



Appendix D4: Mammals Baseline Study

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List of Acronyms and Abbreviations

AC CDC	Atlantic Canada Conservation Data Centre
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
ELC	Ecological Land Classification
GIS	Geographic Information System
HGP	Hydrogen Generation Plant
HP	Hydrogenation Plant
ID	identification
IUCN	International Union for Conservation of Nature
km	kilometre
km ²	square kilometre
kV	kilovolts
LAA	Local Assessment Area
LOHC	Liquid Organic Hydrogen Carrier
m	meters
MET Tower	Meteorological tower
MW	megawatts
NL	Newfoundland and Labrador
NL ESA	Endangered Species Act (Newfoundland and Labrador)
NL FFA	Newfoundland and Labrador Department of Fisheries, Forestry, and Agriculture
NL WD	Newfoundland and Labrador Wildlife Division
North Atlantic	North Atlantic Refining Corp.
PA	Project Area
RAA	Regional Assessment Area
SAR	Species at Risk
SARA	Species at Risk Act (Federal)
SCC	Species of Conservation Concern
spp.	species
the Project	North Atlantic Wind to Hydrogen Project
UTM	Universal Transverse Mercator

1.0 Introduction

North Atlantic Refining Corp. (North Atlantic) is proposing to undertake the development of a Wind to Hydrogen project (the Project) on the Isthmus of Avalon Region in Newfoundland and Labrador (NL). This Project will entail the development, construction, operation and eventual decommissioning of a 324-megawatt (MW) Wind Farm consisting of 45 wind turbines on an undeveloped peninsula situated between Sunnyside and Deer Harbour. The Wind Farm will provide renewable electricity via a 138 kilovolt (kV) transmission line to a newly developed Hydrogen Generation Plant (HGP), from where generated hydrogen will be transported to a Hydrogenation Plant (HP) for transformation into a Liquid Organic Hydrogen Carrier (LOHC), which will then be shipped from North Atlantic's port facilities to international markets for use in various decarbonization technologies.

In support of the Project, North Atlantic has undertaken environmental baseline studies throughout the Project Area (PA). The Mammals Baseline Study included generalized, opportunistic observations throughout terrestrial field surveys as well as species-specific surveys for the Newfoundland marten (*Martes americana atrata*) and muskrat (*Ondatra zibethicus obscurus*). Additionally, mammal studies were expanded to include portions of the Local Assessment Area (LAA) and Regional Assessment Area (RAA). It is important to understand the ecology of the network of connected habitats near the PA to understand the potential for the presence of various mammal species. Some mammals are known to have wide ranges of movement seasonally or on a smaller temporal scale (e.g., food acquisition, breeding). For example, moose (*Alces alces*) often range large distances, and coyote (*Canis latrans* x *Canis lycaon*) have been observed occupying up to 300 km² home ranges (Huang *et al.*, 2021).

Mammals from the orders Artiodactyl (split-hoofed, such as caribou and moose), Carnivora (carnivores such as foxes, coyotes, and otters), Rodentia (rodents such as beavers and voles), Insectivora (insect-eaters such as shrews), and Lagomorpha (hare forms such as rabbits and hares) were all considered during the baseline studies. Note that the order Chiroptera (bats) are the subject of a bat-specific baseline study (Appendix D2) and will not be discussed in this report. The mammal data obtained in all areas of interest (i.e., PA, LAA, and RAA) is discussed in this report.

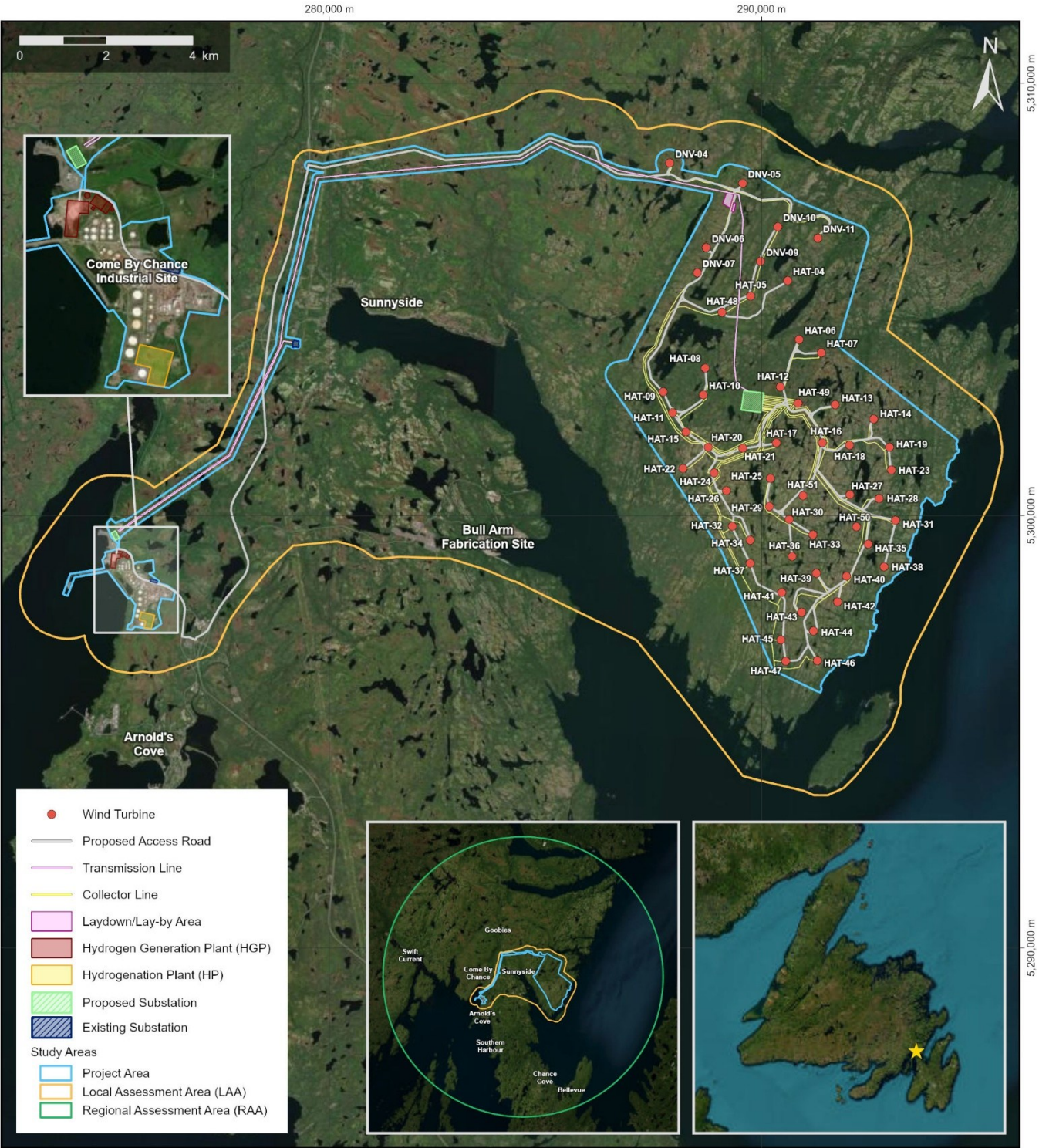


	FIGURE TITLE: Project Location Overview	NOTES: The location of proposed project infrastructure is considered preliminary and is subject to change.	PREPARED BY: C. Burke	DATE: 10/07/2025
	PROJECT TITLE: North Atlantic Wind to Hydrogen Project		REVIEWED BY: C. Bursey 10/07/2025	
			APPROVED BY: C. Collins 10/07/2025	
			CRS: WGS 1984 UTM Zone 22N	
			SEM MAP ID: 016-015-GIS-001-Rev0	

Figure D4-1.0-1 Project location and preliminary infrastructure layout.

2.0 Methods

2.1 Desktop Study

A comprehensive desktop review was conducted to confirm the mammal species known to occur in the PA/LAA/RAA. This desktop study included a literature review of relevant material, like scientific articles, government reports and management plans, and open-source databases like iNaturalist. A review was also conducted of the SAR and Species of Conservation Concern (SCC) for the PA through an Atlantic Canada Conservation Data Centre (AC CDC) request. This request was made for the entire PA with a 5 km buffer which also included the LAA and part of the RAA. In addition to SAR and SCC, the Newfoundland muskrat was researched as the NL Wildlife Division (NL WD) requested a study program for this species.

2.2 Field Surveys

2.2.1 General Mammal Surveys

General mammal surveys were conducted concurrently (opportunistically) with other terrestrial field surveys. This approach enabled a large amount of coverage across a variety of habitat types. Various forms of mammal sign were noted while walking throughout the PA, including visual and auditory observations, tracks, food caches, fur, kill sites (predators), scat, and browse. Tracks were especially visible during winter surveys when the ground was snow-covered. Where possible, the number of individuals in an area could be determined based on the number of tracks in an area at the same time. This allowed for insight into species abundance.

Two trail cameras were deployed in areas of interest to supplement the mammal data. The first camera was deployed in the RAA (47.672497, -53.825632) from December 18, 2023, until January 8, 2024. The team deployed an Apeman H55 trail camera, which records in 1080P and uses no-glow LEDs for night vision. This area was selected because the field team consistently observed fresh tracks in the snow of an American river otter (*Lontra canadensis*). The camera was positioned 0.6 m off the ground on a large balsam fir tree. It was positioned to focus directly on where the tracks of the otter had been observed.

The second camera was deployed in the PA (47.876898, -53.780624) on January 24, 2025, and collected on February 6, 2025. This camera was a Reconyx Hyper Fire 2 which also operates in 1080P and uses no-glow high output covert infrared for night vision. This camera was positioned approximately 1.3 m from the ground and pointed directly at the marten trap SS Mart 2. This orientation would allow for a visual of any animals that were lured to the marten trap.

2.2.2 Newfoundland Marten Surveys

Species-specific surveys for the Newfoundland marten were undertaken following consultation with NL WD. Surveyors adopted hair snag survey protocol provided by the NL WD (attached as Appendix D4-3) to detect the presence of Newfoundland marten in the PA. Hair snag traps are used to attain hair samples, which are then sent for genetic analysis in a laboratory to identify samples to species. Genetic analysis can also confirm the number of individuals in a given area based on microsatellite markers (Herdman, 2014).

Ten (10) hair snag traps were deployed for three weeks from January 17, 2025 (deployment date) to February 6, 2025 (retrieval date), with checks and sticky pad/bait renewal conducted January 24, 2025, and January 31, 2025. All samples of hair snags were collected using pliers to remove staples and sticky pads, placing segments of flagging tape over the sticky portion, and placing the samples into small envelopes labelled with the specific trap ID and retrieval date.

Trap Construction

Marten hair snag traps were constructed in following with protocol and build plans provided by NL WD, using examples from work completed in British Columbia (Mowat & Paetkau, 2002). Biologists built ten (10) triangular prism-shaped traps using three (3) wooden boards (1x6 inch) cut at specific measurements (i.e., one longer bottom board and two top triangle pieces), joined with 12-gauge wire for easy transport and setup (Herdman, 2014). The wire was inserted into holes strategically drilled into the wood so that the boards could fold as if on hinges, and a wire was used to shut the triangle shape when complete. The middle board was used to secure the trap to a large softwood tree using double-headed nails or screws for stability, using the middle board as the attachment point so that the top and bottom boards could be opened and closed without removing the trap from the tree. Along the bottom board (horizontal when set), a tin of sardines was stapled as bait. Sticky pads (cut from commercial glue boards) were stapled to segments of the trap on the two shorter angled board segments above the bait so that a marten feeding on the bait would brush against them and snag some of its fur. Anise oil was used as a lure and placed nearby the trap to attract marten. Photos of each marten trap are available in Appendix D4-1.

Trap Locations



Marten traps were positioned in suitable habitat (i.e., mature coniferous and/or mixedwood forest) and spaced according to known marten home ranges (Herdman, 2014). The median home range of adult female marten is thought to be 8 km², roughly half the size of the adult male home range (Hearn & Durocher, 2023). Marten home range information was used to create blocks of suitable habitat in the PA. Marten traps were then set to effectively cover overlapping home ranges and therefore detect the presence/absence of adult martens using these habitats. Based on the NL WD protocol, marten home

range information, and data on the composition of suitable habitat in the PA, it was determined that ten (10) traps were to be deployed at 1 km distances throughout selected habitat. Locations were chosen based on ground-truthing surveys and aerial imagery, and GIS data was used to space and plot the trap sites. Marten trap locations and habitat type information are provided in Table D4-2.2-1. Trap locations are illustrated in Figure D4-2.2-1. Data sheets and photographs for each marten trap are available as Appendix D4-1.

Table D4-2.2-1 Marten trap location and habitat type.

Trap ID	UTM Coordinates (Zone 22 T)	Habitat Type
SS Mart 1	285405.15 m E 5308687.97 m N	Balsam Fir Sphagnum
SS Mart 2	292103.26 m E 5306354.85 m N	Balsam Fir Feathermoss (near mature Mixedwood valley)
SS Mart 3	290095.52 m E 5304111.40 m N	Balsam Fir Feathermoss (Lake Riparian)
SS Mart 4	293311.37 m E 5301711.54 m N	Black Spruce Feathermoss
SS Mart 5	291346.31 m E 5296949.79 m N	Balsam Fir - Black Spruce Scrub
SS Mart 6	288161.08 m E 5303541.52 m N	Open Coniferous Forest
SS Mart 7	289020.58 m E 5307727.78 m N	Balsam Fir Feathermoss
SS Mart 8	289254.60 m E 5302946.57 m N	Balsam Fir Feathermoss
SS Mart 9	292452.97 m E 5298750.20 m N	Balsam Fir Feathermoss
SS Mart 10	291170.56 m E 5304174.92 m N	Open Coniferous (Balsam Fir Kalmia)
Notes All marten traps were placed within the Mature Coniferous Forest ecotype, with the exception of SS Mart 5, which was placed within Coniferous Scrub.		



	FIGURE TITLE:	NOTES:	PREPARED BY:	DATE:
	Marten Hair Snag Trap Locations in the Project Area		C. Burke	06/06/2025
	PROJECT TITLE:		REVIEWED BY:	C. Bursey 06/06/2025
	North Atlantic Wind to Hydrogen Project		APPROVED BY:	C. Collins 06/06/2025
			CRS:	WGS 1984 UTM Zone 22N
				

SEM MAP ID: 016-015-GIS-401-Rev0

Figure D4-2.2-1 Marten hair snag trap locations in the PA.

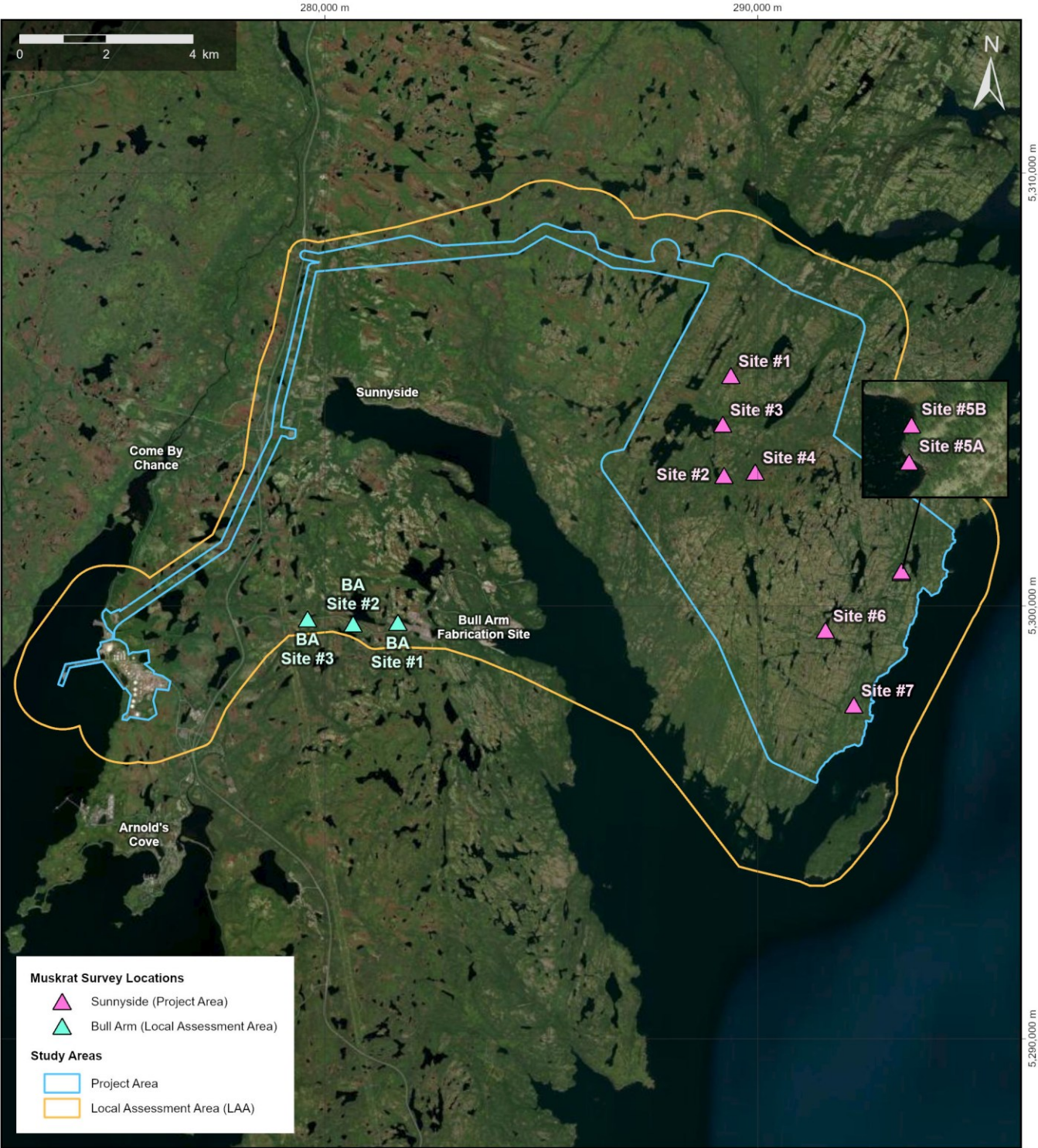
2.2.3 Muskrat Surveys

Species-specific muskrat surveys were undertaken throughout the PA, in accordance with survey protocols provided by NL WD (attached as Appendix D4-4). Surveys are to be conducted in wetlands where open water exists, as well as in riverine and lacustrine environments that provide suitable habitat for some part of the muskrat life cycle. Of particular interest are areas where dense aquatic vegetation occurs such as water horsetail (*Equisetum fluviatile*), which is known to be preferred for building houses, lining burrows, and seemingly to protect against predators (Soper, 1995). North American cattail (*Typha latifolia*) is also known to be important to muskrat.

GIS specialists used aerial imagery and survey data from Ecological Land Classification (ELC) efforts (see Appendix D3: ELC) to identify potential muskrat habitat in the PA and around the Bull Arm site within the LAA. Wetlands with visible water, or waterbodies and streams with slow-moving water and aquatic vegetation in shallow zones were deemed suitable. The northwest and southeast zones of the PA have deep valleys with numerous shallow bays, and in the central portion of the PA, elevated rocky barren terrain is dominant with sparse forested valleys between ridges. In these areas, wetlands often exist in bowl-shaped depressions in the rock terrain. These habitats contrast those in the valleys, with less diversity and forage potential. However, the wetlands in these areas, especially when connected to forested valleys or running water, were found to have visible mammal tracks and passages, hypothesized to be muskrat and/or otter. Several of these wetlands with existing mammal sign were selected for muskrat surveys. The following criteria were used to identify suitable habitat:

- 50 to 80% emergent vegetation;
- Vegetated shoreline within 10 m of a waterbody or watercourse;
- Stable seasonal water depth of 0.5 to 1.5 m (assumed and later field validated);
- Slow moving and/or standing water; and
- Burrow potential (i.e., clay content, not too rocky, slope $\geq 10^\circ$, minimum height of 0.2 m).

As per the protocol, surveys were conducted between September 1, 2025 and November 1, 2025, capitalizing on the temporal window with the highest muskrat abundance annually and elevated sign detectability. Survey locations were selected from the results of the GIS analysis along with previous habitat observations. Surveyors collected data according to the datasheets provided by NL WD, using multiple sampling locations within each site where applicable (e.g., one pond with several smaller survey transects in suitable habitat zones). Surveyors identified muskrat sign at each potential site, including scat, clippings, burrows, trails, tracks, feed beds, and houses. The total distance surveyed and amount of sign identified correlates to a rating of sign/100 m, illustrating the density of sign and likelihood of muskrat inhabitation. Figure D4-2.2-2 illustrates the locations of the muskrat surveys.





	FIGURE TITLE:	NOTES:	PREPARED BY:	DATE:
	Muskrat Survey Locations in the Project Area and Local Assessment Area		C. Burke	06/06/2025
	PROJECT TITLE:		REVIEWED BY:	C. Bursley 06/06/2025
			APPROVED BY:	C. Collins 06/06/2025
			CRS:	WGS 1984 UTM Zone 22N
				
North Atlantic Wind to Hydrogen Project				

Figure D4-2.2-2 Muskrat survey locations in the PA and LAA.

3.0 Results

3.1 Desktop Study

The PA, LAA, and RAA are part of the Maritime Barrens ecoregion. This ecoregion hosts a variety of terrestrial mammals, including both native and introduced species. The PA/LAA/RAA is assumed to host species associated with the Maritime Barrens, listed below in Table D4-3.1-1. Additional terrestrial mammals possible for these areas are also included in the table.

Table D4-3.1-1 Terrestrial mammals known for the Maritime Barrens ecoregion.

Native Terrestrial Mammals		Non-native/Introduced Terrestrial Mammals	
Scientific Name	Common Name	Scientific Name	Common Name
<i>Vulpes vulpes</i>	Red fox	<i>Mustela vison</i>	Mink
<i>Mustela richardsonii</i>	Short-tailed weasel	<i>Tamiasciurus hudsonicus</i>	Red squirrel
<i>Microtus pennsylvanicus</i>	Meadow vole	<i>Lepus americanus</i>	Snowshoe hare
<i>Ursus americanus</i>	Black bear	<i>Alces alces</i>	Moose
<i>Lynx canadensis</i>	Canada lynx	<i>Sorex cinereus</i>	Masked shrew
<i>Castor canadensis</i>	Beaver	<i>Tamias striatus</i>	Eastern chipmunk
<i>Ondatra zibethicus obscurus</i>	Muskrat	<i>Rattus norvegicus</i>	Norway rat
<i>Lontra canadensis</i>	River otter	<i>Myodes glareolus</i>	Bank vole
<i>Martes americana atrata</i>	Newfoundland marten	<i>Peromyscus maniculatus</i>	Deer mouse
<i>Rangifer tarandus</i>	Caribou	<i>Myodes gapperi</i>	Red-backed vole
<i>Lepus arcticus</i>	Arctic hare	<i>Mus musculus</i>	House mouse
		<i>Canis latrans x Canis lycaon</i>	Coyote (range expansion)

3.1.1 Species at Risk

There are two terrestrial SAR mammals possible for insular Newfoundland. Only the Newfoundland marten is believed to be likely for the PA, based on historical data and habitat composition; however, there is a paucity of available survey data to inform this issue. A recent expansion of the known range of marten also necessitates survey effort in the PA. Although historical data does not indicate that caribou (*Rangifer tarandus*) are known for the area, it is possible that some individuals may use the area temporarily or as vagrants. Table D4-3.1-2 lists the conservation status of these species according to the Newfoundland and Labrador **Endangered Species Act** (NL ESA), the federal **Species at Risk Act** (SARA), and the International Union for Conservation of Nature (IUCN) Red List of Threatened Species (IUCN, 2024).

Table D4-3.1-2 Conservation status of mammal SAR in Newfoundland.

Common Name	Scientific Name	NL ESA	SARA	IUCN Red List
American marten (Newfoundland population)	<i>Martes americana atrata</i>	Vulnerable	Threatened	Least Concern*
Caribou (Newfoundland population)	<i>Rangifer tarandus</i>	Not Listed	Special Concern	Vulnerable
Newfoundland muskrat**	<i>Ondatra zibethicus obscurus</i>	Not Listed	Not Listed	Least Concern*
Notes *IUCN Red List status is for <i>Martes americana</i> and <i>Ondatra zibethicus</i> , not specific to subspecies. **Newfoundland muskrat was studied at the request of NL WD. This species is not yet considered to be at risk.				

The AC CDC data request returned zero (0) results for mammal SAR or SCC in the PA. Further information on the range and habitat use of the Newfoundland marten, muskrat, and caribou is provided below.

Newfoundland marten

The Newfoundland marten (*Martes americana atrata*) is a subspecies of the American marten (*Martes americana*) endemic to the island of Newfoundland (COSEWIC, 2022). The marten has recently been downlisted under both the NL ESA and SARA, as new data demonstrates increased territory expansion (COSEWIC, 2022). Marten populations started declining in the early 1900s as a result of deforestation and overexploitation (Hearn & Durocher, 2023). A provincial trapping ban for this species has been in effect since 1934, and ample research has since been undertaken to understand its habitat use (Hearn & Durocher, 2023). Positive trends in Newfoundland marten populations have led to a wider use of traditional habitats across the island, and a new occupancy model has recently been developed to reflect this (Hearn & Durocher, 2023). Within this new model, the PA is projected to have a 10.47 to 60% chance of marten occupancy, with one observation listed north of the PA near Long Beach (Hearn & Durocher, 2023). The Newfoundland marten typically inhabits mature coniferous and mixedwood forest but has been known to use regenerating forest stands after anthropogenic activity, clear-cutting, or natural deforestation events (Snyder & Bissonette, 1987). The marten is an opportunistic hunter, typically preying on smaller mammals and insects or berries when available (COSEWIC, 2022).

Newfoundland muskrat

The Newfoundland muskrat (*Ondatra zibethicus obscurus*) is a distinct subspecies of muskrat native to the island of Newfoundland (Rigby & Threlfall, 1982; Willner et al., 1980). It is a semi-aquatic rodent that prefers wetlands and certain riverine and lacustrine environments for its habitat (Laurence et al., 2011). The Newfoundland muskrat lives in burrows (or houses) of its own construction near small water bodies, streams, and rivers, often with underwater access (Willner et al., 1980; Nadeau et al., 1995). Muskrats are generally solitary, and are highly territorial during breeding season (Marinelli & Messier, 1992).

Newfoundland muskrat populations were drastically reduced following the introduction of the mink (*Mustela vison*) to the island of Newfoundland as escapees from fur farms in 1934 (Northcott et al., 1974; Soper & Payne, 1997; NL FFA, n.d.). However, in recent years muskrat populations are thought to be recovering (NL FFA, n.d.). Potential natural adaptation to mink predation may have allowed the muskrat to become less susceptible to predation or more successful at evasion (NL FFA, n.d.).

Caribou

Caribou are a culturally important ungulate (hoofed mammal) belonging to the deer family. Caribou exist across the island of Newfoundland as part of both natural and introduced subpopulations (COSEWIC, 2014). The caribou population in NL has been steadily declining over the past three decades, having been reduced from approximately 94,000 individuals in the mid 1990s to approximately 27,000 in 2021 (COSEWIC, 2014; Government of NL, 2024). Known natural subpopulations of caribou do not exist along the Isthmus of Avalon; however, sub-populations relocated from elsewhere in the 1990s likely spillover into the area as they move across the landscape (COSEWIC, 2014). The closest introduction site is Random Island, but Bay De Verde and Sound Island may provide the PA and especially the RAA vagrant or migrating caribou throughout the year. Caribou are herbivorous, with a diet that largely consists of terrestrial lichens supplemented with leaves, grasses, and shrubs (COSEWIC, 2014). Caribou in Newfoundland are known to use a variety of habitats, including coniferous forest, barrens, shrublands, and wetlands (COSEWIC, 2014).

3.2 Field Surveys

This section presents results from mammal surveys undertaken throughout the PA, LAA, and RAA. Results are presented by survey type and separated between the PA and LAA/RAA. Datasheets for the Newfoundland marten and muskrat surveys are available as Appendix D4-1 and Appendix D4-2.

3.2.1 General Mammal Surveys

During terrestrial field effort in the PA, LAA, and RAA, surveyors noted mammal observations on an opportunistic basis. This included visual and auditory observations, as well as the identification of mammal sign (e.g., tracks, scat). Specific mammal surveys for the Newfoundland marten and muskrat are discussed in Sections 3.2.2 and 3.2.3 respectively.

3.2.1.1 Project Area

General mammal surveys undertaken within the PA resulted in the observation of 13 different mammal species, with further differentiation possible between voles. Vole species could not be determined from tracks – it is likely that more than one species of vole exist in the PA. Voles observed were thus recorded

as Vole spp. The game camera set up in the PA did not capture footage of any mammal species. The species observed are listed in Table D4-3.2-1.

Table D4-3.2-1 Mammal observations in the PA, 2024.

Common Name	Scientific Name	Observation Types
Moose	<i>Alces alces</i>	Visual observation, tracks, Rut pit and other rut sign, antler scrapes, scat, game trail, browse, shed antlers
Red squirrel	<i>Tamiasciurus hudsonicus</i>	Visual observation, tracks, call, scat, cache, nests
Snowshoe hare	<i>Lepus americanus</i>	Visual observation, tracks, game trail, scat, browse
Coyote	<i>Canis latrans x Canis lycaon</i>	Tracks, kill site, game trail
Canada lynx	<i>Lynx canadensis</i>	Tracks
Masked shrew	<i>Sorex cinereus</i>	Visual observation, tracks, scat
Short-tailed weasel	<i>Mustela richardsonii</i>	Tracks, hair snags
Beaver	<i>Castor canadensis</i>	Visual observation, tracks, cache, dams, lodges, game trail, chews, downed trees
Vole spp.*	<i>Microtus pennsylvanicus</i> , <i>Clethrionomys gapperi</i>	Tracks, game trail (tunnels)
Red fox	<i>Vulpes vulpes</i>	Tracks, scat, kill site
Black bear	<i>Ursus americanus</i>	Visual observation, tracks, scat
Muskrat	<i>Ondatra zibethicus obscurus</i>	Cache, burrows, houses, chews/browse, game trails
River otter	<i>Lontra canadensis</i>	Tracks, burrow/trails
Notes *Vole spp. could not be identified to species based on tracks but is likely either <i>Microtus pennsylvanicus</i> or <i>Clethrionomys gapperi</i> .		

Ungulates in the PA

Biologists often observed upwards of ten (10) moose in a single day while flying over the PA in helicopter. Several large bulls were observed occupying territory in the PA, and four with 15 to 20+ points on their antlers were observed during the rutting season (September to October) as they searched for cows. One very large bull with large paddle antlers was observed with several cow moose in the upland sites of the PA near the MET Tower during the rut. This bull was also observed in the southern extent of the PA toward Bull Arm later in the fall. Most moose observations were made within the late afternoon into the evening as they moved in the open habitats of the PA. Several moose were observed resting within forested areas during the day. No caribou were observed in the PA, despite extensive helicopter coverage during terrestrial surveys undertaken throughout the calendar year.

3.2.1.2 Local and Regional Assessment Area

Opportunistic mammal observations were made within the LAA and RAA during other terrestrial surveys. This resulted in the observation of 13 different mammal species, with possible differentiation between voles, as noted for the PA. The species observed are listed in Table D4-3.2-2.

Table D4-3.2-2 Mammal observations in the LAA/RAA, 2024.

Common Name	Scientific Name	Observation Types
Moose	<i>Alces alces</i>	Visual observation, tracks, rut pit and other rut sign, antler scrapes, scat, game trail, browse, shed antlers
Red squirrel	<i>Tamiasciurus hudsonicus</i>	Visual observation, tracks, call, scat, cache, nests
Snowshoe hare	<i>Lepus americanus</i>	Visual observation, tracks, game trail, scat, browse
Coyote	<i>Canis latrans x Canis lycaon</i>	Tracks, kill site, game trail
Canada lynx	<i>Lynx canadensis</i>	Tracks
Masked shrew	<i>Sorex cinereus</i>	Visual observation, tracks, scat
Short-tailed weasel	<i>Mustela richardsonii</i>	Tracks, hair snags
Beaver	<i>Castor canadensis</i>	Visual observation, tracks, cache, dams, lodges, game trail, chews, downed trees
Vole spp.*	<i>Microtus pennsylvanicus</i> , <i>Clethrionomys gapperi</i>	Tracks, game trail (tunnels)
Red fox	<i>Vulpes vulpes</i>	Tracks, scat, kill site
Caribou	<i>Rangifer tarandus</i>	Visual observation (RAA near Come By Chance)
Muskrat	<i>Ondatra zibethicus obscurus</i>	Cache, burrows, houses, chews/browse, game trails
River otter	<i>Lontra canadensis</i>	Tracks, Burrows/trails, Visual (trail camera footage)
<u>Notes</u> *Vole spp. could not be identified to species based on tracks but is likely either <i>Microtus pennsylvanicus</i> or <i>Clethrionomys gapperi</i> .		

Game Camera

A game camera placed near a suspected otter habitat in the Chance Cove area of the RAA yielded video footage of at least one adult river otter (see Figure D4-3.2-1).



Figure D4-3.2-1 River otter in Chance Cove, RAA, winter 2024.

Ungulates in the LAA and RAA

Several bull moose and cows were observed calling during the rut in the Bull Arm area of the LAA. Two (2) bull moose were observed during the rut in October along the road in the Bull Arm site. Both bulls were calling for females. One bull nearer to the gate of the site was with a female which was responding to the calls of the bull.

A single stag caribou was observed feeding in the upland scrub in the RAA north of the North Atlantic Industrial Site (Figure D4-3.2-2). Nearby a cow and calf moose grazed in a similar area. Helicopter surveys while travelling from the site in the late afternoon did not result in any additional observations of caribou.



Figure D4-3.2-2 Adult caribou, RAA, 2025.

3.2.2 Newfoundland Marten Surveys

All marten traps were placed in mature coniferous forest within the PA. Trap check dates and results are presented in Table D4-3.2-3. No marten hair snags were obtained during the survey, however short-tailed weasel (*Mustela erminea*) were recorded through hair snags and tracks. Masked shrew was recorded with visual observations and droppings within the traps.

Table D4-3.2-3 Marten hair snag trap results.

Trap ID	Check 1	Check 2	Retrieval	Species Sampled
SS Mart 1	24-Jan-25	31-Jan-25	06-Feb-25	Short-tailed weasel
SS Mart 2	24-Jan-25	31-Jan-25	06-Feb-25	-
SS Mart 3	24-Jan-25	31-Jan-25	06-Feb-25	-
SS Mart 4	24-Jan-25	31-Jan-25	06-Feb-25	Short-tailed weasel
SS Mart 5	24-Jan-25	31-Jan-25	06-Feb-25	Short-tailed weasel
SS Mart 6	24-Jan-25	31-Jan-25	06-Feb-25	-
SS Mart 7	24-Jan-25	31-Jan-25	06-Feb-25	-
SS Mart 8	24-Jan-25	31-Jan-25	06-Feb-25	Short-tailed weasel
SS Mart 9	24-Jan-25	31-Jan-25	06-Feb-25	Short-tailed weasel
SS Mart 10	24-Jan-25	31-Jan-25	06-Feb-25	-
Notes Dates highlighted in green indicate that hair samples were collected.				

3.2.3 Newfoundland Muskrat Surveys

Muskrat surveys were conducted in both the PA and the Bull Arm site of the LAA. While several areas of suitable and active habitat were identified, no muskrat were visually observed. Findings are outlined below, and survey tracks are presented in Figure D4-3.2-4.

3.2.3.1 Project Area

Seven (7) sites were surveyed for muskrat in the PA during September and October 2024. The eastern portion of the PA contained several areas of highly suitable habitat and evidence of muskrat presence (sign) within large, forested valleys and associated wetlands. Observations of sign were scarcer in areas of higher elevation where suitable habitat was fragmented by upland dry sites, and the network of wetlands was interrupted more frequently. Table D4-3.2-4 presents an overview of the information obtained during the surveys. See Appendix D4-2 for complete datasheets with vegetation descriptions.

Table D4-3.2-4 Sunnyside muskrat survey data.

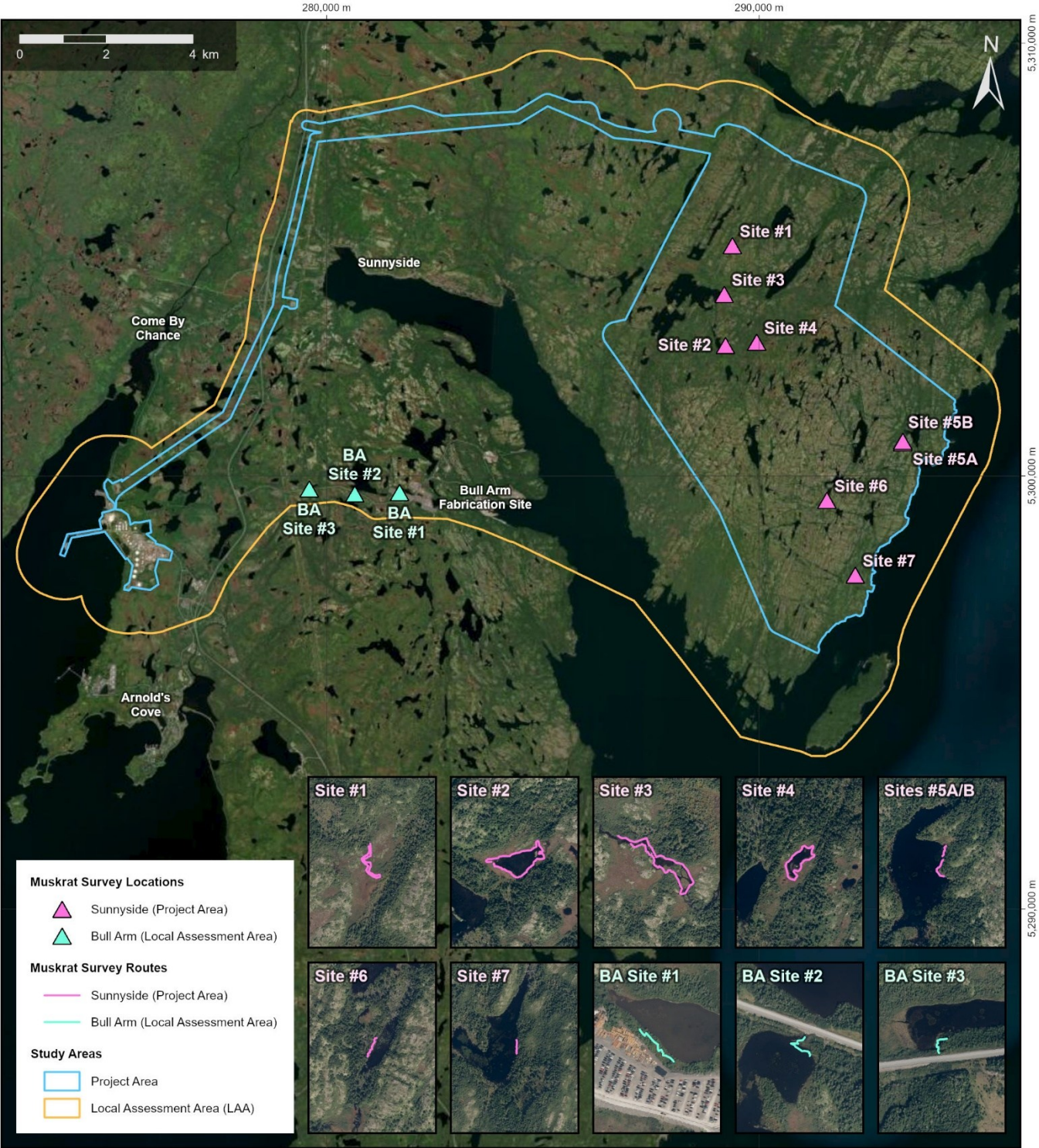
Site ID	Section ID	Section Length (m)	Habitat Type	Sign/100m	Average Water Depth
Site #1	A	172 m	Wetland - Fen	2.9	1 m
Site #2	A	273 m	Wetland - Fen	0.37	1.5 m
Site #3	A	363 m	Wetland - Fen	0.275	0.5 m
Site #4	A	191 m	Wetland - Fen	0	1 m
Site #5A	A	40 m	Marshy Pond	25	0.75 m
Site #5B	B	20 m	Marshy Pond	45	0.75 m
Site #6	A	40 m	Marshy Pond - Swamp	20	0.5 m
Site #7	A	20 m	Valley Shallow Pond	65	0.75 m



3.2.3.2 Local Assessment Area

Three (3) separate potential muskrat habitats were surveyed in Bull Arm in early October 2024. These were all marshy ponds. Table D4-3.2-5 presents general findings of the muskrat surveys in Bull Arm (also available in Appendix D4-2).

Table D4-3.2-5 Bull Arm muskrat survey data.

Site ID	Section	Section Length (m)	Habitat Type	Sign/100 m	Average Water Depth
BA Site #1	A	95.5 m	Marshy Pond	7.3	1 m
BA Site #2	A	76.5 m	Marshy Pond	14.4	1 m
BA Site #3	A	42.6 m	Marshy Pond	14.1	1 m



	FIGURE TITLE: Muskrat Survey Routes in the Project Area and Local Assessment Area	NOTES: Inset maps showing detailed survey routes are all displayed with a 1:10,000 map scale.	PREPARED BY: C. Burke	DATE: 06/06/2025
	PROJECT TITLE: North Atlantic Wind to Hydrogen Project		REVIEWED BY:	C. Bursley 06/06/2025
			APPROVED BY:	C. Collins 06/06/2025
			CRS:	WGS 1984 UTM Zone 22N
				

SEM MAP ID: 016-015-GIS-403-Rev0

Figure D4-3.2-4 Muskrat survey routes in the PA and LAA.

4.0 Discussion

Fourteen (14) mammal species were observed within the PA, LAA, and RAA. There is potential for a fifteenth with the possibility of small vole tracks belonging to another species besides meadow vole (e.g., red-backed vole).

Many of the mature forested valleys in the eastern portion of the PA meet the criteria as suitable habitat for marten. However, these habitats are fragmented by upland rocky and barren terrain and are not well-networked from east to west. In the west and northwest portions of the PA, several areas of mature forest connectivity exist, including forests towards Long Beach, where marten was once observed (Hearn & Durocher, 2023). The deep mature valleys near Deer Harbour Steady also connect via the sea level transition as Southwest Arm River meets Deer Harbour, and could provide suitable habitat for marten. The nature of the segregated valleys and limited mature forest makes the probability of marten occurrence here relatively lower than larger forest patches based on their preferred ranges; however, it also allows for strategically-placed hair snag traps to accurately assess the area as mature forest is limited to linear corridors (e.g., Deer Harbour Steady and Northwest Arm River Valley). This area was prioritized during hair snag surveys, but no evidence of marten habitation was observed.

Moose were observed throughout the PA using all habitat types, with a high frequency of sign detected throughout. Predators such as Canada lynx (*Lynx canadensis*) and coyote were observed quite often via tracks in the snow throughout the PA. Lynx were most often observed in the western portion of the PA during late fall and winter surveys. Coyote tracks were observed in the snow and scent marking was observed throughout.

River otter sign was observed in both the PA and RAA. During winter surveys in Chance Cove, an infrared trail camera was opportunistically deployed at an active otter site where tracks and burrow/trails were regularly observed. The camera footage revealed a single individual travelling through the area adjacent to a wetland (fen) with a shallow pool and outflow stream where it was presumably feeding. Along the access road to Chance Cove, surveyors also observed a recently deceased adult river otter. Nearby, various moose bones were observed, and coyote urine and tracks were observed surrounding the site of the dead otter and moose remnants. Several small mustelid tracks were observed in the Chance Cove area along a stream, presumably created by mink. However, it was not determined that this was mink based on the condition of the tracks after snow melt.

5.0 References

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Appendix D4-1: Marten Survey Data

SS Mart 1

Site ID	SS Mart 1	Deployment Date	January 17, 2025
Coordinates (UTM Zone 22 T)	285405.15 m E 5308687.97 m N	Retrieval Date	February 6, 2025
Surveyors	B. Meaney, C. Hearn	Notes	Situated in a balsam fir sphagnum forest

Check	Date	Hair Snag	Species
Check 1	January 24, 2025	N	-
Check 2	January 31, 2025	N	-
Retrieval	February 6, 2025	Y	Short-tailed weasel (<i>Mustela richardsonii</i>)



Figure 1 SS Mart 1 trap.

SS Mart 2

Site ID	SS Mart 2	Deployment Date	January 17, 2025
Coordinates (UTM Zone 22 T)	292103.26 m E 5306354.85 m N	Retrieval Date	February 6, 2025
Surveyors	B. Meaney, C. Hearn	Notes	Situated in a balsam fir feathermoss forest near a mature Mixedwood valley

Check	Date	Hair Snag	Species
Check 1	January 24, 2025	N	-
Check 2	January 31, 2025	N	-
Retrieval	February 6, 2025	N	-



Figure 1 SS Mart 2 trap.

SS Mart 3

Site ID	SS Mart 3	Deployment Date	January 17, 2025
Coordinates (UTM Zone 22 T)	290095.52 m E 5304111.40 m N	Retrieval Date	February 6, 2025
Surveyors	B. Meaney, C. Hearn	Notes	Situated in a balsam fir feathermoss forest adjacent to lake riparian habitat

Check	Date	Hair Snag	Species
Check 1	January 24, 2025	N	-
Check 2	January 31, 2025	N	-
Retrieval	February 6, 2025	N	-



Figure 1 SS Mart 3 trap.

SS Mart 4

Site ID	SS Mart 4	Deployment Date	January 17, 2025
Coordinates (UTM Zone 22 T)	293311.37 m E 5301711.54 m N	Retrieval Date	February 6, 2025
Surveyors	B. Meaney, C. Hearn	Notes	Situated in a black spruce feathermoss forest

Check	Date	Hair Snag	Species
Check 1	January 24, 2025	N	-
Check 2	January 31, 2025	Y	Short-tailed weasel (<i>Mustela richardsonii</i>)
Retrieval	February 6, 2025	Y	Short-tailed weasel (<i>Mustela richardsonii</i>)



Figure 1 SS Mart 4 trap.

SS Mart 5

Site ID	SS Mart 5	Deployment Date	January 17, 2025
Coordinates (UTM Zone 22 T)	291346.31 m E 5296949.79 m N	Retrieval Date	February 6, 2025
Surveyors	B. Meaney, C. Hearn	Notes	Situated in a balsam fir forest in black spruce scrub

Check	Date	Hair Snag	Species
Check 1	January 24, 2025	N	-
Check 2	January 31, 2025	N	-
Retrieval	February 6, 2025	Y	Short-tailed weasel (<i>Mustela richardsonii</i>)



Figure 1 SS Mart 5 trap.

SS Mart 6

Site ID	SS Mart 6	Deployment Date	January 17, 2025
Coordinates (UTM Zone 22 T)	288161.08 m E 5303541.52 m N	Retrieval Date	February 6, 2025
Surveyors	B. Meaney, C. Hearn	Notes	Situated in a patch of open coniferous forest

Check	Date	Hair Snag	Species
Check 1	January 24, 2025	N	-
Check 2	January 31, 2025	N	-
Retrieval	February 6, 2025	N	-



Figure 1 SS Mart 6 trap.

SS Mart 7

Site ID	SS Mart 7	Deployment Date	January 17, 2025
Coordinates (UTM Zone 22 T)	289020.58 m E 5307727.78 m N	Retrieval Date	February 6, 2025
Surveyors	B. Meaney, C. Hearn	Notes	Situated in a balsam fir feathermoss forest

Check	Date	Hair Snag	Species
Check 1	January 24, 2025	N	-
Check 2	January 31, 2025	N	-
Retrieval	February 6, 2025	N	-



Figure 1 SS Mart 7 trap.

SS Mart 8

Site ID	SS Mart 8	Deployment Date	January 17, 2025
Coordinates (UTM Zone 22 T)	289254.60 m E 5302946.57 m N	Retrieval Date	February 6, 2025
Surveyors	B. Meaney, C. Hearn	Notes	Situated in a balsam fir feathermoss forest

Check	Date	Hair Snag	Species
Check 1	January 24, 2025	Y	Short-tailed weasel (<i>Mustela richardsonii</i>)
Check 2	January 31, 2025	N	-
Retrieval	February 6, 2025	Y	Short-tailed weasel (<i>Mustela richardsonii</i>)



Figure 1 SS Mart 8 trap.

SS Mart 9

Site ID	SS Mart 9	Deployment Date	January 17, 2025
Coordinates (UTM Zone 22 T)	292452.97 m E 5298750.20 m N	Retrieval Date	February 6, 2025
Surveyors	B. Meaney, C. Hearn	Notes	Situated in a balsam fir feathermoss forest

Check	Date	Hair Snag	Species
Check 1	January 24, 2025	N	-
Check 2	January 31, 2025	N	-
Retrieval	February 6, 2025	Y	Short-tailed weasel (<i>Mustela richardsonii</i>)



Figure 1 SS Mart 9 trap.

SS Mart 10

Site ID	SS Mart 10	Deployment Date	January 17, 2025
Coordinates (UTM Zone 22 T)	291170.56 m E 5304174.92 m N	Retrieval Date	February 6, 2025
Surveyors	B. Meaney, C. Hearn	Notes	Situated in an open coniferous forest (balsam fir kalmia)

Check	Date	Hair Snag	Species
Check 1	January 24, 2025	N	-
Check 2	January 31, 2025	N	-
Retrieval	February 6, 2025	N	-



Figure 1 SS Mart 10 trap.

Appendix D4-2: Muskrat Survey Data

Datasheet – Site #1

Site #	1	Date	2024-09-26
Coordinates	47.866917, -53.816358	Surveyors	B. Meaney
Average Water Depth	1 m	Notes	A poor fen stream was followed down one side and up the other.

Plant Species	Abundance Scale
Sphagnum spp.	4
<i>Eriophorum vaginatum</i>	2
<i>Kalmia polifolia</i>	2
<i>Sparganium americanum</i>	3
<i>Myrica gale</i>	2
<i>Trichophorum cespitosum</i>	4
<i>Aronia melanocarpa</i>	5
<i>Juncus tweedyi</i>	+
<i>Juncus articulatus</i>	1
<i>Carex oligosperma</i>	3

Distance Surveyed (m)	Scats	Clippings	Burrows	Trails	Tracks	Feed Beds	Houses	Other	Sign/100 m
172	-	-	1	2	-	-	2	-	2.9

Photos – Site #1



Figure 1 Site map of Muskrat Site #1.



Figure 2 Habitat picture of Muskrat Site #1.

Datasheet – Site #2

Site #	2	Date	2024-09-26
Coordinates	47.846123, -53.817357	Surveyors	B. Meaney
Average Water Depth	1.5 m	Notes	The full border of a bog hole was surveyed

Plant Species	Abundance Scale
Sphagnum spp.	4
<i>Rhynchospora alba</i>	4
<i>Sarracenia purpurea</i>	+
<i>Carex utriculata</i>	2
<i>Trichophorum cespitosum</i>	2
<i>Kalmia angustifolia</i>	+
<i>Nuphar variegata</i>	2
<i>Rhododendron groenlandicum</i>	+
<i>Oclemena nemoralis</i>	+
<i>Empetrum nigrum</i>	2
<i>Vaccinium oxycoccos</i>	+
<i>Larix laricina</i>	+
<i>Menyanthes trifoliata</i>	+
<i>Eriocaulon aquaticum</i>	+

Distance Surveyed (m)	Scats	Clippings	Burrows	Trails	Tracks	Feed Beds	Houses	Other	Sign/100 m
273	-	1	-	-	-	-	-	-	0.37

Photos – Site #2



Figure 1 Site map of Muskrat Site #2.



Figure 2 Habitat picture of Muskrat Site #2.

Datasheet – Site #3

Site #	3	Date	2024-09-26
Coordinates	47.856736, -53.818320	Surveyors	B. Meaney
Average Water Depth	0.5 m	Notes	Stream and marsh area followed down one side and up the other.

Plant Species	Abundance Scale
<i>Potamogeton</i> spp.	4
<i>Myrica gale</i>	3
<i>Solidago uliginosa</i>	+
<i>Iris versicolor</i>	2
<i>Rosa nitida</i>	+
<i>Carex oligosperma</i>	2
<i>Carex echinata</i>	2
<i>Glyceria canadensis</i>	+
<i>Calamagrostis canadensis</i>	2
<i>Triadenum fraseri</i>	+
<i>Carex nigra</i>	2
<i>Juncus</i> spp.	+
<i>Utricularia intermedia</i>	+
<i>Eriocaulon aquaticum</i>	+
<i>Lobelia dortmanna</i>	+

Distance Surveyed (m)	Scats	Clippings	Burrows	Trails	Tracks	Feed Beds	Houses	Other	Sign/100 m
363	-	-	-	1	-	-	-	-	0.275

Photos – Site #3



Figure 1 Site map of Muskrat Site #3.



Figure 2 Habitat picture of Muskrat Site #3.

Datasheet – Site #4

Site #	4	Date	2024-09-26
Coordinates	47.847051, -53.807769	Surveyors	B. Meaney
Average Water Depth	1 m	Notes	Circumference of small waterbody surveyed

Plant Species	Abundance Scale
Sphagnum spp.	4
<i>Trichophorum cespitosum</i>	3
<i>Nuphar variegata</i>	2
<i>Carex oligosperma</i>	2
<i>Aronia melanocarpa</i>	+
<i>Rhynchospora alba</i>	2
<i>Chamaedaphne calyculata</i>	2
<i>Maianthemum trifolium</i>	+
<i>Ilex mucronata</i>	+
<i>Vaccinium oxycoccos</i>	+
<i>Myrica gale</i>	+
<i>Empetrum nigrum</i>	+
<i>Kalmia polifolia</i>	+
<i>Sarracenia purpurea</i>	+
<i>Glyceria canadensis</i>	+
<i>Menyanthes trifoliata</i>	+

[illegible]

Photos – Site #4



Figure 1 Site map of Muskrat Site #4.



Figure 2 Habitat picture of Muskrat Site #4.

Datasheet – Site #5A

Site #	5A	Date	2024-10-17
Coordinates	47.827289, -53.761591	Surveyors	C. Hearn
Average Water Depth	0.75 m	Notes	15 m NW of the coordinate

Plant Species	Abundance Scale
<i>Typha latifolia</i>	1
<i>Calamagrostis canadensis</i>	+
<i>Glyceria canadensis</i>	+
Carex spp.	2
Sparganium spp.	+
<i>Nuphar variegata</i>	2

Distance Surveyed (m)	Scats	Clippings	Burrows	Trails	Tracks	Feed Beds	Houses	Other	Sign/100m
40	-	2	3	3	-	-	1	1	25

Photos – Site #5A



Figure 1 Site map of Muskrat Site #5A.



Figure 2 Habitat picture of Muskrat Site #5A.

Datasheet – Site #5B

Site #	5B	Date	2024-10-17
Coordinates	47.827592, -53.761578	Surveyors	C. Hearn
Average Water Depth	0.75 m	Notes	Survey was 20 m north of the point

Plant Species	Abundance Scale
<i>Typha latifolia</i>	1
<i>Calamagrostis canadensis</i>	+
<i>Glyceria canadensis</i>	+
<i>Nuphar variegata</i>	+
Carex spp.	1
<i>Nuphar variegata</i>	+
<i>Juncus articulatus</i>	+

Distance Surveyed (m)	Scats	Clippings	Burrows	Trails	Tracks	Feed Beds	Houses	Other	Sign/100 m
20	-	1	3	3	-	1	-	1	45

Photos – Site #5B



Figure 1 Site map of Muskrat Site #5B.



Figure 2 Feed bed with associated burrow observed at Muskrat Site #5B.

Datasheet – Site #6

Site #	6	Date	2024-10-17
Coordinates	47.814761, -53.784327	Surveyors	C. Hearn
Average Water Depth	0.5 m	Notes	Survey was conducted along the edge of the waterbody from the coordinate 40 m south. Marshy Pond

Plant Species	Abundance Scale
Eriophorum spp.	+
<i>Chamaedaphne calyculata</i>	1
<i>Nuphar variegata</i>	2
<i>Menyanthes trifoliata</i>	+
Juncus spp,	+
<i>Gramminoids</i>	1

Distance Surveyed (m)	Scats	Clippings	Burrows	Trails	Tacks	Feed Beds	Houses	Other	Sign/100 m
40	-	-	3	4	-	-	-	1	20

Photos – Site #6



Figure 1 Site map of Muskrat Site #6.

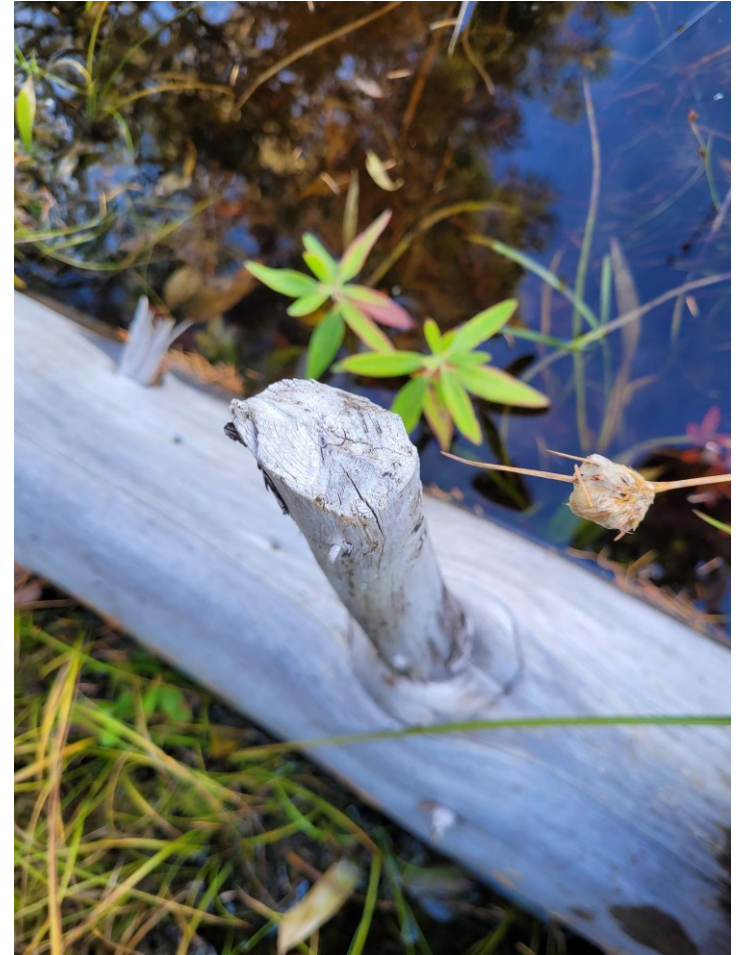


Figure 2 A chewed log (muskrat or beaver) observed at Muskrat Site #6.

Datasheet – Site #7

Site #	7	Date	17-Oct-24
Coordinates	47.799435, -53.774761	Surveyors	C. Hearn
Average Water Depth	0.75 m	Notes	Survey conducted from the coordinates to 20m south along the water body. Productive birch forest surrounded the water.

Plant Species	Abundance Scale
<i>Nymphaea odorata</i>	1
<i>Eriocaulon aquaticum</i>	+
<i>Sparganium angustifolium</i>	1
Potamogeton spp.	1
<i>Oclemena nemoralis</i>	1
Juncus spp.	+

Distance Surveyed (m)	Scats	Clippings	Burrows	Trails	Tracks	Feed Beds	Houses	Other	Sign/100 m
20	-	3	2	2	1	4	-	1	65

Photos – Site #7



Figure 1 Site map of Muskrat Site #7.



Figure 2 Habitat picture of Muskrat Site #7.

Datasheet – Bull Arm – Site #BA1

Site #	BA 1	Date	08-Oct-24
Coordinates	47.8130933545, -53.916228842	Surveyors	B. Meaney, C. Hearn
Average Water Depth	1.0 m	Notes	A marshy linear pond with inlet and outlet. The shoreline was dominated by woody shrubs.

Plant Species	Abundance Scale
<i>Viburnum nudum</i>	+
<i>Myrica gale</i>	3
<i>Chamaedaphne calyculata</i>	2
<i>Rhododendron groenlandicum</i>	2
<i>Juncus militaris</i>	2
<i>Sparganium angustifolium</i>	2
<i>Typha latifolia</i>	+
<i>Glyceria canadensis</i>	+
<i>Juniperus communis</i>	2
<i>Calamagrostis canadensis</i>	+
<i>Potamogeton natans</i>	+
<i>Symphyotrichum puniceum</i>	+
<i>Nuphar variegata</i>	+
<i>Iris versicolor</i>	+
<i>Carex echinata</i>	+
<i>Eleocharis palustris</i>	+
<i>Juncus effusus</i>	+
<i>Sparganium americanum</i>	+
<i>Galium palustre</i>	+

Distance Surveyed (m)	Scats	Clippings	Burrows	Trails	Tracks	Feed Beds	Houses	Other	Sign/100 m
95.5	-	3	-	4	-	-	-	-	7.3

Photos – Bull Arm – Site #BA1



Datasheet – Bull Arm – Site #BA2

Site #	BA 2	Date	08-Oct-24
Coordinates	47.8124539341, -53.9300195619	Surveyors	B. Meaney, C. Hearn
Average Water Depth	1.0 m	Notes	A marshy pond with large mats of emergent graminoids and rocky bottoms.

Plant Species	Abundance Scale
<i>Glyceria canadensis</i>	3
<i>Carex utriculata</i>	2
<i>Eriocaulon aquaticum</i>	+
<i>Eleocharis palustris</i>	+
<i>Chamaedaphne calyculata</i>	+
<i>Juncus militaris</i>	+
<i>Myrica gale</i>	2
<i>Spirea</i> spp.	+
<i>Thalictrum pubescens</i>	+
<i>Sparganium angustifolium</i>	+
<i>Juncus conglomeratus</i>	+
<i>Carex lasiocarpa</i>	+
<i>Scirpus cyperinus</i>	+
<i>Iris versicolor</i>	+
<i>Hippuris vulgaris</i>	+
<i>Triadenum fraseri</i>	+

Distance Surveyed (m)	Scats	Clippings	Burrows	Trails	Tracks	Feed Beds	Houses	Other	Sign/100 m
76.5	-	3	1	5	-	2	-	-	14.4

Photos – Bull Arm – Site #BA2



Figure 1 Site map of Bull Arm Site #BA2.



Figure 2 Habitat picture of Bull Arm Site #BA2.

Data Sheet – Bull Arm Site #BA3

Site #	BA 3	Date	08-Oct-24
Coordinates	47.8131189378, -53.944110853	Surveyors	B. Meaney, C. Hearn
Average Water Depth	1.0 m	Notes	A marshy pond with the majority of the area growing various graminoid species.

Plant Species	Abundance Scale
<i>Glyceria canadensis</i>	+
<i>Sparganium americanum</i>	+
<i>Alnus alnobetula</i>	+
<i>Juncus effusus</i>	2
<i>Juncus conglomeratus</i>	2
<i>Picea mariana</i>	2
<i>Larix laricina</i>	2
<i>Juncus militaris</i>	2
<i>Carex echinata</i>	+
<i>Rhododendron groenlandicum</i>	+
<i>Kalmia angustifolia</i>	+
<i>Juncus brevicaudatus</i>	+
<i>Carex utriculata</i>	+
Spongilla spp.	+
<i>Nymphaea odorata</i>	+

Distance Surveyed (m)	Scats	Clippings	Burrows	Trails	Tracks	Feed Beds	Houses	Other	Sign/100 m
42.6	-	3	2	1	-	-	-	-	14.1

Photos – Bull Arm – Site #BA3



Figure 1 Site map of Bull Arm Site #BA3.



Figure 2 Habitat picture of Bull Arm Site #BA3.

Appendix D4-3: NL WD Marten Survey Protocol



Newfoundland Marten Hair Snag Construction and Deployment Guidelines

March 27, 2014

Prepared by Emily Herdman (Wildlife Division)

These guidelines are provided to help in the planning and completion of hair snag surveys. Exact locations of hair snags should be determined in collaboration with the Wildlife Division.

Introduction

Hair snag traps were developed as a relatively simple, cost-effective and non-invasive way to monitor marten abundance and distribution. The use of hyper-variable microsatellite markers has made it feasible to reliably and efficiently identify individuals from hair samples. Small hair samples (10 or more hairs with roots attached) are sufficient for determination of individual identity and sex.

The idea and trap design originated from research performed in British Columbia (Mowat and Paetkau 2002). Wildlife Division staff tested various prototypes of vertical and horizontal positioning in the Main River Marten Study Area from 2004-2006. Using the standard size trap (instructions to follow) with horizontal placement seems to result in the highest snag success rates.

Construction of Hair Snags

Traps were constructed from 2 boards 1x6x24 inches and 1 board 1x6x32 inches. The three boards are joined together with 12 gauge wire inserted through three 5/16 inch holes. Fastening the boards in this manner, as opposed to forming the trap into a solid unit using screws allows the triangular shaped trap to fold out flat for transportation and allow for easier trap setting. A 1/8 inch hole drilled through the two edge pieces and the 6 inch piece of wire inserted to hold the trap closed when set. This wire provides a quick

release to enable trap baiting and removal of the sticky pads. The wire should be twisted enough so that the trap will not open but is stable enough as to not be “shaky”.



Figure 1. The opened hair trap showing sticky pads (with fur) and sardine can for bait. The top section folds down and the bottom section folds up to form a triangle with the stationary center section which is nailed to the tree trunk. Note placement of sticky pads. Cable ties were used in early work but wire seems to be sturdier and less likely to be damaged by weather conditions.



Figure 2. Side-view of a set trap. Note sardine can and sticky pads.

Sticky pads are made from mouse glue boards (e.g. Catchmaster). The ends of the glue trap (the section with no glue) are first cut off (Figure 4a). The non- glue edges (about a $\frac{1}{4}$ inch wide) along the 2 long sides should be left on as they facilitate handling and removal of the protective paper in the field. Next, the glue traps are cut 7 times across the width and once lengthwise through the middle to make 14 sticky pads (Figure 4b). Protective paper should be left on the trap until it is set.



Figure 3. Commercial glue boards used in the marten hair snags.

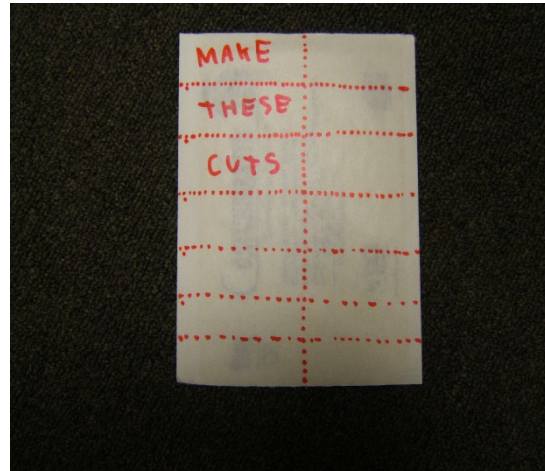


Figure 4. a) Sticky trap showing areas to discard. This border area contains no glue and cannot be used for the snags. b) Cuts to make in order to get the proper sticky pad size. Each pad will be approximately 1 x 2.5 inches.

Setting Hair Snags

Timing

Completion of hair snags in winter will provide information on the use of the area by resident animals. Hair snags should be left out for at least a one month time period. During that time, hair snags should be checked at least 3 times. Timing of hair snag checks should be spaced as evenly as possible within the one month period and there should be at least 5 days between any two checks, with a recommended timing of checks every 7-10 days.

Placement

A fishnet grid of 8 km² blocks (average female home range size) covering the Island of Newfoundland has been generated to guide the placement of hair snags. Hair snags should be placed as close to the centre of the block as possible. However, all snags must be placed in suitable marten habitat and adjustments to exact location should be made to take this into account. Each hair snag should be placed in a large living softwood (≥ 9 inches diameter), preferably in a relatively continuous stand of softwood. Weather conditions can also play a role in successfully obtaining a usable sample. Rain, high humidity, and very cold temperatures will render the sticky pads useless and may also deteriorate the sample itself. Placing hair snags in areas of good canopy cover can reduce the effect of rain. During cold weather, it is important that the animals move around in the trap a bit to increase contact rates with sticky pads. This can be achieved by making sure bait is pushed well into the corners of the sardine can. Branches below the height of the hair snag should be removed from the tree to discourage mink from visiting the trap.

Setting the trap

Traps should be attached to the tree securely as high as feasible in the tree. 3 inch deck screws or 2 ¼ inch double-headed nails both work well. Nails may be preferable because hammers are less likely to malfunction in the field than cordless drills. The use of double-headed nails or screws allows for easy removal of the hair snag at the end of the survey for re-use in other areas or to prevent loss of hair snags due to bear activity. Nails or screws should be staggered in order to provide stability to the trap. Wobbly traps may discourage entry.

Using a staple gun, attach an empty sardine can lengthwise in the middle of the longest board which is the bottom section of the trap. Two ½ inch staples should be enough to securely hold it in place and prevent a marten from tearing it off. Next attach the 4 sticky pads to the inside walls on the two short trap sides. Staple them on both ends of the pad about 1/2 the way in to the sardine can. It is easiest if you staple the sticky end of the pad first, peel off the protective paper then staple the non sticky end of the pad. Put 2 to the left and 2 to the right of the sardine can and peel off the protective layers. Next bait the trap. By folding the bottom board up perpendicular to the tree trunk you can spoon in about a 1/3-1/2 of a can of sardines. Mash the fish under both ends of the can to make the marten work at the bait. If the intact fish is just placed in the can, the marten will go in once, grab the entire piece, back out of the trap and eat it outside. By making the marten work for the bait, the odds of collecting an adequate genetic sample is increased. Using a small amount of bait can reduce the chance that a second marten will be attracted to the trap, which would result in a sample with two sources of hair, making individual identification impossible. Skunk lure is placed in the area to attract the marten to the site.

Checking the trap

When checking the trap, look through the ends at the sticky pads to see if a marten had visited and had left a hair sample (Figure 5). If successful, the pads need to be carefully removed as to not contaminate the sample. Untie the wire that holds the trap closed. The “outer” board will have to be held upright so it will not touch the “inner” board of the trap. Remove all staples with pliers or fingers and place a section of clean flagging tape or a section of waterproof, parchment, or wax paper over the entire sticky pad to protect it and prevent it from sticking to anything (Figure 6). Remove all pads that have fur, make sure that remaining pads contain no fur as this may create a “mixed

sample” if another marten enters the trap. Replace with a fresh pad(s). All hair samples from a single trap collected in a single day should be included in a single paper sample envelope (e.g. if there is hair on 3 sticky pads when checked then all 3 sticky pads should be placed in one envelope). Coin envelopes work very well as sample envelopes.

Hair sample envelopes should be clearly marked with:

- Date
- Name of Surveyors
- Coordinates
- General Location

At the end of the day, sample envelopes containing samples should be dried if any moisture is expected. Moisture will rapidly deteriorate the sample and will ruin the ability to successfully extract usable DNA. Samples envelopes can be placed in a plastic bag for transportation in the field but should be removed immediately upon return. Do not freeze or place samples in a plastic bag for storage. Proponents are responsible for genetic confirmation of samples. Results must be reported to the Wildlife Division.



Figure 5. Checking the hair trap. A marten has entered one side of the trap and has left hair samples on 2 of the 4 pads.



Figure 6. Trap with pads removed and covered with flagging tape for protection. Trap is re-padded and re-baited. The pads are then placed in a labeled paper envelope.

One of the purposes of checking hair snags is to recharge bait and scent (e.g. skunk lure). If a trap has been visited by a non-target species (e.g. mink, weasel) and the bait is not replaced, marten will have very little motivation to visit a trap.

Accurate collection of location data is very important to this effort. UTM's should be provided for each snag location. Hair snag data sheet templates can be provided by the Wildlife Division upon request. At minimum, the following information should be included on any data sheet: General Location, Surveyor names, Date hair snag was set, Date of each check and result (no hair, sample collected etc.), location data for snag (e.g. UTM's). The inclusion of additional comments (e.g. forest type, other species of interest sighted) is encouraged but not required. Providing data in excel spreadsheet or through the creation of a shape file with appropriate attribute table will make it easier for the Wildlife Division to process hair samples in a timely manner. Hair snag data sheets and all hair samples (including non-target species) must be returned to the Wildlife Division in a timely manner. This is particularly important if recommendations will be partially based on the outcome of hair snag surveys. Proponents are responsible for genetic confirmation of samples. Results must be reported to the Wildlife Division.

Adapted from:

Neville, John. 2006. Hair snag trap design and deployment methodology for use in documenting Newfoundland marten distribution and population size. Draft Internal Report. Wildlife Division, Department of Environment and Conservation, Government of Newfoundland and Labrador.

Appendix D4-4: NL WD Muskrat Survey Protocol

Newfoundland Muskrat Distribution and Population survey

BACKGROUND:

Muskrat (*Ondatra zibethicus*) are considered one of the most valuable semi-aquatic furbearers and continues to be the most harvested pelt in North America. Canadian statistics for 2014-15 showed muskrat's overall value at \$1.7 million with 314,000 pelts harvested. They are an important prey source for native and introduced species in Newfoundland as well as significantly affecting wetland vegetation.

Typically, muskrat use the most available wetland plant species. In other parts of North America cattails (*Typha latifolia*) has often been identified as one of the most important sources for food and structural material but the presence of cattails is limited on the Island. In Newfoundland, muskrat have fewer plant species available for house building and may rely more heavily on burrows for dwellings. Exclusive use of burrows may make muskrat more vulnerable to mink predation. Soper (1988) found sites on the Northern Peninsula were shallow ponds or slow-moving brooks, while the other study areas in Western Newfoundland consisted of marshy areas or bogs bordering deep ponds.

On the Island of Newfoundland, trapper opinion has indicated that muskrat populations have been declining and disappearing from many areas in their historic range. Trapper opinion from Labrador suggests the population there has remained stable over time. Historical declines on the Island have been attributed to the introduction of mink, possibly accentuated due to marginal muskrat habitat available on the Island and predator naivety. While mink may still be a factor in declines, current threats have not been properly quantified and larger factors may be at play with muskrat declines reported across N.E. North America.

While efforts in N.E. North America are looking at causes of decline, on the Island a good understanding of muskrat distribution and abundance is necessary in order to support appropriate management strategies and determine further monitoring/research needs.

GOAL:

To understand the current distribution and relative abundance of muskrat across the Island of Newfoundland.

OBJECTIVES:

- 1) Conduct yearly muskrat surveys across Newfoundland in appropriate habitat for this species.
- 2) Provide for longterm (10 year minimum) data to evaluate current population size and distribution of muskrat on the Island
- 3) Quantify wetland habitat associated with muskrat on the Island.

METHODOLOGY:

Equipment:

*Canoe	Datasheets
*Paddles	Clipboard
*Lifejackets	Camera
*Canoe safety gear	(Chest) waders
10m measuring tape	Measuring string with weight
*site dependent	

Site Selection:

Survey site selection will be based on current or historic muskrat sites as identified by trappers, FLR officers, and through other local knowledge. Historically surveyed sites will be of particular importance. As accessibility, time, and staff availability allow; other sites deemed suitable for muskrat can also be surveyed. Appropriate sites could be a portion of a larger wetland or waterbody. Ideal habitat would typically include some/all of the following features.

- 50-80% of water surface covered with emergent vegetation
- Presence of shoreline herbaceous vegetation within 10m of water's edge
- Water depth of 0.5 to 1.5m with stable seasonal water levels
- Slow flowing/standing water
- Burrow sites:
 - Soft high clay content, not rocky
 - slope $\geq 10^\circ$, minimum ht. 0.2m

Survey timing:

The survey window is from **September 1 to November 1**. Fall counts provide for the greatest opportunity for detection of fresh sign due to muskrat being at the highest population levels at this time. Sites should not be visited right after extensive rainfall which can disturb or interfere with the detection of sign.

Delineating Habitat and Quantifying Emergent Vegetation

While the priority is to determine presence/non-detection and relative abundance of muskrat, habitat should also be classified for each site visited.

- 1) Enter all data on the datasheet (see Appendix A and example in Figure 2).
- 2) Print out a Google Earth map of each wetland to be surveyed (Fig.1).
- 3) At the site, delineate uniform wetland habitat boundaries on the site map. Distinct habitat boundaries are decided by a visual inspection to determine discrete areas with similar species assemblages. Label each habitat 'A', 'B', 'C', etc. (Fig.1). Include unsuitable areas, such as open water in mapping, even if not surveyed.

Newfoundland Muskrat Distribution and Population survey



Figure 1: Example of survey site habitat delineation

- 2) Based on surveyor opinion, establish a 10mX10m plot in each distinctive, but suitable, habitat. **This plot is for habitat classification purposes only.** Mark the plot location with an 'X' on the map provided. Given habitat boundaries may change over time, plot location will be decided yearly based on the surveyors visual examination of the site. It is not necessary to use the same plot location each year, but is recommended when habitat boundaries have not changed significantly. Extent of survey area will be limited to areas considered appropriate for detection of muskrat sign. Survey areas do not need to include portions with deep open water or fast running streams. In the example above only 'A' and 'B' may need surveying.
- 3) Estimate water depth for each habitat. A weighted string or canoe paddle can be helpful for estimating.
- 4) If present, identify all common wetland species described in Appendix B and quantify using the Braun Blanquet scale (Table 1). **Note: most species will be in various stages of senescence and not flowering at the time of the survey.** If possible, categorize all other identifiable species. If a species cannot be identified, particularly if it is highly represented, it should be photographed or a sample taken for further identification. Unknowns will still be classified using the Braun Blanquet scale and labeled as 'Unknown1', 'Unknown2', etc.

Table 1: Braun Blanquet cover and abundance categories

Rating	Description of cover
+	< 5 % and sparse
1	< 5 % and plentiful
2	5 – 25%
3	26 – 50%
4	51 – 75%
5	76 – 100%

Newfoundland Muskrat Distribution and Population survey

MUSKRAT SURVEY FORM (2018 version)						Page 1 of 1
Site name: Plum Point Pond 2			Date: October 19, 2017			
Coordinates: 51.058139N 56.851083W			Name of Surveyors: D. Chambers, B. Rodrigues			
General Habitat Description (pond, ditch, fen, bog, bank composition, stream, shoreline vegetation etc.):						
Pond beside main road, mainly open water. Shallow, rocky bank bordered by ericaceous vegetation and spruce forest						
Average Water depth (m):						
Plot A	Plot B	Plot C	Plot D	Plot E		
0.4m	0.3m	5m	-	-		
Emergent plant species assemblage:						
	Abundance rating (see scale below)					
Plant Species	Plot A	Plot B	Plot C	Plot D	Plot E	Comments
Sedge (<i>Carex</i> spp.)	5	4				Seed pods and stalks, plus leaves present Pic 1437, pink stem. Whorled, toothed leaves, 1m ht, on shoreline
Horsetail (<i>Equisetum</i>)	2	2				
Blue Flag (<i>Iris versicolor</i>)	1					
Unknown1		+				

Figure 2: example of habitat data entry

Surveying for Muskrat Sign:

- At each site, an observer will travel along the shoreline, either on foot or in watercraft- site conditions determining the most appropriate means of transport.



- Count the total number of distinct groups of scat, clippings, burrows, trails, tracks, feed beds and houses. Consider each type of sign found in each 1 meter traveled as one distinct sign. For example, if 10 clippings are clustered within a 1 meter section, it is just still just counted as one observation. See Appendix C for examples. There is no set criteria for size of wetland or distance of shoreline to survey. If feasible, cover the full extent of potential muskrat habitat at a given site.
- Tabulate observations and total distance surveyed by delineated habitat (eg. A, B and C). Enter all information on the data form (Appendix A). An example of entered data is found in Figure 3.
- An index of relative muskrat abundance of sign/100m of shoreline covered, can then be calculated by distinct habitat and site

Habitat	distance surveyed (m)	Scats/latrines	clippings	burrows	trails	tracks	Feed beds	houses	*Other:	sign/100m =(sign/dist)*100
A	220m	2	4	0	3	0	1	1	-	5

Figure 3: example of datasheet entry of muskrat sign

Appendix B: Common emergent/shoreline vegetation used by muskrat

Differentiating sedges, grasses and rushes:

Sedges: Solid, triangular stems (“*sedges have edges*”) with some exceptions; leaves 3-ranked; fruit a nutlet subtended by a scale

• **Grasses:** Hollow (between the nodes), round stems; leaves 2-ranked; fruit a grain covered by two papery scales

• **Rushes:** Solid, round stems; leaves few; fruit a several to many-seeded capsule surrounded by 6 scale-like structures

Sedges (*Carex* spp.):



Grass spp.



Rush (*Juncus* spp.)



Moss:



Newfoundland Muskrat Distribution and Population survey

Water horsetail (*Equisetum fluviatile*):



Blue Flag (*Iris versicolor*)



Bullhead-lily (*Nuphar variegatum*):



Pond weed (*Potamogeton* spp.)



Bulrush (*Schoenoplectus* spp.):



Cattail (*Typha latifolia*)



Newfoundland Muskrat Distribution and Population survey

Broad leaf Arrowhead (*Sagittaria latifolia*)



Buckbean (*Menyanthes trifoliata*)



Canadian burnet (*Sanquisorba Canadensis*)



Goldenrod (*Solidago* spp.)



American Bur-reed (*Sparganium americanum*)



Sweet Gale (*Myrica gale*)



Wetland Plant Identification References:

websites:

http://www.ducks.ca/assets/2016/01/wetlandscare_v8.pdf

<https://www.ducks.ca/assets/2015/03/field-guide-new.pdf>

<http://fernhillns.ca/fernhillnsWP/wp-content/uploads/2017/05/PeatlandGuideDRAFT.pdf>

<http://www.bwsr.state.mn.us/wetlands/training/PlantID-sedges.pdf>

books:

Wetland Plants of Ontario Paperback – Feb 26 1997 by Steven Newmaster (Author), Alan Harris (Author), Linda Kershaw (Author)

Aquatic and Wetland Plants of Northeastern North America, Volume II: A Revised and Enlarged Edition of Norman C. Fassett's A Manual of Aquatic Plants, Volume II: Angiosperms: Monocotyledons Paperback – Feb 10 2006 by Garrett E. Crow (Author), C. Barre Hellquist (Author)

Hotchkiss, Neil. 1972. Common Marsh, Underwater & Floating-leaved Plants of the United States and Canada.

Photo credits:

Sedge: By Kristian Peters -- Fabelfroh 16:01, 13 July 2006 (UTC) [GFDL (<http://www.gnu.org/copyleft/fdl.html>) or CC-BY-SA-3.0 (<http://creativecommons.org/licenses/by-sa/3.0/>)], from Wikimedia Commons

Grass: Photo: Tom Koerner/USFWS (bluejoint grass)

Bullrush: By Jerry Oldenettel, <https://www.flickr.com/photos/7457894@N04/1527128096>

Bullhead lily: By Cephas - Own work, CC BY-SA 3.0, <https://commons.wikimedia.org/w/index.php?curid=15970887>

Broad leaf Arrowhead: CC BY-SA 3.0, <https://commons.wikimedia.org/w/index.php?curid=539878>

Buckbean: By H. Zell - Own work, CC BY-SA 3.0, <https://commons.wikimedia.org/w/index.php?curid=10684516>

Canada Burnet: By Donald Cameron. Copyright © 2018 Donald Cameron

Sweet Gale: CC BY-SA 3.0, <https://commons.wikimedia.org/w/index.php?curid=204817>

Tradescent Aster: By Donald Cameron (S.tradescantii). Copyright © 2018 Donald Cameron

Water plantain: By Matt Lavin - Flickr: Alisma triviale, CC BY-SA 2.0, <https://commons.wikimedia.org/w/index.php?curid=16901224>

Floating Heart: By Jomegat - Own work, CC BY-SA 3.0, <https://commons.wikimedia.org/w/index.php?curid=6959221>

Mermaid weed: By Choess - Own work, CC BY-SA 3.0, <https://commons.wikimedia.org/w/index.php?curid=11454845>

American Bur-reed: by Jill Lee, <https://www.flickr.com/photos/jillllybean/20083090940/>

Appendix C: Description of sign

- 1) **houses:** >30cm above water surface: with fresh activity=active, lacking fresh activity =inactive



- 2) **Feed beds:** An accumulation of herbaceous material, clipped off, sometimes found under bank cover (see picture under 'burrows')

- 3) **Burrows:** best observed in clear water, typically found just under surface to about 3ft depth. Can have multiple entrances



- 4) **Scat/latrine:** usually found on rocks, dirt mounds, or logs projecting out of the water

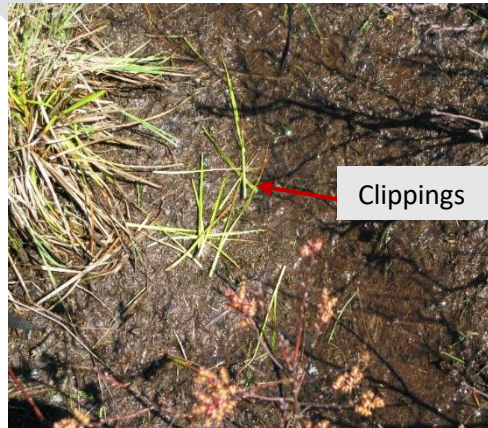
Newfoundland Muskrat Distribution and Population survey



5) Trails: paths through aquatic vegetation or along shore frequented by muskrat



6) Clippings: bitten off herbaceous vegetation often floating in water



7) Tracks:

Newfoundland Muskrat Distribution and Population survey

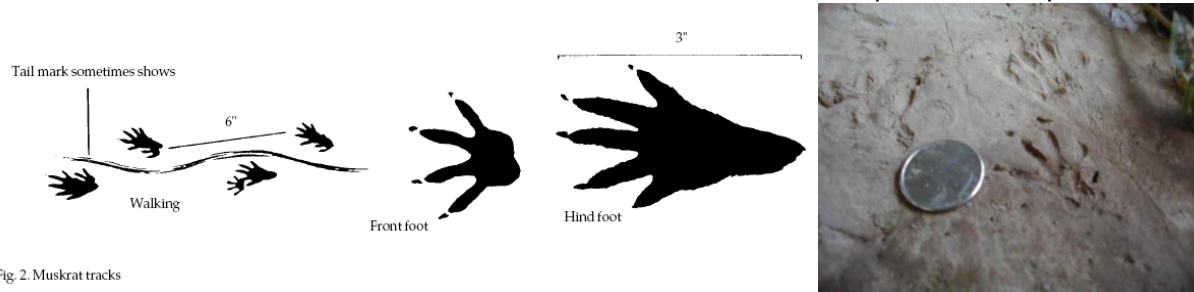


Fig. 2. Muskrat tracks

8) Other: eg. Fresh shells (along shoreline), animal seen, presence of mink, etc.



Newfoundland Muskrat Distribution and Population survey

Rare wetland plants to look out for (optional). Take photos and coordinates:

Sweetflag (*Acorus americanus*)



mermaidweed (*Proserpinaca pectinata*)



waterplantain (*Allisma triviale*).



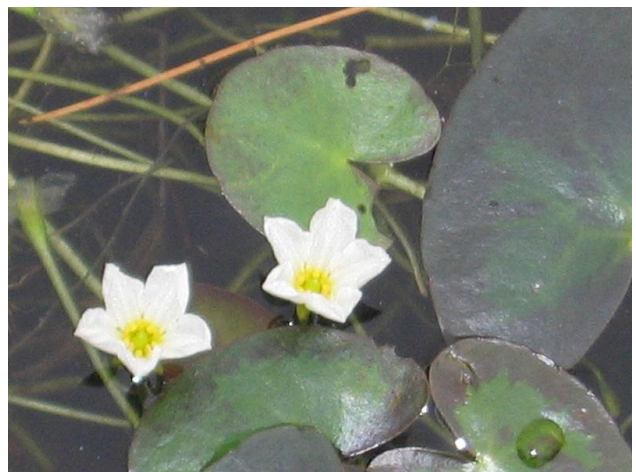
Tradescant's aster (*Symphyotrichum tradescantii*)



Wild calla (*calla palustris*)



floatingheart (*Nymphoides cordata*)



MUSKRAT SURVEY FORM (2018 version)

Site name:

Date:

Coordinates:

Name of Surveyors:

General Habitat Description (pond, ditch, fen, bog, bank composition, stream, shoreline vegetation etc.):

Average Water depth (m):

Plot A	Plot B	Plot C	Plot D	Plot E

Emergent plant species assemblage:

[illegible]

List each species (or lowest practical taxa) on a separate line. Use as many sheets as necessary.

Rating	Description of abundance
+	< 5 % and sparse
1	< 5 % and plentiful
2	5 – 25%
3	26 – 50%
4	51 – 75%
5	76 – 100%

MUSKRAT SURVEY FORM (2018 version)

Page 2 of 2

Site name:
Coordinates:

Date:
Name of Surveyors:

Count of Muskrat sign:

Plot	distance surveyed (m)	scats	clippings	burrows	trails	tracks	Feed beds	houses	*Other:	sign/100m
A										
B										
C										
D										
E										

*Comments/ Other Observations: