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FINAL DATA REPORT
13 February 1998

**Bullen Point to Staines River
Large Mammal Distribution,
Summer 1997**

Prepared by

LGL ALASKA RESEARCH ASSOCIATES, INC.
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Anchorage, Alaska 99508

Prepared for

BP EXPLORATION (ALASKA) INC.
Environmental and Regulatory Affairs Department
P.O. Box 196612
Anchorage, Alaska 99519-6612

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ABSTRACT

Large mammal distribution was documented from Bullen Point on the west to the Staines/Canning River on the east and from the Beaufort Sea coast on the north to 69° 54.5' N Latitude, on the North Slope, Alaska, during seven systematic strip-transect surveys on 16 June, 6 July, 11 July, 17 July, 22 July, 2 August, and 7 August 1997. During the caribou calving period survey on 16 June 1997, 81 groups with 624 total caribou were recorded. Calf to cow ratio for this survey was 70 calves/100 cows, similar to 1997 Central Arctic Caribou Herd (CAH) productivity of 72 calves/100 cows. During the post-calving period, caribou numbers within the study area ranged from 1,666 on 22 July to 16 on 7 August 1997. The ratio of 19 bulls/100 cows for combined survey data within the study area was lower than for the CAH in 1996 with 61 bulls/100 cows. This was likely due to the preponderance of cow/calf dominated groups within the study area. Three brown bears were recorded within the study area during the seven systematic surveys; one on 16 June and two on 17 July 1997. No muskoxen or moose were observed within 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 from Bullen Point to the Staines River (or Sourdough study area) to the east of Prudhoe Bay, Alaska. This effort focused on calving and 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 large aggregations sought relief on or near deltas of the Kuparuk, Shaviovik, and Canning rivers during intense insect harassment; however, caribou groups were observed along the coast within the entire Oliktok Point to Canning River area.

By the late 1800's, 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 the Arctic National Wildlife Refuge (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 during June and July. 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 within the study area during seven systematic aerial surveys.

Our objectives during 1997 were:

- To determine the number, sex/age composition, and distribution of caribou during the calving season within the study area.
- 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, brown bears, and moose within the study area.

STUDY AREA

The study area is bounded on the west by Bullen Point, extends east to the Staines River north to the Beaufort Sea, and south to approximately 69° 54.5' latitude (Fig. 1). The Bullen Point to Staines River or Sourdough study area includes transect numbers 48 to 70 (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 within five miles of the coast has little relief. Further inland the landscape begins a gradual ascent from 25 feet above sea level to 350 feet above sea level at the southern edge of the study area, about 24 miles inland. Contours within the study area form concentric bands oriented north northwest. This area has been referred to as the Canning alluvial fan, formed by sediment deposition from the Canning River. Vegetation in the southern portion of the study area is a mixture of dry or moist herbaceous tundra and wet herbaceous tundra. Moisture increases to the east, approaching the Canning River, and toward the coast (U.S. Geological Survey, Alaska Vegetation and Land Cover Series, Mt. Michelson Quadrangle, Map L-206).

METHODS

Aerial Surveys

During summer 1997, seven 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 48 to 70, Fig. 1) were flown during each of seven 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*TM 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 photographs 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. Thirty incremental 1-km intervals were constructed (Fig. 2). Lake area within intervals was calculated and subtracted from the interval area to give the land area within each interval (Table 1). Available land area 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 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 adult 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

Seven systematic surveys of the Bullen Point to Staines River study area were completed (Appendix A). With one exception, all surveys included 100 percent coverage of the study area (Figs. A-2 to A-7). The single exception occurred on 16 June when 97 percent of the area was surveyed. A total of 5,082 caribou in 186 groups were recorded within the study area during the seven systematic surveys from 16 June to 7 August 1997 (Table 2). The total number of caribou within the study area ranged from 16 on 7 August to 1,666 on 17 July (Table 2). Cows and calves comprised 91 percent of classified caribou for combined surveys, ranging from 41 to 100 percent of classified caribou for individual surveys. Cows and calves predominated within the study area between 16 June and 17 July, accounting for 93 to 100 percent of classified caribou. Bulls predominated during the 2 August survey at 59 percent of classified caribou. The proportion of unclassified caribou for individual surveys ranged from 2 to 49 percent of the total number of caribou recorded. Unclassified caribou are primarily young bulls, non-maternal cows and yearlings.

Caribou

Survey 1—16 June 1997

Survey weather conditions were fair to good with scattered clouds at 4,600 m, moderate wind at 3.9 meters per second (mps) from the northeast (30° to 40°) and a temperature of 7° to 8°C from 1300 to 1700 Alaska Standard Time (AST, ASCC 1997). Lighting was flat and distinguishing individual caribou was difficult during the first part of the survey. Lighting continued to improve during the survey. Very little snow remained on the tundra and snow cover was 2 to 4 percent. Approximately 70 percent of the tundra was flooded. A portion of the study area in the southeastern corner was not surveyed due to misinterpretation of the southern endpoints for these transects, resulting in 97 percent coverage (Fig. A-1).

Survey 1 was conducted late during the calving period (prior to 20 June). Eighty-one groups with 624 total caribou were recorded within the study area (Fig. A-1, Table 2, Table A-1). Thirty-six percent of caribou were in six cow/calf groups of 20 to 51 total caribou, 23 percent of caribou were in eleven cow/calf groups of 10 to 18 total caribou and the remaining 41 percent of caribou were in 64 groups of less than 10 total caribou. Mean group size was 7.7 ± 2.13 (95 percent confidence interval [95CI]). Except for a single bull within the study area, all caribou were cows with calves (Table A-1). For classified caribou the composition was 70 calves per 100 cows (pregnancy rate of 70 percent).

Caribou were generally concentrated in the southwestern portion of the study area (Fig A-1). Eighty-six percent of caribou were located inland 12 to 28 km from the Beaufort Sea coast

(Fig. 4, Table 4). Seven percent of caribou were observed from 1 to 5 km from the Beaufort Sea coast (Fig. 4, Table 4). Daily mean temperature was 5.7°C and daily mean wind speed was 2.9 mps (Table C-1). Mosquito and oestrid activity indices indicated conditions were too cool for insect activity on 16 June (Fig. 3, Table C-1).

Survey 2—6 July 1997

Survey weather conditions were favorable, with broken clouds at 1,800 m to 3,000 m, with moderate to strong winds at 4.6 to 7.0 mps from the east northeast (70° to 80°), and a temperature of 4° to 5°C from 1200 to 1700 AST. Survey 2 and the following surveys were conducted during the post-calving period (20 June to 15 August). Ten groups with 481 total caribou were recorded within the study area (Fig. A-2, Table 2, Table A-1). Eighty-seven percent of caribou were in three cow/calf-dominated groups of 90 to 182 total caribou (Fig. A-2, Table A-1 Attribute 2, 4, and 8). Ten percent of caribou were in two cow/calf-dominated groups of 20 and 28 total caribou (Fig. A-2, Table A-1 Attribute 6 and 9). The remaining three percent of caribou were in five groups of five or fewer caribou. Mean group size was 48.1 ± 41.60 95CI. Cows and calves again predominated in the study area comprising 95 percent of classified caribou, with 91 percent of caribou classified.

Caribou were generally concentrated in the northern portion of the study area (Fig. A-2). Ninety-nine percent of caribou were between 7 and 13 km from the Beaufort Sea coast (Fig. 5, Table 4). Bull and calf caribou appeared to be similarly distributed within the study area (Fig 6, Table 4, Table A-1). Bulls were again rare within the study area and were generally associated with the larger cow/calf-dominated groups. Daily mean temperature was 3.2°C and daily mean wind speed was 5.0 mps (Table C-1). Mosquito and oestrid indices indicate conditions were too cool and windy to be conducive to insect activity (Fig. 3, Table C-1).

Survey 3—11 July 1997

Survey weather conditions were favorable, with overcast skies at 370 m, moderate winds at 3.1 mps from the northeast (40°), and a temperature of 9°C at 1700 AST. Twelve groups with 1,047 total caribou were recorded within the study area (Fig. A-3, Table 2, Table A-1). Forty-three percent of caribou were in a single cow/calf-dominated group of 450 total caribou (Fig. A-3, Table A-1 Attribute 11). Forty-seven percent of caribou were in three groups of 140 to 180 total caribou (Fig. A-3, Table A-1 Attribute 5, 8, and 12). The remaining 10 percent of caribou were in 8 groups of less than 50 caribou (Fig. A-3, Table A-1). Mean group size was 87.2 ± 75.80 95CI. Cows and calves were 93 percent of classified caribou, with 51 percent of caribou classified.

Fifty-nine percent of caribou were within 2 km of the Beaufort Sea coast (Fig. 5, Table 4), while 39 percent of caribou were inland between 16 and 25 km from the coast (Fig. 5, Table 4). Both of the large inland groups were moving, a group of 142 caribou (Attribute 5) was headed toward the northwest and another group of 180 caribou (Attribute 8) was headed toward the west (Fig. A-3, Table A-1). These groups may have been moving toward the coast along the watershed to the west (Fig. A-3). Bull caribou were associated with the groups inland 16 to 25 km from the coast, but were not associated with the two large coastal groups (Fig. 6, Table 4, Fig. A-3, Table A-1). Daily mean temperature was 4.4°C and daily mean wind speed was 4.0 mps. Mosquito and oestrid activity indices indicated conditions were too cool and windy for insect activity on 11 July (Fig. 3, Table C-1). However, weather data for 11 July is missing records between 0551 and 1645 AST (ASCC 1997), which includes the warmest part of the day. Mosquitoes were active and swarming near the coast at Bullen Point at 1425 AST, and it is likely they were also active inland.

Survey 4—17 July 1997

Survey weather conditions were favorable with few clouds at 2,300 m, variable winds from 1.9 to 4.3 mps from the northeast and north (30° to 360°), and a temperature of 14°C from 1100 to 1600 AST. Eight groups of 1,162 total caribou were recorded within the study area (Fig. A-4, Table 2, Table A-1). Ninety-eight percent of caribou were in three cow/calf-dominated groups of 290 to 450 total caribou along the coast (Fig. A-4, Table A-1 Attribute 2, 8, and 9). The remaining two percent of caribou were in five groups of less than 15 caribou. Mean group size was 145.2 ± 138.10 95CI. Cows and calves were again 93 percent of classified caribou, with 74 percent of caribou classified.

All but three of the 1,162 caribou observed on 17 July were within 1 km of the Beaufort Sea coast (Fig. 5, Table 4). The three groups of 418 total caribou farthest east along the coast were standing and lying on spits (Fig. A-4, Table A-1, Attribute 2, 4, and 6). The two groups with 740 total caribou were headed east along the coast (Fig. A-4, Table A-1 Attribute 8 and 9). Bulls and calves were distributed a similar distance from the coast (Fig. 6, Table 4, Fig. A-4, Table A-1). Daily mean temperature was 7.6°C and daily mean wind was 2.2 mps (Table C-1). The mosquito index indicates that conditions were suitable for mosquito activity for one hour during the day (Fig. 3, Table C-1). However, there are no weather records between 0551 and 1646 AST on 17 July, so during the warmest part of the day there is no calculated activity index (Table C-1). The clumped and coastal distribution of caribou on 17 July suggests caribou were responding to mosquitoes.

Survey 5—22 July 1997

Survey weather conditions were favorable, with overcast skies at 150 to 300 m, moderate winds from 3.1 to 3.0 mps from the north (20° to 360°), and a temperature of 11°C to 12°C from 1530 to 2000 AST. Twenty-nine groups of 1,666 total caribou were recorded within the study area (Fig. A-5, Table 2, Table A-1). Eighty-two percent of caribou were in three cow/calf groups of 300, 475, and 600 total caribou (Fig. A-5, Table A-1, Attributes 26, 29, and 30). Twelve percent of caribou were in two cow/calf-dominated groups of 71 and 130 total caribou (Fig. A-5, Table A-1, Attributes 7 and 11). The remaining six percent of caribou were in 24 groups of less than 26 total caribou (Fig. A-5, Table A-1). Mean group size was 75.4 ± 53.41 95CI. Cows and calves were 87 percent of classified caribou, with 63 percent of caribou classified.

Caribou were generally concentrated along the coast, with 71 percent of caribou within 1 km of the Beaufort Sea coast (Fig. 5, Table 4). The group east of Bullen Point was standing on a spit and a few were in the water (Appendix B Photos 9 and 10, Fig. A-5, Table A-1, Attribute 26). The group at Bullen Point was headed east along the coast (Fig. A-5, Table A-1, Attribute 29). One large group of caribou was approximately 10 km from the coast, but this group was moving north towards the coast. Ninety-nine percent of caribou were within 10 km of the coast (Fig. 5, Table 4). Daily mean temperature was 8.8°C and daily mean wind speed was 2.9 mps (Table C-1). Mosquito and oestrid indices indicated conditions were too windy for insect activity; however, data are missing for the early afternoon, so no indices were calculated for the warmest part of the day (Fig. 3, Table C-1). The formation of large groups and their coastal distribution, along with movements of caribou from inland toward the coast, indicates that caribou were responding to insects.

Survey 6—2 August 1997

Survey weather conditions were favorable, with scattered to broken clouds at 3,000 m, variable winds from 1.5 to 4.7 mps from the northwest switching to the east (310° to 80°), and a temperature of 18°C to 19°C from 1100 to 1600 AST. Thirty-five groups of 86 total caribou were recorded in the study area (Fig. A-6, Table 2, Table A-1). Fifty-six percent of caribou were in a single bull-dominated group of 48 total caribou on the coast near Bullen Point (Fig. A-6, Table A-1, Attribute 15). The remaining 44 percent of caribou were in 34 groups of one or two caribou scattered throughout the study area (Fig. A-6, Table A-1). Mean group size was 2.5 ± 2.63 95CI. Bulls predominated in the study area at 59 percent of classified caribou, with 77 percent of caribou classified.

Sixty-four percent of caribou were within 1 km of the Beaufort Sea coast (Fig. 5, Table 4). Two groups along the coast were both moving toward the east. The remaining 36 percent of

caribou were scattered inland from 1 to 26 km from the coast (Fig. 5, Table 4). A few of these caribou were responding to oestrid fly harassment; one cow caribou (Attribute 1) was exhibiting a head down stance on a gravel river bar, a bull caribou (Attribute 12) was also in a head down stance in the center of a large frost boil, and another caribou (Attribute 13) was running erratically (Fig. A-6, Table A-1). Daily mean temperature was 13.7°C and daily mean wind speed was 2.6 mps (Table C-1). Insect activity indices indicate conditions were suitable for mosquito activity for five hours and oestrid activity for seven hours on 2 August (Fig. 3, Table C-1). Based on the behaviors observed, caribou appeared to be responding to oestrid fly harassment.

Survey 7—7 August 1997

Survey weather conditions were marginal with overcast to broken ceilings from 400 m to 1500 m, moderate wind from 2.3 to 3.9 mps from the east and southeast (90° to 120°), and a temperature of 10°C to 11°C from 1700 to 2200 AST. During the latter part of the survey, skies began to darken and sightability was reduced from good to fair. Few caribou were in the study area. Only 11 groups of 16 total caribou were sighted. Activity was recorded for seven of the 11 groups, and all seven groups were feeding. All caribou groups consisted of either one or two animals, and mean group size was 1.5 ± 0.31 95CI.

Sixty-two percent of caribou were from 19 to 27 km from the Beaufort Sea coast, and the remaining 38 percent were within 3 km of the coast (Fig. 5, Table 4). Daily mean temperature was 9.9°C and daily mean wind speed was 2.7 mps (Table C-1). Mosquito and oestrid activity indices indicate that conditions were too cool and windy for insect activity. Caribou did not appear to be responding to insect harassment.

Other Large Mammals

A single brown bear was observed within the study area of 16 June 1997 (Table 2, Fig. A-8, Table A-2). No brown bears were observed within the study area during the 6 or 11 July surveys. Two brown bears were observed within the study area on 17 July, one of these was near the Canning River, and the other was within a riparian area of a small stream in the southwestern corner of the study area. No brown bears were observed within the study area during the 22 July, 2 August, or 7 August surveys.

No moose or muskoxen were observed during any of the seven surveys conducted during 1997.

DISCUSSION

During the seven systematic strip–transect surveys conducted in the study area, 16 to 1,666 caribou were recorded (Table 2). Population size of the CAH in 1997 has been estimated at

20,000 (19,730 count), with an estimated 12,000 (11,766 count) in the eastern segment of the CAH (Elizabeth Lenart, 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, 0 to 8 percent of the CAH and 0 to 14 percent of the eastern segment of the CAH used the Bullen Point to Staines River Study Area during the post-calving period.

Sex and age composition of classified caribou varied between surveys, but for all post-calving surveys, combined ratios were 19 bulls/100 cows and 62 calves/100 cows (Table 2). CAH composition in October 1996 was 61 bulls/cows and 67 calves/100 cows (Hicks 1997). Some unclassified caribou may have been small bulls, contributing to an underestimate of the number of bulls within the study area. However, many unclassified caribou are also likely to be non-maternal cows, shifting the bias in the opposite direction. These biases do not account for the large difference between the ratio of bulls to cows within the study area compared to the CAH composition. It is more likely that there is segregation between bull groups and cow/calf groups, and more cow/calf-dominated groups were within the study area during the 1997 surveys (Table 2, Table A-1).

The lack of bulls within the study area during the calving period survey on 16 June is consistent with earlier studies showing that bulls do not arrive at the coast until post-calving in early July (Whitten and Cameron 1980; Jakimchuk et al. 1987). Aerial survey results from west of Bullen Point to the Sagavanirktok River indicate that bulls were more common there at 100 bulls/100 cows during the post-calving season (Noel 1998).

During the late calving period survey on 16 June 1997, caribou distribution was more uniform within the study area than during any of the post-calving period surveys (Fig. 5, Table 4). The area between Bullen Point and the Canning River has been used consistently by calving caribou in most years since at least 1969 (Pollard et al. 1992). Calf production within the study area on 16 June 1997 was 70 calves/100 cows (Table 2). Calf production (pregnancy rate) for the CAH during calving period surveys in June 1997 between the Colville River and the Canning River was 72 calves/100 cows (Hicks 1997).

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 (Curatolo et al. 1982; White et al. 1975; Dau 1986; Pollard et al. 1996b). From the patterns of caribou density by 1-km intervals from the Beaufort

Sea coast between 6 July and 22 July 1997 (Fig. 4), it appears that caribou shifted toward coastal insect-relief habitats during this period, and most caribou had left the study area by 2 August. 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 fluctuated from 7.7 caribou per group during the calving period, increased from 48.1 to 145.2 from 6 July to 17 July during the post-calving period, and then declined from 57.4 to 1.5 from 22 July to 7 August.

The number of caribou within 2 km of the Beaufort Sea coast increased from 625 caribou on 11 July to 1,159 on 17 July and 1,178 on 22 July (Fig. 5, Table 4). This pattern may represent caribou movement from inland foothill locations toward coastal insect-relief habitat. The increase also may represent eastward movement of coastal caribou groups from areas to the west. However, group movements were not monitored during this period so no conclusions can be drawn.

The formation of large caribou groups and their coastal distribution within this period suggest that caribou were experiencing mosquito harassment (White et al. 1975; Dau 1986; Johnson and Lawhead 1989). Unfortunately, the incompleteness of midday hourly weather records prevents accurate modeling of insect activity during most of the post-calving period.

Brown bears were recorded within the study area on 16 June and 17 July. On 17 July, the two bears recorded were within riparian habitats of the Canning River and an unnamed creek. No muskoxen or moose were recorded in the study area.

SUMMARY

- During the calving period survey on 16 June 1997, 81 groups with 624 total caribou were recorded (Table 2). Early productivity was 70 calves/100 cows, and was similar to CAH productivity of 72 calves/100 cows for the 1997 calving period (Hicks 1997).
- Six post-calving surveys were completed in 1997, with a total of 4,458 caribou in 105 groups recorded (Table 2, Table A-1). The number of caribou within the Bullen Point to Staines River study area ranged from 1,666 on 22 July 1997 to 16 on 7 August. The 1,666 caribou in the study area on 22 July represents 8 percent of the CAH based on fall 1997 population estimates (Table 2, Elizabeth Lenart, pers. comm.). Mean caribou group size increased from 48.1 to 145.2 during 6 July to 17 July and then decreased from 57.4 on 22 July to 1.5 on 7 August (Table 2).

- The ratio of 19 bulls/100 cows within the Bullen Point to Staines River Study Area was lower than for the CAH in 1996 with 61 bulls/100 cows (Table 2, Hicks 1997). This is likely due to the preponderance of cow/calf-dominated groups within the study area (Table A-1). More bull groups were west of the study area between the Sagavanirktok River and Bullen Point with 100 bulls/100 cows for three surveys combined (Noel 1998).
- Caribou distribution relative to the Beaufort Sea coast likely was related to parasitic insect activity, but missing weather data impaired the models used to predict mosquito and oestrid activity (Figures 3 and 5).
- Three brown bears were recorded in the Bullen Point to Staines River study area during the seven systematic surveys; one on 16 June and two on 17 July 1997 (Table 2). No muskoxen or moose were observed within the study area.

LITERATURE CITED

- ASCC (Alaska State Climate Center). 1997. Deadhorse Weather Station, January to September 1997 data. Environment and Natural Resources Institute, University of Alaska Anchorage, Anchorage, AK.
- Cameron, R.D., and K.R. Whitten. 1978. Third interim report on the effects of the Trans-Alaska Pipeline on caribou movements. Spec. Rep. No. 22. Joint State/Fed. Fish and Wildl. Advis. Team, Anchorage, AK. 29p.
- Cameron, R.D., E.A. Lenart, D.J. Reed, K.R. Whitten, and W.T. Smith. 1995. Abundance and movements of caribou in the oil field complex near Prudhoe Bay, Alaska. *Rangifer*, 15(1):3-7.
- Cameron, R.D., W.T. Smith, and S.G. Fancy. 1989. Distribution and productivity of the Central Arctic Caribou herd in relationship to petroleum development. Alaska Dept. Fish and Game. Fed. Aid in Wildl. Rest. Prog. Rep. Projs. W-23-1 and W-23-2, Study 3.35. Juneau, AK. 52 p.
- Carruthers, R.D., R.D. Jakimchuk, and S.H. Ferguson. 1984. The relationship between the Central Arctic caribou herd and the Trans-Alaska Pipeline. Report to Alyeska Pipeline Service Co. by Renewable Resources Consulting Services Ltd., Sidney, B.C. 207pp.
- Caughley, G. 1977. Sampling in aerial survey. *J. Wildl. Manage.* 41:605-615.
- Clough, N.K., P.C. Patton, and A.C. Christiansen (eds). 1987. Arctic National Wildlife Refuge, Alaska, coastal plain resource assessment-Report and recommendation to the Congress of the United States and final environmental impact statement: Washington, D.C., U.S. Fish and Wildlife Service, U.S. Geological Survey, and Bureau of Land Management, v.1. 208 pp.

- Curatolo, J.A., S.M. Murphy, and M.A. Robus. 1982. Caribou responses to the pipeline/road complex in the Kuparuk oil field, Alaska, 1981. Final Rep. by Alaska Biological Research, Inc., Fairbanks, AK. for ARCO Alaska, Inc., Anchorage, AK 62 p.
- Dau, J.R. 1986. Distribution and behavior of barren-ground caribou in relation to weather and parasitic insects. M.S. thesis, University of Alaska, Fairbanks. 149pp.
- Gavin, A. 1983. Spring and Summer Caribou Movements, Prudhoe Bay, Alaska, 1969–1979. Report to Atlantic Richfield Co., Los Angeles. 50pp.
- Hicks, M.V., editor. 1997. Annual Performance Report of Survey-Inventory Activities, 1 July 1996 - 30 June 1997. Caribou. Fed. Aid in Wildl. Rest. Prog. Rep., Proj. W-24-5, Study 3.0. Alaska Dept. Fish and Game, Juneau, AK.
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- Jakimchuk, R.D., S.H. Ferguson, and L.G. Sopuck. 1987. Differential habitat use and sexual segregation in the Central Arctic caribou herd. *Can. J. Zool.* 65:534–541.
- Johnson, C.B., and B.E. Lawhead. 1989. Distribution, movements, and behavior of caribou in the Kuparuk oil field, summer 1988. Final report to ARCO Alaska, Inc., and Kuparuk River Unit, Anchorage, by Alaska Biological Research, Inc., Fairbanks. 71pp.
- Lawhead, B.E., and J.A. Curatolo. 1984. Distribution and Movements of the Central Arctic Herd, Summer 1983. Final report by Alaska Biological Research, Fairbanks, AK to ARCO Alaska, Inc., Anchorage, AK. 52pp.
- Noel, L.E. 1998. Large mammal distribution in the Badami Study Area, summer 1997. Final report to BP Exploration (Alaska) Inc., by LGL Alaska Research Associates, Inc., Anchorage, AK. 19 pp. + App.
- Pennycuik, C.J., and D. Western. 1972. An investigation of some sources of bias in aerial transect sampling of large mammal populations. *E. Afr. Wildl. J.* 10:175–191.
- Pollard, R.H., and L.E. Noel. 1994. Large mammal surveys of the Badami Development area, summer 1994. Final Report to BP Exploration (Alaska) Inc., by LGL Alaska Research Associates, Inc., Anchorage, AK.
- Pollard, R.H., and L.E. Noel. 1995. Distribution of large mammals between the Sagavanirktok and Staines Rivers, Alaska, Summer 1995. Final Report to BP Exploration (Alaska) Inc., by LGL Alaska Research Associates, Inc.
- Pollard, R.H., M.E. Miller, and R.C. Wilkinson. 1992. Caribou distribution in the Prudhoe Bay oil field, summer 1990. Final report prepared by LGL Alaska Research Associates, Inc., Anchorage, AK for BP Exploration (Alaska) Inc., Anchorage, AK. 41 p. + maps.
- Pollard, R.H., W.B. Ballard, L.E. Noel, and M.A. Cronin. 1996a. Summer distribution of caribou, *Rangifer tarandus granti*, in the area of the Prudhoe Bay oil field, Alaska, 1990–1994. *Can. Field-Nat.* 110:659-674.
- Pollard, R.H., W.B. Ballard, L.E. Noel, and M.A. Cronin. 1996b. Parasitic insect abundance and microclimate of gravel pads and tundra within the Prudhoe Bay oil field, Alaska, in relation to use by caribou. *Can. Field-Nat.* 110:649-658.
- Roby, D.D. 1978. Behavioral patterns of barren-ground caribou of the Central Arctic Herd adjacent to the Trans-Alaska Pipeline. M.S. thesis, Univ. Alaska, Fairbanks. 200 p.

- Russell, D.E., A.M. Martell, and W.A.C. Nixon. 1993. Range ecology of the Porcupine caribou herd. *Rangifer*, Special Issue No. 8:3-167.
- Smith, M.D. 1996. Distribution, abundance, and quality of forage within the summer range of the Central Arctic Caribou Herd. M.S. thesis, University of Alaska Fairbanks, Fairbanks, AK. 43 pp.
- Walker, D.A., and W. Acevedo. 1987. Vegetation and a Landsat-derived land cover map of the Beechey Point Quadrangle, Arctic Coastal Plain, Alaska. CRREL Report 87-5, U.S. Army Corps of Engineers, Cold Regions Research and Engineering Laboratory, Hanover, NH.
- White, R.G., B.R. Thomson, T. Skogland, S.J. Person, D.E. Russell, D.F. Holleman, and J.R. Luick. 1975. Ecology of caribou at Prudhoe Bay, Alaska. Pages 151-187. *In*: J. Brown (ed.). Ecological investigations of the tundra biome in the Prudhoe Bay region, Alaska. Biol. Pap., Univ. Alaska, Spec. Rep. No. 2. Univ. Alaska, Fairbanks.
- Whitten, K.R., and R.D. Cameron. 1980. Composition and harvest of the Porcupine caribou herd. Fed. Aid in Wildl. Rest. Prog. Rep., Projs. W-17-9, W-17-10, W-17-11, W-17-21. Job 3.23R. Alaska Dept. Fish and Game, Juneau, AK.
- Whitten, K.R., and R.D. Cameron. 1985. Distribution of caribou calving in relation to the Prudhoe Bay oil field. Pp. 35-39 *in* A.M. Martell and D.E. Russell, editors. Proc. 1st No. Amer. Caribou Workshop. Can. Wildl. Serv. Spec. Publ., Ottawa.

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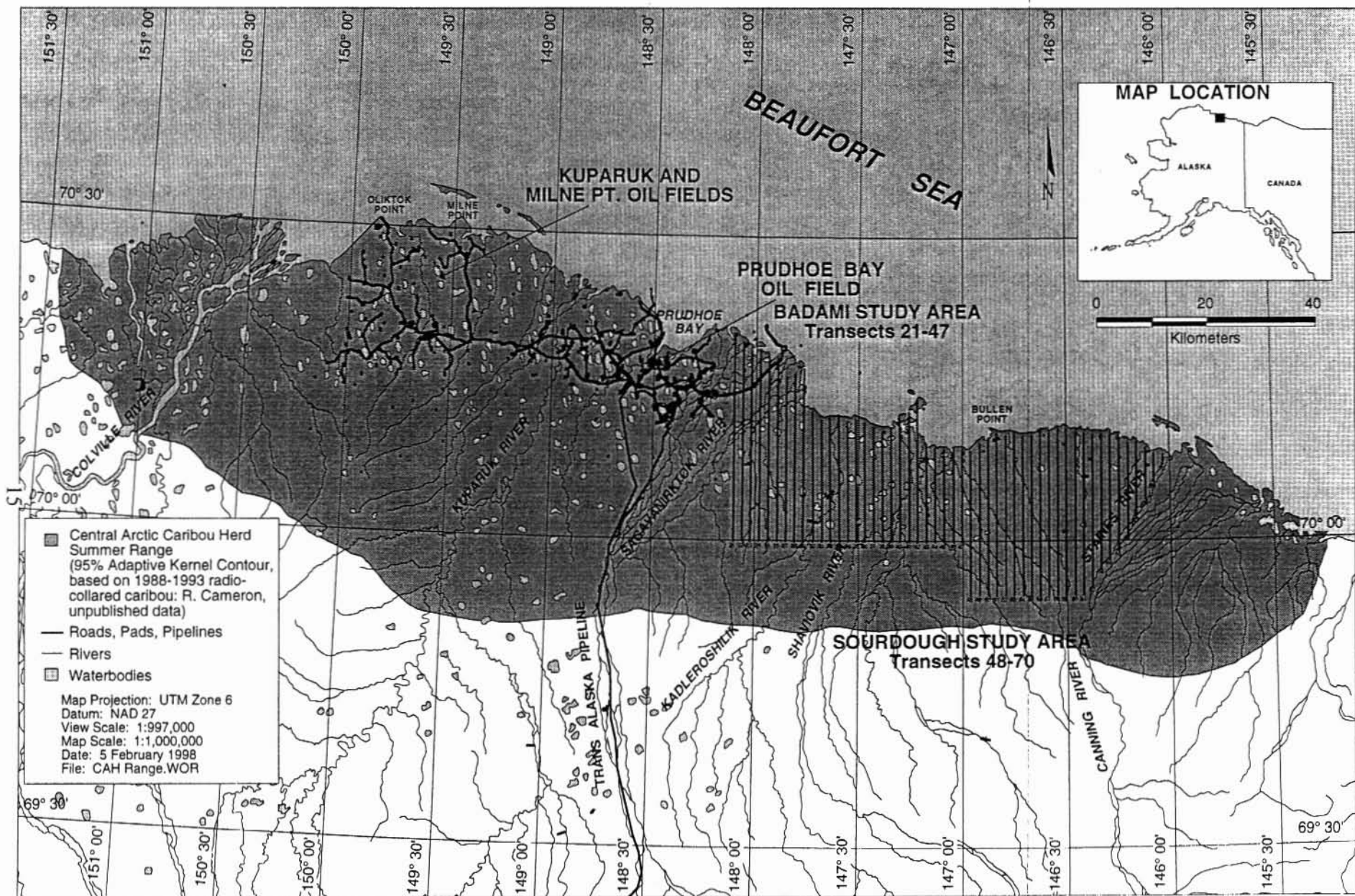


Figure 1. Study area survey transects within the summer range of the Central Arctic Caribou Herd and location of the Prudhoe Bay, Kuparuk, and Milne Point oil fields, Arctic Coastal Plain, Alaska (Smith 1996).

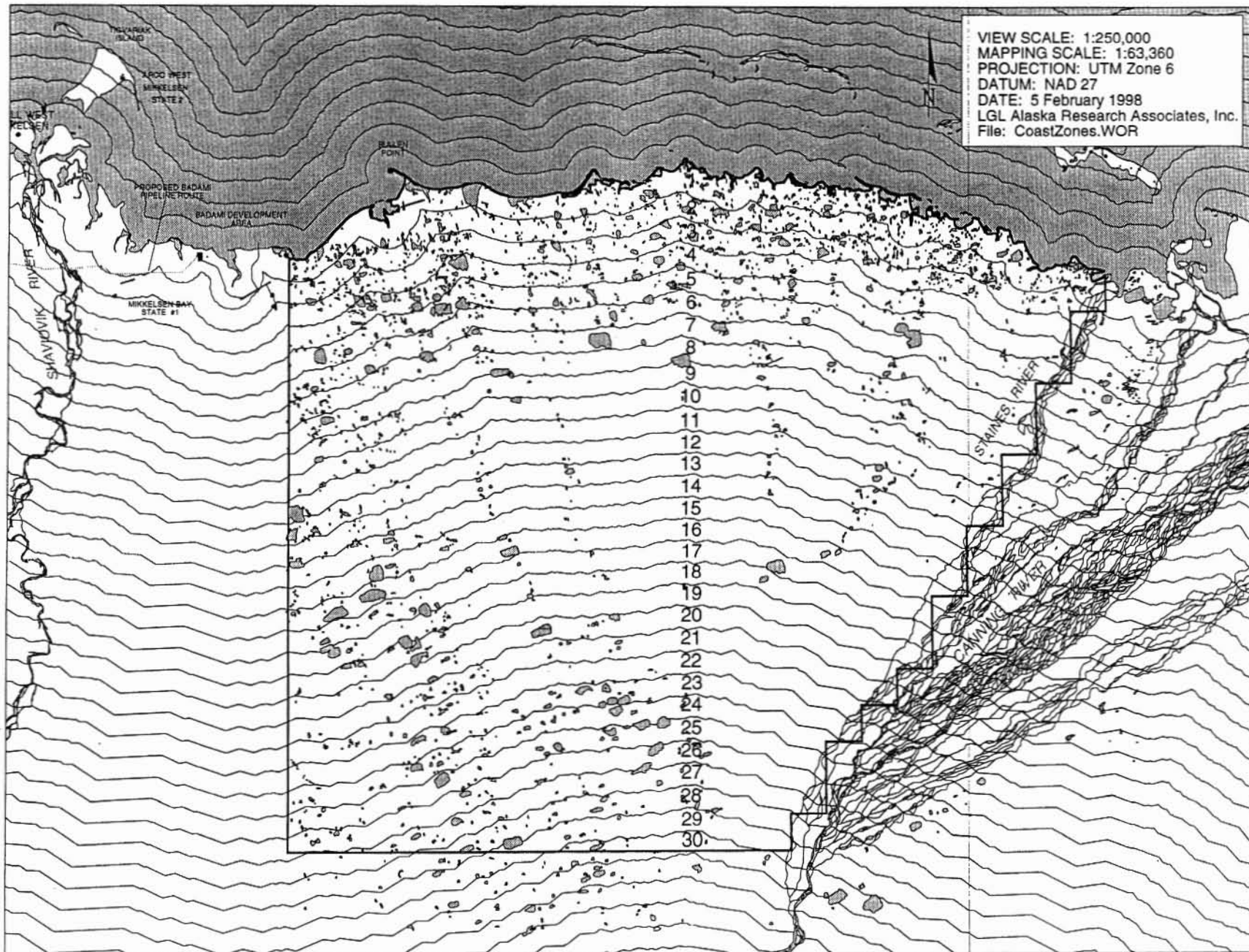


Figure 2. One kilometer intervals from the Beaufort Sea coast in the Bullen Point to Staines River study area, Alaska.

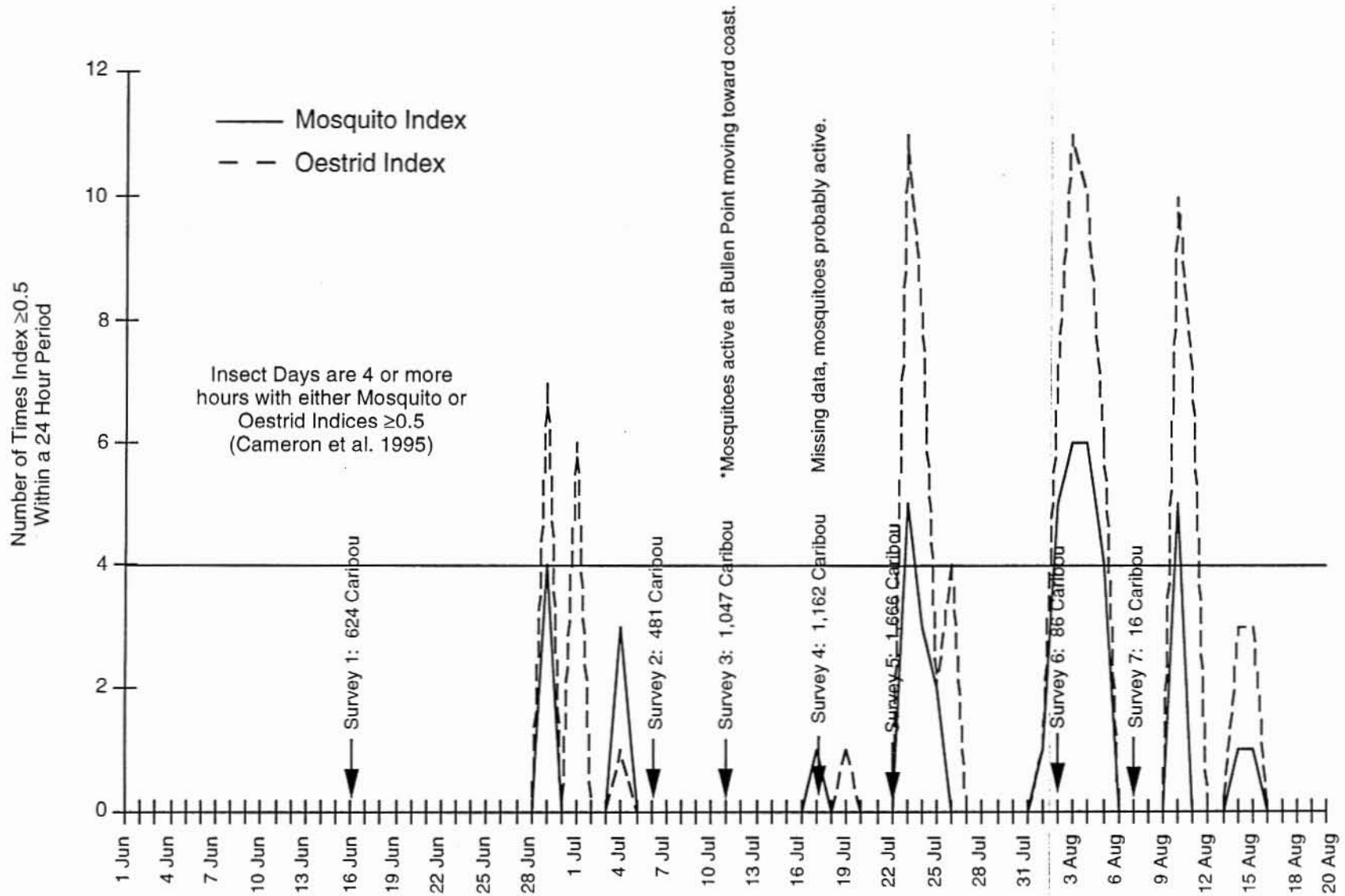


Figure 3. Mosquito and oestrid activity indices (Russell et al. 1993) based on hourly weather data collected at the Deadhorse Weather Station (ASCC 1997) and 1997 aerial caribou survey dates, Bullen Point to Staines River study area, Alaska.

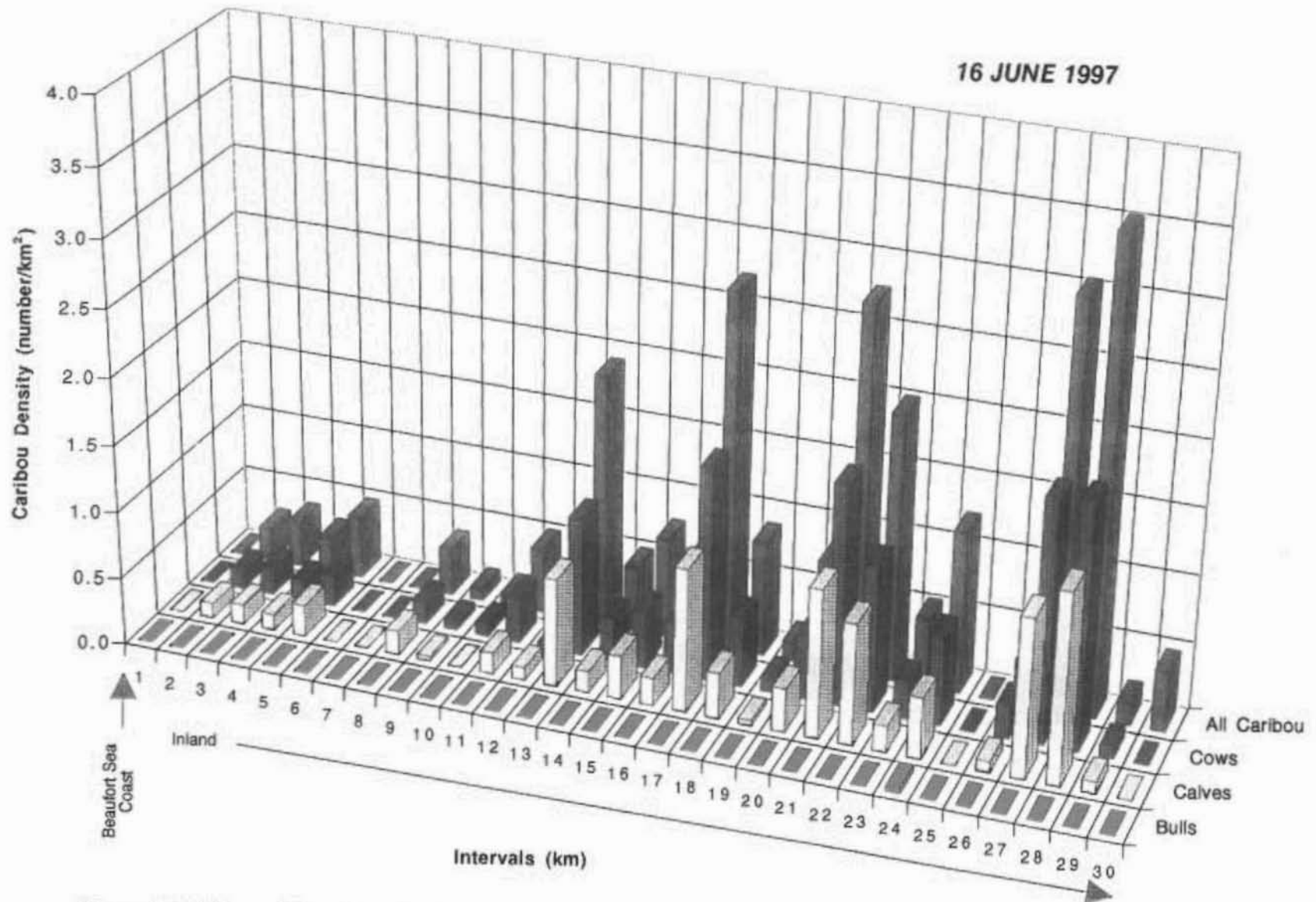


Figure 4. Calving period caribou density by 1-km intervals from the Beaufort Sea coast on 16 June 1997, Bullen Point to Staines River Study Area, Alaska.

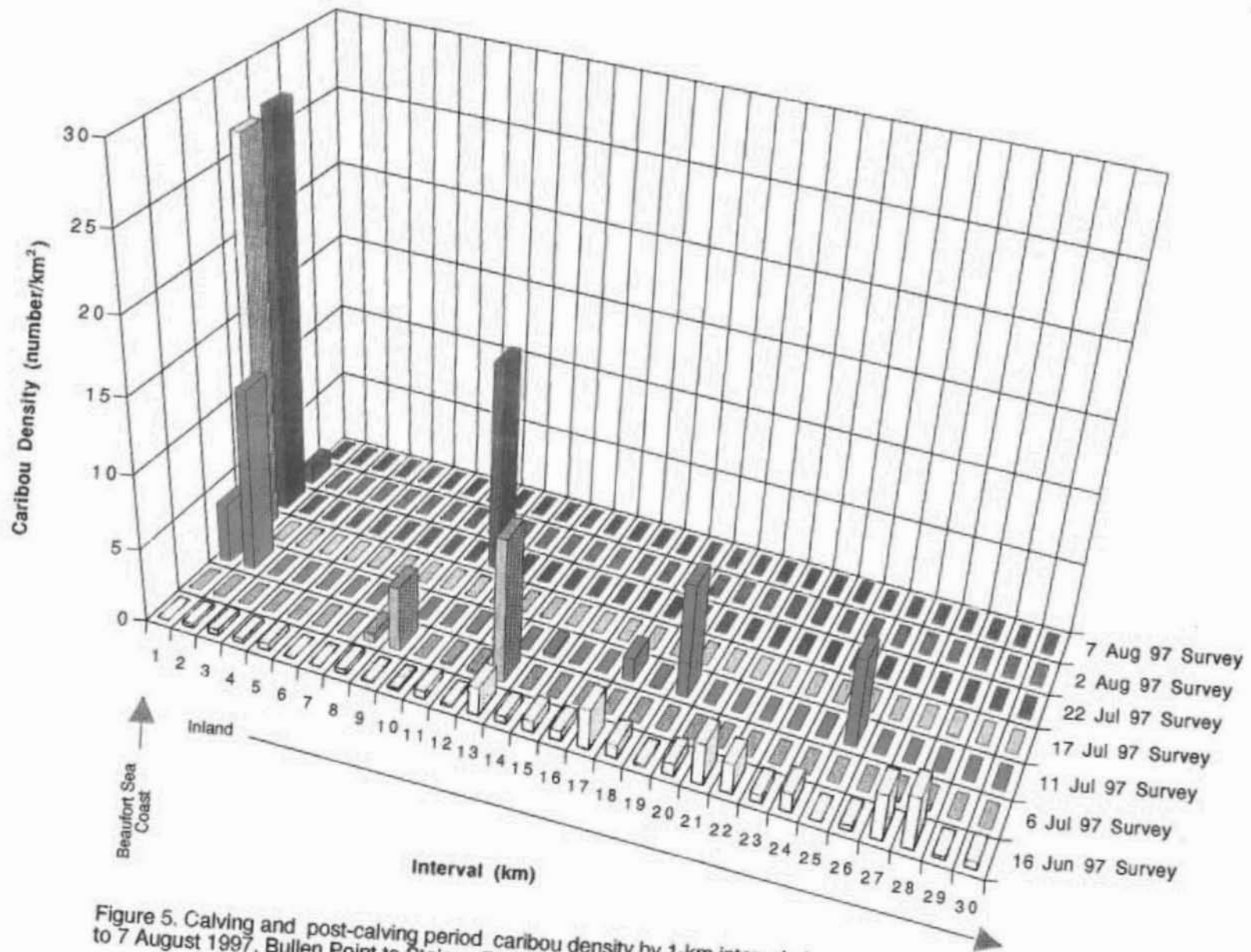


Figure 5. Calving and post-calving period caribou density by 1-km intervals from the Beaufort Sea coast from 16 June to 7 August 1997, Bullen Point to Staines River Study Area, Alaska.

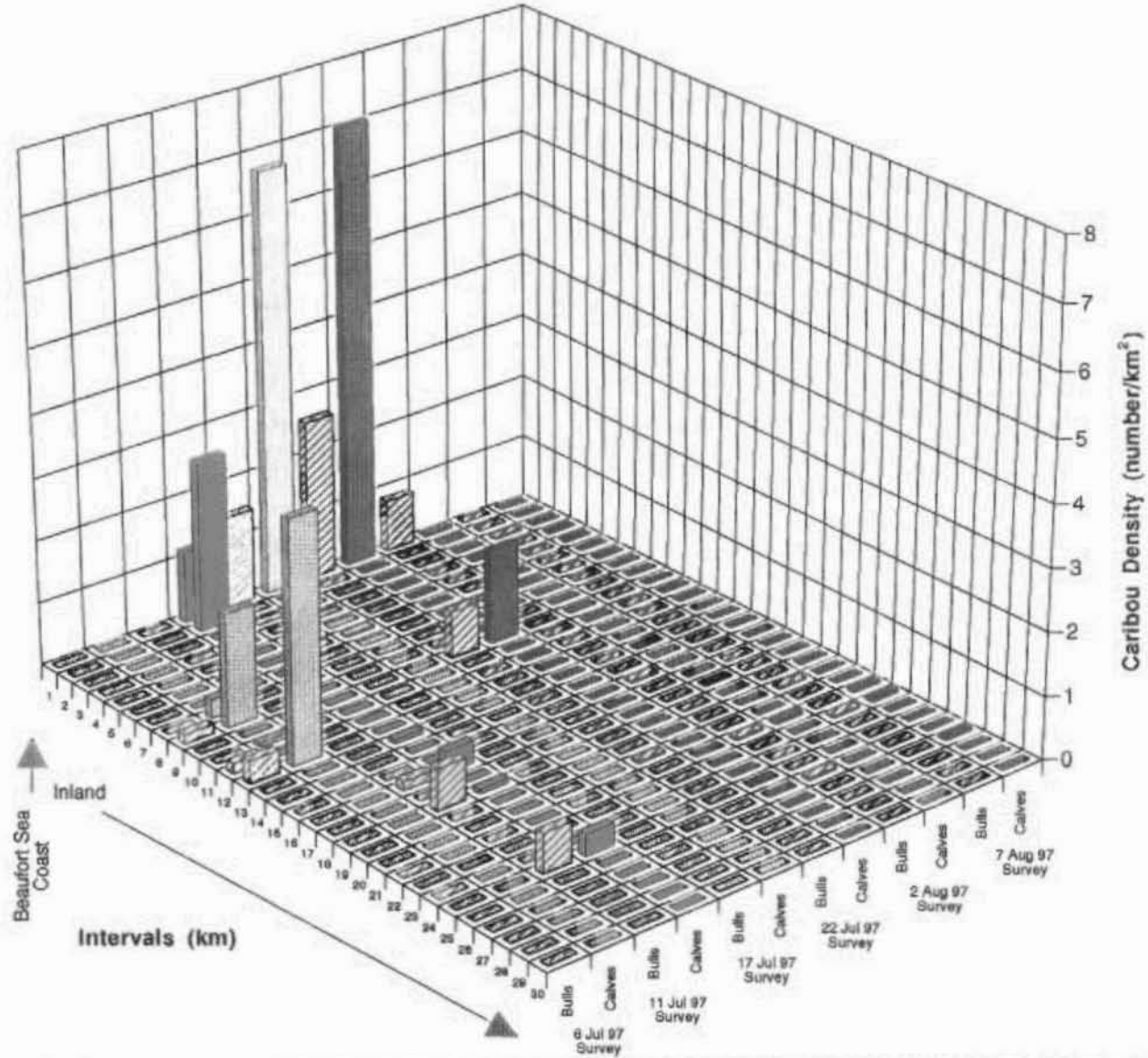


Figure 6. Comparison of post-calving period bull and calf caribou density by 1-km intervals from the Beaufort Sea coast from 6 July to 7 August 1997, Bullen Point to Staines River Study Area, Alaska.

Table 1. Area calculated from 1:63,360 base map files for 1-km distance intervals from the Beaufort Sea coast, Bullen Point to Staines River 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	48.04	4.64	9.7	43.40	90.3	5.4
2	39.78	3.59	9.0	36.18	91.0	4.4
3	38.23	2.81	7.4	35.41	92.6	4.3
4	37.72	2.67	7.1	35.04	92.9	4.2
5	37.17	2.71	7.3	34.46	92.7	4.1
6	35.43	1.69	4.8	33.74	95.2	4.0
7	35.39	1.58	4.5	33.81	95.5	4.0
8	35.33	0.99	2.8	34.34	97.2	3.9
9	34.12	0.76	2.2	33.36	97.8	3.8
10	33.61	0.40	1.2	33.21	98.8	3.8
11	33.50	0.63	1.9	32.87	98.1	3.7
12	33.17	0.75	2.3	32.42	97.7	3.7
13	31.76	0.64	2.0	31.12	98.0	3.5
14	31.71	0.47	1.5	31.24	98.5	3.5
15	31.70	0.72	2.3	30.99	97.7	3.5
16	30.65	1.55	5.1	29.10	94.9	3.4
17	30.04	0.97	3.2	29.06	96.8	3.4
18	30.10	0.81	2.7	29.29	97.3	3.4
19	29.86	0.79	2.6	29.07	97.4	3.3
20	28.52	0.78	2.7	27.74	97.3	3.2
21	28.40	0.37	1.3	28.03	98.7	3.2
22	26.95	0.30	1.1	26.66	98.9	3.0
23	26.70	1.12	4.2	25.58	95.8	3.0
24	25.26	1.13	4.5	24.12	95.5	2.8
25	25.14	1.29	5.1	23.85	94.9	2.8
26	24.94	0.84	3.4	24.10	96.6	2.8
27	20.07	0.64	3.2	19.43	96.8	2.2
28	15.51	0.70	4.5	14.81	95.5	1.7
29	12.24	0.33	2.7	11.91	97.3	1.4
30	4.56	0.15	3.3	4.41	96.7	0.5
Study Area Total	895.59	36.84		858.75		100

Table 2. Sex and age classifications for caribou and brown bear observed during sytematic aerial surveys in the Bullen Point to Staines River study area, Alaska, 16 June to 7 August 1997.

Survey	Date	Bulls	Cows	Calves	Unclass	Total	Number of Groups	Mean Group Size
<u>Caribou Sightings</u>								
1	16 Jun 97	1	358	251	14	624	81	7.7
2	6 Jul 97	21	223	192	45	481	10	48.1
3	11 Jul 97	38	326	172	511	1047	12	87.2
4	17 Jul 97	64	504	293	301	1162	8	145.2
5	22 Jul 97	139	554	355	618	1666	29	57.4
6	2 Aug 97	39	25	2	20	86	35	2.5
7	7 Aug 97	3	3	3	7	16	11	1.5
Totals		305	1993	1268	1516	5082	186	
<u>Brown Bear Sightings</u>								
1	16 Jun 97	0	0	0	1	1	1	1.0
4	17 Jul 97	0	0	0	2	2	2	1.0

Table 3. Summary of caribou observations just south of the Bullen Point to Staines River study area, Alaska, during systematic aerial surveys, 16 June to 7 August 1997.

Survey	Date	Bulls	Cows	Calves	Unclass	Total	Number of Groups
1	16 Jun 97	0	28	19	2	49	6
3	11 Jul 97	250	0	0	50	300	1
6	2 Aug 97	0	1	0	1	0	2

Table 4. Caribou density (numbers/km²) by sex/age class for 1-km intervals from the Beaufort Sea coast in the Bullen Point to Staines River study area, Alaska, 16 June to 7 August 1997.

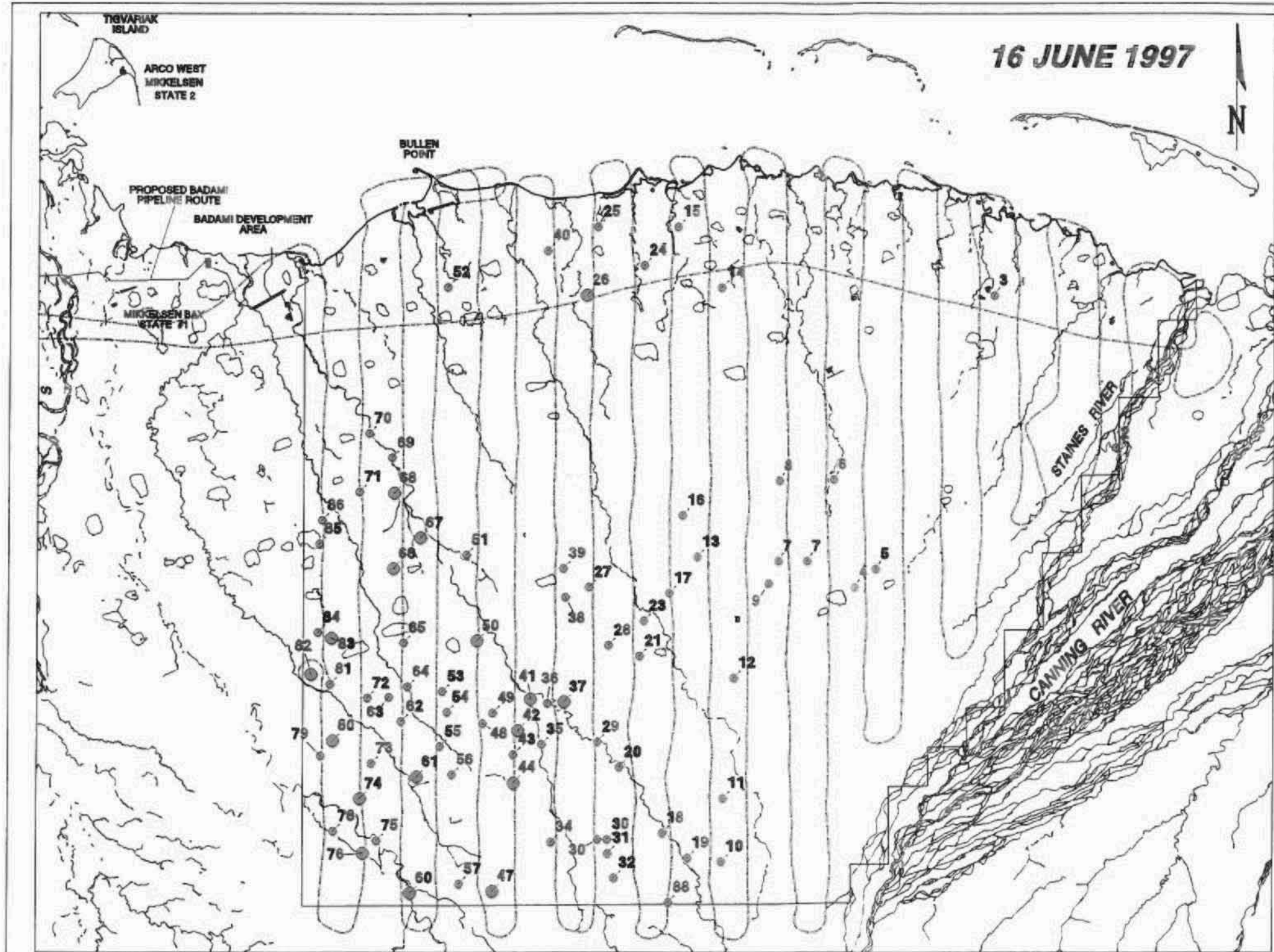
Interval	One-Kilometer Intervals																														Area of Caribou Totals
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
Area	43.4	36.18	35.4	35	34.5	33.7	33.8	34.3	33.4	33.2	32.9	32.4	31.1	31.2	31	29.1	29.1	29.3	29.1	27.7	28	26.7	25.6	24.1	23.9	24.1	19.4	14.8	11.9	4.41	858.75
Survey 1--16 June (Calving Period)																															
Bull Density	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	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bull Number	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(1)	(0)	(0)	(0)	(0)	(0)	(0)	1
Cow Density	0.00	0.14	0.20	0.14	0.23	0.00	0.00	0.17	0.06	0.09	0.33	0.03	1.03	0.32	0.42	0.38	1.58	0.51	0.10	0.47	1.64	1.09	0.27	0.66	0.00	0.25	1.80	1.82	0.08	0.00	
Cow Number	(0)	(5)	(7)	(5)	(8)	(0)	(0)	(6)	(2)	(3)	(11)	(1)	(32)	(10)	(13)	(11)	(46)	(15)	(3)	(13)	(46)	(29)	(7)	(16)	(0)	(6)	(35)	(27)	(1)	(0)	358
Calf Density	0.00	0.11	0.14	0.11	0.23	0.00	0.00	0.17	0.03	0.00	0.15	0.09	0.80	0.16	0.32	0.21	1.07	0.34	0.03	0.32	1.11	0.90	0.20	0.46	0.00	0.08	1.18	1.42	0.08	0.00	
Calf Number	0	4	5	4	8	0	0	6	1	0	5	3	25	5	10	6	31	10	1	9	31	24	5	11	0	2	23	21	1	0	251
Unclass Density	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.07	0.03	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.00	0.00	0.05	0.27	0.00	0.45	
Unclass Number	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	1	0	0	0	0	0	1	1	0	0	1	4	0	2	14
Total Density	0.00	0.25	0.34	0.26	0.48	0.00	0.00	0.35	0.09	0.09	0.49	0.12	1.90	0.48	0.74	0.65	2.68	0.85	0.14	0.79	2.75	1.99	0.51	1.20	0.00	0.33	3.04	3.51	0.17	0.45	
Total Number	0	9	12	9	16	0	0	12	3	3	16	4	59	15	23	19	78	25	4	22	77	53	13	29	0	8	59	52	2	2	624
Survey 2--6 July (Post-Calving Period)																															
Bull Density	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.00	0.00	0.15	0.35	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	
Bull Number	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(5)	(0)	(0)	(5)	(11)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	21
Calf Density	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.29	1.80	0.00	0.06	0.00	3.86	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	
Calf Number	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(10)	(60)	(0)	(2)	(0)	(120)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	192
All Caribou Density	0.00	0.08	0.00	0.00	0.00	0.03	0.00	0.58	4.35	0.00	0.15	0.15	9.87	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
All Caribou Number	(0)	(3)	(0)	(0)	(0)	(1)	(0)	(20)	(145)	(0)	(5)	(5)	(301)	(0)	(0)	(0)	(0)	(0)	(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	481
Survey 3--11 July (Post-Calving Period)																															
Bull Density	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	0.14	0.00	0.65	0.00	0.00	0.00	0.00	0.00	0.63	0.00	0.00	0.00	0.00	0.00	0.00	
Bull Number	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(4)	(0)	(19)	(0)	(0)	(0)	(0)	(0)	(15)	(0)	(0)	(0)	(0)	(0)	(0)	38
Calf Density	1.15	2.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.34	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.34	0.00	0.00	0.00	0.00	0.00	0.00	
Calf Number	(50)	(100)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(2)	(0)	(0)	(10)	(0)	(2)	(0)	(0)	(0)	(0)	(0)	(8)	(0)	(0)	(0)	(0)	(0)	(0)	172
All Caribou Density	4.03	12.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.22	0.00	0.00	1.51	0.07	7.67	0.00	0.04	0.00	0.00	0.04	5.95	0.00	0.00	0.00	0.00	0.00	
All Caribou Number	(175)	(450)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(2)	(0)	(0)	(7)	(0)	(0)	(44)	(2)	(223)	(0)	(1)	(0)	(0)	(1)	(142)	(0)	(0)	(0)	(0)	(0)	1047
Survey 4--17 July (Post-Calving Period)																															
Bull Density	1.47	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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Bull Number	(64)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	64
Calf Density	6.73	0.00	0.00	0.00	0.00	0.03	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	0.00	0.00	0.00	
Calf Number	(292)	(0)	(0)	(0)	(0)	(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	293
All Caribou Density	26.71	0.00	0.00	0.00	0.00	0.06	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	0.07	0.00	0.00	
All Caribou Number	(1159)	(0)	(0)	(0)	(0)	(2)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(1)	(0)	(0)	1162

Table 4. continued.

Interval	One-Kilometer Intervals																														Area of 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	25	26	27	28	29	30			
Survey 5--22 July (Post-Calving Period)																																	
Bull Density	2.58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	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
Bull Number	(112)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(1)	(25)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	139
Calf Density	7.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.51	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	0.00	
Calf Number	(305)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(50)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	355	
All Caribou Density	27.10	0.06	0.03	0.00	0.03	0.03	0.06	0.00	0.03	14.33	0.06	0.03	0.00	0.00	0.00	0.03	0.03	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
All Caribou Number (1176)	(2)	(1)	(0)	(1)	(1)	(2)	(0)	(1)	(476)	(2)	(1)	(0)	(0)	(0)	(0)	(1)	(1)	(0)	(0)	(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	1666		
Survey 6--2 August (Post-Calving Period)																																	
Bull Density	0.83	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	0.03	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00		
Bull Number	(36)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(1)	(0)	(0)	(0)	(0)	(0)	(1)	(0)	(0)	(0)	(0)	(1)	(0)	(0)	(0)	(0)	(0)	39	
Calf Density	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	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00		
Calf Number	(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(1)	(0)	(0)	(0)	(0)	(1)	(0)	(0)	(0)	(0)	(0)	2		
All Caribou Density	1.27	0.03	0.03	0.03	0.00	0.03	0.03	0.06	0.03	0.03	0.03	0.03	0.00	0.00	0.03	0.00	0.07	0.10	0.04	0.11	0.19	0.08	0.04	0.04	0.04	0.04	0.00	0.00	0.00	0.00	0.00		
All Caribou Number	(55)	(1)	(1)	(1)	(0)	(1)	(1)	(2)	(1)	(1)	(1)	(1)	(0)	(0)	(1)	(0)	(2)	(3)	(1)	(3)	(5)	(2)	(1)	(1)	(1)	(1)	(0)	(0)	(0)	(0)	86		
Survey 7--7 August (Post-Calving Period)																																	
Bull Density	0.00	0.00	0.03	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	0.04	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Bull Number	(0)	(0)	(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(1)	(0)	(0)	(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	3		
Calf Density	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	0.04	0.04	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00			
Calf Number	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(1)	(1)	(1)	(0)	(0)	(0)	(1)	(0)	(0)	(0)	(0)	3			
All Caribou Density	0.07	0.03	0.06	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	0.07	0.00	0.08	0.16	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00			
All Caribou Number	(3)	(1)	(2)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(2)	(0)	(2)	(4)	(0)	(0)	(0)	(2)	(0)	(0)	(0)	(0)	16			

APPENDIX A.

1997 DATA



16 JUNE 1997

Figure A-1

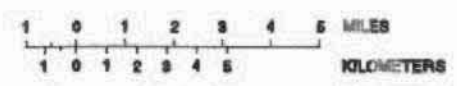
Distribution of caribou during the calving period, 16 June 1997, in the Sourdough study area, Alaska.

Caribou Group Size

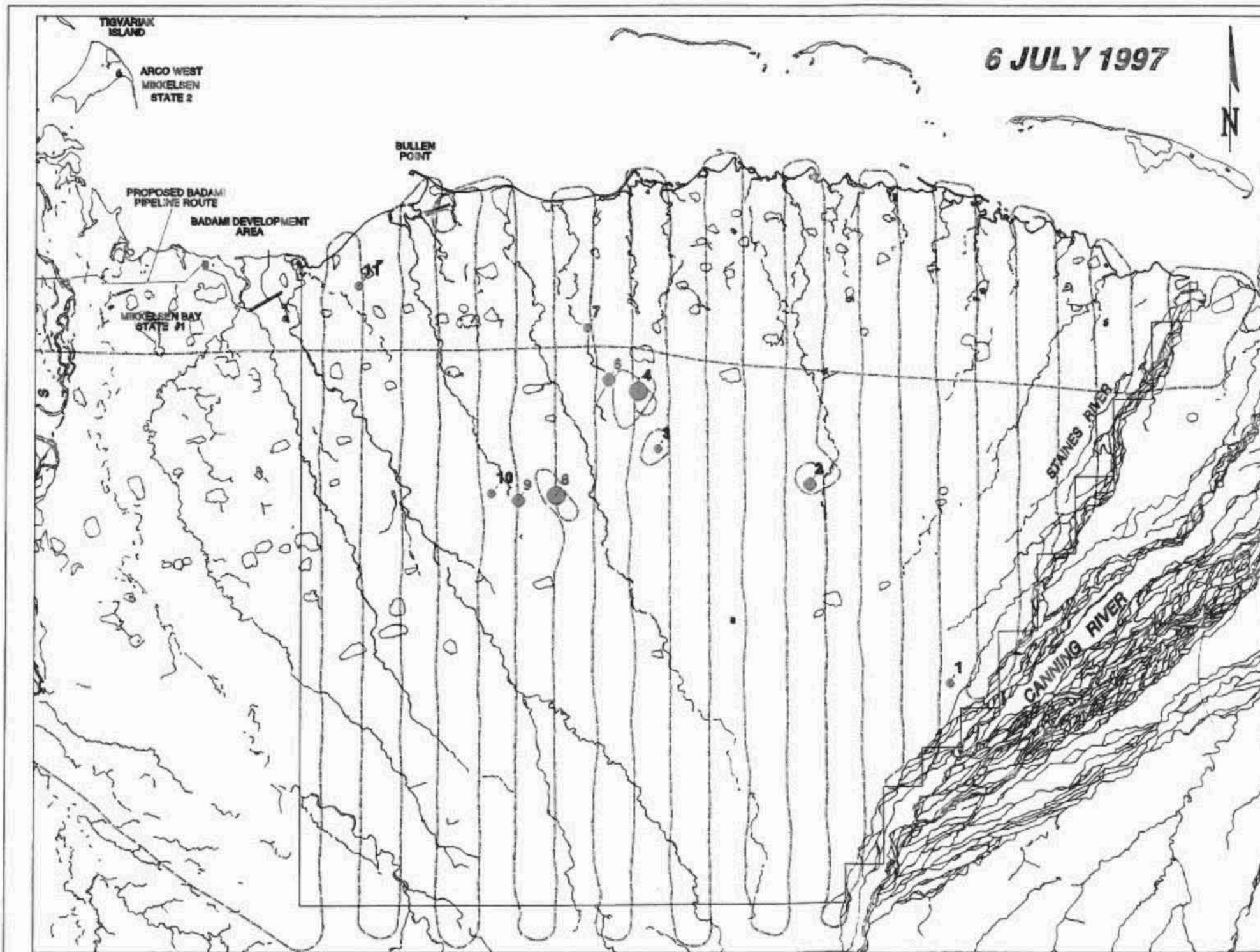
Group Size	Groups
<10	64
10 to 100	17
101 to 1000	0
>1000	0

15 Caribou Group Attribute Number (see Table A-1)

- Rivers, Coastline, and Lakes (>20 acres)
- Roads, Pipelines, and Study Area Boundary
- Flightpath
- Oil Production and Service Facilities



Map Projection: UTM Zone 6
 Datum: NAD 27
 View Scale: 1:200,000
 Mapping Scale: 1:63,360
 Date: 17 December 1997
 Prepared by: LGL Alaska Research Associates
 File: Sourdough Mammals Fig A-1.WOR



6 JULY 1997

Figure A-2

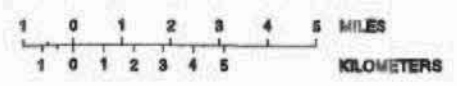
Distribution of caribou during the post-calving period, 6 July 1997, in the Sourdough study area, Alaska.

Caribou Group Size Groups

•	<10	5
●	10 to 100	3
●	101 to 1000	2
●	>1000	0

15 Caribou Group Attribute Number (see Table A-1)

— Rivers, Coastline, and Lakes (>20 acres)
 — Roads, Pipelines, and Study Area Boundary
 - - - Flightpath
 ■ Oil Production and Service Facilities



Map Projection: UTM Zone 6
 Datum: NAD 27
 View Scale: 1:200,000
 Mapping Scale: 1:63,360
 Date: 17 December 1997
 Prepared by: LGL Alaska Research Associates
 File: Sourdough Mammals Fig A-2.WOR

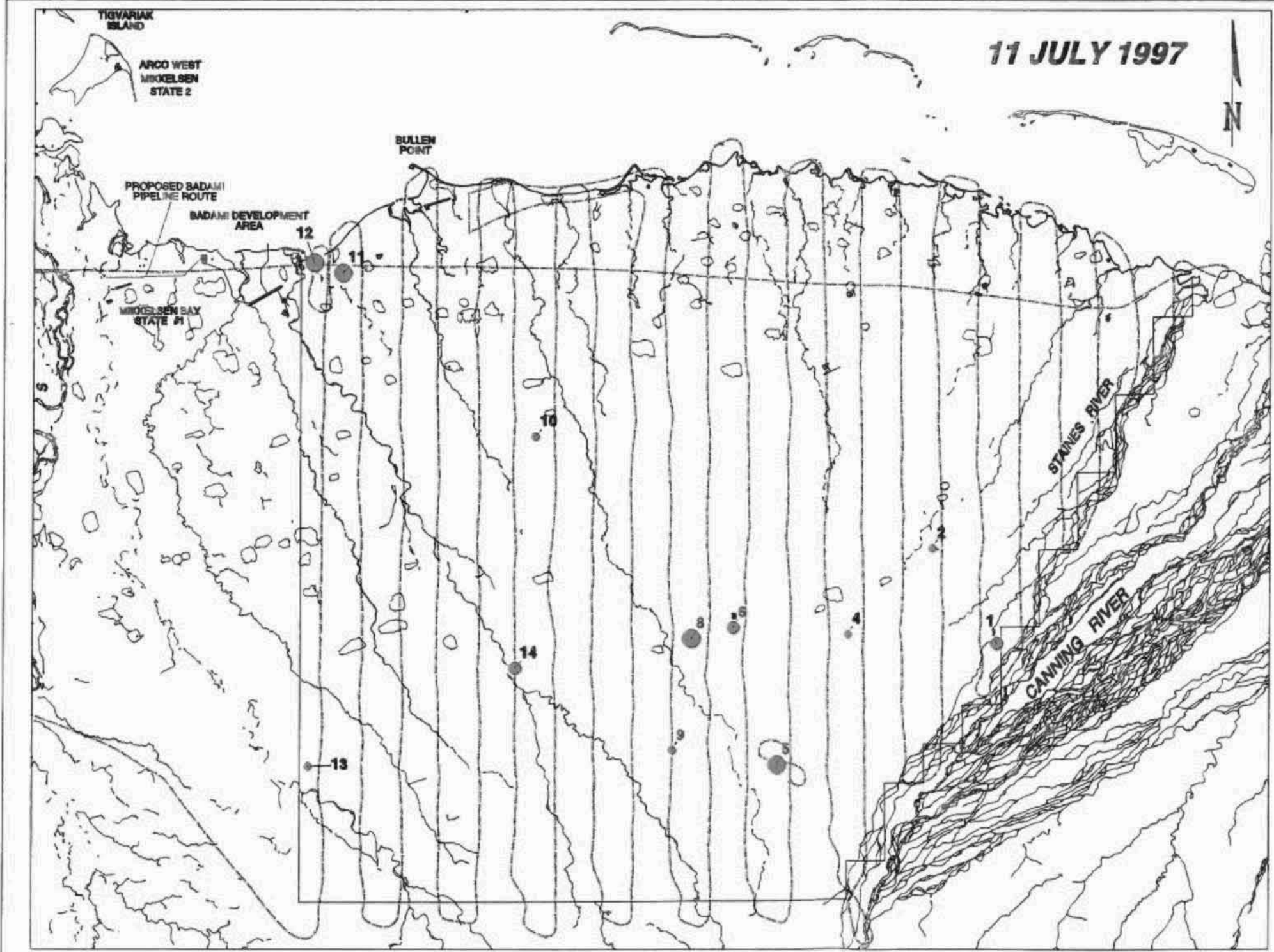


Figure A-3
 Distribution of caribou during the post-calving period, 11 July 1997, in the Sourdough study area, Alaska.

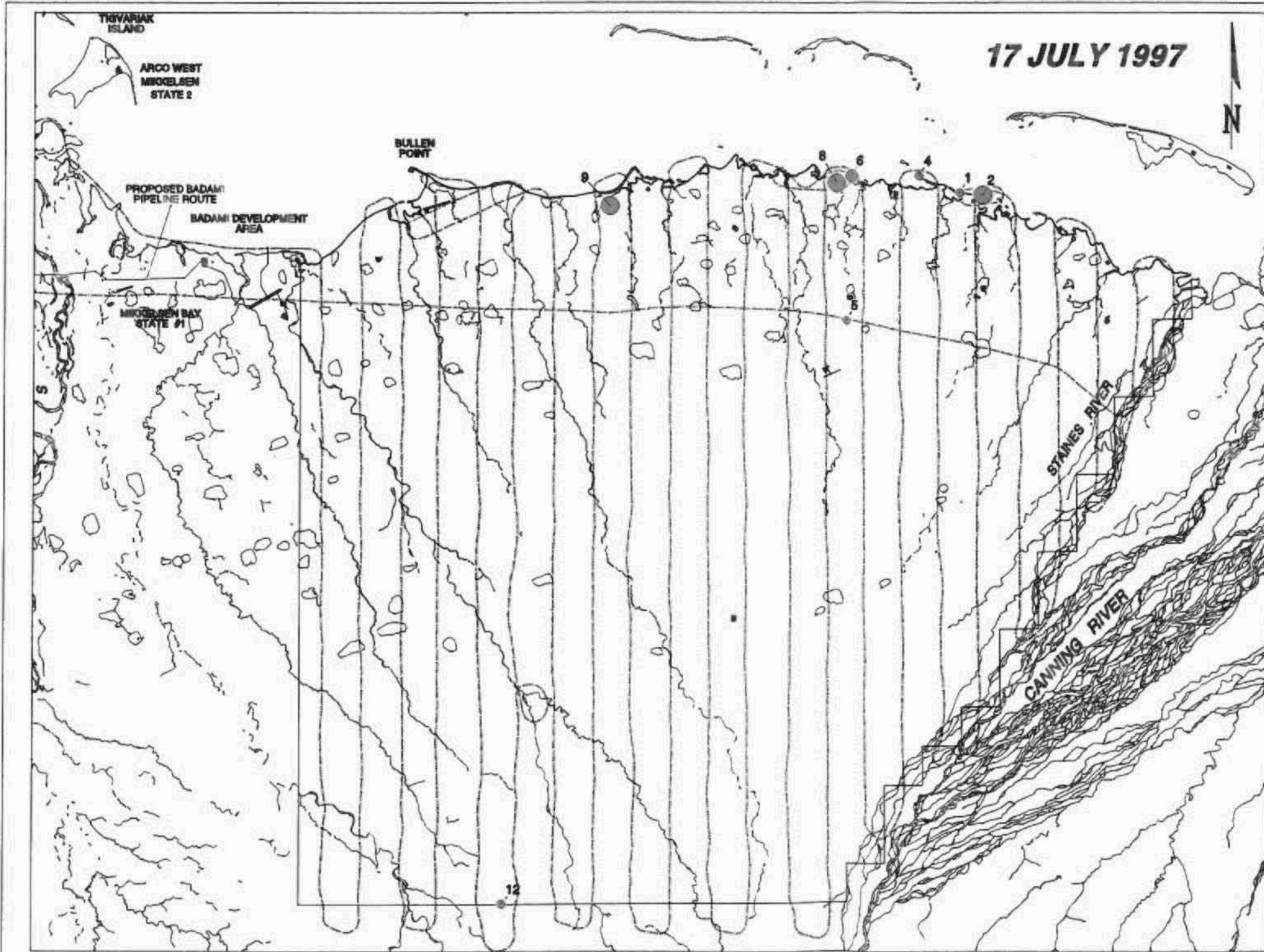
Caribou Group Size	
Symbol	Groups
•	<10 5
●	10 to 100 3
●	101 to 1000 4
●	>1000 0

15 Caribou Group Attribute Number (see Table A-1)

— Rivers, Coastline, and Lakes (>20 acres)
 — Roads, Pipelines, and Study Area Boundary
 - - - Flightpath
 ■ 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: 17 December 1997
 Prepared by: LGL Alaska Research Associates
 File: Sourdough Mammals Fig A-3.WOR



17 JULY 1997

Figure A-4

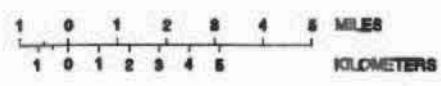
Distribution of caribou during the post-calving period, 17 July 1997, in the Sourdough study area, Alaska.

Caribou Group Size
Groups

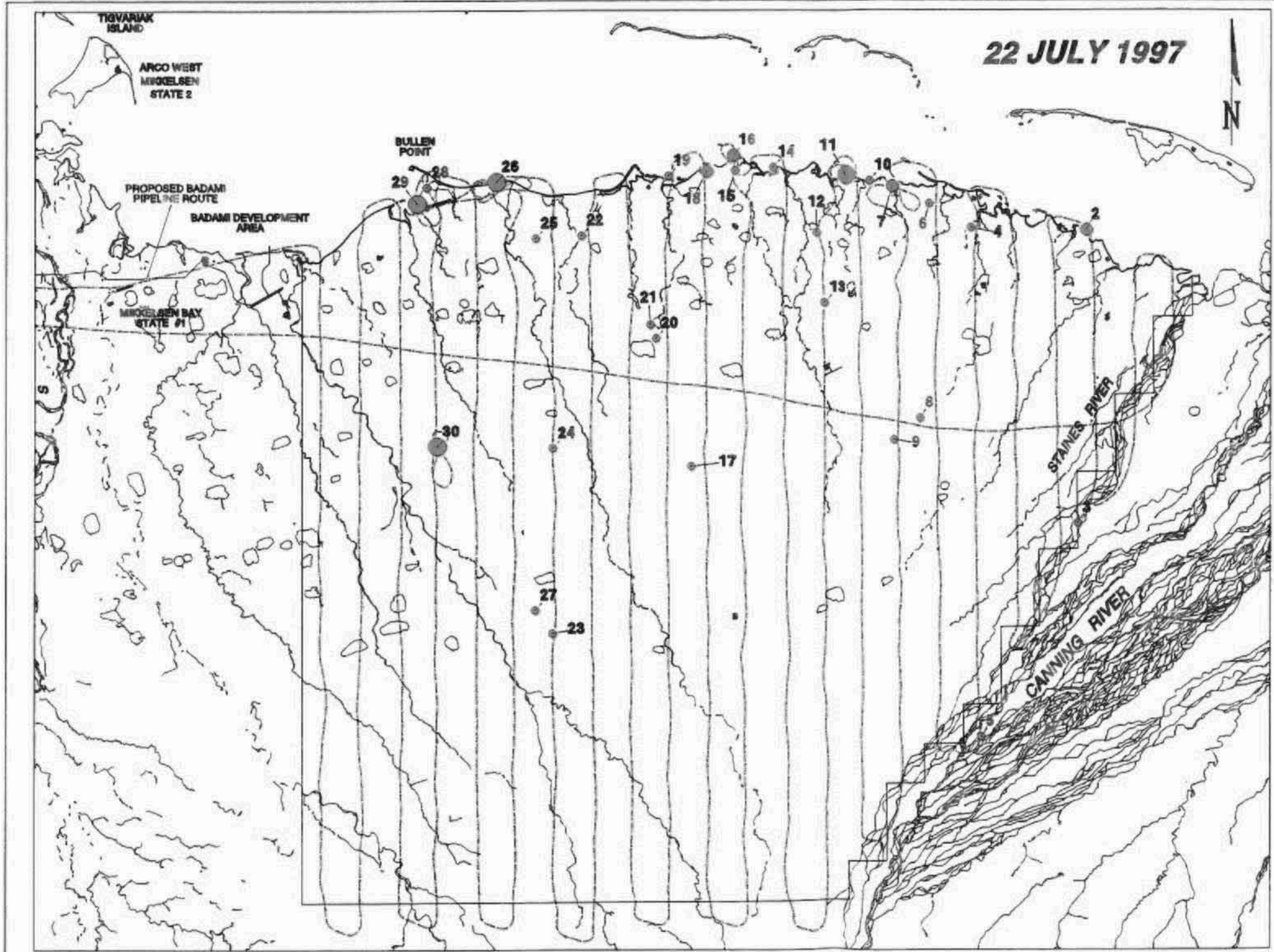
- <10 4
- 10 to 100 1
- 101 to 1000 3
- >1000 0

15 Caribou Group
Attribute Number
(see Table A-1)

- Rivers, Coastline, and Lakes (>20 acres)
- Roads, and Study Area Boundary
- Flightpath
- Oil Production and Service Facilities



Map Projection: UTM Zone 6
 Datum: NAD 27
 View Scale: 1:200,000
 Mapping Scale: 1:63,360
 Date: 17 December 1997
 Prepared by: LGL Alaska Research Associates
 File: Sourdough Mammals Fig A-4.WOR



22 JULY 1997

Figure A-5

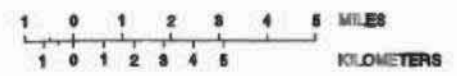
Distribution of caribou during the post-calving period, 22 July 1997, in the Sourdough study area, Alaska.

Caribou Group Size Groups

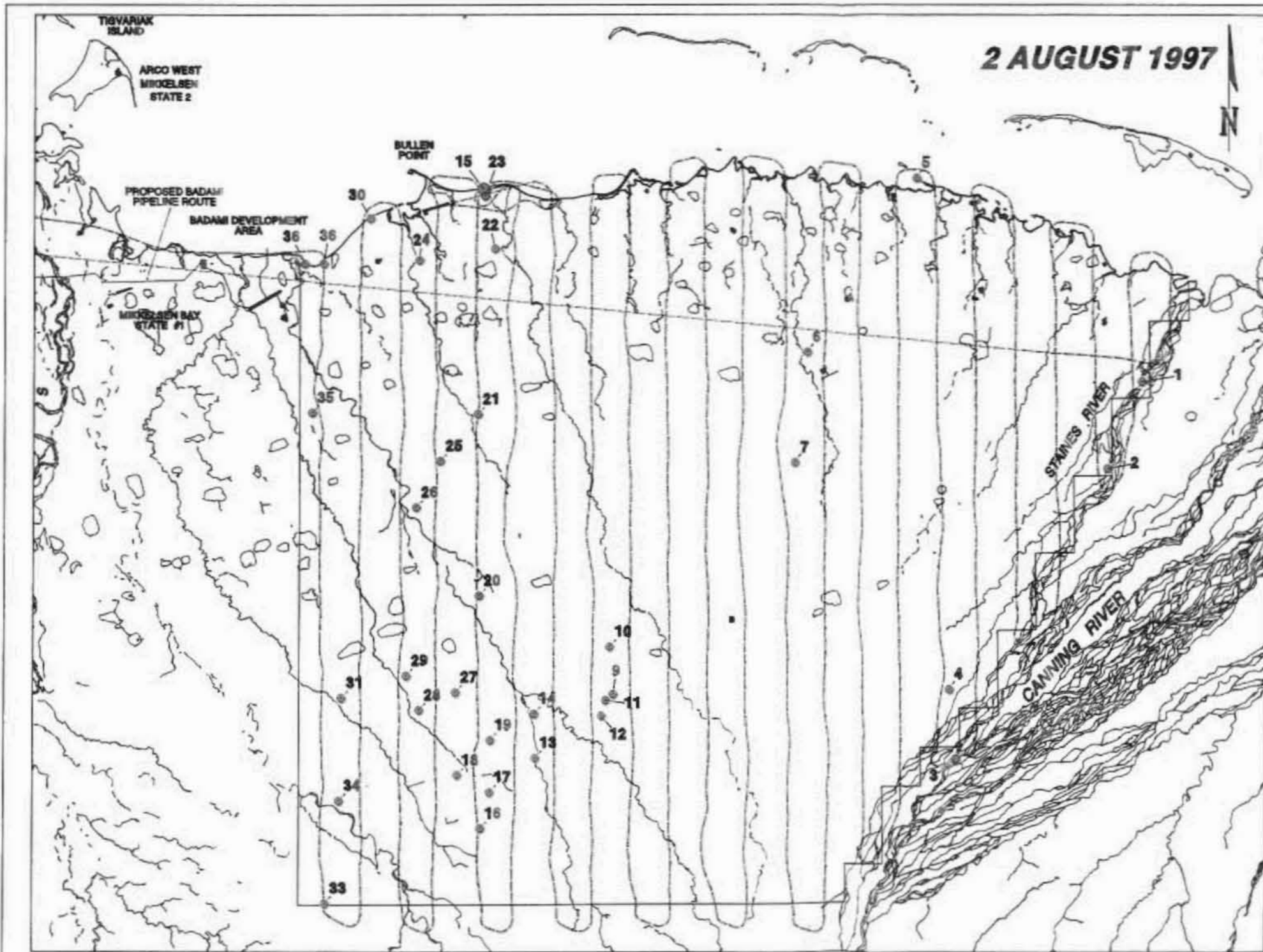
•	<10	21
●	10 to 100	4
●	101 to 1000	4
●	>1000	0

15 Caribou Group Attribute Number (see Table A-1)

- Rivers, Coastline, and Lakes (>20 acres)
- Roads, and Study Area Boundary
- - - Flightpath
- Oil Production and Service Facilities



Map Projection: UTM Zone 6
 Datum: NAD 27
 View Scale: 1:200,000
 Mapping Scale: 1:63,360
 Date: 18 December 1997
 Prepared by: LGL Alaska Research Associates
 File: Sourdough Mammals Fig A-5.WOR



2 AUGUST 1997

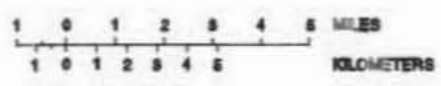
Figure A-6
 Distribution of caribou during the post-calving period, 2 August 1997, in the Sourdough study area, Alaska.

Caribou Group Size

Group Size	Number of Groups
<10	34
10 to 100	1
101 to 1000	0
>1000	0

15 Caribou Group Attribute Number (see Table A-1)

— Rivers, Coastline, and Lakes (>20 acres)
 — Roads, and Study Area Boundary
 - - - Flightpath
 ■ Oil Production and Service Facilities



Map Projection: UTM Zone 6
 Datum: NAD 27
 View Scale: 1:200,000
 Mapping Scale: 1:63,360
 Date: 18 December 1997
 Prepared by: LGL Alaska Research Associates
 File: Sourdough Mammals Fig A-6.WOR

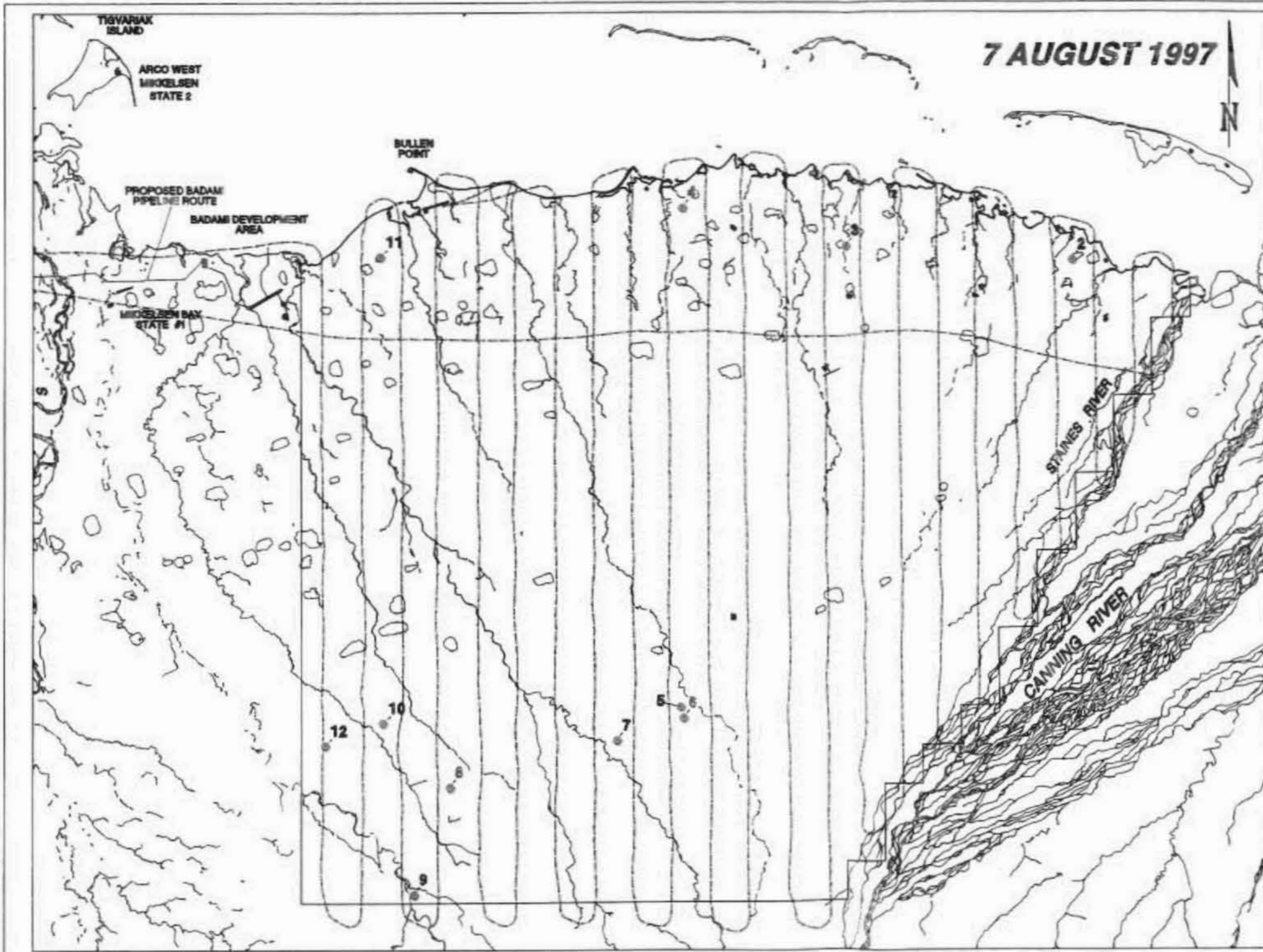


Figure A-7

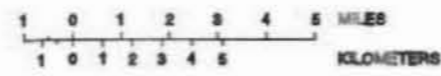
Distribution of caribou during the post-calving period, 7 August 1997, in the Sourdough study area, Alaska.

Caribou Group Size Groups

•	<10	11
●	10 to 100	0
●	101 to 1000	0
●	>1000	0

15 Caribou Group Attribute Number (see Table A-1)

- Rivers, Coastline, and Lakes (>20 acres)
- Roads, and Study Area Boundary
- - - Flightpath
- Oil Production and Service Facilities



Map Projection: UTM Zone 6
 Datum: NAD 27
 View Scale: 1:200,000
 Mapping Scale: 1:63,360
 Date: 18 December 1997
 Prepared by: LGL Alaska Research Associates
 File: Sourdough Mammals Fig A-7.WOR

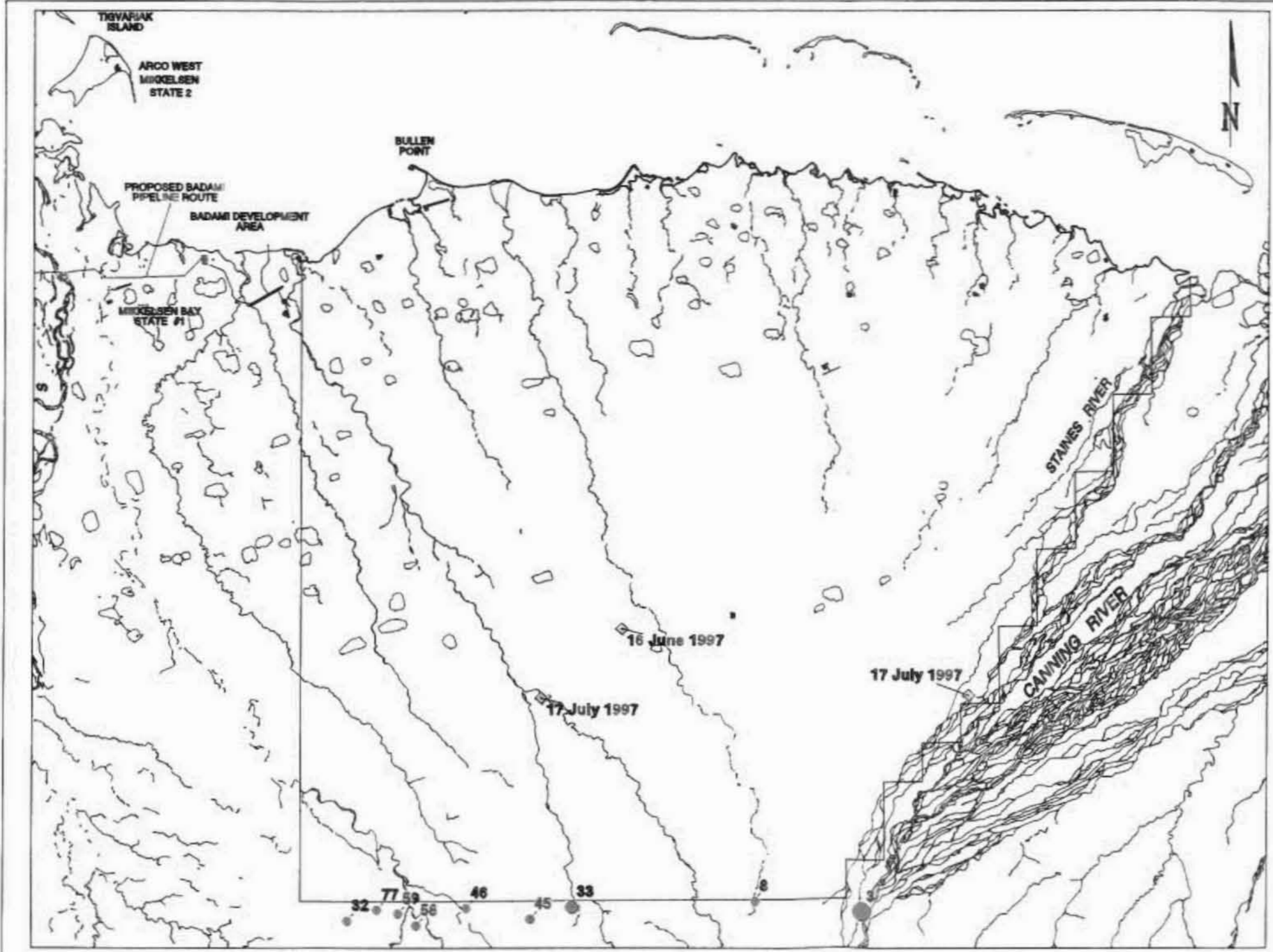
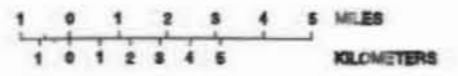


Figure A-8

Brown bear and caribou sightings, 16 June to 7 August 1997, in or near the Sourdough study area, Alaska.

- Caribou Group Size**
- | | |
|---|-----------------|
| | Groups |
| • | <10 7 |
| ● | 10 to 100 1 |
| ● | 101 to 1000 1 |
| ● | >1000 0 |
- 15 Caribou Group Attribute Number (see Table A-3)
- ◇ Brown Bear Sighting (see Table A-2)

- Rivers, Coastline, and Lakes (>20 acres)
- Roads, and Study Area Boundary
- Flightpath
- Oil Production and Service Facilities



Map Projection: UTM Zone 6
 Datum: NAD 27
 View Scale: 1:200,000
 Mapping Scale: 1:63,360
 Date: 18 December 1997
 Prepared by: LGL Alaska Research Associates
 File: Sourdough Mammals Fig A-8.WOR

Table A-1. Caribou sightings in the Bullen Point to Staines River study area, Alaska, 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
146.103028	70.079638	06/16/97	13:20:50	1	2	ca	0	4	4	0	8
146.233675	70.137318	06/16/97	13:36:44	1	3	ca	0	5	3	0	8
146.388212	70.028446	06/16/97	13:58:40	1	4	ca	0	4	1	0	5
146.364926	70.035283	06/16/97	13:58:55	1	5	ca	0	1	0	0	1
146.411047	70.069085	06/16/97	14:09:15	1	6	ca	0	3	3	1	7
146.472555	70.038536	06/16/97	14:20:34	1	7	ca	0	5	4	0	9
146.440705	70.038490	06/16/97	14:20:34	1	7	ca	0	1	0	0	1
146.470762	70.068675	06/16/97	14:21:42	1	8	ca	0	0	0	1	1
146.483050	70.030115	06/16/97	14:32:25	1	9	ca	0	0	0	1	1
146.535901	69.926602	06/16/97	14:38:13	1	10	ca	0	1	0	0	1
146.533877	69.950048	06/16/97	14:39:05	1	11	ca	0	3	2	0	5
146.521883	69.994818	06/16/97	14:40:48	1	12	ca	0	2	1	0	3
146.560203	70.040312	06/16/97	14:42:30	1	13	ca	0	0	0	2	2
146.532778	70.141095	06/16/97	14:46:13	1	14	ca	0	3	3	0	6
146.579884	70.163988	06/16/97	14:49:16	1	15	ca	0	4	4	0	8
146.576127	70.055958	06/16/97	14:53:03	1	16	ca	0	2	1	0	3
146.590834	70.026760	06/16/97	14:54:02	1	17	ca	0	7	1	0	8
146.599247	69.937223	06/16/97	14:57:05	1	18	ca	0	6	0	0	6
146.571926	69.927968	06/16/97	14:57:24	1	19	ca	0	0	0	4	4
146.645665	69.961811	06/16/97	15:01:04	1	20	ca	0	2	0	1	3
146.623431	70.003209	06/16/97	15:02:38	1	21	ca	0	2	2	0	4
146.618744	70.016430	06/16/97	15:03:08	1	23	ca	0	1	0	0	1
146.617052	70.149687	06/16/97	15:08:09	1	24	ca	0	5	4	0	9
146.667325	70.164143	06/16/97	15:10:47	1	25	ca	0	1	0	0	1
146.679498	70.138776	06/16/97	15:11:38	1	26	ca	0	5	5	0	10
146.677774	70.029233	06/16/97	15:15:21	1	27	ca	0	1	0	0	1
146.656634	70.007380	06/16/97	15:16:06	1	28	ca	0	1	1	0	2
146.668928	69.971305	06/16/97	15:17:19	1	29	ca	0	5	4	0	9
146.668950	69.935042	06/16/97	15:18:33	1	30	ca	0	5	4	0	9
146.658476	69.935042	06/16/97	15:18:33	1	30	ca	0	2	1	0	3
146.657866	69.929855	06/16/97	15:18:44	1	31	ca	0	5	3	0	8
146.651548	69.920790	06/16/97	15:19:02	1	32	ca	0	1	1	0	2
146.719278	69.934136	06/16/97	15:21:14	1	34	ca	0	3	0	0	3
146.729029	69.970508	06/16/97	15:22:36	1	35	ca	0	0	0	1	1
146.722648	69.985759	06/16/97	15:23:11	1	36	ca	0	5	3	0	8
146.704586	69.986330	06/16/97	15:23:12	1	37	ca	0	12	8	0	20
146.703050	70.025497	06/16/97	15:24:40	1	38	ca	0	5	4	0	9
146.705401	70.036345	06/16/97	15:25:05	1	39	ca	0	1	1	0	2
146.722110	70.155449	06/16/97	15:29:33	1	40	ca	0	1	1	0	2
146.741000	69.987414	06/16/97	15:37:35	1	41	ca	0	15	10	0	25
146.754538	69.975721	06/16/97	15:37:58	1	42	ca	0	10	8	0	18
146.759590	69.966752	06/16/97	15:38:17	1	43	ca	0	2	2	0	4
146.759485	69.956185	06/16/97	15:38:38	1	44	ca	0	5	5	0	10
146.782149	69.916053	06/16/97	15:41:24	1	47	ca	0	21	18	0	39
146.793124	69.978379	06/16/97	15:43:46	1	48	ca	0	5	2	0	7
146.782021	69.982324	06/16/97	15:43:55	1	49	ca	0	4	3	0	7

Table A-1. Continued.

Longitude °W	Latitude °N	Date	TimeAST	Flight	Attribute	Species	Bulls	Cows	Calves	Unclass	Total
146.799079	70.009366	06/16/97	15:44:55	1	50	ca	0	6	4	0	10
146.810507	70.041635	06/16/97	15:46:09	1	51	ca	0	1	0	0	1
146.831387	70.142012	06/16/97	15:53:29	1	52	ca	0	1	1	0	2
146.836687	69.990425	06/16/97	15:58:31	1	53	ca	0	2	0	0	2
146.831524	69.982615	06/16/97	15:58:47	1	54	ca	0	1	0	0	1
146.839514	69.969844	06/16/97	15:59:12	1	55	ca	0	2	2	0	4
146.826606	69.959342	06/16/97	15:59:33	1	56	ca	0	1	1	0	2
146.818339	69.918828	06/16/97	16:00:56	1	57	ca	0	0	0	1	1
146.871115	69.915484	06/16/97	16:02:18	1	60	ca	0	22	18	0	40
146.864340	69.958552	06/16/97	16:03:55	1	61	ca	0	10	8	0	18
146.881454	69.979285	06/16/97	16:04:42	1	62	ca	0	2	1	0	3
146.894513	69.988333	06/16/97	16:05:04	1	63	ca	0	3	1	0	4
146.874700	69.992242	06/16/97	16:05:13	1	64	ca	0	3	3	0	6
146.878789	70.008642	06/16/97	16:05:50	1	65	ca	0	3	3	0	6
146.890159	70.036512	06/16/97	16:06:54	1	66	ca	0	7	4	0	11
146.860692	70.048100	06/16/97	16:07:20	1	67	ca	0	29	22	0	51
146.889266	70.064890	06/16/97	16:07:58	1	68	ca	0	10	4	0	14
146.891796	70.078122	06/16/97	16:08:29	1	69	ca	0	2	1	0	3
146.916464	70.087341	06/16/97	16:39:58	1	70	ca	0	2	2	0	4
146.927099	70.065372	06/16/97	16:40:44	1	71	ca	0	3	0	0	3
146.917969	69.988041	06/16/97	16:43:22	1	72	ca	0	2	2	0	4
146.913596	69.963669	06/16/97	16:44:12	1	73	ca	0	1	2	0	3
146.925634	69.950514	06/16/97	16:44:40	1	74	ca	0	7	6	0	13
146.907640	69.934954	06/16/97	16:45:12	1	75	ca	1	0	0	0	1
146.922379	69.930234	06/16/97	16:45:22	1	76	ca	0	9	6	0	15
146.954557	69.938485	06/16/97	16:48:03	1	78	ca	0	1	0	0	1
146.968233	69.966449	06/16/97	16:49:07	1	79	ca	0	1	1	0	2
146.955131	69.972098	06/16/97	16:49:19	1	80	ca	0	7	5	0	12
146.958397	69.993220	06/16/97	16:50:08	1	81	ca	0	3	3	0	6
146.978793	69.996834	06/16/97	16:51:12	1	82	ca	0	27	20	0	47
146.956609	70.010396	06/16/97	16:52:11	1	83	ca	0	7	6	0	13
146.971627	70.012586	06/16/97	16:52:31	1	84	ca	0	5	4	0	9
146.970383	70.045815	06/16/97	16:53:35	1	85	ca	0	1	3	0	4
146.967423	70.054703	06/16/97	16:53:55	1	86	ca	0	1	1	0	2
146.592870	69.911579	06/16/97	14:59	1	88	ca	0	0	0	2	2
146.280359	69.992534	07/06/97	13:13:31	2	1	ca	0	0	0	1	1
146.432454	70.067917	07/06/97	13:42:06	2	2	ca	1	40	40	10	91
146.599042	70.081757	07/06/97	14:29:15	2	3	ca	0	3	2	0	5
146.620240	70.103505	07/06/97	14:36:15	2	4	ca	5	60	60	20	145
146.652812	70.107885	07/06/97	14:54:32	2	6	ca	0	10	10	0	20
146.676208	70.127453	07/06/97	14:55:15	2	7	ca	0	0	0	1	1
146.710147	70.064590	07/06/97	15:01:19	2	8	ca	2	100	70	10	182
146.751262	70.062781	07/06/97	15:15:06	2	9	ca	8	10	10	0	28
146.780422	70.065402	07/06/97	15:45:10	2	10	ca	5	0	0	0	5
146.925356	70.143471	07/06/97	16:22:23	2	11	ca	0	0	0	3	3
146.230873	70.005692	07/11/97	12:45:15	3	1	ca	4	10	10	20	44
146.300012	70.041661	07/11/97	12:56:42	3	2	ca	0	5	2	0	7
146.392119	70.009699	07/11/97	13:23:30	3	4	ca	0	0	0	2	2
146.471953	69.961207	07/11/97	13:38:10	3	5	ca	15	8	8	111	142

Table A-1. Continued.

Longitude °W	Latitude °N	Date	TimeAST	Flight	Attribute	Species	Bulls	Cows	Calves	Unclass	Total
146.519353	70.012605	07/11/97	13:46:29	3	6	ca	3	2	2	5	12
146.563896	70.008580	07/11/97	13:59:33	3	8	ca	12	0	0	168	180
146.585613	69.966753	07/11/97	14:06:02	3	9	ca	0	1	0	0	1
146.732133	70.084718	07/11/97	15:01:33	3	10	ca	0	0	0	2	2
146.941529	70.146066	07/11/97	16:02:29	3	11	ca	0	200	100	150	450
146.972830	70.149942	07/11/97	16:04:20	3	12	ca	0	100	50	25	175
146.978871	69.961294	07/11/97	16:10:57	3	13	ca	0	0	0	1	1
146.754680	69.997930	07/11/97	13:45	3	14	ca	4	0	0	27	31
146.266194	70.175388	07/17/97	12:03:58	4	1	ca	1	0	0	0	1
146.240896	70.174423	07/17/97	12:04:20	4	2	ca	0	200	100	100	400
146.309998	70.181796	07/17/97	12:21:29	4	4	ca	0	2	2	1	5
146.391839	70.128454	07/17/97	12:37:47	4	5	ca	0	1	1	0	2
146.384756	70.182305	07/17/97	12:39:49	4	6	ca	13	0	0	0	13
146.402556	70.179656	07/17/97	13:02:32	4	8	ca	50	200	100	100	450
146.649907	70.171749	07/17/97	13:44:40	4	9	ca	0	100	90	100	290
146.769378	69.910976	07/17/97	14:41:13	4	12	ca	0	1	0	0	1
146.127779	70.160046	07/22/97	16:07:10	5	2	ca	10	2	2	0	14
146.141012	70.050324	07/22/97	16:11:04	5	3	ca	0	0	0	1	1
146.254870	70.161525	07/22/97	16:20:27	5	4	ca	1	1	0	1	3
146.248850	69.970909	07/22/97	16:26:59	5	5	ca	1	0	0	0	1
146.299502	70.170596	07/22/97	16:35:00	5	6	ca	0	1	1	0	2
146.340492	70.177260	07/22/97	16:36:24	5	7	ca	1	30	20	20	71
146.311740	70.090598	07/22/97	16:40:58	5	8	ca	1	0	0	0	1
146.341133	70.082561	07/22/97	16:41:14	5	9	ca	0	0	0	1	1
146.365524	70.179396	07/22/97	16:55:46	5	10	ca	0	8	1	0	9
146.391917	70.181853	07/22/97	16:56:20	5	11	ca	20	40	40	30	130
146.425606	70.160401	07/22/97	16:58:19	5	12	ca	0	1	0	0	1
146.417704	70.134273	07/22/97	16:59:10	5	13	ca	0	1	0	0	1
146.472740	70.184675	07/22/97	17:18:04	5	14	ca	0	1	1	0	2
146.514262	70.183626	07/22/97	17:18:51	5	15	ca	0	1	1	0	2
146.515749	70.189295	07/22/97	17:19:14	5	16	ca	0	5	5	15	25
146.563515	70.073224	07/22/97	17:36:18	5	17	ca	0	0	0	1	1
146.544056	70.183440	07/22/97	17:40:33	5	18	ca	0	10	3	0	13
146.586166	70.181843	07/22/97	17:41:24	5	19	ca	0	1	1	0	2
146.601303	70.121392	07/22/97	17:43:24	5	20	ca	0	0	0	2	2
146.607346	70.126465	07/22/97	17:59:28	5	21	ca	0	0	0	1	1
146.682350	70.159890	07/22/97	18:02:46	5	22	ca	0	1	0	0	1
146.715738	70.010899	07/22/97	18:16:16	5	23	ca	0	0	0	1	1
146.714798	70.080451	07/22/97	18:18:54	5	24	ca	0	1	0	0	1
146.732638	70.158938	07/22/97	18:21:53	5	25	ca	0	0	0	1	1
146.774694	70.180057	07/22/97	18:23:25	5	26	ca	60	150	150	240	600
146.734903	70.019669	07/22/97	18:54:12	5	27	ca	0	0	0	1	1
146.850896	70.178184	07/22/97	19:10:07	5	28	ca	0	0	0	3	3
146.861011	70.172116	07/22/97	19:10:17	5	29	ca	20	100	80	100	300
146.840270	70.081332	07/22/97	19:15:13	5	30	ca	25	200	50	200	475
146.065072	70.104545	08/02/97	11:47:07	6	1	ca	0	1	0	0	1
146.104296	70.072028	08/02/97	11:49:02	6	2	ca	0	2	0	0	2
146.272784	69.963898	08/02/97	12:13:12	6	3	ca	0	1	1	0	2
146.279287	69.989853	08/02/97	12:14:31	6	4	ca	0	1	0	0	1

Table A-1. Continued.

Longitude °W	Latitude °N	Date	TimeAST	Flight	Attribute	Species	Bulls	Cows	Calves	Unclass	Total
146.310144	70.181778	08/02/97	12:21:55	6	5	ca	0	1	1	0	2
146.432884	70.117132	08/02/97	12:43:37	6	6	ca	0	0	0	1	1
146.447466	70.075733	08/02/97	12:58:01	6	7	ca	0	0	0	1	1
146.646172	69.988962	08/02/97	13:37:24	6	9	ca	0	0	0	1	1
146.650079	70.006787	08/02/97	13:38:03	6	10	ca	0	0	0	1	1
146.654410	69.986729	08/02/97	13:51:48	6	11	ca	0	0	0	1	1
146.659140	69.980942	08/02/97	13:52:00	6	12	ca	1	0	0	0	1
146.731086	69.965269	08/02/97	13:57:30	6	13	ca	0	0	0	1	1
146.731912	69.981817	08/02/97	13:58:05	6	14	ca	0	0	0	1	1
146.786620	70.178840	08/02/97	14:28:57	6	15	ca	35	13	0	0	48
146.791055	69.939092	08/02/97	14:41:27	6	16	ca	0	1	0	0	1
146.780915	69.952578	08/02/97	14:41:56	6	17	ca	0	0	0	1	1
146.816180	69.959075	08/02/97	14:42:11	6	18	ca	0	1	0	0	1
146.780215	69.972093	08/02/97	14:42:40	6	19	ca	0	0	0	1	1
146.792303	70.026259	08/02/97	14:44:40	6	20	ca	1	0	0	0	1
146.793423	70.094566	08/02/97	14:47:12	6	21	ca	0	1	0	0	1
146.774067	70.156555	08/02/97	14:49:34	6	22	ca	0	0	0	1	1
146.785058	70.176219	08/02/97	14:50:18	6	23	ca	0	0	0	2	2
146.856842	70.152425	08/02/97	14:52:16	6	24	ca	0	0	0	1	1
146.834111	70.076998	08/02/97	14:54:51	6	25	ca	0	1	0	0	1
146.860662	70.059625	08/02/97	14:55:27	6	26	ca	0	0	0	1	1
146.817840	69.990020	08/02/97	14:57:59	6	27	ca	0	0	0	1	1
146.857335	69.983434	08/02/97	14:58:13	6	28	ca	0	0	0	1	1
146.871634	69.996312	08/02/97	15:05:00	6	29	ca	0	1	0	0	1
146.910422	70.167983	08/02/97	15:12:09	6	30	ca	0	0	0	1	1
146.941618	69.988019	08/02/97	15:18:25	6	31	ca	0	0	0	1	1
146.959098	69.911452	08/02/97	15:22:03	6	33	ca	1	0	0	0	1
146.944020	69.949567	08/02/97	15:23:29	6	34	ca	0	0	0	1	1
146.973761	70.095256	08/02/97	15:28:56	6	35	ca	0	1	0	0	1
146.982073	70.151163	08/02/97	15:31:05	6	36	ca	1	0	0	0	1
146.961125	70.151163	08/02/97	15:31:05	6	36	ca	0	0	0	1	1
146.141522	70.149360	08/07/97	17:49:40	7	2	ca	0	0	0	1	1
146.390461	70.155793	08/07/97	18:34:22	7	3	ca	1	0	0	1	2
146.569237	70.170385	08/07/97	19:19:06	7	4	ca	0	0	0	2	2
146.574846	69.983257	08/07/97	19:25:56	7	5	ca	0	1	1	0	2
146.571554	69.979056	08/07/97	19:26:06	7	6	ca	1	0	0	0	1
146.644267	69.970894	08/07/97	19:31:35	7	7	ca	0	0	0	1	1
146.825362	69.953738	08/07/97	20:51:21	7	8	ca	0	1	1	0	2
146.864535	69.913896	08/07/97	20:54:00	7	9	ca	0	1	1	0	2
146.897829	69.977865	08/07/97	20:56:17	7	10	ca	0	0	0	1	1
146.899747	70.152802	08/07/97	21:04:26	7	11	ca	0	0	0	1	1
146.961046	69.969366	08/07/97	21:16:32	7	12	ca	1	0	0	0	1

Table A-2. Brown bear sightings in the Bullen Point to Staines River study area, Alaska, 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
146.637307	70.011983	06/16/97	15:02:58	1	22	bb	0	0	0	1	1
146.259058	69.985934	07/17/97	12:11:50	4	3	bb	0	0	0	1	1
146.724580	69.986131	07/17/97	13:58:06	4	10	bb	0	0	0	1	1

Table A-3. Caribou sightings south of the defined Bullen Point to Staines River survey area, Alaska, 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
146.692232	69.908506	06/16/97	15:20:17	1	33	ca	0	18	14	0	32
146.737406	69.904119	06/16/97	15:40:24	1	45	ca	0	4	2	0	6
146.806534	69.908235	06/16/97	15:41:08	1	46	ca	0	3	1	0	4
146.860998	69.901839	06/16/97	16:01:40	1	58	ca	0	1	0	0	1
146.880674	69.906232	06/16/97	16:01:57	1	59	ca	0	2	2	0	4
146.903796	69.907682	06/16/97	16:46:10	1	77	ca	0	0	0	2	2
146.377428	69.905912	07/11/97	13:18:47	3	3	ca	250	0	0	50	300
146.495005	69.910177	08/02/97	13:12:30	6	8	ca	0	1	0	0	1
146.936315	69.903612	08/02/97	15:21:35	6	32	ca	0	0	0	1	1

APPENDIX B.

1997 PHOTODOCUMENTATION

Revised counts based on photodocumentation, copies of the photodocumentation and a summary of changes are presented in Photos 1 to 11 and Table B-1. Eight attributes were corrected based on photodocumentation, two from 11 July 1997, three from 17 July 1997, and three from 22 July 1997 systematic surveys. 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 decreased by an average of -7 animals ± 23.3 95CI, number of cows increased by an average of 41 ± 77.5 95CI, number of calves increased by an average of 47 ± 94.0 95CI, number of unclassified caribou increased by an average of 47 ± 68.4 95CI, and number of total caribou increased by an average of 129 ± 181.2 95CI. Changes within sex/age classes generally were proportional to the original group compositions.

- PHOTO 1: Caribou--Sourdough Survey Area
Attribute 5, 15 Bulls, 8 Cows, 8 Calves,
111 Unclassified, 142 Total
146.471953 W, 69.961207 N
11 July 1997, Lynn Noel
- PHOTO 2: Caribou--Sourdough Survey Area
Attribute 14, 4 Bulls, 0 Cows, 0 Calves,
27 Unclassified, 31 Total
146.754680 W, 69.997930 N
11 July 1997, Lynn Noel
-
- PHOTO 3: Caribou--Sourdough Survey Area
Attribute 8, 12 Bulls, 0 Cows, 0 Calves,
168 Unclassified, 180 Total
146.563896 W, 70.008580 N
11 July 1997, Lynn Noel
- PHOTO 4: Caribou--Sourdough Study Area
Attribute 2, 0 Bulls, 200 Cows, 100 Calves,
100 Unclassified, 400 Total.
146.240896°W, 70.174423°N
17 July 1997, Lynn Noel
- PHOTO 5: Caribou--Sourdough Study Area
Attribute 8, 50 Bulls, 200 Cows, 100 Calves,
100 Unclassified, 450 Total
146.402556°W, 70.179656°N
17 July 1997, Lynn Noel
- PHOTO 6: Caribou--Sourdough Study Area
Attribute 8, 50 Bulls, 200 Cows, 100 Calves,
100 Unclassified, 450 Total
146.402556°W, 70.179656°N
17 July 1997, Lynn Noel
- PHOTO 7: Caribou--Sourdough Study Area
Attribute 9, 0 Bulls, 100 Cows, 90 Calves,
100 Unclassified, 290 Total
146.649907°W, 70.1717491°N
17 July 1997, Lynn Noel
- PHOTO 8: Caribou--Sourdough Study Area
Attribute 7, 1 Bulls, 30 Cows, 30 Calves,
34 Unclassified, 95 Total
146.340492 W, 70.177260 N
22 July 1997, Lynn Noel
- PHOTO 9: Caribou--Sourdough Study Area
Attribute 26, 60 Bulls, 350 Cows, 350 Calves,
240 Unclassified, 1000 Total
146.774694° W, 70.180057° N
22 July 1997, Lynn Noel

PHOTO 10: Caribou--Sourdough Study Area
Attribute 26, 60 Bulls, 350 Cows, 350 Calves,
240 Unclassified, 1000 Total
146.774694° W, 70.180057° N
22 July 1997, Lynn Noel

PHOTO 11: Caribou--Sourdough Study Area
Attribute 30, 30 Bulls, 325 Cows, 200 Calves,
320 Unclassified, 875 Total
146.840270° W, 70.081332° N
22 July 1997, Lynn Noel

Table B-1. Sex and age structure for caribou groups with corrections based on photographic analysis, Bullen Point to Staines River study area, Alaska, summer 1997. Abbreviations are: 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.

Attribute	Date	Bulls			Cows			Calves			Unclassified			Total Caribou		
		Uncorr.	Corr.	Diff.	Uncorr.	Corr.	Diff.	Uncorr.	Corr.	Diff.	Uncorr.	Corr.	Diff.	Uncorr.	Corr.	Diff.
5	11 Jul	80	15	-65	3	8	5	3	8	5	10	111	101	96	142	46
8	11 Jul	12	12	0	0	0	0	0	0	0	23	168	145	35	180	145
2	17 Jul	0	0	0	200	200	0	25	100	75	150	100	-50	375	400	25
8	17 Jul	50	50	0	200	200	0	200	100	-100	100	100	0	550	450	-100
9	17 Jul	0	0	0	100	100	0	50	90	40	50	100	50	200	290	90
7	22 Jul	1	1	0	30	30	0	20	30	10	20	34	14	71	95	24
26	22 Jul	60	60	0	150	350	200	150	350	200	240	240	0	600	1000	400
30	22 Jul	25	30	5	200	325	125	50	200	150	200	320	120	475	875	400
Average Difference				-7.50			41.25			47.50			47.50			128.75
Standard Deviation				23.30			77.49			93.96			68.42			181.20
95 Percent Confidence Interval				16.15			53.70			65.11			47.41			125.56

B-4



Photo #3

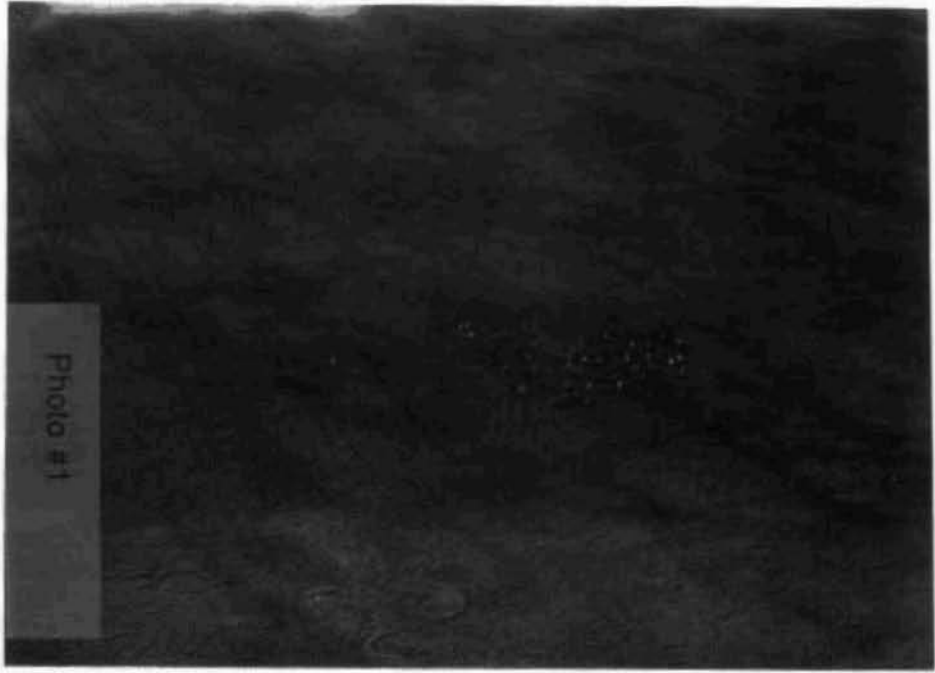


Photo #1



Photo #4

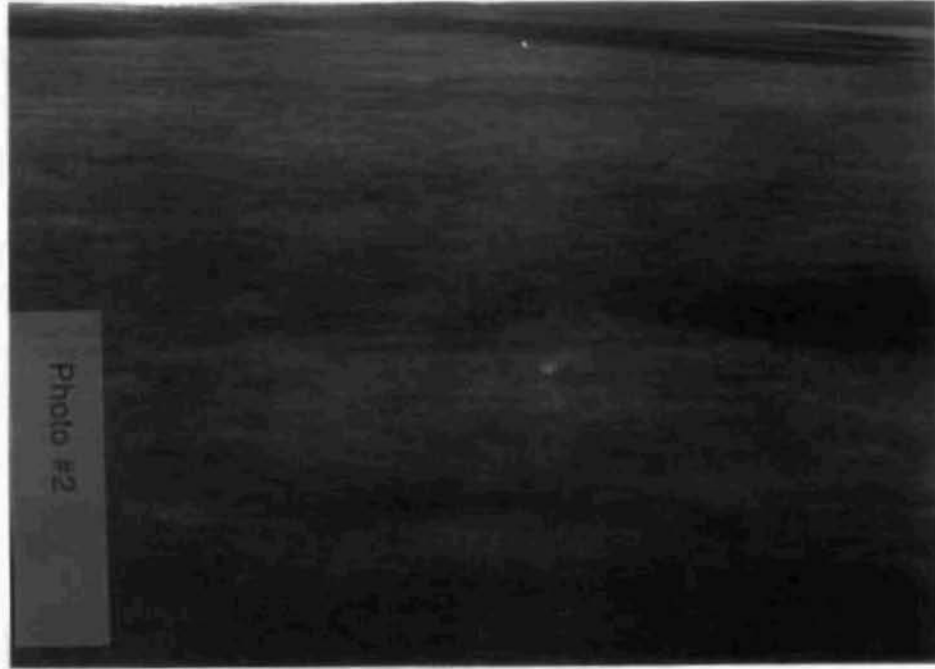


Photo #2

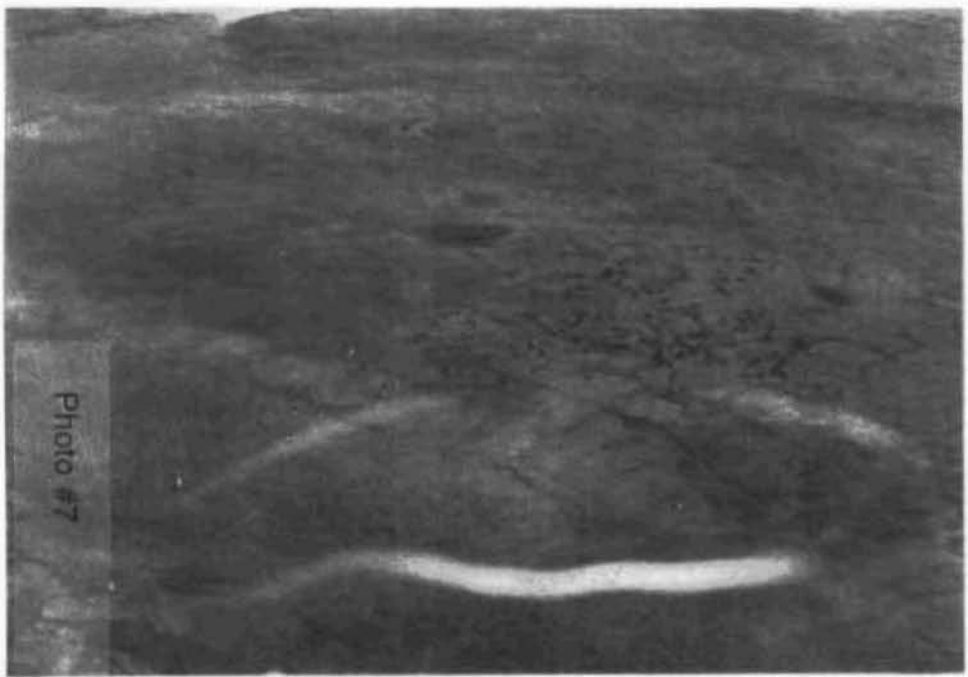


Photo #7



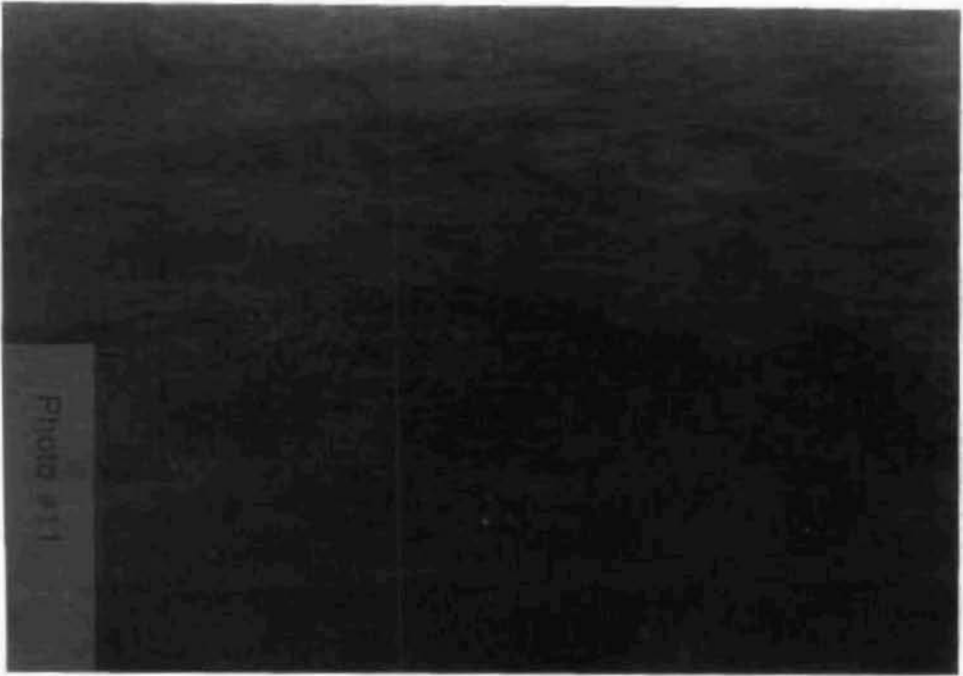
Photo #5



Photo #8



Photo #6



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)

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

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