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ABUNDANCE AND COMPOSITION OF MOOSE IN THE WHITEHORSE SOUTH, NISUTLIN AND LIARD EAST AREAS, NOVEMBER 1986

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ABSTRACT

Moose were censused in three different areas of southern Yukon using a stratified random block technique during aerial surveys between 7-26 November, 1986. Moose density and composition were similar in the Nisutlin and Liard East areas with 0.13 and 0.14 moose/km^2, respectively. Compared with previous surveys of moose in southern Yukon, adult sex ratios were more balanced and calf survival/yearling recruitment figures were higher in the Nisutlin and Liard East areas with 89 and 79 bulls/100 cows, 36 and 37 yearlings/100 cows and 49 and 51 calves/100 cows, respectively. Twinning rates in the two areas were 12% and 13%. In the Whitehorse South survey area, moose density was higher (0.29 moose/km^2) but the proportion of bulls, yearlings and calves in the population was lower (27 bulls, 18 yearlings and 31 calves/100 cows) than in the Nisutlin and Liard East areas. Twinning rate was also lower (4%). The resident and non-resident harvest of moose in each survey area was tabulated and appear to have decreased in recent years.

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INTRODUCTION

While moose are distributed in varying densities throughout the Yukon, only about 15% of the total potential moose range has been inventoried to date. Survey efforts have been concentrated in southwestern Yukon where populations were censused annually between 1981-1984 to determine moose population density, distribution, composition and changes in population size over time (Larsen, 1982; Johnston and McLeod, 1983; Markel and Larsen, 1983, 1984, 1985). These areas received priority based on hunting pressure expressed as actual number of moose killed or number of days spent hunting moose (Larsen, 1982).

Since survey results from the priority areas indicated low calf survivorship (6-24 calves/100 cows; Larsen et al., 1985) and local population declines, a study was carried out between 1983-1985 to evaluate 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.).

In 1986, the inventory program was extended to include additional priority areas that currently receive heavy pressure from both native and non-native hunters. The objective is to gain a Yukon-wide perspective of moose population abundance, distribution, and composition which can be used to identify areas with a harvestable surplus of moose. The inventory program is scheduled to continue until 1989-90 when all priority areas will have been intensively surveyed at least once. Reported here are moose population characteristics and harvest data from three areas in southern Yukon that were surveyed in November 1986.

SURVEY AREA

The three areas that were surveyed for moose in 1986 were Whitehorse South, Nisutlin and Liard East (Fig. 1).

The Whitehorse South area includes Game Management Subzones (GMS) 7-13 to 7-27 and about 2500 km^2 of habitable moose range. This area was surveyed for moose annually between 1981 and 1983 (Larsen, 1982; Johnston and McLeod, 1983; Markel and Larsen, 1984). The terrain consists of precipitous mountains rising to over 2200 m and separated by wide U-shaped valleys. Treeline occurs between 1070 m (3500 feet) and 1220 m (4000 feet). Shrub birch (Betula spp.) and willow (Salix spp.) are the predominant species in the extensive subalpine zone ranging from treeline to 1520 m (5000 feet). On the lower slopes, the dominant tree species are white spruce (Picea glauca) and lodgepole pine (Pinus contorta) with scattered stands of birch (Betula papyrifera) and poplar (Populus spp.).

The Nisutlin area includes GMS 10-21 to 10-23 and about 4210 km^2 of habitable moose range. The Nisutlin River valley and delta were last surveyed for moose in the mid-70's (Hoefs 1974, 1976; Lortie, 1974). The area is less mountainous than Whitehorse South with wide valleys dominated by climax stands of open canopy black spruce (Picea mariana) or dense stands of white spruce (P. glauca), riparian willow (Salix spp.) and poplar (Populus spp.) near drainages. Patchy burns have been revegetated with primarily willow and pine (Pinus contorta). The subalpine shrub zone was similar, but less extensive, to that found in Whitehorse South.

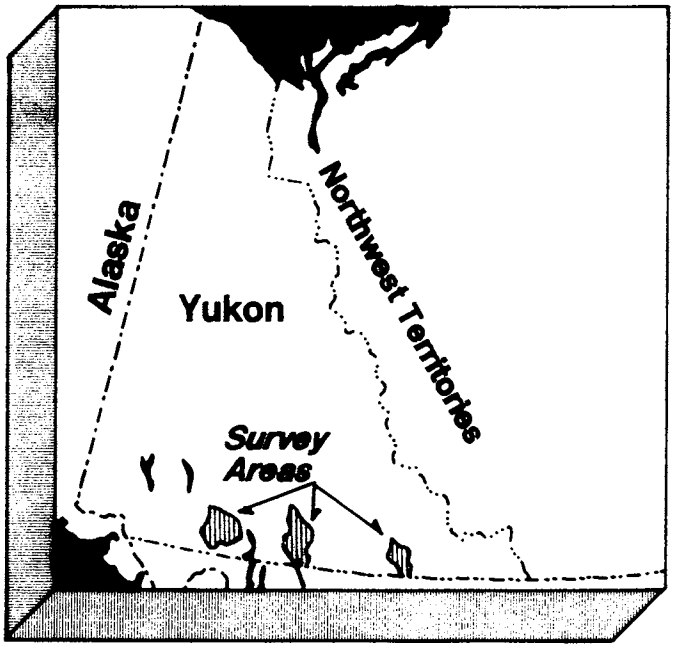
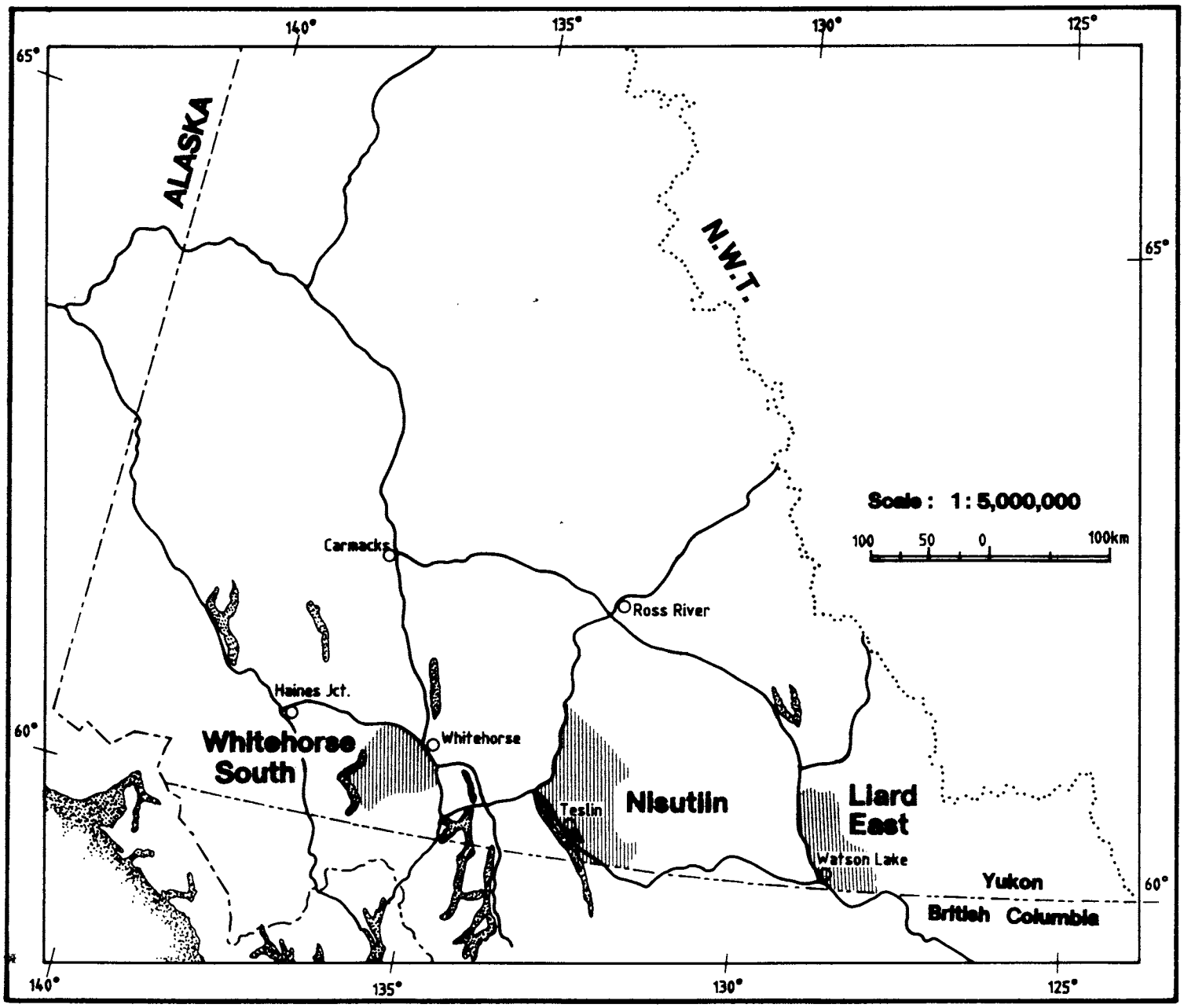


Fig. 1 : Moose Survey Areas in the Southern Yukon



The Liard East area includes GMS 11-28 and 11-29 with a total habitable moose range of about 2210 km^2. This area, north and east of Watson Lake and the Liard River, has never been systematically surveyed for moose. However, a moose survey over a large area west of the Liard River was done in 1983 (Johnston and McEwen, 1984). The Liard East area is characterized by rolling topography with extensive stands of mature black spruce (Picea mariana) and white spruce (P. glauca) occasionally mixed with aspen (Populus tremuloides) on south-facing slopes. A mosaic of small burns with shrub willow (Salix spp.) and Pine (Pinus contorta) is evident in parts of the survey area. A large recent (1982) burn covers an area of about 2000 km^2 east of the survey area.

The physiography, climate and vegetation in these areas have been described in detail elsewhere (Oswald and Senyk, 1977).

METHODS

Aerial surveys were conducted between 7-12 November, 15-21 November, and 20-26 November in the Whitehorse South, Nisutlin, and Liard East areas 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). In addition, the ground is covered with snow by early November. Both of these factors increase moose sightability during aerial surveys (Gasaway et al., 1981). The presence of antlers on most bulls to mid-December facilitates the sexing of moose from aircraft.

To estimate moose abundance and composition, a stratified random block sampling technique was used (Gasaway et al., 1981) with modifications to accommodate the terrain, weather conditions and distribution of moose in Yukon (Larsen, 1982). Briefly, the technique involves the stratification of blocks, or sample units, based on moose densities observed during an initial reconnaissance survey in fixed-wing aircraft (Cessna 185, Maule or similar). The stratification is followed by a census, or intensive search, of randomly selected sample units in each density stratum using a helicopter (Bell 206). Search patterns during the census varied from parallel overlapping transects and following contour lines to tight circling depending upon the terrain and wind.

Moose observations included information on the number of animals in each aggregation, their age (calves, yearlings and adults) and sex. Moose were sexed by the presence or absence of antlers and vulva patch (Mitchell, 1970). Males were further classified into small bulls (yearlings) or large bulls

(adults) based on antler morphology (DuBois et al., 1981; Oswald, 1982). Yearling cows (18 months old) could not reliably be identified in the field but were assumed to occur in the population in the same proportion as yearling bulls.

A population estimate with associated variance was determined for each stratum within the survey area using a ratio estimator (Gasaway et al., 1981). The overall population estimate, as well as composition, was obtained by adding stratum estimates and variances together. A 90% confidence interval (CI) that fell within 20% of the overall population estimate was considered an acceptable level of precision. The density of moose was calculated based on habitable moose range which generally excluded areas above 1550 m (5000 feet) elevation and water bodies larger than 1 km^2.

Moose harvest data were tabulated by GMS from questionnaires returned by licensed resident and non-resident hunters. Annual harvest (non-native) was estimated for each survey area using Kale (1982).

RESULTS AND DISCUSSION

Search and Sampling Intensity

During the initial stratification, search intensity averaged 0.41 min/km^2, 0.30 min/km^2 and 0.21 min/km^2 in Whitehorse South, Nisutlin, and Liard East, respectively. Search intensity during the census increased to an average of 1.8 min/km^2 which did not differ markedly between strata or survey areas.

The proportion of all sample units (SUs) surveyed varied from 35% in Whitehorse South and Liard East to 24% in the Nisutlin area (Table 1). The lower sampling intensity in the latter area was partly due to its larger size and its less variable distribution of moose. As has been the case in past surveys, sampling effort was concentrated in the high and medium density strata (Table 1) to reduce the overall variance of the population estimate. In comparison, between 18-27% of all SUs in the low density stratum were surveyed.

The size of individual SUs averaged 17.3 km^2 overall and ranged from 14.5 km^2 in the Whitehorse South area to 20.6 km^2 in Liard East.

Population Characteristics and Distribution

Whitehorse South Area

The estimated number of moose in the Whitehorse South area at the time of the survey area was 717 $\pm$ 20% (90% CI) which corresponded to a mean density of 0.29 moose/km^2 (Table 2). This is not significantly different from the 1983 estimate of 651 $\pm$ 22% moose or 0.25 moose/km^2 (Markel and Larsen, 1984).

Table 1. Sampling intensity by stratum and survey area.

Survey Area	Sample Units (SU)	Stratum			
		High	Medium	Low	Total
WHITEHORSE SOUTH (2500 km^2)	No. of SU (%)	17 (10)	18 (10)	138 (80)	173 (100)
	SU surveyed (% sampled)	17 (100)	12 (67)	31 (22)	60 (35)
NISUTLIN (4210 km^2)	No. of SU (%)	13 (5)	18 (8)	205 (87)	236 (100)
	SU surveyed (% sampled)	12 (92)	9 (50)	36 (18)	57 (24)
LIARD EAST (2210 km^2)	No. of SU (%)	8 (7)	7 (7)	92 (86)	107 (100)
	SU surveyed (% sampled)	7 (88)	5 (71)	25 (27)	37 (35)

Table 2. Moose population abundance and composition in the Whitehorse South survey area, November 1986.

Parameter	Stratum			
	High	Medium	Low	Total (90% C.I.)
A. Abundance				
Estimated total moose	298	128	291	717 ± 20%
Density (moose/km^2)[a]	1.13	0.43	0.15	0.29
B. Composition				
Adult bulls (≥ 30 mo.)	52	17	42	111 ± 25%
Adult cows (≥ 30 mo.)	165	60	181	406 ± 25%
Yearlings (18 mo.)[b]	40	18	17	75 ± 24%
Calves	41	33	51	125 ± 22%
Bulls/100 cows (≥ 30 mo.)	31	28	23	27 ± 19%
Yearlings/100 cows	24	30	9	18 ± 33%
Calves/100 cows	25	55	28	31 ± 23%

[a] Density is calculated based on habitable moose range.
[b] Yearling males are assumed to equal yearling females in number.

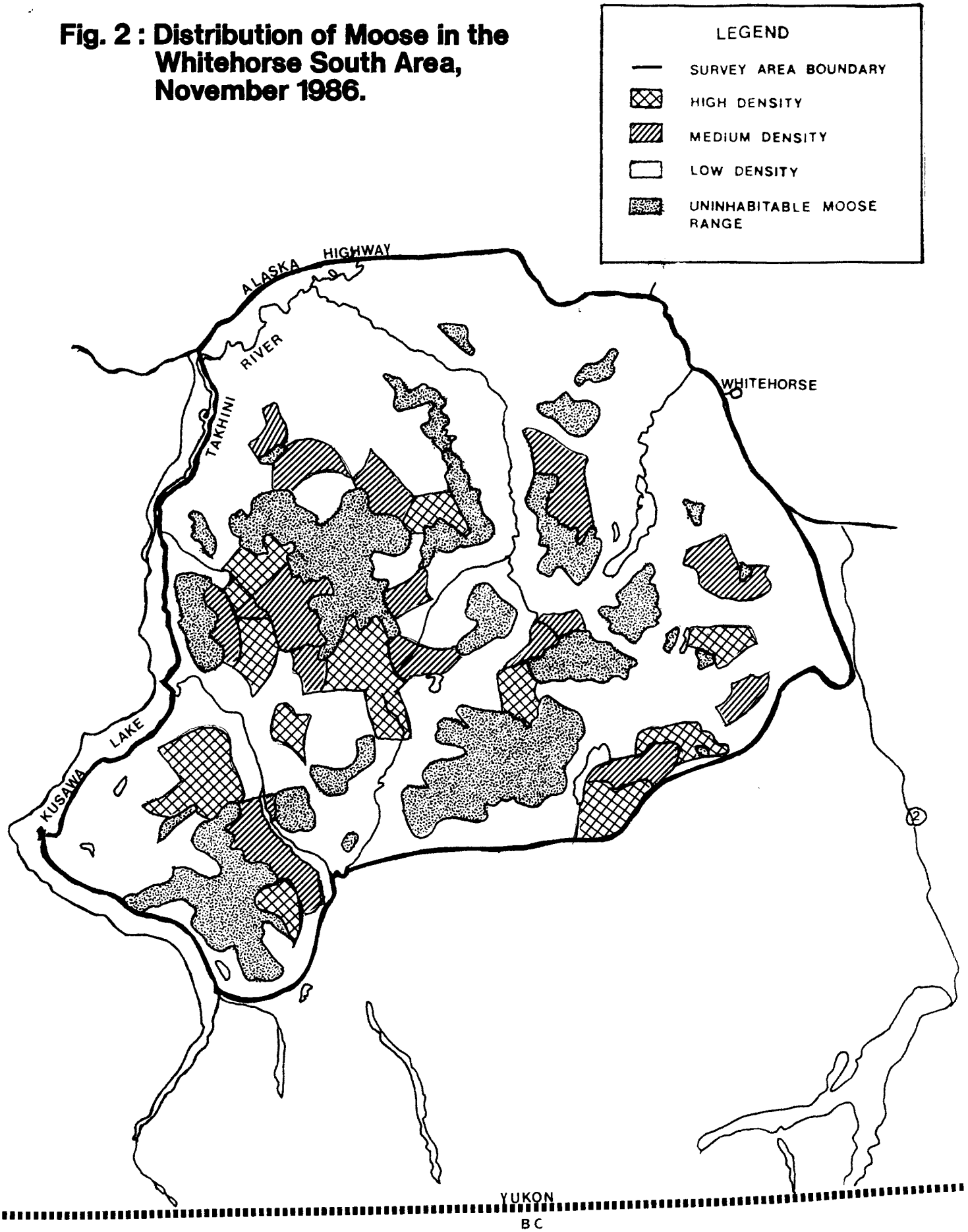
Adult cows ($\geq$ 30 mo.) were the largest single cohort making up 57% of the estimated populaion (Table 2). Calves were more common (17%) than adult bulls (15%) while yearlings represented 10% of the total estimated population, or 13% if calves were excluded. In 1983, there were more adult bulls (24%) and fewer yearlings (3%; Markel and Larsen, 1984).

In 1983, Markel and Larsen (1984) estimated 42 bulls/100 cows while in 1986, the ratio was further skewed to 27 bulls/100 cows (Table 2). In comparison, the ratio of yearlings had increased to 18 yearlings/100 cows (Table 2) from 5 yearlings/100 cows in 1983. Identification of yearlings in 1986 was facilitated by the presence of green collars placed on calves in 1985. During the census (9-11 Nov.), two collared yearling bulls had already lost their antlers on one side while one yearling bull had lost both antlers and showed only pedicel scars. In comparison, all adult bulls, except two, were still carrying their antlers during the survey.

Calf survival to early winter, as expressed by calf/cow ratios, was similar in both years (30 and 31 calves/100 cows in 1983 and 1986, respectively). In this survey, the proportion of cows with twins to all cows with calves (twinning rate) was 4%.

Moose in the survey area showed a distinctly clumped distribution (Fig. 2). While the high and medium density strata comprised only 22% of the habitable moose range, the areas accounted for 60% of the moose. The majority (> 76%) of the population was located above 1240 m (4100 feet) in elevation which approximates the subalpine shrub zone. The general pattern of distribution was similar to that found by Markel and Larsen (1984) in 1983.

Fig. 2 : Distribution of Moose in the Whitehorse South Area, November 1986.



Several large post-rut aggregations (16-19 moose/group) were observed in the high density stratum where mean group size was 3.5 ± 0.4 (SE). Overall mean group size in the survey area was 3.0 ± 0.3 (SE) for 142 aggregations, including single animals.

Nisutlin Area

The estimated moose population in the Nisutlin survey area was 563 ± 19% (90% CI) with a mean density of 0.13 moose/km^2 (Table 3). This density is about half of that recorded in the Whitehorse South area (0.25 moose/km^2; Table 2).

Adult cows and bulls made up 36% and 33% respectively, of the estimated population with an adult sex ratio of 89 bulls/100 cows. Calves represented 18% of the total population while yearlings accounted for 13% (16% if calves excluded from the total). The corresponding yearling/cow and calf/cow ratios were 36 yearlings/100 cows and 49 calves/100 cows. Twinning rate in the Nisutlin area was 12%. When compared to the Whitehorse South area (Table 3), calf survival and yearling recruitment were considerably higher in the Nisutlin area in 1986. The adult sex ratio was also less skewed in the Nisutlin area (89 versus 27 bulls/100 cows).

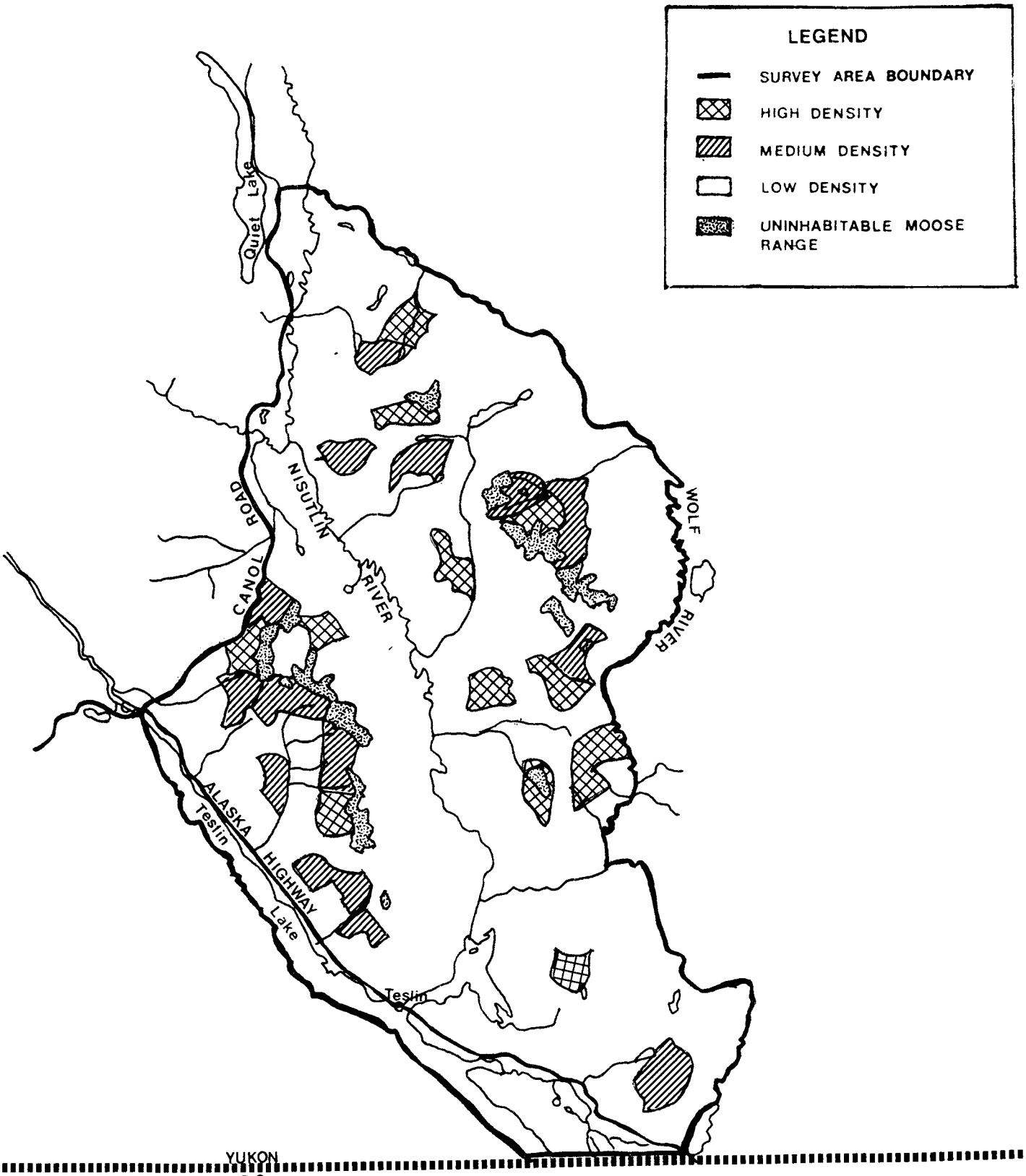
Again, moose showed a clumped distribution (Fig. 3). About 54% of the estimated population was located in the high and medium density strata that made up 14% of the total survey area. Concentrations of moose were observed in the subalpine shrub zone and in shrub-conifer habitat at higher elevations. Over 86% of all moose observations were made in areas located above 1090 m (3600 feet). Few moose were observed along the Nisutlin River valley (Fig. 3) where most of the resident hunting occurs in the fall (Aug. - Oct.).

Table 3. Moose population abundance and composition in the Nisutlin survey area, November 1986.

Parameter	Stratum			
	High	Medium	Low	Total (90% C.I.)
A. Abundance				
Estimated total moose	203	99	261	563 ± 19%
Density (moose/km^2)[a]	0.79	0.28	0.07	0.13
B. Composition				
Adult bulls (≥ 30 mo.)	67	45	70	182 ± 31%
Adult cows (≥ 30 mo.)	82	18	104	204 ± 25%
Yearlings (18 mo.)[b]	23	16	35	74 ± 38%
Calves	30	18	52	100 ± 33%
Bulls/100 cows (≥ 30 mo.)	82	255	67	89 ± 36%
Yearlings/100 cows	29	89	33	36 ± 49%
Calves/100 cows	36	100	50	49 ± 27%

[a] Density is calculated based on habitable moose range.
[b] Yearling males are assumed to equal yearling females in winter.

Fig 3 : Distribution of Moose in the Nisutlin Area, November 1986.



During a drainage survey in February 1974, Hoefs (1974) observed over 160 moose along the lower Nisutlin River (1.4 moose/km^2) of which 21% were calves (50 calves/100 cows). A similar survey in February 1976 (Hoefs, 1976) confirmed high densities in the Nisutlin River delta area (about 2.8 moose/km^2) with slightly lower densities along the river (about 4.4 moose/km of river flown). Apparently, moose concentrate in these areas in late winter. Lortie (1974) found no moose along the Nisutlin River during a helicopter survey in early December 1974. He found most moose at higher elevations (above 1320 m) and speculated that moose moved out of the valley bottom with the onset of the breeding season and returned in late winter as snow accumulated at higher elevations. His observations of moose distribution in early winter agree with our findings during the 1986 survey.

During a wolf survey in the Nisutlin area in January 1987, Hayes and Baer (1987) found most moose in conifer habitat between the river valley and subalpine areas. They estimated the survey area was used by 47-53 wolves in 9 packs which would represent a range of ratios of 9-14 moose/wolf. Gasaway et al. (1983) found that wolf predation was usually sufficient to cause a decline in moose abundance and low calf adult survival at ratios of less than 20 moose/wolf. Our survey data indicate good calf survival in both 1985 and 1986 (Table 3) despite apparently high wolf numbers. We do not know to what extent favourable winters may have enhanced calf survival or to what degree wolves in the area use other prey species, such as woodland caribou, seasonally.

Liard East Area

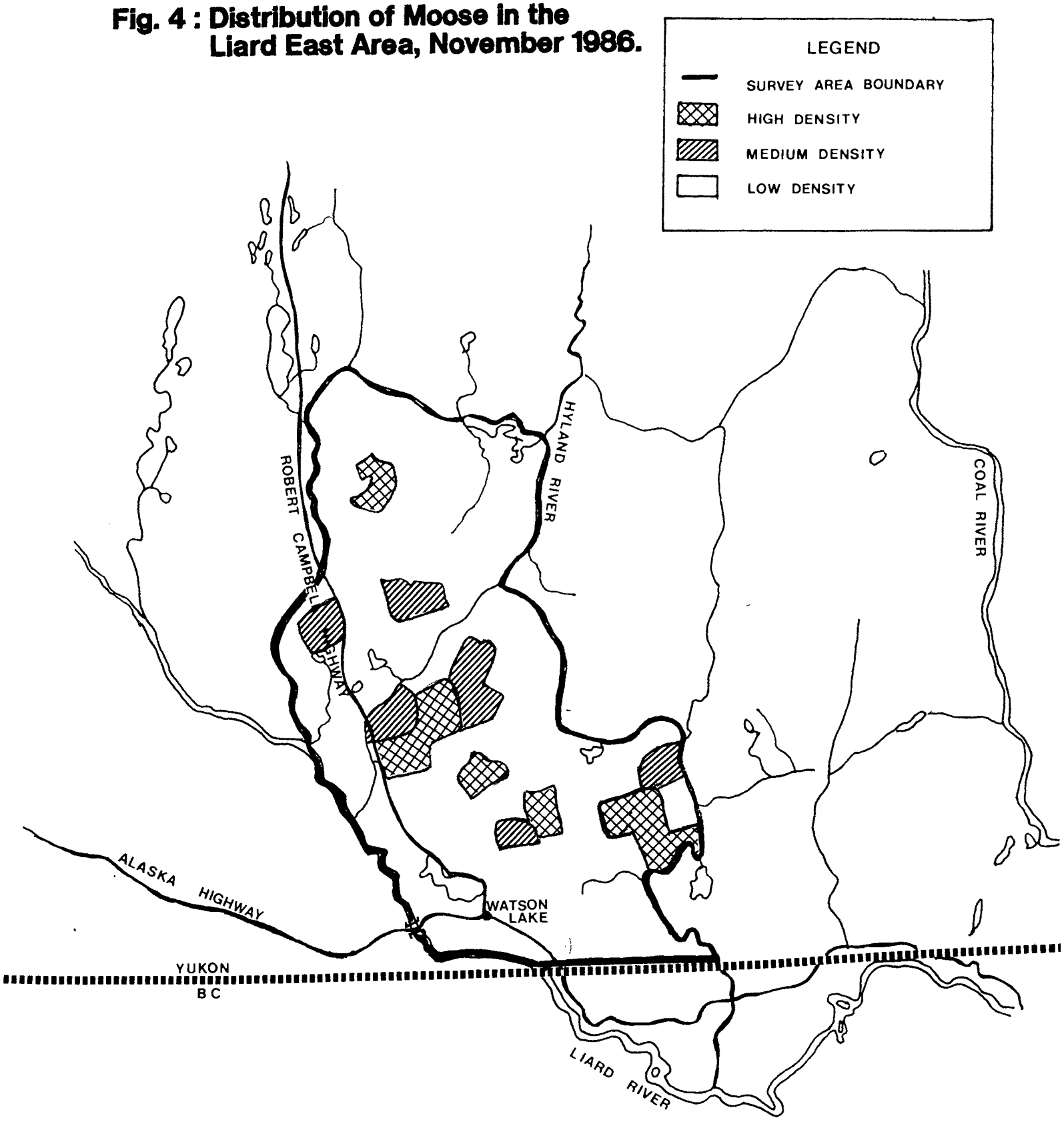
The estimated number of moose in the Liard East area was 305 $\pm$ 21% (90% CI) with a mean density of 0.14 moose/km^2 (Table 4). This density is similar to

Table 4. Moose population abundance and composition in the Liard East survey area, November 1986.

Parameter	Stratum			
	High	Medium	Low	Total (90% C.I.)
A. Abundance				
Estimated total moose	52	52	201	305 ± 21%
Density (moose/km^2)[a]	0.34	0.31	0.11	0.14
B. Composition				
Adult bulls (≥ 30 mo.)	25	15	50	90 ± 30%
Adult cows (≥ 30 mo.)	13	15	86	114 ± 34%
Yearlings (18 mo.)[b]	6	8	29	43 ± 42%
Calves	8	14	36	58 ± 27%
Bulls/100 cows (≥ 30 mo.)	193	100	58	79 ± 35%
Yearlings/100 cows	43	55	33	37 ± 53%
Calves/100 cows	64	91	42	51 ± 34%

[a] Density is calculated based on habitable moose range.
[b] Yearling males are assumed to equal yearling females in winter.

Fig. 4 : Distribution of Moose in the Liard East Area, November 1986.



that found in the Nisutlin area (0.13 moose/km^2) and also comparable to the density observed in an area west of the Liard River in 1983 (0.12 moose/km^2; Johnston and McEwen, 1984).

Moose composition in the Liard East area was also similar to observations from the Nisutlin area. Adult cows and bulls accounted for 37% and 30%, respectively, and the adult sex ratio was 79 bulls/100 cows (Table 4). Calves made up 19% of the total while yearlings represented 14% (17% if calves are not included in the total population). Calf survival and yearling recruitment appeared good with 51 calves/100 cows and 37 yearlings/100 cows. The twinning rate was 13%.

The distribution of moose throughout the Liard East area was less clumped when compared to the other two survey areas. About 34% of the estimated moose population occurred in the high and medium density strata that represented 15% of the total survey area (Fig. 4). In the rolling, spruce-dominated habitat of the Liard East area, most moose were observed along riparian creek drainages in or near recent burns. About 75% of all moose observed were found below 900 m (3000 feet) elevation which may reflect the lack of subalpine habitat within the survey area. The mean group size over all strata was 1.9 $\pm$ 0.2 (SE) and the largest group observed was 7 moose.

A large area west of Watson Lake and the Liard River ("Liard West" - 7230 km^2) was surveyed for moose in early winter 1983 (Johnston and McEwen, 1984). Overall moose density was low (0.12 moose/km^2) but comparable to the Liard East area (0.14 moose/km^2). While the adult sex ratio was similar in both areas (75 versus 79 bulls/100 cows), calf survival and yearling recruitment

were considerably lower in the Liard West area where 18 calves/100 cows and 18 yearlings/100 cows were recorded (cf. Table 4). When survey results were analyzed by topographic zone, Johnston and McEwen (1984) found that moose in the lowland areas had a greater proportion of calves and yearlings than did moose in the foothills and mountain zones. The lowland areas west of the Liard would also be more similar in habitat types to the Liard East area where calf and yearling counts were relatively high.

Hunter Harvest

The number of moose harvested by resident hunters in the three survey areas appears to have decreased in recent years (Table 5). From a mean annual harvest of 44 moose in the Whitehorse South area between 1979-1983, the estimated harvest in 1985 was only 13 moose. The non-resident sport harvest also declined from 11 to 2 moose. When compared with the 1986 moose population estimate (717 moose) the combined resident and non-resident harvest decreased from 8% to 2% of the estimated population.

In the Nisutlin and Liard East areas, where there were no reported harvest by non-resident hunters, the mean annual resident harvest between 1979-1983 corresponded to 4% of respective moose population estimates. In 1985, the resident harvest in both areas had decreased to 3% of the estimated moose populations.

A bulls-only regulation for licensed hunters came into effect in 1982 for GMZ 7 (Whitehorse South) and in 1984 for GMZs 10 (Nisutlin) and 11 (Liard East). Thus the 1985 harvest by resident hunters was on bulls only.

The number of moose harvested by natives is unknown, but likely equals or exceeds the sport hunter harvest (Larsen, pers. comm.). A program to collect native harvest data is currently underway in Teslin and Watson Lake and will likely be expanded to other communities in conjunction with further inventory work.

Table 5. Estimated number of moose harvested annually by sport hunters in Game Management Subzones (GMS) surveyed for moose.[a]

Survey Area	Resident Harvest 1979-83 (Mean)	Resident Harvest 1985	Non-resident Harvest 1979-83 (Mean)	Non-resident Harvest 1985
Whitehorse South (GMS 7-13 to 27)	44	13	11	2
Nisutlin (GMS 10-21 to 23)	24	17	0	0
Liard East (GMS 11-28 to 29)	13	8	0	0

[a] Does not include native harvest.

Cost

Including personnel, aircraft rental, fuel and accommodation, the cost for the 1986 surveys was $107,600.00 or $12/km^2 of habitable moose range (Table 6). Rental of aircraft contributed most to overall cost (59% helicopter and 12% fixed-wing), while personnel costs accounted for 19% of the total budget.

Table 6. Cost breakdown for the 1986 moose surveys.

Item	Cost
Fixed-wing (stratification)	$ 13,000
Helicopter (census)	63,200
Personnel - permanent	5,500
- casual or contract	14,500
Food and accommodation	5,500
Miscellaneous (fuel caching, maps, etc.)	5,900
TOTAL:	$107,600

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