



FINAL REPORT
28 September 2001

**BULLEN POINT TO STAINES RIVER
LARGE MAMMAL DISTRIBUTION,
SUMMER 2000**



Prepared for

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P520

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Cite report as:

Noel, L.E., and T.L. Olson. 2001. Bullen Point to Staines River large mammal distribution, summer 2000. Report for BP Exploration (Alaska) Inc. by LGL Alaska Research Associates, Inc., Anchorage, Alaska, USA. 27 p + append.

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ABSTRACT

We documented the distribution of large mammals within a study area that extended from the Beaufort Sea coastline south to lat 69°54.5'N between Bullen Point and the Staines/Canning rivers on the North Slope of Alaska. Five aerial strip-transect surveys, providing 100% coverage of the study area, were flown from 16 June through 24 July 2000. During the 16 June caribou (*Rangifer tarandus*) calving period survey, we counted 365 caribou, including 107 calves (44 calves:100 cows). During the first post-calving period survey (28 June), 2,596 caribou were counted. We saw fewer than 1000 caribou during all 3 July surveys. For the 4 post-calving period surveys, the pooled sex/age composition of classified caribou was 7% bulls, 57% cows, and 36% calves. Other large mammals observed during the surveys included grizzly bears (*Ursus arctos*) during 3 flights and muskoxen (*Ovibos moschatus*) during 4 flights. Multi-year comparisons of caribou distributions and densities within the study area were made using aerial survey data collected in 1993, 1995, and 1997 to 2000. Although calving and post-calving distributions within the study area varied among years, some general patterns were evident. Two trends in calving period (>20 June) distribution were consistent among years: (1) very few cow-calf pairs use the northeast corner of the study area, and (2) most cow-calf pairs used the 4 townships in the southwest corner of the study area (1993 = 84%, 1997 = 86%, 12 June 1998 = 88%, 19 June 1998 = 2%, 1999 = 85%, and 2000 = 96%). It is possible that cows with calves remained further inland than our survey area due to the late snow cover, while cows that either did not calve or lost calves early continued to the coastal plain. During the post-calving period or the 6 years of post-calving period surveys combined, >50% of the 5,038 total caribou recorded within 2 km of the coast were within 4 km of Bullen Point (32%) or Point Thomson (24%). Across study years, the mean total caribou density was 1.89 ± 1.15 caribou/km² during the calving period and 1.37 ± 0.72 caribou/km² during the post-calving period.

Key words: Alaska, caribou, Central Arctic Caribou Herd, grizzly bear, muskoxen, North Slope, oilfield, *Ovibos moschatus*, *Rangifer tarandus*, *Ursus arctos*

INTRODUCTION

STUDY RATIONALE

Caribou are the arctic coastal plain's most conspicuous summer resident. They are an important subsistence and cultural resource for Inupiat communities. Perceived detrimental effects of oil and gas development on caribou have and will inhibit this industry from accessing additional coastal plain resources. Controversy over potential development effects on caribou has been an issue since the beginning of oil and gas development on Alaska's North Slope. Perceptions that calving caribou and oilfield development cannot coexist, and that oilfield infrastructure blocks caribou movement to coastal insect-relief habitats are widely held. These beliefs persist despite a lack of evidence that oilfield developments have had any herd level effect on CAH caribou (Cronin et al. 1998, 2000). A lack of pre-development caribou calving distribution data, along with a lack of post-development calving caribou use, have led to speculation that development of the Prudhoe Bay oilfield caused caribou to abandon this area for calving (Whitten 2001).

Therefore, pre-development data on caribou distribution, abundance, and reproductive status in the Bullen Point to Staines River study area are necessary to assess potential development impacts and to develop effective mitigation measures. Potential impacts to caribou from oilfield development due to construction of roads, pipelines, or other related facilities and oilfield activities in the Bullen Point to Staines River study area include: (1) displacement or blocked access of CAH caribou to calving habitats, (2) displacement or blocked access of CAH caribou to post-calving and coastal insect-relief habitats, and (3) blocked PCH and CAH movements to and from the Arctic National Wildlife Refuge. Data collection in the adjacent Badami study area allows comparison of caribou distributions between these 2 areas. Monitoring caribou distribution and abundance at the neighboring Badami pipeline and coastal development will allow direct comparison to assess potential impacts from similar developments in the Point Thomson Unit. These data are critical to evaluate post-development effects on caribou distribution.

LARGE MAMMALS BETWEEN THE SAGAVANIRKTOK AND THE STAINES RIVERS

Caribou (*Rangifer tarandus*) from 2 herds may occur in the area between the Sagavanirktok and Staines/Canning rivers: the Central Arctic Caribou Herd (CAH) and the Porcupine Caribou Herd (PCH). Studies conducted over the past 20 years in the Arctic National Wildlife Refuge (ANWR) have shown that little, if any, PCH calving occurs west of the Canning River, nor is the area used by large numbers of PCH caribou during post-calving and dispersal periods (Clough et al. 1987, Russell et al. 1993). Most caribou observed within this area probably belong to the CAH.

During spring migration, CAH caribou move from the northern foothills of the Brooks Range to the coastal plain. In general, cows arrive on the coastal plain between late April and early June, while bulls do not arrive until post-calving in early July (Whitten and Cameron 1980, Jakimchuk et al. 1987). The CAH uses 2 general areas for calving: (1) west of the Sagavanirktok River (near the Kuparuk and Milne Point oilfields), and (2) east of the Sagavanirktok River and west of the Canning River. Two areas with CAH calving concentrations have been documented in most years since 1969: (1) between Oliktok Point and the Kuparuk River (Kuparuk and Milne Point), and (2) between Bullen Point and the Canning River (Cameron and Whitten 1978, Gavin 1983, Lawhead and Curatolo 1984, Whitten and Cameron 1985, Cameron et al. 1989). Lower-density concentrations of calving caribou have been observed west of the Colville River and east of the Canning River (Carruthers and Jakimchuk 1986). Curatolo and Reges (1984) described the 1984 CAH calving distribution as low-density and relatively dispersed, especially in comparison with other herds. The number of caribou using east and west ranges fluctuate among years, probably due to movements across the Sagavanirktok River (Cronin et al. 2000).

The CAH uses a broad area along the Arctic Coastal Plain between the Colville and Canning rivers for summer range (Smith 1996). Coastal areas, river deltas, river channels, and wind-swept uplands and ridges are used as insect-relief habitats by mosquito- and oestrid fly-harassed caribou during the post-calving period. Large groups of caribou have often been 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, as well as along the coast between Oliktok Point and the Canning River. Beginning in late July or early August, caribou begin to disperse across the coastal plain as mosquito harassment abates and oestrid fly harassment increases (Curatolo 1975, Lawhead and Curatolo 1984, Carruthers et al. 1987). Caribou gradually drift inland, group sizes decrease, and movement patterns become less directed (Carruthers et al. 1987, Jakimchuk et al. 1987, Cameron et al. 1989).

Other large mammals that occur between the Sagavanirktok and Staines rivers include muskoxen (*Ovibos moschatus*), grizzly bears (*Ursus arctos*), moose (*Alces alces*), and wolves (*Canis lupus*). By the late 1800s, muskoxen were exterminated from the North Slope of Alaska and little is known about 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 (Clough et al. 1987), and they have also dispersed to the west as far as the Colville River (J. Helmericks, pers. comm.). Muskoxen have been regularly sighted as far west as the Sagavanirktok River near the Prudhoe Bay oilfield (Pollard and Noel 1994, 1995; Noel 1998). Muskoxen are non-migratory, but move in response

to seasonal changes in snow cover and vegetation. During summer and fall, muskoxen are found primarily in riparian habitats, which are important for travel and foraging, but they move to adjacent uplands in winter and spring (Clough et al. 1987).

Coastal areas are used seasonally by grizzly bears. Bears generally move north from denning areas in the foothills of the Brooks Range in late May and are most abundant in the study area during June and July. In late July, most bears gradually return south to the foothills (Clough et al. 1987). Moose are uncommon on the North Slope, but they were observed in the area during 1994 and 1995 summer surveys (Pollard and Noel 1994, 1995). Wolves are also uncommon, but were observed west of Bullen Point in the southern portion of the Badami study area during a summer 1999 survey (Noel and King 2000b).

Environmental assessments have been completed for 3 oil exploration and development areas between the Sagavanirktok River delta and the Staines River: (1) Sourdough, (2) Yukon Gold, and (3) Badami. In support of these environmental assessments, LGL Alaska Research Associates, Inc. (LGL) was contracted by BP Exploration (Alaska) Inc. to collect baseline large mammal distribution information during aerial surveys conducted between the Sagavanirktok and Staines rivers for most years since 1993 (Pollard and Noel 1994, 1995; Noel 1998; Noel and Olson 1998, 1999; Noel and King 2000a,b). In 1997, LGL established 2 study areas: (1) Badami, between the Sagavanirktok River delta and Bullen Point, and (2) Bullen Point to the Staines River (Fig. 1). These 2 study areas extend from the Beaufort Sea coastline south to lat 69°54.5'N in most years. Surveys of these 2 study areas continued during summer 2000 and this report includes our 2000 survey results and related data analyses for the Bullen Point to Staines River study area. Results of surveys in the Badami study area are presented in the report *Large Mammal Distribution in the Badami Study Area, Summer 2001* (Noel and Olson 2001).

SURVEY OBJECTIVES

Our summer 2000 survey efforts were to determine the distribution and abundance of caribou and other large mammals within the Bullen Point to Staines River study area during the calving and post-calving periods. Our primary objectives were to: (1) estimate the number, sex/age composition, and distribution of large mammals during the caribou calving and post-calving periods, (2) summarize data for the Bullen Point to Staines River study area across years, and (3) describe distribution and abundance of large mammals in the Bullen Point to Staines River study area in relation to the adjacent Badami study area (Noel and Olson 2001).

STUDY AREA

BULLEN POINT TO STAINES RIVER

The 2000 Bullen Point to Staines River study area was bounded on the west by Bullen Point, extended east to the Staines River, north to the Beaufort Sea, and south to approximately lat $69^{\circ}54.5'N$ (Fig. 1). This area is part of the Arctic Coastal Plain, which is characterized by a gently rolling thaw lake plain landscape (Walker and Acevedo 1987). Tundra within 5 mi of the coast has little topographic relief. Further inland, the landscape begins a gradual ascent from 25 to 350 ft above sea level at the southern edge of the study area (about 24 mi inland from the Beaufort Sea coast). Contours within the study area form concentric bands oriented north-northwest. The area has been referred to as the Canning alluvial fan, formed by sediment deposition from the Canning River. Calcareous loess deposited downwind of the Canning River results in soils with high silt content, high pH (6.0 to 8.4), and low organic content (Tedrow 1977, Gesper et al. 1980). 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 1981, Mt. Michelson, Map L-206).

BADAMI

The 2000 Badami study area was bounded on the west by the Sagavanirktok River, extended east to Bullen Point, north to the Beaufort Sea, and south to approximately lat $69^{\circ}54.5'N$ (Fig. 1). We used a southern boundary of lat $69^{\circ}0'N$ during the single calving period survey. The area is part of the Arctic Coastal Plain, and is characterized by a gently rolling thaw lake plain landscape (Walker and Acevedo 1987). Tundra in the area gradually rises 6 to 8 m above the level of streams and river channels. Topographic relief results in many well-drained areas; moist and dry tundra vegetation types are common 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. The Badami pipeline extends 40 km across the northernmost section of the study area. The pipeline ranges from 1 to 5 km inland from the coast between the Endicott pipeline to the west and the Badami facility to the east (Fig. 1).

METHODS

AERIAL SURVEYS

During summer 2000, we conducted 5 aerial strip-transect aerial surveys (Caughley 1977) from a Cessna 206 fixed-wing aircraft. A single caribou calving period (≤ 20 June) survey was flown on 16 June, and post-calving period (> 20 June) surveys were flown on 28 June and 6 July,

20 July, and 24 July. We completed 1 instead of the usual 2 calving period surveys in 2000, because the Alaska Department of Fish and Game (ADFG) was also flying a calving period survey within this study area. Because of a combination of problems with our additional survey aircraft and poor flying weather, we were unable to complete the 7 planned surveys. Between 1993 and 2000, 8 calving period (<21 June) surveys were conducted in 6 study years (1993 = 1, 1995 = 1, 1997 = 1, 1998 = 2, 1999 = 2, 2000 = 1; Pollard and Noel 1995, Noel 1998, Noel and Olson 1998, Noel and King 2000a). Twenty-nine post-calving period surveys were conducted between 1993 and 2000 in 6 study years (1993 = 7, 1995 = 2, 1997 = 6, 1998 = 5, 1999 = 5, 2000 = 4; Pollard and Noel 1994, 1995; Noel 1998; Noel and Olson 1998; Noel and King 2000a).

Transect centerlines, spaced at 1.6-km intervals, 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-three transects (numbered 48 to 70; Fig. 1) were flown during each of the 5 Bullen Point to Staines River surveys. Surveys were flown at 90 m altitude and 115-125 km/hr airspeed (Pollard et al. 1992, 1996a). Two observers were used for each survey; each observer was responsible for searching an 800-m swath on one side of the transect centerline, providing for 100% transect coverage. Aircraft wing struts were marked to enable visual control of transect strip width (Pennycuik and Western 1972). Observers verified strut markings using inclinometers.

A Global Positioning System (GPS) receiver was used by the pilot to navigate the aircraft during surveys. Locations of the aircraft at the time of animal sightings were determined using a Motorola Workhorse™ GPS receiver linked to a notebook computer using Geolink® software. This system associated a real-time GPS-determined position with each sighting record. Sighting data were entered by a 3rd crewmember acting as a data recorder (16 and 28 June, 6 and 20 July) or by one of the two observers (24 July). Sighting entries included a visual estimate of distance from the aircraft, species, and number of individuals by sex/age classification. Coordinates of animal sightings were later calculated using the visual estimates of distance from the aircraft to offset the GPS aircraft positions. When possible, predominant behavior and habitat were noted along with group attributes and time of sighting on audiotapes; these data were later transcribed and added to the survey database. Behavior was defined as the activity of the majority of caribou in a group. Habitat types were categorized from the observer descriptions, which included comments on landform features and soil moisture following Walker's (1983) hierarchical classification system.

We counted and classified caribou as bulls, cows, calves, or unclassified based on body size, antler development, pelage, and calf presence. "Unclassified" caribou were adults (or yearlings) that could not be classified with confidence. Caribou near the outer margin of transect strips were most difficult to count and classify. Other factors that may have affected counting and

classification of caribou include observer experience, lighting conditions, caribou behavior, and survey weather conditions. When a large group of caribou was encountered, the survey aircraft often left the transect and circled the group to facilitate counting and classification. The GPS allowed the aircraft to return to the point of departure from the transect; therefore, no survey coverage was lost as a result of transect departures. In some cases, caribou group counts were refined using counts made from 35 mm slides taken during the surveys. Muskoxen were classified as bull, cow, unclassified, or calf; grizzly bears as adult or female with cubs; and arctic foxes as adult or kit.

DATA ANALYSIS

We used MapInfo® Geographic Information System (GIS) software to map and analyze the survey data. The base maps used for analyses were at a scale of 1:63,360. To assist with describing the summer 2000 distributions, we constructed a set of concentric 1-km intervals around the Beaufort Sea coastline in the Bullen Point to Staines River study area, and grouped caribou numbers by these distance intervals. Caribou densities (caribou/km²) were calculated for each distance interval using the total land area of each interval. Caribou density within the study area was calculated using the total land area of the 2000 Bullen Point to Staines River study area (904.6 km²) as the divisor.

Caribou observations recorded during surveys conducted in 1993, 1995, 1997, 1998, 1999, and 2000 compared caribou use of the study area among years. The southern boundary of some of the eastern transects varied among years; consequently, we established a common multi-year boundary and limited analysis to this area. Densities compared among years were calculated based on the land area within this multi-year study area (862.3 km²). Because caribou behavior, distribution, and sex/age composition differ between the calving and post-calving periods (Whitten and Cameron 1980), we prepared separate analyses for each of these 2 periods using ≤20 June as the end of the calving period.

Between 1993 and 2000, 8 calving period (≤20 June) surveys were conducted in 6 study years (1993 = 1, 1995 = 1, 1997 = 1, 1998 = 2, 1999 = 2, 2000 = 1; Pollard and Noel 1995, Noel 1998, Noel and Olson 1998, Noel and King 2000a). We excluded 2 of these surveys (6 June 1995 and 19 June 1999) from the calving period analyses because survey coverages were incomplete. The combined multi-year distribution was converted to a grid format using inverse distance weighting interpolation (grid cell size = 200 m; 5-km radius; 100-point maximum) in Vertical Mapper™ for MapInfo®. The resulting grid was then contoured based on percentile occurrence for values of caribou calves, which ranged from 0 to 54. Prior reports have generated regions based on natural neighbor interpolation (Noel and Olson 1998, Noel and King 2000a).

Twenty-nine post-calving period surveys were conducted between 1993 and 2000 in 6 study years (1993 = 7, 1995 = 2, 1997 = 6, 1998 = 5, 1999 = 5, 2000 = 4; Pollard and Noel 1994, 1995; Noel 1998; Noel and Olson 1998; Noel and King 2000a). Because these surveys were primarily conducted in late June and July (23 of 29 surveys), and we were focusing on coastal insect-relief habitats, we limited our analyses to data collected during these months. The 1995 surveys included the 2-km area along the coast and were used in the post-calving analysis. The combined multi-year post-calving distribution for an area within 2 km of the coast was converted to a grid format using inverse distance weighting interpolation (grid cell size = 200 m, 2-km radius, 25-point maximum). The resulting grid was then contoured based on percentile occurrence for values of total caribou, which ranged from 0 to 600. We focused this analysis on the coastline because coastal areas have been consistently identified as potential insect-relief habitat (Roby 1978, Dau 1986, Johnson and Lawhead 1989, Pollard et al. 1996a,b).

We calculated parasitic insect activity based on weather parameters using predictive models of mosquito activity (Russell et al. 1993) and oestrid fly activity (Mörschel 1999; Appendix B). Mosquito and oestrid fly activity index values were calculated for each hour that temperature and wind data were recorded at the Deadhorse Weather Station (ASCC 2001; Appendix B). All mean values are presented with 95% confidence intervals.

RESULTS

SUMMER 2000 SURVEYS

Synopsis

Five aerial surveys of the Bullen Point to Staines River study area were completed (Figure 2, Table 1, Appendix A). All classified caribou on the 16 June calving period survey were cows and calves. Calf density on 16 June was 0.12 calves/km², while total caribou density was 0.40 caribou/km². Cows and calves also predominated during the post-calving period (Table 1). Calf density during the post-calving period ranged from <0.01 calves/km² (24 July) to 0.77 calves/km² (28 June). The largest number of caribou seen during a single survey occurred on 28 June, with a density of 2.87 caribou/km². Fewer than 1000 caribou were seen during the 3 surveys in July combined (Table 1).

Muskoxen were observed during 4 of the 5 surveys (Tables 1 and A-2). Of the 38 muskoxen recorded, 34 were within 3 km of the Staines/Canning rivers (Figures A-1, A-2, A-4, and A-5). Other mammals seen included grizzly bears during 3 surveys (all were west of the Point Hopson transect [transect 59]), and arctic foxes during 4 surveys (Figures A-1 through A-5; Table A-2).

Aerial Survey Descriptions

Survey 1, 16 June 2000.—Survey weather conditions were good, with clear skies, winds at 3.1 to 4.6 meters per second (mps) from the northeast (70° to 100°), and temperature 13 to 15°C between 1030 and 1400 Alaska Daylight Savings Time (ADST; ASCC 2001). Areas of patchy snow cover (30% to 40%) and flooded tundra were noted in the study area. Indices of parasitic insect activity indicated conditions were not suitable for mosquito or oestrid activity on 16 June (Fig. 3, Table B-1). Small groups (mean = 5.5 ± 2.04 caribou) of cows and calves were in the study area, with a total density of 0.40 caribou/km² (0.12 calves/km², Figures 2 and A-1, Tables 1 and A-1). Calf production appeared low (44 calves:100 cows). Eighty-eight percent of caribou (including 90% of cow-calf pairs) were west of the Point Hopson transect (transect 59) and more than 12 km south of the coastline (Fig. A-1, Table 2). For caribou sightings with behavior and habitat noted, most caribou were feeding or resting on moist or dry tundra (Table 3). Other mammals recorded during the survey included muskoxen, grizzly bear, and arctic fox (Fig. A-1; Tables 1 and A-2).

Survey 2, 28 June 2000.—Survey weather conditions were good, with skies overcast at 2,000 ft, winds at 4.6 to 7.2 mps primarily from the northwest (290° to 300°), and temperature 6 to 7°C between 1230 and 1630 ADST (ASCC 2001). No snow cover remained. Indices of parasitic insect activity indicated conditions were not favorable for mosquito or oestrid activity on 28 June (Fig. 3, Table B-1). The largest number of caribou during 2000 surveys were recorded on this date, with 2.87 caribou/km² (0.77 calves/km²; Fig. A-2, Tables 1 and A-1). Mean group size increased from 5.5 ± 2.04 caribou/group on 16 June to 13.8 ± 2.64 caribou/group on 28 June. The composition of classified caribou was 4% bulls, 60% cows, and 36% calves. Most caribou (95%) were between 9 and 20 km inland from the coast (Fig. A-2, Table 2). Most caribou groups were resting or feeding on wet and moist tundra habitats (Table 3). Other mammals recorded during the survey included 3 groups of muskoxen near the Staines/Canning rivers, and an arctic fox 8.5 km south of Point Hopson (Fig. A-2, Tables 1 and A-2).

Survey 3, 6 July 2000.—Survey weather conditions were good with 20,000 ft broken ceiling, winds at 4.6 to 7.7 mps from the east (80° to 90°), and temperature 10 to 12°C between 1100 and 1430 ADST (ASCC 2001). Indices of parasitic insect activity indicated conditions were not favorable for mosquito or oestrid activity on 6 July (Fig. 3, Table B-1). Caribou density within the study area decreased from 2.87 caribou/km² on 28 June to 0.83 caribou/km² (0.13 calves/km²) on 6 July, while mean group size continued to increase from 13.8 ± 2.64 caribou/group on 28 June to 34.0 ± 28.90 caribou/group on 6 July (Fig. A-3, Tables 1 and A-1). Fewer than half of the caribou seen during this survey were classified according to sex/age class. Forty-two percent of caribou were within approximately 3.5 km of Bullen Point and 56% were along the

Staines/Canning rivers (Fig. A-3). Most caribou were feeding on wet or moist tundra or traveling (primarily eastward; Table 2). Two arctic foxes were seen: 1 near the Staines River, and 1 at a den in the southwest corner of the study area (Fig. A-3, Table A-2).

Survey 4, 20 July 2000.—Survey weather conditions were good, with 21,000 ft overcast and 2,100 broken to scattered ceiling, winds at 4.6 to 6.1 mps from the east-northeast (60° to 80°), and temperature 6 to 8°C between 1630 and 2030 ADST (ASCC 2001). Indices of parasitic insect activity indicated conditions were not favorable for mosquito or oestrid activity on 20 July (Fig. 3, Table B-1). Few caribou were within the study area (0.02 caribou/km²; Fig. A-4, Tables 1 and A-1). Caribou groups were clustered in small groups (2.6 ± 1.84 caribou/group) from 1 to 5 km and 12 to 16 km from the coast (Table 2). Most groups were feeding on wet or moist tundra (Table 3). Other mammals recorded included a grizzly bear sow with 3 cubs, an arctic fox with 4 kits at a den, and muskoxen (Fig. A-4, Tables 1 and A-2).

Survey 5, 24 July 2000.—Survey weather conditions were fair, with overcast skies, some light rain and haze, winds at 4.1 to 5.1 mps from the east (70° to 100°), and temperature 6 to 7°C between 1020 and 1400 ADST (ASCC 2001). Indices of parasitic insect activity indicated conditions were not favorable for mosquito or oestrid activity on 24 July (Fig. 3, Table B-1). Few caribou (0.04 caribou/km²) remained in the study area, and mean group size remained small with 2.8 ± 2.57 caribou/group (Fig. A-5, Tables 1 and A-1). Most caribou were near the Staines/Canning rivers (Fig. A-5), where they fed or stood on tundra that ranged from wet to dry (Table 3). Other mammals seen were grizzly bear and muskoxen (Fig. A-5, Tables 1 and A-2).

GENERAL CARIBOU DISTRIBUTIONS AND ABUNDANCE: MULTI-YEAR COMPARISONS

Calving Period

The total number of caribou seen during the 6 calving period surveys over the multi-year Bullen Point to Staines River study area between 1993 and 2000 ranged from 355 (0.41 caribou/km²) in 2000 to 2,496 (2.89 caribou/km²) in 1998. Calf production by survey ranged from 44 calves:100 cows in 2000 to 70 calves:100 cows in 1997. Across study years, mean cow density was 1.16 ± 0.72 cows/km², mean calf density was 0.67 ± 0.42 calves/km², and mean total caribou density was 1.89 ± 1.15 caribou/km².

The distribution of calves within the multi-year study area varied somewhat within and among survey years. However, 2 trends were consistent: (1) very few cow/calf pairs used the northeast corner of the study area, and (2) during 5 of 6 years, most cow/calf pairs used the 4 townships in the southwest corner of the study area (1993 = 84%, 1997 = 86%, 12 June 1998 = 88%, 19 June 1998 = 2%, 1999 = 85%, and 2000 = 96%; Fig. 4). These patterns are illustrated by the contours generated from an inverse distance weighting interpolation of the multi-year

data. Nearly 70% of the contour area with >5 calves/km² was located in the 4 southwest corner townships, which represent 39% of the study area (Fig. 5).

Post-calving Period

The total number of caribou seen during the 21 post-calving period surveys (excluding 1995 surveys) of the multi-year Bullen Point to Staines River study area conducted between 1993 and 2000 ranged from 3 (<0.01 caribou/km²) to 5,730 (6.65 caribou/km²; each in 1993). By year, mean post-calving caribou densities ranged from 0.87 ± 2.12 caribou/km² in 2000 ($n = 4$ surveys) to 1.89 ± 5.07 caribou/km² in 1993 ($n = 4$ surveys). Across study years, the mean density of caribou was 1.37 ± 0.72 caribou/km².

To identify areas along the coast where caribou concentrated during the post-calving period, we plotted the locations of all caribou groups observed within 2 km of the coast across study years (Fig. 6). Caribou were recorded within that 2-km buffer during 17 of 23 surveys (including 1995 surveys). More than half of the 5038 total caribou recorded within 2 km of the coast were within 4 km of Bullen Point (32%) or 4 km of Point Thomson (24%; Fig. 6). These concentrations were reflected in the contouring generated from inverse distance weighting interpolation of the data (Fig. 6).

CARIBOU IN THE BULLEN POINT TO STAINES RIVER AND BADAMI STUDY AREAS

Fewer caribou were present within the Bullen Point to Staines River study area (0.40 caribou/km²) than the Badami study area (0.68 caribou/km²) during the calving period in 2000 (Fig. 7, Noel and Olson 2001). This may be due in part to the 30% to 40% snow cover that remained in the Bullen Point to Staines River study area, while the Badami study area was primarily snow free. The Badami calf:cow ratio was slightly higher (47 calves:100 cows) than the Bullen Point to Staines River ratio (44 calves:100 cows). Calving caribou abundance was similar between 1999 (915 caribou) and 2000 (1,149 caribou) in the Badami study area (Noel and King 2000a, Noel and Olson 2001). Calving caribou abundance was lower in 1999 (Table 1) than in 2000 (2,252 caribou) in the Bullen Point to Staines River study area (Noel and King 2000b). Both study areas were snow free during calving-period surveys in 1999.

Except on 28 June 2000, far fewer caribou occurred in the Bullen Point to Staines River study area than in the Badami study area (Fig. 7, Noel and Olson 2001). The number of caribou within combined study areas for paired post-calving period surveys ranged from 2,675 on 24-25 July to 6,915 on 6-7 July 2000. Mean post-calving caribou density during 4 paired surveys in 2000 was 0.94 ± 2.133 caribou/km² in the Bullen Point to Staines River study area, and 4.44 ± 4.206 caribou/km² in the Badami study area (Noel and Olson 2001). Mean difference in caribou

density between the 2 study areas was -3.51 ± 5.760 caribou/km². Except for 28-29 June surveys, caribou density was consistently higher in the Badami study area (Fig. 7).

Few bulls were observed within the Bullen Point to Staines River study area. Post-calving composition for classified caribou was 7% bulls, compared to 36% bulls within the Badami study area (Fig. 7, Noel and Olson 2001). There were large numbers of unclassified caribou recorded for both study areas, however.

DISCUSSION

The area between Bullen Point and the Canning River has been used consistently by calving caribou in most years since 1969 (Pollard et al. 1992). The distribution of animals observed during calving surveys may reflect survey timing within the calving period (early or late June) and/or spring snow and flood patterns (Gavin 1983, Whitten and Cameron 1985). Calving period distributions in the Bullen Point to Staines River study area across the study years of 1993, 1997, and 1998-2000 have consistently shown: (1) few cow-calf pairs used the northeast portion of the study area, and (2) concentration within the southwest 4 townships in the study area, with the exception of 1 late calving period survey conducted on 19 June 1998 (Figures 4 and 5).

The most recent population size count for the CAH in 2000 is 27,128 animals, with 12,833 animals east of the west bank of the Sagavanirktok River (E. Lenart, ADFG, pers. comm.). Caribou calving between Bullen Point and the Canning River were considered the eastern segment of the CAH (Cameron and Whitten 1978, Lawhead and Curatolo 1984, Whitten and Cameron 1985, Cameron et al. 1989). But there are probably movements between these eastern and western segments of the CAH (Cronin et al 1998, 2000). Based on the 2000 herd size, about 3% of CAH east of the Sagavanirktok River (1% of the CAH) used the Bullen Point to Staines River study area during calving. The calf:cow ratio recorded for our 2000 calving period survey (44:100 on 16 June) was significantly lower than the 70:100 reported for CAH calving transects flown by ADFG on 15, 16, and 17 June 2000 (E. Lenart ADFG, pers. comm.). ADFG's calving period transects extend further into the foothills to lat 69°45'N and group composition is more comprehensive than our surveys; however, in previous years our reported calf:cow ratios have been comparable. It is possible that cows with calves remained further inland than our survey area due to the late snow cover; while cows that either did not calve or lost calves early continued to the coastal plain. Our calf:cow ratio on 28 June was 61:100, and was intermediate between ADFG's late June (70:100) and fall (56.5:100) ratios (E. Lenart ADFG, pers. comm.).

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). In the Prudhoe Bay and Kuparuk oilfields, caribou were reported to move to coastal areas to ameliorate insect harassment

(Roby 1978, Dau 1986, Johnson and Lawhead 1989, Pollard et al. 1996a,b). Caribou were observed 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). During the post-calving period in 2000, the percentage of the CAH east of the west channel of the Sagavanirktok River, which used the Bullen Point to Staines River study area, ranged from less than 1% to 20% (<1% to 10% of the CAH). An interpolation of coastal post-calving caribou distributions across study years shows that caribou concentrated primarily along coastlines and spits near Bullen Point, Point Gordon, Point Sweeney, east of Point Thomson, and near North Staines River #1 (Fig. 6).

The composition of the CAH in November 2000 was 56.5 calves:100 cows and 83.8 bulls:100 cows (E. Lenart, ADFG, pers. comm.). The pooled calf:cow and bull:cow ratios for our 4 post-calving surveys in 2000 (61 calves:100 cows, 13 bulls:100 cows) indicate that the proportion of calves in the study area was representative of the herd, but that the proportion of bulls was substantially lower within the Bullen Point to Staines River study area. The 86 bull:100 cow ratio for post-calving surveys in the Badami study area, however, was more similar to the fall CAH composition (Noel and Olson 2001).

ACKNOWLEDGMENTS

Jim Helmericks piloted the survey aircraft. Jamie King, Steve Johnson, and Adam Freedman served as observers or data recorders. Support for this study was provided by the Point Thomson Unit Partners. BP Exploration (Alaska) Inc., Environmental Studies Group coordinated studies in the Point Thomson Unit providing assistance with logistics. Dr. William Streever, Environmental Studies Group Leader, and Dr. Sammy King, Department of Forestry, Wildlife, and Fisheries, University of Tennessee, provided comments which improved this report.

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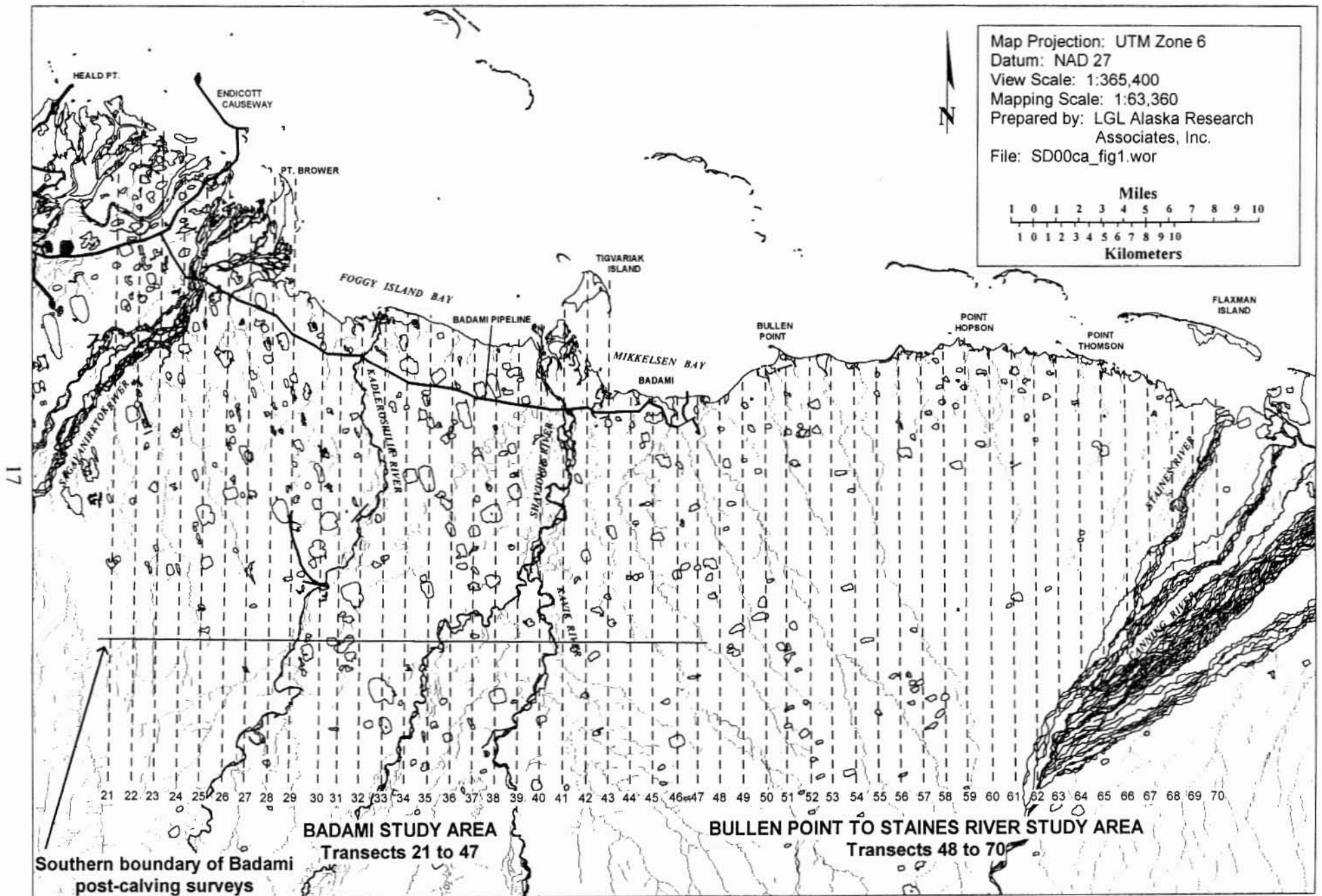
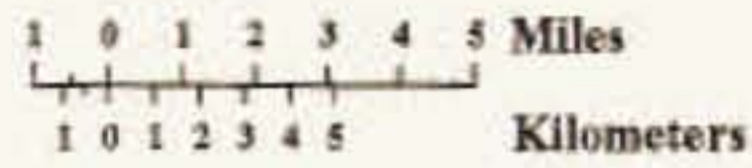


Figure 1. Survey transects in the Bullen Point to Staines River and Badami study areas, Alaska, summer 2000. This report presents data for transects 48-70 in the Bullen Point to Staines River study area, summer 2000.

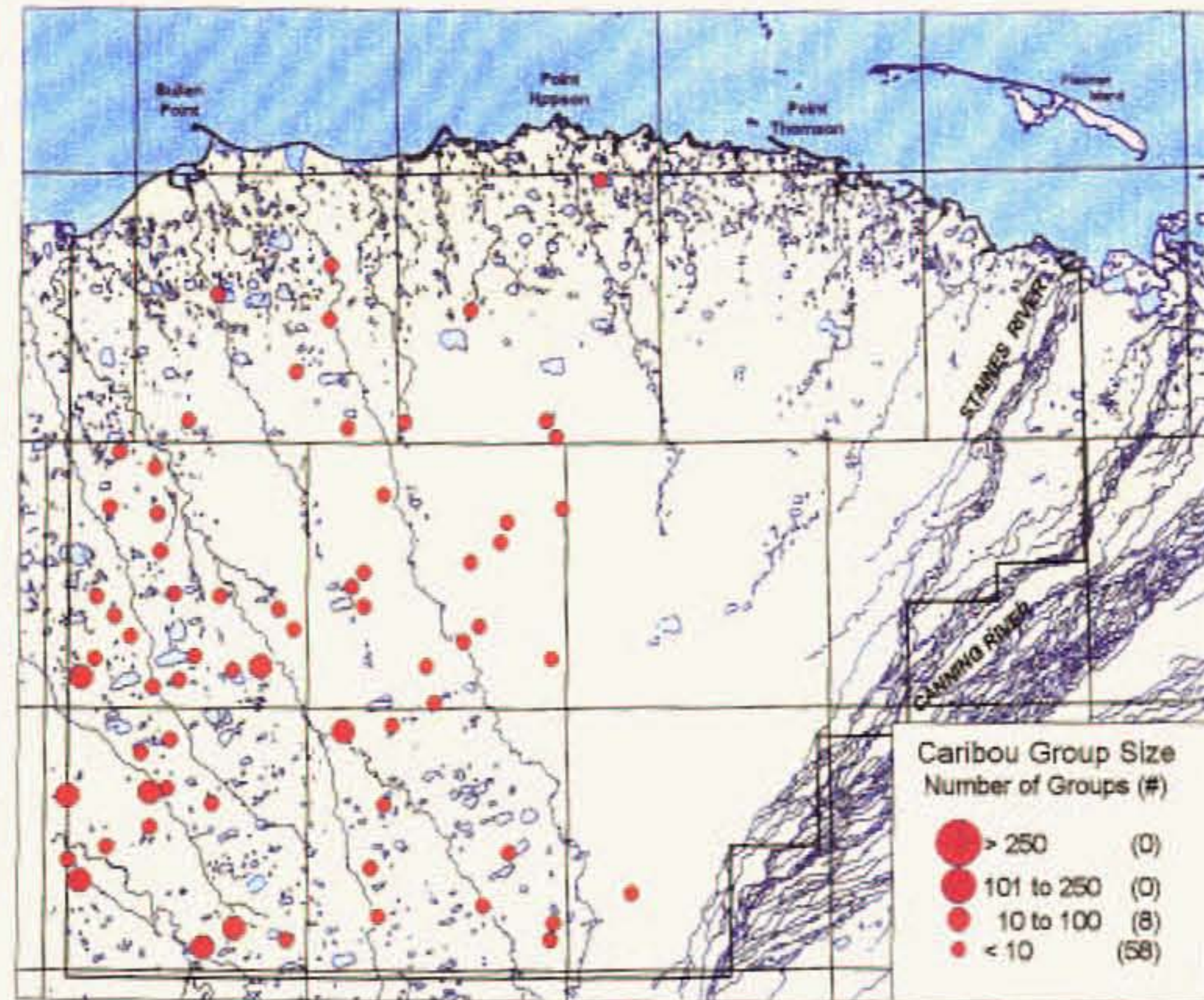
Figure 2

Distribution of caribou in the Bullen Point to Staines River study area, Alaska, during aerial surveys conducted summer 2000.

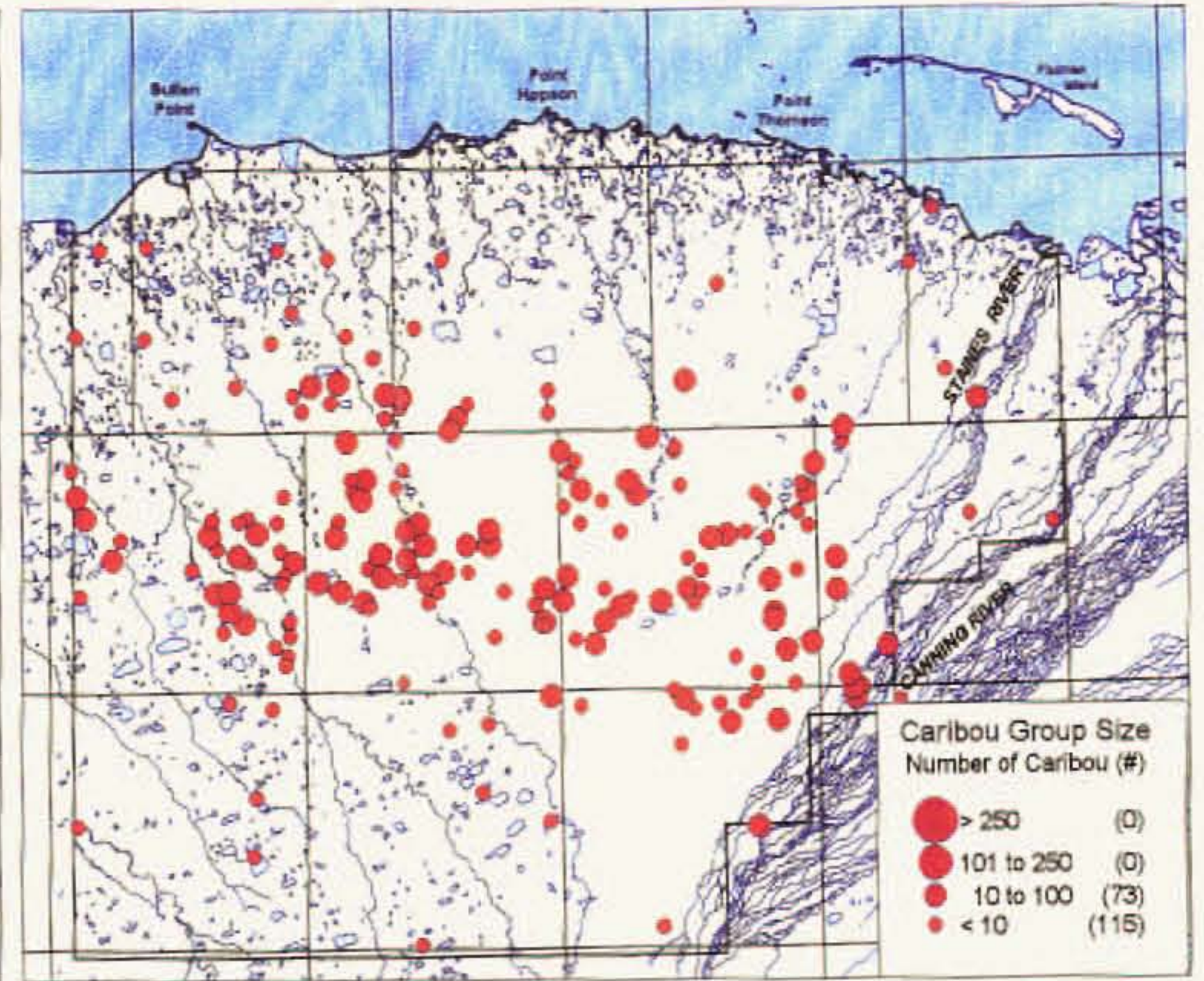
— Study Area Boundary



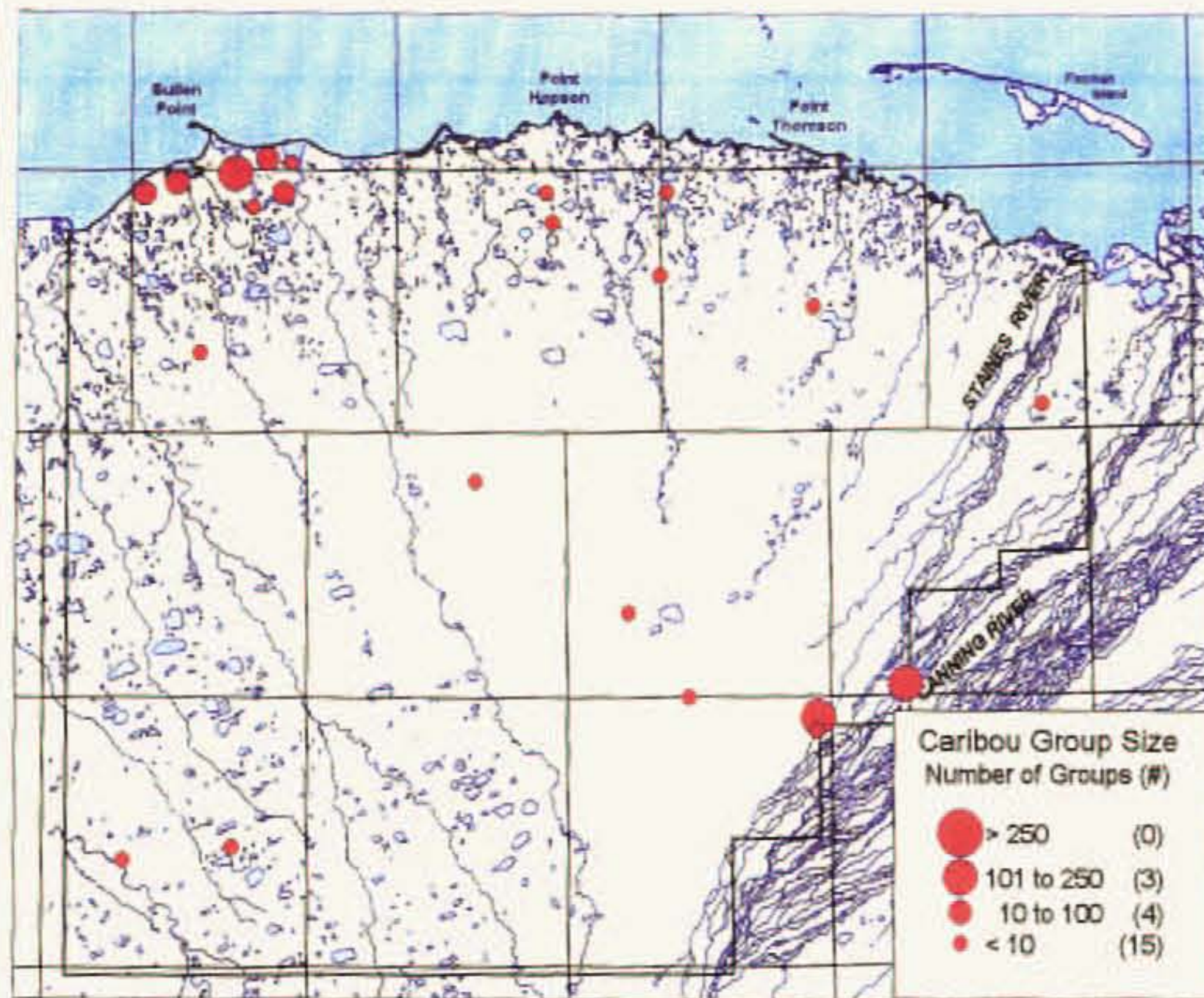
Projection: UTM Zone 6
Datum: NAD 27
View Scale 1:335,000
Mapping Scale: 1:63,360
File: SD00ca_fig2.wor



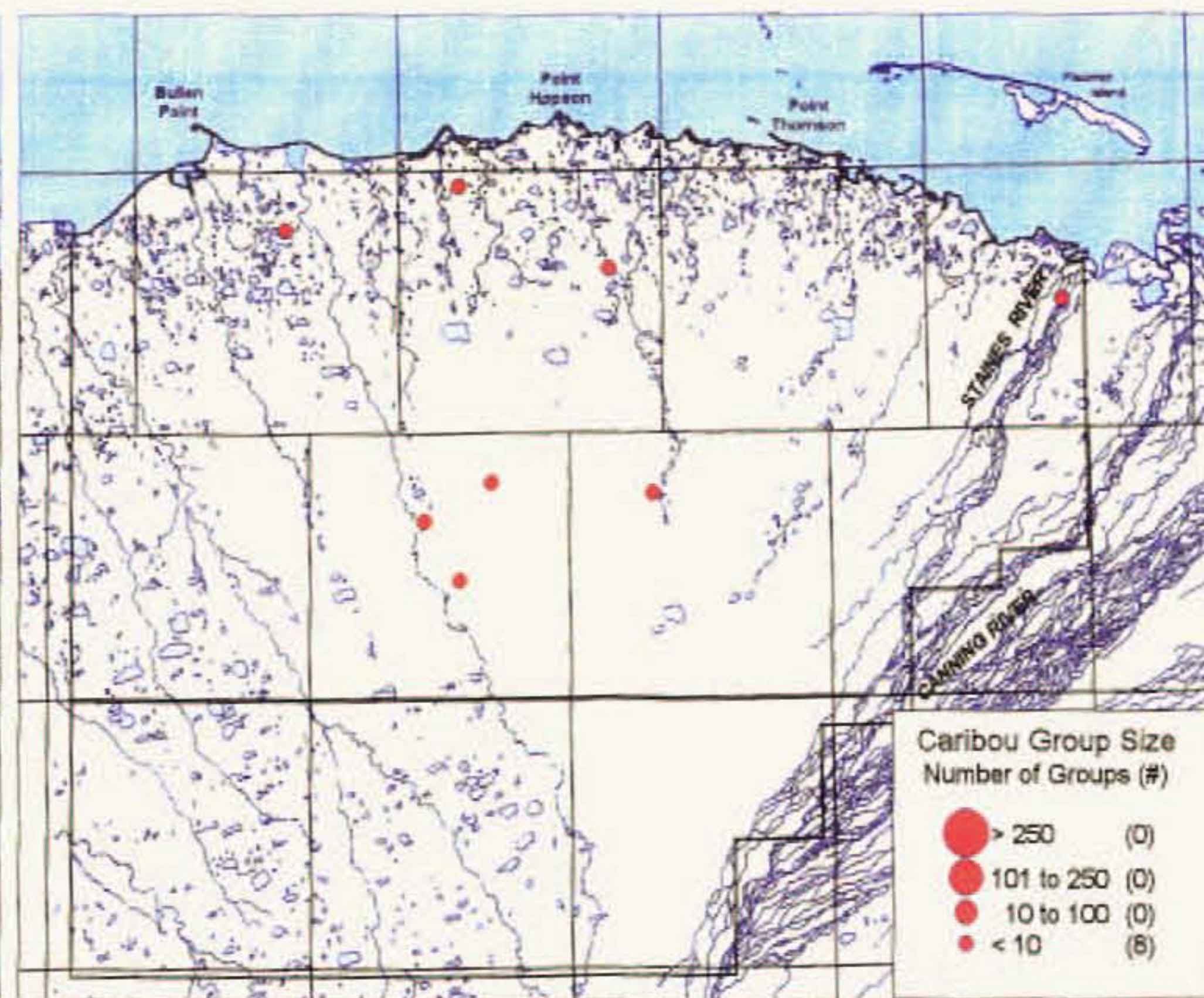
Survey 1: 16 June 2000



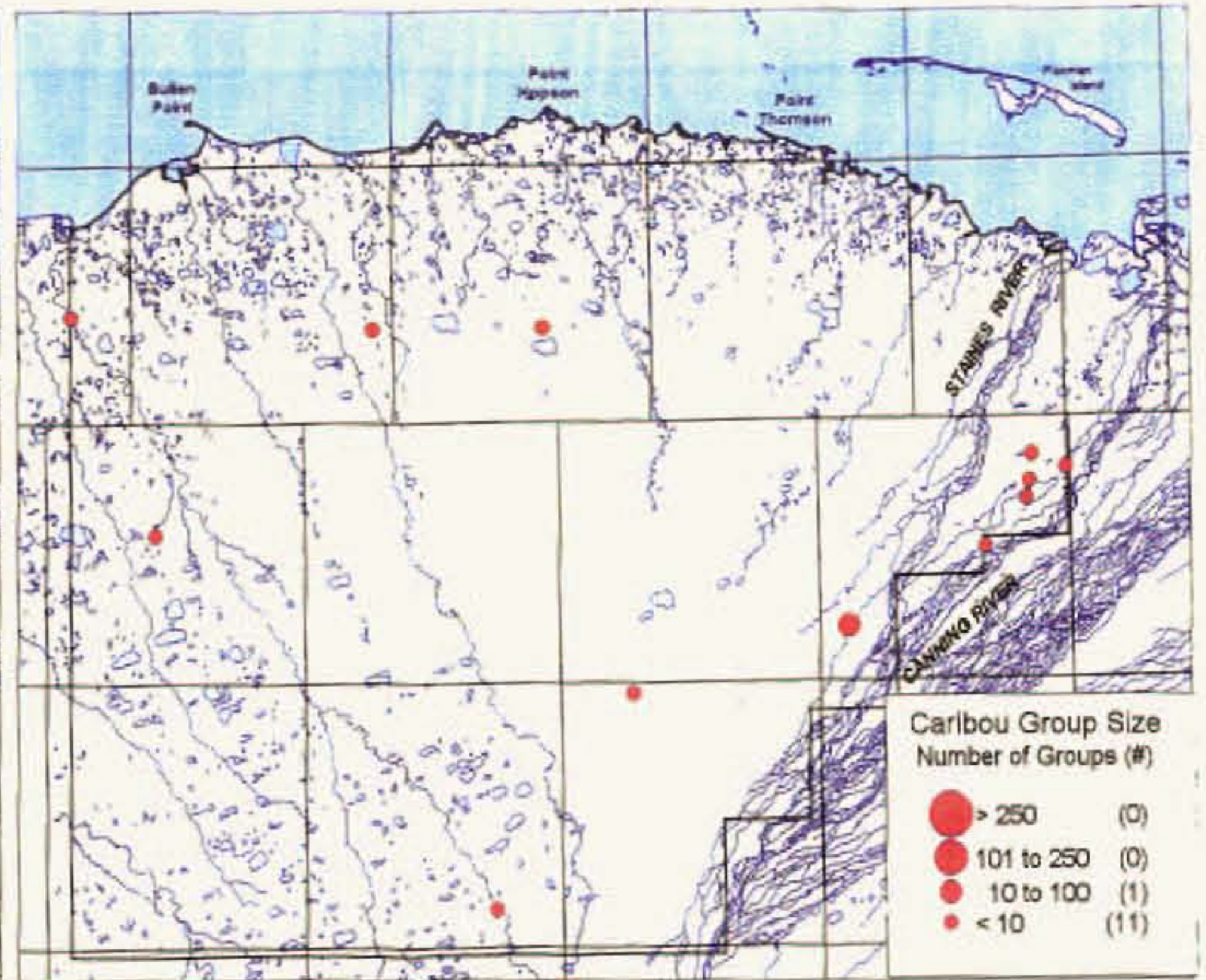
Survey 2: 28 June 2000



Survey 3: 6 July 2000



Survey 4: 20 July 2000



Survey 5: 24 July 2000

Indices of Parasitic Insect Activity

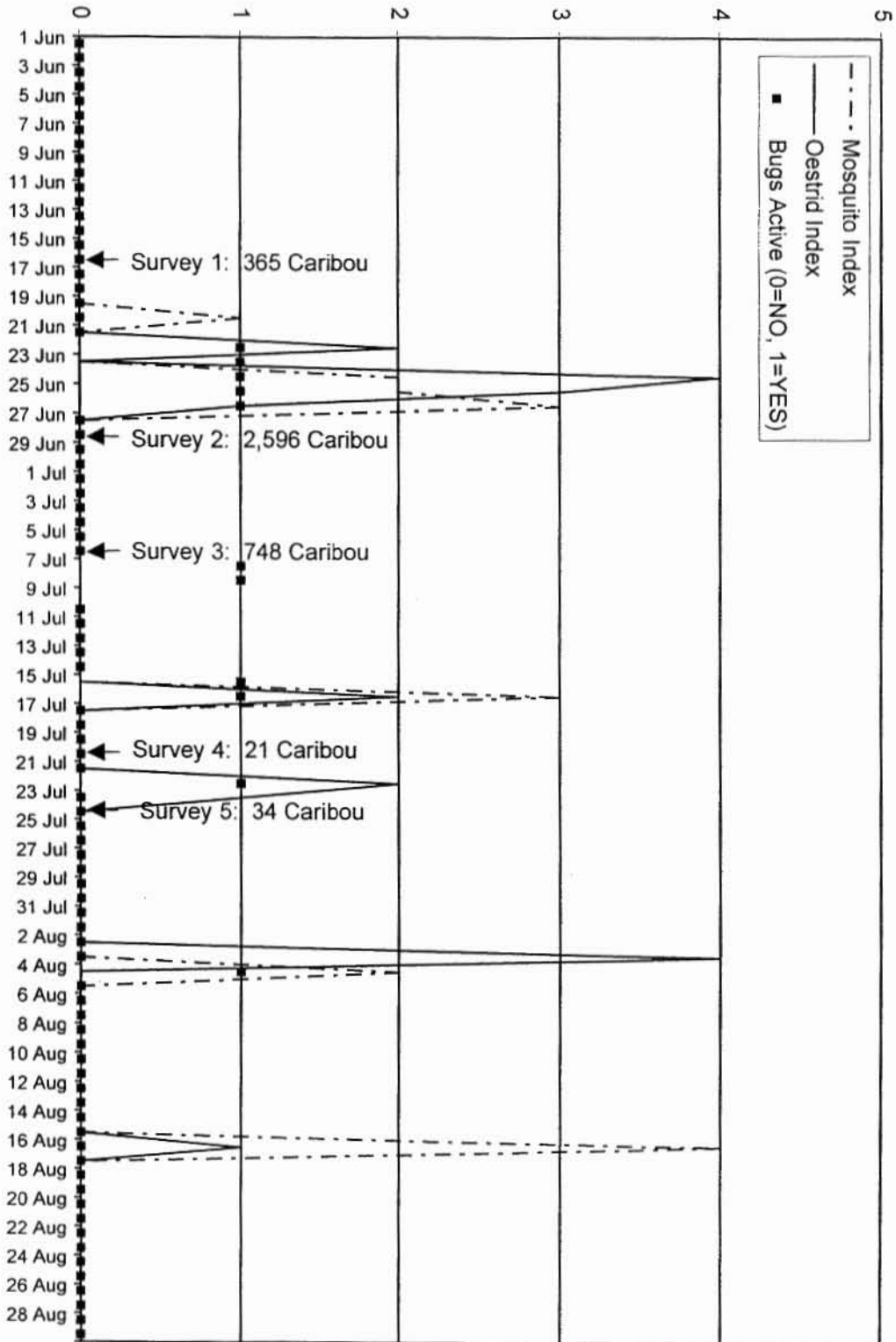


Figure 3. Daily mosquito and oestrid activity indices based on hourly weather data collected at the Deadhorse Weather Station (ASCC 2001), and aerial survey caribou counts, Bullen Point to Staines River study area, Alaska, summer 2000. Bugs active based on mean daily temperature $\geq 13^{\circ}\text{C}$ and mean daily wind speed < 6 mps (Walsh et al. 1992).

Figure 4

Distribution of caribou calves in the Bullen Point to Staines River study area, Alaska, during calving period (<20 June) surveys conducted in 1993, 1995, and 1997 to 2000.

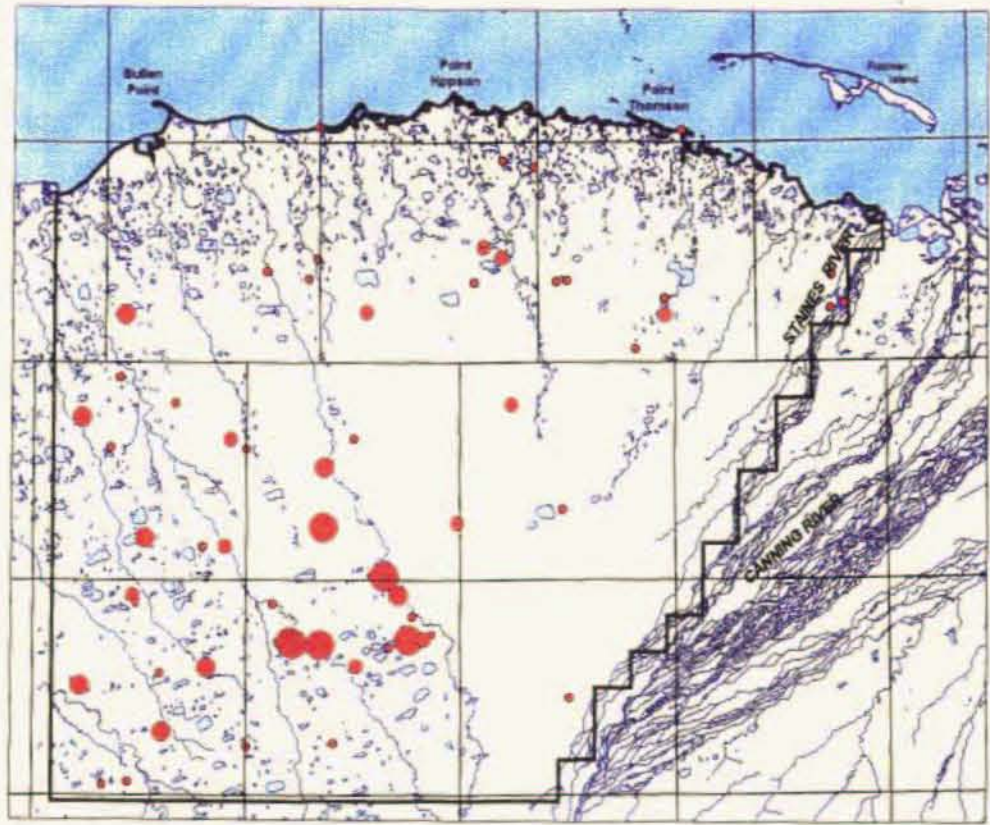
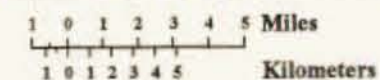
Number of Calves

- Less than 5
- 5 to 10
- 11 to 25
- Greater than 25
- Study Area Boundary

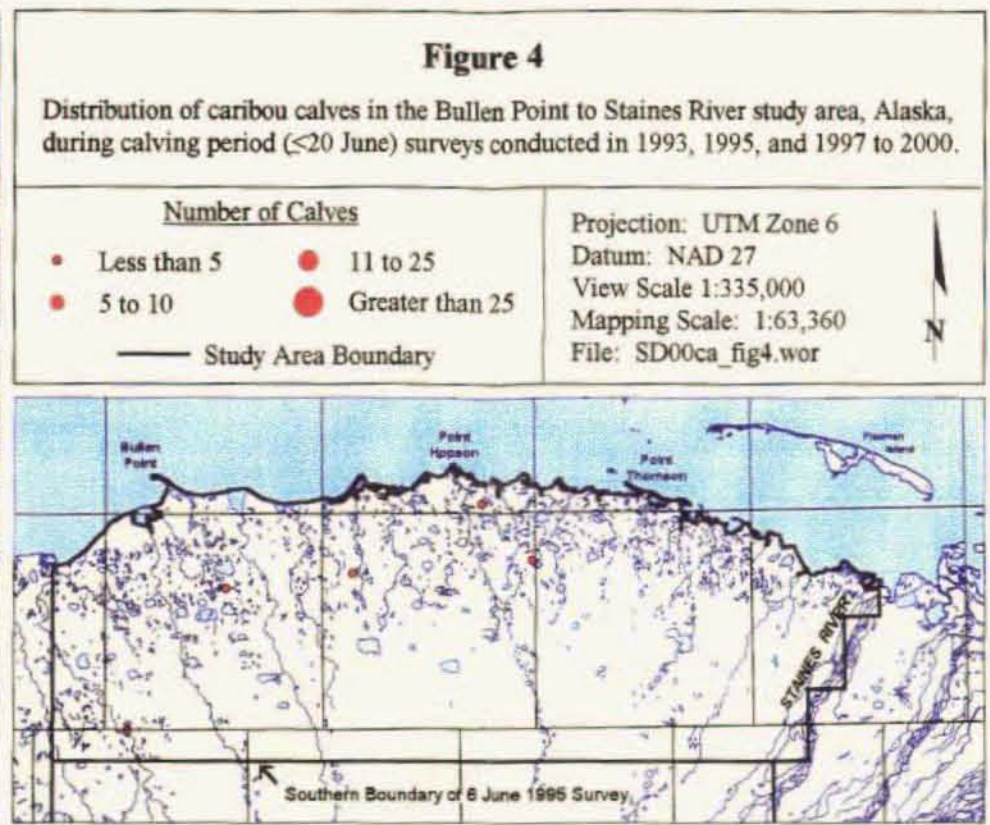
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File: SD00ca_fig4.wor



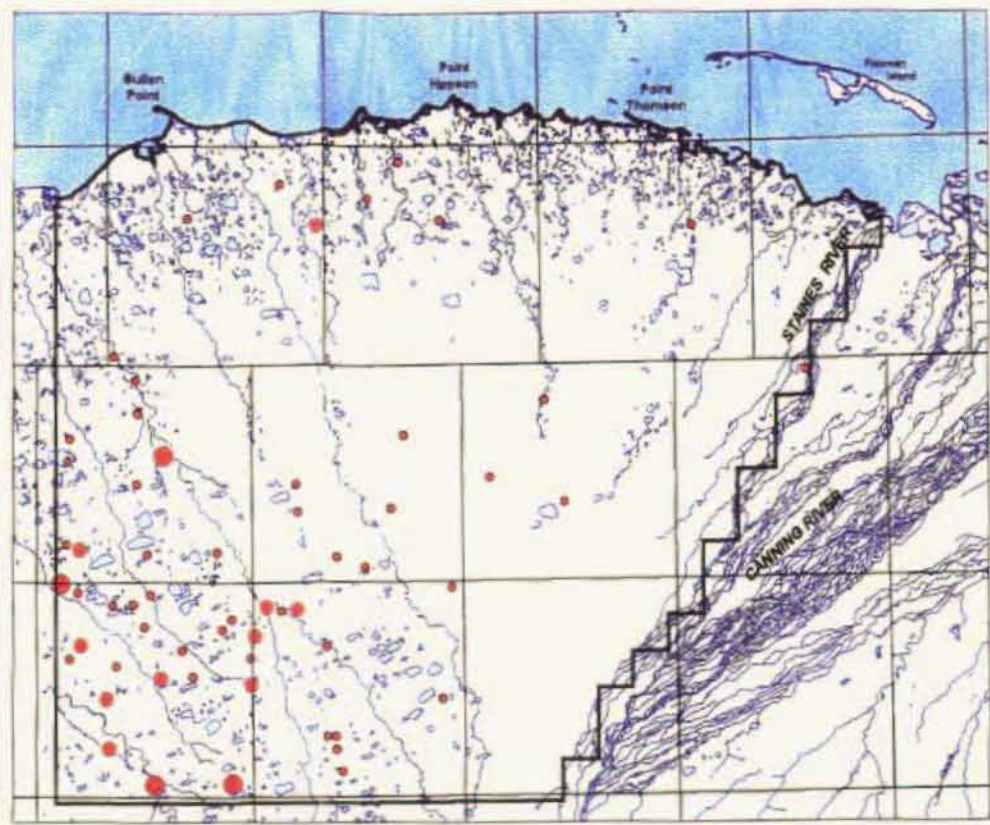
Southern Boundary of 6 June 1995 Survey



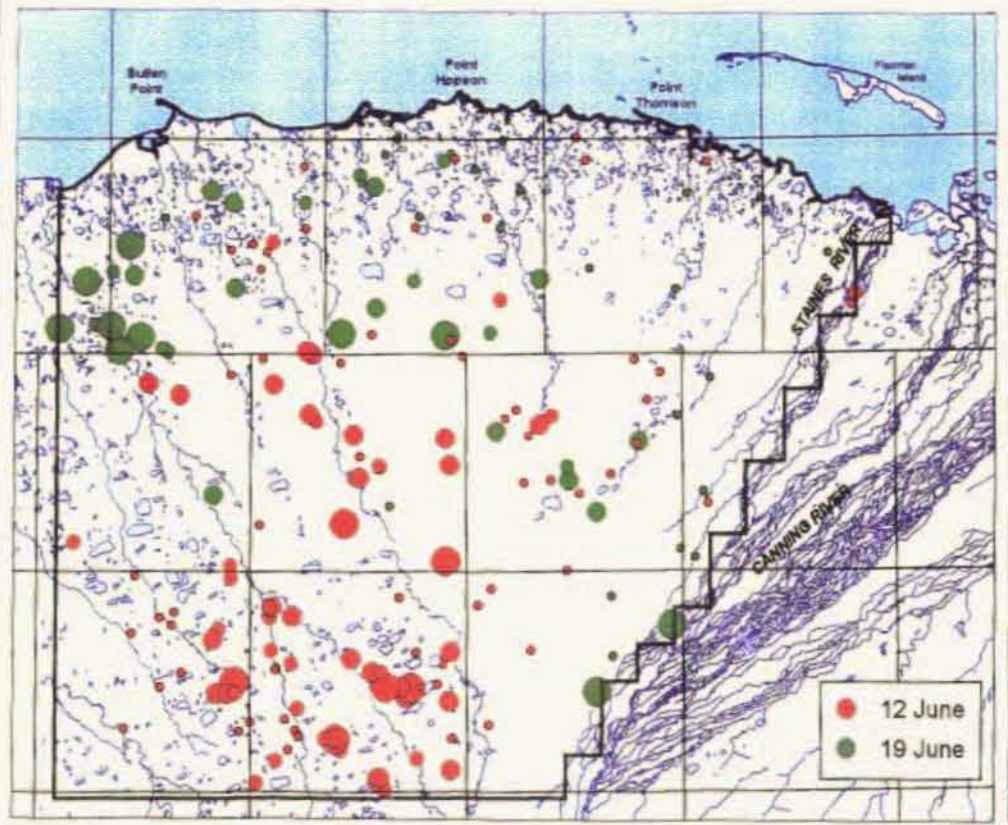
1993: 16 June Survey



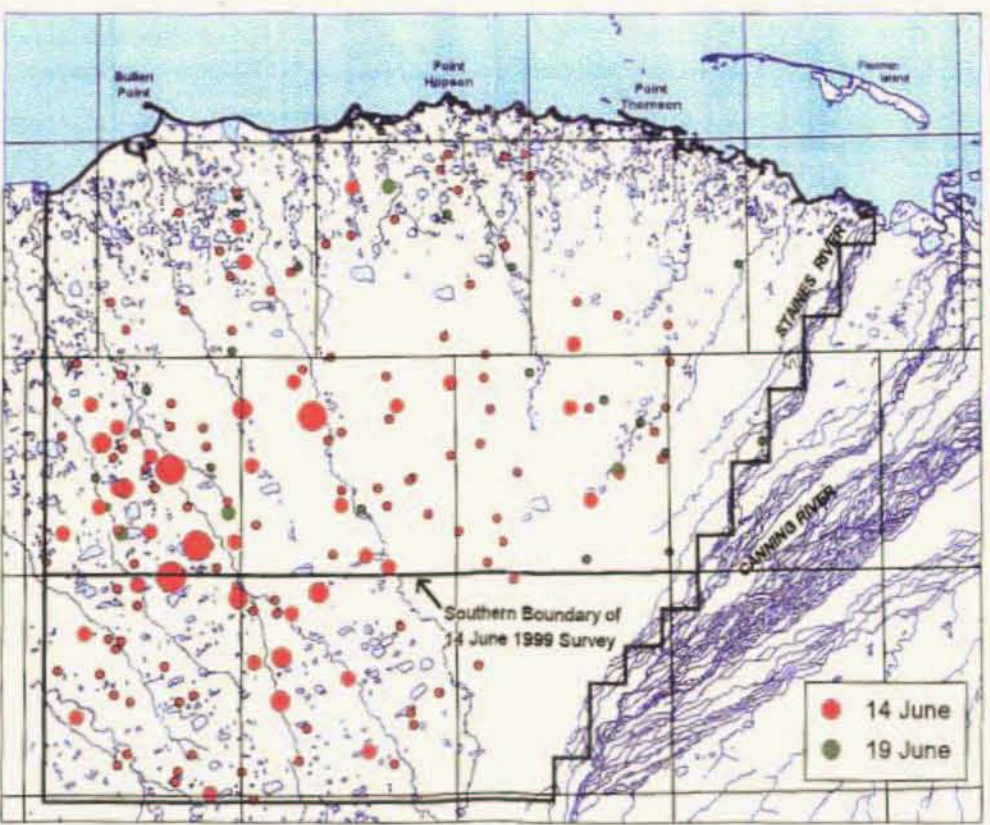
1995: 6 June Survey



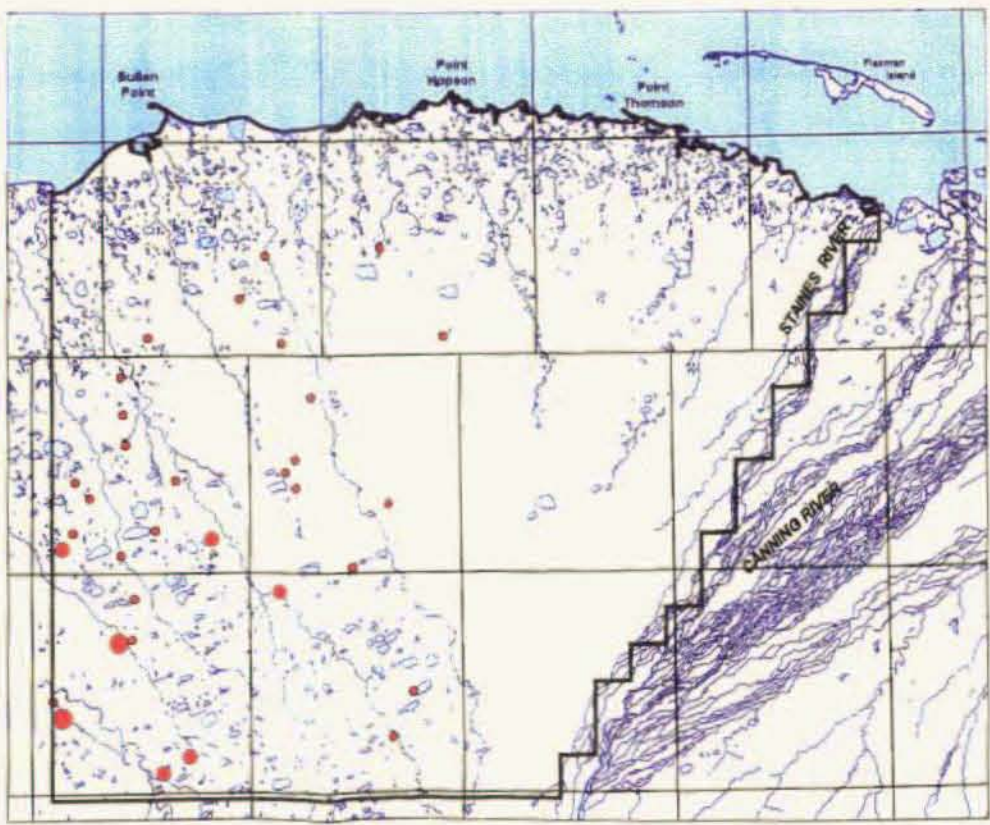
1997: 16 June Survey



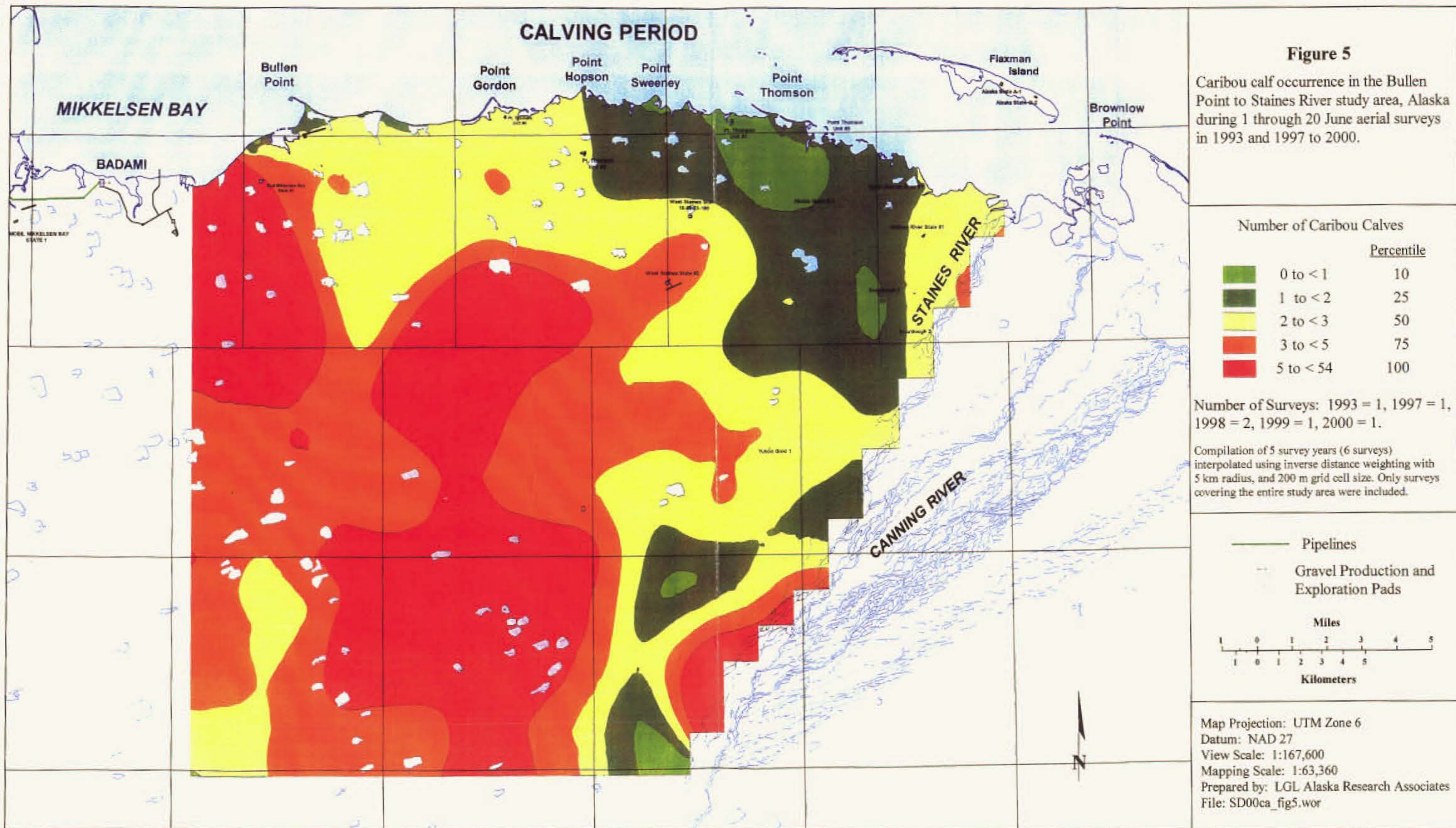
1998: 12 and 19 June Surveys



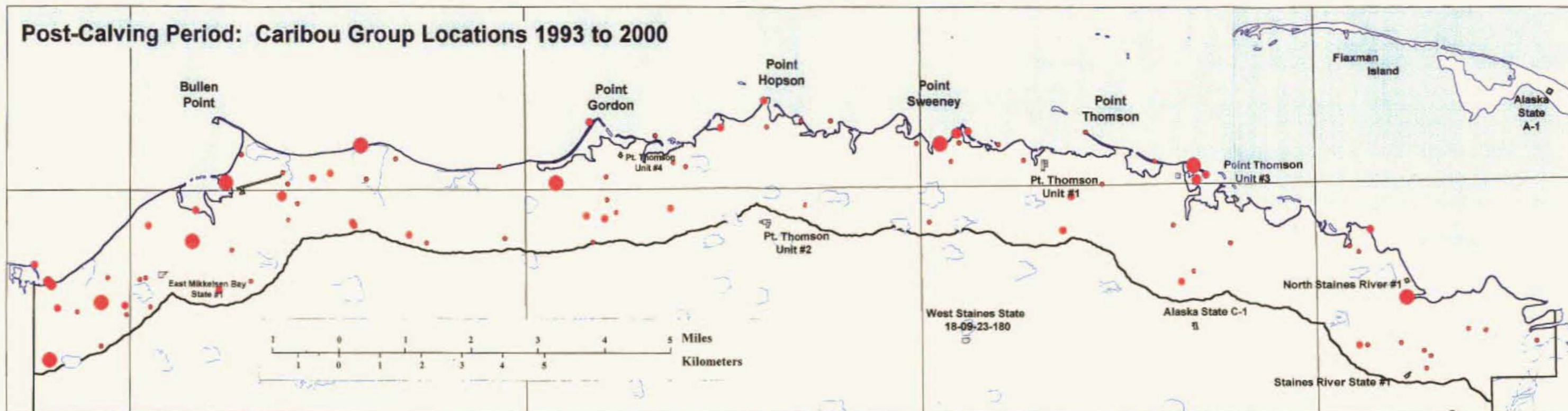
1999: 14 and 19 June Surveys



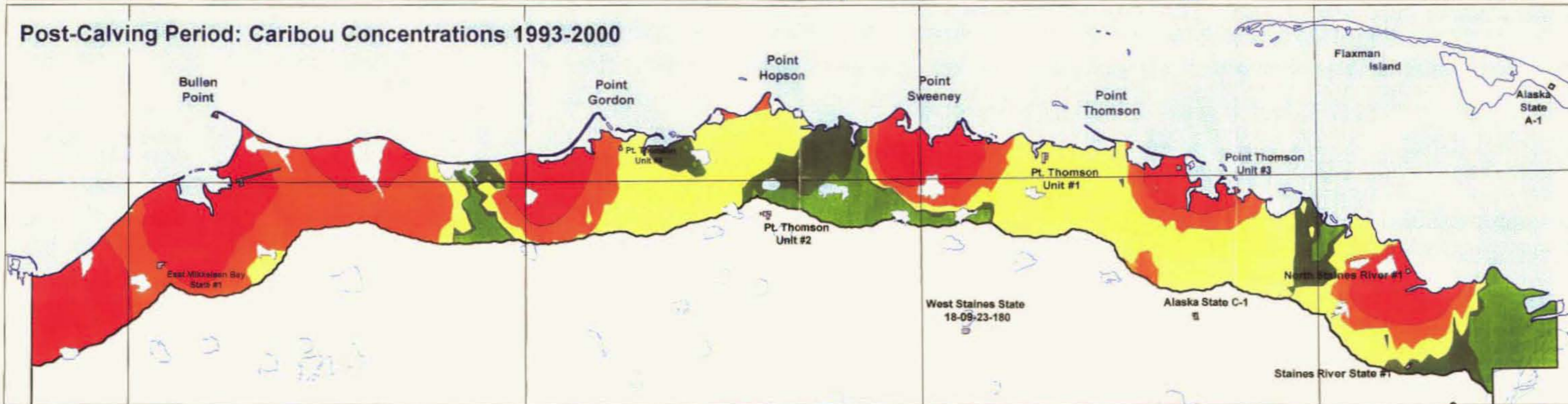
2000: 16 June Survey



Post-Calving Period: Caribou Group Locations 1993 to 2000



Post-Calving Period: Caribou Concentrations 1993-2000



Caribou Group Size		Number of Caribou		Boundary of 2 km Coastal Buffer	Gravel Production and Exploration Pads	Map Projection: UTM Zone 6 Datum: NAD 27 View Scale: 1:96,630 Mapping Scale: 1:63,360 Prepared by: LGL Alaska Research Associates, Inc. File: SD00ca_fig6.wor
	No. Groups		Percentile			
•	Less than 10	52	10			Figure 6 Caribou occurrence within 2 km of the coast in the Bullen Point to Staines River study area, Alaska, during 21 June through 31 July, based on aerial surveys conducted in 1993, 1995, and 1997 to 2000. Compilation of caribou sighting data from 23 aerial surveys, interpolated using inverse distance weighting with 2 km radius, and 200 m grid cell size.
•	10 to 100	24	25			
•	101 to 250	5	50			
•	Greater than 250	9	75			
•			100			

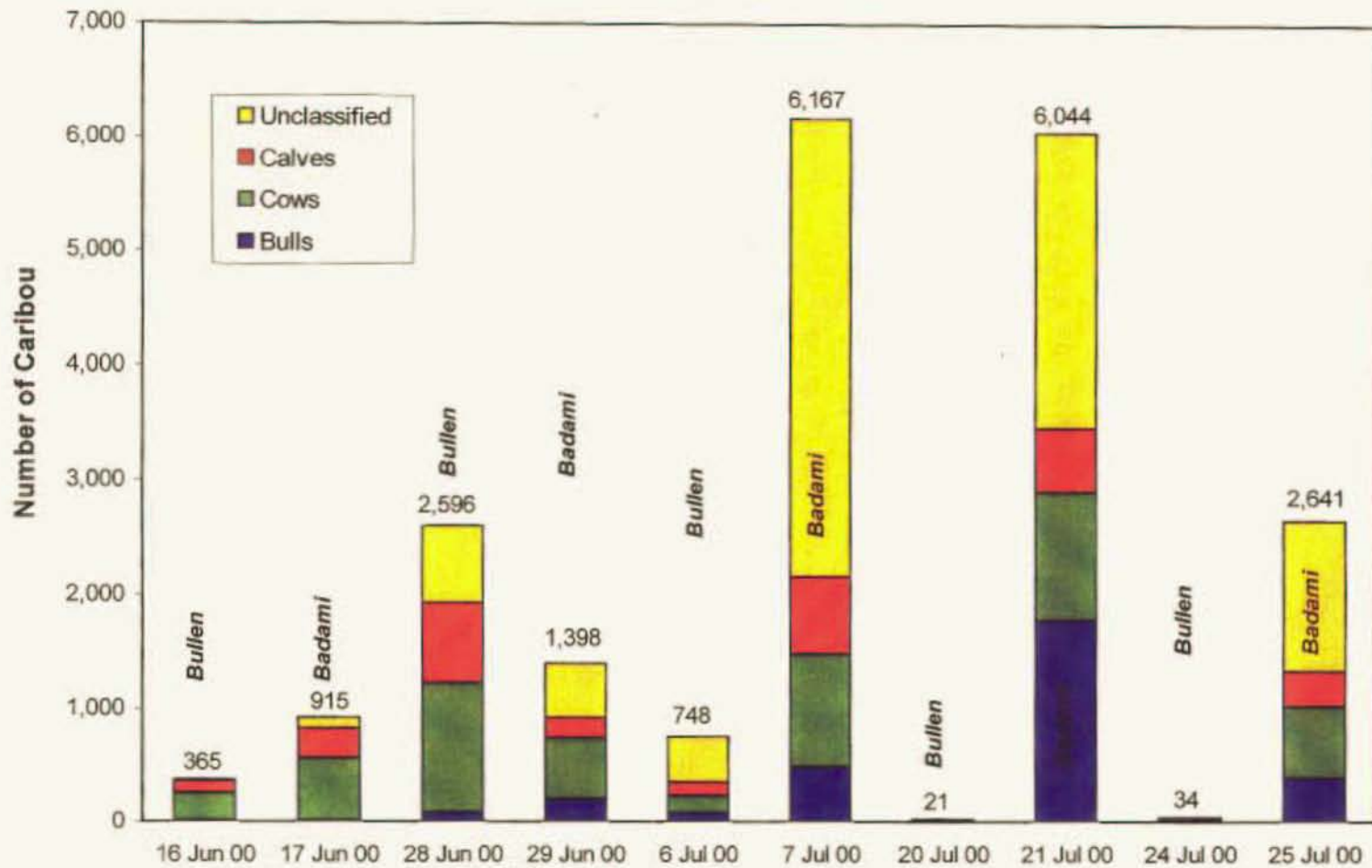


Figure 7. Comparison of the number of caribou by sex/age class during paired surveys in the Bullen Point to Staines River and the Badami study areas, Alaska, summer 2000.

Table 1. Sex and age classification of caribou and muskoxen observed during systematic aerial surveys in the Bullen Point to Staines River study area, Alaska, 16 June to 24 July 2000.

Flight	Date	Number of Caribou					Number of Groups
		Bulls	Cows	Calves	Unclass	Total	
Caribou							
1	16 Jun 00	0	241	107	17	365	66
2	28 Jun 00	76	1,145	700	675	2,596	188
3	6 Jul 00	70	152	118	408	748	22
4	20 Jul 00	2	5	5	9	21	8
5	24 Jul 00	6	4	2	22	34	12
Muskoxen							
1	16 Jun 00	0	0	0	2	2	1
2	28 Jun 00	2	2	0	15	19	3
3	6 Jul 00	0	0	0	0	0	
4	20 Jul 00	1	3	0	4	8	2
5	24 Jul 00	1	0	0	8	9	1

Table 2. Caribou densities (number/km²) by 1-km intervals from the Beaufort Sea coast in the Bullen Point to Staines River study area, Alaska, 16 June to 24 July 2000.

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	25	26	27	28	29	30		
Land Area (sq km)	43.6	37.5	37.2	36.7	36.6	37.3	37.6	38.0	38.2	37.4	34.9	34.6	32.6	31.4	31.0	30.3	30.7	30.6	28.6	27.6	28.0	27.9	27.1	24.2	23.9	23.9	20.3	16.4	13.3	7.2	904.5
Calving Period																															
Survey 1--16 June 2000																															
Total	0.00	0.05	0.00	0.19	0.00	0.21	0.00	0.13	0.05	0.21	0.09	0.12	0.25	0.61	1.13	0.76	0.85	0.46	0.18	2.76	0.61	0.18	1.18	0.08	0.00	1.97	0.39	0.37	0.23	0.00	365
	(0)	(2)	(0)	(7)	(0)	(8)	(0)	(5)	(2)	(8)	(3)	(4)	(8)	(19)	(35)	(23)	(26)	(14)	(5)	(76)	(17)	(5)	(32)	(2)	(0)	(47)	(8)	(6)	(3)	(0)	
Calves	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.05	0.03	0.05	0.03	0.03	0.06	0.16	0.45	0.26	0.26	0.13	0.00	0.80	0.21	0.04	0.44	0.00	0.00	0.50	0.00	0.12	0.00	0.00	107
	(0)	(0)	(0)	(0)	(0)	(4)	(0)	(2)	(1)	(2)	(1)	(1)	(2)	(5)	(14)	(8)	(8)	(4)	(0)	(22)	(6)	(1)	(12)	(0)	(0)	(12)	(0)	(2)	(0)	(0)	
Post-Calving Period																															
Survey 2--28 June 2000																															
Total	0.07	0.03	0.05	0.27	0.33	0.54	0.32	0.42	3.59	2.70	2.29	5.26	8.45	13.00	10.49	12.90	7.03	6.24	1.26	4.21	0.79	0.54	0.00	0.66	0.00	0.17	0.00	0.00	0.15	0.28	2596
	(3)	(1)	(2)	(10)	(12)	(20)	(12)	(16)	(137)	(101)	(80)	(182)	(276)	(408)	(325)	(391)	(216)	(191)	(36)	(116)	(22)	(15)	(0)	(16)	(0)	(4)	(0)	(0)	(2)	(2)	
Calves	0.00	0.00	0.03	0.03	0.11	0.16	0.08	0.03	1.26	0.83	0.57	1.56	2.27	3.79	3.16	3.69	1.66	0.98	0.11	1.34	0.21	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	700	
	(0)	(0)	(1)	(1)	(4)	(6)	(3)	(1)	(48)	(31)	(20)	(54)	(74)	(119)	(98)	(112)	(51)	(30)	(3)	(37)	(6)	(0)	(0)	(1)	(0)	(0)	(0)	(0)	(0)	(0)	
Survey 3--6 July 2000																															
Total	3.31	4.50	0.08	0.08	0.08	0.19	0.03	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	6.51	0.03	7.43	0.07	0.00	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	748
	(144)	(169)	(3)	(3)	(3)	(7)	(1)	(0)	(0)	(0)	(0)	(1)	(0)	(0)	(0)	(200)	(1)	(212)	(2)	(0)	(1)	(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	
Calves	0.69	0.27	0.03	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	2.66	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	118
	(30)	(10)	(1)	(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(76)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	
Survey 4--20 July 2000																															
Total	0.00	0.19	0.00	0.03	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.03	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	21
	(0)	(7)	(0)	(1)	(3)	(0)	(0)	(0)	(0)	(0)	(0)	(8)	(1)	(0)	(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	
Calves	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	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	5
	(0)	(3)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(2)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	
Survey 5--24 July 2000																															
Total	0.00	0.00	0.00	0.03	0.00	0.00	0.11	0.18	0.08	0.00	0.03	0.03	0.00	0.00	0.00	0.49	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	34
	(0)	(0)	(0)	(1)	(0)	(0)	(4)	(7)	(3)	(0)	(1)	(1)	(0)	(0)	(0)	(15)	(0)	(0)	(0)	(0)	(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(1)	(0)	
Calves	0.00	0.00	0.00	0.00	0.00	0.00	0.03	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	2
	(0)	(0)	(0)	(0)	(0)	(0)	(1)	(0)	(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	

Table 3. Caribou group sightings by activity and habitat types (Walker 1983; see Table 4) recorded during aerial strip-transect surveys conducted in the Bullen Point to Staines River study area, Alaska, 16 June to 24 July 2000.

Flight Activity	Water	Wet Sedge Tundra	Wet Sedge/Moist Sedge, Dwarf Shrub Tundra Complex	Wet Sedge/Moist Sedge/Barren Complex	Moist/Wet Sedge Complex	Moist Sedge, Dwarf Shrub Tundra	Moist Tussock Sedge, Dwarf Shrub Tundra	Dry, Dwarf Shrub, Crustose Lichen Tundra	Moist Graminoid, Dwarf Shrub Tundra/ Barren Complex	Dry Barren/Dwarf Shrub Forb Grass Complex	River Gravels	Wet Mud	No Habitat Data	Total
	Ia	IIla	IIId	IIIe	IVa	Va	Vb	Vc	Ve	IXb	Xa	Xb		
Flight 1 -- 16 June 2000														
Rest	0	0	0	0	0	3	0	3	1	0	0	0	3	10
Stand	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Feed	0	1	0	0	0	3	0	3	0	0	0	0	9	16
Walk	0	0	2	0	0	0	0	0	1	0	0	0	0	3
Trot	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Run	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Move	0	0	0	0	0	0	0	0	1	0	0	0	0	1
No Data	0	0	0	0	0	1	0	1	1	0	0	0	32	35
Total	0	1	2	0	0	7	0	8	4	0	0	0	44	66
Flight 2 -- 28 June 2000														
Rest	0	0	9	11	2	7	2	3	5	0	0	0	1	40
Stand	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Feed	0	0	9	8	0	6	2	2	1	0	0	0	0	28
Walk	0	0	2	1	0	1	2	0	0	1	0	0	0	7
Trot	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Run	0	0	1	1	0	1	0	0	0	0	0	0	0	3
Move	0	0	0	0	0	0	0	0	0	0	0	0	0	0
No Data	0	0	1	3	0	0	0	2	1	0	0	0	101	108
Total	0	0	22	24	2	16	6	8	7	0	1	0	102	188
Flight 3 -- 6 July 2000														
Rest	0	0	0	1	0	0	0	0	0	1	0	0	0	2
Stand	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Feed	0	0	2	2	0	3	0	0	1	0	0	0	1	9
Walk	0	0	0	0	0	1	1	0	0	0	0	0	0	2
Trot	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Run	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Move	1	0	1	0	0	0	0	0	0	0	0	1	1	4
Swim	0	0	0	0	0	0	0	0	0	0	0	0	1	1
No Data	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Total	1	2	3	3	0	4	1	1	1	2	0	1	3	22
Flight 4 -- 20 July 2000														
Rest	0	0	0	0	0	0	0	1	0	0	0	0	1	2
Stand	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Feed	0	1	1	0	0	1	1	0	0	0	0	0	0	4
Walk	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Trot	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Run	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Move	0	0	0	0	0	0	0	0	0	0	0	0	0	0
No Data	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Total	0	1	1	1	0	1	1	1	0	0	0	0	2	8
Flight 5 -- 24 July 2000														
Rest	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Stand	0	0	0	0	0	0	0	1	1	0	0	0	0	2
Feed	0	1	0	0	0	1	0	1	1	0	0	0	0	4
Walk	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Trot	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Run	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Move	0	0	0	0	0	0	0	1	0	0	0	0	0	1
No Data	0	0	0	0	0	0	0	0	0	0	0	0	3	3
Total	0	1	0	0	0	1	0	4	3	0	0	0	3	12

Table 4. Hierarchical vegetation categories based on Walker's (1983) vegetation classification.

LEVEL A SMALL- SCALE UNITS	LEVEL B LANDSAT- SCALE UNITS	LEVEL C PHOTO-INTERPRETED MAP UNITS	LEVEL D TYPICAL PLANT COMMUNITIES
A. Water	I. Water	Ia. Water (ponds, lakes, rivers, streams, saltwater)	No vegetation
B. Wet Tundra	II. Very Wet Tundra	IIb. Aquatic Graminoid Tundra (emergent vegetation)	Aquatic <i>Arctophila fulva</i> Grass Tundra Aquatic <i>Carex aquatilis</i> Sedge Tundra
		IIc. Water/Tundra Complex (pond complex with emergent vegetation)	Typical communities listed in IIb, IIIa, and Va
	III. Wet Tundra	IIIa. Wet Sedge Tundra	Wet <i>Carex aquatilis</i> , <i>Scorpidium scorpioides</i> Sedge Tundra (wettest facies of wet alkaline tundra) Wet <i>Carex aquatilis</i> , <i>Eriophorum angustifolium</i> , <i>Pedicularis sudetica</i> , <i>Drepanocladus brevifolius</i> Sedge Tundra (wet alkaline tundra) Wet <i>Eriophorum angustifolium</i> , <i>Dupontia fisheri</i> , <i>Campylium stellatum</i> Graminoid Tundra (wet acidic tundra, coastal areas)
		IIIb. Wet Graminoid Tundra (wet saline tundra, saltmarsh)	Wet <i>Carex subspathacea</i> , <i>Puccinellia phryganodes</i> , <i>Stellaria humifusa</i> , <i>Cochlearia officinalis</i> Sedge Tundra
		IIIc. Wet Sedge Tundra/Water Complex (pond complex, no emergent vegetation)	Typical communities listed in IIIa and Va
		IIId. Wet Sedge/Moist Sedge, Dwarf Shrub Tundra Complex (wet patterned-ground complex)	Typical communities listed in IIIa and Va, and sometimes IIb
		IIIe. Wet Sedge/Moist Sedge/Barren Complex (wet frost-scar tundra complex)	Typical communities listed in IIIa, Va and Ve
C. Moist Tundra	IV. Moist/Wet Tundra Complex	IVa. Moist Sedge, Dwarf Shrub/Wet Graminoid Tundra Complex (moist patterned ground complex)	Typical communities listed in IIIa and Va
	V. Moist or Dry Tundra	Va. Moist Sedge, Dwarf Shrub Tundra	Moist <i>Carex bigelowii</i> , <i>Eriophorum angustifolium</i> , <i>Dryas integrifolia</i> , <i>Salix reticulata</i> , <i>Tomenthypnum nitens</i> , <i>Thamnolia subuliformis</i> Sedge, Dwarf Shrub Tundra (moist alkaline tundra) Moist <i>Luzula arctica</i> , <i>Poa arctica</i> , <i>Saxifraga cernua</i> , <i>Salix planifolia</i> , <i>Dicranum elongatum</i> , <i>Ochrolechia frigida</i> Graminoid, Dwarf Shrub, Crustose Lichen Tundra (moist acidic tundra)

Table 4. Continued

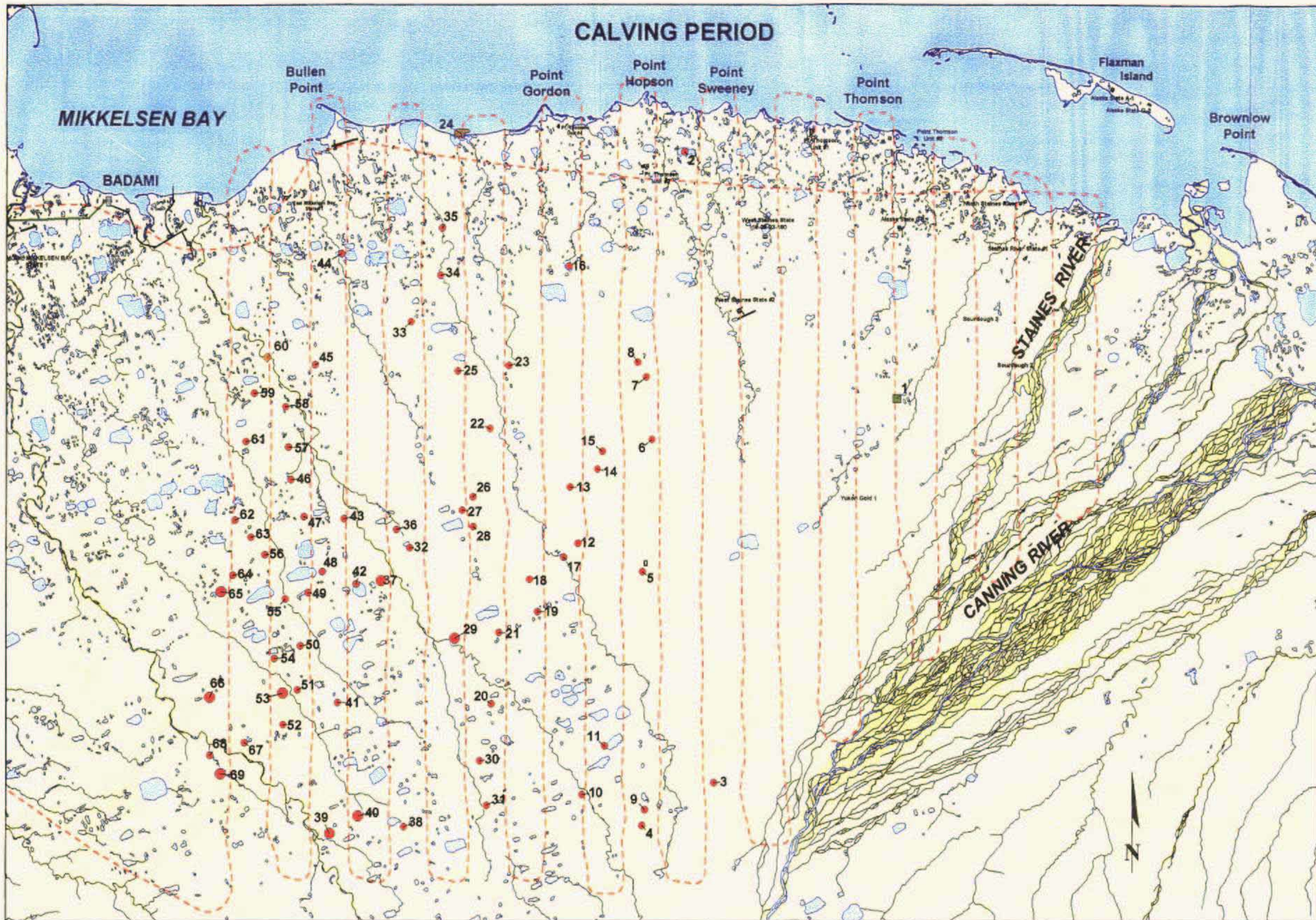
LEVEL A SMALL- SCALE UNITS	LEVEL B LANDSAT- SCALE UNITS	LEVEL C PHOTO-INTERPRETED MAP UNITS	LEVEL D TYPICAL PLANT COMMUNITIES
C. Moist Tundra (continued)	V. Moist or Dry Tundra (continued)	Va. Moist Sedge, Dwarf Shrub Tundra (continued)	Moist <i>Carex aquatilis</i> , <i>Eriophorum angustifolium</i> , <i>Salix planifolia</i> , <i>Campylium stellatum</i> Sedge, Dwarf Shrub Tundra (moist acidic tundra, wetter facies)
		Vb. Moist Tussock Sedge, Dwarf Shrub Tundra	Moist <i>Eriophorum vaginatum</i> , <i>Dryas integrifolia</i> , <i>Salix reticulata</i> , <i>S. arctica</i> , <i>Tomenthypnum nitens</i> , <i>Thamnolia subuliformis</i> , Tussock Sedge, Dwarf Shrub Tundra (alkaline tussock tundra) Moist <i>Eriophorum vaginatum</i> , <i>Dryas integrifolia</i> , <i>Salix planifolia</i> ssp. <i>pulchra</i> , <i>Salix reticulata</i> , <i>Hylocomium splendens</i> , <i>Ptilidium ciliare</i> , <i>Cetraria cucullata</i> Tussock Sedge, Dwarf Shrub Tundra (neutral to slightly acidic tussock tundra)
		Vc. Dry, Dwarf Shrub, Crustose Lichen Tundra (<i>Dryas</i> tundra, pingos, river bars)	Dry <i>Dryas integrifolia</i> , <i>Carex rupestris</i> , <i>Oxytropis nigrescens</i> , <i>Salix reticulata</i> , <i>Ditrichum flexicaule</i> , <i>Lecanora epibyron</i> Dwarf Shrub, Forb, Crustose Lichen Tundra (<i>Dryas</i> tundra, pingos) Dry <i>Dryas integrifolia</i> , <i>Astragalus alpinus</i> , <i>Oxytropis borealis</i> , <i>Salix reticulata</i> , <i>Distichium capillaceum</i> , <i>Lecanora epibyron</i> Dwarf Shrub, Forb, Crustose Lichen Tundra (<i>Dryas</i> tundra, river bars)
		Vd. Dry, Dwarf Shrub, Fruticose Lichen Tundra (dry acidic tundra)	Dry <i>Salix rotundifolia</i> , <i>Pedicularis kanei</i> , <i>Luzula arctica</i> , <i>Polytrichum</i> sp., <i>Alectoria nigricans</i> , <i>Cetraria islandica</i> Dwarf Shrub, Fruticose Lichen Tundra (dry acidic tundra near coast)
		Ve. Moist Graminoid, Dwarf Shrub Tundra/Barren Complex (frost-scar tundra complex)	Typical communities listed in Va plus either completely barren frost scars or communities such as: Dry <i>Saxifraga oppositifolia</i> , <i>Dryas integrifolia</i> , <i>Chrysanthemum integrifolium</i> , <i>Juncus biglumis</i> , <i>Arctagrostis latifolia</i> , <i>Ochrolechia frigida</i> Barren (alkaline frost scars)
E. Partially Vegetated and Barren	IX. Partially Vegetated	IXb. Dry Barren/Dwarf Shrub, Forb Grass Complex (forb rich river bars)	Typical communities listed in Vc, and mixed forb, grass and dwarf shrub communities such as: Dry <i>Bromus pumpehianus</i> , <i>Festuca rubra</i> , <i>Astragalus alpinus</i> , <i>Androsace chamaejasme</i> , <i>Salix ovalifolia</i> Grass, Forb, Dwarf Shrub Tundra (forb rich river bars) Dry <i>Dryas integrifolia</i> , <i>Artemisia borealis</i> , <i>A. glomerata</i> , <i>Salix ovalifolia</i> , <i>Androsace chamaejasme</i> Dwarf Shrub, Forb Tundra (<i>Dryas</i> river bars near arctic coast)

Table 4. Continued

LEVEL A SMALL- SCALE UNITS	LEVEL B LANDSAT- SCALE UNITS	LEVEL C PHOTO-INTERPRETED MAP UNITS	LEVEL D TYPICAL PLANT COMMUNITIES
E. Partially Vegetated and Barren (continued)	IX. Partially Vegetated (continued)	IXe. Dry Barren/Grass Complex (coastal sand dune grassland)	Dry <i>Elymus arenarius</i> Grass Tundra (coastal sand dune grassland)
		IXf. Dry Barren/Dwarf Shrub Grass complex (sand dune steppe)	Dry <i>Artemisia borealis</i> , <i>A. glomerata</i> , <i>Deschampsia caespitosa</i> , <i>Trisetum spicatum</i> Dwarf Shrub, Grass Tundra (sand dune steppe)
		IXg. Dry Barren/Low Shrub, Grass Complex (sand dune scrub)	Dry <i>Salix alaskensis</i> , <i>S. glauca</i> , <i>Elymus arenarius</i> , <i>Carex obtusata</i> , <i>Dryas integrifolia</i> Low Shrub, Tundra (sand dune scrub)
		IXh. Wet Barren/Wet Sedge Tundra Complex (barren/saline tundra complex, saltmarsh)	Typical communities listed in IIIb
		IXi. Dry Barren/Forb, Graminoid Complex (coastal barrens)	Dry <i>Cochlearia officinalis</i> , <i>Stellaria humifusa</i> , <i>Puccinellia phryganodes</i> , <i>P. andersonii</i> , <i>Salix ovalifolia</i> , <i>Potentilla pulchella</i> Forb, Graminoid Tundra (coastal saline barrens)
X. Light- colored Barrens (ground cover <30%)		Xa. River Gravels	Completely barren or with communities listed under IXb and IXc..
		Xb. Sand Dunes	Typical communities listed under IXe, IXf, IXg
		Xc. Barren Gravel Outcrops	Typical communities listed under Vd or IXe or the following among many others; <i>Dry Dryas octopetala</i> , <i>Lupinus arcticus</i> , <i>Potentilla biflora</i> , <i>Smelowski calycina</i> , <i>Saxifraga tricusoidata</i> , <i>Salix phlebophylla</i> , <i>Silene acaulis</i> Dwarf Shrub Barren (gravel outcrops)
		Xe. Gravel Roads and Pads	Completely barren or partially vegetated with communities similar to IXb and IXc
XI. Dark-colored Barrens (ground cover <30%)		XIa. Wet Mud (drained lakes and ponds)	Completely barren or occasionally with colonizing species such as <i>Deschampsia caespitosa</i> and <i>Senecio congestus</i>
		XIc. Bare Peat (mostly barren coastal areas caused by storm surges)	Completely barren or with sparse communities similar to IIIa, Va, and IXi

APPENDIX A

2000 DATA



CALVING PERIOD

Figure A-1

Distribution of large mammals in the Bullen Point to Staines River study area, Alaska, on 16 June 2000.

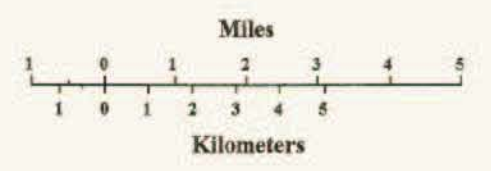
Caribou Group Size

	Groups
• Less than 10	58
• 10 to 100	8
• 101 to 250	0
• Greater than 250	0

- ◆ Arctic Fox
- Muskoxen
- Grizzly Bear

22 Group Attribute Number (see Tables A-1 and A-2)

- - - Survey Flight Lines
- Pipelines
- Oil Production and Service Facilities



Map Projection: UTM Zone 6
 Datum: NAD 27
 View Scale: 1:167,600
 Mapping Scale: 1:63,360
 Prepared by: LGL Alaska Research Associates
 File: SD00ca_a1.wor

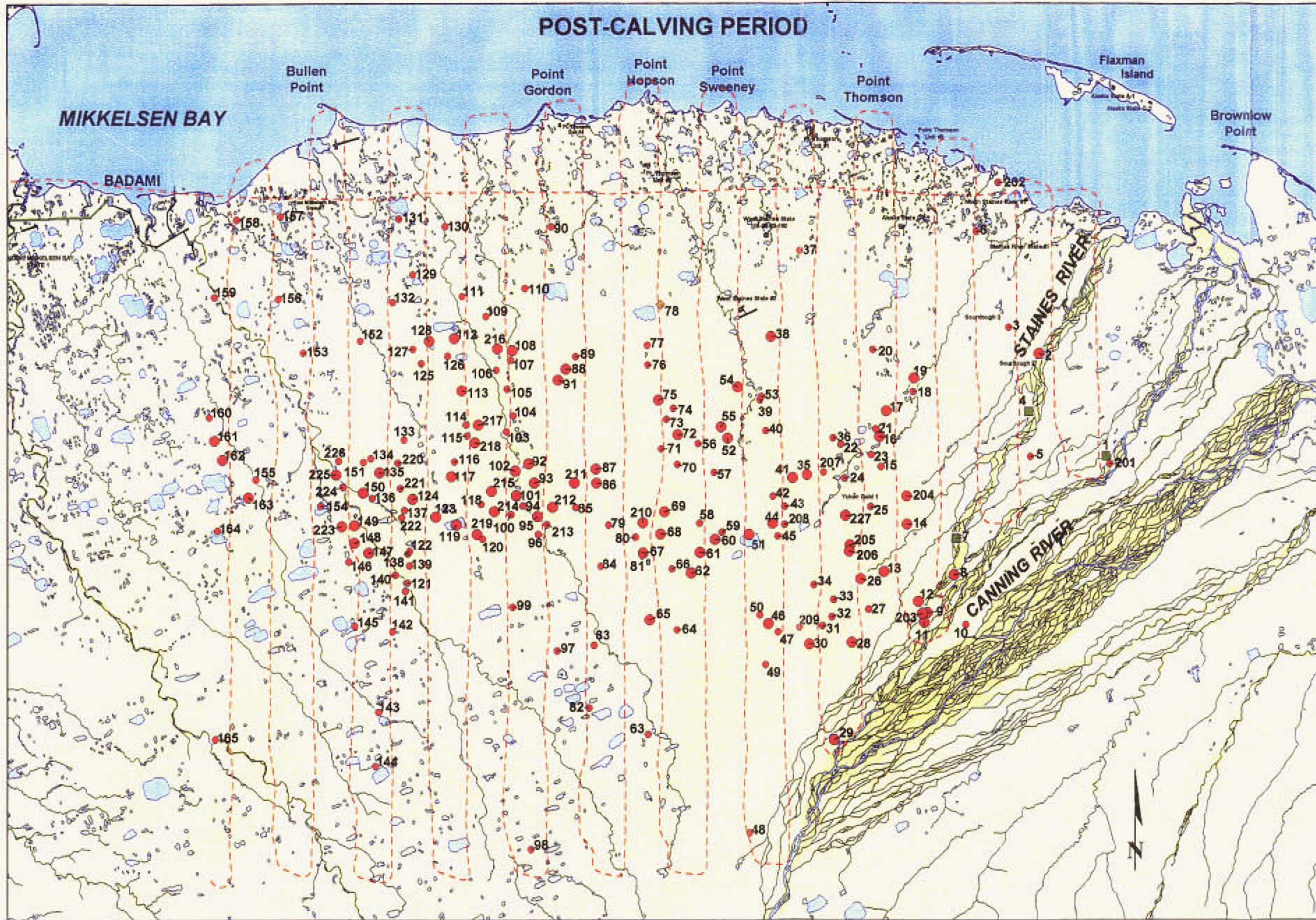


Figure A-2

Distribution of large mammals in the Bullen Point to Staines River study area, Alaska, on 28 June 2000.

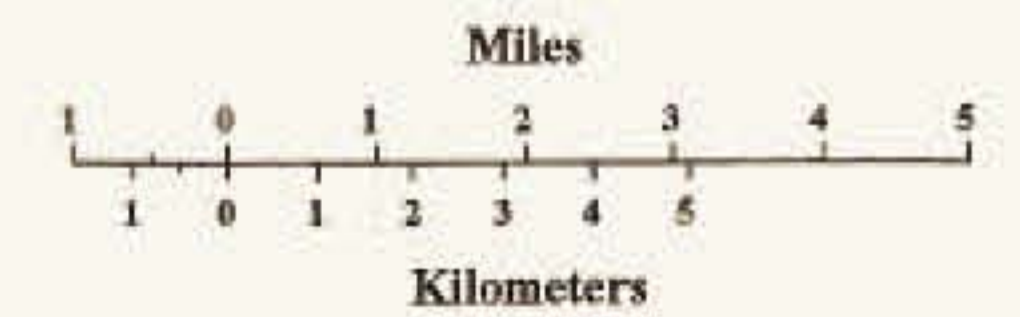
Caribou Group Size

	<u>Groups</u>
• Less than 10	115
• 10 to 100	73
• 101 to 250	0
• Greater than 250	0

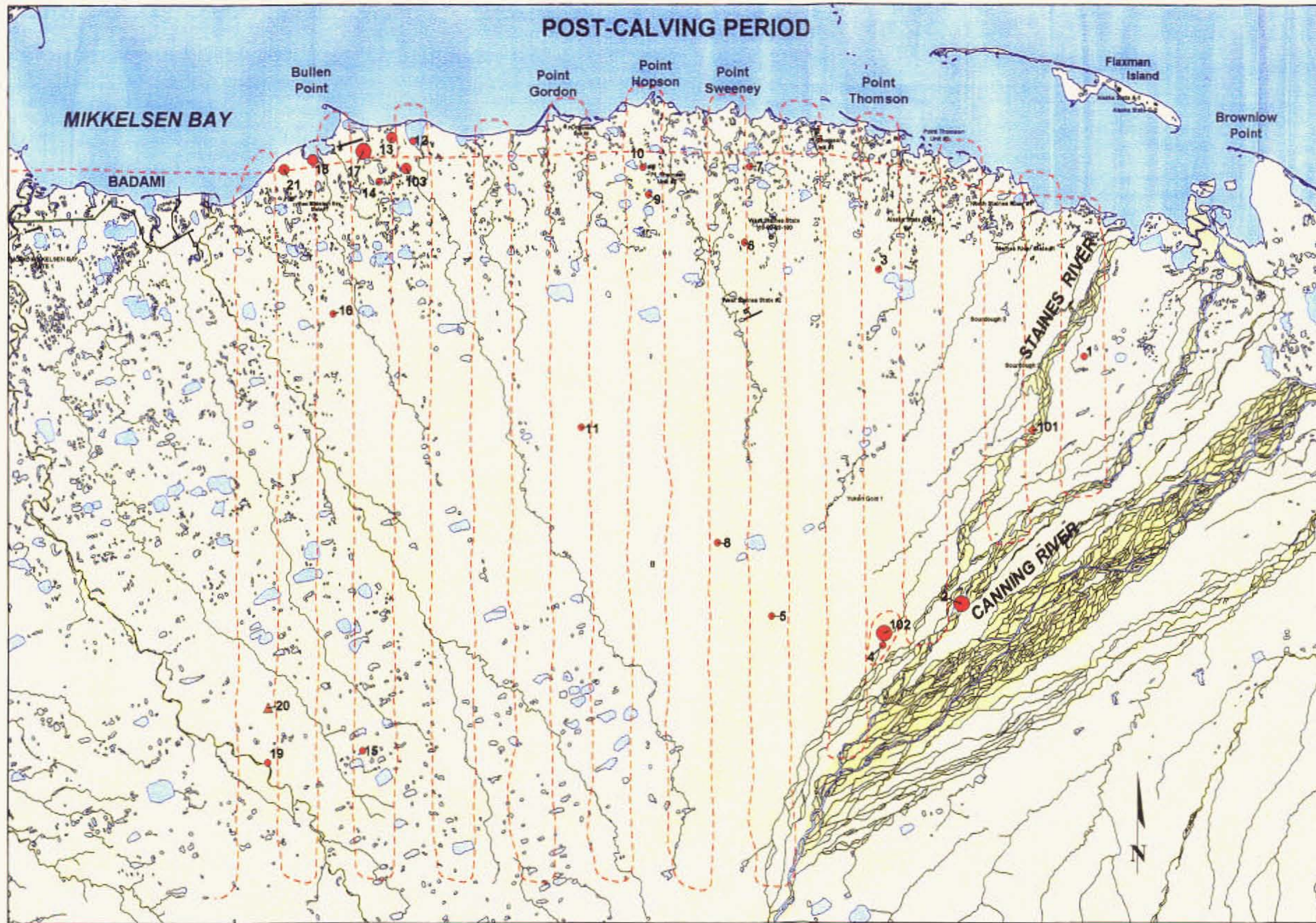
◆ Arctic Fox ■ Muskoxen

22 Group Attribute Number
(see Tables A-1 and A-2)

- Survey Flight Lines
- Pipelines
- Oil Production and Service Facilities



Map Projection: UTM Zone 6
 Datum: NAD 27
 View Scale: 1:167,600
 Mapping Scale: 1:63,360
 Prepared by: LGL Alaska Research Associates
 File: SD00ca_a2.wor



POST-CALVING PERIOD

Figure A-3

Distribution of large mammals in the Bullen Point to Staines River study area, Alaska, on 6 July 2000.

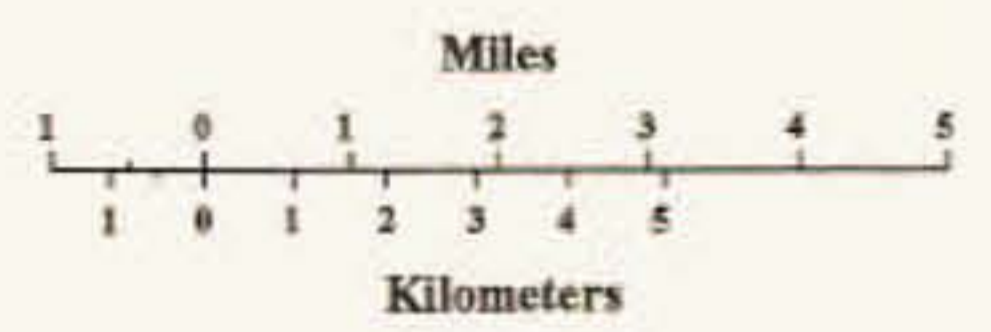
Caribou Group Size

Caribou Group Size	Groups
Less than 10	15
10 to 100	4
101 to 250	3
Greater than 250	0

- ◆ Arctic Fox
- ▲ Arctic Fox at Den

22 Group Attribute Number (see Tables A-1 and A-2)

- - - Survey Flight Lines
- Pipelines
- Oil Production and Service Facilities



Map Projection: UTM Zone 6
 Datum: NAD 27
 View Scale: 1:167,600
 Mapping Scale: 1:63,360
 Prepared by: LGL Alaska Research Associates
 File: SD00ca_a3.wor

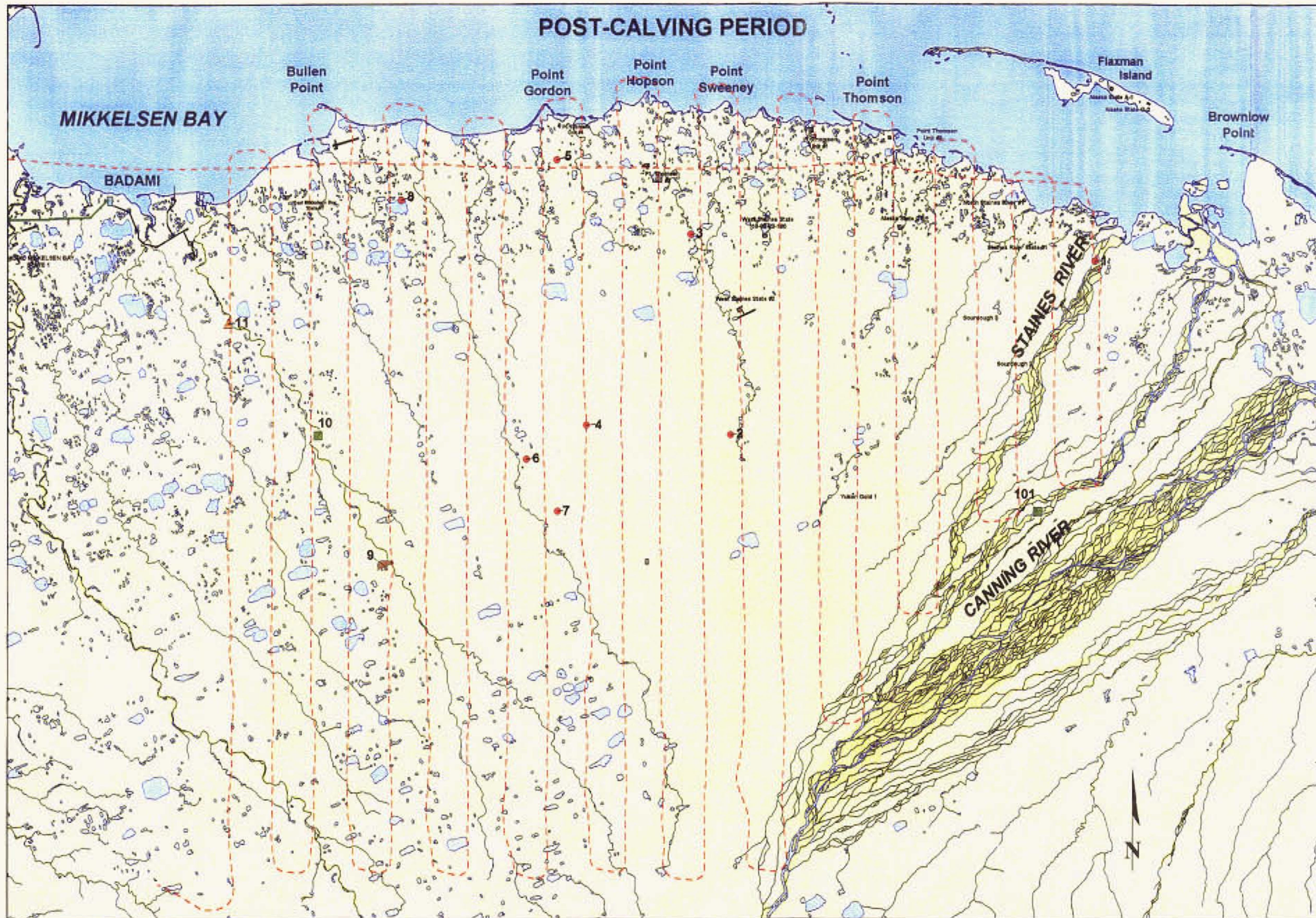


Figure A-4

Distribution of large mammals in the Bullen Point to Staines River study area, Alaska, on 20 July 2000.

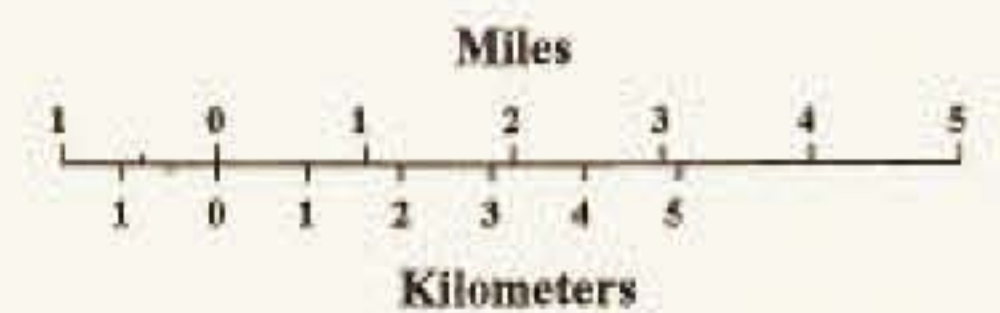
Caribou Group Size

Caribou Group Size	Groups
• Less than 10	8
• 10 to 100	0
• 101 to 250	0
• Greater than 250	0

- ▲ Arctic Fox at Den
- Grizzly Bear
- Muskoxen

22 Group Attribute Number (see Tables A-1 and A-2)

- - - Survey Flight Lines
- Pipelines
- Oil Production and Service Facilities



Map Projection: UTM Zone 6
 Datum: NAD 27
 View Scale: 1:167,600
 Mapping Scale: 1:63,360
 Prepared by: LGL Alaska Research Associates
 File: SD00ca_a4.wor

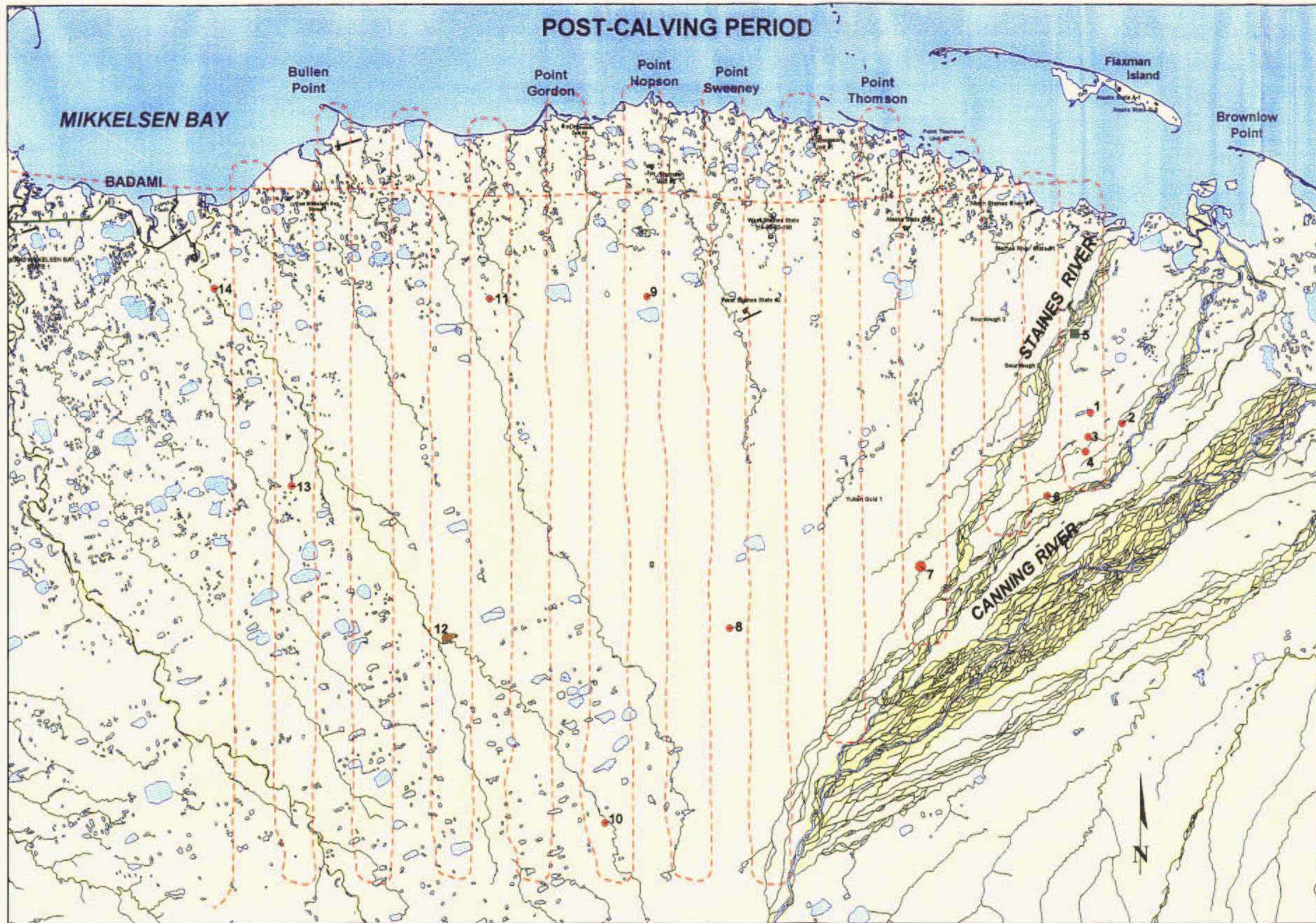


Figure A-5

Distribution of large mammals in the Bullen Point to Staines River study area, Alaska, on 24 July 2000.

Caribou Group Size

Caribou Group Size	Groups
Less than 10	11
10 to 100	1
101 to 250	0
Greater than 250	0

Grizzly Bear Muskoxen

Group Attribute Number (see Tables A-1 and A-2)

Survey Flight Lines

Pipelines

Oil Production and Service Facilities



Map Projection: UTM Zone 6
 Datum: NAD 27
 View Scale: 1:167,600
 Mapping Scale: 1:63,360
 Prepared by: LGL Alaska Research Associates
 File: SD00ca_a5.wor

Table A-1. Caribou sightings in the Bullen Point to Staines River study area, Alaska, summer 2000. Coordinates are longitude/latitude on the WGS 1984 ellipsoid. Time is Alaska Daylight Savings Time. See Table 4 for habitat code definitions.

Longitude°W	Latitude°N	Date	Time ADST	Flight	Attribute	Species	Bulls	Cows	Calves	Unclass	Total	Behavior	Direction	Habitat
146.476407	70.168131	16 Jun 00	11:54:54	1	2	ca	0	2	0	0	2	feed		Vc
146.450004	69.936183	16 Jun 00	12:02:44	1	3	ca	0	2	0	2	4	rest		Va
146.526971	69.920714	16 Jun 00	12:05:03	1	4	ca	0	2	0	0	2	feed		Va
146.525358	70.013587	16 Jun 00	12:08:17	1	5	ca	0	2	0	0	2			Ve
146.514097	70.062483	16 Jun 00	12:09:57	1	6	ca	0	1	0	0	1	feed		Va
146.519885	70.085651	16 Jun 00	12:10:45	1	7	ca	0	1	0	0	1			
146.529145	70.091103	16 Jun 00	12:10:56	1	8	ca	0	1	1	0	2			
146.523798	69.926469	16 Jun 00	12:23:56	1	9	ca	0	0	0	1	1			
146.591003	69.932061	16 Jun 00	12:26:33	1	10	ca	0	2	2	0	4	move		Ve
146.566718	69.949683	16 Jun 00	12:27:10	1	11	ca	0	1	1	1	3	feed		IIIa
146.594305	70.024186	16 Jun 00	12:29:44	1	12	ca	0	2	2	0	4	walk	w	Ve
146.602200	70.045081	16 Jun 00	12:30:27	1	13	ca	0	3	0	0	3			
146.573086	70.051616	16 Jun 00	12:30:41	1	14	ca	0	0	0	1	1	walk		IIIId
146.567277	70.058139	16 Jun 00	12:30:54	1	15	ca	0	1	0	0	1	walk		IIIId
146.602021	70.126649	16 Jun 00	12:33:16	1	16	ca	0	2	2	0	4	rest		Vc
146.609617	70.019145	16 Jun 00	12:41:30	1	17	ca	0	0	0	3	3			
146.645741	70.011105	16 Jun 00	12:41:46	1	18	ca	0	3	0	0	3			
146.637340	69.999062	16 Jun 00	12:42:12	1	19	ca	0	4	4	0	8	feed		
146.686600	69.965340	16 Jun 00	12:48:01	1	20	ca	0	2	0	0	2	rest		Ve
146.678154	69.991531	16 Jun 00	12:48:55	1	21	ca	0	1	0	0	1	rest		Va
146.686675	70.066907	16 Jun 00	12:51:31	1	22	ca	0	5	1	0	6			
146.666446	70.090365	16 Jun 00	12:52:19	1	23	ca	0	1	0	0	1	feed		Va
146.721265	70.088363	16 Jun 00	12:59:00	1	25	ca	0	1	1	0	2	rest		Vc
146.705547	70.041683	16 Jun 00	13:00:35	1	26	ca	0	4	3	0	7			
146.717114	70.036779	16 Jun 00	13:00:45	1	27	ca	0	5	3	0	8	rest		Vc
146.705178	70.030588	16 Jun 00	13:00:58	1	28	ca	0	1	1	0	2			

Table A-1 Continued.

Longitude°W	Latitude°N	Date	Time ADST	Flight	Attribute	Species	Bulls	Cows	Calves	Unclass	Total	Behavior	Direction	Habitat
146.725348	69.989481	16 Jun 00	13:02:22	1	29	ca	0	6	6	2	14			Vc
146.698871	69.944662	16 Jun 00	13:03:53	1	30	ca	0	1	0	0	1			
146.691872	69.928495	16 Jun 00	13:04:26	1	31	ca	0	0	0	2	2	stand		Vc
146.773450	70.022896	16 Jun 00	13:09:55	1	32	ca	0	3	0	0	3			
146.771318	70.106535	16 Jun 00	13:12:49	1	33	ca	0	1	1	0	2			
146.739426	70.123683	16 Jun 00	13:13:25	1	34	ca	0	2	2	0	4			
146.737425	70.140950	16 Jun 00	13:14:01	1	35	ca	0	0	0	5	5	rest		
146.788016	70.029558	16 Jun 00	13:21:17	1	36	ca	0	1	0	0	1			
146.804915	70.010681	16 Jun 00	13:21:57	1	37	ca	0	8	5	0	13	feed		
146.780475	69.920737	16 Jun 00	13:25:05	1	38	ca	0	4	0	0	4			
146.860390	69.918386	16 Jun 00	13:26:43	1	39	ca	0	25	5	0	30			
146.829877	69.924665	16 Jun 00	13:26:56	1	40	ca	0	7	6	0	13	feed		Vc
146.851931	69.965908	16 Jun 00	13:28:25	1	41	ca	0	1	0	0	1			
146.831832	70.009502	16 Jun 00	13:29:57	1	42	ca	0	3	0	0	3			
146.844756	70.033729	16 Jun 00	13:30:48	1	43	ca	0	3	3	0	6			Va
146.847180	70.131656	16 Jun 00	13:34:13	1	44	ca	0	2	0	0	2	rest		Va
146.875497	70.090828	16 Jun 00	13:39:54	1	45	ca	0	1	1	0	2	feed		Vc
146.901585	70.048211	16 Jun 00	13:41:23	1	46	ca	0	3	1	0	4	feed		
146.887979	70.034500	16 Jun 00	13:41:51	1	47	ca	0	4	0	0	4			
146.868223	70.014147	16 Jun 00	13:42:34	1	48	ca	0	5	3	0	8			
146.883535	70.006381	16 Jun 00	13:42:50	1	49	ca	0	1	0	0	1			
146.891727	69.986781	16 Jun 00	13:43:31	1	50	ca	0	5	4	0	9			
146.894971	69.970693	16 Jun 00	13:44:04	1	51	ca	0	4	2	0	6	feed		
146.910260	69.957969	16 Jun 00	13:48:43	1	52	ca	0	1	0	0	1			
146.910432	69.969498	16 Jun 00	13:49:07	1	53	ca	0	40	12	0	52	feed		
146.919251	69.982300	16 Jun 00	13:49:35	1	54	ca	0	2	0	0	2			
146.907605	70.004121	16 Jun 00	13:50:21	1	55	ca	0	4	2	0	6	rest		
146.929418	70.020496	16 Jun 00	13:50:55	1	56	ca	0	1	0	0	1			
146.904230	70.060409	16 Jun 00	13:52:19	1	57	ca	0	1	1	0	2	rest		

Table A-1 Continued.

Longitude°W	Latitude°N	Date	Time ADST	Flight	Attribute	Species	Bulls	Cows	Calves	Unclass	Total	Behavior	Direction	Habitat
146.906973	70.075416	16 Jun 00	13:52:51	1	58	ca	0	1	1	0	2	feed		
146.940208	70.080502	16 Jun 00	13:53:02	1	59	ca	0	1	0	0	1			
146.949367	70.062524	16 Jun 00	14:00:14	1	61	ca	0	3	0	0	3			
146.960921	70.033383	16 Jun 00	14:01:16	1	62	ca	0	1	1	0	2			
146.944045	70.027090	16 Jun 00	14:01:28	1	63	ca	0	3	2	0	5			
146.963059	70.013047	16 Jun 00	14:01:58	1	64	ca	0	2	2	0	4			
146.975758	70.006963	16 Jun 00	14:02:10	1	65	ca	0	12	9	0	21	feed		
146.987840	69.968235	16 Jun 00	14:03:30	1	66	ca	0	6	4	0	10	feed		
146.950911	69.951466	16 Jun 00	14:04:05	1	67	ca	0	3	0	0	3			
146.987173	69.946969	16 Jun 00	14:04:14	1	68	ca	0	1	1	0	2	feed		
146.976041	69.940248	16 Jun 00	14:04:28	1	69	ca	0	20	12	0	32			
146.024683	70.051019	28 Jun 00	12:54:20	2	201	ca	2	0	0	0	2	rest		IVa
146.098125	70.092149	28 Jun 00	12:56:36	2	2	ca	0	4	4	2	10	rest		Ve
146.139138	70.155134	28 Jun 00	12:59:17	2	202	ca	0	0	0	2	2	walk	e	Va
146.130005	70.102040	28 Jun 00	13:01:06	2	3	ca	0	3	2	0	5	rest		Va
146.108574	70.054080	28 Jun 00	13:02:46	2	5	ca	0	0	0	2	2	rest		IIIId
146.163212	70.137305	28 Jun 00	13:07:47	2	6	ca	0	1	1	0	2			
146.191854	70.010682	28 Jun 00	13:14:59	2	8	ca	0	0	0	35	35	rest		IVa
146.221160	69.996828	28 Jun 00	13:15:27	2	9	ca	0	0	0	40	40	rest		Vb
146.179917	69.992426	28 Jun 00	13:15:37	2	10	ca	1	0	0	0	1	feed		IIIId
146.224598	69.993342	28 Jun 00	13:16:33	2	11	ca	0	0	0	18	18			
146.226635	69.996612	28 Jun 00	13:16:40	2	203	ca	0	0	0	40	40	rest		Vb
146.230807	70.001141	28 Jun 00	13:16:51	2	12	ca	0	5	5	20	30			
146.267291	70.012154	28 Jun 00	13:17:14	2	13	ca	8	4	4	6	22			Ve
146.242001	70.029623	28 Jun 00	13:17:50	2	14	ca	15	35	20	20	90			
146.242075	70.040073	28 Jun 00	13:18:12	2	204	ca	0	20	10	5	35	walk		Vb
146.269164	70.050994	28 Jun 00	13:18:35	2	15	ca	4	0	0	4	8			
146.270435	70.062245	28 Jun 00	13:18:58	2	16	ca	0	8	5	20	33	rest		IIIe
146.262895	70.071675	28 Jun 00	13:19:17	2	17	ca	0	4	3	5	12			

Table A-1 Continued.

Longitude°W	Latitude°N	Date	Time ADST	Flight	Attribute	Species	Bulls	Cows	Calves	Unclass	Total	Behavior	Direction	Habitat
146.233797	70.078692	28 Jun 00	13:19:31	2	18	ca	0	0	0	5	5			
146.232692	70.083741	28 Jun 00	13:19:41	2	19	ca	0	3	3	5	11	walk		IIIId
146.276220	70.094394	28 Jun 00	13:26:28	2	20	ca	0	3	1	1	5	feed		IIIe
146.274391	70.065034	28 Jun 00	13:27:29	2	21	ca	0	0	0	3	3	feed		Va
146.312300	70.059438	28 Jun 00	13:27:40	2	22	ca	0	0	0	4	4	rest		Vc
146.279705	70.055482	28 Jun 00	13:27:49	2	23	ca	0	3	0	0	3	feed		IIIe
146.309022	70.046994	28 Jun 00	13:28:06	2	24	ca	0	0	0	3	3	feed		Vc
146.280698	70.036311	28 Jun 00	13:28:29	2	25	ca	0	5	0	0	5			
146.322488	69.950806	28 Jun 00	13:32:15	2	29	ca	9	0	0	4	13	rest		Vc
146.308006	70.033103	28 Jun 00	13:28:36	2	204	ca	0	5	5	3	13	walk	s	Vb
146.303454	70.022183	28 Jun 00	13:29:00	2	205	ca	0	16	16	0	32	feed		Vb
146.304206	70.019907	28 Jun 00	13:29:05	2	206	ca	0	20	20	10	50	feed		Vb
146.292202	70.009659	28 Jun 00	13:29:27	2	26	ca	0	3	3	10	16			
146.284172	69.998472	28 Jun 00	13:29:51	2	27	ca	0	3	3	2	8	run		IIIId
146.302245	69.986279	28 Jun 00	13:30:17	2	28	ca	0	15	15	10	40	walk		IIIId
146.348818	69.985762	28 Jun 00	13:33:28	2	30	ca	0	20	20	5	45	rest		IIIId
146.334006	69.992498	28 Jun 00	13:33:42	2	31	ca	0	2	1	0	3			Vc
146.323514	69.995788	28 Jun 00	13:33:48	2	32	ca	0	4	2	0	6			Vc
146.321434	70.002142	28 Jun 00	13:34:01	2	33	ca	0	5	4	0	9	feed		IIIId
146.342740	70.007647	28 Jun 00	13:34:12	2	34	ca	0	2	2	1	5	rest		IIIe
146.349425	70.048328	28 Jun 00	13:35:36	2	35	ca	0	40	40	10	90			IIIe
146.331134	70.049263	28 Jun 00	13:35:38	2	207	ca	0	4	2	0	6	rest		IIIId
146.320337	70.061848	28 Jun 00	13:36:04	2	36	ca	0	2	0	0	2	feed		IIIId
146.355102	70.131347	28 Jun 00	13:38:28	2	37	ca	0	0	0	1	1	feed		IIIe
146.387469	70.099764	28 Jun 00	13:43:30	2	38	ca	0	6	5	0	11			
146.399814	70.076463	28 Jun 00	13:44:17	2	39	ca	0	0	0	3	3			
146.393950	70.064928	28 Jun 00	13:44:41	2	40	ca	0	2	1	0	3			
146.365382	70.047388	28 Jun 00	13:45:18	2	41	ca	0	25	20	5	50	feed		IIIId
146.387021	70.040669	28 Jun 00	13:45:32	2	42	ca	0	5	2	0	7			

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Table A-1 Continued.

Longitude°W	Latitude°N	Date	Time ADST	Flight	Attribute	Species	Bulls	Cows	Calves	Unclass	Total	Behavior	Direction	Habitat
146.374373	70.036732	28 Jun 00	13:45:40	2	43	ca	0	1	0	0	1	rest		IIIe
146.387497	70.030577	28 Jun 00	13:45:53	2	44	ca	0	20	10	0	30			
146.374384	70.030103	28 Jun 00	13:45:54	2	208	ca	0	0	1	1	2	rest		IIIe
146.381964	70.025847	28 Jun 00	13:46:03	2	45	ca	0	5	2	2	9			
146.393106	69.993625	28 Jun 00	13:47:10	2	46	ca	0	0	0	15	15			
146.359224	69.992138	28 Jun 00	13:47:13	2	209	ca	0	0	0	3	3	rest		IIIId
146.382860	69.990483	28 Jun 00	13:47:17	2	47	ca	0	6	1	0	7			
146.415315	69.917554	28 Jun 00	13:51:08	2	48	ca	0	0	0	2	2			
146.396483	69.978582	28 Jun 00	13:53:15	2	49	ca	0	0	0	2	2			
146.402409	69.996799	28 Jun 00	13:53:52	2	50	ca	0	2	2	4	8			
146.413496	70.026594	28 Jun 00	13:54:53	2	51	ca	0	12	5	0	17			
146.435287	70.062396	28 Jun 00	13:56:07	2	52	ca	0	14	7	0	21	rest		Va
146.398299	70.077675	28 Jun 00	13:56:38	2	53	ca	0	0	0	2	2			
146.423936	70.081316	28 Jun 00	13:56:45	2	54	ca	0	8	8	3	19	feed		IIIe
146.442300	70.066623	28 Jun 00	14:05:08	2	55	ca	0	0	0	15	15	rest		IIIId
146.466742	70.060406	28 Jun 00	14:05:21	2	56	ca	0	1	0	0	1			
146.450109	70.049745	28 Jun 00	14:05:42	2	57	ca	4	0	0	0	4	feed		IIIId
146.465866	70.030907	28 Jun 00	14:06:20	2	58	ca	0	1	1	0	2			
146.442156	70.027617	28 Jun 00	14:06:27	2	59	ca	0	0	0	1	1	rest		IIIe
146.449971	70.025002	28 Jun 00	14:06:33	2	60	ca	0	6	4	0	10			
146.465845	70.020138	28 Jun 00	14:06:43	2	61	ca	0	5	2	5	12			
146.475567	70.012588	28 Jun 00	14:06:59	2	62	ca	0	0	0	20	20			
146.522838	69.953370	28 Jun 00	14:13:07	2	63	ca	0	4	0	0	4	rest		IIIe
146.491164	69.991646	28 Jun 00	14:14:25	2	64	ca	0	0	0	2	2			
146.520459	69.995444	28 Jun 00	14:14:33	2	65	ca	0	7	5	0	12	rest		IIIe
146.496058	70.014183	28 Jun 00	14:15:10	2	66	ca	0	0	0	2	2			
146.526822	70.020011	28 Jun 00	14:15:22	2	67	ca	0	15	10	5	30	rest		
146.508268	70.027036	28 Jun 00	14:15:37	2	68	ca	0	15	10	0	25			
146.526875	70.031288	28 Jun 00	14:15:45	2	210	ca	1	5	5	0	11	walk		IIIe

Table A-1 Continued.

Longitude°W	Latitude°N	Date	Time ADST	Flight	Attribute	Species	Bulls	Cows	Calves	Unclass	Total	Behavior	Direction	Habitat
146.503739	70.035266	28 Jun 00	14:15:53	2	69	ca	0	50	25	20	95			
146.489336	70.052823	28 Jun 00	14:16:28	2	70	ca	0	3	0	0	3			
146.506574	70.058494	28 Jun 00	14:16:40	2	71	ca	0	4	1	0	5	run		IIIe
146.488798	70.063850	28 Jun 00	14:16:51	2	72	ca	0	40	30	20	90			
146.500814	70.069607	28 Jun 00	14:17:03	2	73	ca	0	4	2	0	6			
146.493288	70.073597	28 Jun 00	14:17:12	2	74	ca	0	1	1	0	2			
146.509187	70.076699	28 Jun 00	14:17:18	2	75	ca	0	30	30	10	70	feed		IIIId
146.520626	70.089703	28 Jun 00	14:17:46	2	76	ca	0	0	0	4	4	rest		Vc
146.520852	70.097029	28 Jun 00	14:18:02	2	77	ca	0	5	3	0	8	feed		IIIId
146.564035	70.030490	28 Jun 00	14:27:15	2	79	ca	0	0	0	5	5			
146.534924	70.026002	28 Jun 00	14:27:24	2	80	ca	0	5	2	2	9	rest		Ve
146.527960	70.019026	28 Jun 00	14:27:39	2	81	ca	0	0	3	0	3	feed		IIIe
146.586082	69.963277	28 Jun 00	14:34:21	2	82	ca	1	0	0	0	1			
146.580331	69.986173	28 Jun 00	14:35:07	2	83	ca	0	5	0	0	5			
146.572815	70.015256	28 Jun 00	14:36:05	2	84	ca	0	3	0	0	3			
146.598832	70.037010	28 Jun 00	14:36:49	2	85	ca	0	2	2	0	4			
146.576481	70.046072	28 Jun 00	14:37:08	2	86	ca	0	20	10	10	40			
146.600044	70.046158	28 Jun 00	14:37:08	2	211	ca	0	8	7	0	15	rest		Ve
146.577099	70.051240	28 Jun 00	14:37:18	2	87	ca	0	15	6	0	21			
146.608268	70.088472	28 Jun 00	14:38:36	2	88	ca	0	0	0	10	10	rest		Ve
146.597466	70.092925	28 Jun 00	14:38:46	2	89	ca	0	4	4	0	8	rest		IIIe
146.622640	70.140664	28 Jun 00	14:44:00	2	90	ca	0	2	0	0	2	run	e	Va
146.616532	70.084403	28 Jun 00	14:45:52	2	91	ca	0	15	5	5	25	feed		IIIe
146.648159	70.053405	28 Jun 00	14:46:52	2	92	ca	0	40	15	10	65			
146.642586	70.046284	28 Jun 00	14:47:06	2	93	ca	0	10	8	0	18			
146.654471	70.037838	28 Jun 00	14:47:23	2	94	ca	0	2	2	2	6			
146.623156	70.037236	28 Jun 00	14:47:24	2	212	ca	0	6	4	0	10			
146.639424	70.033785	28 Jun 00	14:47:31	2	95	ca	0	20	10	5	35			
146.629332	70.030687	28 Jun 00	14:47:37	2	213	ca	0	5	3	0	8	rest		IIIe

Table A-1 Continued.

Longitude°W	Latitude°N	Date	Time ADST	Flight	Attribute	Species	Bulls	Cows	Calves	Unclass	Total	Behavior	Direction	Habitat
146.638795	70.027219	28 Jun 00	14:47:44	2	96	ca	0	5	3	0	8			
146.619385	69.984143	28 Jun 00	14:49:12	2	97	ca	4	0	0	0	4	feed		III d
146.648098	69.912098	28 Jun 00	14:52:44	2	98	ca	0	0	0	2	2			
146.665891	70.000405	28 Jun 00	14:55:47	2	99	ca	0	5	0	0	5			
146.667064	70.034660	28 Jun 00	14:56:57	2	100	ca	0	4	0	2	6			
146.685248	70.035746	28 Jun 00	14:56:59	2	214	ca	0	15	10	5	30	rest		III d
146.661494	70.041677	28 Jun 00	14:57:12	2	101	ca	0	10	3	2	15			
146.687790	70.043311	28 Jun 00	14:57:15	2	215	ca	0	5	5	0	10			III e
146.662441	70.050787	28 Jun 00	14:57:31	2	102	ca	0	20	12	7	39			
146.671742	70.065373	28 Jun 00	14:58:01	2	103	ca	0	0	0	1	1	rest		V a
146.664413	70.071301	28 Jun 00	14:58:13	2	104	ca	0	1	0	0	1			
146.670479	70.081134	28 Jun 00	14:58:35	2	105	ca	1	2	0	0	3			
146.681926	70.088253	28 Jun 00	14:58:50	2	106	ca	1	0	0	0	1	feed		V a
146.666737	70.091888	28 Jun 00	14:58:58	2	107	ca	0	3	4	0	7			
146.664761	70.095364	28 Jun 00	14:59:05	2	108	ca	0	8	7	0	15			
146.680718	70.096136	28 Jun 00	14:59:07	2	216	ca	0	20	20	10	50			III d
146.692815	70.108047	28 Jun 00	14:59:32	2	109	ca	0	0	0	3	3	feed		III e
146.650785	70.118277	28 Jun 00	14:59:54	2	110	ca	0	0	0	5	5			
146.718723	70.115475	28 Jun 00	15:04:50	2	111	ca	0	3	2	0	5			
146.727278	70.100008	28 Jun 00	15:05:20	2	112	ca	0	10	6	1	17			
146.719598	70.080687	28 Jun 00	15:05:57	2	113	ca	0	8	4	0	12			
146.714757	70.068083	28 Jun 00	15:06:21	2	114	ca	0	3	2	0	5			
146.701655	70.068046	28 Jun 00	15:06:21	2	217	ca	5	15	10	0	30			
146.713682	70.063993	28 Jun 00	15:06:29	2	115	ca	0	2	0	0	2			
146.705499	70.061382	28 Jun 00	15:06:34	2	218	ca	0	10	5	5	20			
146.727591	70.054315	28 Jun 00	15:06:48	2	116	ca	0	1	0	2	3			
146.731189	70.048861	28 Jun 00	15:06:58	2	117	ca	0	5	5	7	17			
146.699263	70.038508	28 Jun 00	15:07:18	2	118	ca	1	1	0	2	4			
146.725941	70.030869	28 Jun 00	15:07:33	2	119	ca	0	5	5	4	14			

Table A-1 Continued.

Longitude°W	Latitude°N	Date	Time ADST	Flight	Attribute	Species	Bulls	Cows	Calves	Unclass	Total	Behavior	Direction	Habitat
146.703876	70.027366	28 Jun 00	15:07:40	2	219	ca	2	20	10	5	37			
146.697874	70.025659	28 Jun 00	15:07:43	2	120	ca	2	0	0	0	2			
146.778835	70.009512	28 Jun 00	15:16:04	2	121	ca	3	0	0	0	3	feed		Vc
146.778164	70.020321	28 Jun 00	15:16:27	2	122	ca	0	0	0	7	7			IIIe
146.748177	70.033900	28 Jun 00	15:16:55	2	123	ca	0	7	5	0	12			
146.772975	70.040528	28 Jun 00	15:17:09	2	124	ca	0	50	20	10	80			
146.763131	70.090720	28 Jun 00	15:18:58	2	125	ca	0	2	0	0	2			
146.734687	70.093431	28 Jun 00	15:19:04	2	126	ca	0	0	0	3	3			
146.771977	70.095916	28 Jun 00	15:19:09	2	127	ca	0	3	0	0	3	rest		Ve
146.754140	70.099011	28 Jun 00	15:19:16	2	128	ca	0	8	3	0	11			
146.772118	70.123436	28 Jun 00	15:20:09	2	129	ca	0	7	2	0	9	feed		Va
146.736476	70.141046	28 Jun 00	15:20:47	2	130	ca	0	0	0	3	3			
146.786648	70.143849	28 Jun 00	15:24:03	2	131	ca	0	1	1	0	2	feed		Va
146.793848	70.113298	28 Jun 00	15:25:01	2	132	ca	0	1	1	0	2	feed		IIIId
146.781852	70.062466	28 Jun 00	15:26:39	2	133	ca	0	5	0	0	5	rest		IIIe
146.817979	70.055515	28 Jun 00	15:26:52	2	134	ca	0	0	0	6	6			
146.788695	70.053920	28 Jun 00	15:26:55	2	220	ca	0	1	1	0	2	rest		IIIId
146.808558	70.050360	28 Jun 00	15:27:02	2	135	ca	0	12	10	10	32			
146.786094	70.044535	28 Jun 00	15:27:13	2	221	ca	0	5	0	0	5			
146.816690	70.040796	28 Jun 00	15:27:20	2	136	ca	0	0	0	3	3			
146.781955	70.036333	28 Jun 00	15:27:29	2	137	ca	0	6	3	0	9	feed		IIIe
146.784804	70.033659	28 Jun 00	15:27:34	2	222	ca	0	5	4	0	9	rest		IIIId
146.776491	70.021177	28 Jun 00	15:27:58	2	138	ca	0	0	0	4	4			
146.776350	70.015907	28 Jun 00	15:28:08	2	139	ca	0	0	0	7	7			
146.791573	70.012390	28 Jun 00	15:28:15	2	140	ca	5	0	0	0	5			
146.781090	70.006405	28 Jun 00	15:28:27	2	141	ca	3	0	0	0	3	walk		Xa
146.794756	69.991571	28 Jun 00	15:28:56	2	142	ca	0	1	0	0	1	rest		IIIId
146.810536	69.962001	28 Jun 00	15:29:54	2	143	ca	0	0	0	4	4			
146.813768	69.942280	28 Jun 00	15:30:34	2	144	ca	0	1	1	0	2			

Table A-1 Continued.

	Longitude°W	Latitude°N	Date	Time ADST	Flight	Attribute	Species	Bulls	Cows	Calves	Unclass	Total	Behavior	Direction	Habitat
	146.835938	69.993605	28 Jun 00	15:35:40	2	145	ca	0	1	0	0	1	stand		Vc
	146.841758	70.017277	28 Jun 00	15:36:29	2	146	ca	2	0	0	0	2	rest		Va
	146.820833	70.020582	28 Jun 00	15:36:38	2	147	ca	0	0	0	11	11			
	146.835706	70.024353	28 Jun 00	15:36:46	2	148	ca	0	11	2	0	13			
	146.849166	70.030423	28 Jun 00	15:36:59	2	223	ca	0	20	10	5	35	feed		Va
	146.836003	70.030791	28 Jun 00	15:37:00	2	149	ca	0	30	15	0	45			
	146.826565	70.042821	28 Jun 00	15:37:25	2	150	ca	0	4	4	15	23			
	146.847500	70.044931	28 Jun 00	15:37:30	2	224	ca	0	7	1	0	8	rest		Va
	146.855347	70.049621	28 Jun 00	15:37:40	2	225	ca	0	10	6	0	16	rest		Va
	146.826143	70.054152	28 Jun 00	15:37:50	2	151	ca	0	1	1	6	8			
	146.852269	70.054747	28 Jun 00	15:37:51	2	226	ca	0	4	2	0	6	rest		Va
	146.828993	70.099011	28 Jun 00	15:39:26	2	152	ca	0	0	0	3	3			
	146.889632	70.094784	28 Jun 00	15:45:38	2	153	ca	0	2	0	0	2			
A-14	146.871856	70.038127	28 Jun 00	15:47:27	2	154	ca	1	0	0	2	3	feed		Ve
	146.940163	70.048090	28 Jun 00	15:57:21	2	155	ca	0	0	0	2	2	feed		Va
	146.915672	70.114805	28 Jun 00	15:59:45	2	156	ca	0	5	2	0	7			
	146.913453	70.144996	28 Jun 00	16:00:52	2	157	ca	0	0	0	1	1			
	146.960101	70.143873	28 Jun 00	16:02:37	2	158	ca	0	1	0	0	1	trot	n	Va
	146.984705	70.115556	28 Jun 00	16:03:31	2	159	ca	0	3	0	0	3			
	146.990173	70.071230	28 Jun 00	16:04:55	2	160	ca	0	0	0	3	3			
	146.984751	70.062475	28 Jun 00	16:05:12	2	161	ca	0	4	4	4	12			
	146.975936	70.055380	28 Jun 00	16:05:26	2	162	ca	0	30	20	10	60			
	146.948240	70.041439	28 Jun 00	16:05:53	2	163	ca	0	12	4	0	16	rest		IIIe
	146.981320	70.029266	28 Jun 00	16:06:16	2	164	ca	1	0	0	2	3			
	146.983700	69.952379	28 Jun 00	16:08:46	2	165	ca	0	1	0	0	1			
	146.056038	70.091621	6 Jul 00	11:07:26	3	1	ca	0	0	0	7	7	feed		Va
	146.189828	70.000915	6 Jul 00	11:31:08	3	2	ca	20	0	0	180	200	stand		IXb
	146.273422	69.990317	6 Jul 00	11:32:12	3	102	ca	0	76	76	60	212	move	w	Ia
	146.275027	70.124456	6 Jul 00	11:41:18	3	3	ca	2	0	0	0	2	feed		IIIe

Table A-1 Continued.

Longitude°W	Latitude°N	Date	Time ADST	Flight	Attribute	Species	Bulls	Cows	Calves	Unclass	Total	Behavior	Direction	Habitat
146.275014	69.985917	6 Jul 00	11:48:10	3	4	ca	1	0	0	0	1	move	n	III d
146.394852	69.997150	6 Jul 00	12:05:39	3	5	ca	0	1	0	0	1	walk	e	V b
146.420642	70.135079	6 Jul 00	12:17:56	3	6	ca	0	0	0	1	1	feed		III e
146.413519	70.162683	6 Jul 00	12:18:54	3	7	ca	0	1	0	0	1	feed		III d
146.452577	70.024471	6 Jul 00	12:26:06	3	8	ca	0	0	0	1	1	feed		III d
146.523019	70.152810	6 Jul 00	12:39:53	3	9	ca	0	2	1	0	3	feed		V e
146.528907	70.162804	6 Jul 00	12:40:13	3	10	ca	0	1	1	0	2	feed		V a
146.597739	70.067438	6 Jul 00	12:58:03	3	11	ca	0	1	0	0	1	trot		III a
146.775072	70.172668	6 Jul 00	13:42:11	3	12	ca	9	0	0	0	9	swim		
146.798075	70.173933	6 Jul 00	13:43:20	3	13	ca	0	20	20	15	55			V c
146.782852	70.162742	6 Jul 00	13:43:45	3	103	ca	3	10	10	0	23	feed		V a
146.812061	70.157869	6 Jul 00	13:43:56	3	14	ca	0	0	0	1	1	walk	e	V a
146.831298	69.948916	6 Jul 00	13:54:51	3	15	ca	0	0	0	1	1	run	s	III a
146.862405	70.109831	6 Jul 00	14:00:20	3	16	ca	0	0	0	1	1	rest		III e
146.828928	70.169032	6 Jul 00	14:02:20	3	17	ca	25	20	0	100	145	move	e	X b
146.884279	70.166003	6 Jul 00	14:03:40	3	18	ca	10	20	10	30	70	move	e	
146.933535	69.944891	6 Jul 00	14:14:46	3	19	ca	0	0	0	1	1	rest		IX b
146.915040	70.162636	6 Jul 00	14:22:11	3	21	ca	0	0	0	10	10	feed		
146.034845	70.125997	20 Jul 00	16:55:41	4	1	ca	0	3	3	0	6	feed		V b
146.430664	70.063656	20 Jul 00	17:59:35	4	2	ca	0	2	2	2	6	rest		
146.471465	70.137777	20 Jul 00	18:06:21	4	3	ca	2	0	0	1	3	feed		III d
146.586326	70.067526	20 Jul 00	18:42:03	4	4	ca	0	0	0	2	2			
146.615399	70.165277	20 Jul 00	18:47:25	4	5	ca	0	0	0	1	1	rest		V c
146.650166	70.055043	20 Jul 00	18:51:11	4	6	ca	0	0	0	1	1	walk		III e
146.617238	70.035675	20 Jul 00	18:51:52	4	7	ca	0	0	0	1	1	feed		V a
146.783127	70.150721	20 Jul 00	19:28:44	4	8	ca	0	0	0	1	1	feed		III a
146.049692	70.070759	24 Jul 00	10:39:17	5	1	ca	1	0	0	0	1	feed		V a
146.015860	70.066636	24 Jul 00	10:39:25	5	2	ca	1	1	1	0	3			
146.052287	70.061920	24 Jul 00	10:39:35	5	3	ca	0	0	0	5	5	rest		V c

Table A-1 Continued.

Longitude°W	Latitude°N	Date	Time ADST	Flight	Attribute	Species	Bulls	Cows	Calves	Unclass	Total	Behavior	Direction	Habitat
146.055101	70.056415	24 Jul 00	10:39:46	5	4	ca	0	1	1	1	3	feed		Vc
146.096581	70.040402	24 Jul 00	10:48:58	5	6	ca	0	0	0	1	1			
146.232698	70.015006	24 Jul 00	11:02:48	5	7	ca	3	2	0	10	15	feed		Ve
146.439506	69.993279	24 Jul 00	11:53:03	5	8	ca	0	0	0	1	1			
146.524541	70.115412	24 Jul 00	12:03:55	5	9	ca	1	0	0	0	1	walk	e	Ve
146.573089	69.922671	24 Jul 00	12:17:50	5	10	ca	0	0	0	1	1	move		Vc
146.692097	70.115124	24 Jul 00	12:45:02	5	11	ca	0	0	0	1	1	stand		Ve
146.904521	70.046604	24 Jul 00	13:42:26	5	13	ca	0	0	0	1	1	feed		IIIa
146.986656	70.119489	24 Jul 00	13:48:29	5	14	ca	0	0	0	1	1	stand		Vc

Table A-2 Muskoxen (mx), grizzly bear (bb), arctic fox (af), and fox den (afdn) sightings in the Bullen Point to Staines River study area, Alaska, summer 2000. Coordinates are longitude/latitude on the WGS 1984 ellipsoid. For grizzly bear and fox records, dependent young are listed as "Calves", adult males as "Bulls", and adult females as "Cows". Time is Alaska Daylight Savings Time. See Table 4 for habitat code definitions.

Longitude°W	Latitude°N	Date	Time ADST	Flight	Attribute	Species	Bulls	Cows	Calves	Unclass	Total	Behavior	Direction	Habitat
146.249430	70.076730	16 Jun 00	11:13:42	1	1	mx	0	0	0	2	2	rest		IVa
146.716046	70.175047	16 Jun 00	12:56:01	1	24	bb	0	0	0	1	1	walk		Xa
146.926835	70.093698	16 Jun 00	13:53:29	1	60	af	0	0	0	1	1			
146.028294	70.053859	28 Jun 00	12:54:14	2	1	mx	2	2	0	0	4	rest		
146.109268	70.070887	28 Jun 00	13:02:10	2	4	mx	0	0	0	12	12			
146.189180	70.024142	28 Jun 00	13:14:30	2	7	mx	0	0	0	3	3	feed		IXb
146.506000	70.111978	28 Jun 00	14:18:34	2	78	af	0	0	0	1	1			
146.111808	70.064644	6 Jul 00	11:17:32	3	101	af	0	0	0	1	1	trot	w	
146.933154	69.964903	6 Jul 00	14:15:28	3	20	afdn	0	0	0	1	1			
146.098743	70.033832	20 Jul 00	17:07:50	4	101	mx	0	0	0	4	4			
146.801941	70.015936	20 Jul 00	19:33:20	4	9	bb	0	1	3	0	4	rest		Vc
146.873500	70.064175	20 Jul 00	19:52:00	4	10	mx	1	3	0	0	4	stand		Xa
146.969226	70.105959	20 Jul 00	20:09:45	4	11	afdn	0	0	4	1	5			Vc
146.064354	70.100101	24 Jul 00	10:42:35	5	5	mx	1	0	0	8	9	feed		Vc
146.736568	69.990100	24 Jul 00	13:00:18	5	12	bb	0	0	0	1	1	walk	e	Vc

APPENDIX B

MOSQUITO AND OESTRID ACTIVITY INDICES

Appendix B. Mosquito and Oestrid Fly Activity Indices.

Mosquito Activity Index (after Russell 1993):

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

The above parameters were translated into the following IF statements for TI_m and WI_m :

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

$WI_m = \text{IF}(V_h > 6, 0, ((6 - V_h) / 6))$

Where:

T_h = Temperature in °C recorded hourly at Deadhorse Weather Station

V_h = Wind velocity in mps recorded hourly at Deadhorse Weather Station

Syntax of the above IF statements is: IF (logical test, value if true, value if false)

Oestrid Fly Activity Index (after Mörschel 1999):

$$y = \frac{e^{(-2.9646 + 0.166 \times \text{Temp} - 0.1951 \times \text{Wind})}}{1 + e^{(-2.9646 + 0.166 \times \text{Temp} - 0.1951 \times \text{Wind})}}$$

where:

y = Estimated probability of oestrid fly presence (between 0 and 1)

Temp = Temperature in °C recorded hourly at Deadhorse Weather Station

Wind = Wind speed in mps recorded hourly at Deadhorse Weather Station

The oestrid fly activity index (y) predicts presence/absence of oestrid flies with 83% reliability. Oestrid flies were considered present when y was ≥ 0.4

Table B-1. Daily mean temperature and wind speed recorded at the Deadhorse Weather Station (ASCC 2001) with tabulations of hourly mosquito (Russel et al. 1993) and oestrid activity indices (Mörschel 1999), summer 2000. Bugs Active is 0=NO and 1=YES based on Walsh et al. 1992.

Date	Mean Temperature		Mean Wind		Mosquito Index			Oestrid Index	
	°C	<i>n</i>	Speed (mps)	<i>n</i>	Number of Records <0.5	Number of Records ≥0.5	Bugs Active	Number of Records <0.4	Number of Records ≥0.4
1 May 00	-11.79	24	4.05	24	24	0	0	24	0
2 May 00	-11.04	24	5.10	24	24	0	0	24	0
3 May 00	-11.22	23	4.99	23	23	0	0	23	0
4 May 00	-12.50	24	4.59	24	24	0	0	24	0
5 May 00	-11.17	24	4.91	24	24	0	0	24	0
6 May 00	-4.00	24	5.61	23	23	0	0	23	0
7 May 00	-9.58	24	4.89	24	24	0	0	24	0
8 May 00	-12.61	23	3.20	23	23	0	0	23	0
9 May 00	-16.08	24	3.26	24	24	0	0	24	0
10 May 00	-1.00	23	8.63	23	23	0	0	23	0
11 May 00	-5.70	23	7.70	24	23	0	0	23	0
12 May 00	-9.83	24	3.49	24	24	0	0	24	0
13 May 00	-16.75	24	1.67	24	24	0	0	24	0
14 May 00	-15.96	23	3.20	23	23	0	0	23	0
15 May 00	-13.86	22	4.21	22	22	0	0	22	0
16 May 00	-12.00	24	2.92	24	24	0	0	24	0
17 May 00	-10.74	19	3.51	23	19	0	0	19	0
18 May 00	-9.33	24	3.94	24	24	0	0	24	0
19 May 00	-10.88	24	2.85	24	24	0	0	24	0
20 May 00	-9.50	20	0.81	21	20	0	0	20	0
21 May 00	-8.27	22	3.67	23	22	0	0	22	0
22 May 00	-7.50	16	7.15	18	16	0	0	16	0
23 May 00	-6.54	24	3.00	24	24	0	0	24	0
24 May 00	-5.83	24	2.92	24	24	0	0	24	0
25 May 00	-5.13	24	4.97	24	24	0	0	24	0
26 May 00	-6.33	24	6.99	24	24	0	0	24	0
27 May 00	-7.50	22	8.49	22	22	0	0	22	0
28 May 00	-7.13	24	6.62	24	24	0	0	24	0
29 May 00	-5.79	24	5.19	24	24	0	0	24	0
30 May 00	-4.96	23	3.88	24	23	0	0	23	0

Table B-1. Continued.

Date	Mean Temperature (°C)	<i>n</i>	Mean Wind Speed (mps)	<i>n</i>	Mosquito Index			Oestrid Index	
					Number of Records <0.5	Number of Records ≥0.5	Bugs Active	Number of Records <0.4	Number of Records ≥0.4
31 May 00	-3.35	23	3.49	23	23	0	0	23	0
1 Jun 00	0.25	24	6.56	24	24	0	0	24	0
2 Jun 00	-1.50	24	6.82	24	24	0	0	24	0
3 Jun 00	-3.33	24	3.39	24	24	0	0	24	0
4 Jun 00	-3.63	24	5.04	24	24	0	0	24	0
5 Jun 00	-3.38	24	3.75	24	24	0	0	24	0
6 Jun 00	-0.83	24	4.87	24	24	0	0	24	0
7 Jun 00	1.29	24	4.97	24	24	0	0	24	0
8 Jun 00	3.21	24	3.92	24	24	0	0	24	0
9 Jun 00	1.29	24	5.12	24	24	0	0	24	0
10 Jun 00	-0.33	24	6.56	24	24	0	0	24	0
11 Jun 00	-0.46	24	2.29	24	24	0	0	24	0
12 Jun 00	0.85	20	3.97	21	20	0	0	20	0
13 Jun 00	1.40	20	4.40	20	20	0	0	20	0
14 Jun 00	6.15	20	2.86	20	20	0	0	20	0
15 Jun 00	8.54	24	2.66	24	24	0	0	24	0
16 Jun 00	10.23	22	3.93	22	22	0	0	22	0
17 Jun 00	9.13	24	3.52	24	24	0	0	24	0
18 Jun 00	9.05	22	4.89	22	22	0	0	22	0
19 Jun 00	8.58	24	3.30	24	24	0	0	24	0
20 Jun 00	10.58	24	4.57	24	23	1	0	24	0
21 Jun 00	8.77	22	5.31	22	22	0	0	22	0
22 Jun 00	13.71	24	4.22	24	24	0	1	22	2
23 Jun 00	15.67	24	4.91	24	24	0	1	24	0
24 Jun 00	16.67	24	4.27	24	22	2	1	20	4
25 Jun 00	16.33	24	4.44	24	22	2	1	21	3
26 Jun 00	13.83	24	4.78	24	21	3	1	23	1
27 Jun 00	8.29	24	5.98	24	24	0	0	24	0
28 Jun 00	4.79	24	6.41	24	24	0	0	24	0
29 Jun 00	4.17	24	3.26	24	24	0	0	24	0
30 Jun 00	7.00	23	3.80	23	23	0	0	23	0
1 Jul 00	9.67	24	6.71	24	24	0	0	24	0
2 Jul 00	6.08	24	5.92	24	24	0	0	24	0
3 Jul 00	7.08	24	3.19	24	24	0	0	24	0
4 Jul 00	13.08	24	7.35	24	24	0	0	24	0

Table B-1. Continued.

Date	Mean Temperature (°C)	<i>n</i>	Mean Wind Speed (mps)	<i>n</i>	Mosquito Index			Oestrid Index	
					Number of Records <0.5	Number of Records ≥0.5	Bugs Active	Number of Records <0.4	Number of Records ≥0.4
5 Jul 00	5.47	15	9.81	15	15	0	0	15	0
6 Jul 00	10.67	18	5.26	18	18	0	0	18	0
7 Jul 00	14.96	24	5.04	24	24	0	1	24	0
8 Jul 00	13.60	10	4.48	10	10	0	1	10	0
10 Jul 00	2.79	24	7.63	24	24	0	0	24	0
11 Jul 00	2.41	17	7.81	17	17	0	0	17	0
12 Jul 00	2.35	17	7.08	17	17	0	0	17	0
13 Jul 00	0.21	24	9.07	24	24	0	0	24	0
14 Jul 00	2.25	24	8.83	24	24	0	0	24	0
15 Jul 00	12.92	24	5.14	24	24	0	0	24	0
16 Jul 00	15.92	24	4.12	24	21	3	1	22	2
17 Jul 00	7.63	24	3.75	24	24	0	0	24	0
18 Jul 00	4.96	24	2.19	24	24	0	0	24	0
19 Jul 00	4.82	22	4.30	22	22	0	0	22	0
20 Jul 00	4.96	24	4.57	24	24	0	0	24	0
21 Jul 00	7.88	24	3.37	24	24	0	0	24	0
22 Jul 00	16.00	24	4.54	24	22	2	1	22	2
23 Jul 00	11.04	24	5.34	24	23	1	0	23	1
24 Jul 00	4.67	24	3.79	24	24	0	0	24	0
25 Jul 00	5.86	21	4.31	21	21	0	0	21	0
26 Jul 00	6.17	24	4.69	24	24	0	0	24	0
27 Jul 00	3.63	24	5.70	24	24	0	0	24	0
28 Jul 00	6.00	24	4.16	24	24	0	0	24	0
29 Jul 00	5.88	24	3.02	24	24	0	0	24	0
30 Jul 00	4.42	24	4.29	24	24	0	0	24	0
31 Jul 00	5.18	22	4.12	22	22	0	0	22	0
1 Aug 00	9.79	24	4.24	24	24	0	0	24	0
2 Aug 00	7.83	24	7.59	24	24	0	0	24	0
3 Aug 00	12.33	24	3.67	24	24	0	0	20	4
4 Aug 00	13.29	24	3.97	24	22	2	1	24	0
5 Aug 00	11.88	24	7.70	24	24	0	0	24	0
6 Aug 00	7.13	24	4.87	24	24	0	0	24	0
7 Aug 00	10.46	24	4.48	24	24	0	0	24	0
8 Aug 00	9.09	23	5.51	24	23	0	0	23	0
9 Aug 00	10.96	23	6.98	23	23	0	0	23	0

Table B-1. Continued.

Date	Mean		Mean Wind		Mosquito Index			Oestrid Index	
	Temperature	<i>n</i>	Speed (mps)	<i>n</i>	Number of	Number of	Bugs	Number of	Number of
	(°C)				Records	Records	Active	Records	Records
	(°C)	<i>n</i>	Speed (mps)	<i>n</i>	<0.5	≥0.5		<0.4	≥0.4
10 Aug 00	8.61	23	8.97	23	23	0	0	23	0
11 Aug 00	0.96	23	12.45	24	23	0	0	23	0
12 Aug 00	0.17	24	4.69	24	24	0	0	24	0
13 Aug 00	0.38	24	5.29	24	24	0	0	24	0
14 Aug 00	0.50	24	4.05	24	24	0	0	24	0
15 Aug 00	1.42	24	2.87	24	24	0	0	24	0
16 Aug 00	8.73	22	2.94	24	18	4	0	21	1
17 Aug 00	8.48	23	3.94	23	23	0	0	23	0
18 Aug 00	6.04	23	4.72	24	23	0	0	23	0
19 Aug 00	5.08	24	3.09	24	24	0	0	24	0
20 Aug 00	1.48	23	5.26	23	23	0	0	23	0
21 Aug 00	0.67	18	5.00	18	18	0	0	18	0
22 Aug 00	0.04	24	5.92	24	24	0	0	24	0
23 Aug 00	-1.74	23	5.91	23	23	0	0	23	0
24 Aug 00	-1.64	22	4.78	24	22	0	0	22	0
25 Aug 00	-0.62	21	3.97	21	21	0	0	21	0
26 Aug 00	-1.96	24	4.29	24	24	0	0	24	0
27 Aug 00	-1.17	24	5.98	24	24	0	0	24	0
28 Aug 00	0.78	23	9.22	24	23	0	0	23	0
29 Aug 00	1.00	22	10.87	24	22	0	0	22	0
30 Aug 00	4.83	24	5.29	24	24	0	0	24	0