Bird Surveys at King Point, Yukon in 1981 to Assess the Potential Impact of Development

by Lynne Dickson

June 1985

CANADIAN WILDLIFE SERVICE

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ABSTRACT

In 1979, Dome Petroleum Limited identified King Point as the most suitable location for development of a deep draft port to support future production of oil and gas in the Beaufort Sea. In order to assess the effect of such development on birds, the Canadian Wildlife Service conducted a field study at King Point from June to September in 1981. This report presents the results of the field study, as well as an evaluation of the impact of development at King Point on birds and recommendations for mitigative measures.

Aerial surveys were conducted at King Point on 19 June 1981 for nesting birds, 24 July for moulting and brood-rearing birds, and 3 September for fall staging birds. In addition, an aerial survey specifically for raptors nesting along the Trail River valley was conducted on 23 June, and one other survey specifically for fall staging Lesser Snow Geese was conducted on 3 September. Ground surveys were done at four sites near King Point between 11 and 26 June to obtain more detailed information on nesting birds and habitat types.

The results of the study showed that the King Point area was regionally important to Lesser Snow Geese during fall migration in 1981. On 3 September, an estimated 42 300 snow geese or 10% of the entire western population of snow geese staged near King Point with the highest concentrations being along the Deep Creek valley.

According to the results of both the 1981 surveys and previous reports, the Babbage River delta and Phillips Bay support higher densities of nesting Glaucous Gulls, Tundra Swans, geese and shorebirds than

elsewhere along the Yukon Coastal Plain. The delta is also locally important to moulting Tundra Swans, Northern Pintails, Oldsquaws and Red-breasted Mergansers, while offshore in Phillips Bay moulting scoters are common. During fall migration, the Babbage River delta is regionally important to staging shorebirds, Brant, Lesser Snow Geese and in some years, Greater White-fronted Geese. This and previous studies also indicate that the upper Babbage and Trail river valleys are prime habitat for cliff-nesting raptors.

Both the aerial and ground surveys in 1981 showed that nesting waterfowl, loons, gulls, terns, jaegers and shorebirds were more abundant within 10 km of the coast than further inland. Several species of passerine, rare elsewhere on the Yukon Coastal Plain, were found nesting in the Babbage River valley. Whimbrel and Stilt Sandpipers occurred in higher densities in wetlands near King Point than has been reported elsewhere on the Yukon Coastal Plain. Deep Creek supported unusually high densities of brood-rearing and moulting dabbling ducks, while the lagoon at King Point was locally important to moulting Oldsquaw.

Habitats surveyed near King Point were grouped into ten types and the nesting density of each bird species calculated for each habitat type. The highest densities and species richness of shorebirds occurred in Wet Sedge-Patterned Ground and Tussocky Tundra-Patterned Ground, the two graminoid habitat types with polygons found in the wetlands. Passerine species richness and densities were highest in the habitat types dominated by shrubs and dwarf shrubs. The habitat type least used was Tussocky Tundra, the habitat type which had no patterned-ground and

which was dominated by tussocks of Eriophorum species growing on moist, flat to gently sloping terrain.

A deep draft port at King Point could result in impacts on birds from aircraft overflights, movements of surface vehicles, oil spills and loss of habitat from construction activity, particularly access roads, borrow pits and work pads. Important areas which should be protected from impacts include:

1. the area used by fall staging Lesser Snow Geese;
2. Phillips Bay and the Babbage River delta;
3. wetland habitat suitable for nesting shorebirds, loons, gulls, terns and waterfowl; and
4. the cliffs and bluffs along the Trail and Babbage rivers used by nesting raptors.

In addition, impacts from an influx of hunters, tourists and recreationalists, due to the improved road access, should be controlled.

ACKNOWLEDGEMENTS

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1.0 INTRODUCTION

In November of 1979, Dome Petroleum Limited released a document which described their projected land requirements for future oil and gas development in the Beaufort Sea (Dome Petroleum Limited 1979). In this document, King Point, on the Yukon north coast, was identified as the most logical choice for development of a deep draft port. King Point was selected for several reasons: there was deep water just offshore; there was a major source of quarry rock nearby at Mount Sedgewick; the offshore oil fields were nearby; and there was level land suitable for development of onshore facilities. The development proposed for King Point included the following:

- a harbour for docking, refueling and maintaining ships with a 25 m draft,
- an airstrip 2100 m long to accommodate Boeing 737 or 767 aircraft,
- an all-weather road to connect King Point to the Dempster Highway near Fort McPherson, NWT
- accommodation for 500 personnel,
- warehousing and storage yards,
- a fuel storage area, and
- a Liquified Natural Gas (LNG) terminal (Dome, Esso and Gulf 1982; Dome Petroleum Limited 1979).

Due to a lack of site specific data on birds in the vicinity of King Point, the Canadian Wildlife Service initiated a study in 1981 with the following objectives:

1) to determine the density, distribution and species composition of nesting, brood rearing, moulting and fall staging birds in the vicinity of King Point,
2) to identify areas and types of habitat important to birds at King Point,
3) to assess the regional importance of King Point to birds,
4) to assess the impact on birds of developing a port at King Point, and
5) to recommend mitigative measures.

2.0 STUDY AREA

King Point (lat. 69°06'N, long. 137°58'W) is located on the Beaufort Sea coast in the northern Yukon Territory (Fig. 1). Most of the coastline in the vicinity of King Point has narrow beaches and gullied rapidly eroding cliffs; however, at King Point there is a lagoon enclosed by a sand and gravel beach. Inland lies a gently rolling morainal plain dotted with numerous shallow lakes and ponds. The permafrost is continuous and the depth of thaw is shallow (25 cm), so that much of the soils are wet and acidic (Wiken et al. 1981).

The summers are short and cool, with frequent fog and frosts. The average daily minimum temperature exceeds 0°C only in June and July (Wiken et al. 1981).

The vegetation forms a continuous cover and is relatively lush compared to other areas of arctic Canada. Sedges dominate the lowlands, while a mixture of dwarf shrubs and cotton grass tussocks grow on the drier uplands.

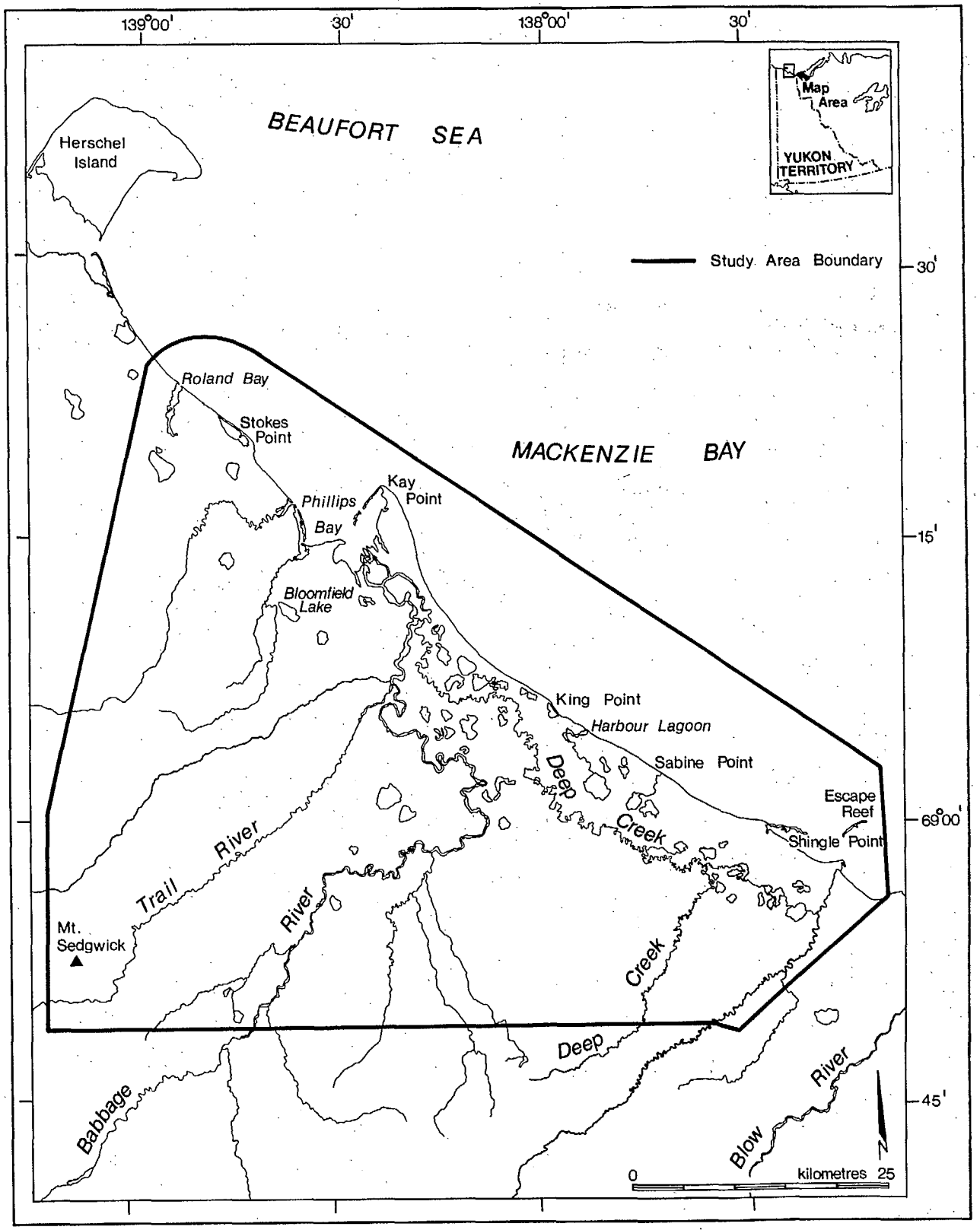

Figure 1. Map of the study area.

3.0 LITERATURE REVIEW

In the early 1970's several ornithological studies were conducted on the coastal plain of northern Yukon in response to a proposal to build a gas pipeline. Many of these studies are summarized in Salter et al. (1980), Richardson and Johnson (1981), and Johnson and Richardson (1982). The first report describes the distribution and abundance of the birds on the coastal plain of northern Yukon, while the other two reports discuss the spring and summer migration of birds along the Yukon coast.

There are several studies that were not included in the above summary reports. In 1973, Vermeer and Anweiler (1975) surveyed the Yukon coast for moulting and fall staging birds. Similar surveys were undertaken by Barry in 1980 and 1981 (Barry et al. 1981; Barry and Barry 1982). In 1974, Searing et al. (1975) conducted a series of aerial surveys for birds offshore in the Beaufort Sea, as well as on 90 coastal lakes, lagoons and bays. Campbell (1973; Campbell and Davies 1973) surveyed for nesting waterbirds and raptors in 1972. Mossop (1974; 1975) conducted waterfowl counts along the north coast of the Yukon in 1974 and 1975, and has completed a raptor inventory along the coastal drainages of the northern Yukon each year since 1975 (Mossop pers. comm.). In 1981, Spindler (1981) surveyed for fall staging Lesser Snow Geese on the north coastal plain of both Alaska and the Yukon.

Studies prior to 1970 provide annotated checklists for the birds of the western Arctic, but contain very little quantitative data (Schweinsburg 1974).

4.0 METHODS

4.1 Aerial Surveys

Aerial surveys were conducted at King Point on 19 June 1981 for all nesting birds, 24 July for moulting and brood rearing birds and 3 September for fall migrating birds. Additionally, a survey specifically for raptors nesting along the Trail River valley was undertaken on 23 June and a survey for fall staging Lesser Snow Geese was undertaken on 3 September. All flightlines are shown in Figures 2, 3 and 4.

A Bell 206 Jet Ranger helicopter was used for all surveys, with one observer in the left front seat and one in the right back seat. The data were recorded on cassette tape recorders and transcribed onto forms later the same day. At the beginning of each flight the date, time of day and weather (temperature, wind speed and direction, cloud cover and precipitation) were noted.

The surveys intended for all bird species were conducted at 30 m agl and at an air speed of 160 km/h. Birds within 200 m on either side of the helicopter were recorded as "on transect", whereas those beyond the 400 m wide strip were recorded as "off transect". Only "on transect" data were used in the data analysis unless otherwise specified. For each bird observation, we recorded species, number, habitat and whenever possible, age, sex and general behaviour. Sightings of nests and broods were also noted.

To facilitate locating each bird sighting when analyzing the data, the survey lines were divided into segments. At the beginning of each segment both observers recorded the segment number and the time. The time was also noted for each observation. Thus, at a later date the

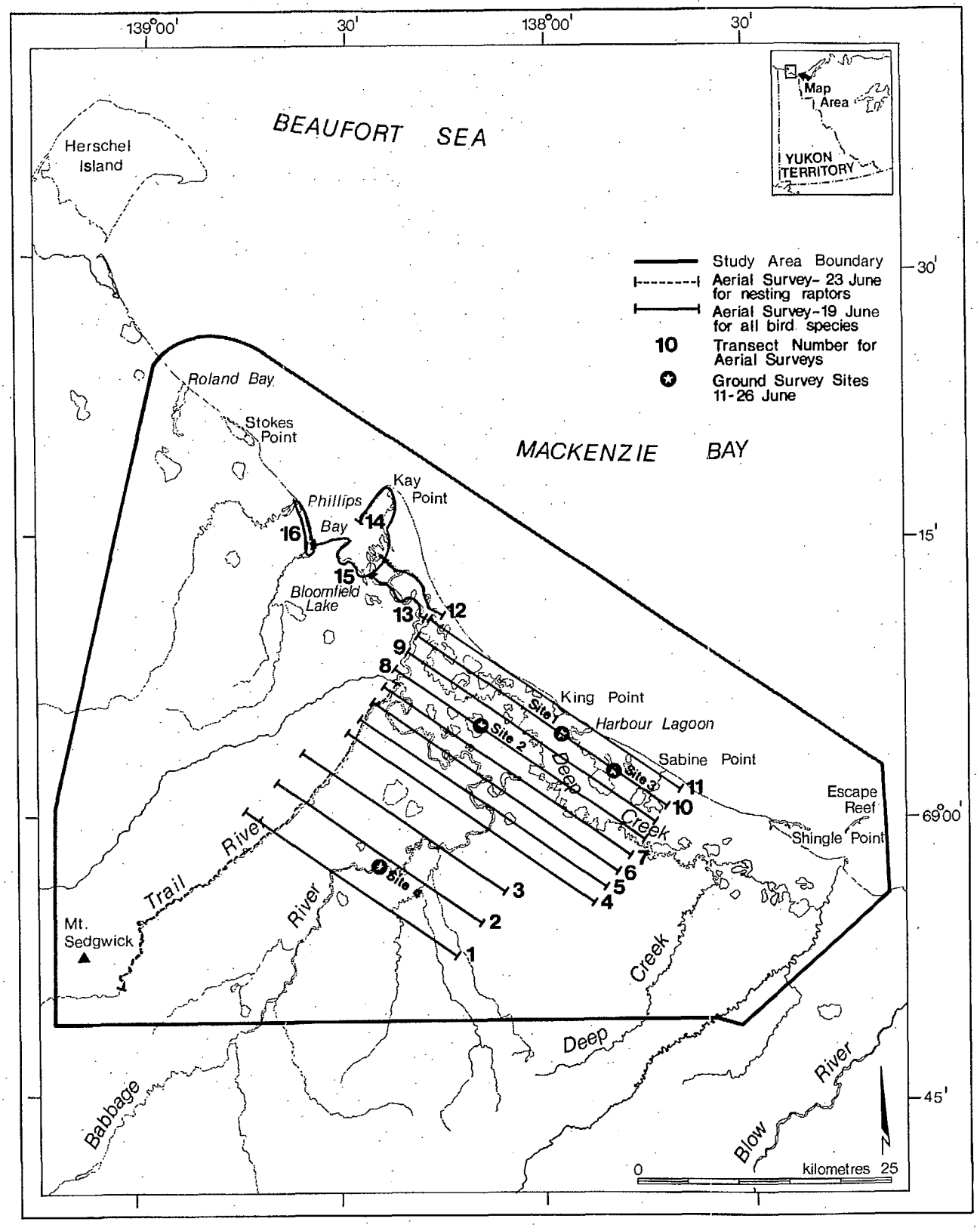

Figure 2. Location of the aerial survey transects flown on 19 and 23 June, 1981, and the ground surveys conducted 11-26 June, 1981, at King Point, Yukon.

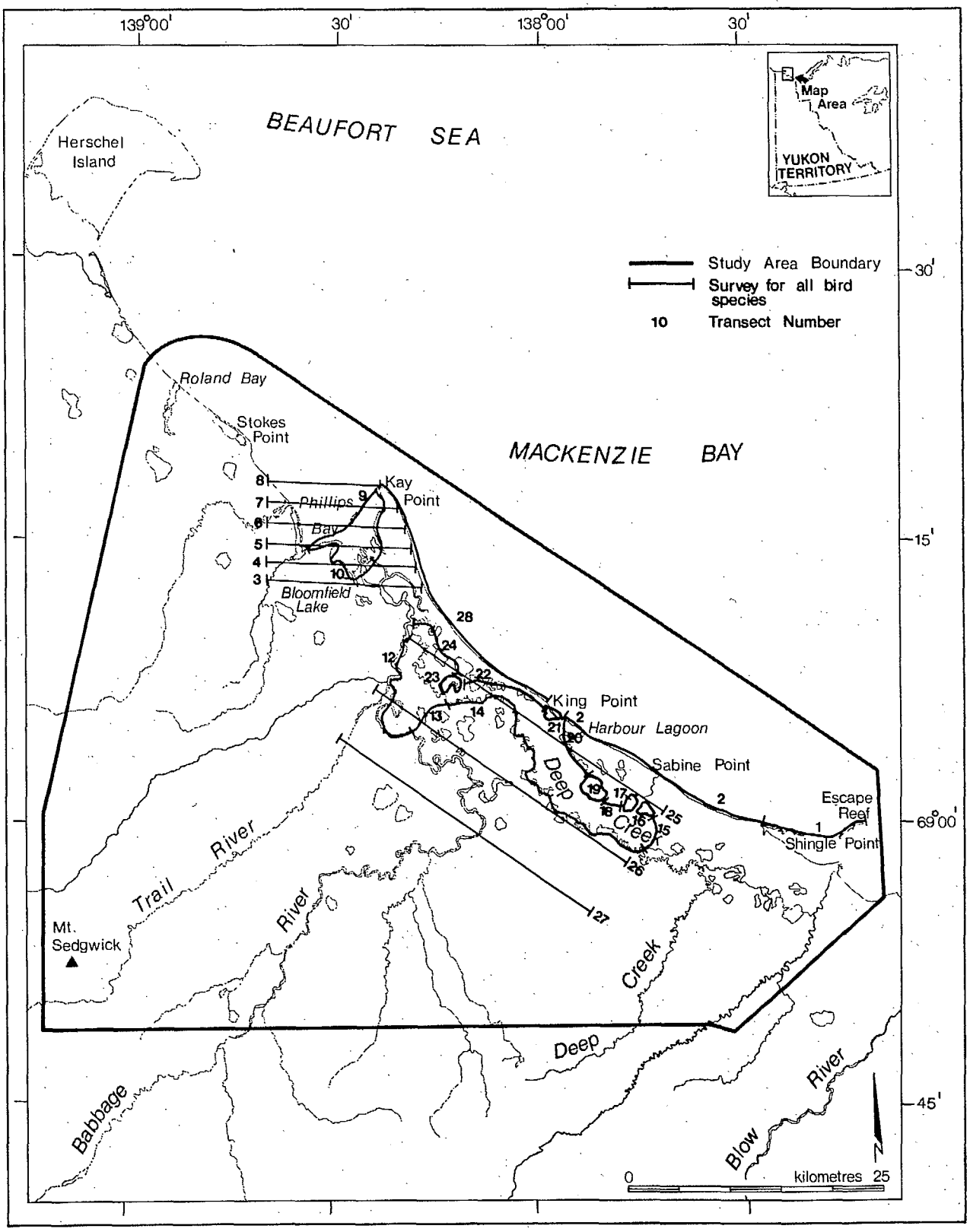

Figure 3. Location of the aerial survey transects conducted on 24 July 1981, at King Point, Yukon.

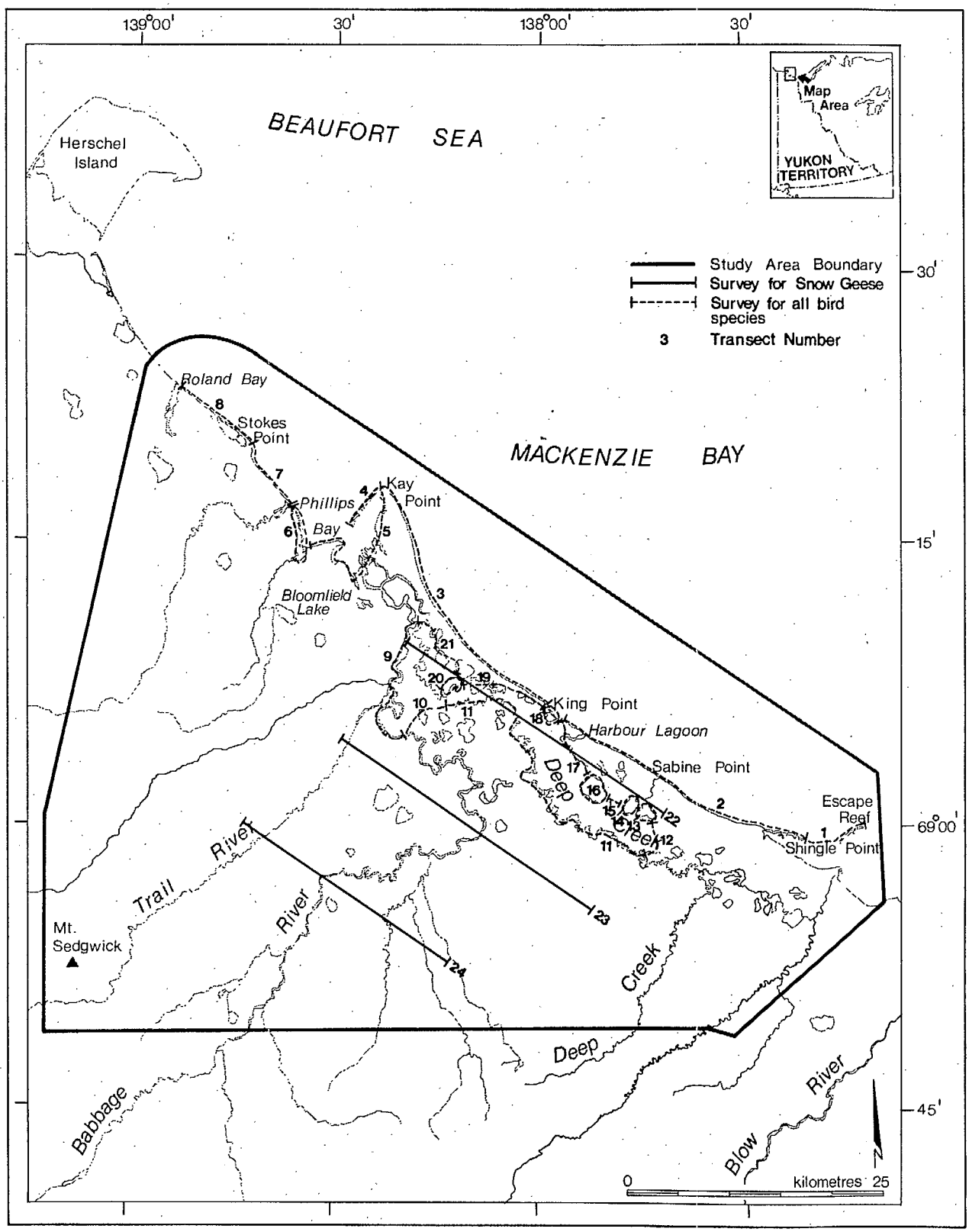

Figure 4. Location of the aerial survey transects flown on 3 September 1981, at King Point, Yukon.

approximate location of a given bird sighting could be calculated by converting to distance the time between the beginning of the segment and the bird sighting.

The surveys for fall staging Lesser Snow Geese were conducted as described above, except we flew at 150 m agl and the transect width was increased to 1000 m on each side of the aircraft.

When searching for nesting raptors along the Trail River, we flew along the top third of the cliff about 30 m from the cliff-face at about 50 km/h. We made several passes by some cliffs, but did not check any cliffs from the ground. For each raptor observation, the species, number and general behavior were recorded. All nests were checked for eggs or young, and the condition of the nest was described. Areas with heavy "whitewash" due to a build-up of bird excrement were also noted. The location of each of the above observations was marked on a 1:250 000 scale topographical map.

4.2 Ground Surveys

To obtain more detailed information on nesting birds and habitat, ground surveys were conducted at four sites near King Point from 11 to 26 June (Fig. 2). Five transects were surveyed at the first site, and three transects were surveyed at each of the other sites (Appendix A).

The transect method of surveying was used as follows. Two observers walked parallel to each other 25 m apart and recorded all birds seen on a 55 m wide transect. Birds observed beyond the transect width were recorded as "off transect". One observer kept track of the number of

paces they had walked, so that every observation could be located along the transect. For each bird observation, the species, number, age, sex, behavior and pace number were recorded. All nests, eggs and young were also noted. The following details were gathered about the habitat:

- macro relief (e.g. flat lowland, rolling upland, slope),
- micro relief (tussocks, hummocks, patterned ground),
- moisture (dry, moist, wet, wet with standing water - percent cover of standing water),
- percent cover of vegetation,
- dominant classes of vegetation - shrub (0.5 m or higher), dwarf shrub (less than 0.5 m high), graminoid (grasses, sedges and rushes), heath (the Ericaceae family), forb (broad-leafed herbaceous vegetation), lichen and moss,
- percent cover of each dominant class of vegetation and
- dominant species and their percent cover.

Whenever the habitat changed, the pace number was noted.

Data analysis was usually based on "on transect" data, except when examining the distribution, habitat preferences and species composition of water-oriented birds such as loons, ducks and gulls. For these species, both "on" and "off transect" data were used, because the majority of sightings were on waterbodies "off transect". The limitations and biases of the ground survey method used in this study are discussed by McLaren and Alliston (1981).

5.0 RESULTS

5.1 Aerial Surveys

Spring Surveys

Shorefast ice was still present along the coastline at the time of the spring survey on 19 June, 1981. Likewise, large lakes along the coastal plain were covered with ice except for a narrow lead of open water along the shore. However, the land was snow-free and the rivers, wetlands and small ponds were open.

Table 1 summarizes the results of the spring aerial surveys by species group. For a more detailed presentation of the data by species refer to Appendix B1. Waterfowl, loons, gulls, terns and raptors were all more abundant within 8 km of the coast than further inland. Within 8 km of the coast, their combined density was 3.8 birds/km^2, compared to 0.7 birds/km^2 between 8 and 25 km from the coast.

Summer Survey

The results of the survey on 24 July, 1981, for moulting and brood rearing birds are summarized in Table 2 and presented in detail in Appendix B2. There was a marked increase in the number of ducks in the study area presumedly due to the influx of moulting birds. Notable moulting areas were just off the coast between Shingle Point and Kay Point, Phillips Bay, Deep Creek and the larger lakes (Table 2). Unlike nesting ducks which the June surveys indicated were more abundant on wetlands near the coast than farther inland, moulting ducks occurred in relatively high densities on lakes both near the coast and inland (density of 5.4 ducks/km^2 along the transect 14 km inland from the coast).

Table 1. Densities of birds recorded during an aerial survey near King Point, Yukon on 19 June 1981.

Area surveyed	Transect number	Density (birds/km^2)											
		Loons	Swans	Geese	Ducks	Ptarmigan	Jaegers	Gulls	Terns	Raptors	Shorebirds	Passerines	Total
Transects 25 km inland	1,2,3		*		0.6		0.2		0.1		0.7	0.3	1.9
Transects 13 km inland	4,5	0.2			0.4	0.1	0.1		0.1		0.2	0.3	1.5
Transects 8 km inland	6,7,8	0.3	0.3	0.1	2.7	0.2	0.1	*	0.6	0.1	0.6	0.3	5.2
Transects 2 km inland	9,10,11	0.3	0.2	*	2.5	0.1	0.1	0.1	0.2	0.2	0.3	0.2	4.2
Lower Babbage River	12,13		0.7		5.3			0.2	0.2		0.4		6.8
Phillips Bay	14,15,16	0.2	2.0	0.5	5.0			7.4		0.1	0.8		16.1

*Less than 0.05 birds/km^2.

Note: a blank represents 0.0 birds/km^2.

Table 2. Densities of birds recorded during an aerial survey near King Point, Yukon on 24 July 1981.

Area surveyed	Transect number	Density (birds/km^2)											
		Loons	Swans	Geese	Ducks	Ptarmigan	Jaegers	Gulls	Terns	Raptors	Shorebirds	Passerines	Total
Transect 14 km inland	27	0.5			5.4	0.2		0.1	0.3	0.2	0.2	1.9	8.9
Transect 8 km inland	26	0.9	0.3		7.1	0.2				0.1	0.1	0.9	9.6
Transect 2 m inland	25	1.1	0.5		1.5	0.3	0.2	0.2	0.8	0.2	0.4	0.2	5.5
Babbage River	12	0.7	0.3		0.6		0.2		1.3		2.2	0.2	5.4
Deep Creek	14	0.8	0.1		21.7	0.4			0.2	0.3	0.7	1.9	26.2
Coastal lakes	16,17, 19,23	0.9	2.5		13.7			0.1	0.3	0.1		0.6	18.3
Cross country	13,15,18, 20,22,24	1.4	0.7		3.9			0.1	1.8	0.2	0.4	1.1	9.6
King Point Lagoon	21	1.2			8.1			2.5					11.9
Escape Reef	1	0.7		2.7				71.1	2.7				77.3
Coast-Shingle Point to Kay Point	2,28				32.5			1.5	0.2				34.2
Phillips Bay-transects	3-8	0.8	1.1	0.4	11.9	0.3	0.1	2.0	0.1	0.1	1.5	0.5	18.8
Phillips Bay-shoreline	9,10,11	0.8	0.4		6.9			3.1	0.4	0.1	4.8	0.3	16.8

Note: a blank represents 0.0 birds/km^2.

Glaucous Gull nesting colonies were recorded on Escape Reef, and on the two spits in Phillips Bay (Fig. 5). Small Arctic Tern colonies were recorded on Escape Reef, and at two lakes between King Point and the Babbage River (Fig. 5).

Fall Surveys

The survey on 3 September, 1981, for fall staging birds is summarized by species group in Table 3. For a more detailed presentation of the data, refer to Appendix B3.

The most abundant species recorded during the survey on 3 September was the Lesser Snow Goose. There were no dabbling ducks and much fewer swans, raptors, jaegers, shorebirds and passerines than on the previous surveys. The lagoon at King Point had the highest density of ducks in the study area (56.9 ducks/km^2).

The following is a more detailed account of the species composition, distribution and habitat preferences of birds recorded during the aerial surveys.

Loons

From June through to early September, loons were seen throughout the study area, although they were more abundant within 10 km of the coast (Tables 1, 2 and 3). Both Arctic and Red-throated loons were present, the Arctic Loon being the more common by a ratio of about 3:1 (Appendix B).

Swans

Most of the 56 Tundra Swans sighted during the aerial survey in June were scattered across the coastal plain either singly or in pairs.

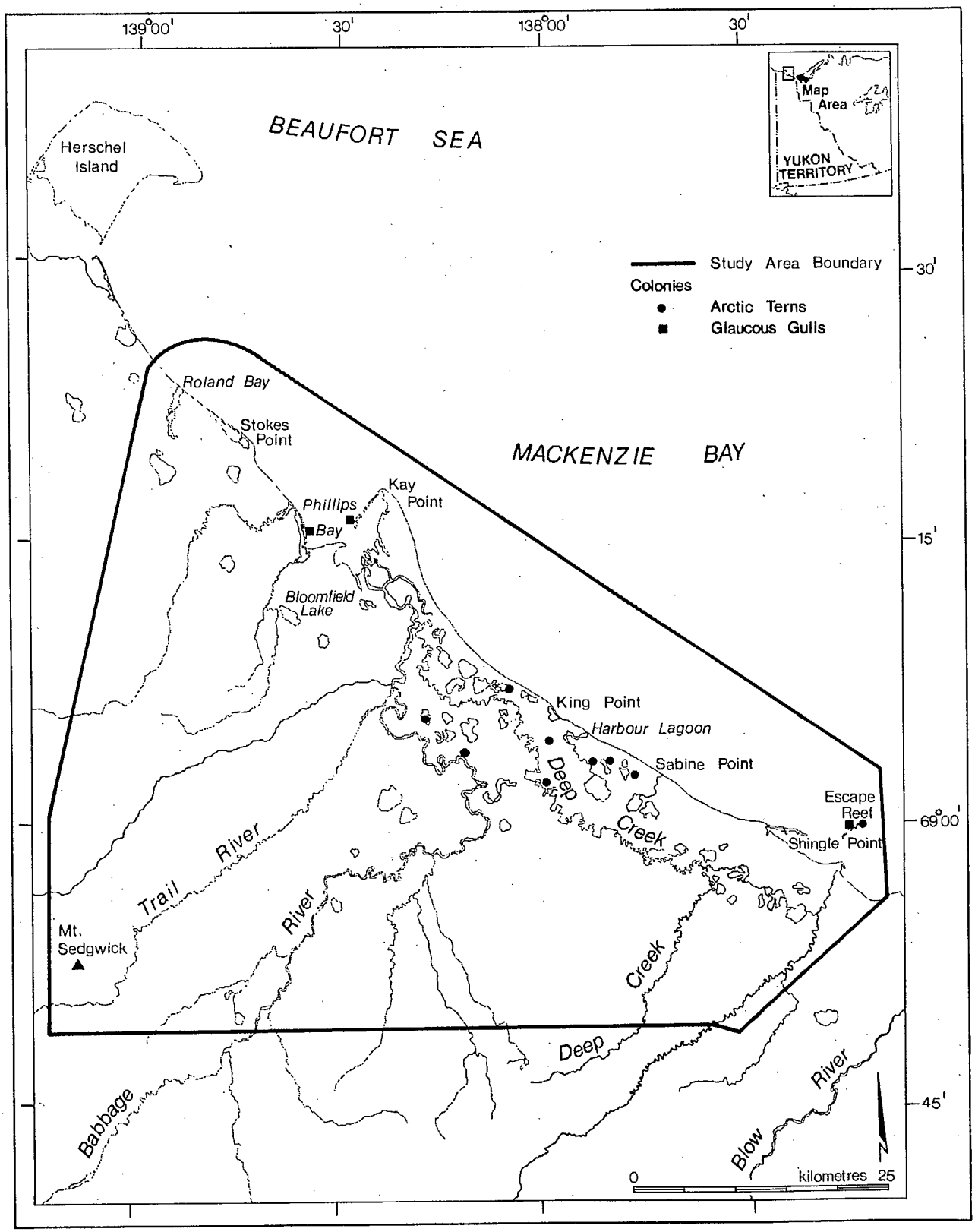

Figure 5. Location of Glaucous Gull and Arctic Tern colonies observed during aerial and ground surveys conducted near King Point, Yukon in 1981.

Table 3. Densities of birds recorded during an aerial survey near King Point, Yukon on 3 September 1981.

Area surveyed	Transect number	Density (birds/km^2)											
		Loons	Swans	Geese	Ducks	Ptarmigan	Jaegers	Gulls	Terns	Raptors	Shorebirds	Passerines	Total
Babbage River	9	0.6		5.4				0.2				0.2	6.3
Deep Creek	11	0.1		152.9									152.9
Coastal lakes	13,14,16, 20	0.5		87.0	15.1							0.1	102.7
Cross-Country	10,12,15, 17,19,21	0.4		57.4						0.1			57.8
King Point Lagoon	18				56.9			4.4					61.2
Escape Reef	1	0.9			0.4			17.5			4.6	0.2	23.6
Coast-Shingle Point to Kay Point	2,3	0.6			3.2			1.9					5.7
Coast-Phillips Bay to Roland Bay	7,8	0.2		1.2	7.8		0.3	2.2			0.3		12.0
Phillips-shoreline	4,5,6	0.4	0.2		3.3			4.1			1.2		9.2
Snow Goose Survey													
Transect 27 km inland	24			2.6									2.6
Transect 14 km inland	23			54.2									54.2
Transect 2 km inland	22			93.0									93.0

Note: a blank represents 0.0 birds/km^2.

The exception was a flock of 20 swans that we found on the Babbage River delta. All but two of the swan sightings were within 8 km of the coast (Appendix B1). Three nests were found: two by ponds on Transect 6 and 8 and one by a creek on Transect 8 (Appendix C).

In July, there were fewer sightings of single birds and pairs, and more small flocks of swans. Fifty of the 88 swans sighted were in groups of 3 to 13 birds. Although 16 pairs were recorded, only one pair had young. This was a brood of two cygnets on Harbour Lagoon. Swans were most abundant on the large coastal lakes (2.5/km^2) and at Phillips Bay (1.1/km^2) (Table 2).

On 3 September, we saw only three swans, all of which were in Phillips Bay (Appendix B3).

Geese

The only geese seen during the June aerial survey were Canada Geese: two pairs and a group of four in Phillips Bay, and three on the transect 8 km inland (Appendix B1).

In July, a pair of Canada Geese with two young was recorded on a pond to the west of Phillips Bay (Appendix B2). Also, a flock of 10 Brant was found on a channel in the Babbage River delta, and another flock of 12 Brant was seen at Escape Reef.

In September, the only sightings of geese other than Lesser Snow Geese were a flock of eight Brant on the west side of Phillips Bay and a flock of 15 Brant "off transect" on the Babbage River delta (Appendix B3).

During the survey designed specifically for fall staging Lesser Snow Geese (the three straight-line transects 22, 23 and 24 surveyed on

3 September), we recorded 8963 Lesser Snow Geese "on transect" and an additional 4305 geese "off transect" for a total count of 13 269 birds (Appendix B3). An estimated 42 300 Lesser Snow Geese were in the area surveyed (based on the "on transect" data only). Twenty-six percent of the count were young of the year based on a sample of 1493 birds in 14 flocks.

Most (99%) of the Lesser Snow Geese were on the two transects nearest the coast, with very few on the transect inland 27 km (Table 3). The highest density of Lesser Snow Geese (152.9/km^2) occurred on the lowlands adjacent to Deep Creek.

Ducks

The most abundant species of ducks during the June survey were Oldsquaw (49%), scaup (20%) and Northern Pintail (17%). Most ducks were single or in pairs, although there were several small flocks averaging seven birds, particularly of Oldsquaw and Northern Pintail. The largest flock encountered was 32 Oldsquaw on the lagoon at King Point.

In June, duck densities encountered within 8 km of the coast were substantially higher than those further inland: 2.6 ducks/km^2 compared to 0.5/km^2 respectively (Table 1). The highest densities occurred on the lower Babbage River (5.3/km^2) and along the coast of Phillips Bay (5.0/km^2), although ducks were most frequently sighted on lakes (39% of all observations).

In July, there was a substantial increase in the number of ducks in the study area due to an influx of moulting birds. We recorded 650

moulting scoters, most of which were Surf Scoters located just off shore between Shingle Point and Kay Point (32.5 scoters/km^2) (Appendix B2). In Phillips Bay there was an average of 11.9 moulting ducks/km^2, the most common species being the Surf Scoter, Oldsquaw, Red-breasted Merganser and Northern Pintail (Table 2 and Appendix B2). There were 21.7 ducks/km^2 on Deek Creek, most of which were moulting dabbling ducks - Northern Pintail, American Wigeon, Mallard and Green-winged Teal. The large coastal lakes averaged 13.7 ducks/km^2, most of which were moulting scaup, Red-breasted Mergansers and American Wigeons (Table 2 and Appendix B2).

Seventeen duck broods were sighted: seven on Deep Creek, four on the four large coastal lakes surveyed, and the remainder scattered throughout the study area on lakes and ponds (Fig. 3).

On 3 September, scaup were most abundant (46%), followed by Oldsquaws (31%), scoters (14%) and Red-breasted Mergansers (8%). The greatest concentration of ducks was 91 Oldsquaws in the lagoon at King Point (Appendix B3). The second highest density occurred on the four large coastal lakes surveyed (Table 3 and Fig. 4). Dabblers were not encountered.

Jaegers, Gulls and Terns

A total of 12 jaegers were sighted during the aerial survey in June, seven in July and two in September (Appendices B1, 2 and 3). Jaegers identified to species were either Long-tailed or Parasitic.

In June, we found a nesting colony of Glaucous Gulls in Phillips Bay on the spit off Kay Point with at least 17 nests and 60 adult birds

(Appendix B1 and Fig. 5). Another colony of 42 Glaucous Gulls and several nests were noted on the spit on the west side of Phillips Bay. Elsewhere in the study area Glaucous Gulls nested singly on islets in lakes.

In July at Phillips Bay, 20 Glaucous Gulls were recorded on the spit off Kay Point and another 21 on the spit on the west side of the bay (Appendix B2). The total number of Glaucous Gulls recorded in Phillips Bay was 65 adults and 2 chicks. In addition, 313 adult Glaucous Gulls and 12 young were sighted at Escape Reef. The chick count at both localities was likely grossly underestimated, because the chicks are difficult to see compared to the adults. In September, the Glaucous Gulls were still concentrated at Phillips Bay and Escape Reef where we recorded 64 and 77 gulls respectively (Appendix B3).

In June and July, Arctic Terns were encountered in small numbers on lakes, ponds and rivers throughout the study area. The following nesting colonies were identified: 18 terns on a large lake near the confluence of the Babbage River and Trail River, 15 terns on a lake 5 km west of King Point, and 12 terns on Escape Reef (Fig. 5). Arctic Terns were not seen during the survey on 3 September (Table 3).

Raptors

When the cliffs along the Trail River were surveyed on 23 June (Fig. 2), we found two productive Gyrfalcon nests (one with two young and one with three young), and two productive Golden Eagle nests (each with one young) (Appendix D). In addition, a pair of Golden Eagles flushed from a cliff which had two stick nests, but neither nest contained

young. A Peregrine Falcon flushed from a cliff, but we were unable to find a scrape. We did find a small empty stick nest on the cliff.

During the two surveys in June and July along the Yukon Coastal Plain, the raptor species sighted, in order of abundance, were the Northern Harrier, Golden Eagle, Short-eared Owl, Rough-legged Hawk, Gyrfalcon and Bald Eagle (Appendices B1 and B2). On 3 September, the only raptor seen was a Northern Harrier (Appendix B3).

Shorebirds

In June, shorebirds were fairly evenly distributed throughout the study area in wetland habitat (Table 1). In July, similar densities were encountered throughout the study area except on the Babbage River delta where there were several flocks of shorebirds which accounted for 45% of the total count (Table 2). In September, we saw very few shorebirds: a flock of 20 on Escape Reef, and only 20 elsewhere in the study area (Appendix B3).

5.2 Ground Surveys

5.2.1 Habitat Types

The habitats surveyed near King Point in June of 1981 were grouped into ten types (Table 4). Descriptions of each habitat type follow.

Shrub

Shrub habitat consisted almost exclusively of Salix species ranging in height from about 0.5 m to 3.0 m and was found primarily along river banks and on the lower parts of slopes. In the Babbage River

valley it was also found on ridges. Generally, Shrub habitat occurred where soils were well drained, where there was protection from the wind, and where snow had accummulated during winter.

Dwarf Shrub

Dwarf Shrub habitat consisted primarily of Salix species and Betula species less than 0.5 m in height, with some grasses and/or heath. This habitat occurred in well drained areas such as hillsides and gently sloping uplands. The soil was dry to moist and there were usually hummocks.

Dwarf Shrub - Patterned Ground

This habitat which had both high-centred and low-centred polygons, occurred on either flat lowlands or gently sloping uplands, often in association with lakes or large ponds. Sedges grew in the ditches of the high-centred polygons and in the centres of low-centred polygons, whereas Salix species and Betula species dominated the higher parts of the polygons. Subdominant vegetation included Ledum decumbens, Vaccinium vitis-idaea and Vaccinium uliginosum.

Wet Dwarf Shrub

This habitat, dominated by Salix species and interspersed with sedge, occurred in flat lowland areas adjacent to ponds and small lakes. Standing water in June covered an average of 80% of the ground.

Graminoid/Dwarf Shrub

This habitat was generally found on slopes or gently rolling uplands, although it occasionally occurred in flat lowlands. It consisted of a mixture of Eriophorum species, grasses, Salix species, Betula

Table 4. Description of habitat types encountered during ground surveys near King Point, 11-26 June 1981.

Habitat type	m surveyed	No. of samples	Vegetation class (% cover)					Macro relief	Micro relief	Moisture	% standing water	Lakes and ponds	Dominant species of vegetation
			Shrub	Dwarf shrub	Heath	Graminoid	Moss						
Shrub	6719	18	90	*	*	*	0	River banks or slope	None	Dry to moist	0	No	Salix spp.
Dwarf shrub	5301	15	0	70	10	10	*	Slope or gentle slope	Hummocks or none	Dry to moist	0	No	Salix spp.
Dwarf shrub - patterned ground	5598	8	0	40	20	30	Sometimes moss base	Gently sloping uplands or flat lowlands	Sometimes hummocks or tussocks, both high and low-centred polygons	Moist	<10	Yes	Betula sp., Salix spp., Carex spp., Eriophorum spp., Vaccinium spp., Ledum decumbens
Wet dwarf shrub	868	3	0	70	0	30	0	Flat lowlands	None	Wet	80	Yes	Salix spp., Carex spp.
Graminoid/Dwarf shrub	10311	17	0	30	20	40	10 sometimes moss base	Slope or gently sloping uplands or flat lowlands	Hummocks and/or tussocks	Moist, sometimes dry	0	No	Eriphorum spp., Gramineae Betula sp., Salix spp., Vaccinium vitis-idaea, Ledum decumbens
Wet sedge	6852	14	0	10	*	70	10 sometimes moss base	Flat lowlands	None	Wet	50	Yes	Carex spp.

Table 4. Continued.

Habitat type	m surveyed	No. of samples	Vegetation class (% cover) Shrub	Dwarf shrub	Heath	Graminoid	Moss	Macro relief	Micro relief	Moisture	% standing water	Lakes and ponds	Dominant species of vegetation
Wet sedge - patterned ground	12737	20	0	10	*	80	*	Flat lowlands	Low-centred polygons	Wet	50	Yes	*Carex* spp.
Dry sedge	6063	9	0	10	10	70	Sometimes moss base	Flat lowlands	None	Dry to wet	Occasionally 10	Sometimes	*Carex* spp., *Eriophorum* spp.
Tussocky tundra	7307	14	0	10	20	60	10 sometimes moss base	Lowlands or uplands flat to gently sloped	Tussocks	Moist	0	Sometimes	*Eriophorum* spp., *Vaccinium vitis-idaea*, *Ledum decumbens*, *Empetrum nigrum*
Tussocky tundra - patterned ground	4109	5	0	10	20	70	Moss base	Flat lowlands	Tussocks, high-centred polygons	Wet	10	Sometimes	*Eriophorum* spp. *Carex* spp., *Ledum decumbens*, *Empetrum nigrum*, *Vaccinium vitis-idaea*

*Present but less than 10 percent of cover.

species and lesser amounts of Vaccinium species, Ledum decumbens and Empetrum nigrans. Hummocks were usually present and sometimes tussocks. The soil was either moist or dry.

Wet Sedge

Wet Sedge habitat was dominated by sedges and grasses with small amounts of Salix species and heath. A mat of moss was usually present. This habitat which had about 50% cover of standing water in June occurred in wet lowlands where there were numerous tundra ponds.

Wet Sedge - Patterned Ground

The patterned ground generally consisted of low-centred polygons with sedges growing in the wet centres, and dwarf shrubs and heath dominating the polygon ridges. This habitat was found in wet lowlands adjacent to lakes and ponds, and had an average cover of 50% standing water.

Dry Sedge

A mixture of sedges and lesser amounts of Eriophorum species dominated Dry Sedge habitat. Salix species, Betula species, Vaccinium vitis-idaea and Ledum decumbens were present in small amounts. This habitat was distinguished from Wet Sedge habitat by the drier substrate which ranged from dry to wet with never more than a 10% cover of standing water.

Tussocky Tundra

Tussocky tundra habitat was dominated by tussocks of Eriophorum species. Heaths such as Vaccinium vitis-idaea, Ledum decumbens and Empetrum nigrans, as well as some Salix species, Betula species, grasses,

sedges and moss were all subdominant. The habitat was found both in lowlands and uplands on flat to gently sloping terrain. Soils were moist with no standing water, although there were sometimes ponds nearby.

Tussocky Tundra - Patterned Ground

This habitat usually had high-centred polygons, the centres of which generally consisted of a wet moss mat with tussocks of Eriophorum species, while the ditches contained standing water and were fringed by sedges. Subdominant types of vegetation included Vaccinium species, Ledum decumbens, Empetrum nigrans, Betula species and Salix species. Small ponds were sometimes associated with this habitat type.

5.2.2 Habitat Preferences of Nesting Birds

Shorebirds

The highest densities and species richness of shorebirds occurred in the two graminoid wetland habitat types with polygons: Wet Sedge-Patterned Ground (108.4/km^2) and Tussocky Tundra-Patterned Ground (84.0/km^2) (Tables 5 and 6). Shorebirds were least abundant in Shrub, Dwarf Shrub, and Dwarf Shrub-Patterned Ground habitats.

Nesting Red-necked Phalaropes were most abundant in the Wet Sedge-Patterned Ground habitat (67.1/km^2), but also quite common in both Wet Sedge (26.5/km^2) and Tussocky Tundra-Patterned Ground habitat (22.2/km^2), probably due to the numerous ponds usually associated with these habitats. The high value for the Dry Sedge habitat (Table 5) was largely due to the sighting of flocked female phalaropes staging on a small pond in that habitat. Very few phalaropes were found actually

Table 5. Densitites of birds in each habitat type surveyed near King Point, 11-26 June 1981.

Bird species	Density in each habitat type (birds/km^2)[1]								
	Shrub	Dwarf shrub	Dwarf shrub-patterned ground	Graminoid/ Dwarf shrub	Wet sedge	Wet sedge-patterned ground	Dry sedge	Tussocky tundra	Tussocky tundra-patterned ground
Arctic Loon					5.3				13.3
Red-throated Loon				3.4		1.4			8.9
All loons				3.4	5.3	1.4			22.2
Canada Goose					2.7				
Mallard	8.2								
Northern Pintail					16.0	10.0	14.9		
Green-winged Teal	5.4		6.5		2.7				
Scaup spp.			19.4			2.9			8.9
Oldsquaw			48.7		8.0	4.4	12.0		8.9
Unidentified duck	2.7				8.0				
All ducks	16.2		74.7		34.5	17.1	26.9		17.6
Northern Harrier	5.4								
Willow Ptarmigan	24.4	17.1	6.5	14.2	5.3	2.9	12.0		
Rock Ptarmigan	2.7	6.9	3.3			1.4			4.4
Sandhill Crane					5.3				
Lesser Golden-Plover	5.4	10.4		14.2	5.3	7.1	2.9	7.4	8.9
Semipalmated Plover	5.4								
Whimbrel				1.8		10.0			22.2
Pectoral Sandpiper					5.3	7.1		2.5	
Semipalmated Sandpiper	2.7			1.8	2.7	7.1		7.4	13.3
Stilt Sandpiper						4.4			8.9
Least Sandpiper						1.4			
Long-billed Dowitcher									4.4

Table 5. Continued.

Species	Density in each habitat type (birds/km^2)[1]								
	Shrub	Dwarf shrub	Dwarf shrub–patterned ground	Graminoid/ Dwarf shrub	Wet sedge	Wet sedge–patterned ground	Dry sedge	Tussocky tundra	Tussocky tundra–patterned ground
Red-necked Phalarope					26.5	67.1	42.0		22.2
Unidentified shorebirds					5.3	1.4		2.5	4.4
All shorebirds	13.4	10.4		17.6	45.1	108.4	45.1	19.8	84.0
Parasitic Jaeger				1.8		5.7			
Long-tailed Jaeger				3.5		4.4			
Glaucous Gull						2.9			
Yellow Wagtail			3.3						
Rusty Blackbird		3.4	3.3						
Yellow Warbler	5.4	6.9	3.3						
Northern Waterthrush							2.9		
Redpoll spp.	40.5	24.0	3.3		21.3		2.9		
Savannah Sparrow	51.4	51.4	110.4	38.7	95.6	30.0	48.0	10.0	22.2
American Tree Sparrow	59.4	34.4	6.5	1.8	5.3		18.0	2.5	
White-crowned Sparrow	13.4	17.1							
Fox Sparrow	8.2	6.9							
Lapland Longspur	18.9	41.1	58.4	141.1	45.1	77.1	36.0	116.9	88.5
Unidentified passerines	2.7	6.9	3.3		2.7	1.4	2.9		
All passerines	200.2	192.2	191.6	181.6	169.8	108.4	110.9	129.3	110.5
All species	262.4	226.4	276.0	222.2	270.7	252.5	195.1	149.3	238.9
Distance surveyed (km)	6.72	5.30	5.60	10.31	6.85	12.74	6.06	7.31	4.11

[1]Calculations based on "on transect" data only.

Note: Wet Dwarf Shrub habitat was excluded, because the sample size was <1.0 km; a blank represents 0.0 birds/km2.

Table 6. The number of species of birds found in each habitat type surveyed near King Point, 11-26 June 1981.

Habitat type[2]	km surveyed	Number of species[1]			
		Shorebirds	Passerines	Other species	All species
Shrub	6.7	3	7	5	15
Dwarf shrub	5.3	1	8	2	11
Dwarf shrub - patterned ground	5.6	0	7	5	12
Graminoid/Dwarf shrub	10.3	3	3	4	10
Wet sedge	6.8	4	4	7	15
Wet sedge - patterned ground	12.7	8	2	9	19
Dry sedge	6.1	2	5	3	10
Tussocky tundra	7.3	3	3	0	6
Tussocky tundra - patterned ground	4.1	6	2	5	13

[1]Based on "on transect" data only.

[2]Wet Dwarf Shrub habitat was excluded because the sample size was <1.0 km.

nesting in Dry Sedge habitat. The Pectoral Sandpiper was most numerous in Wet Sedge-Patterned Ground habitat (7.1/km^2), whereas the Semi-palmated Sandpiper, Stilt Sandpiper and Whimbrel were most abundant in Tussocky Tundra-Patterned Ground habitat. The Lesser Golden-Plover which occurred in highest densities in Graminoid/Dwarf Shrub habitat (14.2/km^2), was the only shorebird species more abundant in drier upland habitat than lowlands.

Passerines

The density of nesting passerines was highest in the five habitat types which contained either shrubs or dwarf shrubs (Table 5). The Yellow Warbler, Rusty Blackbird, Yellow Wagtail, White-crowned Sparrow and Fox Sparrow were only found in those five habitat types. The Savannah Sparrow was most abundant in Dwarf Shrub-Patterned Ground (110.4/km^2), but were also quite common in the shrubless Wet Sedge (95.6/km^2) and Dry Sedge habitats (48.0/km^2). American Tree Sparrows were most numerous in Shrub (59.4/km^2) and Dwarf Shrub habitat (34.4/km^2), but were also found in Dry Sedge habitat (18.0/km^2). The highest densities of Lapland Longspurs occurred in Graminoid/Dwarf Shrub habitat (141.1/km^2) and Tussocky Tundra habitat (116.9/km^2), which were the two major habitats of the rolling uplands.

Ptarmigan

Ptarmigan preferred the drier habitat types and occurred mostly in Shrub (27.1/km^2) and Dwarf Shrub habitats (24.0/km^2).

Loons

Loon densities were highest on the lakes and ponds in lowland areas associated with the Tussocky Tundra-Patterned Ground habitat (Tables 5). All of the Red-throated Loons, both "on" and "off transect" were on ponds (waterbodies 0.25 km^2 or less in size). About 1/3 of the Arctic Loons were observed on ponds and 2/3 were on lakes.

Waterfowl

Duck densities were highest in the lowland habitat types that had lakes and ponds: Wet Sedge (34.5 ducks/km^2) and Dwarf Shrub-Patterned Ground (29.2 ducks/km^2 - non breeding flock of Oldsquaw excluded) (Table 5). The Wet Sedge habitat had the largest number of "off transect" sightings (9.0 ducks/km surveyed). The drier habitat types such as Dwarf Shrub and Tussocky Tundra had no ducks "on transect".

Jaegers, Gulls and Terns

Most sightings of jaegers, gulls and terns were "off transect". Jaegers, both "on" and "off transect", were most numerous in Wet Sedge-Patterned Ground habitat (Table 5). Glaucous Gulls were scattered in low numbers on lakes and on the Babbage River. All Arctic Tern colonies were on either ponds (75%) or lakes.

Summary

In summary, the habitat type least preferred by most species was Tussocky Tundra. Only six species were found in that type and the average density of birds was only 149.3/km^2 (Tables 5 and 6). The Lapland Longspur, which was found in relatively high numbers in most habitat

types, accounted for 78% of the bird observations in the Tussocky Tundra habitat.

Passerines preferred the habitat types with shrubs or dwarf shrubs which occurred most frequently in river and creek valleys, and near the base of hills. Ptarmigan were most numerous in the drier upland habitat types. On the other hand, shorebirds preferred wetlands, particularly those with a patterned ground and predominantly graminoid vegetation. The exception was the Lesser Golden-Plover which was abundant in drier, well drained upland habitat types. As expected, densities of water-oriented birds such as waterfowl, loons, gulls and terns were highest in those lowland habitat types which had numerous lakes and ponds.

5.2.3 Distribution of Nesting Birds

Sites 1, 2 and 3 of the ground surveys were within 6 km of the coast, whereas Site 4 was 25 km inland within the Babbage River valley (Fig. 2). Although bird densities and species richness were similar for all three sites near the coast, several differences were noted at the inland site (Tables 7, 8 and 9). Loons, swans, terns, jaegers and shorebirds were all more abundant at the three sites near the coast than at the inland site. The Lesser Golden-Plover, Whimbrel, Pectoral Sandpiper, Semipalmated Sandpiper and Stilt Sandpiper showed a particularly strong preference for the lowlands near the coast (Appendix E). Furthermore, species richness of shorebirds was higher near the coast than at the inland site.

Table 7. The number of species of birds found at each ground survey site near King Point, 11-26 June 1981.

Site number	km surveyed	Number of individual species within each species group[1]						
		Loons	Waterfowl	Raptors	Shorebirds	Passerine	Other	Total
1	16.1	2	9	3	7	8	5	34
2	14.9	2	8	3	8	9	7	37
2	15.1	3	10	4	9	5	8	39
4	20.6	2	9	3	5	14	6	39

[1]Includes both "on" and "off transect" data.

Table 8. Density of birds recorded "on transect" at each site near King Point where ground surveys were conducted, 11-26 June 1981.

		Density (birds/km^2)												
Site number	km surveyed	Loons	Swans	Geese	Ducks	Ptarmigan	Cranes	Jaegers	Gulls	Terns	Raptors	Shorebirds	Passerines	Total
1	16.1	2.3			10.2	11.3		3.4				54.2	154.7	236.0
2	14.9	3.6			13.4	11.0		3.7				50.0	176.9	258.7
3	15.1	6.0		1.2	26.5	4.8	2.4	4.8	2.4			65.0	124.0	237.2
4	20.6				23.8	17.6					1.8	10.6	158.0	211.8

Note: a blank represents 0.0 birds/km^2.

Table 9. Number of birds recorded "on and off transect" at each site near King Point where ground surveys were conducted, 11-26 June 1981.

		Number of birds[1]												
Site number	km surveyed	Loons	Swans	Geese	Ducks	Ptarmigan	Cranes	Jaegers	Gulls	Terns	Raptors	Shorebirds	Passerines	Total
1	16.1	2 (33)	(30)	(7)	9 (63)	10 (8)		3 (27)	(16)	(25)	(9)	48 (87)	137 (151)	209 (456)
2	14.9	3 (19)	(12)		11 (88)	9 (2)		3 (7)	(2)	(24)	(9)	41 (69)	145 (119)	212 (351)
3	15.1	5 (45)	(15)	1 (3)	22 (89)	4 (3)	2 (4)	4 (13)	2 (6)	(39)	(7)	54 (104)	103 (64)	197 (392)
4	20.6	(10)	(1)	(5)	27 (58)	20 (2)		(5)	(8)	(9)	2 (3)	12 (52)	179 (140)	240 (293)

[1]Numbers in brackets are birds observed "off transect".
Note: a blank represents 0.0 birds/km2.

On the other hand, the site located inland on the Babbage River had a greater variety of passerine species including the Bank Swallow, Grey-cheeked Thrush, Northern Shrike, Rusty Blackbird and Northern Water-thrush which were found only at Site 4 (Appendix E). Also, both the American Tree Sparrow and Fox Sparrow were more abundant at Site 4 than near the coast. However, the overall density of passerines was similar at all four sites, due to the ubiquitous nature of the three most common passerines - the Lapland Longspur, Savannah Sparrow and redpoll spp.

Nesting pairs of ducks were more numerous near the coast than inland (Table 10). Specifically, counts of nesting Northern Pintail and Oldsquaw were highest near the coast, although nesting Green-winged Teal were more abundant inland at Site 4.

5.2.4 Species Composition of Nesting Birds

Based on both "on" and "off transect" data at all four ground survey sites passerines composed 44% of all observation, shorebirds 20%, ducks 16%, loons 5%, terns 4%, jaegers 3% and ptarmigan 3%, while geese, swans, raptors, gulls and cranes composed the remaining 5%.

The ratio of Arctic Loons to Red-throated Loons at the four ground survey sites was about 5:1 (Appendix E). In addition, one Yellow-billed Loon was sighted.

Only 16 geese were observed in June; 10 of these were Greater White-fronted Geese, three were Canada Geese, while the remainder were unidentified dark geese.

Table 10. Species composition and distribution of nesting ducks observed during ground surveys near King Point, 11-26 June 1981[1].

Species	Number of nesting pairs					Species composition (%)
	Site 1	Site 2	Site 3	Site 4	Total	
Mallard	2	1	5	1	9	5
Northern Pintail[2]	16	12	15	2	45	23
Green-winged Teal	0	2	1	9	12	6
American Wigeon	3	3	0	0	6	3
Northern Shoveler	0	0	0	1	1	1
Scaup sp.[2]	5	20	4	11	40	21
Oldsquaw[2]	18	23	18	7	66	34
White-winged Scoter	0	0	3	0	3	2
Red-breasted Merganser	3	3	1	4	11	6
Unidentified ducks	3	3	13	5	24	
Total	50	67	60	40	217	

[1]All sightings of lone males, lone females, pairs and males in flocks of 4 or less were considered to be nesting locally. Both "on" and "off transect" data were used in these calculations.

[2]Confirmed nesters.

Diver ducks outnumbered dabblers by a ratio of 3:2. The most common species of nesting ducks were Oldsquaw (34%), Northern Pintail (23%) and scaup sp. (21%) (Table 10).

The Northern Harrier, Rough-legged Hawk and Short-eared Owl were the most common species of raptors sighted.

Eighty-two percent of all ptarmigan sightings identified to species were the Willow Ptarmigan while the rest were Rock Ptarmigan.

The most abundant shorebird was the Red-necked Phalarope which accounted for 44% of the shorebirds identified to species. The Lesser Golden-Plover (14%), Semipalmated Sandpiper (11%), Whimbrel (10%) and Stilt Sandpiper (7%) were also quite common.

The Long-tailed Jaeger and Parasitic Jaeger were both relatively abundant, the former being slightly more common (56% of all observations). The Pomarine Jaeger was sighted only once.

The Lapland Longspur was the most abundant passerine species accounting for 42% of all passerine observations. Other relatively common passerines were the Savannah Sparrow (31%), redpoll spp. (12%) and American Tree Sparrow (7%). For a complete list of the bird species encountered during the ground surveys, see Appendix E.

6.0 DISCUSSION

In order to assess the importance of the King Point area to birds in the Beaufort Sea region, emphasis in this discussion is placed on comparing bird densities at King Point to those reported elsewhere on the Yukon Coastal Plain, Alaska Coastal Plain and Mackenzie Delta. In

addition, key areas and habitats for birds in the vicinity of King Point are differentiated. An area or habitat was considered important if it had either relatively high densities of a bird species, a high species richness, a rare or endangered species, or a large portion of a population of a species.

To facilitate the discussion, a comparison of the abundance of bird species near King Point to the entire Yukon Coastal Plain is given in Table 11. A map of the areas referred to on the Tuktoyaktuk Peninsula, Mackenzie Delta and northern Yukon is also provided (Fig. 6). Any conclusions reached should be regarded as tentative, since this was only a one-year study and the number of birds using an area in the Arctic may vary considerably from one year to the next.

This study did not attempt to gather information on use of the King Point area by spring migrants, since previous studies have indicated that the Yukon North Slope is not heavily used during spring migration (Wiseley et al. 1977; Schweinsburg 1974; Richardson and Johnson 1981; Barry 1976). With the exception of river mouths, nearshore waters are ice bound in late May and early June, hence unattractive to water-oriented birds. Offshore, on the other hand, there are leads of open water which support thousands of eiders, Oldsquaws, loons, Brant and Glaucous Gulls, as they move eastward through the Beaufort Sea in the spring (Barry 1976; Richardson and Johnson 1981; Barry and Barry 1982). A few birds, particularly Brant, use the river deltas. In addition, small numbers of Tundra Swans, Northern Pintails, Greater White-fronted Geese, Lesser Snow Geese and Canada Geese heading westward use the melt-water ponds and tundra along the Yukon Coastal Plain (Richardson and

Table 11. Comparison of species abundance near King Point to the entire Yukon North Slope.

Common name	Scientific name	No. of sites[1] where species occurred (maximum=4)	Total bird count[1]	Abundance	
				King Point[11]	Yukon North Slope[111]
Arctic Loon	Gavia arctica	4	80	A	C
Red-throated Loon	Gavia stellata	4	19	FC	FC
Yellow-billed Loon	Gavia adamsii	1	1	U	U
Horned Grebe	Podiceps auritus	1	1	U	R
Canada Goose	Branta canadensis	2	3	U	R
Gr. White-fronted Goose	Anser albifrons	2	10	FC	U
Tundra Swan	Cygnus columbianus	4	58	A	FC
Mallard	Anas platyrhynchos	4	16	FC	R
Northern Pintail	Anas acuta	4	79	A	FC
American Wigeon	Anas americana	2	9	FC	R
Northern Shoveler	Anas clypeata	1	1	U	VR
Green-winged Teal	Anas crecca	3	16	FC	U
Lesser/Greater Scaup	Aythya sp.	4	65	A	C
Common Goldeneye	Bucephala clangula	1	6	U	R
Oldsquaw	Clangula hyemalis	4	107	A	A
White-winged Scoter	Melanitta fusca	1	5	U	FC
Red-breasted Merganser	Mergus serrator	4	20	C	U
Northern Harrier	Circus cyaneus	4	12	FC	U
Rough-legged Hawk	Buteo lagopus	3	5	FC	U
Golden Eagle	Aquila chrysaetos	1	3	U	U
Gyrfalcon	Falco rusticolus	1	1	U	U
Willow Ptarmigan	Lagopus lagopus	4	40	C	A
Rock Ptarmigan	Lagopus mutus	4	9	FC	FC
Sandhill Crane	Grus canadensis	1	6	U	U
Lesser Golden-Plover	Pluvialis dominica	3	59	A	A
Semipalmated Plover	Charadrius semiplamatus	1	4	U	R
Whimbrel	Numenius phaeopus	3	44	C	U
Lesser Yellowlegs	Trainga flavipes	1	10	U	R
Stilt Sandpiper	Calidris himantopus	3	28	C	U
Long-billed Dowitcher	Limnodromus scolopaceus	2	5	FC	U
Pectoral Sandpiper	Calidris melanotos	3	19	FC	C
Least Sandpiper	Calidris minutilla	2	3	U	U
Semipalmated Sandpiper	Calidris pusilla	3	48	C	A
Red-necked Phalarope	Phalaropus lobatus	4	189	A	A
Common Snipe	Gallinago gallinago	4	17	FC	FC
Parasitic Jaeger	Stercorarius parasiticus	4	24	C	C
Pomerine Jaeger	Stercorarius pomarinus	1	1	U	C
Long-tailed Jaeger	Stercorarius longicaudus	4	22	C	C
Glaucous Gull	Larus hyperboreus	4	34	C	C
Arctic Tern	Sterna paradisaea	4	97	A	A
Short-eared Owl	Asio flammeus	4	7	FC	U
Bank Swallow	Riparia riparia	1	6	U	R

Table 11. Continued.

Common name	Scientific name	No. of sites[1] where species occurred (maximum=4)	Total bird count[1]	Abundance: King Point[11]	Abundance: Yukon North Slope[111]
Common Raven	Corvus corax	4	14	FC	FC
Grey-cheeked Thrush	Catharus minima	1	2	U	U
Yellow Wagtail	Motacilla flava	2	3	U	U
Northern Shrike	Lanius excubitor	1	1	U	VR
Yellow Warbler	Dendroica petechia	2	17	FC	U
Northern Waterthrush	Seiurus noveboracensis	1	1	U	–
Rusty Blackbird	Euphagus carolinus	1	2	U	VR
Hoary/Common Redpoll	Carduelis sp.	4	125	A	A
Savannah Sparrow	Passerculus sandwichensis	4	314	A	C
American Tree Sparrow	Spizella arborea	4	72	A	A
White-crowned Sparrow	Zonotrichia leucophrys	3	18	FC	U
Fox Sparrow	Passerella iliaca	3	15	FC	U
Lapland Longspur	Calcarius lapponicus	4	436	A	A
Snow Bunting	Plectrophenax nivalis	1	1	U	FC

[1] Based on both "on" and "off transect" data.
[11] Based on this study - ground surveys, 11-26 June 1981.
[111] Based on Salter et al. (1980) summary of bird studies conducted along the Yukon North Slope in the early to mid 1970's.

Key to abundance categories (definitions are similar to those used by Salter et al. (1980) to facilitate comparison).

A - abundant - occurred in large numbers throughout the study area (found at all four sites and at least 50 birds recorded).

C - common - occurred in moderate numbers throughout the study area (found at three or four sites and at least 20 birds recorded).

FC - fairly common - found in low numbers, but fairly widely distributed (found at 2 or more of the four sites and 5 to 19 birds recorded).

U - uncommon - found in low numbers with a restricted distribution (found at only one site or less than 5 birds recorded).

Salter et al. (1980) used two additional categories which we did not use because our study was based on only 20 days of field work in a single year.

R - rare - found in two or more years, but only a few records each year.

VR - very rare - less than five records during study.

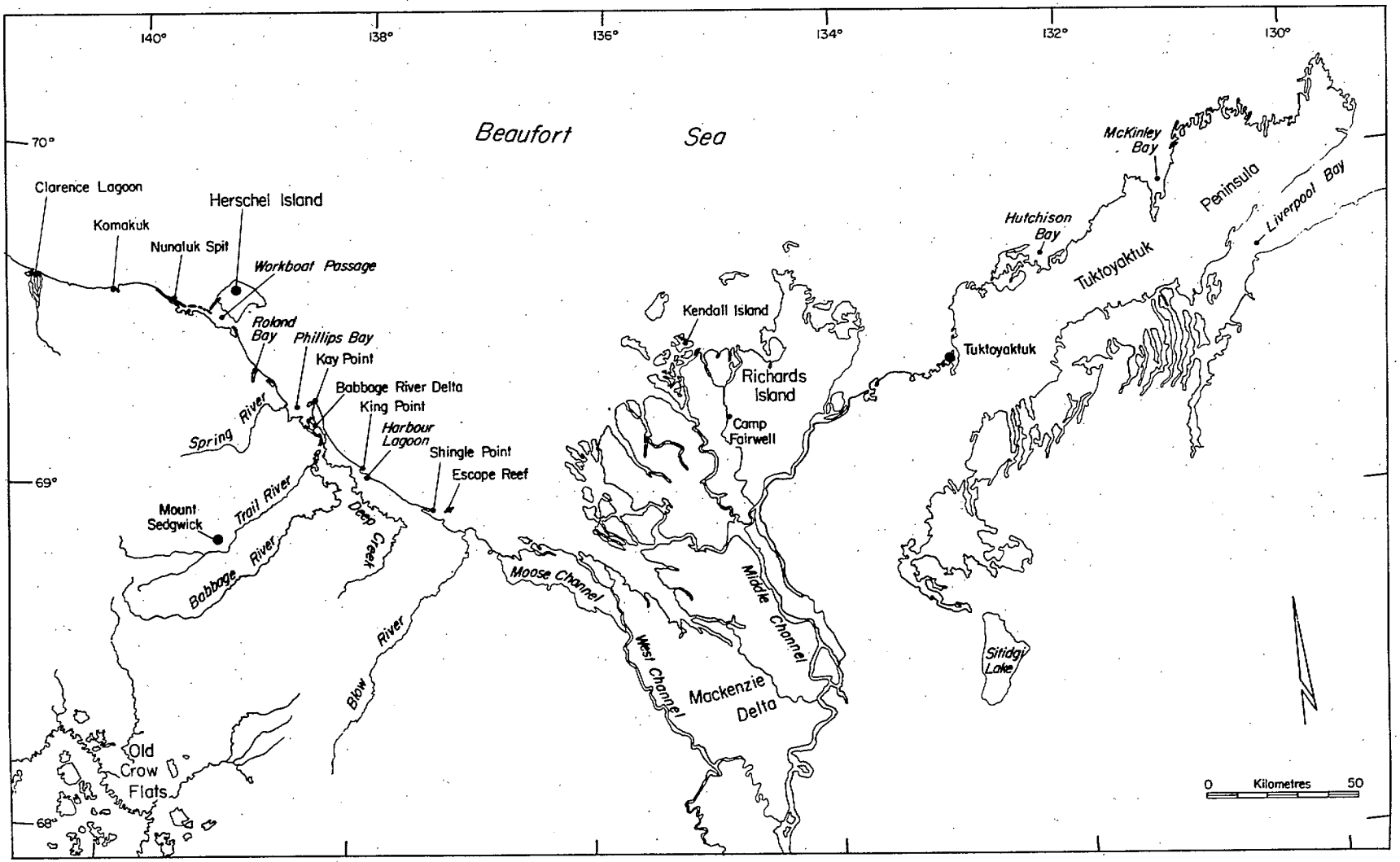

Figure 6. Location of places on the Tuktoyaktuk Peninsula, Mackenzie Delta and Northern Yukon referred to in the text.

Johnson 1981). Nevertheless, these westward moving species are all found in much higher densities on the Mackenzie Delta than on the Yukon Coastal Plain during spring migration (Wiseley et al. 1977). According to radar observations near Komakuk, Y.T. and Oliktok, AK, large numbers of shorebirds also move westward, but do not seem to use shoreline habitats along the Beaufort Sea in the spring (Richardson and Johnson 1981). By mid-June, spring migration in the Beaufort Sea region is generally complete (Barry 1976; Bergman et al. 1977; Richardson and Johnson 1981).

The discussion of nesting, moulting and fall migration which follows is presented by species group.

6.1 Loons

Both the Red-throated Loon and Arctic Loon breed in moderate numbers throughout the Mackenzie Delta, and north coastal plains of Yukon and Alaska, the Arctic Loon being the more common of the two species (Derksen et al. 1981; Salter et al. 1980; Campbell and Weber 1973; Slaney and Co. Ltd. 1974; Wiseley et al. 1977). Densities of loons at King Point in 1981 were similar to those reported in adjacent areas. An average of 2.0 loons/km^2 were recorded at the three ground survey sites near the coast at King Point, compared to 0.9 to 2.8 loons/km^2 reported on the Alaska Coastal Plain (Derksen et al. 1981). The density of loons during aerial surveys near King Point ranged from 0.0 to 0.3 loons/km^2, compared to aerial survey results on the Mackenzie Delta of 0.2 loons/km^2 in 1975 (Wiseley et al. 1977) to 0.3 loons/km^2 in 1973 (Slaney and Co. Ltd. 1974).

During the ground surveys at King Point, all of the Red-throated Loons seen were on ponds, whereas the Arctic Loons tended to use the lakes. This difference in habitat preferences has been noted by Barry (1976) in the Beaufort Sea region, and has been well documented in northern Alaska (Bergman and Derksen 1977) and in the Hudson Bay lowlands (Davis 1972). Arctic Loons usually obtain food (fish and invertebrates) from the lake where they are nesting, whereas the Red-throated Loon usually nests on ponds that freeze to the bottom in winter, hence, contain no fish. As a result, the Red-throated Loon must feed in nearby marine waters or lakes and rivers that do have fish (Davis 1972; Barry 1976). The count of 60 Red-throated Loons reported by Vermeer and Anweiler (1975) just offshore along the Yukon coast in 1973, illustrates the importance of the marine nearshore area to this species. Davis (1972) also noted that the Red-throated Loons that nested nearest the coast had the highest productivity.

One Yellow-billed Loon was sighted near King Point on 20 June in 1981. Small numbers of this species are known to migrate along the Yukon coast in the spring and are seen occasionally in the summer in coastal marine or fresh water (Salter et al. 1980). Similarly on both the Alaska Coastal Plain and the Mackenzie Delta, the Yellow-billed Loon is an accidental visitor (Derksen et al. 1981; Campbell and Weber 1973).

6.2 Tundra Swans

Swans nest in low densities throughout the Yukon Coastal Plain, but appear more abundant in the vicinity of the Babbage River delta

(Schweinsburg 1974; Barry 1976). During the aerial survey conducted on 19 June, nearly half of all sightings of nesting swans in the study area were on the Babbage River delta or just upstream. The densities of 0.2 to 0.3 swans/km^2 elsewhere along the coastal plain near King Point were similar to those reported by Derksen et al. (1981) on the Alaska Coastal Plain; however, results of studies by Slaney and Co. Ltd. (1974), Mossop (1974), Campbell and Weber (1973) and Barry (pers. comm.) indicate that the outer Mackenzie Delta supports much higher densities of nesting swans.

The small flocks of moulting nonbreeding or failed-breeding swans that we recorded on the Babbage River delta in both June and July have been noted in several previous studies (Schweinsburg 1974; Mossop 1974; Vermeer and Anweiler 1975). Swan numbers peak at Phillips Bay (over 100 birds) in late August just prior to fall migration (Mossop 1974; Mossop 1975; Koski 1977b; Vermeer and Anweiler 1975). Phillips Bay has the largest concentration of moulting swans on the Yukon Coastal Plain, however, the outer Mackenzie Delta supports several thousand throughout the summer and early fall (Campbell and Weber 1973; Koski 1977a; Koski 1977b; Barry pers. comm.).

Swans showed preference for large freshwater lakes, as reported in previous studies (Searing et al. 1975; Sharp et al. 1974; Barry 1976; Derksen et al. 1981). Derksen et al. (1981) noted that most of the lakes that were occupied by swans in June and July had the emergent vegetation, Arctophyla fulva growing nearshore and suggested that this was a prime source of food for the swans. Swans with young tend to move to larger lakes and rivers in August or September, presumably to avoid early freeze-up while the young are still flightless (Barry pers. comm.).

6.3 Geese

Nesting

Previous studies have reported low numbers of Canada Geese along the Yukon Coastal Plain throughout spring migration and the nesting season (Salter et al. 1980). This is in accordance with our observation of 14 Canada Geese (including three pairs) in June, as well as a brood seen on 24 July. Similarly, on the Alaska Coastal Plain, the status of the Canada Goose varies from an uncommon breeder to a regular nonbreeding visitor (Derksen et al. 1981).

The Greater White-fronted Goose occurred in low numbers at King Point during the nesting season, although no nests or young were located. Salter et al. (1980) likewise found no evidence of nesting on the Yukon Coastal Plain during the 1970's; however in 1982, 23 adults and 30 young were seen in midsummer on the Babbage River delta (Hogg et al. in prep.). On the Alaska Coastal Plain, the Greater White-fronted Goose is a common breeder (Derksen et al. 1981).

Although we found no evidence of Brant nesting in June, the small number seen at Phillips Bay and at Escape Reef in July indicate that they may nest in those two localities in some years. Salter et al. (1980) reported that Brant were uncommon nesters along the Yukon Coastal Plain. On the Alaska Coastal Plain they are uncommon to common breeders (Derksen et al. 1981), and on the outer Mackenzie Delta there are several small colonies (Barry 1976; Dickson et al. 1983).

Moulting and Fall Staging

Very few dark geese were sighted during the aerial survey on 3 September, nevertheless, the Phillips Bay area has been identified as

important for Brant during their westward migration in the fall (Mossop 1975; Koski 1977b; Barry et al. 1981). For example, Barry et al. (1981) estimated that 12 000 Brant were staging on the west side of Phillips Bay during an aerial survey in mid-September, 1980. During fall migration in the Beaufort Sea region, Brant tend to stage in an area for only a few hours (Barry pers. comm.) which may explain why the number of Brant observed at Phillips Bay in the fall has varied so much from one survey to the next. Nevertheless, Brant are restricted to very specific habitat for staging: the vegetated tidal flats that occur at river deltas, lagoons and bays (Vermeer and Anweiler 1975; Koski 1977b; Mossop 1974). Thus, although Brant may not stop over for very long, Phillips Bay should be considered a key area for Brant during fall migration. Peak numbers tend to occur in late August and early September (Koski 1977a; Barry et al. 1981).

In fall, the Greater White-fronted Goose migrates eastward from Alaska to a major staging area on the Mackenzie Delta (Koski 1977b). In some years, however, large concentrations also stage along the Yukon Coastal Plain. For example, in 1976 Koski (1977b) estimated that 18 000 birds occurred along the Yukon coast, primarily at Shingle Point and Blow River, and to a lesser extent at Phillips Bay. In comparison, very few Canada Geese have been seen on the Yukon Coastal Plain during fall migration (Mossop 1974; Koski 1977b).

During our survey for Lesser Snow Geese on 3 September, approximately 10% of the western arctic population estimated at 430 000 birds (Barry 1981; Spindler 1981) were staging at the King Point study area.

Concentrations were found within 14 km of the coast with the highest densities in the Deep Creek valley. In most years, however, the nearby Babbage River has been favoured over King Point as a major staging area for Lesser Snow Geese (Koski 1977b; Barry and Barry 1984). Since the concentration areas for staging Lesser Snow Geese vary from one year to the next, any area of the Yukon Coastal Plain may serve as a concentration area at some point over the years (Barry pers. comm.).

Due to inclement weather, the King Point area was not surveyed again for Lesser Snow Geese in 1981; however, the geese likely left the area between 16 and 18 September due to a storm with strong westerly winds, snow and fog (Spindler 1981). The length of time the Lesser Snow Geese stage on the Yukon Coastal Plain varies from one year to the next. According to Barry and Barry (1984), the average length of stay between 1973 and 1983 was 18 days. The snow geese generally arrive in late August and remain on the coastal plain until the first heavy snowstorm drives them out.

During our aerial survey on 3 September, 1981, 26% of the snow geese were juveniles, compared to Spindler's (1981) estimate of young in September that year which varied from 40% south of Liverpool Bay, N.W.T. to 7% at Komakuk Beach, Yukon. Barry (pers. comm.) speculated that the geese seen at King Point during this study were from the Anderson River Delta and Kendall Island nesting colonies, as well as nonbreeders from the Banks Island colonies.

6.4 Ducks

Nesting

Densities of nesting ducks in the King Point study area were similar to densities reported elsewhere on the Yukon Coastal Plain (Salter et al. 1980), the Alaska Coastal Plain (Derksen et al. 1981) and Mackenzie Delta (Slaney and Co. Ltd. 1974; Schweinsburg 1974; Wiseley et al. 1977). Densities during ground surveys on the Alaska Coastal Plain ranged from 8.9 to 19.2 ducks/km^2 in 1977 and 1978 (Derksen et al. 1981) compared to a range of 10.2 to 26.5 ducks/km^2 in this study. On the Mackenzie Delta, Schweinsburg (1974) recorded 24 ducks/km^2 on the outer delta and as few as 4 ducks/km^2 in the forested part of the delta. Aerial surveys on the Alaska Coastal Plain reported 2.8 ducks/km^2 (Derksen et al. 1981), compared to 0.4 to 5.6/km^2 which we found at King Point and 4.6/km^2 on the outer Mackenzie Delta (Wiseley et al. 1977).

The most common nesting duck at King Point in 1981 was the Oldsquaw which is also the most abundant breeding duck throughout both the Yukon and Alaska coastal plains (Table 12) (Salter et al. 1980; Derksen et al. 1981). The Oldsquaw also nests on the outer Mackenzie Delta, but is less common there than the scaup sp., wigeon, pintail, Mallard, and scoter sp. (U.S. Fish and Wildlife surveys 1975-1984).

The second most abundant breeding duck at King Point was the Northern Pintail which Salter et al. (1980) rated as fairly common on the Yukon Coastal Plain (Table 12). On the outer treeless portion of the Mackenzie Delta, the Northern Pintail is the most abundant duck (U.S.

Fish and Wildlife survey 1948-1954 in Martell et al. 1984), although on the entire Mackenzie Delta it ranks third (U.S. Fish and Wildlife survey 1975-1984). On the Alaska Coastal Plain, the Northern Pintail is the most abundant duck, but Derksen et al. (1981) noted that a high percentage of these ducks were males and suggested that many are nonbreeders. During the ground surveys at King Point in June, the ratio of males to females was about 3:1; however, there was only one flock of more than four birds which suggests that most of the Northern Pintails in the King Point area were breeding birds.

Scaup sp., which was the third most common breeding duck at King Point, nests only near the foothills on the Alaska Coastal Plain (Derksen et al. 1981), but is a common breeder all along the Yukon Coastal Plain (Table 11) (Salter et al. 1980). It is also the most abundant breeding duck on the Mackenzie Delta (U.S. Fish and Wildlife surveys 1975-1984).

In summary, the King Point area does not appear to be regionally unique for nesting ducks. The overall duck density and most common species found at King Point are similar to those found throughout the region including the Mackenzie Delta and the Alaska Coastal Plain.

Derksen et al. (1981) noted that the arctic coastal plain in Alaska supports relatively low breeding densities of water birds in comparison to wetland areas elsewhere in Alaska such as the Yukon River flats. Similarly, in the Yukon, the Old Crow Flats north of the Porcupine River are more productive for waterfowl than the coastal plain. For example, aerial surveys by Barry (1961) showed a waterfowl breeding density of 33.6 birds/km^2 on the Old Crow Flats (99% of these birds were ducks).

The Old Crow Flats supports particularly high numbers of Lesser Scaup, but also numerous Oldsquaw, scoter sp., Northern Pintail and American Wigeon (U.S. Fish and Wildlife surveys 1975-1984; Mossop 1974; Barry 1961).

Moulting

The influx of ducks to moult along the Yukon Coastal Plain, both on the freshwater lakes and offshore along the coast, has been recorded by several previous studies (Schweinsburg 1974; Wiseley et al. 1977; Johnson and Richardson 1981; Johnson and Richardson 1982; Barry et al. 1981; Barry and Barry 1982). The moulting ducks are primarily males and generally arrive on their moulting grounds along the Beaufort Sea coastline in the first 20 days of July (Cornish and Allen 1983; Barry and Barry 1982; Richardson and Johnson 1981). During this study, the most common species of moulting ducks encountered in the marine areas were the Oldsquaw and Surf Scoter which apparently are the most abundant moulting species all along the Yukon coast (Vermeer and Anweiler 1975; Mossop 1975; Barry and Barry 1982). The preference shown by divers for deep open lakes, as well as coastal marine waters concurs with previous studies (Bergman et al. 1977; Barry 1976; Derksen et al. 1981; Sharp et al. 1974). The high density of dabblers along Deep Creek had not been noted before. High numbers may have occurred partly due to the low water levels that prevailed on the Prairies in 1981. In years of drought on the Prairies, ducks are forced to bypass their prairie breeding grounds and spend the summer in the Arctic (Derksen and Eldridge 1980).

The density of moulting ducks encountered in the King Point study area both inland and offshore in 1981 averaged 9.0 ducks/km^2 which was much higher than densities that have been reported on the outer Mackenzie Delta. Wiseley et al. (1977) recorded 1.5 ducks/km^2 on a transect across the outer Delta, while Barry and Barry (1982) recorded a similar low density of 0.7 ducks/km^2 offshore along the coast of the Delta. On the other hand, there are several areas along the Beaufort Sea coastline where moulting diving ducks concentrate in much higher numbers than at King Point or Phillips Bay (Barry and Barry 1982; Barry et al. 1981; Cornish and Dickson 1984). These areas include Workboat Passage at Herschel Island, and Hutchison Bay and McKinley Bay on the Tuktoyaktuk Peninsula, each of which support over 10 000 moulting ducks, primarily Oldsquaws and scoters (Cornish and Dickson 1984; Mossop 1974; Vermeer and Anweiler 1975). At Workboat Passage, 834.0 moulting ducks/km^2 were recorded in 1980 (Barry et al. 1981) and 145.4/km^2 were recorded in 1981 (Barry and Barry 1982). In comparison, the highest density we recorded in 1981 was 32.5/km^2 which occurred offshore between Shingle Point and Kay Point. At Phillips Bay we encountered only 11.9 ducks/km^2. Thus, although the King Point offshore area supports substantial numbers of moulting diving ducks, particularly Oldsquaws and Surf Scoters, it is not one of the critical areas for moulting diving ducks in the Beaufort Sea region.

Fall staging

The amount of time diving ducks spend along the Yukon coast after the moult varies from one year to the next. Gollop and Davis (1974)

reported that in 1972 the peak movement of Oldsquaws westward past Nunaluk Spit occurred between 30 August and 6 September and the peak eastward movement of scoters was in mid-September. In this study, fewer Oldsquaws and scoters were encountered on 3 September than on 24 July (901 versus 169). On the other hand, Vermeer and Anweiler (1975) noted an influx of Oldsquaw, eider and scaup as late as 21 September in 1973. Like geese, the timing and degree of use of the Yukon coast by fall staging diving ducks is likely dependent on the weather (Barry and Barry 1982). Barry et al. (1981) found large concentrations of ducks along the Yukon coast in the second week of September in 1980, whereas at the same time the following year, there were very few diving ducks. Barry and Barry (1982) speculated that stormy weather along the Yukon coast delayed the westward movement of ducks from the eastern Beaufort Sea that year.

Information about the distribution of diving ducks along the Yukon coast in September is limited to Barry and Barry (1982) who reported 3.2 ducks/km^2 in Workboat Passage and 2.7/km^2 at Phillips Bay on 11 September, compared to our record of 3.3/km^2 in Phillips Bay and 7.8/km^2 between Phillips Bay and Roland Bay on 3 September in the same year.

Dabblers were not seen during the aerial survey on 3 September 1981, which concurs with previous studies that indicate most dabblers have left the Yukon Coastal Plain by early September (Wiseley et al. 1977; Vermeer and Anweiler 1975; Gollop and Davis 1974; Schweinsburg 1974). Gollop and Davis (1974) noted that the peak eastward migration of pintail along the Yukon Coastal Plain in 1972 occurred between 4 and 20 August.

6.5 Raptors

The Yukon North Slope supports a relatively high density of nesting Gyrfalcons (Platt and Tull 1977; Salter et al. 1980; Mossop pers. comm.). Primary nest sites are bluffs and cliffs along the rivers that flow out of the mountains, although knolls and outcrops on the coastal plain provide some nest sites (Platt 1976; Campbell and Davis 1973; Salter et al. 1980; this study). Gyrfalcons are fairly evenly distributed across the North Slope; however, the Trail and Babbage river valleys are considered some of the best nesting habitat (Mossop pers. comm.).

Golden Eagle nests were found throughout the Yukon North Slope during surveys adjacent the proposed pipeline route in the 1970's (Salter et al. 1980). However, densities of nesting Golden Eagles on the Yukon North Slope are not exceptionally high compared to the rest of the Yukon (Mossop pers. comm.). As in this study, the Bald Eagle has been recorded occasionally on the Yukon Coastal Plain, but there has been no evidence of nesting. The Bald Eagle does, however, nest nearby on the Mackenzie Delta and Old Crow Flats (Campbell and Davis 1973; Mossop pers. comm.).

Formerly, the Peregrine Falcon nested on the Yukon North Slope (Fyfe et al. 1975); however, numbers declined and the last nesting pair recorded was in 1980. In 1981, only one sighting of a Peregrine Falcon was reported on the Yukon North Slope other than the single sighting in this study (Mossop pers. comm.). Since then the Yukon Territorial Wildlife Service has started to reintroduce the Peregrine Falcon (tundrius subspecies) onto the North Slope by means of a fostering

project (Mossop pers. comm.). The tundrius subspecies of the Peregrine Falcon still occurs naturally in Alaska (Roseneau et al. 1981), and although it does not nest on the Mackenzie Delta, it does occur in low numbers elsewhere in the Canadian Arctic. Due to its low numbers, the tundrius subspecies of the Peregrine Falcon is considered a "threatened" wildlife species in Canada (Committee on the Status of Endangered Wildlife in Canada).

The three most abundant species of raptors encountered around King Point were the Northern Harrier, Rough-legged Hawk and Short-eared Owl which all occur in low numbers throughout the Yukon Coastal Plain (Salter et al. 1980). Nesting has been recorded for the Rough-legged Hawk and Short-eared Owl, but not for the Northern Harrier which was the most abundant raptor species in our study area. On the Alaska Coastal Plain, the Rough-legged Hawk and Short-eared Owl are uncommon breeders, whereas the Northern Harrier is a visitor with no confirmed nesting (Martin and Moitoret 1981). On the outer Mackenzie Delta, nests of all three species have been located (Barry pers. comm.). The Northern Harrier likely breeds on the Yukon Coastal Plain as well, but no nests have been reported.

6.6 Jaegers

According to previous studies, the Pomarine Jaeger is common during spring migration on the Yukon Coastal Plain, but is rarely seen in summer and fall (Salter et al. 1980; Richardson and Johnson 1981). During this study, we saw only one Pomarine Jaeger which occurred on 20 June. The

eastward migration of the Pomarine Jaeger in late May and the first half of June is in some years followed by a westward migration in mid-June according to Richardson and Johnson (1981). They suggest that the westward migration occurs in years when lemmings, their main food source, are scarce, since they are known to abandon parts of their nesting range soon after arrival if lemming numbers are low. The lack of sightings during the ground surveys in June suggest that this westward migration did not occur in 1981.

The most abundant species of jaeger in the King Point study area during June and July was the Long-tailed Jaeger, which according to Salter et al. (1980) is a common summer resident throughout the Yukon Coastal Plain. We found two nests near King Point in 1981 (Appendix C). The number of Long-tailed Jaegers nesting in an area in a given year is likely dependent on the abundance of lemmings that year (Salter et al. 1980). In Alaska, the Long-tailed Jaeger is common throughout the northern coastal plain during the summer and nests in some areas (Derksen et al. 1981). We saw no Long-tailed Jaegers during the aerial survey on 3 September; similarly Salter et al. (1980) reported that few are seen after the first week of August on the Yukon Coastal Plain.

The Parasitic Jaeger was also common at King Point in 1981. This species is considered a common summer resident and breeds throughout the northern coastal plain in both the Yukon and Alaska, as well as on the Mackenzie Delta (Salter et al. 1980; Derksen et al. 1981; Campbell and Weber 1973).

6.7 Gulls

The Glaucous Gull nesting colonies that we found at Phillips Bay and Escape Reef have been noted by several previous studies (Gollop and Richardson 1974; Barry et al. 1981; Vermeer and Anweiler 1975). The only other colonies that have been recorded along the Yukon Coast are at Nunaluk Spit, the Clarence Lagoon and Moose Channel on the west side of the Mackenzie Delta (Barry et al. 1981; Salter et al. 1980; Barry and Barry in prep.). During this study, Glaucous Gulls were also seen nesting singly on islets in wetlands at King Point. Similarly, Salter et al. (1980) noted a few solitary nesters and considered the Glaucous Gull a common summer resident on the Yukon Coastal Plain, particularly near the coast. On the outer Mackenzie Delta, the Glaucous Gull is widespread, nesting both singly and in small colonies inland on freshwater ponds and on the offshore islands (Campbell 1973). On the other hand, throughout most of the Alaska Coastal Plain the Glaucous Gull is considered an uncommon breeder (Derksen et al. 1981).

During a study of the breeding success of Glaucous Gulls in the Beaufort Sea region, Barry and Barry (in prep.) noted that pairs of gulls nesting in isolation were frequently more successful than the gulls nesting in colonies. Therefore, the pairs nesting singly inland may be an important component for recruitment of young gulls each year.

The Glaucous Gull remains along the Yukon coast later in the fall than many species (Salter et al. 1980). Vermeer and Anweiler (1975), who conducted a series of surveys along the Yukon coast in August and September of 1973, recorded their second highest count of Glaucous Gulls on 21 September.

6.8 Terns

The Arctic Tern which was abundant in the King Point study area is widely distributed and common throughout the Yukon Coastal Plain (Table 12) (Salter et al. 1980; Schweinsburg 1974) and the Mackenzie Delta (Campbell and Weber 1973; Wiseley et al. 1977), although there may be fewer terns west of Herschel Island (Vermeer and Anweiler 1975). Further west on the Alaska Coastal Plain, the Arctic Tern is considered an uncommon breeder (Derksen et al. 1981). On the Yukon Coastal Plain, the Arctic Tern nests both offshore on barrier islands and inland on marshes or by lakes (Salter et al. 1980; this study). Barry (1976) identified both Escape Reef and Phillips Bay as critical areas for nesting Arctic Terns. Although we noted a colony at Escape Reef, there was no colony at Phillips Bay in 1981; however, tern use of an area is known to be erratic in the Beaufort Sea region (Barry et al. 1981).

We found no Arctic Terns in the study area during the aerial survey on 3 September. This concurs with previous studies which report very few terns along the Yukon coast by the end of August (Mossop 1975; Campbell and Weber 1973; Vermeer and Anweiler 1975; Salter et al. 1980; Wiseley et al. 1977). According to Gollop and Davis (1974), the peak fall migration of Arctic Terns occurs in mid-August.

6.9 Shorebirds

The wetlands in the vicinity of King Point may be regionally important to Whimbrels and Stilt Sandpipers. Of the shorebirds occurring in our study area, the Whimbrel and Stilt Sandpiper were the fourth and

fifth most abundant species, whereas throughout the rest of the Yukon Coastal Plain both species are considered uncommon breeders (Table 12) (Salter et al. 1980). To the west on the Alaska Coastal Plain, the Wimbrel is an accidental visitor with no record of breeding, and the Stilt Sandpiper is an uncommon to rare nester (Derkson et al. 1981; Martin and Moitoret 1981). On the Mackenzie Delta, the Stilt Sandpiper is an uncommon nester, although the Whimbrel may occur more frequently (Martell et al. 1984).

The most abundant shorebird species near King Point in 1981 was the Red-necked Phalarope which is also abundant throughout the entire Yukon Coastal Plain (Salter et al. 1980) and the outer Mackenzie Delta (Slaney and Co. Ltd. 1974). On the Alaska Coastal Plain, it is less common than the Red Phalarope and nests only in certain areas (Derksen et al. 1981). The second and third most common species in the study area, the Lesser Golden-Plover and Semipalmated Sandpiper, are both common breeders throughout most of the Yukon and Alaska coastal plains (Salter et al. 1980; Derksen et al. 1981); however, these two species as well as the Pectoral Sandpiper are much less abundant on the Mackenzie Delta (Tull et al. 1979). The Common Snipe which was a relatively abundant breeder near King Point is rarely seen on the Alaska Coastal Plain (Derksen et al. 1981), but considered fairly common elsewhere on the Yukon Coastal Plain (Salter et al. 1980) and is a common breeder below the treeline in the Mackenzie Delta (Martell et al. 1984).

The preference that nesting Lesser Golden-Plovers showed for drier upland habitats at King Point in 1981 has also been noted on the Alaska

Coastal Plain (Connors et al. 1979; Derksen et al. 1981; Martin and Moitoret 1981). The preference that nesting Red-necked Phalaropes and Pectoral Sandpipers showed for wet lowlands with patterned-ground at King Point also concurred with studies on the Alaska Coastal Plain (Martin and Moitoret 1981; Troy and Johnson 1982). A study at the Canning River delta on the Alaska Coastal Plain in 1979 and 1980 concluded that the Semipalmated Sandpiper preferred to nest on patterned-ground either in upland habitat or a mosaic of upland and lowland habitat (Martin and Moitoret 1981). We found the highest densities of nesting Semipalmated Sandpipers in Tussocky Tundra-patterned ground habitat which occurred primarily in lowlands.

According to Connors et al. (1979), in July following nesting the littoral areas such as delta mudflats, spits and beaches become important to certain species of shorebirds including phalaropes, the Semipalmated Sandpiper and Baird's Sandpiper. About 45% of all shorebirds counted during the aerial surveys on 24 July in the King Point study area were at the Babbage River delta which suggests that the river delta is an important staging area for some species of shorebirds.

Most species of shorebirds that nest in the King Point area abandon their young shortly after hatch. Thus, there are usually two waves of migration: the adults in July, and the juveniles in August (Martin and Moitoret 1981). The peak movement of shorebirds past Nunaluk Spit to the west of the study area in 1972 occurred in the first two weeks of August (Gollop and Davis 1974). By the first week in September there are few shorebirds left along the Yukon Coastal Plain (Gollop and Davis 1974; Vermeer and Anweiler 1975).

6.10 Passerines

The most common species of passerines at King Point - the Lapland Longspur, Savannah Sparrow, redpoll spp. and American Tree Sparrow - are common throughout the Yukon Coastal Plain (Salter et al. 1980) and Mackenzie Delta (Patterson et al. 1977). The Lapland Longspur is also a common breeder on the Alaska Coastal Plain, although the other species are less abundant (Derksen et al. 1981).

Generally, the species richness and density of songbirds is greater on the Mackenzie Delta than the Yukon North Slope (Tull et al. 1974; Patterson et al. 1977), due to the more complex habitat (Tull et al. 1974). However, the Yellow Wagtail which is Asiatic in origin, is one species found on the Yukon Coastal Plain which does not occur on the Mackenzie Delta (Tull et al. 1974). It is considered an uncommon breeder near the foothills on the Alaska Coastal Plain (Derksen et al. 1981).

Although the coastal plain around King Point does not appear to support any exceptional passerine populations, the upper Babbage River may be of local importance to several species. Five of the 16 passerine species that were recorded in our study area occurred only at the site on the upper Babbage River. Of these species, the Bank Swallow, Northern Shrike, Rusty Blackbird and Northern Waterthrush are either rare or very rare on the Yukon North Slope (Table 11). Furthermore, most of the previous sightings of these species also occurred along the upper Babbage River (Salter et al. 1980).

6.11 Summary

The following is a summary of the importance of the King Point area to birds.

Beaufort Sea Region

The lowlands adjacent the Beaufort Sea, including the Yukon Coastal Plain, are an exceptionally lush and productive part of the Canadian Arctic. This area is characterized by a nearly complete vegetative cover, and copious wetlands as well as a variety of habitats (river deltas, bays, lagoons) associated with the marine coastline. In comparison, much of the Arctic Islands are almost void of vegetation with only patches of lushly vegetated wetlands. Although densities and species richness adjacent to the Beaufort Sea are low relative to southern latitudes, this region is very important to species restricted to breeding in the Arctic. Furthermore, due to the proximity of the Beaufort Sea, this area is particularly important to those species that are oriented towards marine habitat such as Brant, Red-throated Loon, Oldsquaw, scaup spp., scoters spp., Glaucous Gull, Arctic Tern and several species of shorebirds.

Yukon Coastal Plain

The coastal plain at King Point is part of a relatively homogeneous strip of tundra which extends from the edge of the Mackenzie Delta westward into Alaska. Nesting birds on the coastal plain appear to be relatively evenly distributed. Breeding densities were very similar at the

three sites near the coast in this study, probably because of the recurrence of suitable habitat types along the coastal plain in a regular patchwork manner. Wetlands containing the four most heavily used habitat types (Wet Sedge, Wet Sedge-patterned ground, Shrub and Dwarf Shrub-patterned ground) are relatively evenly dispersed among the drier less productive rolling uplands. Derksen et al. (1981) likewise found that the Alaska Coastal Plain was a homogeneous mosaic of wetland types with a relatively uniform distribution of water-oriented birds.

At King Point, the strip of coastal plain which supports relatively high densities of nesting loons, waterfowl, jaegers, gulls, terns and shorebirds is not very wide. Both the aerial and ground survey results from this study show that densities of those species groups during the nesting season were much higher within 10 km of the coast than further inland. Schweinsburg (1974), likewise found densities of water-oriented birds were higher at sites near the coast than 12 km inland during studies on the Yukon Coastal Plain in 1971. Thus, although the Yukon coastal plain extends from Alaska to the Mackenzie Delta, the portion which supports relatively high densities of nesting water-oriented birds is limited to a narrow strip adjacent to the coast.

The following are key areas of concern within the King Point study area with respect to their importance to various species.

Entire study area - Lesser Snow Geese

The King Point study area is regionally important to Lesser Snow Geese during fall migration at least in some years. In early September

of 1981, about 10% of the entire western population of snow geese staged near King Point with the highest concentrations along the Deep Creek valley. In other years, the nearby Babbage River has served as a major fall staging area for Lesser Snow Geese.

Phillips Bay and Babbage River delta

Phillips Bay, including the Babbage River delta supports high densities of nesting water-oriented birds. During the aerial survey in June, the overall density of birds along the lower Babbage River and shoreline at Phillips Bay was nearly twice the value found elsewhere in the study area. In particular, Glaucous Gulls, Tundra Swans, geese and shorebirds were found in higher densities than elsewhere along the coastal plain. Nesting colonies of Glaucous Gulls occur on both spits in Phillips Bay and in some years Arctic Terns also nest there. In summer, the delta is locally important to moulting Tundra Swans, Northern Pintails, Oldsquaws, and Red-breasted Mergansers, while offshore in Phillips Bay moulting scoters are common. During both spring and fall migration, the Babbage River delta and nearby Spring River delta are regionally important to staging Brant. Greater White-fronted Geese stage on the delta as well in the fall in some years. The mudflats of the Babbage River delta are used as feeding grounds by migrant flocks of shorebirds throughout the summer.

Babbage and Trail river valleys - raptors

The Babbage and Trail river valleys of the Yukon North Slope provide prime habitat for cliff-nesting birds. In particular, these two

valleys are considered some of the best nesting habitat in the region for Gyrfalcons.

Babbage River valley - passerines

The upper Babbage River valley is locally important to several passerine species that are rare elsewhere along the Yukon North Slope. During this study, the Bank Swallow, Northern Shrike, Rusty Blackbird, Grey-cheeked Thrush and Northern Waterthrush were sighted only on the upper Babbage River site. Furthermore, most sightings of the Yellow Wagtail along the Yukon North Slope have occurred in the Babbage River valley. This species, which is Asiatic in origin, does not occur east of Yukon Territory.

Deep Creek - dabblers

Deep Creek supported high densities of moulting and brood rearing dabblers in 1981. This may not have been a typical year due to low water levels that occurred on the Prairies which may have forced ducks to bypass their prairie breeding grounds and spend the summer in the Arctic. Nevertheless, Deep Creek is likely one of the preferred habitats for breeding and moulting dabblers.

King Point lagoon - moulting and staging Oldsquaw

Lagoons and other sheltered areas along the Yukon coast provide moulting and staging habitat for thousands of Oldsquaws and scoters. The King Point lagoon may be locally important as a moulting area for Oldsquaws that are breeding nearby.

Wetlands in the vicinity of King Point - Whimbrel and Stilt Sandpiper

The wetlands in the vicinity of King Point may be regionally important to the Whimbrel and the Stilt Sandpiper; both species were fairly abundant in our study area, but are considered uncommon along the rest of the Yukon Coastal Plain, the Alaska Coastal Plain, and on the Mackenzie Delta. To verify this observation, further studies are needed, particularly on the outer Mackenzie Delta where there is very little information on the distribution of shorebirds.

7.0 POTENTIAL IMPACT OF DEVELOPMENT AT KING POINT

7.1 Effects of development

The following is a brief discussion of the potential impact of the year round, deep water port which may eventually be developed at King Point. First, a summary is given of the available information which deals with the impact of development on birds in the Arctic. Then, the impacts of greatest concern at King Point are evaluated, based on our knowledge of the birds that inhabit that region. For simplicity, the effect of development on birds has been divided into three categories: loss or degradation of habitat, disturbance, and direct mortality.

Loss or degradation of habitat

For loss of habitat to have an effect on a population of birds, habitat must be a limiting resource, otherwise the displaced birds would only have to shift to nearby similar unused habitat. Two studies in northern Alaska indicate that habitat is a limiting resource for tundra

birds. Both Holmes (1970), and Seastedt and MacLean (1979) found that when male birds were removed from their breeding territory, another bird of the same species moved into the territory immediately. This indicated that for at least some species there was insufficient habitat to support all potential breeders, thus nesting habitat was a limiting resource. The results of these studies likely also apply to the nearby Yukon Coastal Plain, since the habitat and bird populations are similar to those of northern Alaska.

How severely the loss of habitat affects birds is dependent on both the amount lost and its value to the birds. Most bird species on the Yukon Coastal Plain including loons, waterfowl, gulls, terns and many shorebirds occur on the wetlands, lakes, and ponds found in the lowland areas. Most passerine species, likewise, prefer the lowlands, particularly river and creek valleys where Shrub and Dwarf Shrub habitat prevail. On the other hand, much of the uplands have Tussocky Tundra habitat which supports the lowest bird densities and species richness of all habitat types. Thus, the loss of a lowland area will likely have a greater effect on more species of birds than the loss of an upland.

Linear facilities such as pipelines and roads can potentially affect an extensive amount of habitat by interrupting the natural drainage pattern. When this happens, ponds form upstream of the pipeline or road, while wetlands downstream dry up. This tends to occur particularly in wetland areas where there is sheet flow (Pamplin 1979). Culverts can alleviate this problem, but if too much water is directed through one culvert, hydraulic and thermal erosion will occur (Pamplin 1979). On the

Alaska Coastal Plain, Troy and Johnson (1982) found that bird densities on the impounded side of a road were lower than on the dry side of the road. They reported half as many nests on the impounded side, but suggested further studies to see if the impoundments became foraging areas for some bird species over time.

Dust from sources such as roads and airstrips may lower breeding densities of birds nearby. At Prudhoe Bay, Alaska, Connors and Risebrough (1979) found that the nesting densities of several species of shorebirds were lower adjacent to a road where dust deposition was heavy. They attributed the density reduction to dusting, although disturbance was also a factor. Troy and Johnson (1982) hypothesized that dust indirectly affected bird densities as follows: the dust changed the plant community by eliminating certain species of lichens, mosses and herbaceous plants; the dust altered the invertebrate community including the dipteran species that were a major food source for several species of shorebirds; the dust caused early snow melt which in turn may have caused early emergence of dipterans and upset the synchrony of chick hatch and available adult dipterans. According to Troy and Johnson (1982), most dust fall-out occurred within 150 m of the road.

Another form of habitat degradation that may affect birds is oil pollution. Fuel spills were a common occurrence during development of the Prudhoe Bay oil field (Pamplin 1983). Broken feeder lines, spills while refueling and improper handling of waste oil drums were a few of the activities which contributed to the spills. Several studies were conducted at Prudhoe Bay to determine the effects of oil spills on fresh

water invertebrates, wetland plant communities, and salt water invertebrates (Mozley and Butler 1978; Walker et al. 1978; Busdoch and Atlas 1977; Abraham 1975). Abraham (1975) examined the immediate effects of crude oil contamination of tundra ponds on aquatic macro-invertebrates and on bird activity in certain wetlands. Frequency of visits of all birds decreased significantly on oiled ponds immediately following treatment. However, use of the treated ponds returned to normal the subsequent year. Similarly, Walker et al. (1978) noted that on a very wet plot with standing water, the vegetation showed total recovery one year following a crude oil spill. Although sedges and willows recovered very rapidly, mosses, lichens and most dicotyledons showed little or no recovery in a year. A study of the effects of crude oil on the aquatic insects which inhabit tundra ponds showed that certain species (Nemoura and Asynarchus) did not recover seven years after the spill, but the abundance of the other aquatic insects, as well as total biomass, did recover (Mozley and Butler 1978).

Garbage disposal sites are another form of habitat alteration which can become a problem. If garbage is improperly handled, it will attract and maintain larger numbers of scavenging birds, particularly the Common Raven and Glaucous Gull, than the area would normally support (LGL Limited 1982; Jehl and Smith 1970). During the breeding season, nest sites that were previously occupied by other species may be taken over by the bulging population of scavenging species. For example, the Glaucous Gull which tends to nest on islets in ponds may displace species such as the Arctic Tern, Red-throated Loon and Brant which also favour islets in

ponds. Similarly, the Common Raven may compete with cliff-nesting raptors such as the Gyrfalcon and Rough-legged Hawk for nest sites (LGL Limited 1982).

Tundra habitats, particularly wetlands, are both easy to damage and slow to recover. For example, seismic lines created in the mid 1960's are still easy to distinguish because the vegetation which grows on them consists of species which colonize a disturbed site. Thus, valuable bird habitat along the Yukon Coastal Plain would be susceptable to damage caused by tourist and recreational activity such as travel by All Terrain Vehicle, heavy foot traffic and camping. Similarly, fishermen could deplete the food source of fish-eating birds such as the Arctic Tern, Arctic Loon and Red-breasted Merganser.

Disturbance

Disturbance related to development can have an even greater impact on birds than direct habitat loss, because it generally affects a much larger area. Types of disturbance include:

- noise from aircraft, vehicular and boat traffic;
- noise from other activities such as rock crushing and blasting;
- noise from facilities such as pumping stations;
- human activity around camps, staging areas and docks; and
- recreational activity of personnel working on the project and of tourists and local residents using the access road.

The degree of impact that disturbance has on birds is often difficult to predict because the reaction of birds to disturbance varies markedly with

the species and the time of year. Gollop et al. (1974a), for example, found that incubating Common Eiders at Nunaluk Spit, Yukon did not flush from their nests when repeatedly harassed by either a small fixed-wing aircraft or a helicopter flying at altitudes ranging from 40 to 300 m. On the other hand, fall staging Lesser Snow Geese have flushed in response to an aircraft flying as high as 3000 m or as far away as 14 km (Salter and Davis 1974). Because the reaction of birds to disturbance is so variable, past studies which have investigated the effect of a particular noise or activity often cannot be applied to a new development proposal. Furthermore, most of the past disturbance studies have been inconclusive due to either insufficient sample sizes or uncontrollable variables. Nevertheless, the following is a brief summary of the results of relevant studies which have examined the effect of various types of disturbance on birds in tundra habitat.

Several studies indicate that when Lesser Snow Geese are staging on the Yukon Coastal Plain during fall migration, they are highly sensitive to aircraft overflights (Schweinsburg 1974; Davis and Wiseley 1974; Salter and Davis 1974). Davis and Wisely (1974) observed that repeated overflights significantly reduced the feeding time for staging Lesser Snow Geese. Patterson (1974) investigated the amount of energy reserves accummulated by the Lesser Snow Geese while staging on the Yukon North Slope, and found that in 1973 juvenile geese more than doubled their fat deposits. Several authors expressed concern that frequent disturbance would significantly reduce feeding time for the geese, and force them to depart their staging grounds with low fat reserves, thus lessening their

chance of surviving migration (Davis and Wiseley 1974; Patterson 1974; Salter and Davis 1974; LGL Limited 1982; Barry pers. comm.).

Simpson et al. (1984) studied the effect of aircraft overflights on Brant moulting on the Alaska Coastal Plain. They found that Brant reacted to 41 of 60 aircraft overflights, that the average response time was 4.4 min. and that the response consisted of the geese exhibiting alert postures, running or entering the lake. They concluded that, if the frequency of disturbance was high enough, the extra energy costs for escape behavior might retard growth of flight feathers.

Ward and Sharp (1974) found that overflights with a small helicopter at 300 m agl had no effect on moulting flocks of Oldsquaws and Surf Scoters at Herschel Island, Yukon. At 100 m agl there was an immediate response, but they could not detect any lasting effect. Gollop et al. (1974a) found that a small helicopter, when flown at 600 m agl, had no apparent effect on a colony of incubating Glaucous Gulls at Nunaluk Spit, Yukon, but caused the gulls to flush when flown at 150 m agl or below. Although not reported quantitatively, during a bird study on the outer Mackenzie Delta, Barry and Spencer (1976) observed that helicopter overflights caused increased predation by gulls and jaegers on the eggs and young of geese and other birds.

Several other studies illustrate how birds react to other types of noise and activity. Wiseley (1974) investigated how Lesser Snow Geese would react to a gas compressor sound simulator while staging during fall migration on the Yukon Coastal Plain, and found that the geese would not feed closer than 800 m. Barry and Spencer (1976) studied the effect of

oil drilling on nesting, moulting and brood rearing birds, and found that 43% of the bird species in the area were less numerous within 2.5 km of the drill rig. Swans and geese were most affected; none of them moulted or raised their young within 2.5 km of the rig. In addition, MacInnes and Mesra (1972) noted that the mere presence of people near nesting geese caused increased predation and nest abandonment. Stirling and Dzubin (1967) reported that goose banding and boating activity caused moulting Canada Geese to abandon their traditional moulting site on the Thelon River, N.W.T., and that the geese did not return the following year. When Lapland Longspurs on the Yukon Coastal Plain were subjected to both human (6 to 20 man camp) and aircraft disturbance (Jet Ranger helicopter flying at 15 m agl), the densities remained the same, but reproductive success was reduced (Gollop et al. 1974b). At Churchill, Manitoba, Jehn and Smith (1970) reported a decline in the densities of Lesser Golden-Plovers, Semipalmated Sandpipers and Lapland Longspurs near the townsite and roads, whereas there was no decline away from the disturbed areas. Van der Zande et al. (1980) also reported lower shorebird densities around buildings.

There is very little information available on the impact of road traffic on birds in the Arctic; however, the preliminary results of a study by Connors and Risebrough (1979) indicated that disturbance from vehicular traffic contributed to lower bird densities and productivity adjacent a road on the tundra in northern Alaska. Van der Zande et al. (1980) found up to 60% loss of breeding bird populations within 500 to

600 m of a quiet rural road in the Netherlands. Although this study was not conducted in arctic habitat, it shows that road traffic can affect bird populations.

A source of disturbance indirectly related to development of a port at King Point will be the influx of tourists and recreationalists on the access road to King Point. The resultant noise and activity can affect the productivity of nesting birds or completely displace them from traditional nesting areas. The impact will be worst in the spring, when the birds first establish a nesting territory and lay eggs, since that is when birds are most prone to nest abandonment (Fyfe and Olendorff 1976; Buckley and Buckley 1976; Olson and Marshall 1952). However, disturbance at any time during incubation or shortly after hatch may also result in mortality of the offspring, for when left unattended, eggs or newly hatched young are vulnerable to chill, heat prostration or predation (Fyfe and Olendorff 1976).

All of the above studies suggest that due to the noise and activity associated with development, the impact on birds extends well beyond the physical boundaries of the development itself.

Direct mortality

The road proposed to link King Point to the Dempster Highway will enable both sport and subsistance hunters to reach areas previously difficult to access. The resultant increased hunting pressure can have a major impact on birds, particularly fall staging geese which would not only be the prime species group harvested, but would also be the most sensitive of all bird species to disturbance at that time of year.

To date, the falcons which nest in the foothills adjacent the Yukon Coastal Plain have been relatively protected due to their isolated location. The proposed road to King Point and inland to a rock quarry will make it easier for poachers to capture falcons for illegal sale.

Another aspect of the proposed development which could cause direct mortality of birds is oil spills. As mentioned, fuel spills were a common occurrence during construction of the Alaska pipeline (Pamplin 1979). Likewise in the Canadian Beaufort, there have been several small spills each year in connection with oil and gas exploration (spill reports filed with the Environmental Protection Service in Yellowknife). For example, in May of 1981, approximately 773 000 l (170 000 gal) of oil drained from storage tanks at Camp Fairwell on the Mackenzie Delta. Three months later at Tuktoyaktuk, an overloaded fuel barge sank and 20 450 l (4500 gal) of oil leaked into the harbour.

The sensitivity of birds to oil pollution is well known, for there have been numerous experimental studies and several past major oil spills such as the Amoco Cadiz which have been extensively documented. When birds contact oil, their feathers mat, so that the insulating and waterproofing properties of the feathers are broken down. The resultant loss of heat and bouyancy leads to depletion of energy reserves and eventual death (Brown 1982; Holmes and Cronshaw 1977). Oil can also be lethal to birds if it is ingested, either through preening oiled feathers or consuming oil-contaminated food (Brown 1982; Holmes and Cronshaw 1977; Custer and Albers 1980; Lawler et al. 1978). In the Arctic, due to the added stress of severe environmental conditions, contact with extremely

minute amounts of oil could be lethal to birds (Holmes and Cronshaw 1977; Levy 1980). Numerous studies have demonstrated that very small amounts of oil can also affect the productivity of birds by delaying egg laying, lowering the laying rate and hatchability of eggs, or retarding growth of the young (Miller et al. 1978; Coon et al. 1979; Szaro 1979; Hartung 1965; Peakall et al. 1982). For example, as little as 5 ul of Bunker C fuel oil will significantly reduce the hatchability of Mallard eggs (Szaro 1979). Thus, even a minor oil spill could have a significant effect on local bird populations.

Lighted towers occasionally cause large die-offs of birds due to collisions (Weir 1976; Avery et al. 1976). For example, 10 000 migrating birds were killed at the twin stacks of Ontario Hydro's Lennex generating station near Kingston, Ontario one weekend in September of 1981 (Curtis 1981). The probability of birds hitting a tower increases under certain conditions: if the tower is relatively high, has a non-flashing light and is located along a migration route; if it is dark; and if there is fog or low cloud (Weir 1976; Avery et al. 1976). Considering fog and low clouds are common at King Point in the fall, darkness occurs at that time of year, and several bird species such as the Lapland Longspur and the Red-necked Phalarope migrate along the coastline in the fall, bird collisions with lighted towers could occur.

7.2 Summary of the Potential Impacts of Greatest Concern at King Point

The potential conflicts between birds and development at King Point which are of greatest concern are as follows.

1) Disturbance of fall staging Lesser Snow Geese.

The Lesser Snow Goose is likely the most vulnerable bird species to development of a port at King Point. The Yukon North Slope, including the King Point area, is a major staging area for these geese prior to fall migration (Barry and Barry 1984; Koski 1975; Koski 1977a; Koski 1977b). During this study, for example, on 3 September 1981 an estimated 42 300 Lesser Snow Geese were staging in the vicinity of King Point. Although the degree of use varies from one year to the next depending on the weather, in some years over three quarters of the entire western Arctic Lesser Snow Goose population of 200 000 to 500 000 birds stages on the Yukon Coastal Plain during fall migration (Barry and Barry 1984). The geese generally arrive on the staging grounds at the end of August, and feed on berries, grasses and sedges to accummulate the fat reserves necessary for migration. They remain there until the first major snow storm which drives them out (Patterson 1974; Gollop and Davis 1974; Barry 1976). Thus, the Yukon Coastal Plain, including the King Point area, is a vital link in the survival of the western population of the Lesser Snow Goose.

During fall staging the Lesser Snow Goose is highly sensitive to disturbance as has been discussed. The noise and activity associated with development of a port may force the geese to depart on their 2000 km non-stop migration to northern Alberta prior to accumulating the necessary fat reserves, thus lessen their chance of survival. Because such a large portion of the western Arctic Lesser Snow Goose population stage along the Yukon Coastal Plain, particularly in some years, development at King Point could have a major impact on this species of bird.

2) Influx of hunters, tourists and recreationalists due to the access road.

The greatest impact of the Trans-Alaska Pipeline project on wildlife was the increased road access (Pamplin pers. comm.). If a road is built to link King Point to the Dempster Highway, the country will be opened to tourists, recreationalists and hunters whose activities could both disturb the wildlife and damage key habitat. New roads will also enable both sport and subsistance hunters to reach areas that were previously inaccessible. Furthermore, nesting falcons, once protected due to their isolation, will become vulnerable to poachers interested in capturing them to sell on the black market.

3) Disturbance of the birds that use the Phillips Bay/Babbage River delta.

The Phillips Bay area including the Babbage River delta is regionally important to several bird species. In the spring, the Babbage River delta is one of the few areas along the Yukon coastline where there is open water for staging birds. Brant concentrate in the area as well as small numbers of Oldsquaw and eiders during spring migration. Glaucous Gull colonies occur on the spit at Kay Point and in some years Arctic Terns also nest in the area.

During the summer, the delta is a locally important moulting area for Tundra Swans and for ducks, especially Northern Pintails, Oldsquaws, and Red-breasted Mergansers, while offshore on Phillips Bay, moulting scoters are common. Migrant flocks of shorebirds feed on the mudflats

of the Babbage River delta. During fall migration, Phillips Bay is a major staging area for Brant, and in some years for Lesser Snow Geese and Greater White-fronted Geese.

If development occurs at King Point, aircraft traffic will likely disturb the birds in nearby Phillips Bay and the Babbage River delta. If the construction of facilities is permitted to spread towards Kay Point and Phillips Bay, the activity and noise associated with these facilities will further impact the birds that use the Babbage River delta and Phillips Bay.

4) Loss of wetland habitat suitable for nesting shorebirds, loons, gulls, terns and waterfowl.

The relatively high densities of nesting waterfowl, shorebirds, loons, gulls and terns on the Yukon Coastal Plain are restricted to a narrow band adjacent to the coast. At King Point, this area is only about 10 km wide, and further inland, nesting densities drop considerably. If linear facilities such as a road or pipeline are constructed from King Point eastward across this narrow band of regionally important habitat for nesting birds, a substantial amount of this area could be affected. The area affected could extend well beyond the development itself, especially if there were problems such as ponding, dusting or disturbance due to heavy traffic.

5) Oil pollution

As activities in connection with oil and gas development accelerate, the frequency of oil spills will likely also increase. This could

have a major impact on birds since they are highly sensitive to contact with oil. The most vulnerable birds would likely be diving birds such as Red-throated Loons, and moulting Oldsquaws and scoters because they tend to dive when they encounter an oilspill and become covered with oil when emerging (Vermeer and Anweiler 1975). Oldsquaws and scoters occur in large numbers during moulting; thus, if an oil spill occurred near an area where these birds were concentrated, it could destroy a significant portion of the regional population.

8.0 RECOMMENDED MITIGATIVE MEASURES

The impact of development on birds at King Point can be alleviated in several ways. One key way would be to confine development to as small an area and as few sites as possible. Thus, the port should be designed so that the facilities can be expanded for other potential users. This will avoid the necessity of developing ports at other sites along the Beaufort Sea coast in the future. In addition to restricting the amount of land developed, blocks of the coastal plain should be preserved with development prohibited (Bergman et al. 1977; Derksen et al. 1981). The blocks of undeveloped land, if large enough to exclude the impact of disturbance, will help to ensure that breeding populations are preserved.

Another effective mitigative measure would be to locate facilities away from habitat that is valuable to birds or sensitive to disturbance. On the Yukon Coastal Plain most bird species prefer the wetland habitats; thus facilities such as airstrips, roads, and buildings will have less impact on most bird species if located on the drier uplands. Although

further site specific field investigations would be required, it might be less detrimental to birds if a road to Fort McPherson was located inland along the foothills rather than along the coastal plain. Since the Phillips Bay area, including the Babbage River delta is more heavily used by several bird species than other areas near King Point, the location of facilities at King Point should be partly determined by the impact the resultant disturbance will have on the birds at Phillips Bay. For example, an airstrip should be orientated so that aircraft do not approach or take off over the Babbage River delta.

Disturbance due to particular project activities can often be alleviated by timing the activity to avoid conflict. For example, the impact of aircraft activity, vehicular traffic and blasting on fall staging Lesser Snow Geese can be minimized by restricting such activity while the geese are present (an average of 16 days usually between 25 August and 19 September (Barry and Barry 1984)). In addition, activities such as blasting should be restricted to the non-nesting time of year, particularly near areas where falcons nest. For more precise guidelines on restrictions to protect raptors, the project authorities should contact the Yukon Territory Government raptor biologist.

The impact of aircraft overflights on birds can be partially mitigated by creating flight corridors. Restricting aircraft to specific flightlines will ensure that a minimum number of birds are disturbed, and may also result in some birds accommodating to the overflights. Several studies have indicated that birds do accommodate to some degree to aircraft overflights (Schweinsburg 1974; Davis and Wiseley 1974; Sharp

1978). The impact of aircraft overflights can be further mitigated by locating the flight corridors over areas not used by the more sensitive species such as geese (Barry pers. comm.). For example, a corridor over the ocean will, in most cases, disturb fewer of the more sensitive species of birds. Flying at a specific altitude may also lessen the impact. Studies are presently being conducted by the Canadian Wildlife Service to determine the altitude at which aircraft overflights disturb Lesser Snow Geese the least. Contrary to previous thinking, preliminary results of the study suggest that aircraft flown at a low altitude (100 m agl), rather than at a high altitude (1500 m agl) may disturb fewer geese (Barry pers. comm.).

Construction techniques that minimize disturbance to permafrost terrain should be used. For instance, when constructing a road, enough culverts must be installed to provide adequate cross-drainage of spring melt water and sheet flow to minimize flooding along the upstream side of the road (Pamplin 1979). The natural drainage of beaded streams should not be disrupted because of their importance in maintaining water levels in contiguous ponds, lakes and meadows (Craig and McCart 1975 in Derksen et al. 1981). Areas with steep slopes or high ice content soils should be avoided to lessen problems with erosion, frost heave or slumping. In areas where the tundra vegetation would be easily damaged by heavy machinery, construction should be restricted to the winter when snow and ice pads can be used to protect the vegetation. Disturbed areas should be revegetated as soon as possible, preferably with native plant species (Pamplin 1983). When considering areas for temporary use such as con-

struction camps and stockpile sites, habitat that would be difficult to restore should be avoided. Fuel storage containers should be dyked with an impervious material. Whenever possible, a buffer zone should be left between sensitive habitat such as a river or wetland and the development (including borrow sites, construction camps and stockpile sites).

Access on the road from Fort McPherson to King Point should be restricted to project-related activities only. If the public insists on access, the hunting of game birds should be restricted (perhaps zoned) and the harvest monitored. Camping should be restricted to designated sites and off-road vehicular traffic including travel by All Terrain Vehicles should be prohibited. An adequate number of people must be provided to enforce these regulations.

Project personnel should be prohibited from having firearms or All Terrain Vehicles while working at the project site and should be instructed not to drive vehicles off the roads.

The impact of dust on bird habitat adjacent to roads and the possibility of using a non-toxic dust control should be further investigated (LGL Ltd. 1982). Any towers that are constructed should be no higher than necessary and have strobe lights to minimize bird collisions (Weir 1976). Garbage should be disposed in such a way that animals, including ravens and gulls, are not attracted to it. There should be an oil spill contingency plan for the project with equipment and trained people on site. The plan should include a proposed method to keep birds away from an oil spill. This plan should be periodically reviewed and updated. The bonds that are posted by the project sponsors prior to construction

should include assessments for potential damages to public wildlife resources, so that funds to re-establish wildlife habitat are included in the bond (Pamplin 1979).

It is important that biologists become involved in the review of a development proposal early in the preconstruction phase to ensure protection of the wildlife resource. Mitigative measures such as restrictions on timing of activity or relocation of a facility will likely be easier to incorporate into a project design, if suggested at an early stage in planning. Another reason for biologists to become involved in a project early is that a field investigation may be necessary prior to advising on some aspect of the development proposal. For example, if development is to occur near raptor nesting habitat, a biologist would have to locate the nests before impacts could be fully assessed and mitigative measures recommended. Involvement early in the preconstruction phase will help to ensure that there is time for such field investigations.

During the construction phase of the project, biologists should be assigned to monitor the construction activity to ensure compliance with approved designs and environmental stipulations, and to act as advisors if a last minute change is proposed (Pamplin 1983). The biologist monitoring construction may also notice unforeseen impacts and be able to correct them prior to damage occurring (Pamplin 1983).

Studies designed specifically to monitor the impacts of a development project or the effectiveness of mitigative measures, contribute to our understanding of the impact of industrial development on the migratory bird resource in the north. The kinds of monitoring studies which

should be conducted in response to development at King Point will depend on what the final development scenario is. Two likely monitoring studies, however, are:

1) a study to determine the impact of disturbance from project-related activities, including vehicular traffic and air traffic, on the geese that stage along the Yukon Coastal Plain during the fall; and
2) a study to monitor the impact of development on local raptor populations.

In addition, the loss of bird habitat as a result of development at King Point should be documented. In order to understand the significance of this loss, there should be at least two more years of field studies to identify and evaluate bird habitats along the Yukon Coastal Plain prior to development.

Bird populations in the arctic fluctuate a great deal depending on the weather (Barry and Barry 1984), so that the results of a one year study, such as this study at King Point in 1981, can be misleading. Therefore, further investigations of the birds that use the King Point area are strongly recommended.

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Appendix A. Location of the transect-lines surveyed on the ground from 11 to 26 June 1981, near King Point, Yukon.

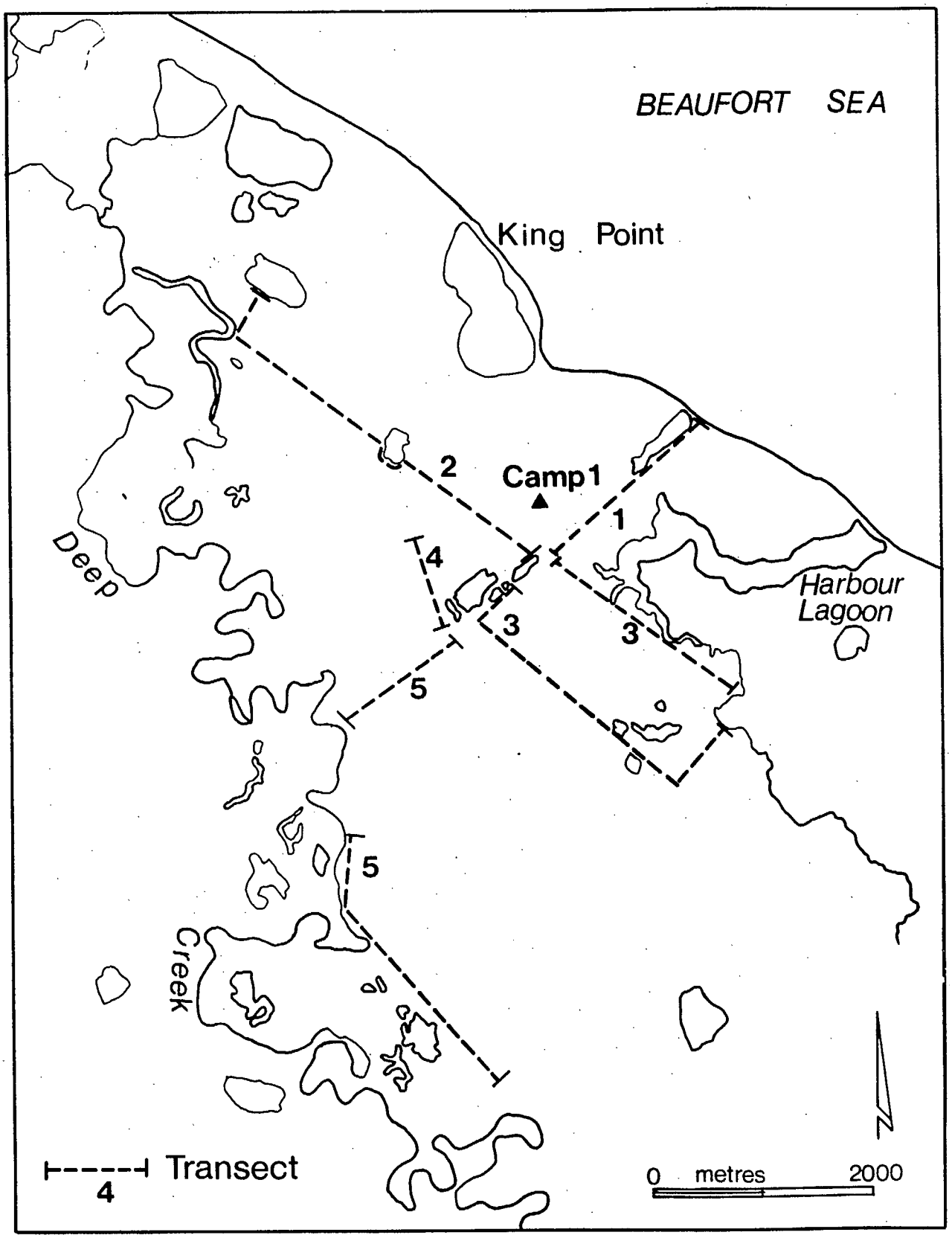


Figure A1. Ground transects surveyed near Camp 1 (137° 58'W; 69° 05'N) at King Point, 11-15 June, 1981.

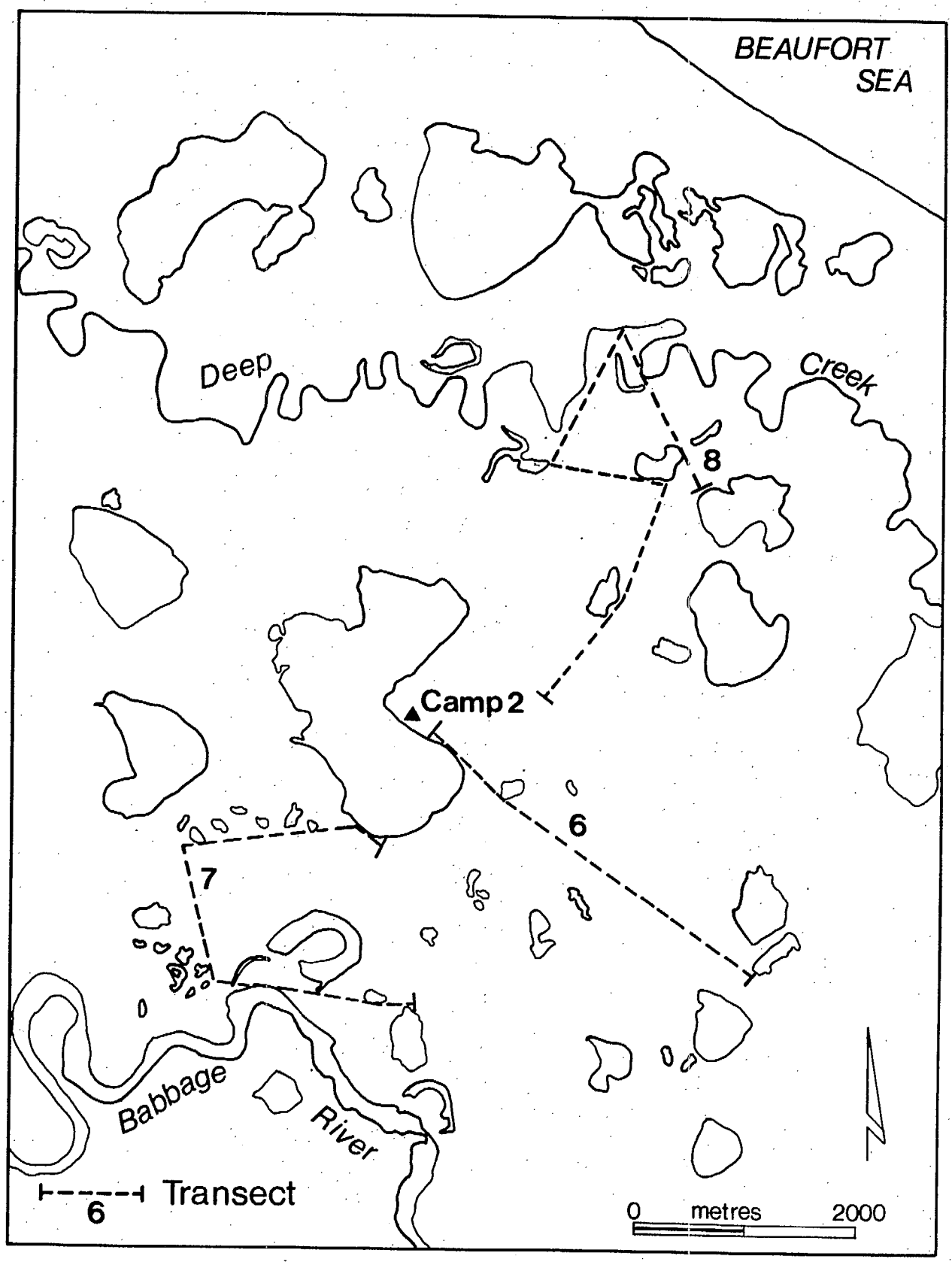


Figure A2. Ground transects surveyed near Camp 2 (138° 11'W; 69° 05'N) west of King Point, 16-18 June, 1981.

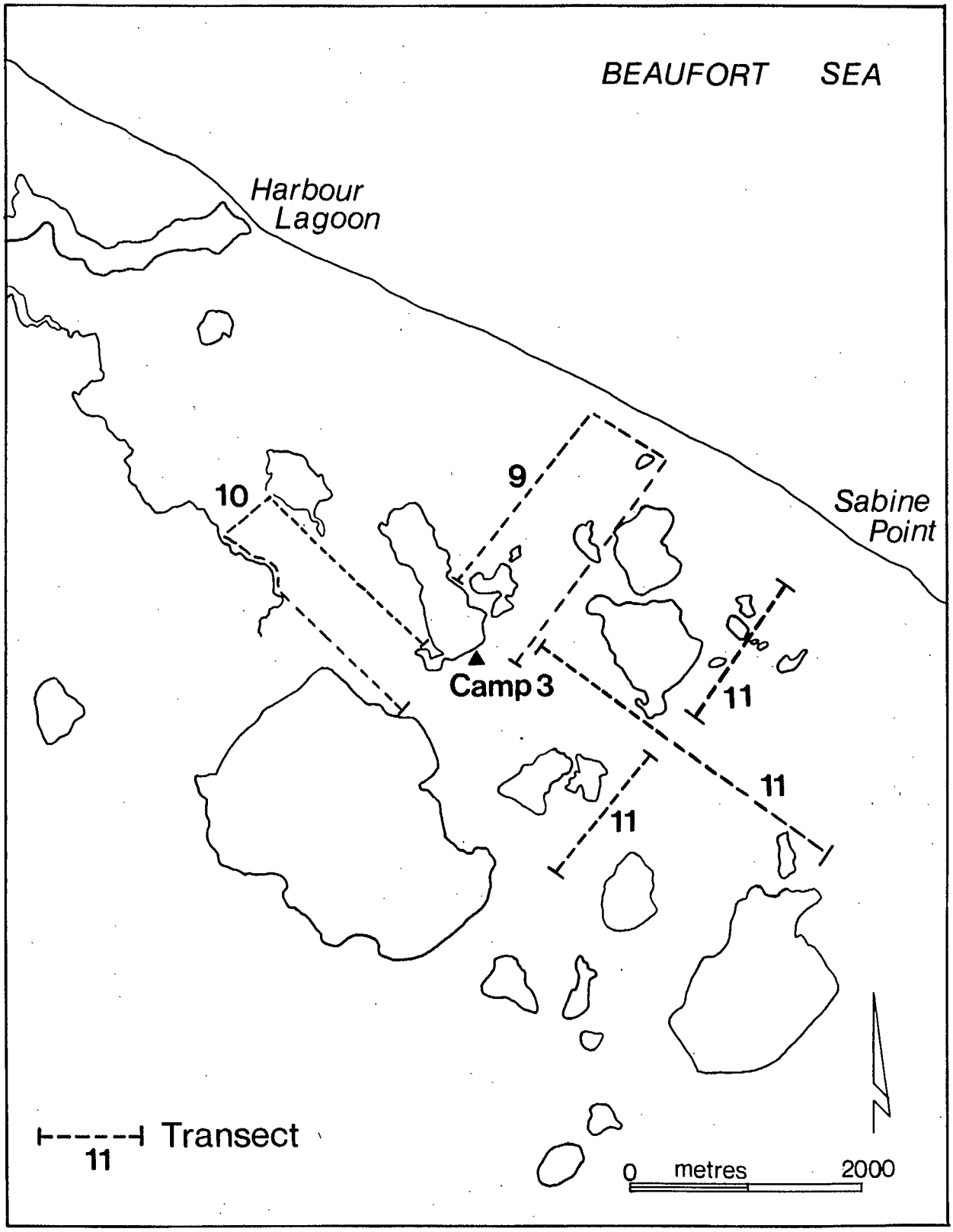


Figure A3. Ground transects surveyed near Camp 3 (137° 50'W; 69° 03'N) east of King Point, 20-22 June, 1981.

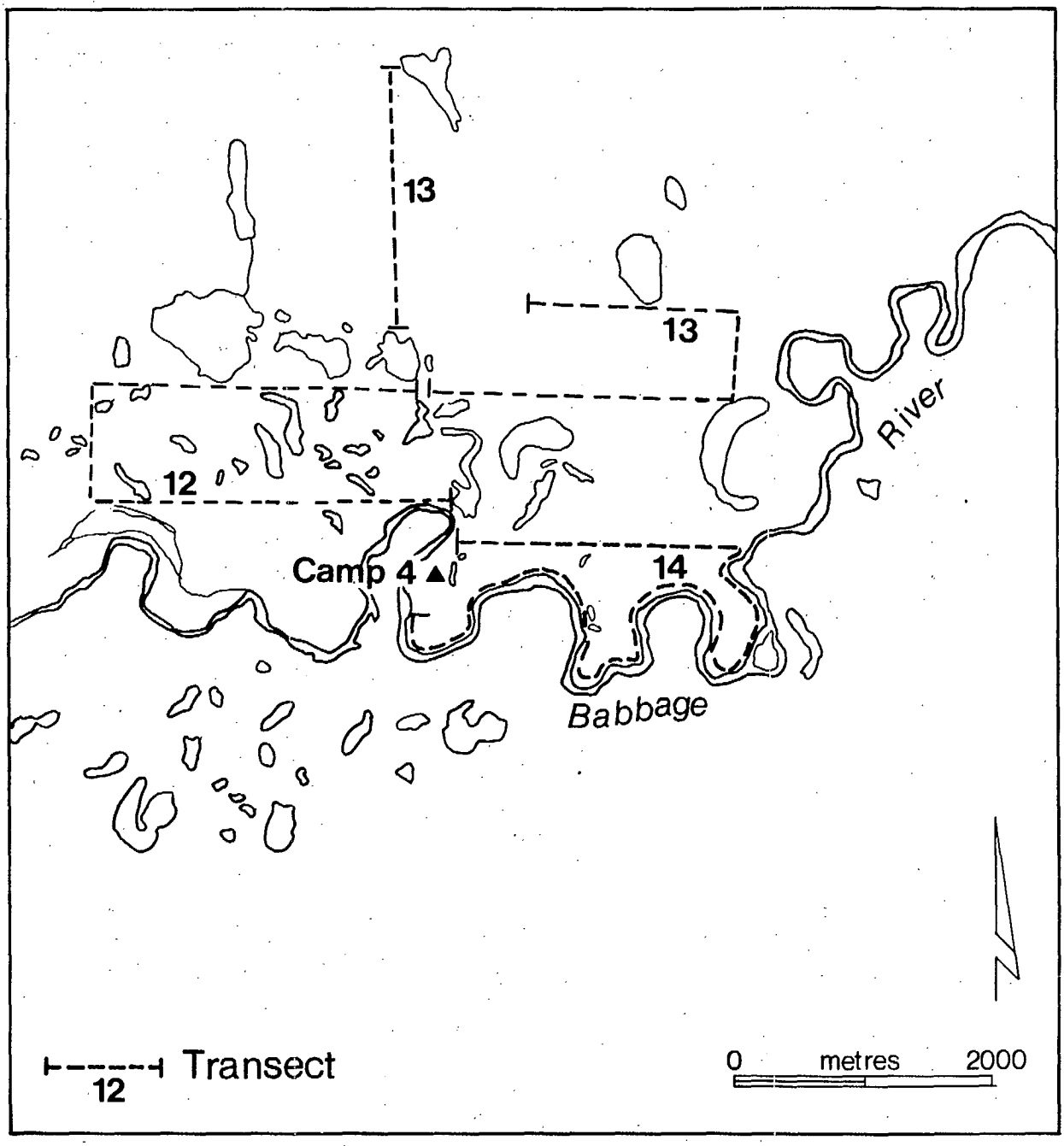


Figure A4. Ground transects surveyed near Camp 4 (138° 25'W; 68° 57'N) on the upper Babbage River, 224-26 June, 1981.

Appendix B. Number of birds by species observed during each of the aerial surveys conducted near King Point, Yukon in 1981.

Table B1. Number of birds observed during an aerial survey near King Point, Yukon on 19 June 1981.

Species	Survey segment[1]																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total
Arctic Loon					2	4	2		3					2			13
Red-throated Loon				2					2								4
Unidentified loon						2	1	1	2	3	1					1	11
Tundra Swan		1				1		9	2	6	1	4	1	1	28	2	56
Brant																	
Canada Goose							3									8	11
Lesser Snow Goose																	
Unidentified dark goose										1							1
Mallard																	
Northern Pintail			1			2	1	2		3	1	4	1	8	10	10	43
American Wigeon							6			2							8
Green-winged Teal														1			1
Scaup spp.		3				8	9	8	7	3	5	4		1		1	49
Common Eider														1	1	8	10
King Eider																	
Oldsquaw	1	2	2	5	3	12	11	12	7	5	39	13	1	1	6	3	123
White-winged Scoter									1			1					2
Surf Scoter																	
Scoter spp.																	
Red-breasted Merganser	2				1	2		1		2			1			4	13
Unidentified duck		3	4		1	10	3	10	6	7	3	9	2	12	7	2	79
Rough-legged Hawk																1	1
Northern Harrier							1	1			1						3
Golden Eagle							2		2								4
Bald Eagle																	
Gyrfalcon																	
Unidentified raptor																	
Short-eared Owl									1		2						3
Ptarmigan spp.				1	2		2	4	1	1	2						13
Parasitic Jaeger											1						1

Table B1. Continued.

Species	Survey segment[I]																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total
Long-tailed Jaeger	2			1				2									5
Unidentified jaeger	2		1		1			1	1								6
Glaucous Gull						1					3		1	60	11	42	118
Arctic Tern		2			3		20	1	2	5			1				34
Shorebirds	5	6	10	2	4	6	8	7	7	1	4	3		10	3		76
Common Raven								1									1
Passerines	3	2	4	2	5		7	4	2	3	3						35
Distance surveyed (km)	25	25	25	30	30	30	30	30	30	30	30	9	8	13	13	12	370

[I]For location of survey segments refer to Figure 2.

Note: a blank represents 0.0 birds/km^2.

Table B2. Number of birds observed during an aerial survey near King Point, Yukon on 24 July 1981.

Species	Survey segments[1]																											Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	
Arctic Loon			3		2						3	2							2	1		3	2	2	8	1	2		31
Red-throated Loon				6	1					1															2		1		12
Unidentified loon	3		2	7		2		3		5	3	3	3	11	3		1		2	2	2	3	1	1	3	10	3		73
Tundra Swan			20	13	2					6		2		2	1	6	5		3	4		2	9	3	6	4	2		90
Brant	12				10																								22
Canada Goose					4																								4
Lesser Snow Goose																													
Unidentified dark goose																													
Mallard										7				27						3			2						39
Northern Pintail				4	15	3	10		16	2	9			22	5					1					2	1			90
American Wigeon														59			10			2									71
Green-winged Teal														2											1				3
Scaup spp.						6				1	7			5			20		1				45	5		8			98
Common Eider																													
King Eider																													
Oldsquaw					60						20										8	2					50		140
White-winged Scoter																													
Surf Scoter	360					70			3							5					1							40	479
Scoter spp.	250						80					1												1					332
Red-breasted Merganser			7	15	2	13	10		3		5	1		3		1	16		7				1		2		1		87
Unidentified duck			5	2	9	18	61		3	11	21	2	1	166	4	10	5			19	4	2	3	8	13	76	14		477
Rough-legged Hawk							1				1															1			3
Northern Harrier				1	1									1										1	1		1		6
Golden Eagle														2										1					3
Bald Eagle														1															1
Gyrfalcon																									1				1
Unidentified raptor					1																								1
Short-eared Owl																							1		1		1		3
Ptarmigan spp.			2	1		8								6											4	2	2		25
Parasitic Jaeger					1																								1

Table B2. Continued.

Species	Survey segments[I]																												Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	
Long-tailed Jaeger												1													3				4
Unidentified jaeger						1		1																					2
Glaucous Gull	313	24	2	2	26	3	30	2	20	7	21								1		4			1	2		1	6	465
Arctic Tern	12	1		1		1				2	5	9	9	3			3					15			9		4	4	78
Shorebirds			17	3	26	2	2			73	2	15	2	10	1							3			5	1	2		164
Common Raven				1						3									1					2		3	10		20
Passerines			6	6	1		1				2	1		27		1			4	12		1			3	8	13		86
Distance surveyed (km)	11	22	15	15	14	14	13	11	5	20	14	17	5	35	3	5	5	2	7	7	4	9	6	8	30	30	30	28	385

[I]For location of survey segments refer to Figure 3.

Note: a blank represents 0.0 birds/km^2.

Table B3. Number of birds observed during an aerial survey near King Point on 3 September 1981.

Species	Survey segments[1]																							Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
Arctic Loon		1	1					1																	3
Red-throated Loon				2																					2
Unidentified loon	4	9	2	1	3				4		1		5						5						34
Tundra Swan					2	1																			3
Brant							8																		8
Canada Goose																									
Lesser Snow Goose									37		2140		800				780					5580	3253	130	12720
Unidentified dark goose																									
Mallard																									
Northern Pintail																									
American Wigeon																									
Green-winged Teal																									
Scaup spp.						4		25						60		4				75					168
Common Eider																									
King Eider					1																				1
Oldsquaw		3	2	4				15										91							115
White-winged Scoter																									
Surf Scoter			2																						2
Scoter spp.		50		2																					52
Red-breasted Merganser				25	4																				29
Unidentified duck	2	2	4		9	3	10																		30
Rough-legged Hawk																									
Northern Harrier																			1						1
Golden Eagle																									
Bald Eagle																									
Gyrfalcon																									
Unidentified raptor																									
Short-eared Owl																									
Ptarmigan spp.																									
Parasitic Jaeger																									

Table B3. Continued.

Species	Survey segments[1]																								Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
Unidentified jaeger								2																	2
Glaucous Gull	77	14	24	47	7	10	2	12	1									7							201
Arctic Tern																									
Shorebirds	20			2	14	2		2																	40
Common Raven	1								1																2
Passerines																1									1
Distance surveyed (km)	11	22	28	5	20	14	7	9	17	5	35	3	5	5	2	7	7	4	9	6	8	30	30	25	314

[1]For location of survey segments refer to Figure 4.

Note: a blank represents 0.0 birds/km^2.

Appendix C. Nests found during ground surveys near King Point, Yukon 11-26 June, 1981.

Appendix C. Nests found during ground surveys near King Point, Yukon, 11-26 June 1981.

Date	Site number	Transect	Species	Number of Eggs	Number of Young	Habitat type	Comments
13 June	1	3	Lapland Longspur	1	3	On gently rolling uplands in Graminoid/Dwarf Shrub	Both adults present
15 June	1	5	Long-tailed Jaeger	2	0	At edge of Wet Sedge - Patterned Ground	Both adults present
17 June	2	7	Oldsquaw	2	0	Wet lowland with ponds in Tussocky Tundra - Patterned Ground	Both adults present
			Scaup sp.	7	0	same as above	Both adults present
			Northern Pintail	6	0	same as above	Female only present
			Red-necked Phalarope	2	0	Wet lowland with ponds in Wet Sedge	Male only present
18 June	2	8	Red-necked Phalarope	4	0	Wet lowland with ponds in Wet Sedge - Patterned Ground	Male only present
			Red-necked Phalarope	4	0	By pond in Wet Sedge	Both adults present
20 June	3	9	Arctic Loon	1	0	By shore of lake in Wet Sedge	One adult present
			Oldsquaw	4	0	About 20 m from lake in Dwarf Shrub-Patterned Ground	Female only present
21 June	3	10	Oldsquaw	7	0	On hummock about 10 m from lakeshore in Wet Sedge	Female only present

Appendix C. Continued.

Date	Site number	Transect	Species	Number of Eggs	Number of Young	Habitat	Comments
			Lapland Longspur	-	1	In Graminoid/Dwarf Shrub habitat	Out of nest with female
			Long-tailed Jaeger	2	-	On slope 100 m from lake in Graminoid/Dwarf Shrub habitat	Both adults present
22 June	3	11	Oldsquaw	6	-	In wet lowlands with lakes and ponds in Wet Sedge habitat	Female only present
24 June	4	12	Willow Ptarmigan	-	4 or more	Graminoid/Dwarf Shrub habitat	Both adults present
			Willow Ptarmigan	-	4 or more	Dry Sedge habitat	Both adults present
			Willow Ptarmigan	-	1 or more	Same as above	Both adults present
25 June	4	13	American Tree Sparrow	1	-	In Dwarf Shrub - Patterned Ground habitat	Both adults present
			Lapland Longspur	-	1	In Graminoid/Dwarf Shrub habitat	Both adults present
	4	14	Raptor	-	-	Stick nest on cliff by Babbage River	Nest in good condition - no adult present

Appendix D. Raptors observed nesting along the Trail River, Yukon during an aerial survey on 23 June 1981.

Appendix D. Observations made during a survey for nesting reptors along the Trail River on 23 June, 1981.

The following are observations that were made during a helicopter survey for nesting raptors along the cliffs on the Trail River valley on 23 June, 1981.

Site 1 - Two Golden Eagles flushed from a cliff. There were two stick nests on the cliff within a few metres of each other, but neither contained young.

Site 2 - A Peregrine Falcon flushed from the cliff. The only nest found was a small stick nest (size of raven's or hawk's nest) that was empty. The cliff had lots of whitewash.

Site 3 - Two adult Common Ravens attended a stick nest on a cliff. The nest contained several young and there was a lot of whitewash in the vicinity of the nest. A few metres away there was a second nest which was empty.

Site 4 - There was an old stick nest in fair condition on a ledge.

Site 5 - A dark phased Gyrfalcon flushed from a stick nest which contained 3 young.

Site 6 - A Golden Eagle flushed from a large stick nest which contained 1 young.

Site 7 - There was lots of whitewash on the cliff.

Site 8 - A Golden Eagle flushed from near a stick nest which contained 1 young Golden Eagle.

Site 9 - A gyrfalcon was on a small stick nest with 2 young, while a second Gyrfalcon circled nearby.

Appendix E. Number of birds by species observed during ground surveys near King Point, Yukon, 11-26 June 1981.

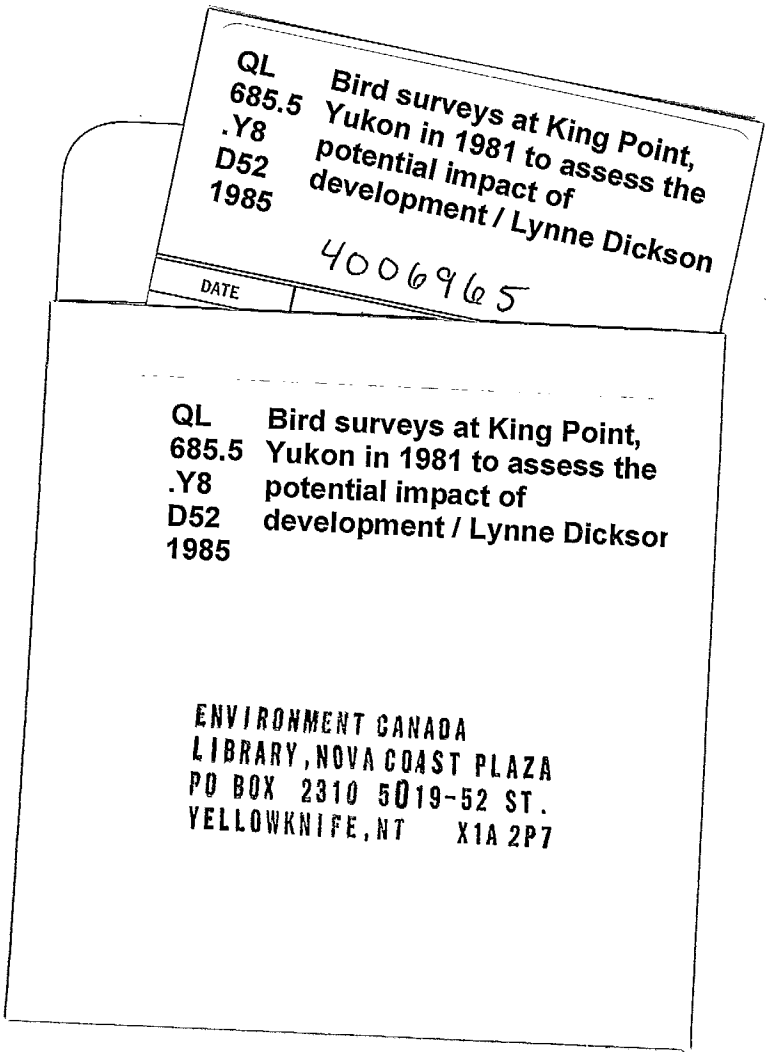
Appendix E. Number of birds by species observed during ground surveys near King Point, 11-26 June 1981. Numbers in brackets are birds observed "off transect".

Species	Transect number														Total
	Site 1					Site 2			Site 3			Site 4			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Arctic Loon	(5)	(4)	(9)	(2)	(4)	(4)	1 (5)	(6)	2 (7)	(9)	2(14)	(3)	(2)	(1)	5 (75)
Red-throated Loon		2	(2)	(2)	(2)		2 (3)		1		(3)	(2)			5 (14)
Yellow-billed Loon									(1)						(1)
Unidentified loons	(2)		(1)					(1)			(11)	(1)		(1)	(17)
Horned Grebe							(1)								(1)
Canada Goose			(2)								1				1 (2)
Gr. White-fronted Goose			(5)											(5)	(10)
Unidentified dark geese											(3)				(3)
Tundra Swan	(1)	(10)	(19)			(2)	(1)	(9)	(5)	(8)	(2)			(1)	(58)
Mallard			(1)		2		(1)		(5)	1	(2)		(3)	(1)	3 (13)
Northern Pintail			1 (4)	(8)	1 (8)		1(11)	2 (2)	2(16)	2 (2)	7 (5)	4	(3)		20 (59)
Green-winged Teal							(1)	1		2		(8)	2 (1)	(1)	5 (11)
American Wigeon			(1)		(3)		(1)	(4)							(9)
Northern Shoveler												(1)			(1)
Scaup spp.					(6)		2(21)	2 (8)	(3)		(3)	3 (6)	3	(4)	10 (51)
Oldsquaw	(6)	3 (3)	(5)	(4)	2 (5)	(2)	2(22)	1 (5)	1 (4)	1 (6)	3 (7)	14 (2)	(12)	(1)	27 (84)
Red-breasted Merganser					(5)	(2)	(1)	(2)			(1)	(3)	(1)	(5)	(20)
White-winged Scoter										(3)	(2)				(5)
Common Goldeneye									(6)						(6)
Unidentified dabblers									(2)	(3)				1	1 (5)
Unidentified ducks	(1)				(3)	(2)	(3)		(7)	(4)	3 (8)	(6)			3 (34)
Rough-legged Hawk	(1)								(2)	(1)				(1)	(5)
Golden Eagle							(2)	(1)							(3)
Northern Harrier	(1)	(2)			(2)		(2)		(1)	(1)		1 (1)		1	2 (10)
Short-eared Owl		(1)	(1)	(1)		(1)		(1)		(1)				(1)	(7)
Gyrfalcon									(1)						(1)
Unidentified hawks								(1)							(1)
Unidentified falcons							(1)								(1)
Willow Ptarmigan	1	2 (1)	1 (1)		5	1	2 (1)	4	(1)	2	1	7	2	7 (1)	35 (5)
Rock Ptarmigan								2	1		(1)	1		2	6 (1)
Unidentified ptarmigans	(3)	1 (1)	(1)	(1)				(1)			(1)	(1)		1	2 (9)
Sandhill Crane										2	(4)				2 (4)
Lesser Golden-Plover	1 (1)	2 (3)	(5)	2	2 (3)	2 (4)	(4)	6 (4)	6 (5)	3 (3)	2 (3)				26 (35)
Semipalmated Plover														2 (2)	2 (2)
Common Snipe		2 (2)	(1)		(2)		(1)	(1)	(1)	(2)	(3)	(2)			2 (15)

Appendix E. Continued.

Species	Transect number														Total
	Site 1					Site 2			Site 3			Site 4			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Whimbrel		(7)	4 (7)	1 (4)	5 (2)	3 (1)	(4)				(6)				13 (31)
Lesser Yellowlegs												(2)	(5)	(3)	(10)
Pectoral Sandpiper		1	3 (3)				1	2		(4)	1 (4)				8 (11)
Semipalmated Sandpiper			2 (7)	(5)		2	2 (6)	(4)	1 (4)	2 (6)	5 (2)				14 (34)
Stilt Sandpiper		(3)	(4)	2 (2)	(1)	1	1 (2)	(1)	1 (5)	(2)	(3)				5 (23)
Least Sandpiper									1				(2)		1 (2)
Long-billed Dowitcher						1			(1)	2	(1)				3 (2)
Red-necked Phalarope	(2)	2 (1)	2 (6)	11 (3)	6 (3)	2 (2)	10(27)	7 (6)	8 (5)	7 (9)	11(22)	2(26)		8 (1)	76(113)
Unidentified shorebirds	(1)	(5)	(3)		(1)	1	(2)		2 (1)	1 (1)	1(11)	(4)		(5)	5 (34)
Parasitic Jaeger	(1)	(4)	(3)	(2)	1 (2)	(1)	(1)	2		2	(3)	(2)			5 (19)
Long-tailed Jaeger	(4)	(2)	(2)	(1)	2 (4)	(1)	1 (1)	(3)	(1)	(3)	2 (2)		(2)	(1)	5 (27)
Pomarine Jaeger									(1)						(1)
Unidentified jaegers	(1)		(1)						(2)		(1)				(5)
Glaucous Gull	(1)	(1)	(8)	(3)	(3)			(2)	2 (3)	(1)	(2)	(5)		(3)	2 (32)
Arctic Tern		(3)	(6)	(6)	(10)	(3)	(19)	(2)	(9)	(10)	(20)	(5)	(1)	(3)	(97)
Bank Swallow												(4)		(2)	(6)
Common Raven			(2)	(1)			(2)	(2)	(3)	(1)	(2)			(1)	(14)
Grey-cheeked Thrush												(1)		(1)	(2)
Yellow Wagtail							1					(2)			1 (2)
Northern Shrike														1	1
Rusty Blackbird												1		1	2
Yellow Warbler						(1)	3 (2)					2 (2)		2 (5)	7 (10)
Northern Waterthrush												1			1
Redpoll spp.	(3)	2(10)	(7)	(2)	2 (7)	2 (5)	10 (9)	1(16)	(1)	2 (2)	(2)	4 (8)	(9)	9(12)	32 (93)
Savannah Sparrow	(2)	17(17)	9(14)	(2)	12 (9)	6 (2)	27(16)	14(23)	1 (6)	17 (7)	9 (5)	22 (9)	34(18)	13 (3)	181(133)
American Tree Sparrow		(2)	1		7 (1)	(1)	7 (2)	2 (1)		1	(1)	8 (5)	3 (4)	16(10)	45 (27)
White-crowned Sparrow			(1)		4		3 (2)	(1)				1		3 (3)	11 (7)
Fox Sparrow					1		(2)	(2)				2 (3)		2 (3)	5 (10)
Lapland Longspur	18 (1)	15(20)	36(26)	(8)	12(15)	18(11)	15 (6)	36(13)	25(17)	17(10)	29 (7)	3 (8)	46(22)	1 (1)	271(165)
Snow Bunting	(1)														(1)
Unidentified passerines					1						2	1 (1)	(1)	3 (2)	7 (4)
Total	20(38)	49(102)	59(158)	16(57)	65(101)	39(45)	91(185)	82(122)	54(126)	64(99)	79(167)	77(123)	90(86)	73(84)	858(1493)
Distance surveyed (km)	1.8	3.7	5.8	1.0	3.8	3.7	5.0	6.2	4.8	4.6	5.7	6.3	6.5	7.8	

Note: a blank represents 0.0 birds/km^2.



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