FINAL DATA REPORT
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Large Mammal Distribution in the Badami Study Area, Summer 1997

Prepared by

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Environmental and Regulatory Affairs Department
P.O. Box 196612
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ABSTRACT

Large mammal distribution was documented from the Sagavanirktok River delta on the west to near Bullen Point on the east and inland up to 24 km from the coast within the Badami development area on the North Slope, Alaska during three systematic strip-transect surveys on 3, 10 and 15 July 1997. Caribou numbers within the study area ranged from 859 on 3 July to 3,742 on 15 July 1997. Mean caribou group size ranged from 17 caribou per group on 3 July to 110 caribou per group on 15 July. This represents 4 to 19 percent of the Central Arctic Caribou Herd, and 11 to 47 percent of the eastern segment of the Central Arctic Caribou Herd in 1997. Large caribou groups were using riparian and coastal insect-relief habitats and few caribou were inland on 3 July and 15 July. Caribou appeared to be using inland foraging habitats on 10 July, however coastal fog prevented surveying coastal areas. Two muskoxen groups were recorded within the study area, one group of 12 were in Sagavanirktok River riparian habitat on 3 July, and one group of 7 were on tundra about 7 km east of the Shaviovik River. No brown bear or moose were recorded in the study area.

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INTRODUCTION

During 1997, LGL Alaska Research Associates, Inc. (LGL) conducted systematic aerial surveys of large mammals within the area of the Badami development and the Badami pipeline corridor. This effort focused on post-calving caribou distribution within the study area.

Two caribou herds may occur in the area between the Sagavanirktok and Staines rivers: the Porcupine Caribou Herd (PCH) and the Central Arctic Caribou Herd (CAH). PCH studies conducted over the past 20 years have shown that little, if any, calving occurs west of the Staines River, nor is the area used by large numbers of PCH caribou during post-calving and dispersal periods (Clough et al. 1987). The CAH uses a broad area along the Arctic Coastal Plain between the Colville and Canning rivers for summer range (Fig. 1, Smith 1996). During spring migration, CAH caribou move from the northern foothills of the Brooks Range to the coastal plain.

Coastal areas, river deltas, river channels, and wind–swept uplands and ridges are used as insect-relief habitats by mosquito– and oestrid–harassed caribou during the post–calving period. Large groups are often observed near Franklin Bluffs and on the deltas of the Kadleroshilik, Sagavanirktok, Shaviovik, and Staines rivers (Gavin 1983; Carruthers et al. 1984). Lawhead and Curatolo (1984) reported that large aggregations of caribou sought relief on or near deltas of the Kuparuk, Shaviovik, and Canning rivers during intense insect harassment; although caribou groups were observed along the coast within the entire Oliktok Point to Canning River area.

By the late 1800s, muskoxen were exterminated from the North Slope of Alaska and little is known about past historic levels (Clough et al. 1987). Muskoxen were reintroduced into ANWR in 1969 and 1970 and the population has grown exponentially since 1974. Mixed-sex herds have dispersed into areas east of the Aichilik River (i.e., the eastern border of ANWR) (Clough et al. 1987). Muskoxen are regularly sighted as far west as the Sagavanirktok River near the Prudhoe Bay oil field (Pollard and Noel 1994, 1995). Muskoxen are non-migratory, but move in response to seasonal changes in snow cover and vegetation. During summer and fall, they are found primarily in riparian habitats, but move to adjacent uplands in winter and spring (Clough et al. 1987). Riparian habitats are important travel corridors and foraging areas.

Coastal areas are used seasonally by brown bears. They generally move north from denning areas in the foothills in late May and are most abundant in the study area during June and July when caribou are on the coastal plain. In late July, they gradually return south to the foothills after caribou have left the coastal plain (Clough et al. 1987). Riparian areas are used as travel corridors and contain abundant prey and preferred vegetation. Moose are not common on the

North Slope, but they were observed in the area during 1994 and 1995 surveys (Pollard and Noel 1994, 1995).

During 1997, we documented large mammal distributions in the Badami development area during three systematic aerial surveys on 3, 10, and 15 July.

Our objectives during 1997 were:

- To determine the number, sex/age composition, and distribution of caribou during the post-calving season within the study area.
- To describe caribou distribution and abundance in relationship to weather–moderated parasitic insect abundance within the study area.
- To determine the number, age composition, and distribution of muskoxen within the study area.
- To determine the number, age composition, and distribution of brown bears within the study area.
- To determine the number, sex/age composition, and distribution of moose within the study area.

STUDY AREA

The study area is bounded on the west by the Sagavanirktok River, extends east to Bullen Point, north to the Beaufort Sea, and south to approximately 70° 00' latitude (Fig. 1). The study area lies within Alaska's Arctic Coastal Plain and is characterized by a gently rolling thaw-lake plain landscape (Walker and Acevedo 1987). Tundra in the area gradually rises 20 to 25 feet above the level of streams and river channels which gives the landscape a gently rolling appearance. This topographic relief results in many well-drained areas, and moist and dry tundra vegetation types are common throughout the area on high-centered ice wedge polygon terrain. However, drainage is poor, away from fluvial gradients and low-centered ice-wedge polygons, strangmoor, thaw-lakes and ponds, and drained lake basins predominate in these areas.

METHODS

Aerial Surveys

During summer 1997, three systematic, strip–transect aerial surveys (Caughley 1977) were conducted from a Cessna 206 fixed–wing aircraft. Two observers recorded mammal sightings. Surveys were scheduled, when possible, to coincide with periods of parasitic insect abundance

(warm calm days). Transect centerlines were spaced at 1.6 km intervals providing for 100 percent study area coverage. All transects were oriented north–south and centered on township and section lines mapped on 1:63,360–scale U.S. Geological Survey (USGS) topographic maps. Twenty-seven transects (numbers 21 to 47, Fig. 1) were flown during each of three surveys. Systematic surveys were flown 90 m above ground level at 115 km/hr airspeed. During surveys, each observer was responsible for searching an 800 m–wide swath on one side of the transect centerline. Aircraft wing struts were marked to enable visual control of transect strip–width (Pennycuick and Western 1972). Observers verified strut markings by comparison to survey maps. Species, number, sex/age composition, and group location were recorded for each observation.

As with previous aerial surveys conducted by LGL in the Prudhoe Bay oil field and adjacent areas, a Trimble *Pathfinder*™ Global Positioning System (GPS) was used to navigate the aircraft during systematic surveys. Locations of animals were determined by using GPS in combination with visual estimates of their distance from the airplane. At the time of sighting, all data were entered directly into a portable notebook computer linked to a GPS receiver. For each sighting, real–time GPS–determined position is associated with group attributes (e.g., species, number of individuals and sex/age classification) entered by one of the observers.

Caribou were counted and classified as bulls, cows, calves, or unclassified based on body size, antler development, pelage, and calf presence. "Unclassified" caribou are adults (or yearlings), that cannot be classified with confidence; caribou near the outer margin of transect strips are most difficult to classify. When large groups of caribou were encountered, the survey aircraft left the transect and circled the group to facilitate counting and classifying. The GPS allows the aircraft to return to the point of departure from the transect, and no survey coverage was lost as a consequence of transect departures. Muskoxen were classified as adult (unclassified) or juvenile (calves), and brown bears were classified as adults or females with cubs.

Photographic Analysis

Still photography of large caribou groups were taken as often as possible during aerial surveys. All photography used in analysis was taken with a Fujica SLR camera, 55 mm lens, and Provia 100 ASA transparency film. Transparencies were projected onto 27 inch by 36 inch sheets, and when images were of sufficient quality, individual caribou were identified and circled on the sheets. When distinguishable, caribou were classified and labeled "b" for bulls and "c" for calves. All marks were then counted. In most cases, caribou sex and age were not distinguishable in the transparencies and the group structure reported in the field was used to determine the numbers of bulls, calves and unclassified caribou within each group.

Geographic Analysis

After the field season, large mammal observation data were combined with base–map data in MapInfo® Geographic Information System (GIS). Spatial data were used to produce maps of distributions for each survey. In order to evaluate caribou distribution in relation to the Beaufort Sea coast, buffers were constructed at 1-km intervals around the coastline. The coastline was considered as the contiguous line following the southern most margin of the Beaufort Sea on 1:63,360 scale base maps. Within the base mapping, river channels cut inland a short distance, and islands are north of the coastline. Twenty-four incremental 1-km intervals were constructed (Fig. 2). Lake area (1:63,360 scale) within intervals was calculated and subtracted from the interval area to give the land area within each interval (Table 1). Available land area (km^2) for each interval, excluding the area of lakes and ponds, was used to calculate caribou density, and to evaluate caribou distribution within intervals.

Data collected in the Badami study area during 1997 were analyzed using the distribution and abundance of bulls, calves and all sex/age classes of caribou. These classes of caribou were chosen because previous research has suggested that bulls and maternal cows respond differently to habitat features, and bulls and calves were easiest to identify during the surveys. Analyses were based on individual caribou rather than on groups. Individual caribou were used because: 1) during aerial surveys, groups are sometimes difficult to distinguish; 2) groups may be extremely disparate in size, ranging from 2 to 2,000 or more individuals; and 3) groups are not of fixed membership. However, location data are collected by groups; therefore individual caribou locations are not independent.

Modeled Parasitic Insect Activity

Predictive models for mosquito and oestrid fly activity, developed by Russell et al. (1993), were used to classify days as either insect or non-insect days. Insect days were defined as days when either the mosquito index or the oestrid index were ≥0.5 for four or more hours (Cameron et al. 1995). Indices were calculated from hourly temperature and wind data recorded at the Deadhorse Weather Station (ASCC 1997). Indices were then cross-tabulated to give the count of the number of hours the index was ≥0.5. Indices as developed for mosquito and oestrid activity by Russell et al. (1993), and the syntax used to calculate the indices, are presented in Appendix C.

RESULTS

Three systematic surveys of the study area were completed (Appendix A). Weather conditions prevented surveying the entire study area on 3 July (97 percent coverage, Fig. A-1) and 10 July (68 percent coverage, Fig. A-2). Photographic counts of eight caribou groups were used to correct group attribute data (Appendix B). Photographic counts were generally higher than

observer estimates, with the average group size changing by 204 ± 205.9 95 percent confidence interval (95CI, Table B-1). A total of 5,721 caribou in 139 groups was recorded for all three surveys (Table 2). Cows and calves were 62 percent of classified caribou for combined surveys (38 percent cows, 24 percent calves). For individual surveys, cows and calves ranged from 42 to 72 percent of classified caribou. Bulls were 38 percent of classified caribou for combined surveys, ranging from 28 to 58 percent for individual surveys. A total of 19 muskoxen in 2 groups was observed during systematic surveys (Table 2). A single brown bear was observed within the study area, but was not recorded. This bear had been recently tranquilized, captured, and was in the process of being examined. Location of the bear prior to capture was unknown.

Caribou

Survey 1—3 July 1997

Survey conditions were good with scattered clouds at 2,700 to 3,000 m, moderate winds at 3.9 to 4.7 meters per second (mps) from the east northeast (40° to 90°) and temperature 7° to 11°C from 1500 to 2000 Alaska Standard Time (AST, ASCC 1997). Coastal fog west of Endicott made it necessary to cut transects short of the coast resulting in approximately 97 percent coverage of the study area (Fig. A-1). Fifty-one groups with 859 total caribou were recorded within the study area (Fig. A-1, Table 2, Table A-1). Thirty-seven percent of caribou were in two mixed sex groups along the Kadleroshilik River (Fig. A-1, Table A-1 Attributes 20 and 21). Forty percent of caribou were in four bull-dominated groups and one cow/calf dominated group of between 60 and 100 total caribou (Fig. A-1, Table A-1 Attributes 1, 16, 18, 23, and 24). The remaining 23 percent of caribou were in 44 groups of less than 20 total caribou (Fig. A-1, Table A-1). Mean group size was 16.8 ± 9.82 95CI.

Daily mean temperature was 5.7°C and daily mean wind speed was 4.1 mps (Table C-1). Mosquito and oestrid activity indices indicated conditions were too cool and windy for insect activity on 3 July (Fig. 3, Table C-1). Caribou groups were generally moving northeast toward the coast, a few were standing on pingoes or standing and resting on tundra. Most caribou (86 percent) were observed between 3 and 8 km from the Beaufort Sea coast (Fig. 4, Table 4). Several days prior to 3 July, on 29 June and 1 July, weather conditions were favorable for parasitic insect activity (Fig. 3, Table C-1) and it is possible that the more coastal distribution of caribou on 3 July reflects these conditions (Fig. 4, Table 4). It is also likely that either the indices are conservative for conditions suitable for mosquito and oestrid activity, or that the Deadhorse weather data does not accurately reflect conditions across the study area.

Survey 2—10 July 1997

Survey conditions were poor with overcast conditions at 120 to 210 m, strong winds at 6.2 to 7.8 mps from the east northeast (70°), and temperature 4° to 6°C from 1400 to 1800 AST. Coastal fog prevented surveying the coastal portions of all transects resulting in approximately 68 percent coverage of the study area (Fig. A-2). Fifty-four groups of 1,120 caribou were recorded within the survey area (Fig. A-2, Table 2, Table A-1). An additional 340 caribou in three groups were just south of the defined study area (Fig. C-1, Table A-3). Thirty-three percent of caribou were in three cow/calf dominated groups of between 100 and 150 total caribou (Fig. A-2, Table A-1 Attributes 1, 38 and 44). Forty-five percent of caribou were in 11 groups (two bull dominated, three cow/calf dominated and six unclassified) of between 20 and 75 total caribou (Fig. A-2, Table A-1). The remaining 22 percent of caribou were in 40 groups of less than 20 total caribou. Mean group size was 20.7 ± 8.19 95CI.

Daily mean temperature was 3.7°C and daily mean wind speed was 6.1 mps (Table C-1). Mosquito and oestrid activity indices indicated conditions were too cool and windy for insect activity on 10 July (Fig. 3, Table C-1). The more inland distribution of caribou during this survey appears to support the lack of insect harassment (Fig. 4, Table 4). However, the lack of data from coastal areas makes this observation equivocal.

Survey 3—15 July 1997

Survey conditions were good with a few clouds at 2,400 to 3,000 m, moderate to strong winds at 3.9 to 7.0 mps variable from the northeast to east (50° to 90°), and temperatures 13° to 15°C from 1100 to 1700 AST. Thirty-four groups with 3,742 total caribou were recorded within the study area (Fig. A-3, Table 2, Table A-1). Eighty percent of caribou were in three groups (two mixed sex and one cow/calf dominated) of between 500 and 1,700 total caribou (Fig. A-3, Table A-1 Attributes 9, 20, and 21). Seventeen percent of caribou were in eight groups (two bull dominated, two cow/calf dominated, and four unclassified) of between 30 and 250 total caribou. The remaining three percent were in 23 groups of less than 20 total caribou. Mean group size was 110.1 ± 109.07 95CI.

Daily mean temperature was 9.4°C and daily mean wind speed was 3.9 mps (Table C-1). Mosquito and oestrid activity indices indicate conditions were too windy for insect activity on 10 July (Fig. 3, Table C-1). Seventy-five percent of all caribou observed on 10 July were within 1 km of the coastline and 99 percent were within 3 km of the coast (Fig. 4, Table 4). The relatively large caribou groups observed, and their coastal distribution on 10 July (Fig. 4, Table 4), indicate that caribou were responding to mosquito harassment. The insect activity indices, however, do not indicate mosquitoes were active. Indices may be conservative for conditions suitable for mosquito

and oestrid activity, or the Deadhorse weather data may not accurately reflect conditions across the study area. The single group of 1,700 total caribou on the coast between the Sagavanirktok and Kadleroshilik rivers were primarily resting and foraging (Fig. A-3, Table A-1 Attribute 20). Of the six groups for which direction of movement was noted, three groups were moving toward the east, two groups were moving toward the north, and one group was moving toward the southeast.

Non–systematic Observations

Caribou were also observed within the Badami study area during return flights from systematic surveys to the east of the Badami study area. These observations are presented in Figure A-4, Table 3, and Table A-3. Two days after the 15 July systematic survey, on 17 July, 2,130 caribou were recorded in four groups along the coast between Bullen Point and the east channel of the Sagavanirktok River. This represents 57 percent of the total number of caribou observed within the entire Badami study area on 15 July (Table 2, Table 3, Fig. A-4).

Muskoxen

A single group of 12 muskoxen, including two calves, was located along the east channel of the Sagavanirktok River on the 3 July survey (Fig. A-1, Table 2). No muskoxen were observed on the 10 July survey, but coastal fog prevented coverage of much of the study area (Fig. A-2, Table 2). A single group of seven adult muskoxen was located in the southeast corner of the study area on 15 July (Fig. A-3, Table 2).

During non-systematic overflights between 16 June and 7 August, four muskoxen groups were sighted (Fig. A-4, Table 3). A single group of 28 muskoxen, including two calves, was sighted on 16 June within riparian habitat near the Shaviovik River. Three of these sightings, between 2 and 7 August, were of a group of 18 or 19 muskoxen which included a single calf. One sighting was on the tundra between the Shaviovik and Kadleroshilik rivers, and two sightings were in riparian habitats in the Kadleroshilik River (Appendix B, Photo 18). It is likely that these sightings represent a single muskoxen group and their movements between 2 and 7 August 1997 (Fig. A-4, Table 3, Table A-3).

DISCUSSION

During the three systematic strip–transect surveys conducted in the Badami study area, 859 to 3,742 caribou were recorded (Table 2). Population size of the CAH in 1997 has been estimated at 20,000 (19,730 count), with an estimated 8,000 7,733 count) in the eastern segment of the CAH (Pat Valkenburg, pers. comm.). Caribou calving between Bullen Point and the Canning River are generally considered the eastern segment of the CAH (Cameron and Whitten 1978; Lawhead and Curatolo 1984; Whitten and Cameron 1985; Cameron et al. 1989). Based on these population

estimates, 4 to 19 percent of the CAH and 11 to 47 percent of the eastern segment of the CAH used the Badami study area during the post–calving period. Sex and age composition of classified caribou varied between surveys, but for the combined post–calving surveys, 38 percent were bulls, 38 percent were cows, and 24 percent were calves.

During the post–calving period, weather–moderated insect activity probably influences caribou distribution, movements, and behavior more than any other environmental factor (White et al. 1975; Roby 1978; Dau 1986; Johnson and Lawhead 1989). Caribou move to coastal areas to ameliorate insect harassment (Roby 1978; Dau 1986; Johnson and Lawhead 1989; Pollard et al. 1996a,b), and tend to drift inland and feed during periods of low temperatures and/or high wind velocities which suppress mosquito activity (White et al. 1975; Curatolo et al. 1982; Dau 1986; Pollard et al. 1996b). From the patterns of caribou density by 1–km intervals from the Beaufort Sea coast between 3 July and 15 July 1997 (Fig. 4), it appears that caribou shifted between coastal insect–relief and inland foraging habitats during this period. Although caribou group size generally begins to increase after peak calving, mosquito harassment apparently is a major factor causing large aggregations (Roby 1978; Johnson and Lawhead 1989). During 1997, mean caribou group size increased from 16.8 on 3 July to 110.1 on 15 July.

The models for mosquito and oestrid activity do not appear to explain the shifts in caribou distribution observed between 3 and 15 July 1997. According to these models, insects were inactive during both the 10 July and 15 July surveys (Fig. 3). The formation of large caribou groups and their coastal distribution indicates that caribou were experiencing mosquito harassment on 15 July (Dau 1986, Johnson and Lawhead 1989, White et al. 1975). There are three plausible explanations for the lack of agreement between the modeled insect activity and caribou distributions: 1) the indices may be conservative for conditions when mosquitoes and oestrids are active; 2) the Deadhorse Weather Data may not accurately represent conditions within the study area; and 3) caribou distributions may reflect conditions prior to the actual survey date.

A single group of muskoxen was observed within the Badami study area on each of six different dates from 16 June to 7 August 1997 during both systematic and non-systematic surveys. Group size ranged from 7 to 26, with 0 to 2 calves. Muskoxen were within riparian habitats within the Sagavanirktok, Kadleroshilik, and Shaviovik rivers, on tundra between the Kadleroshilik and Shaviovik rivers, and on tundra in the southeast corner of the study area. No moose or brown bear were recorded in the study area.

SUMMARY

- Three post-calving aerial surveys were completed in 1997, with a total of 5,721 caribou in 139 groups recorded (Table 2), with 38 percent bulls, 38 percent

cows, and 24 percent calves. Mean caribou group size increased during the course of the study from 16.8 on 3 July to 20.7 on 10 July to 110.1 on 15 July.

- Large caribou groups were using riparian and coastal insect-relief habitats during the 3 July and 15 July surveys (Figs. A-1 and A-3). Few caribou occurred in inland habitats during these surveys. Caribou appeared to be using inland foraging habitats on 10 July (Fig. 4, Fig. A-2, Table 4). However, coastal fog on 10 July prevented surveying coastal habitats.
- Calculated indices of mosquito and oestrid activity may be inadequate for determining insect conditions within the study area. Indices are either conservative for conditions suitable for mosquito and oestrid activity, or the Deadhorse Weather Station data may not adequately reflect conditions within the Badami study area. Alternatively, caribou distributions during a particular survey may reflect insect activity conditions over an extended period prior to the survey day.
- Two muskoxen groups were recorded during systematic surveys, one each on 3 and 15 July 1997. No moose or brown bear were recorded within the study area.

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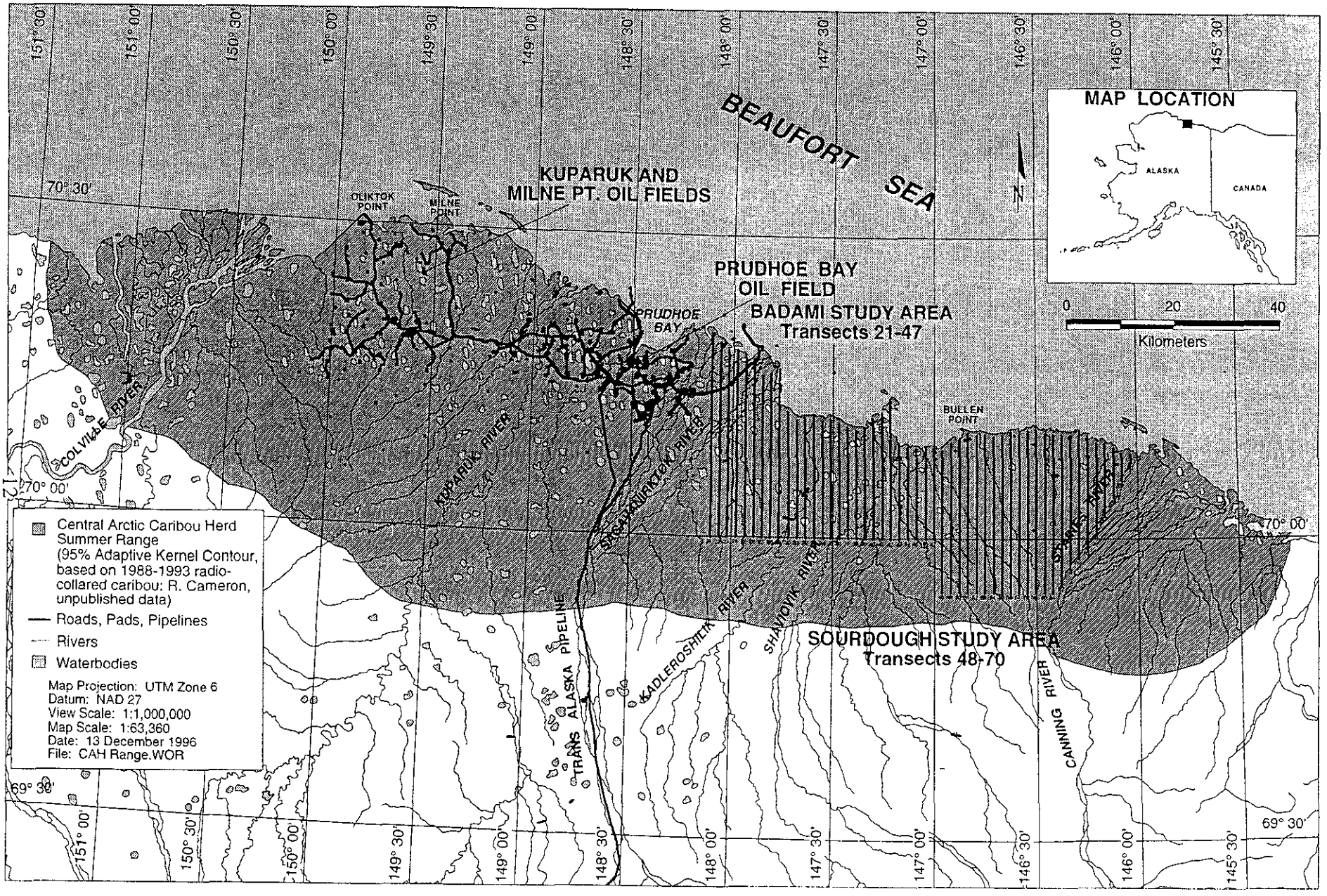


Figure 1. Study area survey transects within the summer range of the Central Arctic Caribou Herd and location of the Prudhoe Bay, Kuparuk, and Milne Point oil fields, Arctic Coastal Plain, Alaska (Smith 1996).

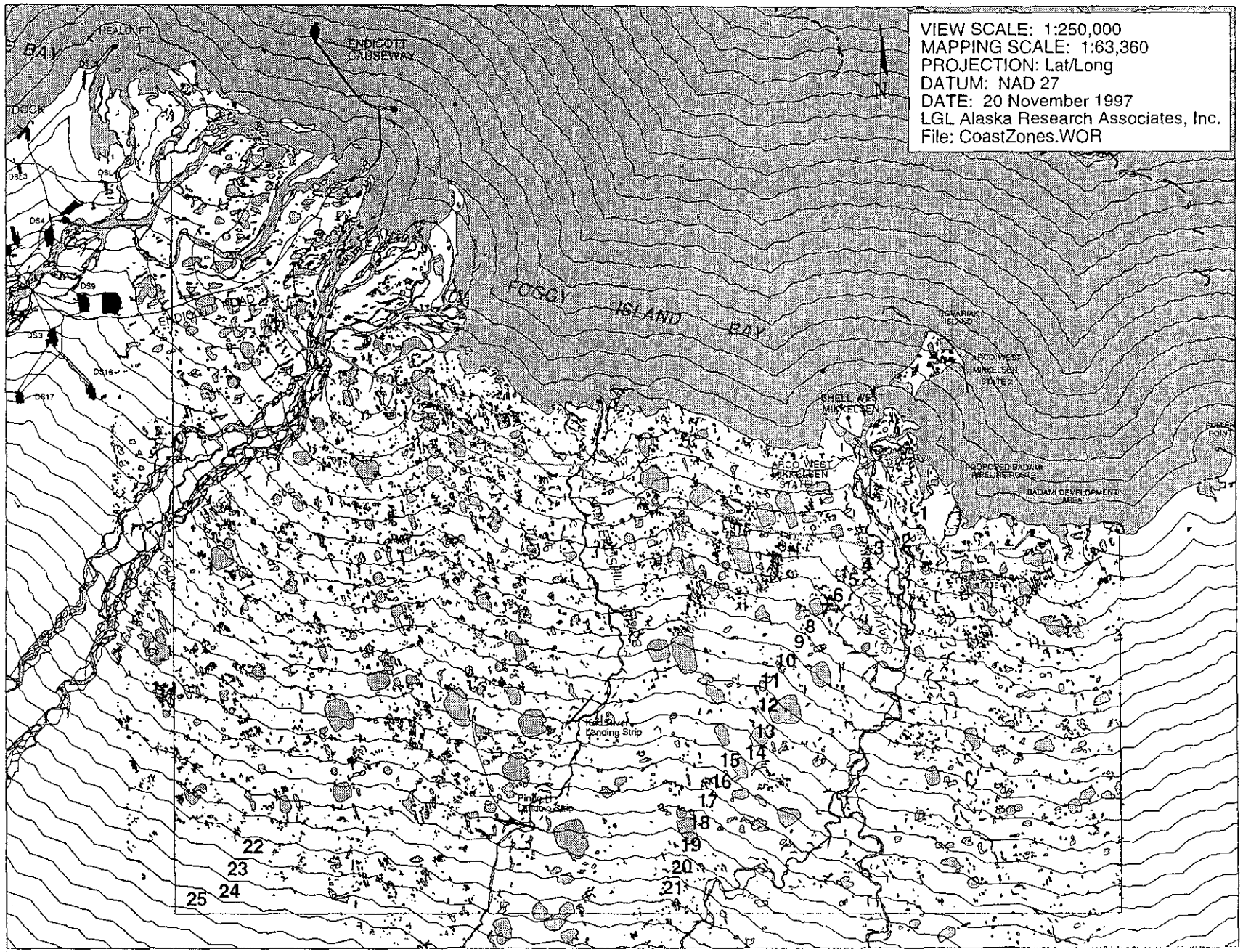


Figure 2. One kilometer intervals from the Beaufort Sea coast in the Badami study area, Alaska.

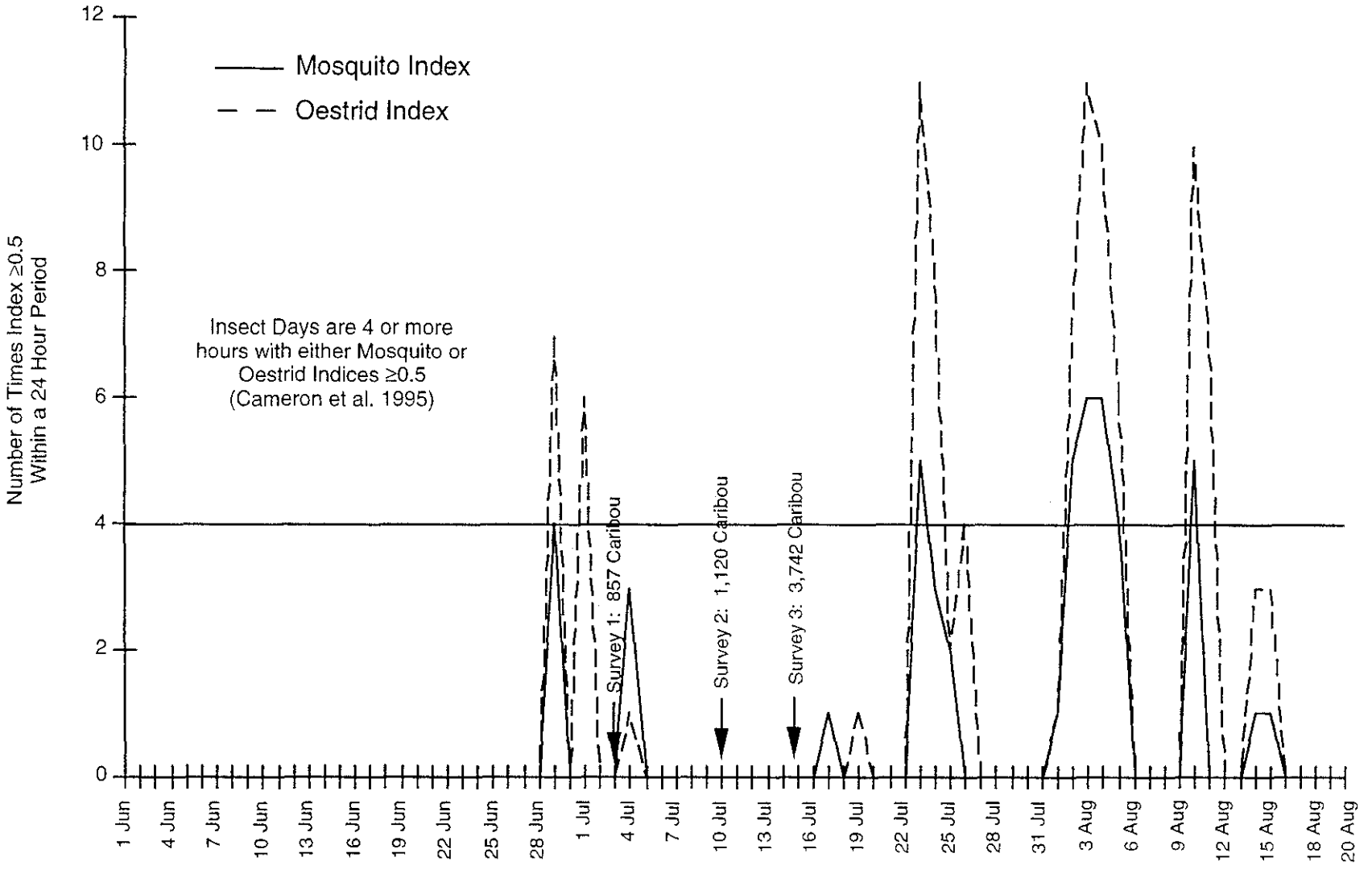


Figure 3. Mosquito and oestrid activity indices (Russell et al. 1993) based on hourly weather data collected at the Deadhorse Weather Station (ASCC 1997) and 1997 aerial caribou survey dates, Badami study area, Alaska.

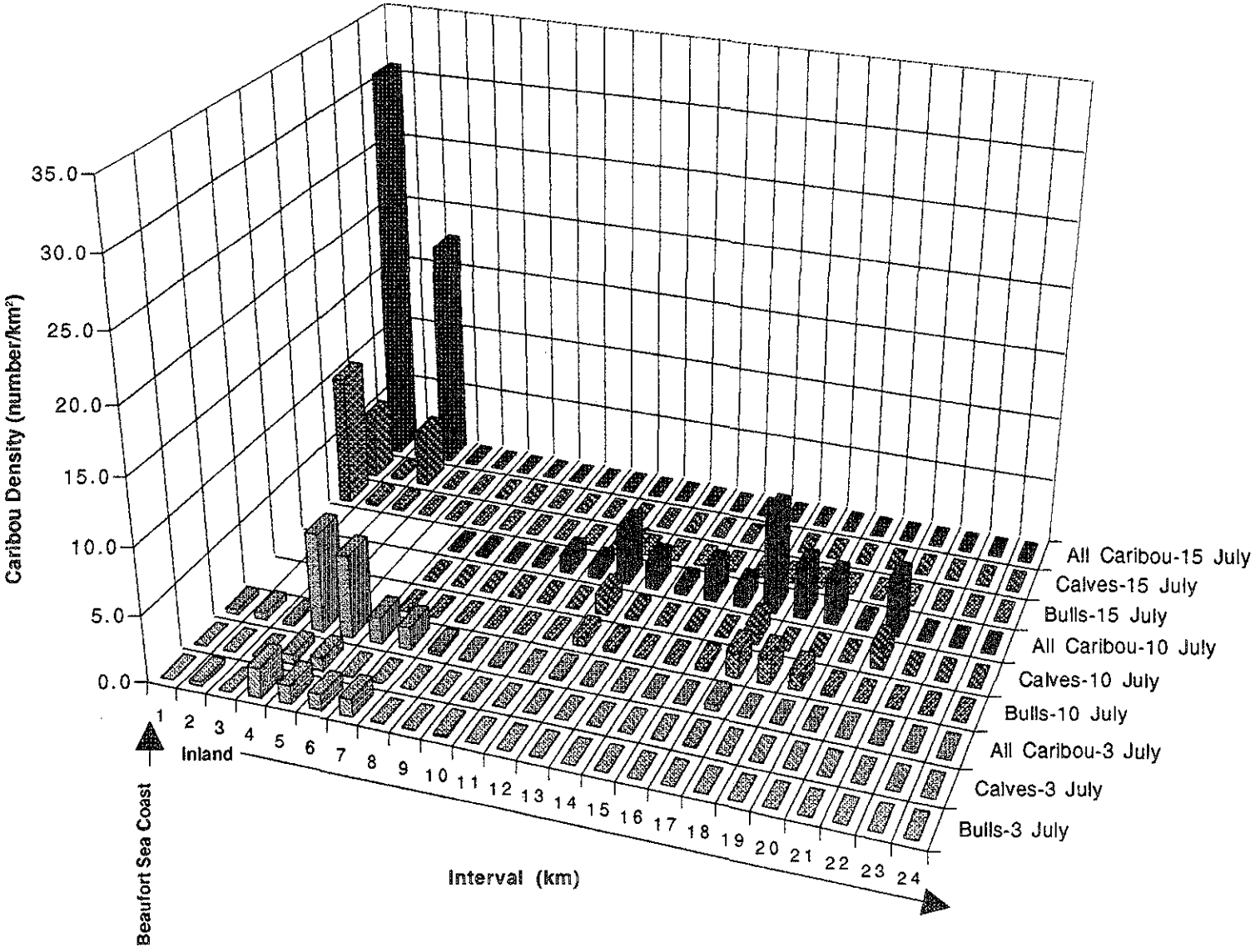


Figure 4. Caribou density by 1-km intervals from the Beaufort Sea coast during aerial surveys on 3, 10, and 15 July 1997, Badami study area, Alaska.

Table 1. Area calculated from 1:63,360 base map files for 1-km distance intervals from the Beaufort Sea coast, Badami study area, Alaska, 1997.

Interval	Interval Area (km^2)	Lake Area (km^2)	Percent Water Area	Land Area (km^2)	Percent Land Area	Percent of Study Area
1	104.24	12.05	11.6	92.20	88.4	10.0
2	64.13	8.62	13.4	55.52	86.6	6.1
3	55.40	9.38	16.9	46.02	83.1	5.3
4	52.22	9.53	18.3	42.69	81.7	5.0
5	49.72	5.51	11.1	44.20	88.9	4.8
6	49.08	6.83	13.9	42.25	86.1	4.7
7	48.58	5.47	11.3	43.11	88.7	4.7
8	48.18	4.26	8.8	43.93	91.2	4.6
9	48.02	4.86	10.1	43.16	89.9	4.6
10	47.73	4.94	10.4	42.79	89.6	4.6
11	46.86	6.43	13.7	40.43	86.3	4.5
12	46.19	5.03	10.9	41.17	89.1	4.4
13	45.94	3.99	8.7	41.95	91.3	4.4
14	45.60	5.76	12.6	39.83	87.4	4.4
15	45.46	4.67	10.3	40.79	89.7	4.4
16	44.95	5.09	11.3	39.86	88.7	4.3
17	39.15	2.96	7.6	36.20	92.4	3.8
18	34.57	3.15	9.1	31.42	90.9	3.3
19	30.87	3.60	11.7	27.27	88.3	3.0
20	27.94	1.93	6.9	26.01	93.1	2.7
21	25.74	1.30	5.0	24.44	95.0	2.5
22	20.66	1.64	7.9	19.03	92.1	2.0
23	13.01	0.52	4.0	12.49	96.0	1.2
24	9.02	0.13	1.5	8.89	98.5	0.9
Study Area Total	1043.28	117.65		925.63		100.0

Table 2. Sex and age classifications for caribou and muskoxen observed during systematic aerial surveys in the Badami study area, Alaska, 3 to 15 July 1997.

Survey	Date	Bulls	Cows	Calves	Unclass	Sum	Number of Groups	Mean Group Size
Caribou Sightings								
1	03 Jul 97	299	139	76	345	859	51	16.8
2	10 Jul 97	211	374	176	359	1120	54	20.7
3	15 Jul 97	957	953	673	1159	3742	34	110.1
	Totals	1467	1466	925		5721		
Muskoxen Sightings								
1	03 Jul 97	0	0	2	10	12	1	
3	15 Jul 97	0	0	0	0	7	1	

Table 3. Summary of opportunistic observations during non-systematic flights in and near the Badami study area, 16 June to 7 August 1997.

Survey	Date	Species	Bulls	Cows	Calves	Unclass	Total	Number of Groups
Sourdough #1	16 Jun 97	mx	0	0	2	26	28	1
Badami #2	06 Jul 97	ca	60	130	10	200	400	4
Sourdough #4	17 Jul 97	ca	520	685	200	725	2130	4
Sourdough #5	22 Jul 97	ca	10	40	40	50	140	1
Sourdough #6	02 Aug 97	ca	0	5	3	78	86	4
Sourdough #6	02 Aug 97	mx	0	0	1	17	18	1
Snow Goose	05 Aug 97	mx	0	0	1	18	19	1
Sourdough #7	07 Aug 97	mx	0	0	1	18	19	1

Table 4. Caribou density (number/km²) by sex/age class for 1-km intervals from the Beaufort Sea coast in the Badami study area, Alaska, 3 July to 15 July 1997.

	One-Kilometer Intervals																								Area and Caribou Totals
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
Area (km²)	92.2	55.5	46.0	42.7	44.2	42.2	43.1	43.9	43.2	42.8	40.4	41.2	42.0	39.8	40.8	39.9	36.2	31.4	27.3	26.0	24.4	19.0	12.5	8.9	925.6
Survey 1 (3 July 1997)																									
Bulls	0.03	0.31	0.00	2.25	1.43	1.21	1.39	0.02	0.05	0.12	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	(3)	(17)	(0)	(96)	(63)	(51)	(60)	(1)	(2)	(5)	(0)	(0)	(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	299
Calves	0.01	0.02	0.00	0.68	0.86	0.05	0.02	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	(1)	(1)	(0)	(29)	(38)	(2)	(1)	(0)	(0)	(0)	(0)	(2)	(0)	(0)	(0)	(0)	(2)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	76
Total	0.38	0.50	0.22	7.43	6.18	1.94	1.65	0.25	0.05	0.12	0.00	0.15	0.02	0.03	0.00	0.03	0.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	(35)	(28)	(10)	(317)	(273)	(82)	(71)	(11)	(2)	(5)	(0)	(6)	(1)	(1)	(0)	(1)	(16)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	859
Survey 2 (10 July 1997)																									
Bulls						0.00	0.00	0.00	0.00	0.05	0.07	0.58	0.24	0.03	0.05	0.25	1.80	1.88	1.14	0.15	0.00	0.00	0.00	0.00	
						(0)	(0)	(0)	(0)	(2)	(3)	(24)	(10)	(1)	(2)	(10)	(65)	(59)	(31)	(4)	(0)	(0)	(0)	(0)	211
Calves						0.00	0.02	0.00	0.05	0.07	0.05	1.46	0.24	0.05	0.12	0.00	1.41	0.00	0.00	0.00	1.64	0.00	0.00	0.00	
						(0)	(1)	(0)	(2)	(3)	(2)	(60)	(10)	(2)	(5)	(0)	(51)	(0)	(0)	(0)	(40)	(0)	(0)	(0)	176
Total						0.09	0.12	0.00	0.14	1.24	0.84	4.35	1.98	0.50	2.30	1.33	7.65	3.79	3.26	0.15	4.09	0.00	0.00	0.00	
						(4)	(5)	(0)	(6)	(53)	(34)	(179)	(83)	(20)	(94)	(53)	(277)	(119)	(89)	(4)	(100)	(0)	(0)	(0)	1120
Survey 3 (15 July 1997)																									
Bulls	10.07	0.27	0.22	0.05	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	(928)	(15)	(10)	(2)	(0)	(0)	(0)	(0)	(0)	(1)	(0)	(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	957
Calves	4.99	0.23	4.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	(460)	(13)	(200)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	673
Total	30.64	1.73	17.64	0.09	0.00	0.00	0.00	0.00	0.00	0.05	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	(2825)	(96)	(812)	(4)	(0)	(0)	(0)	(0)	(0)	(2)	(1)	(1)	(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	3742

APPENDIX A.

1997 DATA

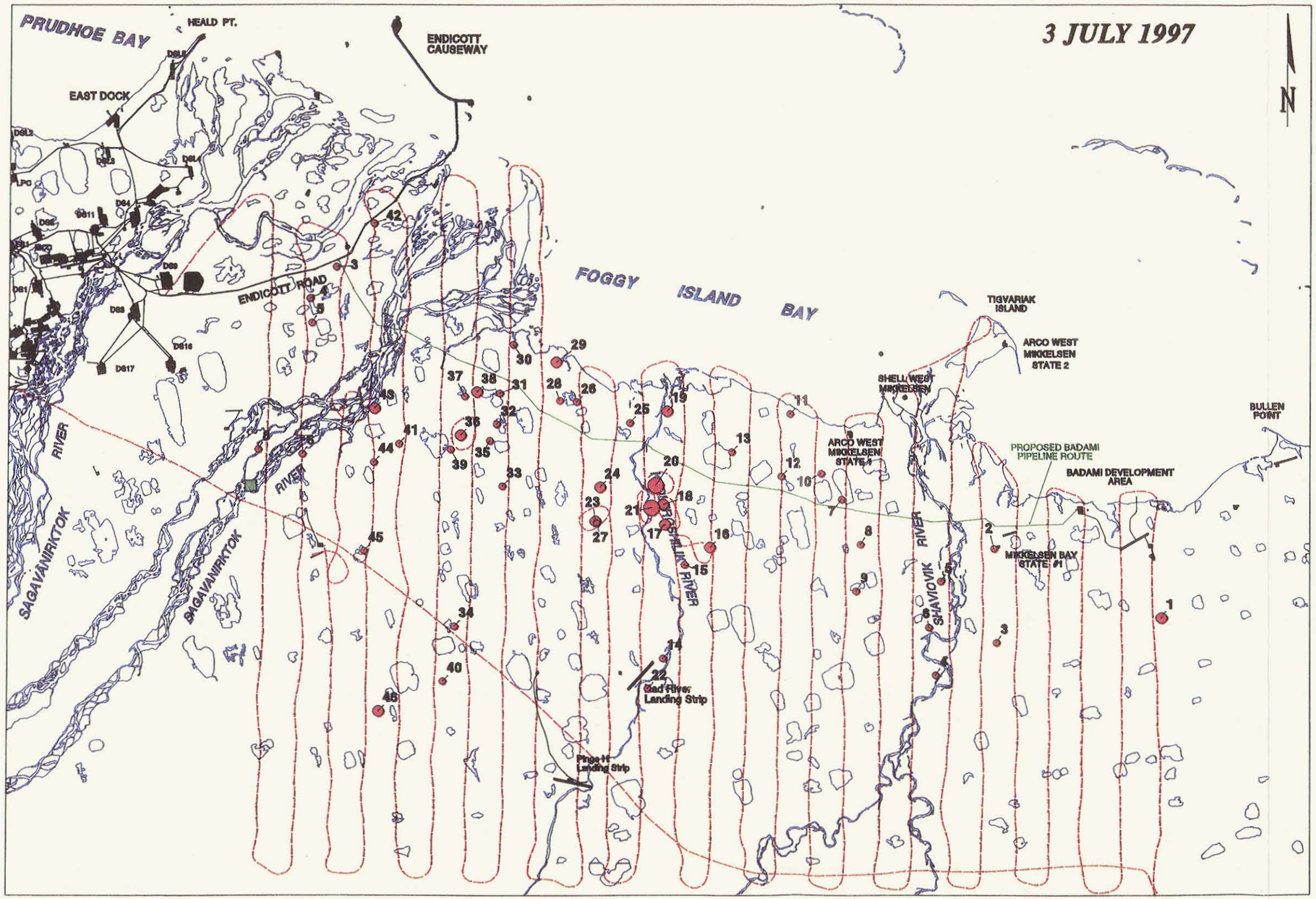


Figure A-1

Distribution of caribou and muskoxen on 3 July 1997, Badami study area, Alaska.

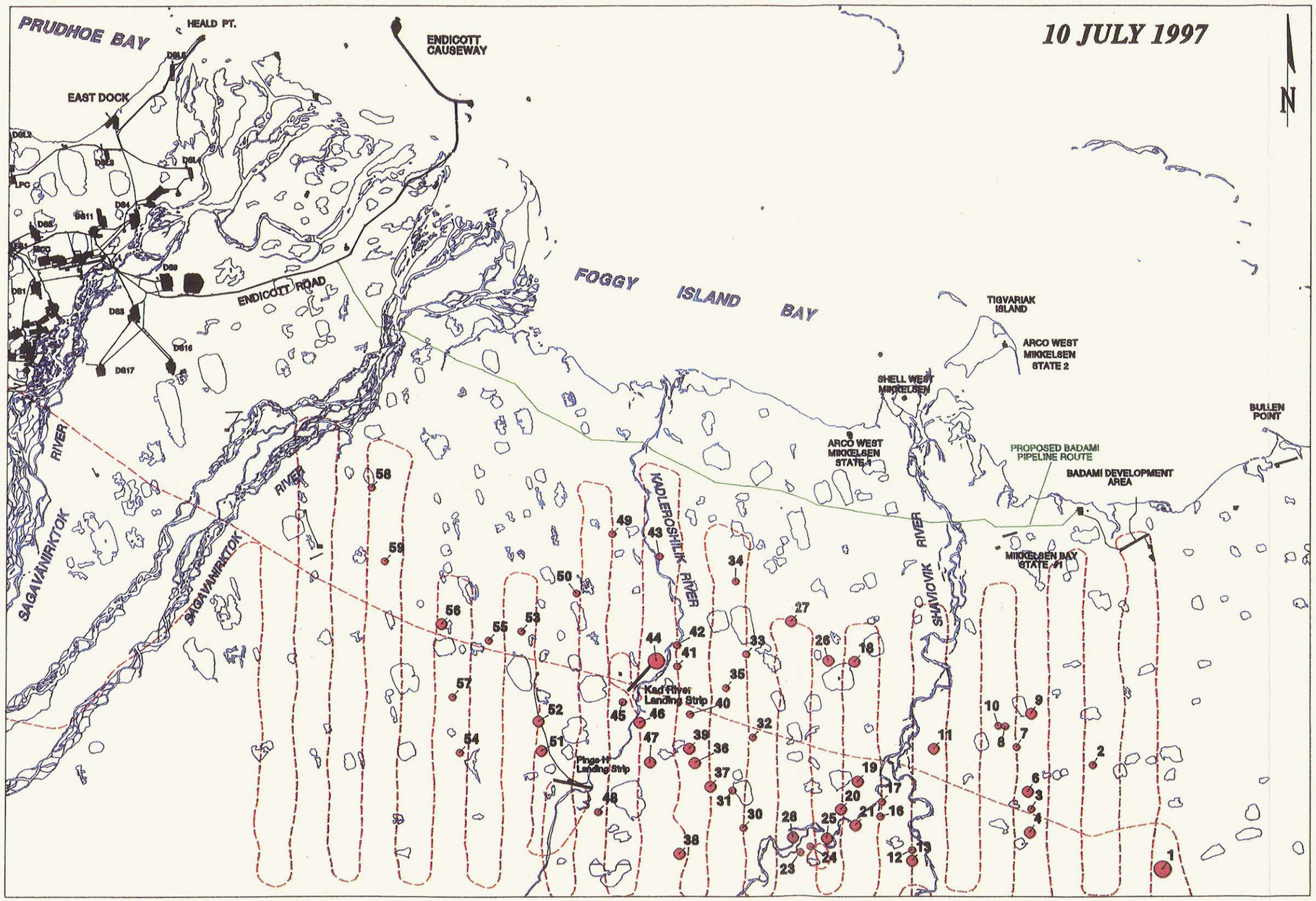


Figure A-2

Distribution of caribou on 10 July 1997, Badami study area, Alaska.

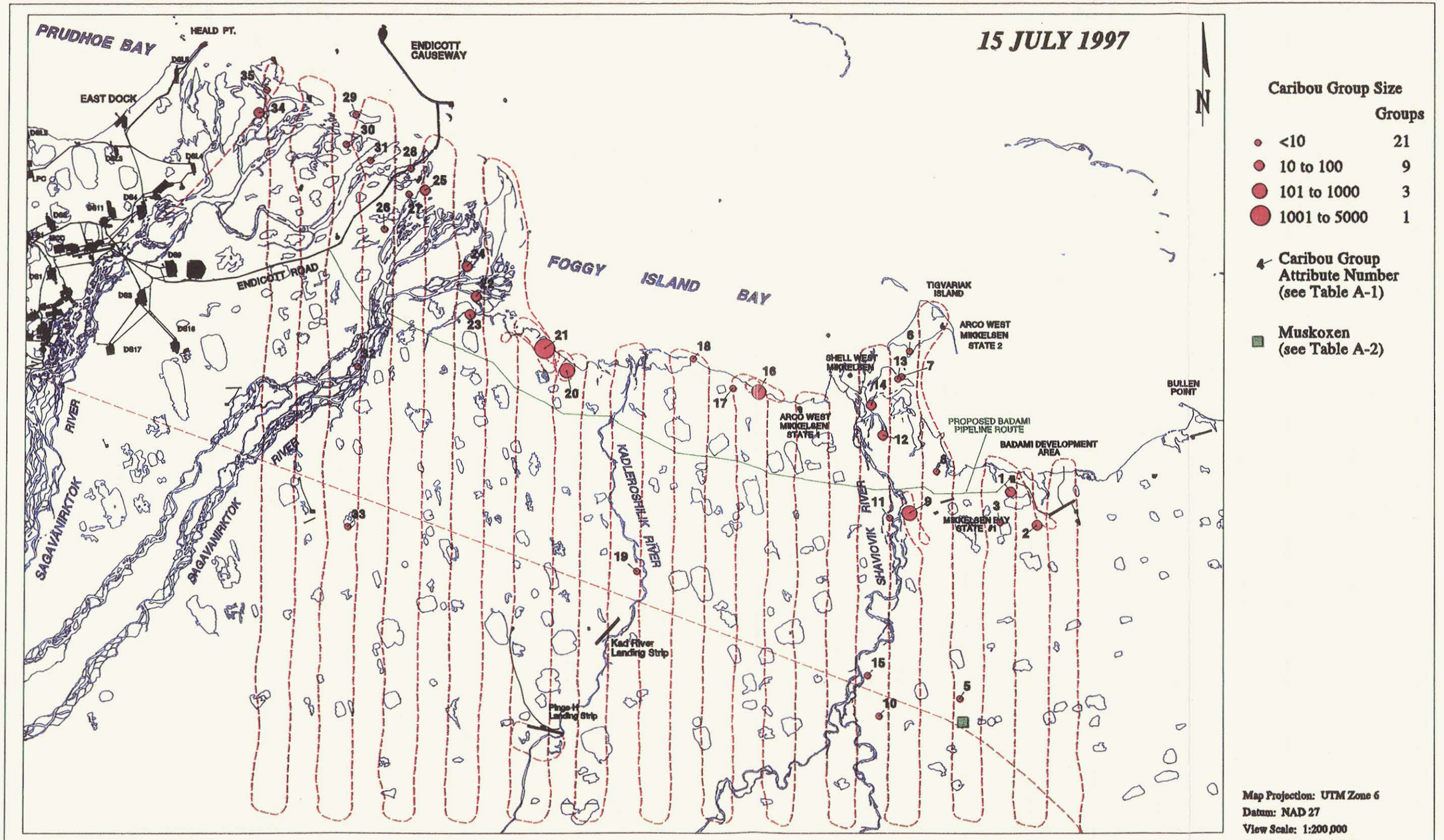
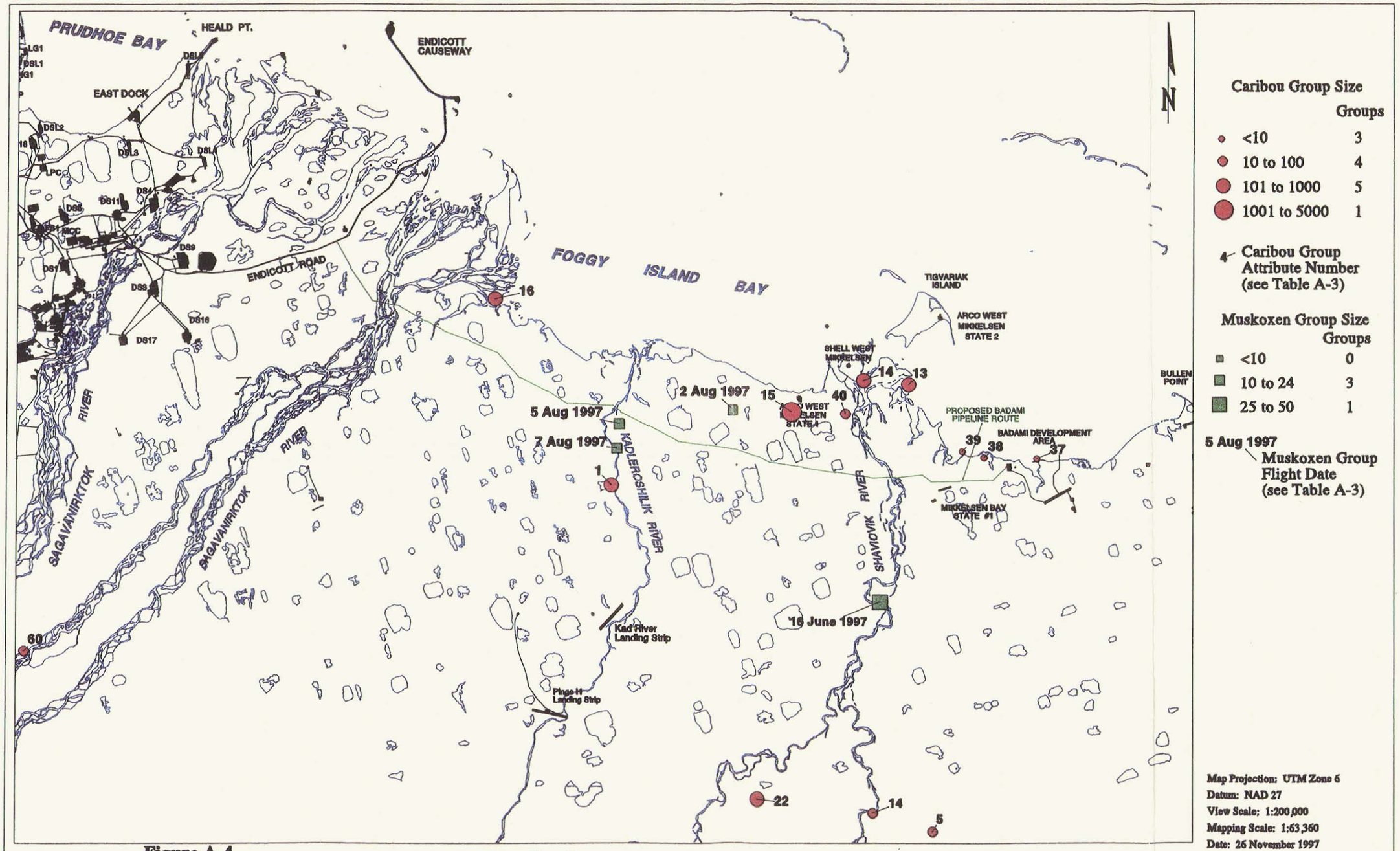


Figure A-3

Distribution of caribou and muskoxen on 15 July 1997, Badami study area, Alaska.



Caribou Group Size

	Groups
<10	3
10 to 100	4
101 to 1000	5
1001 to 5000	1

4 ← Caribou Group Attribute Number (see Table A-3)

Muskoxen Group Size

	Groups
<10	0
10 to 24	3
25 to 50	1

5 Aug 1997 ← Muskoxen Group Flight Date (see Table A-3)

Rivers, Coastline, and Lakes (>20 acres)

Roads and Pipelines

Oil Production and Service Facilities

1 0 1 2 3 4 5 MILES

1 0 1 2 3 4 5 KILOMETERS

Map Projection: UTM Zone 6
Datum: NAD 27
View Scale: 1:200,000
Mapping Scale: 1:63,360
Date: 26 November 1997
Prepared by:
LGL Alaska Research Associates
File: Badami Mammals Fig A-4.WOR

Figure A-4

Caribou and muskoxen within and near the Badami study area, Alaska, 16 June to 7 August 1997.

Table A-1. Caribou sightings in the Badami study area, summer 1997. Coordinates are longitude, latitude and datum is NAD 27.

Longitude °W	Latitude °N	Date	TimeAST	Flight	Attribute	Species	Bulls	Cows	Calves	Unclass	Total
146.993417	70.104762	07/03/97	15:36:28	1	1	ca	0	40	28	0	68
147.200899	70.134400	07/03/97	16:08:25	1	2	ca	0	1	0	0	1
147.196952	70.094161	07/03/97	16:09:52	1	3	ca	0	0	0	1	1
147.272849	70.080094	07/03/97	16:17:27	1	4	ca	2	0	0	0	2
147.267344	70.120213	07/03/97	16:19:02	1	5	ca	3	0	0	0	3
147.281588	70.100424	07/03/97	16:29:18	1	6	ca	0	0	0	1	1
147.391313	70.155050	07/03/97	16:43:12	1	7	ca	3	0	0	0	3
147.367507	70.135765	07/03/97	16:43:53	1	8	ca	1	0	0	0	1
147.372535	70.115675	07/03/97	16:44:37	1	9	ca	0	5	0	3	8
147.417353	70.166129	07/03/97	16:56:18	1	10	ca	0	0	0	2	2
147.457999	70.191780	07/03/97	16:58:11	1	11	ca	1	0	0	2	3
147.467942	70.164816	07/03/97	16:59:15	1	12	ca	0	2	0	0	2
147.530659	70.175274	07/03/97	17:15:57	1	13	ca	0	0	0	5	5
147.612093	70.086579	07/03/97	17:26:34	1	14	ca	0	3	2	1	6
147.586820	70.126598	07/03/97	17:28:06	1	15	ca	1	0	0	0	1
147.556284	70.134157	07/03/97	17:29:38	1	16	ca	60	0	0	5	65
147.611503	70.143756	07/03/97	17:30:25	1	17	ca	9	1	1	2	13
147.613736	70.152436	07/03/97	17:30:45	1	18	ca	40	0	0	20	60
147.610617	70.192487	07/03/97	17:33:41	1	19	ca	0	0	0	15	15
147.623569	70.160506	07/03/97	17:36:47	1	20	ca	50	20	20	90	180
147.628475	70.150926	07/03/97	17:38:25	1	21	ca	20	40	10	70	140
147.630228	70.073605	07/03/97	17:42:33	1	22	ca	0	0	0	1	1
147.697613	70.144907	07/03/97	17:51:42	1	23	ca	40	1	1	23	65
147.692519	70.159576	07/03/97	17:53:35	1	24	ca	40	2	2	45	89
147.656947	70.187378	07/03/97	17:54:42	1	25	ca	0	0	0	1	1
147.723325	70.195976	07/03/97	17:56:24	1	26	ca	1	1	0	0	2
147.695993	70.144187	07/03/97	17:58:17	1	27	ca	0	0	0	2	2
147.744537	70.196444	07/03/97	18:12:29	1	28	ca	1	0	0	4	5
147.750061	70.212886	07/03/97	18:13:08	1	29	ca	0	1	1	11	13
147.803379	70.220143	07/03/97	18:19:24	1	30	ca	2	1	0	0	3
147.819078	70.199318	07/03/97	18:20:10	1	31	ca	0	0	0	1	1
147.822301	70.186029	07/03/97	18:20:40	1	32	ca	1	0	0	0	1
147.813958	70.159472	07/03/97	18:21:39	1	33	ca	0	3	1	0	4
147.870174	70.099181	07/03/97	18:32:12	1	34	ca	1	0	0	0	1
147.830201	70.178908	07/03/97	18:35:17	1	35	ca	0	0	0	1	1
147.866890	70.181125	07/03/97	18:36:52	1	36	ca	0	5	5	10	20
147.862795	70.197784	07/03/97	18:37:30	1	37	ca	0	1	0	0	1
147.847535	70.199684	07/03/97	18:37:34	1	38	ca	14	0	0	0	14
147.879228	70.174981	07/03/97	18:45:38	1	39	ca	1	4	1	0	6
147.883578	70.075668	07/03/97	18:49:12	1	40	ca	0	0	0	1	1
147.943328	70.177004	07/03/97	18:59:35	1	41	ca	0	0	0	1	1
147.979930	70.270652	07/03/97	19:04:31	1	42	ca	1	0	0	0	1
147.974254	70.191975	07/03/97	19:07:27	1	43	ca	0	1	1	13	15
147.973883	70.168857	07/03/97	19:08:19	1	44	ca	1	0	0	0	1
147.983798	70.130761	07/03/97	19:09:40	1	45	ca	1	0	0	0	1
147.961934	70.062423	07/03/97	19:12:05	1	46	ca	0	2	2	12	16

Table A-1. Continued.

Longitude °W	Latitude °N	Date	TimeAST	Flight	Attribute	Species	Bulls	Cows	Calves	Unclass	Total
148.025927	70.251981	07/03/97	19:46:33	1	3	ca	0	4	1	0	5
148.057353	70.238426	07/03/97	19:48:43	1	4	ca	0	1	0	0	1
148.054585	70.228045	07/03/97	19:49:05	1	5	ca	1	0	0	0	1
148.062524	70.171931	07/03/97	19:51:01	1	6	ca	0	0	0	2	2
148.117148	70.173667	07/03/97	20:03:52	1	8	ca	4	0	0	0	4
146.991457	69.999182	07/10/97	14:42:21	2	1	ca	0	75	40	0	115
147.078010	70.042836	07/10/97	14:56:38	2	2	ca	0	0	0	7	7
147.153092	70.024241	07/10/97	15:04:27	2	3	ca	0	0	0	4	4
147.154647	70.014443	07/10/97	15:04:47	2	4	ca	0	0	0	55	55
147.157319	70.031513	07/10/97	15:08:29	2	6	ca	10	0	0	30	40
147.171907	70.050339	07/10/97	15:09:14	2	7	ca	2	0	0	0	2
147.185975	70.059133	07/10/97	15:09:35	2	8	ca	1	0	0	0	1
147.153604	70.064452	07/10/97	15:09:48	2	9	ca	0	0	0	40	40
147.194781	70.059329	07/10/97	15:14:25	2	10	ca	0	0	0	1	1
147.274382	70.049443	07/10/97	15:19:33	2	11	ca	18	0	0	0	18
147.300548	70.006924	07/10/97	15:25:56	2	12	ca	2	0	0	0	2
147.300529	70.002392	07/10/97	15:26:06	2	13	ca	10	0	0	0	10
147.339961	70.020856	07/10/97	15:29:58	2	16	ca	8	0	0	0	8
147.338348	70.026941	07/10/97	15:30:13	2	17	ca	2	0	0	0	2
147.373696	70.086134	07/10/97	15:34:06	2	18	ca	0	8	2	0	10
147.368192	70.035511	07/10/97	15:35:51	2	19	ca	2	0	0	10	12
147.388626	70.023718	07/10/97	15:36:16	2	20	ca	13	0	0	0	13
147.370569	70.017136	07/10/97	15:36:30	2	21	ca	50	0	0	0	50
147.439580	70.005424	07/10/97	15:39:32	2	23	ca	3	0	0	0	3
147.426424	70.007933	07/10/97	15:39:40	2	24	ca	5	0	0	3	8
147.405808	70.011526	07/10/97	15:39:50	2	25	ca	40	20	0	0	60
147.405968	70.086383	07/10/97	15:42:54	2	26	ca	0	0	0	11	11
147.454339	70.103175	07/10/97	15:43:47	2	27	ca	0	8	3	0	11
147.449261	70.011570	07/10/97	15:47:13	2	28	ca	25	0	0	50	75
147.511050	70.015698	07/10/97	15:49:36	2	30	ca	1	0	0	0	1
147.525165	70.031436	07/10/97	15:50:14	2	31	ca	3	0	0	5	8
147.500496	70.053872	07/10/97	15:51:11	2	32	ca	0	6	0	0	6
147.509947	70.089114	07/10/97	15:52:38	2	33	ca	1	3	0	0	4
147.523988	70.120171	07/10/97	15:53:56	2	34	ca	0	4	2	0	6
147.534802	70.074712	07/10/97	15:57:42	2	35	ca	1	4	2	0	7
147.572027	70.042854	07/10/97	15:58:49	2	36	ca	0	0	0	18	18
147.552529	70.033028	07/10/97	15:59:10	2	37	ca	6	0	0	35	41
147.588900	70.004657	07/10/97	16:01:46	2	38	ca	0	60	40	0	100
147.578887	70.048823	07/10/97	16:03:37	2	39	ca	0	0	0	14	14
147.578451	70.063291	07/10/97	16:04:12	2	40	ca	0	0	0	2	2
147.594385	70.083683	07/10/97	16:05:02	2	41	ca	4	1	0	0	5
147.595239	70.092634	07/10/97	16:05:24	2	42	ca	0	2	0	0	2
147.617797	70.130643	07/10/97	16:10:19	2	43	ca	0	0	0	2	2
147.620020	70.085882	07/10/97	16:11:50	2	44	ca	0	90	60	0	150
147.660880	70.068258	07/10/97	16:14:29	2	45	ca	0	9	0	0	9
147.639880	70.059613	07/10/97	16:14:49	2	46	ca	0	20	5	0	25
147.626276	70.042848	07/10/97	16:15:24	2	47	ca	0	30	10	5	45
147.689013	70.021781	07/10/97	16:18:58	2	48	ca	0	1	0	0	1
147.676267	70.139995	07/10/97	16:23:46	2	49	ca	0	3	0	1	4

Table A-1. Continued.

Longitude °W	Latitude °N	Date	TimeAST	Flight	Attribute	Species	Bulls	Cows	Calves	Unclass	Total
147.719563	70.114420	07/10/97	16:26:38	2	50	ca	1	0	0	0	1
147.760261	70.047322	07/10/97	17:01:04	2	51	ca	0	2	1	31	34
147.764741	70.059703	07/10/97	17:01:34	2	52	ca	0	2	0	13	15
147.788019	70.098006	07/10/97	17:03:06	2	53	ca	1	0	0	1	2
147.861767	70.046085	07/10/97	17:11:26	2	54	ca	1	4	0	0	5
147.828241	70.093904	07/10/97	17:13:21	2	55	ca	0	0	0	3	3
147.887073	70.100644	07/10/97	17:15:26	2	56	ca	0	20	10	10	40
147.871917	70.069582	07/10/97	17:16:31	2	57	ca	0	0	0	8	8
147.976016	70.158492	07/10/97	17:28:06	2	58	ca	0	2	1	0	3
147.958143	70.126991	07/10/97	17:29:12	2	59	ca	1	0	0	0	1
147.096128	70.144968	07/15/97	11:48:20	3	1	ca	5	10	5	10	30
147.061257	70.129455	07/15/97	11:49:56	3	2	ca	9	20	13	45	87
147.110413	70.130776	07/15/97	11:53:10	3	3	ca	0	0	0	2	2
147.163307	70.048984	07/15/97	12:00:46	3	5	ca	0	1	0	0	1
147.233717	70.210461	07/15/97	12:09:16	3	6	ca	0	0	0	2	2
147.243946	70.198668	07/15/97	12:09:46	3	7	ca	0	0	0	2	2
147.196337	70.154392	07/15/97	12:11:19	3	8	ca	0	0	0	1	1
147.232280	70.134957	07/15/97	12:12:03	3	9	ca	10	400	200	200	810
147.271494	70.040845	07/15/97	12:21:55	3	10	ca	0	0	0	1	1
147.258814	70.132641	07/15/97	12:25:31	3	11	ca	1	0	0	0	1
147.269075	70.171318	07/15/97	12:27:01	3	12	ca	0	8	2	1	11
147.249235	70.197549	07/15/97	12:28:02	3	13	ca	1	0	0	0	1
147.285310	70.185258	07/15/97	12:30:00	3	14	ca	10	0	0	30	40
147.287609	70.059415	07/15/97	12:34:39	3	15	ca	1	0	0	0	1
147.439184	70.191162	07/15/97	13:00:47	3	16	ca	0	100	50	100	250
147.474981	70.192680	07/15/97	13:03:26	3	17	ca	0	3	0	0	3
147.529722	70.206205	07/15/97	13:18:54	3	18	ca	1	0	0	0	1
147.600937	70.106979	07/15/97	13:31:28	3	19	ca	1	0	0	0	1
147.699132	70.200398	07/15/97	13:52:53	3	20	ca	100	100	100	200	500
147.729797	70.210458	07/15/97	15:14:58	3	21	ca	700	300	300	400	1700
147.824131	70.234327	07/15/97	15:23:06	3	22	ca	0	0	0	55	55
147.831911	70.225836	07/15/97	15:23:24	3	23	ca	0	0	0	50	50
147.837141	70.248017	07/15/97	15:41:44	3	24	ca	0	0	0	18	18
147.895834	70.282817	07/15/97	15:45:09	3	25	ca	80	0	0	20	100
147.949701	70.264497	07/15/97	16:06:00	3	26	ca	0	1	1	0	2
147.917832	70.280685	07/15/97	16:06:36	3	27	ca	0	0	0	6	6
147.915854	70.292483	07/15/97	16:07:02	3	28	ca	1	0	0	0	1
147.991449	70.316609	07/15/97	16:08:42	3	29	ca	6	0	0	1	7
148.004013	70.303031	07/15/97	16:09:12	3	30	ca	0	0	0	3	3
147.970516	70.295866	07/15/97	16:09:31	3	31	ca	0	4	1	0	5
147.981935	70.200842	07/15/97	16:13:03	3	32	ca	1	0	0	2	3
147.990801	70.126016	07/15/97	16:15:43	3	33	ca	0	1	0	0	1
148.122635	70.316677	07/15/97	16:57:00	3	34	ca	30	1	1	10	42
148.113004	70.327225	07/15/97	16:57:35	3	35	ca	0	4	0	0	4

Table A-2. Muskoxen sightings in the Badami study area, summer 1997. Coordinates are longitude, latitude and datum is NAD 27.

Longitude °W	Latitude °N	Date	TimeAST	Flight	Attribute	Species	Bulls	Cows	Calves	Unclass	Total
148.1255257	70.15799432	07/03/97	20:03:18	1	7	mx	0	0	2	10	12
147.1590796	70.03832626	07/15/97	12:00:20	3	4	mx	0	0	0	7	7

Table A-3. Opportunistic non-systematic large mammal sightings in and near the Badami study area, summer 1997. Coordinates are longitude, latitude and datum is NAD 27.

Longitude °W	Latitude °N	Date	TimeAST	Flight	Attribute	Species	Bulls	Cows	Calves	Unclass	Total
147.195676	69.980348	07/10/97	15:06:26	2	5	ca	10	0	0	40	50
147.276859	69.988684	07/10/97	15:27:36	2	14	ca	30	0	0	40	70
147.434687	69.994784	07/10/97	15:37:58	2	22	ca	10	100	0	110	220
148.437694	70.058564	07/10/97	17:59:37	2	60	ca	10	30	10	10	60
147.269222	70.086984	06/16/97	17:02:38	1S	87	mx	0	0	2	26	28
147.231941	70.190134	07/17/97	15:37:44	4S	13	ca	0	0	0	160	160
147.293794	70.191920	07/17/97	15:39:04	4S	14	ca	0	125	40	125	290
147.392527	70.176854	07/17/97	15:41:31	4S	15	ca	500	500	150	400	1550
147.805330	70.229252	07/17/97	15:47:51	4S	16	ca	20	60	10	40	130
147.641519	70.141546	07/22/97	15:40:13	5S	1	ca	10	40	40	50	140
147.054922	70.155154	08/02/97	15:32:20	6S	37	ca	0	1	1	0	2
147.127792	70.155521	08/02/97	15:33:08	6S	38	ca	0	0	0	1	1
147.157610	70.158499	08/02/97	15:33:28	6S	39	ca	0	4	2	2	8
147.318353	70.176122	08/02/97	15:35:17	6S	40	ca	0	0	0	75	75
147.474824	70.177838	08/02/97	15:36:58	6S	41	mx	0	0	1	17	18
147.631651	70.170789	08/05/97	14:00	1SG	1	mx	0	0	1	18	19
147.634587	70.159103	08/07/97	17:21:46	7S	1	mx	0	0	1	18	19

APPENDIX B.

1997 PHOTODOCUMENTATION

Revised counts based on photodocumentation, copies of the photodocumentation and a summary of changes are presented in Photos 1 to 18 and Table B-1. Eight attributes were corrected based on photodocumentation, six from the systematic survey on 15 July 1997, and two from opportunistic observations on 17 July 1997. Additional groups were photographed, but transparencies were not of sufficient quality to reliably distinguish individual caribou. Group size was increased for most of the revised counts. The number of bulls increased by an average of 62 animals ± 87.8 95CI, number of cows decreased by an average of -6 ± 75.6 95CI, number of calves increased by an average of 44 ± 62.0 95CI, number of unclassified caribou increased by an average of 104 ± 60.8 95CI, and number of total caribou increased by an average of 204 ± 205.9 95CI. Changes within sex/age classes generally were proportional to the original group compositions.

PHOTO 1: Caribou--Badami Survey Area
Attribute 2, 9 Bulls, 20 Cows, 13 Calves,
45 Unclassified, 87 Total
147.061257° W, 70.129455° N
15 July 1997, Lynn Noel

PHOTO 2: Caribou--Badami Survey Area
Attribute 2, 9 Bulls, 20 Cows, 13 Calves,
45 Unclassified, 87 Total
147.061257° W, 70.129455° N
15 July 1997, Lynn Noel

PHOTO 3: Caribou--Badami Survey Area
Attribute 9, 10 Bulls, 400Cows, 200 Calves,
200 Unclassified, 810 Total
147.232280° W, 70.134957° N
15 July 1997, Lynn Noel

PHOTO 4: Caribou--Badami Survey Area
Attribute 14, 10 Bulls, 0 Cows, 0 Calves,
30 Unclassified, 40 Total
147.285310° W, 70.185258° N
15 July 1997, Lynn Noel

PHOTO 5: Caribou--Badami Survey Area
Attribute 16, 0 Bulls, 100 Cows, 50 Calves,
100 Unclassified, 250 Total
147.439184° W, 70.191162° N
15 July 1997, Lynn Noel

PHOTO 6: Caribou--Badami Survey Area
Attribute 20, 100 Bulls, 100 Cows, 100 Calves,
200 Unclassified, 500 Total
147.699132° W, 70.200398° N
15 July 1997, Lynn Noel

PHOTO 7: Caribou--Badami Survey Area
Attribute 20, 100B, 100 Cows, 100 Calves,
200 Unclassified, 500 Total
147.699132° W, 70.200398° N
15 July 1997, Lynn Noel

PHOTO 8: Caribou--Badami Survey Area
Attribute 21, 700 Bulls, 300 Cows, 300 Calves,
400 Unclassified, 1700 Total
147.729797° W, 70.210458° N
15 July 1997, Lynn Noel

PHOTO 9: Caribou--Badami Survey Area
Attribute 21, 700 Bulls, 300 Cows, 300 Calves,
400 Unclassified, 1700 Total
147.729797° W, 70.210458° N
15 July 1997, Lynn Noel

PHOTO 10: Caribou--Badami Survey Area
Attribute 21, 700 Bulls, 300 Cows, 300 Calves,
400 Unclassified, 1700 Total
147.729797° W, 70.210458° N
15 July 1997, Lynn Noel

PHOTO 11: Caribou--Badami Survey Area
Attribute 21, 700 Bulls, 300 Cows, 300 Calves,
400 Unclassified, 1700 Total
147.729797° W, 70.210458° N
15 July 1997, Lynn Noel

PHOTO 12: Caribou--Badami Survey Area
Attribute 21, 700 Bulls, 300 Cows, 300 Calves,
400 Unclassified, 1700 Total
147.729797° W, 70.210458° N
15 July 1997, Lynn Noel

PHOTO 13: Caribou--Badami Survey Area
Attribute 21, 700 Bulls, 300 Cows, 300 Calves,
400 Unclassified, 1700 Total
147.729797° W, 70.210458° N
15 July 1997, Lynn Noel

PHOTO 14: Caribou--Badami Survey Area
Attribute 25, 80 Bulls, 0 Cows, 0 Calves,
20 Unclassified, 100 Total
147.895834° W, 70.282817° N
15 July 1997, Lynn Noel

PHOTO 15: Caribou--Badami Study Area
Attribute 14, 0 Bulls, 125 Cows, 40 Calves,
125 Unclassified, 290 Total
147.293794°W, 70.191920°N
17 July 1997, Lynn Noel

PHOTO 16: Caribou--Badami Study Area
Attribute 14, 0 Bulls, 125 Cows, 40 Calves,
125 Unclassified, 290 Total
147.293794°W, 70.191920°N
17 July 1997, Lynn Noel

PHOTO 17: Caribou--Badami Study Area
Attribute 15, 500 Bulls, 500 Cows, 150 Calves,
400 Unclassified, 1550 Total
147.392527°W, 70.176854°N
17 July 1997, Lynn Noel

PHOTO 18: Muskoxen--Badami Study Area
Attribute 1, 18 Adult, 1 Calf, 19 Total
147.631651° W, 70.170789 ° N
5 August 1997, Jim Helmericks

Table B-1. Sex and age structure for caribou groups with corrections based on photographic analysis, Badami study area, Alaska, summer 1997. Abbreviations area: Uncorr. = uncorrected number (field estimate), Corr. = corrected number (photo count), and Diff. = difference between corrected and uncorrected number. Corrected attribute data is presented in Table A-1 and Table A-3.

		Bulls			Cows			Calves			Unclassified			Total Caribou		
Attribute	Date	Uncorr.	Corr.	Diff.	Uncorr.	Corr.	Diff.	Uncorr.	Corr.	Diff.	Uncorr.	Corr.	Diff.	Uncorr.	Corr.	Diff.
2	15 Jul	9	9	0	20	20	0	10	13	3	40	45	5	79	87	8
9	15 Jul	10	10	0	600	400	-200	200	200	0	0	200	200	810	810	0
14	15 Jul	10	10	0	0	0	0	0	0	0	15	30	15	25	40	15
16	15 Jul	0	0	0	100	100	0	50	50	0	40	100	60	190	250	60
20	15 Jul	125	100	-25	125	100	-25	60	100	40	40	200	160	350	500	150
21	15 Jul	380	700	320	350	300	-50	40	300	260	180	400	220	950	1700	750
14	17 Jul	0	0	0	100	125	25	40	40	0	100	125	25	240	290	50
15	17 Jul	300	500	200	300	500	200	100	150	50	250	400	150	950	1550	600
Average Difference				61.88			-6.25			44.13			104.38			204.13
Standard Deviation				126.72			109.18			89.55			87.69			297.14
95 Percent Confidence Interval				87.81			75.65			62.05			60.76			205.90

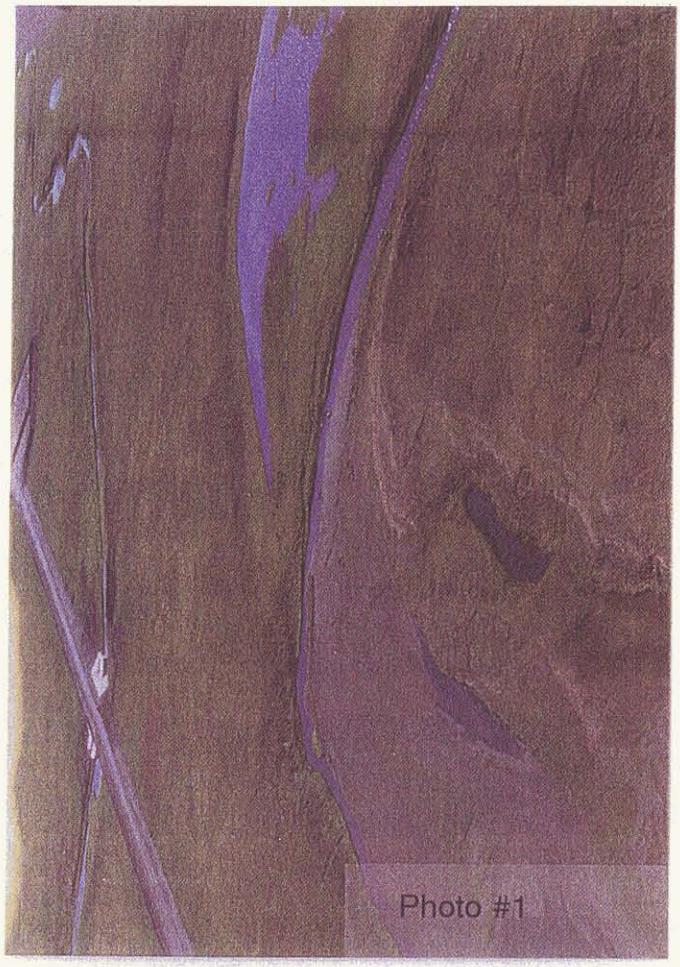


Photo #1

Photo #2

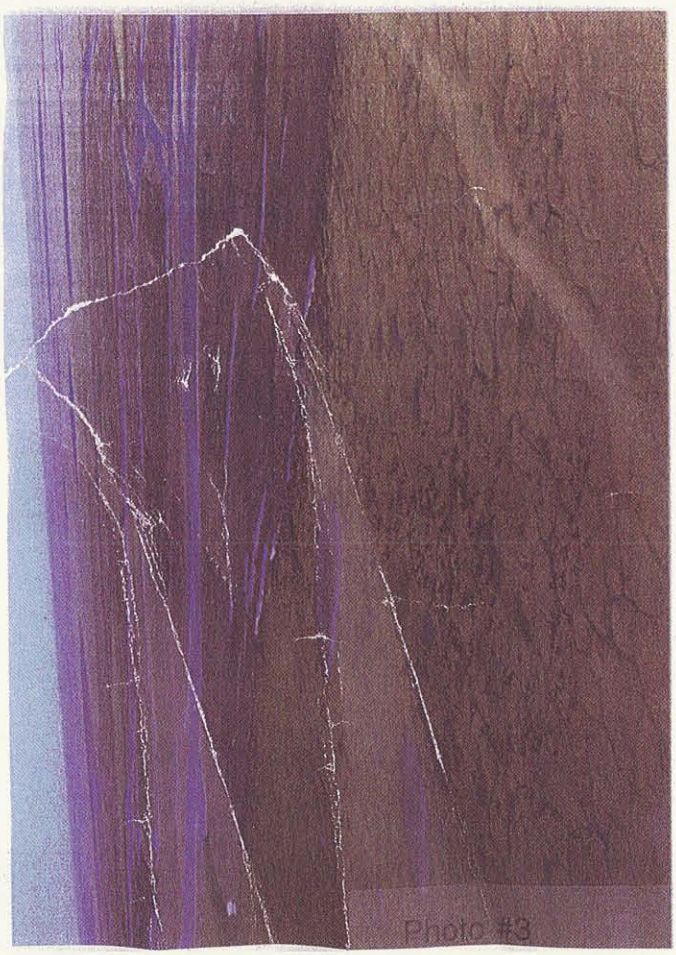


Photo #3

Photo #4

PW-LAB 019 NNAN 104.----

Caribou--Badami Survey Area
Attribute 2, 9 Bulls, 20 Cows, 13 Calves,
45 Unclassified, 87 Total
147.061257° W, 70.129455° N
15 July 1997, Lynn Noel

PW-LAB 051 NNAN 2.----

Caribou--Badami Survey Area
Attribute 2, 9 Bulls, 20 Cows, 13 Calves,
45 Unclassified, 87 Total
147.061257° W, 70.129455° N
15 July 1997, Lynn Noel

Caribou--Badami Survey Area
Attribute 14, 10 Bulls, 0 Cows, 0 Calves,
30 Unclassified, 40 Total
147.285310° W, 70.185258° N
15 July 1997, Lynn Noel

PW-LAB 029 NNAN 11.----

Caribou--Badami Survey Area
Attribute 9, 10 Bulls, 400Cows, 200 Calves,
200 Unclassified, 810 Total
147.232280° W, 70.134957° N
15 July 1997, Lynn Noel

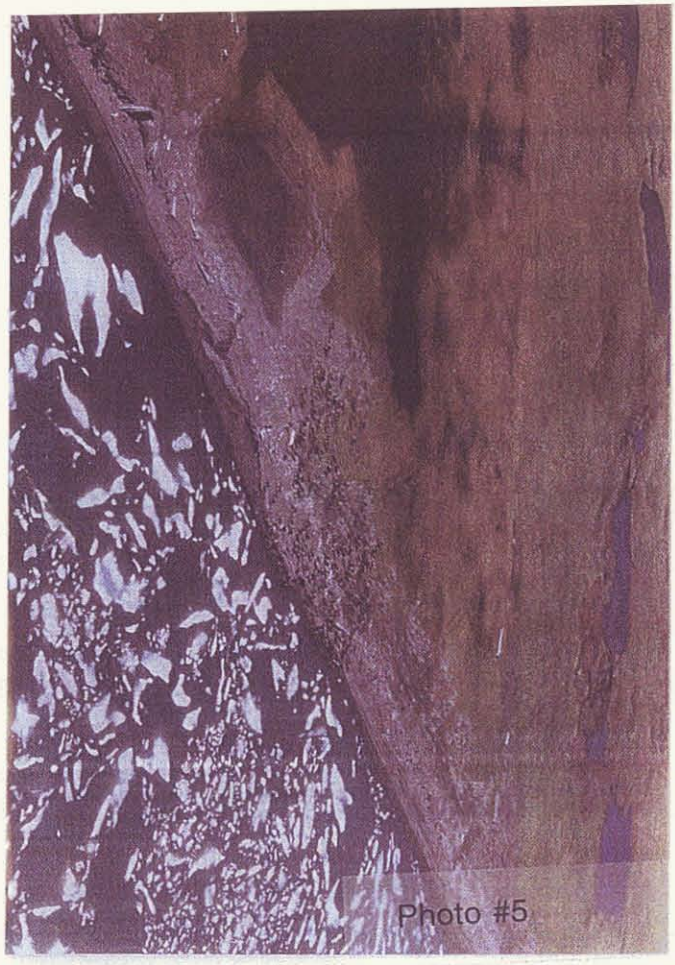


Photo #5

Photo #6

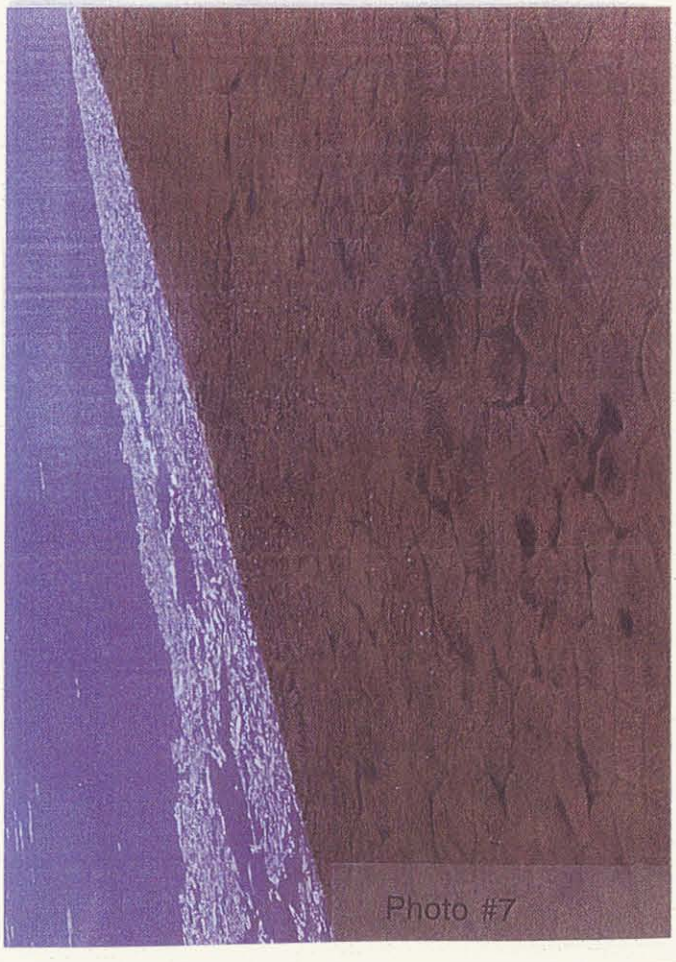


Photo #7

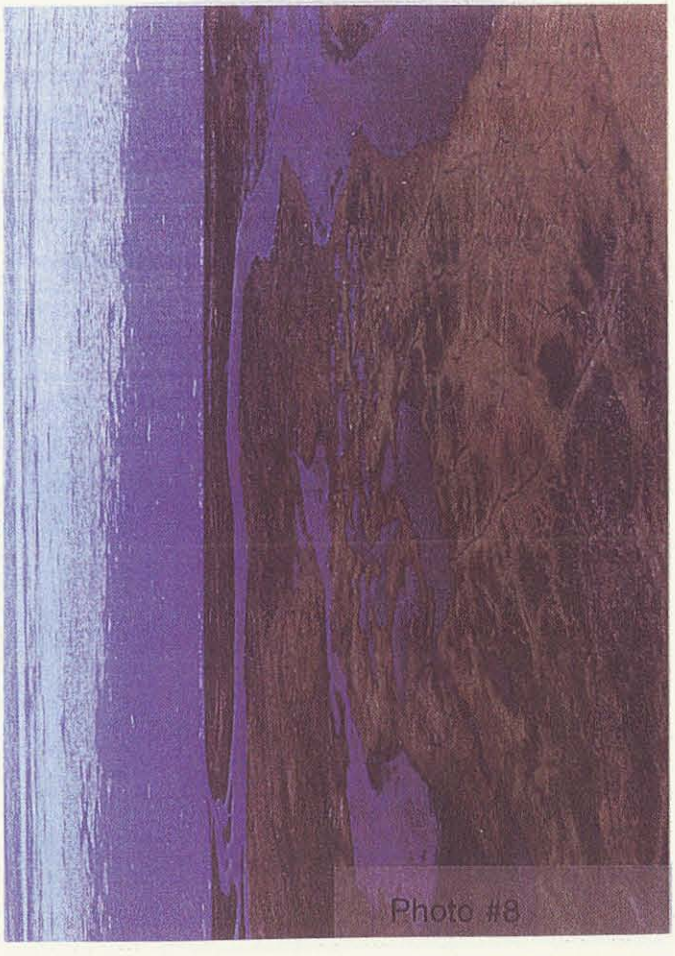


Photo #8

PW-LAB 019 NNAN 77.---

Caribou--Badami Survey Area
Attribute 20, 100 Bulls, 100 Cows, 100 Calves,
200 Unclassified, 500 Total
147.699132° W, 70.200398° N
15 July 1997, Lynn Noel

PW-LAB 019 NNAN 83.---

Caribou--Badami Survey Area
Attribute 16, 0 Bulls, 100 Cows, 50 Calves,
100 Unclassified, 250 Total
147.439184° W, 70.191162° N
15 July 1997, Lynn Noel

PW-LAB 019 NNAN 29.---

Caribou--Badami Survey Area
Attribute 21, 700 Bulls, 300 Cows, 300 Calves,
400 Unclassified, 1700 Total
147.729797° W, 70.210458° N
15 July 1997, Lynn Noel

PW-LAB 019 NNAN 69.---

Caribou--Badami Survey Area
Attribute 20, 100B, 100 Cows, 100 Calves,
200 Unclassified, 500 Total
147.699132° W, 70.200398° N
15 July 1997, Lynn Noel

Photo #9

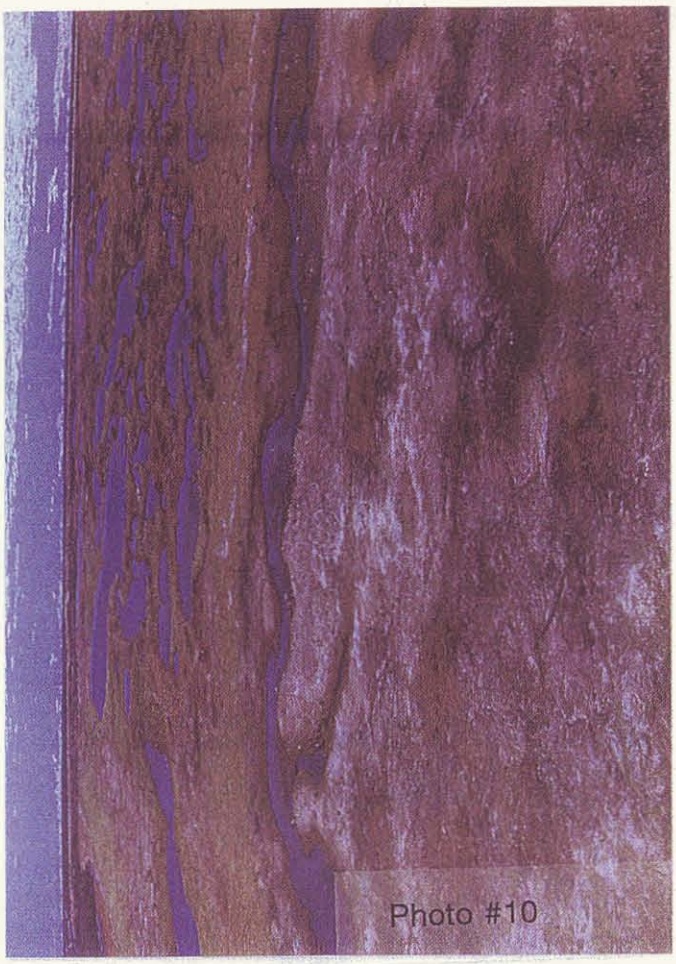


Photo #10

Photo #11

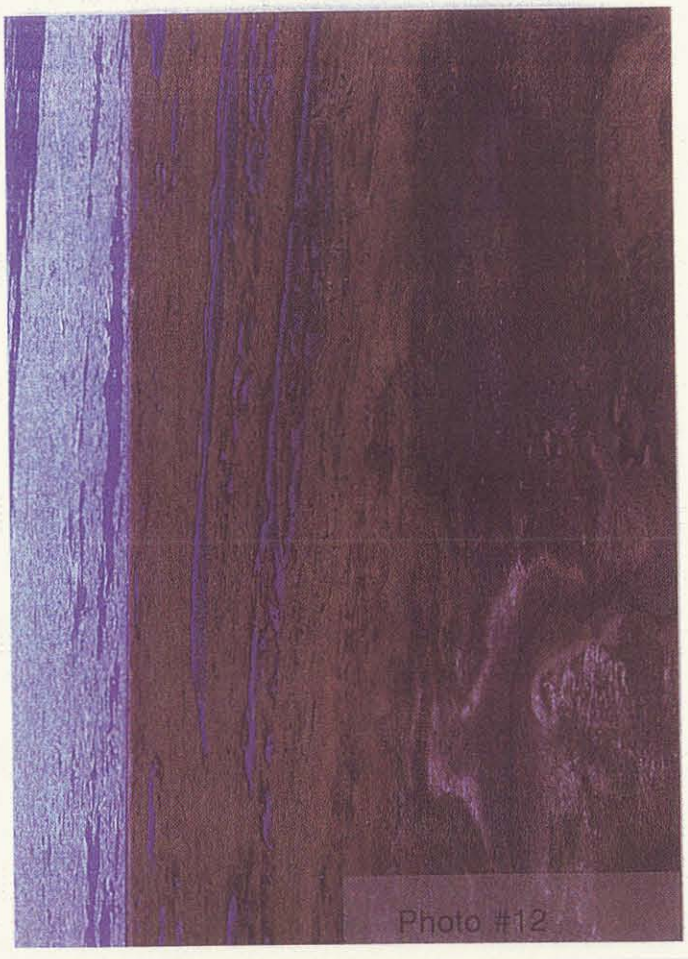


Photo #12

PW-LAB 019 NNAN 51.---

Caribou--Badami Survey Area
Attribute 21, 700 Bulls, 300 Cows, 300 Calves,
400 Unclassified, 1700 Total
147.729797° W, 70.210458° N
15 July 1997, Lynn Noel

PW-LAB 019 NNAN 62.---

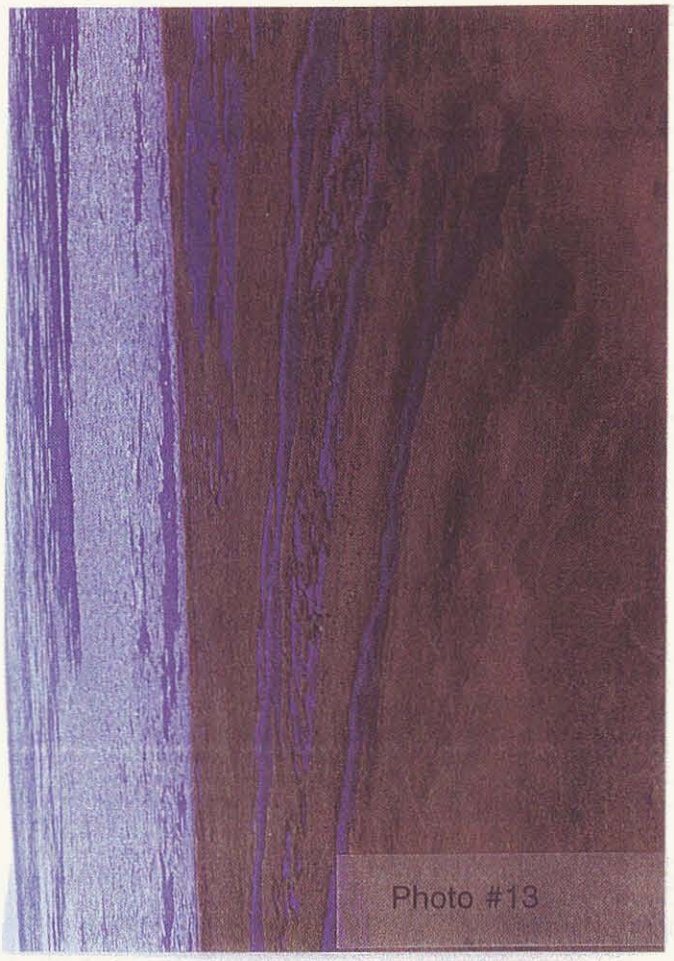
Caribou--Badami Survey Area
Attribute 21, 700 Bulls, 300 Cows, 300 Calves,
400 Unclassified, 1700 Total
147.729797° W, 70.210458° N
15 July 1997, Lynn Noel

PW-LAB 019 NNAN 22.---

Caribou--Badami Survey Area
Attribute 21, 700 Bulls, 300 Cows, 300 Calves,
400 Unclassified, 1700 Total
147.729797° W, 70.210458° N
15 July 1997, Lynn Noel

PW-LAB 019 NNAN 49.---

Caribou--Badami Survey Area
Attribute 21, 700 Bulls, 300 Cows, 300 Calves,
400 Unclassified, 1700 Total
147.729797° W, 70.210458° N
15 July 1997, Lynn Noel



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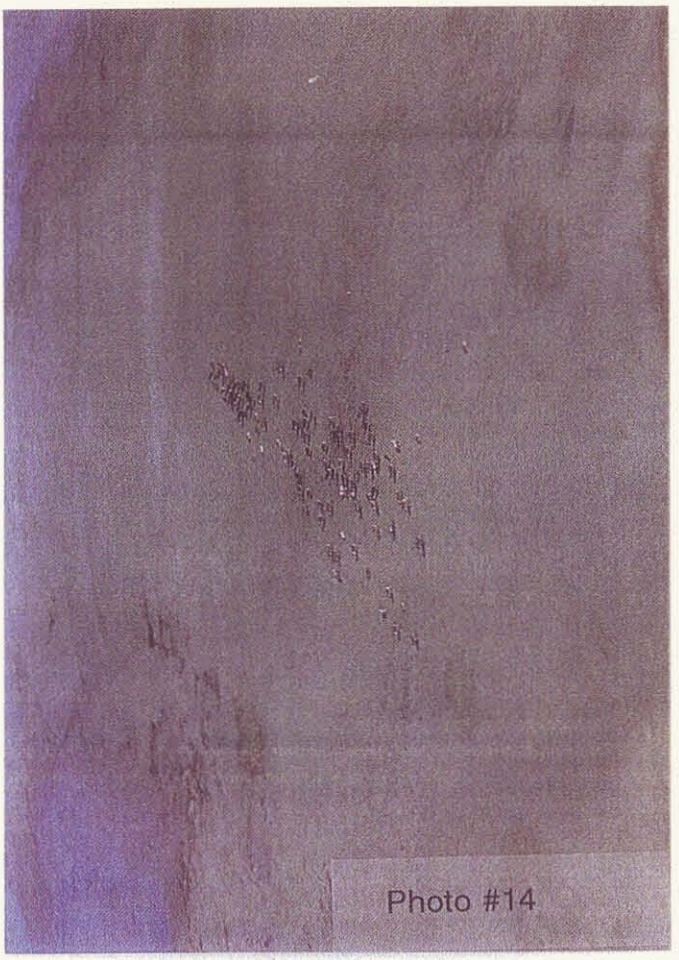

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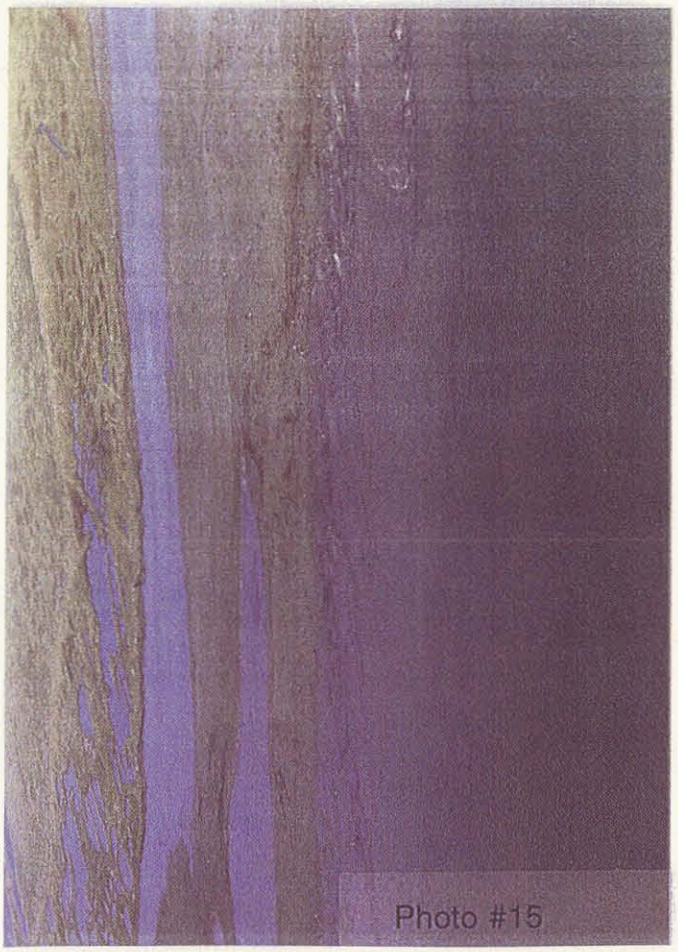

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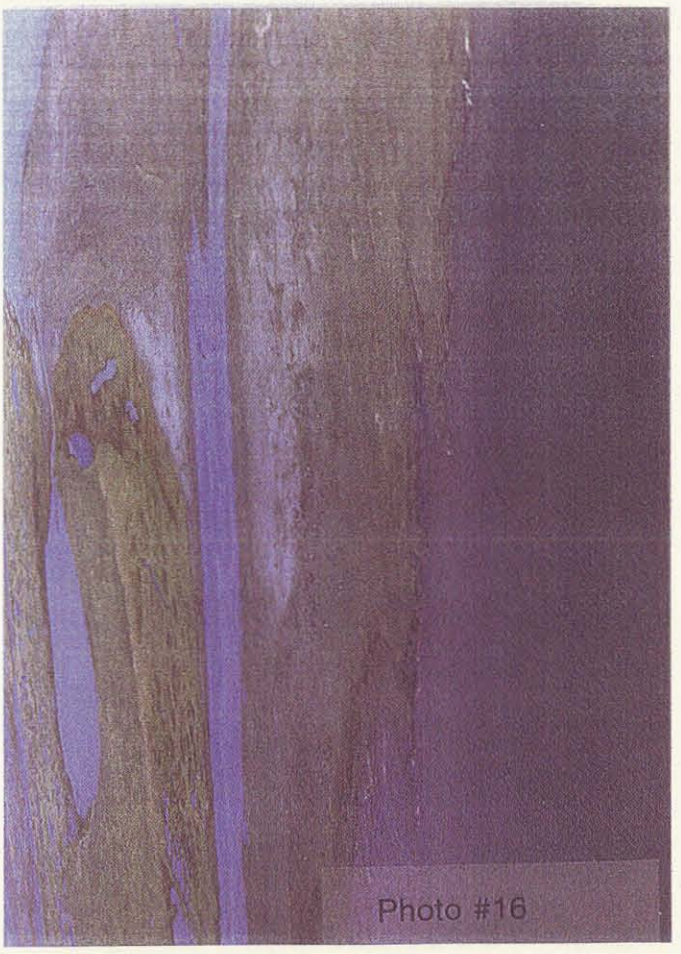

Photo #16

Caribou--Badami Survey Area
Attribute 25, 80 Bulls, 0 Cows, 0 Calves,
20 Unclassified, 100 Total
147.895834° W, 70.282817° N
15 July 1997, Lynn Noel

PW-LAB 019 NNAN 41.----

Caribou--Badami Survey Area
Attribute 21, 700 Bulls, 300 Cows, 300 Calves,
400 Unclassified, 1700 Total
147.729797° W, 70.210458° N
15 July 1997, Lynn Noel

Caribou--Badami Study Area
Attribute 14, 0 Bulls, 125 Cows, 40 Calves,
125 Unclassified, 290 Total
147.293794°W, 70.191920°N
17 July 1997, Lynn Noel

Caribou--Badami Study Area
Attribute 14, 0 Bulls, 125 Cows, 40 Calves,
125 Unclassified, 290 Total
147.293794°W, 70.191920°N
17 July 1997, Lynn Noel

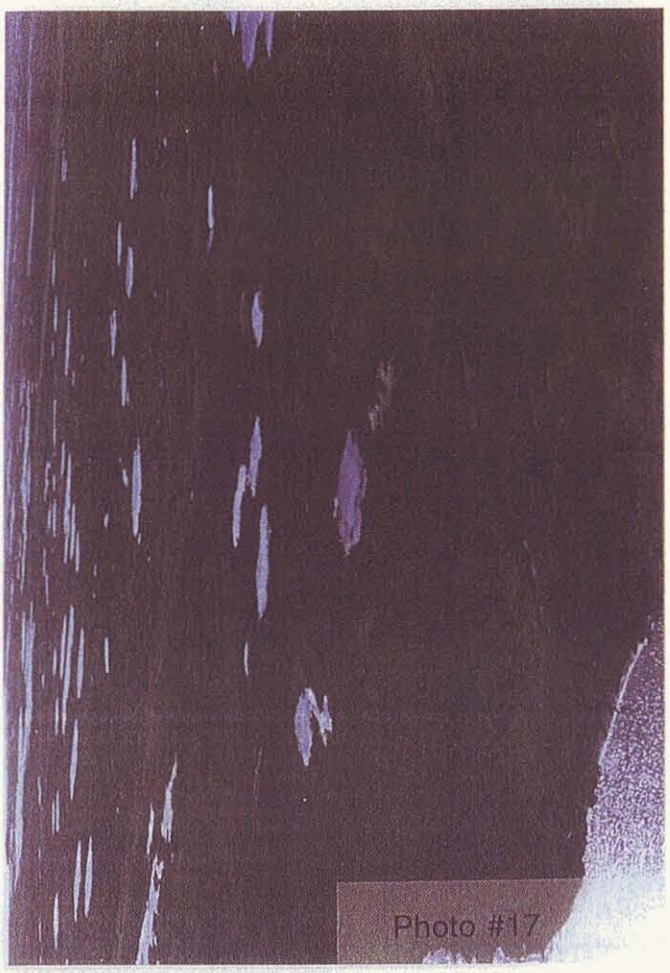

Photo #17

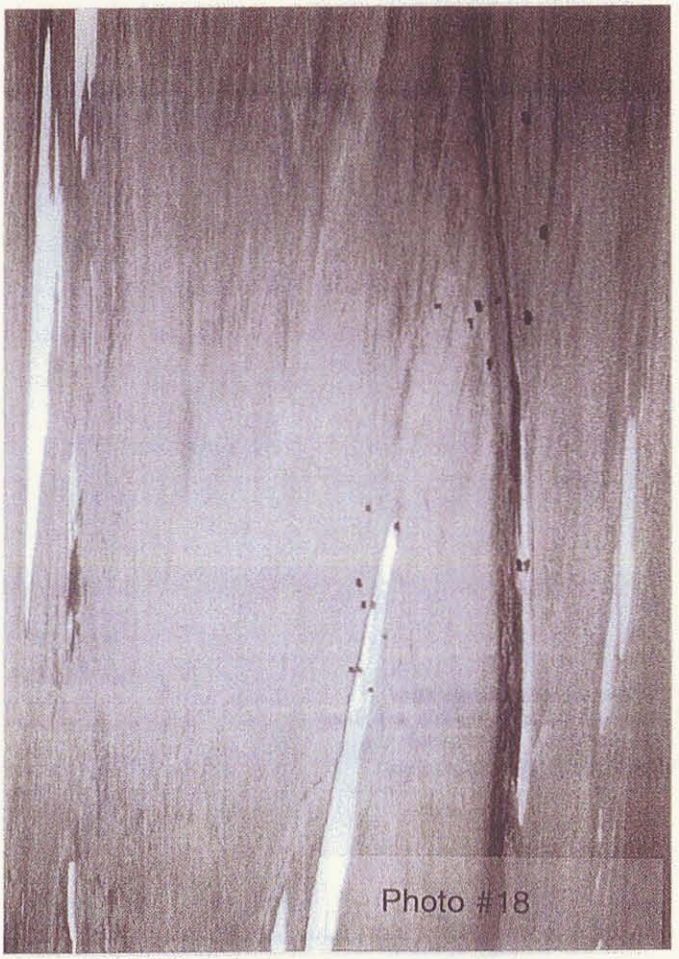

Photo #18

Muskoxen--Badami Study Area
Attribute 1, 18 Adult, 1 Calf, 19 Total
147.631651° W, 70.170789 ° N
5 August 1997, Jim Helmericks

Caribou--Badami Study Area
Attribute 15, 500 Bulls, 500 Cows, 150 Calves,
400 Unclassified, 1550 Total
147.392527°W, 70.176854°N
17 July 1997, Lynn Noel

APPENDIX C.

MOSQUITO AND OESTRID ACTIVITY INDICES

Appendix C. Mosquito and Oestrid Activity Indices.

Mosquito Activity Index

IF temperature >18°C THEN $TI_m = 1$
IF temperature <6°C THEN $TI_m = 0$
$TI_m = 1-((18\text{-temperature})/13)$
IF wind >6 mps then $WI_m = 0$
$WI_m = (6\text{-wind})/6$
$I_m = TI_m \times WI_m$

where:

TI_m = Temperature Index for Mosquitoes
WI_m = Wind Index for Mosquitoes
I_m = Mosquito Activity Index

These parameters were translated into IF statements for TI_m and WI_m with inputs as follows:

T_h = Temperature in °C recorded hourly at Deadhorse Weather Station
V_h = Wind velocity in mps recorded hourly at Deadhorse Weather Station

Syntax is IF (logical test, value if true, value if false)

$TI_m = IF\ (T_h < 6, 0, IF(T_h > 18, 1, (1-((18-T_h)/13))))$
$WI_m = IF\ (V_h > 6, 0, ((6-V_h)/6))$

then $I_m = TI_m \times WI_m$

Oestrid Activity Index

IF temperature >18°C THEN $TI_o = 1$
IF temperature <13°C THEN $TI_o = 0$
$TI_o = 1-((18\text{-temperature})/10)$
$WI_o = (9\text{-wind})/9$
$I_o = TI_o \times WI_o$

where:

TI_o = Temperature Index for Oestrids
WI_o = Wind Index for Oestrids
I_o = Oestrid Activity Index
T_h = Temperature in °C recorded hourly at Deadhorse Weather Station
V_h = Wind velocity in mps recorded hourly at Deadhorse Weather Station

These parameters were translated into IF statements for TI_o and WI_o which were then multiplied to give I_o.

$TI_o = IF\ (T_h < 13, 0, IF(T_h > 18, 1, (1-((18-T_h)/10))))$
$WI_o = IF\ (V_h > 9, 0, ((9-V_h)/9))$

and $I_o = TI_o \times WI_o$

Table C-1. Daily average temperature and wind velocity recorded at the Deadhorse Weather Station (ASCC 1997), with tabulations of hourly mosquito and oestrid activity indices (Russell et al. 1993). Daily totals of four or more hours with either mosquito or oestrid indices ≥0.5 were considered "Insect Days" (Cameron et al. 1995).

Date	Mean Temperature (°C)	n	Mean Wind Speed (mps)	n	Mosquito Index		Oestrid Index		Total Number of Records
					Number of Records <0.5	Number of Records ≥0.5	Number of Records <0.5	Number of Records ≥0.5	
1 May 97	-4.97	(33)	2.20	(33)	33	0	33	0	33
2 May 97	-6.26	(34)	2.65	(34)	34	0	34	0	34
3 May 97	-6.92	(36)	3.10	(36)	36	0	36	0	36
4 May 97	-8.57	(21)	3.75	(21)	21	0	21	0	21
5 May 97	-11.00	(23)	4.20	(23)	23	0	23	0	23
6 May 97	-12.04	(23)	6.33	(23)	23	0	23	0	23
7 May 97	-12.21	(24)	5.48	(24)	24	0	24	0	24
8 May 97	-11.00	(27)	2.95	(27)	27	0	27	0	27
9 May 97	-11.60	(20)	2.06	(20)	20	0	20	0	20
10 May 97									
11 May 97	-4.40	(5)	5.59	(5)	5	0	5	0	5
12 May 97	-3.59	(22)	6.93	(22)	22	0	22	0	22
13 May 97	-1.55	(22)	3.90	(22)	22	0	22	0	22
14 May 97	0.97	(30)	1.90	(30)	30	0	30	0	30
15 May 97	-1.38	(32)	2.84	(32)	32	0	32	0	32
16 May 97	-2.36	(28)	3.77	(28)	28	0	28	0	28
17 May 97	1.18	(17)	3.13	(17)	17	0	17	0	17
18 May 97	2.05	(20)	3.94	(20)	20	0	20	0	20
19 May 97	3.35	(23)	1.82	(23)	23	0	23	0	23
20 May 97	2.32	(25)	2.78	(25)	25	0	25	0	25
21 May 97	-0.53	(34)	3.92	(34)	34	0	34	0	34
22 May 97	-2.94	(34)	3.84	(34)	34	0	34	0	34
23 May 97	-6.16	(32)	3.07	(32)	32	0	32	0	32
24 May 97	-7.79	(29)	4.32	(29)	29	0	29	0	29
25 May 97	-6.00	(30)	6.08	(30)	30	0	30	0	30
26 May 97	-0.87	(23)	2.89	(23)	23	0	23	0	23
27 May 97	1.43	(28)	4.01	(28)	28	0	28	0	28
28 May 97	0.11	(27)	4.66	(28)	28	0	28	0	28
29 May 97	-0.64	(25)	3.36	(26)	26	0	26	0	26
30 May 97	-2.16	(25)	2.93	(25)	25	0	25	0	25
31 May 97	-2.33	(27)	4.57	(27)	27	0	27	0	27
1 Jun 97	-4.54	(24)	6.37	(24)	24	0	24	0	24
2 Jun 97	-4.59	(22)	6.46	(22)	22	0	22	0	22
3 Jun 97	-1.39	(28)	7.44	(28)	28	0	28	0	28
4 Jun 97	1.67	(30)	7.30	(30)	30	0	30	0	30
5 Jun 97	3.27	(22)	5.57	(22)	22	0	22	0	22
6 Jun 97	4.76	(25)	2.56	(25)	25	0	25	0	25
7 Jun 97	3.69	(26)	2.16	(26)	26	0	26	0	26
8 Jun 97	2.52	(31)	3.18	(31)	31	0	31	0	31
9 Jun 97	-0.46	(26)	2.97	(26)	26	0	26	0	26
10 Jun 97	0.33	(33)	2.87	(33)	33	0	33	0	33

Table C-1. Continued.

Date	Mean Temperature (°C)	n	Mean Wind Speed (mps)	n	Mosquito Index		Oestrid Index		Total Number of Records
					Number of Records <0.5	Number of Records ≥0.5	Number of Records <0.5	Number of Records ≥0.5	
11 Jun 97	1.43	(23)	4.42	(23)	23	0	23	0	23
12 Jun 97	2.23	(31)	3.17	(31)	31	0	31	0	31
13 Jun 97	3.57	(21)	4.04	(22)	22	0	22	0	22
14 Jun 97	3.34	(32)	3.10	(33)	33	0	33	0	33
15 Jun 97	4.42	(31)	2.78	(31)	31	0	31	0	31
16 Jun 97	5.73	(26)	2.94	(26)	26	0	26	0	26
17 Jun 97	2.58	(26)	3.69	(26)	26	0	26	0	26
18 Jun 97	3.28	(32)	3.32	(32)	32	0	32	0	32
19 Jun 97	3.76	(17)	3.01	(17)	17	0	17	0	17
20 Jun 97	4.86	(21)	4.25	(21)	21	0	21	0	21
21 Jun 97	3.89	(28)	3.37	(28)	28	0	28	0	28
22 Jun 97	6.14	(28)	2.95	(28)	28	0	28	0	28
23 Jun 97	6.93	(28)	2.62	(29)	29	0	29	0	29
24 Jun 97	13.71	(24)	4.14	(24)	24	0	24	0	24
25 Jun 97	8.18	(28)	4.95	(28)	28	0	28	0	28
26 Jun 97	4.33	(33)	3.49	(33)	33	0	33	0	33
27 Jun 97	3.30	(20)	4.50	(20)	20	0	20	0	20
28 Jun 97	5.00	(26)	4.97	(26)	26	0	26	0	26
29 Jun 97	9.71	(28)	3.76	(29)	25	4	22	7	29
30 Jun 97	11.82	(22)	3.97	(23)	23	0	23	0	23
1 Jul 97	11.22	(23)	3.51	(23)	23	0	17	6	23
2 Jul 97	4.90	(31)	5.41	(31)	31	0	31	0	31
3 Jul 97	5.74	(27)	4.15	(27)	27	0	27	0	27
4 Jul 97	8.77	(30)	2.64	(30)	27	3	29	1	30
5 Jul 97	5.48	(27)	3.85	(27)	27	0	27	0	27
6 Jul 97	3.16	(25)	5.00	(25)	25	0	25	0	25
7 Jul 97	3.11	(28)	5.68	(28)	28	0	28	0	28
8 Jul 97	2.10	(30)	5.81	(30)	30	0	30	0	30
9 Jul 97	3.46	(24)	6.18	(24)	24	0	24	0	24
10 Jul 97	3.68	(22)	6.12	(22)	22	0	22	0	22
11 Jul 97	4.45	(20)	4.00	(20)	20	0	20	0	20
12 Jul 97	4.97	(30)	3.74	(30)	30	0	30	0	30
13 Jul 97	4.39	(23)	6.95	(23)	23	0	23	0	23
14 Jul 97	5.77	(26)	2.28	(26)	26	0	26	0	26
15 Jul 97	9.36	(22)	3.88	(22)	22	0	22	0	22
16 Jul 97	6.16	(31)	5.62	(31)	31	0	31	0	31
17 Jul 97	7.58	(12)	2.20	(12)	11	1	12	0	12
18 Jul 97	7.25	(16)	6.79	(16)	16	0	16	0	16
19 Jul 97	9.29	(24)	2.83	(25)	25	0	24	1	25
20 Jul 97	9.33	(30)	3.36	(30)	30	0	30	0	30
21 Jul 97	7.38	(26)	5.67	(26)	26	0	26	0	26
22 Jul 97	8.79	(28)	2.92	(28)	28	0	28	0	28
23 Jul 97	13.04	(25)	2.47	(25)	20	5	14	11	25
24 Jul 97	16.00	(24)	3.56	(24)	21	3	16	8	24
25 Jul 97	11.56	(27)	2.93	(27)	25	2	25	2	27
26 Jul 97	14.20	(15)	3.93	(15)	15	0	11	4	15

Table C-1. Continued.

Date	Mean Temperature (°C)	n	Mean Wind Speed (mps)	n	Mosquito Index		Oestrid Index		Total Number of Records
					Number of Records <0.5	Number of Records ≥0.5	Number of Records <0.5	Number of Records ≥0.5	
27 Jul 97	6.81	(31)	5.15	(31)	31	0	31	0	31
28 Jul 97	4.60	(30)	3.96	(30)	30	0	30	0	30
29 Jul 97	6.85	(27)	5.10	(27)	27	0	27	0	27
30 Jul 97	8.04	(25)	6.86	(25)	25	0	25	0	25
31 Jul 97	8.29	(28)	3.80	(28)	28	0	28	0	28
1 Aug 97	11.20	(15)	3.00	(15)	14	1	14	1	15
2 Aug 97	13.68	(22)	2.63	(22)	17	5	15	7	22
3 Aug 97	16.39	(23)	3.32	(23)	17	6	12	11	23
4 Aug 97	15.95	(22)	3.55	(22)	16	6	12	10	22
5 Aug 97	14.61	(23)	2.43	(23)	19	4	17	6	23
6 Aug 97	11.67	(33)	2.93	(33)	33	0	33	0	33
7 Aug 97	9.88	(26)	2.75	(26)	26	0	26	0	26
8 Aug 97	11.50	(34)	4.68	(34)	34	0	34	0	34
9 Aug 97	8.79	(28)	3.56	(28)	28	0	28	0	28
10 Aug 97	12.35	(23)	3.39	(23)	18	5	13	10	23
11 Aug 97	15.61	(28)	4.22	(29)	29	0	22	7	29
12 Aug 97	9.89	(27)	3.42	(27)	27	0	27	0	27
13 Aug 97	9.04	(28)	3.10	(28)	28	0	28	0	28
14 Aug 97	12.12	(25)	2.67	(26)	25	1	23	3	26
15 Aug 97	13.48	(25)	4.32	(25)	24	1	22	3	25
16 Aug 97	7.42	(24)	4.51	(24)	24	0	24	0	24
17 Aug 97	4.72	(29)	4.36	(29)	29	0	29	0	29
18 Aug 97	3.54	(24)	5.29	(24)	24	0	24	0	24
19 Aug 97	7.10	(30)	6.51	(30)	30	0	30	0	30
20 Aug 97	4.69	(35)	2.86	(35)	35	0	35	0	35
21 Aug 97	7.26	(34)	2.76	(34)	34	0	34	0	34
22 Aug 97	8.55	(33)	3.08	(34)	34	0	34	0	34
23 Aug 97	5.46	(28)	5.07	(28)	28	0	28	0	28
24 Aug 97	3.00	(27)	8.60	(27)	27	0	27	0	27
25 Aug 97	2.82	(28)	9.49	(28)	28	0	28	0	28
26 Aug 97	3.22	(27)	8.67	(27)	27	0	27	0	27
27 Aug 97	4.39	(23)	1.49	(24)	24	0	24	0	24
28 Aug 97	4.65	(31)	1.19	(32)	32	0	32	0	32
29 Aug 97	5.06	(36)	4.22	(36)	36	0	36	0	36
30 Aug 97	4.40	(30)	5.41	(30)	30	0	30	0	30