Summary of 1983 Moose Surveys in the Kluane, Haines Junction, Whitehorse South, Teslin Burn and Mt. Lorne Areas

R.L. Markel and D.G. Larsen

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MOOSE MANAGEMENT ANNUAL REPORT

Big Game Section
Fish and Wildlife
Department of Renewable Resources
Government of Yukon
P.O. Box 2703
Whitehorse, Yukon

Approved: _____
Director, Fish and Wildlife

_____
Senior Big Game Biologist

Date: 3 august 1987

Southwest Yukon Moose Survey Results, November - December 1983

R.L. Markel and D.G. Larsen

ABSTRACT

Moose in a 10,501 km^2 area of southwest Yukon were censused using a stratified random block aerial survey technique. Moose densities were highest (0.43 moose/km^2) in the southeast portion of the study area and lowest (0.02 moose/km^2) in the northwest portion. Adult females were the most abundant age/sex cohort in all of the survey areas ranging from 57% of the population in Whitehorse South to 72% in the Haines Junction survey area. Yearlings were the least abundant cohort. Hunting removed an average of 8% of the pre-hunt population. Moose were clumped in distribution in 3 out of 5 areas with over 50% of the moose occurring in less than 10% of the area. Most (>70%) of the calves were found in the low density areas.

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INTRODUCTION

Moose (Alces alces) populations in the southwest Yukon have been censused annually since 1981 (Larsen 1982, Johnston and McLeod 1983, Markel and Larsen 1983). The primary objectives of those surveys were to determine moose population density, distribution, composition, and changes in population size over time. As a result of the low calf survivorship (6-24 calves/100 females ≥30 mo) documented to six months of age and a decline in population size in some areas, a study was initiated in 1983 to determine the limiting factors on moose population growth in southwestern Yukon. It was found that predation by grizzly bears and wolves was the major cause of calf and adult cow mortality (Larsen and Gauthier in prep.).

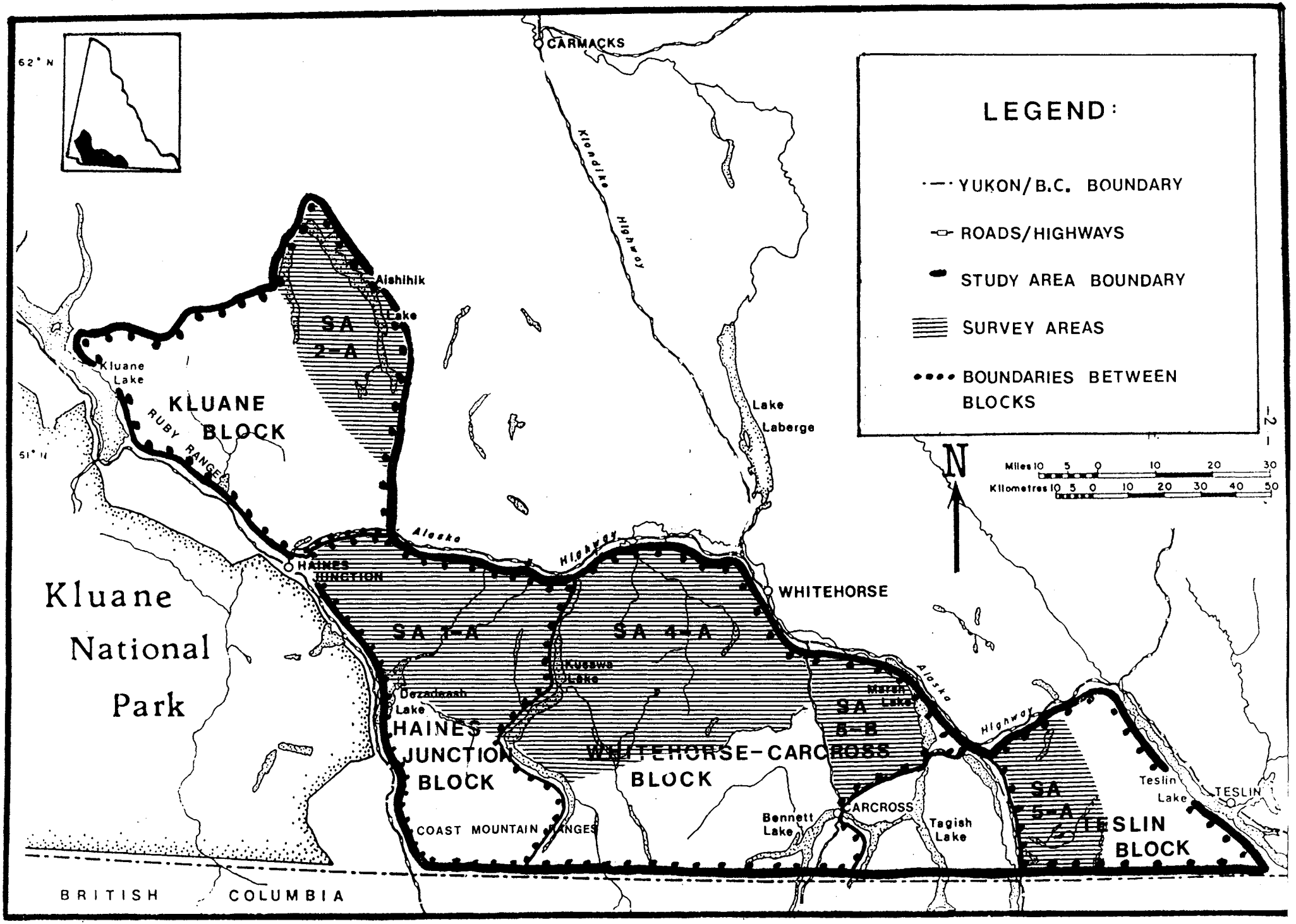
A predator reduction program was introduced in 1982/83 as part of an experimental study design to determine if predators were limiting the growth of the moose population. Four predator prescription blocks were delineated (Fig. 1). These blocks were further divided into 5 survey areas (SAs). The response of moose populations, i.e. changes in calf and adult female survivorship and overall population size, to different predator prescriptions are monitored using aerial survey and telemetry techniques. This document is reporting only on the 1983 aerial survey results in those prescription blocks. The effects of the predator prescriptions on the moose population will be analyzed at a later date.

STUDY AREA

The study area, which consists of 10,501 km^2 total land area, lies in the Ruby and Coastal Mountain ranges in southwest Yukon (Fig. 1). The area is characterized by rugged mountains and numerous large water bodies. Treeline occurs between 1,067 and 1,220 metres above sea level. Shrub birch (Betula spp.) and willow (Salix spp.) are the predominant vegetation in the subalpine zone which extends from treeline to 1,542 metres. On the lower slopes white spruce (Picea glauca) and lodgepole pine (Pinus contorta) are the dominant tree species. A few small burns have occurred throughout this area over the past two decades and one major burn occurred in 1958 in the southeast corner of the study area. The physiography, climate and vegetation in these areas have been described elsewhere (Oswald and Senyk 1977, Larsen 1982).

The Yukon is divided into 11 Game Management Zones (GMZ) which are further

FIG. 1 MOOSE SURVEY AREAS IN SOUTHWEST YUKON, NOV.– DEC. 1983.



divided into Game Management Subzones (GMS) (Anon 1982). The Kluane survey area (S.A. 2-A) is composed of GMS 5-40, while the Haines Junction survey area (1-A) is composed of GMS 7-01 to 7-06, Whitehorse South (4-A) is composed of GMS 7-13 to 7-27, Carcross (5-B) is composed of GMS 9-01, 9-02, and 9-04 and lastly the Teslin Area (5-A) is composed of GMS 9-08 and 9-09.

METHODS

Aerial surveys were conducted between November 15-21, November 29 - December 1, December 1-6 and December 5-8 for areas 4-A, 1-A, 2-A, 5-A and 5-B respectively. This time period is preferred for moose surveys in Yukon due to the aggregation behaviour of moose in open habitats during and immediately following the rut (Peek et al., 1974; Lynch, 1975; Rounds, 1978; Mytton and Keith, 1981; Y.T.G. internal files). In addition, the ground is covered with snow by early November. Both of these factors increase visibility of moose on aerial surveys (Gasaway et al., 1981). The presence of antlers on males to mid-December facilitates the sexing of moose from aircraft.

A stratified random block sampling technique was used (Gasaway et al., 1981) with modifications to accomodate the terrain, weather conditions and distribution of moose in Yukon (Larsen, 1982). Briefly the technique used was as follows. Each SA was divided into sample units (SU) using natural terrain features for borders and delineated on 1:500,000 topographical maps. For comparative purposes the SUs used on this survey were consistent with the SUs from previous years (1981 and 1982). All of the survey areas were portions (or sub areas) of previously censused areas (Fig 1). For example S.A. 1-A is a sub area of the original Haines Junction (SA 1) survey area.

Fixed-wing aircraft were used to stratify SUs into high, medium and low strata based on the number of moose and tracks seen in the SU. Areas above 1,542 metres elevation, water bodies larger than 0.8 km^2 and precipitous slopes were considered uninhabitable for moose and were not surveyed. Areas above 1.542 metres consisted of primarily talus slopes with little to no vegetation. In SA 4-A 1,199 km^2 or 32% was considered not habitable while in SA 2-A, 1-A, 5-A and 5-B it was 399 km^2 (25%), 613 km^2 (21%), 61 km^2 (5%) and 105 km^2 (10%).

Helicopters were employed to census the SU within 48 hours of completing the stratification. Sample units to be surveyed were randomly selected, therefore the same SUs were not necessarily surveyed between years. Total counts of moose were made within each SU surveyed. Search patterns varied from parallel overlapping transects and following contour lines to tight circling depending upon the terrain and wind. A detailed description of the techniques can be found in Gasaway et al. (1981) and Larsen (1982).

Moose observations included information on the number of animals in each aggregation, their age (calves, yearlings and adults) and sex. Habitat characteristics at each observation were classified according to vegetation (herbaceous, shrub, shrub-conifer, conifer and deciduous), elevation and aspect.

Moose harvest data were tabulated by GMS from questionnaires returned by licenced resident and non-resident hunters. Annual harvest (non-native) was estimated from each survey areas using Kale (1982). Information on non-licenced (native) harvest was not available.

RESULTS AND DISCUSSION

Search and Sampling Intensity

Search intensity ranged among SAs from 0.28 to 0.33 min./km^2 for stratification and 1.74 to 1.94 min./km^2 for the census (Table 1).

Table 1. Search and sampling intensity for each survey area in Southwestern Yukon, Nov/Dec 1983.

S.A.	Total Habitable Moose Range (km^2)	Search Intensity min./km^2 Stratification	Census
Haines Junction (1A)	2332.4	.30	1.75
Kluane (2A)	1144.1	.28	1.81
Whitehorse South (4A)	2613.2	.31	1.74
Teslin (5A)	1096.0	.33	1.94
Carcross (5B)	915.5	.28	1.83

The overall sampling intensity regardless of SA or stratum averaged 28% with a range of 19% to 43% among SAs (Table 2). All of the high strata SUs were surveyed, while 94% of the medium and 20% of the low strata were surveyed.

The high and medium strata combined constituted 9% of the area with the remainder (91%) in the low stratum. A total of 164 SUs averaging 13.9 km^2 in size were surveyed in the combined SAs.

Table 2. Sampling Intensity by Stratum and Survey Area, Nov/Dec 1983

Survey Area	Sample Units	S T R A T A High	Medium	Low	Total
1-A Haines Junction	No. of SUs (%)	8 (4)	10 (5)	166 (90)	184 (100)
	SUs surveyed (% sampled)	8 (100)	10 (100)	29 (18)	47 (26)
2-A Kluane	No. of SUs (%)	0	3 (3)	88 (97)	91 (100)
	SUs surveyed (% sampled)	N/A	3 (100)	14(16)	17 (19)
4-A Whitehorse South	No. of SUs (%)	11 (6)	9 (5)	155 (89)	175 (100)
	SUs surveyed (% sampled)	11 (100)	9 (100)	27 (17)	47 (27)
5-A Teslin	No. of SUs (%)	2 (3)	7 (9)	68 (88)	77 (100)
	SUs surveyed (% sampled)	2 (100)	5 (71)	17 (25)	24 (31)
5-B Carcross	No. of SUs (%)	0	6 (9)	62 (91)	68 (100)
	SUs surveyed (% sampled)	N/A	6 (100)	23 (37)	29 (43)
Overall S.A.'s	No. of SUs (%)	21 (4)	35 (6)	539 (91)	595 (100)
	SUs surveyed (% sampled)	21 (100)	33 (95)	110 (20)	164 (28)

Population Estimate, Density and Composition

The smallest population was found in SA 2-A (29 moose ± 34%; 90% C.I.) and the largest in SA 4-A (651 ± 22%; 90% CI) (Table 3). The precision of the overall population estimates by SA ranged form ±22% to ±36%. Moose densities were highest (.43 moose/km^2) in the southeastern portion (SA 5-A) of the study area and the lowest (.02 moose/km^2) in the northwest (SA 2-A) (Table 3). This trend in decreasing densities across the study area from SE to NW was consistent with results from previous years (Larsen 1982, Johnston and McLeod 1983, and Markel and Larsen 1983).

A higher density was documented in the medium stratum as compared to the high stratum in SA 1A. This was likely due to a combination of movement between high and medium SUs after stratification and before surveying; or incorrect stratification.

Adult females (≥ 30 mo.) were the largest single cohort in each of the SAs ranging from 57% (SA 4-A) to 72% (SA 1-A) of the overall population estimate (Table 4). Adult males (≥ 30mo.) represented the next largest cohort in all except SA 5-A where calves were more prominent. Yearlings (males and females) ranged from 1-6% of the estimated population while calves ranged form 0-19% of the population.

Calf/cow ratios varied greatly among the survey blocks with the highest ratios in SAs 5-A (30 calves/100 females) and 4-A (30 calves/100 females) followed by substantially fewer calves in SAs 1-A (7 calves/100 females) and 5-B (4 calves/100 females). No calves were observed in SA 2-A (Table 4).

The lowest calf/cow ratio was documented in the area (SA 2-A) with the lowest density of moose, while the highest calf/cow ratio was documented in the area (SA 5-A) with the highest density of moose. This relationship was consistent in all of the SAs in 1983 as well as in previous years (Markel and Larsen 1983, Johnston *et al.*, 1983). We interpret this data to suggest that the apparent high mortality of calves has resulted in a negative balance between calf recruitment and adult mortality, leading to a decline in the population.

Table 3. Estimated moose population and density by survey area and strata, November - December 1983

Area	Parameter	High	Medium	Low	Total
Haines Jct. 1-A	Estimated total moose	66	121	159	346 ± 27%
	Density (moose/km^2)[a]	0.60	1.02	0.08	0.15
Kluane 2-A	Estimated total moose	-	23	6	29 ± 34%
	Density (moose/km^2)[a]	-	0.61	0.01	0.02
Whitehorse South 4-A	Estimated total moose	259	79	313	651 ± 22%
	Density (moose/km^2)[a]	1.35	0.55	0.14	0.25
Teslin 5-A	Estimated total moose	32	56	384	472 ± 27%
	Density (moose/km^2)[a]	0.98	0.59	0.40	0.43
Carcross 5-B	Estimated total moose	-	66	105	171 ± 36%
	Density (moose/km^2)[a]	-	0.86	0.13	0.19

[a]density is calculated based on habitable moose range.

Table 4. Estimated moose population composition by Survey Area November to December 1983.

Area	Parameter	STRATUM High	Low	Medium	Total (90% CI)
1-A Haines Junction	Adult bulls (≥30 mo.)	18	31	29	78 ± 41%
	Adult cows (≥30 mo.)	46	79	124	249 ± 30%
	Yearlings (18 mo)[a]	0	2	0	2[b]
	Calves	2	9	6	17 ± 55%
	Bulls/100 cows (≥30 mo.)	39	39	25	32 ± 38%
	Yearlings/100 cows	-	-	-	1[b]
	Calves/100 cows	4	11	5	7 ± 60%
2-A Kluane	Adult bulls (≥30 mo.)	NA	8	0	8[b]
	Adult cows (≥30 mo.)	NA	13	6	19[b]
	Yearlings (18 mo)[a]	NA	2	0	2[b]
	Calves	NA	0	0	0[b]
	Bulls/100 cows	NA	62	0	42[b]
	Yearlings/100 cows	NA	15	0	11[b]
	Calves/100 cows	NA	0	0	0[b]
4-A Whitehorse South	Adult bulls (≥30 mo.)	50	29	74	153 ± 32%
	Adult cows (≥30 mo.)	175	37	159	371 ± 26%
	Yearlings (18 mo.)[a]	8	8	0	16[b]
	Calves	26	5	80	111 ± 53%
	Bulls/100 cows (≥30 mo.)	30	78	46	42 ± 42%
	Yearlings/100 cows	-	-	-	4[b]
	Calves/100 cows	15	14	50	30 ± 37%
5-A Teslin	Adult bulls (≥30 mo.)	4	6	78	88 ± 46%
	Adult cows (≥30 mo.)	17	41	235	293 ± 24%
	Yearlings (18 mo.)[a]	2	2	-	4[b]
	Calves	9	7	71	87 ± 32%
	Bulls/100 cows (≥30 mo.)	24	13	33	30 ± 34%
	Yearlings/100 cows	-	-	-	1[b]
	Calves/100 cows	53	17	30	30 ± 20%

Table 4. Estimated moose population composition by Survey Area November to December 1983.

Area	Parameter	STRATUM High	Low	Medium	Total (90% CI)
5-B Carcross	Adult Bulls (≥30 mo.)	-	21	33	54 ± 37%
	Adult Cows (≥30 mo.)	-	42	66	108 ± 37%
	Yearlings (18 mo.)[a]	-	2	3	5 ± 78%
	Calves	-	1	3	4 ± 99%
	Bulls/100 cows (≥30 mo.)	-	50	52	51 ± 20%
	Yearlings/100 cows	-	7	9	7 ± 82%
	Calves/100 cows	-	2	4	4 ± 102%

[a] Yearling males are assumed to equal yearling females in number.
[b] The sample size was too small to estimate confidence intervals.

Distribution

Moose in three of the five SAs had a clumped distribution as reflected by the proportion of the moose population in each stratum (Fig. 2-5). In areas 1-A, 2-A and 4-A the high and medium density strata comprised 10%, 3% and 11% of the habitable moose range respectively (Table 2) and accounted for 54%, 79% and 52% of the moose (Table 4). In contrast, moose in SAs 5-A and 5-B had a less clumped distribution with a smaller (19% and 39%) proportion of the moose occurring in the high and medium strata (Table 4) which comprised 12% and 9% of the habitable moose range respectively (Table 2). The more dispersed distribution in SAs 5-A and 5-B is most likely due to the late date when these latter areas were surveyed. Both were not surveyed until the beginning of December at which time post-rut aggregations start to disband (Larsen 1982).

The majority of calves (ranging from 72% in SA 4-A to 83% in SA 5-A) were recorded in the low stratum, except for SA 1-A, suggesting that cows with calves avoid high density areas.

Habitat

The shrub dominated vegetative class was most commonly occupied by all sex/age classes in all of the SAs except 5-A (Table 5). In SA 5-A, 30% of the estimated population occurred in the shrub-vegetative class whereas 48% occurred in the shrub-conifer class. If the shrub and shrub-conifer classes are combined to form a "shrub-related" vegetative class then 82%, 100%, 94%, 78% and 98% of the moose in areas 1-A through 5-B respectively would be found in this class. The herbaceous class was used least followed by the deciduous and conifer classes. Johnston et al. (1984) addressed moose habitat selection in SA 1 and SA 4 in 1982, and determined that the distribution of moose among vegetation classes at that time was non-random, with a greater than expected proportion of moose occurring in the shrub vegetative class.

The majority ($\geq$67%) of the moose population in all five SAs was located between 1097 and 1524 m (Table 5). These elevations approximate a subalpine shrub zone which extends from treeline to non-vegetated talus slopes at higher elevations.

Fig. 2 : Moose Distribution in Survey Area 1–A, November–December 1983.

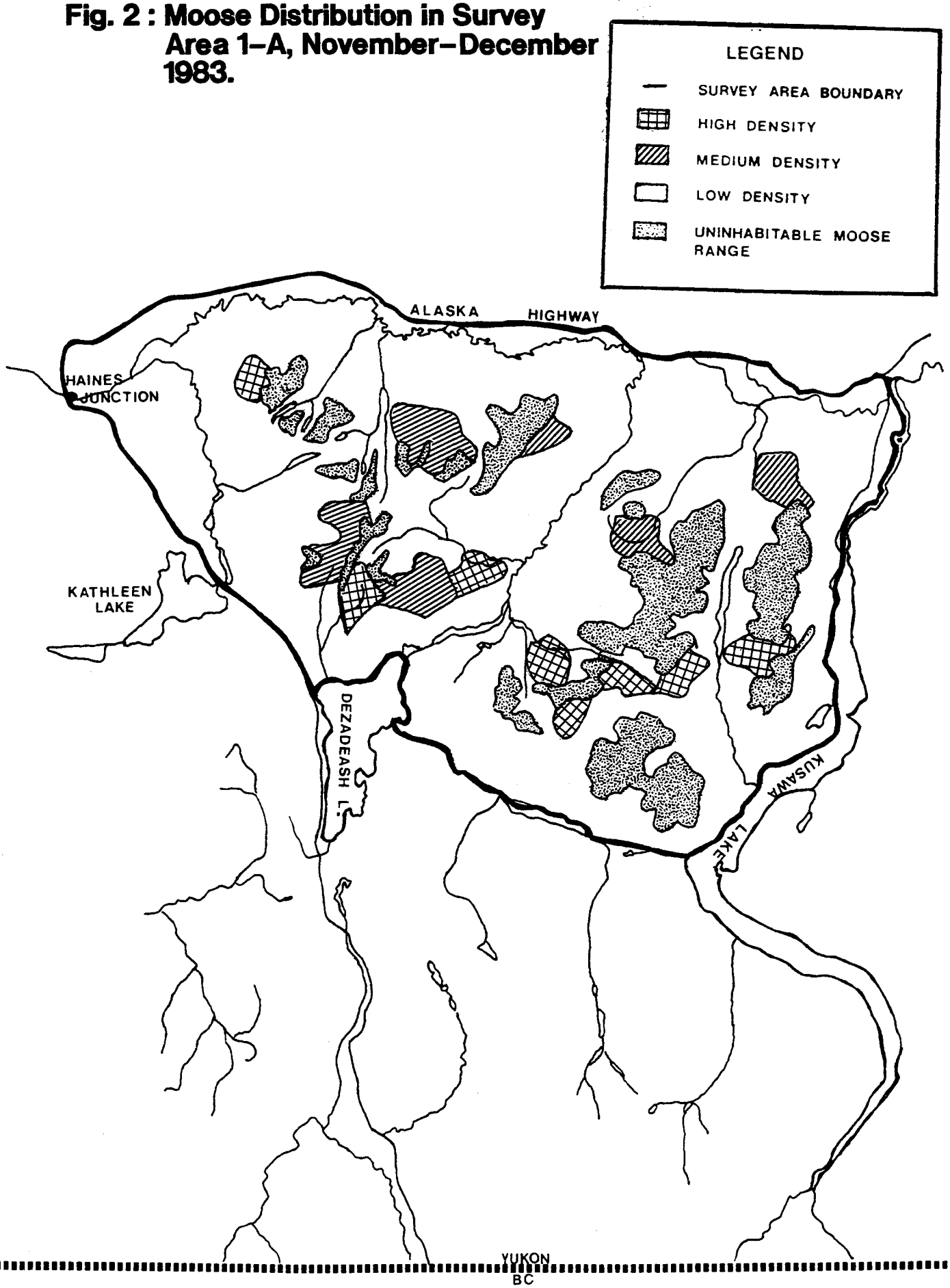


Fig 3 : Moose Distribution in Survey Area 2–A, November–December 1983.

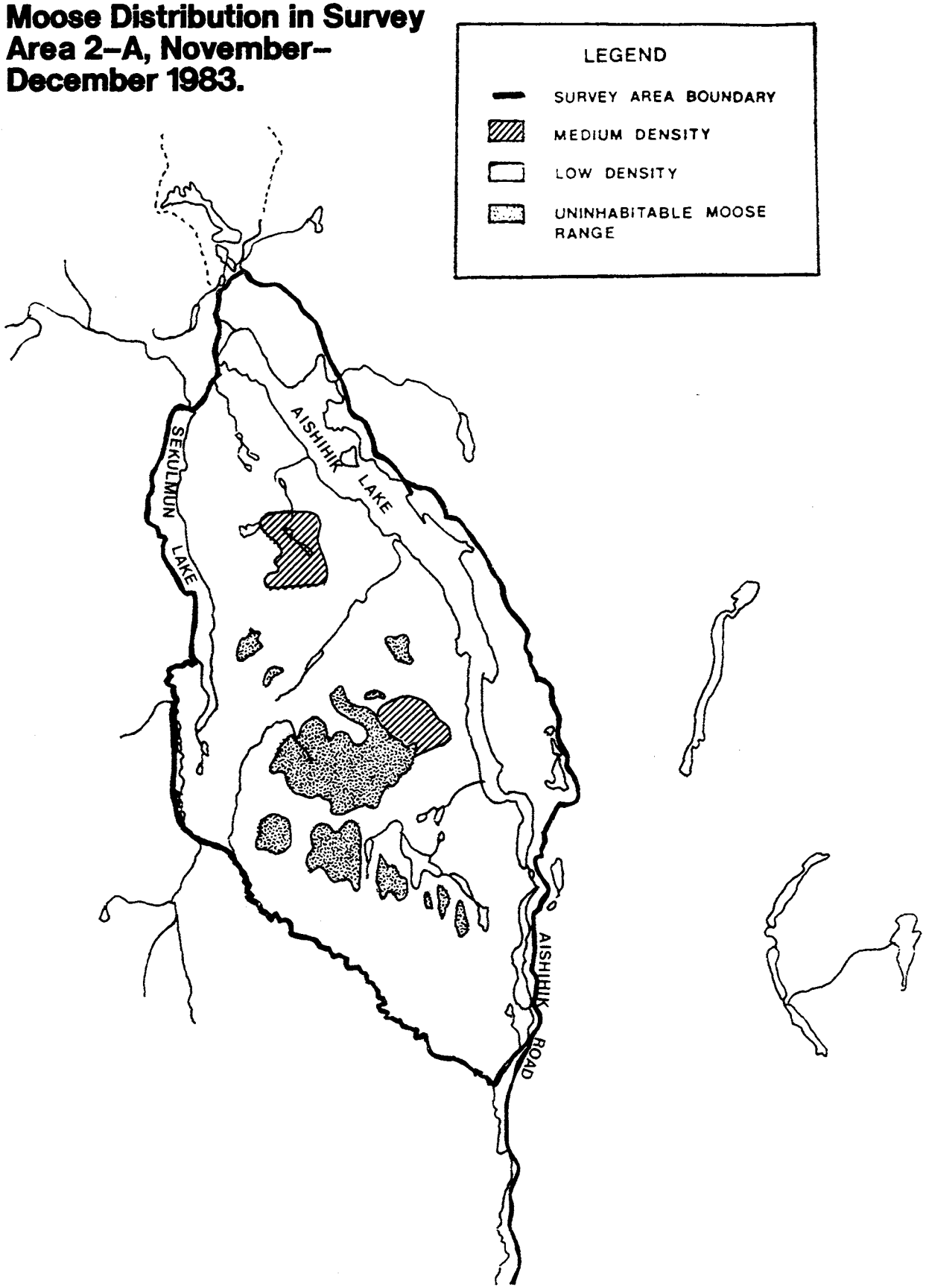


Fig. 4 : Moose Distribution in Survey Area 4–A, November–December 1983.

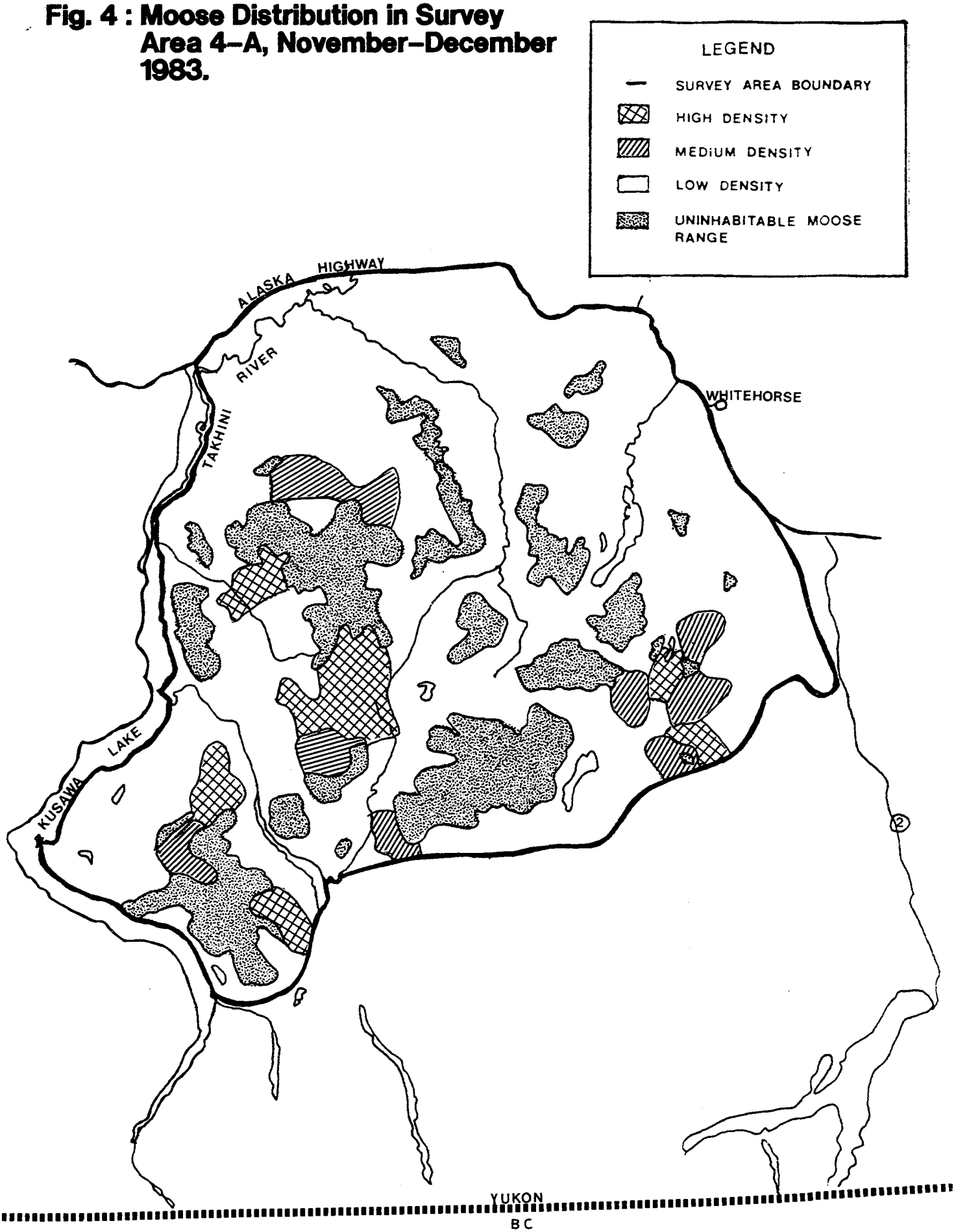


Fig. 5 : Moose Distribution in Survey Area 5–A, November – December 1983.

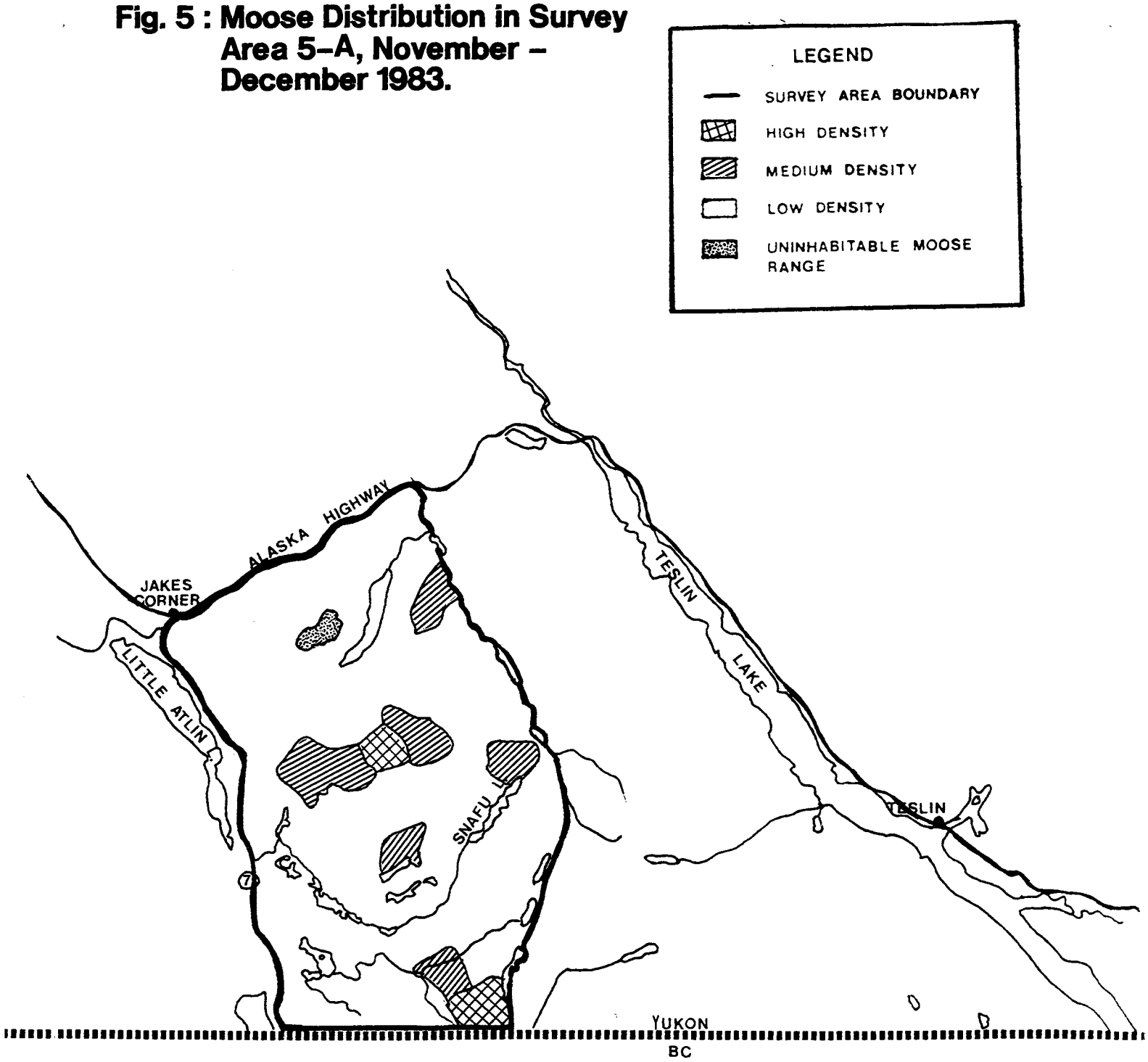
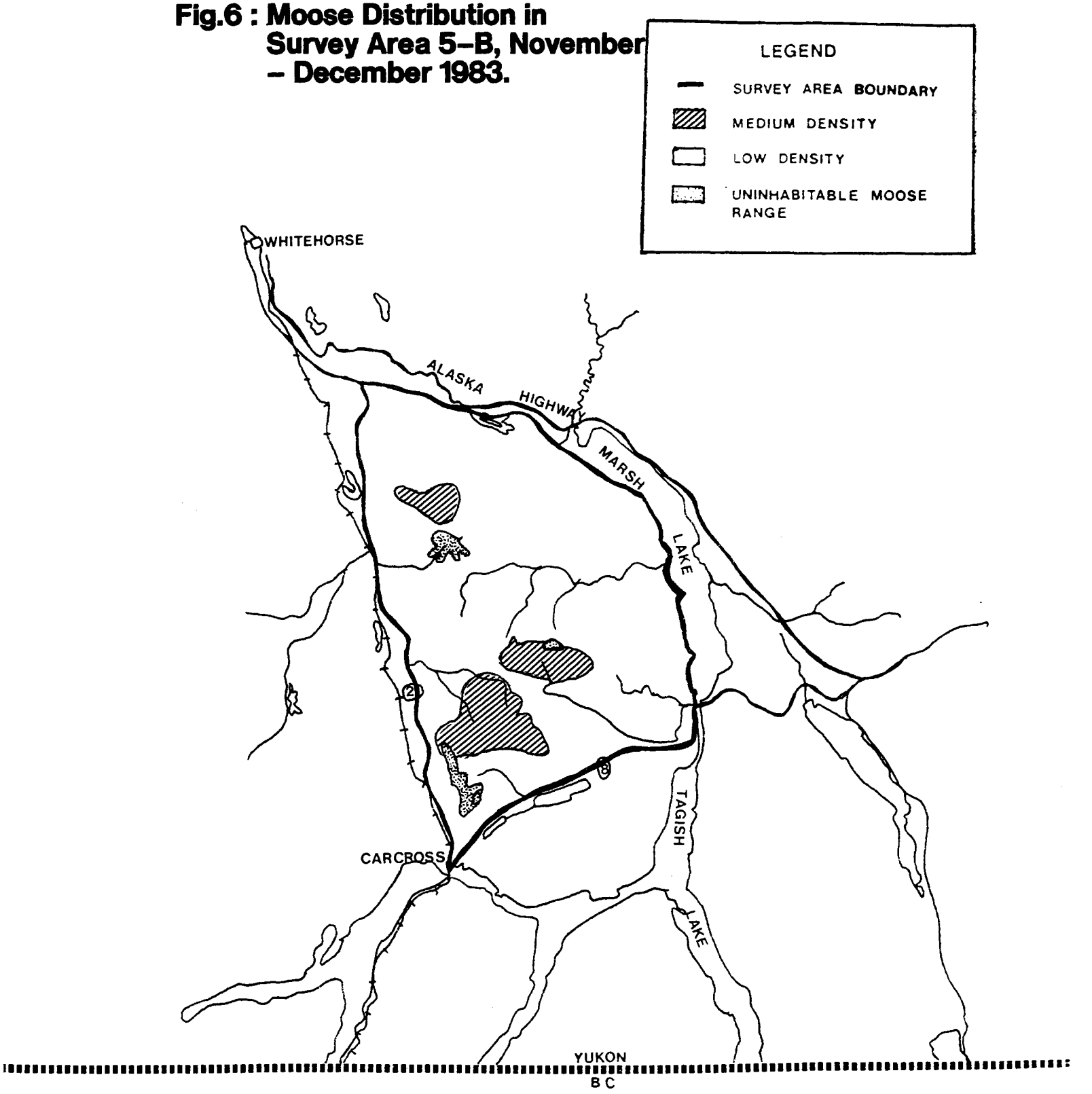


Fig.6 : Moose Distribution in Survey Area 5–B, November – December 1983.



The distribution of moose among aspect classes varied among SAs (Table 5). In SAs 1-A and 2-A, 66% and 79% of the observations respectively were made on northerly aspects (291^{o} -90^{o}). Area 5-B showed a higher utilization of easterly aspects (0^{o} - 180^{o}) and areas 4-A and 5-A showed less defined patterns although the northeasterly aspect (0^{o} - 90^{o}) was the most important single class.

Hunter Harvest

Hunting was estimated to remove an average of 7% (range 0-8%) of the prehunt population (Table 6). The estimated harvest does not include native hunters whose take may equal or exceed the non-native harvest.

The skewed bull/cow ratios (Table 4) can be partially explained by the disproportionately high number of males in the licenced harvest. In 1983 the harvest composition in GMZ 5, 7 and 9 was 91% males, 8% females and 1% calves. This selection for males has undoubtedly contributed to the present skewed ratios.

Table 5. Distribution (% frequency) of moose (all ages and sexes) among habitat classes by Survey Area, November - December 1983.

Habitat Parameter	Survey Area 1-A	2-A	4-A	5-A	5-B
Herbaceous	2.3	-	0.5	-	-
Shrub	60.4	78.8	65.4	30.4	50.3
Shrub-conifer	22.0	21.2	29.5	47.9	47.4
Conifer	15.3	-	0.6	7.5	2.3
Deciduous	-	-	4.0	14.2	-
457 - 1096 m	31.5	21.2	16.9	32.5	4.8
1096 - 1401 m	53.0	75.3	52.9	-	61.6
1402 - 1524 m	15.5	3.4	30.2	67.5	33.6
0 - 90° (N-E)	33.1	79.3	29.1	39.8	25.2
91 - 180° (E-S)	12.9	-	15.6	13.0	39.1
181 - 290° (S-W)	23.7	-	12.9	25.2	13.5
292 - 360° (W-N	30.3	-	23.3	12.6	22.1
Flat	-	20.7	19.0	9.4	-

Table 6. Estimated Moose Harvest by Sport Hunters in the Survey Areas, 1983[a]

S.A.	HARVEST			1983 post-hunt pop. Estimate	1983 pre-hunt pop. Estimate	% of 1983 pre-hunt population Harvested
	Resident	Non-Resident	Total			
1-A (GMS 7-01 to 7-06)	25	1	26	346	372	7%
2-A (GMS 5-40)	0	0	0	29	29	0%
4-A (GMS 7-13 to 7-27)	32	12	44	651	695	6%
5-A (GMS 9-08, 9-09)	41	0	41	472	513	8%
5-B (GMS 9-01,9-02, 9-04)	11	0	11	171	182	6%
TOTAL	109	13	122	1669	1791	7%

[a] does not include native harvest

Cost

The survey cost, including personnel, aircraft rental, fuel and accommodation was $85,128.00 or 10.97 km^2 habitable moose range. Rental of aircraft contributed most to overall cost (79% helicopter and 14% fixed-wing), while labour added 11% to the total budget (Table 7). The price of fuel was incorporated into the aircraft rental cost.

Table 7. Cost Breakdown for the 1983 moose surveys

Item	Cost
Fixed-wing (stratification)	$11,500.
Helicopter (census)	60,475.
Personnel - already on staff	6,638.
- newly hired	2,515.
Food and Lodging	3,000.
Miscellaneous (vehicle, cost, supplies phone, etc.)	1,000.
Total Cost:	$85,128.

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