPACT

Electrical transmission lines represent a loss of habitat as the rights-of-way are regularly cleared of shrubs and trees. Those transmission lines are in place (past effect) and occur over a relatively small proportion of the known distribution of marten. However, as mining and other developments increase so does the need for power. There is a possibility of further increase in the development of utility corridors and associated loss of marten habitat. The access provided by utility and service lines could increase trapping and snaring activities (reported in 5.1).

Threat 5.3: Logging and Wood Harvesting – LOW IMPACT

The perceived threat of logging (Thompson 1991) has decreased following recent research and an improved understanding of the habitat ecology of Newfoundland Marten (Hearn *et al.* 2010). Marten use regenerating forests (<6 m) and precommercially thinned stands in addition to old-growth forests. However, marten do use old forest types and logging occurs across a large portion of the known range of the species (Scope = Large – Restricted). Hearn *et al.* (2010) recommended that a home range should include a minimum of 24% mature and overmature forest and ≤29% younger-aged forest. These threshold values for the percent of young and mature forests were incorporated in the recent Marten Occupancy Model used to estimate the abundance of Newfoundland Marten (Fuller *et al.* 2006, 2007). There is likely an interaction between logging, associated road building, and trapping. Greater access to formerly inaccessible habitat could increase trapping pressure and mortality of marten (reported in 5.1).

Other Threats and Limiting Factors

Climate change will likely have long-term implications for the distribution of plant communities and marten habitat across the island of Newfoundland. Those changes would result from shifting bioclimatic conditions, increased wild fire, and more frequent and extreme storm events leading to flooding and wind-related forest damage (Government of Newfoundland and Labrador 2016). However, there is no evidence to suggest that climate change will be a substantive direct threat to marten or their habitat over the next 10 years. There are likely future threats associated with Climate Change with particular concern with “Habitat shifting and alteration” and “Storms and flooding”.

The diversity and abundance of prey for Newfoundland Marten are limited relative to other populations in North America. Thus, the availability of prey was thought to be a limiting factor for population growth of Newfoundland Marten. Introductions of prey species to Newfoundland, in particular the Southern Red-backed Vole (see Hearn *et al.* 2006), have increased the biomass of available prey and the prospects of population growth. Conversely, historical and concurrent introductions (or eliminations) of predators, including coyotes and wolves, may negatively affect marten and their prey (Dodds 1983; Hearn *et al.* 2006; Strong and Leroux 2014).

Newfoundland Marten is likely susceptible to a number of pathogens, including canine distemper virus (CDV) and parvoviruses, which have been associated with declines of carnivore populations (Gabriel *et al*. 2012). Although diseases like canine distemper can have significant impacts on free-ranging populations of highly susceptible species, impacts of this disease on other susceptible species are less clear (Rossiter *et al*. 2001). However, it is important to consider that CDV-related mortalities in small or insular *Martes* populations could have a significant impact on their persistence and viability (Gabriel *et al*. 2012). For example, an outbreak of encephalitis, likely caused by CDV, killed 10 of 40 study animals at Little Grand Lake in 1986–1987 (Bissonette *et al.* 1989; Fredrickson 1990). However, no outbreaks of disease or parasites were reported following the two most recent long-term studies (Gosse *et al.* 2005; Hearn 2007).

Parvoviruses are generally not thought to limit wild carnivore populations, with the possible exception of small or otherwise vulnerable populations (Barker and Parrish 2001). That being said, introduction of Aleutian Mink Disease Virus (AMDV; Carnivore amdoparvovirus 1) to wild populations from escaped domestic mink and mink farms is of potential concern (Canuti *et al.* 2020). AMDV may be contributing to the long-term and sustained decline of wild mustelid species (i.e., mink) populations through direct mortality of adults, reducing productivity of adult females, and impacting survivorship of juveniles (Nituch *et al*. 2011). American Marten seroconverted following experimental inoculation (Kenyon *et al*. 1978); however, impacts on wild populations are not known.

Number of Locations

Previously, Newfoundland Marten occurred within 4 to 5 geographic core areas. Since the last COSEWIC assessment (2007), an increase in the abundance and spatial distribution of marten as well as the redefinition and expansion of high-quality habitat has resulted in a contiguous population with relatively little subpopulation structure (Figure 1). The major threats of incidental trapping and snaring, vehicle collision, and habitat loss are unlikely to result in a rapid decline in the population that now occurs over an area of 4,692 km^2. Thus, a single threatening event is unlikely to rapidly affect a large proportion (>50%) of marten on the island. This suggests that the concept of 'threat' location does not apply to the Newfoundland population of marten.

PROTECTION, STATUS AND RANKS

Legal Protection and Status

The Newfoundland population of American Marten is protected under the federal *Species at Risk Act*. The population was designated *Threatened* in April, 2007 and is listed on Schedule 1. The species was provincially designated *Threatened* in February 2008 under the Newfoundland and Labrador *Endangered Species Act*, a downlisting from its prior designation of *Endangered* (2002). The recovery target of 1000 individuals, as specified in the 2010 Provincial Recovery Plan, was met (Environment Canada 2013).

The provincial *Endangered Species Act* protects Newfoundland Marten from activities such as harassment, capture, trade, and killing. Regulated trapping of marten has been illegal since 1934. There continues to be some amount of incidental bycatch of marten in traps and snares set for other species.

All land-based trapping and snaring (including snaring of Snowshoe Hare) have been prohibited in the Pine Marten Study Area (2,078 km^2 provincial wildlife reserve created in 1973) and in three protected areas established in 2002: Little Grand Lake Provisional Ecological Reserve (729 km^2), Little Grand Lake Wildlife Reserve (569 km^2), and Glover Island Public Reserve (178 km^2). Trapping and snaring also are prohibited in the Main River Study Area (200 km^2), Terra Nova National Park (399 km^2), and parts of Gros Morne National Park (1805 km^2; Government of Newfoundland and Labrador 2015).

Use of specified wire for hare snares, from which marten can be released, has been required island-wide, including Gros Morne National Park, since 2008. Prior to that, only four zones of critical marten habitat totalling 5,236 km^2 required these snares.

Non-Legal Status and Ranks

In 2003, NatureServe assigned a status of Critically Imperilled (G5T1) to the Newfoundland population, but that needs review. In 2021, the provisional NatureServe ranking of marten on the island of Newfoundland was Vulnerable to Apparently Secure (S3S4; J. Humber pers. comm. 2021). The IUCN has not assessed *M. americana atrata* subspecies or Newfoundland Marten, but assessed *M. americana* as Least Concern (Reid and Helgen 2008).

Habitat Protection and Ownership

Most of the range of Newfoundland Marten is on provincial “Crown” land. In 2020, approximately 9% of the current area of occupancy was within protected areas (27% of the Terra Nova core area, 9% of the Main River core area, and 22% of the Little Grand Lake-Red Indian Lake core area). Additional protected areas include provincial parks and wilderness reserves. Further, 4% of the area of occupancy was protected from wood harvesting alone, 8% was closed to all trapping and snaring, and an additional 9% was within modified trap and snare zones.

In 2010, a total area of 6,208 km^2 was identified as Critical Habitat based on a combination of marten occurrence data and information on habitat quality available at the time. Sixteen percent of that Critical Habitat is fully protected, 16% is protected from wood harvesting alone, 29% is closed to all trapping and snaring, and an additional 28% occurs in modified trap and snare zones. Critical Habitat encompasses approximately 51% of the area of occupancy in 2007 (Environment Canada 2013). These habitat protection percentages are currently lower as a consequence of the significant increase in spatial distribution of marten on the island.

Protected areas include Gros Morne (1,805 km^2) and Terra Nova (392 km^2) National Parks. The *Canada Gazette* published descriptions of Critical Habitat in the two parks (5,380 ha in Gros Morne, and 33,315 ha in Terra Nova), pursuant to SARA and the recovery strategy (Environment Canada 2013). The Little Grand Lake Provisional Ecological Reserve (729 km^2) was established in 2002, and protects habitat for Newfoundland Marten. Further, two protected areas adjacent to that reserve were also created in 2002 to extend the area under protection and buffer against the effects of any human activity that would be harmful to the recovery of marten: Little Grand Lake Wildlife Reserve (569 km^2) and Glover Island Public Reserve (178 km^2). Limited timber harvesting continues within one national park and in the sections of the Pine Marten Study Area (2,078 km^2) that are not within reserves.

Some marten habitat (12,083 km^2) is managed by the Government of Newfoundland and Labrador (2014) as Special Forest Management Areas (SFMA), including Intact Landscape Forest Management Areas (ILFMA) and Dynamic Species-Specific Areas (DSSA). Industrial forest activity is deferred in the ILFMAs until 2024.

ACKNOWLEDGEMENTS AND AUTHORITIES CONTACTED

We thank the following individuals for their assistance in preparing this report:

Graham Forbes and Chris Johnson, Co-chairs, COSEWIC Terrestrial Mammals Specialist Group

Darroch Whitaker, Janet Feltham, Shawn Gerrow, and John Gosse, Parks Canada

Megan Lafferty, Conservation Biologist, Newfoundland and Labrador, Nature Conservancy of Canada, Atlantic Region

Shelley Moores, Jessica Humber, Wildlife Research, Wildlife Division, Department of Fisheries, Forestry and Agriculture, Government of Newfoundland

Adam Durocher, Atlantic Canada Conservation Data Centre

Jenny Wu, Karen Timm, Sonia Schnobb, Angèle Cyr and Bev McBride, COSEWIC Secretariat, Canadian Wildlife Service

Authorities Contacted

Tim Birt, Assistant Professor, Adjunct, Queen's University, Kingston, ON

Sean Blaney, Executive Director & Senior Scientist, Atlantic Canada Conservation Data Centre, Sackville, NB

Andrew Boyne, Species at Risk Biologist, Canadian Wildlife Service - Atlantic Region, Dartmouth, NS.

Shawn Gerrow, Ecologist, Parks Canada, Rocky Harbor, NL

John Gosse, Independent Consultant (currently with Parks Canada) and past member of the Newfoundland Marten Recovery Team, Traytown, NL

Jessica Humber, Ecosystem Management Ecologist, Wildlife Research, Wildlife Division, Department of Fisheries, Forestry and Agriculture, Government of Newfoundland and Labrador, Corner Brook, NL

Neil Jones, Scientific Project Officer & ATK Coordinator, COSEWIC Secretariat, Canadian Wildlife Service, Environment Canada, Gatineau QC

Kamal Khidas, Curator, Vertebrate Zoology, Research and Collections, Canadian Museum of Nature, Ottawa, ON

Rachel McDonald, Senior Advisor - J9 Compliance, CAF Real Property Operations Group, ADM(IE), Department of National Defence, Ottawa, ON

Shelley Moores, Senior Manager, Wildlife Research, Wildlife Division, Department of Fisheries, Forestry and Agriculture, Government of Newfoundland and Labrador, Corner Brook, NL

Patrick Nantel, Ecosystem Scientist, Office of the Chief, Parks Canada, Gatineau, QC

INFORMATION SOURCES

Allen, G.W., and T. Barbour. 1937. The Newfoundland wolf. Journal of Mammalogy 18:229–234.

Anderson, E. 1970. Quaternary evolution of the genus *Martes* (Carnivora, Mustelidae). Acta Zoologica Fennica 130:1–132.

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.

Barker, I.K., and C.R. Parrish. 2001. Parvovirus infections. Pp. 131-146 In Infectious Diseases of Wild Mammals. E.S. Williams and I.K. Barker. (Eds.). John Wiley & Sons.

Barta, R.M., L.B. Keith, and S.M. Fitzgerald. 1989. Demography of sympatric arctic and snowshoe hare populations: an experimental assessment of interspecific competition. Canadian Journal of Zoology 67:2762–2775.

Bateman, M.C. 1986. Winter habitat use, habits and home range size of the marten, *Martes americana*, in western Newfoundland. Canadian Field-Naturalist 100:58–62.

Bergerud, A.T. 1967. The distribution and abundance of arctic hares in Newfoundland. Canadian Field-Naturalist 81:242–248.

Bergerud, A.T. 1969. The status of pine marten in Newfoundland. Canadian Field-Naturalist 83:128–131.

Bissonette, J.A., R.J. Frederickson, and B J. Tucker. 1988. The effects of forest harvesting on marten and small mammals in western Newfoundland. Rep. prepared for the Newfoundland & Labrador Wildlife Division and Corner Brook Pulp & Paper Co. Ltd., Utah Cooperative Fish and Wildlife Research Unit, Utah State University, Logan. 109 pp.

Bissonette, J.A., R.J. Fredrickson, and B.J. Tucker. 1989. American marten: a case for landscape-level management. Transactions of the North American Wildlife and Natural Resources Conference 54:89–101.

Bridger, M.C., C.J. Johnson, and M.P. Gillingham. 2016. Assessing cumulative impacts of forest development on the distribution of furbearers using expert-based habitat modeling. Ecological Applications 26:499–514.

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.

Buskirk, S.W., and L.F. Ruggiero. 1994. American marten. Pp. 7–37 In L.F. Ruggiero, K.B. Aubrey, S.W. Buskirk, L.J. Lyon, and W.J. Zielinski (Eds.). The Scientific Basis for Conserving Forest Carnivores: American Marten, Fisher, Lynx, and Wolverine in the western United States. Unites States Forest Service General Technical Report, RM-254:1–184.

Buskirk, S.W., J. Bowman, and J.H. Gilbert. 2012. Population biology and matrix demographic modeling of American Martens and Fishers. Pp. 77-92 In K.B. Aubry, W.J. Zielinski, M.G. Raphael, G. Proulx, and S.W. Buskirk (Eds.). Biology and Conservation of Marten, Sables, and Fishers, A New Synthesis. Cornell University Press.

Burton, J. 2020. American Marten habitat mapping Gros Morne National Park. Report prepared for Parks Canada.

Canadian Endangered Species Conservation Council (CESCC). 2011. Wild Species 2010: The General Status of Species in Canada. National General Status Working Group. Minister of Public Works and Government Services Canada, Ottawa. 302 pp. Website: http://www.wildspecies.ca [accessed October 2015].

Canuti, M., E. McDonald, S.M. Graham, B. Rodrigues, E. Bouchard, R. Neville, M. Pitcher, H.G. Whitney, H.D. Marshall, and A.S. Lang. 2020. Multi-host dispersal of known and novel carnivore amdoparvoviruses. Virus Evolution 6:veaa072.

Carr, S.M., and S.A. Hicks. 1997. Are there two species of marten in North America? genetic and evolutionary relationships with *Martes*. Pp. 15–25 In G. Proulx, H.N. Bryant, and P.M. Woodard (eds.), *Martes*: Taxonomy, Ecology, Techniques, and Management. Provincial Museum of Alberta, Edmonton, Alberta, Canada.

Clark, T.W. 1984. Analysis of pine marten population organization and regulatory mechanisms in Jackson Hole, Wyoming. National Geographic Society Research Report 1975:131–143.

Clark, T.W., E. Anderson, C. Douglas, and M. Strickland. 1987. *Martes americana*. Mammalian Species 289:1–8.

COSEWIC. 2000. COSEWIC assessment and update status report on the American marten *Martes americana atrata* in Canada (Newfoundland population). Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 9 pp.

COSEWIC. 2007. COSEWIC assessment and update status report on the American marten (Newfoundland population) *Martes americana atrata* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 26 pp.

Dawson, N., and J. Cook. 2012. Behind the genes: Diversification of North American martens (*Martes americana* and *M. caurina*). Pp. 23–38 In K. Aubry, W. Zielinski, M. Raphael, G. Proulx, and S. Buskirk (Eds.). Biology and Conservation of Martens, Sables, and Fishers: A New Synthesis. Cornell University Press.

Dodds, D. 1983. Terrestrial mammals. Pp. 509–550 In G. Robin South (ed.): Biogeography and Ecology of the Island of Newfoundland, Dr. W. Junk Publishers. The Hague, Netherlands.

Drew, G.S., and J.A. Bissonette. 1997. Winter activity patterns of American martens (*Martes americana*): rejection of the hypothesis of thermal-cost minimization. Canadian Journal of Zoology 75:812–816.

Environment Canada. 2013. Recovery strategy for the American marten (*Martes americana atrata*), Newfoundland population. *Species at Risk Act* Recovery Strategy Series. Environment Canada, Ottawa. xi pp. + appendix.

Fisher, J.T., and C. Twitchell. 2003. Quantifying the differences in tension and torque between snared American marten (*Martes americana*) and snowshoe hare (*Lepus americanus*). Final Report, Alberta Research Council Inc., Sustainable Ecosystems Unit, Vegreville, Alberta. viii + 12 pp.

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, Alberta. 13 pp.

Fisher, J.T., C. Twitchell, W. Barney, E. Jenson, and J. Sharpe. 2005. Utilizing behavioral biophysics to mitigate mortality of snared endangered Newfoundland marten. Journal of Wildlife Management 69:1743–1746.

Fitzgerald, S.M., and L.B. Keith. 1990. Intra-and inter-specific dominance relationships among arctic and snowshoe hares. Canadian Journal of Zoology 68:457–464.

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. Recovery of Nationally Endangered Wildlife Committee Report No. 14. Ottawa. 29 pp.

Forsey, E.S., and E.M. Baggs. 2001. Winter activity of mammals in riparian zones and adjacent forests prior to and following clear-cutting at Copper Lake, Newfoundland, Canada. Forest Ecology and Management 145:163–171.

Fredrickson, R.J. 1990. The effects of disease, prey fluctuation, and clear-cutting on American marten in Newfoundland, Canada. M.Sc. Thesis, Utah State University, Logan, Utah. 84 pp.

Fuller, A.K. 2006. Multi-scalar responses of forest carnivores to habitat and spatial pattern: case studies with Canada lynx and American martens. Ph.D. Dissertation, University of Maine, Orono, Maine, USA. xxii + 223 pp.

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, and B.J. Hearn. 2007. Application and testing of models to predict probability of occupancy and density of Newfoundland martens. Final Contract Report. Prepared for Natural Resources Canada-Canadian Forest Service-Atlantic; Newfoundland and Labrador Department of Environment and Conservation, Inland Fish and Wildlife Division; University of Maine, Department of Wildlife Ecology. xiv + 75 pp.

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 by martens in Newfoundland and Maine. Final Contract Report. Prepared for Natural Resources Canada, Canadian Forest Service-Atlantic; University of Maine, Department of Wildlife Ecology; Western Newfoundland Model Forest Inc.; Newfoundland & Labrador Department of Environment and Conservation, Inland Fish and Wildlife Division; Abitibi Consolidated Limited; Corner Brook Pulp and Paper Limited; and, Department of Forest Resources and Agrifoods, Newfoundland & Labrador Forest Service. xi + 92 pp.

Gabriel, M.W., G.M. Wengert, and R.N. Brown. 2012. Pathogens and Parasites of Martes Species: Management and Conservation Implications. Pp. 138–185 In K. Aubry, W. Zielinski, M. Raphael, G. Proulx, and S. Buskirk (Eds.). Biology and Conservation of Martens, Sables, and Fishers. Cornell University Press.

Gerrow, S., pers. comm. 2021. Email correspondence to C. Johnson. November 2021. Ecologist, Parks Canada, Western Newfoundland & Labrador Field Unit, Rocky Harbour, NL.

Gibilisco, C.J. 1994. Distributional dynamics of modern *Martes* in North America. Pp. 59–71 In S.W. Buskirk, A.S. Harestad, M.G. Raphael, and R.A. Powell (Eds.). Martens, sables and fishers: biology and conservation. Comstock Publishing Associates, Ithaca, New York.

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.

Godbout, G., and J.-P. Ouellet. 2010. Fine-scale habitat selection of American marten at the southern fringe of the boreal forest. Ecoscience 17:175–185.

Gosse, J. 2014. An assessment of the occurrence of Newfoundland marten and resident birds within NCC property, southwestern Newfoundland. Unpublished manuscript, prepared for The Nature Conservancy of Canada, St. John's NL. 17 pp.

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 martens, *Martes americana atrata*. Canadian Field Naturalist 119:43–47.

Gosse, J.W., and W.A. Montevecchi. 2001. Relative abundance of forest birds of prey in western Newfoundland. Canadian Field-Naturalist 115:57–63.

Gould, W.P., and W.O. Pruitt, Jr. 1969. First Newfoundland record of *Peromyscus*. Canadian Journal of Zoology 47:469.

Government of Canada. 2017. Species at Risk Public Registry for American marten, Newfoundland population. Web site: https://species-registry.canada.ca/index-en.html#/species/134-119#species_details [accessed May 2017].

Government of Newfoundland and Labrador. 2014. Growing our renewable and sustainable forest economy, provincial sustainable forest management strategy, 2014–2024. Centre for Forest Science and Innovation Department of Natural Resources Fortis Building, Corner Brook, NL. 64 pp.

Government of Newfoundland and Labrador. 2016. Turn Back the Tide. https://www.turnbackthetide.ca/about-climate-change-and-energy-efficiency/impacts-of-climate-change.shtml

Hagmeier, E.M. 1958. The inapplicability of the subspecies concept to the North American marten. Systematic Zoology 7:150–168.

Hagmeier, E.M. 1961. Variation and relationships in North American marten. Canadian Field-Naturalist 75:122–137.

Hall, E.R. 1981. The mammals of North America. 2nd edition. John Wiley and Sons, New York. 1181 pp.

Hancock, J., J. Snyder, and T. St. George. 1985. Marten questionnaire to trappers in western Newfoundland, 1983. Internal Report, Newfoundland Wildlife Division, St. John's. 9 pp.

Hearn, B.J., and A. Durocher. (In Prep) Habitat availability and population size for American Marten (*Martes americana atrata*) on the Island of Newfoundland. Internal Report, Department of Fisheries, Forestry and Agriculture, Government of Newfoundland and Labrador. 65 pp.

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. Prepared for Natural Resources Canada, Canadian Forest Service-Atlantic; University of Maine, Department of Wildlife Ecology; Newfoundland & Labrador Department of Environment and Conservation, Inland Fish and Wildlife Division; Western Newfoundland Model Forest Inc.; Abitibi Consolidated Limited; Corner Brook Pulp and Paper Limited; and, Department of Forest Resources and Agrifoods, Newfoundland & Labrador Forest Service. xvi + 86 pp.

Hearn, B.J., L.B. Keith, and O.J. Rongstad. 1987. Demography and ecology of the arctic hare (*Lepus arcticus*) in southwestern Newfoundland. Canadian Journal of Zoology 65:852–861.

Hearn, B.J., J.T Neville, W.J. Curran, and D.P. Snow. 2006. First record of the southern red-backed vole, *Clethrionomys gapperi*, in Newfoundland: 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, Maine, USA. xxvi + 226 pp.

Hearn, B.J., D.J. Harrison, A.K. Fuller, C.G. Lundrigan, and W.J. Curran. 2010. Paradigm shifts in habitat ecology of threatened Newfoundland martens. Journal of Wildlife Management 74:719–728.

Hillman, T.L. 2014. Genetic health and population viability of reintroduced American Marten in Michigan. Master's Thesis, Grand Valley State University, Michigan, USA.

Hodgman, T.P., D.J. Harrison, D.M. Phillips, and K.D. Elowe. 1997. Survival of American marten in an untrapped forest preserve in Maine. Pp. 86–99 in G. Proulx, H.N Bryant, and P.M. Woodward (Eds.). Martes: Taxonomy, Ecology, Techniques, and Management. Provincial Museum of Alberta, Edmonton, Canada.

Humber, J. pers. comm. 2021. Email correspondence to C. Johnson. June 2021. Co-chair Terrestrial Mammals Species Specialist Subcommittee

Kenyon, A. J., B.J. Kenyon, and E.C. Hahn. 1978. Protides of the Mustelidae: immunoresponse of mustelids to Aleutian mink disease virus. American Journal of Veterinary Research 39:1011–1015.

Krohn, W.B., K. D. Elowe, and R.B. Boone. 1995. Relations among fishers, snow, and martens: Development and evaluation of two hypotheses. The Forestry Chronicle 71:97–105.

Krohn, W.B., W.J. Zielinski, and R.B. Boone. 1997. Relations among fishers, snow, and martens in California: results from small-scale spatial comparisons. Pp. 211–232 In G. Proulx, H.N Bryant, and P.M. Woodward (Eds.). *Martes*: Taxonomy, Ecology, Techniques, and Management. Provincial Museum of Alberta, Edmonton, Canada.

Kyle, C.J., and C. Strobeck. 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.

Lemon, J. 1996. Update COSEWIC status report on the American marten *Martes americana atrata* in Canada (Newfoundland population). Committee on the Status of Endangered Wildlife in Canada. 9 pp.

Master, L.L., D. Faber-Langendoen, R. Bittman, G.A. Hammerson, B. Heidel, L. Ramsay, K. Snow, A. Teucher, and A. Tomaino. 2012. NatureServe conservation status assessments: factors for evaluating species and ecosystems risk. NatureServe, Arlington, Virginia. Website: https://www.natureserve.org/publications/natureserve-conservation-status-assessments-factors-evaluating-species-and-ecosystem [accessed May 2021].

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.

Mercer, E., B.J. Hearn, and C. Finlay. 1981. Arctic hare populations in Newfoundland. Pp. 450–468 In K. Meyers, and C. D. MacInnes (Eds.). Proceedings of the World Lagomorph Conference. University of Guelph, Ontario, Canada, August 12–16.

Nagorsen, D.W., R.W. Campbell, and G.R. Giannico. 1991. Winter food habits of Marten, *Martes americana* in Haida Gwaii. Canadian Field-Naturalist 105:55–59.

Nagorsen, D.W., K.F. Morrison, and J.E. Forsberg. 1989. Winter diet of Vancouver Island marten. Canadian Journal of Zoology 67:1394–1400.

National Forestry Database. 2017. Compendium 6.1, Silvicultural statistics by province/territory, *a, 1990–2015. Website: http://nfdp.ccfm.org/[accessed April 2017].

Northcott, T.H., E. Mercer, and E. Menchenton.1974. The eastern Chipmunk, *Tamias striatus,* in insular Newfoundland. Canadian Field-Naturalist 88:86.

Newfoundland marten Recovery Team. 2010. Recovery plan for the threatened Newfoundland population of American marten (*Martes americana atrata*). Wildlife Division, Department of Environment and Conservation, Government of Newfoundland and Labrador, Corner Brook, Canada. iii + 31 pp.

Nituch, L.A., J. Bowman, K.B. Beauclerc, and A.I. Schulte-Hostedde. 2011. Mink farms predict Aleutian disease exposure in wild American mink. PLoS One 6:e21693.

Paragi, T.F., W.N. Johnson, D.D. Katnik, and A.J. Magoun. 1996. Marten selection of post-fire seres in the Alaskan taiga. Canadian Journal of Zoology 74:2226–2237.

Parker, G.R. 1995. Eastern coyote: the story of its success. Nimbus Publishing, Halifax, Nova Scotia, Canada.

Parks Canada. 2011. Detailed assessment for the American marten – Newfoundland population (*Martes americana* pop. 1). In Terra Nova National Park of Canada. Species at Risk Detailed Assessments. Parks Canada Agency, Ottawa. 7 pp.

Parks Canada. 2012. Detailed assessment for the American marten – Newfoundland population (*Martes americana* pop. 1). In Gros Morne National Park of Canada. Species at Risk Detailed Assessments. Parks Canada Agency, Ottawa. 7 pp.

Parks Canada. 2017. Forests at risk in Newfoundland and Labrador. Website: https://www.pc.gc.ca/en/nature/science/conservation/forets-forests. [accessed May 2017].

Payer, D.C. 1999. Effects of timber harvesting and trapping on habitat selection and demographic characteristics of American marten. PhD Thesis, University of Maine, Orono, USA.

Payer, D.C., and D.J. Harrison. 2000. Structural differences between forests regenerating following spruce budworm defoliation and clear-cut harvesting: implications for marten. Canadian Journal of Forest Research 30:1965–1972.

Payer, D.C., and D.J. Harrison. 2003. Influence of forest structure on habitat use by American marten in an industrial forest. Forest Ecology and Management 179:145–156.

Payne, N.F. 1975. Trapline management and population biology of Newfoundland beaver. Ph.D. Dissertation, Utah State University, Logan, Utah, USA.

Pilgrim, B., and E. Perry. 2014. Microsatellite identification of individual Newfoundland marten (*Martes americana atrata*) in Terra Nova National Park. Genomics and Proteomics Facility, CREAIT Network, Memorial University of Newfoundland, St. John's, NL. Unpubl. rep. 15 pp.

Poole, K.G., A.D. Porter, A. de Vries, C. Maundrell, S.D. Grindal, and C.C. St. Clair. 2004. Suitability of a young deciduous-dominated forest for American marten and the effects of forest removal. Canadian Journal of Zoology 82:423–435.

Potvin, F., L. Bélanger, and K. Lowell. 2000. Marten habitat selection in a clearcut boreal landscape. Conservation Biology 14:844–857.

Powell, R.A. 1994. Structure and spacing of *Martes* populations. Pp. 101–121 In S.W. Buskirk, A.S. Harestad, M.G. Raphael, and R.A. Powell (Eds.). Martens, Sables and Fishers: Biology and Conservation. Cornell University Press, Ithaca, New York, 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.

Reid, F., and K. Helgen. 2008. *Martes americana*. The IUCN Red List of Threatened Species 2008: e.T41648A10528129. Website: https://www.iucnredlist.org/species/41648/45212861. [accessed October 2015].

Rodrigues, B. 2012. Newfoundland and Labrador small mammal monitoring network 2011 season report. Wildlife Division, Department of Environment and Conservation, Government of Newfoundland and Labrador, Corner Brook, Newfoundland and Labrador, Canada.

Rodrigues, B., E.S. Yaskowiak, B.J. Hearn, and H.D. Marshall. 2013. Origins and diversity of the introduced southern red-backed vole (*Myodes gapperi*) population in Newfoundland, Canada based on mitochondrial haplotypes: Ecological and management implications of a potentially invasive species. Canadian Wildlife Biology & Management 2:1–10.

Rossiter, P., E.S. Williams, L. Munson, and S. Kennedy. 2001. Morbilliviral diseases. Pp. 37–76 in E.S. Williams and I.K. Barker. (Eds.). Infectious Diseases of Wild Mammals. John Wiley & Sons.

Salafsky, N., D. Salzer, A.J. Stattersfield, C. Hilton-Taylor, R. Neugarten, S.H.M. Butchart, B. Collen, N. Cox, L.L. Master, S. O'Connor, and D. Wilkie. 2008. A standard lexicon for biodiversity conservation: unified classifications of threats and actions. Conservation Biology 22:897–911.

Schneider, R. 1995. The Newfoundland marten population: viability and spatial dynamics. Western Newfoundland Model Forest Report. 20pp. + figs.

Schneider, R. 1997. Simulated spatial dynamics of martens in response to habitat succession in the western Newfoundland model forest. Pp. 419–436 In G. Proulx, H.N. Bryant, and P.M. Woodard (Eds.). *Martes*: Taxonomy, Ecology, Techniques, and Management. Provincial Museum of Alberta, Edmonton, Alberta, Canada.

Schneider, R.R., and P. Yodzis. 1994. Extinction dynamics in the American marten (*Martes americana*). Conservation Biology 8:1058–1068.

Skinner, W.R. 1979. Status report on the Newfoundland pine marten, *Martes americana atrata*, in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 14 pp.

Slough, B.G. 1989. Movements and habitat use by transplanted marten in the Yukon Territory. Journal of Wildlife Management 53:991–997.

Slough, B.G. 1994. Translocations of American martens: an evaluation of factors in success. Pp. 165–178 In S.W. Buskirk, A.S. Harestad, M.G. Raphael, and R.A. Powel (Eds.). Martens, Fishers, and Sables: Biology and Conservation. Cornell Univ. Press, Ithaca, N.Y.

Small, R. J., L.B. Keith, and R.M. Barta. 1992. Demographic responses of arctic hares (*Lepus arcticus*) placed on two predominantly forested islands in Newfoundland. Ecography 15:161–165.

Snyder, J.E. 1984. Marten use of clear-cuttings and residual forest stands in western Newfoundland. Master's Thesis, University of Maine, Orono, USA.

Snyder, J.E. 1985. Updated status report on the marten (Newfoundland population), *Martes americana atrata*, in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 42 pp.

Snyder, J.E., and J.A. Bissonette. 1987. Marten use of clear-cuttings and residual forest stands in western Newfoundland. Canadian Journal of Zoology 65:169–174.

Snyder, J.E., and J. Hancock. 1985. Newfoundland pine marten population estimate. Newfoundland and Labrador Wildlife Division, Unpublished Report 14 pp.

Strickland, M.A., and C.W. Douglas. 1987. Marten. Pp. 531–546 In M. Novak, J.A. Baker, M.E. Obbard, and B. Malloch (Eds.). Wild furbearer management and conservation in North America. Ontario Trappers Association, North Bay, Ontario.

Strickland, M.A., C.W. Douglas, M. Novak, and N.P. Hunziger. 1982. Marten. Pp. 599–612 In J.A. Chapman and G.A. Feldhamer (Eds.). Wild Mammals of North America: Biology, Management, and Economics. Johns Hopkins Univ. Press, Baltimore, MD.

Strong, J.S., and S.J. Leroux. 2014. Impact of non-native terrestrial mammals on the structure of the terrestrial mammal food web of Newfoundland, Canada. PLoS One 9:106264.

Sturtevant, B.R. 1996. Second growth forest as potential marten habitat in western Newfoundland: an examination of forest habitat structure and microtine abundance. Ph.D. Thesis, Utah State University, Logan, Utah.

Sturtevant, B.R., and J.A. Bissonette. 1997. Stand structure and microtine abundance in Newfoundland: Implications for marten. Pp. 182–198 In G. Proulx, H.N. Bryant, and P.M. Woodard (Eds.). *Martes*: Taxonomy, Ecology, Techniques, and Management. Provincial Museum of Alberta, Edmonton, AB.

Sturtevant, B.R., J.A. Bissonette, and J.N. Long. 1996. Temporal and spatial dynamics of boreal forest structure in western Newfoundland: silvicultural implications for marten habitat management. Forest Ecology and Management 87:13–25.

Sturtevant, B.R., J.A. Bissonette, J.N. Long, and D.W. Roberts. 1997. Coarse woody debris as a function of age, stand structure, and disturbance in boreal Newfoundland. Ecological Applications 7:702–712.

Thompson, I.D. 1991. Could marten become the spotted owl of eastern Canada? The Forestry Chronicle 67:136–140.

Thompson, I.D., and P.W. Colgan. 1987. Numerical responses of martens to a food shortage in northcentral Ontario. Journal of Wildlife Management 51:824–835.

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., J. Fryxell, and D.J. Harrison. 2012. Improved insights into use of habitat by American martens. Pp. 209–230. In K.B. Aubry, W.J. Zelinski, M.G. Raphael, G. Proulx, and S.W. Buskirk. Biology and Conservation of Martens, Sables and Fishers. A New Synthesis. Cornell University Press.

Thompson, I.D., and A.S. Harestad. 1994. Effects of logging on American martens with models for habitat management. Pp. 355–367 In S.W. Buskirk, A.S. Harestad, M.G. Raphael, and R.A. Powell (Eds.). Martens, Sables, and Fishers: Biology and Conservation. Cornell University Press, Ithaca, New York.

Tuck, L.M. 1968. Recent Newfoundland bird records. Auk 85:304–311.

Weckworth, R.P., and V.D. Hawley. 1962. Marten food habits and population fluctuations in Montana. Journal of Wildlife Management 26:55–74.

BIOGRAPHICAL SUMMARY OF REPORT WRITERS

Brian G. Slough obtained an M.Sc. in Biological Sciences from Simon Fraser University in 1976. His thesis on Canadian Beaver ecology led him to a 15-year career as furbearer management biologist with the Yukon Fish and Wildlife Branch. He has published work on several furbearer species including Beaver, Arctic Fox (*Alopex lagopus*), American Marten, and Canada Lynx, and has also written about trapline and furbearer management in northern and western Canada. He prepared COSEWIC status reports on Wolverine (*Gulo gulo*) (2003 and 2014), American Marten, Newfoundland population (2007) and Western Toad (*Anaxyrus boreas*) (2013). He has also prepared NWT SARC status reports on the Northern Leopard Frog (*Lithobates pipiens*) (2013), Western Toad (2014) and Wolverine (2014). Since leaving the Yukon government in 1996, Mr. Slough has conducted environmental assessments, protected areas research, and research on rare amphibians and mammals, including rodents, shrews and bats. He served two terms as a member of the Terrestrial Mammals Specialist Subcommittee of COSEWIC.

Dr. Brian J. Hearn is a former Wildlife Research Biologist with the Newfoundland and Labrador Wildlife Division. Between 1995 and 2012, he led several interagency research projects on Newfoundland Marten while working as a Research Ecologist for Natural Resources Canada – Canadian Forest Service. His PhD Dissertation in Wildlife Ecology from the University of Maine (2007) focused on the factors affecting habitat selection and population characteristics of American Marten in Newfoundland. He is past Co-Chair of the Newfoundland Marten Recovery Team.

COLLECTIONS EXAMINED

No collections were examined for the preparation of this report.

Appendix 1. Threats Calculator for American Marten.

THREATS ASSESSMENT WORKSHEET			
Species or Ecosystem Scientific Name	Newfoundland Population - American Marten		
Element ID		**Elcode**	
Date:	16/07/2021		
Assessor(s):	Jenny Heron (facilitator), Chris Johnson, Brian Hearn, Jessica Humber, Amit Saini, Angèle Cyr, Fannie Pelletier, Elizabeth Gillis, Erin Baerwald, Thomas Calteau, Brian Hearn, Catherine Cullingham, Albrecht Schulte-Hostedde, Isabelle Ceillier, Darroch Whitaker, John Gosse, Praveen Jayarajan, Shelley Moores		
References:			
Overall Threat Impact Calculation Help:	**Level 1 Threat Impact Counts**		
Threat Impact		**high range**	**low range**
A	Very High	0	0
B	High	0	0
C	Medium	1	0
D	Low	1	2
Calculated Overall Threat Impact:		Medium	Low
Assigned Overall Threat Impact:	**CD = Medium - Low**		
Impact Adjustment Reasons:			
Overall Threat Comments	Some inherent ecological and biological limiting factors may influence the recovery of this population. In particular, NF Marten have a much larger homerange when compared to mainland American Marten. There are few data describing the underlying demographics, including fecundity, of this population.		

Threat		**Impact (calculated)**		**Scope (next 10 Yrs)**	**Severity (10 Yrs or 3 Gen.)**	**Timing**	**Comments**
1	Residential & commercial development						
1.1	Housing & urban areas						Not applicable.
1.2	Commercial & industrial areas						Not applicable.
1.3	Tourism & recreation areas						Not applicable/Unknown
2	Agriculture & aquaculture						
2.1	Annual & perennial non-timber crops						Not applicable.
2.2	Wood & pulp plantations						Not applicable.
2.3	Livestock farming & ranching						Not applicable.
2.4	Marine & freshwater aquaculture						Not applicable.
3	Energy production & mining		Negligible	Negligible (<1%)	Serious (31-70%)	Moderate (Possibly in the short term, < 10 yrs/3 gen)	

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
3.1	Oil & gas drilling						Not applicable.
3.2	Mining & quarrying		Negligible	Negligible (<1%)	Serious (31-70%)	Moderate (Possibly in the short term, < 10 yrs/3 gen)	One mine, Marathon Gold, is currently in the planning and permitting stage and found in habitat for marten.
3.3	Renewable energy						Not applicable.
4	Transportation & service corridors	D	Low	Small (1-10%)	–Moderate-Slight (1-30%)	High (Continuing)	
4.1	Roads & railroads	D	Low	Small (1-10%)	Moderate - Slight (1-30%)	High (Continuing)	Roads are a direct source of mortality for Marten. Although the total exposure of marten to roads and the probability of being struck by a vehicle is uncertain. Long-term, there is concern about a rerouting of a major highway with potential increase of the threat (> 10 years). Increased observations of road-killed Marten are likely a reflection of a recovering population. Indirectly, roads provide access to trapping and snaring activities (reported in 5.1).
4.2	Utility & service lines	D	Low	Small (1-10%)	Slight (1-10%)	Moderate - Low	Electrical transmission lines represent a loss of habitat as the rights-of-way are regularly cleared of shrubs and trees. However, those transmission lines are in place (past effect) and occur over a relatively small area of marten range. As mining and other developments increase so does the need for power and these will continue to go across the landscape.
4.3	Shipping lanes						Not applicable.
4.4	Flight paths						Not applicable.
5	Biological resource use	CD	Medium - Low	Large (31-70%)	Moderate - Slight (1-30%)	High (Continuing)	
5.1	Hunting & collecting terrestrial animals	CD	Medium - Low	Large (31-70%)	Moderate - Slight (1-30%)	High (Continuing)	Snares set for Snowshoe Hare and other furbearer species can result in significant mortality for Marten (Forsey *et al*. 1995; Hearn 2007). However, trapping effort has decreased, a new snare is less lethal to Marten, and changes in harvest regulation have reduced incidental trapping of Marten. Nonetheless, this is still a relatively widespread, significant, and continuing threat for this population of Marten.
5.2	Gathering terrestrial plants						Not applicable.

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
5.3	Logging & wood harvesting	D	Low	Large - Restricted (11-70%)	Slight (1-10%)	High (Continuing)	Forest harvesting results in a reduction in old forest, a forest type that was thought to be an essential component of marten habitat. However, recent research suggests that marten can use younger forest types, including regenerating stands (Hearn *et al*. 2010). Since the last status assessment there has been a reduction in the rate of forest harvest associated with the closure of two pulp mills, but there is still harvest for saw logs. Relative to trapping and snaring (T5.1) this is thought to be a lesser threat.
5.4	Fishing & harvesting aquatic resources						Not applicable.
6	Human intrusions & disturbance						
6.1	Recreational activities						Hunting is scored under 5.1
6.2	War, civil unrest & military exercises						Not applicable.
6.3	Work & other activities						Not applicable.
7	Natural system modifications		Unknown	Restricted - Small (1-30%)	Unknown	High (Continuing)	
7.1	Fire & fire suppression						Most fires in Newfoundland are relatively small in area leading to negligible impact for Marten and habitat. Fire suppression could influence the long-term forest dynamics, but the implications are not known.
7.2	Dams & water management/use						Not applicable/Unknown
7.3	Other ecosystem modifications		Unknown	Restricted - Small (1-30%)	Unknown	High (Continuing)	Moose were introduced to Newfoundland at the start of the 20th Century. Since that time, they have become abundant with herbivory leading to changes in forested plant communities, but the extent to which that represents or affects marten habitat is unclear. Alternatively, moose can serve as a source of carion for Marten leading to a possible benefit for the Population. The implications of intensive herbivory for marten habitat are not clear, but this is not thought to be a severe threat. Insect outbreaks, such as Spruce Budworm, and suppression of those outbreaks could influence the structure and age class of forests with implications for marten habitat. Some evidence suggests that insect-killed stands are a benefit to marten (i.e., highly selected), but the total area of such disturbance is relatively small.

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
8	Invasive & other problematic species & genes		Not a Threat	Pervasive (71-100%)	Neutral or Potential Benefit	High (Continuing)	
8.1	Invasive non-native/alien species/diseases		Not a Threat	Pervasive (71-100%)	Neutral or Potential Benefit	High (Continuing)	Southern Red-backed Vole were recently introduced to Newfoundland. This small mammal is now an important prey species for marten. However, Southern Red-backed Vole could have long-term implications for the plant-animal communities that marten inhabit (e.g., reduction in distribution and abundance of Meadow Vole). There is thought to be a net benefit to marten of this abundant, novel prey.
8.2	Problematic native species/diseases						Canine distemper is known to occur in marten and a recorded source of mortality. Although there is some uncertainty, this is not thought to be a widespread or a significant source of mortality or morbidity for marten.
8.3	Introduced genetic material						Not applicable.
8.4	Problematic species/diseases of unknown origin						Not applicable/Unknown
8.5	Viral/prion-induced diseases		Unknown	Small (1-10%)	Unknown	High (Continuing)	Introduced mink are known to carry Aleutian mink disease that can be transmitted to marten (Canuti *et al.* 2020). Currently, the disease is not known to be widespread or a significant source of mortality or morbidity for marten. There is some concern about the possible spread of COVID-19 from mink to marten.
8.6	Diseases of unknown cause						Not applicable/Unknown
9	Pollution						
9.1	Domestic & urban waste water						Not applicable.
9.2	Industrial & military effluents						Not applicable.
9.3	Agricultural & forestry effluents						Not applicable.
9.4	Garbage & solid waste						Not applicable.
9.5	Air-borne pollutants						Not applicable.
9.6	Excess energy						Not applicable.
10	Geological events						
10.1	Volcanoes						Not applicable.
10.2	Earthquakes/tsunamis						Not applicable.
10.3	Avalanches/landslides						Not applicable.

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
11	Climate change & severe weather						Climate change will likely have long-term implications for the distribution of plant communities and marten habitat across Newfoundland. Those changes would result from shifting bioclimatic conditions, increased wild fire, and more frequent and extreme storm events leading to flooding and wind-related forest damage. However, there is no evidence to suggest that climate change will be a substantive direct threat to marten or their habitat over the next 10 years. There are likely future threats associated with climate change with particular concern with "Habitat shifting and alteration" and "Storms and flooding".
11.1	Habitat shifting & alteration						Unknown, but a consideration for future threats assessment.
11.2	Droughts						Unknown
11.3	Temperature extremes						Unknown
11.4	Storms & flooding						Unknown, but a consideration for future threats assessment.
11.5	Other impacts						Unknown
Classification of Threats adopted from IUCN-CMP, Salafsky *et al*. (2008).							