

**WESTERN NFLD MODEL FOREST  
Pine Marten Habitat Utilization Study  
1993 - 1995**

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## ABSTRACT

One of the goals of the Western Newfoundland Model Forest is to incorporate wildlife and timber management objectives in an integrated resource management approach. The Marten Habitat Utilization Study was initiated to collect information on habitat utilization by a marten (*Martes americana atrata*) population in western Newfoundland for use within an integrated planning process. Research was conducted over two years in three separate study areas. A total of 32 martens were captured during live-trapping sessions. Trap placement was selective in order to enhance trapping success. Twelve martens were radio-collared (11 juveniles and 1 adult) to obtain home range and habitat utilization information. Habitat use was also investigated through snow tracking. Vegetation types were identified from the Newfoundland Forest Service's forest inventory database. The data indicates a preference by the martens for old-growth, softwood-dominated forests.

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## INTRODUCTION

The Newfoundland marten (*Martes americana atrata*) has been chosen as an indicator of mature coniferous forest habitat by the Western Newfoundland Model Forest (WNMF). Additional priority has been assigned to the Newfoundland population due to its designation of "endangered" by the Council on the Status of Endangered Wildlife in Canada (COSEWIC). Two groups have been distinguished in North America with the "americana" group containing five subspecies and "caurina" group containing three subspecies (Clark et al., 1987). Only two of the eight subspecies have been geographically isolated in presettlement times. One of these is the Newfoundland marten, considered by some to be a distinct subspecies (Clark et al., 1987).

Marten habitat requirements are well documented. Marten are associated with mature and over-mature conifer dominated stands (Koehler and Hornocker, 1977; Bateman, 1986). In Newfoundland, marten appear to prefer old-growth balsam fir-black spruce (*Abies balsamea-Picea mariana*) and balsam fir-white birch (*Abies balsamea-Betula papyrifera*) forests with dense overhead cover (Bateman, 1982). These old softwood stands characteristically contain abundant coarse woody debris that provides access to subnivean zones. These subnivean areas provide the marten with increased food opportunities (e.g. voles), escape routes/cover, and energy conservation (Sturtevant and Bissonette, 1993).

As diet generalists, marten obtain nourishment from a wide variety of sources including: small mammals, birds, invertebrates, various plants, and berries (Bateman, 1982; Douglass et al., 1983; Thompson, 1988). Throughout North America, studies have shown that the red-backed vole (*Clethrionomis gapperi*) is a dominant component of the marten diet (Lensink, et al., 1955; Buskirk and MacDonald, 1983; Douglass, et al., 1983); however, this vole does not occur in Newfoundland. In Newfoundland, marten appear to forage primarily on meadow vole (*Microtus pensylvanicus*) and snowshoe hare (*Lepus americanus*) (Bateman, 1982; Bissonette, et al., 1988).

Timber harvesting practices have diminished the amount of suitable marten habitat that is available. In Newfoundland, marten rarely use clearcuts during the first year after cutting and Snyder and Bissonette (1987) documented minimal use of clearcuts less than 23 years old and of residual patches less than 15 hectares in size. In Maine, Soutiere (1979) found that marten rarely used stands less than 15 years of age and that marten densities were, on average, 60% lower in clearcut areas than in undisturbed areas. Bissonette et al. (1988) concluded that extensive clearcutting caused severe declines in the marten population of Newfoundland. Marten use of older second growth stands and the related effects on the population are not well known.

The objectives of this study are:

- 1: Use radio telemetry to determine marten movement and habitat use. Telemetry observations, in combination with tracking and trapping data, will be used to verify and/or modify "habitat" definitions.
- 2: Estimate densities through live-trapping and mark/ recapture techniques.

## STUDY AREAS

The Newfoundland and Labrador Wildlife Division conducted marten bait station work throughout western Newfoundland during the early 1990's (Howes, 1993) which suggested study areas for this project. For this study three areas were delineated based upon geographic, ecological, or administrative boundaries (Figure 1).

### Study Area 1 : Little Grand Lake

This study area, approximately 235 km<sup>2</sup> in size, is bounded by Grand Lake to the west and Little Grand Lake to the south. The Little Grand Lake area is classified within the Central Newfoundland Damman site types with minimal overlap of Western Newfoundland types (G. Kitchen; J. Gosse, pers. comm., 1995). The area is dominated by Balsam Fir Forest Types: *Pleurozium*-Balsam Fir, *Hylocomium*-Balsam Fir, *Dryopteris-Lycopodium*-Balsam Fir, with some Black Spruce Forest Types: Black Spruce-Feathermoss/Bedrock. *Kalmia*-Black Spruce Forest Types are relatively rare (Meades and Moores, 1989)

### Study Area 2: Portage Lake

This study area, approximately 138 km<sup>2</sup> in size, is bounded by barren and non-forested areas to the north and cutovers to the south. The Portage Lake area is comprised of characteristic Central Newfoundland site types with no overlap of Western Newfoundland site types (G. Kitchen, J. Gosse, pers. comm. 1995). The area is dominated by Balsam Fir Forest Types: *Pleurozium*-Balsam Fir, *Hylocomium*-Balsam Fir) and Black Spruce Forest Types: Black Spruce-Feathermoss/Bedrock). There is considerable *Kalmia* interspersation and a minor component of *Kalmia*-Black Spruce Forest Types, specifically *Kalmia*-Black Spruce (Meades and Moores, 1989).

### Study Area 3 -Victoria Lake

This study area, approximately 124 km<sup>2</sup> in size, is bounded by Victoria Lake and Red Indian Lake, to the south and north respectively, and by an expansive barren to the east. The Victoria Lake area is comprised of characteristic Central Newfoundland site types (G. Kitchen, J. Gosse, pers. comm., 1995), consisting of predominantly Balsam Fir Forest Type: *Pleurozium*-Balsam Fir and the *Kalmia*-Black Spruce Forest Type: *Kalmia*-Black Spruce. A lesser component is the Balsam Fir Forest Type: *Hylocomium*-Balsam Fir (Meades and Moores, 1989).

## METHODS

### Live Trapping

Live-trapping was conducted in the Study Area 1 - Little Grand Lake during October and November, 1993 and March and June 1994; in Study Area 2 - Portage Lake during October 1993 and March 1994; and in Study Area 3 - Victoria Lake during October 1993, March 1994, February 1995, and March 1995. Live-trapping protocol followed Strickland and Douglas (1987) and were similar to methods used in previous studies of Newfoundland marten. Trap locations were established to maximize the probability of marten captures (i.e., placement in forested areas only, choke-points, riparian areas, etc.).

Marten were weighed, aged, sexed, and ear-tagged (Snyder and Bissonette, 1987). Hair, blood and epithelial cell samples were collected for genetic analysis (McGowan and Davidson, 1994). Radio-collars (LOTEK SMRC5, 150-152 mhz, 29 g.) were to be placed only on adult marten. Age (i.e. juvenile vs. adult) was initially determined in the field by tooth sharpness and overall body size (Mayo, pers. comm., 1993). Marten < 1 year old were considered juveniles and marten > 1 year old were considered adults. First premolars were extracted for age determination by cementum analysis.

Mark-and-recapture techniques (Snyder and Hancock, 1985) were employed to estimate abundance of marten in each of the three study areas. This technique simply overlays live-trapping data on the delineated study area and a density estimate is generated.

### HABITAT USE

#### Habitat Use Analysis

Snow tracking and radio-telemetry from fixed wing aircraft, helicopter, and ground triangulation was used to identify vegetation types utilized by marten. For ground monitoring, telemetry stations, with known GPS locations differentially corrected, were used as reference points for the triangulation. Telemetry readings permitted differentiation of collared marten into

residents (fidelity to a home range), temporary residents (remain in study area for more than one month but less than one year), and transients (remain in study area for less than one month). Home range was determined using the Minimum Convex Polygon technique (Mohr, 1947).

Habitat use was assessed using Chi-squared analysis (5% significance level). The number of marten locations in each vegetation type was compared to the proportion of each vegetation type comprising each study area.

The positions of four stationary collars were recorded using a GPS unit (accuracy 2-5 metres). The collars were monitored from fixed-wing aircraft and helicopter to determine the level of error associated with aerial monitoring. These stationary collars indicated an average locational error of approximately 200 metres.

Buffers of radius 200 metres were plotted on each location using the Newfoundland Forest Service Geographic Information System (GIS). When buffers included boundaries between two or more habitat types, they were assessed and assigned the habitat type that comprised the largest proportion of the polygon (water excluded).

For analysis of habitat use by marten the following vegetation types were delineated:

- Veg. Type A:** Scrub (forested area producing  $< 35 \text{ m}^3$  of timber at 60 years old)  
Hardwood (pure hardwood stands without any coniferous component)
- Veg. Type B:** Bog and Treed Bog (non-forested areas typified by poor drainage and having a characteristic flora of sedges, heaths and mosses)
- Veg. Type C:** Rb (Rock Barren) (non-forested areas with large outcrops of rock and having a characteristic flora of grasses, shrubs and mosses)  
Sb (Soil Barren) (non-forested areas having a characteristic flora of grasses, shrubs and mosses)
- Veg. Type D:** Hardwood- Dominated stands and Softwood stands of  $< 60$  years of age,  $< 6.5$  metres in height, and crown closure classified as "0" (immature stands up to 40 years) or classified as "1" ( $>75\%$  crown closure) when between 40-60 years.
- Veg. Type E:** Softwood and Softwood-dominated stands of  $>60$  years of age,  $>6.5$  metres in height, and crown closure  $> 25\%$

## Snow Tracking

Snow tracking focused on two radio-collared animals in Study Area 3 - Victoria Lake. All tracks were located with the assistance of telemetry readings. Foraging behaviour in old-growth and second-growth stands was observed during tracking. All other species tracks were also recorded.

Snyder and Bissonette (1987) identified snow-tracking data analysis as a function of comparing marten trail distance in each vegetation type with the expected distance in each vegetation type based on the proportion of each type present in the study area. Our analysis was conducted only on data from Study Area 3 - Victoria Lake and followed this methodology.

## RESULTS and DISCUSSION

### Live Trapping

Live trapping results for the three study areas are presented in Table 1. Errors in accurately assessing the age of captured marten resulted in the collaring of 10 juveniles and only one adult. These errors were, in part, a function of the large body size of the animals and subjective estimations of tooth wear.

Live-trapping results are skewed toward males and juveniles. One factor influencing the capture data may be the increased mobility of juveniles and adult males. Also trapping sessions conducted in spring and early summer may not reflect the number of adult females in an area since they may be more cautious of traps and have restricted ranges because of the presence of kits.

### **Study Area 1 - Little Grand Lake**

Trapping sessions in Fall 1993 and Spring/Summer 1994 at Study Area 1 - Little Grand Lake resulted in a total of 42 captures (18 individuals and 24 recaptures) over 750 trap nights (1 capture/18 trapnights). Six males (# 1-6) were fixed with radio-collars. The remaining animals (a - h) were measured and ear-tagged. A further 4 individuals caught in June 1994 were not processed and are not represented in Table 1. These unmarked marten captures were considered individual marten due to the large distance between trap locations over a short period of time.

In 1995 a further five individuals were trapped by the Newfoundland and Labrador Wildlife Division. Of the 14 marked animals captured in 1993-94, 3 were retrapped in the area during this time and their continued presence in the area confirms residency.

The approximate size of the area live-trapped was 235 km<sup>2</sup>. If we assume that all 23 marten were residents in this area, a crude density estimate is calculated to be 0.09 marten/km<sup>2</sup>.

### **Study Area 2 - Portage Lake**

A trapping session in October 1993 resulted in a total of 8 captures: 4 individuals (2 male, 2 female) and 4 recaptures in 114 trap nights (1 capture/14 trapnights). Two males (# 7-8) were fixed with radio-collars. The remaining animals (i-j) were measured and ear-tagged.

Marten densities were estimated to be 0.03 marten/km<sup>2</sup> (4 animals ranging over approximately 138 km<sup>2</sup>).

### **Study Area 3 - Victoria Lake**

Trapping sessions in October 1993, March 1994, February/ March 1995 resulted in 8 captures: 5 individuals (3 male, 2 female) and 3 recaptures in 329 trap nights (1 capture/41 trapnights). Four individuals (# 9-12) were fixed with radio-collars. One other individual (k) was measured and ear-tagged.

Marten densities were estimated to be 0.04 marten/km<sup>2</sup> (5 animals ranging over approximately 124 km<sup>2</sup>).

TABLE 1: MARTEN LIVE-TRAPPING RESULTS

Study Area	Marten #	Collar Date	Freq.	Ear Tag #	Sex	Age	Mass (gm)	Total Body Length (cm)
Lit Gr Lk	1	04-10-93	150.280	31	M	JUV	912	66.0
	2	03-10-93	150.320	21	M	-	1100	62.0
	3	01-10-93	150.330	29	M	-	1064	-
	4	02-10-93	150.339	15	M	-	1200	63.0
	5	04-10-93	150.350	22	M	JUV	-	61.5
	6	06-11-93	150.420	55	M	JUV	1250	65.5
	a	01-10-93	-	19	F	-	750	60.5
	b	02-10-93	-	30	F	-	570	58.5
	c	04-10-93	-	14	F	ADULT	800	-
	d	06-10-93	-	50	M	ADULT	1200	61.0
	e	07-10-93	-	32	M	-	1254	58.0
	f	07-10-93	-	23	M	-	1500	66.0
	g	07-10-93	-	11	M	ADULT	1500	63.5
h	03-11-93	-	18	F	ADULT	567	53.5	
Portage Lk	7	21-10-93	150.269	39	M	JUV	1100	65.0
	8	23-10-93	150.369	40	M	JUV	1100	62.0
	i	18-10-93	-	49	F	JUV	700	55.0
	j	24-10-93	-	48	F	JUV	800	56.0
Victoria Lk	9	18-10-93	150.379	53	M	-	1205	59.5
	10	18-10-93	150.290	54	M	AD	1254	64.0
	11	31-03-94	150.361	52	M	JUV	1368	61.0
	12	31-03-94	152.150	75	F	-	748	62.5
	k	17-10-93	-	51	F	-	684	58.0

## Home Ranges

We calculated home ranges for 12 individuals (6 in Little Grand Lake, 2 in Portage Lake, 4 in Victoria Lake) (Figures 2-6, Table 2).

**Table 2. Home Range Size (km<sup>2</sup>) calculated by Minimum Convex Polygon (MCP), Age and Sex of 12 Radio-collared Marten**

Study Site	Animal #	Sex (M/F)	Age	Home Range (km <sup>2</sup> )
Lit. Grnd. Lk.	1	M	Juvenile	2.18 (13)*
	2	M	-	7.49 (12)
	3	M	Juvenile	7.71 (14)
	4	M	-	14.18(18)
	5	M	Juvenile	11.53(22)
	6	M	Juvenile	16.59 (17)
Portage Lk.	7	M	Juvenile	39.65 (18)
	8	M	Juvenile	27.47 (14)
Victoria Lk.	9	M	-	13.00 (13)
	10	M	Adult	26.25 (19)
	11	M	Juvenile	** (31)
	12	F	-	9.22 (14)

\* number of telemetry points

\*\* Juv range - 17.53 km<sup>2</sup> (16); Adult range - 11.21 km<sup>2</sup> (15)

## Survival

We pooled survival data from all 12 radio-collared marten. One mortality was recorded for Study Area #1- Little Grand Lake. No mortalities were recorded for Study Areas 2 and 3 (Table 3).

The annual survival rate of all animals for the duration of the study was 87.7% ( $\frac{2781-1}{2781}^{365}$ ) (Micromort, Heisey & Fuller, 1985).

**Table 3. # Days of Survival and Fates of 12 Radio Collared Marten**

Study Area	Animal #	Sex	Monitoring Period	Days with Transmitter	Fate <sup>1</sup>
Lit. Grnd. Lk.	1	M	10/93-03/94	149	A
	2	M	10/93-01/94	105	M
	3	M	10/93-06/94	254	A
	4	M	10/93-09/94	356	A
	5	M	10/93-06/94	250	A
	6	M	11/93-03/94	138	A
Portage Lake	7	M	10/93-09/94	337	A
	8	M	10/93-06/94	247	S
Victoria Lake	9	M	10/93-03/94	164	A
	10	M	10/93-09/94	340	A
	11	M	10/93-10/94	410	A
	12	F	02/95-03/95	31	S
TOTAL TRANSMITTER DAYS				2781	

1. A - alive at end of study; M - mortality ; S - slipped collar

## HABITAT USE

### **Snow tracking**

The tracks of 2 marten (#11 and #12), totaling 2.21 km, were observed in 1995 in Study Area 3 - Victoria Lake and were analyzed in an effort to determine if these animals were selecting for particular vegetation types (Table 4).

The test conducted ( Snyder and Bissonette 1987) indicates that strongly avoided vegetation types are those with alpha-vector index values less than  $1/n$  where  $n$  = number of available vegetation types, and strongly selected vegetation types show values greater than  $1/n$ . Thus vegetation types A and B appear to be strongly avoided; vegetation type D is used in proportion to its availability; and vegetation type E is strongly selected. Vegetation type C was not used in the calculations because of its low representation in the study area.

**Table 4. Distribution of 2 marten (*Martes americana atrata*) trails among vegetation types - Study Area 3-Victoria Lake - 1995.**

Veg. Type	Percent of Study Area	Proportional Availability (n <sub>i</sub> )	Travel Distance (km)		Proportional Use (r <sub>i</sub> )	Alpha-vector Index	Interp. <sup>1</sup>
			Expected	Observed			
A	24.1%	28.2	0.53	0.13	5.7	0.054	A
B	12.1%	14.2	0.27	0.02	0.8	0.015	A
D	27.6%	32.3	0.61	0.52	23.5	0.194	P
E	21.6%	25.3	0.48	1.54	70	0.737	S
C	3.4%	-	0.07	0.00	0		
WATER	11.2%	-	0.25	0.00	0		
<b>TOTALS</b>	<b>100.0%</b>	<b>100.0</b>	<b>2.21</b>	<b>2.21</b>	<b>100</b>		

1. Interpretation of Alpha-vector Index. A - avoidance; P - use in proportion to availability ; S - selected

Tracking observations also suggest that these marten preferred old-growth forests in the Victoria Lake area. The majority of one individual's tracks were found within mature to overmature stands, where she exhibited typical hunting patterns (e.g., subnivean investigation, zig-zagging paths, and investigation of prey tracks). In contrast, tracks of this marten that passed through second-growth stands were straight line paths with very little investigation of subnivean zones. Most of the old-growth stands utilized by this marten had high levels of squirrel activity and her tracks often intersected or paralleled the squirrel tracks for short distances. A large quantity of black spruce seeds were visible on the snow. These seeds may support voles in addition to squirrels. Marten may prefer such areas because of increased prey abundance and, therefore, a greater chance of hunting success. We also noted that snowshoe hare sign was relatively low within the overall study area.

### Telemetry Locations

Tables 5, 6, and 7 indicate the number of marten locations per vegetation type in each of the three study areas. Points were collected during fixed-wing monitoring (107 points (52%), helicopter (48 points (24%) and ground monitoring (50 points (24%). Locational error is assumed to be 200 m. Locations are identified as a function of the proportion of each study area comprised of each vegetation type.

**Table 5. Proportional Composition by Vegetation Type of Study Area 1 - Little Grand Lake and the Number of Telemetry Locations in each Vegetation Type for Six Marten -October 1993-June 1994, Jan-Mar 1995.**

Veg. Type	Prop. of study area	Marten #1 n(%)	Marten #2 n(%)	Marten #3 n(%)	Marten #4 n(%)	Marten #5 n(%)	Marten #6 n(%)	Total Loc/Type
A	0.22	1(7.1)	0	1(6.7)	5(29.4)	4(17.4)	4(22.2)	15
B	0.06	0	0	0	0	0	4(22.2)	4
C	0.02	0	0	0	0	0	0	0
D	0.19	3(21.4)	1(7.7)	1(6.7)	2(11.8)	1(4.3)	3(16.7)	11
E	0.51	10(71.4)	12(92.3)	13(66.7)	10(58.8)	18(78.3)	7(38.9)	70
<b>TOT.</b>	100	14	13	15	17	23	18	100

**Table 6: Proportional Composition by Vegetation Type of Study Area 2 - Portage Lake and the Number of Telemetry Locations in each Vegetation Type for Two Marten -Oct 1993 - June 1994**

Veg. Type	Proportion	Marten #7 n(%)	Marten #8 n(%)	Loc/Veg Type
A	0.30	4(23.5)	1(6.2)	5
B	0.21	2(11.8)	4(25.0)	6
C	0.02	0	0	0
D	0.21	3(17.6)	3(18.7)	6
E	0.26	8(47.1)	8(50.0)	16
<b>TOTAL</b>	100.00	17	16	33

**Table 7: Proportional Composition by Vegetation Type of Study Area 3 - Victoria Lake and the Number of Telemetry Locations in each Vegetation Type for Four Marten: October 1993 - June 1994 and January -March 1995**

<b>Veg Type</b>	<b>Proportion</b>	<b>Marten #9 n(%)</b>	<b>Marten #10 n(%)</b>	<b>Marten #11 n(%)</b>	<b>Marten #12 n(%)</b>	<b>Tot Loc/Type</b>
A	0.27	4	5	1	0	10
B	0.14	0	1	5	0	6
C	0.04	0	0	0	0	0
D	0.31	4	7	5	8	24
E	0.24	6	6	16	16	44
<b>TOT</b>	<b>100.00</b>	<b>14</b>	<b>19</b>	<b>27</b>	<b>24</b>	<b>84</b>

Data was pooled over all animals in each study area and then analyzed (Table 8). The numbers were not pooled over all three study areas due to the different vegetation type composition among areas. Although there are problems associated with pooling the data such as independence of observations and potentially incorrect population inferences (White and Garrott, 1990), it was done in an effort to strengthen the statistical test. The pooled data indicates that preference for specific vegetation types did occur.

Bonferroni Confidence Intervals were calculated for the proportion of time spent by the marten in each vegetation type and interpreted for marten preference or avoidance (Table 9).

**Table 8. Chi-square Analysis (Test of Preference) of Pooled Telemetry Locations for Radio-collared Marten in 3 Study Areas ( $p=0.05$ ,  $dF=4$ ).**

Study Area	Veg. Type	Prop. of Study Area	Expected	Observed	$\chi^2$
Lit Gr. Lk.	A	0.22	22	15	2.23
	B	0.06	6	4	.67
	C	0.02	2	0	2.00
	D	0.19	19	11	3.37
	E	0.51	51	70	7.08
				Pooled $\chi^2$	15.35
Portage Lk.	A	0.30	10	5	2.50
	B	0.21	7	6	0.14
	C	0.02	0.7	0	0.70
	D	0.21	7	6	0.14
	E	0.26	9	16	5.44
				Pooled $\chi^2$	8.92
Victoria Lk.	A	0.27	23	10	7.35
	B	0.14	12	6	3.00
	C	0.04	3	0	3.00
	D	0.31	26	24	0.15
	E	0.24	20	44	28.80
				Pooled $\chi^2$	42.30

**Table 9. Interpretations as to Marten Preference and/or Avoidance of Five Vegetation Types in the Three Study Areas.**

Animals	$\chi^2$ Statistic	Degrees of Freedom	Probability	Vegetation Type				
				A	B	C	D	E
Lit Grnd Lk Pooled	15.65	4	0.00403	*	*	*	Avoid	Prefer
Portage Lk Pooled	8.92	4	0.04486	Avoid	*	*	*	Prefer
Glitter Pond Pooled	42.29	4	0.00008	Avoid		*	*	Prefer

\* Data shows no avoidance or preference for this vegetation type

## Management Recommendations

Bissonette et al. (1988) and Thompson (1991) both indicate that future habitat for marten will be in short supply on the Island of Newfoundland. The RENEW Marten Recovery Plan (Forsey et al. 1994) also identifies an urgent long-term problem of habitat availability. As the Little Grand Lake area vegetation composition analysis indicates, only 51% of that area is classified as mature/overmature, the forest structure considered critical for marten. Similarly, Bissonette et al. (1988) determined that approximately 56,100 ha. (561 sq. km.) of mature/overmature forest occurred within the 164,000 ha Environmental Assessment Area (EAA) centered around the Little Grand Lake area. Considering that this is the last large contiguous area of old softwood forest remaining in western Newfoundland, the EAA probably provides the core habitat for the existing marten population. Estimations of approximately 56,100 ha of mature/overmature forest in this area do not consider the availability of the potential habitat to marten. Habitat patch size and spatial considerations such as connectivity must be included in any estimate and would further reduce this estimate of available habitat.

A "reserve" approach is proposed for this core area. The limited availability of mature and senescent stands at present and into the next 50 years has necessitated discussion on a "reserve" approach for the core area at Little Grand lake. This approach will only be beneficial if it is applied as part of a landscape-level management plan that addresses the "business as usual" removal of timber outside of the current EAA. Unmanaged timber harvesting outside of reserve boundaries often causes these reserves to become isolated "islands" of habitat, with no connectivity to remnant forest patches outside. Furthermore, this core reserve area will probably not be large enough to provide an adequate mosaic of habitat types and successional stages necessary to ensure the long term persistence of a viable marten population in western Newfoundland.

The incorporation of marten habitat requirements with timber management planning will further the process of Integrated Resource Management (IRM) within the WNMF. The development and application of timber harvesting guidelines (Bissonette et al., 1988) in areas outside the EAA where marten currently reside is also necessary if IRM planning goals are to be achieved.

The data collected during this study supports the conclusions of numerous other studies (Raine, 1983; Bissonette et. al, 1988; Bissonette et al., 1989; Drew, 1994; Ruggiero et. al. 1994) that reductions in mature/senescent forest, through human- induced or natural means, is highly correlated with reductions in marten populations. Thompson and Harstead (1994) presented a conceptual model that indicated that carrying capacity for marten would be maximized when up to 25% of the forest is removed, therefore marten may actually benefit from harvesting at this scale. Second- growth areas with sufficient residual stands may provide suitable marten habitat and support densities of marten. However, at this point we do not know what level of disturbance will allow the maintenance of a viable population. Future research should focus on marten population performance indicators (fecundity, mortality) in areas dominated by mature/senescent forest and in areas that have been largely altered by past timber harvesting.

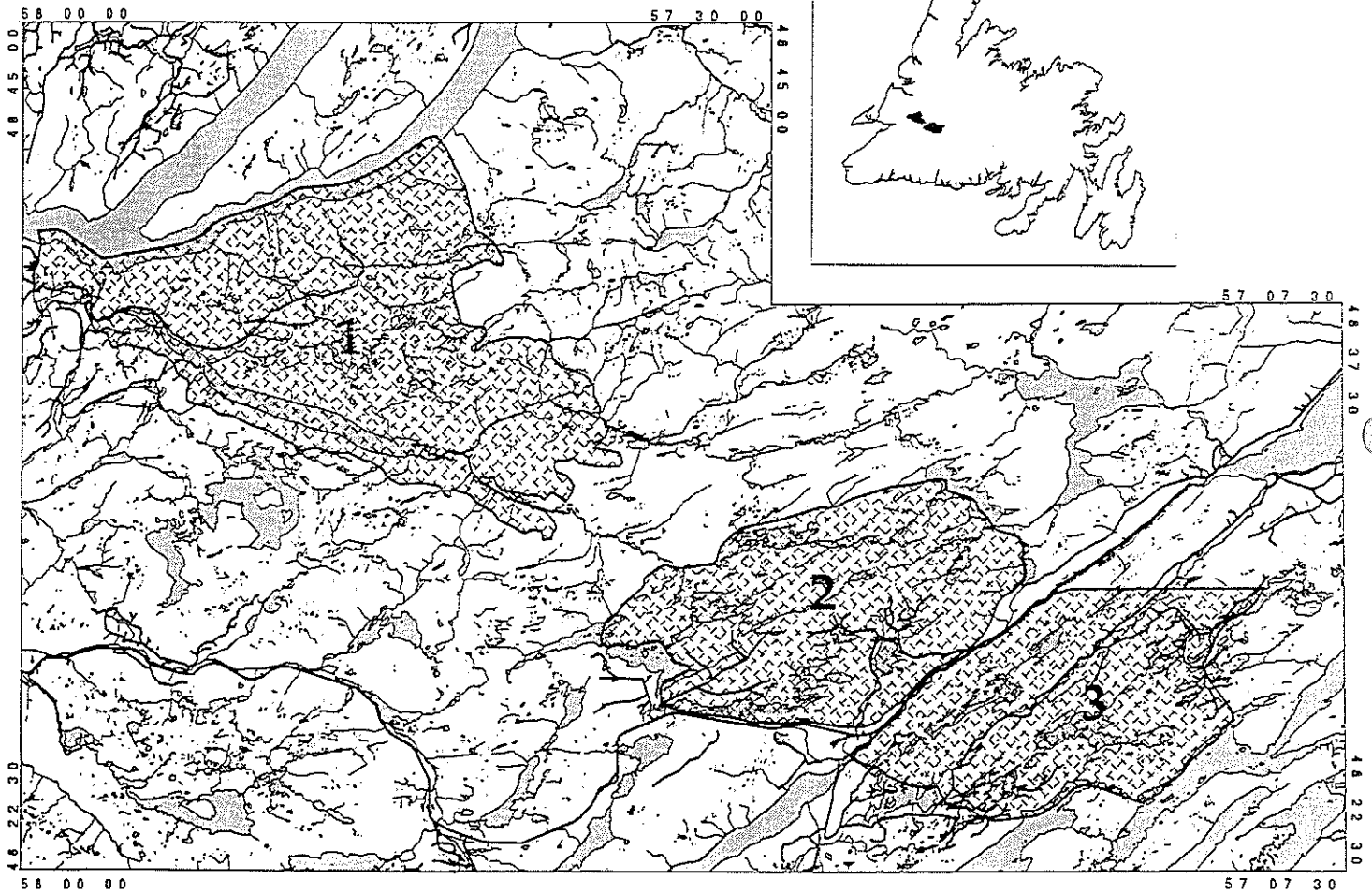
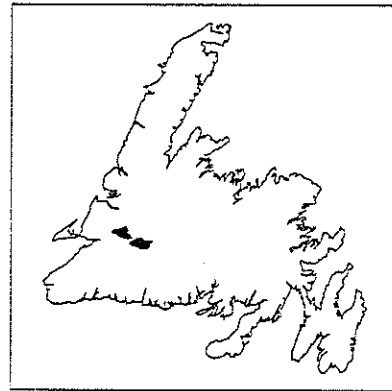
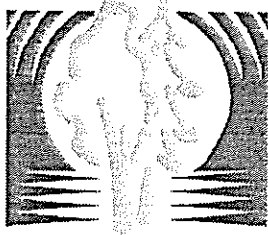
*Role of  
large down  
wood debris  
ever been  
studied?*

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FIGURE 1: LOCATION OF STUDY AREAS



LEGEND

- 1.. Little Grand Lake Study Area
- 2.. Portage Lake Study Area
- 3.. Victoria Lake Study Area

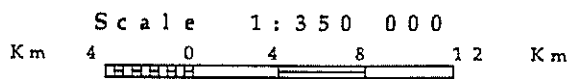










FIGURE 2: HOME RANGES OF MARTENS #2, 5 & 6  
STUDY AREA 1 - LITTLE GRAND LAKE. 1993 - 94



Marten  
Home Range

Vegetation Type

- |  |            |   |                       |  |   |
|--|------------|---|-----------------------|--|---|
|  | Marten # 6 |  | Scrub & Pure Hardwood |  | Softwood < 60 years &<br>Hardwood Dominant Stands |
|  | Marten # 5 |  | Bog & Treed Bog       |  | Softwood & Softwood<br>Dominant Stands > 60 years |
|  | Marten # 2 |  | Rock & Soil Barren    |  |   |

Scale 1:70 000

Km 2 0 2 Km

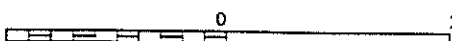










FIGURE 3: HOME RANGES OF MARTENS #1, 3 & 4  
STUDY AREA 1 - LITTLE GRAND LAKE. 1993 - 94



Marten Home Range

-  Marten #1
-  Marten #3
-  Marten #4

Vegetation Type

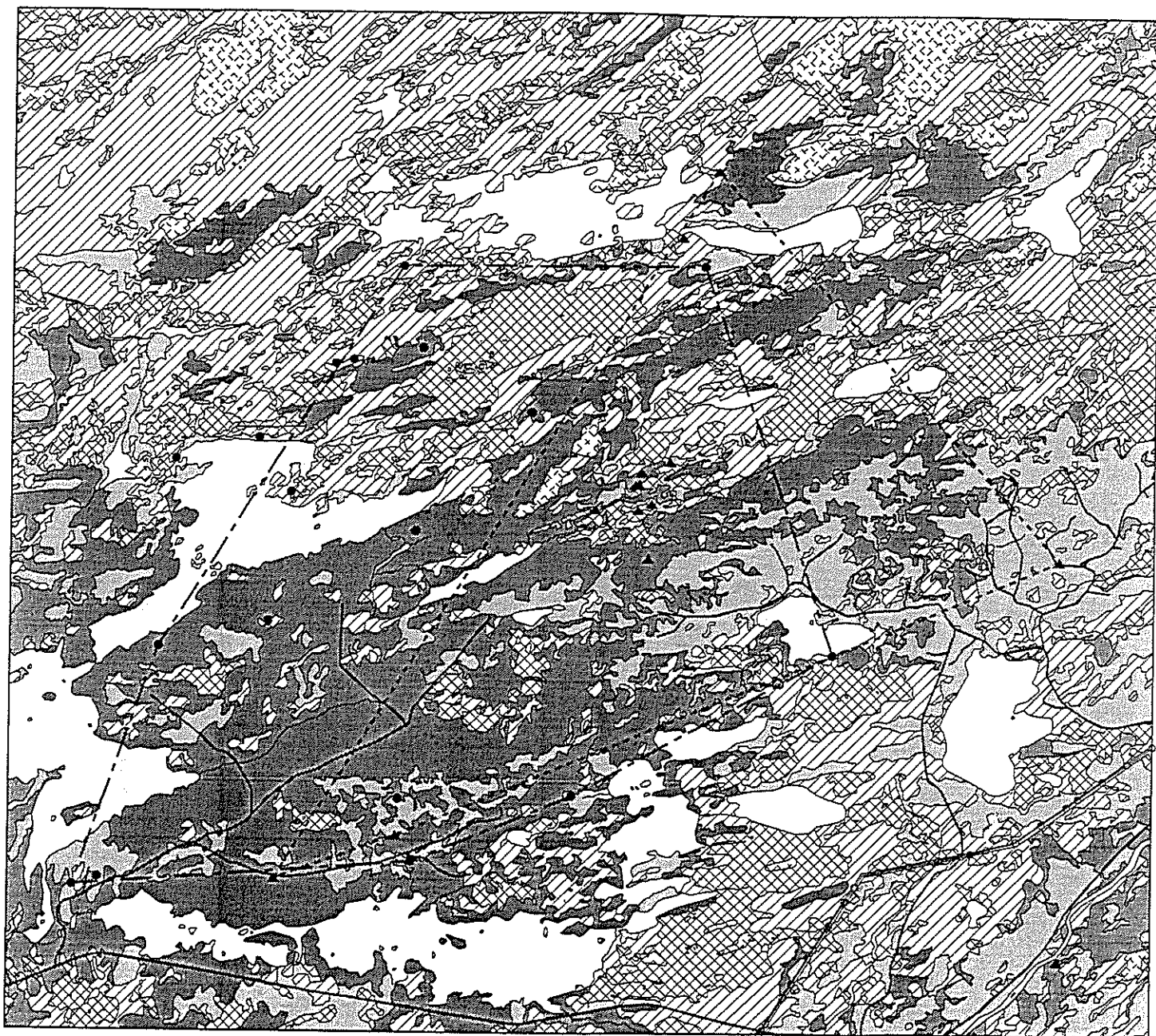
-  Scrub & Pure Hardwood
-  Bog & Treed Bog
-  Rock & Soil Barren
-  Softwood < 60 years & Hardwood Dominant Stands
-  Softwood & Softwood Dominant Stands > 60 years



Scale 1:70 000








Km 2 0 2 Km

FIGURE 4: HOME RANGES OF MARTENS #7 & 8  
STUDY AREA 2 - PORTAGE LAKE. 1993 - 94



Marten  
Home Range

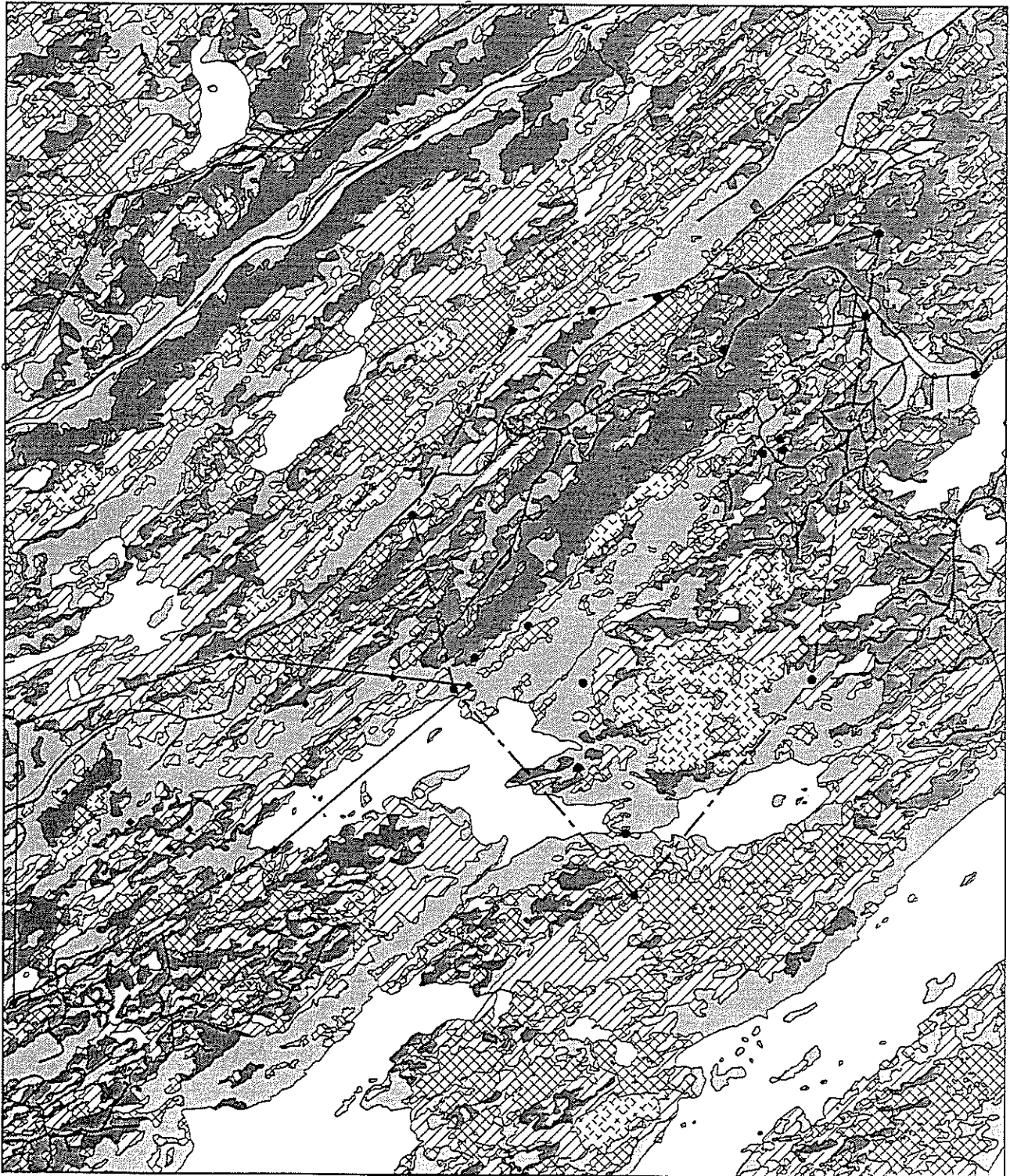
Vegetation Type

- |   |           |   |                       |  |   |
|---|-----------|---|-----------------------|--|---|
|  | Marten #7 |  | Scrub & Pure Hardwood |  | Softwood < 60 years &<br>Hardwood Dominant Stands |
|  | Marten #8 |  | Bog & Treed Bog       |  | Softwood & Softwood<br>Dominant Stands > 60 years |
|   |           |  | Rock & Soil Barren    |  |   |

Scale 1:70 000  
Km 2 0 2 Km



FIGURE 5: HOME RANGES OF MARTENS #9 & 10  
STUDY AREA 3 - VICTORIA LAKE. 1993-94



Marten Home Range

- ▧ Marten #10
- ▨ Marten #9

Vegetation Type

- ▩ Scrub & Pure Hardwood
- ▧ Bog & Treed Bog
- ▨ Rock & Soil Barren
- Softwood < 60 years & Hardwood Dominant Stands
- Softwood & Softwood Dominant Stands > 60 years

Scale 1:70 000  
Km 2 0 2 Km

