Abundance, sex/age composition and seasonal distribution of moose in the northern Richardson Mountains

Annual Progress Report

C.M.M. SMITS

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Yukon
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ABSTRACT

Preliminary results of a population study of moose in the northern Richardson Mountains are presented. During an aerial drainage survey in March and April, 1987, 181 moose were observed, which is thought to be a minimum estimate. Twenty-nine (16%) moose were classified as calves, the remaining 152 (84%) as adults (≥22 months). In a similar survey during October 1987, sex and age composition of moose in the study area were determined (N = 105). Bulls (≥30 months) and cows (≥30 months) made up 44% and 33%, respectively, of observed moose. Calves and yearlings comprised 17% and 6% respectively. Bull/cow, yearling/cow and calf/cow ratios were 132:100, 17:100 and 51:100, respectively. Twenty moose (14 adult cows and 6 adult bulls) were captured and fitted with radio collars during October 1987. From December 1987 through March 1988, monthly monitoring flights were performed to relocate radio-collared moose. Two radio-collared moose died during winter. Moose captured in the northern part of the study area appeared to make more extensive movements between relocations than moose captured further to the south. There seemed to be a tendency for moose to move towards the south and towards lower elevations as winter progressed. During both the late winter and the fall survey, moose were most often associated with willow vegetation.

INTRODUCTION

Little is known of the biology of moose (Alces alces) on the Yukon North Slope. Most observations of moose in the area were made in the early 1970's in conjunction with caribou studies addressing the impact of a proposed pipeline route (Watson et al., 1973; Doll et al., 1974; Jakimchuk et al., 1974; Ruttan, 1974; Walton-Rankin, 1977; Wooley, 1976). This information suggests that these moose constitute a unique population; striking features appear to be their migratory behavior and their dependence on often widely dispersed habitat patches. These characteristics make this moose population vulnerable to hunting and disturbance.

Up to the present, moose in the area have occurred under relatively pristine conditions, however various sources of potentially negative impact are anticipated for the future. They include: 1) habitat degradation and displacement by road development supporting exploration and development of hydrocarbon resources in the Beaufort Sea; 2) increased harvest levels facilitated by these roads; and, 3) the establishment of an outfitting industry.

The eastern part of the Yukon North Slope is likely to be the first area to become exposed to these impacts. The Yukon Fish and Wildlife Branch, in support of the Wildlife Management Advisory Council (North Slope) therefore embarked on a study to determine the sustainable harvest levels and to delineate key habitat of moose in the northern Richardson Mountains and adjacent coastal plain.

STUDY AREA

The study area includes the northern Richardson Mountains and adjacent Yukon Coastal Plain (Fig. 1). The southern extension of the study area includes the northern slopes of Mt. Millen. To the west, the area extends as far as the headwaters of the western tributaries of the upper Bell River, and the Blow River excluding its western tributaries. The Mackenzie River Delta forms the eastern and northern boundary.

The following description is derived from Wiken et al. (1981). The northern Richardson Mountains are angular mountains eroded from the folds of cretaceous sandstones. Much of the landscape is composed of colluvium-covered slopes and valley bottoms covered with fluvial sediments. The northern part of the Richardson Mountains has substantially less relief, forming a transition between the high, angular mountains to the south and the relatively low and flat Yukon Coastal Plain. The Yukon Coastal Plain consists of rolling deposits of moraine interspersed with nearly flat areas of lacustrine materials.

The climate of the area is subarctic continental. The mean daily temperatures in the winter are commonly below $-20^{\circ}C$, whereas those in the summer are slightly above $3^{\circ}C$. Precipitation at all times of the year is light; total annual accumulation is often under 13cm.

Alpine vegetation is widespread in the Richardson Mountains; upper slopes are largely bare of vegetation. Middle and lower portions of slopes have open stands of white spruce (Picea glauca), in the northern and eastern part, or white spruce along with white birch (Betula papyrifera), in the southern part.

White spruce lines the river and stream borders in the southern part of the study area; along many of the streams common species include balsam poplar (Populus balsamifera), and willow shrubs (Salix spp.). In the northern part, river and stream bottoms are typified by thickets or scattered individuals of willow shrub. Vegetation of river and stream terraces is highly variable across the study area, depending upon surface materials, but common species are willow shrub and shrub birch (Betula glandulosa), along with white spruce, Alpine blueberry (Vaccinium uliginosum), bog cranberry (V. vitis-idaea), common crowberry (Empetrum nigrum), Labrador tea (Ledum palustre), cloudberry, (Rubus chamaemorus) and mosses.

The vegetation of the Yukon Coastal Plain is predominately tussock and trailing heath tundra composed of sheated cottongrass (Eriophorum vaginatum), along with Labrador tea, bog cranberry and dwarf birch (Betula nana). Other trailing shrubs such as Alpine blueberry, crowberry, Arctic heather (Cassiope tetragona) and common bog-rosemary (Andromeda polifolia) are widespread, while mosses, particularly Sphagnum sp., are locally abundant.

METHODS

Abundance

Information of abundance was collected through an aerial survey during late winter of all moose habitat in the study area. Winter moose habitat is assumed to consist of tree and shrub vegetation protruding above the snow, practically all of which occurs in relatively narrow valley bottoms (Watson et al., 1973; Walton-Rankin, 1977). The survey was therefore essentially a drainage survey (Martin and Garner, 1985). The survey was flown with a Piper PA-18 Super Cub at 60-120 m above ground level at an indicated airspeed of approximately 112 $km.hr.^{-1}$. Valley bottoms with relatively open moose habitat narrower than 800 m were covered with two adjacent transects (one flying up, the other flying down the valley). In wider habitat units or those with a relatively dense vegetation, more transects were flown to minimize avoiding animals. Survey routes were standardized and will continue to be used in future surveys of the study area (Fig. 1). The observer in the rear seat watched one side while the pilot watched the other side and the front. The locations of moose were plotted on a 1:250,000 topographical map. Moose were classified as adult or short yearling and group size was recorded. A group was defined as all moose within a maximum of approximately 50 m of one another. Notes were also made of the habitat unit moose were associated with (e.g. willow vegetation <2 m, willow vegetation >2 m, coniferous forest, deciduous forest, mixed coniferous/deciduous forest). Corrections to these counts will have to be performed when information from radio-collared moose in future surveys allows quantification of the number of unobserved animals or of animals associated with habitat units other than tree and shrub vegetation.

Sex and Age Composition

Information of sex and age composition was determined from an aerial drainage survey in October, covering the same route established during the previous late winter survey. The procedures of this survey were similar to the late winter survey with the exception that moose were classified as adult male, adult female, yearling male (based on antler characteristics, Dubois et al., n.d.), and calf. The proportion of all yearlings in the sample population was subsequently calculated by doubling the proportion of yearling males observed, assuming even sex ratio at birth and no difference in calf mortality between males and females. Since yearling females are likely mistaken for adult females, the proportion of adult females was similarly corrected by subtracting the observed number of yearling males from the total number of adult females.

Immobilization

Following the October survey, 20 moose were captured and fitted with radio collars. Fourteen adult female and six adult male moose were immobilized from a Bell 206B Jet Ranger helicopter using a Cap-Chur gun and a combination of Carfentanil and Xylazine (Glover et al., in prep.). The moose were fitted with radio transmitters attached to collars (Telonics Inc., Mesa, Arizona). The transmitters pulsed initially at approximately 60 beats/minute (slow mode) and when movement ceased for 6 hours the pulse rate tripled (fast or mortality mode). An outside incisor was pulled for aging (Sergeant and Pimlott, 1959), a tuft of hair was plucked from the right or left shoulder for analysis of trace elements (Franzmann et al., 1975), and a sample of fecal pellets was collected from the rectum for food habits analysis. Female moose were palpated via the rectum for pregnancy diagnosis. Blood samples were collected to determine serum progesterone levels providing another means of pregnancy diagnosis. After handling, a mixture of Nalaxone and Diprenorphine (Glover et al., in prep.) was administered as an antagonist.

From December 1987 to March 1988 aerial searches were made approximately once a month to locate radio collared moose. The airplane used was a Cessna 185. Information collected was similar to that recorded during the surveys. Notes of collarless moose encountered during these searches were also made .

Habitat Use

A habitat map derived from Satellite imagery (thematic mapper) of part of the study area is currently in progress (D. Russell, in prep.) while the development of such a map for the remaining Yukon part of the study area has been proposed (M. Hoefs, pers. comm.). Analyses evaluating association with habitat units as determined from moose survey and relocation data will be performed upon completion of this map.

Harvest

Harvest information of moose is being collected from Mackenzie Delta communities through the IFA Harvest Management Program (Fabijan, in prep.).

RESULTS

Abundance

An aerial survey covering the whole study area was performed between March 12 and April 20, 1987. Snow cover was continuous across all moose habitat (depth in Bell River valley was measured at 75 cm) and observability was considered to be good. Moose were observed in the valleys of the Bell River, Fish Creek, Scho Creek, Little Bell River, Big Fish River, Sheep Creek and Rat River (Fig. 1).

A total of 181 moose were observed. The area with the greatest number of moose was the upper Bell River (Table 1). On several occasions when flying over a previously surveyed drainage, moose not observed before (as indicated by the distance from the nearest moose located previously or the total number observed between the two flights) were sighted, suggesting that not all moose present in the study area may have been counted. The estimate of moose numbers is therefore less than the actual number of moose.

Table 1. Distribution of moose observed across the study area in an aerial survey during March - April, 1987.

Drainage	Number of Adults	Number of Calves	Total
Bell River	100	18	118
Little Bell River	13	2	15
Big Fish River	9	3	12
Fish Creek	9	2	11
Scho Creek	6	2	8
Rat River	2	1	3
Barrier River	2	-	2
Sheep Creek	1	-	1
Several unnamed creeks south of Summit Lake combined	10	1	11
Total	152	29	181

Sex and Age Composition

During the October survey inclement weather prevented surveying the Blow River valley and its tributary creeks. In the remainder of the study area moose were observed in the same drainages as late winter. Snow depth was only 5-10 cm, with many snowfree areas in valley bottoms at lower elevations, and observability was poor locally. It was therefore felt that many more moose may have been present than those observed. A total of 105 moose were classified as to sex and age class (Table 2). Adult males ($\geq$30 months) were

Table 2: Sex/age composition of moose observed during late winter and fall surveys in the northern Richardson Mountains, 1987.

Sex/age composition	March/April Survey		October Survey	
	n*	%	n*	%
Bulls (≥30 mo.)	46	44		
Cows (≥30 mo.)	35	33	152	84
Yearlings (18 mo.)	6	6		
Calves	18	17	29	16
Bulls/100 cows	132			
Yearlings/100 cows	17			
Calves/100 cows	51			
TOTAL	105	100	181	100

* number of moose in category observed (yearlings and adult females corrected as outlined in Methods).

the largest single cohort making up 44% of all moose observed compared to 33% adult females (≥30 months). The few yearlings observed represented 6%, while calves comprised 17% of all moose observed. Calf survival appeared good while yearling recruitment seemed low, with 51 calves/100 cows and 17 yearlings/100 cows, respectively. The twinning rate was 20% (3 sets of twins among 15 calf-cow groups).

Group Size

The 181 moose observed during the March-April survey and the 105 moose of the October survey occurred in 92 and 40 groups, respectively. Mean group size was significantly greater in the fall (2.6) than in late winter (2.0) (Table 3, Appendix).

Seasonal Distribution

Radio-collaring

Twenty moose (14 adult females and 6 adult males) were captured across the study area (Fig. 2 a, b, c, d) and fitted with radio collars (Tables 4 and 5, Appendix). An attempt was made to distribute moose captures over the whole

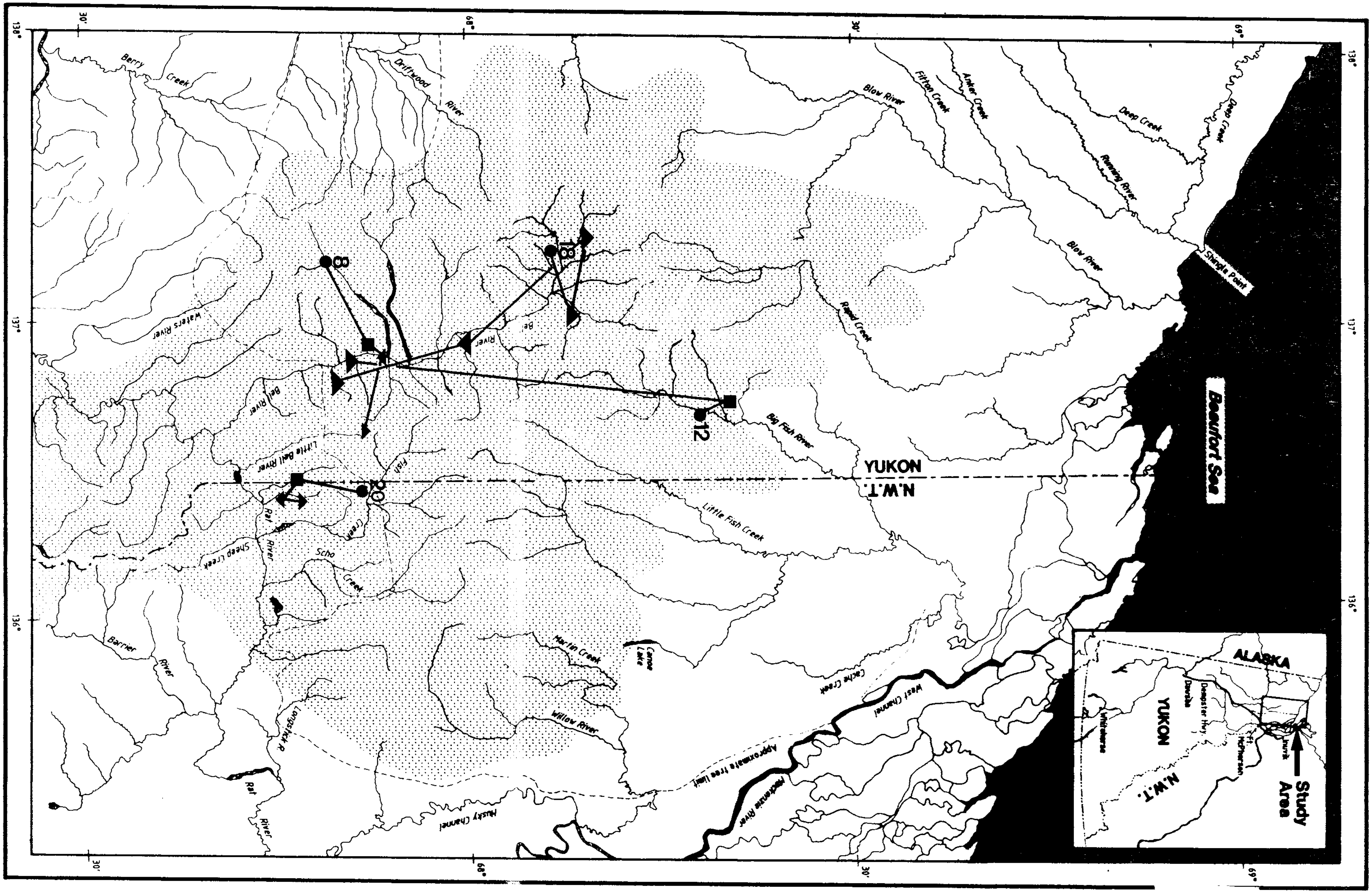

Fig. 2a. Locations of radio collared moose as determined from monitoring flights; (●) capture location/ October 1987 (number is moose id#), (■) December 1987 locations, (O) January 1988 locations, (▼) February 1988 locations, (▲) March 1988 locations.

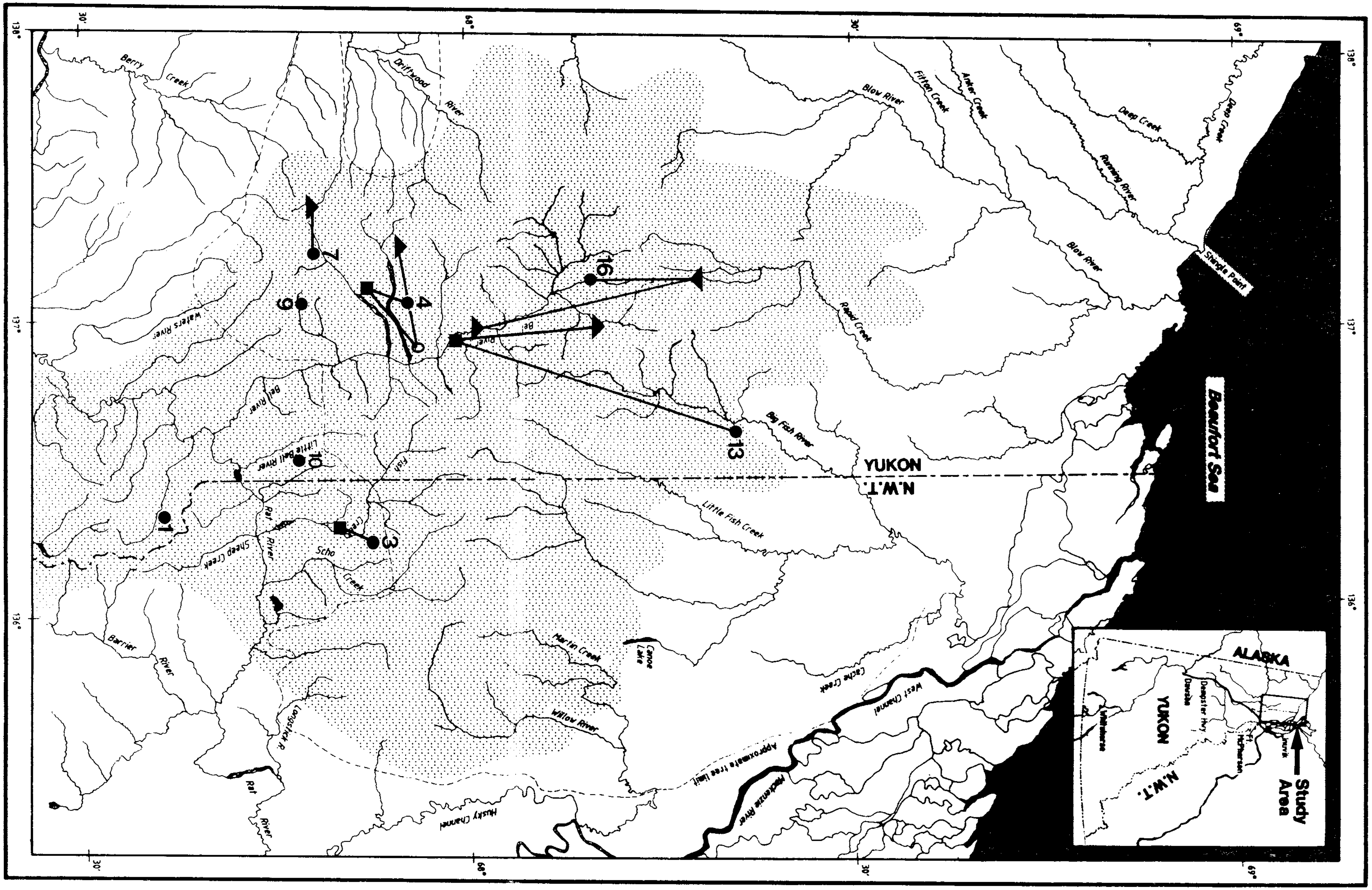

Fig. 2b. Locations of radio collared moose as determined from monitoring flights; (●) capture location-October 1987 (number is moose #), (■) December 1987 locations, (O) January 1988 locations, (▼) February 1988 locations, (▲) March 1988 locations.

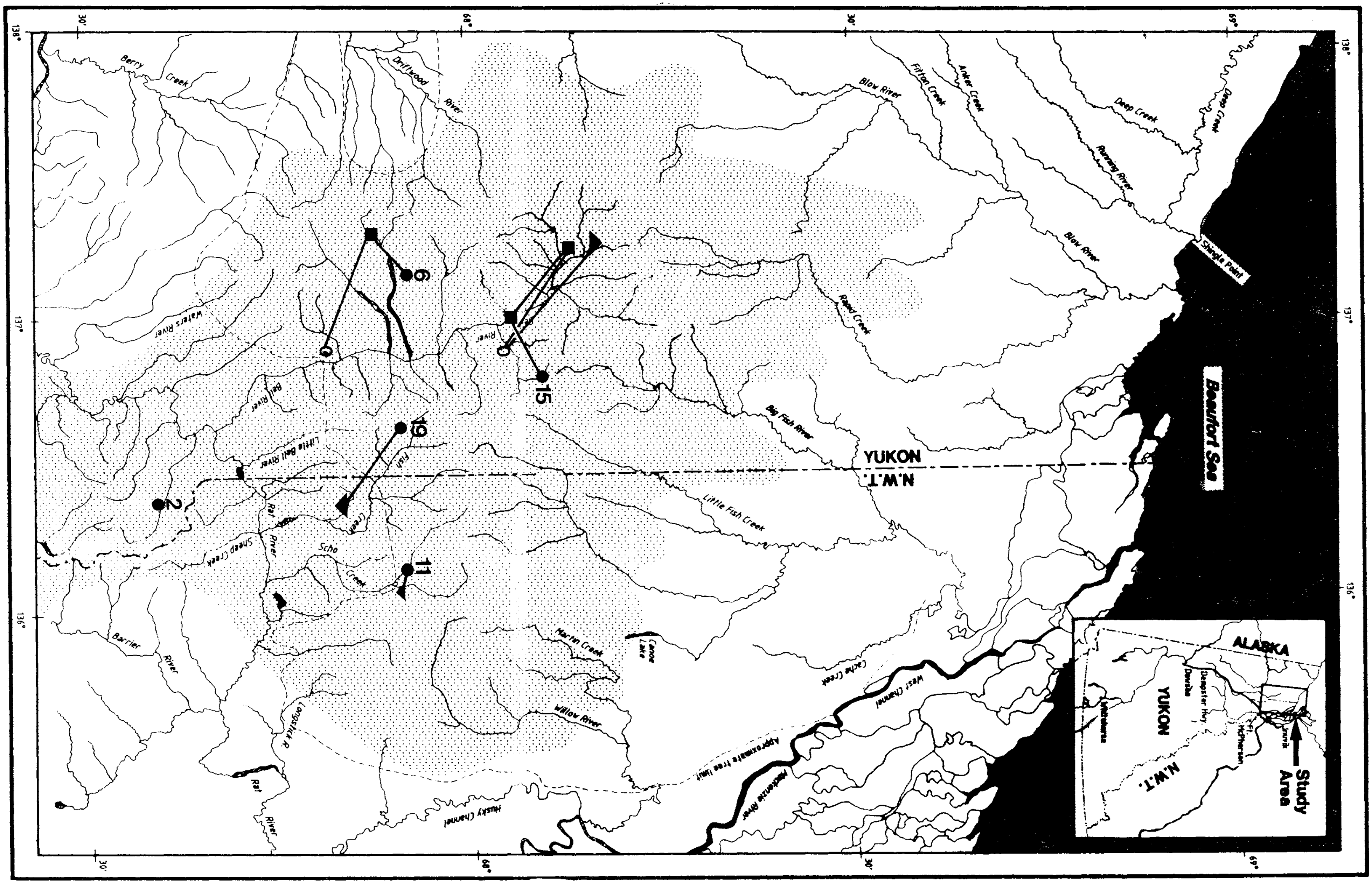

Fig. 2c. Locations of radio collared moose as determined from monitoring flights; (●) capture location-October 1987 (number is moose ID#), (■) December 1987 locations, (O) January 1988 locations, (▼) February 1988 locations, (▲) March 1988 locations.

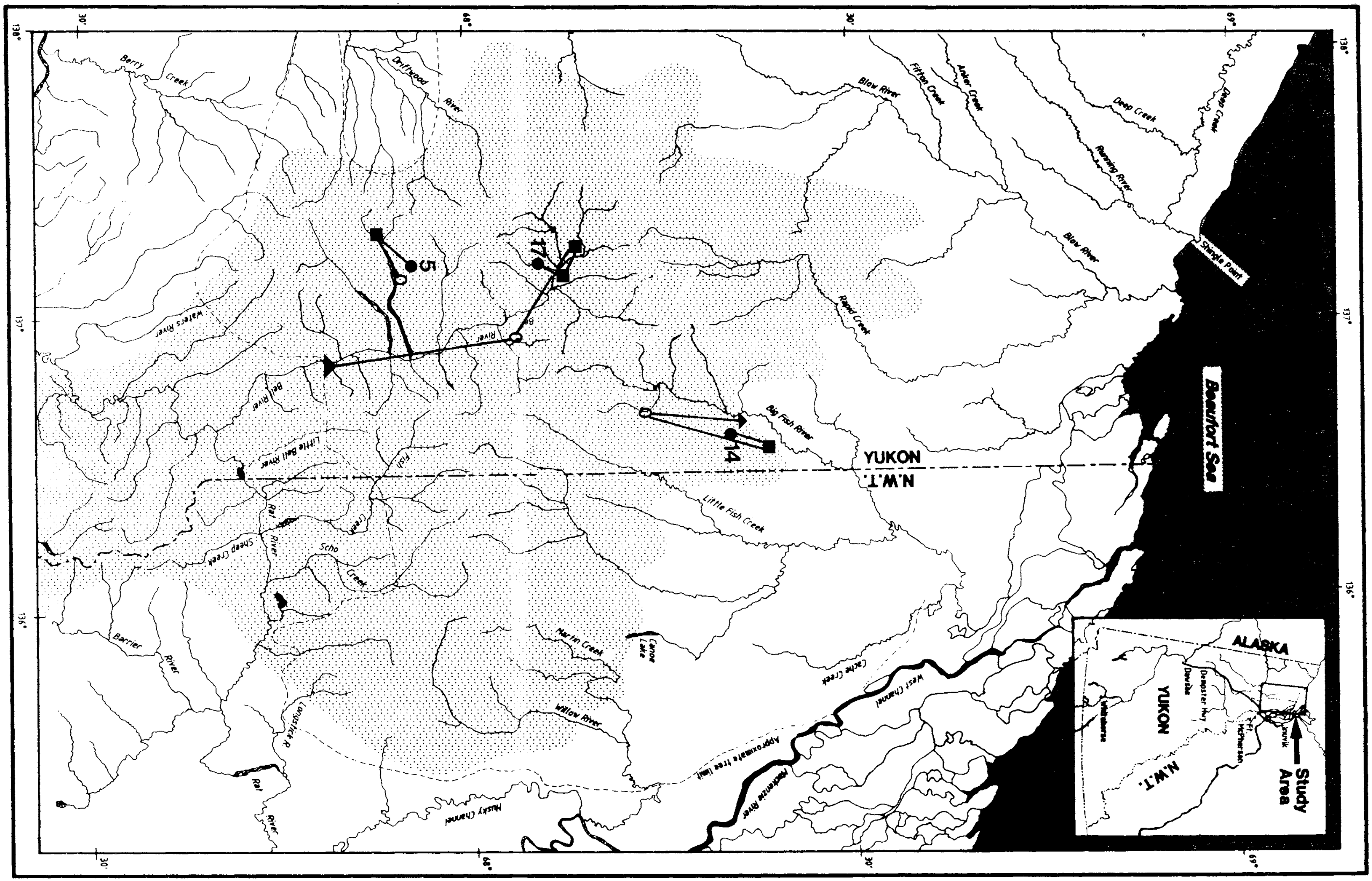

Fig. 2d. Locations of radio collared moose as determined from monitoring flights; (●) capture location-October 1987 (number is moose ID#), (■) December 1987 locations, (O) January 1988 locations, (▼) February 1988 locations, (▲) March 1988 locations.

study area. However, inclement weather prevented captures in the northwestern portion of the study area. A report on the effects of Carfentanil and Xylazine will appear under separate cover (Glover et al., in prep.). Eleven (79%) of the cow moose immobilized were accompanied by calves, three of which had twin calves. These calf/cow ratios and twinning rates should not be taken to be representative of the population as a whole. Whenever two or more females were encountered in a group, females with calves were selected for capture; females with twin calves were selected over females with single calves. This capture process of selecting against cows without calves would also cause an age-bias in the capture sample. Reproductive rates of yearling cows and old cows are lower than those of middle-aged cows (Pimlott, 1959; Markgren, 1969; Blood, 1974) and middle-aged cows would thus tend to be captured in disproportionately higher numbers. The mean age of females captured in this study was 7.3 years (±3.5 S.D.)(Table 5, Appendix). In eleven (79%) of the female moose, eight of which were accompanied by calves, pregnancy was confirmed by rectal palpation. This figure should be considered a minimum estimate as foetuses can usually be detected by this method after only approximately two weeks (Glover, pers. comm.). The results of the serum progesterone analysis will appear at a later date.

Aerial Monitoring

Relocation flights were made on December 1, 1987, January 21 and February 6, 1988. Frequent occassions of ice fog and low clouds precluded the relocation of all moose during each flight. The radio transmitters of two moose (no.'s 3 and 7) were on mortality mode, on December 1 and on March 5 respectively. Moose captured in the northern part of the study area appeared to make more extensive movements between flights than moose captured further to the south (Fig. 2 a, b, c, d). There seemed to be a tendency for moose to move towards the south and towards lower elevations as winter progressed. Among the six live females located during the February and March flights, one (no. 17) was not accompanied by its calf.

Habitat Use

Moose locations were analyzed with respect to their association with vegetation types. A total of 124 and 86 locations from the March-April survey and the October survey, respectively, were analyzed (Table 6). During both periods, moose were most often associated with willow vegetation; almost to the exclusion of any other vegetation type during October. A full habitat-use analysis based on utilization-availability (Neu et al., 1974) will be performed upon completion of a vegetation map and analyses of home range information of moose.

Table 6. Distribution of association with vegetation types of moose during aerial surveys in the northern Richardson Mountains, 1987, expressed as a proportion of combined sightings of adult moose.

	Vegetation Type*					
					Willow	
Survey Period	White Spruce	White Spruce/ Willow	Willow/ Aspen	Spruce/ Aspen	<2m	>2m
March - April	20.2	21.8	0.1	5.7	51.6 (combined classes)	
October	-	3.5	-	-	94.2	2.3

* Dominant vegetation type

DISCUSSION

The actual number of moose present during the late winter survey is probably substantially higher than the 181 observed. Although snow conditions during late winter would favour identifying moose during this period, the occurrence of moose in smaller groups (Peek et al., 1974; Novak, 1981; this study) and their association with a more dense and tall vegetation (Peek et al., 1974; Mytton and Keith, 1981; Gasaway et al., 1986) would reduce sightability of moose. Since almost half of the moose observed during the late winter survey were associated with relatively tall vegetation (Table 6), we expect the overall sightability to have been substantially lower than 100%. In other aerial surveys sightability has varied from as high as 98% under ideal conditions (Gasaway et al., 1986) to as low as 50% under suboptimal conditions (Hauge and Keith, 1981). During the 1988 late winter survey we plan to derive a sightability correction factor from the proportion of radio-collared moose observed.

A sex-specific difference in sightability would bias the apparent sex ratios as observed during the fall survey. Such biases have been reportedly caused by differences in habitat use, activity patterns and aggregation patterns between the sexes (Peek et al., 1974; Linkswiler, 1982). One estimate that seems obviously biased is the high (>1) bull-cow ratio. Bull-cow ratios usually favour cows as a result of the higher natural mortality rates suffered by bulls (e.g. Boer, 1988). A bias favouring bulls in the sex ratio during the fall survey may have been caused by cows with calves selecting low visibility habitat. In other surveys in southern Yukon, cows and calves have been observed to occur in low density survey units disproportionately more frequent than other sex/age categories (K. Jingfors, pers. comm.). In the present study, the low density areas during the fall survey were areas with low visibility. Such sex-specific differences in habitat use might also cause an underrepresentation of calves in the aerial observations. What is obviously needed is an unbiased survey technique.

The calf-cow and yearling-cow ratios fall within the range reported for other moose populations in Yukon and Alaska (Gasaway et al., 1983; Larsen et al., 1985; Martin and Garner, 1985). However, yearling cow ratios compared to calf/cow ratios appear low, suggesting calves may suffer high mortality (assuming that calf/cow ratios in fall of 1986 were similar to those in fall of 1987). The calf/cow ratio appears high compared with that reported for moose in the Arctic National Wildlife Refuge, Alaska (Martin and Garner, 1985), a similar ecosystem, particularly if calves are indeed underrepresented in the present study. Martin and Garner reported an estimated sightability of 95%.

The limited amount of information from radio-collared moose precludes extensive conclusions on seasonal distribution of moose in the study area. however, preliminary results confirm observations by Doll et al. (1974) and Ruttan (1974) that at least some of the moose that occur on the North Slope during fall are migratory, spending the winters along south flowing drainages.

FURTHER ACTIVITIES PLANNED

For the fiscal year 1988/89 the following reserach activities are planned:

1) An aerial survey of the whole study area during April 1988. The purpose of this survey is to determine the abundance of moose in the area. A sightability correction factor will be derived from the number of radio-collared moose observed.

2) Monthly aerial relocations of radio-collared moose. The purpose of this is to determine seasonal distribution and adult mortality rates of moose in the study area.

3) Capture and radio-collaring of an additional six moose on the Yukon Coastal Plain to aid in the determination of seasonal distribution of moose in the study area (it was felt that moose of the Yukon Coastal Plain were underrepresented during collaring operations in October 1987).

4) An aerial survey of the study area during October 1988 to determine sex and age composition of moose in the study area. The study area will be divided into high visibility and low visibility strata and a sightability correction factor will be derived for each stratum.

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APPENDIX

Table 3. Frequency distribution of groups of moose observed during aerial surveys in the northern Richardson Mountains during late winter and fall, 1987.

	Group Size										Mean Group Size
Period	1	2	3	4	5	6	7	8	9	N*	(+SE)
March-April	40	33	9	4	4	2	-	-	-	92	2.0 (0.1)**
October	16	8	6	4	2	2	-	1	1	40	2.6 (0.3)**

* total number of groups

** $t=-2.28$, d.f.=130, $p<0.05$

Table 4. Radio transmitter information and location of moose captured in the northern Richardson Mountains, during October, 1987.

Moose ID#	Sex	Number of Calves	Age	Radio Frequency (MHz)	Transmitter Serial No.	Capture Location (UTM)	General Location
1	F	-	5	152.178	18065	MK4399	South of Summit Lake
2	M	-	5	151.508	14873	MK4298	South of Summit Lake
3	F	2	6	150.642	14853	ML4830	Fish Creek
4	M	-	3	153.751	21372	ML1235	Bell River
5	M	-	9	153.820	14837	ML0936	Bell River
6	F	-	7	153.770	21374	ML0935	Bell River
7	F	1	14	150.892	14861	ML0624	Bell River
8	F	1	5	153.730	18063	ML0725	Bell River
9	F	1	-	150.061	14827	ML1321	Bell River
10	F	1	4	150.588	18029	ML3519	Little Bell River
11	F	2	7	153.832	14840	ML5234	Scho Creek
12	M	-	-	152.450	21689	ML2978	Big Fish River
13	F	1	-	152.100	18058	ML3383	Big Fish River
14	M	-	-	153.861	14848	ML3382	Big Fish River
15	M	-	4	152.901	21690	ML2555	Bell River
16	F	1	3	151.781	18046	ML1062	Bell River
17	F	1	9	153.890	18034	ML0955	Bell River
18	F	2	7	153.807	14830	ML0755	Bell River
19	F	1	13	153.739	18071	ML3133	Vunta Creek
20	F	-	-	153.650	R CAR04/87	ML4028	Fish Creek

Table 5. Body measurements* of moose captured in the northern Richardson Mountains during October 1987.

Moose ID#	Sex	Preg-nant	Age	Total Length	Tail Length	Body Circumference	Foreleg Length	Hindleg Length	Shoulder Height	Neck Girth Min	Neck Girth Max	Antler Spread	Palm Width Lft.	Palm Width Rght.	Palm Length Lft.	Palm Length Rght.	Shaft Circum. Lft.	Shaft Circum. Rght.
1	F	Yes	5	293	7	200	62	86	-	89	96	-	-	-	-	-	-	-
2	M	-	5	313	8	203	68	86	206	113	130	-	23.5	22.0	71.0	68.5	18.5	18.0
3	F	Yes	6	307	8	198	57	84	190	86	107	-	-	-	-	-	-	
4	M	-	3	297	8	203	86	87	-	100	115	-	9.0	13.8	59.0	59.0	15.0	16.0
5	M	-	9	282	6	205	61	-	-	113	123	-	32.5	31.5	84.0	86.5	21.0	22.0
6	F	Yes	7	297	6	-	63	87	198	82	92	-	-	-	-	-	-	-
7	F	Yes	14	295	8	192	64	82	193	76	88	-	-	-	-	-	-	-
8	F	Yes	5	287	7	-	61	85	192	82	93	-	-	-	-	-	-	-
9	F	Yes	-	299	9	-	65	87	200	86	103	-	-	-	-	-	-	-
10	F	Yes	4	310	9	-	63	-	-	72	84	-	-	-	-	-	-	-
11	F	Yes	7	299	9	-	-	-	-	73	88	-	-	-	-	-	-	-
12	M	-	-	288	7	-	68	85	210	-	-	146	33.0	33.6	84.0	83.5	21.0	20.5
13	F	?	-	-	-	-	69	87	-	-	-	-	-	-	-	-	-	-
14	M	-	-	307	5	-	-	-	-	108	125	150	33.5	34.0	79.0	79.0	21.0	21.0
15	M	-	4	286	10	-	66	88	203	-	-	132	26.0	27.0	74.0	75.5	20.0	19.5
16	F	Yes	3	276	9	-	61	84	191	79	84	-	-	-	-	-	-	-
17	F	No	9	299	7	-	63	85	204	82	91	-	-	-	-	-	-	-
18	F	No	7	304	8	-	61	85	-	87	97	-	-	-	-	-	-	-
19	F	Yes	13	285	7	183	61	89	171	76	94	-	-	-	-	-	-	-
20	F	Yes	-	278	7	-	61	85	193	83	99	-	-	-	-	-	-	-

*All length measurements are in cm.