Component Studies
Terrestrial Environment

Large Mammals

Report 1 of 6

Wildlife Habitat Associations in the Lower Churchill Valley

January 2009

Environmental Impact Statement for the
Lower Churchill Hydroelectric Generation Project

nalcor energy

WILDLIFE HABITAT ASSOCIATIONS IN THE LOWER CHURCHILL VALLEY

ENVIRONMENTAL BASELINE REPORT
LCP 535740

DRAFT REPORT

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Prepared by Minaskuat Inc.
for
Newfoundland and Labrador Hydro

EXECUTIVE SUMMARY

As part of its expanded energy mandate, Newfoundland and Labrador Hydro ("Hydro") is proposing to develop the hydroelectric potential of the lower Churchill River. This watershed provides year-round, seasonal and other temporary habitat for a variety of wildlife in central Labrador. As such, understanding how the proposed Lower Churchill Hydroelectric Generation Project ("Project") will affect this habitat and the wildlife it supports, as well as whether wildlife will be able to use other habitats, is an important objective. Minaskuat Limited Partnership ("Minaskuat") conducted a series of investigations to examine wildlife habitat relationships within the watershed of the lower Churchill River designed to collect observations indicating the presence of selected species of terrestrial wildlife (primarily mammals) in the lower Churchill River valley and to relate indices of abundance and distribution of these species to the habitats they prefer. In addition to developing an index of relative use by habitat for several species of wildlife, a specific effort was employed for small mammals in the Survey Area. The objectives of this second component were to identify small mammal species within the lower Churchill River valley and identify abundance and habitat relationships.

Ground surveys covering 323 km were conducted during late summer 2006. The effort was designed to overlap a period when several species would be present and active. Line transect sampling provided an indication of wildlife use of the lower Churchill River valley and surrounding areas that are used in late summer and which areas may be considered prime habitat for different species. Transects were selected both below and above the future reservoir level, along the transmission line, downstream of Muskrat Falls, and others within the river valley to provide a balance between assessing potential losses and providing a baseline against which to compare conditions post-construction.

Data were compiled in spreadsheets by habitat type and wildlife species. Data were analyzed for trends across habitats and species. Habitats were also grouped according to moisture regime and coniferous versus deciduous cover. For the small mammal trapping data, abundance indices were calculated as the total number of animals (individuals of a species) captured per habitat type. A statistical t-test was performed on upper and lower trap grids to determine whether differences existed.

The highest frequencies of mammal observations were in Mixed-Fir Dominant, Mixed-Spruce Dominant, Fir-Spruce and Wet Spruce forests, while the lowest frequencies were in Wetland, Burn and Riparian habitats. Although Riparian habitat accounted for the second fewest number of observations per kilometre, it had the highest number of observational categories with peak values (i.e., relatively few wildlife signs were found in Riparian habitat, but those that were present tended to be found more often in this habitat type than in other habitat types). Observation rates in mesic (moist) areas were above average, while both dry and wet habitats were below average. As expected, results demonstrated an overwhelming use of wet habitats by aquatic furbearers.

Data for common herbivorous species such as moose, snowshoe hare and red squirrel were readily collected, due to the fact that evidence of these species was more easily observed than many other (e.g., marten, flying squirrel) species. Sign of moose and red squirrel were the most commonly encountered, primarily associated with Mixed-Fir Dominant habitats. Snowshoe hare evidence was also relatively common, usually in Mixed-Fir Dominant, Mixed-Spruce Dominant and Wet Spruce habitats.

Relatively recent black bear sign (i.e., summer) was recorded throughout habitat types, at relatively low frequencies. Porcupine used a variety of mature forested habitats. Browse was commonly found in all habitat types sampled, reflective of their generalist nature, but predominantly in coniferous-dominated forests. Wolf evidence was rare and consisted largely of easily detected tracks in open burns. Fox evidence was most often in the form of tracks or droppings and most were made in Riparian, Burn and

Mixed-Deciduous habitat types, but were overall relatively scarce. Evidence of caribou was low and relatively consistent across habitat types. Slightly higher observations (per linear distance sampled) were made in Mixed-Fir Dominant and Dry Spruce habitats. Beaver and muskrat sign were usually in Wetland and Riparian habitats, though evidence of their presence was relatively scarce. Evidence of Mustelids (mink, river otter and marten) was almost absent from the surveys.

A total of 238 small mammals were collected over 4,758 trap nights, at eight trapping grids, during the small mammal trapping component. Red-backed vole was the most frequently captured small mammal and represented 70 percent of the total. Masked shrew, woodland jumping mouse and meadow vole were also recorded.

The index to abundance for all species was 5.0 small mammals per 100 trap nights. However, this index was higher for certain habitats, particularly Mixed-Spruce Dominant (9.29 mammals per 100 trap nights), Mixed-Deciduous Dominant (9.87 mammals per 100 trap nights) and Mixed-Fir Dominant (11.2 mammals per 100 trap nights). There was no difference in the mean number of captures of red-backed voles from sites at higher elevations (upper sites) compared to sites at lower elevations (lower sites) ($P=0.74$). Low capture rates of masked shrew, meadow vole and woodland jumping mouse were not sufficient to rigorously test habitat observations.

In general, small mammal survey results indicate that red-backed voles are most common in Wet Spruce habitats, meadow voles and woodland jumping mouse in Mixed-Deciduous Dominant, and masked shrew in Mixed-Fir Dominant habitats, however the scale of the habitat classifications used during this study may not reflect specific habitat characteristics important to the small mammal species captured. Micro-site characteristics within these and other habitat types would need to be further assessed to fully understand habitat preferences of these species.

Overall, the Wildlife Habitat Associations surveys proved to be effective means to collect baseline information on a variety of wildlife species that would not be as obvious through aerial or other techniques.

TABLE OF CONTENTS

Page No.

LIST OF TABLES

Page No.

LIST OF FIGURES

Page No.

1.0 INTRODUCTION

Newfoundland and Labrador Hydro (“Hydro”) is proposing to develop the hydroelectric potential of the lower Churchill River. The lower Churchill River watershed and adjacent watersheds provide year-round, seasonal and other temporary habitat for a variety of wildlife species in central Labrador. Minaskuat Limited Partnership (“Minaskuat”) was retained by Hydro in June 2006 to conduct a Terrestrial Wildlife Component Study. This Environmental Baseline Report presents the results of the Wildlife Habitat Associations study, focused primarily on mammalian species and associated habitat identified in the lower Churchill River valley. Information was also collected on other wildlife species (e.g., herpetiles and birds) encountered in the Survey Area. The intent of this study was to gain an understanding of wildlife habitat associations and use.

1.1 Lower Churchill Hydroelectric Generation Project

The Lower Churchill Hydroelectric Generation Project (the “Project”) will include hydroelectric generating facilities at Gull Island and Muskrat Falls, and interconnecting transmission lines to the existing Labrador grid. The Gull Island facility will consist of a generating station with a capacity of approximately 2,000 MW and include:

- a dam 99 m high and 1,315 m long and
- a reservoir 215 km² in area at an assumed full supply level (fsl) of 125 m above sea level (asl)

The dam will be a concrete faced rockfill dam. The reservoir will be 230 km long, and the area of inundated land will be 85 km² at fsl. The powerhouse will contain four to six Francis turbines.

The Muskrat Falls facility will consist of a generating station that will be approximately 800 MW in capacity and will include:

- a concrete dam with two sections on the north and south abutments of the river and
- a 100 km² reservoir at an assumed fsl of 39 m asl

The north section dam will be 32 m high and 432 m long, while the south section will be 29 m high and 125 m long. The reservoir will be 60 km long and the area of inundated land will be 41 km² at fsl. The powerhouse will contain four to five propeller or Kaplan turbines, or a combination of both.

The interconnecting transmission lines will consist of:

- a 735 kV transmission line between Gull Island and Churchill Falls and
- two 230 kV transmission lines between Muskrat Falls and Gull Island

The 735 kV transmission line will be 203 km long and the 230 kV transmission lines will be 60 km long. Both lines will likely be lattice-type steel structures. The location of the transmission lines will be north of the Churchill River; the final route is the subject of a route selection study that will be included in the environmental assessment. The lines between Muskrat Falls and Gull Island will be combined on double-circuit structures.

The Project design may be refined as Project details become available.

1.2 Report Study

Habitat diversity is defined as the variety of places where different wildlife species live. The lower Churchill River valley features habitats typical of a northern boreal or sub-Arctic environment. It includes areas of riparian habitat along shorelines of water bodies, as well as a variety of forest and wetland habitats. Riparian habitat typically supports a greater diversity of plant and animal species than other habitat types further away from water bodies. Species occur in direct relation to forest cover, composition, age structure, time since disturbance (e.g., forest fire), moisture regimes and other local parameters.

A variety of wildlife currently uses the lower Churchill River valley including: several species of mammals such as black bear (*Ursus americanus*), moose (*Alces alces*), caribou (*Rangifer tarandus caribou*), snowshoe hare (*Lepus americanus*), beaver (*Castor canadensis*), coloured (or red) fox (*Vulpes vulpes*) and lynx (*Lynx canadensis*); birds such as raptors, waterfowl and songbirds; and amphibians such as frogs and toads. These species all occupy individual niches as part of the greater ecosystem that comprises the valley. Some species, such as beaver, river otter (Lutra canadensis), muskrat (*Ondatra zibethicus*) and mink (*Mustela vison*) occupy aquatic or semi-aquatic niches but exploit the aquatic environment in different ways (e.g., beavers are "ecosystem engineers", building dams to raise water levels to improve access to trees, while otter are primarily predators of fish). Similarly, in terrestrial environments, some mammals are predatory, such as the ermine (*Mustela erminea*), shrew and lynx, while others such as the meadow vole (*Microtus pennsylvanicus*), snowshoe hare and moose are herbivorous. Niche segregation occurs on many levels, even among closely related species such as warblers, which forage at different heights in the forest (MacArthur 1958). It is the sum of all the interactions between these and other living organisms and non-living processes and their environment that comprise the ecosystem of the lower Churchill River valley.

Wildlife sightings of all types (observations of individuals, tracks, droppings, browse) are presented and discussed in this Environmental Baseline Report. There were two main areas of investigation: (1) a survey of wildlife presence and relative frequency of habitat use in each of the main habitat types; and (2) a determination of the current population status of small mammals.

2.0 BACKGROUND

2.1 Previous Studies

Information available from previous studies (described below) will provide additional background data on a variety of species, to support the environmental assessment of the Project. Specific results of these studies can be found elsewhere, where referenced.

2.1.1 Related to the Project

Background studies related to previous proposals to develop the hydroelectric potential of the lower Churchill River have been conducted on several occasions over the last three decades. Studies related to species of wildlife in the Churchill River valley include:

- a mammal survey, literature search and informant interviews regarding these species in the Churchill River valley during 1978 (Northland Associates Ltd. 1978), including historic (1800s) information on wildlife species from the Fort Winokapau Journals
- Wildlife Atlas Phase I and II containing a series of maps indicating observations and sign (Northland Associates Ltd. 1978, 1980)
- a series of informant interviews with trappers regarding their activity in the lower Churchill River valley (Budgell 1981).

2.1.2 Annual Monitoring within the Low Level Military Flight Training Area

An extensive database on the distribution of wildlife in central Labrador has been collected over the last 19 years as a result of the monitoring program being conducted for the low level military flight training activities by the Department of National Defence. While the primary focus of this effort related to birds, all encounters of wildlife and wildlife sign were recorded. This information exists on 1:50,000 National Topographic Series (NTS) map sheets filed at the Minaskuat Inc. office in Happy Valley-Goose Bay. In recent years, the Institute for Environmental Monitoring and Research (IEMR) has assumed responsibility for the monitoring program.

2.1.3 Studies in Relation to the Trans Labrador Highway

Over the previous decade, the Newfoundland and Labrador Department of Transportation and Works has been expanding and upgrading its highway network in Labrador. Several aerial surveys (e.g., JWEL 1998; 1999) for raptors, caribou and other wildlife species have been conducted. Observations have been recorded on 1:50,000 NTS map sheets in association with the Trans Labrador Highway (TLH) Phase II (Cartwright to Red Bay) and the TLH Phase III (Happy Valley-Goose Bay to Cartwright Junction) Environmental Assessments (Newfoundland and Labrador Department of Works, Services and Transportation 2003).

2.2 Potential Wildlife Species

There are many wildlife species that use the lower Churchill River valley for different purposes. Some use it for foraging, some for breeding habitat, some as a travel corridor, or as a combination of these. Mammal species present in the valley range from large ungulates like moose and caribou to small mammals such as shrews and mice. A brief summary of species expected in the lower Churchill River valley is presented below.

The only bear species in the lower Churchill River valley is the black bear, which is distributed throughout Labrador in forested areas and is known from the lower Churchill River Valley (Kolenosky and Strathearn 1987; Jacques Whitford 1997a). There are two species of large ungulates, the moose and caribou. Moose occurs throughout the valley, and is thought to especially prefer coniferous forest near water (Phillips 1983; Dalton 1986; Trimper et al. 1996; Jacques Whitford 1997b; Peek 1997). Woodland caribou is also known from the lower Churchill River valley (Northland Associates Ltd. 1980) notably in the area north of Gull Lake, at the headwaters of the Pinus River and at the confluence of the Cache and Churchill Rivers.

Wolves (*Canis lupus*) are usually found often in association with caribou in Labrador (Ballard et al. 1981). Other members of the canid family include coyote (*Canis latrans*), which was first documented in Labrador in 1995 by a specimen trapped on the Churchill River (Chubbs and Phillips 2002); and the red fox which is widely distributed throughout Labrador and thought to be common in the lower Churchill River valley.

Snowshoe hare is a widely distributed boreal forest herbivore found in various forest habitats throughout the lower Churchill River valley (Krebs et al. 1986; Boutin 1995). The range of the Arctic hare extends to the periphery of the lower Churchill River valley but is not thought to use the valley.

Red squirrel (*Tamiasciurus hudsonicus*) is known to be one of the most common mammal species in the valley and is generally associated with coniferous forest (Klugh 1927; Kemp and Keith 1970). The woodland jumping mouse (*Napaeozapus insignis*), red-backed vole (*Clethrionomys gapperi*) and meadow vole are also common small mammals in Labrador (Trimper 1989).

Two semi-aquatic rodents are known to use the lower Churchill River valley. Beaver occupy rivers, streams, marshes, lakes and ponds throughout Labrador and muskrat inhabit marshes, pond and lake edges and streams (Banfield 1974; Northland Associates Ltd. 1978). There are potentially six members of the weasel family (Mustelidae) found in the region: river otter, fisher (*Martes pennantis*), mink, marten (*Martes americana*), ermine and wolverine (*Gulo gulo*) (Bangs 1898; Northland Associates Ltd. 1980; Melquist and Dronkert 1987; Knox 1994; Smith and Schaefer 2002). Fisher and wolverine, however, are not known to exist in the Survey Area (Northcott 1990. The lynx is the only member of the cat family (Felidae) known to inhabit the lower Churchill River valley.

The masked shrew (*Sorex cinereus*) is one of three small insectivores known from the valley. Little brown bat (*Myotis lucifugus*) and northern long-eared bat (*Myotis septentrionalis*) are resident in Labrador and are thought to exist in the lower Churchill River valley.

3.0 DESCRIPTION OF THE STUDY TEAM

The Wildlife Habitat Associations Environmental Baseline Study was conducted by Minaskuat. The Study Team included the component manager, a study lead, an alternate study lead, a scientific authority, field leads, field assistants and data management personnel (Table 3-1). All team members have in-depth knowledge and experience in their fields of expertise and a broad general knowledge of the work conducted by other experts in related fields. Brief biographical statements, highlighting project roles and responsibilities and relevant education and employment experience, are provided below.

Table 3-1 Study Team - General Wildlife and Habitat Surveys

Role	Personnel
Component Manager	Perry Trimper
Study Lead	Marcel Gahbauer
Alternate Study Lead	Francis Schwab
Scientific Authority	Dave Westworth, Lawrence Brusnyk
Field Leads	Marcel Gahbauer, Steve Gullage, Lem Mayo, Jennifer Mitchell, Tina Newbury, Tony Parr, Karen Rashleigh, Perry Trimper
Aboriginal (Innu) Field Assistants	Penute Andrew, Terry Andrew, Maniai (Mary Ann) Aylward, Don Blake, Chris Gregoire, Peter McKay, Patrick Penashue, Apenam Pone, Clarence Snow
Data Management and Reporting	Marcel Gahbauer, Tina Newbury, Steve Gullage, Jennifer Mitchell

Perry Trimper, B.Sc.F. (Jacques Whitford) is a Principal and senior Wildlife Biologist based in Labrador. His 22 years of experience is primarily in northern environments of both Canada and Russia where areas of specialization include boreal and Arctic wildlife research, northern indigenous peoples, environmental assessment, and sustainable resource development. He has been involved in every large environmental assessment in Labrador over the last two decades. Since joining Jacques Whitford in 1987, he has worked in Labrador on a variety of projects, involving hydroelectric, military, mining and transportation developments, aboriginal culture and wildlife ecology. Mr. Trimper is the overall Project Manager for the Terrestrial Wildlife Component.

Marcel Gahbauer, Ph.D., candidate (Jacques Whitford-Axys) is an experienced Wildlife Biologist based in Calgary, Alberta. Mr. Gahbauer's experience in Labrador includes the design, execution and analysis of information collected during baseline surveys for raptors, passerines and other wildlife species as part large-scale environmental assessments in the region, including mining as well as additional aspects of the Lower Churchill Project. Through these and other projects, as well as his academic research, he has extensive knowledge of wildlife, habitat and related issues in boreal forests of Canada. Mr. Gahbauer was the Study Lead for the Wildlife Habitat Associations Environmental Baseline Study and participated in the field, data management/analysis and written components of the study.

Francis Schwab, Ph.D., is a Wildlife Ecologist who teaches at the College of the North Atlantic, in Labrador City. Of particular interest to Dr. Schwab is the relationship between the effects wildlife habitat loss or alteration during resource developments. In this regard he has pursued specific research initiatives regarding Ptarmigan, waterfowl, nuisance wildlife, terrestrial and aquatic furbearers, small mammals, raptors, and shore-birds. Specific skills, related to the above, include the ability to plan, train participants for, and engage in reconnaissance level terrestrial ecology inventory, browse biomass inventory, breeding bird inventory, and laboratory food habits analyses. He is well-published with approximately 40 peer-reviewed and other publications on breeding bird habitat in Labrador; effects of natural and human disturbance on breeding bird habitat; wintering Labrador willow ptarmigan, effects of natural and human disturbance on Labrador forest structure; effects of disturbance on Labrador small mammals; effects of trapping and food habits of Labrador marten; effects of lead shot on waterfowl; effects of human disturbance on moose habitat; browse biomass inventory; and moose habitat assessment. Dr. Schwab served as an Advisor to the Manager for the Terrestrial Wildlife Component and as the Alternate Study Lead.

Dave Westworth, M.Sc., P.Biol. (Westworth Associates Environmental Ltd., an affiliate of Jacques Whitford) is an Environmental Specialist based in Edmonton, AB. Mr. Westworth has over 30 years of experience in wildlife research and management, habitat assessment, environmental impact assessment and environmental planning. He has worked on a number of projects in Newfoundland and Labrador, including earlier investigations of the potential effects of Lower Churchill hydro development on Moose populations, an assessment of the effects of military aircraft training on wildlife in Labrador and a review of potential effects of mineral exploration and development on wildlife near Voisey's Bay, Labrador. Mr. Westworth served as a Senior Reviewer/Advisor to the Environmental Baseline Study.

Lawrence Brusnyk, M.Sc., P.Biol., (Westworth Associates Environmental Ltd., an affiliate of Jacques Whitford) is a senior Environmental Specialist based in Edmonton, AB. He has over 23 years of experience in environmental research, impact assessment, mitigation planning and environmental monitoring, participating in over 250 projects throughout Alberta, British Columbia and elsewhere in Canada. Lawrence is a highly respected authority on ungulate behaviour and habitat and has extensive project experience in semi-aquatic and terrestrial furbearers, small mammals, birds, herpetofauna and fish and fish habitat assessment. He has designed a number of habitat improvement programs for moose and other ungulates, and has developed habitat mitigation and environmental monitoring programs for surface mining operations, pipelines, dams and reservoir developments, roads, highways and other developments. Mr. Brusnyk served as a Scientific Authority to the Environmental Baseline Study.

Steve Gullage, M.Sc. (Jacques Whitford) is a Terrestrial Biologist based in St. John's, NL. His responsibilities at Jacques Whitford include wildlife and plant surveys, data analysis, and report-writing for various projects. In addition to a Masters degree specializing in ornithology, he has a Bachelor of Science degree in Forestry and Environmental Management and a minor in Wildlife. He has worked on various wildlife components associated with the proposed Newfoundland Liquid Natural Gas project, the proposed Long Harbour Nickel Commercial Processing Plant, a proposed wind power project for Fermeuse, NL, various proposed mining developments in Labrador, as well as additional wildlife surveys associated with the the Lower Churchill project. Mr. Gullage served as a field Study Lead for the Wildlife Habitat Associations surveys and small mammal trapping surveys, as well as participated in data analysis and reporting

Jennifer Mitchell, B.Sc. (Minaskuat Inc.) is an Environmental Scientist based out of Happy Valley-Goose Bay, Labrador. Since joining the firm in 2006, Ms. Mitchell has been involved in various aspects of field data collection, results analysis and reporting. Specific projects which demonstrate her environmental experience include multiple small mammal studies, seasonal wildlife surveys associated with proposed mining developments in Labrador as well as participation in other terrestrial wildlife baseline studies related to the proposed lower Churchill River hydroelectric development. Ms. Mitchell is a beneficiary of the Nunatsiavut Government (formerly the Labrador Inuit Association). She served as a Field Biologist and writer on the Study Team.

Lem Mayo (Minaskuat Inc. Associate) is a senior Natural Resource Technician based in Pasadena, Newfoundland. Mr. Mayo has 35 years Natural Resource Management experience in the Wildlife and Forestry applied disciplines and has extensive experience in wildlife related studies, including studies related to moose, caribou, bear and pine marten. He has a proven interest in Natural Areas through volunteer work as a member and co-chair of the Wilderness and Ecological Reserves Advisory Council. Mr. Mayo brings a comprehensive range of experiences including a life-long commitment to environmental issues, extensive technical field experience and a career that has focused on cooperation, collaboration, and efficient delivery of ecosystem resource management. He is experienced in project management, public presentations and computer software programs. Mr. Mayo served as a Field Lead on the Study Team.

Tina Newbury, M.Sc., (Minaskuat Inc. Associate) is an experienced Wildlife Biologist based in Corner Brook, Newfoundland. She has over 10 years field and other experience, including her involvement on various large-scale projects associated with military activities and proposed mining and hydroelectric development projects in the province. Her work in Labrador includes wildlife investigations of small mammals, forest songbirds, waterfowl, raptors, woodland caribou and other species in the region, as well as various habitat characterization studies. Ms. Newbury served as a Field Lead on the Study Team.

Tony Parr, B.Sc. (Institute for Environmental Monitoring and Research (IEMR)), is a GIS Specialist currently living and working in Labrador. Mr. Parr implements the database strategy and performs GIS analysis of datasets as part of the Department of National Defence's monitoring and mitigation program, through IEMR. In addition, Mr. Parr was a key participant in the long-term River Ecosystem Study that involved a field reconnaissance of the Little Mecatina and the St. Augustin river valleys and a pilot study examining the community composition, abundance, and habitat associations of songbirds, small mammals, and vegetation within the Churchill River valley. He has participated in several summer field programs led by Minaskuat, including various monitoring programs in relation to military aircraft activities. Through these projects and his personal experiences growing up in Labrador, Mr. Parr has a broad background and knowledgebase of wildlife in the region. He served as a Field Lead on the Study Team.

Karen Rashleigh, M.Sc., (Minaskuat Inc.) is an Environmental Scientist based in Happy Valley-Goose Bay specializing in ecological investigations related to resource development in the Labrador region. Since 2003, Ms. Rashleigh has been involved with field and written components of several large-scale investigations including wildlife and rare plant surveys for the Trans Labrador Highway EIS, annual wildlife monitoring programs for the Institute of Environmental Monitoring and Research and formerly the Department of National Defense, as well as terrestrial wildlife surveys as part of the Environmental Assessment for the Lower Churchill Project. Her responsibilities in the Wildlife Habitat Associations Environmental Baseline Study were as Field Lead during the field program, as well as data management, analyses and reporting.

Innu Field Technicians for the Wildlife Habitat Associations Environmental Baseline Study included Penute Andrew, Terry Andrew, Chris Gregoire, Don Blake, Peter McKay, Patrick Penashue, Apenam Pone and Clarence Snow. Technicians were experienced in the field and provided additional insight and traditional knowledge regarding species behavior and distribution within the Survey Area. Their responsibilities for the Wildlife Habitat Associations surveys were as observers for wildlife signs and activity.

4.0 SUMMARY OF STUDY OBJECTIVES

The main objective of this Environmental Baseline Study was to collect information on wildlife habitat associations in the lower Churchill River valley. Specifically, this study was designed to:

- collect observations indicating the presence of selected species of terrestrial wildlife (primarily mammals) in the lower Churchill River valley;
- relate these species to habitat types;
- to characterize wildlife habitat associations; and
- relate small mammal abundances to habitat types to determine habitat preferences/ associations.

The original objectives included habitat use characterization, identification of population trends, classification of habitat, development of Habitat Suitability Indices (HSIs), and to provide an ecosystem description. However, the lack of previous studies on these species in the lower Churchill River valley and Labrador precluded the formation of HSIs specific to the lower Churchill River valley area, and the identification of population trends. Specifically, using dedicated ground surveys, the goals were to gain insight into the current status of various populations and classify habitat to characterize existing conditions. The results of this study will provide an ecosystem description of important habitats and areas of relative concentration (in terms of habitat use) within the Survey Area. Combined with the findings of other studies conducted as part of the Terrestrial Wildlife Component, information collected as part of this Environmental Baseline Study will be used to support the environmental assessment of the proposed Project.

5.0 DESCRIPTION OF THE SURVEY AREA

The Wildlife Habitat Associations surveys were completed within the lower Churchill River valley, including a portion of tributaries and the near-by Goose River valley (Figure 5-1).

The Survey Area included the Mecatina River and Lake Melville ecoregions, that are characterized by a mean annual temperature of approximately -1°C to -2°C and mean annual precipitation of between 800 to 1,000 mm (ESWG 1995). The Mecatina River Ecoregion has a “low sub-Arctic ecoclimate” and is dominated by low, open and sometimes closed patches of black spruce. The Lake Melville Ecoregion is characterized as having a “perhumid high-boreal ecoclimate” and is predominantly a mixed forest of balsam fir, black spruce, white birch and trembling aspen. Elevations range from sea level (Lake Melville Ecoregion) to approximately 600 m asl.

5.1 Wildlife Habitat Association Surveys

Most of the 76 dedicated transects and sampling areas were distributed along the lower Churchill River; others were located along the lower Goose River, as well as the proposed transmission line and within known caribou migration corridors (Figure 5-2).

5.2 Small Mammal Survey Areas

The Study Team established eight trapping grids that occurred in four pairs throughout the lower Churchill River valley (Figure 5-3) to survey small mammals. The location of each pair of trapping grids was selected prior to the surveys to include a variety of habitat types and to permit a comparison between areas below and above the limits of the future reservoirs.

Figure 5-1 Wildlife Habitat Associations Survey Area

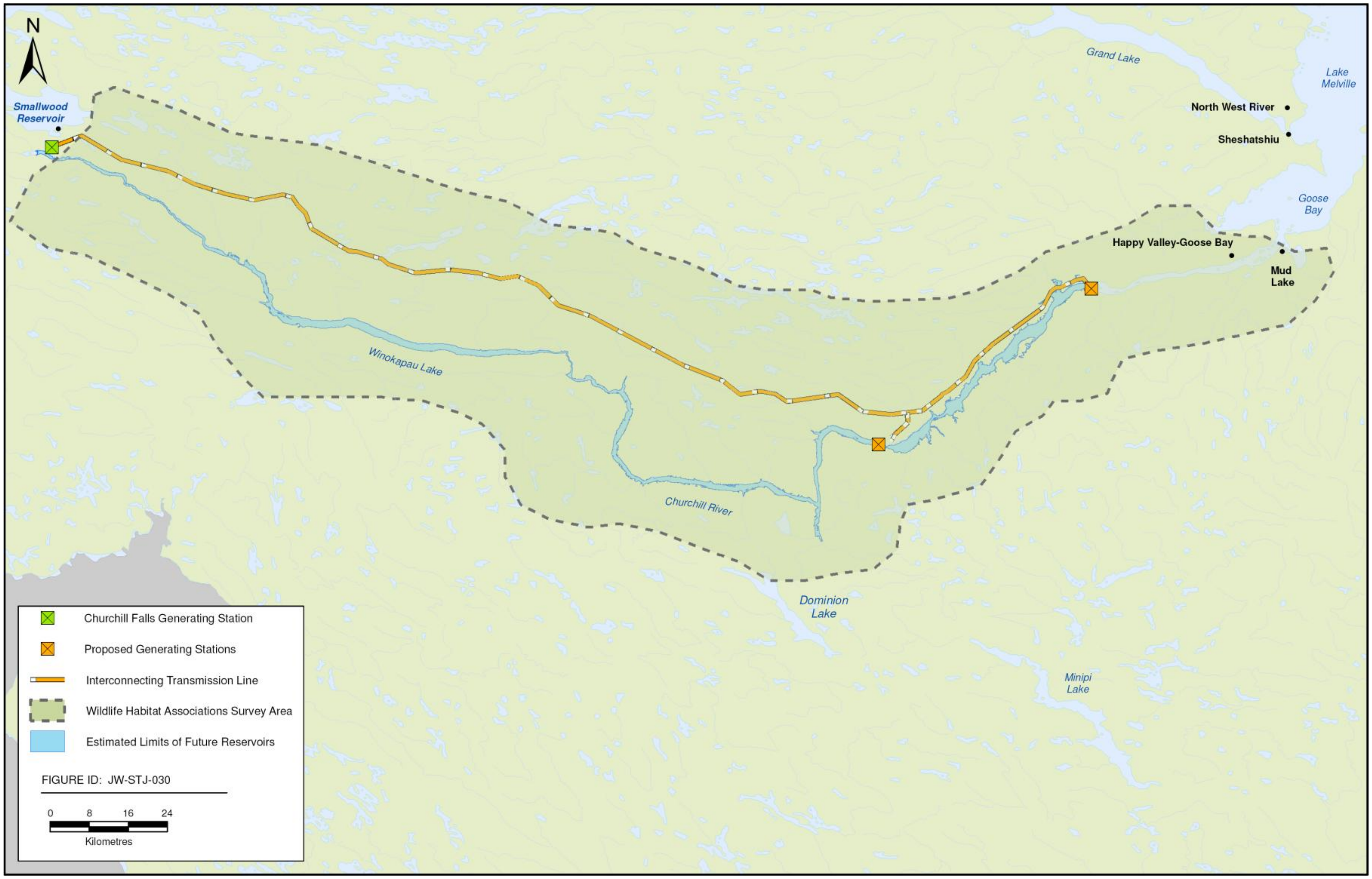


Figure 5-2 Ground Transect Survey Locations

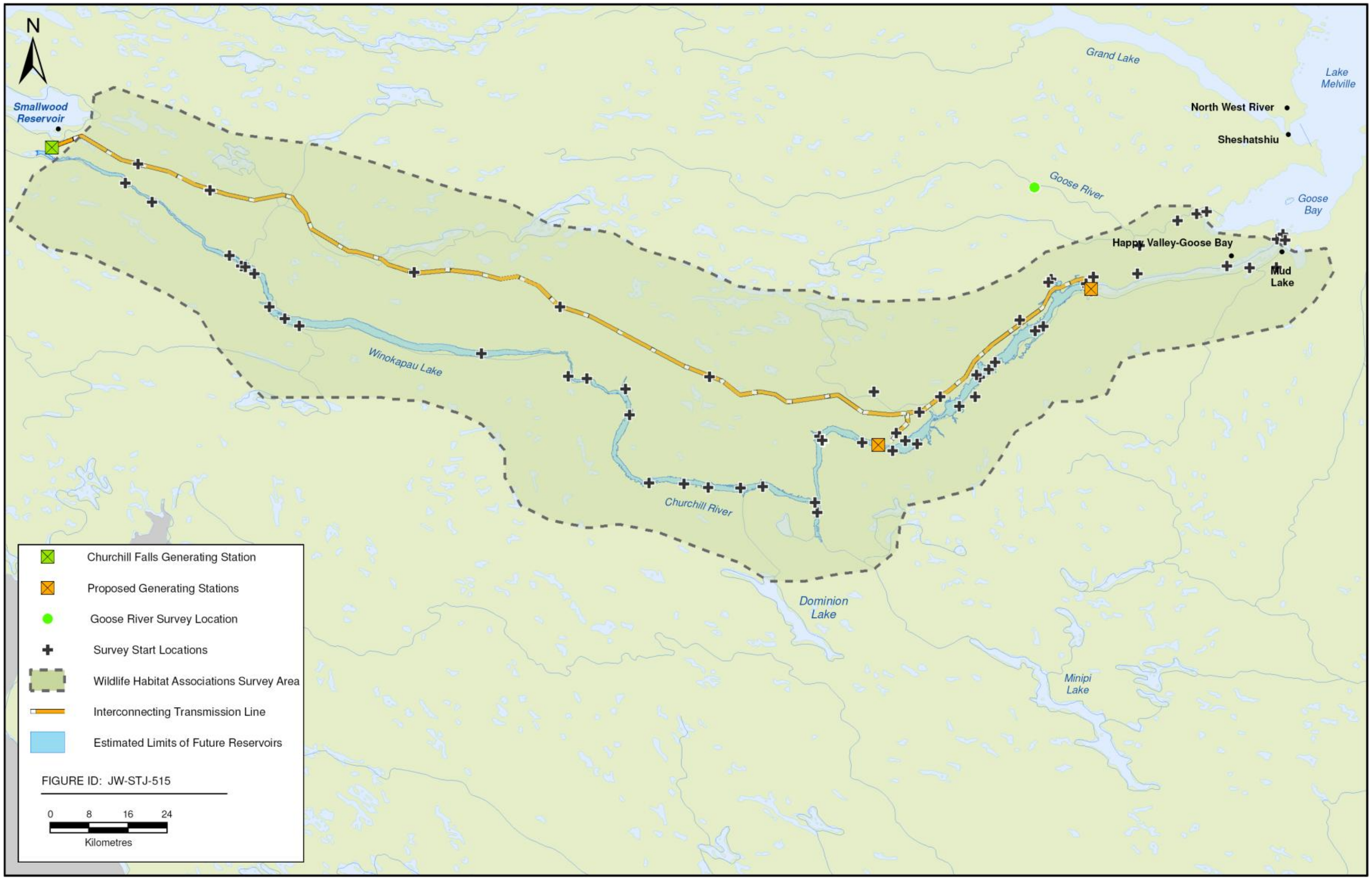
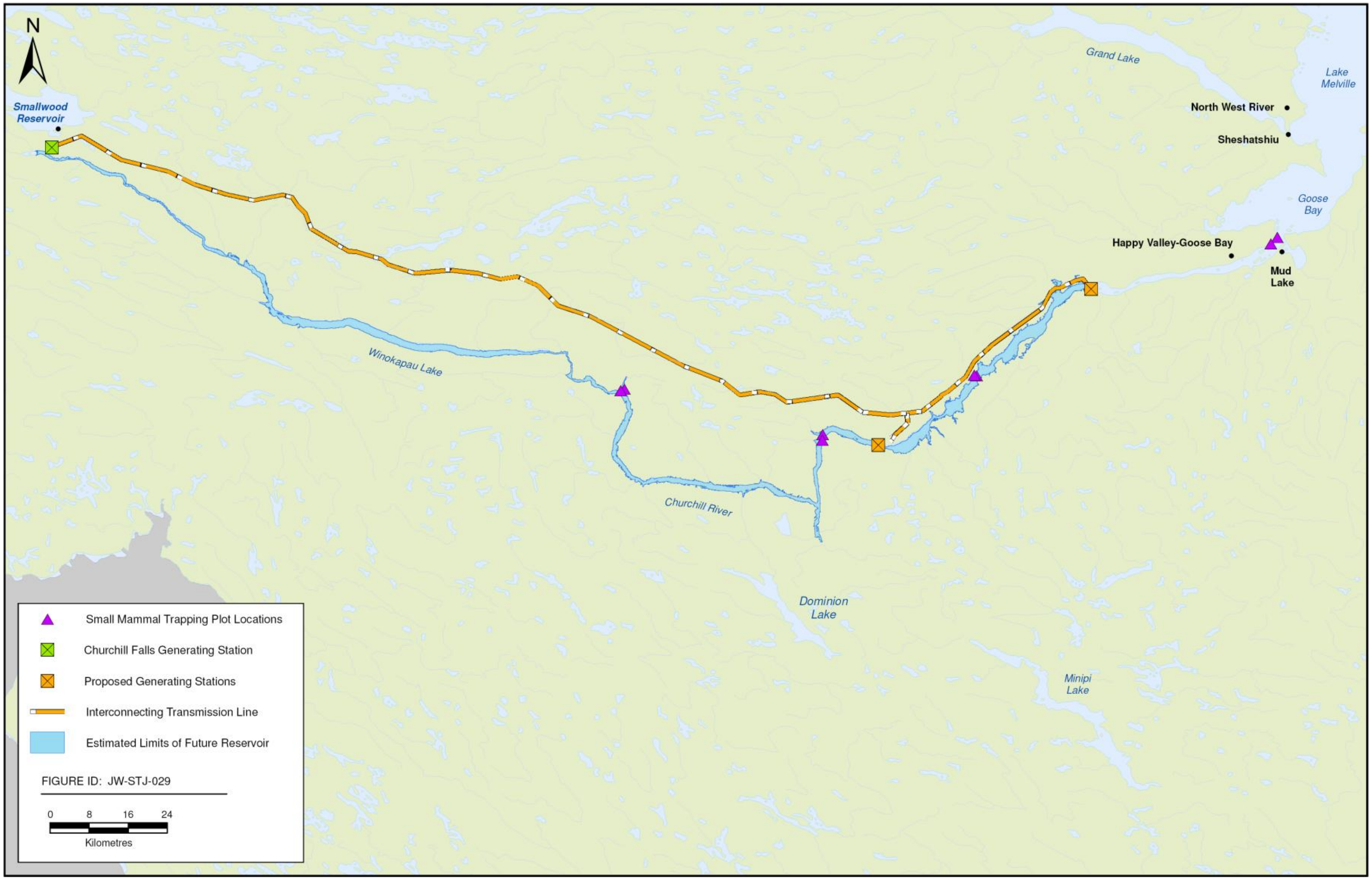


Figure 5-3 Small Mammal Trapping Grid Locations



6.0 METHODS

6.1 Training

Prior to the start of the field surveys, a training program for the aboriginal assistants was provided by Marcel Gahbauer (Study Lead), Tina Newbury and Lem Mayo (Field Leads), with hands-on instruction for data collection methods. Assistants participated by sharing their knowledge of animal sign and providing input on methods. This session also included information on habitat classification, counting (e.g., pellet piles, browse) and distance measurement protocol.

6.2 Data Collection

6.2.1 Ground Transect Surveys

The Wildlife Habitat Associations surveys were conducted from August 8 to September 14, 2006. The timing coincided with the post-breeding season of most species and before the migration or shifts to wintering areas/modes of some species in fall. Rather than estimating abundance, the purpose of these wildlife surveys was to determine relative levels of use between and within habitat types. Such surveys are heavily dependent on the amount of effort, observer skill and time of year and day and, as such, there is some inherent variability in the species-specific data that was collected. Observations were non-independent, as preferred habitat in which one or more animals remained and were present for an extended period yielded more evidence of wildlife presence (e.g., browse, droppings) than poor quality habitat in which wildlife would only be transient. These surveys provided an indication of late-summer use of the lower Churchill River valley and surrounding areas and allowed for the identification of relative areas of concentration for certain species of wildlife.

Thirty-nine transects representing all habitat types were started at or near the beginning of each of the 39 point count transects established for the forest songbirds survey (Minaskuat Inc. 2008a) conducted earlier in the summer. Transects were selected both above (along the transmission line, downstream of Muskrat Falls, and others within the river valley) and below the future reservoir level, to provide insight regarding assessing potential losses and provide a baseline against which to compare conditions post-construction. In many cases, transects were situated at the confluence of a tributary with the Churchill River. Wildlife survey transects at these locations typically followed the shoreline of the Churchill River for approximately 1 to 2 km. Similarly, part of each transect was placed along the tributary. The remainder of these transects were oriented through primarily wooded habitat between the Churchill River and the upstream end of the transect along the tributary. An additional 37 transects were selected to provide more complete and even coverage of all habitat types along the lower Churchill River valley. The majority of these were also based along the Churchill River, with some located inland along either existing transmission line corridors, or within traditional caribou migration corridors. Where topography permitted, a full day (seven to nine hours) was spent surveying long transects from a single base; elsewhere, half-day (two to four hours) transects were conducted. All locations were pre-selected to achieve at least 3 km of habitat survey potential. A summary of transect locations is provided in Appendix A.

Each Field Team surveyed the entire transect, recording wildlife sign, changes in habitat and time and distance covered in each habitat. Opportunistic searches for herpetiles were conducted when suitable habitat was encountered. To the extent possible, Field Teams attempted to adequately sample all habitats within an area and modified the routing of transects accordingly. Data were recorded and expressed as the number of encounters of a target parameter (e.g., observation, droppings, track/trail, browse, or other) per kilometre of each habitat type. Transects were walked at a mean rate of 1.2 km/hour, to permit Study Teams to search thoroughly for wildlife sign.

Habitat was classified according to nine categories (Table 6-1). The data sheets were designed such that observations were recorded on a separate page for each habitat type. The habitat classifications were consistent with those used for the small mammal trapping but at a larger scale.

Table 6-1 Description of Habitat Types

Habitat Type	Description
RI - Riparian	Shoreline vegetation, typically dominated by alders, willows, gale, grasses and sedges. Generally referring to the Churchill River.
WE - Wetland	Wet meadows with standing water in floodplain; alder beds away from the river edge; fens/bogs (sphagnum) in higher areas
SW – Wet Spruce	Canopy >90% spruce; ground moist and typically dominated by feather moss
SD - Dry Spruce	Canopy >90% spruce; ground dry and typically dominated by reindeer lichen
FS - Fir-Spruce	Canopy <10% deciduous, and >10% each fir and spruce (usually fir dominant, and often with white spruce more common than black)
MF - Mixed-Fir Dominant	Canopy 10 to 49% deciduous; fir dominant
MS - Mixed-Spruce Dominant	Canopy 10 to 49% deciduous; spruce dominant
MD- Mixed-Deciduous Dominant	Canopy >50% deciduous
BU - Burn	Recent (<20 years) burn, with or without regenerating vegetation

Field Teams consisted of two to three members, with a Field Lead and one or more Innu field assistants. As the Field Teams walked along transects, habitat was regularly monitored for changes. Minor changes in habitat were not included in the data (e.g., a 20-m 'patch' of reindeer lichen (*Cladina* sp.) groundcover amid an otherwise moss-covered spruce forest). Teams walked around such patches to stay within a consistent habitat. As soon as the habitat was determined to have definitively changed, time and distance were recorded and habitat data sheets were noted accordingly. The distance walked in each habitat type was recorded using a hip chain and start and stop points were recorded on a GPS unit.

6.2.1.1 Mammals

Mammals were the primary focus of the wildlife habitat surveys. Individuals heard or seen were recorded as "observed". The protocols used in collecting other types of data on each species are outlined in Table 6-2. Each type of evidence collected was considered an observational category. For example, observations of individuals, droppings, track/trail, browse and other sign were each recorded in separate columns on the data sheet. Results for each species, in each observational category, in each habitat type, are found in Appendix B and summarized in Section 7.

Table 6-2 Protocols for Recording Mammal Evidence during the 2006 Surveys

Species	Observations
Moose	Each group of droppings was recorded as one incident. Likewise, each track was counted individually, unless following a trail, in which case it was counted only once. Browse was recorded as a separate incident for each distinct plant affected. Leaders were encouraged to identify the species browsed in the notes and indicate the intensity of browsing (light to heavy). Flattened vegetation used as beds were noted as 'other' evidence of use by moose.
Caribou	Protocol similar to that for moose. Other signs of presence included antlers and other bones.
Black Bear	Droppings and tracks were recorded as for moose. Evidence of digging for food was recorded as an incident of browse.
Porcupine	Each porcupine-stripped tree was recorded as an incident of browse (unlike woodpeckers, porcupines debark trees down to the cambium, rather than just flaking off outer bark or drilling holes). Droppings and tracks were recorded as for moose.
Wolf and Red Fox	Droppings and tracks were recorded as for moose. Any kills that could be identified to predator were recorded as browse.
Beaver	Droppings, tracks and browse recorded as for moose. Lodges and dams were recorded under "other" and their UTM coordinates were recorded in the notes section. Lodges consisted primarily of branches as opposed to aquatic plants as used by muskrat.
River Otter/ Mink/ Muskrat/Pine Marten/Fisher	Droppings and tracks were recorded as for moose and were photographed when possible to confirm identification. Otter and mink are known to use "slides" to enter the water, with mink slides being narrower. Muskrat lodges consist of mud and aquatic plants and were recorded as 'other'. Marten and fisher are secretive and evidence was not expected to be found; the protocol for both was as for otter, mink, and muskrat. However, fisher is the only eastern animal that preys on porcupine (Rezendes 1999), so evidence of this would indicate fisher presence.
Snowshoe Hare	Droppings, tracks and browse were recorded as for moose. Trails were also detected as narrow tracks through the ground vegetation, with no clearing of vegetation above to indicate use by larger mammals.
Red Squirrel	Individual tracks were not seen at this time of year, but 'squirrel trails' in lichen or other ground cover between trees were recorded as single tracks. Each feeding site (pile of eaten cones) was recorded as one incident of browse.
Rodent trails/holes	Each small trail was recorded; some of these may have been made by red squirrels, but most were likely sign of smaller rodents. Each hole or potential burrow observed was also recorded in this category.
Game trails	Each large, heavily-used trail was recorded in this category; it is likely that such trails are created and used primarily by caribou, moose and/or black Bear.

6.2.1.2 Other Species

Point count surveys for breeding birds were conducted as part of the forest songbird study during late June and early July of 2006 at 39 of the 76 sites used for wildlife surveys (Minaskuat Inc. 2008a). These surveys were repeated in June of 2007, with sixteen additional transects surveyed to fill geographic gaps in the original sampling strategy and to target habitats that were underrepresented in 2006. As it was past the breeding season for most passerines, bird observations were not a priority during these Wildlife Habitat Associations surveys. However, all incidental observations were recorded to supplement the previously collected point count data. Trees foraged by woodpeckers were also recorded on the data sheets, indicating evidence of Black-backed (*Picoides arcticus*), American Three-toed (*P. dorsalis*) or Hairy (*P. villosus*) Woodpeckers. Grouse and ptarmigan droppings were also noted.

Dedicated surveys were conducted for Herpetiles in July 2006 (Minaskuat Inc. 2008b). August/September is not considered an ideal period to search for these species, however, incidental observations were recorded throughout the Wildlife Habitat Associations field program, in particular of frogs and toads. All sightings were documented, along with a brief description of the microhabitat in which they were observed.

Other teams working on related Environmental Baseline Studies (e.g., wetlands (Minaskuat Inc. 2008c), Ecological Land Classification (Minaskuat Inc. 2008d)) for the Project also noted relevant observations. This information was eventually combined with the wildlife habitat survey database to supplement the number of observations and provide an enhanced depiction of species' distributions and habitat preferences.

6.2.2 Small Mammal Trapping

The field program for the small mammal program was conducted from August 10 to 26, 2006. This timing coincided with post-breeding and prior to the onset of wintering behaviour.

Following established techniques used by the Study Team and other researchers in Labrador (e.g., Simon et al. 1998; 2002), trapping grids comprised 100 trapping stations in a 180 m by 180 m pattern set at lower and higher elevations. Each trap station consisted of two snap traps (Victor Traps) placed within 1 m of each other, with stations spaced 20 m apart. Following the initial day of set up, the traps were checked for three days, on the last of which the traps were removed. A bait mixture consisting of peanut butter and rolled oats was applied to each trap upon deployment and reapplied as necessary each time the traps were checked.

Weather conditions were recorded daily for each trapping grid. At each station, the habitat was recorded according to the classifications in Table 6-1. The status of each trap (untouched, bait gone, specimen trapped) was recorded, with any trapped specimens identified, bagged and pre-labeled by species and location. The identification of all specimens was subsequently confirmed by senior team members at the Minaskuat Inc. office.

6.3 Data Analyses

Data were compiled in spreadsheets by habitat type and wildlife species. Data were analyzed for trends across habitats and species. Sixty-seven observational categories were used in the analysis, including five types of wildlife sign (observed, droppings, track/trail, browse, or other) for each of the 13 species that were surveyed, plus game trails and rodent burrows.

A linear regression was performed on the survey data to determine whether the number of observations was correlated to effort (i.e., the distance traversed). Habitats were also grouped according to moisture regime and coniferous versus deciduous cover.

For the small mammal trapping data, abundance indices were calculated as the total number of animals (individuals of a species) captured per habitat type. Capture rates were determined for each species by dividing the number of animals captured by the number of trap nights. A statistical t-test was performed on upper and lower trap grids for each species to determine if there was a statistically significant difference in abundance related to elevation.

6.4 Quality Assurance/Quality Control

To ensure consistent delivery of high quality products and services, Minaskuat Inc. has developed and implemented a Quality Management System (QMS) for its operations. The QMS is registered to ISO 9001:2000 (Quality Management Systems - Requirements) by QMI Management System Registration (CERT-0011312:026332).

An in-house technical peer review process was conducted of the draft report by senior reviewers to ensure that this report adequately addresses the Project scope and conforms to the quality requirements stipulated by Minaskuat Inc.

7.0 RESULTS

7.1 Wildlife Habitat Associations

Over 10,000 individual observations of wildlife and wildlife sign (mammals, avifauna and herpetiles) were tallied during 323 km of transects in nine habitat types during the 2006 Wildlife Habitat Associations surveys (Table 7-1) (refer to Appendix B for linear density of observations). Red squirrel, snowshoe hare and moose sign accounted for the majority of mammal records in these favored habitat types. Spruce forest, either wet or dry sites, accounted for 48 percent of all observations but were also the most intensively surveyed. Mixed habitat, comprised of Mixed-Fir Dominant, Mixed-Spruce Dominant, or Mixed-Deciduous Dominant, accounted for 27 percent of the observations. The remainder of the observations occurred within Riparian, Burn, Wetland and Fir-Spruce habitats.

Table 7-1 Total Number of Wildlife Observations by Habitat Type

Habitat Type	Observations[A,B]	Total Distance (km)[A]	Observations/km
Burn	384 (8)	19.41 (5)	19.89.8 (9)
Fir-Spruce	1118 (4)	25.70 (4)	34.4 (3)
Mixed-Deciduous Dominant	391 (7)	16.87 (8)	18.1 (6)
Mixed-Fir Dominant	1307 (3)	18.30(7)	63.5 (1)
Mixed-Spruce Dominant	910 (5)	18.79 (6)	38.1 (2)
Riparian	860 (6)	50.35 (3)	14.1 (7)
Dry Spruce	2368 (2)	97.08 (1)	18.5 (5)
Wet Spruce	2363 (1)	62.14 (2)	33.1 (4)
Wetland	352 (9)	14.87 (9)	11.4 (8)
Total	**10,053**	**323.51**	**24.7**

[A] number in parentheses denotes relative ranking of each habitat type by parameter.
[B] Observations include mammals, avifauna and herpetiles (amphibians).

The total number of wildlife observations (Table 7-1) was related to the distance sampled in each habitat type (P=0.006). Observation rates in mesic (moist) areas (such as Fir-Spruce, Mixed-Fir Dominant, Mixed-Spruce Dominant, Mixed-Deciduous Dominant and Wet Spruce habitats) were above average, while both dry (Burn and Spruce) and wet habitats (Riparian and Wetland) were below average. Most observations were of browse, tracks and droppings (Table 7-2). Observations of moose evidence outnumbered other species, likely due in part to the obvious nature of the browse, tracks and droppings generally recorded as evidence of this species (Table 7-2). Red squirrel observations were also high, primarily due to the high number and visibility of coniferous cone caches on the surveys (Table 7-2). Red squirrels were also vocal and therefore often identified by sound. Snowshoe hare sign was also common, likely due to the high visibility of droppings, tracks and browse (Table 7-2). Some terrestrial species such as marten, grey wolf and red fox were rarely observed, as they are secretive and difficult to identify by sign. These species also occupy relatively large territories with low densities. Evidence was also difficult to collect for aquatic and semi-aquatic species like beaver, otter, muskrat and mink as they spend significant time in the water.

Table 7-2 Number and Type of Observations for Mammal Species Across all Habitats

Species	Observed	Droppings	Track	Browse	Other	Total
Moose	2	914	679	1,045	22	2,662
Woodland Caribou	0	37	41	15	18	111
Black Bear	2	14	243	96	7	495
Porcupine	6	31	4	348	6	395
Grey Wolf	3	75	42	0	0	120
Red Fox	2	20	57	2	1	82
Beaver	2	1	5	14	5	27
Muskrat	0	10	13	3	0	26
Mink	0	3	3	0	0	6
River Otter	0	7	9	0	0	16
Marten	0	2	0	0	0	2
Snowshoe Hare	5	316	815	113	5	1,254
Red Squirrel	294	12	288	1,339	564	2,497
Unidentified small rodent	na	na	168	na	na	168
Unidentified large game	na	na	121	na	na	121
Total	**316**	**1,529**	**2,186**	**2,993**	**63**	**7,982**

Certain species appeared to prefer some habitat types (Table 7-3). Based on sign density calculations (i.e., total number of observations per linear distance surveyed), evidence of moose and red squirrel were the most commonly encountered, primarily associated with Mixed-Fir Dominant habitats (Table 7-3). Snowshoe hare evidence was also relatively common, usually in Mixed-Fir Dominant, Mixed-Spruce Dominant and Wet Spruce habitats (Table 7-3).

Relatively recent black bear sign (i.e., summer) was recorded throughout habitat types, at relatively low frequencies (Table 7-3). Porcupine browse was commonly found in all habitat types sampled, reflective of their generalist nature, but predominantly in coniferous-dominated forests (Table 7-3). Wolf evidence was rare and consisted largely of easily detected tracks in open burns (Tables 7-2 and 7-3). Fox evidence was most often in the form of tracks or droppings and most were made in Riparian, Burn and Mixed-Deciduous habitat types, but were overall relatively scarce (Tables 7-2 and 7-3). Evidence of caribou was low and relatively consistent across habitat types, with slightly higher observations rates in Mixed-Fir Dominant and Dry Spruce habitats (Table 7-3). Beaver and muskrat sign were usually in Wetland and Riparian habitats, though evidence of their presence was relatively scarce (Table 7-3). Evidence of Mustelids (mink, river otter and marten) was almost absent from the surveys (Table 7-3).

The highest frequencies of observation occurred in Mixed-Fir Dominant, Mixed-Spruce Dominant, Fir-Spruce and Wet Spruce habitats; the lowest frequencies of observation were in Wetland, Burn and Riparian habitats (Table 7-1). Riparian habitat accounted for the third fewest number of observations per kilometre, but had the highest number of observational categories (observed, droppings, track, browse or other) with peak values in this habitat (e.g., the highest proportion of Moose browse was identified in Riparian habitats) (Table 7-4, Appendix B). This suggests that while the overall level of activity in Riparian habitats was low, these areas were actually of high importance for some species.

Table 7-3 Total Number of Observations of Mammal Species per Linear Distance Surveyed

Species	Habitat Type[A]									Overall Density[B]
	BU	FS	MD	MF	MS	RI	SD	SW	WE	
Moose	4.95	11.56	9.25	24.10	11.02	9.20	5.16	6.45	6.72	8.23
Caribou	0.26	0.04	0.18	0.66	0.37	0.24	0.55	0.23	0.27	0.34
Bear	1.13	0.97	1.24	1.26	2.08	1.19	1.80	1.93	0.67	1.53
Porcupine	0.05	2.65	1.07	2.13	1.38	0.52	0.61	2.49	0.20	1.22
Wolf	2.11	0.27	0.47	0.11	0.11	0.34	0.32	0.13	0.27	0.37
Fox	0.46	0.08	0.47	0.05	0.16	0.56	0.24	0.10	0.13	0.25
Beaver	0.00	0.00	0.00	0.00	0.00	0.38	0.03	0.03	0.20	0.08
Muskrat	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.81	0.08
Mink	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.02
Otter	0.00	0.00	0.00	0.05	0.00	0.28	0.00	0.00	0.07	0.05
Marten	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.01
Hare	0.15	3.77	3.08	11.86	7.93	0.12	2.39	7.89	0.54	3.88
Squirrel	0.52	14.86	2.13	23.06	14.58	0.54	5.29	13.18	0.87	7.72
Rodent trails/holes	0.00	0.04	0.12	0.05	0.21	0.02	1.39	0.37	0.07	0.52
Game trails	0.21	0.16	0.06	0.16	0.21	0.30	0.68	0.26	0.54	0.37
Total	9.84	34.44	18.08	63.50	38.05	14.06	18.46	33.07	11.36	24.67

A RI = Riparian; WE = Wetland; SW = Wet Spruce; SD = Dry Spruce; FS = Fir-Spruce; MF = Mixed-Fir Dominant; MS = Mixed-Spruce Dominant; MD= Mixed-Deciduous Dominant; BU = Burn
B Density of all observations, by species, across habitat types

Table 7-4 Peak Observations of Wildlife Signs per Habitat Type

Habitat Type	Number of Wildlife Observation Categories with Peak Values in that Habitat[A]	Rank (number of observations per survey km)[B]
Mixed-Fir Dominant	8	1
Mixed-Spruce Dominant	6	2
Fir-Spruce	6	3
Wet Spruce	1	4
Dry Spruce	4	5
Mixed-Deciduous Dominant	3	6
Riparian	16	7
Wetland	6	8
Burn	3	9

[A] Categories for wildlife observations are: Observed, Droppings, Tracks, Browse and Other.
[B] One (1) denotes the highest occurrence of observations and 9 the lowest.

Mixed-Fir Dominant ranked second in terms of the number of peak observations of wildlife sign (Table 7-4), indicating that not only does it support the highest overall level of mammal activity, but that it is the preferred habitat for a large number of species and activities. When the habitats were re-grouped according to moisture regime (with wetland and riparian comprising the wet category), the aquatic furbearers naturally showed up overwhelmingly in the wet cluster. Few observational categories peaked at the dry end of the spectrum (with the exception of wolf and fox); the vast majority was within the mesic habitat types.

Another grouping that was investigated was the potential effects of forest composition, with respect to coniferous or deciduous cover. For the "all-coniferous" vs. "all or partially deciduous" habitat types, there were more cases (21 vs. 4) where rate of occurrence of observational categories in all or partially deciduous habitat was twice as high as that in coniferous habitat. The rate of occurrence of observational categories in all or partially deciduous versus coniferous was 9 vs. 4, when observations of aquatic and semi-aquatic furbearers were removed from the calculated rates.

7.2 Small Mammal Survey Results

A total of 238 small mammals, comprised of four species, were collected over 4,758 trap nights involving the eight trapping grids (Table 7-5). Red-backed vole was the most frequently captured small mammal (n=166 or 69.7 percent), followed by masked shrew (n=32 or 13.4 percent), woodland jumping mouse (n=23 or 9.7 percent) and meadow vole (n=17 or 7.1 percent) (Table 7-5). Most captures were in the Wet Spruce habitat (Table 7-5), the most heavily sampled habitat type. Capture rate was positively correlated to effort for red-backed vole (P=0.04). Note that burns were not sampled during the small mammal trapping, due to lack of availability of this habitat type in the valley. Sample sizes were not sufficient to rigorously test habitat associations, but some trends were evident from the data (refer to Appendix C for site data).

Table 7-5 Small Mammals Captured by Habitat Type in 2006

Habitat Type	Total Number of Trap Nights	Total Captures by Species per Habitat Type (number per 100 trap nights)				Total Captures per Habitat Type
		Red-backed Vole*	Meadow Vole	Masked Shrew	Woodland Jumping Mouse	
Riparian	18	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
Wetland	72	3 (4.17)	0 (0.00)	1 (1.39)	0 (0.00)	4 (5.56)
Wet Spruce	2016	43 (2.13)	4 (0.20)	8 (0.40)	8 (0.40)	63 (3.13)
Dry Spruce	948	15 (1.58)	3 (0.32)	1 (0.11)	1 (0.11)	20 (2.11)
Fir-Spruce	498	22 (4.42)	1 (0.20)	5 (1.00)	2 (0.40)	30 (6.02)
Mixed-Spruce Dominant	420	32 (7.69)	2 (0.48)	3 (0.71)	2 (0.48)	39 (9.29)
Mixed-Fir Dominant	330	26 (7.90)	0 (0.00)	10 (3.03)	1 (0.30)	37 (11.21)
Mixed-Deciduous Dominant	456	25 (5.48)	7 (1.54)	4 (0.88)	9 (1.97)	45 (9.87)
Total	**4,758**	**166 (3.49)**	**17 (0.36)**	**32 (0.67)**	**23 (0.48)**	**238 (5.00)**

Capture rate gave an accurate picture of the importance of each habitat, as it accounts for effort. Mixed-Fir Dominant habitat had the highest capture rate for red-backed vole and masked shrew (Table 7-5). Mixed-Spruce Dominant habitat had the second highest capture rate for red-backed vole (Table 7-5). Meadow vole and woodland jumping mouse appeared to prefer some deciduous habitat, as they were both captured most often in Mixed-Deciduous Dominant habitat (Table 7-5).

Species richness ranged from 0 (in Riparian habitat) to 4 small mammal species per habitat. All four species were found in Mixed-Deciduous Dominant, Mixed-Spruce Dominant, Fir-Spruce, Dry Spruce and Wet Spruce habitat (Table 7-5). Wetland habitat had the least number of captured species, with only red-backed vole and masked shrew being captured (Table 7-5). All species but meadow vole were captured in Wet Spruce and Mixed-Fir Dominant habitat (Table 7-5).

The paired sampling grids allowed for a comparison between the upper (above the limits of the future reservoirs) versus lower (below the limits of the future reservoirs) sites. A two-sample t-test was done on the red-backed vole data for the upper versus lower sites. Data were "bootstrapped" to obtain a larger sample size and calibration for equal effort. No significant difference was found between the two means (P=0.74), suggesting that red-backed voles may not select their habitats based on whether the site is at lower or higher elevations within the valley. Masked shrew mean captures were found to be significantly higher on the upper sites than the lower sites (P=0.02). For woodland jumping mouse, there was no significant difference between upper and lower sites (P=0.79), while the number of meadow vole captures was significantly higher on the upper sites (P=0.00).

7.3 Observations from Other Environmental Baseline Studies

Several observations of wildlife were made during other Environmental Baseline Studies, including songbirds (Minaskuat Inc. 2008a), herpetiles (Minaskuat Inc. 2008b), wetlands (Minaskuat Inc. 2008c) and Ecological Land Classification (Minaskuat Inc. 2008d). As these observations did not consistently include habitat data or effort calculations, they have not been included in the Wildlife Habitat database. Rather, these data have been used to supplement information on the distribution of and habitat use by these species and included in the environmental assessment where appropriate.

7.4 Wildlife Habitat Mapping

Observation data collected during the Wildlife Habitat field program and other dedicated baseline studies (e.g., moose, caribou) were subsequently pooled and used in conjunction with supporting literature on specific habitat requirements, to develop maps depicting year-round habitat suitability for selected species or species groups. Detailed habitat data were obtained for the lower Churchill River valley during the Ecological Land Classification survey (Minaskuat Inc. 2008d). Where possible, wildlife habitat type for each species (or group) was classified as primary, secondary or tertiary habitat according to its importance for food, shelter and/or other criteria during a sensitive period or year-round (Table 7-6). The abundance and distribution of primary, secondary or tertiary habitat in the lower Churchill River valley is unique to each species. Examples of habitat suitability maps developed for moose, bear, porcupine, marten and caribou are provided in Figures 7-1 to 7-5, respectively.

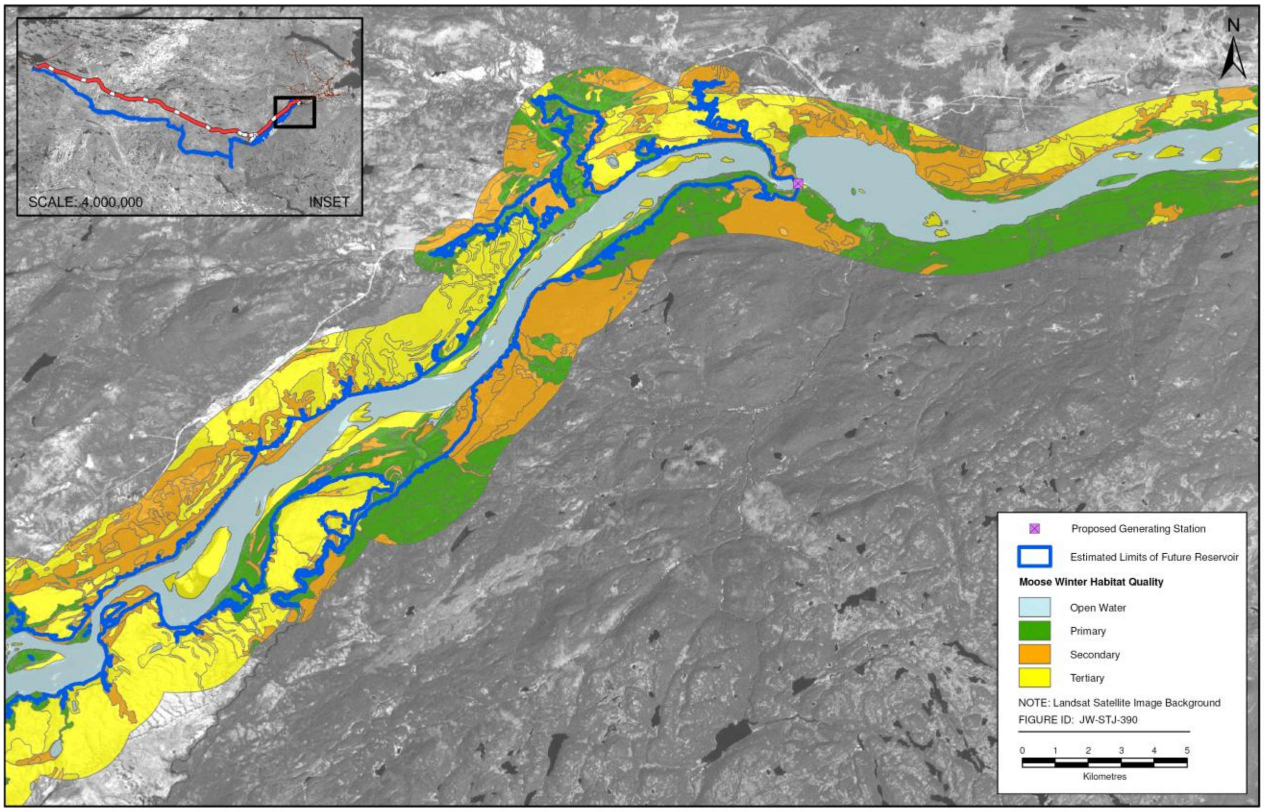
Table 7-6 Wildlife Habitat Types and Relative Seasonal Importance for Selected Species in the Lower Churchill River Valley

Habitat Type	**Moose**		**Bear**		**Porcupine**	**Marten**
	Fall/ Winter	**Spring/ Summer**	**Spring/early Summer**	**Summer/ Fall**	**Year-round**	**Year-round**
Riparian (RI)	Secondary	Secondary	Primary	Secondary	Secondary	Tertiary
Wetlands (WE)	Secondary	Primary	Secondary	Secondary	Tertiary	Tertiary
Dry Black Spruce (SD)	Tertiary	Tertiary	Primary	Primary	Secondary	Secondary
Wet Black Spruce (SW)	Secondary	Secondary	Primary	Primary	Primary	Primary
Mixed White Spruce (WH)	Primary	Secondary	Primary	Primary	Primary	Primary
Fir-Spruce (FS)	Primary	Secondary	Primary	Primary	Primary	Primary
Mixed Fir (MF)	Primary	Secondary	Secondary	Primary	Secondary	Primary
Mixed Spruce (MS)	Primary	Secondary	Secondary	Primary	Secondary	Primary
Hardwood (HA)	Secondary	Secondary	Secondary	Primary	Secondary	Secondary
Burns (BU)	Secondary	Secondary	Secondary	Secondary	Tertiary	Tertiary
Non-Habitat (open water)	None	None	None	None	None	None
				Caribou		
Reclassified Habitat Type	**Typical Habitat**			**Calving**	**Post-calving**	**Winter**
Coniferous-Dominated Forest	WS, pine and/or BF, moderate-dense canopy, low lichen cover			Tertiary	Tertiary	Tertiary
Deciduous/hardwood Dominated Forest	Aspen or birch dominated, dense canopy, little or no lichen cover			Tertiary	Tertiary	Tertiary
BS dominated Forest	BS dominated, dense canopy, typically low lichen /high feathermoss cover			Secondary	Secondary	Secondary
BS/Softwood Scrub	Stunted BS with some young BS and BF, high lichen ground cover			Primary	Primary	Primary
Young Forest/ Hardwood Scrub	All young forest habitats & deciduous dominated shrublands, low lichen cover			Tertiary	Tertiary	Tertiary
Bog	Peatlands, little tree cover (BF, larch, birch and/or BS), low lichen cover			Secondary	Secondary	Secondary
Treed Bog	BS dominated peatlands, open canopy, low to moderate lichen cover			Secondary	Secondary	Secondary
Barren	Rock, soil and/or sand dominant, no lichen			Tertiary	Tertiary	Tertiary
Cultural	e.g., cleared land, agriculture, residential			Tertiary	Tertiary	Tertiary
Linear Features	e.g., roads, highways, transmission lines			Tertiary	Tertiary	Tertiary
Water	Water			Tertiary	Tertiary	Tertiary
Cut-overs	Logging disturbance (≤ 20 years)			Tertiary	Tertiary	Tertiary
Natural Disturbance	e.g., fire, insect outbreaks, wind storms and disease (≤ 20 years)			Tertiary	Tertiary	Tertiary

Notes:

1. Selected species are based on information available from documents (Key Indicators) prepared as part of the Environmental Assessment for the proposed Project.
2. Habitat Type descriptions for moose, bear, porcupine and marten are provided in Table6-1. Caribou habitat was reclassified and definitions are provided.
3. Primary Habitat: provides all the main habitat requirements of a species (e.g., abundance of food, protection, resting, spatial separation from predators and/or other habitat such as that utilized for breeding, denning or other activities); Secondary Habitat: provides an abundance of one or more of the three elements (or marginal amounts of all); Tertiary Habitat: marginal habitat providing few or no habitat requirements, may be used as a corridor and/or avoided.
4. BS = Black Spruce; BF = Balsam Fir; WS = White Spruce

Figure 7-1 Moose Habitat Quality - Muskrat Falls (above) and Gull Island (below)



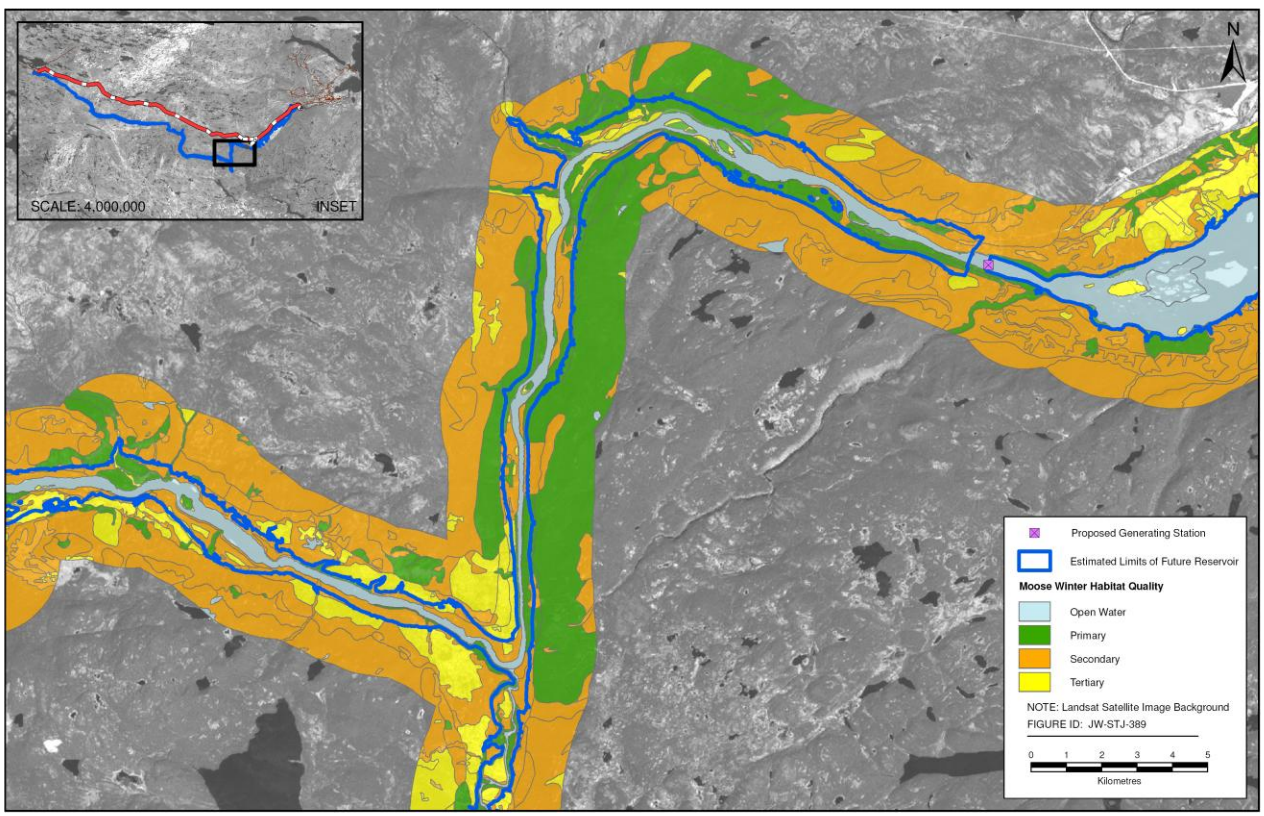
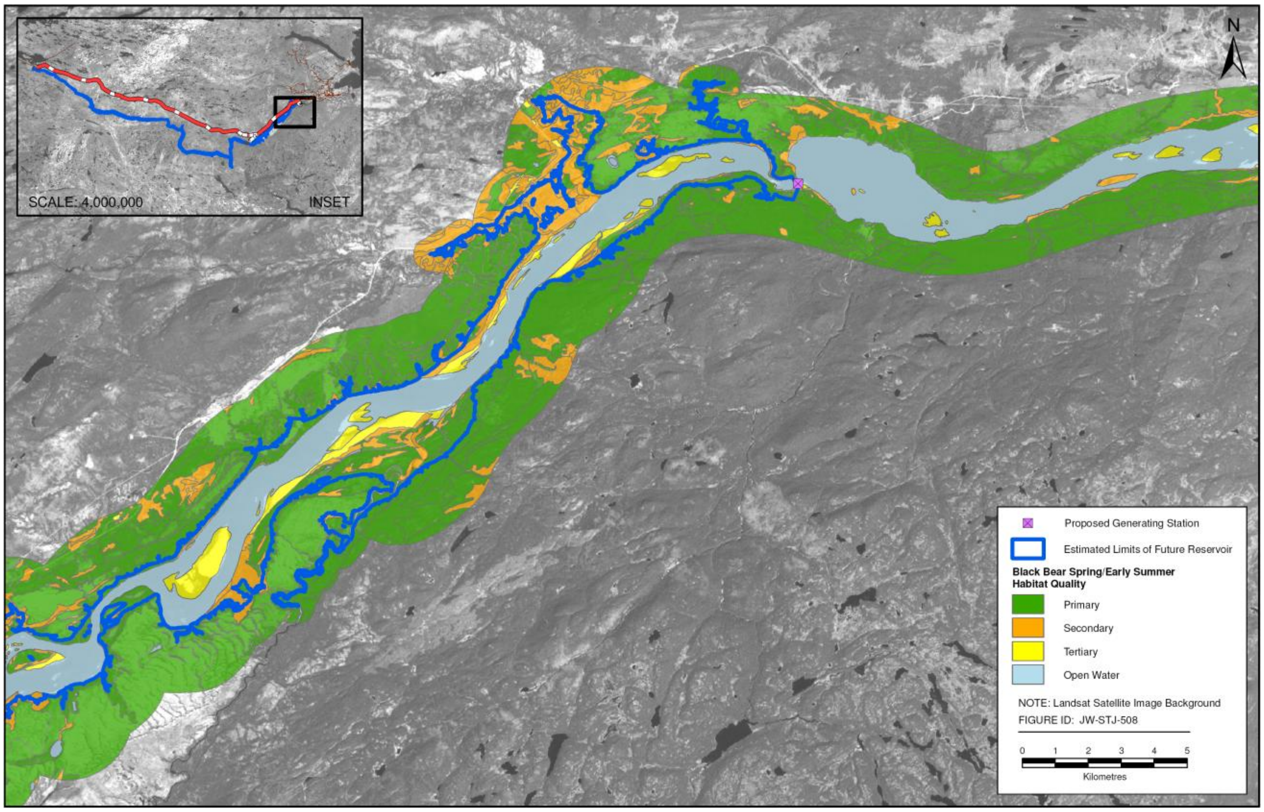


Figure 7-2 Black Bear Habitat Quality Spring/Early Summer– Muskrat Falls (above) and Gull Island (below)



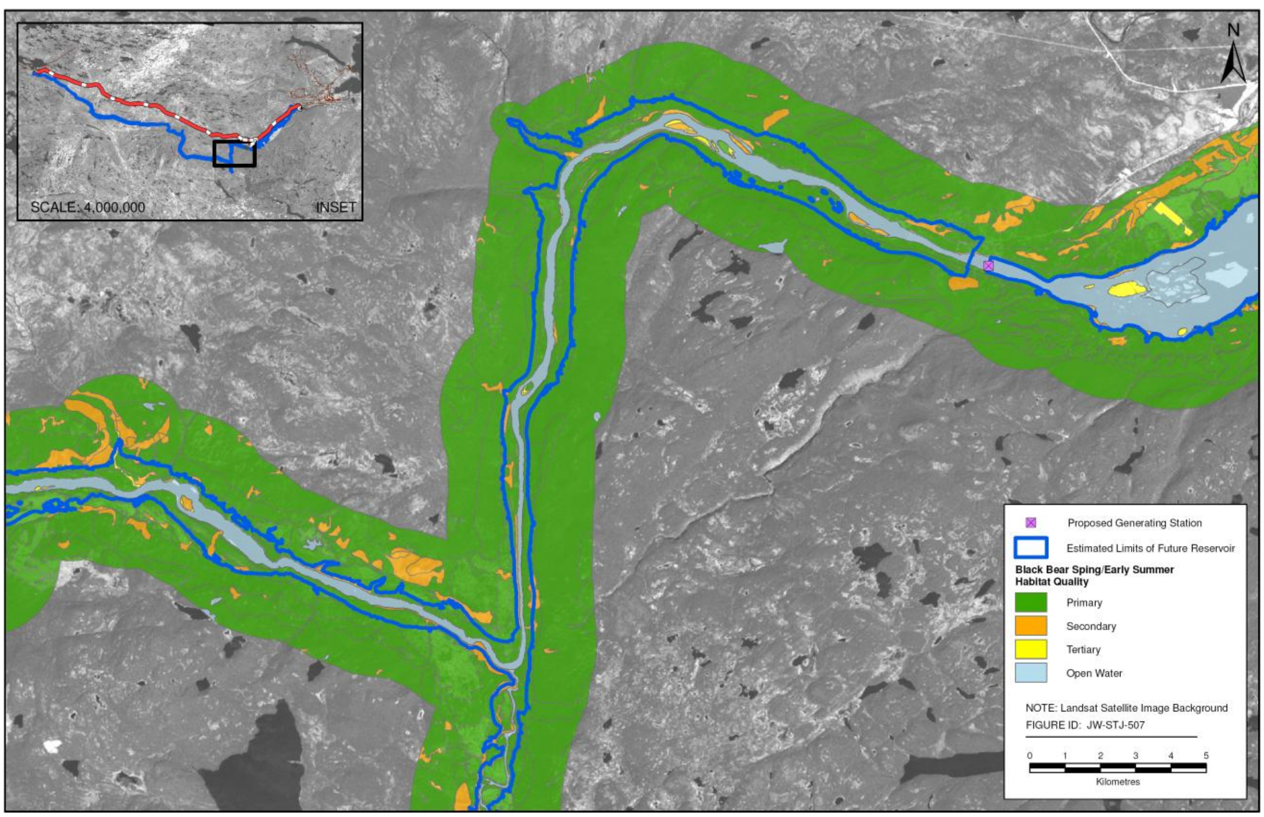
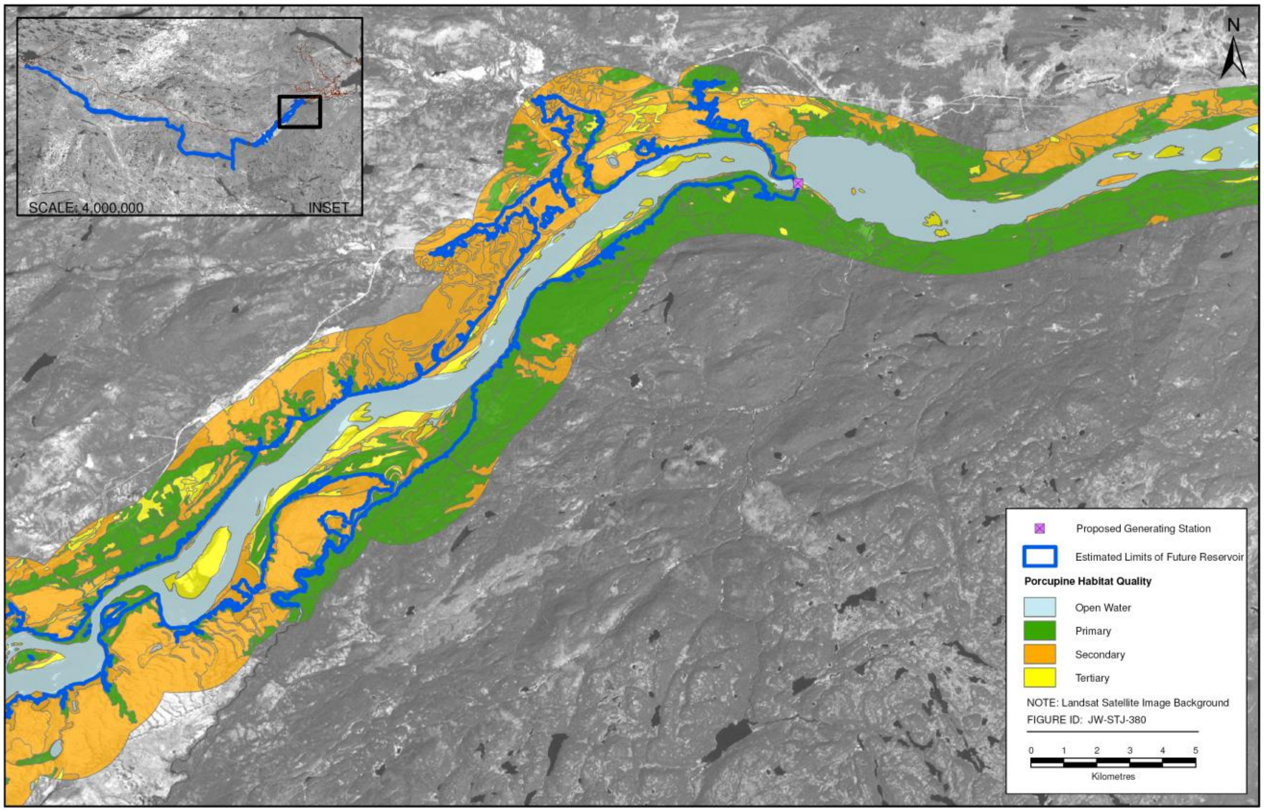


Figure 7-3 Porcupine Habitat Quality - Muskrat Falls (above) and Gull Island (below)



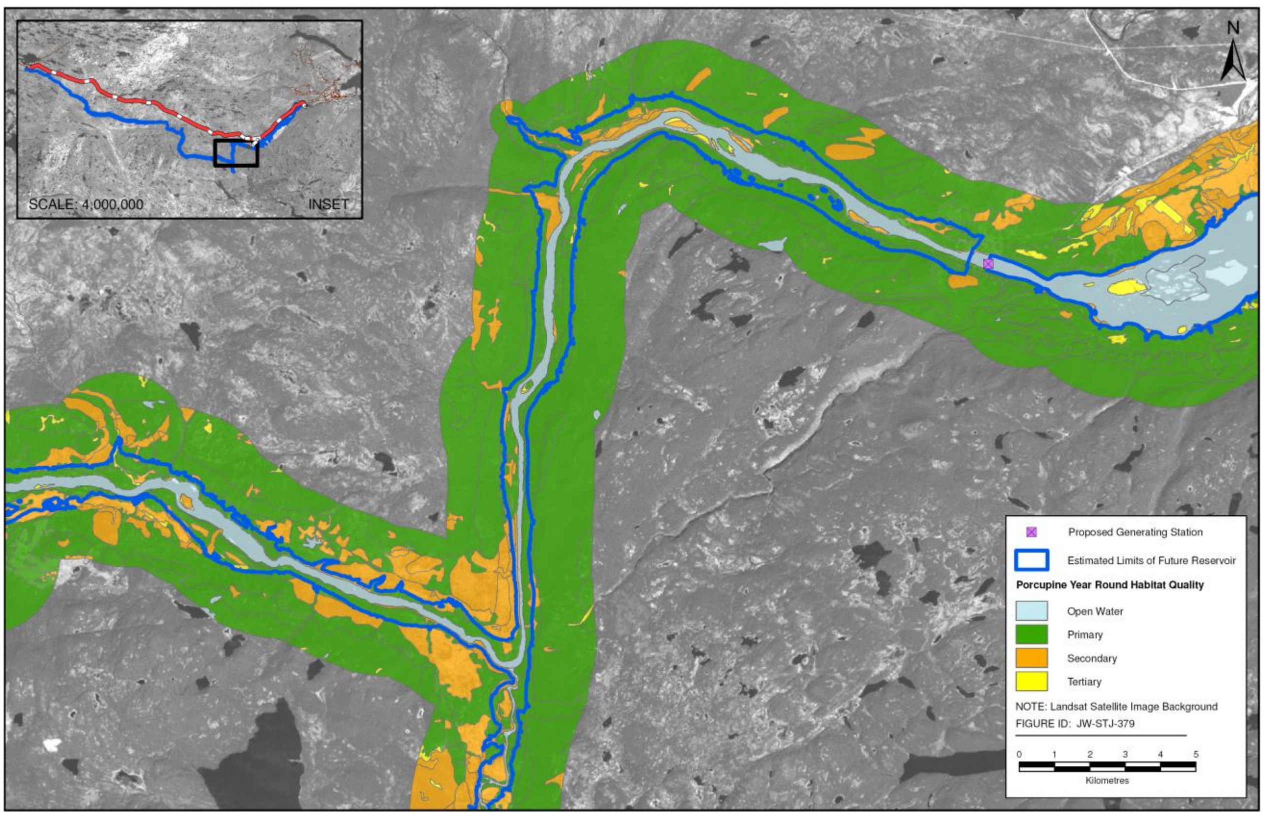
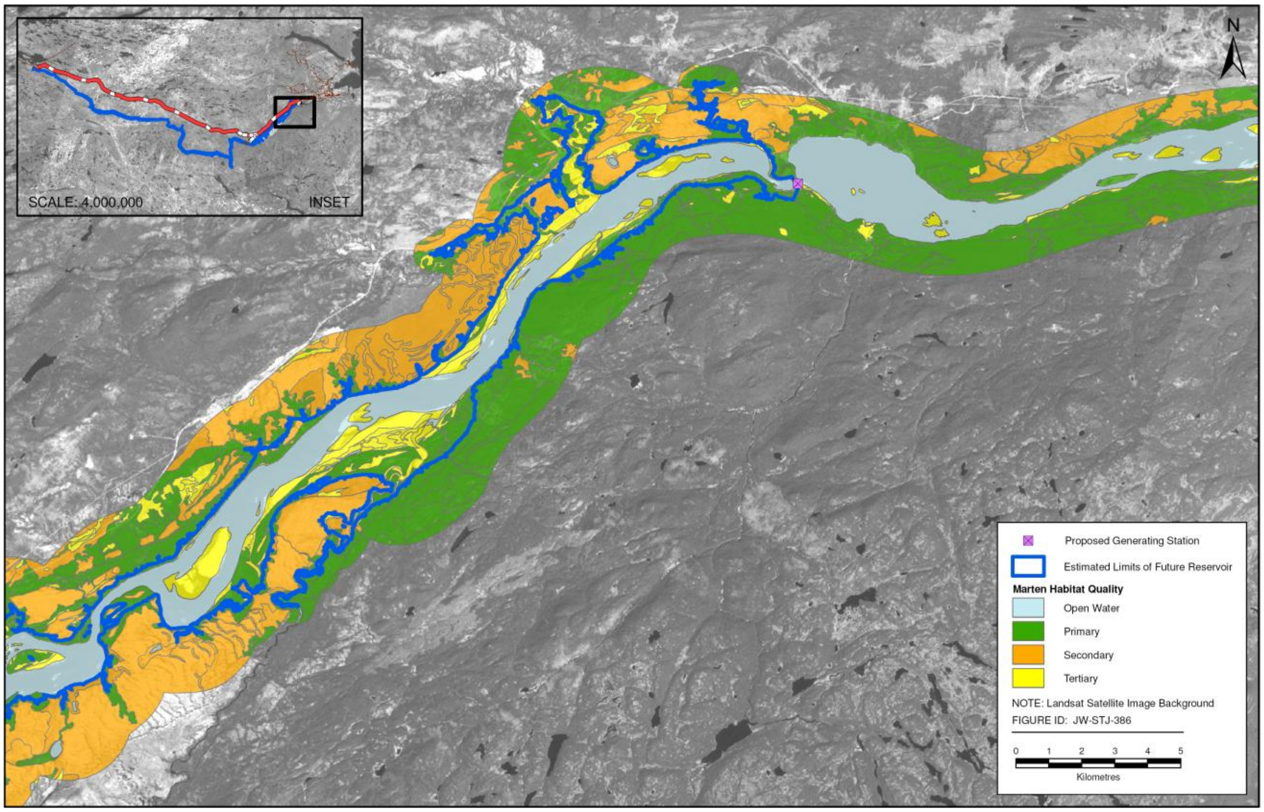


Figure 7-4 Marten Habitat Quality - Muskrat Falls (above) and Gull Island (below)



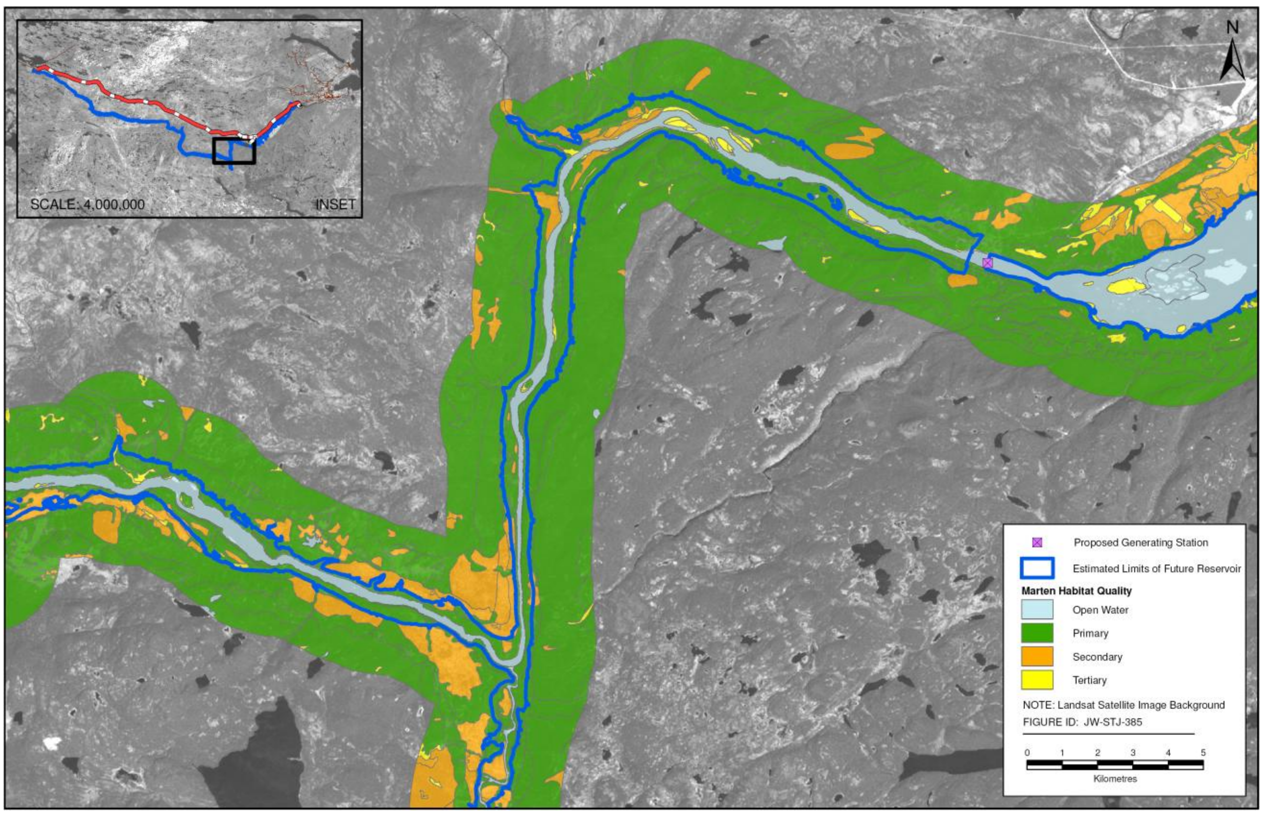
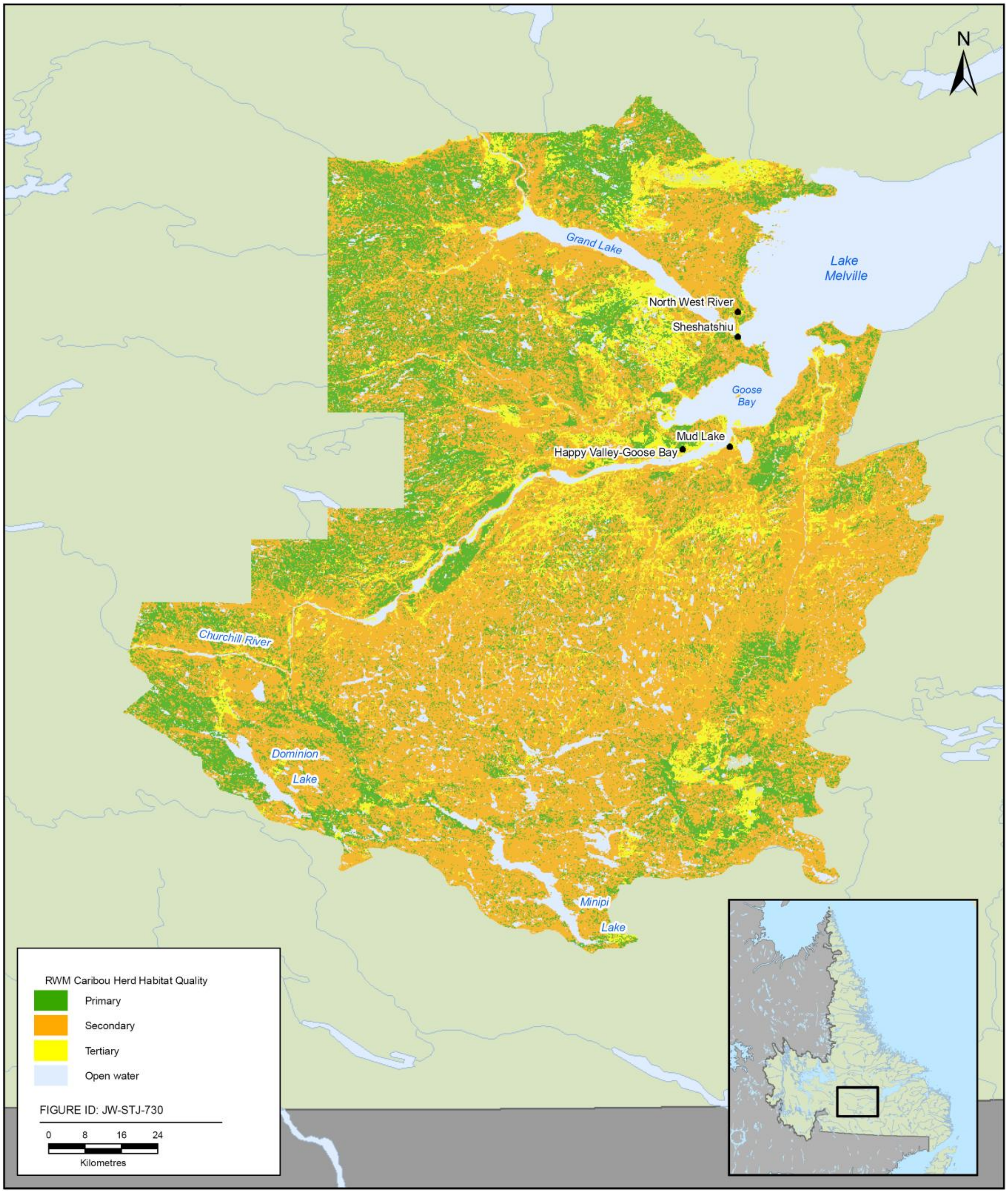


Figure 7-5 Caribou Habitat Quality



8.0 DISCUSSION

This study was effective in collecting evidence and information pertaining the habitat associations for approximately 13 mammalian species in the Survey Area. No unusual or unexpected species were encountered throughout these surveys. Results are discussed in the following sections by habitat sampled (Section 8.1, Habitat Use) and by species (Section 8.2, Wildlife Habitat Associations). Small mammals are in Section 8.3.

8.1 Habitat Use

The lowest frequencies of observations of the 13 common species identified in this study were in Wetland, Riparian and Burn habitats. Habitats with the fewest number of wildlife observation categories with peak values in that habitat were Wet and Dry Spruce, Mixed-Deciduous Dominant and Burns. Thus, Burns apparently were used less frequently overall, compared to other habitat types. This may be expected, as burns typically have minimal vertical structure, low ground cover and generally provide minimal food resources, protection from predators, and breeding habitat for most mammal species.

Riparian habitat accounted for the second fewest number of observations per kilometer, but had the highest number of observational categories with peak values. In other words, less wildlife sign was found in Riparian habitat, but those that were present tended to be found more often in this habitat type than in other habitat types. This is due to the fact that primarily aquatic or semi-aquatic species such as beaver, mink, muskrat and river otter accounted for 20 of the 67 observational categories. Mixed-Fir Dominant ranked second in this evaluation, and also had the highest number of observations per survey kilometer, indicating that not only does it support the highest overall level of mammal activity, but that it is the preferred habitat for a large number of species/activities.

Among the 67 observational categories, there were many more cases (21 versus 4) where observations in deciduous or partially deciduous habitat were twice as high as in pure-coniferous habitat. When observations of aquatic and semi-aquatic furbearers were removed from the calculation, the ratio of occurrence of observational categories in all or partially deciduous versus all coniferous habitat was 9:4. This indicates an importance of deciduous (or partially deciduous) habitats for many species of mammals identified in the Survey Area. Identification of primary, secondary and tertiary habitats for moose, bear, porcupine, marten and caribou also indicated the importance of deciduous habitat for food, shelter and/or other criteria during a sensitive period or year-round.

According to moisture regime, aquatic furbearers were overwhelmingly in the wet cluster, as expected given that such species tend to remain with or adjacent to aquatic areas. Observations in dry habitat were relatively rare, and dominated by tracks and droppings (which may have been more evident/visible in sandy or lichen-encrusted habitats rather than an association to dry habitats). The peak abundance for the majority of species occurred within mesic habitats. This is also expected since mesic habitats tend to have higher biodiversity and strata, reflecting the greater vegetation diversity and structure offering a broader range of ecological niches.

8.2 Wildlife Habitat Associations

Black Bear

Black bear are distributed throughout Labrador in various habitat types. The results showed that black bear exhibited no distinct habitat preferences and evidence was found consistently in all habitat types. Black bear tend to vary their habitat preferences depending on the season. During the spring and early summer, Black Bear occupy different habitat types such as coniferous forests and wetlands in search of food, primarily berry crops of *Vaccinium* spp. and *Empetrum* spp. supplemented with hunting or scavenging (VBNC 1997). During the late summer and early fall, coniferous forests are suitable areas for forage, finding shelter, and building fat reserves in preparation for winter. Because of their generalist nature, it is unlikely that the black bear specifically depend on one specific habitat within the lower Churchill River valley.

Caribou

Caribou are historically known to occupy the lower Churchill River valley (Northland Associates Ltd. 1980), The ranges of both the migratory George River (GR) Herd and the non-migratory Red Wine Mountains (RWM) Herd are know to overlap with portions of the valley (Schaefer et al. 1999). Results from our study showed low evidence of caribou that was relatively consistent across habitat types. This may be explained by the nomadic nature of caribou (the GR Herd may occupy wintering ranges that span 450 km in subsequent years (Schaefer et al. 2000) and the RWM Herd also exhibit some, relatively limited migrations (RRCSL 1989)), which may be passing through several habitat types on their way to foraging or calving grounds. In winter caribou typically select areas of high lichen abundance and from spring to fall they use forested and wetland habitat.

The RWM Herd is currently listed as threatened under the *Endangered Species Act* of Newfoundland and Labrador, and also under Schedule 1 of the federal *Species at Risk Act* (COSEWIC 2002). George River Caribou are not considered a species at risk.

Moose

Previous surveys (Trimper et al. 1996, Chubbs and Schaefer 1997, Jacques Whitford 1997) and dedicated moose surveys as part of the Lower Churchill Environmental Impact Statement (EIS) (Minaskuat Inc. 2008e) indicate that moose use several riparian areas and other habitats within the lower Churchill River valley during winter but appear to move out of the valley to higher elevations and wetland areas during summer months. Thus the majority of evidence of moose documented as part of this study (primarily in the form of browse and droppings) likely reflected winter habitat use in the lower reaches of the valley. Fresh tracks were also documented and likely indicative of preferred summer habitat.

Moose appear to utilize all habitat types in the Survey Area, either for forage, shelter, transit or otherwise. Observations were most pronounced in mixed coniferous-deciduous forests, and to a lesser extent riparian areas, within the river valley. This is expected, as moose generally prefer willow, birch and alder as a food source, supplementing those with conifers (preferentially Balsam Fir), during fall and winter (Bowyer et al. 2003). Tracks were most common in wetland and spruce or fir dominated mixed (coniferous-deciduous) forests, consistent with literature (Girard and Joyal 1984; Allen et al. 1987; Forbes and Théberge 1993; Courtois et al. 2002; Dussault et al. 2005).

Wolf

The home range of wolves extends up to 1,400 km^2, particularly for wolves that feed primarily on moose or caribou (Ballard et al. 1981), as documented in Labrador (Parker and Luttich 1986). As expected given this large home range, evidence for wolves accounted for fewer than two percent of all observations in this study. Evidence of their presence consisted largely of easily detected tracks in open burns, however, wolves are considered opportunistic predators and are generally more dependent on prey density than a reliance on a particular habitat type (Carbyn 1987). In addition to caribou, the diet of wolves includes microtines, birds, beaver, hare, squirrel and muskrat (Spaulding et al. 1998) that are found in a variety of habitat types, which is consistent with documentation of wolf evidence across all habitats sampled.

Porcupine

Porcupine is found at the northern limit of their range in Labrador and exhibit relatively large home ranges compared to other north American populations (Schmelzer and Fenske ND). Evidence of porcupine was found in all habitat types sampled, reflective of their generalist nature (Schmelzer and Fenske ND), but predominantly in coniferous-dominated forests. Porcupine display seasonal changes in their foraging ranges (Sweitzer 1996) and shift from a diet containing conifer bark in the winter to one containing leaves and other foliage in the summer and fall (Woods 1973, Banfield 1974). Given the more obvious nature of conifer browse versus leaf browse during studies such as this (88 percent of observations were of browse dominated by evidence on coniferous trees), results are likely reflective of winter habitat use in the region.

Red Fox

The red fox is found in many habitats and is widely distributed in Labrador (Voigt 1987), consistent with documented evidence of fox across habitat types in this study. Fox observations were most often in the form of tracks or droppings and most were made in Riparian, Burn and Mixed-Deciduous habitat types. Research has shown that red fox preferentially feed on meadow voles (Voigt 1987), which were also evident in Mixed-Deciduous habitats in the Survey Area. Overall, however, fox evidence was uncommon and conclusions regarding habitat use in the Survey Area are suspect, especially given that habitat is unlikely to limit the distribution of this species (Voigt 1987).

American Marten

Marten observations were only made in Wet Spruce and Fir-Spruce habitat types during surveys. One observation was found in Fir-Spruce and one in Wet Spruce. From other studies it is known that marten prefer mature conifer or mixed forests (Strickland and Douglas 1987). These sites also coincide with two of the sites with higher numbers of captures of Red-backed Voles from the small mammal trapping survey. Red-backed Voles are known to be one the marten's preferential foods in Labrador (Simon et al. 1999). Hares also are a preferred food (Simon et al. 1999) and were documented throughout all habitat types. Marten have large home ranges in Labrador (males, 45.0 km^2; females 27.6 km^2; Smith and Schaefer 2002), which may explain the low number of observations. Elsewhere in Labrador, marten habitat selection is thought to revolve around the use of dense canopy forest patches isolated in a matrix of bogs and scrub (Smith and Schaefer 2002). This may not apply to the lower Churchill River valley ecosystem due to differences in habitat distributions.

Snowshoe Hare

Observations of snowshoe hare in this study were prevalent in fir and spruce dominated mixedwood habitats as well as wet spruce habitats, primarily in the form of tracks. This is consistent with the literature, in that snowshoe hare are widely distributed throughout the boreal forest and are found in coniferous, deciduous and mixedwood habitats (Keith 1963, Banfield 1974). Tracks would easily be identifiable in these habitats, given that snowshoe hare routinely use the same routes to travel between shelter and feeding areas, as well as the persistence of such trails throughout their home range (approximately 0.3 to 0.8 km^2, depending on sex) (Banfield 1974). In summer, travel routes appear as well padded trails, with vegetation trimmed back to allow for more efficient travel (Banfield 1974).

Red Squirrel

The red squirrel is one of the most common, widespread and well-known species in North America (Klugh 1927) and is known throughout Labrador. They are generally associated with coniferous forest, but also use mixed and deciduous forest (Kemp and Keith 1970). Consistent with those findings, the highest density of red squirrel observations was made in spruce-dominated forests in this Study. Evidence was also found in all other habitat types. Food caches of conifer seeds accounted for the majority of the observations, which they store during late summer and fall (Klugh 1927).

Beaver

Beavers occupy rivers, streams, marshes, lakes and ponds throughout Labrador. The evidence of beaver was scarce during these terrestrial surveys but consistent with aerial surveys associated with the Beaver Environmental Baseline Report (Minaskuat Inc. 2008f). Beaver evidence was most frequently found in Riparian and Wetland habitat types, which would provide optimal food, protection from predators, and breeding habitat. Alder, a common shrub of these habitat types, is the preferred winter food and building material (Northcott 1971). These habitats also have abundant herbaceous vegetation for summer foraging, such as water lilies (Nuphar spp.)(Northcott 1971). As expected, there was negligible evidence of beaver in forested habitats, as beavers tend to stay near wetlands and riparian zones and prefer not to travel far inland away from water.

Muskrat

Muskrat observations, like beaver, were scarce during the 2006 surveys, due to the terrestrial nature of the surveys. Evidence of their presence was only documented in Wetland and Riparian habitats, which is expected given their generally aquatic nature and susceptibility to predators when travelling on land (Banfield 1974). Evidence of Muskrat would be more obvious during winter, when characteristic “push-up” (or domes) of frozen vegetation can be identified over holes in the ice from which the muskrat feed (Banfield 1974).

River Otter

Observations of river otter were also scarce during surveys, consisting only of a few tracks and droppings, primarily in Riparian habitats. This is consistent with the amphibious nature of this species (Banfield 1974) and they are known as one of the more aquatic-seeking members of the weasel family Mustelidae (Melquist and Dronkert 1987).

Mink

Mink are distributed throughout Labrador (Eagle and Whitman 1987) and occupy a variety a wet habitats such as stream, river, and lake edges, marshes and coastlines, reaching their highest densities where such habitats include numerous potential den sites and abundant foraging cover (Allen 1987).

Consistent with the literature, all six observations of mink (consisting of droppings and tracks) were recorded in Riparian habitat.

8.3 Small Mammal Trapping

Trapping results from 2006 indicate that the red-backed vole is the most common small mammal in the lower Churchill River valley, consistent with Simon et al. (1998) and IEMR (2003). Meadow vole and masked shrew generally have a more restricted distribution (Simon et al. 1998), as indicated by the few captures recorded during this baseline survey. Capture rates may also have been influenced by factors such as predation and the natural cycle for voles, mice, shrews and other small mammals in the boreal forests of North America, including Labrador (Korpimäki and Krebs 1996, Sundell 2006). In this regard, 2006 may have represented a regional crash in the small mammal population.

From the results of the statistical t-test on the red-backed vole data, it was concluded that there was no difference in the mean number of captures at sites at higher elevations (upper sites) compared to sites at lower elevations (lower sites) ($P=0.74$). This may reflect preferred conditions in these upper sites, differences between habitat sampled from upper and lower sites, or other factors related to habitat characteristics or sampling methods. It is likely that this (and other) species generally select habitat based on forest structure, coarse woody debris, forest composition, food availability and micro-site characteristics, rather than whether the site is higher or lower in the valley. Low capture rates of masked shrew, meadow vole and woodland jumping mouse were not sufficient to rigorously test habitat observations.

In terms of habitat associations, the scale of habitat classifications used – generally limited to tree species composition and moss versus lichen ground cover – may not reflect the micro-site characteristics important to the small mammal species captured during this study (e.g., ground vegetation characteristics, amount of woody debris, leaf litter). For example, ground cover containing leaves, woody debris and herbaceous vegetation is particularly important to masked shrew, as they generally forage for food (primarily insects) among the leaves and debris of the forest floor (Banfield 1974). Humidity also appears to be a limiting factor for this species (Banfield 1974), which may not be evident from (or across) habitat types characterized during surveys. Simon et al. (1998) sampled small mammals in successional and mature forests in Labrador and found red-backed voles were positively correlated with broad leafed shrubs 0.5 m high and trees greater than 2 m high, while negatively associated with lichens. Similarly, masked shrew were negatively associated with grasses and sedges and positively associated with broad-leafed shrubs less than 5 m high (Simon et al. 1998). Results from the 2006 surveys indicate an absence of small mammals in Riparian areas and low numbers associated with Wetland habitats. However, the literature suggests that species such as meadow vole prefer wet meadows and grasslands near streams, lakes, ponds and swamps (Government of Newfoundland and Labrador 2006).

Thus, associating a particular species with preferred habitat characteristics was not entirely possible without error. In general, and considering the previous discussion, survey results indicate that red-backed voles are most common in Wet Spruce habitats, meadow voles and Woodland Jumping Mouse in Mixed-Deciduous Dominant, and masked shrew in Mixed-Fir Dominant habitats. Micro-site characteristics within these and other habitat types would need to be further assessed to fully understand habitat preferences of these species.

8.4 Data Considerations

Several variables can influence the amount and type of data during wildlife surveys, including the following:

Survey Conditions – Weather influences the behaviour of most wildlife species, as does time of day and time of year. During the field program, the team recorded information on date, time, temperature, wind speed/direction and other observations, for each survey day.

Survey Effort – Species richness is frequently used as a measure of biodiversity, but observed species richness is strongly dependent on sample size (Melo 2004). Both the number of species observed and the number of observational categories recorded can therefore be expected to be positively correlated with the total distance of transects surveyed.

Observer Bias – All observers received training (Section 6.1) in the use of data recording protocols, as well as the various techniques of recognizing wildlife sign in the field, to reduce the amount of observer bias. Rate of travel was highly dependent upon topography, vegetation (e.g., open spruce-lichen forest vs. thick alder beds) and the abundance of observed wildlife evidence. Rate of travel was used as a means of verifying efficiencies among Field Teams.

Sampling Bias – The more obvious the sign, the more easily it is detected. The techniques employed were most effective in collecting baseline data for common herbivorous species (e.g., moose, snowshoe hare and red squirrel) in contrast to carnivorous species which are generally more difficult to confirm given that identifying browse is not possible (with the exception of a few cases where prey remains may be documented), scat is often less frequent, they are more cautious and solitary by nature, and occupy relatively large territories.

Life History – Some species (e.g., wolves) may be more dependent on prey density than a reliance on any one particular habitat type. As well, whether they are using a habitat primarily for transit versus other activities (e.g., foraging and shelter) can not be confirmed from the data where tracks and droppings were the primary evidence type documented.

Season – Evidence (observed, droppings, tracks, browse, other) of a species may reflect any one seasons habitat use, a combination of seasons, or all seasons, and would differ between species and between evidence types collected within species.

Scale – A multi-scale approach would be ideal to provide a complete picture of habitat use in the Survey Area. For example, Morin et al. (2005) found porcupines to be generalists at a landscape level, but selective at the home range and tree levels.

Habitat – Fluctuations in river level can inundate riparian and shoreline areas, obscuring tracks and droppings. As well, the heavy cover of leaf litter in deciduous habitats (i.e., Mixed-Deciduous Dominant, Riparian) can obscure wildlife sign. Therefore, wildlife sign in these habitat types may be under-represented.

Data Analysis – Low capture rates of masked shrew, meadow vole and woodland jumping mouse were not sufficient to rigorously test habitat observations. The data was analyzed (‘bootstrapped’) to obtain a larger sample size and calibration for equal effort. Deviations from these wildlife habitat associations in the data are likely due to microsite differences that differ from the primary habitat type, possibly magnified by small sample sizes that required bootstrapping.

9.0 SUMMARY

The over 10,000 observations and 323 km of transects surveyed for Wildlife Habitat Associations resulted in the following conclusions regarding the terrestrial wildlife species in the lower Churchill River valley:

- Observation rates in mesic (moist) areas (such as Fir-Spruce, Mixed-Fir Dominant, Mixed-Spruce Dominant, Mixed-Deciduous Dominant and Wet Spruce habitats) were above average, while both dry (Burn and Spruce) and wet habitats (Riparian and Wetland) were below average.
- Sign of red squirrel and winter moose were the most commonly encountered. Sign from both species was usually associated with Mixed-Fir dominant habitats.
- Relatively recent black bear sign (i.e., summer) was recorded throughout habitat types, at relatively low frequencies.
- Porcupine used a variety of mature forested habitats. Browse was commonly found in all habitat types sampled, reflective of their generalist nature, but predominantly in coniferous-dominated forests.
- Wolf evidence was rare and consisted largely of easily detected tracks in open burns.
- Fox evidence was most often in the form of tracks or droppings and occurred in Riparian, Burn and Mixed-Deciduous habitat types, but were overall relatively scarce.
- Evidence of caribou was low and relatively consistent across habitat types. Slightly higher observations (per linear distance sampled) were made in Mixed-Fir Dominant and Dry Spruce habitats.
- Beaver and muskrat sign was more common in Wetland and Riparian habitats, though evidence of their presence was relatively scarce. Evidence of Mustelids (mink, river otter and marten) was almost absent from the surveys.
- Snowshoe hare evidence was relatively common, usually in Mixed-Fir Dominant, Mixed-Spruce Dominant and Wet Spruce habitats.
- The highest frequencies of wildlife sign were observed in Mixed-Fir Dominant, Mixed-Spruce Dominant and Fir-Spruce habitats. The lowest frequency of observation was in Burn habitat. Riparian habitat accounted for the third fewest number of observations per kilometre, but had the highest number of observational categories with peak values in this habitat.
- Observations associated with aquatic and semi-aquatic furbearers naturally peaked in wet habitat types. Few observational categories peaked within the drier habitat types (with the exception of wolf and fox). The majority of observations were most common within mesic habitat types.

The collection of 238 small mammals during over 4,758 trap nights at eight trapping grids resulted in the following conclusions:

- Red-backed vole was the most frequently captured small mammal and represented 70 percent of the total. Masked shrew, woodland jumping mouse and meadow vole were also recorded but were relatively scarce.
- The index to abundance for all species was 5.0 small mammals per 100 trap nights. However, this index was higher for certain habitats, particularly Mixed-Spruce Dominant (9.29 mammals

per 100 trap nights), Mixed-Deciduous Dominant (9.87 mammals per 100 trap nights) and Mixed-Fir Dominant (11.2 mammals per 100 trap nights).

- There was no difference in the mean number of captures of red-backed voles from sites at higher elevations (upper sites) compared to sites at lower elevations (lower sites) (P=0.74). Low capture rates of masked shrew, meadow vole and woodland jumping mouse were not sufficient to rigorously test habitat observations.
- In general, survey results indicate that red-backed voles are most common in Wet Spruce habitats, meadow voles and Woodland Jumping Mouse in Mixed-Deciduous Dominant, and masked shrew in Mixed-Fir Dominant habitats, however the scale of the habitat classifications used during this study may not reflect specific habitat characteristics important to the small mammal species captured. Micro-site characteristics within these and other habitat types would need to be further assessed to fully understand habitat preferences of these species.

Limitations to the data collection methods included:

- Survey conditions (e.g., weather, time of day), survey effort (e.g., transect length), observer bias, sampling bias, species' life history characteristics, season, habitat (e.g., river level fluctuations, amount of leaf litter), scale and overall low capture rates.

Overall, the Wildlife Habitat Associations surveys proved to be effective means to collect baseline information on a variety of wildlife species that would not be as obvious through aerial or other techniques. The mapping of transects and their allocation above and below projected areas of flooding, will be useful for aspects of the Environmental Assessment for this Project. An example of this would be the wildlife habitat maps produced for Key Indicator species associated with the Project (Section 7.4), based on data collected from these surveys combined with data from other baseline surveys and information from scientific literature.

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11.0 GLOSSARY AND ACRONYMS

asl	Above sea level.
Bootstrapping	The creation of pseudoreplicate datasets with resampling.
dbh	Diameter at breast height (accepted as 1.3 m above the ground). A forestry term used for the measurement of a tree's diameter.
EIS	Environmental Impact Statement
ELC	Ecological Land Classification; A classification scheme used to delineate differing scales of landscape, or ecosystems, based on factors such as climate, landform and vegetation.
Ericaceous Shrubs	Shrubs belonging to the heath family; grow on acidic sites.
Forest Composition	The tree species that comprise a forest or stand (group of trees).
Forest Structure	The different strata (layers) of forest vegetation, including the emergent trees above the canopy, the main tree canopy, understory trees, saplings and seedlings on the ground. Also includes snags and downed logs.
GIS	Geographic Information System.
GR	George River, referring to the George River Caribou Herd
HSI	Habitat Suitability Index.
HVAC	High Voltage Alternating Current.
HVDC	High Voltage Direct Current.
IEMR	Institute for Environmental Monitoring and Research.
Insectivore	A carnivore that feeds primarily on insects.
ISO	International Organization for Standardization.
kV	Kilovolt.
LCP	Lower Churchill Study.
Mesic	Refers to sites characterized by intermediate moisture conditions ¬neither decidedly wet nor decidedly dry.
Microsite	An ecological term to describe the immediate environment of an organism, with unique features and characteristics. Microsite boundaries can depend on vegetation cover, temperature, humidity, sunlight, soil, or other factors.
MW	Megawatt.
Niche	Functional role of a species in the community including activities and relationships.
NTS	National Topographic Services map sheets.
The Project	Lower Churchill Hydroelectric Generation Project.
QMS	Quality Management Service
RWM	Red Wine Mountains, referring to the Red Wine Mountains Caribou Herd
Trap night	A 24 hour-period.
Warblers	An insectivorous Family (Parulidae) of songbirds characterized by thin bills, usually with bright plumage, and migratory.

Appendix A

Summary of Transect Locations

Table A-1 Summary of Transect Locations

Transect ID	Habitat Type*	Distance Surveyed (km)	Duration of Survey (hrs:min)	Survey Date	Transect Start UTMs		Total Observations
					Easting	Northing	
2	MD	0.435	0:54	31-Aug	672650	5918000	20
2	MF	2.195	2:14	31-Aug	672650	5918000	83
2	MS	0.61	0:43	31-Aug	672650	5918000	97
2	RI	1.152	0:56	31-Aug	672650	5918000	35
2	SW	0.148	0:14	31-Aug	672650	5918000	26
3	MS	0.605	0:36	8-Aug	670600	5917500	19
3	SD	0.936	1:11	8-Aug	670600	5917500	46
3	SW	1	0:25	8-Aug	670600	5917500	24
4	FS	0.506	0:35	31-Aug	666700	5916100	41
4	MD	2.181	1:16	31-Aug	666700	5916100	37
4	MS	1.131	0:39	31-Aug	666700	5916100	24
4	SW	1.497	1:56	31-Aug	666700	5916100	120
7	FS	1.737	2:03	26-Aug	637400	5922900	113
7	MF	0.068	0:08	26-Aug	637400	5922900	7
7	RI	1.41	0:44	26-Aug	637400	5922900	13
7	SW	0.314	0:25	26-Aug	637400	5922900	22
9	FS	0.033	0:10	12-Aug	687000	5906500	11
9	RI	0.266	0:40	12-Aug	687000	5906500	3
9	SW	0.75	1:20	12-Aug	687000	5906500	22
10	MD	0.845	0:39	12-Aug	688758	5912142	15
10	MF	0.077	0:05	12-Aug	688758	5912142	5
10	SW	0.919	0:49	12-Aug	688758	5912142	5
10	WE	0.508	0:33	12-Aug	688758	5912142	5
13	SD	3.185	2:03	27-Aug	648000	5903200	71
13	SW	0.43	0:35	27-Aug	648000	5903200	42
14	MF	0.395	0:28	27-Aug	648291	5902613	62
14	MS	0.34	0:18	27-Aug	648291	5902613	24
14	SD	4.751	1:54	27-Aug	648291	5902613	92
14	SW	0.32	0:32	27-Aug	648291	5902613	23
15	MS	0.405	0:45	27-Aug	640800	5904100	8
15	SD	1.154	1:25	27-Aug	640800	5904100	68
16	MD	0.481	0:21	27-Aug	640303	5903423	11
16	MS	0.299	0:35	27-Aug	640303	5903423	27
16	RI	0.15	0:12	27-Aug	640303	5903423	6
16	SD	1.77	1:05	27-Aug	640303	5903423	25
17	MD	0.1	0:23	23-Aug			7
17	SD	0.822	1:38	23-Aug			67

Transect ID	Habitat Type*	Distance Surveyed (km)	Duration of Survey (hrs:min)	Survey Date	Transect Start UTMs		Total Observations
					Easting	Northing	
17	SW	0.356	0:44	23-Aug			67
17	WE	0.359	0:20	23-Aug			8
18	FS	0.027	0:06	24-Aug	625600	5884400	15
18	MD	0.34	0:30	24-Aug	625600	5884400	9
18	MS	0.1	0:20	24-Aug	625600	5884400	17
18	RI	1.616	1:40	24-Aug	625600	5884400	42
18	SD	2.142	1:23	24-Aug	625600	5884400	65
18	SW	0.848	0:59	24-Aug	625600	5884400	83
18	WE	0.162	0:35	24-Aug	625600	5884400	7
19	BU	2.488	0:54	10-Sep	613780	5876800	39
19	MS	1.007	0:41	10-Sep	613780	5876800	34
19	SD	3.128	2:00	10-Sep	613780	5876800	85
19	SW	2.234	1:07	10-Sep	613780	5876800	63
19	WE	0.594	0:14	10-Sep	613780	5876800	4
27	FS	0.061	0:04	20-Aug	593300	5871900	6
27	RI	1.206	1:08	20-Aug	593300	5871900	4
27	SD	1.641	1:25	20-Aug	593300	5871900	56
27	SW	0.521	0:19	20-Aug	593300	5871900	6
28	FS	0.174	0:24	19-Aug	593880	5871027	30
28	SD	0.09	0:07	19-Aug	593880	5871027	10
28	SW	0.051	0:06	19-Aug	593880	5871027	2
28	WE	0.23	0:15	19-Aug	593880	5871027	4
34	FS	0.141	0:06	29-Aug	483679	5896017	11
34	MF	0.5	0:46	29-Aug	483679	5896017	98
34	MS	0.466	0:30	29-Aug	483679	5896017	54
34	RI	2.582	1:15	29-Aug	483679	5896017	145
34	SD	3.43	2:01	29-Aug	483679	5896017	137
34	SW	0.418	0:24	29-Aug	483679	5896017	86
35	RI	2.579	1:34	29-Aug	480558	5898391	167
35	SD	0.371	0:20	29-Aug	480558	5898391	111
37	RI	0.957	0:39	30-Aug	475600	5906600	8
37	SD	0.81	1:07	30-Aug	475600	5906600	78
37	SW	0.607	0:51	30-Aug	475600	5906600	62
38	BU	2.686	1:12	30-Aug	474733	5906832	235
38	MS	1.151	0:29	30-Aug	474733	5906832	74
38	RI	0.432	0:22	30-Aug	474733	5906832	9
38	SW	0.553	0:37	30-Aug	474733	5906832	87
41	RI	0.8	1:30	14-Aug	637564	5893511	28

Transect ID	Habitat Type*	Distance Surveyed (km)	Duration of Survey (hrs:min)	Survey Date	Transect Start UTMs		Total Observations
					Easting	Northing	
41	SD	0.206	0:31	14-Aug	637564	5893511	4
41	SW	2.755	2:33	14-Aug	637564	5893511	62
41	WE	1.209	1:10	14-Aug	637564	5893511	75
43	MS	0.321	0:23	11-Aug	687100	5912300	21
43	SD	0.63	0:33	11-Aug	687100	5912300	22
43	SW	0.12	0:18	11-Aug	687100	5912300	9
44	FS	1.21	1:25	9-Sep	649459	5904539	47
44	MD	1.019	1:13	9-Sep	649459	5904539	45
44	MF	0.071	0:06	9-Sep	649459	5904539	1
44	MS	1.846	2:18	9-Sep	649459	5904539	48
44	SW	0.178	0:12	9-Sep	649459	5904539	12
44	WE	0.158	0:16	9-Sep	649459	5904539	3
50	FS	0.505	0:16	11-Aug	688300	5913350	25
50	MF	0.298	0:17	11-Aug	688300	5913350	7
50	MS	0.15	0:08	11-Aug	688300	5913350	10
50	RI	2.514	2:21	11-Aug	688300	5913350	30
50	SW	1.982	1:45	11-Aug	688300	5913350	71
51	FS	1.9335	1:08	11-Aug	681512	5906419	68
51	MF	3.1305	2:21	11-Aug	681512	5906419	69
51	MS	0.141	0:10	11-Aug	681512	5906419	12
51	RI	1.167	0:50	11-Aug	681512	5906419	15
51	SW	0.81	0:50	11-Aug	681512	5906419	42
51	WE	0.072	0:11	11-Aug	681512	5906419	0
52	MD	0.6	0:30	27-Aug	676850	5906800	9
52	WE	0.05	0:05	27-Aug	676850	5906800	0
54	MS	0.05	0:15	27-Aug	658500	5905200	48
54	SD	1.40	1:00	27-Aug	658500	5905200	60
55	BU	7.853	3:54	9-Sep	634388	5895670	66
55	MS	1.462	0:42	9-Sep	634388	5895670	12
55	SD	1.325	0:33	9-Sep	634388	5895670	25
56	MD	0.16	0:17	7-Sep	626250	5883960	8
56	MS	0.625	0:57	7-Sep	626250	5883960	12
56	RI	1.404	0:56	7-Sep	626250	5883960	8
56	SD	3.488	2:02	7-Sep	626250	5883960	74
56	SW	1.514	2:53	7-Sep	626250	5883960	41
57	FS	0.159	0:19	7-Sep	622061	5878012	7
57	MD	2.303	1:36	7-Sep	622061	5878012	11
57	MF	0.092	0:12	7-Sep	622061	5878012	5

Transect ID	Habitat Type*	Distance Surveyed (km)	Duration of Survey (hrs:min)	Survey Date	Transect Start UTMs		Total Observations
					Easting	Northing	
57	MS	1.808	1:45	7-Sep	622061	5878012	84
57	RI	1.703	1:47	7-Sep	622061	5878012	19
57	SD	0.037	0:04	7-Sep	622061	5878012	1
57	SW	0.198	0:08	7-Sep	622061	5878012	1
57	WE	0.459	0:46	7-Sep	622061	5878012	19
58	RI	2.3	2:20	17-Aug	625250	5879970	10
58	SD	2.5	1:40	17-Aug	625250	5879970	28
58	SW	2.3	1:50	17-Aug	625250	5879970	39
58	WE	1.106	1:00	17-Aug	625250	5879970	16
62	FS	3.592	2:45	27-Aug	613325	5870285	69
62	SW	1.82	1:03	27-Aug	613325	5870285	33
62	WE	2.142	1:20	27-Aug	613325	5870285	12
63	FS	0.585	1:12	25-Aug	608350	5868850	42
63	RI	2.014	1:53	25-Aug	608350	5868850	20
63	SD	0.086	0:11	25-Aug	608350	5868850	8
63	SW	0.896	0:49	25-Aug	608350	5868850	69
63	WE	0.116	0:18	25-Aug	608350	5868850	11
66	FS	0.307	0:26	20-Aug	592876	5856249	6
66	RI	0.204	0:08	20-Aug	592876	5856249	0
66	SD	1.492	0:52	20-Aug	592876	5856249	20
66	SW	2.362	1:43	20-Aug	592876	5856249	36
67	FS	0.152	0:11	20-Aug	592365	5858262	13
67	MF	0.118	0:14	20-Aug	592365	5858262	20
67	MS	0.134	0:10	20-Aug	592365	5858262	19
67	SD	0.879	0:35	20-Aug	592365	5858262	15
67	SW	1.561	1:30	20-Aug	592365	5858262	80
67	WE	0.05	0:10	20-Aug	592365	5858262	0
68	FS	1.101	0:35	20-Aug	581700	5861500	12
68	MF	0.184	0:15	20-Aug	581700	5861500	40
68	MS	0.61	0:32	20-Aug	581700	5861500	6
68	RI	0.015	0:03	20-Aug	581700	5861500	1
68	SD	0.326	0:11	20-Aug	581700	5861500	6
69	FS	0.185	0:20	20-Aug	577142	5861207	9
69	RI	0.01	0:02	20-Aug	577142	5861207	2
69	SD	3.356	1:42	20-Aug	577142	5861207	83
69	SW	0.671	0:30	20-Aug	577142	5861207	15
69	WE	0.13	0:10	20-Aug	577142	5861207	3
70	FS	1.494	0:50	20-Aug	570540	5861361	26

Transect ID	Habitat Type*	Distance Surveyed (km)	Duration of Survey (hrs:min)	Survey Date	Transect Start UTMs		Total Observations
					Easting	Northing	
70	RI	0.34	0:24	20-Aug	570540	5861361	9
70	SD	0.269	0:10	20-Aug	570540	5861361	5
70	SW	0.432	0:27	20-Aug	570540	5861361	20
71	FS	0.588	0:33	21-Aug	565622	5862129	24
71	RI	1.536	0:53	21-Aug	565622	5862129	12
71	SD	0.408	0:37	21-Aug	565622	5862129	15
73	FS	0.2	0:21	21-Aug	558400	5862300	19
73	MS	0.201	0:23	21-Aug	558400	5862300	19
73	RI	1.4	0:40	21-Aug	558400	5862300	5
73	SW	0.535	0:49	21-Aug	558400	5862300	83
76	FS	0.319	0:27	15-Aug	554450	5876200	28
76	RI	2.234	1:40	15-Aug	554450	5876200	16
76	SD	1.197	0:44	15-Aug	554450	5876200	26
78	FS	2.457	1:24	16-Aug	545680	5883660	225
78	MF	0.155	0:07	16-Aug	545680	5883660	29
78	MS	0.057	0:06	16-Aug	545680	5883660	0
78	RI	0.557	0:36	16-Aug	545680	5883660	11
78	SD	0.175	0:09	16-Aug	545680	5883660	3
78	SW	0.843	0:27	16-Aug	545680	5883660	17
78	WE	0.072	0:10	16-Aug	545680	5883660	7
80	MF	1.043	1:05	17-Aug	541850	5884150	80
80	RI	0.538	1:15	17-Aug	541850	5884150	7
80	SW	0.223	0:13	17-Aug	541850	5884150	9
81	FS	0.208	0:10	17-Aug	524053	5888772	10
81	MF	1.019	0:50	17-Aug	524053	5888772	24
81	MS	0.548	0:33	17-Aug	524053	5888772	16
81	RI	1.564	0:37	17-Aug	524053	5888772	3
84	SD	0.3	0:19	29-Aug	486700	5894450	31
84	MF	0.19	0:18	29-Aug	486700	5894450	23
84	RI	1.6	0:37	29-Aug	486700	5894450	17
84	WE	1.18	0:51	29-Aug	486700	5894450	80
86	MS	0.071	0:18	6-Sep	477500	5905250	7
86	RI	0.746	0:35	6-Sep	477500	5905250	4
86	SD	1.099	1:25	6-Sep	477500	5905250	52
86	SW	0.064	0:08	6-Sep	477500	5905250	8
87	MD	0.157	0:11	6-Sep	472347	5908895	1
87	MF	0.202	0:11	6-Sep	472347	5908895	20
87	MS	0.98	1:00	6-Sep	472347	5908895	35

Transect ID	Habitat Type*	Distance Surveyed (km)	Duration of Survey (hrs:min)	Survey Date	Transect Start UTMs		Total Observations
					Easting	Northing	
87	RI	0.484	0:50	6-Sep	472347	5908895	2
87	SW	0.694	0:36	6-Sep	472347	5908895	17
87	WE	0.203	0:17	6-Sep	472347	5908895	2
88	MF	1.011	0:51	6-Sep	456550	5919950	31
88	MS	0.37	0:45	6-Sep	456550	5919950	27
88	RI	0.512	0:20	6-Sep	456550	5919950	5
88	SW	0.273	0:21	6-Sep	456550	5919950	26
91	FS	0.369	0:15	6-Sep	451009	5923859	13
91	MD	0.048	0:07	6-Sep	451009	5923859	1
91	MF	1.069	1:02	6-Sep	451009	5923859	55
91	MS	0.297	0:33	6-Sep	451009	5923859	17
91	RI	0.967	1:03	6-Sep	451009	5923859	6
92	MF	1.3	1:14	25-Aug	628050	5885600	203
92	RI	1.4	1:11	25-Aug	628050	5885600	23
92	SD	0.025	0:04	25-Aug	628050	5885600	14
93	SD	7.5	4:32	14-Aug	629367	5887032	90
93	SW	2.5	2:23	14-Aug	629367	5887032	53
94	MD	1.099	2:00	11-Aug			76
95	FS	0.152	0:17	19-Aug	594068	5870851	27
95	SD	0.36	0:33	19-Aug	594068	5870851	46
95	SW	0.746	0:39	19-Aug	594068	5870851	48
95	WE	0.106	0:10	19-Aug	594068	5870851	20
96	FS	2.638	2:50	11-Sep	639235	5894408	69
96	MF	1.898	1:15	11-Sep	639235	5894408	22
96	RI	3.024	1:38	11-Sep	639235	5894408	32
96	SW	0.262	0:11	11-Sep	639235	5894408	7
97	MD	3.409	2:06	7-Sep	618100	5880050	36
97	MF	1.191	0:35	7-Sep	618100	5880050	27
97	MS	1.572	1:08	7-Sep	618100	5880050	11
97	SW	0.039	0:02	7-Sep	618100	5880050	0
5 / 6	MD	3.407	2:05	1-Sep	659000	5911000	102
5 / 6	MF	2.09	2:31	1-Sep	659000	5911000	396
5 / 6	MS	0.429	1:07	1-Sep	659000	5911000	106
5 / 6	SW	0.304	0:42	1-Sep	659000	5911000	93
11 / 12	FS	1.846	1:39	26-Aug	649008	5901691	34
11 / 12	RI	3.091	1:33	26-Aug	649008	5901691	11
11 / 12	SW	3.567	2:30	26-Aug	649008	5901691	75
20 / 59	FS	0.591	0:36	10-Sep	618080	5880010	21

Transect ID	Habitat Type*	Distance Surveyed (km)	Duration of Survey (hrs:min)	Survey Date	Transect Start UTMs		Total Observations
					Easting	Northing	
20 / 59	MD	0.13	0:05	10-Sep	618080	5880010	1
20 / 59	MS	0.474	0:28	10-Sep	618080	5880010	13
20 / 59	SD	6.695	3:22	10-Sep	618080	5880010	158
20 / 59	SW	0.832	0:21	10-Sep	618080	5880010	19
20 / 59	WE	1.297	0:28	10-Sep	618080	5880010	2
21/23	MS	0.396	0:25	16-Aug	610901	5870937	6
21/23	RI	1.766	1:35	16-Aug	610901	5870937	7
21/23	SD	2.086	1:10	16-Aug	610901	5870937	19
21/23	SW	1.437	1:20	16-Aug	610901	5870937	32
22/24	SD	0.872	0:55	16-Aug	609043	5872500	33
22/24	SW	2.162	2:55	16-Aug	609043	5872500	117
22/24	WE	1.405	1:15	16-Aug	609043	5872500	23
25/26	FS	1.498	2:32	19-Aug	602100	5870550	33
25/26	RI	0.399	0:53	19-Aug	602100	5870550	39
25/26	SW	2.016	1:54	19-Aug	602100	5870550	11
31/32	RI	1.162	1:10	15-Aug	553584	5881536	52
31/32	SD	0.787	0:31	15-Aug	553584	5881536	36
31/32	SW	0.323	0:11	15-Aug	553584	5881536	89
31/32	WE	0.061	0:04	15-Aug	553584	5881536	1
39/40	SD	5.263	2:46	5-Sep	453600	5927700	21
39/40	SW	3.244	1:53	5-Sep	453600	5927700	43
39/40	WE	1.137	0:49	5-Sep	453600	5927700	15
C1	SD	0.66	1:14	28-Aug	604550	5880950	54
C1	SW	2.113	3:30	28-Aug	604550	5880950	155
C2	MD	0.154	0:07	28-Aug			2
C2	SD	4.167	1:56	28-Aug			144
C2	SW	1.345	1:17	28-Aug			70
C2	WE	0.155	0:06	28-Aug			0
C3	SD	5.549	4:10	13-Sep	570838	5884094	88
C3	SW	2.162	1:31	13-Sep	570838	5884094	36
C4	FS	0.545	0:45	13-Sep	570835	5884098	50
C4	SD	1.621	1:46	13-Sep	570835	5884098	32
C4	SW	1.839	1:45	13-Sep	570835	5884098	23
C4	WE	1.408	1:30	13-Sep	570835	5884098	10
T1	BU	6.383	2:57	30-Aug	540200	5898400	44
T1	MS	0.13	0:08	30-Aug	540200	5898400	3
T1	SW	0.2	0:11	30-Aug	540200	5898400	3
T1	WE	0.262	0:39	30-Aug	540200	5898400	9

Transect ID	Habitat Type*	Distance Surveyed (km)	Duration of Survey (hrs:min)	Survey Date	Transect Start UTMs		Total Observations
					Easting	Northing	
T3	RI	0.86	0:30	8-Sep	510300	5905500	13
T3	SD	5.323	3:12	8-Sep	510300	5905500	42
T3	SW	1.533	0:29	8-Sep	510300	5905500	6
T4	SD	4.705	3:47	8-Sep	510305	5905461	95
T4	SW	0.27	0:12	8-Sep	510305	5905461	0
T4	WE	0.51	0:13	8-Sep	510305	5905461	4
T5	FS	0.39	0:22	12-Sep	468325	5922321	14
T5	SD	1.824	1:12	12-Sep	468325	5922321	34
T5	SW	1.671	1:52	12-Sep	468325	5922321	32
T5	WE	0.914	1:24	12-Sep	468325	5922321	12
T6	RI	1.684	1:14	12-Sep	468249	5922460	21
T6	SD	6.238	3:14	12-Sep	468249	5922460	73
T6	SW	1.193	0:38	12-Sep	468249	5922460	21
TOTALS		**323.497**	**23:06**				**10,053**
*RI = Riparian; WE = Wetland; SW = Wet Spruce; SD = Dry Spruce; FS = Fir-Spruce; MF = Mixed-Fir Dominant; MS = Mixed-Spruce Dominant; MD= Mixed-Deciduous Dominant; BU = Burn							

Table A-2 Small Mammal Trapping Grid Locations

Grid	Sampling Dates	Grid NW Corner UTMs	Grid SW Corner UTMs	Grid NE Corner UTMs	Grid SE Corner UTMs	Weather Conditions
43	August 10-12	687161E 5912695N	687007E 5912686N	687146E 5912885N	686979E 5912894N	Cloudy with rain, 10°C to 15°C
94	August 10-12	685872E 5911332N	685728E 5911458N	685979E 5911480N	685834E 5911622N	Cloudy with rain, 13°C to 14°C
32	August 15-17	552557E 5881189N		552737E 5880914N	552817E 5881071N	Cloud, some rain. Clearing by day 3. 10°C to17°C
31	August 15-17	553313E 5881545N		553478E 5881428N	553584E 5881536N	Cloud, some rain. 10°C to 17°C
28	August 19-21	594009E 5872207N	594101E 5872066N	593791E 5871901N		Cloud and mostly rainy. Thunderstorms on August 19. No rain on day 3. 10°C to 20°C.
95	August 19-21	593880E 5871027N	594040E 5871045N	594059E 5870706N	594068E 5870851N	Cloud and mostly rainy. Thunderstorms on August 19. No rain on day 3. 10°C to 20°C.
17	August 23-25	625556E 5884290N	625556E 5884490N	625382E 5884272N	625395E 5884456N	
18	August 24-26	625041E 5884381N	625041E 5884581N	624841E 5884381N	624841E 5884581N	

Appendix B

Linear Densities of Wildlife Observations

Linear Density of Observations per Habitat Type

Species	Habitat Type								
	BU	FS	MD	MF	MS	RI	SD	SW	WE
MAMMALS									
Moose (O)	2.47	5.99	4.27	17.38	4.36	0.87	1.14	1.34	0.13
Moose (D)	2.01	1.75	1.66	3.39	3.46	1.39	1.86	2.27	3.23
Moose (T)	0.46	3.70	3.08	3.33	3.19	6.79	2.14	2.78	3.02
Moose (B)	0.00	0.12	0.24	0.00	0.00	0.12	0.00	0.06	0.34
Moose (X)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Caribou (O)	0.00	0.04	0.18	0.44	0.11	0.02	0.20	0.05	0.00
Caribou (D)	0.15	0.00	0.00	0.16	0.21	0.18	0.21	0.03	0.00
Caribou (T)	0.00	0.00	0.00	0.05	0.00	0.00	0.12	0.03	0.00
Caribou (B)	0.10	0.00	0.00	0.00	0.05	0.04	0.02	0.11	0.27
Caribou (X)	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00
Bear (O)	0.67	0.39	0.83	0.60	0.90	0.34	0.32	0.53	0.07
Bear (D)	0.46	0.35	0.24	0.44	0.80	0.81	1.00	0.82	0.60
Bear (T)	0.00	0.23	0.18	0.05	0.32	0.00	0.46	0.56	0.00
Bear (B)	0.00	0.00	0.00	0.16	0.05	0.00	0.02	0.02	0.00
Bear (X)	0.00	0.08	0.00	0.00	0.00	0.02	0.01	0.03	0.00
Porcupine (O)	0.00	0.12	0.41	0.38	0.00	0.00	0.05	0.14	0.00
Porcupine (D)	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.00	0.07
Porcupine (T)	0.05	2.45	0.65	1.58	1.28	0.46	0.53	2.32	0.13
Porcupine (B)	0.00	0.00	0.00	0.16	0.11	0.02	0.00	0.00	0.00
Porcupine (X)	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wolf (O)	1.96	0.16	0.41	0.11	0.05	0.06	0.15	0.06	0.07
Wolf (D)	0.00	0.12	0.06	0.00	0.05	0.28	0.16	0.06	0.20
Wolf (T)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wolf (B)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wolf (X)	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00
Fox (O)	0.10	0.04	0.24	0.00	0.00	0.08	0.08	0.00	0.07
Fox (D)	0.31	0.04	0.24	0.05	0.11	0.44	0.15	0.08	0.07
Fox (T)	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00
Fox (B)	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00
Fox (X)	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00
Beaver (O)	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00
Beaver (D)	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00
Beaver (T)	0.00	0.00	0.00	0.00	0.00	0.16	0.03	0.03	0.07
Beaver (B)	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.13
Beaver (X)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Muskrat (O)	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00
Muskrat (D)	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.67
Muskrat (T)	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.13
Muskrat (B)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Muskrat (X)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mink (O)	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00

Species	Habitat Type								
	BU	FS	MD	MF	MS	RI	SD	SW	WE
Mink (D)	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00
Mink (T)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mink (B)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mink (X)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Otter (O)	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.00
Otter (D)	0.00	0.00	0.00	0.05	0.00	0.14	0.00	0.00	0.07
Otter (T)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Otter (B)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Otter (X)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Marten (O)	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.02	0.00
Marten (D)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Marten (T)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Marten (B)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Marten (X)	0.00	0.00	0.06	0.00	0.00	0.02	0.02	0.02	0.00
Hare (O)	0.10	1.21	1.01	5.30	2.29	0.00	0.31	1.54	0.00
Hare (D)	0.05	1.87	1.72	6.12	4.95	0.06	1.77	5.65	0.40
Hare (T)	0.00	0.66	0.30	0.44	0.69	0.00	0.28	0.66	0.13
Hare (B)	0.00	0.04	0.00	0.00	0.00	0.04	0.01	0.02	0.00
Hare (X)	0.26	1.98	0.83	1.80	1.54	0.16	0.76	1.19	0.40
Squirrel (O)	0.00	0.31	0.00	0.16	0.05	0.00	0.00	0.00	0.00
Squirrel (D)	0.00	0.62	0.24	0.60	1.76	0.10	1.58	1.05	0.07
Squirrel (T)	0.00	9.42	0.89	13.50	9.05	0.22	2.08	7.27	0.00
Squirrel (B)	0.26	2.53	0.18	6.99	2.18	0.06	0.88	3.67	0.40
Squirrel (X)	2.47	5.99	4.27	17.38	4.36	0.87	1.14	1.34	0.13
Large Game trail	0.21	0.16	0.06	0.16	0.21	0.30	0.68	0.26	0.54
Small Mammal Trail	0.00	0.04	0.12	0.05	0.21	0.02	1.39	0.37	0.07
HERPETILES									
American Toad –Adult	0.00	0.04	0.12	0.00	0.05	0.06	0.00	0.00	0.07
American Toad – Juvenile	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00
Leopard Frog – Adult	0.00	0.00	0.18	0.11	0.05	0.22	0.00	0.03	1.21
Leopard Frog – Juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07
Mink Frog – Adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20
AVIFAUNA									
Alder Flycatcher	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.03	0.27
American Crow	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07
American Goldfinch	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American Pipet	0.00	0.00	0.00	0.00	0.00	0.04	0.02	0.00	0.00
American Robin	0.05	0.12	0.30	0.00	0.11	0.08	0.10	0.08	0.00
American Three-toed Woodpecker	0.05	0.35	0.00	0.05	0.05	0.00	0.01	0.08	0.00
Bald Eagle	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00
Black-backed	0.05	0.00	0.00	0.00	0.00	0.00	0.14	0.08	0.07

Species	Habitat Type								
	BU	FS	MD	MF	MS	RI	SD	SW	WE
Woodpecker									
Belted Kingfisher	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00
Blackpoll Warbler	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00
Boreal Chickadee	0.05	3.93	0.71	4.54	2.08	0.28	1.77	1.96	0.74
Bohemian Waxwing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Brown Creeper	0.00	0.08	0.00	0.05	0.00	0.00	0.00	0.00	0.00
Black-throated Green Warbler	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00
Blue-winged Teal	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07
Canada Goose	0.00	0.00	0.00	0.00	0.00	0.42	0.00	0.00	0.00
Cedar Waxwing	0.00	0.00	1.19	0.00	0.00	0.04	0.00	0.06	0.00
Common Loon	0.00	0.00	0.00	0.00	0.00	0.04	0.01	0.00	0.00
Common Raven	0.05	0.19	0.30	0.00	0.32	0.06	0.08	0.08	0.00
Fox Sparrow	0.00	0.00	0.06	0.00	0.05	0.04	0.02	0.00	0.00
Golden-crowned Kinglet	0.00	0.27	0.00	0.16	0.05	0.02	0.00	0.03	0.00
Gray Jay	0.26	0.70	0.30	0.55	0.90	0.10	0.79	0.84	0.87
Greater Yellowlegs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.13
Hairy Woodpecker	0.00	0.00	0.06	0.05	0.11	0.00	0.03	0.00	0.00
Herring Gull	0.00	0.00	0.00	0.00	0.00	0.40	0.01	0.00	0.00
Hermit Thrush	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.02	0.00
Lincolns Sparrow	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Merlin	0.00	0.00	0.00	0.05	0.11	0.02	0.00	0.00	0.07
Myrtle Warbler	0.00	0.19	0.06	0.16	0.32	0.02	0.07	0.05	0.13
Northern Flicker	0.00	0.00	0.00	0.00	0.11	0.00	0.01	0.00	0.00
Orange-crowned Warbler	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.07
Osprey	0.21	0.12	0.00	0.00	0.00	0.06	0.02	0.02	0.07
Pine Grosbeak	0.00	0.00	0.00	0.05	0.00	0.00	0.08	0.00	0.00
Pine Sisken	0.05	0.12	0.00	0.00	1.54	0.00	0.06	0.13	0.13
Red-breasted Merganser	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00
Red-breasted Nuthatch	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.02	0.00
Ruby-crowned Kinglet	0.00	0.27	0.53	0.33	0.53	0.00	0.12	0.08	0.20
Red-tailed Hawk	0.00	0.00	0.00	0.00	0.00	0.02	0.01	0.06	0.13
Ruffed Grouse	0.00	0.00	0.18	0.00	0.05	0.02	0.00	0.03	0.00
Savannah Sparrow	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.81
Slate-colored Junco	0.05	0.66	0.06	0.71	0.75	0.08	0.80	0.47	0.47
Solitary Sandpiper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00
Song Sparrow	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00
Spruce Grouse	0.00	0.00	0.00	0.05	0.00	0.00	0.07	0.13	0.00
Spotted Sandpiper	0.00	0.00	0.00	0.00	0.00	0.22	0.00	0.00	0.00
Sharp-shinned Hawk	0.00	0.04	0.00	0.00	0.05	0.00	0.00	0.03	0.00
Swamp Sparrow	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.07

Species	Habitat Type								
	BU	**FS**	**MD**	**MF**	**MS**	**RI**	**SD**	**SW**	**WE**
Swainson's Thrush	0.10	0.08	0.00	0.11	0.27	0.06	0.04	0.11	0.00
Tennessee Warbler	0.00	0.00	0.00	0.05	0.11	0.00	0.01	0.00	0.00
White-crowned Sparrow	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.13
Wilson's Snipe	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.07
Wilson's Warbler	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00
Winter Wren	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.02	0.00
White-throated Sparrow	0.05	0.00	0.41	0.00	0.16	0.06	0.09	0.05	0.07
White-winged Crossbill	0.36	0.16	0.00	0.05	0.00	0.00	0.40	0.14	0.00
Yellow Warbler	0.00	0.00	0.06	0.00	0.00	0.04	0.08	0.03	0.13

Notes: (O) = observed
(D) = droppings
(T) = track/trail
(B) = browse
(X) = other.

Habitat codes are as follows:

BU = Burn
FS = Fir-Spruce
MD = Mixed-Deciduous Dominant
MF = Mixed-Fir Dominant
MS = Mixed-Spruce Dominant
RI = Riparian
SD = Dry Spruce
SW = Wet Spruce
WE = Wetland

Appendix C

Results of Small Mammal Surveys

Results of Small Mammal Surveys

Small mammals captured at each site for each species in each habitat were recorded. Birds and amphibians were removed and trap nights adjusted as per communication with Julie Henderson, University of New Brunswick. “Small Mammals Expected” are the number of individuals of each species that would have been expected in each habitat assuming an even distribution of overall habitat types. For example, 70 of 166 RV (42.2 percent) would have been expected in spruce (Wet Site), since 42.2 percent of trap nights were in that habitat.

Site 43

Location: Approximately 150 m beyond the end of Mud Lake Road. The Churchill River is along row 1 (north-south axis).

Description: A relatively flat site, a few metres above the Churchill River. It is primarily a fir/spruce forest with about 10 to 15 percent white birch and scattered trembling aspen. On a local basis, fir and spruce domination alternated considerably, with over 80 percent of stations being mixed forest with either conifer dominant. In general, fir was more abundant on the south half of the plot (A to E), and deciduous trees were most abundant along the east (river) edge (rows 1 to 2).

Results:

43	A	B	C	D	E	F	G	H	I	J
10	RV	2RV	2RV		RV		MV	MS	MV	
9	MS			MS	RV MS	RV	RV			
8		2MS	RV		RV	MS		RV	MS	RV
7					RV	2RV	RV	2RV	RV	
6	MS	RV			MS					
5								RV		
4	RV			RV					2RV	
3	RV			RV					MS	3RV
2	RV	JM		2RV				2RV	2RV	
1	2RV		2RV	RV	MS	RV	RV		2RV	RV

LEGEND

- Riparian
- Wetland
- Spruce (Wet Site)
- Spruce (Dry Site)
- Fir-Spruce
- Mixed (Spruce Dominant)
- Mixed (Fir Dominant)
- Mixed (Deciduous Dominant)
- Burn

Small Mammal Trapping Site 43 - Small Mammals Observed

Habitat	# of Trap Nights	Red-Backed Vole	Meadow Vole	Masked Shrew	Jumping Mouse
Riparian	0	0	0	0	0
Wetland	0	0	0	0	0
Spruce Wet	12	0	0	0	0
Spruce Dry	0	0	0	0	0
Fir-Spruce	72	5	0	2	0
Mixed Forest (Spruce Dominant)	216	18	2	2	1
Mixed Forest (Fir Dominant)	282	23	0	8	0
Mixed Forest (Deciduous Dominant)	18	2	0	0	0
Burn	0	0	0	0	0

Small Mammal Trapping Site 43 - Small Mammals Expected

Habitat	# of Trap Nights	Red-Backed Vole	Meadow Vole	Masked Shrew	Jumping Mouse
Riparian	0	0	0	0	0
Wetland	0	0	0	0	0
Spruce Wet	2	0.96	0.04	0.24	0.02
Spruce Dry	0	0	0	0	0
Fir-Spruce	12	5.76	0.24	1.44	0.12
Mixed Forest Spruce Dominant	36	17.28	0.72	4.32	0.36
Mixed Forest Fir Dominant	47	22.56	0.94	5.64	0.47
Mixed Forest Deciduous Dominant	3	1.44	0.06	0.36	0.03
Burn	0	0	0	0	0

Site 94

Location: Approximately 2 to 3 km before the end of Mud Lake Road, on the west side. The road is along row 1 (north-south axis).

Description: Flat terrain throughout, except for a few minor ridges and depressions. The eastern half (rows 1 to 5) of the plot is overwhelmingly deciduous (mostly aspen; some birch, pin cherry, alder, willow). The western half had much more conifer cover, with 15 to 40 percent deciduous trees in all but a few places. The westernmost row passed through a small marsh near its midpoint.

Results:

94	A	B	C	D	E	F	G	H	I	J
10	HET H	RV ST	RV	2RV	2RV MS		RV	MS		
9		3RV ST	2RV		RV	WF	RV ST			
8	2MS		RV	ST	RV		AT	ST		2RV
7	RV	MV		RV		SWT H	RV	RV	RV	RV
6		RV		3RV			ST	RV		
5			2RV		RV	RV	MS	AT	RV	
4	JM RV AT			2RV WS				AT	RV	
3	JM		RV JM	JM	RV			WS	MS RV	JM
2		ST			RV WS				AT	
1	MV	WS	MV	2JM ST			JM 3MV			JM MV

LEGEND

- Riparian
- Wetland
- Spruce (Wet Site)
- Spruce (Dry Site)
- Fir-Spruce
- Mixed (Spruce Dominant)
- Mixed (Fir Dominant)
- Mixed (Deciduous Dominant)
- Burn

Small Mammal Trapping Site 94 - Small Mammals Observed

Habitat	# of Trap Nights	Red-Backed Vole	Meadow Vole	Masked Shrew	Jumping Mouse
Riparian	0	0	0	0	0
Wetland	18	3	0	1	0
Spruce Wet	0	0	0	0	0
Spruce Dry	0	0	0	0	0
Fir-Spruce	17.5	2	0	0	0
Mixed Forest Spruce Dominant	104	12	0	1	0
Mixed Forest Fir Dominant	23.5	2	0	0	0
Mixed Forest Deciduous Dominant	427	23	7	4	9
Burn	0	0	0	0	0

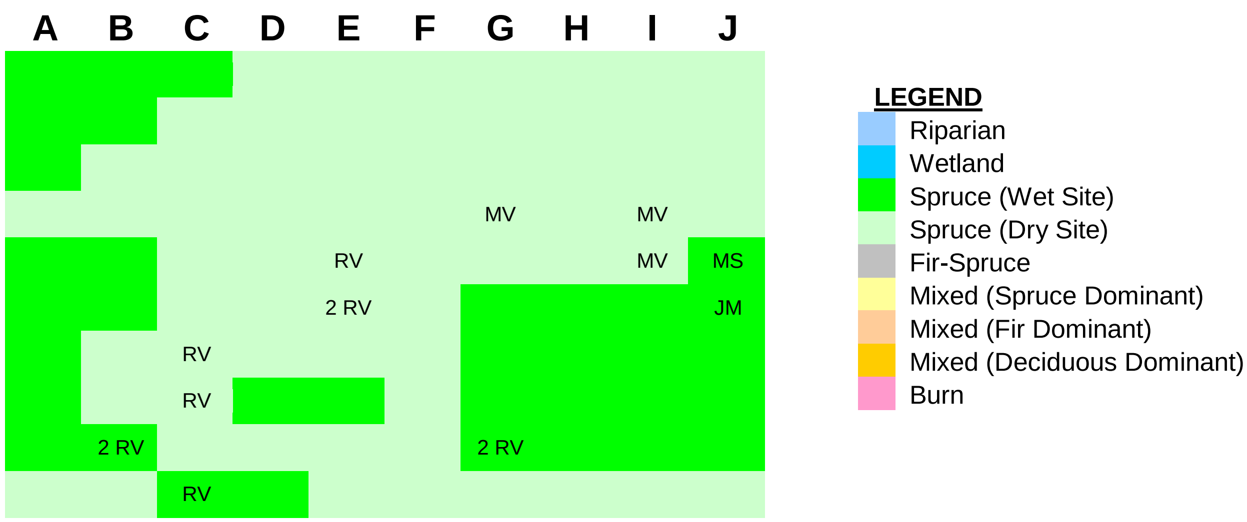
Small Mammal Trapping Site 94 - Small Mammals Expected

Habitat	# of Trap Nights	Red-Backed Vole	Meadow Vole	Masked Shrew	Jumping Mouse
Riparian	0	0	0	0	0
Wetland	3	1.28	0.21	0.18	0.27
Spruce Wet	0	0	0	0	0
Spruce Dry	0	0	0	0	0
Fir-Spruce	3	1.25	0.21	0.18	0.27
Mixed Forest Spruce Dominant	18	7.40	1.23	1.06	1.59
Mixed Forest Fir Dominant	4	1.67	0.28	0.24	0.36
Mixed Forest Deciduous Dominant	72	30.40	5.07	4.34	6.51
Burn	0	0	0	0	0

Site 31

Location: Approximately 800 m north of plot 32, on the higher plateau.

Description: Overall a quite uniform site, entirely dominated by spruce, with only a few scattered firs and alders. The A column is along the top of the slope, and the woods near the edge were generally somewhat moister and more moss-covered. Across most of the grid, especially on the eastern half, there was a low-lying depression centred around rows 2 to 3. It was particularly wet from H to J, with small patches of open water. In columns E through J, there was a considerable slope between rows 3 and 4 and 5 and 6. Along H, the path crossed a small trickle running down the slope.



Small Mammal Trapping Site 31 - Small Mammals Observed

Habitat	# of Trap Nights	Red-Backed Vole	Meadow Vole	Masked Shrew	Jumping Mouse
Riparian	0	0	0	0	0
Wetland	0	0	0	0	0
Spruce Wet	186	5	0	1	1
Spruce Dry	372	5	3	0	0
Fir-Spruce	0	0	0	0	0
Mixed Forest Spruce Dominant	0	0	0	0	0
Mixed Forest Fir Dominant	0	0	0	0	0
Mixed Forest Deciduous Dominant	0	0	0	0	0
Burn	0	0	0	0	0

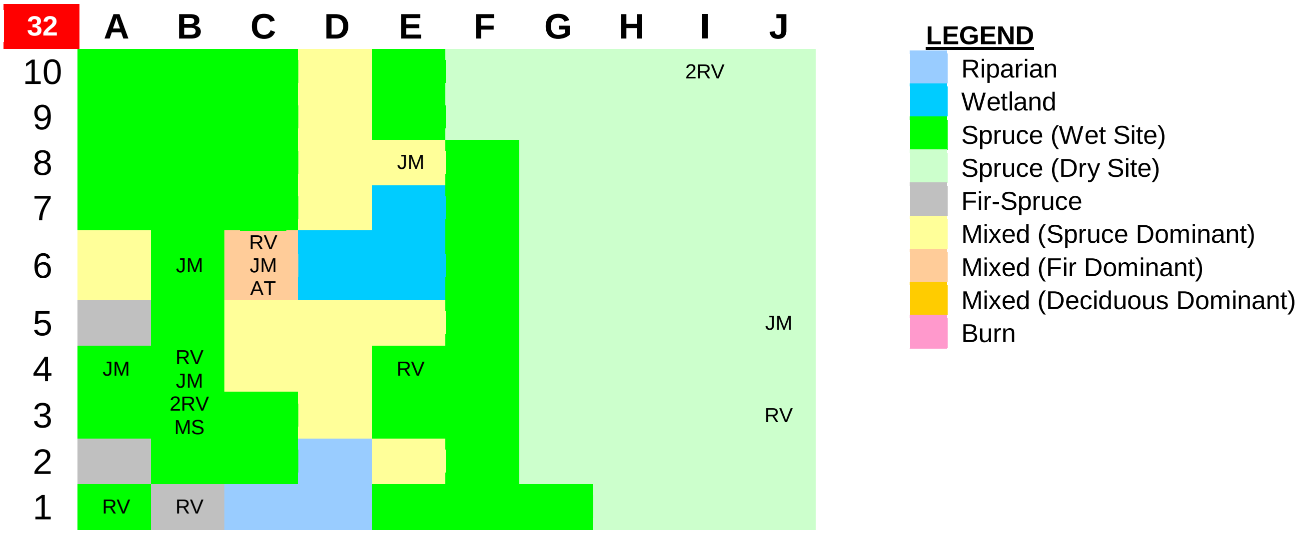
Small Mammal Trapping Site 31 - Small Mammals Expected

Habitat	# of Trap Nights	Red-Backed Vole	Meadow Vole	Masked Shrew	Jumping Mouse
Riparian	0	0	0	0	0
Wetland	0	0	0	0	0
Spruce Wet	0	3.33	1	0.33	0.33
Spruce Dry	0	6.67	2	0.67	0.67
Fir-Spruce	0	0	0	0	0
Mixed Forest Spruce Dominant	0	0	0	0	0
Mixed Forest Fir Dominant	0	0	0	0	0
Mixed Forest Deciduous Dominant	0	0	0	0	0
Burn	0	0	0	0	0

Site 32

Location: Along east side of Cache River, just north of gravel bar along Churchill River.

Description: A band of spruce 50 to 75 m wide along the east bank of the Cache River, with some balsam fir mixed in at isolated locations. East of this was a long narrow depression running the length of the plot, filled with alders, but with some spruce presence in most parts. East of this, there was another band of spruce/moss on the slope, and then fairly uniform dry spruce/lichen on the plateau above.



Small Mammal Trapping Site 32 - Small Mammals Observed

Habitat	# of Trap Nights	Red-Backed Vole	Meadow Vole	Masked Shrew	Jumping Mouse
Riparian	18	0	0	0	0
Wetland	18	0	0	0	0
Spruce Wet	216	5	0	1	3
Spruce Dry	246	3	0	0	1
Fir-Spruce	18	1	0	0	0
Mixed Forest Spruce Dominant	78	0	0	0	1
Mixed Forest Fir Dominant	5.5	1	0	0	1
Mixed Forest Deciduous Dominant	0	0	0	0	0
Burn	599.5	0	0	0	0

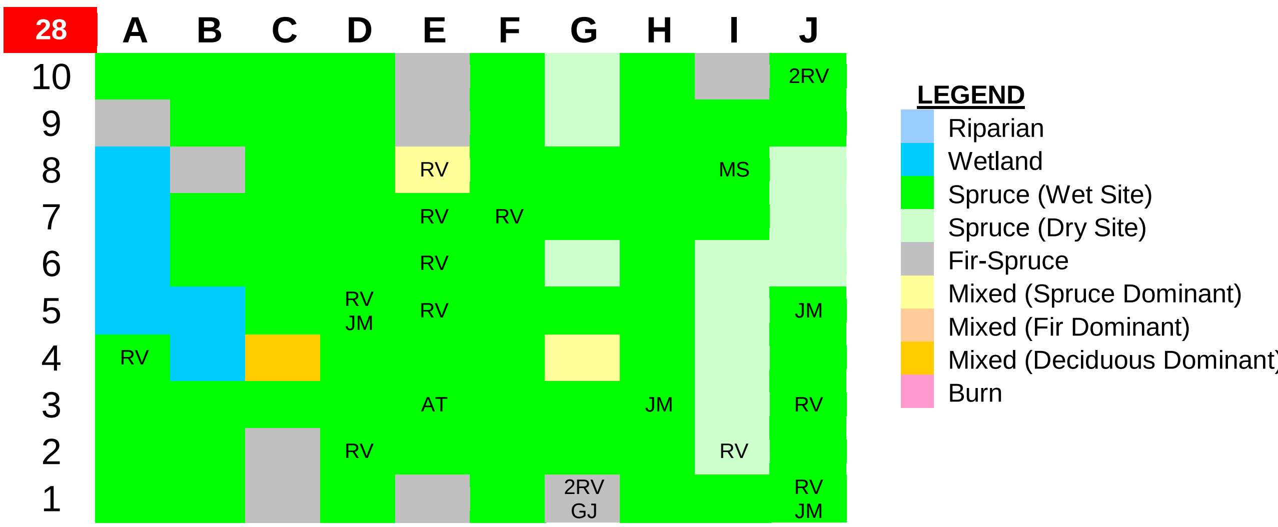
Small Mammal Trapping Site 32 - Small Mammals Expected

Habitat	# of Trap Nights	Red-Backed Vole	Meadow Vole	Masked Shrew	Jumping Mouse
Riparian	0	0.30	0	0.03	0.18
Wetland	0	0.30	0	0.03	0.18
Spruce Wet	0	3.60	0	0.36	2.16
Spruce Dry	0	4.10	0	0.41	2.46
Fir-Spruce	0	0.30	0	0.03	0.18
Mixed Forest Spruce Dominant	0	1.30	0	0.13	0.78
Mixed Forest Fir Dominant	0	0.09	0	0.01	0.06
Mixed Forest Deciduous Dominant	0	0	0	0	0
Burn	0	0	0	0	0

Site 28

Location: Along east side of Cache River, just north of gravel bar along Churchill River.

Description: A band of spruce 50 to 75 m wide along the east bank of the Cache River, with some balsam fir mixed in at isolated locations. East of this was a long narrow depression running the length of the plot, filled with alders, but with some spruce presence in most parts. East of this, there was another band of spruce/moss on the slope, and then fairly uniform dry spruce/lichen on the plateau above.



Small Mammal Trapping Site 28 - Small Mammals Observed

Habitat	# of Trap Nights	Red-Backed Vole	Meadow Vole	Masked Shrew	Jumping Mouse
Riparian	0		0	0	0
Wetland	36	0	0	0	0
Spruce Wet	425.5	11	0	1	4
Spruce Dry	66	1	0	0	0
Fir-Spruce	53.5	2	0	0	0
Mixed Forest Spruce Dominant	12	1	0	0	0
Mixed Forest Fir Dominant	0	0	0	0	0
Mixed Forest Deciduous Dominant	6	0	0	0	0
Burn	0	0	0	0	0

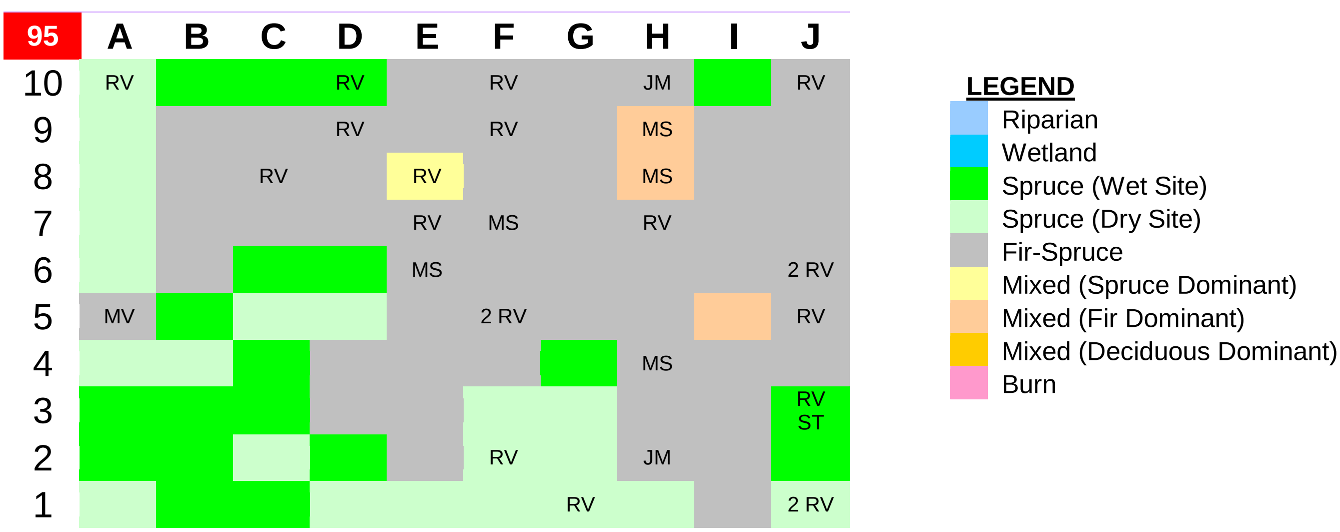
Small Mammal Trapping Site 28 - Small Mammals Expected

Habitat	# of Trap Nights	Red-Backed Vole	Meadow Vole	Masked Shrew	Jumping Mouse
Riparian	0	0	0	0	0
Wetland	0	0.90	0	0.06	0.24
Spruce Wet	0	10.66	0	0.71	2.84
Spruce Dry	0	1.65	0	0.11	0.44
Fir-Spruce	0	1.34	0	0.09	0.36
Mixed Forest Spruce Dominant	0	0.30	0	0.02	0.08
Mixed Forest Fir Dominant	0	0	0	0	0
Mixed Forest Deciduous Dominant	0	0.15	0	0.01	0.04
Burn	0	0	0	0	0

Site 95

Location: On a high (approximately 140 m asl) plateau east of the Churchill River, south of Bob's Brook, approximately 900 m south of plot 28.

Description: Fairly uneven terrain, with a high number of fallen logs across much of the plot. The western edge (column A) and southern edge (rows 1 to 2) were somewhat higher and drier and primarily spruce dominated (moss/wet or lichen/dry depending on slight local changes in topography). The remainder of the plot was slightly lower and wetter and dominated by balsam fir, some of them very large (80+ cm dbh). There were dense alder patches in small clearings in a few patches in the northeast.



Small Mammal Trapping Site 95 – Small Mammals Observed

Habitat	# of Trap Nights	Red-Backed Vole	Meadow Vole	Masked Shrew	Jumping Mouse
Riparian	0	0	0	0	0
Wetland	0	0	0	0	0
Spruce Wet	113.5	2	0	0	0
Spruce Dry	126	5	0	0	0
Fir-Spruce	336	12	1	3	2
Mixed Forest Spruce Dominant	6	1	0	0	0
Mixed Forest Fir Dominant	18	0	0	2	0
Mixed Forest Deciduous Dominant	0	0	0	0	0
Burn	0	0	0	0	0

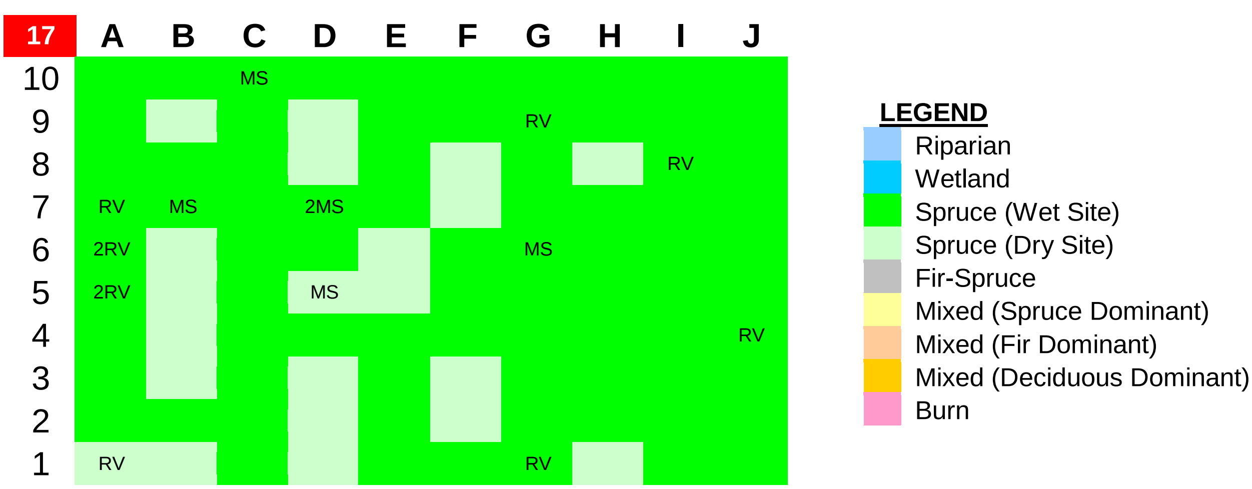
Small Mammal Trapping Site 95 - Small Mammals Expected

Habitat	# of Trap Nights	Red-Backed Vole	Meadow Vole	Masked Shrew	Jumping Mouse
Riparian	0	0	0	0	0
Wetland	0	0	0	0	0
Spruce Wet	0	3.79	0.19	0.95	0.38
Spruce Dry	0	4.20	0.21	1.05	0.42
Fir-Spruce	0	11.21	0.56	2.80	1.12
Mixed Forest Spruce Dominant	0	0.20	0.01	0.05	0.02
Mixed Forest Fir Dominant	0	0.60	0.03	0.15	0.06
Mixed Forest Deciduous Dominant	0	0	0	0	0
Burn	0	0	0	0	0

Site 17

Location: Low site in a wet spruce forest, adjacent to a bog, near Edward's Brook.

Description: Hummocky terrain, but without a slope, or much coarse woody debris present. Variable ground cover, ranging from ericaceous shrubs to wet sphagnum moss. Microsites chosen to represent a wet spruce habitat type (i.e., extremely dry or wet conditions were avoided wherever possible).



Small Mammals Trapping Site 17 - Small Mammals Observed

Habitat	# of Trap Nights	Red-Backed Vole	Meadow Vole	Masked Shrew	Jumping Mouse
Riparian	0	0	0	0	0
Wetland	0	0	0	0	0
Spruce Wet	474	9	0	5	0
Spruce Dry	126	1	0	1	0
Fir-Spruce	0	0	0	0	0
Mixed Forest Spruce Dominant	0	0	0	0	0
Mixed Forest Fir Dominant	0	0	0	0	0
Mixed Forest Deciduous Dominant	0	0	0	0	0
Burn	0	0	0	0	0

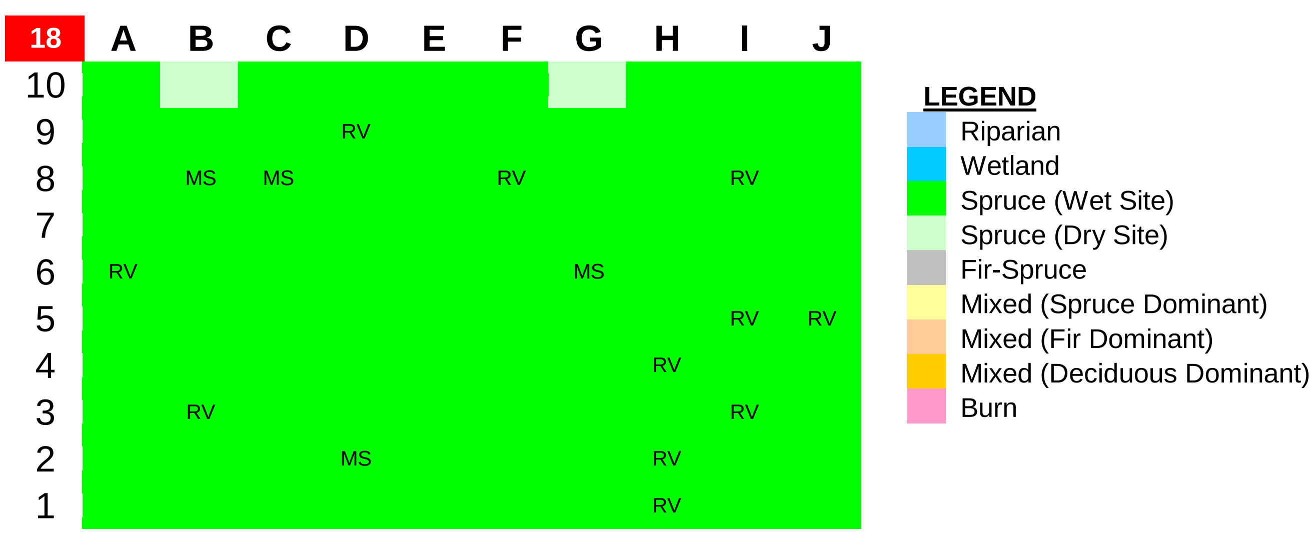
Small Mammals Trapping Site 17 – Small Mammals Expected

Habitat	# of Trap Nights	Red-Backed Vole	Meadow Vole	Masked Shrew	Jumping Mouse
Riparian	0	0	0	0	0
Wetland	0	0	0	0	0
Spruce Wet	0	7.9	0	4.74	0
Spruce Dry	0	2.1	0	1.26	0
Fir-Spruce	0	0	0	0	0
Mixed Forest Spruce Dominant	0	0	0	0	0
Mixed Forest Fir Dominant	0	0	0	0	0
Mixed Forest Deciduous Dominant	0	0	0	0	0
Burn	0	0	0	0	0

Site 18

Location: Upland (northwest) of a bog in wet spruce habitat, near Edward's Brook.

Description: Slopes up a steep hill on the backside and has some alders on the frontside. There was significant coarse woody debris throughout most of this site.



Small Mammals Trapping Site 18 - Small Mammals Observed

Habitat	# of Trap Nights	Red-Backed Vole	Meadow Vole	Masked Shrew	Jumping Mouse
Riparian	0	0	0	0	0
Wetland	0	0	0	0	0
Spruce Wet	588	11	4	0	0
Spruce Dry	12	0	0	0	0
Fir-Spruce	0	0	0	0	0
Mixed Forest Spruce Dominant	0	0	0	0	0
Mixed Forest Fir Dominant	0	0	0	0	0
Mixed Forest Deciduous Dominant	0	0	0	0	0
Burn	0	0	0	0	0

Small Mammals Trapping Site 18 - Small Mammals Expected

Habitat	# of Trap Nights	Red-Backed Vole	Meadow Vole	Masked Shrew	Jumping Mouse
Riparian	0	0	0	0	0
Wetland	0	0	0	0	0
Spruce Wet	0	10.78	3.92	0	0
Spruce Dry	0	0.22	0.08	0	0
Fir-Spruce	0	0	0	0	0
Mixed Forest Spruce Dominant	0	0	0	0	0
Mixed Forest Fir Dominant	0	0	0	0	0
Mixed Forest Deciduous Dominant	0	0	0	0	0
Burn	0	0	0	0	0