THE CALVING GROUND OF THE

CENTRAL ARCTIC CARIBOU HERD, 1984

Final Report

Prepared for:

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Note: This paper reports on surveys of the calving ground of the Central Arctic Caribou Herd in 1984. The body of the report was written for publication; the accompanying appendices provide additional data and discussion.

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EXECUTIVE SUMMARY

1. In 1984, calving in the Central Arctic Herd occurred from approximately 29 May to 12 June. The majority of calves were born between 31 May and 6 June.

2. Productivity was high, with a ratio of 86 calves per 100 cows.

3. The majority of calves were observed in the area bounded by the Colville and Itkillik rivers on the west, the Canning River on the east, and inland to Franklin Bluffs. The overall density of cows in this area was extremely low (0.4 cows/km^2).

4. Cows were unevenly distributed throughout the calving ground. The greatest densities were observed in the Kuparuk Oilfield (2.9/km^2) and the area between Bullen Point and the Staines River (1.6/km^2); caribou were dispersed throughout the remainder of the calving ground (0.06-0.42/km^2).

5. The distribution of caribou on the calving ground changed during the calving season as cows moved into the two major high-density areas. These changes are illustrated as follows:

	Estimated percentage of CAH cows in each area	
	early calving	late calving
Kuparuk Oilfield	10	32
Bullen Point to Staines River area	19	25
Dispersed over remainder of the calving ground	69	42

The importance of the Kuparuk Oilfield as an area of concentrated calving has been emphasized in the past. The reasons for this emphasis were: that the density of caribou in the area was relatively high; the area used was relatively stable in location from year to year; and frequent surveillance trips were flown relative to other portions of the calving ground. The Kuparuk Oilfield probably has been overemphasized as to its importance for calving as there is an equally large number of caribou using the Bullen Point to Staines River Area and an even greater number of caribou dispersed throughout the region between the Colville and Canning rivers.

INTRODUCTION

The Central Arctic Herd (CAH) of caribou (Rangifer tarandus) ranges on the north slope of the Brooks Range between the Canning and Colville rivers (Cameron and Whitten 1979). Most CAH cows calve on the Arctic Coastal Plain during late May and early June and remain there during the summer months. The calving ground encompasses the Prudhoe Bay and Kuparuk oilfields.

Concerns about possible displacement of caribou from traditional calving areas (Cameron 1983) and a lack of specific data describing the extent and use of the CAH calving ground prompted the oil industry to fund investigations to further describe the use of the Arctic Coastal Plain by the CAH during calving. The specific objectives of this study were to delineate the extent of the calving ground in 1984 and the relative distribution of caribou, and to describe changes in the distribution of caribou as calving progressed.

STUDY AREA

The study area was bounded on the north by the Beaufort Sea, on the east by the Tamayariak River, on the south by the northern foothills of the Brooks Range, and on the west by the Colville River (Figure 1). This area is typical of the Arctic Coastal Plain, which, except for several widely scattered groups of low hills, is a flat, poorly drained area that rises from sea level to approximately 200 m elevation at its southern edge (Wahrhaftig 1965).

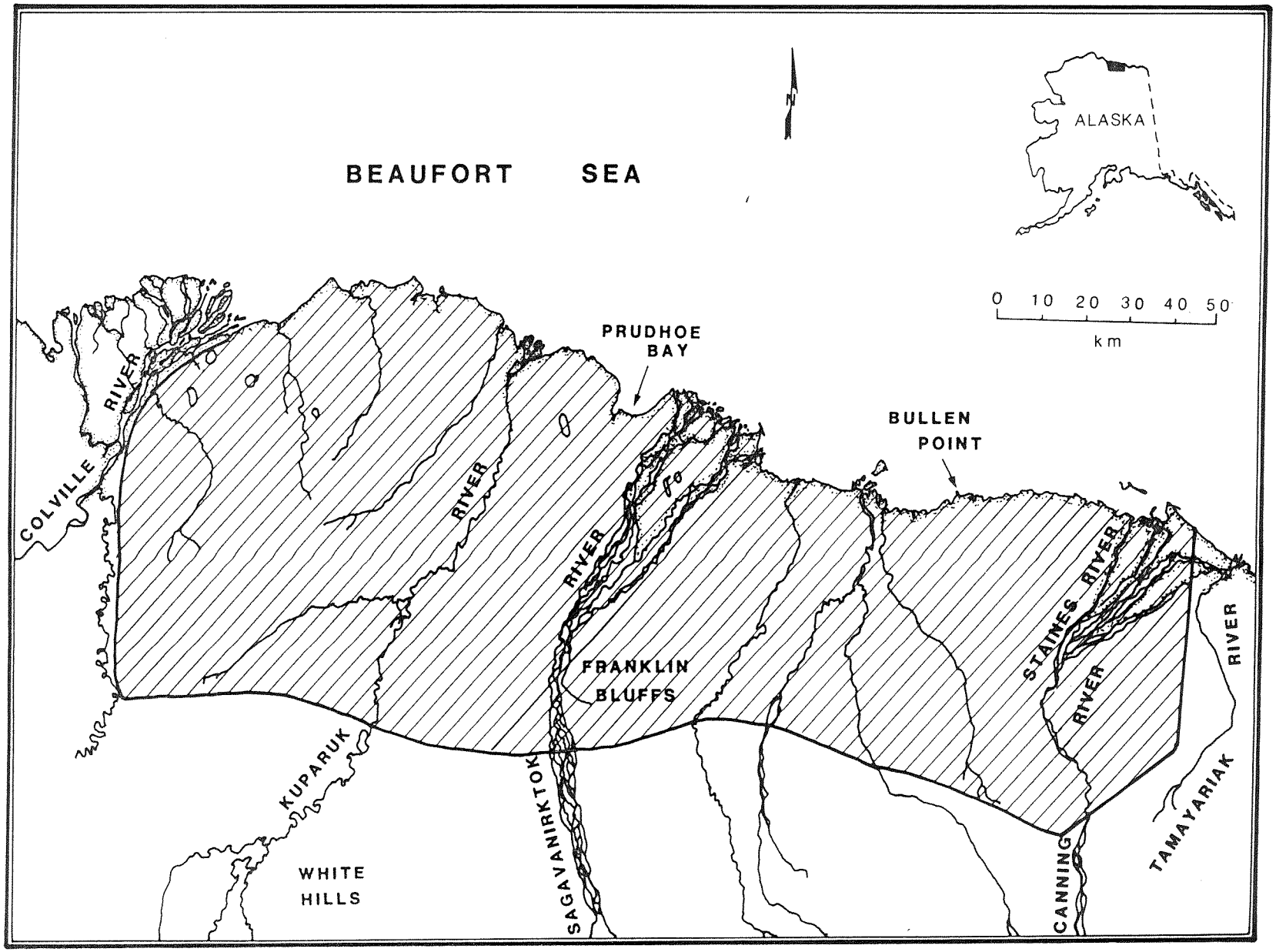


Figure 1. Location of study area for Central Arctic Herd calving ground survey, 1984.

METHODS

Two Piper PA-18 "Super Cub" aircraft were used to conduct aerial surveys between 29 May and 12 June 1984. On 30 May, extensive surveys were flown over the entire study area to delineate the general boundary of the calving ground. On 1 June, adult cows previously radio-collared by the Alaska Department of Fish and Game were located by standard telemetry techniques. These locations were also used to delineate the boundary of the calving ground (i.e., that area where virtually all calving took place). Data collected on the flights of 30 May and 1 June were used to stratify the calving ground into high, moderate, and low density areas.

An attempt was made to survey the entire calving ground intensively, giving priority to areas of relatively high densities. Surveys were flown at approximately 125 m above ground level and 110 km per hour along transects spaced at 1.6-3.2-km intervals. The width of the transects varied depending on the density of caribou, weather conditions, and snow cover, all of which affected the visibility of caribou (sightability). The aircraft occasionally deviated from the transect so that caribou groups could be observed closely, then returned to the transect at the point of departure. The locations of caribou groups were delineated on 1:63,360-scale U.S. Geological Survey topographic maps. Data collected included group size and composition (number of cows, calves, yearlings, bulls, and unknown adults). In several areas, additional composition counts were obtained by observers on the ground.

A planimeter was used to determine the size of the area covered during each survey. These areas were categorized according to the maximum density of caribou observed among all surveys to minimize the variability caused by

different observers and by changes in sightability. Very few bulls were seen during our surveys, hence "unknown adults" were most likely cows and those numbers were lumped with the number of cows when densities were determined. This procedure may have resulted in the inclusion of a small number of young bulls or yearlings in the density calculations, but not enough to affect the rather broad categories we used. The categories used were "very low" (<0.1 cows/km^2), "low" (0.1-0.2 cows/km^2), "moderate" (0.2-0.8 cows/km^2), "high" (0.8-1.5 cows/km^2), and "very high" (>1.5 cows/km^2).

RESULTS AND DISCUSSION

Chronology of Calving

Calves (8 observed) were already present when our study was initiated on 29 May. Most calves were born between 31 May and 6 June (Figure 2). Calving was essentially over after this period as there was a two- to three-fold increase in the number of calves observed between 6 and 12 June, and calf numbers during this latter period were relatively stable and comparable with post-calving counts in previous years (Cameron et al. 1983).

By 31 May, calving was progressing more quickly in the east (Bullen Point to Staines River area, with 26.9% calves) than in the west (Kuparuk Oilfield, with 5.2% calves). The causes of these early differences are unknown. Perhaps, as an extremely synchronous mating pattern is characteristic of caribou (Dauphiné and McClure 1974), it may be that these two concentrations of cows bred at slightly different times. By 6 June, the proportions of calves in both areas were comparable, with 32.4% calves observed in the

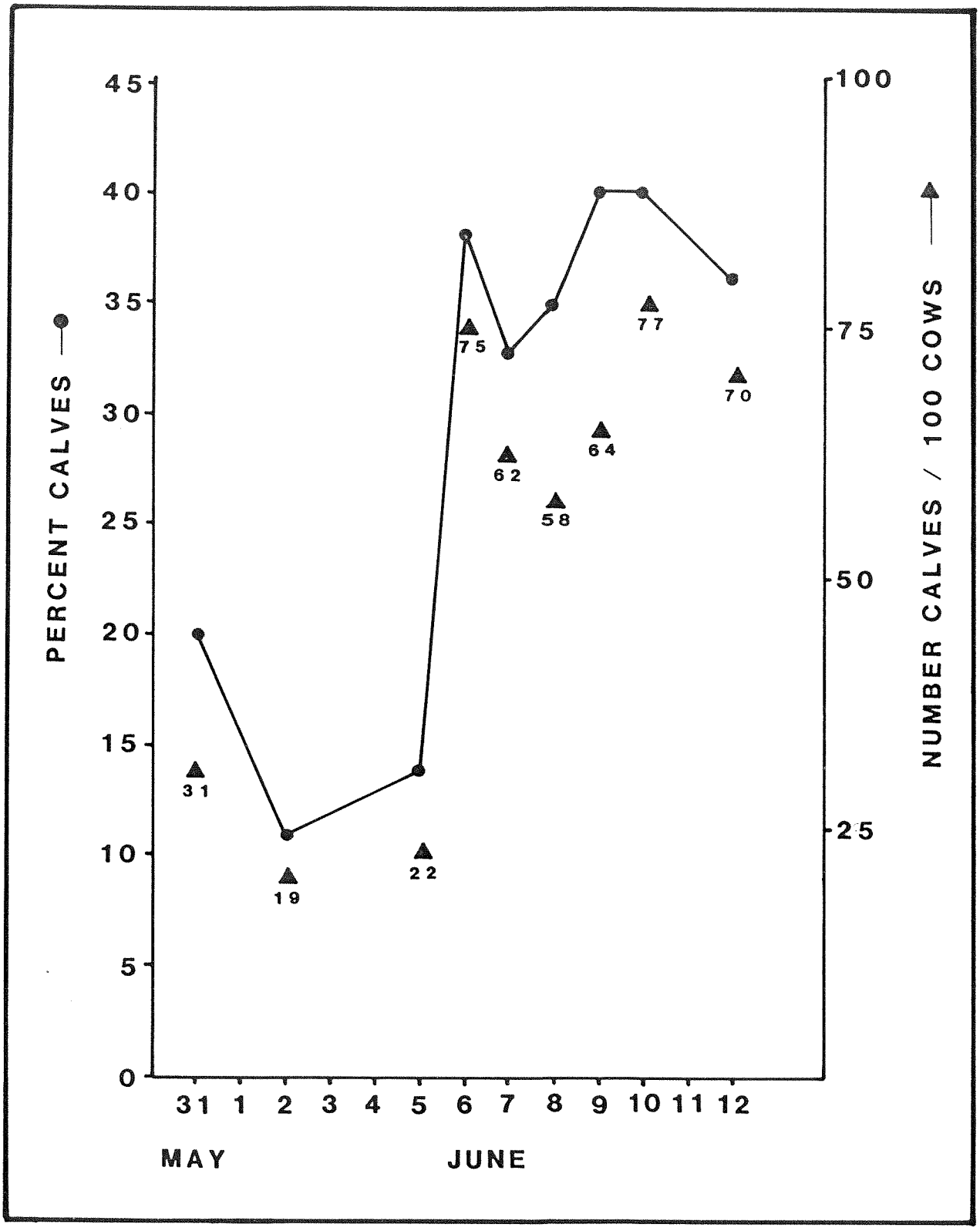


Figure 2. Percent calves observed during aerial (31 May - 12 June) and ground (5 and 8 June) surveys of the CAH calving ground, 1984.

Kuparuk Oilfield and 38.9% calves observed in the Bullen Point to Staines River area.

The chronology of calving in 1984 was similar to previous years (see Keene and Gavin 1984; Lawhead and Curatolo 1984). The timing of calving in the CAH is very similar to the neighboring Porcupine Caribou Herd, in which calving occurs from 30 May to 10 June and peaks between 4 and 9 June (Garner and Reynolds 1984).

Productivity

Productivity of the CAH was high in 1984, with 77 calves/100 cows (n=2635) observed on 10 June. Productivity has been high since at least 1978, when the first calf counts were made. In previous years, productivity has ranged from 69-87 calves/100 cows (Cameron et al. 1983; Whitten and Cameron 1983).

Extent of Calving

In 1984, most cows of the CAH calved in an area of approximately 11,400 km^2 bounded on the north by the Beaufort Sea, on the east by the Tamayariak River, on the west by the Colville River, and inland 40 km to the southern edge of Franklin Bluffs (Figure 3). A few cows with calves were observed as far inland as 65 km, however. In some years caribou have also calved to the south, in the White Hills (Cameron et al. 1983; Lawhead and Curatolo 1984). No calving occurred in the White Hills in 1984, probably due to the light snow cover farther north. The general distribution of caribou during calving is influenced by snow cover along the spring migration routes, with more calving occurring farther north during years of light snow cover (Cameron et al. 1981;

Carruthers et al. 1984).

An estimated 4000 cows were dispersed throughout the study area, based on a herd population of 12,700 in July 1983 (R. Cameron, Alaska Department of Fish and Game, Fairbanks, pers. comm.) and a 32 percent proportion of cows (Kuropat and Curatolo 1983). Thus, the overall density of cows (0.4/km^2) was low compared with other herds, for which densities as high as 24 cows/km^2 have been recorded (Fleck and Gunn 1982).

Distribution of Caribou on the Calving Ground

Caribou were unevenly distributed throughout the calving ground, with the greatest densities being observed in the Kuparuk Oilfield and the area between Bullen Point and the Staines River (Table 1, Figure 3). These areas are roughly similar in size.

The Kavik Hills, the upper Ugnuravik River, and Franklin Bluffs (Table 1) were three small areas that were easily distinguishable because they represented isolated areas of high density relative to the surrounding region. These areas have been discussed by other authors (Cameron et al. 1981, 1983).

The remainder of the CAH cows were dispersed throughout the other areas of the calving ground, although they tended to be more numerous in regions immediately surrounding the two major areas of highest concentration of calving caribou (Figure 3).

As calving progressed, a general increase in the number of caribou was noted in the two major concentration areas. This increase was more pronounced in the Kuparuk Oilfield, where caribou numbers were lower during early calving than in the Bullen Point to Staines River area. The number of cows (and unknown adults) observed in the Kuparuk Oilfield increased from 310 on 31 May

Table 1. Numbers and densities of caribou observed during aerial surveys of the Central Arctic Herd calving ground, 31 May-12 June 1984; data are categorized by maximum density observed in each area.

General Location	Date	Area (km^2)	Number of Caribou Observed						No. Cows & Unk. Ad. per km^2
			Cows	Unk. Ad.	Calves	Yrlg.	Bulls	Total	
VERY HIGH DENSITY									
South of Bullen Point*	10 June	290	446	13	415	42	0	916	1.60
Staines River*	10 June	228	340	1	296	47	0	684	1.50
South of Milne Point**	9 June	161	-	466	299	-	-	765	2.90
HIGH DENSITY									
Bullen Point to Staines River	31 May	709	611	8	263	96	0	978	0.87
	6 June	368	132	4	102	9	0	247	0.37
	8 June	868	101	13	87	21	0	222	0.13
	9 June	1394	623	97	507	71	0	1298	0.52
Kavik Hills	9 June	83	58	10	33	82	0	183	0.82
Kuparuk Oilfield	31 May	1266	240	70	23	108	0	441	0.24
	7 June	710	106	13	72	20	0	211	0.17
	8 June	223	48	30	39	6	0	123	0.35
	9 June	712	116	27	72	13	7	235	0.20
	10 June	754	542	150	432	122	0	1246	0.92
	12 June	891	915	95	709	239	6	1964	1.13

Table 1. Continued.

General Location	Date	Area (km^2)	Number of Caribou Observed						No. Cows & Unk. Ad. per km^2
			Cows	Unk. Ad.	Calves	Yrlg.	Bulls	Total	
MODERATE DENSITY									
Staines - Canning rivers	6 June	137	57	1	46	14	0	118	0.42
Upper Ugnuravik River	1 June	78	40	2	9	8	0	59	0.76
LOW DENSITY									
Franklin Bluffs	1 June	332	34	23	13	20	0	90	0.17
	8 June	394	20	13	16	56	7	112	0.08
East of Sagavanirktok River	2 June	1212	110	47	34	59	5	255	0.13
	6 June	619	11	3	9	17	0	40	0.02
	7 June	987	128	20	93	28	3	272	0.15
West of Sagavanirktok River	1 June	753	38	5	5	33	0	81	0.06
	2 June	1450	193	53	41	102	0	389	0.17
	8 June	707	53	10	23	6	0	92	0.09
	9 June	754	12	12	5	3	0	32	0.03

* These areas within the Bullen Point to Staines River area.

** This area within the Kuparuk Oilfield.

to 1010 on 12 June, whereas the number in the Bullen Point to Staines River area increased from 619 on 31 May to 800 on 10 June (Table 1). These increases evidently occurred as caribou that calved in surrounding regions moved into the two areas of highest concentration.

Based on problems arising from variable sightability (Appendix B), we assumed that at least 25% of the cows in each area were probably missed during our surveys. We calculated that the Kuparuk Oilfield concentration area (800 km^2) was used by approximately 10% of the CAH cows in early calving (31 May), with the proportion increasing to 32% by late calving (12 June). The proportion of cows in the Bullen Point to Staines River concentration area (1000 km^2) increased from 19% to 25% during the same period. The percentage of cows on the remainder of the calving ground (9600 km^2) decreased concurrently from approximately 69% in early calving to 42% by late calving as animals moved into the concentration areas.

A secondary shift in distribution occurred as snow melt progressed. The Bullen Point to Staines River area is flat near the coast, and extensive flooding had occurred by 9 June. Caribou responded by moving to the southern and eastern edges of the concentration area on 10 June (dotted areas in Figure 3). In contrast, caribou in the Kuparuk Oilfield showed only localized movements, probably because variations in terrain provided dry sites within the area already occupied.

Lastly, there appeared to be some localized changes in caribou distribution associated with roads. Surveys of the Kuparuk Oilfield on 10 and 12 June revealed low numbers of caribou near the Milne Point Road, which bisects the concentration area (Figure 4). The low number of caribou, especially calves, observed near the road may reflect the sensitivity of cows

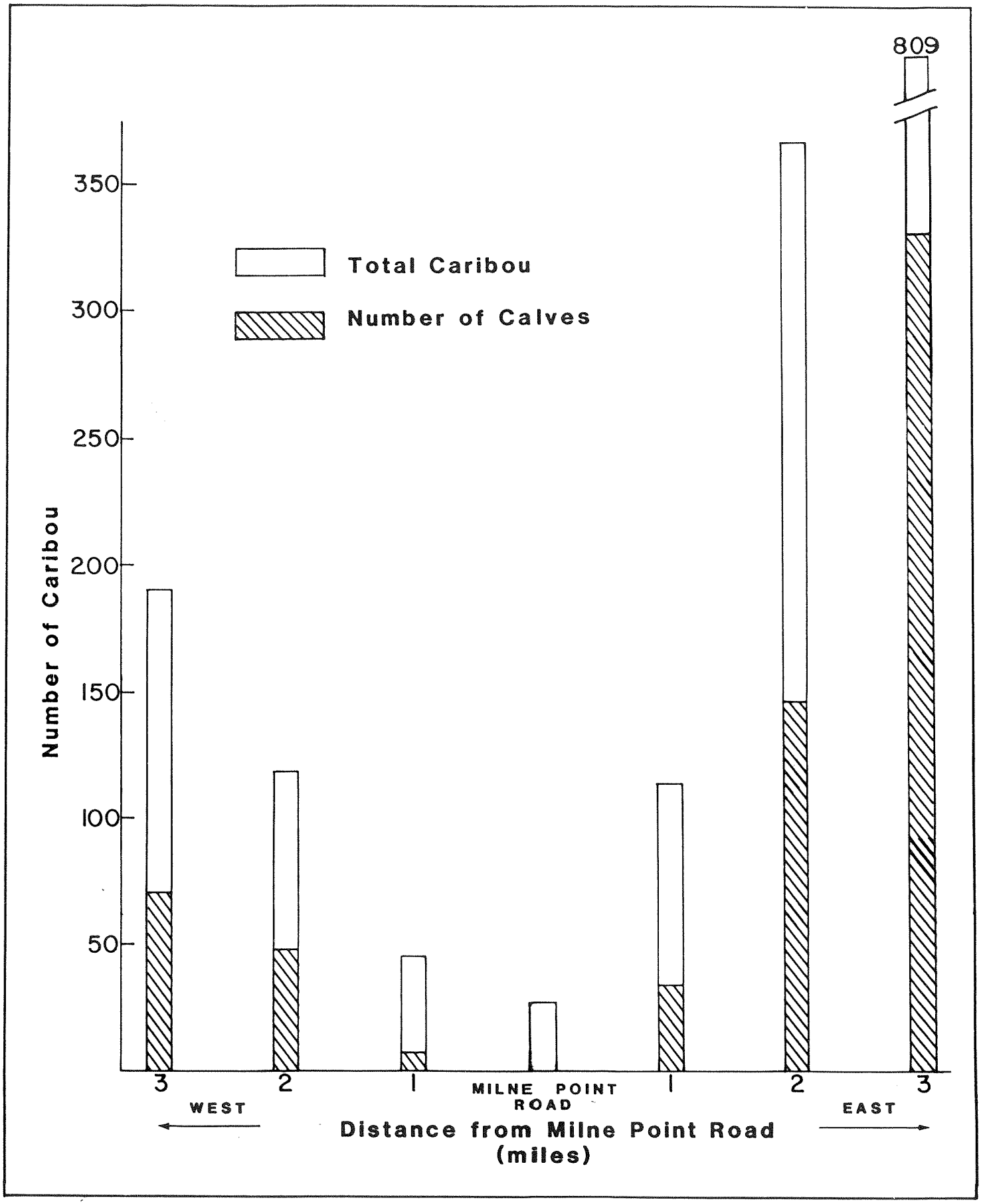


Figure 4. Distribution of caribou observed on aerial surveys within 3 miles of the Milne Point Road on 10 and 12 June 1984.

with calves to disturbance (Lent 1966). This localized displacement has been observed in the past along the Spine Road in the Kuparuk Oilfield (Smith et al. 1984).

CONCLUSIONS

The CAH calving ground is an extremely large area (11,400 km^2) for the size of the herd, extending between the Tamayariak and Colville rivers and from the coast inland to at least Franklin Bluffs. The relatively low density of cows suggests that this herd could increase its present size seven-fold and still have densities lower than many caribou herds (Fleck and Gunn 1982).

Cows on the calving ground were found in two types of distributions: the relatively discrete, high-density areas near the coast in the Kuparuk Oilfield and the Bullen Point to Staines River area, and the extremely large, low-density areas surrounding those concentrations.

The two high-density calving areas received a continual influx of caribou throughout the calving period. During early calving, 10% and 19% of the CAH cows were found in those areas, increasing to 32% and 25% by late calving, respectively. Past studies have emphasized the importance of the high-density areas, or "core calving grounds," especially in the Kuparuk Oilfield (Cameron et al. 1981, 1983). Overall, more cows calved in the large, low-density areas than in either of the two high-density areas described in this study. The large number of cows that used low-density areas for calving in 1984 indicates these areas are relatively more important than previously described.

Caribou herds typically use specific areas within their home range for

calving (Skoog 1968). The dispersed distribution of CAH caribou during calving is a characteristic of this herd that distinguishes it from most other caribou herds. Indeed, the overall calving ground is virtually indistinguishable from the herd's entire summer range.

LITERATURE CITED

Cameron, R.D. 1983. Issue: caribou and petroleum development in Arctic Alaska. Arctic 36(3):227-231.

Cameron, R.D., and K.R. Whitten. 1979. Seasonal movements and sexual segregation of caribou determined by aerial survey. J. Wildl. Manage. 43(3):626-633.

Cameron, R.D., K.R. Whitten, and W.T. Smith. 1981. Distribution and movements of caribou in relation to the Kuparuk Development Area. Third Interim Rep. to ARCO, EXXON, and SOHIO/BP, by Alaska Dep. Fish and Game, Fairbanks. 37 p.

Cameron, R.D., K.R. Whitten, and W.T. Smith. 1983. Responses of caribou to petroleum-related development on Alaska's Arctic Slope. Prog. Rep., Vol. 7, Fed. Aid Wildl. Rest. Proj. W-21-2 and W-22-1, Alaska Dep. Fish and Game, Juneau. 75 p.

Carruthers, D.R., R.D. Jakimchuk, and S.H. Ferguson. 1984. The relationship between the Central Arctic Caribou Herd and the Trans-Alaska Pipeline. Final Rep., prepared for Alyeska Pipeline Service Co. by Renewable Resources Consulting Services Ltd., Sidney, B.C. 207 p.

Dauphiné, T.C., and R.L. McClure. 1974. Synchronous mating in Canadian barren-ground caribou. J. Wildl. Manage. 38(1):54-66.

Fleck, E.S., and A. Gunn. 1982. Characteristics of three barren-ground caribou calving grounds in the Northwest Territories. Prog. Rep. No. 7, N.W.T. Wildl. Serv., Yellowknife, N.W.T. 158 p.

Garner, G.W., and P.E. Reynolds. (eds.) 1984. 1983 update report baseline study of the fish, wildlife, and their habitats. Arctic Nat. Wildl. Refuge Coastal Plain Resource Assessment, U.S. Fish and Wildl. Serv., Anchorage, Alaska. 614 p.

Keene, D.F., and A. Gavin. 1984. Calving, post-calving, and aggregation of the Central Arctic Herd between the Kuparuk and Colville rivers, 1980, 1981, and 1982. Unpubl. Rep., ARCO Alaska, Inc., Anchorage.

Kuropat, P. and J.A. Curatolo. 1983. Caribou. Chap. 4 In: Lisburne Development Area: 1983 Environmental Studies. Final Rep., prepared for ARCO Alaska, Inc., Anchorage, by Woodward-Clyde Consultants, Anchorage, and Alaska Biological Research, Fairbanks.

Lawhead, B.E., and J.A. Curatolo. 1984. Distribution and movements of the Central Arctic Caribou Herd, summer 1983. Final Rep., prepared for ARCO Alaska, Inc., Anchorage, by Alaska Biological Research, Fairbanks. 52 p.

Lent, P.C. 1966. Calving and related social behavior in the barren-ground caribou. Z. Tierpsychol. 6:701-756.

Skoog, R.O. 1968. Ecology of the caribou (Rangifer tarandus granti) in Alaska. Ph.D. Thesis, Univ. Calif., Berkley.

Smith, W.T., R.D. Cameron, and K.R. Whitten. 1984. Distribution and movements of caribou in relation to the Kuparuk Development Area. Prog. Rep., Fed. Aid Wildl. Rest. Project W-22-2, Alaska Dep. Fish and Game, Juneau. 17 p.

Wahrhaftig, C. 1965. Physiographic divisions of Alaska. U.S. Geol. Surv. Prof. Pap. 482. 52 p.

Whitten, K.R., and R.D. Cameron. 1983. Population dynamics of the Central Arctic Herd, 1975-1981. Acta Zool. Fenn. 175:159-161.

Appendix A. A compilation of results from 1984 aerial surveys of the CAH calving ground: surveys flown west of the Sagavanirktok River.

Table A-1. Numbers and density of caribou observed during aerial surveys of the Central Arctic Herd calving ground on 31 May 1984.

Location	Area Surveyed (km^2)	Number of Caribou Observed						No. Cows & Unk. Ad. per km^2
		Cows	Unk. Ad.	Calves	Yrlg.	Bulls	Total	
Kuparuk Oilfield	1226	240	70	23	108	0	441	0.24

COMMENTS:
Cloud Cover: 500' ceiling
Snow Cover: 90-100%, more complete to southwest
Sightability: fair

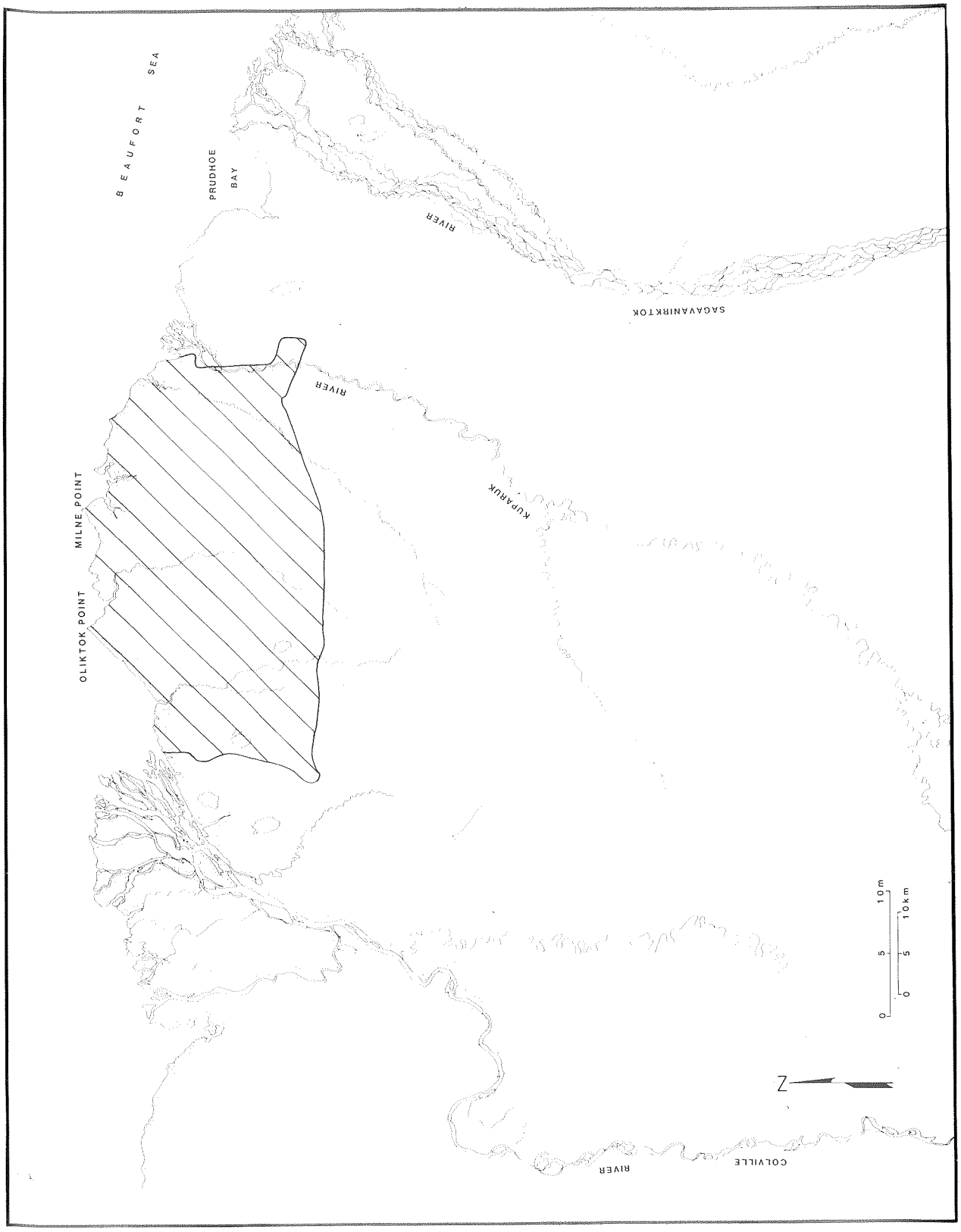


Figure A-1. Location of aerial survey flown 31 May 1984; Kuparuk Oilfield.

Table A-2. Numbers and density of caribou observed during aerial surveys of the Central Arctic Herd calving ground on 1 June 1984.

Location	Area Surveyed (km^2)	Number of Caribou Observed						No. Cows & Unk. Ad. per km^2
		Cows	Unk. Ad.	Calves	Yrlg.	Bulls	Total	
A. West of Sagavanirktok River	544	33	5	2	30	0	70	0.07
B. Upper Ugnuravik River and West of Sagavanirktok River	399	45	2	12	11	0	70	0.12

COMMENTS: Cloud Cover: CAVU*
Snow Cover: 60% along upper Kuparuk and Itkillik rivers, 80-95% elsewhere; more to south
Sightability: good

*CAVU = ceiling absolute, visibility unlimited.

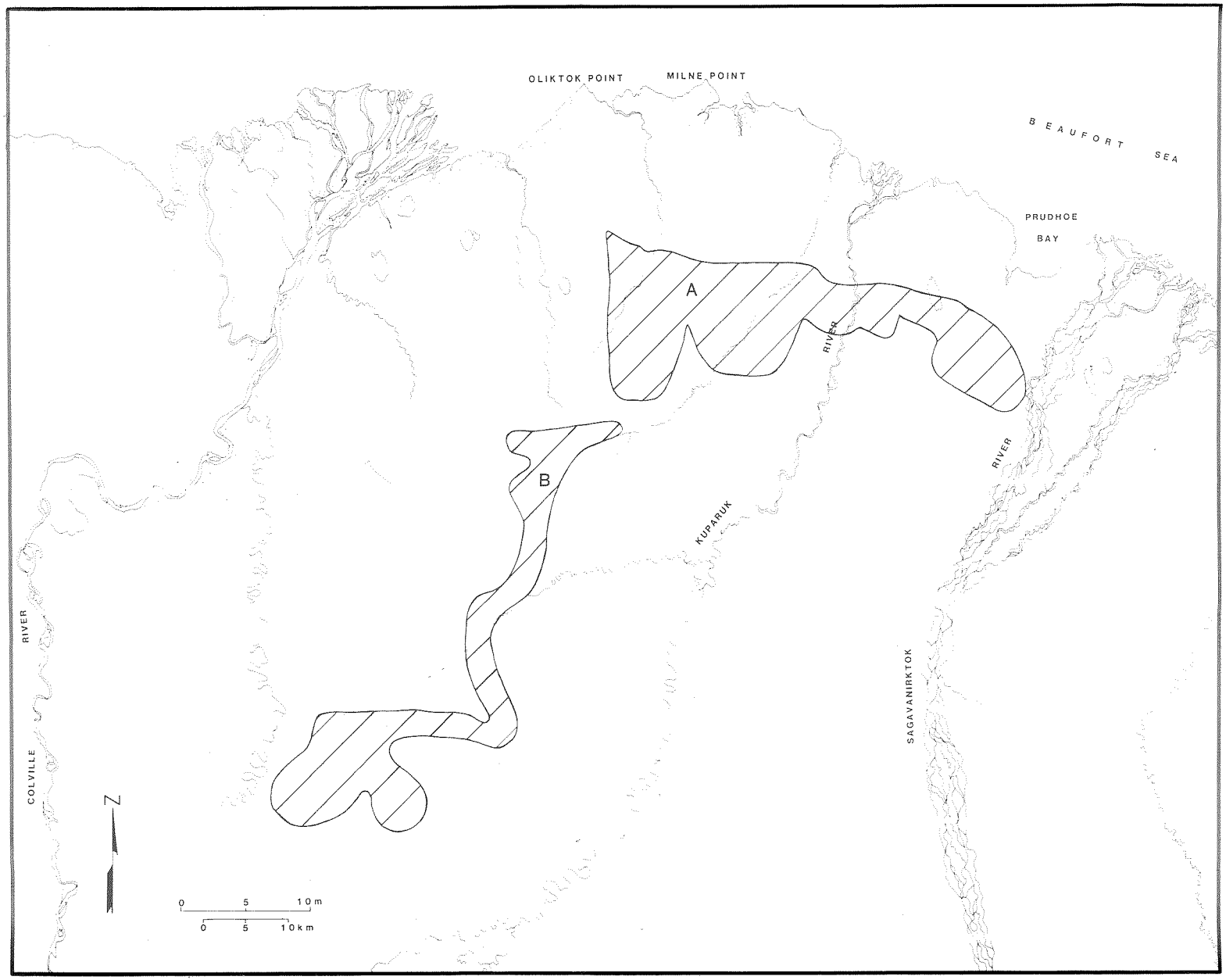


Figure A-2. Location of aerial survey flown 1 June 1984; West of Sagavanirktok River and Upper Ugnuravik River.

Table A-3. Numbers and density of caribou observed during aerial surveys of the Central Arctic Herd calving ground on 2 June 1984.

Location	Area Surveyed (km^2)	Number of Caribou Observed						No. Cows & Unk. Ad. per km^2
		Cows	Unk. Ad.	Calves	Yrlg.	Bulls	Total	
West of Sagavanirktok River	1450	193	53	41	102	0	389	0.17

COMMENTS: Cloud Cover: High broken overcast
Snow Cover: 90-100%; less near rivers; ridgetops snow-free
Sightability: good

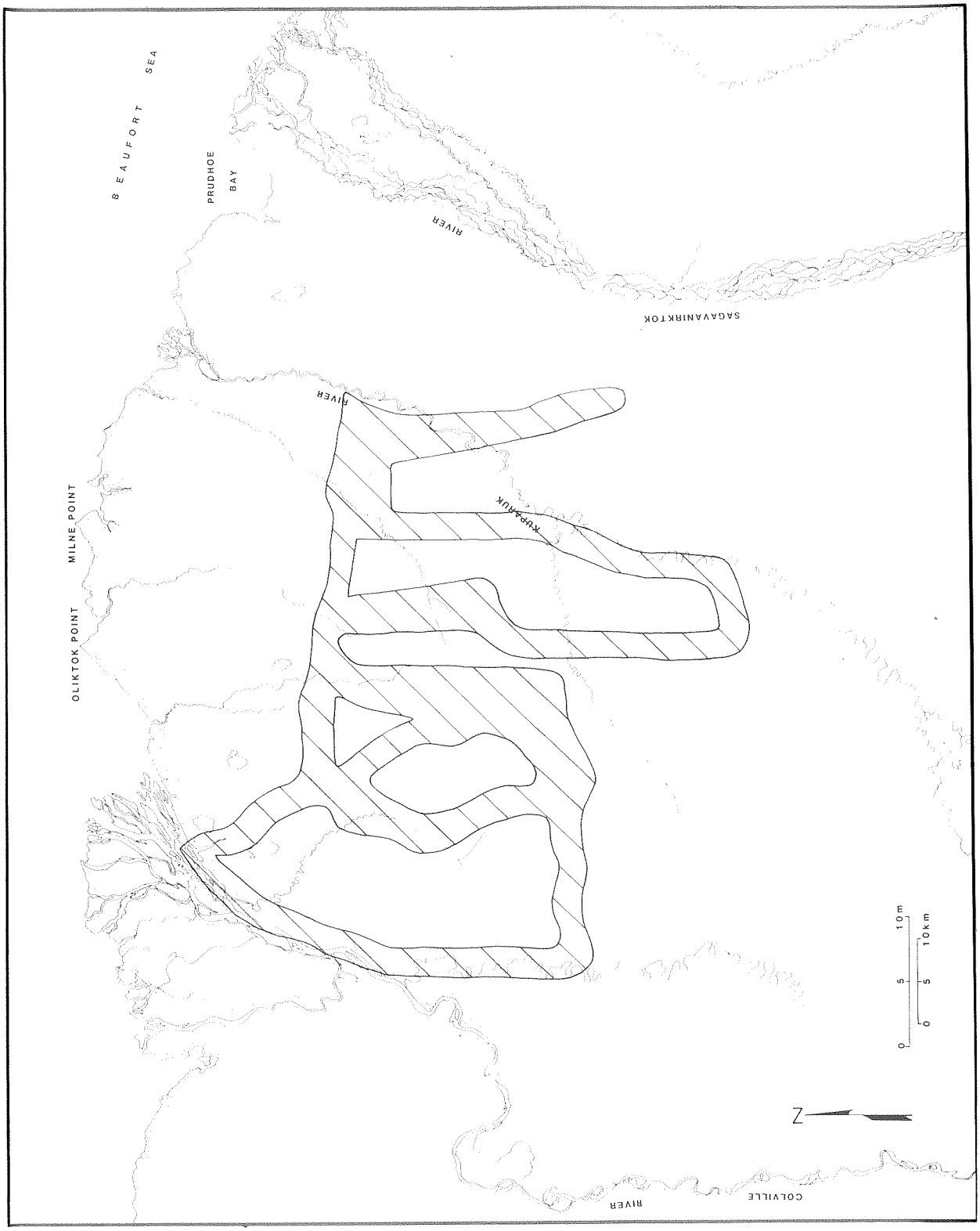


Figure A-3. Location of aerial survey flown 2 June 1984; West of Sagavanirktok River.

Table A-4. Numbers and density of caribou observed during aerial surveys of the Central Arctic Herd calving ground on 7 June 1984.

Location	Area Surveyed (km^2)	Number of Caribou Observed						No. Cows & Unk. Ad. per km^2
		Cows	Unk. Ad.	Calves	Yrlg.	Bulls	Total	
Kuparuk Oilfield	710	106	13	72	20	0	211	0.17

COMMENTS: Cloud Cover: low broken ceiling with fog near coast
Snow Cover: 60%
Sightability: very poor

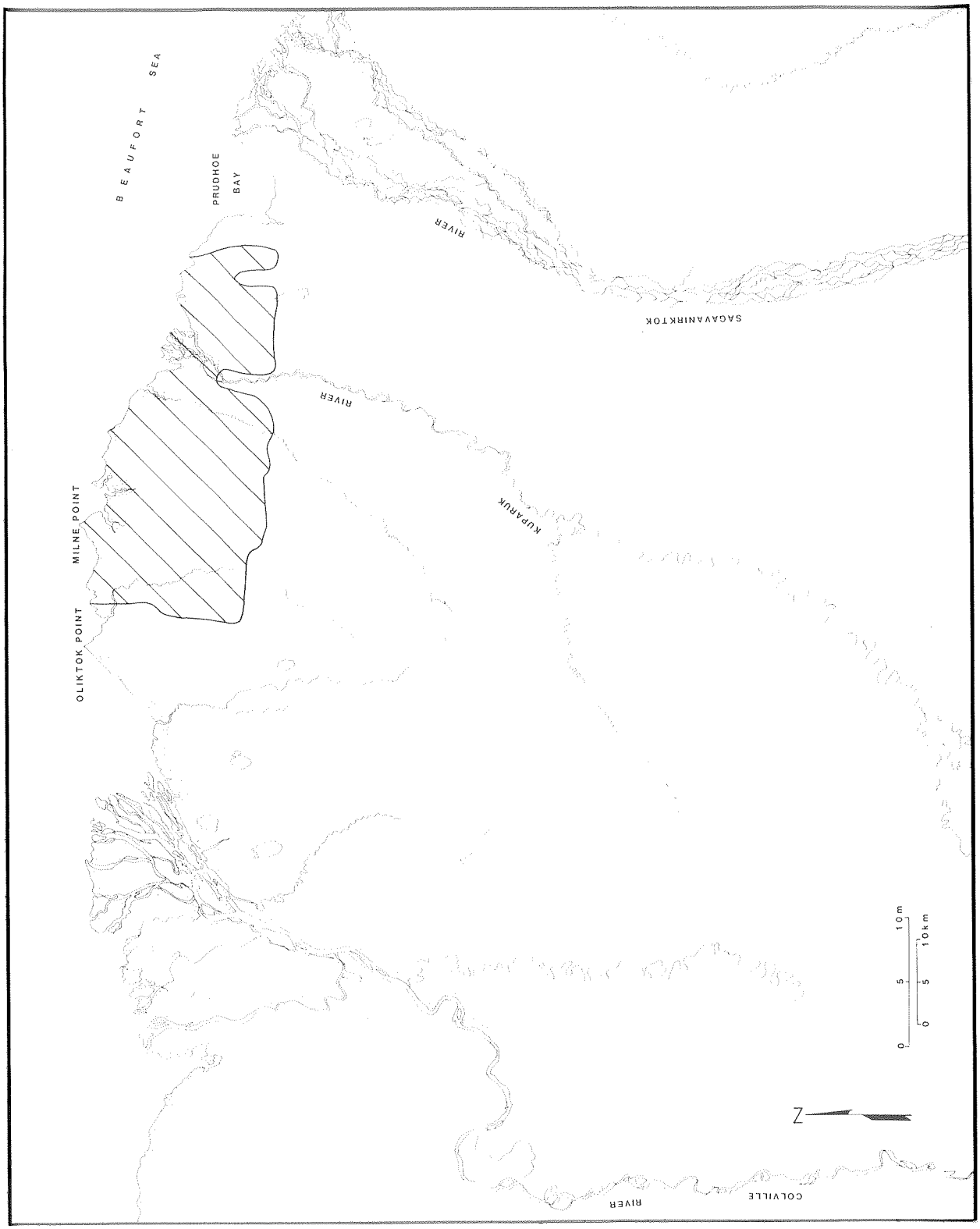


Figure A-4. Location of aerial survey flown on 7 June 1984; Kuparuk Oilfield.

Table A-5. Numbers and density of caribou observed during aerial surveys of the Central Arctic Herd calving ground on 8 June 1984.

Location	Area Surveyed (km^2)	Number of Caribou Observed						No. Cows & Unk. Ad. per km^2
		Cows	Unk. Ad.	Calves	Yrlg.	Bulls	Total	
A. Kuparuk Oilfield	223	48	30	39	6	0	123	0.35
B. West of Sagavanirktok River	707	53	10	23	6	0	92	0.09

COMMENTS: Cloud Cover: 500' ceiling with fog along coast
Snow Cover: variable; 30-75% in Kuparuk Oilfield; 30-50% to south; much flooding
Sightability: poor

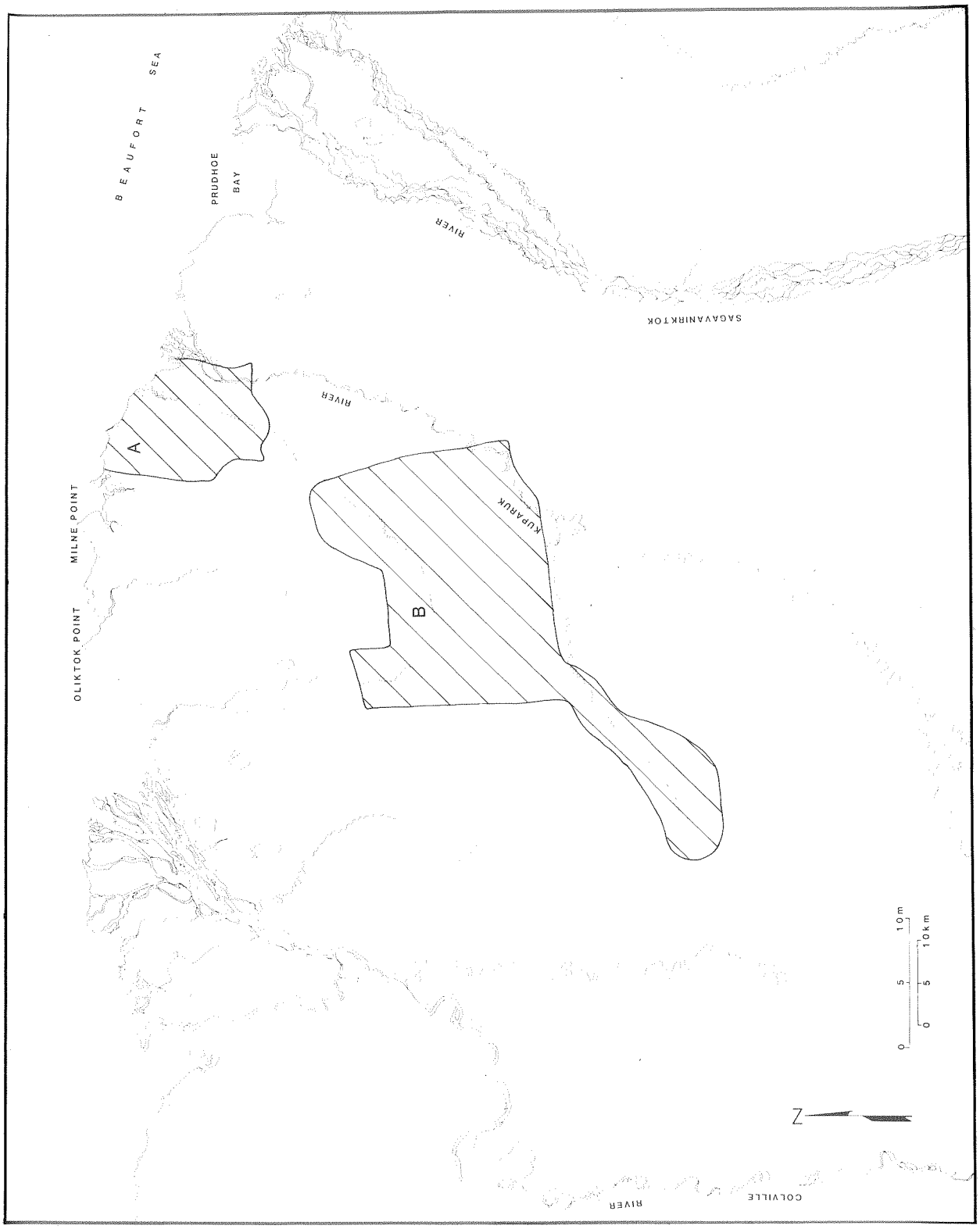


Figure A-5. Location of aerial survey flown on 8 June 1984; Kuparuk Oilfield and West of Sagavanirktok River.

Table A-6. Numbers and density of caribou observed during aerial surveys of the Central Arctic Herd calving ground on 9 June 1984.

Location	Area Surveyed (km^2)	Number of Caribou Observed						No. Cows & Unk. Ad. per km^2
		Cows	Unk. Ad.	Calves	Yrlg.	Bulls	Total	
A. Kuparuk Oilfield	712	116	27	72	13	7	235	0.20
B. South of Milne Point*	161	---	466	299	---	---	765	2.90
C. West of Sagavanirktok River	754	12	12	5	3	0	32	0.03

COMMENTS: Cloud Cover: broken overcast, clearing throughout day
Snow Cover: variable; 0-50%; much flooding
Sightability: poor during day; excellent in evening

* Part of Kuparuk Oilfield area recounted in evening.

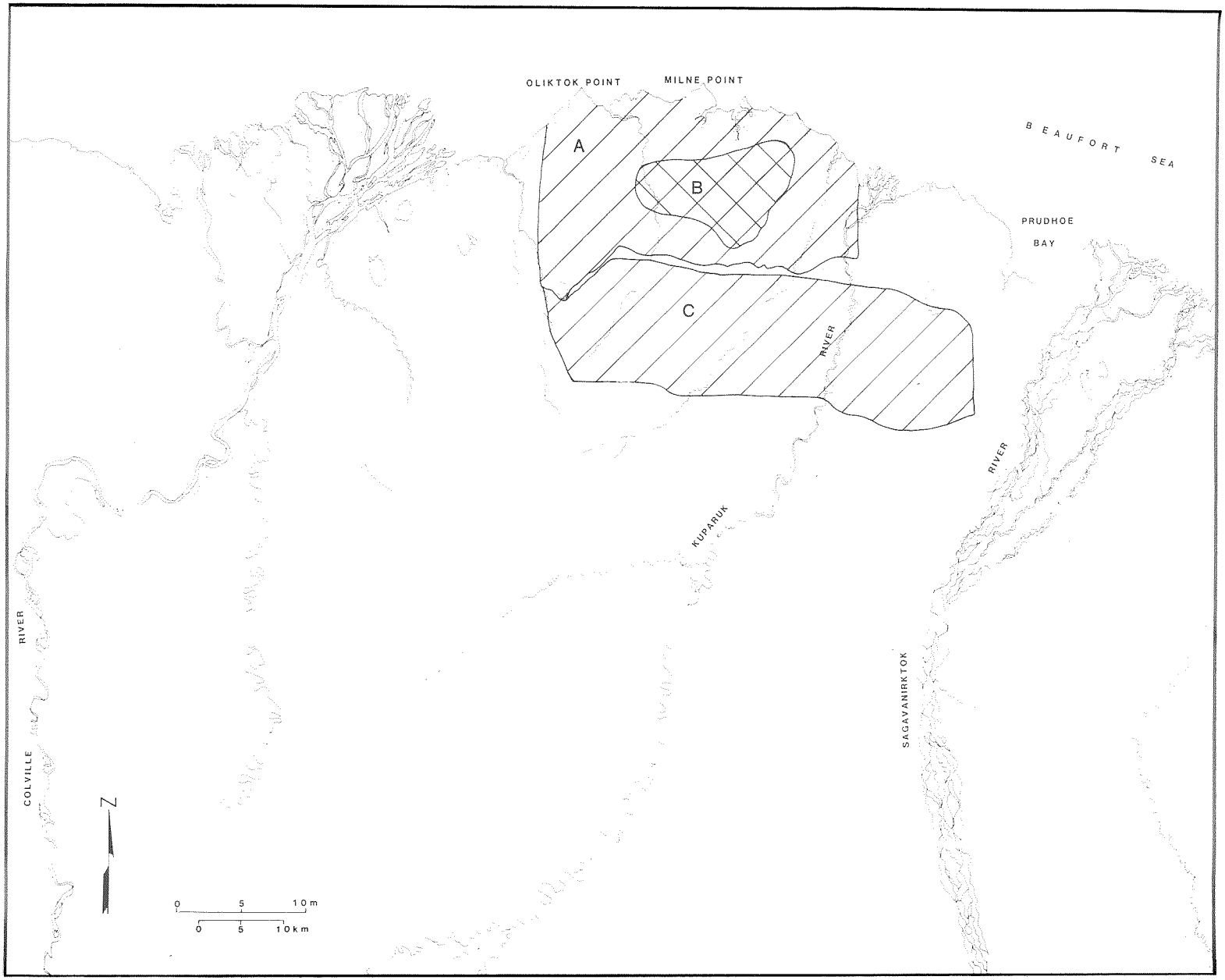


Figure A-6. Location of aerial survey flown on 9 June 1984; Kuparuk Oilfield and West of Sagavanirktok River.

Table A-7. Numbers and density of caribou observed during aerial surveys of the Central Arctic Herd calving ground on 10 June 1984.

Location	Area Surveyed (km^2)	Number of Caribou Observed						No. Cows & Unk. Ad. per km^2
		Cows	Unk. Ad.	Calves	Yrlg.	Bulls	Total	
Kuparuk Oilfield	754	542	150	432	122	0	1246	0.92

COMMENTS: Cloud Cover: CAVU*
Snow Cover: variable, 30-50%; much flooding
Sightability: good; some glare due to meltwater

* CAVU = ceiling absolute, visibility unlimited

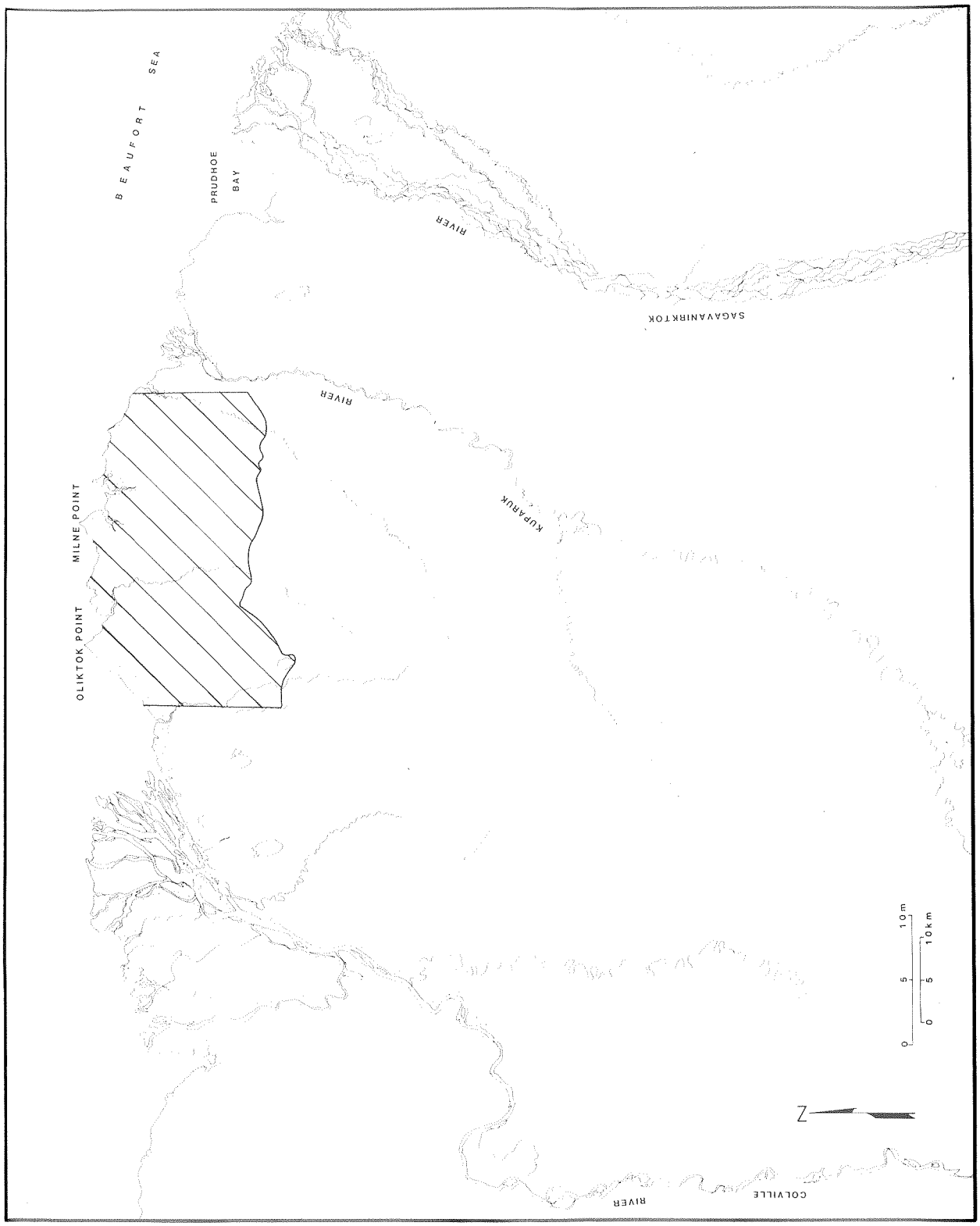


Figure A-7. Location of aerial survey flown 10 June 1984; Kuparuk Oilfield.

Table A-8. Numbers and density of caribou observed during aerial survey of the Central Arctic Herd calving ground on 12 June 1984.

Location	Area Surveyed (km^2)	Number of Caribou Observed						No. Cows & Unk. Ad. per km^2
		Cows	Unk. Ad.	Calves	Yrlg.	Bulls	Total	
Kuparuk Oilfield	891	915	95	709	239	6	1964	1.13

COMMENTS: Cloud Cover: 8000' scattered
Snow Cover: none
Sightability: good

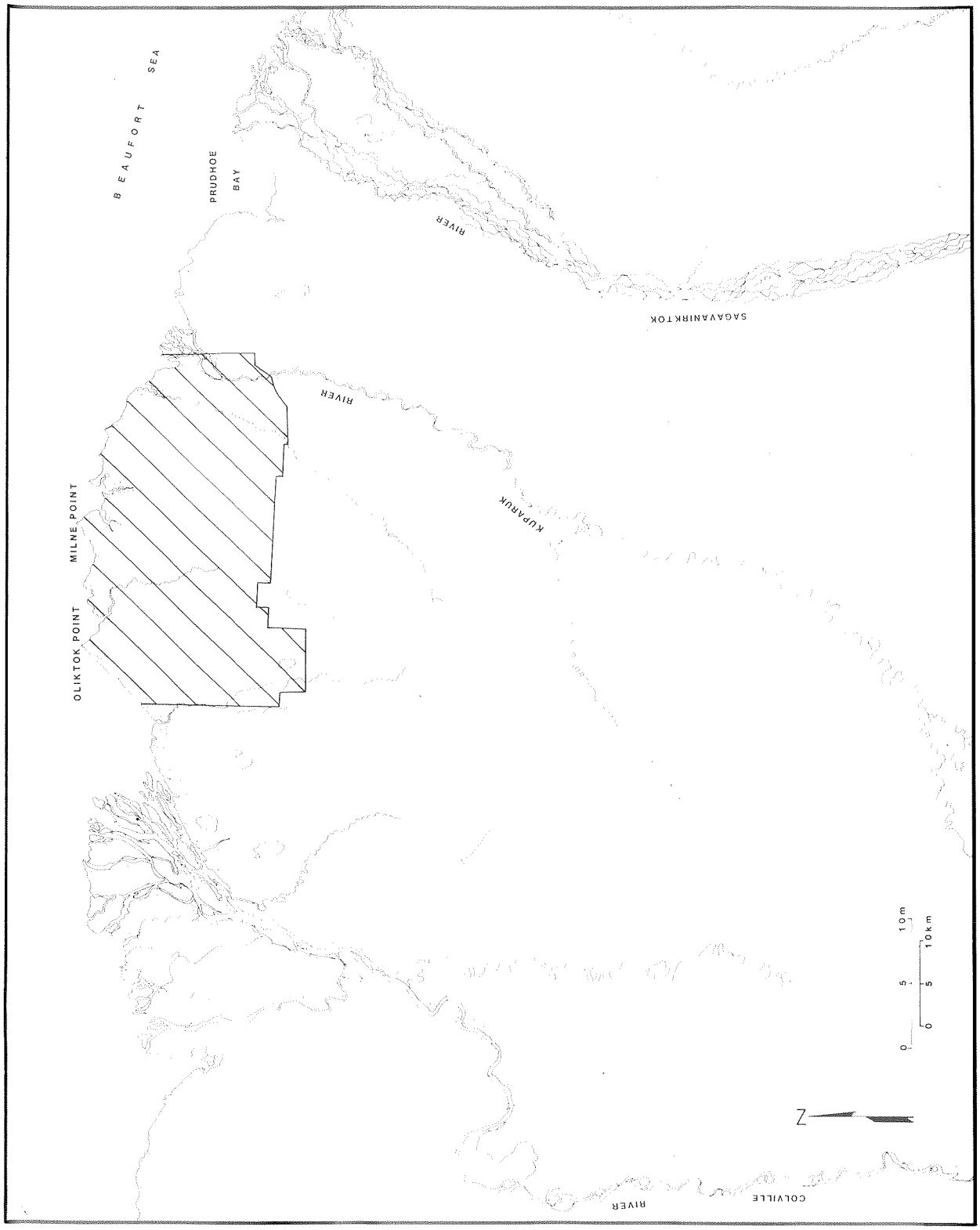


Figure A-8. Location of aerial survey flown 12 June 1984; Kuparuk Oilfield.

Appendix B. A compilation of results from 1984 aerial surveys of the CAH calving ground: surveys flown east of the Sagavanirktok River.

Table B-1. Numbers and density of caribou observed during aerial surveys of the Central Arctic Herd calving ground on 31 May 1984.

Location	Area Surveyed (km^2)	Number of Caribou Observed						No. Cows & Unk. Ad. per km^2
		Cows	Unk. Ad.	Calves	Yrlg.	Bulls	Total	
Bullen Point to Staines River	709	611	8	263	96	0	978	0.87

COMMENTS: Cloud Cover: 500' ceiling
Snow Cover: 90% except approx. 10% near Canning River and along some lake margins
Sightability: good

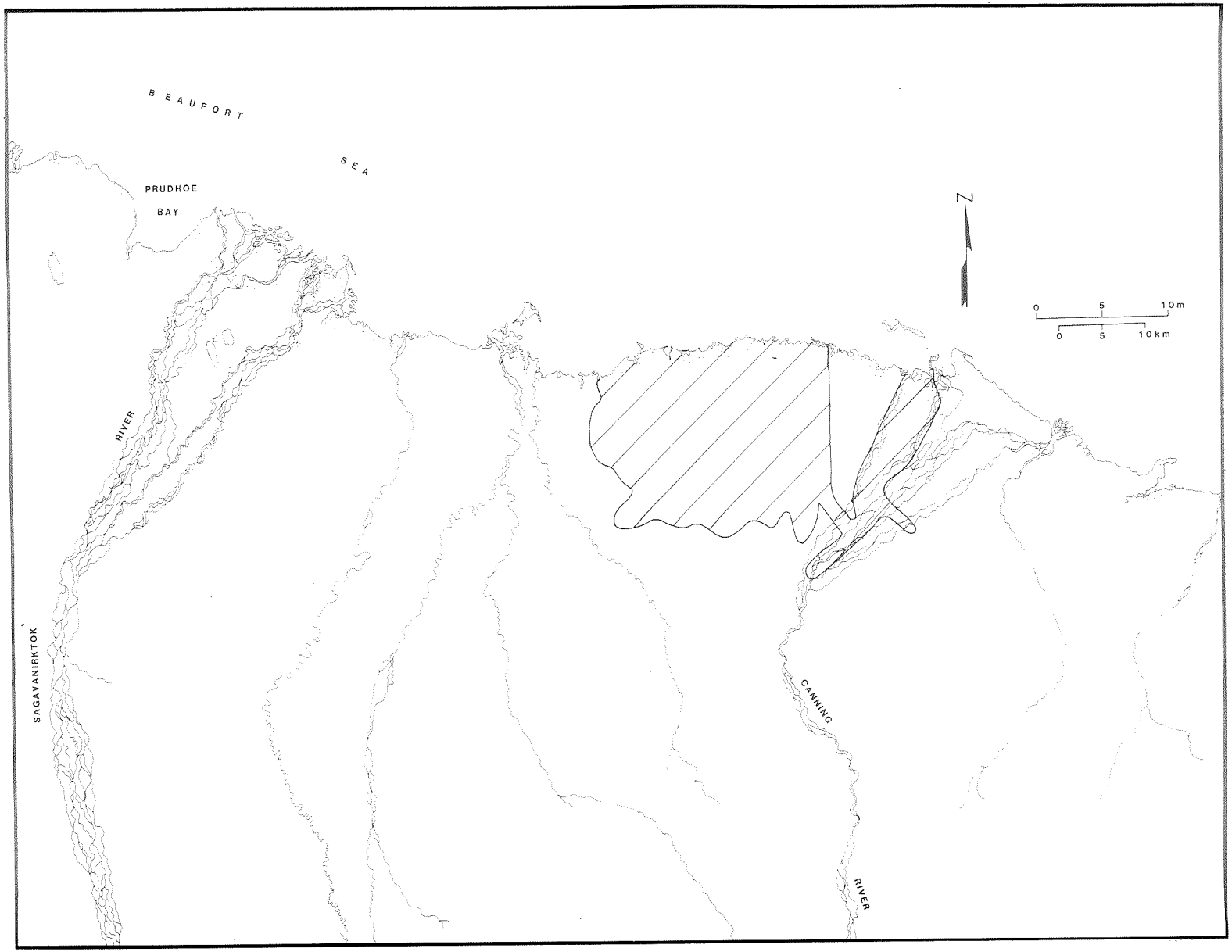


Figure B-1. Location of aerial survey flown 31 May 1984; Bullen Point to Staines River.

Table B-2. Numbers and density of caribou observed during aerial surveys of the Central Arctic Herd calving ground on 1 June 1984.

Location	Area Surveyed (km^2)	Number of Caribou Observed						No. Cows & Unk. Ad. per km^2
		Cows	Unk. Ad.	Calves	Yrlg.	Bulls	Total	
Franklin Bluffs	332	34	23	13	20	0	90	0.17

COMMENTS: Cloud Cover: CAVU*; Fog in evening
Snow Cover: 90% in area between Prudhoe to Staines River, 50% in foothills
Sightability: fair

* CAVU = ceiling absolute, visibility unlimited.

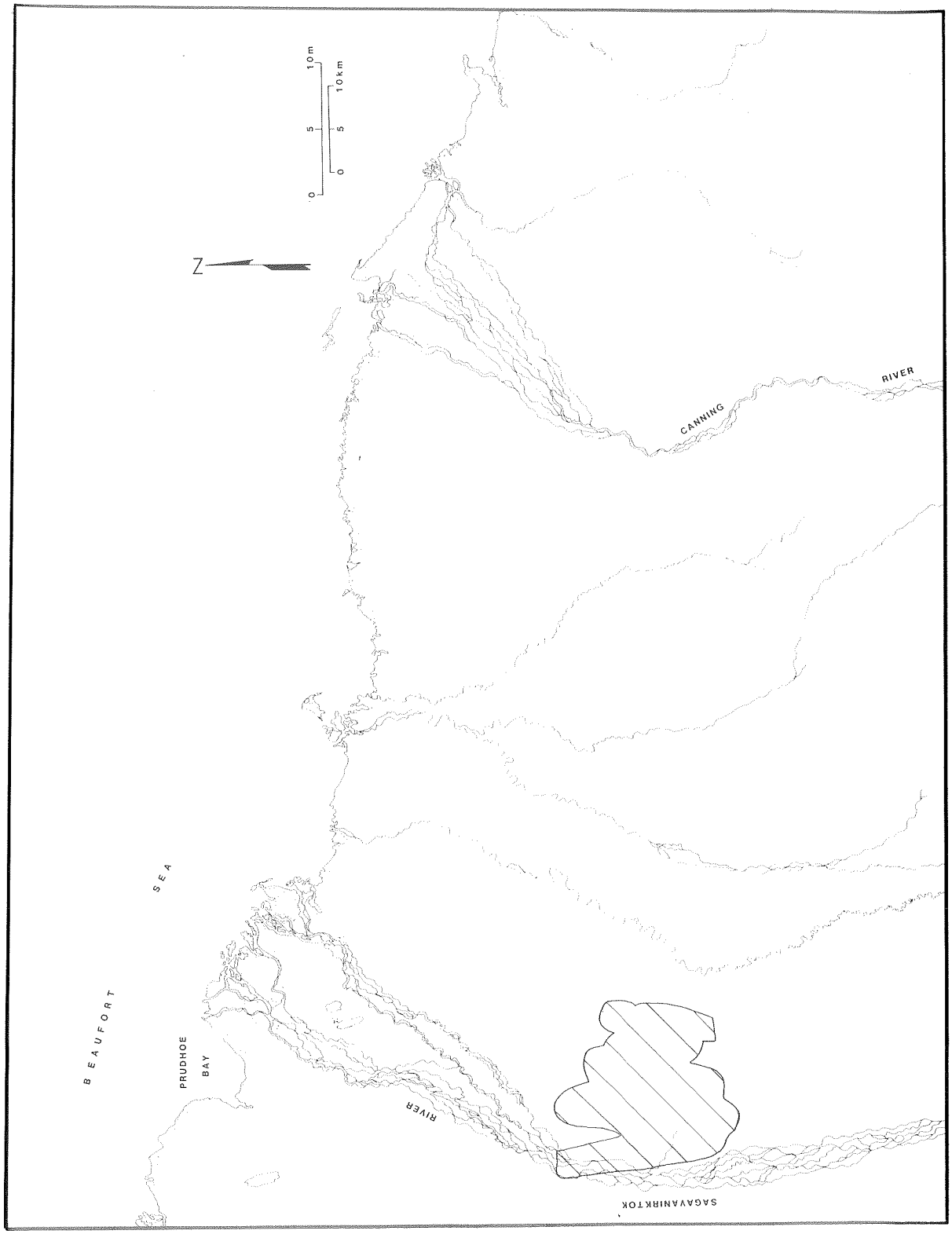


Figure B-2. Location of aerial survey flown 1 June 1984; Franklin Bluffs.

Table B-3. Numbers and density of caribou observed during aerial surveys of the Central Arctic Herd calving ground on 2 June 1984.

Location	Area Surveyed (km^2)	Number of Caribou Observed						No. Cows & Unk. Ad. per km^2
		Cows	Unk. Ad.	Calves	Yrlg.	Bulls	Total	
A. East of Sagavanirktok River	596	88	31	27	26	0	172	0.20
B. East of Sagavanirktok River and Kavik Hills	616	22	16	7	33	5	83	0.06

COMMENTS: Cloud Cover: CAVU
Snow Cover: 80-90% along Sagavanirktok Delta; less to south; very patchy in hills
Sightability: fair to north; poor in hills due to patchy snow cover

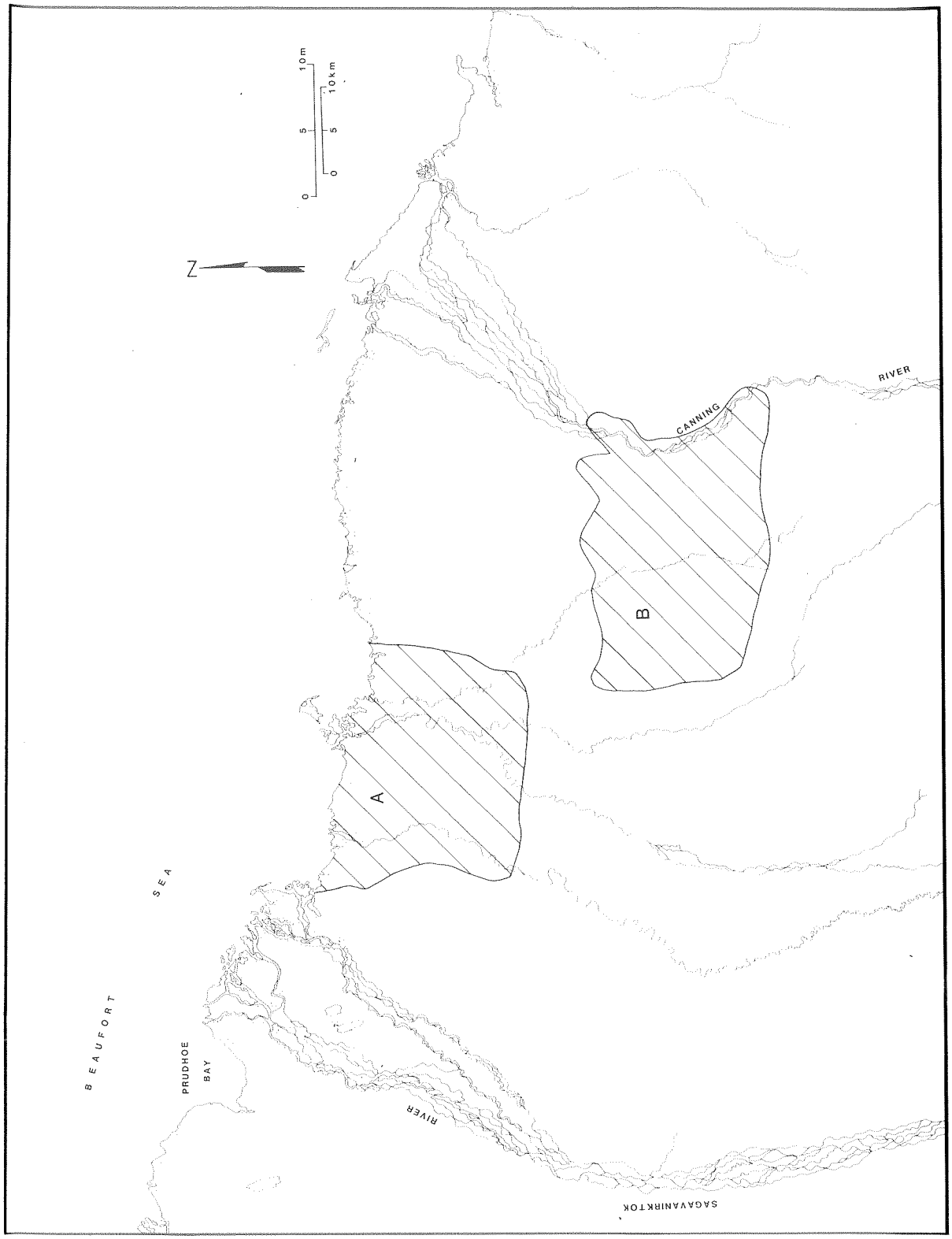


Figure B-3. Location of aerial survey flown 2 June 1984; East of Sagavanirktok River and Kavik Hills.

Table B-4. Numbers and density of caribou observed during aerial surveys of the Central Arctic Herd calving ground on 6 June 1984.

Location	Area Surveyed (km^2)	Number of Caribou Observed						No. Cows & Unk. Ad. per km^2
		Cows	Unk. Ad.	Calves	Yrlg.	Bulls	Total	
A. East of Sagavanirktok River	619	11	3	9	17	0	40	0.02
B. Bullen Pt. to Staines River	368	132	4	102	9	0	247	0.37
C. Staines - Canning rivers	137	57	1	46	14	0	118	0.42

COMMENTS: Cloud Cover: Broken overcast; some fog
Snow Cover: 80% over Sagavanirktok Delta; 50-75% to south; flooding in Staines River area
Sightability: poor

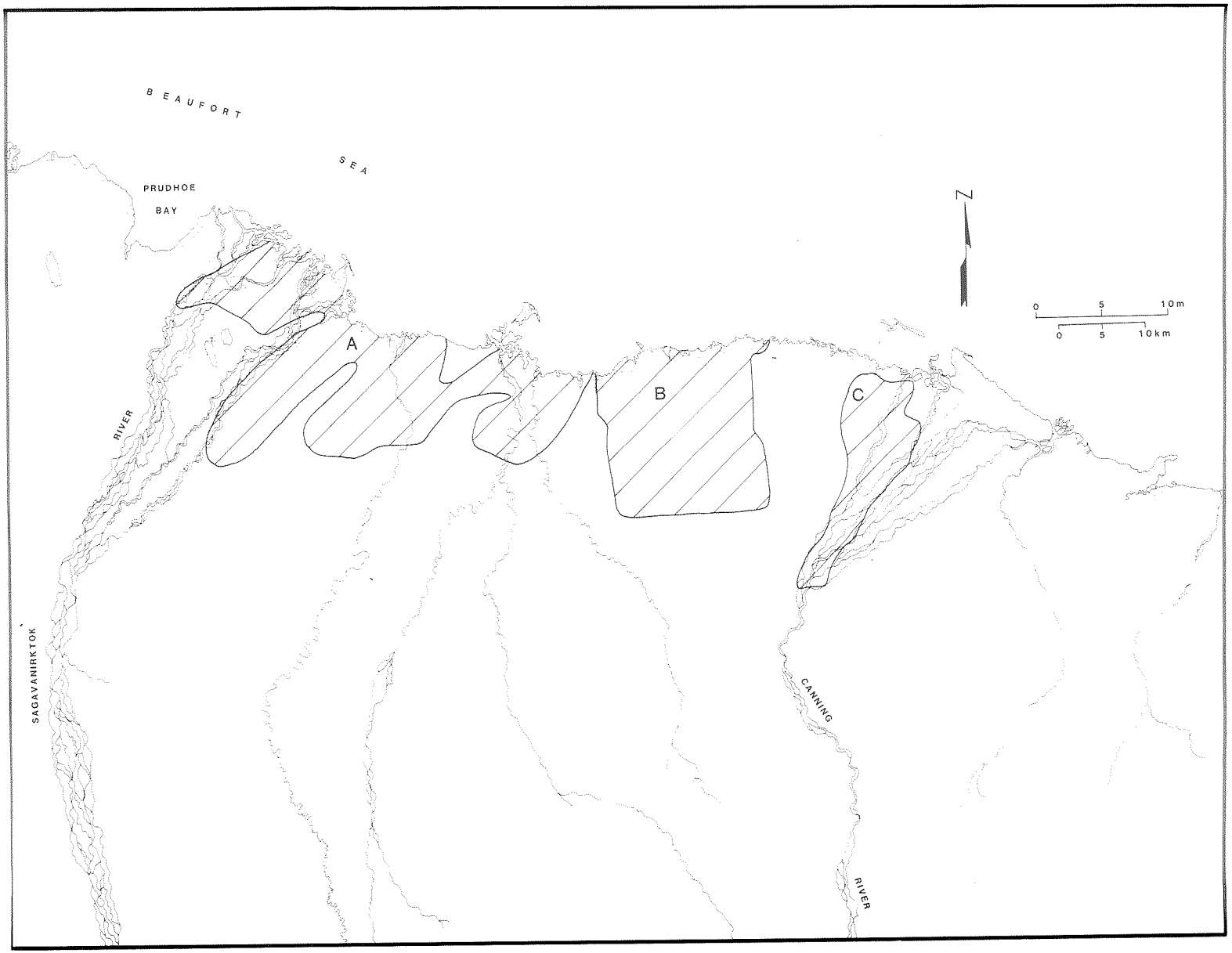


Figure B-4. Location of aerial survey flown 6 June 1984; East of Sagavanirktok River, Bullen Point to Staines River, and Staines - Canning Rivers.

Table B-5. Numbers and density of caribou observed during aerial surveys of the Central Arctic Herd calving ground on 7 June 1984.

Location	Area Surveyed (km^2)	Number of Caribou Observed						No. Cows & Unk. Ad. per km^2
		Cows	Unk. Ad.	Calves	Yrlg.	Bulls	Total	
East of Sagavanirktok River	987	128	20	93	28	3	272	0.15

COMMENTS: Cloud Cover: broken overcast with fog near coast
Snow Cover: 50-75%; less along rivers and in hills
Sightability: poor

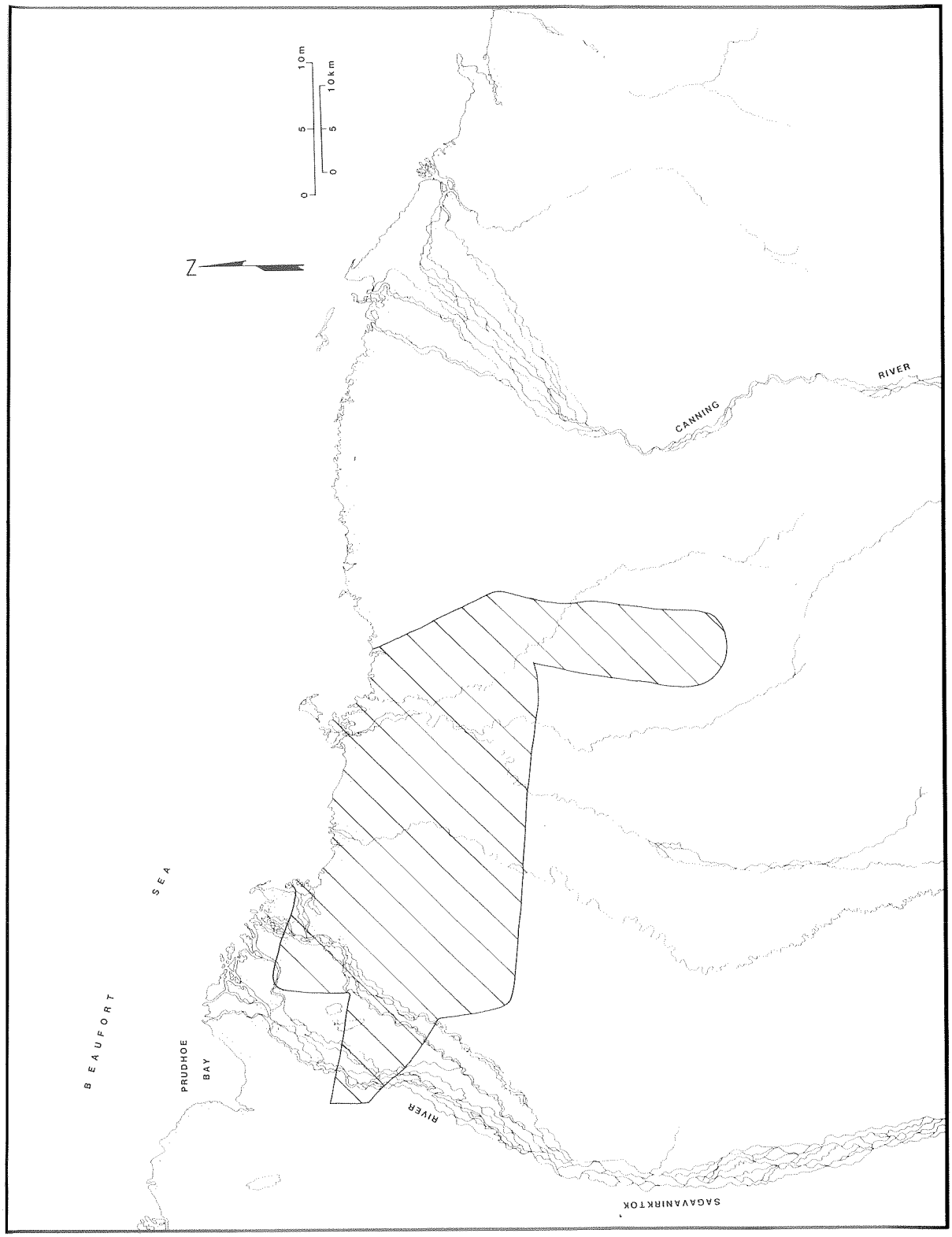


Figure B-5. Location of aerial survey flown 7 June 1984; East of Sagavanirktok River.

Table B-6. Numbers and density of caribou observed during aerial surveys of the Central Arctic Herd calving ground on 8 June 1984.

Location	Area Surveyed (km^2)	Number of Caribou Observed						No. Cows & Unk. Ad. per km^2
		Cows	Unk. Ad.	Calves	Yrlg.	Bulls	Total	
A. Franklin Bluffs	394	20	13	16	56	7	112	0.08
B. Bullen Pt. to Staines River and East of Sagavanirktok River	868	101	13	87	21	0	222	0.13

COMMENTS: Cloud Cover: 400' ceiling with fog
Snow Cover: variable; 0-50%; much flooding
Sightability: poor

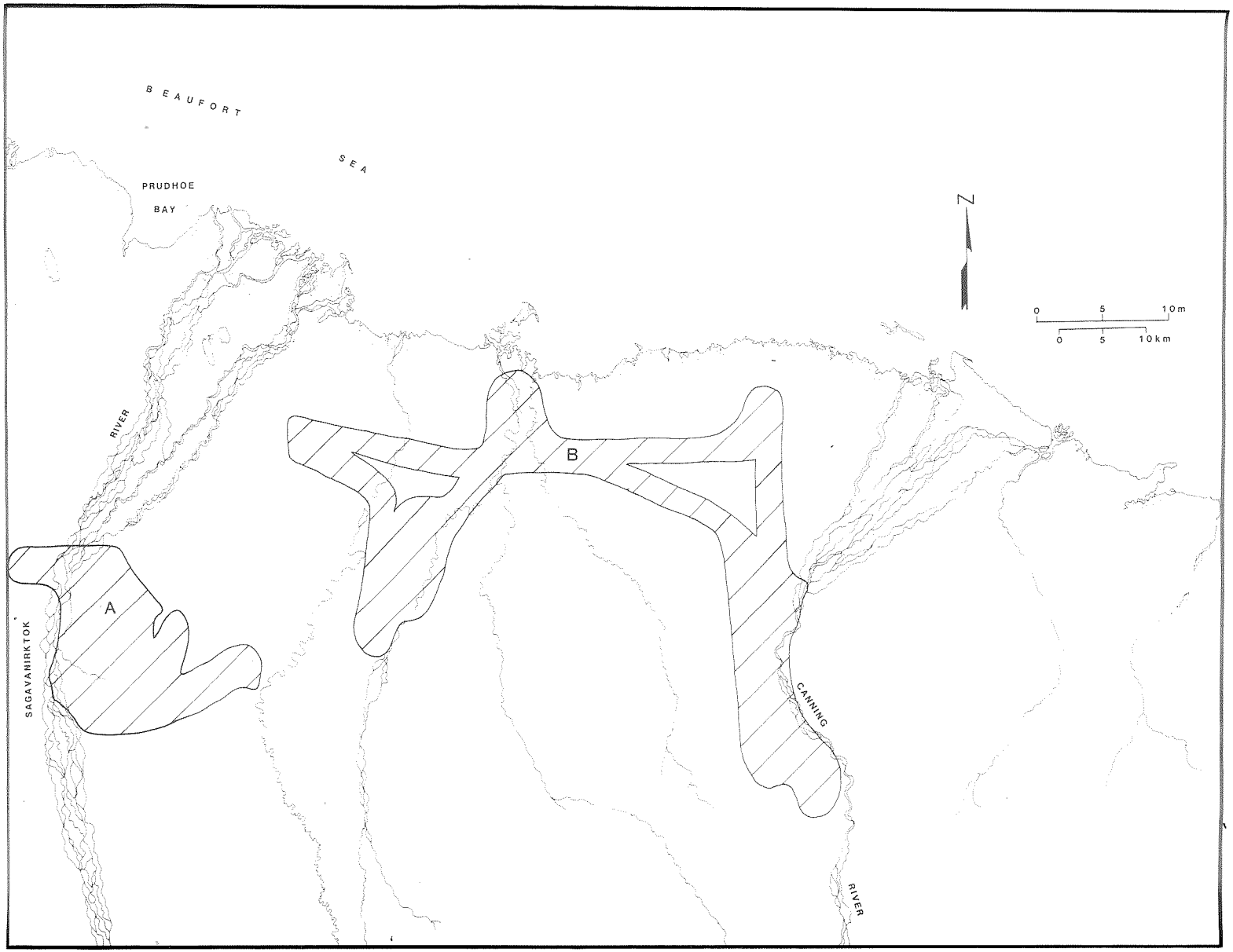


Figure B-6. Location of aerial survey flown 8 June 1984; Franklin Bluffs, Bullen Point to Staines River, and East of Sagavanirktok River.

Table B-7. Numbers and density of caribou observed during aerial surveys of the Central Arctic Herd calving ground on 9 June 1984.

Location	Area Surveyed (km^2)	Number of Caribou Observed						No. Cows & Unk. Ad. per km^2
		Cows	Unk. Ad.	Calves	Yrlg.	Bulls	Total	
A. Bullen Pt. to Staines River and Staines - Canning rivers	868	453	80	372	39	0	944	0.61
B. Bullen Pt. to Staines River and East of Sagavanirktok River	526	170	17	135	32	0	354	0.35
C. Kavik Hills	83	58	10	33	82	0	183	0.82

COMMENTS: Cloud Cover: 600' scattered with 5000' ceiling; clearing throughout day
Snow Cover: variable, 0-70%, more near coast; none in Kavik Hills; much flooding
Sightability: variable depending upon snow cover

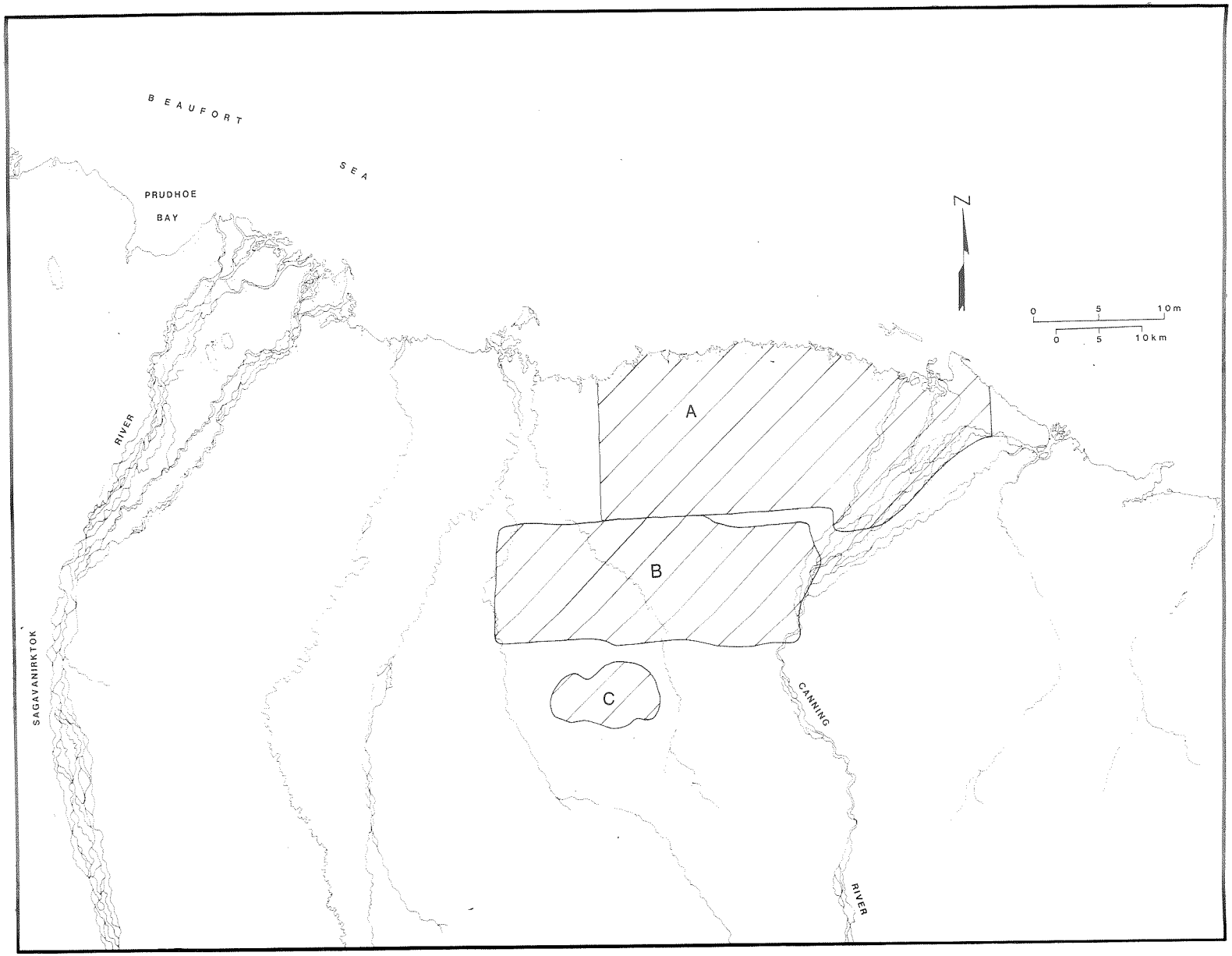


Figure B-7. Location of aerial survey flown 9 June 1984; Bullen Point to Staines River, Staines - Canning rivers, East of Sagavanirktok River, and Kavik Hills.

Table B-8. Numbers and density of caribou observed during aerial surveys of the Central Arctic Herd calving ground on 10 June 1984.

Location	Area Surveyed (km^2)	Number of Caribou Observed						No. Cows & Unk. Ad. per km^2
		Cows	Unk. Ad.	Calves	Yrlg.	Bulls	Total	
A. South of Bullen Point*	290	446	13	415	42	0	916	1.60
B. Staines River*	228	340	1	296	47	0	684	1.50

COMMENTS: Cloud Cover: CAVU
Snow Cover: low with much flooding
Sightability: poor; glare due to meltwater

* These areas within the Bullen Point to Staines River area

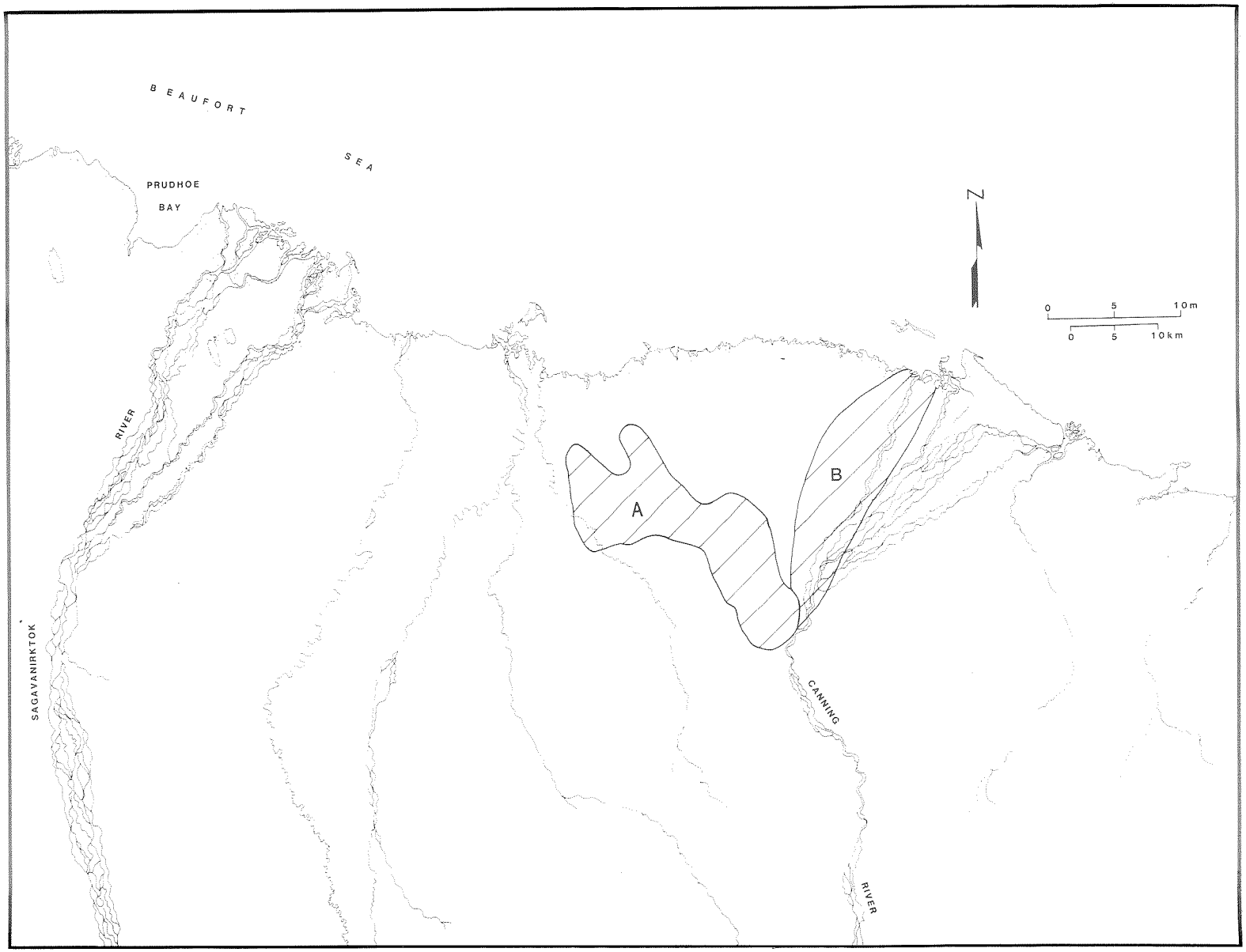


Figure B-8. Location of aerial survey flown 10 June 1984; South of Bullen Point and Staines River, both are within the Bullen Point to Staines River area.

Appendix C. Aerial survey techniques and problems

I. A comparison of two aerial survey techniques for censusing caribou

All surveys of the calving ground during this study were conducted using a Piper PA-18 "Super Cub". This aircraft seats two, with the observer sitting behind the pilot, thereby allowing the observer to see on both sides of the aircraft. On the other hand, intensive surveys of the calving ground by the Alaska Department of Fish and Game are usually conducted by helicopter, with a pilot, two observers, and one recorder; the observers look on opposite sides of the aircraft.

To compare the results obtained using these two different survey aircraft, concurrent surveys of the Kuparuk Oilfield were conducted on 12 June 1984. Each aircraft flew at approximately 100 m above ground level and 100 km per hour with the above mentioned personnel. Both surveys took place during mid-day, when observation conditions were excellent, and covered approximately 880 km^2 (100% coverage) in a similar time period. The transect lines flown by the Super Cub were spaced at 1.6-km intervals, whereas those flown by the helicopter were at 3.2-km intervals. The results of these surveys were as follows:

Aircraft Type	Number of Observers	Composition (Number Observed)					
		Cows	Calves	Yearlings	Bulls	Unk.	Total
Helicopter	2 observers 1 recorder	997	980	145	67	0	2189
Super Cub	1 observer	915	709	239	6	95	1964

In light of differences in the exact area of coverage and in sex/age classification by observers, the results are, in general, quite similar. The fewer calves observed from the Super Cub may have been due to the single observer spending less time observing each group. It appears that the extremely high calf count by the helicopter crew is an overcount, inasmuch as it exceeds the expected pregnancy rate.

The helicopter used was chartered for $685 per hour, whereas the Super Cub cost $150 per hour and had a lower expense in manpower. Use of the Super Cub represented a significant economic savings while achieving results that compare favorably with those obtained during the helicopter survey.

II. Factors Influencing Sightability of Caribou

Several factors affected the sightability of caribou during aerial surveys, including snow cover, fog, aircraft altitude, aircraft speed, transect spacing, and density of caribou.

The amount of snow cover and its effect on sightability changed during the calving period. With 100% snow cover near the coast at the onset of calving, caribou were easily visible but glare was a problem. Caribou that were lying down were difficult to distinguish from patches of ground as the snow began to melt. Because of the variability in snow cover from day to day and over different parts of the study area, observation conditions changed continually.

Fog in combination with snow cover made it possible to mistake stationary caribou for inanimate objects, and sun glare against patchy snow, ice, or

water resulted in very poor sightability.

The effects of these weather and ground cover conditions were magnified at increased altitude or speed. Calves were difficult to see from high altitudes, and additional individuals often were discovered while counting and classifying a group of caribou. Thus, at higher aircraft speeds some caribou were passed over before being noticed.

Proper spacing of transect lines was important for assuring adequate coverage while maximizing the area surveyed each day. The combined effects of aircraft altitude, snow cover, visibility, and sun glare determined the optimal spacing of transect lines for each survey. Transect spacing of 1.6 km worked well for intensive survey coverage.

It was difficult to compensate for the effect that density of caribou had on sightability. Where density was high the observer was likely to see a greater percentage of the caribou present than where density was low. In part, this difference resulted from observers having to continually adjust their search image over various types of terrain and snow cover. In areas of low density it was not always possible to make this adjustment gradually, as could be done in high-density areas where caribou were observed frequently. Thus, in low-density areas a greater percentage of caribou may have been missed before the observers adjusted to different conditions of sightability.

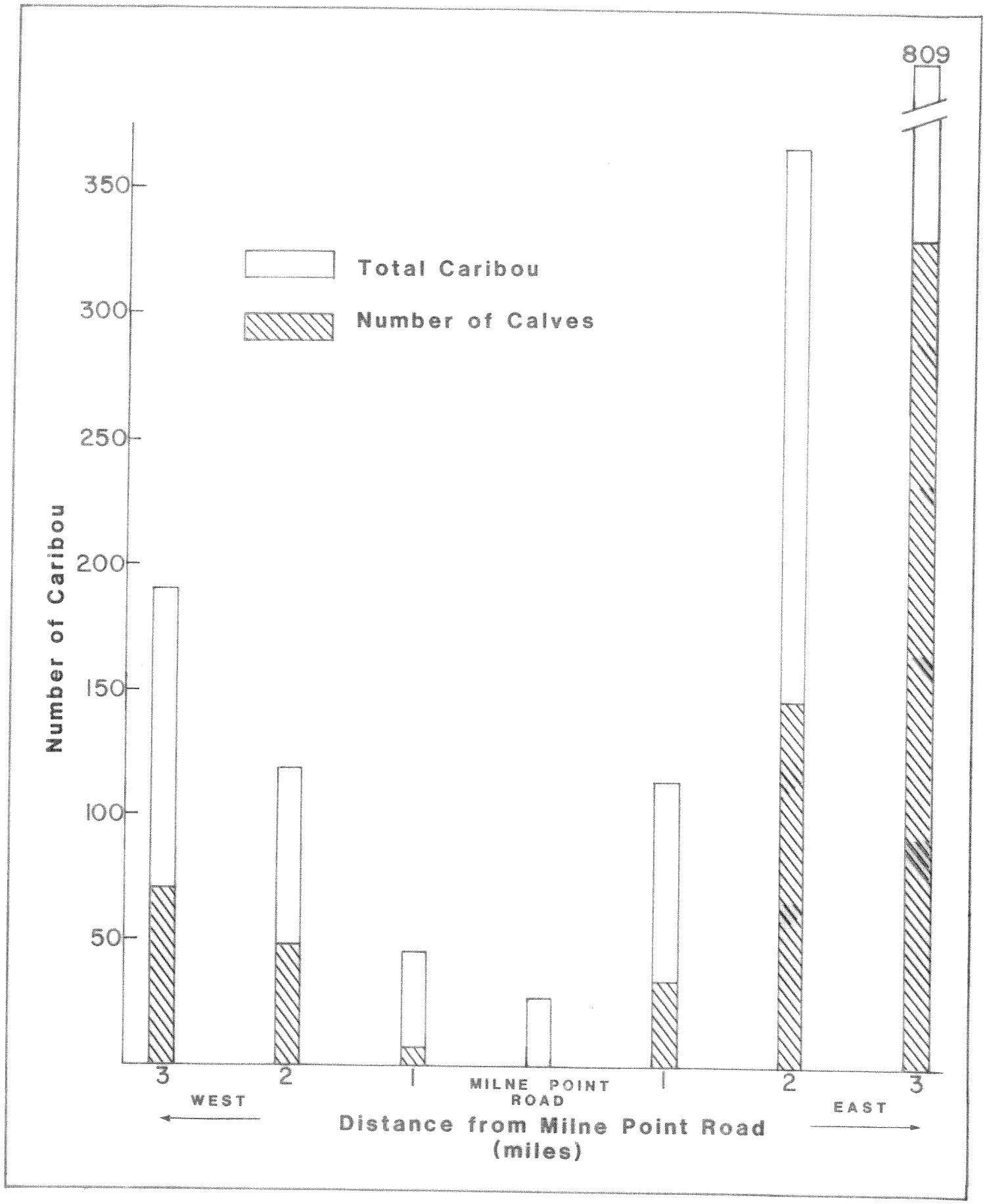
Topography also affected sightability. For instance, rolling hills changed the angle of view for an observer flying at a constant altitude, which in turn altered the effects of snow cover and glare. Adequate coverage of such areas required narrower transect intervals than was necessary for flat terrain so that the observer could see over hills and into valleys and swales.

III. A comparison of composition counts obtained from ground and aerial surveys

To determine if observations during aerial surveys were missing certain age or sex classes, concurrent observations from the ground were conducted for comparison. The following results were obtained:

Type of Survey	Date	Percent Composition					n	Calves/100 Cows and Unknown Adults
		Cow	Calf	Yearling	Bull	Unk.		
Ground	6 June	53	33	9	0	5	448	55.9
Aerial	7 June	50	34	9	0	6	211	60.5
Ground	8 June	52	35	4	0	8	608	58.2
Aerial	8 June	39	32	5	0	24	123	50.0

The composition results were similar, although both survey methods probably resulted in low estimates of number, especially for calves. Even though there is generally more time to observe caribou from the ground, the low angle of observation, as well as the changing field of view as caribou move, may mask some calves from view.


809
350
300
250
200
150
100
50
Total Caribou
Number of Calves
Number of Caribou
3
2
1
MILNE POINT ROAD
1
2
3
WEST
EAST
Distance from Milne Point Road (miles)