WINTER ECOLOGY OF PINE MARTEN *(Martes americana)* IN THE SOUTH-CENTRAL YUKON TERRITORY, 1980/81

NORTHERN BIOMES LTD.
ENVIRONMENTAL SERVICES

April 1983

There still remains information to be gleaned from the winter field data, although we feel we have covered the major points of concern. We also believe that it would be worthwhile to publish some of these results. The high occurrence of hare in the marten scats is particularly interesting. We realize that all data and results from the Evelyn Creek marten study will be compiled and presented in a report, but internal government reports are often hard to access and knowledge of their existence is often a stroke of luck. We would be interested in participating with you and Harvey in publishing this data and we would expect no renumeration.

We certainly enjoyed the opportunity to analyze the winter field data which we collected during the winter of 1980-81.

Sincerely,

Kate

C. A. McEwen

CM/kw

Enclosures

WINTER ECOLOGY OF PINE MARTEN (*Martes americana*) IN THE SOUTH-CENTRAL YUKON TERRITORY, 1980/81

BY

Catherine A. McEwen

W. Gavin Johnston

NORTHERN BIOMES LTD.

ENVIRONMENTAL SERVICES

BOX 4849

WHITEHORSE, YUKON TERRITORY

FOR

GOVERNMENT OF YUKON

DEPARTMENT OF RENEWABLE RESOURCES

RESOURCES PLANNING AND MANAGEMENT BRANCH

APRIL 1983

ACKNOWLEDGEMENTS

This study involved the assistance and comments of many people. Harvey Jessup provided logistical support, radio contact and field assistance. Further field assistance was given by Ralph Archibald who initiated the study, Beth Gerow, Tony Hamilton and Brian Slough. Ellen and Phil Davignon at Johnson's Crossing were most hospitable during our travels to and from the study area.

Don Russell provided us with details of the vegetation classification, Steve Beare and Art Martel provided information on small mammal ecology, Scott Gilbert commented on the habits of the varying hare and Ken Gerow provided statistical advice. Philip Merchant prepared the scats for analysis, which was conducted by Pauline Erickson.

This report was diligently typed by Kelly Wilkinson and Cathy Macpherson drafted all figures.

ABSTRACT

The winter ecology of pine marten (Martes americana) was studied intensively from November 1980 to March 1981 at Evelyn Creek, in the south-central Yukon Territory. The authors resided near the study area and made observations on marten winter use of vegetation types, the influence of snow depth on marten activities, characteristics of marten digs or points of access to the subnivean, the distribution of certain prey species and also collected scats for food habits analysis.

Marten used the open black and white spruce vegetation type less than expected and used the white and black spruce with fir type predominantly for hunting. Snow depth did not affect marten winter activity. Marten accessed the subnivean passively employing branches, saplings and deadfall protruding above the snow. Marten spent little time in trees. From the scat analysis cricetids, especially red-backed voles, (Clethrionomys rutilus) and varying hare (Lepus americanus) comprised the bulk of the marten winter diet with the frequency of occurrence of these two food items in the scats fluctuating inversely during the winter months.

TABLE OF CONTENTS

TABLE OF CONTENTS (cont'd)

LIST OF TABLES

TABLE OF TABLES (cont'd)

LIST OF FIGURES

INTRODUCTION

The pine marten (Martes americana) is one of the major economic furbearers trapped within the Yukon Territory (Yukon Fur Harvest Records). In 1980/81 the marten harvest of 6,168 animals was worth $230,000 to Yukon trappers, or 17.6% of the total value of the Yukon fur harvest (Slough pers. comm.). Due to the ease in trapping this furbearer and the relative high market value of its pelt, the potential for overharvesting this species in the Yukon exists. (Archibald and Olson 1978, Jessup 1981). Recognizing a need to develop a management strategy for pine marten, Archibald (1978), of the Yukon Wildlife Branch, proposed study to investigate marten ecology.

During 1978, investigations into marten ecology were initiated by the Yukon Wildlife Branch at a 14 km^2 study area in the south-central Yukon Territory. Marten population dynamics were investigated through a systematic live-trapping and radio-telemetry monitoring program (Archibald and Jessup 1982). Intimately related and concurrent with the above population study were: field studies investigating small mammal presence, abundance and distribution (Beare 1981) a vegetation type classification scheme of the study area (Archibald 1980) and a field study of marten winter ecology.

This report presents the results of a field study of the winter ecology of pine marten, conducted intensively for five months, from November 1980 to March 1981 in the south-central Yukon Territory.

The study objectives were to investigate the following:

1) marten winter use of vegetation types
2) the effect of snow depth on marten activity
3) characteristics of marten rest sites and marten access points to the subnivean
4) winter foods of marten through scat analysis
5) the distribution and abundance of certain prey species.

In addition to the above objectives, activity and home ranges of resident marten within the study area were investigated through radio-telemetry and live-trapping. Though an integral part of the winter study, the results from telemetry and trapping are presented elsewhere (Jessup and Slough in prep.).

STUDY AREA

The 14 km^2 study area lies in the Evelyn Creek region of the Nisutlin River drainage in the south-central Yukon Territory, 60° 45′ N, 133° 10′ W (Figure 1). Situated on a north facing slope, the study area ranges in elevation from 875 m to 1,200 m a.s.l.. In proximity to the study area was a base camp where the two authors resided.

The study area, being within the Boreal Forest Region (Rowe 1972) is comprised predominantly of coniferous forest. An xtensive fire history in the area has resulted in a heterogeneity of tree species and tree age. Lodgepole pine (Pinus contorta) and cottonwood (Populus balsamifera) represent the younger seral stages presumably succeeding to spruce stands of white spruce, (Picea glauca) and black spruce, (Picea mariana), and to the climax stage of subalpine fir (Abies lasiocarpa) (Archibald 1980).

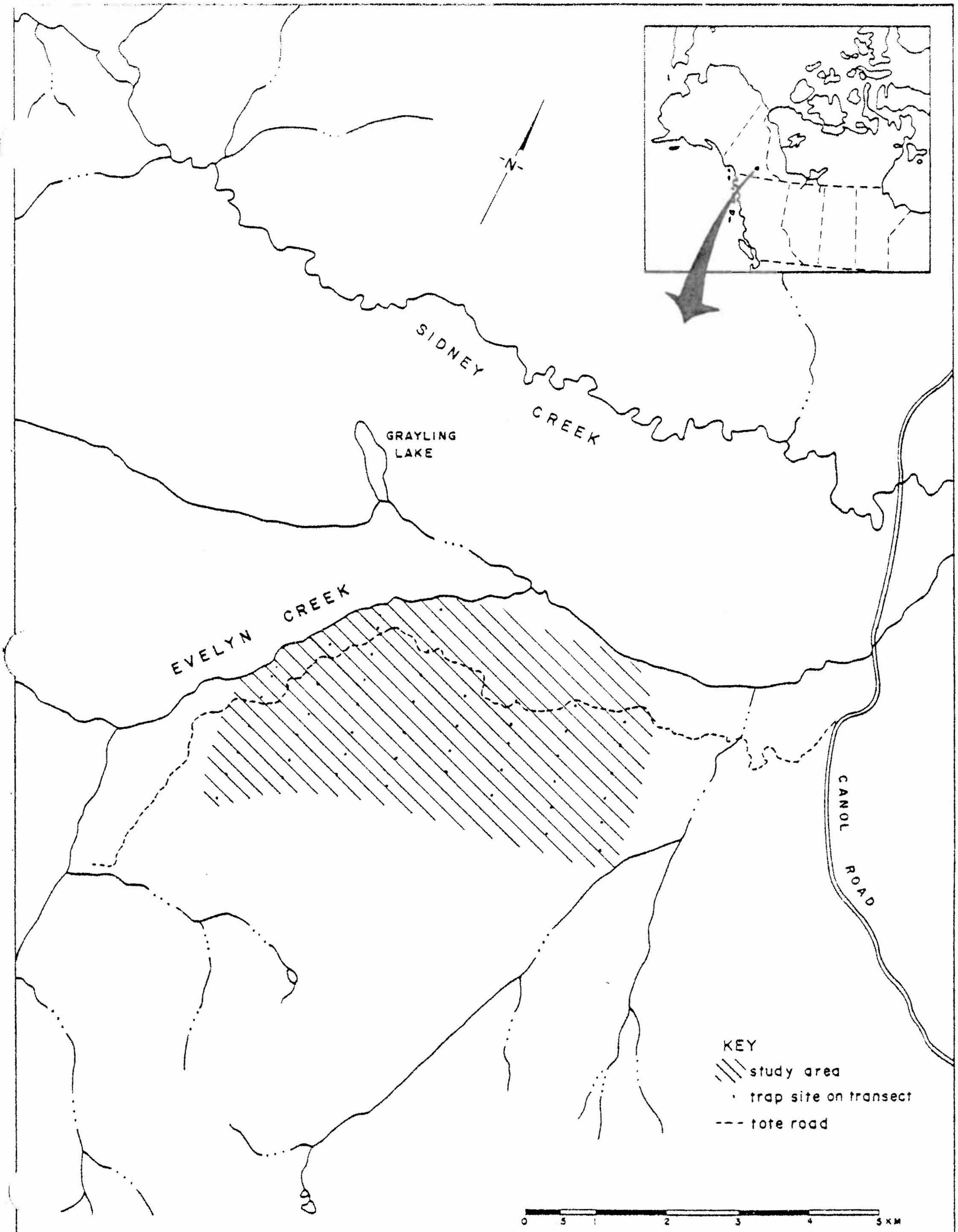


FIGURE 1 Study Area of Evelyn Creek, Yukon Territory

WEATHER

The recorded mean daily temperature from November 1980 to March 1981 was -11.3°C, with a mean daily maximum and minimum temperature of -6.4 and -16.2°C respectively. The month of December had the coldest average temperature while January was unusually warm (Table 1).

TABLE 1 Mean Monthly Winter Temperatures at Evelyn Creek, November 1980 - March 1981.

TEMPERATURE (°C)	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH
Mean daily	-10.5	-21.4	- 9.0	-13.7	- 5.4
Mean daily max.	- 7.2	-14.8	- 5.2	- 8.3	+ 1.3
Mean daily min.	-13.8	-28.1	-12.8	-19.3	-12.1

METHODS

Access

The study area was accessed by snow machine using an abandonned tote road which bisects the area. Travel through the area was on snowshoes, following permanent line transects. The eight transects, each approximately 2 m wide and .8 km apart were orientated in a north-south direction extending on average 2 km (1.5 - 2.7 km) in length (Figure 1).

Snow Survey

Snow depth was measured 15 times over the course of the study period at 30 fixed locations spaced 50 m apart along the eight transects. Each location or snow station consisted of a wooden lathe, marked in increments of two centimeters and staked firmly into the ground with the 0 cm mark at ground level. Snow depths were measured the day immediately following the termination of a snowfall. In cases when snowfall persisted until 0730 hours snow depths were measured the following day. Two observers working independently all day were required to measure depths at all stations during each sampling session. On occassion (4 of 15 sampling sessions) snow depth measurements required two days for complete sampling.

cones of snow would regularly develop around the lathes artificially increasing the snow depth by as much as 12 cm. To ensure accurate snow depth measurement cones were levelled to the proximal snow level.

To moderate the variation in snow depth between consecutive stations, which was often caused by the specific location of the lathe (ie. under a bough or beside a tall shrub), a running average from three sequential stations was calculated to represent the snow depth at a given station, for all stations, within each sampling session. Thus the snow depth value at any given station was calculated as an average value of its value plus the measured depth at the station below and above it. For those stations at either end of a transect, its representative value was an average of its own plus the value of the adjacent station. Each snow station was placed into one of seven vegetation types or classes (see below) on the basis of biophysical sampling done at the station prior to the winter period (Archibald and Jessup 1981). The mean snow depth over the winter period for each vegetation type was calculated and a one way analysis of variance (with unequal sample size) of the mean snow depths of the types was performed.

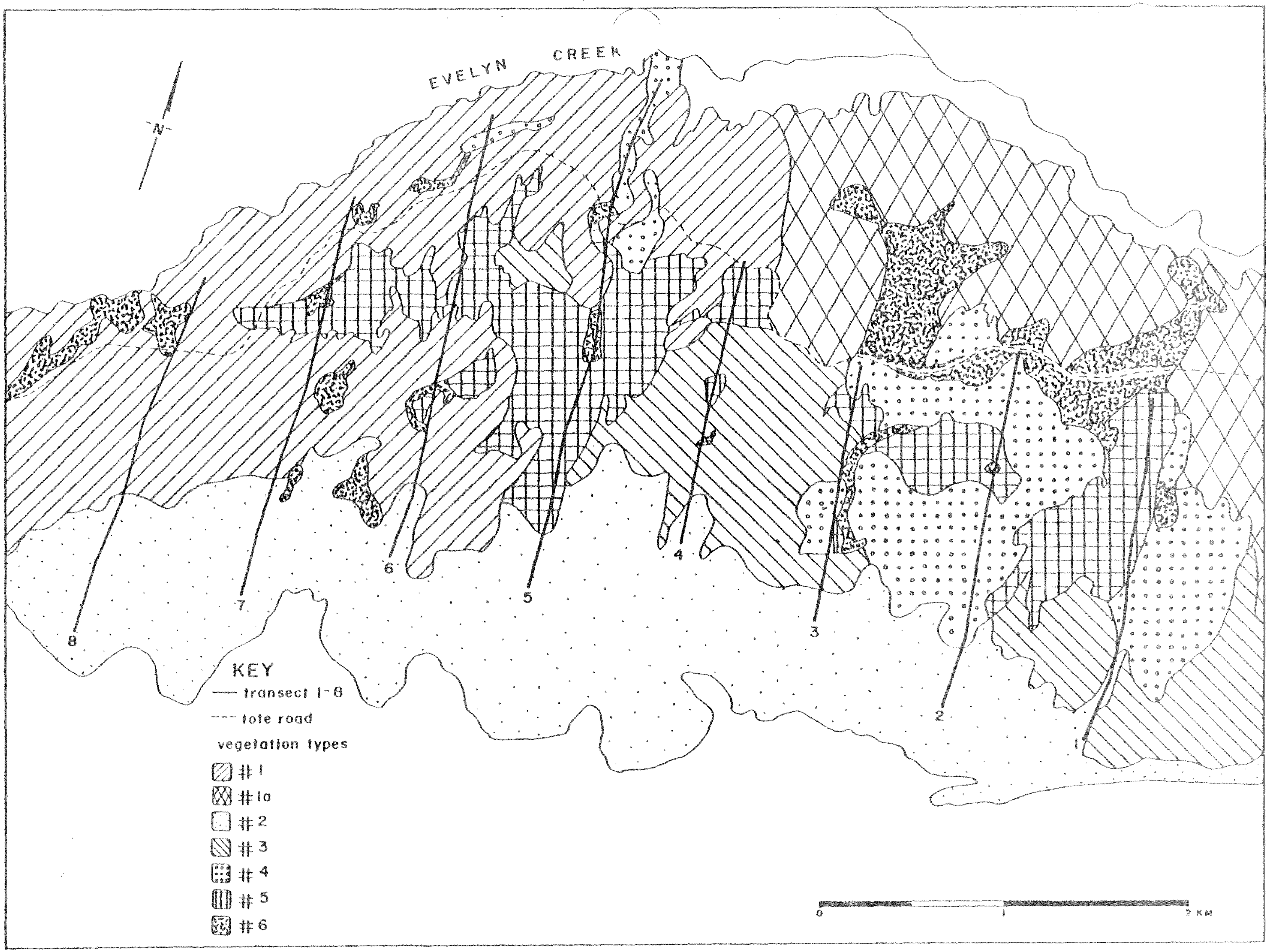
Vegetation Types

Prior to the winter study five vegetation types had been defined and delineated for the study area (Archibald 1980). Using that classification scheme complimented with the sampling results of the biophysical attributes at each snow station (Jessup pers. com.) and a timber-type map of tree age, height and density of the study area (Russell pers. com.), the five vegetation types were increased to seven and their previously defined boundaries adjusted (Figure 2). The seven vegetation types are as follows:

#1 Lodgepole pine with subalpine fir and white spruce - the tall (>1.5 m) shrub layer is comprised of fir saplings and willow (*Salix* spp.)

#1a Regenerating lodgepole pine with balsam poplar and occassional spruce - tall shrubs are represented by willow and alder (*Alnus crispa*).

#2 Subalpine fir with occassional spruce - found at the higher elevations in the study area. Many of the trees are stunted. Regenerating fir comprises the tall shrub layer.


EVELYN CREEK
N
1
2
3
4
5
6
7
8
KEY
transect 1-8
tote road
vegetation types
1
1a
2
3
4
5
6
0
1
2 KM

#3 Subalpine fir with white spruce - the shrub layer is well developed and comprised of regenerating fir, willow and shrub birch (*Betula glandulosa*). Horsetails (*Equisetum* spp.), though not obvious in the winter, typify this habitat.

#4 White and black spruce with subalpine fir - fir saplings and willow comprise the tall shrub layer. Wild rose (*Rosa acicularis*) is considered an indicative species of this habitat.

#5 Open black spruce with white spruce - this habitat is very moist. Spruce and willow predominate in the tall shrub understory.

#6 Willow and alder shrub - localized thickets of tall shrubs. The occassional spruce and cottonwood tree is encountered within the type.

Archibald (1980) gives further details of the vegetation types. Plant names follow Hulten (1968).

Track-Counts

Mammal track-counts were conducted concurrent with the snow depth sampling sessions. For each set of observed tracks the appropriate animal species, the location of the tracks by vegetation type and snow station and the direction of travel were recorded. Tetraonid sign was recorded similarly. All mammal species names follow Youngman (1975).

To provide a relative index of abundance of each animal species whose tracks were routinely observed, the number of tracks recorded were standardized to tracks per km-day using the following formula (Penner 1979):

$$\text{tracks/km-day} = \frac{\text{no. of tracks of given species}}{\text{distance censused X no. of days since last snowfall}}$$

To determine animal-vegetation type associations, the method of Neu <u>et al</u> (1974) of habitat utilization - availability was employed. Based on the assumption that an animal uses a habitat in proportion to its availability to the animal, a chi-square goodness-of-fit test is performed, testing the observed and expected distribution of tracks among the habitat types.

the calculated chi-square value is significant, the null hypothesis (that the observed animal tracks followed an expected distribution among the vegetation types) is rejected. A Bonferroni Z statistic is then used to calculate a confidence interval to determine whether the observed tracks occurred more or less frequently than expected in a given habitat (Neu et al 1974). Johnson (1980) cautions about using the terms preference and avoidance in relation to an animal's use of a habitat as, "conclusions about whether an individual component is used above, in proportion to or below its availability are dependent upon the choice of components deemed available to the animal ... which is somewhat arbitrarily decided by the investigator."

An inventory of all bird species present in the study area was conducted concurrent with track-counts. This information will be presented elsewhere (Johnston and McEwen in prep.)

Marten Tracking

Throughout the study period, marten tracks found within the study area, either along the tote road or along any of the transects, were followed on snowshoe to investigate the daily activities of pine marten.

While tracking, the following parameters and observations were recorded: start location, the direction of travel of the observer relative to the marten's travel direction, the fashion of the marten's travel (hunting or straight travelling), changes in the use of vegetation types, dig sites (defined as a site where the marten tunnelled under the snow to access the subnivean), rest sites (defined as a site where marten spent an extended period of time as implied by the difference in the age of the tracks entering and leaving the site), and the number of quamaniqs entered. A quamaniq is defined as that area around the base of a large tree which is sheltered from maximum snow fall by large, overhanging boughs (Pruitt 1965). Hunting was defined by a marten's zig-zag pattern of movement (Lensink 1953, Steventon and Major 1982).

The vegetation type in which the marten tracks were observed and followed, was determined on the basis of the predominant tree species present, tree density and the visible understorey plant species as well as by superimposing the general path of travel onto the vegetation map of the study area.

At each dig and rest site the following parameters were recorded; location relative to the snow's surface (above or below), snow depth, the type of access to the subnivean (active passive) and if passive, how access was achieved.

ıssive access to the subnivean meant the use of a pre-existing tunnel usually created by a leaning tree branch or stump extending above the snow surface, while active access meant the marten actually dug its own tunnel. It could not be determined if a rest site was used strictly for rest or was used as a place in which to feed and rest.

The distances that marten tracks were followed were recorded as the number of observer paces and converted to kilometers using separate conversion factors calculated for each observer's pace length.

To investigate the utilization of quamaniqs by marten, we compared the measured density of quamaniqs randomly occurring, with the density of quamaniqs in which marten entered. To measure the natural occurrence of quamaniqs in the study area, a line transect along a specific compass bearing was walked within each vegetation type (except #6) and the number of quamaniqs intersected by the observer was recorded. As the transect lengths were short the results from all vegetation classes were pooled. A Student's t-test was used to test the difference in means between the random occurrence of quamaniqs in the study area and marten use of them.

od Habits

Marten food habits were interpreted through scat analysis. Marten scats were routinely collected throughout the study area during the 1980/81 winter study period. All scats collected were found on top of fresh snow and presumably were not older than approximately four days.

Each scat was individually stored in a whirlpac plastic bag, labelled by date, collector and location and kept frozen in the dark. In the laboratory the scats were washed with tap water over a 1.00 mm mesh sieve, the residual fragments (teeth, bone, air, feather and vegetation) were separated, oven dried at 50°C for a maximum of 24 hours and stored dry in a plastic vial (Merchant pers. com.). The residual scat fragments were then identified to the species level, when possible, using microhistological techniques (Jessup and Slough, in prep.). The identification of mammals represented in the scats was accomplished by the examination of guard hairs for medulla and scale patterns and subsequent comparisons with a reference collection (Erickson pers. com.). When hairs were unavailable or proved insufficient for identification, teeth and bones were used for mammal identification.

RESULTS

Snow Survey

The mean snow depths among the vegetation types throughout the winter were significantly different (ANOVA, F= 16.5, α= .01). On average, the willow and alder shrub type (#6) had the deepest snow depth while the shallowest snow depth was recorded in the white and black spruce with subalpine fir vegetation type (#4) (Table 2).

TABLE 2 Mean Snow Depths of the Vegetation Types at Evelyn Creek, November 1980 - March 1981

	VEGETATION TYPE					
	1	2	3	4	5	6
MEAN WINTER SNOW DEPTH (cm)	74.6	78.8	77.4	71.8	78.5	81.9

(Habitat #1a omitted from analysis due to small sample size, ie. only 5 snow stations)

Snow accumulation on the ground was measured daily at the base camp. The greatest snow accumulation was recorded in February (Table 3). The maximum recorded snow accumulation on the ground in the study area was 156 cm in the subalpine fir vegetation type (#2).

TABLE 3 Mid-month Depth of Winter Snow Accumulation at the Base Camp, Evelyn Creek, November 1980 - March 1981

	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH
SNOW DEPTH ON GROUND (cm)	28	50	80	100	84

ack-Counts

The abundance of some common mammals and tetraonids at Evelyn Creek, as expressed by the no. of tracks/km-day, is presented in Table 4. Varying hare tracks were most common. Tracks of tetraonids cannot be compared with the abundance of mammals tracks for though the birds feed on the ground and loaf under the snow their travel is by flight. Tracks of all animals were most abundant in January, a reflection of increased activity not increased population numbers.

The observed distribution of marten tracks among the vegetation types varied significantly from the expected distribution (chi-square= 18.15, 5 d.f., α= .05). The open black spruce with white spruce type (#5) was used less than expected by marten relative to its availability along the transects (Table 5 & 6). All other vegetation types were used in proportion to their relative availability.

The observed distribution of hare tracks among the vegetation types varied significantly from the expected distribution (chi-square= 40.9, 5 d.f., α = .05). Varying hares used the white and black spruce with fir type (#4) more than expected, and the mature lodgepole pine (31) and subalpine fir 2) types less than expected according to their availability along the transects (Table 6).

.BLE 4 Relative Abundance of Some Mammals and Tetraonids at Evelyn Creek, November 1980 - March 1981. Results of track-counts expressed as (# of tracks/km-day), n = number of track-count sessions.

	NOVEMBER n=4	DECEMBER n=2	JANUARY n=3	FEBRUARY n=2	MARCH n=2	OVERALL n=13
Pine Marten	.8	.3	1.4	1.0	.6	.8
varying Hare	2.0	3.3	7.9	.7	.9	3.0
Red Squirrel	.3	.2	.6	.4	.6	.4
*Tetraonid	.1	.1	.4	.1	.1	.1

* Spruce grouse and ptarmigan

TABLE 5 Availability and Utilization of Vegetation Types by Marten at Evelyn Creek, November 1980 - March 1981

Vegetation* Type	Area** (km²)	km	Proportion of total area	No. of marten tracks observed	No. of marten tracks expected	Marten tracks as a proportion	Confidence interval of proportion observed	Utilization
1	.67	335	.211	45	41	.232	.152 < Pi < .312	=
2	.68	340	.214	55	42	.284	.199 < Pi < .370	=
3	.31	155	.098	12	19	.062	.016 < Pi < .108	=
4	.49	245	.155	32	30	.165	.095 < Pi < .235	=
5	.79	395	.249	29	48	.150	.082 < Pi < .218	<
6.115	.23	150	.073	21	14	.108	.049 < Pi < .167	=
TOTAL	3.17	1620		194				

* Type 1a omitted due to small sample size

** Refers only to 2 m wide transect

BLE 6 Vegetation Type Availability - Utilization by Marten, Varying Hare, Red Squirrel, and Tetraonid at Evelyn Creek, November 1980 - March 1981

	VEGETATION TYPE					
	1	2	3	4	5	6
Marten	=	=	=	=	<	=
Varying Hare	<	<	=	>	=	=
Red Squirrel	>	=	=	=	=	=
Tetraonid	=	=	=	=	=	=

= used in equal proportion

< used proportionately less than its availability

> used proportionately more than its availability

Red squirrel (Tamiasciurus hudsonicus) tracks were observed going to and from snow tunnels and between trees. Tracks were most abundant in January through to March (Table 4). A significant difference was found between the observed distribution of squirrel tracks and their expected distribution among the vegetation types (chi-square= 40.9, 5 d.f., α= .05). Red squirrels used the mature lodgepole pine habitat more than expected and the open black spruce with white spruce type less than expected (Table 6).

Tetraonids in the study area were predominantly spruce ouse (Dendragopus canadensis), some willow ptarmigan (Lagopus ıagopus) and the occassional white-tailed ptarmigan (Lagopus leucurus).

Tetraonid sign (birds, tracks, and kieppis or subnivean resting sites) was infrequently seen (Table 4) and could not be differentiated to specific bird species. No significant difference was found in the observed distribution of observed tetraonid sign among the vegetation types and the expected distribution (chi-square= 6.61. 5 d.f., α= .05). Lumping the habits of ptarmigan and grouse together to determine their use of available vegetation types likely muted any significant differences, as the two bird groups inhabit different habitats.

Tracks of mammals which were observed in the study area infrequently include moose (Alces alces), porcupine (Erethizon dorsatum), wolf (Canis lupus), weasel (Mustela sp.), mink (Mustela vison), wolverine (Gulo gulo) and lynx (Felis canadensis).

Marten Tracking

Cumulatively, marten tracks were followed for a total of 32.84 km. In over 60% of this distance, the marten tracks followed a zig-zag pattern, implying that the marten were hunting (Steventon and Major 1982). The hunting pattern of travel by marten was most prevalent in the white and black spruce with subalpine fir vegetation type (#4) where marten apparently hunted for 86% of the 6.85 kilometers tracked (Table 7).

In the mature lodgepole pine vegetation type (#1) the hunting pattern of the marten was observed for 62% of the distance tracked. Sixty-five percent of the 3.02 km tracked in the regenerating pine vegetation type (#1a) suggested the marten was not hunting but travelling through the area (Table 7).

BLE 7 Patterns of Travel (Hunt, Non-hunt) By Marten Within the Vegetation Types of Evelyn Creek, November 1980 - March 1981

VEGETATION TYPE	TOTAL DISTANCE TRAVELLED (km)	DISTANCE HUNTED KM	DISTANCE HUNTED %	DISTANCE NON-HUNTED KM	DISTANCE NON-HUNTED %
1	9.30	5.80	62	3.50	38
1a	3.02	1.05	35	1.97	65
2	0.18	-	-	0.18	100
3	4.26	2.04	48	2.22	52
4	6.85	5.89	86	0.96	14
5	7.27	4.06	56	3.21	44
6	1.86	0.96	52	0.90	48
ALL TYPES	32.84	19.80	60.3	13.04	39.7

Of the approximate 33 km in which marten tracks were followed, seldom was their activity arboreal. On five occassions the marten tracks being followed suggested that the animal had climbed a tree, often travelling a few metres before descending and resuming its pace on the ground. Marten tracks followed were usually in the 2 and 2 gait, the typical mustelid style. This gait was broken to a slow walk (1, 2, 3, 4) usually around dig sites, kill sites and in quamaniqs. Although the marten's feet are obviously adapted for light travel in snow by their large size and surface area relative to the rest of the body, it was not uncommon to follow marten tracks on top of the tracks of hare or snowshoes. Of the 33 km tracked, the marten never bellied out in the snow.

Marten tracks also went below the snow surface, to the subnivean, exiting either through the entrance or using another hole. These sites of subnivean access were identified and classified as a marten rest site only if there was an obvious difference in the age of the tracks entering and leaving the site.

Three subnivean rest sites were located. In all cases access to the subnivean was gained by following a trunk, deadfall or sapling which extended above the snow's surface. A fourth rest site was located in a large, hollow, white spruce trunk above the snow level.

1 other observed access to the subnivean by marten was assumed to be a dig site in quest of prey.

A total of 77 digs or subnivean access sites were recorded, with an overall density of 2.04 digs/km of marten tracks followed. The greatest dig density (4.7 digs/km) occurred in vegetation type #4, white and black spruce with subalpine fir (Table 8). Observed dig density was also relatively high (3.3 digs/km) in the regenerating lodgepole pine vegetation type (#1a). Although no marten digs were found in the subalpine fir type (#2) only 0.2 km of tracks were followed in this vegetation type.

Marten access to the subnivean was predominantly (86%) by passive means in which tree trunks, deadfall or saplings were most frequently used (Table 9). Active digs, wherein the marten presumably had to make a tunnel to the subnivean rather than use a pre-existing one, were frequent in the mature pine (#1) and regenerating pine (#1a) vegetation types where they represented 50% and 67% of the marten digs respectively (Table 8). No significant difference was found between snow depth at passive and active dig sites.

3LE 8 Density and Number of Marten Winter Digs in Each Vegetation Type at Evelyn Creek, November 1980 - March 1981

VEGETATION TYPE	1 n=12	1a n=10	2 n=0	3 n=6	4 n=32	5 n=13	6 n=4	TOTAL n=77
# DIGS/KM TRAVELLED	1.3	3.3	0	1.4	4.7	1.8	2.1	2.1
# OF PASSIVE DIGS	8	6	0	6	29	12	4	65
OF ACTIVE DIGS	4	4	0	0	3	1	0	12

BLE 9 Passive Digs - Modes of Access to the Subnivean Employed by Marten, Evelyn Creek

MODE OF ACCESS TO SUBNIVEAN	NUMBER OF DIGS	% OF TOTAL
Tree trunk	14	22
Deadfall	24	37
Shrub	6	9
Sapling	17	26
Other (quamaniqs and roots)	4	6

Marten tracks entered significantly fewer quamaniqs than the [illegible]cimated number of quamaniqs occurring by random encounter ($t = 4.07$, $\alpha = .05$). Marten may have been avoiding quamaniqs or selecting specific ones to enter. Quite often marten broke their gait to a walk when they entered quamaniqs. Appendix 1 lists the sampled density of quamaniqs and the observed density of marten use of them in each vegetation type.

Food Habits

Mammals comprised the bulk of the food items identified in the winter pine marten scats. Excluding all scats which were [illegible]0% blood and extraneous, incidental food items such as woodchips, varying hare occurred in 48% of 105 scats while red-backed vole (Clethrionomys rutilus) occurred in 40%. 54% Considering cricetids, this group was represented in 60% of the scats (Table 10). Carrion (moose), and tetraonid remains occurred in the winter scats though infrequently (Table 10). Appendix 2 gives a complete listing of all food items in the marten winter scats.

The predominance of cricetids in the marten scats fluctuated inversely to the predominance of varying hare in the scats over the five month study period (Figure 3). Cricetids occurred most frequently (83%) in the December scats while varying hare remnants were identified in only 25% of the scats. Conversely, [illegible] January and February, varying hare occurred in more than 60% of the scats while cricetids occurred in less than 45% of them.

BLE 10 Number of Occurrences and Percent Frequency of Occurrence of Food Items in 105 Marten Winter Scats, Evelyn Creek, November 1980 - March 1981

Blood and incidental vegetation omitted.

FOOD ITEM	NOVEMBER n=22 #	%	DECEMBER n=12 #	%	JANUARY n=39 #	%	FEBRUARY n=12 #	%	MARCH n=20 #	%	TOTAL n=105 #	%
'eporidae	6	27	3	25	24	62	9	75	8	40	50	48
Cricetidae	16	73	10	83	17	43	5	42	15	75	63	60
Carrion (Cervidae)							1	8	1	5	2	2
Tetraonidae			3	25							3	3

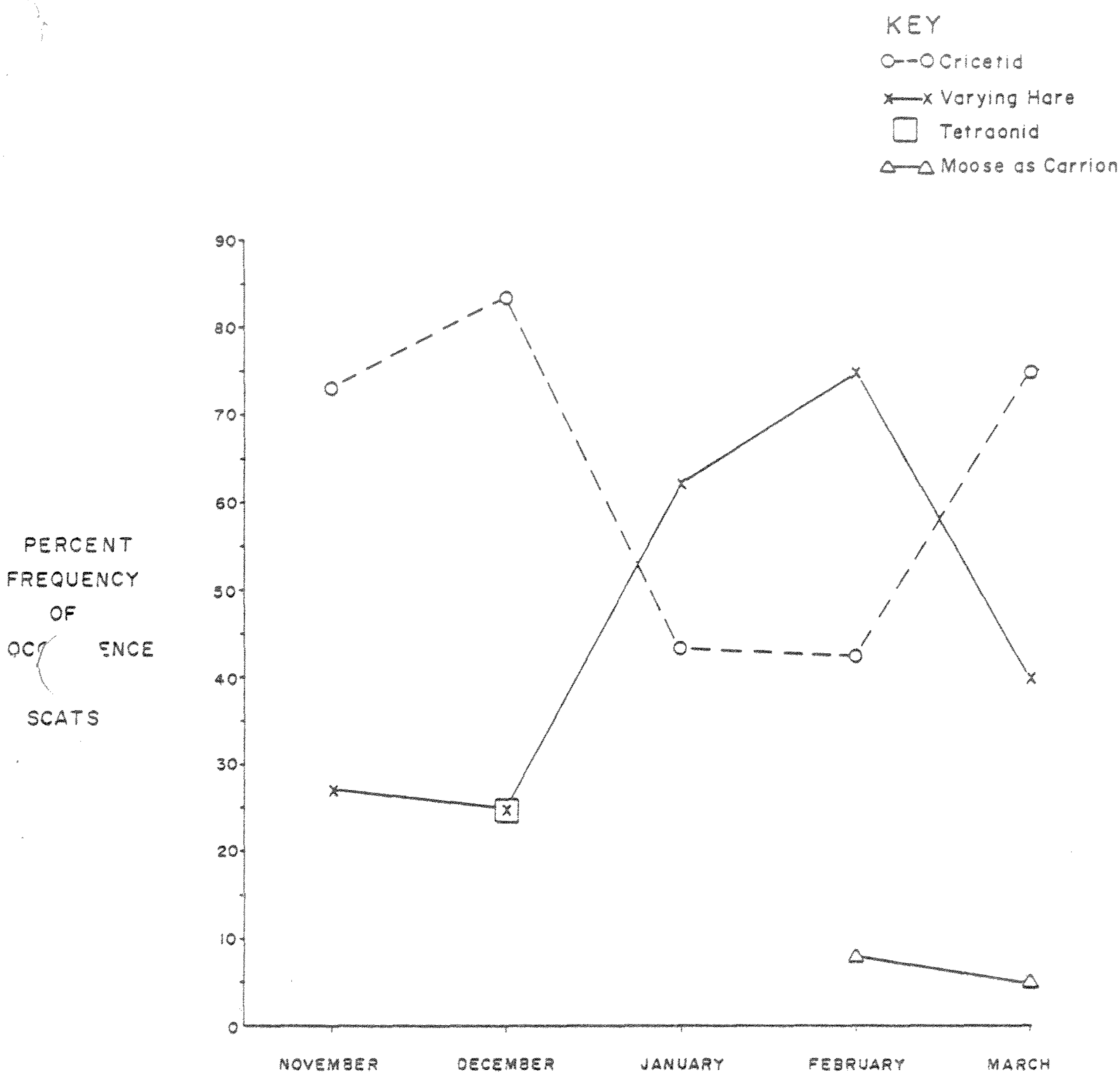


FIGURE 3 Frequency of Occurrence of Food Items in 105 Marten Winter Scats, Evelyn Creek, November 1980 - March 1981

Four species of cricetids were represented and identified in the marten scats; red-backed vole, northern bog lemming (Synatomys borealis), meadow vole (Microtus pennsylvanicus) and siberian lemming (Lemmus sibiricus). Red-backed vole was the most common species, occurring in 90% of the 62 marten scats containing cricetid remains and occurring in no less than 88% of the scats of any given month (Table 11). Siberian lemming was the second most common cricetid, though represented in only 13% of the 62 scats (Table 11). This species occurred consistently in scats collected during each month, yet occurred most frequently in the scats of November.

A comparison of the occurrence of the cricetid species in the winter marten scats and their occurrence in snap-trap captures in the spring and fall of 1980 (Beare 1981) is presented in Table 12. Although Beare (1981) did not trap throughout the study period, he did trap in all the vegetation types (#1-5). Red-backed vole was the predominant cricetid represented both in the snap-trap captures and in the marten scats. Siberian lemming was proportionately more abundant in the scats than in the snap-traps while meadow vole and northern bog lemming showed similar representation in the scats and in the traps (Table 12). Two species which were trapped but not identified in the scats were heather vole (Phenacomys intermedius) and long-tailed vole .icrotus longicaudis).

BLE 11 Number of Occurrences and Percent Frequency of Occurrence of Cricetid Food Items* In Marten Winter Scats, Evelyn Creek, 1980/81

FOOD ITEM	NOVEMBER n=16 #	%	DECEMBER n=10 #	%	JANUARY n=17 #	%	FEBRUARY n=5 #	%	MARCH n=14 #	%	TOTAL n=62 #	%
Red-backed vole (*Clethrionomys rutilus*)	14	88	9	90	15	88	5	100	13	93	56	90
…thern bog lemming (…ynaptomys borealis)									1	7	1	2
Meadow vole (*Microtus pennsylvanicus*)			1	10							1	2
Siberian lemming (*Lemmus sibiricus*)	4	25	1	10	1	6	1	20	1	7	8	13
TOTAL NO. OF FOOD ITEMS	18		11		16		6		15		66	

* unidentified prey remains proportioned between known species

TABLE 12 Comparison of Abundance of Cricetid Species From Snap-Trapping And Their Relative Occurrence in Marten Winter Scats at Evelyn Creek

SPECIES	% of Snaptrap Captures* Spring 1980 (n=48)	% of Snaptrap Captures* Fall 1980 (n=272)	% occurrence in 66 food items from 62 scats
Red-backed vole (Clethrionomys rutilus)	79	89	84.85
Heather vole (Phenacomys intermedius)	7	<1	-
Siberian lemming (Lemmus sibiricus)	4	2	12.12
Meadow vole (Microtus pennsylvanicus)	4	5	1.52
Northern bog lemming (Synaptomys borealis)	4	1	1.52
Long-tailed vole (Microtus longicaudis)	2	<1	-

* ...are, 1981

DISCUSSION

As a predator, the habitat which marten use is a function of the prey species present, their abundance and availability (More 1978) and the availability of resting and den sites. Prey availability is a difficult parameter to estimate and the significance of the availability of one food item is relative to the availability of alternate food sources.

In the Evelyn Creek area, marten apparently changed their food habits through the winter taking cricetids most frequently in the early and late winter while taking hare most frequently in the mid-winter, suggesting a change in the availability of the respective prey and a functional response by marten. Although numerous authors (McT. Cowan and MacKay 1950, Lensink et al 1955, Quick 1955, Murie 1961, Weckwerth and Hawley 1962, More 1978, and Pulliainen 1980a) have documented the consumption of red-backed voles and cricetids in general as a predominant food item by marten, the high consumption of hare as found in this study is not so common. Quick (1955) found a predominance of hare in marten winter scats in northern British Columbia, while other marten food habits studies in various regions of North America (Marshall 1946, McT. Cowan and Mackay 1950, Lensink et al 1955) estimated a relative abundance of hare within the study area but found little reflection of this abundance in the marten scats.

During 1980/81, varying hares in the south-eastern and south-central Yukon were at or very near their peak abundance in their population cycle (Gilbert pers. com.). In the Evelyn Creek study area the maximum relative abundance of varying hare recorded was 7.9 tracks/km-day. This value more than twice exceeds the abundance estimate of hare recorded in the Northwest Territories (Douglas et al 1976) yet is substantially less than the hare estimate of 21.48 tracks/km-day from the Upper Liard River Valley (Penner 1979). A large die-off of hares was recorded in the south-eastern Yukon Territory during February 1981 and the cause of death was starvation (Gilbert and Slough pers. com.). Although no hare carcasses were found in the Evelyn eek study area, the hares may have been eaten by marten as carrion or more probably their stressed and presumably inferior physical condition may have made them easily available to marten. Marten may have shown a functional response to hare. Other predators, notably coyotes (Canis latrans) have shown a functional response to a change in a hare population (Todd et al 1981).

Marten use of hare may have been underestimated in the scat analysis. Marten tend to take large prey (such as hare) to a concealed rest site where they will remain for a number of days, feeding and defecating within the subnivean site (Koehler and nocker 1977, Pulliainen 1980a). Any scats in these subnivean sites were not sampled during this study.

Some authors (Koehler and Hornocker 1977, More 1978) suggest that because of sexual dimorphism, only the larger males are able to capture hare. However, Pulliainen (1980a) found that both male and female marten were equally capable of capturing hares.

Red-backed vole was the most common cricetid species as a food item in the marten winter scats and it was correspondingly the most abundant cricetid trapped in the study area in the spring and fall (Beare 1981). Cricetid species which were less abundant in the study area (Beare 1981) were similarly represented by low occurrence in the marten scats.

Tetraonids occured in three percent of the marten winter scats. During the winter spruce grouse tend to feed in the upper sun crown of trees (Bryant and Kuropat 1980) while marten in the Evelyn Creek area were generally non-arboreal in their habits, climbing trees only on five known occassions throughout the tracking sessions. All tetraonid sign identified in the marten scats occurred in December, the coldest month with the least number of daylight hours. During the more extreme cold temperatures as in December, spruce grouse and ptarmigan roosted under the snow in kieppis for a number of days at a time and at these times would have been available to marten. The occurrence of birds in marten winter scats varies geographically and with a availability of this food item relative to other food items.

Pulliainen (1980a) conducted a four year study of marten food habits in Finland. Birds were most highly represented in the winter scats yet their occurrence varied between the years from <5% to as much as 35% occurrence. McT. Cowan and Mackay (1950) and Weckwerth and Hawley (1962) found marten preyed upon birds seasonally, in the spring and summer. Other studies, Marshall (1946) in Montana, Lensink et al (1955) in Alaska and Soutiere (1979) in Maine, found marten fed upon birds in the winter, occurring in <20% of the scats.

Carrion as moose was represented in two percent of the marten winter scats collected at Evelyn Creek. Other studies (Marshall 1946, McT. Cowan and Mackay 1950, Weckwerth and Hawley 1962 and Pulliainen 1980a) report the occurrence of carrion of cervids in varying proportions in marten winter scats.

No index of abundance or availability of over-wintering berries in the Evelyn Creek area is available. However, berries can represent a significant portion of a marten's winter diet (McT. Cowan and Mackay 1950, Murie 1961, Weckwerth and Hawley 1962, More 1978, Pulliainen 1980a). The vegetable matter that was found in the marten scats of Evelyn Creek was likely ingested incidentally. Quick (1955) suggested the incidental plant matter found in the marten scats was from the stomachs of the prey.

.lliainen (1980a) and More (1978) suggested that leaves, stems and needles are taken unintentionally and pass through the digestive tract of marten essentially unaltered.

No red squirrel was found in the marten winter scats although red squirrels were present in the study area. It is difficult to estimate winter squirrel abundance by their tracks as they remain in the subnivean during cold temperatures. Squirrels have been noted in marten winter scats in varying degrees of frequency of occurrence from 2% (Lensink et al 1955) to as much as 40% (Marshall 1946).

From the track-count results, marten apparently used the open black and white spruce vegetation type less than expected according to its availability. From following the tracks of marten, it was found that for most of the distance (86%), they travelled in the white and black spruce with fir type, they were hunting. In addition, the greatest density of marten subnivean access points, or digs (4.7 digs/km) was in this same spruce vegetation type. Varying hare used this same vegetation type of white and black spruce with fir significantly more than expected according to its availability.

The distribution of cricetids among the vegetation types during the winter is an uncertainty. Beare (1981) found a significant difference in the abundance of small mammal species among the vegetation types in the fall of 1980 but found no significant difference in the spring 1980 distribution.

The vegetation type of white and black spruce with fir where marten hunted predominantly and hare used more than expected, represents a mature vegetation community. The upper canopy cover is closed and the presence and predominance of regenerating 'balpine fir saplings suggests the community is approaching the ulimax stage of forest succession for the area. Shrub cover is diverse and well developed with well drained soil and a mesic moisture regime (Archibald 1980). The use by marten of mature, closed forest is well documented (Wooley 1974, Koehler and Hornocker 1977, More 1978, Pulliainen 1980b). Koehler and Hornocker (1977) defined the selected habitat of marten as having the following criteria; more than 30% tree canopy cover, older than 100 years and mesic.

Deadfall, saplings and decaying stumps, present within the vegetation type of white and black spruce with fir offered access to the subnivean for marten in quest of prey or a rest site.

..lliainen (1980b) and Steventon and Major (1982) found marten regularly accessed the subnivean by passive means (fallen or leaning trees protruding above the snow). Snow depth in the Evelyn Creek area was not a determining factor in whether passive or active means were employed by marten to access the subnivean. Stumps and deadfall below the snow level served as winter rest sites to the marten in the Evelyn Creek area. Other documented marten winter rest sites were below the snow (Pulliainen 1980b, Steventon and Major 1982). In addition, Pulliainen (1980b) and Steventon and Major (1982) found that marten would remain in a rest site for a number of days when supplied with a large amount .f food and the same marten or different individuals would use a .ite successively. Masters (1980) found four of five marten rest sites to be arboreal and postulated that the warm, late winter sun made the subnivean sites unfavourable to marten due to the dense, wet snow.

Although snow depth was shallowest in the white and black spruce with fir vegetation type, it cannot be ascertained if the snow depth differences influenced either marten activity or hare activity. Deep snow cover has been documented to affect marten habitat use (Lensink et al 1955, Koehler and Hornocker 1977). In Idaho, snow deeper than 208 cm apparently forced marten into different habitat (Koehler and Hornocker 1977).

In Alaska excessive snow in the mountains seasonally made food less available to marten and caused marten to move to sea level beach areas (Lensink et al 1955). Raine (1983) investigated marten winter habitat use and the role of snow cover, in southeastern Manitoba, and concluded that marten were influenced more by the availability of prey than by snow depth and as they never bellied out in the snow were likely not impeded by snow depth.

Marten have been described as opportunistic feeders (Weckwerth and Hawley 1962, More 1978, Pulliainen 1980a). Lensink (1953) believed that marten had no preference in their food source rather it was a matter of food availability. Our results of marten switching their food selection from cricetids to hare and back to cricetids within the five month winter period suggest that marten fed on that food source which was most readily available. Snow depth did not play any apparent major influential role in marten winter use of vegetation types at Evelyn Creek nor affect how they accessed (passive or active) subnivean sites. That vegetation type which varying hare used more than expected according to the type's availability was also where marten hunted predominantly.

SUMMARY

1. Marten used the open black spruce with white spruce vegetation type (#5) less than expected according to its availability and used the white and black spruce with subalpine fir type (#4) predominantly for hunting.

2. Marten use of vegetation types was not affected by snowdepth. There was no significant difference in snow depth between active and passive digs.

3. Marten tracks were followed for a total of 33 km, in which marten were hunting for 60% of the distance. Digs occurred at a density of 2.04 digs/km of marten tracks followed. Marten accessed the subnivean area predominantly (86%) through passive means using saplings, branches or deadfall which protruded above the snow.

4. Marten fed predominantly on varying hare and cricetids, particularly red-backed voles. Marten apparently switched their prey selection throughout the winter. In early winter cricetids occurred most frequently in the marten scats while in mid-winter hare occurred most frequently and in late winter cricetids again occurred most frequently in the scats.

Varying hare were abundant in the study area. Hare used the white and black spruce with fir type (#4) more than expected according to the type's availability and used both the pine and the fir types (#1 and #2 respectively) less than expected. Red squirrels were present in the study area yet track-counts may not lend themselves well to an accurate population estimate due to the winter habits of squirrels. Grouse and ptarmigan were present in the study area yet only locally and temporally abundant.

LITERATURE CITED

Archibald, W. R. 1978. Marten study proposal. Yukon Wildlife Branch. 10 p.

Archibald, W. R. 1980. Marten progress report #2. Yukon Wildlife Branch. 30 p.

Archibald, W. R. and R. H. Jessup. 1981. Marten progress report #3. Yukon Wildlife Branch. 20 p. plus tables.

Archibald, W. R. and R. H. Jessup. 1982. Population dynamics of the Pine Marten (Martes americana) in the Yukon Territory. Yukon Resources Planning and Management Branch.

Archibald, W. R. and W. Olson. 1978. 1976/77 fur report. Yukon Wildlife Branch. 5 p.

Beare, S. S. 1981. Diversity and habitat selection of small mammals in southern Yukon. Progress Report #2. Prepared for Yukon Wildlife Branch. 21 p.

Bryant, J. P. and P. J. Kuropat. 1980. Selection of winter forage by subarctic browsing vertebrates: the role of plant chemistry. Ann. Rev. Ecol. and System. Vol. II. 261-286.

Douglas, R. J., L. Fisher and M. Mair. 1976. A study of furbearers with particular reference to marten (Martes americana) at Chick Lake, N.W.T. Unpublished manuscript by Renewable Resources Consulting Services, Edmonton. 44 p.

Hulten, E. 1968. Flora of Alaska and neighboring territories. A manual of the vascular plants. Stanford University Press, California. 1008 p.

Jessup, R. H. 1981. 1980/81 fur harvest report. Yukon Resources Planning and Management Branch.

Jessup, R. H. and B. Slough. in prep. Marten progress report. Yukon Resources Planning and Management Branch.

Johnson, D. H. 1980. The comparison of usage and availability measurements for evaluating resource preference. Ecol. 6 (1): 65-71.

Johnston W. G. and C. A. McEwen. in prep. Observations of birds overwintering in the south-central Yukon Territory.

Koehler, G. M. and M. G. Hornocker. 1977. Fire effects on marten habitat in the Selway-Bitteroot Wilderness. J. Wildl. Manage. 41: 500-505.

Lensink, C. J. 1953. An investigation of the marten in interior Alaska. MSc. Thesis. University of Alaska. 89 p.

Lensink, C. J., R. O. Skoog and J. L. Buckley. 1955. Food habits of marten in interior Alaska and their significance. J. Wildl. Manage. 19: 364-368.

McT. Cowan, I. and R. H. Mackay. 1950. Food habits of the marten (<u>Martes americana</u>) in the Rocky Mountain region of Canada. Can. Field Nat. 64: 100-104.

Marshall, W. H. 1946. Winter food habits of the pine marten in Montana. J. Mammal. 27: 83-84.

Masters, R. D. 1980. Daytime resting sites of 2 Adirondack, New York, U.S.A. pine marten, <u>Martes americana</u>. J. Mammal 61(1): 157

More, G. 1978. Ecological aspects of food selection in pine marten (<u>Martes americana</u>). MSc. Thesis University of Alberta.

Murie, A. 1961. Some food habits of the pine marten. J. Mammal. 42: 516-521

.u, C. W., C. R. Byers and J. M. Peek. 1974. A technique for analysis of utilization - availability data. J. Wildl. Manage. 38(3): 541-545.

Penner, D. F. 1979. Furbearer studies in the Liard River valley, British Columbia. Prepared for Britsh Columbia Hydro and Power Authority by McCourt Management Ltd. 121 p.

Pruitt W. O. 1965. The ecology of snow. Canadian Society of Wildlife and Fishery Biologists, Occassional Papers No. 1. 8 p.

ulliainen, E. 1980a. Food and feeding habits of the pine marten in Finnish forest Lapland in winter. Varrio Subarctic Research Station, Report No. 109. 31 p.

Pulliainen, E. 1980b. Winter habitat selection, home range and movements of the pine marten in Finnish Forest Lapland. Varrio Subarctic Stn., Report No. 110. 31 p.

Quick, H. F. 1955. Food habits of marten (Martes americana) in northern British Columbia. Can. Field Nat. 69: 144-147.

..ine, R. M. 1983. Winter habitat use and responses to snow cover of fisher (Martes pennanti) and marten (Martes americana) in southeastern Manitoba. Can. J. Zool. 61: 25-34.

Rowe, J. S. 1972. Forest regions of Canada. Dept. of Environ. Can. For. Serv. Publ. No. 1300. Ottawa.

Soutiere, E. C. 1979. Effects of timber harvesting on marten in Maine. J. Wildl. Manage. 43: 850-860.

Steventon J. D. and J. J. Major. 1982. Marten use of habitat in a commercially clear-cut forest. J. Wildl. Manage. 46(1): 175-182.

Todd, A., L. B. Keith and C. A. Fisher. 1981. Population ecology of coyotes during a fluctuation of snowshoe hares. J. Wildl. Manage. 45(3): 629-640.

Weckwerth, R. P. and V. D. Hawley. 1962. Marten food habits and population fluctuations in Montana. J. Wildl. Manage. 26: 5-74.

Wooley, D. R. 1974. A study of marten (Martes americana) in the Mackenzie District, N.W.T. IN: Studies of furbearers associated with proposed pipeline routes in the Yukon and Northwest Territories. R. A. Ruttan and D. R. Wooley (eds.). Arctic Gas Biological Report Series Vol. 9. 1-33.

Youngman, P. M. 1975. Mammals of the Yukon Territory. National Museums of Canada, Publications in Zoology, No. 10, Ottawa. 192 p.

APPENDIX 1 Sampled Density of Quamaniqs and Their Density by Marten Use Among the Vegetation Types, Evelyn Creek

	SAMPLED		OBSERVED USE BY MARTEN	
VEGETATION TYPE	DISTANCE SAMPLED(dm)	DENSITY (mean # quam./dm)	DISTANCE TRAVELLED(dm)	DENSITY (mean # quam./dm)
1	20	1.05	822	.12
1a	30	.13	112	0
2	15	1.53	21	0
3	15	1.25	323	.12
4	30	1.27	676	.37
5	30	.73	684	.11
6	-	-	-	-
POOLED		0.99		.12

APPENDIX 2 Number of Occurrences and Percent Frequency of Occurrence of All Items Identified in 116 Marten Winter Scats, Evelyn Creek, 1980/81

	November		December		January		February		March		Overall	
FOOD ITEM	n=23		n=13		n=44		n=15		n=21		n=116	
	#	%	#	%	#	%	#	%	#	%	#	%
LEPORIDAE												
Lepus americanus	6	26.1	3	23.1	24	54.5	9	60	8	38.1	50	43.1
CRICETIDAE (total)	(18)	(78.3)	(12)	(92.3)	(16)	36.4	(6)	(40)	(14)	(66.7)	(66)	56.9
Clethrionomys rutilus	12	52.2	6	46.2	10	22.7	5	33.3	9	42.9	42	36.2
Lemmus sibiricus	4	17.4	1	7.7			1	6.7			6	5.2
Microtus pennsylvanicus			1	7.7							1	0.9
naptomys borealis									1	4.8	1	0.9
Cricetid unident.	2	87.0	4	30.8	6	13.6			4	19.0	16	13.8
CARRION												
Alces alces							1	6.7	1	4.8	2	1.7
AVIAN (total)			(3)	(23.1)							(3)	(2.6)
Tetraonidae			2	15.4							2	1.7
Avian unident.			1	7.7							1	0.9
Plant (total)	(2)	(8.7)	(3)	(23.1)	(7)	(15.9)	(1)	(6.7)	(3)	(14.3)	(16)	(13.8)
Graminae					1	2.3			1	4.8	2	1.7
Bryophyte	1	4.3	1	7.7							2	1.7
Needles of Picea & Abies	1	4.3			2	4.5	1	6.7	1	4.8	5	4.3
Woodchips					1	2.3					1	0.9
·getable unident.			2	15.4	3	6.8			1	4.8	6	5.2
BLOOD	1	4.3	1	7.7	6	13.6	2	13.3	1	4.8	11	9.5
TOTAL NO. OF FOOD ITEMS	27		22		53		19		27		148	