Nalcor Energy Lower Churchill Project, Environmental Effects Monitoring Program – Newfoundland Marten

Hair Snag Trapping and Off Highway Vehicle Surveys

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Does the development of a transmission line right-of-way in an already fragmented area act as a barrier to movements of American marten (*Martes americana atrata*)?

Abstract – The Newfoundland population of American marten (*Martes americana atrata*) is genetically distinct and geographically isolated from other marten populations, and is a species at risk based on substantial declines in population size and continued threats from habitat fragmentation and incidental mortality. We investigated a subpopulation of Newfoundland marten near the Main River in Newfoundland, Canada, before, during, and after the development of a transmission line Right-of-way (RoW) that intercepts habitat identified as critical to the survival of this species. We identified 40 different marten in our study area using hair samples collected from 17 hair snag trap locations over three winter trapping seasons, and assessed movements based on marten captures before, during and after clearing of the RoW. Annual movements of marten crossing the RoW were confirmed by their use of multiple trap sites within the same season. Three of the same individuals that crossed the RoW before it was cleared continued to do so during and after clearing. We concluded that the 60 m-wide RoW in our study area did not act as a barrier to movements of Newfoundland marten.

1.0 INTRODUCTION

The Newfoundland population of American marten (*Martes americana atrata*) are genetically distinct and geographically isolated from their North American counterparts (Kyle and Strobeck 2003). Historically, the population was distributed widely across the island of Newfoundland, but estimates in 2007 indicated that only 300 to 600 breeding individuals remained in five subpopulations in eastern and western Newfoundland (Environment Canada 2013). The substantial decline in population size led to the designation of *Threatened* under federal and provincial legislation (COSEWIC 2007, Government of Newfoundland 2004). This species is still considered at risk, largely because of forest harvesting activities and incidental mortality from snaring and trapping.

Research has confirmed that marten respond negatively to low levels of habitat fragmentation, and that marten tend to avoid natural and anthropogenic open areas such as clearcuts or wetlands (e.g., Gosse et al. 2005, Hargis et al. 1999, Potvin et al. 2000, Snyder and Bissonette 1987). Hargis et al. (1999) documented significant decreases in marten capture rates in increasingly fragmented landscapes, with marten seldom found in forests with > 25% non-forest cover, even when forests remained connected. Marten capture rates also decreased as the proximity of open patches increased. In another study, Poole et al. (2004) found that following removal of immature forests, individual marten either shifted their home range to avoid the clearing, or abandoned their home range altogether. At both the home range and landscape scale, Cheveau et al. (2013) found that marten avoided open areas, including anthropogenic disturbances (e.g., clear-cuts) and natural features, such as, forested bogs.

Studies in Newfoundland have found similar results. Forsey and Baggs (2001) recorded a significant decrease in marten tracks within clear-cuts following prescribed cutting. Similarly, Gosse et al. (2005) found that marten in Newfoundland avoided non-forested areas (e.g., barrens, open fens) within their home ranges, but would occasionally cross smaller (< 100m) open areas. Snyder and Bissonette (1987) found that marten seldom used clear-cuts, but used undisturbed forests and small patches of residual forests in proportion to or greater than expected, based on their occurrence.

Research related to the potential effects of linear openings on marten, whether natural (e.g., rivers) or anthropogenic, are limited, and none were found that were specific to Newfoundland marten. The effects of seismic lines on marten populations in northern Canada were investigated by Tigner et al. (2015). At the home range scale, they found that marten occurrence was negatively correlated with increasing seismic line density. Marten also avoided seismic lines ≥ 3 m wide, but would use wider lines (≥ 6 m) when partially reclaimed. Alexander and Waters (2000) studied the effects of highway corridors on wildlife in Banff National Park and concluded that the Trans Canada Highway acted as a barrier to movements of all species investigated, including marten. In another study in Ontario, Robitaille and Aubry (2000) examined the occurrence and activity pattern of marten near roads and powerlines, and compared findings to forested habitat away from roads. They found that while the occurrence of marten tracks did not differ among areas sampled, tracks were more clumped within forest habitat indicating that marten exhibited different movement patterns and habitat use in forests. The authors suggested that given the general territorial nature of this species, this likely indicated higher levels of activity by marten in forests, rather than the presence of more individuals.

In this study, we investigate marten from the Main River subpopulation in Newfoundland, before, during and after the development of a 60 m-wide transmission line right of way (RoW) that intercepts habitat identified as critical to the survival of this species at risk. Our research question focused specifically on whether the cleared RoW acted as a barrier to movements of Newfoundland marten. Clearing of the RoW in our study area began in 2015 and was completed by 2016. We present information on marten occurrence and movements before, during and after clearing of the RoW. We also discuss off-highway vehicle (OHV) access to the RoW and the potential for increased incidental mortality.

2.0 STUDY AREA AND METHODS

2.1 Study Area

Our study focused on marten in the Main River Marten Core Area (MRMCA) in Newfoundland, Canada (Environment Canada 2013), between 49.89 and 49.75 latitude and -57.54 and -57.10 longitude (Figure 2-1). The area traverses the eastern slopes of the Long Range Mountains and the interior highland plateau, with elevations ranging from approximately 300 m to 500 m above sea level. Summers are short and cool, and winters long and cold, with snow persisting in some areas until late June (Meades 1990). Barrens are extensive in highland areas, and forests are generally limited to deep, sheltered valleys and along the mountain slopes. Forest communities are predominantly comprised of open balsam fir (*Abies balsamea*) and black spruce (*Picea mariana*) mixtures, with the latter dominating at higher elevations (Meades 1990).

At the time of our study, all industrial forest harvesting activities were prohibited, however many non-forested areas persist because of past (pre-2004) harvesting activities (e.g., cutblocks), and there is one main gravel road with several branching side-roads that penetrate the area. Portions of these roads are partially overgrown but are used as snowmobile trails during winter. In addition, many natural features, including open barrens and wetlands, and numerous lakes, ponds, and rivers, contribute to a naturally fragmented landscape. The general area is accessed primarily for recreational activities (the Main River Watershed Provincial Park lies immediately north of the study area) including canoeing, hiking, angling, and hunting and trapping, by outfitters, cabin owners, and other outdoor enthusiasts. All small game snaring is prohibited in the study area, however trapping is permitted provided traps are set in a manner to avoid capture of marten.

The segment of the transmission line RoW we studied was 29.8 km long x 60 m wide and encompassed 106.3 km^2 of critical habitat identified for marten in the MRMCA. Critical habitat was previously identified based on areas of suitable habitat that were known to support resident adult marten (The Newfoundland Marten Recovery Team 2010). In our study area, suitable habitat included primarily mature coniferous forest (Bateman 1986, Snyder and Bissonette 1987, Gosse et al. 2005, Hearn et al. 2010). Seventeen survey blocks (2.5 km x 2.5 km) were identified in the MRMCA study area that overlapped the transmission line RoW (Figure 2-1).

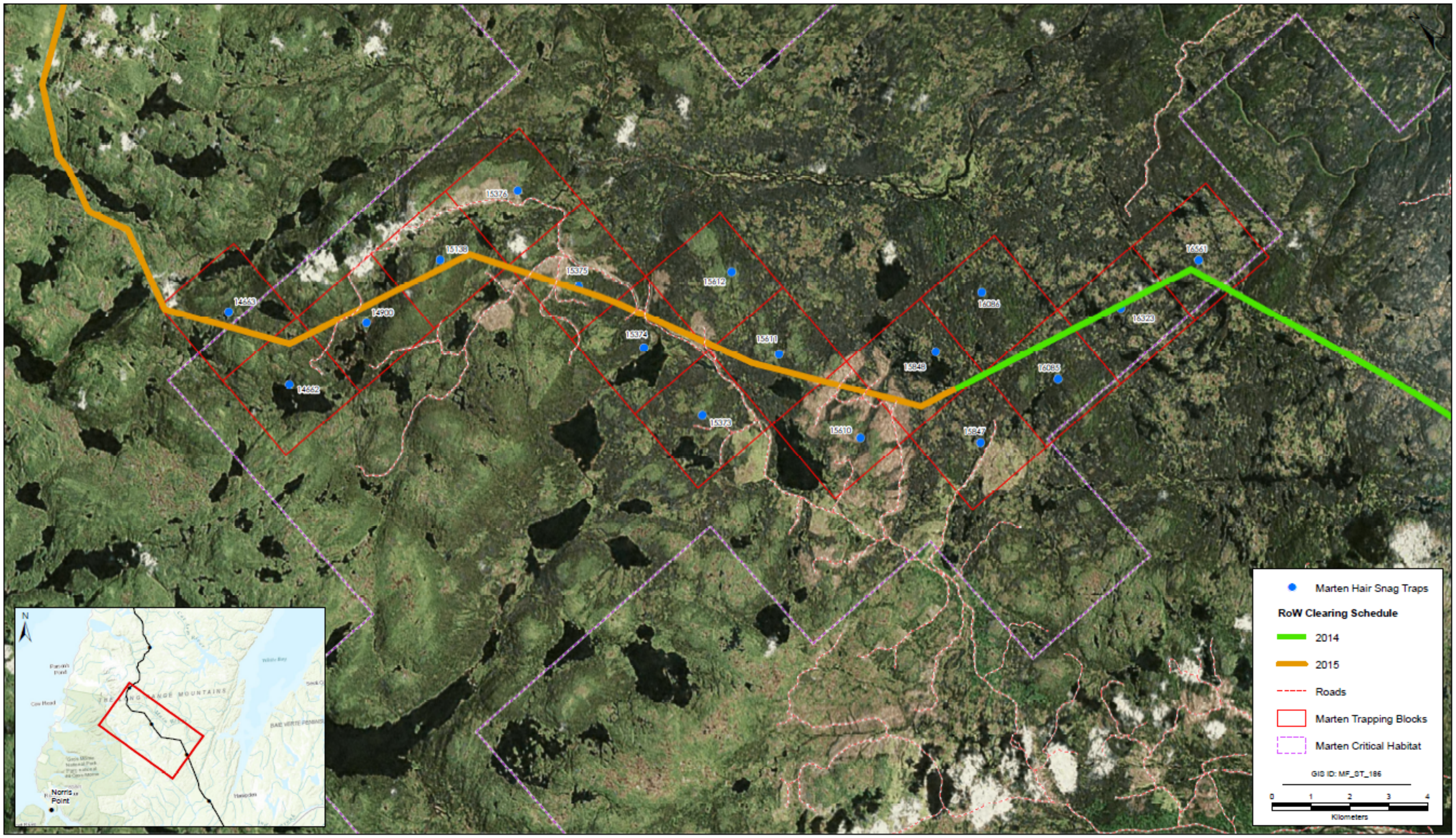

Figure 2-1 Map of the Main River Marten Core Area Study Area in Newfoundland, Canada

2.2 Hair Snag Trapping and Track Surveys

We constructed triangular shaped hair snag traps using three boards joined with 12-gauge wire (two 2.5 cm x 15.4 cm x 61.0 cm boards for the top and one 2.5 cm x 15.4 cm x 81.3 cm for the base), as described in Herdman (2014). This design allowed the trap to fold out flat for ease of transportation, efficient trap set-up, and provided a quick release for trap baiting and sample removal. Four sticky pads made from mouse glue boards (cut to approximately 2.5 cm x 6.5 cm) were placed in each trap, and baited with sardines. Sardines were pushed into the corners of the sardine can, to increase the chance the marten would move around in the trap and contact the sticky pads.

Hair snag stations (traps) were established within each of the 17 survey blocks in 2014 (pre-clearing), 2015 (during clearing), and 2016 (after clearing). We placed the hair snag stations as close to the center of the survey block as possible, but adjusted the locations as necessary to target relatively continuous tracts of forest. This positioning resulted in approximately every other hair snag station to be on opposite sides of the RoW. We mounted traps horizontally as high as feasible in a relatively large (≥ 22-cm diameter), living black spruce or balsam fir tree, and placed marten lure (Hawbaker's Marten Lure, S. Stanley Hawbaker and Sons) on adjacent trees to attract marten.

We checked and re-baited hair snag traps approximately once per week from April 17 to May 8 in 2014, March 21 to April 21 in 2015, and March 2 to April 8 in 2016, resulting in three potential captures per trap per year. Hair samples were removed and stored in envelopes until they were sent for genetic analysis by the Genomics and Proteomics (GaP) Facility of the Core Research Equipment and Instrument Training (CREAIT) Network, Memorial University of Newfoundland. One hair from each trap was collected and analyzed. As there were four tabs from each sticky pad for each trap, the tab with the most guard hairs attached was selected.

We used the results from the genetic analysis to determine the number and sex of marten captured in the study area, and to assess movements of individual marten (i.e., whether marten either used multiple traps or crossed the RoW). We also followed marten tracks near some hair snag traps, to verify movements.

Aerial surveys were conducted in 2014 (March 17), 2015 (April 10 and April 16), and 2016 (March 14 and April 7) to document OHV (i.e., snowmobile) access points along the RoW. The intent of these surveys was to document changes in winter access over time as the RoW was cleared. Prior to the study, the extent of snowmobile use within our study area was unclear. Through documenting changes in access points or volume of use, we hoped to understand any potential effects to marten using the RoW.

3.0 RESULTS

3.1 Marten Captures

We captured 101 hair samples suitable for genetic analyses, and identified 40 individual marten (16 males, 17 females, seven unknown sex) in the study area. Six individuals (three males and three females) were captured in all three years, 11 (two males, seven females and two unknown sex) were captured in two different years, and 23 (11 males, seven females and five unknown sex) were captured in one year only.

All traps successfully captured at least one marten hair sample over the three years, with most (88%) capturing two or more marten (Table 3.1, Figure 3.1). The greatest number of individuals captured at the same hair snag station in a single year was three – the maximum possible due to study design (survey blocks 14900, 15138, and 16085), and overall was six (survey block 14900) (Table 3.1).

Table 3.1 American Marten Hair Snag Captures by Year

Survey Block	2014		2015		2016		Overall	
	Captures	# Marten	Captures	# Marten	Captures	# Marten	Captures	# Marten
14663	3	1	1	1	2	2	6	4
14662	3	2	2	1	3	1	8	3
14900	2	2	3	3	2	2	7	6
15138	3	1	3	2	3	3	9	5
15376	2	2	0	0	1	1	3	2
15375	1	1	2	2	2	2	5	3
15374	2	2	2	2	3	2	7	5
15373	3	1	1	1	3	1	7	2
15612	2	1	2	1	1	1	5	1
15611	1	1	1	1	1	1	3	2
15610	1	1	2	2	2	2	5	3
15848	2	1	2	2	2	1	6	2
15847	2	1	3	2	3	2	8	4
16086	1	1	2	2	3	2	6	2
16085	3	2	3	2	3	3	9	3
16323	0	0	1	1	1	1	2	1
16561	1	1	3	2	1	1	5	2

Notes:
1. The maximum captures per year is three and overall is nine, based on the sampling protocol (i.e., traps were checked three times each year)
2. Trap locations are shown in Figure 2-1.

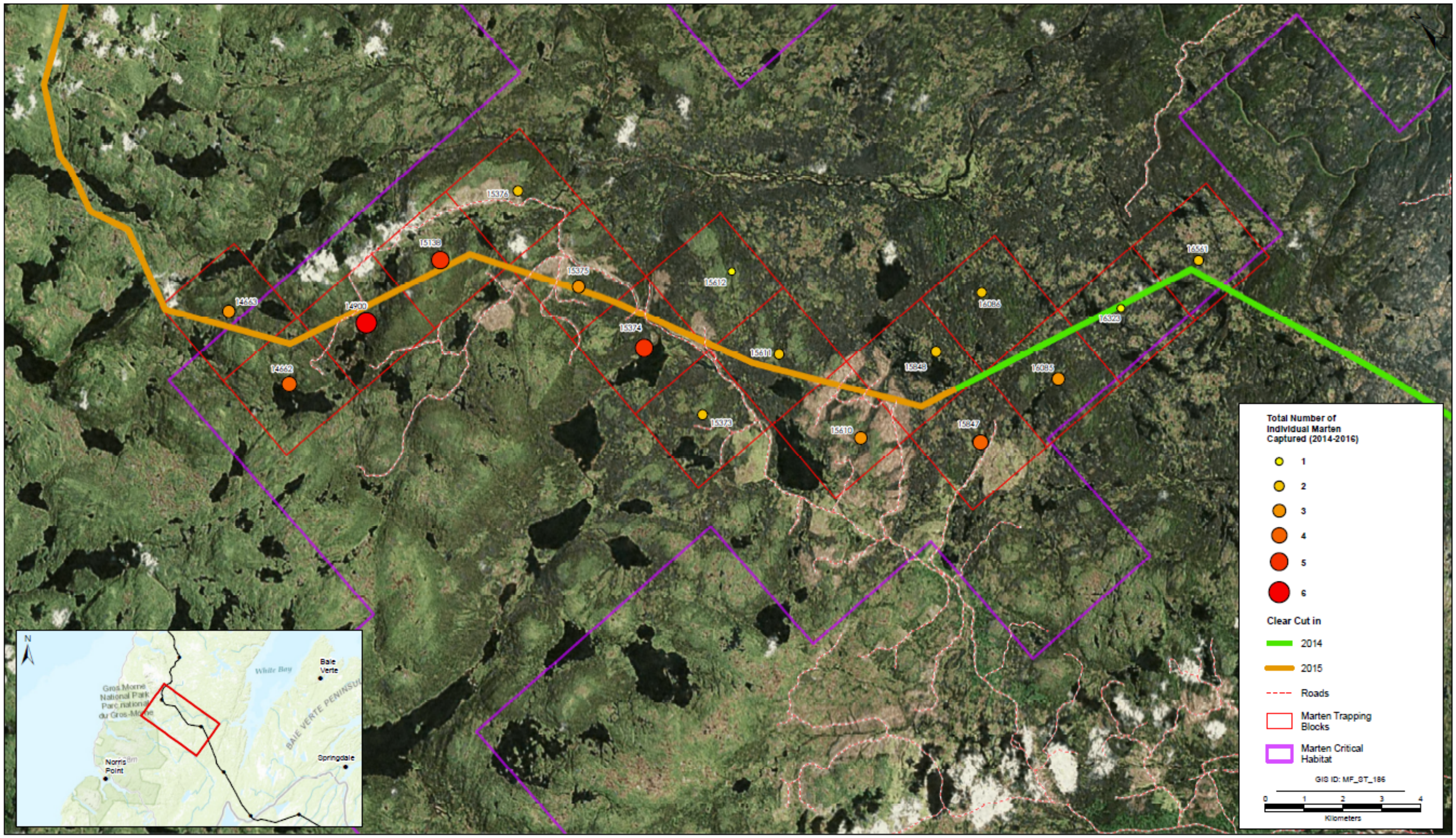

Figure 3-1 Total (Individual) American Marten Captures per Trap Site, 2014-2016

Marten captured at eight hair snag stations (survey blocks 15376, 15373, 15612, 15611, 15610, 15848, 16323, and 16561) were not captured elsewhere over the three-year study, suggesting potentially limited movements in these areas, or that these locations were at the edge of an individual's home range.

We documented male-male overlap (i.e., two or more males within the same survey block) seven times among hair snag stations, and female-female overlap four times. Male-female overlap was documented in eight different survey blocks (13 capture events). Most of this overlap (85%) involved a single male and female. However, we captured two males and one female in survey block 15138 in 2016, and two females and one male in survey block 16085, also in 2016.

3.2 Marten Movements and the RoW

We captured nine marten (23%) at more than one hair snag station (Table 3.2). Three individuals (2/M, 3/M, and 8/M) were confirmed to have crossed the RoW in 2014 (i.e., pre-clearing). In 2015, the RoW was partially cleared (Figure 2-1); we confirmed that two marten (2/M and 13/F) crossed the cleared portion of the RoW and three other marten (11/M, 14/M, and 21/F) had crossed the portion of the RoW that had not been cleared. Four individuals (2/M, 11/M, 13/F, and 34/M) crossed the cleared RoW in 2016. Tracks followed in 2016 confirmed movements of at least one marten across the RoW (survey block 15374). The tracks left the trap site and, after following along a small brook leading into a river, crossed the RoW in a nearly direct line parallel with the river.

Table 3.2 Summary of Individual Marten Captured within Multiple Survey Blocks

Marten ID/Sex	Total Captures	2014		2015		2016	
		Survey Blocks	RoW Status	Survey Blocks	RoW Status	Survey Blocks	RoW Status
2/M	10	16085 16086	Not Cleared	16085 16086 15847	Cleared	16085 16086	Cleared
3/M	4	14662 14663	Not Cleared				
8/M	5	15374 15375	Not Cleared	15375	Not Cleared	15374	Cleared
11/M	4			14900 15138	Not Cleared	14900 15138	Cleared
13/F	6	16085	Not Cleared	16085 16086	Cleared	16085 16086	Cleared
14/M	3			15374 15375	Not Cleared	15375	Cleared
19/F	3			15138	Not Cleared	14900	Cleared
21/F	6			14662 14663	Not Cleared	14662	Cleared
34/M	2					15374 15375	Cleared

Notes:
Trap locations are shown in Figure 2-1.

Two marten (2/M and 13/F) were recorded in all three years (Table 3.2). These individuals visited the same hair snag stations (survey blocks 16085 and 16086), and were captured in these areas before, during and after clearing of the RoW in the study area. Marten 11/M also crossed the RoW before (2015) and after (2016) it was cleared (Table 3.2).

3.3 OHV (Snowmobile) Access to the RoW

Snowmobile access points to the RoW were generally consistent over time, in terms of location and density (Figure 3-2). In 2014, we recorded 25 snowmobile access points to the RoW study area, 17 in 2015 and 22 in 2016 (Table 3.3).

Table 3.3 OHV (Snowmobile) Tracks in the RoW Study Area, 2014-2016

Year	Snowmobile Tracks Recorded		
	<5	5-9	10+
2014	6	6	13
2015	1	4	12
2016	7	3	12

Seasonal conditions varied among survey years and likely influenced overall snowmobile use. Regardless of any weather-related changes in use patterns, tracks were predominantly associated with pre-existing road and trail networks in the study area, over all survey years (Figure 3-1).

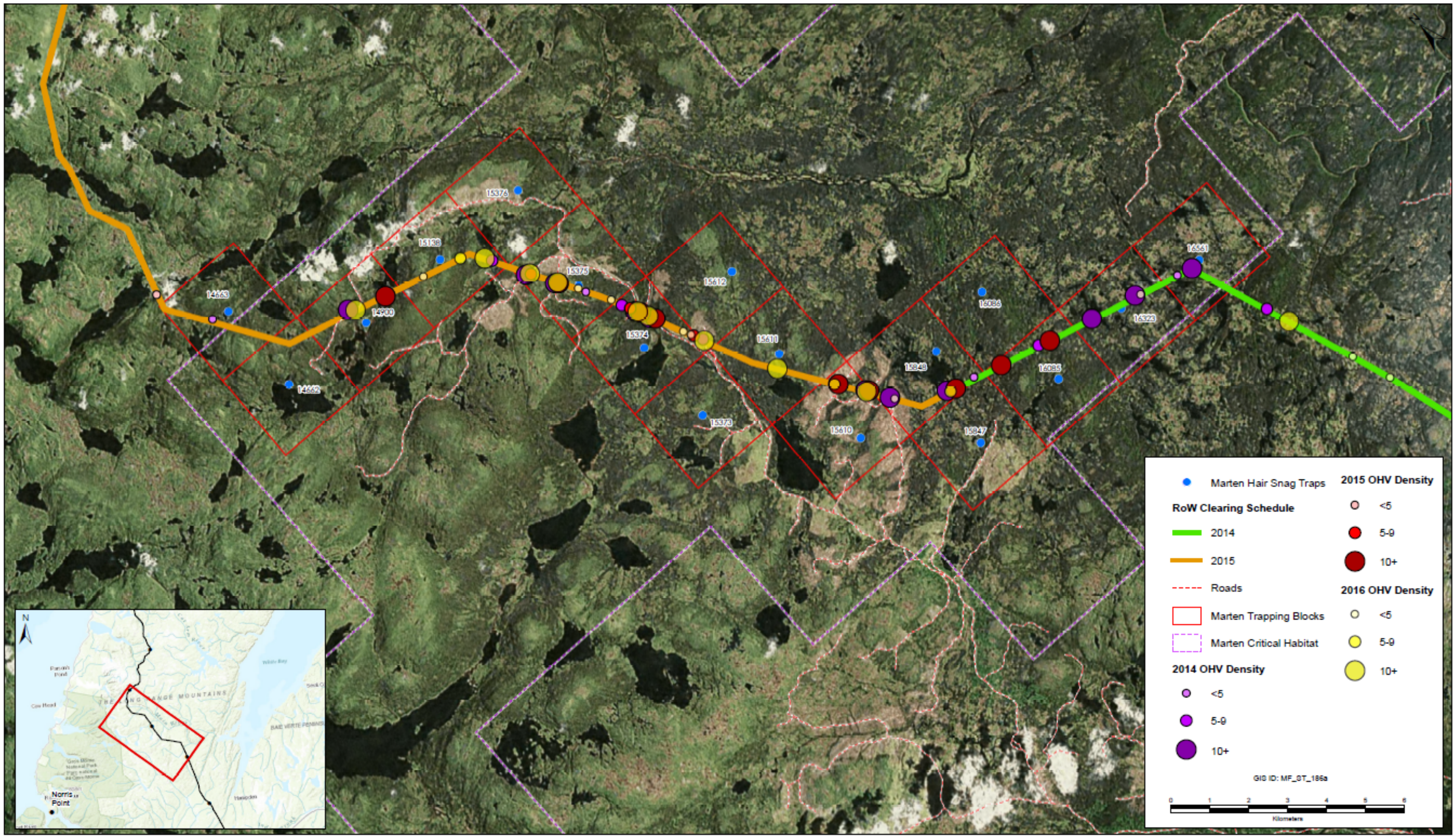

Figure 3-2 OHV (Snowmobile) Use in the Main River Marten Core Area Study Area, 2014-2016

4.0 DISCUSSION

Our research confirmed that habitat in our study area was suitable for marten, based on annual captures of 18-24 marten. In total, 40 individual marten were confirmed among survey blocks, and it is possible that more marten are using the area given that we analyzed hair from only one sticky tab (of four) per trap. Forested components in our study area were primarily open coniferous, and the area in general was highly fragmented by the presence of wetlands, lakes and ponds, roads, and harvested areas. Our findings are consistent with previous research in which tall, open coniferous forests are selected by marten in Newfoundland (Hearn et al. 2010), and that while non-forested areas are generally avoided, marten home ranges may contain < 20% to < 40% open areas or regenerating stands (Bateman 1986, Chapin et al. 1998, Gosse et al. 2005, Hargis et al. 1999, Hearn et al. 2010, Potvin et al. 2000).

Seventeen of the marten we studied were captured in >1 year, suggesting that these individuals continued to occupy the same areas despite the loss of suitable habitat through clearing of the RoW. Poole et al. (2004) examined individual marten response to habitat loss through shearing, and found that all 13 marten monitored responded negatively when an average of 36-37% of their home range was sheared. Marten either disappeared, died, or shifted their home ranges in the subsequent year to include less (19%) cleared habitat. This suggests that at least 17 of the marten we studied did not respond negatively to the amount of habitat removed in our study area.

Our observations confirmed that marten crossed the portion of the transmission line RoW we investigated based on hair samples collected from opposing sides of the RoW. Three marten were confirmed to have crossed the RoW annually before, during, and after clearing of the RoW, indicating that the clearing of the RoW did not change their movement patterns over the period we investigated. The cleared RoW in our study area was 60 m-wide, within the documented range that marten will cross (Bateman 1986, Gosse et al. 2005). Movements across open areas are often in a straight-line trajectory (Gosse et al. 2005) and may be associated with riparian buffers or patches of forested habitat that offer connectivity between areas of suitable habitat (Potvin et al. 2000, Soutiere 1979). In earlier studies in Newfoundland, Bateman (1986) found that approximately 6% of marten trails that were followed, crossed open areas that included power line RoWs, roads, and bogs. The one set of tracks followed in 2016 indicated a direct path across the cleared RoW that paralleled a river, although the tracks were in open habitat above the riparian buffer.

Marten are known to move several kilometers in a day. Bateman (1986) recorded movements of marten in Newfoundland ranging from distances of 3.4 to 6.8 km over periods of 6 to 16.5 hours. In other areas, movements of up to 22 km have been recorded in a 24-hour period for introduced marten, however most consecutive day-to-day movements (82%) were < 3.2 km (Davis 1983). It has been suggested movements of Newfoundland marten may be correlated with snowshoe hare (*Lepus americanus*) abundance during winter (Gosse et al. 2005), when this species is consumed more frequently during a period of lower abundance of preferred prey (Gosse and Hearn 2005). Other researchers have found that marten generally do not hunt but will pass through openings of < 100 m wide during winter (Koehler and Hornocker 1977). This suggests that marten in our study may have used the RoW to access adjacent suitable foraging habitat. However, the reason for these movements may or may not be directly related to food supply (Taylor and Abrey 1982).

In our study, we found evidence of both inter- and intra-sexual overlap among marten. Males overlapped with other males nearly as much as did males and females, and female-female overlap was detected least often. In general, overlap among males and females would be expected as it enhances their reproductive potential, whereas individuals of the same sex are generally less tolerant of each other (Katnik et al. 1994). Banfield (1974) noted that marten are primarily solitary, and only form groups when females raise their young. Indeed, Cheveau et al. (2013) found no overlap among home ranges of 22 radio-collared female marten. It is possible that the overlap we observed was evidence of marten being lured to the traps, whereby marten used them as a source of food during a season when access to resources may be scarce.

Snowmobile access to the RoW did not appear to change over the period investigated. Snowmobile tracks along the RoW appeared to be related primarily to the pre-existing road and trail networks rather than the RoW itself.

In summary, marten occurrence throughout our survey blocks confirmed that the habitat sampled was suitable for marten. Based on DNA extracted from hair samples, we could confirm that individuals crossed the RoW before, during and after it was cleared. We were also able to confirm that three of the same individuals that crossed the RoW before it was cleared continued to do so during and after clearing. These findings indicate that the 60 m-wide RoW in our study area did not act as a barrier to movements of Newfoundland marten in the MRMCA.

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