MARTEN MANAGEMENT AND RESEARCH

IN THE NWT, 1988-89

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ABSTRACT

This report summarizes marten harvest trends, and management and research programs conducted in the NWT during 1988-89. Details on marten carcass collections and a live-trapping study conducted by the Regional Biologist in Ft. Smith will be reported elsewhere.

The marten harvest in the NWT increased 28% between 1986-87 and 1987-88 to 37,249 pelts, the highest level recorded in over 100 years. In 1987-88, average pelt price was $106. Figures for the 1988-89 season are not yet available.

A total of 548 entire marten carcasses were collected from trappers in Ft. Good Hope and Ft. Rae, in order to: 1) examine age and sex ratios in the harvest to assess trapping intensity, 2) examine body condition and reproductive parameters and compare animal size between areas, and 3) develop effective methods to separate juveniles from older animals, and differentiate sex if heads alone are collected. One hundred and twenty heads were also collected from martens taken by Ft. Good Hope trappers near Tunago Lake.

Juveniles comprised 53 and 64% of the Ft. Good Hope and Ft. Rae carcass sample, respectively. Respective juveniles per 2+ year old female ratios were 5.82 and 6.61, and males per female ratios were 1.56 and 1.27. These ratios indicate moderate, but not necessarily heavy, trapping pressure. Lower juveniles:2+ female ratios and males:female ratios (1.18) for the head sample indicate relatively heavier trapping pressure in that area.

Body condition (as determined by fat content) did not differ between areas. Pregnancy rates and reproductive counts (number of corpora lutea in ovaries) were higher in Ft. Good Hope females, and are among the highest reported (93-98% pregnant, 3.9-4.3 corpora lutea per pregnant female). Ft. Good Hope martens were generally heavier and had larger skulls than martens from Ft. Rae.

Skull length was the most reliable measurement for determining sex from head samples; males had skulls longer than 83.0 mm for Ft. Good Hope martens and 82.5 mm for Ft. Rae animals. Use of the ratio of pulp cavity to tooth width in lower canines (as determined from radiographs) correctly identified 94-100% in each sex and age (0 and 1+) class. The technique to determine age class by measuring length of temporal muscle coalescence has some potential, but requires further testing.

A live-trapping and tagging study to examine marten density and prey availability at Stump Lake, northeast of Ft. Good Hope, was conducted in September 1988 and June 1989. Five martens were captured in 1988 and six were trapped in 1989, including two adults recaptured from the previous fall. Density of martens on the study area was 0.4-0.5/km^2. Vole numbers (as indexed by snap-trapping) were 8-10 times greater in the fall than in the spring. Further intensive research on martens in the Sahtu District will shift to a study area closer to Norman Wells.

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INTRODUCTION

Martens (Martes americana) are the single most valuable furbearing resource to trappers in the Northwest Territories (NWT). Martens are readily trapped, have relatively restricted home ranges, and pelt prices are high, making the species vulnerable to overharvest. Recent harvests have reached the highest recorded in over 100 years. Continuing high pelt prices ensure that pressure on marten stocks will remain intense for the foreseeable future. If trapping pressure is too great, large portions of the range may be depleted of marten, with recovery to healthy numbers often taking years.

Given these factors, it is imperative that NWT marten populations be monitored closely and managed wisely. This annual report will summarize marten harvest trends, and management and research programs conducted during the past year. It is hoped that this report will be of use to Department of Renewable Resources (DRR) staff, trappers, and other parties interested in responsible use and management of martens in the NWT. Marten studies conducted by Ron Graf, Regional Biologist in Ft. Smith, including carcass collections and the South Slave live-trapping study, will be reported elsewhere.

The following areas of study will be covered in this report:

1. Harvest trends.
2. Carcass collections conducted primarily to:
   a) examine age and sex ratios in the harvest,

b) provide body and reproductive condition indices, and morphometric comparisons, and

c) examine techniques for rapidly determining carcass age class.

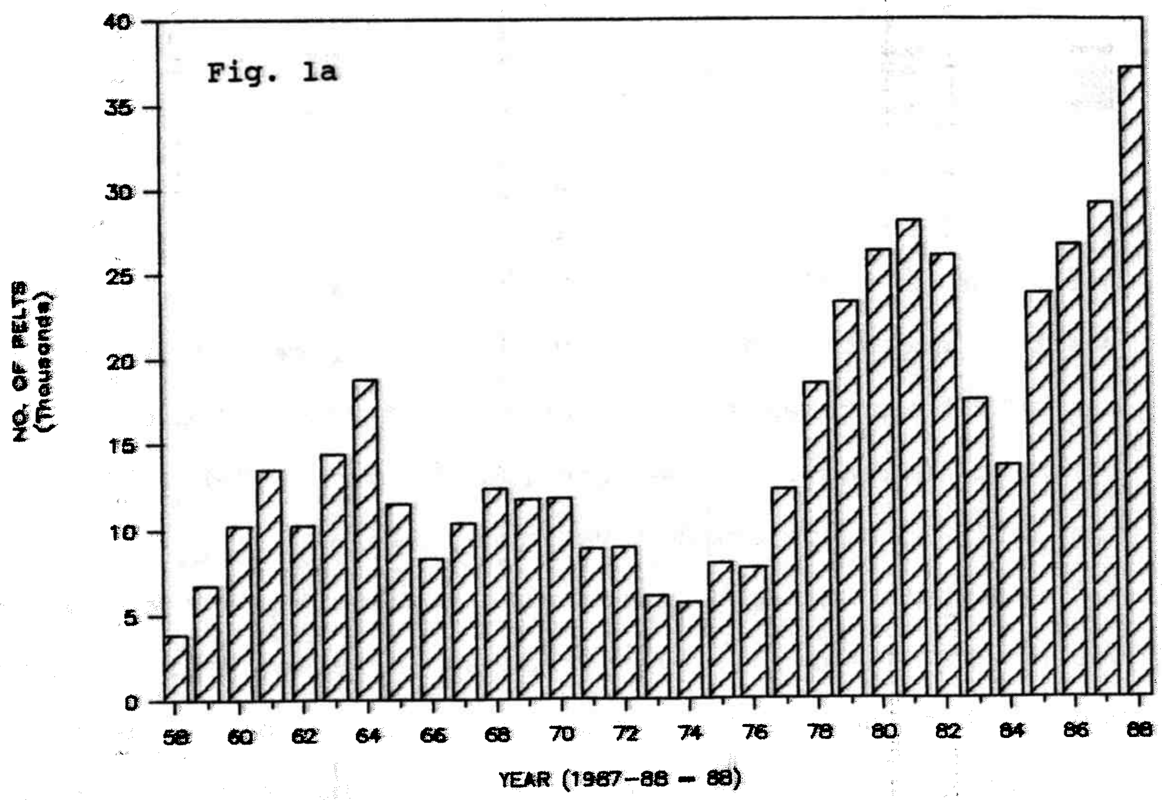
3. Stump Lake marten study to examine marten density and prey availability.

MARTEN HARVEST

During 1987-88, 514 out of 3000 trappers in the NWT sold marten pelts, and harvested 37,294 pelts worth $3,958,000. This was the largest number of martens taken since the 1850s. Marten harvests have remained high for much of the past decade (Fig. 1a), and increased 28% between 1986-87 and 1987-88. Figures for the 1988-89 season are not yet available.

Harvests in recent years were concentrated throughout the western NWT (Table 1). The greatest increases in harvest have been in the Inuvik, Ft. Simpson, Ft. Smith and Ft. Liard areas.

The average price of a marten pelt increased during the late 1970s and increased again in the late 1980s to peak at $110 in the 1986-87 season (Fig. 1b). The average pelt price for the 1987-88 season was $106. Marten pelt prices dropped 15-20% during 1988-89.



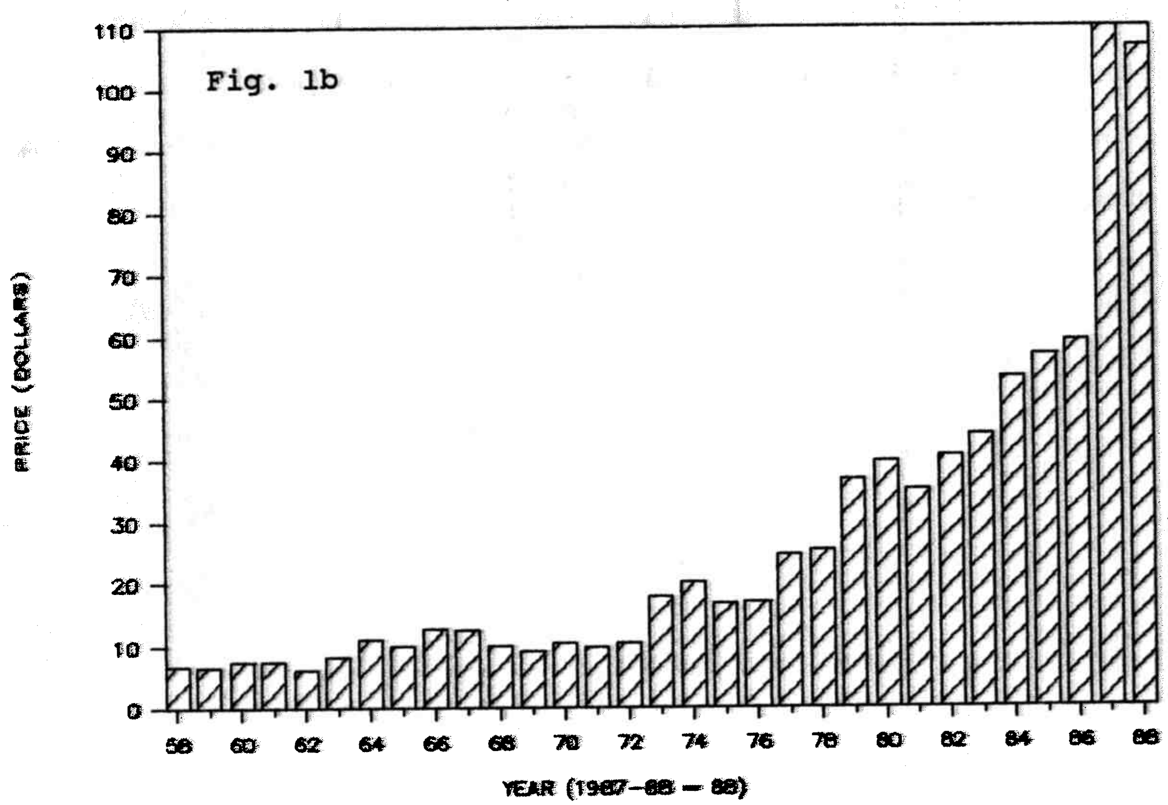


Figure 1. Marten harvest (Fig. 1a) and average pelt price (Fig. 1b) for the NWT, 1957-58 to 1987-88.

Table 1. NWT marten harvest from fur returns for 1986-87 and 1987-88.

Community	1986-87	1987-88	% Change
Aklavik	353	472	+ 34
Arctic Red R.	571	669	+ 17
Colville Lake	1394	1282	- 8
Ft. Franklin	2661	2332	- 12
Ft. Good Hope	2349	2793	+ 19
Ft. McPherson	1088	1583	+ 45
Ft. Norman, N Wells	1168	1479	+ 27
Inuvik	616	1201	+ 95
Tuktoyaktuk	607	778	+ 28
Paulatuk	146	116	- 21
Dettah	91	264	+190
Ft. Liard	2094	3693	+ 76
Ft. Providence	1002	1312	+ 31
Ft. Rae	2599	3316	+ 28
Ft. Reliance	19	67	+253
Ft. Resolution	606	637	+ 5
Ft. Simpson	1534	3448	+125
Ft. Smith	444	919	+107
Hay River	739	854	+ 16
Jean Marie R.	96	230	+140
Kakisa L.	412	350	- 15
Lac La Martre	1285	1005	- 22
Nahanni Butte	280	396	+ 41
Pine Point	68	66	- 3
Rae Lakes	1469	1494	+ 2
Snare L.	329	298	- 9
Snowdrift	977	1587	+ 62
Trout L.	1804	1943	+ 8
Yellowknife	704	601	- 15
Wrigley	1445	1698	+ 18
Tungsten	37	0	-
Alta/Sask Trappers	44	362	-
Other	22	4	-
Total NWT	29045	37249	+ 28

CARCASS COLLECTIONS

Introduction

During the 1988-89 trapping season, marten carcass collections were initiated in several areas in the NWT. Ron Graf, Regional Biologist in Ft. Smith, collected approximately 480 carcasses from Trout Lake, Ft. Resolution and Ft. Smith; data from his sample will be reported elsewhere. This paper deals with a collection of 548 entire carcasses and 120 heads from Ft. Good Hope and Ft. Rae trappers.

The purpose of this collection was several-fold:

1. Because of differences in vulnerability to trapping between males and females and between juveniles and adults, age and sex ratios of harvested animals provide an indication of trapping intensity on a marten population (Strickland and Douglas 1987). Because of seasonal variation in the relative proportion of age and sex classes of martens harvested, the entire harvest from a trapper or area must be examined. Carcass examination can also document the chronology of age and sex classes in the harvest, that is, which classes tend to be taken more frequently at which time of the season.
2. Examination of carcasses provides a comparison of marten body condition (using fat indices) and reproductive parameters among martens from various areas. Examination of

body and skull size will also determine if morphometric differences exist among NWT martens and to what extant. Pelt prices vary considerably from area to area in the NWT, likely as a result of differences in pelt size, colour and/or quality.

3. Rapid and cost-effective techniques are needed to separate juvenile (young-of-the-year) from older age classes, and determine sex (if heads alone are collected), so that large samples of carcasses may be processed. Several methods to identify the juvenile age class have been proposed (summarized in Strickland and Douglas 1987), and two of them will be examined here. Radiographs have been used to determine the percentage of pulp cavity in marten canines. Little or no overlap between juveniles and older animals has been reported (Dix and Strickland 1986, Nagorsen et al. 1988). The degree of coalescence of the temporal muscle on the top of the skull has also been suggested as an inexpensive and effective technique to distinguish between juveniles and adults (Magoun et al. 1989).

If heads alone are collected, a method to determine sex is needed. Martens are sexually dimorphic, and skull measurements of males are on average greater than females (Brown 1983). Three measurements will be examined for use as criteria to identify sex from heads alone; canine tooth width and root length (Brown 1983), and total skull length (Magoun et al. 1989).

Methods

With the assistance of DRR staff in Ft. Good Hope and Ft. Rae, cooperative trappers with a history of high marten harvests were provided with carcass tags, and were asked to tag all martens harvested, noting location and date taken. Trappers were asked to turn in their entire season's catch so that the complete chronology of age and sex over the trapping season would be obtained. A sample of 120 heads, representing undated harvests covering the period from late October to early December, was collected from two trappers based at Tunago Lake east of Ft. Good Hope; these will be referred to as the "head sample". A total of 548 carcasses (the "carcass sample") was collected from Ft. Good Hope (414 carcasses from five trappers, including a trapper based at Tunago Lake) and Ft. Rae (134 carcasses from two trappers).

Carcasses were examined in Yellowknife. Sex, body and tail length, weight, and fat indices (weight of fresh omental fat over fresh weight [minus stomach contents] of skinned carcass) (Buskirk and Harlow 1989) were recorded. Skinned carcass weight approximates 83% of whole body weight (Strickland and Douglas 1987). Stomach contents were weighed and frozen for later examination.

For the first third of the carcasses examined, martens with no obviously visible omental fat were assigned 0 g as the fat weight. This was subsequently changed to 0.5 g based on an examination of martens with no obvious omental fat for which omentum weight was obtained. In addition, in this first group both omental and perirenal fat were combined as fat weight; this was corrected to only omental fat weight by multiplying total fat by 0.63, the average ratio of omental fat to omental and perirenal fat measured from a sample of 30 martens.

Ovaries from carcass sample females judged to be 1 year or older (based on temporal muscle coalescence; Magoun et al. 1989) were stored in 70% alcohol, and subsequently soaked in water overnight, sectioned by freeze-microtome, and stained using Masson's trichrome. Corpora lutea counts were used to assess ovulation rates and litter size in serially sectioned ovaries (Strickland and Douglas 1987). Counts were conducted by two technicians both before and after staining.

Total skull length (measured below lambdoidal crest to top of incisors), zygomatic width at widest point, and length of temporal muscle coalescence (from below lambdal crest to the point where the temporal muscles join [Magoun et al. 1989]) were measured with callipers to the nearest 0.1 mm. The temporal muscle is on the top of the skull adjacent to the sagittal crest; length of temporal muscle coalescence approximates length of sagittal crest (Magoun et al. 1989). Fourteen (2.6%) of the skull lengths and 29 (5.3%) of the temporal muscle lengths were unreadable because of crushed or bloodied skulls. Skull and temporal muscle measurements were not conducted on martens in the head sample.

All lower canines were extracted by simmering lower jaws in hot water for 30-40 minutes, and tooth width and root length were measured with callipers to the nearest 0.1 mm (Dix and Strickland 1986). Following procedures outlined in Dix and Strickland (1986), the ratio of pulp width:tooth width (percent pulp) in lower canines, as determined from radiographs, was examined to determine the dividing point for separating juveniles (≤12 months) from adults (>12 months). Radiographs were taken at the Bowspringer Veterinary Clinic, using Dupont Cronex Par-speed XB film, exposed at 50Kv for 0.4 seconds (head sample), and at the Stanton Yellowknife Hospital using a Senograph 600T Mammo Unit and Cronex 7 film exposed at 36 Kv and 7 Mas (carcass sample). Tooth width and pulp cavity were measured in a dissecting scope equipped with a micrometer eyepiece. Thirteen (2.4%) of the tooth images on the radiographs were unreadable.

All teeth from the head sample were radiographed to determine percent pulp cavity and aged by cementum analysis of the lower canines by Matson's Laboratory in Milltown, MT. All canines from the carcass sample were also radiographed, but only teeth with less than 50% pulp cavity were sent to Matson's for aging; teeth from animals with greater than 50% pulp cavity were assumed to be juveniles. This division was a conservative figure based on the results of the Tunago Lake head sample and published literature (see Results and Discussion).

Determination of the most reliable technique to determine sex from samples of heads only was examined by discriminant function analysis. The distance between the populations (calculated by dividing the difference between the sample means by the mean standard deviation [Snedecor and Cochran 1967:415]) was used to judge which variable had the highest degree of accuracy in classification. This value must exceed 3.0 for a high degree of accuracy. The SAS-DISCRIM procedure (SAS 1988) produced a generalized squared distance between groups that also approximated this distance (Snedecor and Cochran 1967:415), and provided error count estimates. Skull length, canine width and canine root length were examined. Dividing points to separate sexes in each sample were derived from the formula of Dix and Strickland (1986):

$$D = \overline{x}_a + (\overline{x}_b + \overline{x}_a)(SD_a)/SD_b + SD_a$$

where SD = standard deviation of each group, $\overline{x}$ = mean of each group, and $\overline{x}_a < \overline{x}_b$.

Dividing points for separating age classes (juveniles from older) were calculated for percent pulp cavity. Length of coalescence of temporal muscles (non-normal data) was plotted by sex and community to examine the relationship to age.

In this report age class "0" (juvenile) denotes martens in their first winter of life; yearling martens (in their second winter of life) are designated by age class "1". Statistical significance is at the $\underline{P} \leq 0.05$ level.

Results

All but nine of the martens examined were taken before Christmas. Since many trappers did not return to their traplines in the new year and one moved to a new area, these represented their entire sample for their initial trapping area. However, some carcasses from martens taken by two of the Ft. Good Hope trappers who returned to their traplines after Christmas were destroyed by wolverines (Gulo gulo). The nine carcasses from the post-Christmas sample were in poor shape, and were removed from some of the analyses.

The majority of the martens taken in both areas were juveniles (Figs. 2, 3), making up 53 and 64% of the Ft. Good Hope and Ft. Rae samples, respectively. The oldest marten was 10 years of age. Age and sex ratios from the carcass sample showed remarkable consistency within areas (Table 2). Age and sex ratios for the head sample from Tunago Lake trappers were derived by discriminant function analysis using canine width and root length from the sample of carcasses taken from Tunago Lake (see further), and indicate relatively lower ratios of juveniles:adult female and males:female (Fig. 4, Table 2).

The marten harvest in the Ft. Good Hope area was spread fairly evenly between 25 October and early December (Table 3). Age and sex in the harvest varied by 1-week period, but no

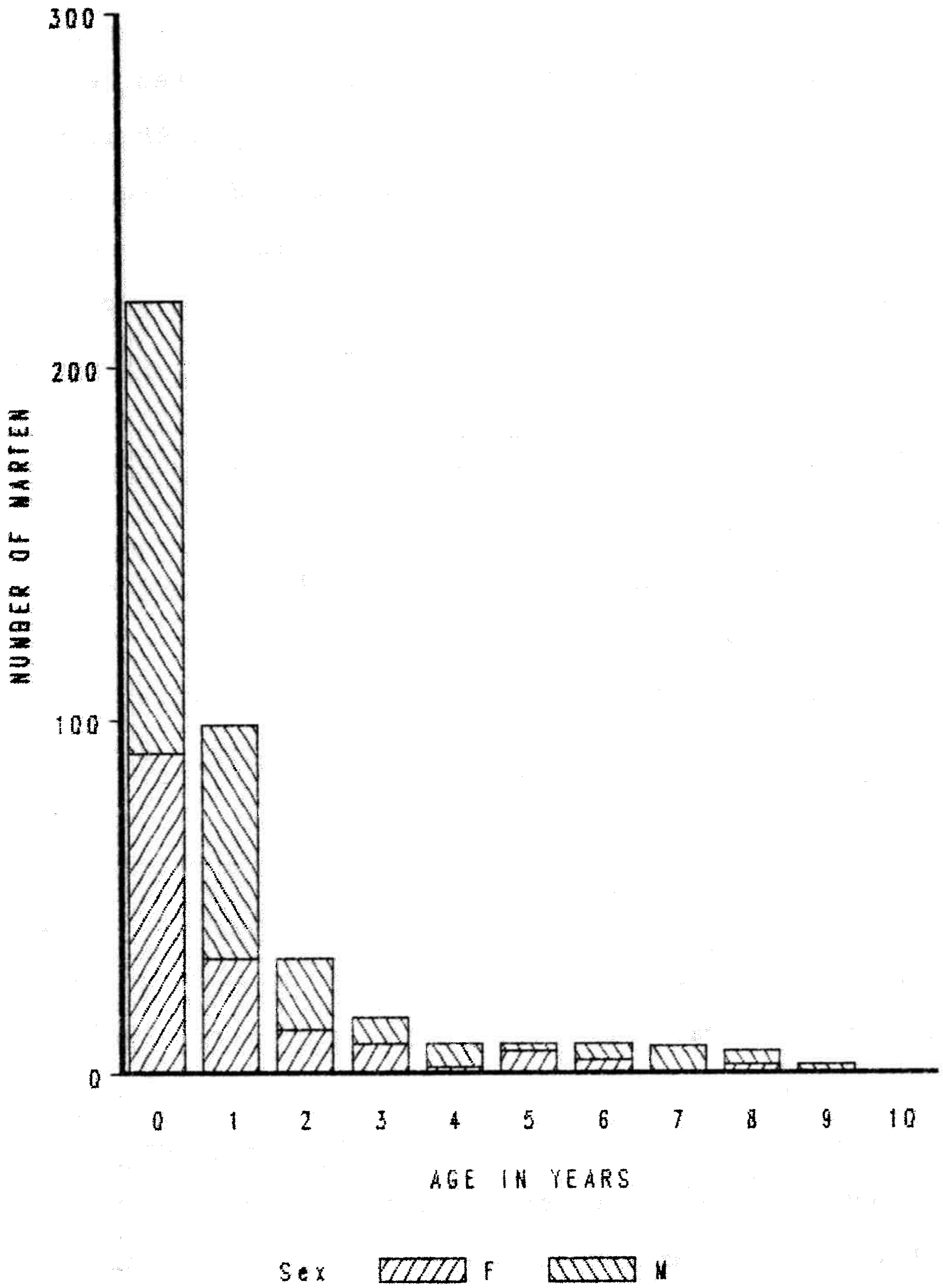


Figure 2. Age and sex of marten carcasses from Ft. Good Hope, 1988-89.

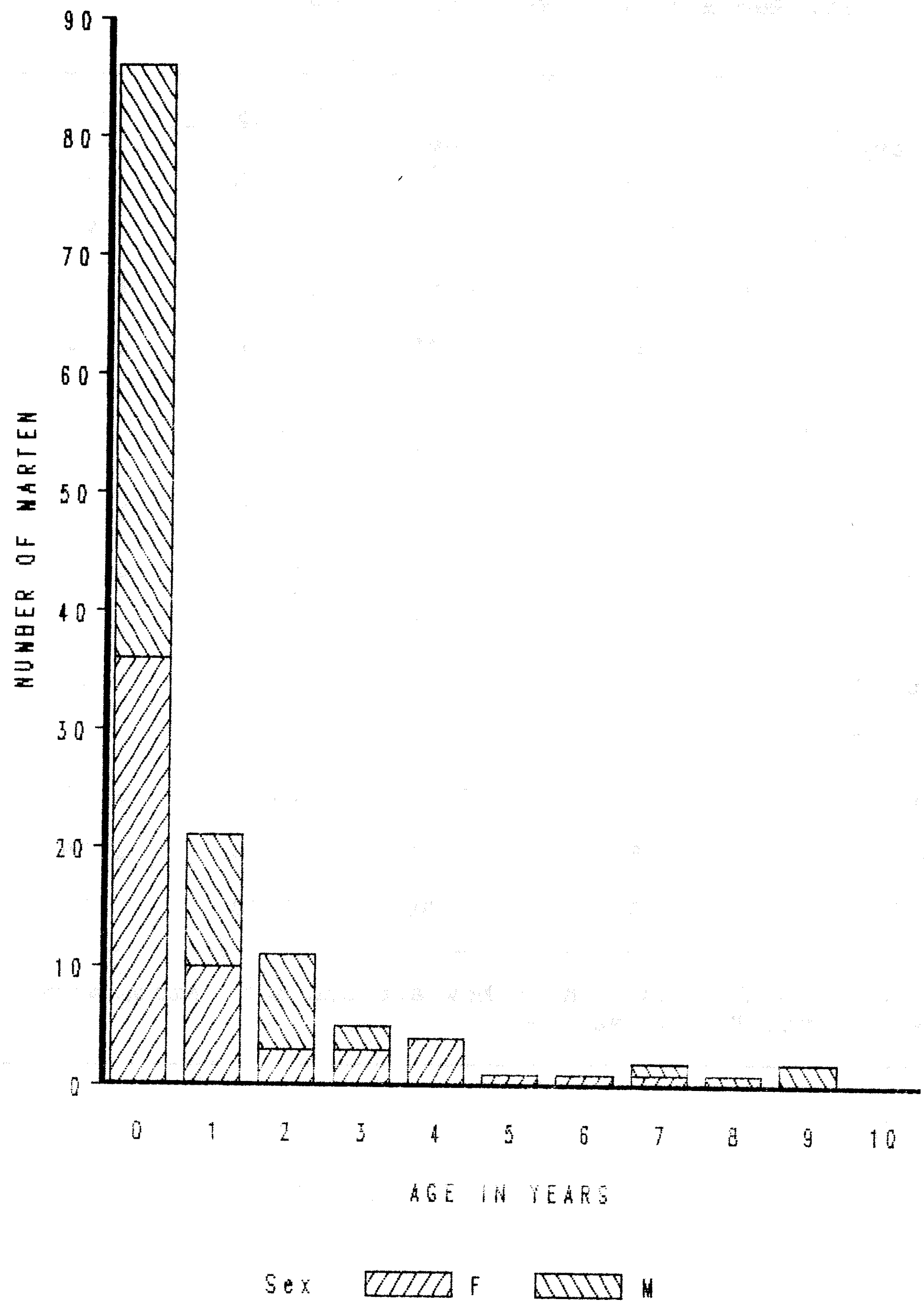


Figure 3. Age and sex of marten carcasses from Ft. Rae, 1988-89.

Table 2. Age and sex ratios from marten carcasses from Ft. Rae and Ft. Good Hope trappers.[1]

Community/ Trapper	Sample Size	Ratios Juv: 1+ Fem	Juv: 2+ Fem	Male: Fem
Ft. Rae - All	134	3.74	6.61	1.27
Trapper A	44	4.57	5.33	1.32
Trapper B	90	3.38	7.71	1.25
Ft. Good Hope All Carcasses	414	3.11	5.82	1.56
Trapper A	60	3.27	5.14	1.95
Trapper B	114	2.84	6.00	1.85
Trapper C	80	3.21	4.50	1.22
Trapper D	89	3.43	6.86	1.34
Trapper E	57	3.20	6.40	1.49
All Heads	120	1.79	3.71	1.18
"Head A"	86	1.76	3.36	1.26
"Head B"	34	1.88	5.00	1.00

[1] See text for description of how age and sex ratios were derived for the "head" sample.

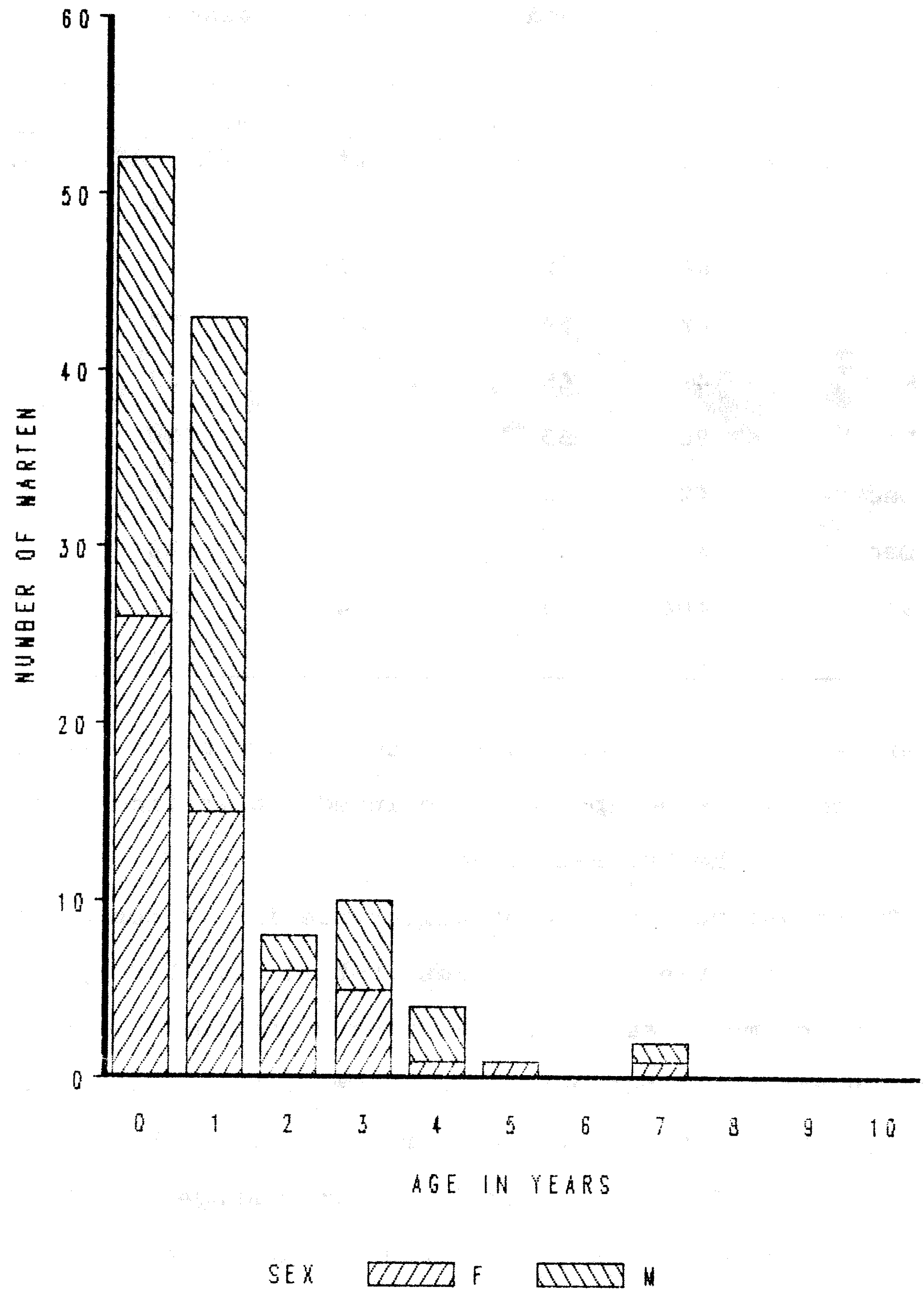


Figure 4. Age and sex of marten heads collected from Tunago Lake area, 1988-89.

Table 3. Age and sex ratios in the harvest by 1-week periods, Ft. Good Hope, 1988-89 season.

		Percent of harvest			Male:
1-week period	n	0 year	1 year	2+ year	Fem
28 Oct	27	70	15	15	1.25
04 Nov	89	52	27	21	1.02
11 Nov	63	59	24	27	1.86
18 Nov	49	65	12	22	2.06
25 Nov	80	55	25	30	1.42
02 Dec	42	40	24	36	2.00
09 Dec	54	50	30	20	2.00
Total	404	53	24	24	1.54

pattern was readily discernable. Small sample size and a harvest centred on two 1-week periods precluded examination of the chronology of the Ft. Rae harvest.

There was no significant difference in fat content by age and sex class between communities (t-test, all $P>0.4$)(Table 4). Combining communities, there was also no difference in the fat index by age class between sexes (t-test, all $P>0.1$). However, juveniles had significantly higher fat indices than 1 and 2+ adults (ANOVA, $P<0.002$, Duncan's Multiple Range Test).

When corpora lutea counts were conducted before and after staining on a sample of 49 pairs of ovaries, only three counts differed after staining (two decreased and one increased).

Table 4. Fat index (ratio of omental mass to skinned carcass weight X 100) by community.

Sex/ Community	Age Class (n)		
	Age 0	Age 1	Age 2+
Male			
Ft. Good Hope	0.25 (115)	0.12 (59)	0.15 (56)
Ft. Rae	0.24 (50)	0.11 (11)	0.17 (14)
Female			
Ft. Good Hope	0.32 (87)	0.11 (25)	0.16 (34)
Ft. Rae	0.25 (36)	0.14 (10)	0.18 (13)

Therefore, staining was not conducted on the final 20 pairs examined.

Although Ft. Good Hope martens had higher mean corpora lutea counts per pregnant female in both yearling and 2+ age classes than females from Ft. Rae, the differences were not significant (t=test, $\underline{P}>0.05$) (Table 5). Small sample sizes from Ft. Rae martens may have masked real differences. After combining the data from both communities, mean corpora lutea counts were significantly higher in 2+ females (4.41) than in yearlings (3.92)(t-test, $\underline{P}=0.01$). Pregnancy rates were similar between yearlings and 2+ females, with only one female in each age class not pregnant (Table 5). See Discussion for comments on the corpora lutea counts in ovaries from juvenile martens.

Marten carcasses from the Ft. Good Hope area were heavier than carcasses from Ft. Rae in all age and sex classes (Table 6).

Table 5. Mean counts of corpora lutea (CL) and percentage of females pregnant by age class of martens, Ft. Good Hope and Ft. Rae, 1988-89.

Comm.	Age Class	No. Fem Examined	Percent Pregnant	Mean CL Per Preg Fem	Mean[2] Fecundity
Ft. GH	0	1	0	-	-
	1	20	95	3.95	3.75
	2+	31	100	4.52	4.52
Total	≥1	51	98	4.30	4.22
Ft. Rae	0[1]	4	50	4.00	2.00
	1	5	100	3.80	3.80
	2+	9	89	4.00	3.56
Total	≥1	14	93	3.92	3.64

[1] Note that two of the four juveniles (cementum age = 0) had CL, giving doubts as to their actual age. See text for further comments.

[2] Mean fecundity = mean CL per pregnant female X pregnancy rate.

Significant differences were detected in adult (2+) males and in 0- and 1-year-old females. Adults (both males and females) 2+ years generally weighed more than 0 and 1 age class animals (Table 6). Yearling females weighed on average slightly less than juvenile females, while juvenile males weighed significantly less than yearlings.

Juvenile skull measurements (total length and zygomatic width) were shorter than those from older age classes in all cases, significantly so in most groups (Table 7). Skull

Table 6. Marten body weight (fresh weight of skinned carcasses in grams) by age and sex class.[1]

Sex/Age Class	Ft. Good Hope			Ft. Rae			
	n	Mean	SD	n	Mean	SD	P
Male							
Age 0	115	892 A	95.6	50	887 A	107.6	ns
Age 1	59	978 B	75.2	11	958 B	69.5	ns
Age 2+	56	1051 C	83.5	14	966 B	77.5	0.001
Female							
Age 0	88	659 A	77.6	36	626 A	71.3	0.03
Age 1	27	657 A	52.8	10	620 A	26.5	0.01
Age 2+	34	696 B	43.0	13	665 A	62.2	ns

[1] ANOVA tests on all age classes by sex were significant (all $P<0.02$), except Ft. Rae females ($P=0.15$). Among age classes, means with same letter are not significantly different (Duncan's Multiple Range Test). P values compare communities by age and sex class (t-test, ns = not significant).

measurements from martens from Ft. Good Hope were larger than those from Ft. Rae in most sex and age group comparisons (Table 7). Significant differences in marten skull length between communities were found only in 2+ males and juvenile females, and all female age classes for zygomatic width.

Comparisons of criteria used to distinguish sex were analyzed by community to account for differences between areas. In both communities, skull length had a higher degree of accuracy for determining sex (mean distance between sexes 4.05), followed by canine width (mean 3.81) and root length (mean 3.30). Error

Table 7. Skull length and zygomatic width (mm) of martens from Ft. Good Hope and Ft. Rae, by age and sex class.

Sex/ Age Cl	Ft. Good Hope n	Mean	SD	Ft. Rae n	Mean	SD	P
Skull Length							
Male							
Age 0	127	86.8 A	2.03	44	86.9 A	2.14	ns
Age 1	66	88.5 B	2.46	11	87.5 A	1.74	ns
Age 2+	57	88.6 B	2.20	13	87.3 A	1.16	0.006
Female							
Age 0	90	79.0 A	1.91	33	78.0 A	2.50	0.02
Age 1	33	80.0 B	1.62	9	80.0 AB	1.65	ns
Age 2+	38	79.8 B	1.21	11	79.1 B	1.52	ns
Zygomatic Width							
Male							
Age 0	128	47.1 A	4.21	50	47.1 A	1.48	ns
Age 1	65	51.3 B	1.29	11	51.5 B	1.32	ns
Age 2+	57	53.2 C	1.88	14	52.2 B	2.15	ns
Female							
Age 0	91	43.5 A	1.59	36	42.9 A	1.67	0.05
Age 1	33	45.2 B	1.19	10	44.0 AB	0.77	0.005
Age 2+	38	45.7 B	0.98	13	44.7 B	1.27	0.004

[1] ANOVA tests on all age classes by sex for skull length and zygomatic width were significant ($\underline{P}<0.05$), except the skull length for Ft. Rae females ($\underline{P}=0.63$). Among age and sex classes by community, means with same letter are not significantly different (Duncan's Multiple Range Test). $\underline{P}$ values compare communities by age and sex class (t-test, ns = not significant).

count estimates using skull length were 0% for females in both communities, and 3.6% and 0% for males in Ft. Good Hope and Ft. Rae, respectively. Error estimates using canine width and root length were higher (average error for canine width - 2.2% and 3.5%, and for root length - 5.6% and 4.4% for Ft. Good Hope and Ft. Rae, respectively). Calculated dividing points for separating female from male martens by skull length were 83.0 mm and 82.5 mm for Ft. Good Hope and Ft. Rae, respectively. Using canine width, the dividing point for discriminating sex was 4.57 mm and 4.41 mm for Ft. Good Hope and Ft. Rae, respectively.

Skull length was not measured for the Tunago Lake head sample, therefore, a dividing point was calculated using canine widths from the Tunago Lake carcass sample (to minimize area effects). A dividing point using a canine width of 4.50 mm produced the most accurate result; however, errors of up to 2% for females and 8% for males were predicted (SAS 1988). Sex of the Tunago Lake head sample was assigned on this basis.

Because of sexual dimorphism in tooth development, pulp cavity ratios for discriminating between juveniles and adults (1+ years) in each community were calculated separately for males and females (Table 8). The calculated dividing points were lower for females than for males in both communities, and were lower in Ft. Rae than in Ft. Good Hope for both sexes. In each sex and age class 94-100% of the animals could be placed in the correct age class using pulp cavity ratios.

Table 8. Pulp cavity ratios (percent of pulp width:tooth width) of lower canine teeth in juvenile and adult (1+ years) martens, Ft. Good Hope and Ft. Rae.

Community	Sex	Age	n	Mean	SD	Dividing Point	% Mis-aged
Ft. Good Hope	M	0	126	57.9	4.49	48.7	1.6
		1+	118	27.8	10.26		0
	F	0	89	53.1	4.61	43.1	1.1
		1+	65	22.3	9.61		1.5
Ft. Rae	M	0	50	50.75	4.36	43.9	6.0
		1+	25	27.88	10.15		4.0
	F	0	35	47.97	4.56	40.0	0
		1+	23	22.59	9.92		4.3

Using the criteria proposed by Magoun et al. (1989), the length of temporal muscle coalescence was correct at identifying almost all of the males with 0-20 mm coalescence as juveniles (Table 9). A group of 11 juvenile males had muscle lengths of 30-40 mm; cementum analysis of teeth from these 11 is currently being rechecked to confirm that these are actually juveniles.

The technique appeared to be less accurate for females. While most juveniles had no temporal muscle coalescence, 9-50% of females in 1 and 2+ age classes also were assigned zero coalescence (Table 9). However, when measurements taken by one of the four technicians were removed from the data set, the accuracy of the technique increased considerably; only 5% (1/19) yearling females and 3% (1/32) 2+ females had 0 mm coalescence.

Table 9. Distribution of martens within each age class (based on cementum age or percent pulp cavity) by groups of length of temporal muscle coalescence (after Magoun et al. 1989).

Temporal Muscle Length (mm)	Ft. Good Hope Age Classes 0	1	2+	Ft. Rae Age Classes 0	1	2+
Females						
0	81	9	4	29	5	1
1-10	7	3	2	4	3	1
>11	0	16	29	0	2	9
Males						
0-20	116	1	0	39	0	0
>21	6	65	57	5	11	13

Thus, the technique may be useful at separating juvenile from older animals based on temporal muscle measurement alone.

Discussion

Population indices as obtained from carcass analyses provide an indication of harvest impact. As summarized by Strickland and Douglas (1987:541) "the differences in vulnerability between males and females, and between juveniles and adults, are reflected in the sex and age ratios of trapped animals, and these ratios form the bases of indices of overharvest." A harvest with a low proportion of juveniles and a high proportion of adult females indicates that the population may be overharvested (Strickland and Douglas 1987, Thompson and Colgan 1987).

Strickland and Douglas (1987) suggest that a healthy harvest has occurred if the ratio of juveniles to adult female 2+ years old is twice or more times the fecundity rate (based on corpora lutea counts in the previous winter). If radiographs are used to separate juveniles from adults (1+ years), a harvest rate of at least three juveniles per adult female 1+ years represents an adequate harvest level (Strickland and Douglas 1987, Thompson and Colgan 1987). Sex ratios will similarly indicate potential overharvest, although less strongly (Strickland and Douglas 1987, Thompson and Colgan 1987). Since usually two or three males are caught per female caught, sex ratios that are nearly even or are dominated by females probably indicate overharvest (Quick 1956, Soukkala 1983, Archibald and Jessup 1984).

The sex and age ratios obtained from the Ft. Good Hope and Ft. Rae carcass collections indicate that in most areas the 1988-89 harvest was high but not excessive. Ratios of juveniles to 1+ and 2+ females indicate that harvest intensity was higher in the Ft. Good Hope area. While juveniles:2+ female ratios do not exceed twice the fecundity, they are not substantially lower. This comparison is not entirely correct, since the fecundity rate used for the comparison should be from the previous year's harvest, not the current year.

More males than females were taken in both areas. In the early 1970s, Boles (1975) reported a M:F ratio of 1.48:1 in a sample from the northern Mackenzie District of the NWT, and Hall (1984) reported a sex ratio of 1.27:1 and a harvest with 55% juveniles and 14% yearlings in a sample from the late 1970s in the Ft. Franklin area.

Lower juvenile to female ratios and an even sex ratio of martens from the Tunago Lake sample caught by one trapper, however, suggest somewhat higher trapping intensity in that area. Although sex was assigned, rather than determined anatomically, the age profile alone indicates relatively heavier trapping pressure than that found in the other collections.

The ratio of omental fat to skinned carcass weight approximates whole body fat content (Buskirk and Harlow 1989). The NWT sample had a considerably lower fat content (range 0.11-0.32%) than comparable indices published for martens from Alaska (2.37%) and Wyoming (4.62%) (Buskirk and Harlow 1989). The reason for this difference is not clear, but may be related to trap type. Thompson and Colgan (1987) found significantly higher fat contents and body weights in martens taken in Conibear (quick-kill) traps than in animals taken in leg-hold traps. All martens examined in the NWT sample were taken in leg-hold traps, while trap type for the American samples was not stated. Samples of Conibear-killed martens will be examined in the coming season.

The pregnancy rates and mean corpora lutea counts, and thus the mean fecundity, from NWT females is high when compared with other areas. From a large data set from southcentral Ontario, Strickland and Douglas (1987) found mean corpora lutea counts of 3.29 for yearlings and 3.57 for 2+ females, and pregnancy rates averaging 80% for yearlings and 93% for older animals. In northcentral Ontario, Thompson and Colgan (1987) had mean counts of about 2.0. In the Yukon, Archibald and Jessup (1984) found mean pregnancy rates of 74% and mean corpora lutea counts of 3.3 and 3.8 for yearlings and 2+ females, respectively. Although corpora lutea counts are only an index to litter size, since some in-utero mortality likely occurs, the data suggest that NWT martens have one of the highest reproductive capacities documented for the species.

Two of the five juveniles (cementum age=0) examined had corpora lutea present. This throws some doubt on the accuracy of the ages, since no breeding of martens in their first year has been documented (Strickland and Douglas 1987). Teeth from these animals are currently being re-examined.

Body size and skull measurement data suggest that martens from the Ft. Good Hope area are often significantly larger than animals from the Ft. Rae area. However, clear-cut patterns are not evident in all variables measured. Further comparisons will be conducted after more samples are collected and data from martens from other areas in the NWT are available.

Comparisons with the published literature suggest that NWT martens are among the largest on the continent. Skull lengths of NWT martens averaged 1.5-2.2% larger for males and 0.6-1.8%

larger for females than martens from interior Alaska (Magoun et al. 1989). The dividing point used to distinguish sexes from canine tooth width gives an indication of tooth size differences; NWT martens had a higher dividing point (4.41-4.57 mm) than martens from Quebec (3.54 mm), Ontario (3.75 mm), and areas on the west coast (4.25-4.26 mm), with the exception of the Queen Charlotte Islands (4.66 mm) (Dix and Strickland 1986, Fortin et al. 1988, Nagorsen et al. 1988). Mean carcass weight also averaged 35-45% greater for males and 30-40% greater for females than martens caught in Ontario (Strickland and Douglas 1987, Thompson and Colgan 1987).

Total skull length is an easy variable to measure, and proved accurate at assigning sex where only heads were collected. Given the differences in skull size between areas, carcass collections should be conducted in all areas where heads are obtained, so that accurate dividing points for distinguishing sex by skull length can be calculated. Some crushed skulls are not measurable; in these cases canine width should be used as the criterion for sexing.

The calculated dividing points used to distinguish juveniles from older animals on the basis of pulp cavity development (males 44-49%, females 40-43%) are considerably higher than those reported elsewhere (Ontario: M 37%, F 33% - Dix and Strickland 1986; Quebec: M 35%, F 34% - Fortin et al. 1988; Pacific coast: M 30-38%, F 27-34% - Nagorsen et al. 1988). This may be a result of slower development by NWT martens, or a later birth date such that juvenile martens have less time to develop prior to the start of the trapping season.

Identification of juvenile martens in the harvest without the use of cementum analysis saves considerable time and expense when age and sex ratios are to be derived from large samples of martens. Pulp cavity ratios provide an apparently accurate indication of the number of juveniles in the harvest. However, the technique has some inherent limitations, including poor radiograph quality rendering some teeth unreadable and the time and expense needed to pull and radiograph teeth, and measure the images. Although further testing is needed, the technique used to identify at least a majority of juvenile martens by measuring temporal muscle coalescence appears to have considerable promise. Longer training periods may be required to ensure consistency in measurements.

The marten carcass collection program will be expanded next season to include larger samples and more areas in the NWT. Efforts will be extended to ensure that the entire season's harvest from a trapping area is collected. Further testing will be conducted to evaluate aging techniques based on percent pulp cavity and length of temporal muscle coalescence aging techniques.

STUMP LAKE MARTEN STUDY

Introduction

Martens are an extremely valuable furbearing resource to trappers in the northern Sahtu District of the NWT. Average pelt prices from the area are typically the highest in the country, and trappers from Ft. Good Hope and Colville Lake derive a large portion of their income from the marten harvest. Little is known about the ecology of the species in this area; the present study was developed to begin to address this knowledge gap by examining marten density and prey availability.

Although originally intended to be a long-term study, the Stump Lake area was too difficult to access on a regular basis, and too labour intensive to cover a large enough area. This report will summarize the results of field work conducted in September 1988 and June 1989. A marten study in an area closer to Norman Wells is currently being developed to continue research in the Sahtu (P. Latour pers. comm.).

Study Area

The Stump Lake study area is located 135 km northeast of Ft. Good Hope (approximately 67°17'N, 127°54'W). Elevations range from 210-300 m asl. Ft. Good Hope receives about 280 mm precipitation annually, with a mean January temperature of -

31.3°C and a July mean of 16.3°C (Canada, Atmospheric Environment Service 1982). The area is in the Northwestern Transition Zone of the Boreal Forest Region (Rowe 1972), and is characterized by open stands of black spruce (_Picea mariana_), with accompanying white birch (_Betula papyrifera_) and tamarack (_Larix laricina_). Small bogs, ponds and lakes dot the area.

Kill-trapping took place along the cutline bisecting the study during winter 1987-88 (W. Jackson pers. comm.). The area was not trapped in 1988-89.

Methods

Traps (Models 204 and 205, Tomahawk Live Trap Co., Tomahawk, WI) were spaced on average at 400-450 m intervals in an 11 km^2 area in September 1988 (34-43 traps) and a 15 km^2 area in June 1989 (54 traps). The traps were baited with a mixture of raspberry jam, sardines and cod liver oil, and were set for six nights in 1988 (total of 235 trap-nights [TN]) and five nights in 1989 (270 TN). Given the trap density and duration trapped, it was assumed that all martens in the study area during the trapping session would be caught (Archibald and Jessup 1984, I. Thompson pers. comm.).

Traps were checked daily, and rebaited at least every 3 days. Captured martens were run into a holding cone and immobilized using Telazol (A.H. Robins Co., Richmond VA) at a dose of about 8 mg drug per kg estimated body weight. The animals were sexed, weighed, body and tail length measured, and a lower premolar was removed for aging (Matson's Laboratory, Milltown, MT). A numbered ear-tag (Style 4-1005, Size 1, National Band & Tag Co., Newport, KY) was placed at the lower anterior portion of each ear, and one ear was tattooed. Induction time averaged 1.45 min (n=11), and most martens had recovered and were released within 1.5-2.0 hours.

Prey availability was assessed by a snap-trap index. Microtine traplines consisted of transects of 25 stations spaced at 15 m intervals, each station consisting of two snap-traps (Victor metal pedal traps in 1988, and Victor Museum Special and Victor wooden pedal in 1989; Woodstream Corp., Niagara Falls, ON). Traps were baited with peanut butter and set for three nights on each transect. Trapping effort totalled 300 TN in 1988 and 600 TN in 1989.

Results

During the September 1988 trapping session five martens (two adults and three juveniles) were captured 13 times, 1 capture per 18 TN (Table 10). Six martens (all yearlings or older) were captured nine times in June 1989, 1 per 30 TN. Two of the six captured in 1989 were recaptured adults from the previous fall. The ear-tags on both animals were present, and the tattoo was readable on one of the animals. Most (7/11) of the martens

Table 10. Martens captured at Stump Lake, September 1988 and June 1989.

ID	Sex	Age	Weight (g)	Date Captured	Ear-tags L/R	# Times Captured
09/1988						
A1	M	3	1585	13/09/88	2/50	2
A2	F	0	795	13/09/88	4/3	4
A3	F	4	905	14/09/88	6/5	3
A4	M	0	1105	14/09/88	7/8	3
A5	M	0	1190	18/09/88	100/99	1
06/1989						
B1	M	1+	1400	04/06/89	11/10	1
B2	M	1+	1460	04/06/89	12/13	2
A1	M	4	1650	05/06/89	2/50	1
A3	F	5	900	05/06/89	6/5	1
B3	M	1+	1350	06/06/89	15/14	2
B4	F	1+	960	06/06/89	17/16	2

Table 11. Microtine capture rate, Stump Lake marten study, 1988-89.

	Sept. 1988		June 1989			
	Line A	Line B	Line A	Line B	Line C	Line D
No. Voles Captured	31	26	3	4	7	4
Vole Sp.[1]	3 CCV 28 RBV	RBV	RBV	RBV	RBV	3 CCV 1 RBV
Captures/ 100 TN	20.7	17.3	2.0	2.7	4.7	2.7

[1] All voles captures were red-backed voles (RBV), except where noted as chestnut-cheeked voles (CCV).

captured were males. Density of martens on the study area was 0.4-0.5/km^2.

One of the martens captured in 1989 (B1) was a male missing his right front leg from the elbow joint. The wound had healed well and the animal appeared to be healthy and mobile.

Microtine trap success during the fall was 8-10 times greater than in the spring (Table 11). The majority of microtines taken were red-backed voles (Clethrionomys rutilus), with a mean weight of 23.3 g (n=63). The larger (mean 55.8 g, n=6) chestnut-cheeked vole (Microtus xanthognathus) was rarely captured.

Discussion

Marten densities observed on the study area were slightly lower than densities reported in the literature. Archibald and Jessup (1984) and Francis and Stephenson (1972) found densities of 0.6 marten/km^2 in the Yukon and south-central Ontario, respectively, and Thompson and Colgan (1987) reported densities ranging from 2.4-0.4 marten/km^2 over four years of a prey decline in central Ontario. It is difficult to assess the impact of harvesting during winter 1987-88 on marten densities in the area.

Vole densities at Stump Lake decreased considerably over the winter. Thompson and Colgan (1987) also found prey densities decreased 70-85% between fall and spring trapping sessions. An extensive three-year microtine study conducted about 150 km south of Stump Lake reported an average of 11.9 microtines/100 TN, with red-backed voles accounting for 85% of the captures, and chestnut-cheeked voles about 7% (Douglass 1977).

Although short in duration, the live-trapping program indicated that marten densities at Stump Lake were similar to or slightly less than those found in other areas, and that prey densities fluctuated widely. Marten live-trapping and prey monitoring at the Norman Wells study site will allow the examination of these trends to continue.

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LITERATURE CITED

Archibald, W.R., and R.H. Jessup. 1984. Population dynamics of the pine marten (Martes americana) in the Yukon Territory. Pp 81-97. In: R. Olson, R. Hastings, and F. Geddes (eds.). Northern ecology and resource management. Univ. Alberta Press, Edmonton.

Boles, B. 1975. Background study for furbearer management in the Mackenzie Valley NWT. Prepared for Environ.-Social Prog. Northern Pipelines. 231pp.

Brown, M.W. 1983. A morphometric analysis of sexual and age variation in the American marten (Martes americana). M.Sc. Thesis. Univ. of Toronto. Toronto, Ont. 190pp.

Buskirk, S.W., and H.J. Harlow. 1989. Body-fat dynamics of the American marten (Martes americana) in winter. J. Mamm. 70:191-193.

Canada, Atmospheric Environment Service. 1982. Canadian climate normals 1951-1980 temperature and precipitation; The north - Y.T. and N.W.T. Environment Canada, Canadian Climate Program. 55pp.

Dix, L.M., and M.A. Strickland. 1986. The use of radiographs to classify marten by sex and age. Wildl. Soc. Bull. 14:275-279.

Douglass, R.J. 1977. Population dynamics, home range, and habitat associations of the Yellow-cheeked Vole, Microtus xanthognathus, in the Northwest Territories. Can. Field-Nat. 91:237-247.

Fortin, C., M. Cantin, and M. Fortin. 1988. Expérimentation d'une méthode radiographique pour la détermination du sexe et l'estimation de l'âge chez la Martre D'Amérique. Quebec Min. du Loisir, de la Chasse et de la Pêche. 23pp.

Francis, G.R., and A.B. Stephenson. 1972. Marten ranges and food habits in Algonquin Provincial Park, Ontario. Ont. Min. Nat. Resour. Res. Rept. 91. 53pp.

Hall, E. 1984. Great Bear Lake marten studies 1976-79. Unpubl. rept. NWT Renewable Resour., Yellowknife. 56pp.

Magoun, A.J., R.M. Gronquist, and D.J. Reed. 1989. Development of a field technique for sexing and aging marten. Final rept. Alaska Dept. of Fish and Game. 36pp.

Nagorsen, D.W., J. Forsberg, and G.R. Giannico. 1988. An evaluation of canine radiographs for sexing and aging Pacific coast martens. Wildl. Soc. Bull. 16:421-426.

Quick, H.E. 1956. Effects of exploitation on a marten population. J. Wildl. Manage. 20:267-274.

Rowe, J.S. 1972. Forest regions of Canada. Can. For. Serv., Dept. of Envir. Publ. No. 1300. 172pp.

SAS. 1988. SAS/STAT user guide, release 6.03 edition. Cary, NC. 1028pp.

Snedecor, G.W., and W.G. Cochran. 1967. Statistical methods, sixth ed. The Iowa State Univ. Press, Ames. 593pp.

Soukkala, A.M. 1983. The effects of trapping on marten populations in Maine. M.Sc. Thesis, Univ. of Maine, Orono. 41pp.

Strickland, M.A., and C.W. Douglas. 1987. Marten. Pp 532-546. In: M. Novak, J.A. Baker, M.E. Obbard and B. Malloch. (eds.). Wild furbearer management and conservation in North America. Ontario Min. Nat. Resour. Toronto, Ont. 1168pp.

Thompson, I.D., and P.W. Colgan. 1987. Numerical responses of martens to a food shortage in northwestern Ontario. J. Wildl. Manage. 51:824-835.