MOOSE POPULATION RESEARCH AND MANAGEMENT STUDIES IN YUKON

SUMMARY OF MOOSE TREND SURVEY RESULTS

1990

by
D.G. Larsen
and
R.M.P. Ward

Yukon Fish and Wildlife Branch
Survey Report

SR-91-5

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A/ Chief, Big Game Management

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ABSTRACT

Trend surveys were conducted near the North Canol Road, Fish Lake, Frederick Lake, and Aishihik Lake in November 1990. The purpose of these surveys was two-fold; to gather trend information on moose abundance, composition and distribution, and to refine the trend survey technique. Two replicate surveys within the same year (November 19-23 and November 23-December 4) were flown in the Aishihik area using standardized techniques. Moose abundance and composition was not significantly different ($P<0.05$) between surveys but distribution was different. Further tests are recommended due to the limited number of replicate surveys flown. These same results suggest that standardized survey techniques provide consistent results with regard to moose abundance and composition. Between year comparison of moose abundance, composition, and distribution were significantly different ($P<0.05$) in both the North Canol and Fish Lake areas between 1989 and 1990. These differences may be contributed to a combination of increased search intensity, different survey periods, different observer experience, and changes in moose demographics. The Fish Lake composition data confirms previous information on a skewed sex ratio in favor of bulls. No significant correlation ($P=0.12$) was found between the time of day and the number of moose observed on surveys.

INTRODUCTION

The first trend survey area was established in the Yukon in 1988. The objective was to provide low cost information annually on moose population trends in selected areas throughout the Yukon (Larsen and Ward 1990). In 1989 the number of areas flown was increased to 6 with the intent of gathering trend information from all moose management priority areas.

Larsen and Ward (1990) recognized the potential for biases in trend survey data and recommended that either the biases be measured and results adjusted accordingly, or standardize survey procedures in order to keep survey biases consistent between surveys. In order to test and refine the survey technique, the number of trend areas was reduced to 4 in 1990.

The specific objectives of the 1990 trend surveys were to:

1. Compare within-year differences in observed moose abundance, composition, and distribution (Aishihik).
2. Assess variability in observed moose abundance when using standardized survey techniques (Aishihik).
3. Compare between-year differences in observed moose abundance, composition, and distribution (North Canol and Fish Lake).
4. Summarize trend data collected from Frederick Lake.
5. Compare within-day differences in observed moose abundance.

STUDY AREAS

The four survey areas were located near the North Canol Road, Fish Lake, Aishihik Lake, and Frederick Lake; each area encompassing 250-350 km^2 (Figure 1, Appendices 1 to 4). North Canol and Fish Lake were the only areas that were previously surveyed. Descriptions of the climate, topography and habitat can be found in Oswald and Senyk (1977) as well as the census reports for each area (Jingfors and Markel 1987, Jingfors 1988, and Larsen and Ward in prep.).

METHODS

Surveys were flown in November 1990 using a Piper supercub (PA 18) or Maule M-7 aircraft with a single observer. The entire area was searched at an intensity of between 1.6 and 2.1 minutes per km^2. For a more detailed description of the survey technique see Larsen and Ward (1990).

Within-year differences in observed moose abundance, composition, and distribution were assessed in the Aishihik area, by replicating standardized surveys (November 19-23 and November 23-December 4). The intent was to have 3 replicate surveys (late October, mid November, and early December) but poor weather prevented us from following this schedule. Surveys were standardized by using a consistent search intensity (1.8 min./km^2), the same aircraft (Piper supercub), the same pilot, the same two observers (alternating days), consistent search patterns, air speed, and altitude. Differences in composition and distribution were tested using Chi-square analysis.

Replicate surveys using standardized techniques also allowed us to assess variability in the number of moose seen under standardized conditions. This assessment was hindered as only two surveys were flown.

Between-year differences in abundance, composition, and distribution were assessed in the North Canol and Fish Lake areas between 1989 and 1990. Differences were tested using Chi-square analysis.

Differences in the number of moose seen at various times of day was assessed by regressing the number of moose seen in each sample unit with time of day. Data from past regional and trend surveys (1988 and 1989) were used for this comparison.

Moose are classified as adult bulls (≥30 mo.) adult cows (≥30 mo.), yearlings (18 mo.), and calves. Yearling cows cannot be reliably identified from adult cows, however yearling bulls can be identified based on antler morphology. Assuming even sex-ratios at birth and similar rates of mortality between birth and 18 months of age for both sexes, the estimated number of yearling males is (a) doubled to estimate the total number of yearlings and (b) subtracted from the total number of cows to calculate the number of mature cows.

RESULTS

Survey results are presented in Tables 1 through 4. A detailed presentation of the results by sample unit is provided in Appendices 1 through 4. Appendix 5 has a breakdown of survey cost.

Aishihik The results from the two trend surveys conducted during the fall of 1990 were similar (Tables 1 and 2). A total of 62 (185 moose/km^2) and 69 (205 moose/1000km^2) moose were recorded on the first and second surveys respectively. Moose were seen at a rate of 1 moose per 9.9 minutes during the first survey and 1 moose per 8.9 minutes during the second. Overall population estimates were within 11% of each other.

The number of mature cows (28 vs 31), bulls (16 vs 18), yearlings (2 vs 8), and calves (16 vs 12) were not significantly different (Chi-square 3.55; $P>0.05$) between surveys (Table 1), however recruitment rates (yearlings/yearlings + adults) significantly increased from 0.04 in the first survey to 0.14 in the second.

Moose distribution over the trend area varied considerably between surveys (Chi-square 22.96 and $P<0.05$ Appendix 1). Three sample units maintained their relative moose density between surveys, 4 units went from low density (=<0.20 moose/km^2) to high (>0.20 moose/km^2) and 3 went from high to low.

Frederick Lake: Moose were seen at a rate of 1 moose/3.6 minutes of survey time (Table 1). A total of 105 moose were seen at an average

density of 432 moose/1,000km2.

Mature cows made up the largest number of moose seen during the trend survey at 36 (34%) (Tables 1 and 2). Twenty-eight yearlings (27%) were estimated for the area, followed by mature bulls at 25 (24%) and calves at 16 (15%). Based on the trend survey data, the recruitment rate for the Frederick Lake area was 0.31.

North Canol: Search intensity for the North Canol area was 2.1 minutes/km^2 (Table 1). A total of 97 moose were recorded in the trend area for an average density of 310 moose/1,000 km^2. Moose were seen at a rate of 1 moose per 6.7 minutes of survey time. This is a substantial increase over the 40 moose seen in the same area in 1989 (Appendix 3).

Mature cows comprised the largest number of moose seen at 33 (34%), followed by calves at 31 (32%). This represents 94 calves per 100 mature cows, the highest calf-cow ratio so far recorded in the Yukon (Anon. 1990). Seventeen (18%) Mature bulls and 16 (16%) yearlings were observed. Recruitment rate was 0.24. Composition from the 1989 survey was significantly (Chi-square 5.99, $P<0.05$) different from 1990, with higher values in 1990 for all age-sex groups except bulls (Appendix 3). Proportionately, cows (35% vs 34%) and yearlings (10% vs 16%) were similar, but bulls (38% vs 18%) and calves (17% vs 32%) were different between 1989 and 1990, respectively.

Distribution of moose amongst sample units differed between 1989 and 1990 (Chi-square 63.66; $P<0.05$; Appendix 3). Five sample units went from having no moose in 1989 to 58 moose, or 60% of moose observed in 1990.

Fish Lake: Search intensity for the Fish Lake area was 1.7 minutes/km^2 (Table 1). One moose was seen per 5.7 minutes of survey time. A total of 75 moose were observed in the Fish Lake trend area this year for a density of 301 moose/1000 km^2. This is a substantial increase from 45 observed in 1989.

Unlike all other survey areas, mature bulls comprised the largest proportion of observed moose at 23 (31%) followed by yearlings 22 (29%), mature cows 16 (21%) and calves 14 (19%). These data indicate that there is a preponderance of male moose in the Fish Lake area, with 144 bulls/100 mature cows. The ratio of yearlings to mature cows was also extremely high at 138/100. The resulting recruitment rate for the Fish Lake area was 0.36.

Composition was significantly different (Chi-square 9.84, $P<0.05$) between the 1989 and 1990 surveys (Appendix 4). More moose were observed in all age-sex groups with similar proportions of cows (20% vs 21%), and calves (13% vs 19%), but different proportions of bulls (49% vs 31%) and yearlings (18% vs 29%) in 1989 and 1990, respectively. Distribution of moose amongst sample units was also different (Chi-square 33.5; $P<0.05$) between years (Appendix 4).

Effects of survey time on moose observed

Data from 515 sample units surveyed at different times of the day during the 1988 and 1989 trend and regional surveys revealed no correlation ($r^2 = 0.005$; $P = 0.12$) between the time a sample unit was surveyed and the number of moose seen (Figure 2).

DISCUSSION

Within-year differences

Minor differences in abundance and composition were documented between the two back to back surveys flown in the Aishihik area, suggesting that survey date has little effect on population counts, at least between mid and late November. These two surveys may not have been sufficiently spaced to show a difference, however. Further tests should be carried out over a wider time period. The consistency in survey results suggest that the existing trend areas are sufficiently large enough to accommodate daily and perhaps weekly movements of moose within the trend area, at this time of year. Currently we assume immigration equals emigration, however this assumption should be tested. The significant difference in moose distribution within the trend area, between surveys, suggests that individual sample units are not large enough to accommodate daily and weekly movements.

Consistency in observed moose abundance and composition between the two standardized replicate surveys indicates that it is possible to duplicate survey results, using standardized techniques. These results suggest that if the existing technique is applied in a standardized fashion in future surveys, any variability in moose abundance and composition is likely not due to survey technique. We recognize that two replicate surveys do not adequately measure variance, and therefore recommend further testing. As well, these results do not prove that consistent data could not be obtained using techniques that are not standardized.

Although the composition between replicate surveys was similar, these data must be viewed with some caution due to limited sample sizes. A difference of only a few moose can significantly alter the apparent status of the population. For example, a difference of 3 yearling bulls between the first and second trend surveys in the Aishihik Lake area translated into two very different recruitment rates. The first (R=0.04) was indicative of a rapidly declining population, and the second (R=0.14) of a stable or slowly increasing population. (Gasaway et al. 1990.)

Between-year differences

Abundance, composition, and distribution of moose between 1989 and 1990 in both the North Canol and Fish Lake areas were significantly different. Several factors may be responsible for these differences. The apparent increase of moose in the North Canol area is likely due to a combination of increased search intensity (2.1 min./km^2 in 1990 vs 1.1 min./km^2 in 1989), more experienced observer in 1990, different survey periods (October 29-November 2 in 1990 vs December 2-3 in 1989), and increased survival and possibly immigration into the area as a result of wolf control (Farnell and McDonald 1988). At this time, it is not possible to separate the effects of these four parameters on the number of moose observed. Further refinement of the survey technique and subsequent regional surveys in the wolf control area will be needed to clarify these results.

The apparent increase of moose in the Fish Lake area is also likely due to a combination of increased search intensity (1.7 min./km^2 in 1990 vs 1.1 min./km^2 in 1989) and a more experienced observer in 1990. Unlike the North Canol area, Fish Lake was not subject to wolf control and surveys were conducted during the same time period. An increase in search intensity alone may explain the differences as Gasaway et al. (1986) showed that the proportion of moose seen increases substantially with increased search intensity up to 1.5 to 2.0 min./km^2. We conclude that between-year comparisons of moose abundance in both the North Canol and Fish Lake areas are invalid due to significant differences in survey techniques.

The effects of different survey techniques on composition is less obvious. In both areas, yearling and calf proportions (percentage of population) increased, cows remained the same, and bulls decreased. Increased search intensity may partially explain the increase in calf numbers as smaller moose are more difficult to spot from the air compared to larger moose. This effect may have been more pronounced in 1989 due to the lower search intensity. We have no other explanation for these differences in composition between years other than perhaps both populations are increasing. High proportions of calves and yearlings in the population are typical of expanding populations.

The skewed sex ratio in Fish Lake is of particular interest. The disproportionately high number of mature bulls in both the 1989 (244 bulls/100 cows) and 1990 (144 bulls/100 cows) surveys is atypical of moose populations in the Yukon. These findings are higher than the

89/100 documented on the regional census in 1986 (Jingfors and Markel 1987), but the latter is also atypically high for the Yukon. Because of those similar results from the region, we suggest the skewed sex ratio is the result of disproportionate cow mortality, and not sampling bias.

Differences in distribution amongst sample units and between years would be expected considering we have previously documented a difference in distribution within years (Aishihik). These differences are due to the small size of individual sample units and therefore, does not necessarily affect abundance and composition within the trend area.

RECOMMENDATIONS

1. Continue with the current trend survey program for at least two more years in the Aishihik Lake, Frederick Lake, Fish Lake, and North Canol areas. The North Canol area will provide an excellent opportunity to make temporal comparisons between trend and regional survey results. This comparison should help evaluate the effectiveness of trend surveys in monitoring changes in regional density. Significant increases in moose numbers is expected in this area as wolf control took place since the last regional survey in 1987. The Fish Lake area is important for comparing changes in moose numbers in a unmanipulated area. The Aishihik and Frederick Lake areas should be monitored in anticipation of an intensive management program there. If this program goes ahead, pre-wolf control information will be essential to an evaluation of our management actions.

2. Monitor the Aishihik area carefully over the next several years to determine population trend. Survey results from both the trend and regional surveys of this area were equivocal with regards to the current population status. Information from both the trend and regional surveys indicates that the population has declined since the 1981 regional survey, is currently at a low level (<100 moose/1,000 km^2), and may be continuing to decline, however.

3. Replicate surveys should be flown to further test variability between surveys conducted at different time during the fall and in counts made using a standardized technique, if funding is available.

ACKNOWLEDGEMENTS

Many people assisted us in the successful completion of our trend survey program again this year. Dave Bakica, Rob Florkiewicz, Torrie Hunter, Lorne LaRocque and Dick Mahoney did a first rate job while acting as survey observers. Denny Denison (Coyote Air) and Rob Lawson (Aerokon) provided safe and efficient flying support. A special thanks is due Torrie Hunter and the Teslin regional office who provided funds to conduct the trend survey in the Fish lake area again this year. Both Norman Barichello and Cor Smits contributed to this paper by providing technical reviews, and Donna Milne by typing.

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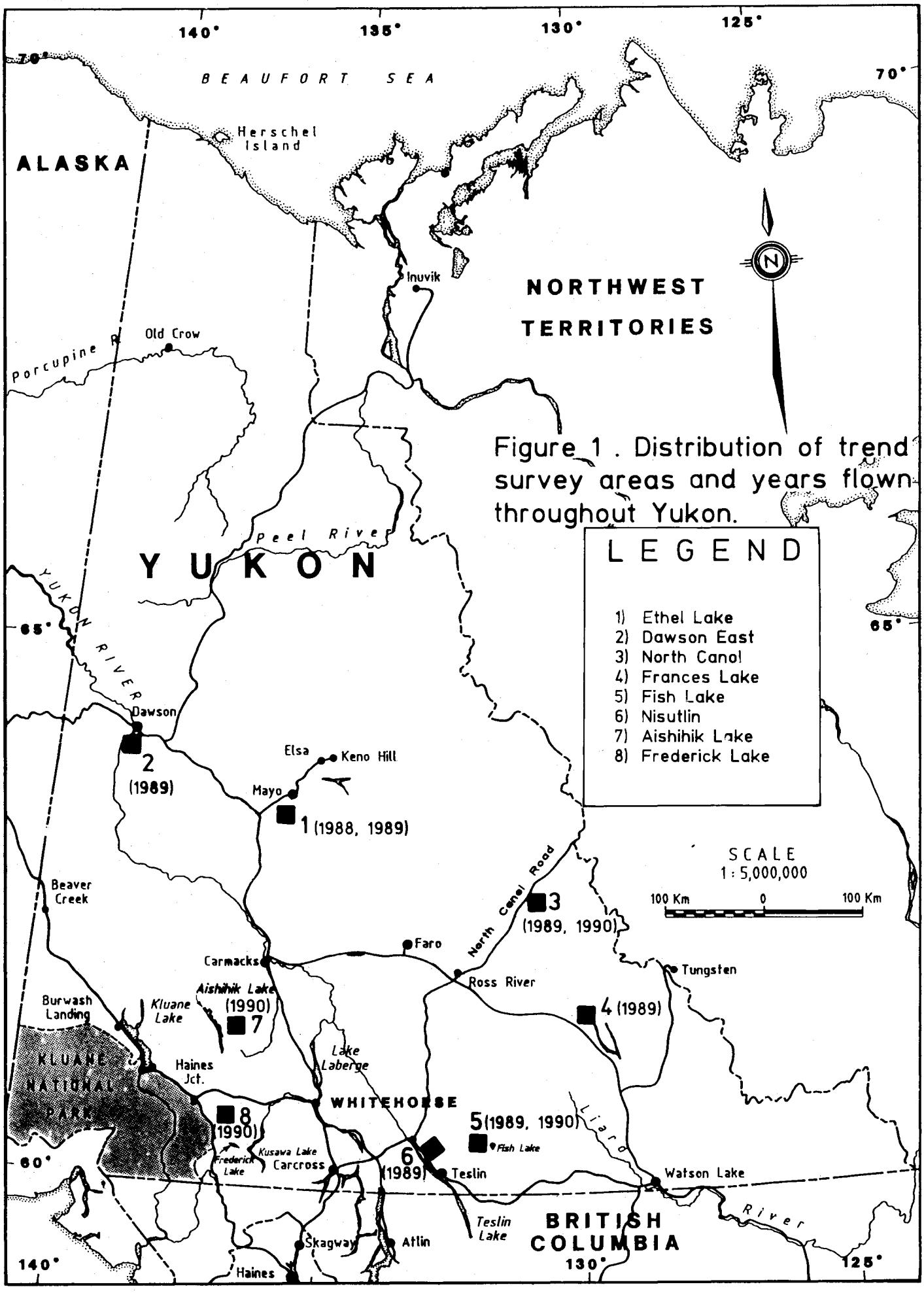


Figure 1. Distribution of trend survey areas and years flown throughout Yukon.

LEGEND

1) Ethel Lake
2) Dawson East
3) North Canol
4) Frances Lake
5) Fish Lake
6) Nisutlin
7) Aishihik Lake
8) Frederick Lake

Figure 2. Survey Start Time versus Number of Moose seen in Sample Unit.

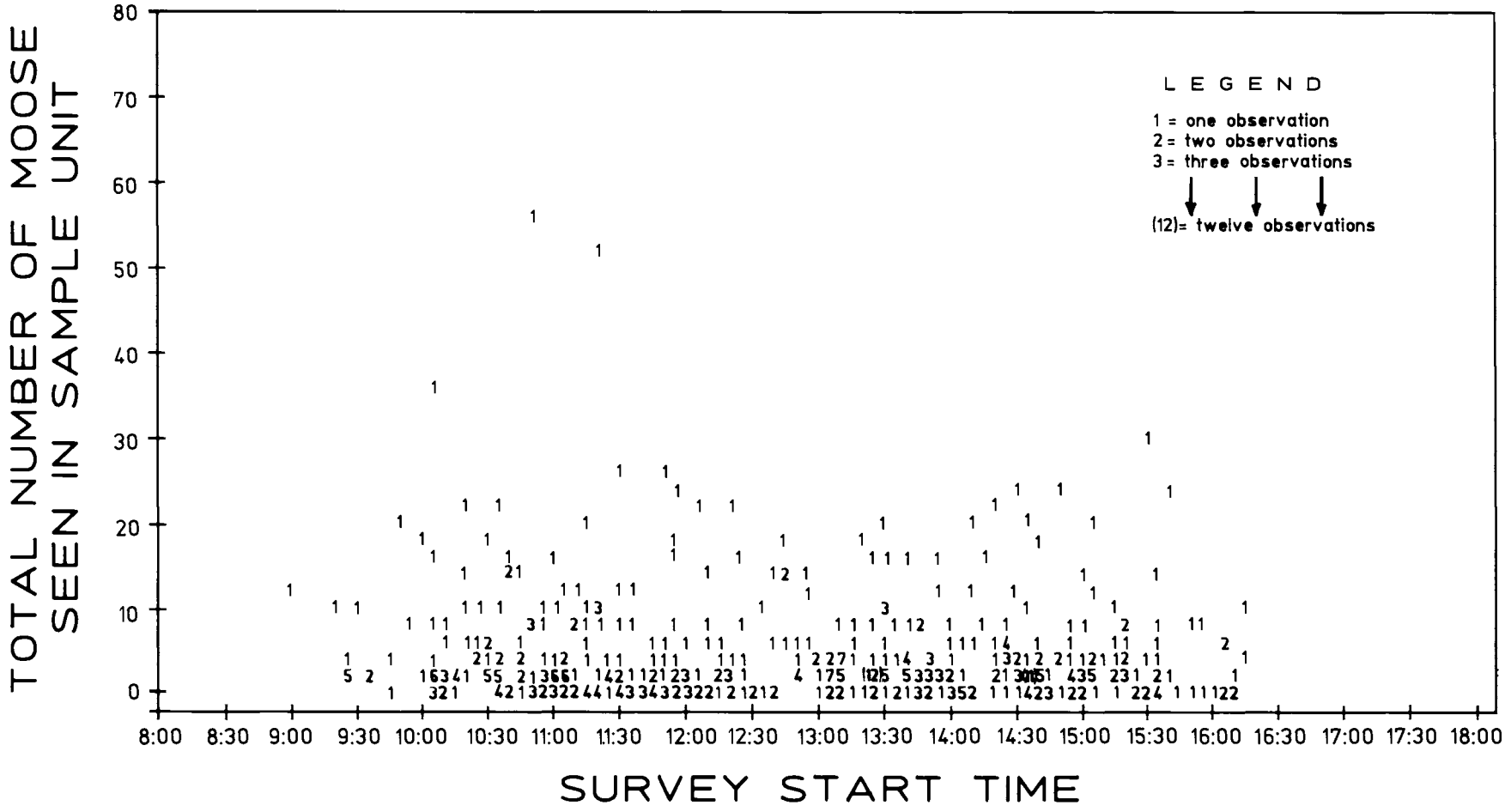


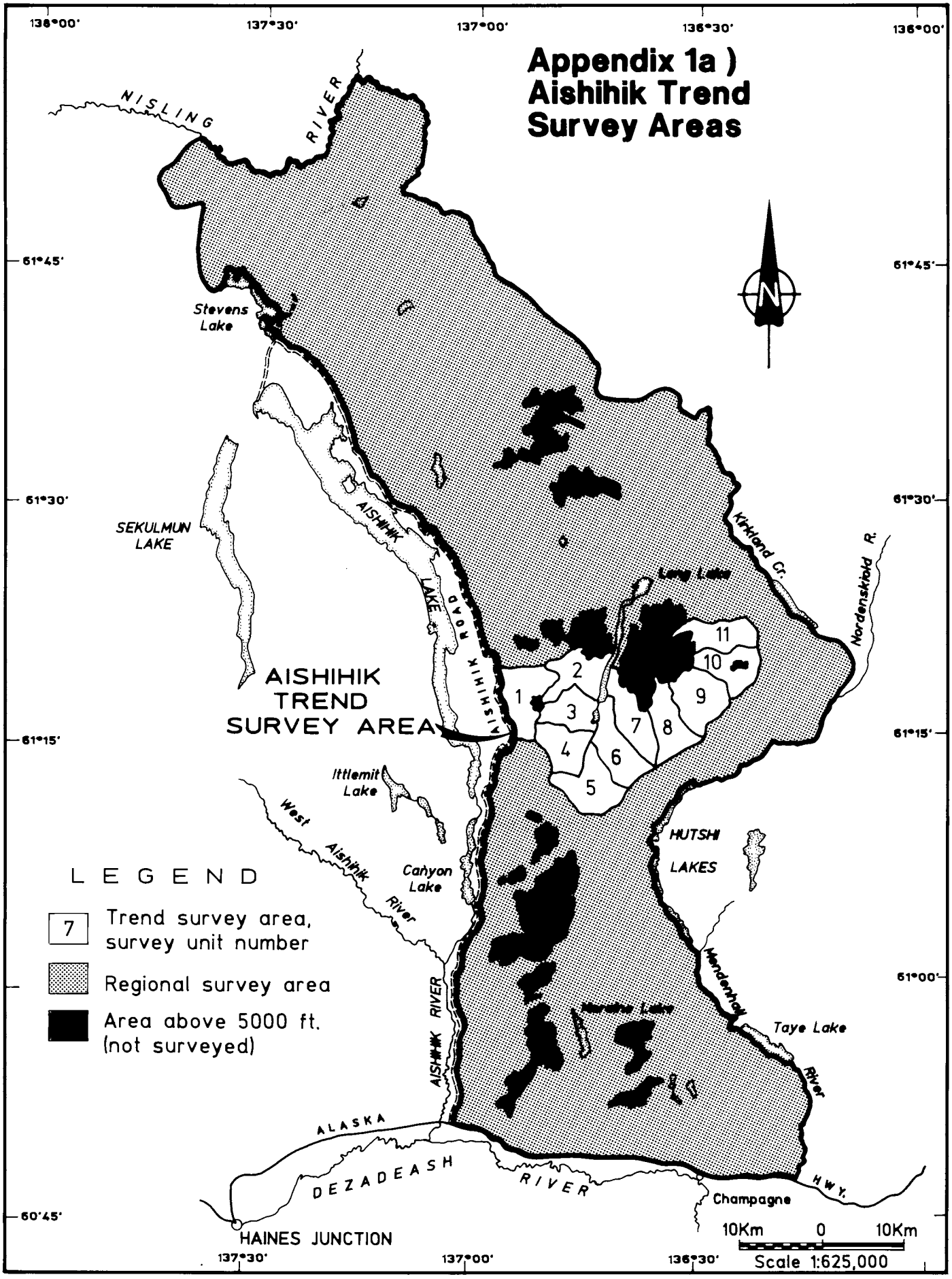
TABLE 1. Moose seen on trend surveys in 1990.

SURVEY AREA	AREA (KM^2)	DATE	SEARCH INTENSITY (MIN./KM^2)	SURVEY TIME/MOOSE SEEN (MIN.)	COWS (≥18 mo)	CALVES	YEARLING BULLS[a]	MATURE BULLS (≥30mo)	TOTAL MOOSE SEEN	TOTAL MOOSE DENSITY (MOOSE/KM^2)
Aishihik #1	335.8	November 19 - 23	1.8	9.9	29	16	1	16	62	0.18
Aishihik #2	335.8	Nov. 23 - Dec. 4	1.8	8.9	35	12	4	18	69	0.20
Frederick Lake	242.6	November 27,28	1.6	3.6	50	16	14	25	105	0.43
North Canol	317.6	Oct. 29 - Nov.2	2.1	6.7	41	31	8	17	97	0.31
Fish Lake	249.1	November 11 - 16	1.7	5.7	27	14	11	23	75	0.30

a. The number of yearling cows were assumed to equal yearling bulls, therefore, total yearlings = 2 x yearling bulls.

TABLE 2. Moose ratios from 1990 trend surveys.

SURVEY AREA	PERCENT MATURE COW	PERCENT MATURE BULLS	PERCENT YRLNGS	PERCENT CALVES	MOOSE/100 MATURE COWS (≥ 30 mo.)			RECRUITMENT RATE
					CALVES	YRLNGS	MATURE BULLS	YRLNGS YRLNGS+ADLTS
Aishihik #1	45	26	3	26	57	7	57	0.04
Aishihik #2	45	26	12	17	39	26	58	0.14
Frederick Lake	34	24	27	15	44	78	69	0.31
North Canol	34	18	16	32	94	48	52	0.24
Fish Lake	21	31	29	19	88	138	144	0.36

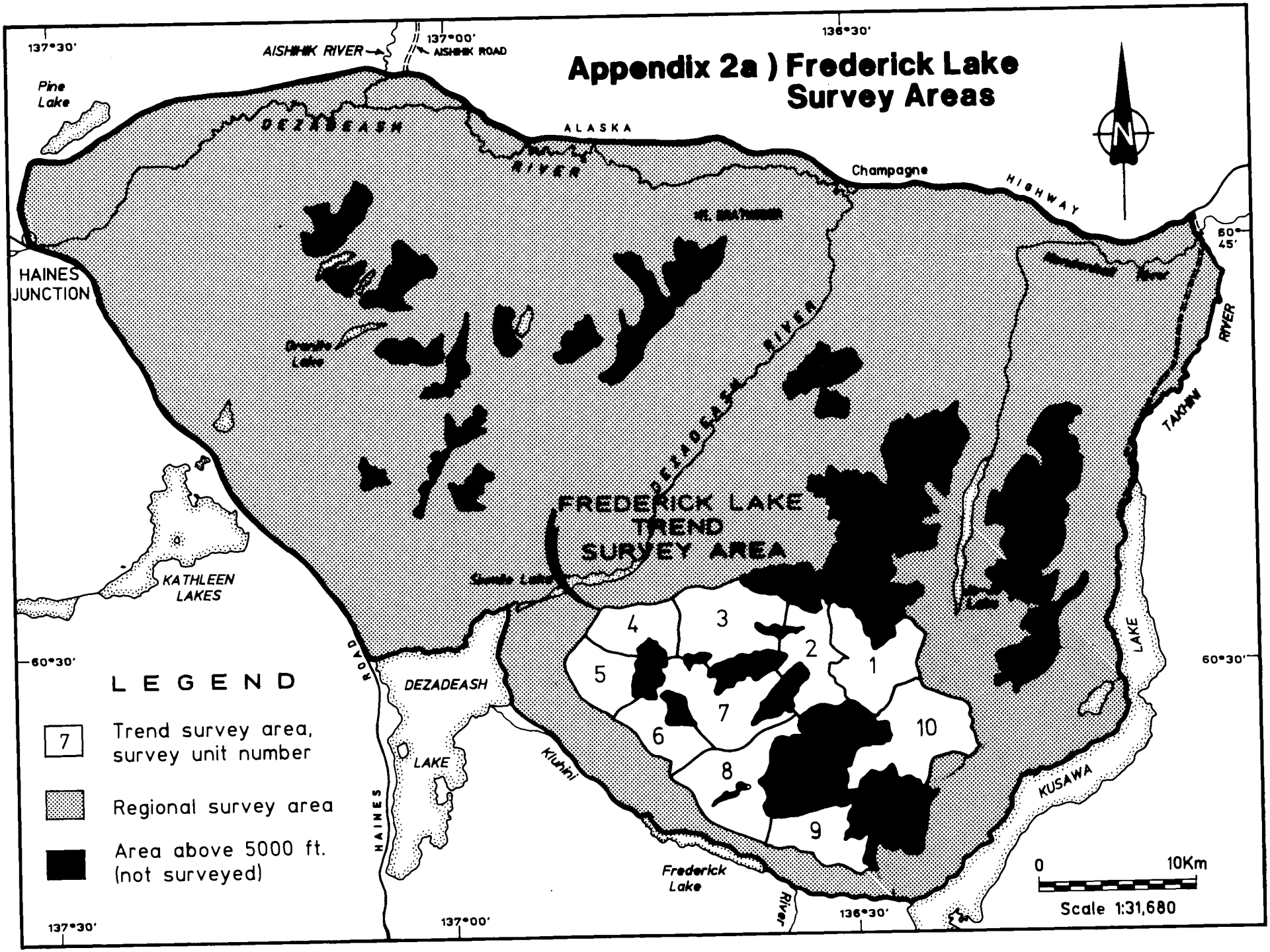

Appendix 1a)
Aishihik Trend
Survey Areas
136°00'
137°30'
137°00'
136°30'
136°00'
61°45'
61°30'
61°15'
61°00'
60°45'
NISLING RIVER
Stevens Lake
SEKULMUN LAKE
AISHIHIK LAKE
AISHIHIK ROAD
AISHIHIK TREND SURVEY AREA
Kirkland Cr.
Nordenskiold R.
Long Lake
1
2
3
4
5
6
7
8
9
10
11
Ittlemit Lake
West Aishihik River
Canyon Lake
HUTSHI LAKES
Henderson
Taye Lake
River
AISHIHIK RIVER
ALASKA
DEZADEASH RIVER
HWY.
Champagne
HAINES JUNCTION
N
LEGEND
7 Trend survey area, survey unit number
Regional survey area
Area above 5000 ft. (not surveyed)
10Km 0 10Km
Scale 1:625,000

APPENDIX 1b. Results from first (#1) and second (#2) surveys of the Aishihik Trend Area, November 19 to December 4 1991.

SAMPLE UNIT	AREA (KM^2)	SURVEY	DURATION	SEARCH INTENSITY	LONE COWS	COWS WITH 1 CALF	COWS WITH 2 CALVES	YEAR-LING BULLS	MATURE BULLS	TOTAL MOOSE SEEN	TOTAL MOOSE DENSITY ($MOOSE/KM^2$)
1	34.3	#1	63.0	1.8	2	1	1	0	1	8	0.23
		#2	66.0	1.9	4	2	1	1	3	15	0.44
2	31.7	#1	57.0	1.8	0	1	0	1	0	3	0.09
		#2	62.0	2.0	4	2	0	1	1	10	0.32
3	27.7	#1	55.0	2.0	3	1	1	0	5	13	0.47
		#2	51.0	1.8	4	0	0	1	1	6	0.22
4	29.7	#1	52.0	1.8	0	0	0	0	0	0	0.00
		#2	52.0	1.8	3	0	0	0	4	7	0.24
5	33.1	#1	58.0	1.8	1	0	0	0	2	3	0.09
		#2	57.0	1.7	0	0	0	0	2	2	0.06
6	26.7	#1	42.0	1.6	1	1	0	0	1	4	0.15
		#2	45.0	1.7	0	1	0	0	0	2	0.07
7	28.1	#1	51.0	1.8	3	1	0	0	4	9	0.32
		#2	55.0	2.0	3	0	0	0	1	4	0.14
8	27.0	#1	54.0	2.0	3	1	0	0	2	7	0.26
		#2	53.0	2.0	2	0	0	0	0	2	0.07

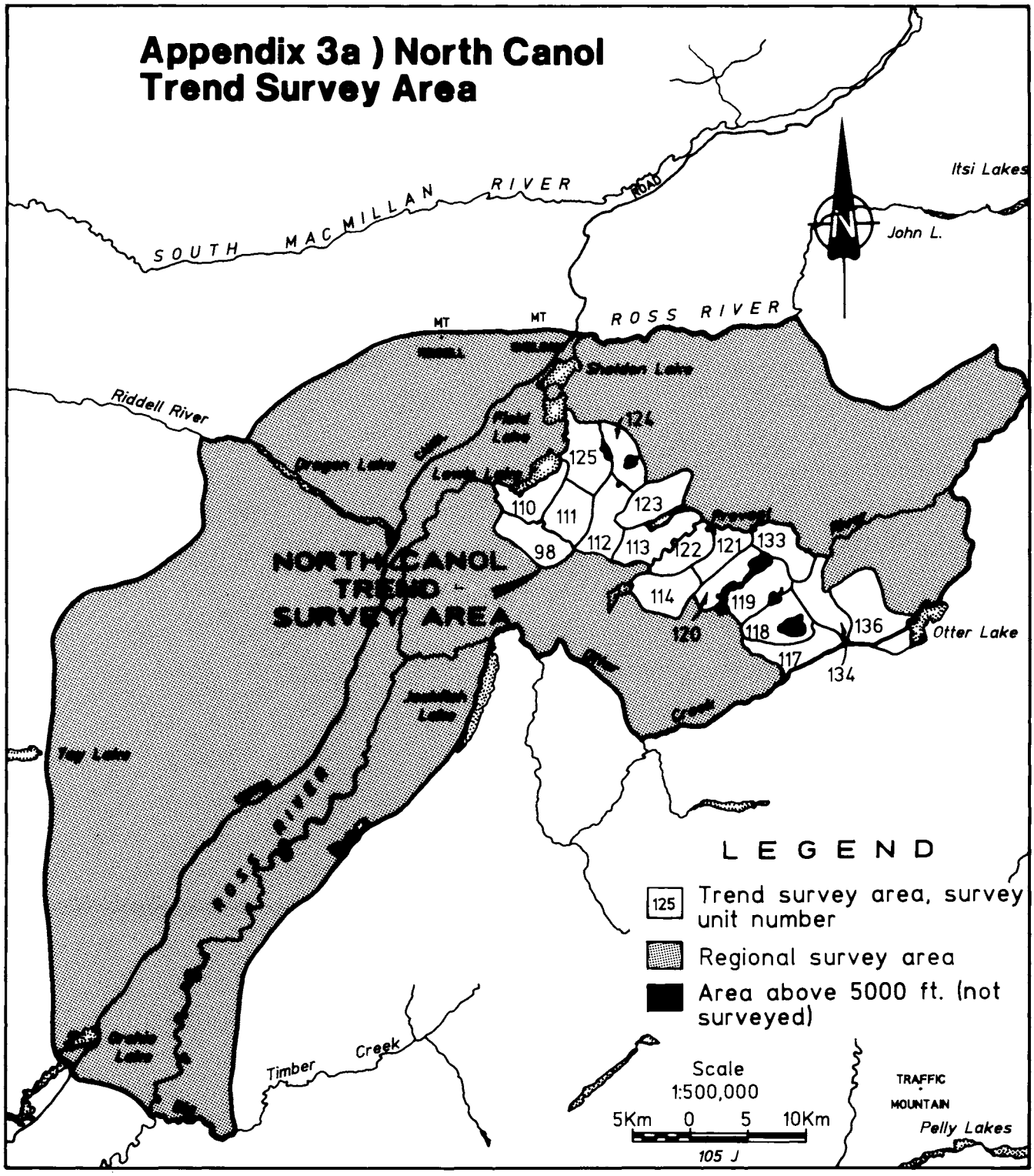
APPENDIX 1b. CONTINUED

SAMPLE UNIT	AREA (KM^2)	SURVEY	DURATION	SEARCH INTENSITY	LONE COWS	COWS WITH 1 CALF	COWS WITH 2 CALVES	YEAR-LING BULLS	MATURE BULLS	TOTAL MOOSE SEEN	TOTAL MOOSE DENSITY ($MOOSE/KM^2$)
9	34.8	#1	72.0	2.1	1	2	0	0	0	5	0.14
		#2	61.0	1.8	3	1	0	1	3	9	0.26
10	35.0	#1	54.0	1.5	1	3	0	0	0	7	0.20
		#2	66.0	1.9	0	3	0	0	0	6	0.17
11	27.7	#1	57.0	2.1	0	1	0	0	1	3	0.11
		#2	48.0	1.7	1	1	0	0	3	6	0.22
TOTAL	335.8	#1	615.0	1.8	15	12	2	1	16	62	0.18
		#2	616.0	1.8	24	10	1	4	18	69	0.20


Appendix 2a) Frederick Lake Survey Areas
137°30'
137°00'
136°30'
AISHIHIK RIVER
AISHIHIK ROAD
Pine Lake
DEZADEASH
ALASKA
RIVER
Champagne
HIGHWAY
60° 45'
HAINES JUNCTION
Dezadeash River
TAKHINI RIVER
FREDERICK LAKE TREND SURVEY AREA
KATHLEEN LAKES
60°30'
LEGEND
7
Trend survey area, survey unit number
Regional survey area
Area above 5000 ft. (not surveyed)
HAINES ROAD
DEZADEASH LAKE
Klukini
Frederick Lake
River
KUSAWA LAKE
1
2
3
4
5
6
7
8
9
10
0
10Km
Scale 1:31,680

APPENDIX 2b. Frederick Lake Trend Area Results, November 27 and 28 1990.

SAMPLE UNIT	AREA (KM^2)	SEARCH INTENSITY (MIN./KM^2)	SEARCH TIME (MIN.)	LONE COWS	COWS WITH 1 CALF	COWS WITH 2 CALVES	YEARLING BULLS	MATURE BULLS	TOTAL MOOSE SEEN	TOTAL MOOSE DENSITY ($_2$) (MOOSE/KM^2)
1	24.4	1.6	38	6	3	0	0	9	21	0.86
2	20.4	1.5	30	1	1	0	0	2	5	0.25
3	29.2	1.0	29	0	2	0	0	0	4	0.14
4	18.8	1.2	22	1	2	0	0	2	7	0.37
5	19.4	1.2	23	3	4	0	9	2	22	1.13
6	24.2	1.9	45	2	0	0	0	5	7	0.29
7	25.0	1.6	39	7	4	0	1	1	17	0.68
8	29.5	1.9	55	3	0	0	3	3	9	0.31
9	20.8	1.8	38	11	0	0	1	1	13	0.68
10	30.9	2.0	62	0	0	0	0	0	0	0.00
TOTAL	242.6	1.6	381	34	16	0	14	25	105	0.43


Appendix 3a) North Canol Trend Survey Area
SOUTH MACMILLAN RIVER
ROAD
Itsi Lakes
John L.
ROSS RIVER
MT
MT
Riddell River
Sheldon Lake
Pigeon Lake
Little Lake
124
125
110
111
123
98
112
113
122
121
133
NORTH CANOL TREND SURVEY AREA
114
119
120
118
136
117
134
Otter Lake
Creek
Twp Lake
Timber Creek
LEGEND
125 Trend survey area, survey unit number
Regional survey area
Area above 5000 ft. (not surveyed)
Scale 1:500,000
5Km 0 5 10Km
105 J
TRAFFIC MOUNTAIN
Pelly Lakes

APPENDIX 3b. North Canol Trend Area Results, December 2 and 3, 1989 and October 29 to November 2, 1990.

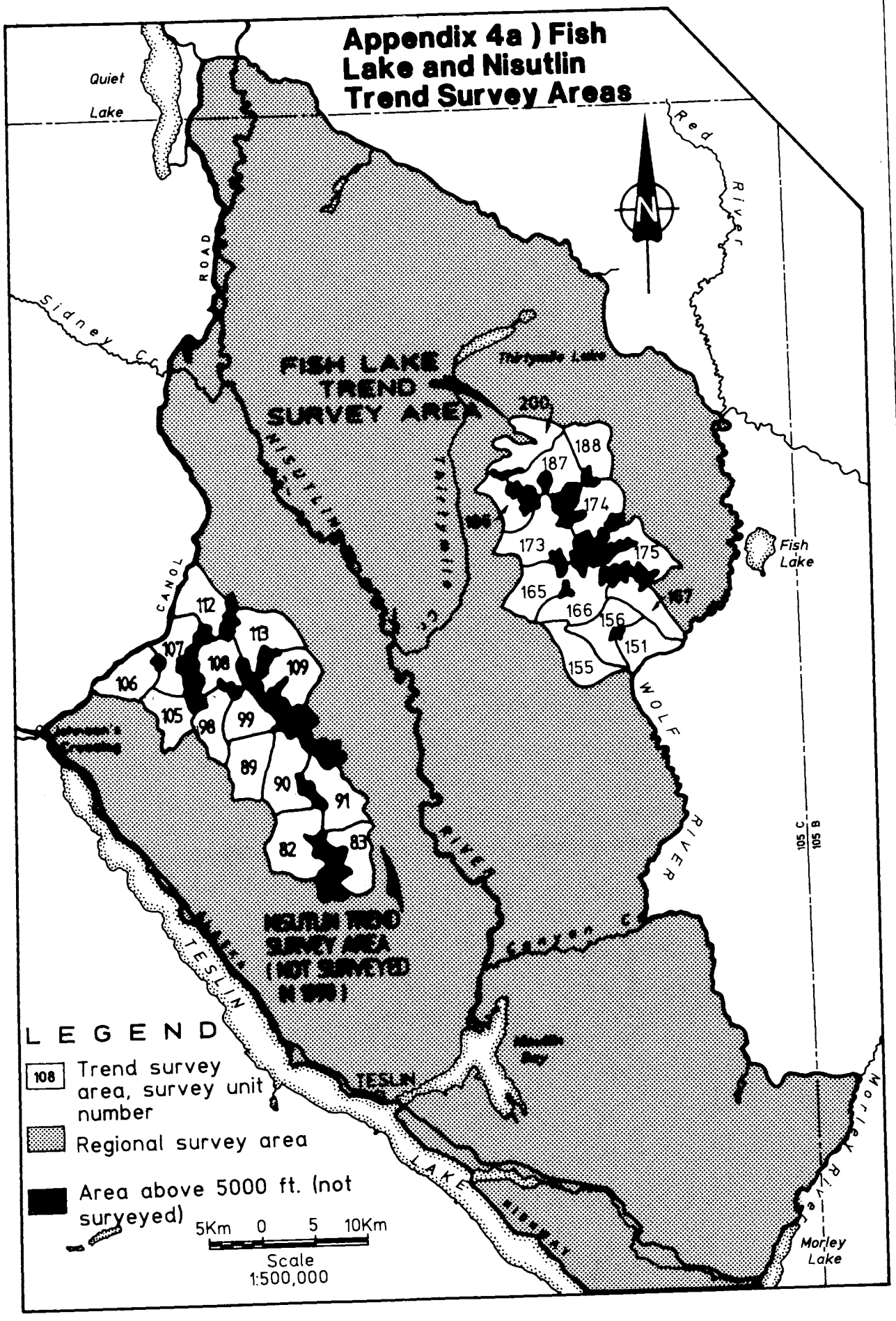
SAMPLE UNIT	AREA (KM^2)	YEAR	SEARCH INTENSITY ($MIN./KM^2$)	SEARCH TIME (MIN.)	LONE COWS	COWS WITH 1 CALF	COWS WITH 2 CALVES	YEAR-LING BULLS	MATURE BULLS	TOTAL MOOSE SEEN	TOTAL MOOSE DENSITY ($MOOSE/KM^2$)
98	18.7	1989	0.7	14	1	0	0	0	0	1	0.05
		1990	1.8	34	0	0	0	0	0	0	0.00
110	16.2	1989	1.2	20	0	0	0	0	0	0	0.00
		1990	1.9	30	0	0	0	0	0	0	0.00
111	18.6	1989	0.8	15	0	0	0	0	0	0	0.00
		1990	1.2	23	0	2	2	1	3	14	0.75
112	17.3	1989	1.4	25	0	0	0	0	0	0	0.00
		1990	2.8	49	4	6	0	1	3	20	1.16
113	15.5	1989	1.4	22	2	0	0	0	2	5	0.32
		1990	2.0	31	0	1	0	0	1	3	0.19
114	16.3	1989	0.9	14	1	2	0	0	2	7	0.43
		1990	2.1	34	2	2	0	0	0	6	0.37
117	16.9	1989	1.0	17	2	0	0	1	4	7	0.41
		1990	1.9	32	0	0	0	0	0	0	0.00
118	16.9	1989	1.2	20	0	0	0	0	0	0	0.00
		1990	2.2	37	2	2	1	1	0	10	0.59

APPENDIX 3b. Continued

SAMPLE UNIT	AREA (KM^2)	YEAR	SEARCH INTENSITY (MIN./KM^2)	SEARCH TIME (MIN.)	LONE COWS	COWS WITH 1 CALF	COWS WITH 2 CALVES	YEAR-LING BULLS	MATURE BULLS	TOTAL MOOSE SEEN	TOTAL MOOSE DENSITY ($MOOSE/KM^2$)
119	18.7	1989	1.1	20	0	1	0	0	0	2	0.11
		1990	2.4	45	1	0	0	0	2	3	0.16
120	15.8	1989	0.8	13	0	0	0	0	0	0	0.00
		1990	2.4	38	0	3	0	0	0	6	0.38
121	16.8	1989	1.1	18	0	0	0	1	1	2	0.12
		1990	2.0	34	0	0	0	2	5	7	0.42
122	15.8	1989	1.3	20	0	0	0	0	0	0	0.00
		1990	2.0	31	0	0	0	0	0	0	0.00
123	17.3	1989	0.9	15	0	0	0	0	0	0	0.00
		1990	1.9	33	0	0	0	0	0	0	0.00
124	16.8	1989	1.5	26	0	0	0	0	0	0	0.00
		1990	1.6	27	1	2	1	0	0	8	0.48
125	19.3	1989	1.2	24	0	3	0	0	0	6	0.31
		1990	2.0	39	0	1	1	0	0	5	0.26
133	18.1	1989	1.0	19	1	1	0	0	4	7	0.39
		1990	2.3	42	0	1	0	0	1	3	0.17

APPENDIX 3b. Continued

SAMPLE UNIT	AREA (KM^2)	YEAR	SEARCH INTENSITY ($MIN./KM^2$)	SEARCH TIME (MIN.)	LONE COWS	COWS WITH 1 CALF	COWS WITH 2 CALVES	YEAR-LING BULLS	MATURE BULLS	TOTAL MOOSE SEEN	TOTAL MOOSE DENSITY ($MOOSE/KM^2$)
134	18.1	1989	1.3	23	1	0	0	0	1	2	0.11
		1990	2.0	36	5	0	0	3	1	9	0.50
136	24.5	1989	1.7	41	1	0	0	0	1	2	0.08
		1990	2.4	59	0	1	0	0	1	3	0.12
ALL SAMPLE UNITS	317.6	1989	1.1	366	9	7	0	2	15	40	0.13
		1990	2.1	654	15	21	5	8	17	97	0.31


Appendix 4a) Fish Lake and Nisutlin Trend Survey Areas
Quiet Lake
Red River
ROAD
Sidney Cr.
FISH LAKE TREND SURVEY AREA
Tuchitua River
NISUTLIN
CANOL
200
188
187
174
173
175
165
166
156
151
155
167
Fish Lake
112
113
107
108
109
106
105
98
99
89
90
91
82
83
WOLF RIVER
105 C
105 B
NISUTLIN TREND SURVEY AREA (NOT SURVEYED IN 1978)
TESLIN
LAKE
Morley River
Morley Lake
LEGEND
108 Trend survey area, survey unit number
Regional survey area
Area above 5000 ft. (not surveyed)
5Km 0 5 10Km
Scale 1:500,000

APPENDIX 4b. Fish Lake Trend Area Results, November 21 and 22, 1989 and November 13 to 16, 1990.

SAMPLE UNIT	AREA (KM^2)	YEAR	SEARCH INTENSITY (MIN./KM^2)	SEARCH TIME (MIN.)	LONE COWS	COWS WITH 1 CALF	COWS WITH 2 CALVES	YEAR-LING BULLS	MATURE BULLS	TOTAL MOOSE SEEN	TOTAL MOOSE DENSITY ($MOOSE/KM^2$)
151	16.6	1989	1.8	30	3	2	1	0	0	6	0.36
		1990	1.9	31	0	2	0	1	0	5	0.30
155	28.2	1989	1.4	40	2	0	0	1	1	4	0.14
		1990	1.8	50	2	1	0	2	5	11	0.39
156	26.4	1989	0.9	25	0	0	0	0	1	1	0.04
		1990	2.1	55	6	1	0	4	7	19	0.72
165	19.9	1989	1.3	25	0	0	0	1	3	4	0.20
		1990	1.9	38	1	0	0	0	2	3	0.15
166	17.9	1989	1.1	20	0	0	0	0	0	0	0.00
		1990	1.3	24	0	0	0	0	0	0	0.00
167	17.9	1989	1.4	25	0	4	0	0	1	9	0.50
		1990	1.8	33	0	1	2	0	0	8	0.45
173	19.2	1989	0.8	15	2	0	0	0	4	6	0.31
		1990	1.9	37	3	1	0	0	1	6	0.31
174	18.1	1989	0.9	16	0	0	0	1	0	1	0.06
		1990	1.9	35	0	0	2	1	2	9	0.50

APPENDIX 4b. Continued

SAMPLE UNIT	AREA (KM^2)	YEAR	SEARCH INTENSITY ($MIN./KM^2$)	SEARCH TIME (MIN.)	LONE COWS	COWS WITH 1 CALF	COWS WITH 2 CALVES	YEAR-LING BULLS	MATURE BULLS	TOTAL MOOSE SEEN	TOTAL MOOSE DENSITY ($MOOSE/KM^2$)
175	19.7	1989	0.8	15	0	0	0	0	0	0	0.00
		1990	1.4	28	2	0	0	0	0	2	0.10
186	14.0	1989	1.1	15	0	0	0	0	4	4	0.29
		1990	1.9	27	2	0	0	3	6	11	0.79
187	15.5	1989	0.6	10	0	0	0	0	0	0	0.00
		1990	1.3	20	0	0	0	0	0	0	0.00
188	17.6	1989	1.4	24	1	0	0	1	5	7	0.40
		1990	1.7	30	1	0	0	0	0	1	0.06
200	18.1	1989	0.8	15	0	0	0	0	3	3	0.17
		1990	1.2	22	0	0	0	0	0	0	0.00
ALL SAMPLE UNITS	249.1	1989	1.1	275	8	4	1	4	22	45	0.18
		1990	1.7	430	17	6	4	11	23	75	0.30

APPENDIX 5. Summary of 1990 Trend Survey Costs.

SURVEY AREA	AIRCRAFT TYPE	CHARTER RATE	HOURS FLOWN	CHARTER COST	FOOD AND ACCOMMODATIONS	MISCELLANEOUS	TOTAL
Aishihik 1	Piper Supercub	$137/hr (dry)	19.9	$2726.30	1)	$15.33[2]	$2741.63
Aishihik 2	Piper Supercub	$137/hr (dry)	20.0	$2740.00	1)	$15.33[2]	$2755.33
Haines Jnct	Maule M-7	$200/hr (dry)	12.2	$2440.00	1)	--------	$2440.00
Fish Lake	Piper Supercub	$137/hr (dry)	14.5	$2036.50	$181.95	$50.00[2]	$2218.45
North Canol	Piper Supercub	$137/hr (dry)	22.1	$3027.70	$1046.75	--------	$4074.45
TOTAL			88.7	$12970.50	$1228.70	$80.66	$14229.86

1) Covered as part of Haines Junction regional surveys
2) Fuel charges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