

FINAL REPORT
28 April 2000

**Bullen Point to Staines River
Large Mammal Distribution,
Summer 1999**



Prepared by

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Prepared for

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

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Prepared by

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and
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ABSTRACT

Large mammal distribution was documented from Bullen Point on the west to the Staines/Canning rivers on the east and from the Beaufort Sea coast on the north, south to 69°54.5' north latitude, on the North Slope of Alaska. Nine systematic strip-transect surveys designed for 100% aerial coverage were flown from 4 June to 28 July 1999. During the caribou calving period surveys, from 1 to 20 June, caribou numbers within the study area ranged from 115 on 4 June (2.3 caribou per group) to 2252 on 14 June (10.8 caribou per group). The 4 and 19 June surveys covered only 64% and 75% of the study area, respectively. Sex-age composition of classified caribou for the combined calving period surveys was 68% cows and 32% calves. Calf:cow ratio was 37 calves:100 cows on 4 June and 48 calves:100 cows for both the 14 and 19 June 1999 surveys. The distribution of cow/calf caribou pairs during the calving period, 1 to 20 June, has varied both within and among years since surveys were initiated in 1993. All except the 1995 survey, have shown a consistently higher concentration of calving caribou between the western edge of the study area east to Point Hopson in the southwestern corner of the study area. In all study years the northeastern portion of the Bullen Point to Staines River study area did not appear to be heavily used by calving caribou. Calving period distribution may reflect survey timing within the calving period and/or spring snow cover and snowmelt flood patterns. During six post-calving period surveys, caribou numbers within the study area ranged from 0 on 9 July to 2529 on 29 June 1999 (mean 20.6 caribou per group), and mean group size ranged from 1.6 caribou per group on 18 July to 100.0 caribou per group on 15 July 1999. Sex-age composition of classified caribou for the combined post-calving period surveys was 8% bulls, 65% cows, and 27% calves. During 1999, caribou did not appear to be using coastal habitats during post-calving surveys. Caribou groups occurred within 2 km of the coast on 15 of 25 post-calving surveys from 1993 to 1999. The coastal area with the highest concentration of caribou was located near the estuary just east of Bullen Point. Coastal areas with 100 to 500 total caribou for the combined surveys were: an estuary and spit between Bullen Point and Point Gordon, Point Gordon and the area southwest of Point Gordon, the unnamed point between Point Sweeney and Point Thomson, the point near Point Thomson Unit #3 pad, and the area near the North Staines River #1 pad. A grizzly bear was observed within the study area on 9 July and on 15 July. Muskoxen were observed during five of nine surveys, including a group of between seven and nine muskoxen along the East Badami creek corridor on each of the last four post-calving surveys from 9 July to 28 July 1999.

Key words: Caribou, *Rangifer tarandus*, Alaska, Central Arctic Herd, oil field, muskoxen, North Slope, *Ovibos moschatus*

INTRODUCTION

Two caribou herds may occur in the area between the Sagavanirktok and Staines rivers: the Porcupine Caribou Herd (PCH) and the Central Arctic Caribou Herd (CAH). PCH studies conducted over the past 20 years in the Arctic National Wildlife Refuge (ANWR) have shown that little, if any, calving occurs west of the Staines River, nor is the area used by large numbers of PCH caribou during post-calving and dispersal periods (Clough et al. 1987). 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 two areas for calving, one west of the Sagavanirktok River (near the Kuparuk and Milne Point oil fields), and one east of the Sagavanirktok River. These are thought to reflect east and west segments of the CAH (Lawhead and Curatolo 1984). Within the eastern and western CAH calving areas, several general areas of concentrated calving have been reported; although the distribution of calving caribou varies annually. Two areas with calving caribou concentrations have been documented in most years since 1969: between Oliktok Point and the Kuparuk River (Milne Point) and 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).

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-harassed caribou during the post-calving period. Large groups are often observed near Franklin Bluffs and on the deltas of the Kadleroshilik, Sagavanirktok, Shaviovik, and Staines rivers (Gavin 1983, Carruthers et al. 1984). Lawhead and Curatolo (1984) reported that large aggregations of caribou sought relief on or near deltas of the Kuparuk, Shaviovik, and Canning rivers during intense insect harassment; although caribou groups were observed along the coast within the entire Oliktok Point to Canning River area. 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 as gregariousness diminishes, 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*), moose (*Alces alces*), grizzly bear (*Ursus arctos*), and wolf (*Canis lupis*). 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 oil field (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, they are found primarily in riparian habitats, but move to adjacent uplands in winter and spring (Clough et al. 1987). Riparian habitats are important travel corridors and foraging areas.

Coastal areas are used seasonally by grizzly bears. They 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 when caribou are on the coastal plain. In late July, they gradually return south to the foothills (Clough et al. 1987). Riparian areas are used as travel corridors and contain abundant prey and preferred vegetation.

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 rare on the Arctic Coastal Plain, but were observed in the southern portion of the Badami study area in 1999 (Noel and King, in prep.).

ISSUES

Potential impacts to caribou from oil field development due to construction of roads, pipelines, or other related facilities and oil field activities in the Bullen Point to Staines River study area include:

- Displacement from or blocked access of CAH caribou to calving habitats,
- Displacement from or blocked access of CAH caribou to post-calving and insect-relief habitats, and
- Blocked westward movements of the PCH from ANWR or blocked eastward movements of the CAH into ANWR

Pre-development data necessary to assess development impacts and mitigate oil field impacts include distribution and abundance, and reproductive status of caribou in the Bullen Point to Staines River area.

OBJECTIVES

During 1999, LGL Alaska Research Associates, Inc. (LGL) conducted systematic aerial surveys of large mammals within the area from Bullen Point to the Staines River to the east of Prudhoe Bay, Alaska. Effort focused on calving and post-calving caribou distribution within the study area. Our objectives during 1999 were:

- 1) to determine the number, sex/age composition, and distribution of caribou and the distribution of other large mammals during the calving and post-calving seasons, and
- 2) to compare distribution and abundance of large mammals in the Bullen Point to Staines river study area with the adjacent Badami study area, between the Sagavanirktok River and Bullen Point (Fig. 1).

STUDY AREA

The study area is bounded on the west by Bullen Point, extended east to the Staines River, north to the Beaufort Sea, and south to approximately 69°54.5' latitude (Fig. 1). The Bullen Point to Staines River study area included transect numbers 48 to 70 (Fig. 1). The study area lies within Alaska's Arctic Coastal Plain and is characterized by a gently rolling thaw-lake plain landscape (Walker and Acevedo 1987). Tundra within five miles of the coast has little topographic relief. Further inland the landscape begins a gradual ascent from 25 feet above sea level to 350 feet above sea level at the southern edge of the study area, about 24 miles inland. Contours within the study area form concentric bands oriented north-northwest. This area has been referred to as the Canning alluvial fan, formed by sediment deposition from the Canning River. Vegetation in the southern portion of the study area is a mixture of dry or moist herbaceous tundra and wet herbaceous tundra. Moisture increases to the east, approaching the Canning River, and toward the coast (U.S. Geological Survey, Alaska Vegetation and Land Cover Series, Mt. Michelson Quadrangle, Map L-206).

METHODS

AERIAL SURVEYS

During summer 1999, nine systematic, strip-transect aerial surveys (Caughley 1977) were conducted from both a Cessna 206 (seven survey days) and a Cessna 207 (two survey days) fixed-wing aircraft. Two observers recorded mammal sightings. 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-seven transects (numbers 48 to 70, Fig. 1) were flown during each of the nine surveys. Surveys were flown 90 m above ground level at approximately 115 km/hr airspeed. During surveys, each of the two observers was responsible for searching an 800-m wide swath on one side of the transect centerline, providing for 100% study area coverage. A third observer, when available, entered data into a computer and assisted with spotting caribou. Aircraft wing struts were marked to enable visual control of transect strip-width (Pennycuik and Western 1972). Observers verified strut markings with inclinometers and by comparison to survey maps.

As with previous aerial surveys conducted by LGL in the Prudhoe Bay oil field and adjacent areas (Pollard et al. 1992a,b and others), Global Positioning System (GPS) receivers were used to navigate the aircraft during surveys and to record the location of the aircraft when animals were observed. Coordinates of animal sightings were determined using the GPS in combination with visual estimates of their distance from the aircraft. At the time of sighting, all data were entered directly into a notebook computer that was linked to a Motorola Workhorse™ GPS receiver using Geolink® software. For each sighting, a real-time GPS-determined position is associated with group attributes (e.g., species, number of individuals, sex/age classification, distance and direction from the aircraft) that are entered by either one of the observers or by a data recorder. When possible, behavior and habitat types were also recorded along with the group attributes and time of sighting into an audio recorder. Behavior was defined as the activity of the majority of caribou in a group, and was classified as rest, stand, feed, move, walk, trot, and run. Habitat types were categorized from field descriptions following Walker's (1983) hierarchical classification system.

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

GEOGRAPHIC ANALYSIS

Large mammal observation data were combined with base-map data in MapInfo® Geographic Information System (GIS). Spatial data were used to produce maps of distributions for each survey and to conduct spatial analyses in MapInfo® and Vertical Mapper™. Data

collected in the study area during 1999 were analyzed using the distribution and abundance of calves and all caribou. These classes of caribou were chosen because previous research has suggested that bulls and maternal cows respond differently to habitat features (Pollard et al. 1992b), and adult bulls and calves were easiest to identify during the surveys. Some analyses were based on individual caribou rather than on groups. Individual caribou were used because: (1) during aerial surveys, groups were sometimes difficult to distinguish; (2) groups were disparate in size, ranging from 1 to 975 individuals; and (3) groups are not of fixed membership. However, location data are collected by caribou group; therefore individual caribou locations are not necessarily independent.

MODELED PARASITIC INSECT ACTIVITY

Predictive models for mosquito (Russell et al. 1993) and oestrid fly (Mörschel 1999) activity were used to identify days with conditions suitable for insect activity. Index values were calculated for each hour that temperature and wind data were recorded at the Deadhorse Weather Station (ASCC 1999). Sweep net sampling for mosquitoes was conducted from 29 June to 24 July 1999 in conjunction with monitoring at the Badami pipeline. Mosquito and oestrid activity indices for the 1999 field season, and the syntax used to calculate the indices, are presented in Appendix B.

RESULTS

Nine systematic surveys of the Bullen Point to Staines River study area were completed (Appendix A; Figures A-1 to A-8 and Tables A-1 to A-3). Five surveys included 100% coverage of the study area, and four surveys covered the northern portion study area to approximately 70°00' north latitude; 4 June Survey-64% of study area (Fig. A-1), 19 June Survey-75% of study area (Fig. A-3), 18 July Survey-78% of study area (Fig. A-7), 28 July Survey-76% of study area (Fig. A-8). A total of 8941 caribou in 541 groups was recorded within the study area during the nine systematic surveys from 4 June to 28 July 1999 (Table 1). The total number of caribou within the study area during a survey day ranged from 0 on 9 July to 2529 on 29 June (Table 1). The first three surveys were conducted during the calving period (1 to 20 June). Most classified caribou sighted during the calving period were cows and calves; 68% cows (1691 of 2499), 32% calves (803 of 2499), and <1% bulls (5 of 2499). During the six post-calving period surveys, cows and calves again predominated; 65% cows (3379 of 5238), 27% calves (1437 of 5238), and 8% bulls (422 of 5238). Thirty-two muskoxen in four groups were observed during the systematic surveys, as well as two grizzly bear sightings on 9 and 15 July, (Table A-2; Figures A-1, A-6, A-7, and A-8).

CARIBOU

Calving Period Surveys

Survey 0—4 June 1999

Survey weather conditions were good, with scattered to broken clouds, winds from 5.1 to 8.2 meters per second (mps) from the west (280° to 290°), and temperature 0 to 1°C between 1000 and 1400 ADST (ASCC 1999). A total of 115 caribou, all cows and calves, in 51 groups was recorded within 64% of the study area (Fig. A-1, Table 1). Mean and 95% confidence interval (95% CI) of group size was 2.3 ± 0.45 caribou. Calf production was 37 calves:100 cows. Sixty-five percent of caribou (75 of 115) and 58% of calves (18 of 31) were located in the southwest half of the study area. Daily mean temperature was -0.1°C and daily mean wind speed was 5.8 mps. Indices of parasitic insect activity indicated conditions were not suitable for mosquito or oestrid activity on 4 June (Fig. 2, Table B-1).

Survey 1—14 June 1999

Survey weather conditions were good, with few clouds, winds at 2.6 to 5.1 mps primarily from the northwest (300° to 340°), and temperature 6 to 8°C between 1100 and 1600 ADST (ASCC 1999). A total of 2252 caribou in 208 groups were recorded within the study area, including 702 cow-calf pairs (Fig. A-2, Tables 1 and A-1). Mean and 95% CI of group size was 10.8 ± 2.48 caribou. The composition of classified caribou was 67% cows (1462 of 2166) and 32% calves (702 of 2166, Table 1). Calf production was 48 calves:100 cows. Most caribou groups (69%, 143 of 208) contained less than 10 animals. Caribou were concentrated (83%, 1880 of 2252) in the southwestern half of the study area. Daily mean temperature was 4.7°C and daily mean wind speed was 3.6 mps (Table B-1). Indices of parasitic insect activity indicated conditions were not suitable for mosquito or oestrid activity on 14 June (Fig. 2, Table B-1). Direction of travel was recorded for four caribou groups: three groups were headed into crosswinds, and one group was headed downwind (Table 2).

Survey 2—19 June 1999

Survey weather conditions were moderate, with overcast skies, winds at 2.0 to 3.6 mps from the west-northwest (290° to 320°), and temperature 2 to 4°C between 1100 and 1600 ADST (ASCC 1999). Low-lying fog prevented flying transect lines south of 70°00' north latitude, resulting in 75% coverage of the study area. A total of 269 caribou in 50 groups was observed, including 70 cow-calf pairs (Fig. A-3, Tables 1 and A-1). Mean and 95% CI of group size was 5.4 ± 1.63 . The composition of classified caribou was 67% cows (145 of 218) and 32% calves (70 of 218, Table 1). Calf production was 48 calves:100cows. Most caribou were in the western

and southern portions of the survey area; only two groups with a total of three caribou were located in the northeast corner of the survey area. Fifty-one percent of caribou (137 of 269) and 57% of calves (40 of 70) were in the nine groups of 10 or more animals. Daily mean temperature was 2.1°C and daily mean wind speed was 3.8 mps (Table B-1) Indices of parasitic insect activity indicated conditions were not suitable for mosquito or oestrid activity on 19 June (Fig. 2, Table B-1). Direction of travel was recorded for 2 caribou groups. Both groups were headed downwind to the south (Table 2).

Calving Period Distributions

The distribution of cow/calf caribou pairs during the calving period (1 to 20 June) has varied both within years and between years since surveys were initiated in 1993 (Figures 3 and 4). In most years, except 1995 when survey coverage was limited in extent, the area between the western study area boundary east to Point Hopson appears to show a consistently higher concentration of cows and calves. In all years, the four townships in the southwest corner of the study area appear to have a consistently larger proportion of area with increased calf numbers (Fig. 4). In 1993 and 1998 there also appeared to be increased calf numbers southwest of Bullen Point, toward Badami, which carries through in the aggregated surveys (Fig. 4). In all study years (1993, 1995, 1997, 1998, and 1999) the northeastern portion of the Bullen Point to Staines River study area did not appear to be heavily used by calving caribou (Fig. 3).

Cow caribou density in the Bullen Point to Staines River study area (904.53 km² land area) was 1.62 cows/km² on 14 June 1999. In the adjacent Badami study area (1313.60 km² land area), cow caribou density was approximately 0.62 cows/km² on 15 June 1999. The density of total caribou in the Bullen Point to Staines River study area was 2.49 caribou/km² on 14 June 1999, compared to 0.87 caribou/km² observed on 15 June in the Badami study area (Fig. 1, Table 1).

Calving caribou use of the Bullen Point to Staines River study area, for the four years of study area coverage, ranged from 358 cows in 1997 (0.40 cows/km²) to 1462 cows in 1999 (1.62 cows/km²). Mean and 95% CI of cow density was 1.16 ± 0.91 cows/km². Calf production has ranged from 48 calves:100 cows in 1999 to 70 calves:100 cows in 1997. Total caribou density during the calving period has ranged from 0.69 to 2.07 caribou/km². Mean and 95% CI of total caribou density during calving was 1.93 ± 1.47 caribou/km².

Activity was recorded for 99 caribou groups during the calving period (Table 3). For most groups of less than 10 caribou, activity was evenly split between resting (43%, 29 of 67) and feeding (42%, 28 of 67), while 13% of groups (9 of 67) were moving (Table 3). For groups of 10 to 100 animals, feeding was the predominant activity (61%, 19 of 31) followed by resting

(32%, 10 of 31; Table 3). For all groups that were resting and feeding, 57% (50 of 87) were on moist sedge, dwarf shrub tundra; and 80% (70 of 87) were on moist to dry tundra types (Table 4). For 10 caribou groups that were recorded as moving, 50% (5 of 10) were on wet/moist or moist/wet tundra complexes (Table 4).

Post-Calving Period Surveys

Survey 3—25 June 1999

Survey weather conditions were good, with a few scattered clouds, winds at 3.1 to 4.6 mps from the east northeast (40° to 80°), and temperature 7 to 9°C between 1100 and 1600 ADST (ASCC 1999). A total of 1721 caribou in 76 groups was recorded, including 487 cow-calf pairs (Figures 5 and A-4, Tables 1 and A-1). Mean and 95% CI of group size was 22.6 ± 10.62 caribou. The composition of classified caribou was <1% bulls, 66% cows, and 34% calves (Table 1). Forty-three percent of caribou were in four cow/calf dominated groups of greater than 100 caribou, located in the southeast corner of the study area, just north of the Staines River (Fig. A-4, Table A-1). Forty-eight percent (829 of 1721) of caribou were in 28 groups of 10 to 100 caribou. Caribou groups were scattered throughout the study area, but most groups were adjacent to riparian habitats. Daily mean temperature was 5.3°C and daily mean wind speed was 5.0 mps (Table B-1). Insect activity indices indicated that conditions were not suitable for insect activity on 25 June and were also not suitable for mosquito or oestrid activity during the two days prior to the survey (Fig. 2, Table B-1). Direction of travel was recorded for seven caribou groups. All groups were headed into the east to northeast winds or crosswinds (Table 2).

Survey 4—29 June 1999

Survey weather conditions were good with clear skies, winds at 6.2 to 8.2 mps from the east northeast (50° to 80°), and temperature 6 to 8°C between 1100 to 1600 ADST (ASCC 1999). A total of 2529 caribou in 123 groups was recorded, including 644 cow-calf pairs (Figures 5 and A-5, Tables 1 and A-1). Mean and 95% CI of group size was 20.6 ± 5.50 caribou. The composition of classified caribou was <1% bulls, 69% cows, and 31% calves (Table 1). Scattered caribou groups occurred throughout the study area, but most caribou were concentrated in the northwestern corner including the 27% of caribou (682 of 2529) occurring in the 5 groups of more than 100 caribou. Daily mean temperature was 4.8°C and daily mean wind speed was 6.4 mps (Table B-1). Indices of parasitic insect activity indicated conditions were not suitable for mosquito or oestrid activity on 29 June or during the two days prior to the survey (Fig. 2, Table B-1).

Survey 5—9 July 1999

Survey weather conditions were marginal, with low clouds and light rain. Winds were 2.1 mps to 3.6 mps from the east and west-northwest (80° to 330°), and temperature 12 to 16°C between 1100 to 1600 ADST (ASCC 1999). No caribou were recorded in the study area (Fig. A-5, Table A-1). Daily mean temperature was 12.0°C and daily mean wind speed was 3.0 mps (Table B-1). Indices of parasitic insect activity indicated conditions were suitable for mosquito activity for three hours and oestrid activity for one hour on 9 July; and sweep net sampling averaged 83 mosquitoes for the third highest number of mosquitoes collected (Table B-1). On the two days prior to the survey, indices indicated that conditions were not suitable for mosquito or oestrid activity. Sweep net sampling indicated mosquitoes were less active; 17.5 mosquitoes on 7 July and 26.9 on 8 July (Fig. 2, Table B-1).

Survey 6—15 July 1999

Survey weather conditions were good with a few scattered clouds, winds at 6.2 to 7.2 mps from the east (80° to 90°), and temperature 9 to 15 °C between 0900 to 1400 ADST (ASCC 1999). A total of 2000 caribou in 20 groups was recorded in the study area (Figures 5 and A-3, Tables 1 and A-1). Mean and 95% CI of group size was 100.0 ± 119.36 caribou. The composition of classified caribou was 24% bulls, 59% cows, and 17% calves. Eighty-eight percent (1765 of 2000) of caribou were in three cow/calf dominated groups with more than 100 caribou (Figures 5 and A-5, Table A-1). Daily mean temperature was 10.2 °C and daily mean wind speed was 4.8 mps (Table B-1). Indices of parasitic insect activity indicated conditions were suitable for mosquito activity during three hours but that conditions were not suitable for oestrid activity. A few mosquitoes were collected during sweep net sampling however, average 7.3 mosquitoes (Table B-1). Indices indicated that conditions were not suitable for either mosquito or oestrid activity for the two days prior to the survey. Sweep net counts were also low on 13 July, 8.5 mosquitoes and on 14 July, 5.0 mosquitoes (Fig. 2, Table B-1). Direction of travel was recorded for eight caribou groups. One group was moving with the wind, one group was headed into the wind and six groups were moving with north and northeast crosswinds (Table 2).

Survey 7—18 July 1999

Survey weather conditions were marginal; overcast skies at 500 to 700 foot ceiling height, winds 2.6 to 4.1 mps from the north-northwest (330° to 350°), and temperature 4 to 5°C between 1700 to 2100 ADST (ASCC 1999). Low fog prevented flying transect lines south of 70°00' north latitude, resulting in 78% coverage of the study area. A total of 13 caribou in eight groups was recorded (Figures 5 and A-7, Tables 1 and A-1). Mean and 95% CI of group size

was 1.6 ± 1.18 caribou. Daily mean temperature was 4.3°C and daily mean wind speed was 5.7 mps (Table B-1). Indices of parasitic insect activity indicated conditions were not suitable for mosquito or oestrid activity on 18 July (Fig. 2, Table B-1). Indices indicated mosquitoes but not oestrids could have been active for one hour on 16 July, when sweep net sampling averaged 29.5 mosquitoes. Conditions were not suitable for mosquito or oestrid activity on 17 July, sweep nets averaged 3.4 mosquitoes.

Survey 8 — 28 July 1999

Survey weather conditions were marginal; overcast skies at 700 feet, winds 2.6 to 4.6 mps from the northeast to east-northeast (40° to 60°), and temperature 3°C between 1600 to 1900 ADST (ASCC 1999). Low fog prevented flying transect lines south of $70^{\circ}00'$ north latitude, resulting in 76% coverage of the study area. A total of 42 caribou in five groups was recorded (Figures 5 and A-8, Tables 1 and A-1). Mean and 95% CI of group size was 8.4 ± 19.86 caribou. The composition of classified caribou was 0% bulls, 62% cows, and 38% calves. Daily mean temperature was 2.0°C and daily mean wind speed was 3.0 mps (Table B-1). Indices of parasitic insect activity indicated conditions were not suitable for mosquito or oestrid activity on 28 July; and conditions were similarly not suitable during the two days prior to the survey (Fig. 2, Table B-1).

Post-Calving Distributions

During the post-calving period on warm calm days, caribou tend to congregate in riparian and coastal insect-relief habitats in response to parasitic insect harassment. During the 1999 post-calving surveys, caribou did not appear to be using coastal habitats (Fig. 5). All groups, with more than 100 caribou, were more than 2 km inland from the Beaufort Sea coastline (Fig. 5). Distribution of caribou on 25 June 1999 suggests that caribou were closely associated with riparian habitats (Fig. 5). Indices of mosquito and oestrid activity indicate that these insects may have been active on 9 July and 15 July (Fig. 2). No caribou were in the study area on 9 July; and on 15 July, 96% of caribou (1923 of 2000) were more than 5 km inland from the coast.

In order to identify areas along the coast where caribou have concentrated, data for surveys covering the entire coastal portion of the study area were combined ($n=25$ surveys in five years, Fig. 6). Weather conditions varied considerably between surveys, thus caribou may not have solely been seeking insect-relief habitats during all surveys. In fact, for the 25 post-calving surveys, caribou groups occurred within 2 km of the coast on only 15 surveys. One small area with 500 to 1000 total caribou for the combined 25 surveys was located near the estuary just east of Bullen Point. Coastal area with 100 to 500 total caribou for the combined surveys were: an

estuary and spit between Bullen Point and Point Gordon, Point Gordon and the area southwest of Point Gordon, the unnamed point between Point Sweeney and Point Thomson, the point near Point Thomson Unit #3 pad, and the area near the North Staines River #1 pad (Fig 6).

During 1999, caribou density peaked in the Bullen Point to Staines River study area on 29 June at 2.80 caribou/km². In the Badami study area, density peaked at 3.20 caribou/km² on 1 July. During the post-calving period, four-100% coverage surveys were flown in the Bullen Point to Staines River study area from 26 June to 19 July 1999. Mean and 95% CI of caribou density for these surveys was 1.86 ± 1.54 caribou/km². This is similar to the five-100% coverage surveys flown from 25 June to 15 July in the Badami study area; where mean and 95% CI of caribou density was 1.72 ± 1.93 caribou/km².

When 72 caribou group locations from 1993 to 1999 were analyzed for habitats as mapped for the Point Thomson Unit Area (Noel and Funk 1999); 22% of groups (16 of 72) were located in water, 3% (2 of 72) were in emergent tundra, 26% (19 of 72) were in wet sedge and wet sedge complexes, 10% (7 of 72) were in moist/wet sedge complex, 32% (23 of 72) were in moist or dry tundra, and 7% (5 of 72) were in barren habitats (Tables 5 and 6). Habitat use-availability analysis (Manley et al. 1993) indicated that habitats were not used in proportion to occurrence ($\chi^2 = 34.96$, $df=12$, $P = 0.00048$) with fewer than expected groups in water and no difference from expected for all other habitat categories (Table A-4). Although caribou groups do sometimes stand in water, especially along the coast in response to insect harassment, it is most likely that group positional error (300 to 400 m) is responsible for most of the 16 groups occurring in water. Nine groups recorded in 1999, occurred within the land cover map area and also included observer-recorded habitats. Of the nine groups, seven were recorded on moist sedge, shrub tundra. Five of these seven records matched observer-recorded and land cover mapped habitats, the remaining two were mapped as wet sedge and wet sedge/water complex. Two caribou groups were recorded on dry crustose lichen tundra. These two groups were both located on areas mapped as moist frost-scar tundra.

OTHER LARGE MAMMALS

A grizzly bear was observed in and just south of study area on 9 July and on 15 July 1999 (Figures A-5 and A-6, Table A-2). Muskoxen were observed during five different surveys (Figures A-1, A-6, A-7, and A-8; Table A-2). A cow/calf pair was observed on 4 June 1999 near Alaska State C-1. A group of seven to nine muskoxen was sighted along the East Badami creek corridor on each of the last four post-calving surveys from 9 July to 28 July 1999 (Figures A-6, A-7, and A-8; Table A-2). It is likely that this is a single group of animals, which ranged within approximately 10 km up and down the East Badami Creek riparian corridor. On 9 July this

muskoxen group was feeding on a gravel river bar; on 15 July a group was feeding on dry, dwarf shrub, crustose lichen tundra; on 18 July a group was resting on dry, dwarf shrub, crustose lichen tundra; and on 28 July muskoxen were again feeding but habitat was not recorded (Tables A-2 and A-4).

DISCUSSION

During the nine systematic strip-transect surveys, 0 to 2529 caribou were recorded (Table 1). The most recent estimate of the population size of the CAH (1997) was 20000 (1997 count: 19730), with an estimated 8000 (1997 count: 7733) in the eastern segment of the CAH (E. Lenart, ADF&G, personal communication). Caribou calving between Bullen Point and the Canning River are generally considered the eastern segment of the CAH (Cameron and Whitten 1978, Lawhead and Curatolo 1984, Whitten and Cameron 1985, Cameron et al. 1989). Based on these 1997 population estimates and assuming that herd size was similar in 1999, 11% of the CAH and 28% of the eastern segment of the CAH used the Bullen Point to Staines River study area during calving. During post-calving, these percentages were 0% to 13% of the CAH and 0% to 32% of the eastern segment of the CAH in the study area.

Sex and age composition of classified caribou varied between surveys, but for the combined post-calving surveys, 8% were bulls, 65% were cows, and 27% were calves (12 bulls:100 cows and 43 calves:100 cows). The entire CAH composition in October 1996 was 61 bulls:100 cows and 67 calves:100 cows as determined by ADF&G (Hicks 1997). Our composition counts are for a limited part of the CAH range and methodology was not as comprehensive as the ADF&G composition surveys.

The area between Bullen Point and the Canning River has been used consistently by calving caribou in most years since 1969 (Pollard et al. 1992a). The distribution of cow/calf caribou pairs between 1 June and 20 June has varied both within and among years since surveys were initiated in 1993. In 1993 and 1998 there appeared to be higher calf numbers southwest of Bullen Point, toward Badami, which were reflected in the aggregated surveys. Few caribou calves occurred in this area in 1995, 1997 and 1999 (Pollard and Noel 1995, Noel 1998). Distribution may reflect survey timing within the calving period (early or late June) and/or spring snow and flood patterns (Whitten and Cameron 1985, Gavin 1983). In all study years (1993, 1995, 1997, 1998, and 1999) the northeastern portion of the Bullen Point to Staines River study area did not appear to be used by calving caribou (Fig. 3).

Calf production within the study area on 16 June 1997 was 70 calves:100 cows (Noel 1998). Calf production (pregnancy rate) for the entire CAH during calving period surveys in

June 1997 between the Colville River and the Canning River was 72 calves:100 cows (Hicks 1997). During 1998, calf production was 69 calves:100 cows on 12 June and 56 calves:100 cows on 19 June (Noel and Olson 1999). During 1999, calf production was 48 calves:100 cows on both 14 June and 19 June 1999.

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 oil fields, caribou move to coastal areas to ameliorate insect harassment (Roby 1978; Dau 1986; Johnson and Lawhead 1989; Pollard et al. 1996a,b). Caribou tend to drift inland and feed during periods of low temperatures and/or high wind velocities, which suppress mosquito activity (Curatolo et al. 1982, White et al. 1975, Dau 1986, Pollard et al. 1996b). In the Bullen Point to Staines River study area during the 1999 post-calving surveys, caribou did not appear to be using coastal habitats, and all groups with more than 100 caribou, were more than 2 km inland from the coastline. Indices of mosquito and oestrid activity indicated that insects may have been active on 9 July and 15 July. However, no caribou were in the study area on 9 July; and on 15 July, 96% of caribou (1923 of 2000) were more than 5 km inland from the coast. Although caribou group size generally begins to increase after peak calving, mosquito harassment is thought to cause large aggregations (Roby 1978; Johnson and Lawhead 1989). During 1999, mean caribou group size fluctuated from 2.3 (4 June) to 10.8 (14 June) caribou per group during the calving period, and increased to 100.0 (15 July) during the post-calving period.

In order to identify coastal concentration areas during the post-calving period, data for surveys covering the entire coastal portion of the study area were combined. Weather conditions varied considerably between surveys, and caribou may not have been in insect-relief habitats during all surveys. Caribou groups occurred within 2 km of the coast on 15 of 25 surveys. The area with the highest concentration of caribou was located near the estuary just east of Bullen Point. This contour was interpolated in response to one group of 600 total caribou at this location. Coastal areas with 100 to 500 total caribou for the combined surveys included the point near Point Thomson Unit #3 pad, and the area near the North Staines River #1 pad. Both of these contours were again drawn in response to one caribou group near each location (Fig. 6). The abandoned exploration pads at Point Thomson #3 and North Staines River #1 may be attractive as insect-relief habitat (Pollard et al. 1996a,b; Noel et al. 1998). The group near Point Thomson #3 was located on the spit just east of the pad site.

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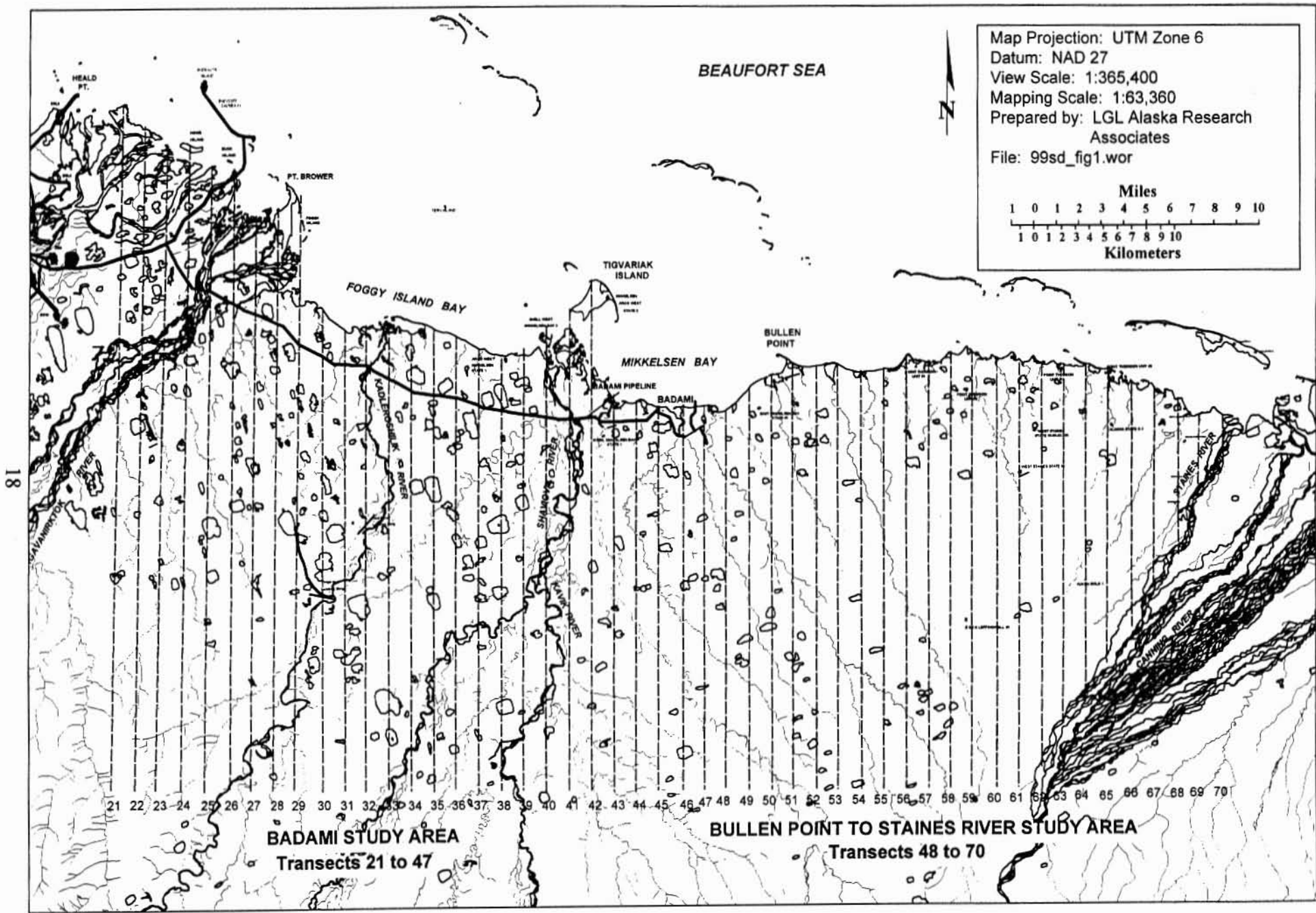


Figure 1. Survey transects in the Bullen Point to Staines River and Badami study areas, Alaska, 1999.

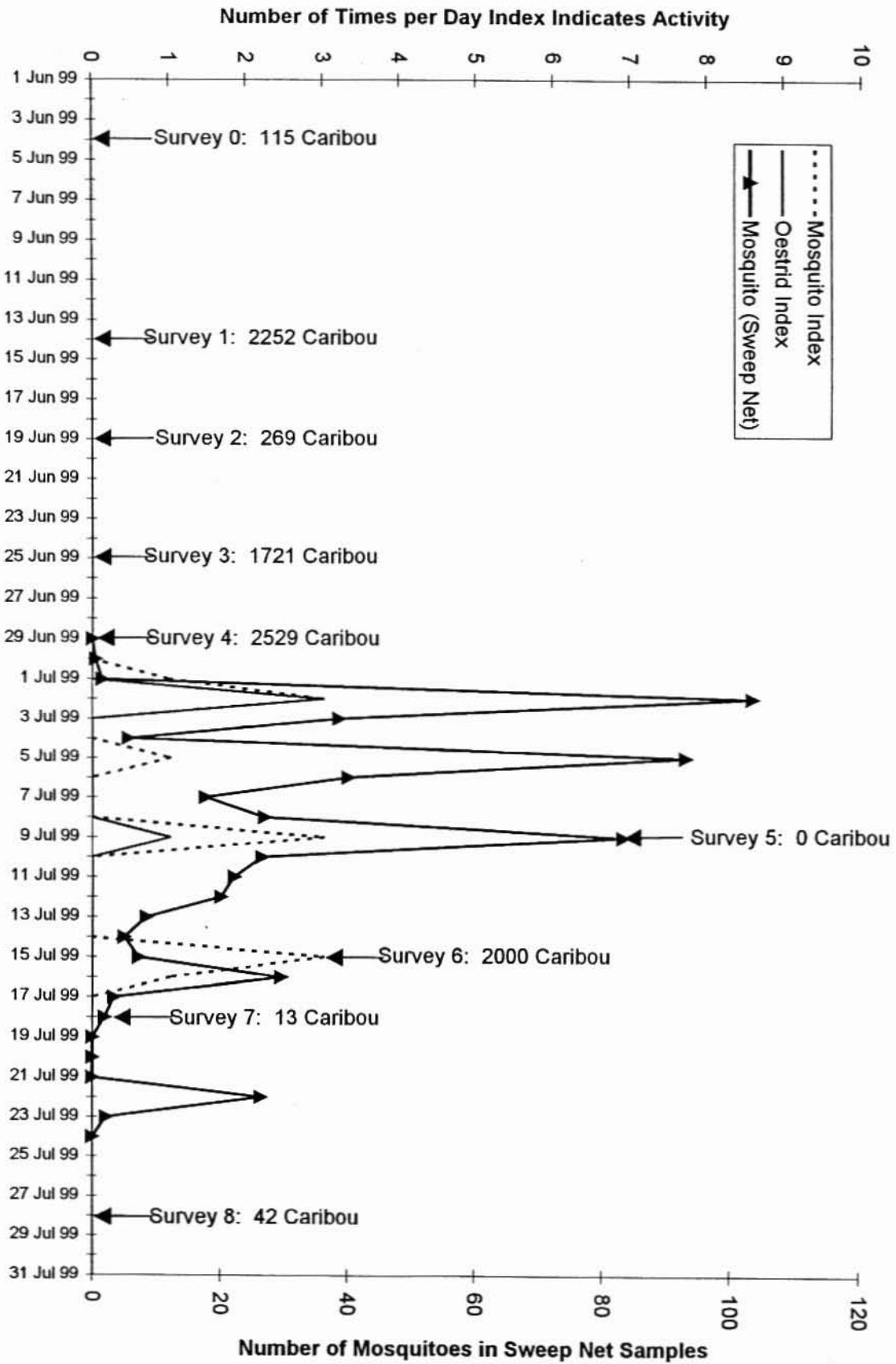


Figure 2. Mosquito and oestrid activity indices based on hourly weather data collected at the Deadhorse Weather Station and 1999 aerial caribou survey dates, Bullen Point to Staines River study area, Alaska, 1999.

1999 DISTRIBUTION OF CARIBOU CALVES DURING THE CALVING PERIOD

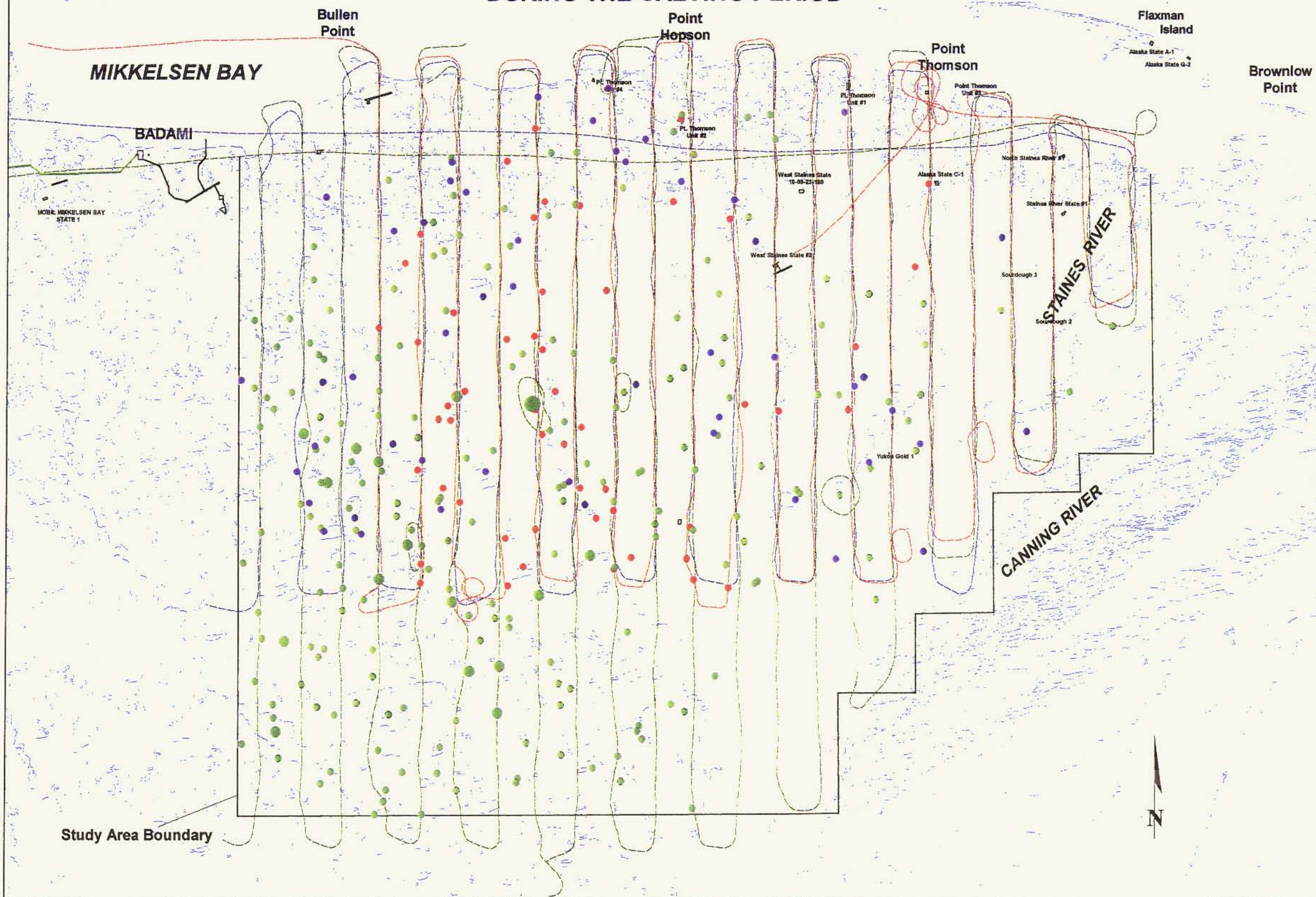
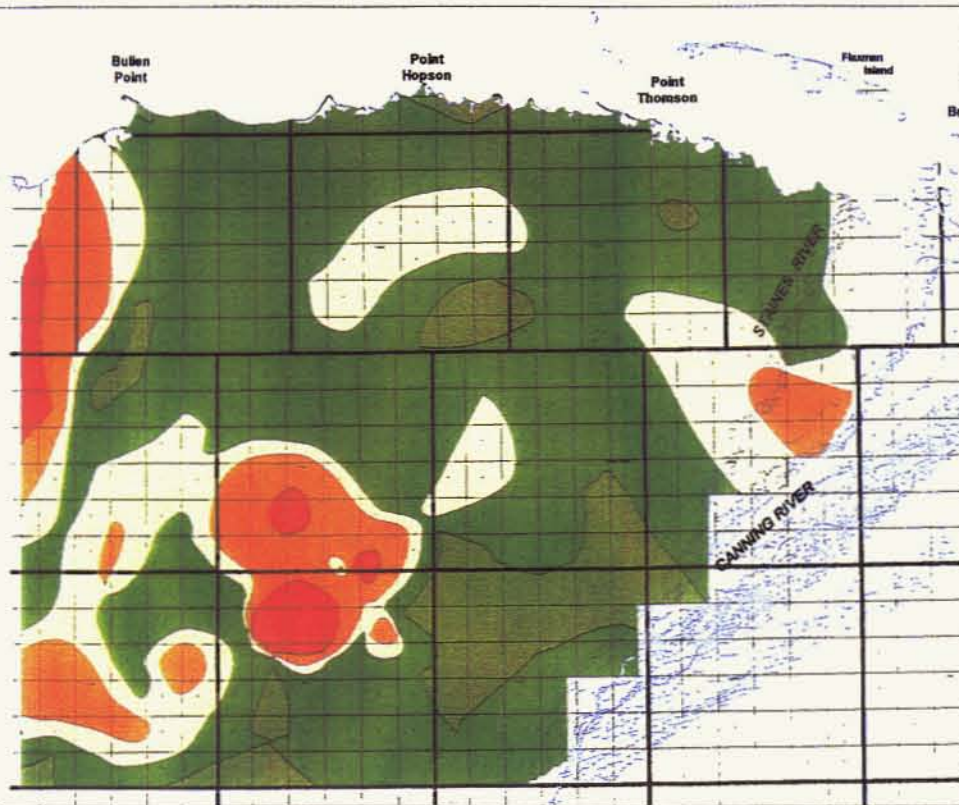


Figure 3

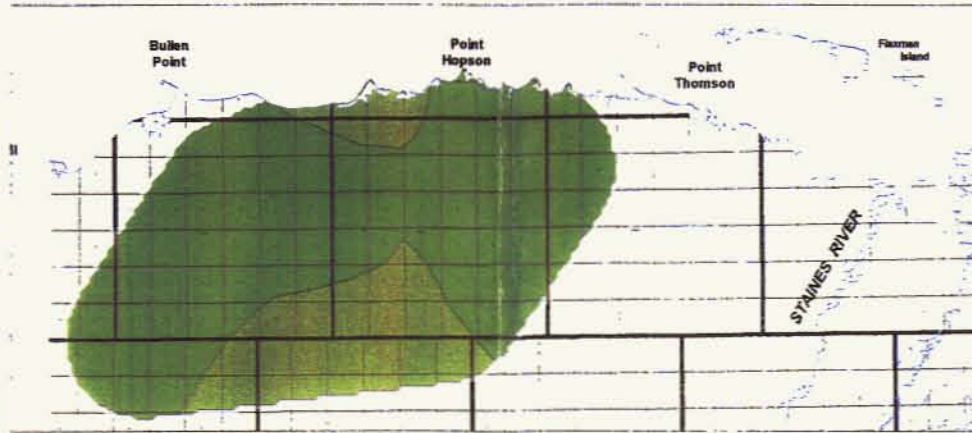
Distribution of caribou calves in the Bullen Point to Staines River study area, Alaska, during calving period surveys on 4, 14, and 19 June 1999.

Caribou Group Size	
<u>4 June 1999</u>	
● (Small Red)	Less than 10
● (Medium Red)	10 to 50
● (Large Red)	51 to 100
● (Very Large Red)	Greater than 100
Groups	
	52
	0
	0
	0
<u>14 June 1999</u>	
● (Small Green)	Less than 10
● (Medium Green)	10 to 50
● (Large Green)	51 to 100
● (Very Large Green)	Greater than 100
Groups	
	192
	15
	1
	0
<u>19 June 1999</u>	
● (Small Purple)	Less than 10
● (Medium Purple)	10 to 50
● (Large Purple)	51 to 100
● (Very Large Purple)	Greater than 100
Groups	
	50
	0
	0
	0
<u>Aerial Coverage</u>	
— (Red Dashed)	Survey Line 4 June
	64%
— (Black Dashed)	Survey Line 14 June
	100%
— (Blue Dashed)	Survey Line 19 June
	75%
— (Green Solid)	Pipelines
■ (Pink)	Oil Production and Service Facilities
Miles	
1 0 1 2 3 4 5	
Kilometers	
1 0 1 2 3 4 5	

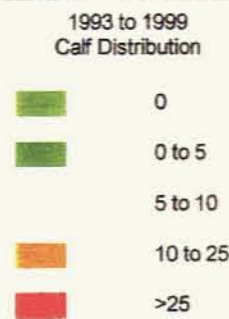
Map Projection: UTM Zone 6
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1993 Calving Period (1 survey)



1995 Calving Period (1 survey)

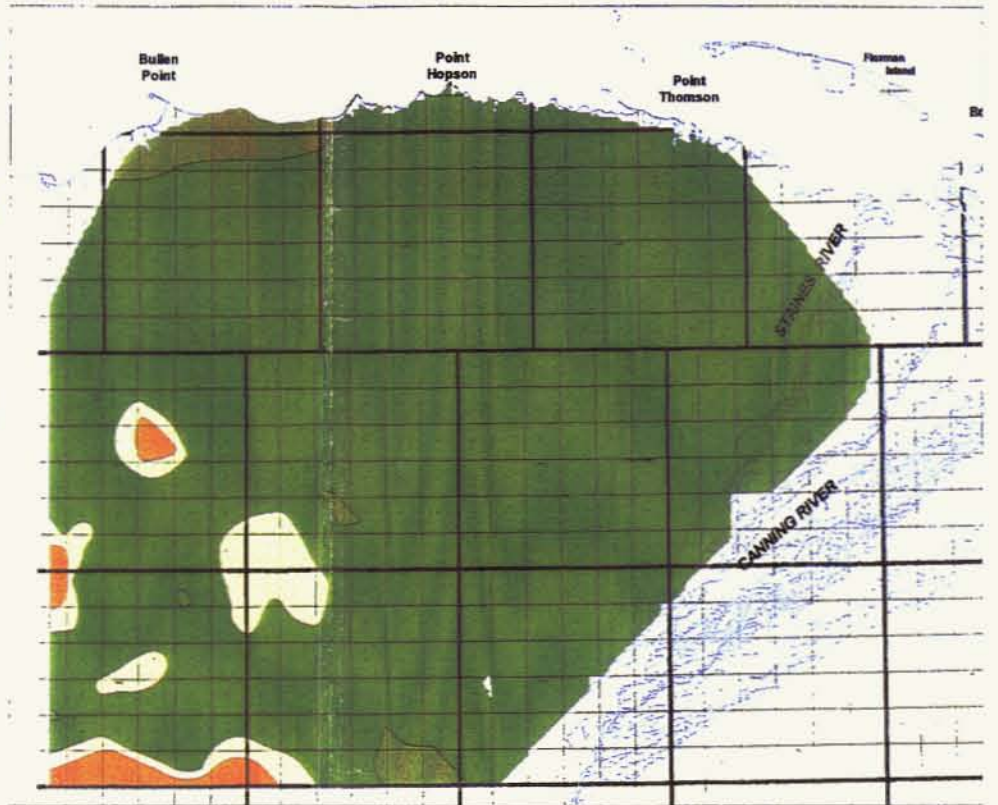


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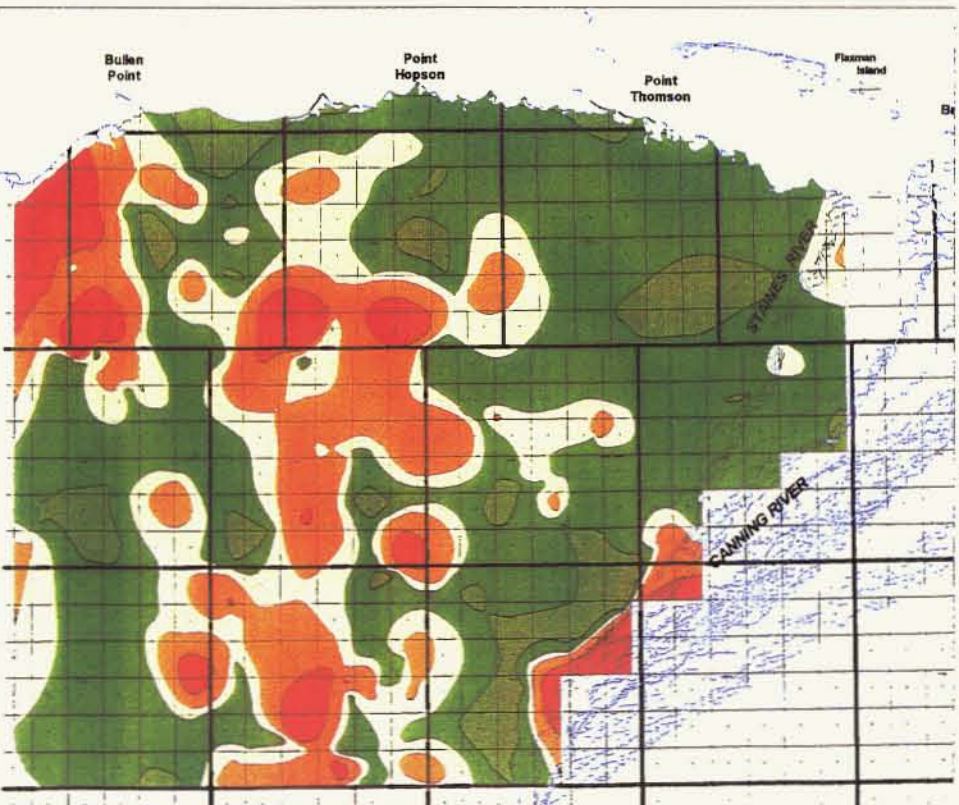


Figure 4

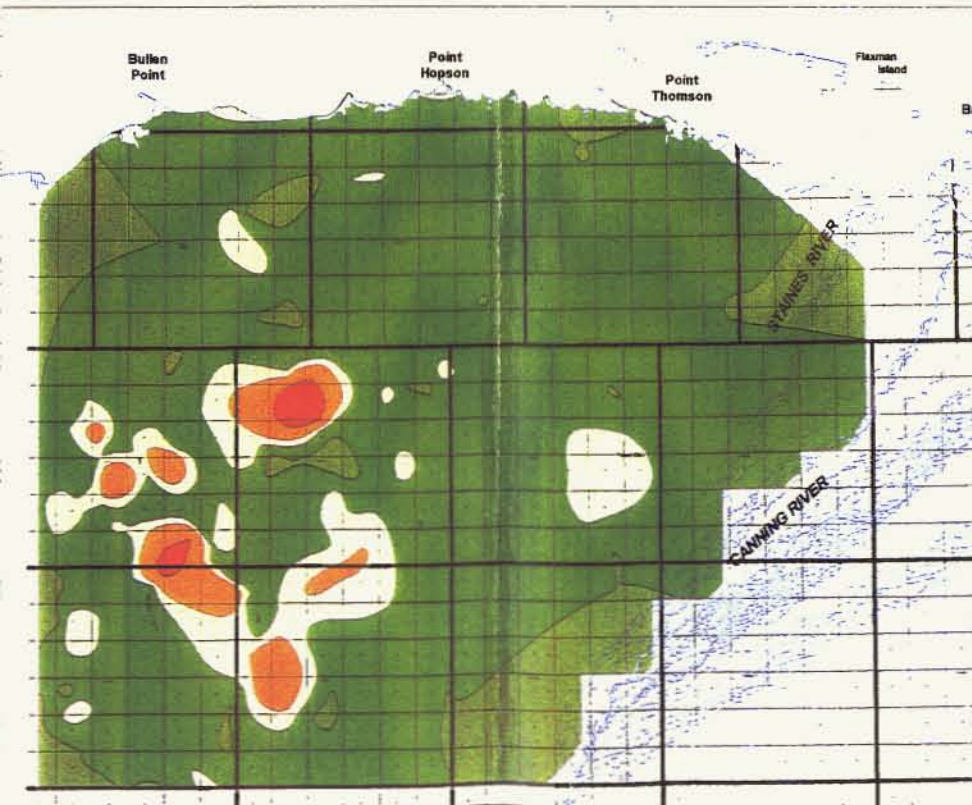
Distribution of calves during the calving period (before 20 June) as contours of the total number of calves by year and for combined 1993 to 1999 distributions (7 surveys), in the Bullen Point to Staines River study area, Alaska.



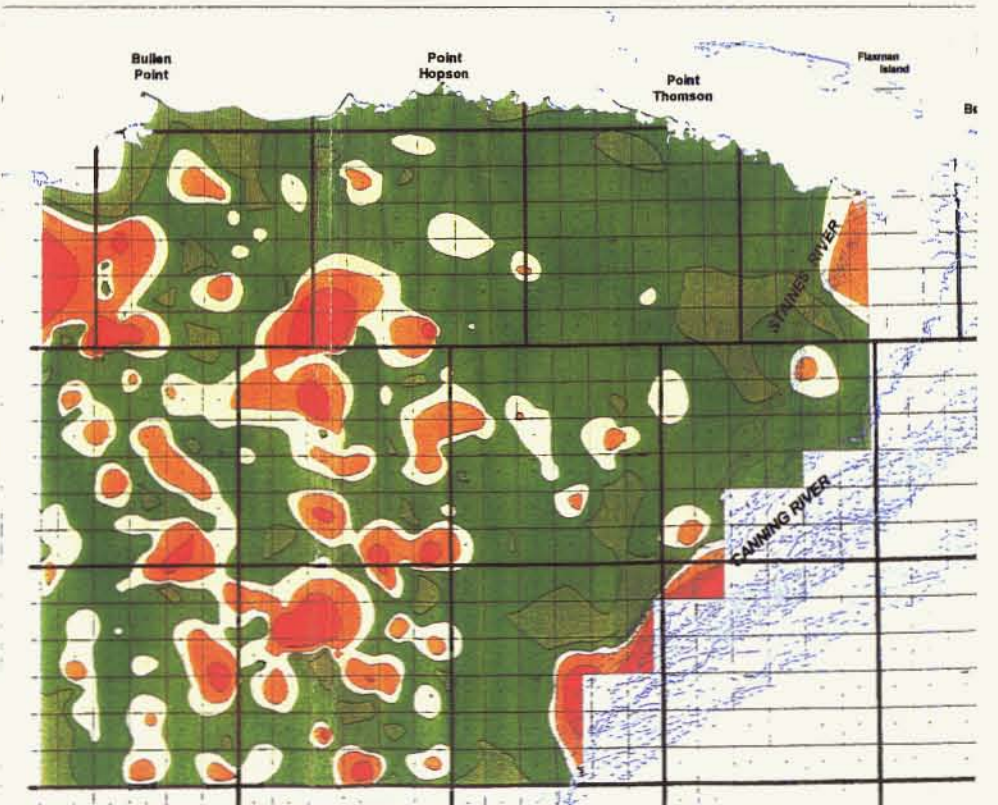
1997 Calving Period (1 survey)



1998 Calving Period (2 surveys)



1999 Calving Period (2 surveys)



1993 to 1999 Calving Period Surveys (7 surveys)

1999 DISTRIBUTION OF CARIBOU DURING THE POST-CALVING PERIOD

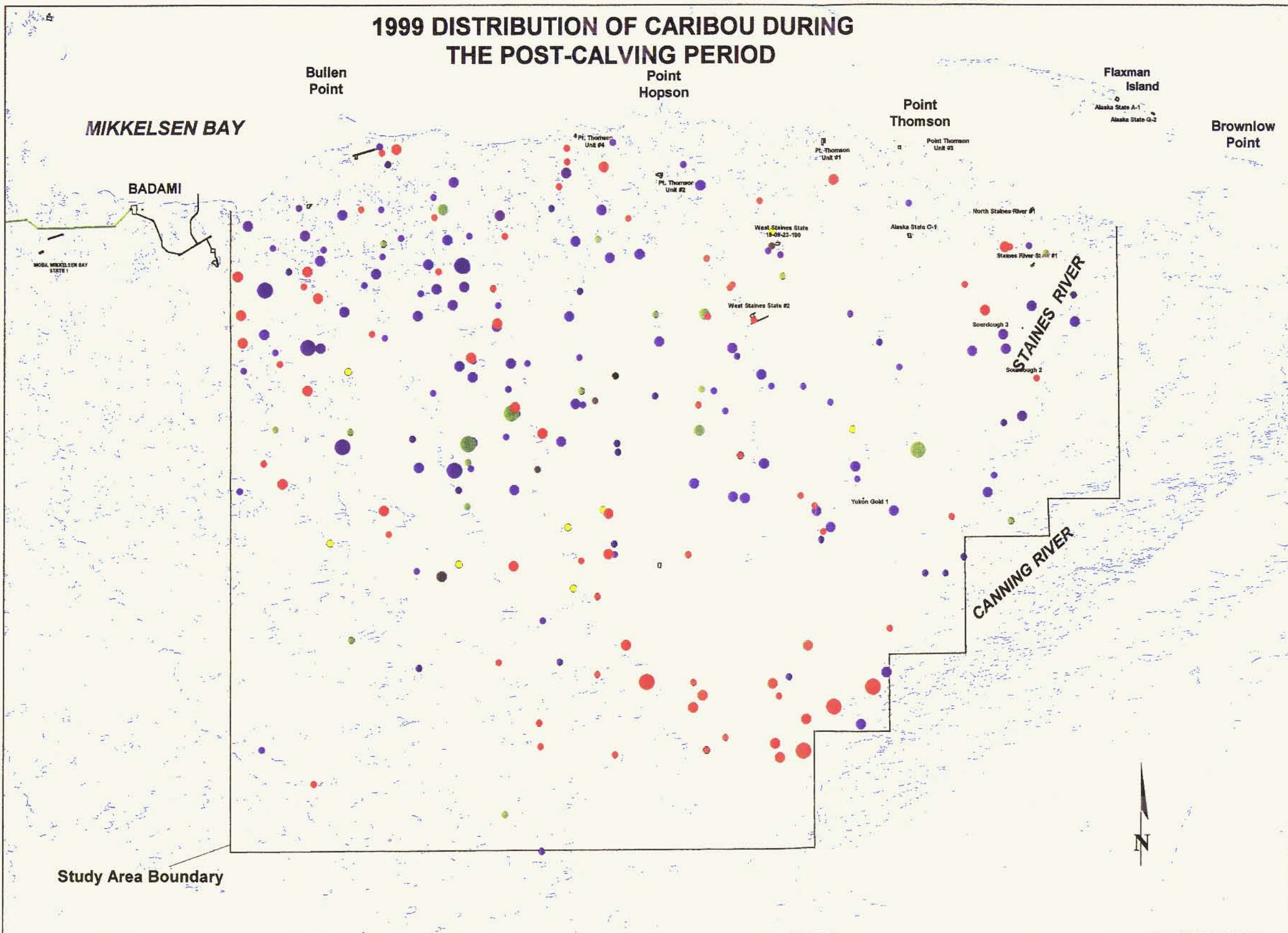


Figure 5

Distribution of caribou in the Bullen Point to Staines River study area, Alaska, during post-calving surveys 25 and 29 June, 9, 15, 18, and 28 July 1999

Caribou Group Size			
25 June 1999		29 June 1999	
● <10	(44)	● <10	(66)
● 10 to 100	(28)	● 10 to 100	(53)
● >100	(4)	● >100	(5)
15 July 1999		18 July 1999 a	
● <10	(14)	● <10	(8)
● 10 to 100	(3)	● 10 to 100	(0)
● >100	(3)	● >100	(0)
28 July 1999 b			
● <10	(4)		
● 10 to 100	(1)		
● >100	(0)		

() Number of Groups

a= 78% coverage b= 76% coverage

No caribou were observed during the 9 July survey 1999.

— Pipelines
 Oil Production and Service Facilities

1 0 1 2 3 4 5 Miles
 1 0 1 2 3 4 5 Kilometers

Map Projection: UTM Zone 6
 Datum: NAD 27
 View Scale: 1:175,000
 Mapping Scale: 1:63,360
 Prepared by: LGL Alaska Research Associates
 File: SD99_Fig.5.wor



**1993 to 1999
Coastal Caribou Concentrations**

0	14.2253 sq km
0 to 5	19.9848 sq km
5 to 100	41.6637 sq km
100 to 500	13.0525 sq km
500 to 1000	0.0044 sq km
1000 to 2500	0.0 sq km

**Caribou Group Size
(Number of Groups)**

◊ < 10	(48)
● 10 to 100	(16)
● 101 to 250	(2)
● > 250	(9)

Figure 6. Coastal post-calving period (after 20 June) distribution as contours of the total number of caribou within 2 km of the coast for combined 1993 to 1999 caribou distributions (25 surveys), in the Bullen Point to Staines River study area, Alaska

Contours created from interpolation grid.
Interpolation type: Natural Neighbors, Forward Step
Aggregation Distance 200 m, Sum of Total Caribou
Method-Slope, Skew=1, Weight=2, Exponent=2
Grid: Convex Hull, 200m cell

Projection: UTM Alaska Zone 6
Datum: NAD 1927
Scale: 1:160,000

Table 1. Sex and age classification for caribou observed during systematic aerial surveys in the Bullen Point to Staines River study area, Alaska, 4 June to 28 July 1999.

Flight	Date	Number of Caribou				Total	Number Of Groups	Mean Group Size	Study Area Coverage
		Bulls	Cows	Calves	Unclassified				
0 ^a	4 Jun 99	0	84	31		115	51	2.3	64%
1	14 Jun 99	2	1,462	702	86	2,252	208	10.8	100%
2 ^b	19 Jun 99	3	145	70	51	269	50	5.4	75%
3	25 Jun 99	2	932	487	300	1,721	76	22.6	100%
4	29 Jun 99	9	1,426	644	450	2,529	123	20.6	100%
5	9 Jul 99	0	0	0	0	0	0		100%
6	15 Jul 99	409	997	293	301	2,000	20	100.0	100%
7 ^b	18 Jul 99	2	4	1	6	13	8	1.6	78%
8 ^b	28 Jul 99	0	20	12	10	42	5	8.4	76%

^aSurvey purpose was to identify arctic fox den sites, caribou sightings were recorded during this flight over a reduced survey area (Fig. A-1.)

^bGround fog prevented surveying portions of transects south of 70°00' north latitude (see Figures A-3, A-7 and A-8).

Table 2. Caribou group movements recorded on systematic strip-transect aerial surveys during the calving and post-calving periods in the Bullen Point to Staines River study area, Alaska, 14 June to 15 July 1999.

Date	Direction					Total	Wind Direction
	N	NE	S	E	W		
Calving Period (1 to 20 June)							
14 Jun 99	0	1	1	0	2	4	NW
19 Jun 99	0	0	2	0	0	2	NW
Total	0	1	3	0	2	6	
Post-calving Period (21 June to 15 August)							
25 Jun 99	2	2	0	3	0	7	ENE
15 Jul 99	2	4	0	1	1	8	E
Total	4	6	0	4	1	15	

Table 3. Caribou activity by group size recorded during systematic strip-transect aerial surveys during the calving and post-calving periods in the Bullen Point to Staines River study area, Alaska, 14 June to 28 July 1999.

Group Size	Activity							
	Calving Period (1 to 20 June)							
	Rest	Stand	Feed	Walk	Trot	Run	Move	Total
Groups <10	29	1	28	6	1	0	2	67
Groups 10 to 100	10	1	19	1	0	0	0	31
Groups >100	1	0	0	0	0	0	0	1
All Groups	40	2	47	7	1	0	2	99
	Post-Calving Period (21 June to 15 August)							
	Rest	Stand	Feed	Walk	Trot	Run	Move	Total
Groups <10	10	2	39	2	0	2	4	59
Groups 10 to 100	2	2	20	1	0	1	4	30
Groups >100	0	0	6	0	0	0	1	7
All Groups	12	4	65	3	0	3	9	96

Table 4. Caribou group sightings by activity and habitat types (Walker 1983, see Table A-3) recorded during systematic strip-transect aerial surveys during the calving and post-calving periods in the Bullen Point to Staines River study area, Alaska, 14 June to 28 July 1999.

Activity	Wet Sedge/Moist Sedge, Dwarf Shrub Tundra Complex IIIId	Wet Sedge/Moist Sedge/Barren Complex IIIe	Moist/Wet Sedge Complex IVa	Moist Sedge, Dwarf Shrub Tundra Va	Moist Tussock Sedge, Dwarf Shrub Tundra Vb	Dry, Dwarf Shrub, Crustose Lichen Tundra Vc	Moist Graminoid, Dwarf Shrub Tundra/Barren Complex Ve	River Gravels Xa	Gravel Roads and Pads Xe	Total
Calving Period (1 June to 20 June)										
Rest	2	1	1	25	2	4	5	0	0	40
Stand	1	0	0	1	0	0	0	0	0	2
Feed	2	5	6	25	3	0	6	0	0	47
Move	0	0	0	0	1	0	1	0	0	2
Walk	4	0	1	2	0	0	0	0	0	7
Trot	0	0	0	1	0	0	0	0	0	1
Run	0	0	0	0	0	0	0	0	0	0
Total	9	6	8	54	6	4	12	0	0	99
Post-calving Period (21 June to 15 August)										
Rest	0	0	0	5	1	2	1	1	1	11
Stand	0	1	0	2	0	0	0	1	0	4
Feed	3	0	1	36	3	12	9	1	0	65
Move	0	0	0	4	0	2	1	0	0	7
Walk	0	1	0	2	0	0	0	0	0	3
Trot	0	0	0	0	0	0	0	0	0	0
Run	0	0	0	2	0	1	0	0	0	3
Total	3	2	1	51	4	17	11	3	1	93

Table 5. Caribou group location by habitat type as mapped for the Point Thomson Unit Area (Noel and Funk 1999) based on point locations recorded during aerial strip-transect surveys in the Bullen Point to Staines River study area, Alaska, 1993 to 1999.

28

Survey Year	Water Ia	Aquatic Graminoid Tundra IIb	Water/Tundra Complex IIId	Wet Sedge Tundra IIIa	Wet Sedge Tundra/Water Complex IIIc	Wet Sedge/Moist Sedge, Dwarf Shrub Tundra Complex IIId	Moist/Wet Sedge Complex IVa	Moist Sedge, Dwarf Shrub Tundra Va	Dry, Dwarf Shrub, Crustose Lichen Tundra Vc	Moist Graminoid, Dwarf Shrub Tundra/Barren Complex Ve	River Gravels Xa	Gravel Roads and Pads Xe	Wet Mud XIa	Total
1993	2	0	0	2	0	3	0	6	0	2	1	1	1	18
1997	12	0	0	0	0	3	0	0	1	1	1	0	0	18
1998	1	0	1	1	0	5	4	5	1	0	0	0	1	19
1999 ^a	1	1	0	1	1	3	3	5	0	2	0	0	0	17
Total	16	1	1	4	1	14	7	16	2	5	2	1	2	72

^a For nine records with observer classified habitat within the landcover map area:
 Five of seven Va observer classes matched map class for 71% accuracy.
 Two Va observer classes were mapped as IIIa and IIIc.
 Two Vc observer classes were mapped as Ve for 0% accuracy.

Table 6. Hierarchical vegetation categories for the Point Thomson Area Vegetation/Land Cover Map, based on Walker's (1983) vegetation classification. Vegetation types were mapped and labeled at Level C.

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
		IVa. Moist Sedge, Dwarf Shrub/Wet Graminoid Tundra Complex (moist patterned ground complex)	Typical communities listed in IIIa and Va
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>Thamnia 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 6. 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)
		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)
		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)
		IXh. Wet Barren/Wet Sedge Tundra Complex (barren/saline tundra complex, saltmarsh)	Typical communities listed in IIIb

Table 6. 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)	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.
		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.

1999 DATA

CALVING PERIOD

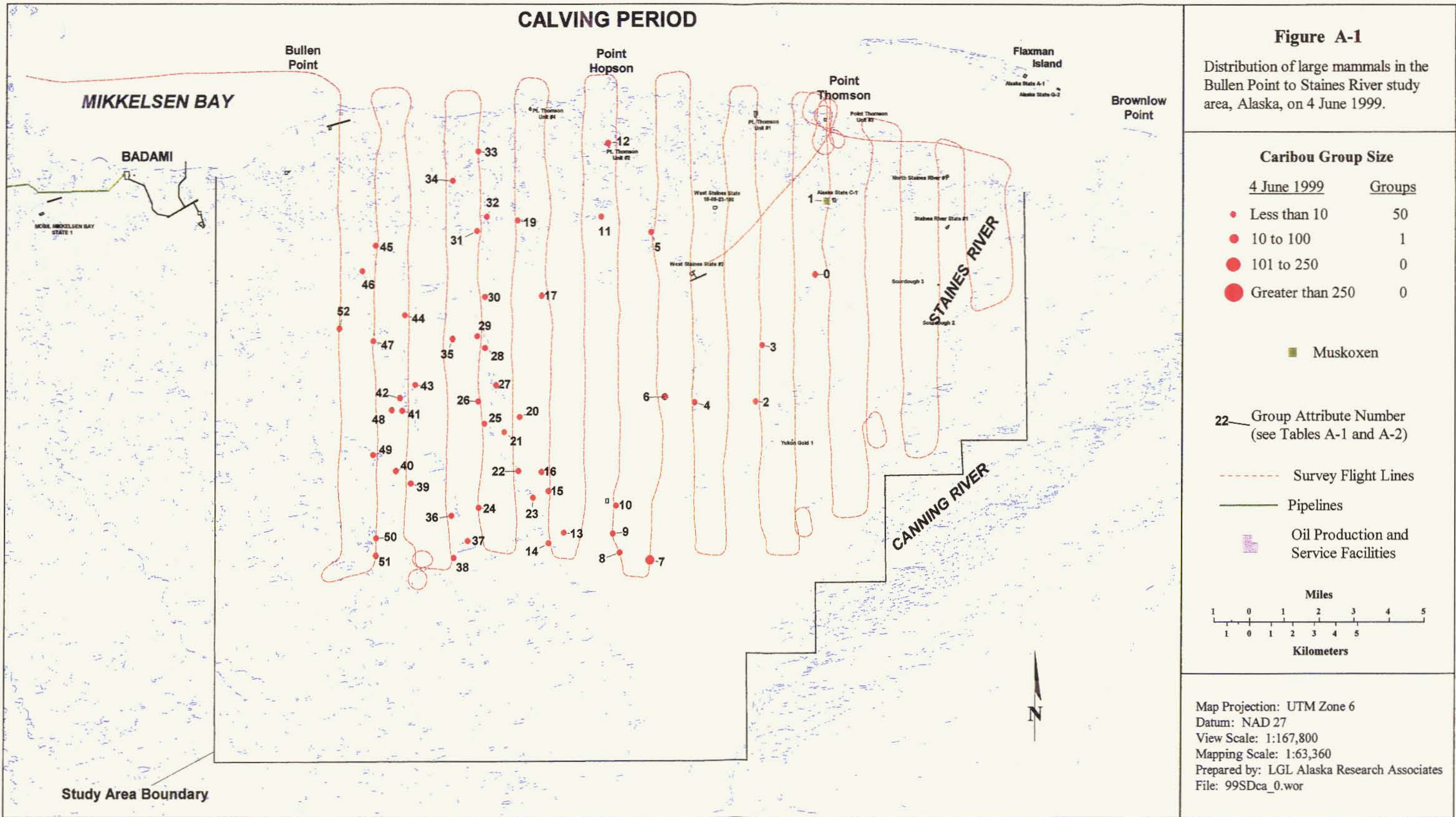


Figure A-1

Distribution of large mammals in the Bullen Point to Staines River study area, Alaska, on 4 June 1999.

Caribou Group Size

4 June 1999 Groups

- Less than 10 50
- 10 to 100 1
- 101 to 250 0
- Greater than 250 0

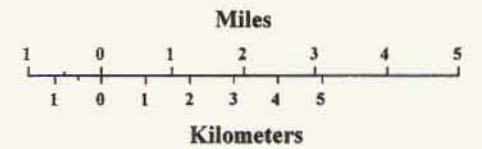
■ Muskoxen

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: 1:167,800
 Mapping Scale: 1:63,360
 Prepared by: LGL Alaska Research Associates
 File: 99SDca_0.wor

CALVING PERIOD

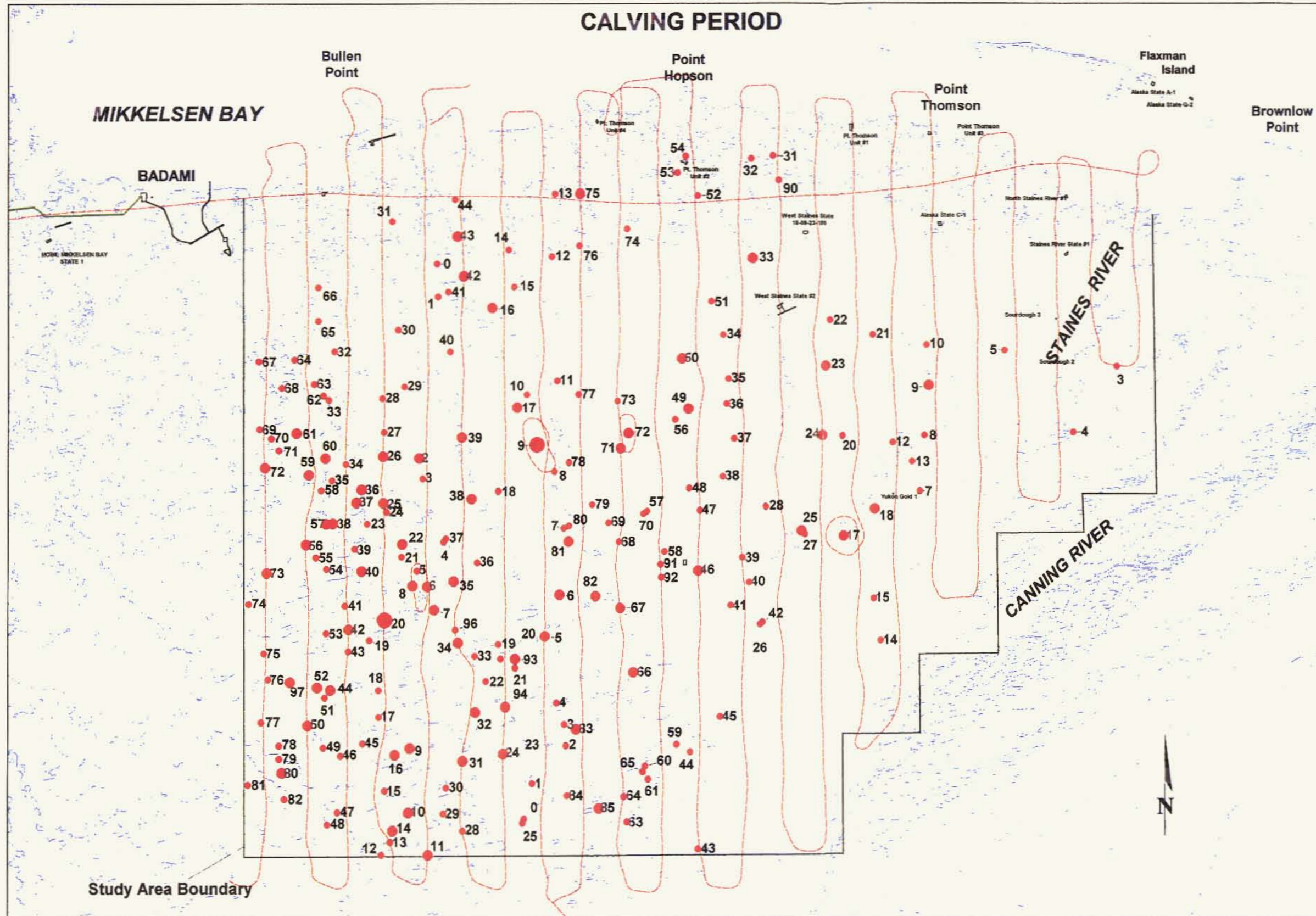


Figure A-2

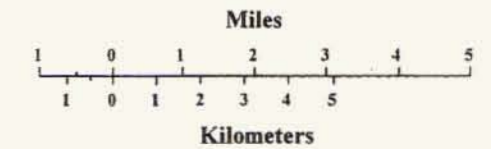
Distribution of large mammals in the Bullen Point to Staines River study area, Alaska, on 14 June 1999.

Caribou Group Size

14 June 1999	Groups
• Less than 10	143
• 10 to 100	63
• 101 to 250	2
• Greater than 250	0

22— Group Attribute Number (see Table A-1)

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



Map Projection: UTM Zone 6
 Datum: NAD 27
 View Scale: 1:167,800
 Mapping Scale: 1:63,360
 Prepared by: LGL Alaska Research Associates
 File: 99SDca_1.wor

CALVING PERIOD

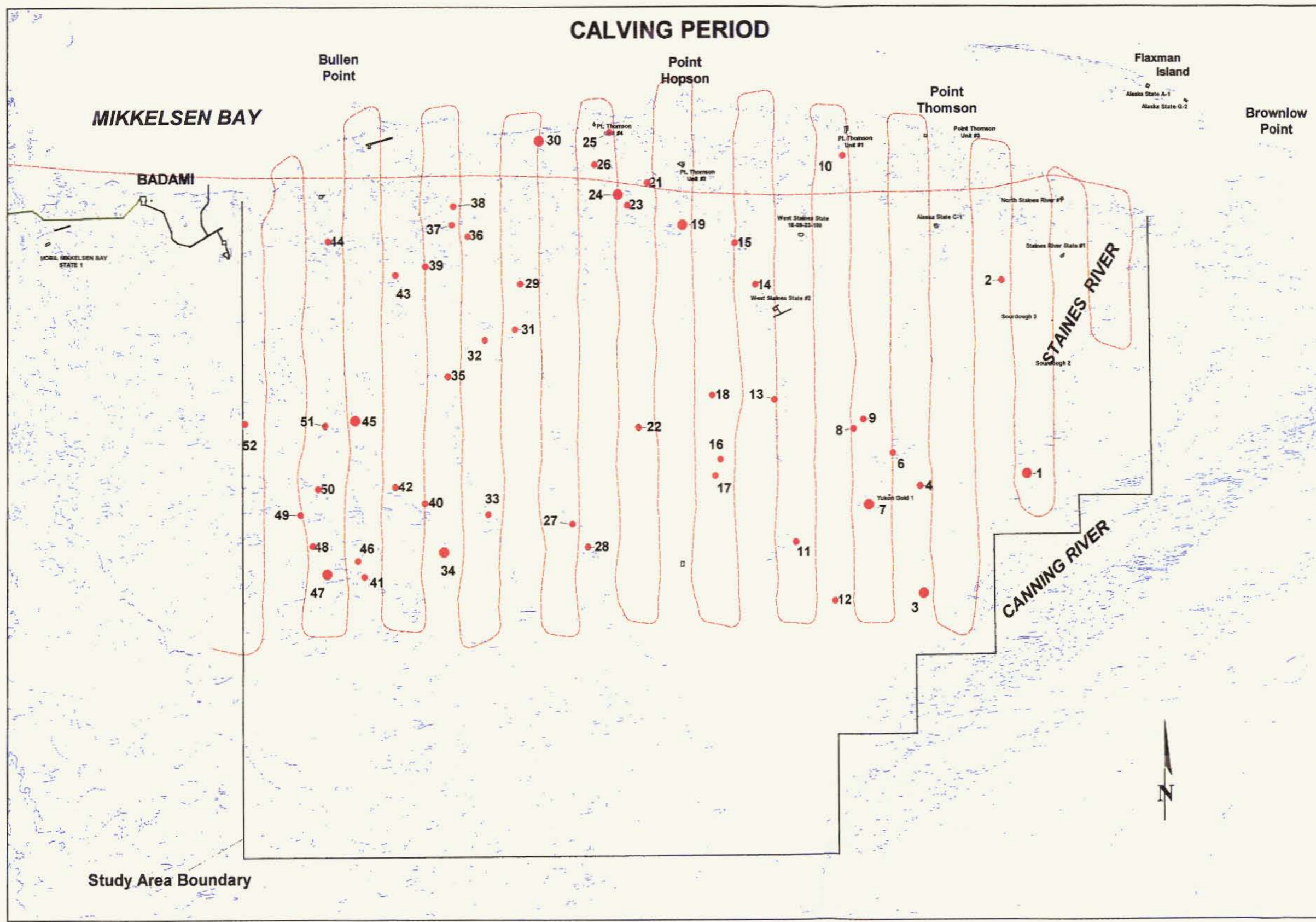


Figure A-3

Distribution of large mammals in the Bullen Point to Staines River study area, Alaska, on 19 June 1999.

Caribou Group Size

19 June 1999 Groups

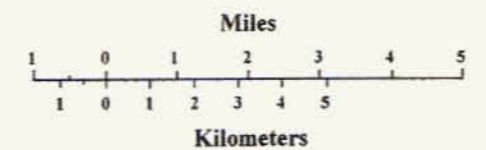
- Less than 10 41
- 10 to 100 9
- 101 to 250 0
- Greater than 250 0

22 — Group Attribute Number (see Table A-1)

--- Survey Flight Lines

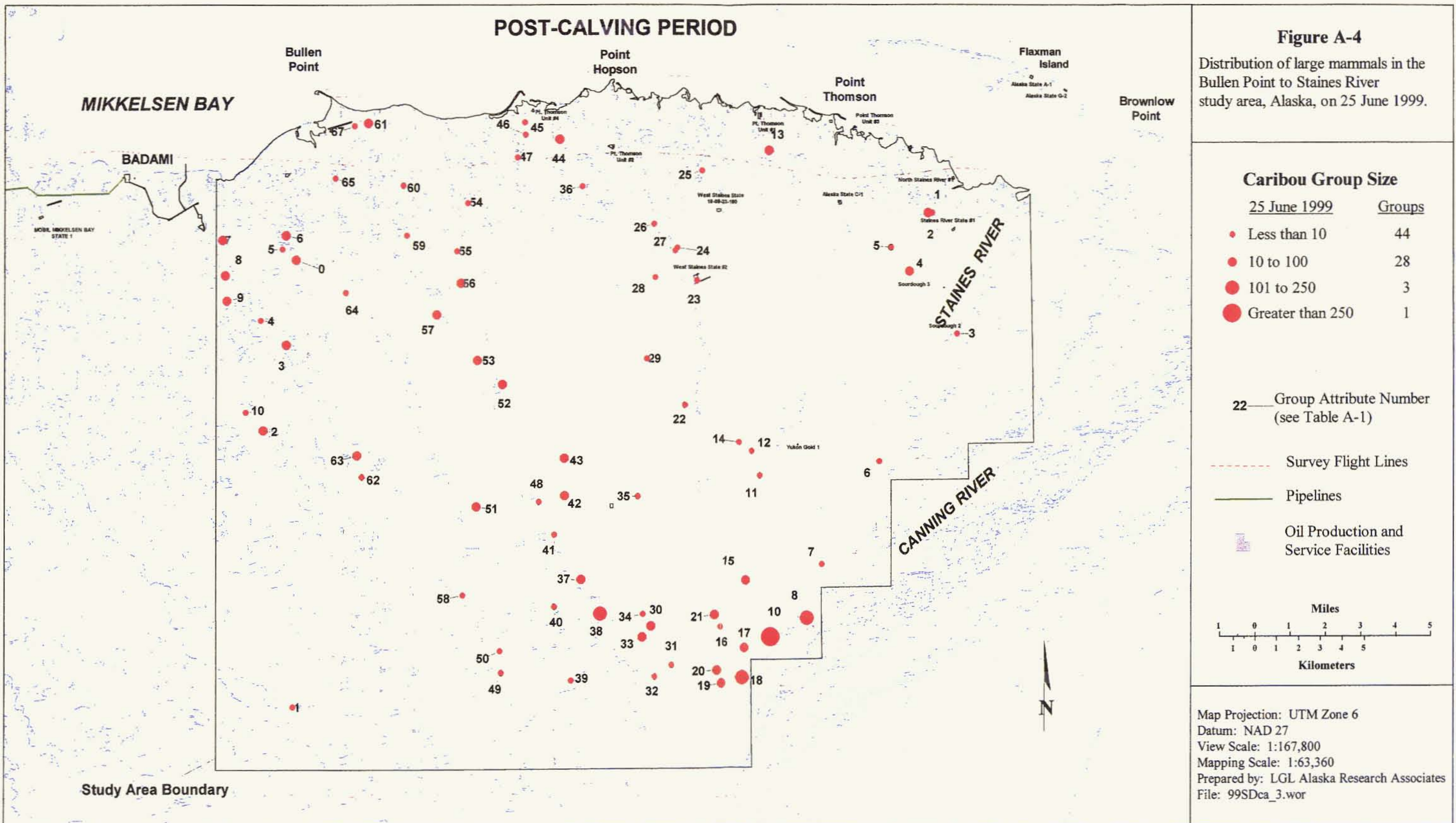
— Pipelines

■ Oil Production and Service Facilities



Map Projection: UTM Zone 6
 Datum: NAD 27
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 Prepared by: LGL Alaska Research Associates
 File: 99SDca_2.wor

Study Area Boundary



POST-CALVING PERIOD

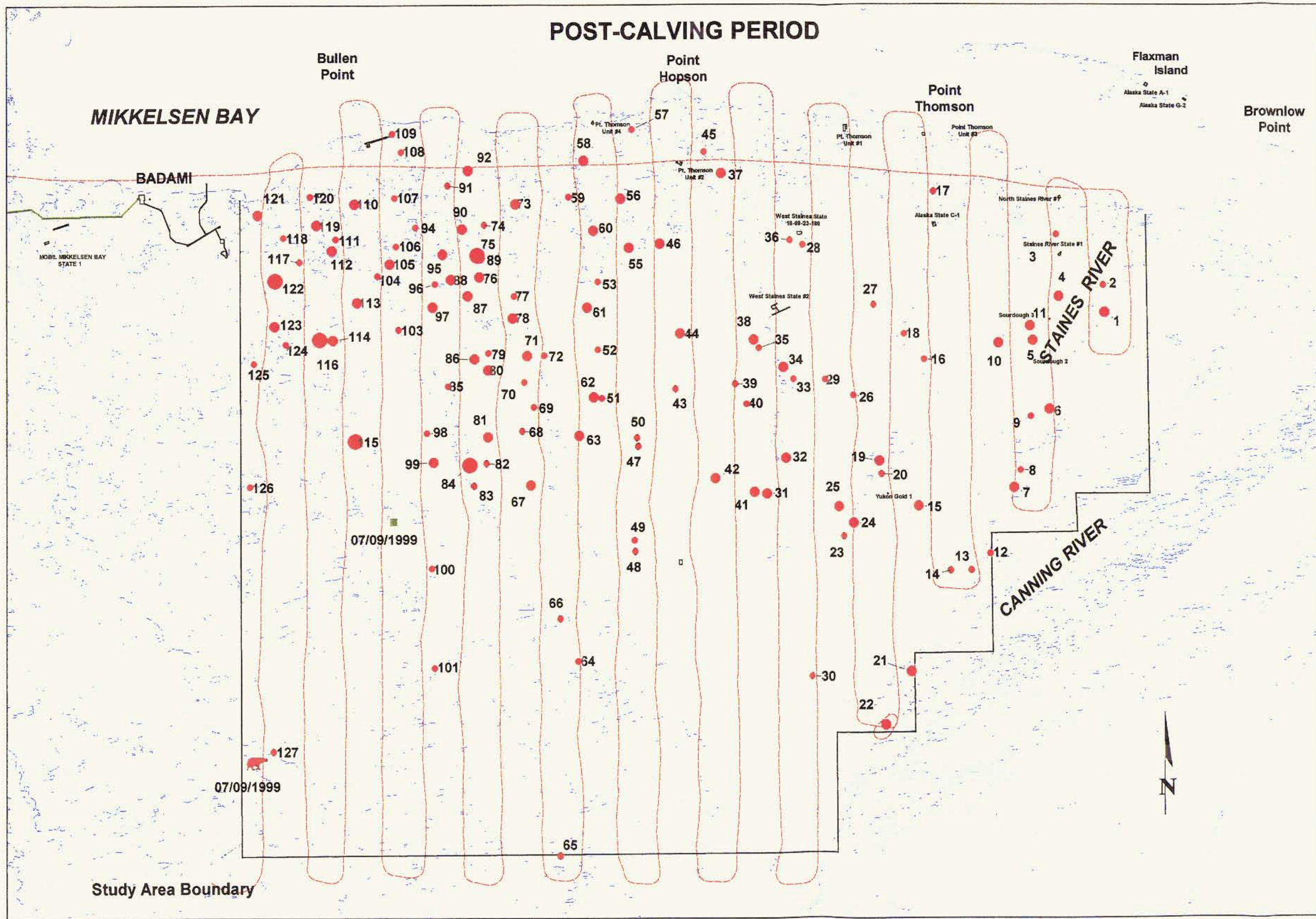


Figure A-5

Distribution of large mammals in the Bullen Point to Staines River study area, Alaska, on 29 June and 9 July 1999.

Caribou Group Size^a

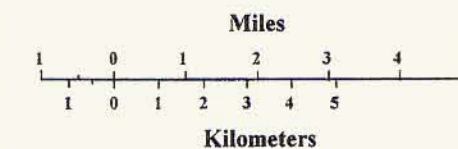
29 June 1999	Groups
Less than 10	66
10 to 100	53
101 to 250	5
Greater than 250	0

^a No caribou were observed on the 9 July 1999 survey.

- Muskoxen 9 July 99
- 🐻 Grizzly Bear 9 July 99

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: 1:167,800
 Mapping Scale: 1:63,360
 Prepared by: LGL Alaska Research Associates
 File: 99SDca_4.wor

POST-CALVING PERIOD

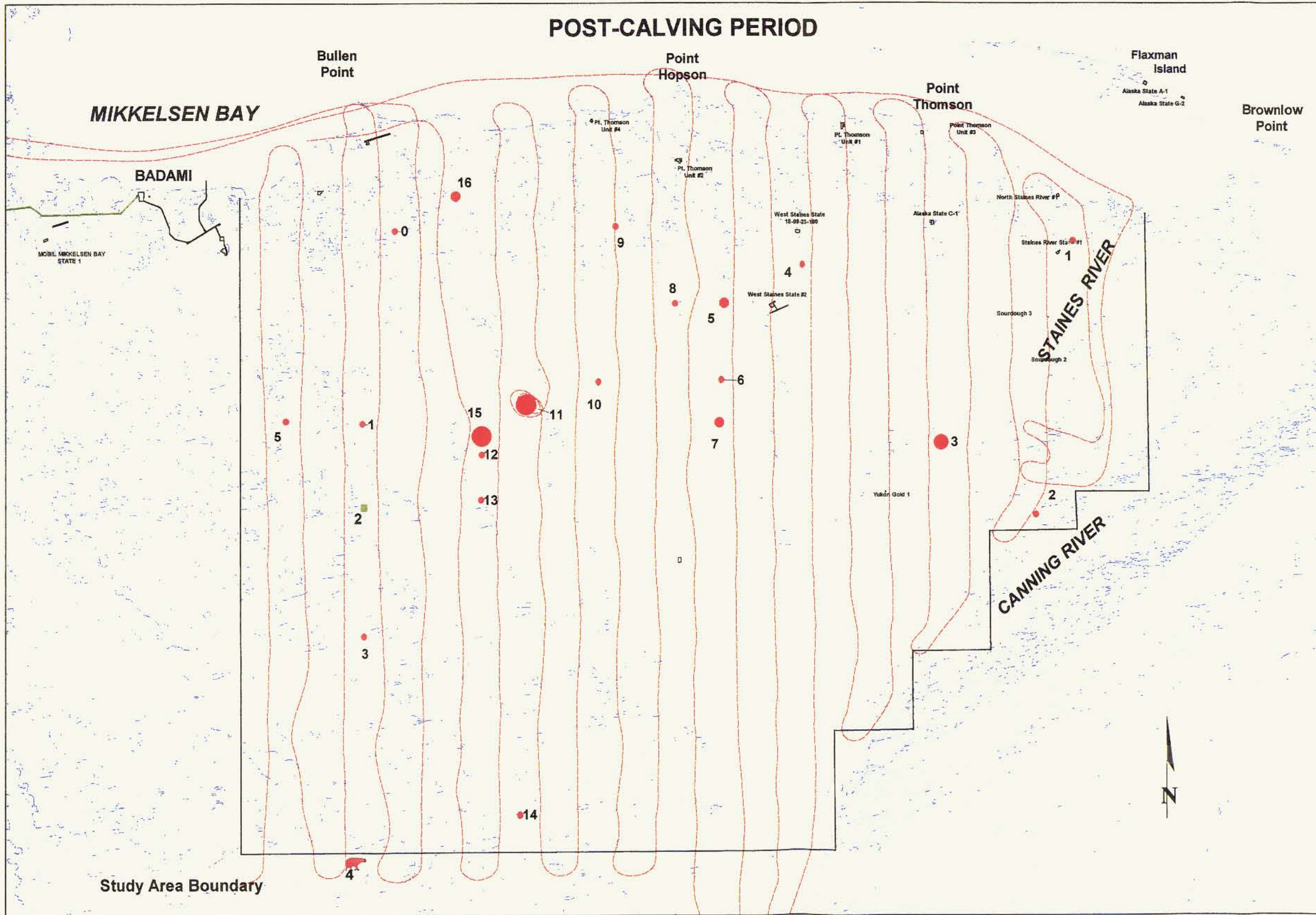


Figure A-6

Distribution of large mammals in the Bullen Point to Staines River study area, Alaska, on 15 July 1999.

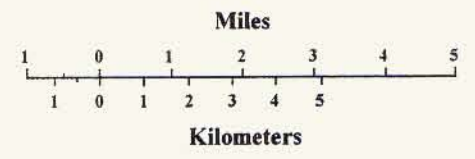
Caribou Group Size

15 July 1999	Groups
● Less than 10	14
● 10 to 100	3
● 101 to 250	1
● Greater than 250	2

- 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: 1:167,800
 Mapping Scale: 1:63,360
 Prepared by: LGL Alaska Research Associates
 File: 99SDca_6.wor

POST-CALVING PERIOD

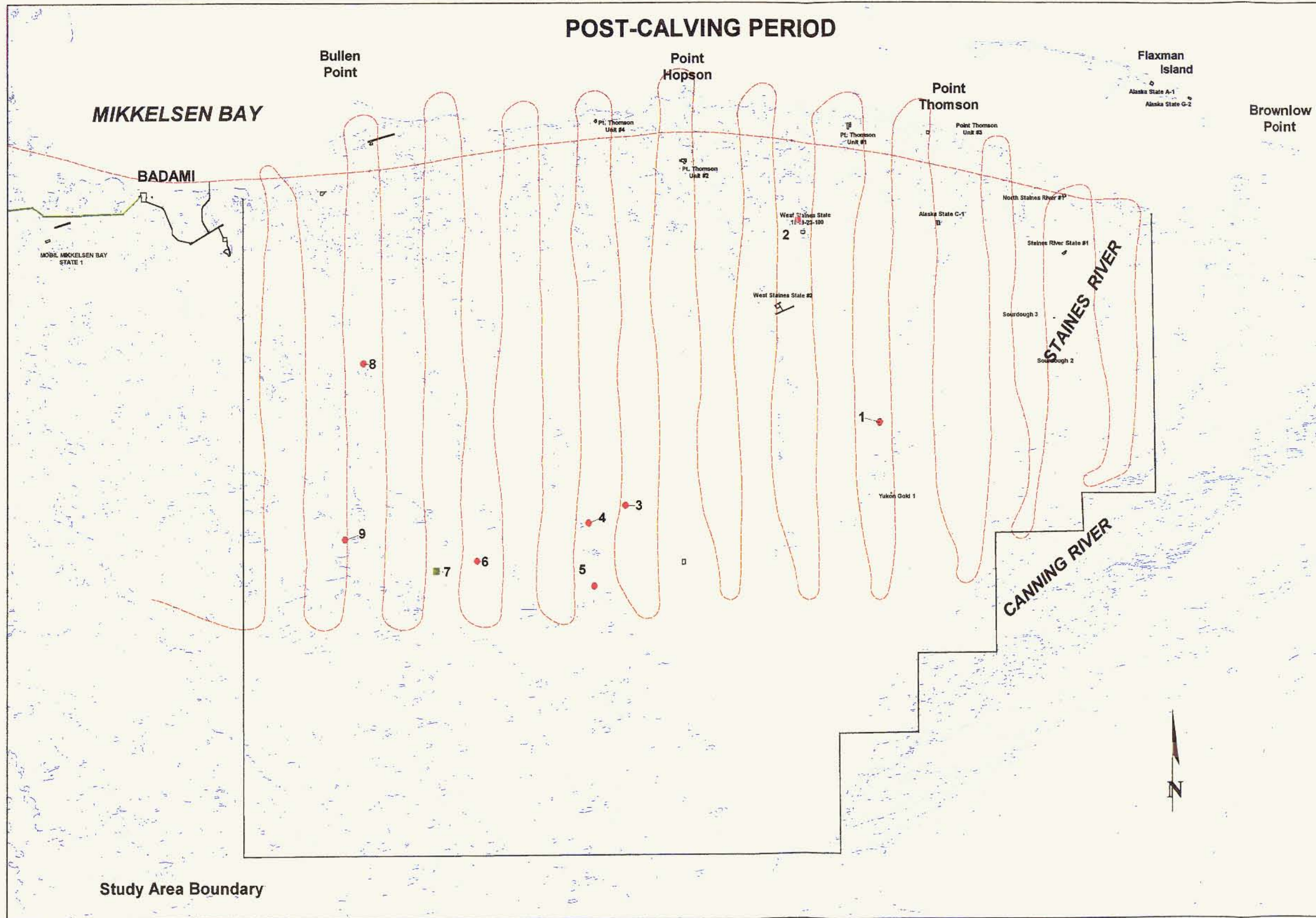


Figure A-7

Distribution of large mammals in the Bullen Point to Staines River study area, Alaska, on 18 July 1999.

Caribou Group Size

18 July 1999 Groups

- Less than 10 8
- 10 to 100 0
- 101 to 250 0
- Greater than 250 0

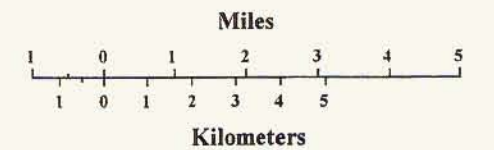
■ Muskoxen

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

--- Survey Flight Lines

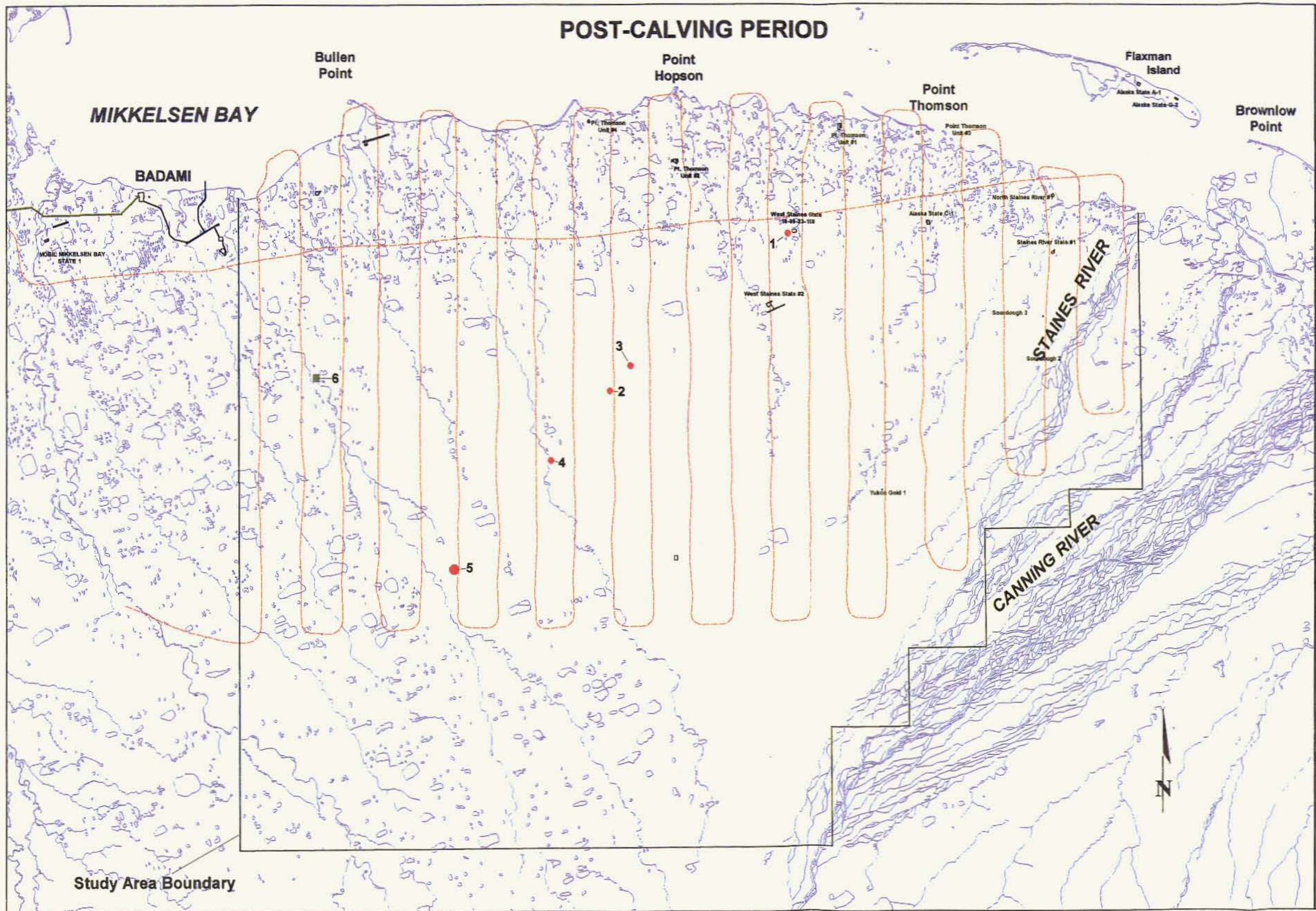
— Pipelines

Oil Production and Service Facilities



Study Area Boundary

Map Projection: UTM Zone 6
 Datum: NAD 27
 View Scale: 1:167,800
 Mapping Scale: 1:63,360
 Prepared by: LGL Alaska Research Associates
 File: 99SDca_7.wor



POST-CALVING PERIOD

Figure A-8

Distribution of large mammals in the Bullen Point to Staines River study area, Alaska, on 28 July 1999.

Caribou Group Size

28 July 1999	Groups
● Less than 10	4
● 10 to 100	1
● 101 to 250	0
● Greater than 250	0

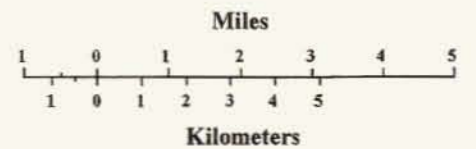
■ Muskoxen

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: 1:167,800
 Mapping Scale: 1:63,360
 Prepared by: LGL Alaska Research Associates
 File: 99SDca_8.wor

Study Area Boundary

Table A-1. Caribou (ca) sightings in the Bullen Point to Staines River study area, Alaska, summer 1999. Coordinates are longitude, latitude, and datum is WGS 1984. Time is Alaska Daylight Savings Time. See Table 6 for habitat code definitions.

Longitude°W	Latitude°N	Date	Time ADST	Flight	Attribute	Species	Bulls	Cows	Calves	Unclass	Total	Behavior	Habitat	Direction
146.268591	70.109060	4-Jun-99	11:17:46	0	0	ca	0	3	3	0	6			
146.342417	70.057150	4-Jun-99	11:32:15	0	2	ca	0	1	0	0	1			
146.333351	70.080270	4-Jun-99	11:33:08	0	3	ca	0	1	1	0	2			
146.417261	70.056950	4-Jun-99	11:47:45	0	4	ca	0	1	0	0	1			
146.467958	70.127080	4-Jun-99	11:55:51	0	5	ca	0	2	0	0	2			
146.453004	70.059450	4-Jun-99	11:58:24	0	6	ca	0	2	1	0	3			
146.471300	69.992370	4-Jun-99	12:00:58	0	7	ca	0	5	5	0	10			
146.507210	69.995470	4-Jun-99	12:02:00	0	8	ca	0	1	1	0	2			
146.514890	70.003280	4-Jun-99	12:02:21	0	9	ca	0	1	0	0	1			
146.511051	70.014700	4-Jun-99	12:02:47	0	10	ca	0	3	1	0	4			
146.527108	70.133600	4-Jun-99	12:07:22	0	11	ca	0	1	0	0	1			
146.518554	70.163640	4-Jun-99	12:08:32	0	12	ca	0	1	1	0	2			
146.573058	70.003750	4-Jun-99	12:17:03	0	13	ca	0	5	0	0	5			
146.591448	69.999540	4-Jun-99	12:18:04	0	14	ca	0	1	0	0	1			
146.591578	70.020970	4-Jun-99	12:18:53	0	15	ca	0	1	1	0	2			
146.599764	70.028830	4-Jun-99	12:19:12	0	16	ca	0	1	0	0	1			
146.598815	70.101510	4-Jun-99	12:21:58	0	17	ca	0	1	0	0	1			
146.627621	70.132350	4-Jun-99	12:27:55	0	19	ca	0	2	0	0	2			
146.625814	70.051540	4-Jun-99	12:30:58	0	20	ca	0	1	1	0	2			
146.644824	70.045420	4-Jun-99	12:31:12	0	21	ca	0	1	0	0	1			
146.627542	70.029260	4-Jun-99	12:31:49	0	22	ca	0	1	1	0	2			
146.610121	70.018240	4-Jun-99	12:32:14	0	23	ca	0	2	1	0	3			
146.675460	70.014270	4-Jun-99	12:34:14	0	24	ca	0	1	1	0	2			
146.668311	70.048870	4-Jun-99	12:35:34	0	25	ca	0	1	1	0	2			
146.675668	70.058050	4-Jun-99	12:35:55	0	26	ca	0	1	1	0	2			
146.654441	70.064780	4-Jun-99	12:36:10	0	27	ca	0	2	0	0	2			
146.667612	70.080030	4-Jun-99	12:36:44	0	28	ca	0	1	1	0	2			
146.676817	70.084890	4-Jun-99	12:36:55	0	29	ca	0	1	0	0	1			

Table A-1. Continued.

Longitude°W	Latitude°N	Date	Time ADST	Flight	Attribute	Species	Bulls	Cows	Calves	Unclass	Total	Behavior	Habitat	Direction
146.667732	70.101150	4-Jun-99	12:37:32	0	30	ca	0	2	0	0	2			
146.677097	70.128180	4-Jun-99	12:38:33	0	31	ca	0	2	1	0	3			
146.665274	70.133920	4-Jun-99	12:38:46	0	32	ca	0	1	1	0	2			
146.675370	70.160430	4-Jun-99	12:39:48	0	33	ca	0	1	0	0	1			
146.705844	70.148610	4-Jun-99	12:42:35	0	34	ca	0	1	1	0	2			
146.706405	70.083820	4-Jun-99	12:45:00	0	35	ca	0	1	0	0	1			
146.707812	70.011010	4-Jun-99	12:47:44	0	36	ca	0	1	0	0	1			
146.688731	70.000640	4-Jun-99	12:48:07	0	37	ca	0	4	0	0	4			
146.705001	69.993670	4-Jun-99	12:48:23	0	38	ca	0	1	0	0	1			
146.756032	70.024230	4-Jun-99	12:52:22	0	39	ca	0	1	0	0	1			
146.773862	70.029450	4-Jun-99	12:52:34	0	40	ca	0	1	0	0	1			
146.765995	70.054230	4-Jun-99	12:53:30	0	41	ca	0	2	0	0	2			
146.768954	70.059450	4-Jun-99	12:53:42	0	42	ca	0	4	0	0	4			
146.750864	70.064870	4-Jun-99	12:53:54	0	43	ca	0	4	0	0	4			
146.763077	70.093550	4-Jun-99	12:54:59	0	44	ca	0	2	1	0	3			
146.798408	70.122250	4-Jun-99	13:01:27	0	45	ca	0	2	2	0	4			
146.814341	70.111720	4-Jun-99	13:01:51	0	46	ca	0	1	1	0	2			
146.800790	70.082900	4-Jun-99	13:02:55	0	47	ca	0	1	0	0	1			
146.778990	70.054550	4-Jun-99	13:03:58	0	48	ca	0	2	1	0	3			
146.800927	70.036100	4-Jun-99	13:04:40	0	49	ca	0	1	1	0	2			
146.797200	70.001730	4-Jun-99	13:05:56	0	50	ca	0	2	1	0	3			
146.797770	69.994710	4-Jun-99	13:06:12	0	51	ca	0	1	0	0	1			
146.841950	70.088130	4-Jun-99	13:11:20	0	52	ca	0	1	0	0	1			
146.058104	70.086580	14-Jun-99	11:52:14	1	3	ca	0	0	0	1	1			
146.104368	70.062820	14-Jun-99	11:59:19	1	4	ca	0	6	3	0	9	rest	Vc	
146.177162	70.093030	14-Jun-99	12:02:47	1	5	ca	0	1	0	0	1			
146.269379	70.041950	14-Jun-99	12:14:15	1	7	ca	0	2	1	0	3	rest	IIe	
146.263742	70.062330	14-Jun-99	12:15:02	1	8	ca	0	5	3	0	8	rest	Va	
146.258425	70.080720	14-Jun-99	12:15:45	1	9	ca	0	6	4	0	10	feed	IVa	
146.260512	70.095500	14-Jun-99	12:16:18	1	10	ca	0	2	1	0	3	feed	IVa	
146.298237	70.060000	14-Jun-99	12:24:50	1	12	ca	0	1	0	0	1			

Table A-1. Continued.

Longitude°W	Latitude°N	Date	Time ADST	Flight	Attribute	Species	Bulls	Cows	Calves	Unclass	Total	Behavior	Habitat	Direction
146.277038	70.052850	14-Jun-99	12:25:05	1	13	ca	0	1	1	0	2	feed	Va	
146.312878	69.987670	14-Jun-99	12:27:25	1	14	ca	0	0	0	2	2	feed	Va	
146.319768	70.003030	14-Jun-99	12:31:17	1	15	ca	0	1	0	0	1	walk	IIIId	
146.352267	70.025907	14-Jun-99	12:33:11	1	17	ca	0	11	9	0	20	feed	Va	
146.317921	70.035720	14-Jun-99	12:34:12	1	18	ca	0	7	3	0	10			
146.352619	70.062580	14-Jun-99	12:35:16	1	20	ca	0	6	1	0	7	rest	IVa	
146.318428	70.099420	14-Jun-99	12:36:41	1	21	ca	0	1	1	0	2	walk	IIIId	
146.365068	70.105070	14-Jun-99	12:43:15	1	22	ca	0	1	1	0	2		Va	
146.370415	70.088240	14-Jun-99	12:43:51	1	23	ca	0	9	5	0	14	feed	IIIe	
146.374620	70.062810	14-Jun-99	12:44:44	1	24	ca	0	10	5	0	15	feed	IIIe	
146.398178	70.027920	14-Jun-99	12:45:58	1	25	ca	0	0	0	12	12			
146.443238	69.994040	14-Jun-99	12:53:41	1	26	ca	0	1	1	0	2	feed	Va	
146.394441	70.026670	14-Jun-99	12:54:57	1	27	ca	0	0	0	3	3			
146.436091	70.036860	14-Jun-99	12:55:21	1	28	ca	0	4	4	0	8			
146.419300	70.155920	14-Jun-99	12:59:56	1	90	ca	0	1	1	0	2	rest	Va	
146.424867	70.164710	14-Jun-99	13:00:15	1	31	ca	0	2	1	0	3			
146.448185	70.163830	14-Jun-99	13:02:35	1	32	ca	0	3	2	0	5	rest	Va	
146.447787	70.127750	14-Jun-99	13:03:51	1	33	ca	0	6	4	0	10	rest	Vc	
146.479399	70.099980	14-Jun-99	13:04:50	1	34	ca	0	0	0	1	1			
146.474354	70.083910	14-Jun-99	13:05:25	1	35	ca	0	1	1	0	2			
146.476271	70.074670	14-Jun-99	13:05:44	1	36	ca	0	1	1	0	2			
146.469004	70.061960	14-Jun-99	13:06:11	1	37	ca	0	1	1	0	2			
146.481298	70.048140	14-Jun-99	13:06:40	1	38	ca	0	5	3	0	8			
146.461520	70.018410	14-Jun-99	13:07:43	1	39	ca	0	3	3	0	6			
146.454262	70.009280	14-Jun-99	13:08:01	1	40	ca	0	3	2	0	5	walk	IIIId	
146.473781	70.000920	14-Jun-99	13:08:19	1	41	ca	0	5	3	0	8			
146.440420	69.994720	14-Jun-99	13:08:31	1	42	ca	0	1	1	0	2	feed	IIIId	
146.509878	69.913040	14-Jun-99	13:12:50	1	43	ca	0	2	0	0	2	rest	Ve	
146.517394	69.947820	14-Jun-99	13:14:09	1	44	ca	0	3	0	0	3	rest	Ve	
146.485431	69.960460	14-Jun-99	13:14:38	1	45	ca	0	2	1	0	3			
146.507580	70.013620	14-Jun-99	13:16:40	1	46	ca	0	6	4	0	10	rest	Va	

Table A-1. Continued.

Longitude°W	Latitude°N	Date	Time ADST	Flight	Attribute	Species	Bulls	Cows	Calves	Unclass	Total	Behavior	Habitat	Direction
146.505180	70.035720	14-Jun-99	13:17:31	1	47	ca	0	2	0	0	2			
146.516874	70.043870	14-Jun-99	13:17:50	1	48	ca	0	2	2	0	4	trot	Va	
146.516972	70.073000	14-Jun-99	13:18:57	1	49	ca	0	14	8	0	22			
146.523491	70.091420	14-Jun-99	13:19:40	1	50	ca	0	6	4	0	10	rest	IIIId	
146.491528	70.112220	14-Jun-99	13:20:28	1	51	ca	0	1	1	0	2			
146.505411	70.150540	14-Jun-99	13:21:56	1	52	ca	0	1	1	0	2			
146.526619	70.158870	14-Jun-99	13:22:15	1	53	ca	0	2	1	0	3			
146.517615	70.164890	14-Jun-99	13:22:29	1	54	ca	0	6	3	0	9			
146.531231	70.069120	14-Jun-99	13:30:41	1	56	ca	0	0	0	2	2	walk	IIIId	W
146.561281	70.035540	14-Jun-99	13:31:51	1	57	ca	0	5	4	0	9			
146.543372	70.020800	14-Jun-99	13:32:23	1	58	ca	0	3	2	2	7			
146.547600	70.016000	14-Jun-99	13:32:33	1	91	ca	0	8	0	0	8	feed	Va	
146.546800	70.011330	14-Jun-99	13:32:43	1	92	ca	0	0	0	2	2	feed	IIIe	
146.531818	69.950530	14-Jun-99	13:34:53	1	59	ca	0	5	3	0	8	feed	Iva	
146.564859	69.942830	14-Jun-99	13:35:10	1	60	ca	0	3	2	0	5			
146.561691	69.938140	14-Jun-99	13:35:20	1	61	ca	0	3	2	0	5			
146.584194	69.922950	14-Jun-99	13:38:06	1	63	ca	0	4	2	0	6			
146.587330	69.931980	14-Jun-99	13:38:26	1	64	ca	0	0	0	2	2			
146.567411	69.940900	14-Jun-99	13:38:47	1	65	ca	0	0	0	6	6			
146.576557	69.976740	14-Jun-99	13:40:08	1	66	ca	0	7	4	0	11			
146.590220	70.000240	14-Jun-99	13:41:02	1	67	ca	0	16	8	0	24	feed	Ve	
146.591180	70.024400	14-Jun-99	13:41:57	1	68	ca	0	4	4	0	8			
146.602471	70.031420	14-Jun-99	13:42:13	1	69	ca	0	1	1	0	2	stand	IIIId	
146.564941	70.034750	14-Jun-99	13:42:21	1	70	ca	0	4	2	0	6			
146.588610	70.058760	14-Jun-99	13:43:15	1	71	ca	0	10	4	0	14	feed	Ve	
146.580209	70.064286	14-Jun-99	13:44:09	1	72	ca	0	22	8	0	30			
146.591690	70.075980	14-Jun-99	13:45:10	1	73	ca	0	4	3	0	7	rest	Vc	
146.580574	70.138800	14-Jun-99	13:47:30	1	74	ca	0	4	2	0	6			
146.631070	70.151660	14-Jun-99	13:51:10	1	75	ca	0	7	5	0	12			
146.632408	70.132790	14-Jun-99	13:51:50	1	76	ca	0	3	2	0	5			
146.633948	70.078560	14-Jun-99	13:53:46	1	77	ca	0	1	0	0	1			

Table A-1. Continued.

Longitude°W	Latitude°N	Date	Time ADST	Flight	Attribute	Species	Bulls	Cows	Calves	Unclass	Total	Behavior	Habitat	Direction
146.644372	70.053640	14-Jun-99	13:54:38	1	78	ca	0	1	1	0	2			
146.619795	70.038160	14-Jun-99	13:55:11	1	79	ca	0	2	0	0	2	feed	Ve	
146.644811	70.030480	14-Jun-99	13:55:27	1	80	ca	0	1	1	0	2			
146.645401	70.024650	14-Jun-99	13:55:40	1	81	ca	0	19	8	0	27			
146.616660	70.004650	14-Jun-99	13:56:23	1	82	ca	0	20	10	0	30	feed	Va	
146.638255	69.956290	14-Jun-99	13:58:05	1	83	ca	0	6	5	0	11			
146.648199	69.932500	14-Jun-99	13:58:56	1	84	ca	0	1	0	0	1			
146.614298	69.927790	14-Jun-99	13:59:06	1	85	ca	0	11	5	0	16	feed	Va	
146.694229	69.924170	14-Jun-99	14:02:58	1	0	ca	0	6	3	0	9	feed	Va	
146.685232	69.936840	14-Jun-99	14:03:26	1	1	ca	0	1	1	0	2	rest	Va	
146.649021	69.950400	14-Jun-99	14:03:55	1	2	ca	0	0	0	4	4	rest	Va	
146.650901	69.958150	14-Jun-99	14:04:12	1	3	ca	0	0	0	1	1			
146.658837	69.965930	14-Jun-99	14:04:30	1	4	ca	0	2	0	0	2			
146.671250	69.990140	14-Jun-99	14:05:23	1	5	ca	0	16	12	0	28	rest	Va	
146.655148	70.005240	14-Jun-99	14:05:58	1	6	ca	0	9	4	0	13			
146.650531	70.029480	14-Jun-99	14:06:52	1	7	ca	0	0	0	1	1			
146.660035	70.050360	14-Jun-99	14:07:39	1	8	ca	0	1	1	0	2			
146.678720	70.060181	14-Jun-99	14:07:58	1	9	ca	0	100	60	0	160			
146.689462	70.078530	14-Jun-99	14:10:40	1	10	ca	0	3	3	0	6	rest	Ve	
146.656820	70.083610	14-Jun-99	14:10:51	1	11	ca	0	1	1	0	2			
146.661745	70.128840	14-Jun-99	14:12:30	1	12	ca	0	4	3	0	7			
146.658318	70.151560	14-Jun-99	14:13:20	1	13	ca	0	1	0	0	1			
146.708672	70.131340	14-Jun-99	14:16:36	1	14	ca	0	0	0	1	1	feed	Va	
146.702915	70.117860	14-Jun-99	14:17:04	1	15	ca	0	1	1	0	2	feed	Ille	
146.726612	70.110310	14-Jun-99	14:17:20	1	16	ca	0	11	4	0	15			
146.700217	70.073850	14-Jun-99	14:18:37	1	17	ca	0	9	5	0	14	feed	Va	
146.720765	70.043210	14-Jun-99	14:19:43	1	18	ca	0	2	0	0	2			
146.721435	69.987270	14-Jun-99	14:21:42	1	19	ca	0	4	3	0	7			
146.718857	69.981860	14-Jun-99	14:21:54	1	20	ca	0	3	2	0	5			
146.703125	69.981850	14-Jun-99	14:21:55	1	93	ca	0	8	8	0	16	rest	Va	
146.703245	69.978540	14-Jun-99	14:22:01	1	21	ca	0	2	0	0	2			

Table A-1. Continued.

Longitude°W	Latitude°N	Date	Time ADST	Flight	Attribute	Species	Bulls	Cows	Calves	Unclass	Total	Behavior	Habitat	Direction
146.734458	69.973780	14-Jun-99	14:22:12	1	22	ca	0	0	0	4	4			
146.713800	69.965180	14-Jun-99	14:22:31	1	94	ca	0	3	3	0	6			
146.713830	69.964430	14-Jun-99	14:22:32	1	23	ca	0	23	12	0	35			
146.716220	69.947570	14-Jun-99	14:23:08	1	24	ca	0	55	20	0	75	rest	Vb	
146.695810	69.922660	14-Jun-99	14:24:00	1	25	ca	0	0	0	5	5	rest	Va	
146.759820	69.919900	14-Jun-99	14:25:58	1	28	ca	0	2	1	0	3			
146.780029	69.926020	14-Jun-99	14:26:12	1	29	ca	0	0	0	1	1	feed	Vb	
146.777191	69.935340	14-Jun-99	14:26:32	1	30	ca	0	2	0	0	2	rest	Va	
146.759630	69.944970	14-Jun-99	14:26:54	1	31	ca	0	40	0	0	40			
146.745822	69.962640	14-Jun-99	14:27:34	1	32	ca	0	20	10	0	30			
146.766900	69.992500	14-Jun-99	14:27:48	1	96	ca	0	2	1	0	3			
146.746475	69.983000	14-Jun-99	14:28:24	1	33	ca	0	4	1	0	5			
146.763960	69.987840	14-Jun-99	14:28:37	1	34	ca	0	30	20	0	50	rest	Va	
146.768354	70.010220	14-Jun-99	14:29:28	1	35	ca	0	10	8	0	18	feed	Iva	
146.743218	70.017040	14-Jun-99	14:29:43	1	36	ca	0	2	1	0	3			
146.776369	70.025940	14-Jun-99	14:30:03	1	37	ca	0	4	3	0	7	rest	IIIId	
146.749134	70.040350	14-Jun-99	14:30:36	1	38	ca	0	18	9	0	27			
146.759400	70.062910	14-Jun-99	14:31:27	1	39	ca	0	29	12	0	41	feed	Iva	
146.771162	70.094350	14-Jun-99	14:32:37	1	40	ca	0	2	1	0	3	feed	IIIId	
146.773121	70.116150	14-Jun-99	14:33:25	1	41	ca	0	1	1	0	2	rest	Va	
146.756800	70.121860	14-Jun-99	14:33:38	1	42	ca	0	12	9	0	21			
146.763257	70.136310	14-Jun-99	14:34:11	1	43	ca	0	8	8	0	16	feed	Va	
146.765597	70.149750	14-Jun-99	14:34:42	1	44	ca	0	1	1	0	2	rest	Va	
146.785077	70.126440	14-Jun-99	15:10:01	1	0	ca	0	2	2	0	4	rest	Va	
146.784167	70.114410	14-Jun-99	15:10:26	1	1	ca	0	1	0	0	1	feed	IIIe	
146.804455	70.055330	14-Jun-99	15:12:31	1	2	ca	0	10	4	0	14			
146.800857	70.047860	14-Jun-99	15:12:47	1	3	ca	0	1	1	0	2			
146.779120	70.024610	14-Jun-99	15:13:35	1	4	ca	0	0	0	1	1	rest	Va	
146.807174	70.014140	14-Jun-99	15:13:57	1	5	ca	0	1	0	0	1			
146.796250	70.008310	14-Jun-99	15:14:09	1	6	ca	0	8	4	0	12			
146.788945	69.999820	14-Jun-99	15:14:28	1	7	ca	0	7	3	0	10			

Table A-1. Continued.

Longitude°W	Latitude°N	Date	Time ADST	Flight	Attribute	Species	Bulls	Cows	Calves	Unclass	Total	Behavior	Habitat	Direction
146.811490	70.008680	14-Jun-99	15:14:57	1	8	ca	0	48	26	0	74	rest	Va	
146.815168	69.949620	14-Jun-99	15:17:45	1	9	ca	0	13	4	0	17			
146.816799	69.926440	14-Jun-99	15:18:34	1	10	ca	0	9	4	0	13			
146.796200	69.911330	14-Jun-99	15:19:06	1	11	ca	0	9	6	0	15	stand	Va	
146.845632	69.911310	14-Jun-99	15:20:11	1	12	ca	0	1	0	0	1			
146.836280	69.915990	14-Jun-99	15:20:22	1	13	ca	0	1	1	0	2			
146.833435	69.920040	14-Jun-99	15:20:33	1	14	ca	0	12	4	0	16			
146.841945	69.934300	14-Jun-99	15:21:07	1	15	ca	0	6	0	0	6			
146.831268	69.947220	14-Jun-99	15:21:36	1	16	ca	0	8	3	0	11			
146.848155	69.960900	14-Jun-99	15:22:07	1	17	ca	0	3	3	0	6	walk	Va	W
146.848305	69.970560	14-Jun-99	15:22:29	1	18	ca	0	2	0	0	2	rest	Ve	
146.857721	69.988820	14-Jun-99	15:23:10	1	19	ca	0	0	0	1	1	feed	Va	
146.841500	69.996210	14-Jun-99	15:23:27	1	20	ca	0	90	36	0	126	rest	Va	
146.823530	70.019170	14-Jun-99	15:24:19	1	21	ca	0	1	0	0	1			
146.822690	70.023960	14-Jun-99	15:24:30	1	22	ca	0	9	3	0	12			
146.859679	70.031340	14-Jun-99	15:24:47	1	23	ca	0	4	3	0	7			
146.839271	70.035720	14-Jun-99	15:24:57	1	24	ca	0	2	0	0	2			
146.842570	70.039010	14-Jun-99	15:25:04	1	25	ca	0	50	26	0	76	walk	Iva	
146.842770	70.056060	14-Jun-99	15:25:43	1	26	ca	0	5	4	3	12	feed	Va	
146.841790	70.065000	14-Jun-99	15:26:03	1	27	ca	0	4	1	0	5			
146.843498	70.077280	14-Jun-99	15:26:30	1	28	ca	0	1	0	0	1	feed	Va	
146.820071	70.081660	14-Jun-99	15:26:40	1	29	ca	0	1	0	0	1			
146.826368	70.102350	14-Jun-99	15:27:28	1	30	ca	0	2	2	0	4			
146.832455	70.141850	14-Jun-99	15:28:58	1	31	ca	0	1	1	0	2			
146.894731	70.094560	14-Jun-99	15:34:39	1	32	ca	0	2	1	0	3			
146.900788	70.076680	14-Jun-99	15:35:16	1	33	ca	0	2	1	0	3			
146.882520	70.053220	14-Jun-99	15:36:04	1	34	ca	0	2	3	3	8			
146.897461	70.047240	14-Jun-99	15:36:17	1	35	ca	0	2	2	0	4			
146.865838	70.043980	14-Jun-99	15:36:24	1	36	ca	0	15	10	0	25			
146.871335	70.039130	14-Jun-99	15:36:34	1	37	ca	0	7	4	0	11			
146.896412	70.031480	14-Jun-99	15:36:50	1	38	ca	0	32	17	0	49			

Table A-1. Continued.

Longitude°W	Latitude°N	Date	Time ADST	Flight	Attribute	Species	Bulls	Cows	Calves	Unclass	Total	Behavior	Habitat	Direction
146.873395	70.022160	14-Jun-99	15:37:10	1	39	ca	0	1	0	0	1			
146.865868	70.014000	14-Jun-99	15:37:27	1	40	ca	0	15	8	0	23	rest	Va	
146.883708	70.001430	14-Jun-99	15:37:53	1	41	ca	0	4	2	0	6			
146.879780	69.992840	14-Jun-99	15:38:11	1	42	ca	0	8	5	0	13	feed	Ve	
146.880080	69.984770	14-Jun-99	15:38:28	1	43	ca	0	1	2	1	4			
146.899341	69.970810	14-Jun-99	15:38:57	1	44	ca	0	20	4	0	24			
146.865168	69.951370	14-Jun-99	15:39:36	1	45	ca	0	2	0	1	3	walk	Va	S
146.888785	69.946970	14-Jun-99	15:39:45	1	46	ca	0	5	3	0	8			
146.892004	69.926640	14-Jun-99	15:40:26	1	47	ca	0	3	1	0	4			
146.902991	69.922280	14-Jun-99	15:42:35	1	48	ca	0	1	1	0	2			
146.907188	69.949880	14-Jun-99	15:43:37	1	49	ca	0	4	2	0	6			
146.923460	69.957940	14-Jun-99	15:43:55	1	50	ca	0	3	3	14	20			
146.941829	69.973550	14-Jun-99	15:44:17	1	97	ca	0	25	10	0	35			
146.905660	69.967910	14-Jun-99	15:44:18	1	51	ca	0	2	2	0	4			
146.913215	69.971600	14-Jun-99	15:44:27	1	52	ca	0	7	3	0	10			
146.903880	69.991450	14-Jun-99	15:45:12	1	53	ca	0	6	1	0	7			
146.903531	70.014830	14-Jun-99	15:46:06	1	54	ca	0	2	1	0	3			
146.914585	70.019070	14-Jun-99	15:46:16	1	55	ca	0	2	0	0	2			
146.925220	70.023690	14-Jun-99	15:46:27	1	56	ca	0	10	5	0	15			
146.903831	70.031440	14-Jun-99	15:46:45	1	57	ca	0	37	7	0	44			
146.908844	70.043640	14-Jun-99	15:47:14	1	58	ca	0	7	2	0	9			
146.922095	70.049400	14-Jun-99	15:47:28	1	59	ca	0	31	15	0	46	feed	Va	
146.904597	70.055450	14-Jun-99	15:47:42	1	60	ca	0	16	5	0	21			
146.935072	70.064600	14-Jun-99	15:48:03	1	61	ca	0	8	5	0	13	feed	Iva	
146.906638	70.078340	14-Jun-99	15:48:35	1	62	ca	0	0	0	1	1			
146.916124	70.082570	14-Jun-99	15:48:45	1	63	ca	0	2	0	0	2			
146.937312	70.091480	14-Jun-99	15:49:05	1	64	ca	0	2	0	0	2	feed	Va	
146.911945	70.105660	14-Jun-99	15:49:37	1	65	ca	0	3	1	0	4			
146.911835	70.117850	14-Jun-99	15:50:05	1	66	ca	0	3	0	0	3			
146.974755	70.090880	14-Jun-99	15:55:20	1	67	ca	0	7	0	0	7	rest	Va	
146.950768	70.081160	14-Jun-99	15:55:41	1	68	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	Habitat	Direction
146.974217	70.066040	14-Jun-99	15:56:12	1	69	ca	0	1	1	0	2			
146.961484	70.062670	14-Jun-99	15:56:19	1	70	ca	0	5	0	0	5			
146.953688	70.058290	14-Jun-99	15:56:29	1	71	ca	0	5	0	0	5			
146.968310	70.051890	14-Jun-99	15:56:42	1	72	ca	0	9	3	0	12	feed	Va	
146.966530	70.013280	14-Jun-99	15:58:00	1	73	ca	0	9	6	0	15	feed	Ve	
146.985339	70.002050	14-Jun-99	15:58:23	1	74	ca	0	1	1	0	2			
146.969538	69.983980	14-Jun-99	15:59:00	1	75	ca	0	1	0	0	1			
146.965161	69.974630	14-Jun-99	15:59:20	1	76	ca	0	2	0	1	3	rest	Va	
146.972338	69.959130	14-Jun-99	15:59:52	1	77	ca	0	3	2	0	5			
146.953518	69.950700	14-Jun-99	16:00:10	1	78	ca	2	0	0	2	4			
146.953458	69.945810	14-Jun-99	16:00:20	1	79	ca	0	0	0	7	7			
146.950610	69.940910	14-Jun-99	16:00:30	1	80	ca	0	27	10	0	37			
146.986169	69.936500	14-Jun-99	16:00:40	1	81	ca	0	2	0	1	3			
146.947890	69.931420	14-Jun-99	16:00:50	1	82	ca	0	4	0	0	4			
146.151167	70.048420	19-Jun-99	11:38:22	2	1	ca	1	10	4	0	15	rest	Ve	
146.175844	70.119470	19-Jun-99	11:41:11	2	2	ca	0	1	1	0	2			
146.262204	70.005090	19-Jun-99	11:50:56	2	3	ca	0	7	2	6	15			
146.264902	70.044450	19-Jun-99	11:52:28	2	4	ca	0	4	3	1	8			
146.293860	70.056690	19-Jun-99	12:02:34	2	6	ca	0	4	3	1	8			
146.319420	70.037780	19-Jun-99	12:06:52	2	7	ca	0	10	6	0	16	feed	Ve	
146.334741	70.065710	19-Jun-99	12:07:56	2	8	ca	0	1	1	0	2	rest	Va	
146.324387	70.069130	19-Jun-99	12:08:04	2	9	ca	1	0	0	0	1	feed	Va	
146.344535	70.165450	19-Jun-99	12:11:48	2	10	ca	0	1	0	0	1			
146.399578	70.024440	19-Jun-99	12:18:40	2	11	ca	0	0	0	2	2	feed	Va	
146.356791	70.002580	19-Jun-99	12:19:26	2	12	ca	0	5	3	0	8			
146.421408	70.076700	19-Jun-99	12:23:20	2	13	ca	0	1	1	0	2			
146.440908	70.118910	19-Jun-99	12:24:59	2	14	ca	0	2	2	0	4			
146.462610	70.134090	19-Jun-99	12:30:05	2	15	ca	0	3	0	0	3	feed	Va	
146.479951	70.054940	19-Jun-99	12:32:51	2	16	ca	0	0	0	3	3	feed	Va	
146.485798	70.049070	19-Jun-99	12:33:03	2	17	ca	0	0	0	1	1	feed	Va	
146.488250	70.078560	19-Jun-99	12:38:46	2	18	ca	0	0	0	3	3	move	Ve	S

Table A-1. Continued.

Longitude°W	Latitude°N	Date	Time ADST	Flight	Attribute	Species	Bulls	Cows	Calves	Unclass	Total	Behavior	Habitat	Direction
146.518664	70.140870	19-Jun-99	12:41:13	2	19	ca	0	6	4	0	10			
146.556195	70.156310	19-Jun-99	12:45:02	2	21	ca	0	1	0	1	2			
146.567461	70.067090	19-Jun-99	12:53:47	2	22	ca	0	0	0	3	3	feed	Va	
146.577645	70.148200	19-Jun-99	12:57:00	2	23	ca	1	0	0	0	1			
146.587850	70.152120	19-Jun-99	12:57:09	2	24	ca	0	7	6	0	13			
146.596407	70.174650	19-Jun-99	12:58:03	2	25	ca	0	4	2	0	6			
146.612690	70.163080	19-Jun-99	12:59:44	2	26	ca	0	0	0	1	1			
146.639005	70.031690	19-Jun-99	13:04:10	2	27	ca	0	2	0	1	3			
146.622235	70.023200	19-Jun-99	13:04:27	2	28	ca	0	1	2	0	3			
146.694008	70.119880	19-Jun-99	13:11:07	2	29	ca	0	1	1	0	2	move	Vb	S
146.672840	70.171680	19-Jun-99	13:13:09	2	30	ca	0	6	4	0	10		Vc	
146.699627	70.103180	19-Jun-99	13:16:45	2	31	ca	0	0	0	1	1			
146.731799	70.099490	19-Jun-99	13:16:52	2	32	ca	0	0	0	3	3	feed	Va	
146.728831	70.035460	19-Jun-99	13:19:01	2	33	ca	0	3	0	1	4			
146.776038	70.021570	19-Jun-99	13:22:21	2	34	ca	0	10	6	2	18			
146.771182	70.086190	19-Jun-99	13:24:55	2	35	ca	0	2	1	0	3	feed	Vb	
146.749944	70.137380	19-Jun-99	13:26:55	2	36	ca	0	1	0	0	1	rest	Vb	
146.766505	70.141520	19-Jun-99	13:27:04	2	37	ca	0	4	3	0	7			
146.765035	70.148250	19-Jun-99	13:27:20	2	38	ca	0	1	1	0	2			
146.794860	70.126450	19-Jun-99	13:31:08	2	39	ca	0	1	0	0	1	rest	Va	
146.795900	70.039600	19-Jun-99	13:34:05	2	40	ca	0	7	1	0	8	rest	Va	
146.860339	70.012610	19-Jun-99	13:36:56	2	41	ca	0	0	0	3	3			
146.827317	70.045570	19-Jun-99	13:38:11	2	42	ca	0	0	0	1	1			
146.826737	70.123380	19-Jun-99	13:41:13	2	43	ca	0	0	0	1	1	rest	Va	
146.898671	70.135710	19-Jun-99	13:45:37	2	44	ca	0	0	0	2	2	rest	Va	
146.869914	70.070120	19-Jun-99	13:47:50	2	45	ca	0	7	3	0	10			
146.867447	70.018520	19-Jun-99	13:49:36	2	46	ca	0	0	0	1	1			
146.900081	70.013690	19-Jun-99	13:51:56	2	47	ca	0	25	5	0	30			
146.915872	70.024060	19-Jun-99	13:52:20	2	48	ca	0	4	3	0	7	rest	Vc	
146.929228	70.035520	19-Jun-99	13:52:46	2	49	ca	0	3	2	0	5			
146.910121	70.044920	19-Jun-99	13:53:08	2	50	ca	0	0	0	9	9		Vb	

Table A-1. Continued.

Longitude°W	Latitude°N	Date	Time ADST	Flight	Attribute	Species	Bulls	Cows	Calves	Unclass	Total	Behavior	Habitat	Direction
146.902101	70.068200	19-Jun-99	13:54:03	2	51	ca	0	0	0	1	1	feed	Va	
146.988038	70.068980	19-Jun-99	14:01:32	2	52	ca	0	0	0	3	3	feed	Vb	
146.134441	70.134720	25-Jun-99	12:13:08	3	1	ca	1	0	0	0	1			
146.139678	70.134720	25-Jun-99	12:13:27	3	2	ca	0	8	2	0	10	feed	Va	
146.106517	70.085400	25-Jun-99	12:15:00	3	3	ca	0	0	0	2	2	rest	Vc	
146.162640	70.111180	25-Jun-99	12:20:10	3	4	ca	0	7	4	0	11	rest	Vc	
146.184341	70.120890	25-Jun-99	12:24:39	3	5	ca	0	0	0	1	1		Va	
146.201342	70.033790	25-Jun-99	12:27:48	3	6	ca	0	2	2	0	4	feed	Vc	
146.270621	69.992170	25-Jun-99	12:43:17	3	7	ca	0	0	0	5	5	stand	Va	
146.288980	69.970400	25-Jun-99	12:44:03	3	8	ca	0	75	40	0	115	feed	Vc	
146.340854	69.953200	25-Jun-99	12:45:44	3	9	ca	0	50	27	0	77	stand	Xa	
146.332200	69.963000	25-Jun-99	12:46:06	3	10	ca	0	130	80	102	312	feed	Va	
146.343014	70.028640	25-Jun-99	12:48:29	3	11	ca	0	3	2	0	5	feed	Vc	
146.352799	70.038620	25-Jun-99	12:48:50	3	12	ca	0	0	0	2	2	feed	Va	
146.328474	70.160580	25-Jun-99	12:53:14	3	13	ca	0	7	5	0	12	feed	Va	
146.368314	70.042340	25-Jun-99	12:59:23	3	14	ca	0	3	2	0	5	feed	Ve	
146.361498	69.986030	25-Jun-99	13:01:23	3	15	ca	0	2	2	8	12	feed	Vc	
146.393321	69.967260	25-Jun-99	13:02:03	3	16	ca	0	4	0	4	8	feed	Va	
146.363697	69.958590	25-Jun-99	13:02:21	3	17	ca	0	7	3	0	10			
146.366833	69.946703	25-Jun-99	13:03:40	3	18	ca	0	120	50	20	190	feed	Xa	E
146.392621	69.944430	25-Jun-99	13:04:07	3	19	ca	0	40	20	15	75	move		NE
146.397878	69.949750	25-Jun-99	13:07:58	3	20	ca	0	40	25	0	65	move		NE
146.400168	69.972120	25-Jun-99	13:08:48	3	21	ca	0	3	2	5	10	feed	Va	
146.433402	70.057750	25-Jun-99	13:11:52	3	22	ca	0	3	2	0	5	feed	Va	
146.417990	70.108320	25-Jun-99	13:13:42	3	23	ca	0	4	2	0	6			
146.441098	70.121750	25-Jun-99	13:14:11	3	24	ca	0	0	0	2	2	feed	Va	
146.410642	70.152890	25-Jun-99	13:15:18	3	25	ca	0	1	0	0	1	feed	Va	
146.469125	70.131600	25-Jun-99	13:19:04	3	26	ca	0	1	0	0	1	feed	Va	
146.443888	70.120630	25-Jun-99	13:19:28	3	27	ca	0	2	1	0	3	feed	Ve	
146.467885	70.109940	25-Jun-99	13:19:51	3	28	ca	0	2	1	0	3	feed	Va	
146.479148	70.076810	25-Jun-99	13:21:00	3	29	ca	0	1	1	0	2	feed	Va	

Table A-1. Continued.

Longitude°W	Latitude°N	Date	Time ADST	Flight	Attribute	Species	Bulls	Cows	Calves	Unclass	Total	Behavior	Habitat	Direction
146.476222	69.967850	25-Jun-99	13:24:50	3	30	ca	0	10	4	5	19	feed	Ve	
146.451905	69.952110	25-Jun-99	13:25:23	3	31	ca	0	0	0	2	2	run	Va	E
146.472044	69.947450	25-Jun-99	13:25:33	3	32	ca	0	2	2	0	4	move	Va	E
146.486581	69.963300	25-Jun-99	13:29:53	3	33	ca	0	0	0	11	11			
146.485841	69.972620	25-Jun-99	13:30:13	3	34	ca	0	0	0	4	4			
146.490998	70.020520	25-Jun-99	13:31:58	3	35	ca	0	2	1	0	3	rest	Va	
146.553877	70.146890	25-Jun-99	13:40:20	3	36	ca	0	3	2	0	5	feed	Va	
146.558522	69.986860	25-Jun-99	13:45:56	3	37	ca	0	30	20	3	53	feed	Va	
146.536025	69.972960	25-Jun-99	13:46:27	3	38	ca	0	70	40	20	130	feed	Ve	
146.570888	69.946020	25-Jun-99	13:50:59	3	39	ca	0	0	0	1	1	rest		
146.590050	69.975900	25-Jun-99	13:52:04	3	40	ca	1	0	0	2	3	feed	Vb	
146.589390	70.005170	25-Jun-99	13:53:07	3	41	ca	0	1	1	2	4	feed	Ve	
146.577285	70.020980	25-Jun-99	13:53:41	3	42	ca	0	50	20	0	70	feed	Ve	
146.577185	70.036270	25-Jun-99	13:54:14	3	43	ca	0	15	10	0	25	feed	Va	
146.580264	70.166030	25-Jun-99	13:58:59	3	44	ca	0	7	4	0	11	stand	Va	
146.621744	70.172990	25-Jun-99	14:00:29	3	45	ca	0	3	2	0	5	feed	Va	
146.621234	70.167950	25-Jun-99	14:00:39	3	46	ca	0	5	4	0	9	feed	Va	
146.630470	70.158830	25-Jun-99	14:00:59	3	47	ca	0	1	1	0	2	rest	Va	
146.607511	70.018620	25-Jun-99	14:05:51	3	48	ca	0	0	0	1	1	feed	Vc	
146.653161	69.949210	25-Jun-99	14:12:07	3	49	ca	0	0	0	2	2			
146.654441	69.958060	25-Jun-99	14:12:26	3	50	ca	0	0	0	1	1			
146.682314	70.016720	25-Jun-99	14:14:33	3	51	ca	0	6	4	1	11	feed	Vc	
146.650251	70.066660	25-Jun-99	14:16:23	3	52	ca	0	0	0	45	45			
146.680452	70.076520	25-Jun-99	14:16:45	3	53	ca	0	35	20	0	55	feed	Ve	
146.690979	70.140510	25-Jun-99	14:19:05	3	54	ca	0	3	1	1	5	feed	Va	
146.704344	70.121050	25-Jun-99	14:23:02	3	55	ca	0	2	2	0	4	feed	Vc	
146.699557	70.108010	25-Jun-99	14:23:29	3	56	ca	0	10	8	0	18	feed	Va	
146.728681	70.095200	25-Jun-99	14:23:55	3	57	ca	0	15	8	15	38	feed	Va	
146.698908	69.980620	25-Jun-99	14:27:50	3	58	ca	0	0	0	1	1	feed	Vc	
146.763985	70.127420	25-Jun-99	14:39:10	3	59	ca	0	2	1	0	3	walk	Va	
146.768164	70.147700	25-Jun-99	14:39:54	3	60	ca	0	4	3	1	8	feed	Va	

Table A-1. Continued.

Longitude°W	Latitude°N	Date	Time ADST	Flight	Attribute	Species	Bulls	Cows	Calves	Unclass	Total	Behavior	Habitat	Direction
146.809302	70.172890	25-Jun-99	14:42:02	3	61	ca	0	11	4	0	15	feed	Va	
146.818028	70.028940	25-Jun-99	14:46:57	3	62	ca	0	0	0	1	1			
146.823538	70.037780	25-Jun-99	14:56:47	3	63	ca	0	9	5	0	14	move	Vc	N
146.836672	70.104200	25-Jun-99	14:59:16	3	64	ca	0	1	0	0	1	feed	Ve	
146.848525	70.150640	25-Jun-99	15:01:00	3	65	ca	0	3	1	0	4	feed	Va	
146.825378	70.171670	25-Jun-99	15:01:46	3	67	ca	0	6	0	0	6			
146.895642	70.117620	25-Jun-99	15:29:19	3	0	ca	0	27	15	0	42	feed	Va	
146.899661	69.935740	25-Jun-99	15:38:15	3	1	ca	0	0	0	1	1			
146.934804	70.047990	25-Jun-99	15:42:25	3	2	ca	0	17	8	0	25	run	Vc	N
146.907337	70.083020	25-Jun-99	15:43:42	3	3	ca	0	45	15	0	60	feed	Vc	
146.937481	70.092980	25-Jun-99	15:44:04	3	4	ca	0	0	0	1	1	feed	Va	
146.911575	70.122010	25-Jun-99	15:45:07	3	5	ca	0	4	3	0	7			
146.907538	70.127600	25-Jun-99	15:45:19	3	6	ca	0	12	7	0	19	feed	Va	
146.983619	70.125760	25-Jun-99	15:48:16	3	7	ca	0	25	10	0	35	rest	Vb	
146.980192	70.111350	25-Jun-99	15:48:46	3	8	ca	0	0	0	13	13	feed	Vc	
146.978152	70.100990	25-Jun-99	15:49:07	3	9	ca	0	30	15	0	45	feed	Vc	
146.955425	70.055470	25-Jun-99	15:50:40	3	10	ca	0	1	0	0	1	feed	Vc	
146.063148	70.106500	29-Jun-99	11:16:36	4	1	ca	0	12	6	0	18			
146.064017	70.116420	29-Jun-99	11:16:59	4	2	ca	0	2	1	0	3			
146.113232	70.135050	29-Jun-99	11:19:26	4	3	ca	0	1	0	0	1			
146.111235	70.112510	29-Jun-99	11:20:13	4	4	ca	0	9	4	0	13			
146.140109	70.096650	29-Jun-99	11:20:46	4	5	ca	4	5	3	0	12			
146.122927	70.071310	29-Jun-99	11:21:37	4	6	ca	0	20	15	0	35			
146.162040	70.042780	29-Jun-99	11:23:32	4	7	ca	0	12	4	0	16			
146.154762	70.049110	29-Jun-99	11:23:47	4	8	ca	0	2	0	0	2			
146.143270	70.068830	29-Jun-99	11:24:32	4	9	ca	0	0	0	7	7			
146.177232	70.095940	29-Jun-99	11:25:34	4	10	ca	0	17	10	0	27			
146.143061	70.102040	29-Jun-99	11:25:47	4	11	ca	0	15	4	0	19			
146.188618	70.018620	29-Jun-99	11:33:59	4	12	ca	0	0	0	2	2		Vc	
146.208785	70.012610	29-Jun-99	11:34:12	4	13	ca	0	0	0	9	9			
146.231030	70.012660	29-Jun-99	11:35:07	4	14	ca	0	3	2	0	5			

Table A-1. Continued.

Longitude°W	Latitude°N	Date	Time ADST	Flight	Attribute	Species	Bulls	Cows	Calves	Unclass	Total	Behavior	Habitat	Direction
146.264772	70.036390	29-Jun-99	11:36:01	4	15	ca	0	25	7	2	34			
146.257415	70.090300	29-Jun-99	11:38:03	4	16	ca	0	7	1	0	8			
146.245432	70.151420	29-Jun-99	11:40:21	4	17	ca	0	2	0	0	2			
146.278947	70.099640	29-Jun-99	11:44:31	4	18	ca	0	4	2	0	6			
146.306484	70.053140	29-Jun-99	11:46:06	4	19	ca	0	8	6	0	14			
146.304285	70.048290	29-Jun-99	11:46:16	4	20	ca	0	1	1	0	2			
146.274388	69.975860	29-Jun-99	11:48:46	4	21	ca	0	55	12	10	77			
146.302334	69.956570	29-Jun-99	11:49:26	4	22	ca	0	35	20	0	55			
146.345394	70.025630	29-Jun-99	11:53:31	4	23	ca	1	1	0	0	2			
146.334530	70.030430	29-Jun-99	11:53:42	4	24	ca	0	11	1	0	12			
146.350681	70.036500	29-Jun-99	11:53:56	4	25	ca	0	25	10	5	40			
146.333808	70.077350	29-Jun-99	11:55:29	4	26	ca	0	1	1	0	2			
146.310851	70.110420	29-Jun-99	11:56:45	4	27	ca	0	3	0	0	3			
146.388134	70.132660	29-Jun-99	12:01:37	4	28	ca	0	3	1	0	4			
146.364487	70.083500	29-Jun-99	12:03:17	4	29	ca	0	5	2	0	7			
146.381817	69.974440	29-Jun-99	12:06:58	4	30	ca	0	1	0	0	1			
146.428842	70.041560	29-Jun-99	12:15:18	4	31	ca	0	50	25	0	75			
146.407835	70.054620	29-Jun-99	12:15:47	4	32	ca	0	30	15	10	55			
146.399230	70.083610	29-Jun-99	12:16:53	4	33	ca	0	6	2	0	8			
146.410134	70.087980	29-Jun-99	12:17:03	4	34	ca	0	15	7	3	25			
146.436469	70.094970	29-Jun-99	12:17:19	4	35	ca	0	1	1	0	2			
146.401758	70.134230	29-Jun-99	12:18:49	4	36	ca	0	3	2	0	5			
146.474861	70.158830	29-Jun-99	12:22:27	4	37	ca	0	20	15	10	45			
146.441680	70.098150	29-Jun-99	12:24:31	4	38	ca	0	12	4	10	26			
146.462040	70.082050	29-Jun-99	12:25:03	4	39	ca	0	1	0	0	1			
146.449897	70.074530	29-Jun-99	12:25:18	4	40	ca	0	1	0	0	1			
146.442131	70.042190	29-Jun-99	12:26:24	4	41	ca	0	0	0	35	35			
146.483890	70.047350	29-Jun-99	12:37:07	4	42	ca	0	20	10	0	30			
146.525828	70.080410	29-Jun-99	12:38:21	4	43	ca	0	1	1	0	2			
146.520712	70.100780	29-Jun-99	12:39:07	4	44	ca	0	11	6	0	17			
146.493027	70.166680	29-Jun-99	12:41:37	4	45	ca	0	2	0	0	2			

Table A-1. Continued.

Longitude°W	Latitude°N	Date	Time ADST	Flight	Attribute	Species	Bulls	Cows	Calves	Unclass	Total	Behavior	Habitat	Direction
146.541702	70.133590	29-Jun-99	12:44:57	4	46	ca	0	5	5	0	10			
146.566089	70.059410	29-Jun-99	12:47:26	4	47	ca	0	0	0	1	1			
146.570130	70.020920	29-Jun-99	12:57:45	4	48	ca	0	2	0	0	2			
146.570810	70.024910	29-Jun-99	12:57:54	4	49	ca	0	1	0	1	2			
146.567420	70.062700	29-Jun-99	12:59:20	4	50	ca	0	0	0	3	3			
146.604631	70.077310	29-Jun-99	12:59:52	4	51	ca	0	4	2	0	6			
146.608768	70.095100	29-Jun-99	13:00:34	4	52	ca	0	0	0	1	1			
146.608008	70.119910	29-Jun-99	13:01:31	4	53	ca	0	0	0	5	5			
146.574427	70.132250	29-Jun-99	13:01:59	4	55	ca	0	6	3	20	29			
146.583271	70.150070	29-Jun-99	13:02:41	4	56	ca	0	8	5	0	13			
146.570191	70.174990	29-Jun-99	13:03:38	4	57	ca	0	0	0	1	1			
146.622735	70.163930	29-Jun-99	13:05:15	4	58	ca	0	16	4	0	20			
146.639394	70.150820	29-Jun-99	13:05:42	4	59	ca	0	0	0	1	1			
146.612477	70.138550	29-Jun-99	13:06:07	4	60	ca	0	20	14	10	44			
146.620017	70.110540	29-Jun-99	13:07:04	4	61	ca	0	14	6	5	25			
146.613368	70.077640	29-Jun-99	13:08:10	4	62	ca	0	15	4	0	19			
146.629450	70.063530	29-Jun-99	13:08:38	4	63	ca	0	7	4	2	13			
146.631908	69.980730	29-Jun-99	13:11:23	4	64	ca	0	1	0	0	1			
146.652210	69.910590	29-Jun-99	13:14:39	4	65	ca	0	0	0	2	2			
146.650641	69.996300	29-Jun-99	13:17:56	4	66	ca	0	0	0	1	1			
146.681462	70.045470	29-Jun-99	13:19:49	4	67	ca	0	54	30	10	94			
146.690659	70.065380	29-Jun-99	13:20:35	4	68	ca	0	5	2	0	7			
146.678037	70.074110	29-Jun-99	13:20:55	4	69	ca	0	1	1	0	2			
146.687891	70.083290	29-Jun-99	13:21:16	4	70	ca	0	2	1	0	3			
146.684971	70.093000	29-Jun-99	13:21:39	4	71	ca	0	20	10	15	45			
146.666641	70.093000	29-Jun-99	13:21:39	4	72	ca	0	3	1	0	4			
146.696808	70.148290	29-Jun-99	13:26:29	4	73	ca	0	7	3	0	10			
146.730619	70.140770	29-Jun-99	13:26:44	4	74	ca	0	0	0	5	5			
146.735308	70.128800	29-Jun-99	13:27:08	4	75	ca	0	0	0	25	25			
146.736008	70.121790	29-Jun-99	13:27:21	4	76	ca	0	0	0	30	30			
146.698668	70.114760	29-Jun-99	13:27:35	4	77	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	Habitat	Direction
146.700355	70.106780	29-Jun-99	13:27:52	4	78	ca	0	20	21	0	41			
146.726559	70.094030	29-Jun-99	13:28:18	4	79	ca	0	2	0	0	2			
146.727251	70.087830	29-Jun-99	13:28:30	4	80	ca	0	30	15	20	65			
146.727574	70.063270	29-Jun-99	13:29:19	4	81	ca	0	3	2	7	12			
146.729211	70.053520	29-Jun-99	13:29:39	4	82	ca	0	5	0	0	5			
146.742727	70.045340	29-Jun-99	13:40:37	4	83	ca	0	2	0	0	2			
146.747055	70.052890	29-Jun-99	13:40:54	4	84	ca	0	65	25	20	110			
146.770002	70.081920	29-Jun-99	13:42:00	4	85	ca	0	0	0	1	1			
146.741578	70.091950	29-Jun-99	13:42:23	4	86	ca	0	15	5	7	27			
146.748654	70.115030	29-Jun-99	13:43:17	4	87	ca	0	9	6	0	15			
146.766414	70.121030	29-Jun-99	13:43:31	4	88	ca	0	7	4	0	11			
146.738290	70.129670	29-Jun-99	13:43:51	4	89	ca	0	75	50	40	165			
146.754242	70.139250	29-Jun-99	13:44:12	4	90	ca	0	15	8	0	23			
146.769505	70.155080	29-Jun-99	13:44:49	4	91	ca	0	4	2	0	6			
146.747537	70.160610	29-Jun-99	13:45:02	4	92	ca	0	23	11	6	40			
146.804525	70.140020	29-Jun-99	13:47:44	4	94	ca	0	1	0	0	1			
146.775251	70.130170	29-Jun-99	13:48:03	4	95	ca	0	0	0	25	25			
146.783517	70.119300	29-Jun-99	13:48:25	4	96	ca	0	4	1	0	5			
146.786465	70.110880	29-Jun-99	13:48:41	4	97	ca	0	20	10	0	30			
146.792742	70.064660	29-Jun-99	13:50:13	4	98	ca	0	1	1	0	2			
146.785707	70.053960	29-Jun-99	13:50:34	4	99	ca	0	35	20	10	65			
146.788122	70.015090	29-Jun-99	13:51:51	4	100	ca	0	1	0	0	1			
146.785617	69.978650	29-Jun-99	13:53:04	4	101	ca	0	2	2	0	4			
146.822590	70.102760	29-Jun-99	14:03:33	4	103	ca	0	0	0	1	1			
146.844907	70.122520	29-Jun-99	14:04:19	4	104	ca	0	3	2	0	5			
146.831974	70.126790	29-Jun-99	14:04:30	4	105	ca	0	7	5	0	12			
146.825028	70.133090	29-Jun-99	14:04:44	4	106	ca	0	5	3	0	8			
146.826428	70.150670	29-Jun-99	14:05:26	4	107	ca	0	2	2	0	4			
146.818991	70.167390	29-Jun-99	14:06:06	4	108	ca	0	0	0	3	3			
146.828375	70.174070	29-Jun-99	14:06:22	4	109	ca	0	1	0	0	1			
146.869028	70.148650	29-Jun-99	14:08:22	4	110	ca	0	28	5	0	33			

Table A-1. Continued.

Longitude°W	Latitude°N	Date	Time ADST	Flight	Attribute	Species	Bulls	Cows	Calves	Unclass	Total	Behavior	Habitat	Direction
146.889315	70.135870	29-Jun-99	14:08:48	4	111	ca	0	4	0	0	4			
146.893502	70.131690	29-Jun-99	14:08:56	4	112	ca	0	15	15	0	30			
146.866898	70.112640	29-Jun-99	14:09:34	4	113	ca	0	26	7	10	43			
146.892842	70.098990	29-Jun-99	14:10:01	4	114	ca	0	15	7	5	27			
146.868987	70.061860	29-Jun-99	14:11:14	4	115	ca	2	70	30	20	122			
146.906978	70.099230	29-Jun-99	14:24:31	4	116	ca	0	70	30	5	105			
146.927887	70.127590	29-Jun-99	14:25:37	4	117	ca	0	5	3	0	8			
146.945288	70.136370	29-Jun-99	14:25:58	4	118	ca	0	0	0	1	1			
146.910068	70.141020	29-Jun-99	14:26:09	4	119	ca	0	40	5	0	45			
146.916845	70.151260	29-Jun-99	14:26:33	4	120	ca	0	2	0	0	2			
146.972607	70.144680	29-Jun-99	14:28:06	4	121	ca	0	15	10	0	25			
146.953757	70.120700	29-Jun-99	14:28:52	4	122	ca	0	120	35	25	180			
146.954594	70.104110	29-Jun-99	14:29:26	4	123	ca	0	7	4	0	11			
146.942701	70.097380	29-Jun-99	14:29:39	4	124	ca	0	0	0	5	5			
146.976784	70.090480	29-Jun-99	14:29:52	4	125	ca	0	1	1	0	2			
146.980899	70.045240	29-Jun-99	14:31:23	4	126	ca	0	1	0	0	1			
146.956605	69.948430	29-Jun-99	14:34:35	4	127	ca	2	0	0	0	2			
146.094241	70.132080	15-Jul-99	10:07:39	6	1	ca	0	2	2	0	4	feed	Va	
146.136702	70.031910	15-Jul-99	10:14:38	6	2	ca	1	0	0	0	1	rest	Xa	
146.238037	70.059060	15-Jul-99	10:34:44	6	3	ca	10	60	25	20	115	feed	Vb	
146.386014	70.124730	15-Jul-99	11:04:12	6	4	ca	0	1	0	0	1	rest	Va	
146.471614	70.110890	15-Jul-99	11:31:38	6	5	ca	10	30	7	0	47	feed	IIIId	
146.475442	70.082740	15-Jul-99	11:32:53	6	6	ca	2	0	0	0	2	feed	IIIId	
146.477931	70.067190	15-Jul-99	11:33:34	6	7	ca	20	50	5	20	95	feed	IIIId	
146.524488	70.110910	15-Jul-99	11:52:31	6	8	ca	0	2	0	0	2	feed	Va	
146.587320	70.139180	15-Jul-99	12:19:33	6	9	ca	1	0	0	0	1	feed	Vb	
146.606681	70.082470	15-Jul-99	12:26:48	6	10	ca	0	1	0	0	1	feed	Ve	
146.684439	70.074191	15-Jul-99	12:42:01	6	11	ca	225	450	150	150	975	move	Va	ENE
146.732169	70.055820	15-Jul-99	12:55:35	6	12	ca	1	0	0	0	1	move	Va	NE
146.733209	70.039290	15-Jul-99	12:56:20	6	13	ca	1	0	0	0	1	move	Ve	W
146.692731	69.924270	15-Jul-99	13:01:28	6	14	ca	0	1	0	3	4	rest	Ve	

Table A-1. Continued.

Longitude°W	Latitude°N	Date	Time ADST	Flight	Attribute	Species	Bulls	Cows	Calves	Unclass	Total	Behavior	Habitat	Direction
146.732077	70.062720	15-Jul-99	13:09:35	6	15	ca	125	350	100	100	675	feed	Va	
146.759248	70.150520	15-Jul-99	13:13:12	6	16	ca	12	50	4	5	71	move	Vc	NE
146.824218	70.137940	15-Jul-99	15:31:15	6	0	ca	1	0	0	0	1	move	Va	N
146.860351	70.067410	15-Jul-99	15:38:33	6	1	ca	0	0	0	1	1	walk	Va	NE
146.859051	69.989220	15-Jul-99	15:41:58	6	3	ca	0	0	0	1	1	feed	Va	NE
146.942491	70.068390	15-Jul-99	15:53:06	6	5	ca	0	0	0	1	1	run	Va	N
146.309282	70.067040	18-Jul-99	18:35:38	7	1	ca	1	0	0	0	1	feed	Va	
146.396751	70.141470	18-Jul-99	18:47:40	7	2	ca	0	1	1	0	2	feed	Iva	
146.583132	70.037650	18-Jul-99	19:24:47	7	3	ca	0	1	0	0	1	stand	IIIe	
146.622407	70.031190	18-Jul-99	19:36:37	7	4	ca	1	0	0	0	1	rest	Va	
146.616401	70.008200	18-Jul-99	19:37:26	7	5	ca	0	1	0	0	1	feed	Va	
146.742548	70.017500	18-Jul-99	19:54:14	7	6	ca	0	0	0	5	5	feed	Va	
146.862678	70.090090	18-Jul-99	20:12:20	7	8	ca	0	0	0	1	1		Ve	
146.882238	70.025630	18-Jul-99	20:21:40	7	9	ca	0	1	0	0	1	feed	Va	
146.397931	70.136100	28-Jul-99	17:26:41	8	1	ca	0	0	0	2	2	Rest	Xe	
146.591497	70.078820	28-Jul-99	18:04:19	8	2	ca	0	0	0	1	1	Rest	Va	
146.568680	70.088050	28-Jul-99	18:04:39	8	3	ca	0	0	0	1	1	Feed	Va	
146.655748	70.053120	28-Jul-99	18:17:35	8	4	ca	0	0	0	1	1	Feed	Va	
146.761377	70.013070	28-Jul-99	18:29:59	8	5	ca	0	20	12	5	37	Walk	IIIe	

Table A-2. Muskoxen (mx) and grizzly bear (bb) sightings in the Bullen Point to Staines River study area, Alaska, summer 1999. Coordinates are longitude, latitude, and datum is WGS 1984. Time is Alaska Daylight Savings Time. See Table 6 for habitat code definitions.

Longitude °W	Latitude °N	Date	Time	Flight	Attribute	Species	Bulls	Cows	Calves	Unclass	Total	Behavior	Habitat	Direction
146.253528	70.139070	4-Jun-99	11:18:55	0	1	mx	0	1	1	0	2	feed	Xa	
146.828515	70.032300	9-Jul-99	13:36:22	5	1	mx	0	0	0	8	8	rest	Vc	
146.974525	69.944310	9-Jul-99	14:08:15	5	2	bb	0	0	0	1	1	feed	Vc	
146.858781	70.036610	15-Jul-99	15:39:54	6	2	mx	0	0	0	8	8	run	Vb	East
146.868955	69.907010	15-Jul-99	15:45:32	6	4	bb	0	0	0	1	1	rest	Vc	
146.786085	70.014080	18-Jul-99	20:07:22	7	7	mx	0	0	0	7	7	feed		
146.907698	70.084130	28-Jul-99	19:01:03	8	6	mx	0	1	1	7	9			

Table A-3. Opportunistic caribou (ca) sightings outside the Bullen Point to Staines River study area, Alaska, summer 1999. Coordinates are longitude, latitude, and datum is WGS 1984. Time is Alaska Daylight Savings Time. See Table 6 for habitat code definitions.

Longitude °W	Latitude °N	Date	Time	Flight	Attribute	Species	Bulls	Cows	Calves	Unclass	Total	Behavior	Habitat	Direction
146.574010	69.898390	14-Jun-99	13:37:03	1	62	ca	0	4	0	0	4			
146.635688	69.904180	14-Jun-99	13:59:57	1	86	ca	0	2	2	0	4			
146.739100	69.900850	14-Jun-99	14:22:37	1	95	ca	0	11	0	0	11			
146.733800	69.900160	14-Jun-99	14:25:03	1	26	ca	0	1	0	0	1			
146.746114	69.909010	14-Jun-99	14:25:33	1	27	ca	0	7	3	0	10			
146.340854	69.953200	25-Jun-99	12:45:44	3	9	ca	0	50	27	0	77	Stand	Xa	

Table A-4. Observed and expected number of caribou groups by habitat type based on systematic strip-transect aerial survey locations in the Bullen Point to Staines River study area from 1993 to 1999, and land cover mapping for the Point Thomson Unit Area (Noel and Funk 1999).

Land Cover Class	Land Area (acres)	Proportion of Total Area	Number of Caribou Groups ¹	Expected Number of Caribou	Proportion Observed in Each Interval	Confidence Interval on Proportion of Occurrence (90% Confidence Coefficient)		Comparison of Proportion of Total Area with Confidence Interval
						Lower	Upper	
Ia	14518.8	0.466	16	34	0.222	0.092	0.353	<Expected
IIb	174.8	0.006	1	0	0.014	-0.023	0.051	Within
IIc	163.1	0.005	1	0	0.014	-0.023	0.051	Within
IIIa	980.4	0.031	4	2	0.056	-0.016	0.127	Within
IIIc	173.5	0.006	1	0	0.014	-0.023	0.051	Within
IIId	5610.1	0.180	14	13	0.194	0.070	0.319	Within
IVa	3366.2	0.108	7	8	0.097	0.004	0.190	Within
Va	3773.5	0.121	16	9	0.222	0.092	0.353	Within
Vc	639.0	0.020	2	1	0.028	-0.024	0.079	Within
Ve	1190.9	0.038	5	3	0.069	-0.010	0.149	Within
Xa	163.3	0.005	2	0	0.028	-0.024	0.079	Within
Xe	66.6	0.002	1	0	0.014	-0.023	0.051	Within
XIa	351.1	0.011	2	1	0.028	-0.024	0.079	Within
Study Area Total	31171.3	1.000	72	72	1.000			

¹ χ^2 for observed versus expected number of caribou per interval ($\chi^2 = 34.96$, $df = 12$, $P = 0.00048$).

APPENDIX B.

MOSQUITO AND OESTRID ACTIVITY INDICES

Appendix B. Mosquito and Oestrid Activity Indices.

Mosquito Activity Index (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

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

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

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

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

Oestrid Activity Index (Mörschel 1999)

Predicts presence/absence of oestrid flies with 83% reliability

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

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

Oestrid flies were considered present when y was ≥ 0.4

Table B-1. Daily average temperature and wind velocity recorded at the Deadhorse Weather Station (ASCC 1999), with tabulations of hourly mosquito (Russel et al. 1993) and oestrid activity indices (Mörschel 1999).

Date	Mean Temperature		Mean Wind Speed (mps)		Mosquito Index			Oestrid Index	
	(°C)	<i>n</i>		<i>n</i>	Number of Records	Number of Records	Mosq. No.	Number of Records	Number of Records
					<0.5	≥0.5		<0.4	≥0.4
1-May-99	-7.56	27	4.05	34	27	0	N/A	27	0
2-May-99	-8.75	12	9.12	12	12	0	N/A	12	0
3-May-99	-12.69	26	9.88	26	26	0	N/A	26	0
4-May-99	-14.29	24	7.88	24	24	0	N/A	24	0
5-May-99	-10.73	30	4.83	32	30	0	N/A	30	0
6-May-99	-9.13	30	2.86	32	30	0	N/A	30	0
7-May-99	-7.75	28	3.60	28	28	0	N/A	28	0
8-May-99	-6.14	29	3.30	31	29	0	N/A	29	0
9-May-99	-5.56	25	3.15	30	25	0	N/A	25	0
10-May-99	-5.91	35	8.03	37	35	0	N/A	35	0
11-May-99	-2.48	27	7.75	27	27	0	N/A	27	0
12-May-99	-2.07	29	9.98	29	29	0	N/A	29	0
13-May-99	-2.93	29	4.71	29	29	0	N/A	29	0
14-May-99	-0.81	21	3.66	23	21	0	N/A	21	0
15-May-99	-1.04	24	3.24	24	24	0	N/A	24	0
16-May-99	-2.04	24	3.81	24	24	0	N/A	24	0
17-May-99	-7.00	27	5.65	29	27	0	N/A	27	0
18-May-99	-7.73	26	9.23	26	26	0	N/A	26	0
19-May-99	-6.42	26	10.81	26	26	0	N/A	26	0
20-May-99	-5.74	27	9.52	27	27	0	N/A	27	0
21-May-99	-5.52	25	6.70	25	25	0	N/A	25	0
22-May-99	-4.23	21	4.13	26	20	0	N/A	20	0
23-May-99	-4.12	25	2.61	29	25	0	N/A	25	0
24-May-99	-3.52	27	8.57	27	27	0	N/A	27	0
25-May-99	-4.36	25	9.52	25	25	0	N/A	25	0
26-May-99	-4.23	26	11.01	26	26	0	N/A	26	0
27-May-99	-2.00	29	7.67	29	29	0	N/A	29	0
28-May-99	-0.36	25	3.56	29	25	0	N/A	25	0
29-May-99	-1.34	29	5.11	30	29	0	N/A	29	0
30-May-99	-2.08	24	7.73	24	24	0	N/A	24	0
31-May-99	-0.61	31	2.77	34	31	0	N/A	31	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	Number of Records	Mosq. No.	Number of Records	Number of Records
					<0.5	≥0.5		<0.5	≥0.5
1-Jun-99	-0.58	31	7.56	32	31	0	N/A	31	0
2-Jun-99	-0.53	17	6.29	27	17	0	N/A	17	0
3-Jun-99	0.06	33	3.59	34	33	0	N/A	33	0
4-Jun-99	-0.07	29	5.84	29	29	0	N/A	29	0
5-Jun-99	-0.32	28	4.98	28	28	0	N/A	28	0
6-Jun-99	-0.07	27	4.69	29	27	0	N/A	27	0
7-Jun-99	-2.07	30	7.29	30	28	0	N/A	28	0
8-Jun-99	-0.52	25	8.30	25	25	0	N/A	25	0
9-Jun-99	1.63	35	6.83	35	35	0	N/A	35	0
10-Jun-99	1.32	37	7.47	37	37	0	N/A	37	0
11-Jun-99	2.37	41	3.89	41	41	0	N/A	41	0
12-Jun-99	5.84	25	5.39	25	25	0	N/A	25	0
13-Jun-99	7.54	26	4.12	26	26	0	N/A	26	0
14-Jun-99	4.66	29	3.62	29	29	0	N/A	29	0
15-Jun-99	5.04	26	5.05	26	26	0	N/A	26	0
16-Jun-99	4.25	28	10.17	28	28	0	N/A	28	0
17-Jun-99	3.58	36	4.15	36	36	0	N/A	36	0
18-Jun-99	1.82	38	3.91	38	38	0	N/A	38	0
19-Jun-99	2.09	33	3.79	33	33	0	N/A	33	0
20-Jun-99	1.18	34	6.48	34	34	0	N/A	34	0
21-Jun-99	0.47	36	12.67	36	36	0	N/A	36	0
22-Jun-99	2.22	37	8.36	37	37	0	N/A	37	0
23-Jun-99	3.53	32	3.88	32	32	0	N/A	32	0
24-Jun-99	2.00	38	5.42	38	38	0	N/A	38	0
25-Jun-99	5.25	24	5.04	24	24	0	N/A	24	0
26-Jun-99	6.92	24	3.77	24	24	0	N/A	24	0
27-Jun-99	1.14	35	3.83	36	35	0	N/A	35	0
28-Jun-99	3.59	29	3.21	29	29	0	N/A	29	0
29-Jun-99	4.83	24	6.35	24	24	0	0	24	0
30-Jun-99	6.38	24	4.53	24	24	0	0.5	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	Mosq. No.	Number of Records <0.4	Number of Records ≥0.4
1-Jul-99	10.79	24	4.31	24	23	1	1.5	24	0
2-Jul-99	15.91	23	3.80	23	20	3	103.3	20	3
3-Jul-99	14.21	24	3.97	24	24	0	38.5	24	0
4-Jul-99	14.63	24	5.234	24	24	0	5.62	24	0
5-Jul-99	15.17	24	4.46	24	23	1	92.9	24	0
6-Jul-99	8.83	42	5.11	42	42	0	40.0	42	0
7-Jul-99	8.30	37	2.40	38	37	0	17.6	37	0
8-Jul-99	9.16	32	2.38	32	32	0	26.9	32	0
9-Jul-99	12.00	26	3.039	26	23	3	83.1	25	1
10-Jul-99	9.20	30	4.29	30	30	0	26.5	30	0
11-Jul-99	6.92	24	3.75	24	24	0	22.1	24	0
12-Jul-99	6.91	23	4.29	24	23	0	20	23	0
13-Jul-99	8.65	23	5.55	23	23	0	8.5	23	0
14-Jul-99	8.63	24	7.21	24	24	0	5	24	0
15-Jul-99	10.21	24	4.76	24	21	3	7.3	24	0
16-Jul-99	10.17	29	3.09	29	28	1	29.5	29	0
17-Jul-99	5.97	36	4.71	36	36	0	3.4	36	0
18-Jul-99	4.26	27	5.70	27	27	0	1.9	27	0
19-Jul-99	3.88	34	3.42	34	34	0	0	34	0
20-Jul-99	2.54	26	8.99	26	26	0	0	26	0
21-Jul-99	1.83	36	6.31	36	36	0	0	36	0
22-Jul-99	2.97	34	5.01	34	34	0	26.3	34	0
23-Jul-99	2.50	34	1.89	34	34	0	2.2	34	0
24-Jul-99	3.0	38	2.94	38	38	0	0	38	0
25-Jul-99	1.52	42	5.85	42	42	0	N/A	42	0
26-Jul-99	1.71	35	8.95	36	35	0	N/A	35	0
27-Jul-99	2.03	36	7.52	36	36	0	N/A	36	0
28-Jul-99	2.03	30	3.04	30	30	0	N/A	30	0
29-Jul-99	2.46	41	6.25	42	41	0	N/A	41	0
30-Jul-99	7.92	24	3.62	24	24	0	N/A	24	0
31-Jul-99	12.00	24	4.63	24	15	0	N/A	15	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	Number of Records	Mosq. No.	Number of Records	Number of Records
					<0.5	≥0.5		<0.4	≥0.4
1-Aug-99	12.86	21	4.01	21	19	2	N/A	21	0
2-Aug-99	11.00	21	3.45	21	21	0	N/A	21	0
3-Aug-99	7.63	32	8.05	32	32	0	N/A	32	0
4-Aug-99	9.97	29	5.76	29	29	0	N/A	29	0
5-Aug-99	17.42	24	4.07	24	20	4	N/A	14	10
6-Aug-99	15.73	30	3.07	32	28	2	N/A	20	10
7-Aug-99	9.52	27	5.79	27	27	0	N/A	27	0
8-Aug-99	7.10	41	5.30	41	41	0	N/A	41	0
9-Aug-99	9.72	43	1.91	45	43	0	N/A	43	0
10-Aug-99	7.22	37	3.26	39	37	0	N/A	37	0
11-Aug-99	12.63	24	3.02	24	18	6	N/A	22	2
12-Aug-99	7.24	34	4.04	43	34	0	N/A	34	0
13-Aug-99	7.13	39	2.93	39	39	0	N/A	39	0
14-Aug-99	9.41	29	3.48	30	29	0	N/A	29	0
15-Aug-99	7.18	39	2.00	39	39	0	N/A	39	0
16-Aug-99	10.38	26	3.06	26	26	0	N/A	26	0
17-Aug-99	10.98	40	6.72	41	40	0	N/A	40	0
18-Aug-99	5.11	57	3.00	57	57	0	N/A	57	0
19-Aug-99	3.32	34	11.91	34	34	0	N/A	34	0
20-Aug-99	4.10	29	10.85	29	29	0	N/A	29	0
21-Aug-99	3.18	39	8.84	44	39	0	N/A	39	0
22-Aug-99	3.07	46	3.50	54	46	0	N/A	46	0
23-Aug-99	3.02	44	9.74	44	44	0	N/A	44	0
24-Aug-99	2.83	36	9.52	36	36	0	N/A	36	0
25-Aug-99	2.55	31	4.59	31	31	0	N/A	31	0
26-Aug-99	5.92	24	5.23	24	24	0	N/A	24	0
27-Aug-99	2.34	41	5.58	41	41	0	N/A	41	0
28-Aug-99	-0.19	31	3.73	31	31	0	N/A	31	0
29-Aug-99	0.69	35	8.39	35	35	0	N/A	35	0
30-Aug-99	2.25	40	6.94	40	40	0	N/A	40	0
31-Aug-99	1.16	19	3.22	27	19	0	N/A	19	0