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**Nalcor Energy Lower Churchill
Project, Environmental Effects
Monitoring Program – 2016
Furbearer**

Furbearer Environmental Effects
Monitoring Program – Beaver
Component



Prepared for:
Nalcor Energy
Hydro Place, 500 Columbus Drive
P.O. Box 12800
St. John's, NL A1B 0C9

Prepared by:
Stassinu Stantec Limited
Partnership
141 Kelsey Drive
St. John's, NL A1B 0L2

File No: 121413999

Interim Report

January 23, 2017

Table of Contents

OVERVIEW OF THE FURBEARER EEMP	ii
1.0 INTRODUCTION	1
2.0 STUDY AREA AND METHODS.....	2
2.1 STUDY AREA	2
2.2 AERIAL SURVEYS	4
2.2.1 Block Density Surveys	4
2.2.2 Shoreline Transect Surveys.....	4
3.0 RESULTS.....	6
3.1 BEAVER DENSITY IN 4 KM ² SURVEY BLOCKS.....	6
3.2 BEAVER DISTRIBUTION AND HABITAT ASSOCIATIONS ALONG THE LOWER CHURCHILL RIVER	7
4.0 DISCUSSION	10
5.0 REFERENCES.....	12

LIST OF TABLES

Table 2.1	Categories used to describe Habitat Associations of Active Beaver Colonies (based on Minaskuat Inc. 2008)	5
Table 3.1	Beaver Colonies in 4-km ² Survey Blocks Inventoried in 2006 and 2014, by Survey Area and Habitat Quality Ranking.....	6
Table 3.2	Habitat Associations of Active Beaver Colonies along the Lower Churchill River in 2014 and 2015	7

LIST OF FIGURES

Figure 2-1	Map of the Study Area in Central Labrador, Canada	3
Figure 3-1	Active Beaver Colonies along the Churchill River, Labrador, 2014 and 2015.	9



NALCOR ENERGY LOWER CHURCHILL PROJECT, ENVIRONMENTAL EFFECTS MONITORING PROGRAM – 2016 FURBEARER

OVERVIEW OF THE FURBEARER EEMP

As part of monitoring requirements and commitments made in the Environmental Impact Statement (EIS) for the Lower Churchill Project (LCP) (Nalcor 2009a, b), a series of Environmental Effects Monitoring Programs (EEMPs) were designed to monitor potential environmental effects of Project construction on wildlife. The Furbearer EEMP represents one component in this series.

The Furbearer EEMP was carried out over the three-year period from 2014 to 2016, inclusive, and focused on four species of interest (Nalcor 2009a, b): American marten (*Martes americana*), porcupine (*Erethizon dorsatum*), river otter (*Lontra canadensis*), and American beaver (*Castor canadensis*; referred to as beaver). This report is the final submission in a series of field, interim and annual reports associated with the Beaver Component of the Furbearer EEMP.

In accordance with the Furbearer EEMP workscope (dated April 7, 2014), this report is organized in a format suitable for publication and includes background information related to beaver in the LCP study area, a description of the study area, results of surveys (i.e., density of beaver colonies by habitat and maps of beaver activity), and a discussion of results.



NALCOR ENERGY LOWER CHURCHILL PROJECT, ENVIRONMENTAL EFFECTS MONITORING PROGRAM – 2016 FURBEARER

INTRODUCTION
January 23, 2017

Distribution of a Low-Density American Beaver (*Castor canadensis*) Population in an area of Central Labrador, Canada

Abstract – Relatively limited information is readily available on American beaver (*Castor canadensis*) populations in Labrador, Canada. We documented beaver densities in central Labrador based on aerial surveys of 36 4-km² survey blocks. We also documented beaver distribution and habitat associations in a 42.3 km² area along the lower Churchill River. Beaver densities in this study were comparable to densities reported for Newfoundland. The density of active beaver colonies within survey blocks inventoried in 2006 was 0.04 colonies / km² and in 2014 was 0.08 colonies / km². Densities along the lower Churchill River were 0.28 and 0.31 colonies / km² in 2014 and 2015, respectively. The average spacing between active colonies along the river was 4.2 km in 2014 and 1.7 km in 2015. Along the lower Churchill River, active colonies were most closely associated with riparian habitats (marshes and thickets) followed by mixedwood forest habitat. These habitat types contain alder (*Alnus* sp.), birch (*Betula* sp.), white spruce (*Picea glauca*), and balsam fir (*Abies balsamea*) as potential sources of food and building materials.

1.0 INTRODUCTION

American beaver (*Castor canadensis*) occurs throughout Canada, north to the tree line (Banfield 1974). Throughout this extensive range, the density of beaver in Labrador is considered comparatively low (Novak 1987). In the late 1800s, beaver was not considered plentiful in the region (Northland Associates Limited 1980), but by the 1950s Northcott (1971) reported that most of the small lakes within 32 km of the Churchill River contained beaver (cited by Northland Associates Limited 1980). Subsequent surveys in 1978 reported that populations were low along the river (Northland Associates Limited 1980). Systematic studies since this time have been limited, with relatively little information available on Labrador beaver in general.

This study investigates beaver presence in an area of Labrador, Canada, where a large-scale hydroelectric generation project is being developed. We present information on the density of active beaver colonies in the project area in 2006 and 2014, and the distribution and habitat use of beaver in the lower Churchill River valley from 2014 and 2015.



NALCOR ENERGY LOWER CHURCHILL PROJECT, ENVIRONMENTAL EFFECTS MONITORING PROGRAM – 2016 FURBEARER

STUDY AREA AND METHODS

January 23, 2017

2.0 STUDY AREA AND METHODS

2.1 Study Area

The study area was situated in central Labrador, Canada, between Happy Valley-Goose Bay (N53.29844, W60.35586) and Churchill Falls (N53.53084 W64.00772) (Figure 2-1). Thirty-six 2 km x 2 km (4 km²) survey blocks were established to evaluate beaver densities throughout the survey area (Figure 2-1). Additional surveys to assess beaver presence and habitat use focused on the area of inundation associated with the hydroelectric project on the lower Churchill River, between Muskrat Falls (N53.24584 W60.77281) and Gull Island (N52.97487 W61.46280).

The area is largely characterized by cool and humid summers, and cold winters. Mean annual temperatures range from -13°C in the winter to 8.5°C in the summer (Ecological Stratification Working Group 1995). Mean annual precipitation ranges from 800 mm to 1000 mm (Ecological Stratification Working Group 1995). The area is described as an irregular lowland dissected by river valleys. Elevations range from near sea level to 500 m above sea level (Ecological Stratification Working Group 1995). Black spruce (*Picea mariana*) is ubiquitous throughout the region, and typically dominates forested upland areas and lichen woodlands (PAA 2008). Balsam fir (*Abies balsamea*), birch (*Betula* sp.), and aspen (*Populus* sp.) dominate along richer slopes (PAA 2008). Extensive fens and bogs occur in upland and coastal areas.



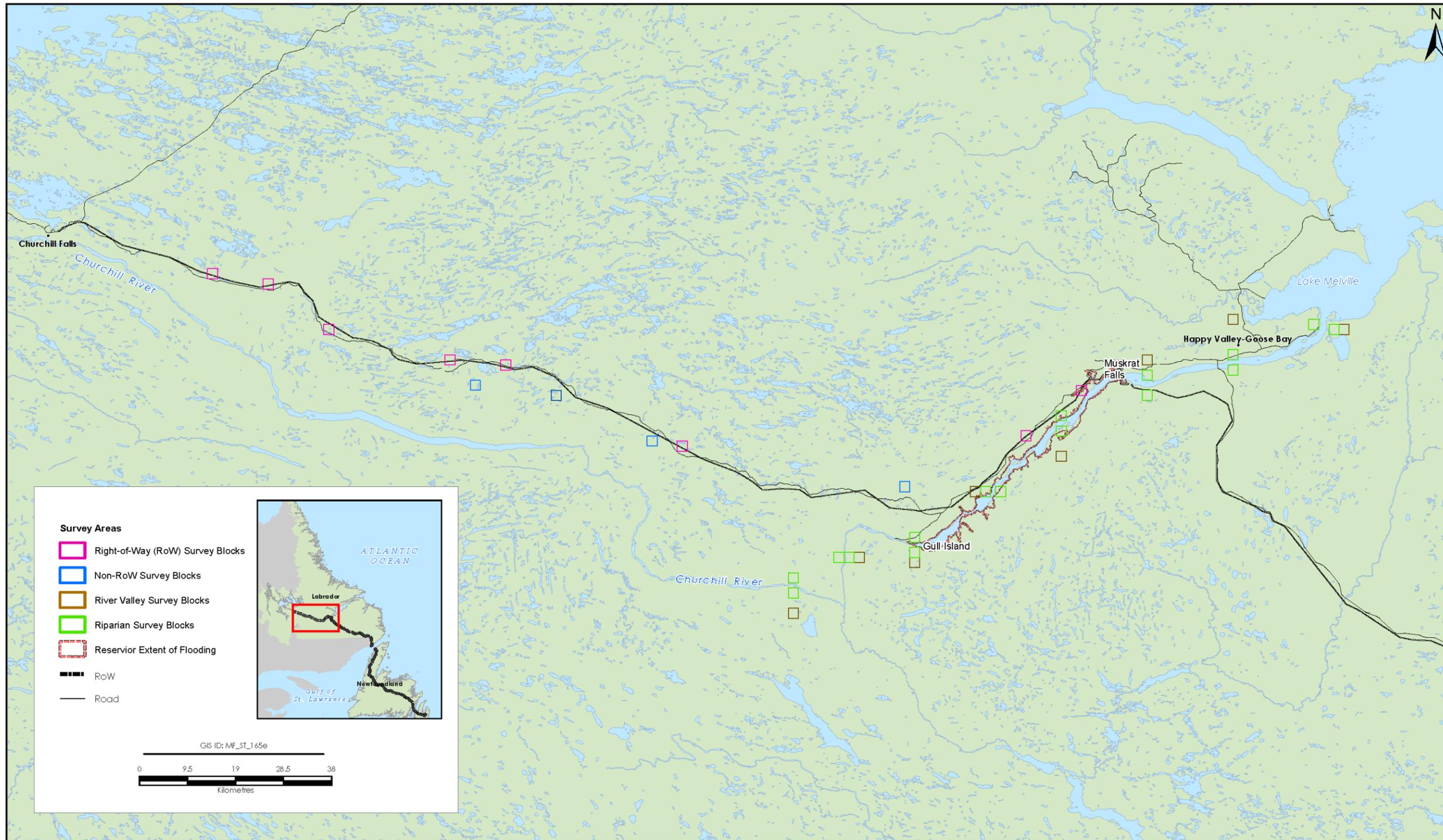


Figure 2-1 Map of the Study Area in Central Labrador, Canada

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STUDY AREA AND METHODS

January 23, 2017

2.2 Aerial Surveys

Aerial beaver inventories were conducted in October of 2006, 2014 and 2015. Surveys were scheduled after most deciduous leaves had fallen and prior to freeze-up, to enhance ground visibility (Hay 1958, Novak 1987). A Bell 206L Long Ranger helicopter equipped with “bubble” rear windows was flown at speeds ranging from hover to 80 to 100 km/h. Search altitudes varied with terrain, with lower altitudes flown in more densely forested areas and higher altitudes in open areas. Along the river, an altitude of approximately 100 m above ground level was maintained. A lead navigator (observer) and pilot were situated in the front, with one or two additional rear-seat observers. When only one rear-seat observer participated, the observer was positioned on the opposite side of the aircraft as the front-seat observer to enhance search efficiency.

2.2.1 Block Density Surveys

Survey blocks were distributed among four key areas related to the project (Figure 2-1): 1) “riparian” survey blocks (n=16) located immediately adjacent to the Churchill River at 20-km intervals, 2) “valley” survey blocks (n=8) located at randomly selected points within 5 km on the north and south shorelines of the Churchill River at each 20-km interval, 3) “right-of-way (RoW)” survey blocks (n=8) along an existing transmission line RoW, and 4) “non-RoW” (n=4) survey blocks adjacent to the existing RoW. Each block was surveyed in 2006 and again in 2014. Repeated passes were made in open areas throughout the survey block and areas on either side of waterways were surveyed until the survey team was confident the survey block was thoroughly searched.

Habitat in each survey block was ranked based on the presence of: 1) deciduous cover as a food source, 2) stable water levels, 3) slow-moving water, and 4) adequate stream structure (valley width >46 m and a valley grade of <6%) (Allen 1983, Northcott 1971, Novak 1987). Survey blocks with three or more of these elements were ranked as “good quality” habitat, blocks with two elements were ranked as “medium quality”, and all remaining ranked as “poor quality”.

2.2.2 Shoreline Transect Surveys

In 2014 and 2015, a series of survey transects were flown along the lower Churchill River to document beaver activity. The Survey area focused on the current shoreline to the 39 m full supply level (fsl) for the planned reservoir, resulting in a survey area of 42.3 km². Transects were flown parallel to the river along the north and south shorelines, until the area had been completely surveyed.

All observations of beaver and / or evidence of their activity (e.g., felled trees, food caches, intact dams, and lodges) were recorded and spatially marked using a Global Positioning System (GPS). The number of active beaver colonies observed during the survey was estimated based on the presence of a food cache and a freshly maintained lodge (Hay 1958, Banfield 1974, Bergerud and Miller 1977, Hatler and Beal 2007).



NALCOR ENERGY LOWER CHURCHILL PROJECT, ENVIRONMENTAL EFFECTS MONITORING PROGRAM – 2016 FURBEARER

STUDY AREA AND METHODS

January 23, 2017

Detailed habitat information was available for the area of land spanning 2 km on either side of the Churchill River from Churchill Falls to Muskrat Falls (Minaskuat Inc. 2008). Based on a review of habitat suitability for beavers by Allen (1983), habitat 800 m upstream and downstream of a colony and 200 m inland from water was described for each active colony. Habitat categories and a brief description are provided in Table 2.1. The linear distance to the nearest active colony was also calculated.

Table 2.1 Categories used to describe Habitat Associations of Active Beaver Colonies (based on Minaskuat Inc. 2008)

Habitat Category	Coverage* (%)	Description
Black Spruce / Feathermoss	41.8	Moderately dense tree cover composed largely of black spruce (Average percent cover in a stand: 45%). Small amounts of alder (3-4%).
Black Spruce / Lichen	22.4	Small patches of black spruce within a carpet of lichens.
Spruce-Fir Feathermoss	5.3	Moderately dense tree cover composed of a mixture of black spruce (30%) and balsam fir (22%). Small amounts of alder (~5%).
Fir-White Spruce	3.8	Dense tree cover composed of a mixture of balsam fir (47%) and white spruce (16%). Birch (2-3%) and alder (5-9%) are common among stands.
Mixedwood	3.7	Dense tree cover composed predominantly of birch (~25%) balsam fir (20%), and black spruce (16%). Alder is common in the shrub layer (~22%).
Hardwood	1.7	Uncommon over most of the study area. Dense tree cover comprised of birch (15-17%), aspen (15%), poplar (8%), balsam fir (3%), and white and black spruce (4-8%). Alder is common in the shrub layer (9-13%).
Wetland	2.4	Marshes, fens, and bogs. Small amounts of alder ($\leq 5\%$) in areas.
Riparian	1.4	Includes drier riparian thickets and wet riparian meadows. Thickets are characterized by a dense shrub layer composed largely of alder (73%). Meadows are dominated by a variety of grasses and low shrub cover (<2m), with small amounts of alder (7%).
Sand / Gravel Bar	1.6	Elevated areas of sediment deposit.
Open Water	15.3	Lakes, ponds, rivers, and tributaries.
*Percent coverage is based on a 2 km-wide swath along the shorelines of the Churchill River, from Churchill Falls to Muskrat Falls.		



NALCOR ENERGY LOWER CHURCHILL PROJECT, ENVIRONMENTAL EFFECTS MONITORING PROGRAM – 2016 FURBEARER

RESULTS

January 23, 2017

3.0 RESULTS

3.1 Beaver Density in 4 km² Survey Blocks

The density of active beaver colonies in 2006 was 0.04 active colonies / km² (Table 3.1). Two of the active colonies were in habitat ranked as “good quality” (0.17 active colonies / km²), with one located in riparian habitat and the other along the existing RoW. The remaining four active colonies in 2006 were in habitat ranked as medium quality (0.05 active colonies / km²), with one located in the valley, and three along the RoW. There were no active colonies identified in poor quality habitat. An additional 22 inactive lodges were noted among the survey blocks, indicating an inactive: active lodge ratio of 3.7:1.

Table 3.1 Beaver Colonies in 4-km² Survey Blocks Inventoried in 2006 and 2014, by Survey Area and Habitat Quality Ranking

Survey Area	# Blocks Survey Blocks	2006		2014	
		# Active Colonies	Active Colonies / km ²	# Active Colonies	Active Colonies / km ²
Good Quality Habitat					
Riparian	1	1	0.25	1	0.25
River Valley	1	0	-	0	-
RoW	1	1	0.25	2	0.50
Total	3	2	0.17	3	0.25
Medium Quality Habitat					
Riparian	8	0	-	5	0.16
River Valley	3	1	0.08	0	
RoW	7	3	0.11	2	0.07
Non-RoW	4	0	-	1	0.06
Total	22	4	0.05	8	0.09
Poor Quality Habitat					
Riparian	7	0	-	0	-
River Valley	4	0	-	0	-
Total	11	0	-	0	-
All Habitats					
Total Riparian	16	1	0.02	6	0.09
Total River Valley	8	1	0.03	0	-
Total RoW	8	4	0.13	4	0.13
Total Non-RoW	4	0	-	1	0.06
Overall	36	6	0.04	11	0.08



NALCOR ENERGY LOWER CHURCHILL PROJECT, ENVIRONMENTAL EFFECTS MONITORING PROGRAM – 2016 FURBEARER

RESULTS

January 23, 2017

The density of active beaver colonies in 2014 was 0.08 active colonies / km² (Table 3.1). Active colonies were in habitats ranked as good quality (n=3) and medium quality (n=8), with six of these located in the riparian and river valley survey blocks, four along the RoW, and one in a non-RoW survey block. An additional 12 inactive colonies were noted in 2014, equating to an inactive: active lodge ratio of 1.1:1.

The highest density of active colonies in both 2006 and 2014 were found along the RoW (0.13 active colonies / km²) (Table 3.1). Only two survey blocks with an active colony in 2006 no longer supported an active colony in 2014, both in habitat ranked as medium quality. Seven survey blocks that showed no sign of activity in 2006 were active when resurveyed in 2014 (one high quality and six medium quality habitats).

3.2 Beaver Distribution and Habitat Associations along the lower Churchill River

Within the area of inundation, 42.3 km² was surveyed each year for evidence of beaver. Twelve active beaver colonies were identified in 2014 and 13 in 2015, corresponding to densities of 0.28 and 0.31 colonies / km², respectively. The average spacing between active colonies was 4.2 km (range 0.2 – 9.1 km) in 2014 and 1.7 km (0.1 – 8.3 km) in 2015. In addition to these colonies, six inactive lodges were identified in 2014, and five in 2015, indicating an inactive: active lodge ratio of 0.5:1 and 0.4:1, respectively.

Active beaver colonies were primarily associated with riparian (26.4%) and mixedwood (17.7%) habitats (Table 3.2). Sand / gravel bars (12.9%) that have formed naturally along the river's edge and fir-white spruce forests (12.8%) also comprise a relatively large proportion of habitat associated with active colonies, followed by the presence of open water (10.4%). Black spruce dominated forests (i.e., black spruce / feathermoss, black spruce / lichen, and spruce-fir feathermoss) comprised proportionally lower amounts of the habitats associated with active colonies compared to their abundance in the study area (see Table 2.1). One exception to this was in 2014, where an individual colony was associated primarily with black spruce / feathermoss habitat (67%).

Table 3.2 Habitat Associations of Active Beaver Colonies along the Lower Churchill River in 2014 and 2015

Habitat Category*	2014		2015		Combined	
	Area (km ²)	%	Area (km ²)	%	Area (km ²)	%
Riparian	1.9	23.0	2.6	29.5	4.5	26.4
Mixedwood	1.5	18.6	1.5	16.9	3.0	17.7
Sand / Gravel Bar	1.1	13.2	1.1	12.7	2.2	12.9
Fir-White Spruce	1.2	14.7	1.0	11.1	2.2	12.8
Open Water	0.9	11.4	0.8	9.5	1.7	10.4
Black Spruce / Feathermoss	0.7	8.5	0.3	3.4	1.0	5.9



NALCOR ENERGY LOWER CHURCHILL PROJECT, ENVIRONMENTAL EFFECTS MONITORING PROGRAM – 2016 FURBEARER

RESULTS

January 23, 2017

Habitat Category*	2014		2015		Combined	
	Area (km ²)	%	Area (km ²)	%	Area (km ²)	%
Hardwood	0.3	3.6	0.6	7.1	0.9	5.4
Wetland	0.2	2.9	0.6	6.2	0.8	4.6
Black Spruce / Lichen	0.3	3.9	0.3	3.6	0.6	3.8
Spruce - Fir Feathermoss	<0.1	0.1	<0.1	0.1	<0.1	0.1
*Habitat descriptions are provided in Table 2.1						

Two areas along the lower Churchill River appeared to be “hot spots” for beaver activity: along the north shoreline upriver from Upper Brook and along the south shoreline, inland from Thomas River (Figure 3-1). Both areas are relatively flat (i.e., grade<6%) with slow-moving, stable water levels, and have adequate deciduous cover as a food source (primarily alder (*Alnus sp.*) and birch).



RESULTS
January 23, 2017

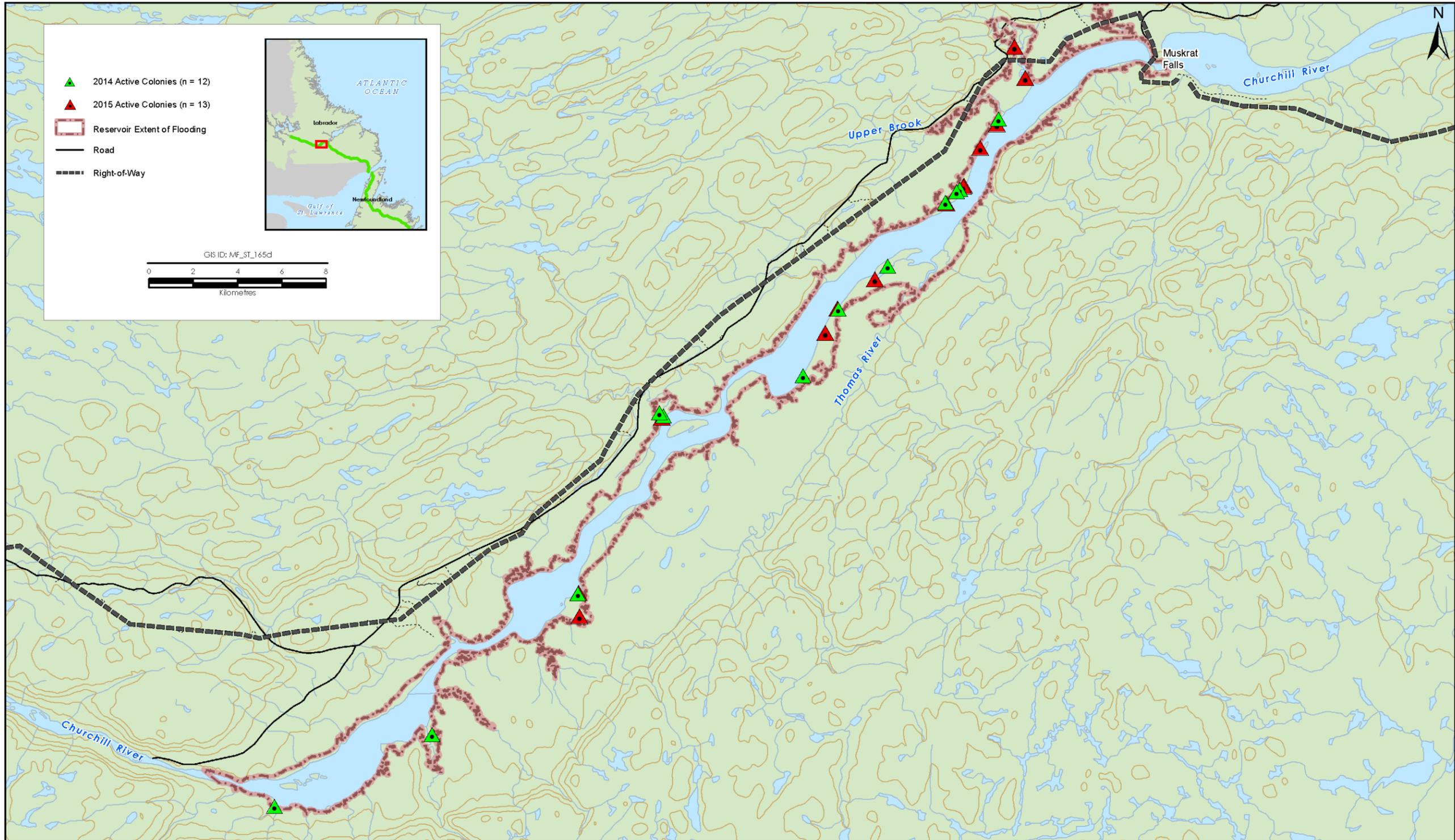


Figure 3-1 Active Beaver Colonies along the Churchill River, Labrador, 2014 and 2015.

NALCOR ENERGY LOWER CHURCHILL PROJECT, ENVIRONMENTAL EFFECTS MONITORING PROGRAM – 2016 FURBEARER

DISCUSSION

January 23, 2017

4.0 DISCUSSION

Beaver distribution is largely determined by food and water availability (Novak 1987). Beaver are unable to survive in areas where water levels fluctuate seasonally, are fast-moving, or have excessive wave action (Allen 1983, Novak 1987). Ideal habitat includes small ponds or lakes and meandering streams, although other habitats (e.g., artificial ponds, reservoirs, and drainage ditches) are readily occupied when food is available (Novak 1983). Granite bedrock is a positive feature, as it retains water collected from seasonal or temporary runoff (Novak 1983).

Access to adequate food supplies will also influence beaver habitat selection. Herbaceous vegetation is generally preferred and will be consumed throughout the year, where available. Woody vegetation (trees and shrubs) are also consumed year-round, but is most utilized as a winter food source (Allen 1983). While aspen and willow (*Salix* sp.) are generally considered to be the preferred woody food items of beaver, several other deciduous species, and occasionally conifers are also utilized (Allen 1983). Northcott (1971) noted that beaver “flourished” on the Island of Newfoundland, despite the lack of abundant supplies of aspen. Instead, beavers subsisted primarily on alders (*Alnus rugosa* and *A. crispa*) for their winter food source, and used them for dam repair during summer.

Key habitat parameters identified in Allen (1983) and Novak (1987) appear to be relevant for beavers in Labrador. In the present study, an active beaver colony was found in only one survey block rated as poor habitat quality, and highest densities of active colonies were found in good quality habitats. The overall low percentage (8%) of survey blocks in the study area considered good quality habitat, however, is indicative of overall habitat quality in the region. Even survey blocks ranked as medium quality were largely devoid of deciduous trees as a potential food source.

Along the lower Churchill River, active colonies were generally associated with habitats that contained varying supplies of alder, birch, fir, and to a lesser extent white spruce. Colonies were most commonly associated with riparian habitats (marshes and thickets), where alders comprise nearly 75% of the shrub layer, followed by mixedwood forest habitat (Minaskuat Inc. 2008). The latter habitat is comprised largely of a mix of birch and balsam fir, with alder also common in the shrub layer. Alder likely forms the largest proportion of their diets in these areas. Birch, fir, and white spruce may also be consumed, but would be expected to constitute only a small portion of their diet (e.g., Northcott 1971).

The density of active colonies reported for the lower Churchill River valley (0.28 colonies per km² in 2014 and 0.31 colonies per km² in 2015) is within the range of values reported for beaver throughout their range. Novak (1987) reported colony densities in the range of 0.15 to 4.6 colonies / km² for North America and the Soviet Union. However, Allen (1983) reported slightly higher densities in suitable habitat (0.4 to 0.8 colonies / km²). He defined suitable beaver habitat following



NALCOR ENERGY LOWER CHURCHILL PROJECT, ENVIRONMENTAL EFFECTS MONITORING PROGRAM – 2016 FURBEARER

DISCUSSION

January 23, 2017

Williams (1965) as having a combination of stable and sufficient water, a channel gradient of less than 15% and sufficient quantity of food available.

The density of active colonies within survey blocks (0.04 colonies per km² in 2006 and 0.08 colonies per km² in 2014) is lower than reported by both Novak (1987) and Allen (1983) but comparable to densities reported for Newfoundland. Payne (1989) surveyed an 8,248 km² area in Newfoundland reported a colony density along registered traplines of 0.05 to 0.46 colonies / km² (mean 0.27 / km²). Bergerud and Miller (1977) stated that densities seldom exceed 0.38 colonies / km² in Newfoundland.

Average colony spacing along the lower Churchill River were somewhat greater than reported in other studies, although minimum distances were comparable. The minimum spacing found in this study was 0.1 km, with an average distance from the closest colony of 4.2 km in 2014 and 1.7 km in 2015. In Newfoundland, Bergerud and Miller (1977) reported average distances of 0.6 km downstream and upstream from the nearest colony, and 0.2 km from the nearest inland colony. The minimum distance recorded was <0.1 km. Boyce (1981) reported a minimum of 0.48 km spacing and average of 1.6 km for active colonies in Alaska (cited in Payne 1989).

The ratio of inactive to active lodges was relatively high in 2006 (3.7:1), when 79% of the lodges observed among survey blocks did not have a food cache and were therefore considered inactive. A high ratio of inactive to active lodges can indicate that a beaver population is at or over its carrying capacity (Payne 1989). Overall low densities in the region suggest that other factors may have contributed to the observed number of inactive lodges in Labrador in 2006. Such factors may include water reliability, food availability (or overuse of quality food items in an area), and trapping activity (Payne and Finlay 1975, Bergerud and Miller 1977, Allen 1983, Payne 1984, Howard and Larson 1985, Novak 1987). The general persistence of abandoned lodges also contributes to the number of inactive colonies observed. Such lodges may have been abandoned when shifting from summer to winter lodges, or may be indicative of historic (i.e., pre-2006) habitat saturation.

Overall, densities of active beaver colonies in the study area in Labrador were generally lower than reported for Newfoundland and elsewhere in North America. The highest densities found in this study were along the lower Churchill River valley (area of inundation). Beaver in this area were most commonly associated with habitats that contain relatively abundant supplies of alder that may be a primary source of winter food for beavers in this region.



NALCOR ENERGY LOWER CHURCHILL PROJECT, ENVIRONMENTAL EFFECTS MONITORING PROGRAM – 2016 FURBEARER

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January 23, 2017

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NALCOR ENERGY LOWER CHURCHILL PROJECT, ENVIRONMENTAL EFFECTS MONITORING PROGRAM – 2016 FURBEARER

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January 23, 2017

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