FALL MIGRATION AND STAGING OF PHALAROPES AND OTHER WATERBIRDS IN THE VICINITY OF NUNALUK SPIT YUKON TERRITORY: 1987

David M. Ealey
Stuart A. Alexander
Bruno Croft

Technical Report Series No. 41
Western and Northern Region 1988
Canadian Wildlife Service

This report may be cited as:

Ealey, D.M.; Alexander, S.A.; Croft, B. 1988. Fall migration and staging of phalaropes and other waterbirds in the vicinity of Nunaluk Spit, Yukon Territory: 1987. Technical Report Series No. 41. Canadian Wildlife Service, Western and Northern Region, Alberta.

Issued under the Authority of the
Minister of Environment
Canadian Wildlife Service

Catalogue No. CW69-5/41E
ISBN 0-662-16204-8
ISSN 0831-6481

Copies may be obtained from:

Canadian Wildlife Service
Western and Northern Region
4999-98 Ave., 2nd. Floor
Edmonton, ALBERTA
T6B 2X3

ABSTRACT

Pre-migratory and migratory activities of birds in the vicinity of Nunaluk Spit, Yukon Territory were monitored from 27 July to 2 September, 1987, as part of a broader investigation of key areas for birds in coastal regions of the Canadian Beaufort Sea. Passage rates were determined for birds flying past an observation post located on the spit. Ground surveys were regularly conducted along 10 km of the spit, and aerial surveys were conducted along the Yukon Territory coastline. Habitat use and distribution of waterbirds and shorebirds, particularly phalaropes, were documented from those surveys. Sixty-eight species were observed during the study period.

Peak passage rates and dates for flights by various species groups were as follows: Ducks and Loons - 32.7 birds/hr, August 11 to 15, and 25.8 birds/hr, August 16 to 20; Geese and Swans - 157.2 birds/hr, August 26 to 30; Shorebirds (Excluding Phalaropes) - 35.2 birds/hr, August 6 to 10; Phalaropes - 163.8 birds/hr, August 6 to 10; Larids - 4.9 birds/hr, July 27 to 31, and 3.0 birds/hr, August 21 to 25; Sparrows - 17.3 birds/hr, August 21 to 25. Changes in passage rate and staging were analysed in relation to wind and habitat conditions, primarily for phalaropes. Local wind direction appeared to influence movement of Red-necked Phalaropes past Nunaluk Spit. The relative proportion of Red-necked Phalaropes versus Red Phalaropes declined as fall progressed from 100% to approximately 60%. Past records for phalaropes in the Nunaluk Spit area are compared with 1987 results. Phalarope staging ecology is discussed in relation to other studies made along the Beaufort Sea coast.

The relative importance of the Malcolm and Firth river deltas, Nunaluk Lagoon and Nunaluk Spit to shorebirds and waterfowl is discussed in comparison with other regions of the Beaufort Sea.

RÉSUMÉ

Les activités prémigratoires et migratoires des oiseaux dans la région de Nunaluk Spit, Territoire du Yukon, ont été surveillées du 27 juillet au 2 septembre 1987 dans le cadre d'une étude plus vaste qui portait sur les zones clés pour les oiseaux dans les régions côtières de la mer de Beaufort au Canada. Les taux de passage ont été établis pour les oiseaux qui survolaient un poste d'observation situé sur la flèche littorale. Des enquêtes au sol ont eu lieu régulièrement le long de la flèche de 10 km, et des enquêtes aériennes ont eu lieu le long de la côte du Territoire du Yukon. Elles ont permis d'obtenir des données sur l'utilisation de l'habitat et la répartition des oiseaux aquatiques et des oiseaux de rivage, en particulier des phalaropes. Soixante-huit espèces ont été observées pendant la période d'étude.

Les taux de passage de pointe et les dates des vols de divers groupes d'espèces étaient les suivants: canards et huarts - 32,7 oiseaux à l'heure, du 11 au 15 août, et 25,8 oiseaux à l'heure, du 16 au 20 août; oies et cygnes - 157,2 oiseaux à l'heure du 26 au 30 août; oiseaux de rivage (sauf les phalaropes) - 35,2 oiseaux à l'heure du 6 au 10 août; phalaropes - 163,8 oiseaux à l'heure , du 6 au 10 août; laridés - 4,9 oiseaux à l'heure du 27 au 31 juillet et 3,0 oiseaux à l'heure du 21 au 25 août; pinsons - 17,3 oiseaux à l'heure du 21 au 25 août. Les changements des taux de passage et des haltes ont été analysés en fonction du vent et des conditions de l'habitat, particulièrement pour les phalaropes. La direction locale des vents semblait influencer le mouvement des Phalaropes hyperboréens au-delà de Nunaluk Spit. La proportion relative de Phalaropes hyperboréens par rapport aux Phalaropes roux a diminué à mesure que l'automne avançait et est passée de 100% à environ 60%. On a comparé les données passées relatives aux phalarope dans la région de Nunaluk Spit aux résultats de 1987. On a traité de l'écologie des zones de repos des phalaropes relativement à d'autres études réalisées le long de la côte de la mer de Beaufort.

L'importance relative des deltas des rivières Malcolm et Firth, de Nunaluk Lagoon et de Nunaluk Spit pour les oiseaux de revage et les oiseaux aquatiques est discutée comparativement aux autres régions de la mer de Beaufort.

ACKNOWLEDGEMENTS

Funding for this study was provided by the Northern Oil and Gas Action Program and the Canadian Wildlife Service. Logistical support for radio communications and helicopter surveys was provided by the Polar Continental Shelf Project in Tuktoyaktuk. Accommodations and office support were made available through the Inuvik Scientific Resource Centre. Antler Aviation pilots and staff transported field personnel and equipment safely and efficiently; we sincerely appreciate the professional and personable attention given to us during this study.

We are grateful to Parks Canada staff in Winnipeg and Haines Junction for approval to place our field camp within the North Yukon National Park Reserve; Chief Park Warden Gordon Antoniuk, his predecessor Ray Frey, Gary Adams (archaeologist), Cam Alexander (environmental assessment review officer) and Park Superintendent Charlie Zynkit were all helpful in this matter. The Park Ranger Trainees from Herschel Island Territorial Park assisted us during one ground survey and provided other information; we would like to thank Dr. Don Pattie for helping coordinate that survey and Victor Allen, Donald Arey, Frank Elanik, Colin Gordon, Lee John Meyook, and Andy Tardiff for participating.

We thank Loney Dickson, Canadian Wildlife Service, for the loan of field equipment; the staff of Environmental Protection Service, Environment Canada, Inuvik, for the loan of a Zodiac; and the Inuvik Scientific Resource Centre for various field equipment.

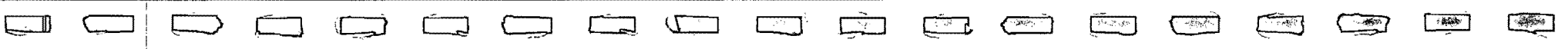
Assistance from Sam Barry, Canadian Wildlife Service, on computer techniques and analysis was greatly appreciated. Drafts of the report were reviewed by Loney Dickson, Lynne Dickson (Canadian Wildlife Service), and Bob Bromley (Northwest Territories Renewable Resources); the quality of the final report benefited greatly from their comments. Thanks to Susan Popowich for drafting the figures.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES



1.0 INTRODUCTION

Nunaluk Spit and vicinity have been identified, in an atlas documenting key areas for birds along the Canadian Beaufort Sea coast, as moderate to high use areas for waterbirds and shorebirds (Alexander et al. 1988). In particular, Nunaluk Spit and nearby Avadlek Spit were identified as major staging sites for phalaropes with over 50 000 estimated to have been present in mid-August, 1985 and 1986. No other locations of such great significance to phalaropes were identified between Clarence Lagoon, at the border with Alaska, and the Bathurst Peninsula, at the east end of the Beaufort Sea mainland coast.

The present study was initiated to examine the apparent importance of the Nunaluk Spit area to phalaropes. In addition, information was gathered on the pre-migratory and migratory activities of all water-associated birds in order to better assess the importance of this area to birds in general. The study was conducted as part of the Northern Oil and Gas Action Program.

The objectives of the study were:

1. to monitor the passage of phalaropes and other birds past Nunaluk Spit during the fall migration period;
2. to examine habitat use and distribution of phalarope and other birds in the vicinity of Nunaluk Spit; and
3. to elaborate on the importance of Nunaluk Spit, Nunaluk Lagoon, and the Malcolm and Firth river deltas to shorebirds and waterbirds within the context of the key area atlas of the Canadian Beaufort Sea.

2.0 STUDY AREA

2.1 Nunaluk Spit

Nunaluk Spit lies along the northwest coast of the Yukon Territory, just west of Herschel Island (Figures 1 and 2). It extends 28.5 km from 69° 37'N 140° W to 69° 33'N 139° 20'W. The spit is continuous for nearly 20 km, the western third of which is attached to the mainland at four sites. Opposite the mouth of the Firth River, the spit is represented by three barrier islands, separated by water gaps maintained by the flow from the Firth and Malcolm rivers and from a small, perennial spring between the rivers (Griffiths et al. 1975). Emphasis in this study is on the continuous portion of the spit that extends from the eastern tip of the spit to the easternmost attachment with the mainland (Figure 2).

The spit is narrow (about 50 m across) and bears similar features throughout most of its length. Numerous spurs of sand and gravel extend 5 to 10 m from the south side of the spit into Nunaluk Lagoon. The spit is largely composed of fine to medium pebble gravel rising about 2 m above the mean water level. The spit is steeper along the ocean side, with abundant driftwood and detritus, the result of late fall gales, scattered over the gently sloping lagoon side.

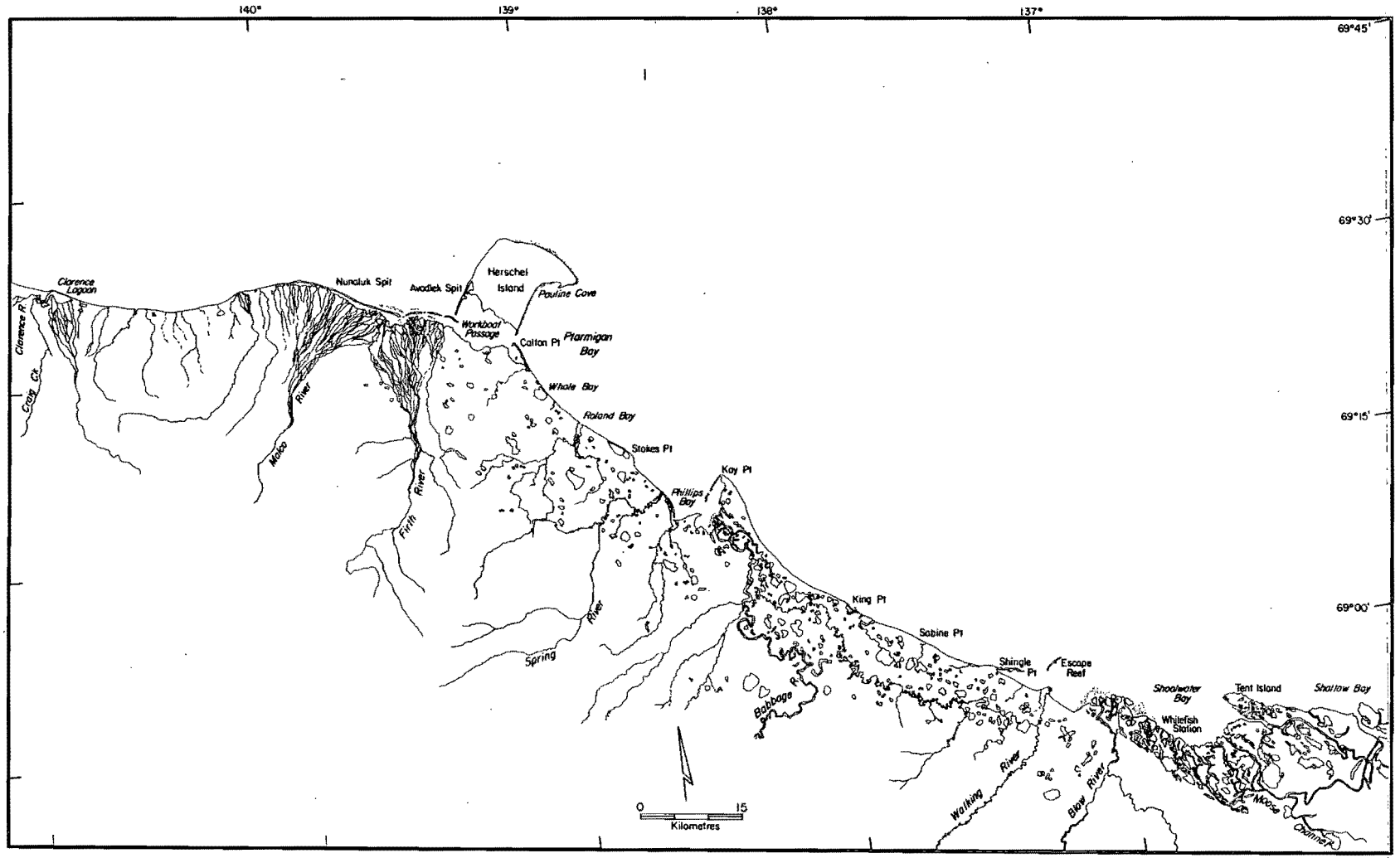


Figure 1. Yukon Territory coastline.

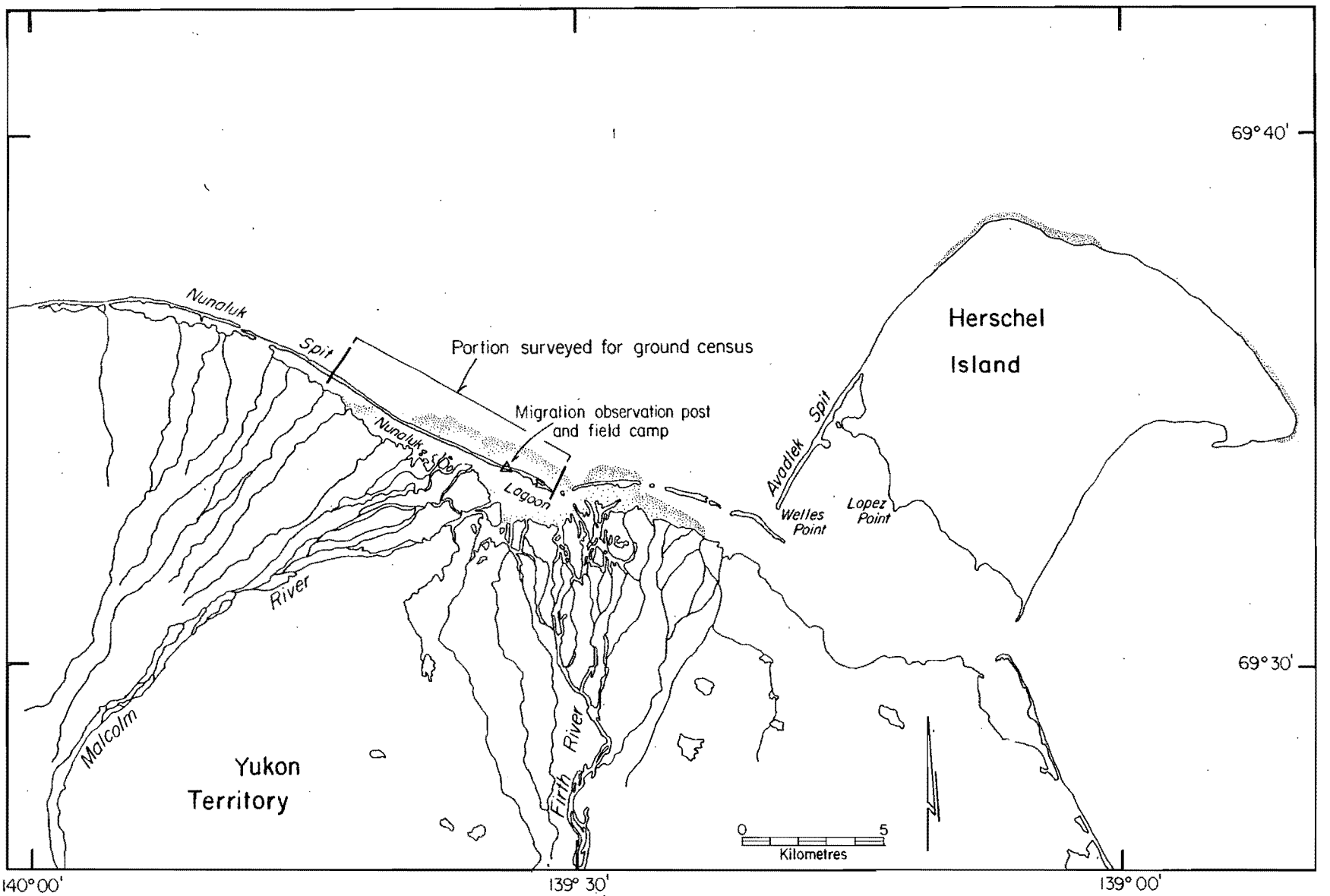


Figure 2. Nunaluk Spit study area and vicinity.

A promontory, which is actually an island remnant composed of clay and silt, anchors Nunaluk Spit at a point 2 km from the eastern tip. This promontory is about 0.25 ha in size; reaches a height of 10 m above water level; and features a mat of dwarf willows, grasses, sedges and a variety of flowering herbaceous plants. Tiny catchment ponds are located on the top and lower south side of the promontory.

East of the promontory, the spit has several larger ponds, patches of low-lying vegetation, and shallow embayments (often uncovered mudflats during late summer). Most of this portion of the spit is composed of gravel and driftwood detritus, similar to the spit to the west of the promontory.

The ocean side of the spit features a substrate of medium gravel which changes to sand and gravel 2-3 m offshore (Griffiths et al. 1975). A relatively shallow (less than 7 m) bench extends for up to a kilometre northwards from the eastern half of the continuous spit and the first barrier island (Canadian Hydrographic Service 1986) (Figure 2).

2.2 Nunaluk Lagoon

Nunaluk Lagoon (Figure 2) has a number of features attractive to moulting and staging waterbirds and shorebirds. The lagoon varies in width from 300 to 1200 m and is protected by the spit from wave action. Sediments from the Firth and Malcolm rivers are trapped in the lagoon, forming a complex of mudflats that is often covered by only a few centimetres of water, depending upon the tide and wind conditions. The deepest part of the lagoon is the western third, where it reaches a maximum depth of 2 m. Sediments in the latter area consist of very fine mud with high organic content (Griffiths et al. 1975). The shallow areas (10 - 15 cm), where the lagoon waters meet Nunaluk Spit, are underlain by fine to medium gravel. Sand and silt predominate along the south side of the lagoon under shallow waters (0 - 20 cm) adjacent the river deltas.

2.3 Avadlek Spit

Avadlek Spit (Figure 2) and parts of Workboat Passage between Herschel Island and the mainland were surveyed a few times during the study. Avadlek Spit, extending 5.5 km towards the SSW from Herschel Island, is similar to Nunaluk Spit but is oriented perpendicular to the latter. Thus, Avadlek Spit cuts across the east-west passage route of many migrants.

2.4 Yukon Coast

The entire length of the Yukon Territory coastline, from Shingle Point to Clarence Lagoon, was included in aerial surveys and subsequent analysis (Figure 1). The major physical features include river deltas, embayments, barrier beaches, spits, barrier islands, and cliffs. Cliff areas are highly unstable; frequent erosion of these sediment-ice complexes occurs as a result of thermal erosion, and wind and wave action. Pebble beaches, spits, and islands are more persistent and protect the mainland from wave

damage during the brief open water period (late June to September). Tidal action is relatively minor (approximately 0.6 m) in this part of the Beaufort Sea (Pilot of Arctic Canada 1968).

2.5 Climate

The most representative weather records for the Nunaluk Spit area come from Komakuk Beach (Figure 1) and Herschel Island (Tables 1 and 2). Summer and early fall months (July through September) are generally cool; daily mean temperatures range from 0°C to 7.3°C, with occasional spells reaching 27°C. Winds blow predominantly from the northwest or east. Very little precipitation falls during the year; about half of it falls as rain during the summer months. The total precipitation recorded at Komakuk Beach for the months of July through September averages 7.2 cm annually (Burns 1973).

3.0 METHODS

3.1 Ground Surveys and Migration Watches

Ground censuses were conducted from July 28 to August 31, 1987, along a portion of Nunaluk Spit that extended 10 km westward from the tip. Ten censuses were completed at intervals of 1 to 5 days. The shorter intervals coincided with anticipated peak staging by phalaropes. Segments of 100 m were flagged along the entire 10 km length of the spit surveyed. Two separate observers, beginning simultaneously, one at the initial segment and one at the mid-point of the 10 km section, walked westward along the survey route. All birds within 100 m of the spit were recorded. Large flocks at distances greater than 100 m were recorded also, but the emphasis of the censuses was on birds that were apparently associated with the spit. Observations of birds on each census included: location (north, south, or on the spit), survey segment, species, number of birds, behaviour, habitat features, weather, and distance from spit. The observations were recorded in field notebooks and transcribed in the field camp onto data forms designed for direct computer input. A code sheet is shown in Appendix 2.

Migration watches were conducted every day (weather permitting), with breaks for ground surveys, from the top of the 10 m high promontory. Six two-hour watches were scheduled over each 24-hour survey period (usually a calendar day) (Table 3). As amount of daily darkness increased, the late evening and early morning observation times (02:00-04:00 and 06:00-08:00) were cancelled. An additional migration watch period (08:00-10:00) was added near the end of the summer to maintain coverage of at least 10 hours of observation during a survey day. A total of 216 hours of migration watches were completed by three different observers. Two of the observers did the majority (80%) of watches.

During the migration watches, 7x35 or 8x40 binoculars were used to scan south and north of the observation post, and a 20 power or 15-60 power spotting scope was used to identify species at a distance. Periodic scans of the sky were used to detect birds flying overhead. For each

Table 1. Weather elements recorded at Komakuk Beach[a], Herschel Island[b] and Nunaluk Spit.

Month/Place	Temperature (°C) Daily Mean	Mean Daily Max.	Mean Daily Min.	Extreme Max.	Extreme Min.	Number of Days With Rain	Snow	Frost	Fog	Gale
July										
Komakuk	7.3	11.6	2.9	27.2	-5.6	6	<1	6	--	--
Herschel	6.7	10.0	2.8	20.6	-1.7	4	2	--	7	3
Herschel (1987)[c]	8.9	12.7	4.7	21.0	-3.0	5	0	--	8	0
August										
Komakuk	5.9	9.6	2.3	25.6	-7.7	5	2	10	--	--
Herschel	5.0	8.3	2.2	17.8	-4.4	4	2	--	5	4
Herschel (1987)	7.9	11.2	4.6	14.0	0.0	4	0	--	4	0
Nunaluk (1987)	8.6	11.4	5.8	15.0	2.0	11	2	--	8	2
September										
Komakuk	0.8	3.6	-2.1	23.3	-17.8	3	2	25	--	--
Herschel	0.0	2.8	-2.8	13.3	-13.3	2	4	--	2	3
No. of years of record (pre-1987)										
Komakuk	July - August 12 yrs, September 13 yrs.									
Herschel	6	6	6	6	6	6	5	--	7	7

[a] Adapted from Burns (1973).
[b] Adapted from Pilot of Arctic Canada (1968).
[c] Data from Herschel Island Park Ranger trainees, at Herschel townsite; includes data from July 1 to August 18, 1987.

Table 2. Wind direction recorded at Herschel Island[a] and Nunaluk Spit.

Month/Place	Percentage Frequencies of Wind Direction								
	N	NE	E	SE	S	SW	W	NW	Calm
July									
Herschel	5	17	21	5	4	9	5	20	14
August									
Herschel	6	10	26	9	0	5	11	21	12
Nunaluk	10.2	1.4	29.2	2.3	3.7	2.8	24.1	22.7	4.2
September									
Herschel	4	5	17	19	1	2	9	26	17
No. of years of record									
Herschel	July to September, 9 yrs;								
Nunaluk	1987 only								

[a] From Pilot of Arctic Canada (1968).

Table 3. Dates and starting times of two-hour migration watches conducted on Nunaluk Spit, July 29 to August 30, 1987.

Survey Period & Number	Date	No. of Hours	Time[a]									
Period 1												
1	July 29	6					10			18	22	
2	July 30	12			02	06	10		14	18	22	
Period 2												
3	Aug. 1	8			02	06				18	22	
4	Aug. 2	12			02	06	10		14	18	22	
5	Aug. 4	12			02	06	10		14	18	22	
Period 3												
6	Aug. 6	10				06	10		14	18	22	
7	Aug. 7	12			02	06	10		14	18	22	
8	Aug. 9-10	10					10		14	18	22	06
Period 4												
9	Aug. 12	12			02	06	10		14	18	22	
10	Aug. 13-14	12	22	02	06		10		14	18		
11	Aug. 14-15	12	22	02	06		10		14	18		
Period 5												
12	Aug. 17-18	12	22	02	06		10		14	18		
13	Aug. 18-19	12	22	02	06		10		14	18		
14	Aug. 20	10			06		10		14	18	22	
Period 6												
15	Aug. 21	12			06	08	10		14	18	22	
16	Aug. 22	8			06	08	10			18		
17	Aug. 24	12			06	08	10		14	18	22	
Period 7												
18	Aug. 26	10				08	10		14	18	22	
19	Aug. 27	2				08						
20	Aug. 28	10				08	10		14	18	22	
21	Aug. 29	4				08	10					
22	Aug. 30	6						12	16	20		

[a] Times are in Mountain Daylight-saving Time; therefore, times are 2 hours ahead of the local Pacific Standard Time.

watch, the following observational data were recorded on a tape recorder: location of birds (north, south, or above the spit), time, weather (temperature, cloud cover, wind speed/direction, and precipitation), visibility, flock observation number (a sequential number used to identify the number of discrete observations per hour of single birds or multiple bird flocks), species, number of birds, age and sex (when possible), height above ground/water level, distance from spit, flight direction, and flight type (probable migration, possible migration, or local flight). Observations recorded on tape were transcribed onto data forms designed for direct computer input. A code sheet is shown in Appendix 2.

The flights of birds past the promontory were classified as either probable migration, possible migration, or local flights. Classification of each observation, though based on a variety of behavioural cues, was subjective. For most species it was usually feasible to make such a distinction; however, most of the phalarope flights could not be clearly designated. Analysis of bird flights past the spit took such classification problems into consideration. To simplify terminology in the analysis, all of the phalaropes recorded flying past the spit and all of the other species recorded as either probable or possible migrants, were categorized as undertaking migration/passage flights. Observations of birds whose flight directions were not ascertained or of birds observed staging near the observation post and whose subsequent flights could not be identified, were excluded from analysis of migration/passage flights.

The limitations of visual observations in monitoring migration trends have been well documented (Richardson et al. 1975). However, for the present study, the objective was to monitor the major migration activity and to concentrate upon those species that were staging at or were in some way associated with the spit. The techniques employed were sufficient to accomplish these objectives.

3.2 Aerial Surveys

Aerial surveys by helicopter were conducted between Escape Reef and Clarence Lagoon on August 8 and 13, 1987. The helicopter surveys were flown along the coastline, so that the number of phalaropes within 100 m from the shore could be recorded by the single observer. These surveys enabled the regional distribution of phalaropes to be examined.

Cursory fixed-wing aerial surveys were conducted on August 25 and September 2. Only a few of the sites surveyed by helicopter were examined during the fixed-wing surveys. These flights were opportunistic and merely supplemented the more rigorous surveys.

3.3 Analysis

Migration watches were grouped for analysis into five-day survey periods and an estimate was made of the number of daylight hours sampled during each period. Except for the first five-day period when only 18 hours were surveyed, all periods had similar total hours of migration watches (32 to 36 hours). The total number of daylight hours in each survey period was based on the average number of hours per day during

which light was adequate for observations. The daylight hours used in this analysis were slightly greater per day than official daylight (official daylight spans the time between sunrise and sunset but does not include dusk and dawn). For each survey period the following estimates applied: period 1 (July 27 to 31) - 24 hrs/day; period 2 (August 1 to 5) - 24 hrs/day; period 3 (August 6 to 10) - 23 hrs/day; period 4 (August 11 to 15) - 22 hrs/day; period 5 (August 16 to 20) - 20 hrs/day; period 6 (August 21 to 25) - 19 hrs/day; period 7 (August 26 to 31) - 18 hrs/day. Hourly rates of migration/passage flights were calculated for each survey period and used to estimate the total number of bird flights during all daylight hours of each survey period.

Observations for various species were combined and analysed in the following seven species groups: Ducks and Loons - 19 species or categories; Geese and Swans - 5; Shorebirds (Excluding Phalaropes) - 14; Phalaropes - 3; Larids - 9; Sparrows - 6; and Others - 4 (see Table 10). These species groups were selected to combine observations of similar birds, and to allow unidentified birds to be accounted for in the group to which they appeared to belong. For example, unidentified waterfowl which were noticeably either ducks or loons, could be considered in the Ducks and Loons species group. The Sparrows group included a number of unidentified sparrow-like birds (ground feeding passerines); the unidentified birds, because of their stature and behaviour, could have been any of the true sparrows identified as well as such species as the Lapland Longspur, Snow Bunting, and Water Pipit. These species were distinct as a group from other passerines observed, such as the Common Raven and the Bank Swallow. Table 10 shows all the species included in each species group, except the following three species for which flight direction was not recorded during migration watches: Larids - unidentified jaegers; Others - Gyrfalcon and Thick-billed Murre.

Descriptive and non-parametric statistics (chi-square, goodness of fit) were employed to elaborate trends and relationships.

4.0 RESULTS

In total, 68 species of birds were identified during the migration watches, ground surveys and periodic observations of Nunaluk Spit and vicinity (Appendix 1). Data on periods of peak abundance, direction of migration/passage flights (all of the phalarope flights and possible or probable migrant flights for all other species), and the nature of association with the spit were examined for differences between and within species groups.

4.1 Temporal Patterns and Abundance

During 216 hours of migration watches, 32 027 birds undertook flights designated as local, possible migration or probable migration (Table 4). Almost 9% of the observations were of birds whose flight direction could not be ascertained, or were of birds staging near the observation post and whose subsequent flight past the observation post was not identified. The estimated number of bird flights during daylight from July 27 to August 30 was 110 731. This is not to say that 110 731 different birds flew past the observation post, particularly among those birds making local flights. It is, however, an indicator of overall flight activity in the vicinity of the spit.

Frequencies of bird flights ranged from 71.8 birds/hr during the period August 21 to 25, to a peak of 299.7 birds/hr during the period August 6 to 10 (Table 4). Substantial frequencies of flights were also recorded during the 5-day periods immediately preceding and following the peak. A secondary peak of 201.5 birds/hr was recorded during the last survey period, August 26 to 30. Phalaropes and other shorebirds accounted for the majority of the observations during the primary peak whereas geese comprised the majority of flights during the secondary peak.

Similar peaks in migration/passage flights were evident when observations of local flights and staging birds were excluded (Table 5). Over three-quarters of the observations of Larids, one-half of Shorebirds (Excluding Phalaropes), and one-third of Ducks and Loons were local flights and staging birds. All observations of phalarope flights, for which a flight direction was recorded, were retained in this analysis since local flights could not be clearly distinguished from possible migration flights. In total, 24 360 birds undergoing migration/passage flights were recorded, and it was estimated that there were 83 012 flights by birds during daylight hours between July 27 and August 30.

The estimated total of 83 012 birds making migration/passage flights may be viewed as the maximum number of individual birds that may have migrated past Nunaluk Spit during daylight hours and visible to observers. This maximum would be the true estimate only if all migration/passage flights were actually migration flights.

Peak periods recorded during ground surveys were similar to those recorded during the migration watches (Table 6). In total, 16 646 birds were recorded (including staging and flying birds), 20.2% of which were observed on August 8. Surveys on August 5, 16 and 31 each accounted for 13 to 14% of all bird observations.

Table 4. Summary of all observations[a] made during migration watch periods on Nunaluk Spit, July 27 to August 30, 1987.

Species Group		Survey Period: July 27-31	August 1-5	August 6-10	August 11-15	August 16-20	August 21-25	August 26-30	Total
Ducks and Loons	all	218	533	422	1310	1042	307	207	4039
	% survey	5.4	13.2	10.4	32.4	25.8	7.6	5.1	12.6
	birds/hr	12.1	16.7	13.2	36.4	30.6	9.6	6.5	18.7
	est	1453	1999	1517	4003	3065	911	582	13530
Geese and Swans	all	0	2	2	136	681	364	5214	6399
	% survey	0	<0.1	<0.1	2.1	10.6	5.7	81.5	20.0
	birds/hr	0	0.1	0.1	3.8	20.0	11.4	162.9	29.6
	est	0	8	7	416	2003	1081	14664	18179
Shorebirds (Excluding Phalaropes)	all	14	537	3317	342	563	703	313	5789
	% survey	0.2	9.3	57.3	5.9	9.7	12.1	5.4	18.1
	birds/hr	0.8	16.8	103.7	9.5	16.6	22.0	9.8	26.8
	est	93	2014	11920	1045	1656	2087	880	19695
Phalaropes	all	1292	2731	5286	1751	321	92	63	11536
	% survey	11.2	23.7	45.8	15.2	2.8	0.8	0.6	36.0
	birds/hr	71.8	85.3	165.2	48.6	9.4	2.9	2.0	53.4
	est	8613	10241	18997	5350	944	273	177	44595
Larids	all	379	384	511	586	384	231	371	2846
	% survey	13.3	13.5	18.0	20.6	13.5	8.1	13.0	8.9
	birds/hr	21.1	12.0	16.0	16.3	11.3	7.2	11.6	13.2
	est	2527	1440	1836	1791	1129	685	1043	10451
Sparrows	all	5	60	52	169	243	594	279	1402
	% survey	0.4	4.3	3.7	12.1	17.3	42.4	19.9	4.4
	birds/hr	0.3	1.9	1.6	4.7	7.1	18.6	8.7	6.5
	est	33	225	187	516	715	1763	785	4224
Others	all	2	3	0	2	4	5	0	16
	% survey	12.5	18.8	0	12.5	25.0	31.3	0	<0.1
	birds/hr	0.1	0.1	0	0.1	0.1	0.2	0	0.1
	est	13	11	0	6	12	15	0	57
TOTAL	all	1910	4250	9590	4296	3238	2296	6447	32027
	% survey	6.0	13.3	29.9	13.4	10.1	7.2	20.1	100.0
	birds/hr	106.1	132.8	299.7	119.3	95.2	71.8	201.5	148.3
	est	12732	15938	34464	13127	9524	6815	18131	110731

[a]all - total number of birds observed during survey period.
% survey - percent of observations of each species group that were made during each survey period; in Total column it is percent of all birds seen that were in each species group.
birds/hr - average number of birds seen per hour of survey.
est - estimated number of birds that would have been observed from the observation post if all daylight hours had been sampled.

Table 5. Summary of migration/passage flights[a] recorded during migration watch periods on Nunaluk Spit, July 27 to August 30, 1987.

Species Group		Survey Period: July 27-31	August 1-5	August 6-10	August 11-15	August 16-20	August 21-25	August 26-30	Total
Ducks and Loons	all	121	108	134	1178	876	231	125	2773
	% survey	4.4	3.9	4.8	42.5	31.6	8.3	4.5	11.4
	birds/hr	6.7	3.4	4.2	32.7	25.8	7.2	3.9	12.8
	est	807	405	482	3599	2576	686	352	8907
Geese and Swans	all	0	2	0	126	612	319	5029	6088
	% survey	0	<0.1	0	2.1	10.1	5.2	82.6	25.0
	birds/hr	0	0.1	0	3.5	18.0	10.0	157.2	28.2
	est	0	8	0	385	1800	947	14144	17284
Shorebirds (Excluding Phalaropes)	all	1	142	1125	218	492	608	309	2895
	% survey	<0.1	4.9	38.9	7.5	17.0	21.0	10.7	11.9
	birds/hr	0.1	4.4	35.2	6.1	14.5	19.0	9.7	13.4
	est	7	533	4043	666	1447	1805	869	9370
Phalaropes	all	1167	2508	5240	1718	317	92	60	11102
	% survey	10.5	22.6	47.2	15.5	2.9	0.8	0.5	45.6
	birds/hr	64.8	78.4	163.8	47.7	9.3	2.9	1.9	51.4
	est	7780	9405	18831	5249	932	273	169	42639
Larids	all	88	0	8	8	77	97	38	316
	% survey	27.9	0	2.5	2.5	24.4	30.7	12.0	1.3
	birds/hr	4.9	0	0.3	0.2	2.3	3.0	1.2	1.5
	est	587	0	29	24	226	288	107	1261
Sparrows	all	1	49	32	106	163	553	276	1180
	% survey	0.1	4.2	2.7	9.0	13.8	46.9	23.4	4.8
	birds/hr	0.1	1.5	1.0	2.9	4.8	17.3	8.6	5.5
	est	7	184	115	324	479	1642	776	3527
Others	all	1	2	0	0	3	0	0	6
	% survey	16.7	33.3	0	0	50.0	0	0	<0.1
	birds/hr	0.1	0.1	0	0	0.1	0	0	<0.1
	est	7	8	0	0	9	0	0	24
TOTAL	all	1379	2811	6539	3354	2540	1900	5837	24360
	% survey	5.7	11.5	26.8	13.8	10.4	7.8	24.0	100.0
	birds/hr	76.6	87.8	204.3	93.2	74.7	59.4	182.4	112.8
	est	9195	10543	23500	10247	7469	5641	16417	83012

[a] all - all migration/passage flights recorded during watches.
% survey - percent of observations of each species group that were made during each survey period; in Total column it is percent of all birds seen that were in each species group.
birds/hr - average number of birds making migration/passage flights per hour of survey.
est - estimated number of flights that would have been seen from the observation post if all daylight hours were sampled.

When only flying birds (suspected migration/passage flights) were considered from the ground surveys, peak passage occurred during the periods August 16 to 20 and 26 to 31 (Table 7). The general impression while in the field was that August 16 was the day of greatest migratory activity (mostly shorebirds, ducks and sparrows). Geese accounted for most of the flight activity during the period August 26 to 31.

4.1.1 Ducks and Loons

Ducks and Loons were fairly common as migrants and staging birds in the vicinity of Nunaluk Spit. A third of the birds observed during migration watches were staging or undertaking local flights (Tables 4 and 5). Only Common Eiders, Red-throated Loons, and possibly other loon species were observed to be associated with nests or young on Nunaluk Spit or on the adjacent deltas. Nearly all of the Duck and Loon species observed have been reported to nest on offshore spits and islands or along the Yukon coastal plain (Hawkings 1987), with the exception of Common and Yellow-billed Loons.

Thirteen species of Ducks and Loons were observed during the migration watches for a total of 4039 birds (Appendix 3). About 20% of these birds were unidentified ducks. The six most frequently observed birds were: Northern Pintail (32.9%), Oldsquaw (19.0%), Red-throated Loon (10.9%), Common Eider (5.7%), American Wigeon (4.2%) and White-winged Scoter (2%). When only migration/passage flights were considered, the six most frequently observed birds were: Northern Pintail (41.3%), Oldsquaw (14.1%), American Wigeon (6.1%), White-winged Scoter (2.5%), Common Eider (1.6%), and Mallard (1.1%). Fewer than 1% of these latter observations were of Red-throated Loons; both this species and Common Eiders undertook a number of local flights, the former undertaking foraging bouts to catch fish for its young and the latter flying from one staging location to another.

Peak migration/passage flights for Ducks and Loons occurred during August 11 to 15 (32.7 birds/hr) and August 16 to 20 (25.8 birds/hr) (Table 5). Peak migration/passage flights for the most regularly observed species occurred during August 11 to 15 (American Wigeon, Northern Pintail, Red-throated Loon, and White-winged Scoter) (Appendix 3).

During ground surveys, Duck and Loon migration flights peaked on August 16th (416 birds; Table 7). This was also the peak for flying Oldsquaw, American Wigeon, Northern Pintails, and Red-throated Loons (in decreasing abundance). The August 16 survey was the day after the peak period identified from the migration watches. Fewer than 61 Ducks and Loons were noted flying during other ground surveys and likely many were on local flights.

4.1.2 Geese and Swans

Geese and Swans were second only to Phalaropes in number of birds seen during migration watches (Tables 4 and 5). In total, 6399 observations of this species group were made, most of which were migration/passage flights. However, numerous Brant and some Snow Geese were observed staging along the outer deltas at the end of August. Migration/passage

Table 6. Summary of all observations[a] made during ground censuses on Nunaluk Spit, July 27 to August 31, 1987.

		Survey Period							
		July		August					
		27-31	27-31	1-5	6-10	11-15	11-15	16-20	16-20
		Survey Date							
Species Group		27/28	31	5	8	11	13	16	20
Ducks and Loons	all	200	151	259	365	168	168	528	119
	% survey	9.1	6.9	11.7	16.6	7.6	7.6	23.9	5.4
	% spp	17.3	21.3	10.9	10.8	14.5	9.2	23.8	16.3
Geese and Swans	all	8	0	7	4	11	49	9	24
	% survey	0.3	0	0.2	0.2	0.4	2.0	0.4	1.0
	% spp	0.7	0	0.3	0.1	0.9	2.7	0.4	3.3
Shorebirds (Excluding Phalaropes)	all	12	236	75	192	233	270	1020	208
	% survey	0.5	10.0	3.2	8.1	9.8	11.4	43.0	8.8
	% spp	1.0	33.3	3.2	5.7	20.1	14.7	46.0	28.5
Phalaropes	all	844	219	1880	2612	496	1099	133	232
	% survey	11.1	2.9	24.8	34.4	6.5	14.5	1.8	3.1
	% spp	72.8	30.9	79.2	77.6	42.8	60.0	6.0	31.8
Larids	all	95	101	149	141	137	199	95	89
	% survey	8.2	8.7	12.9	12.2	11.9	17.2	8.2	7.7
	% spp	8.2	14.3	6.3	4.2	11.8	10.8	4.3	12.2
Sparrows	all	0	1	4	53	115	51	433	57
	% survey	0	0.1	0.5	6.3	13.7	6.1	51.7	6.8
	% spp	0	0.1	0.2	1.6	9.9	2.8	19.5	7.8
Others	all	0	0	0	0	0	0	0	1
	% survey	0	0	0	0	0	0	0	100.0
	% spp	0	0	0	0	0	0	0	0.1
TOTAL	all	1159	708	2374	3367	1160	1836	2218	730
	% survey	7.0	4.3	14.3	20.2	7.0	11.0	13.3	4.4

[a]all - total number of birds seen during each census.
% survey - percent of observations for each species group that were seen during each census.
% spp - percent of observations for each census that were of birds in each species group.

Table 6. (cont.)

Species Group		Survey Period August 21-25 Survey Date 25	Survey Period August 26-31 Survey Date 31	Total
Ducks and Loons	all	183	65	2206
	% survey	8.3	2.9	100.0
	% spp	24.5	2.8	13.3
Geese and Swans	all	414	1960	2486
	% survey	16.7	78.8	100.0
	% spp	55.3	83.6	14.9
Shorebirds (Excluding Phalaropes)	all	43	81	2370
	% survey	1.8	3.4	100.0
	% spp	5.8	3.5	14.2
Phalaropes	all	0	75	7590
	% survey	0	1.0	100.0
	% spp	0	3.2	45.6
Larids	all	37	113	1156
	% survey	3.2	9.8	100.0
	% spp	5.0	4.8	6.9
Sparrows	all	71	52	837
	% survey	8.5	6.2	100.0
	% spp	9.5	2.2	5.0
Others	all	0	0	1
	% survey	0	0	100.0
	% spp	0	0	<0.1
TOTAL	all	748	2346	16646
	% survey	4.5	14.1	100.0

Table 7. Summary of observations[a] of flying birds during ground censuses on Nunaluk Spit, July 27 to August 31, 1987.

		Survey Period							
		July		August					
		27-31	27-31	1-5	6-10	11-15	11-15	16-20	16-20
		Survey Date							
Species Group		27/28	31	5	8	11	13	16	20
Ducks and Loons	all	61	25	39	48	34	27	416	10
	% survey	8.8	3.6	5.6	6.9	4.9	3.9	60.1	1.4
	% spp	26.4	27.8	15.2	9.1	5.7	4.5	21.1	2.2
Geese and Swans	all	0	0	0	0	0	0	9	21
	% survey	0	0	0	0	0	0	0.5	1.1
	% spp	0	0	0	0	0	0	0.5	4.6
Shorebirds (Excluding Phalaropes)	all	1	4	15	11	17	246	1000	172
	% survey	0.1	0.3	1.0	0.7	1.1	15.9	64.5	11.1
	% spp	0.4	4.4	5.8	2.1	2.9	41.2	50.7	37.4
Phalaropes	all	113	16	152	387	385	274	108	147
	% survey	7.0	1.0	9.4	24.0	23.9	17.0	6.7	9.1
	% spp	48.9	17.8	59.1	73.6	64.6	45.9	5.5	32.0
Larids	all	56	45	51	36	52	21	27	53
	% survey	13.6	10.9	12.3	8.7	12.6	5.1	6.5	12.8
	% spp	24.2	50.0	19.8	6.8	8.7	3.5	1.4	11.5
Sparrows	all	0	0	0	44	108	29	414	56
	% survey	0	0	0	5.8	14.1	3.8	54.2	7.3
	% spp	0	0	0	8.4	18.1	4.9	21.0	12.2
Others	all	0	0	0	0	0	0	0	1
	% survey	0	0	0	0	0	0	0	100.0
	% spp	0	0	0	0	0	0	0	0.2
TOTAL	all	231	90	257	526	596	597	1974	460
	% survey	3.4	1.3	3.7	7.6	8.7	8.7	28.7	6.7

[a] all - total number of flying birds seen during each census.
% survey - percent of observations for each species group that were seen during each census.
% spp - percent of observations for each census that were of birds in each species group.

Table 7. (cont.)

Species Group		Survey Period August 21-25 Survey Date 25	Survey Period August 26-31 Survey Date 31	Total
Ducks and Loons	all	11	21	692
	% survey	1.6	3.0	100.0
	% spp	2.1	1.3	10.1
Geese and Swans	all	414	1410	1854
	% survey	22.3	76.1	100.0
	% spp	77.8	86.9	26.9
Shorebirds (Excluding Phalaropes)	all	27	57	1550
	% survey	1.7	3.7	100.0
	% spp	5.1	3.5	22.5
Phalaropes	all	0	29	1611
	% survey	0	1.8	100.0
	% spp	0	1.8	23.4
Larids	all	14	58	413
	% survey	3.4	14.0	100.0
	% spp	2.6	3.6	6.0
Sparrows	all	66	47	764
	% survey	8.6	6.2	100.0
	% spp	12.4	2.9	11.1
Others	all	0	0	1
	% survey	0	0	100.0
	% spp	0	0	<0.1
TOTAL	all	532	1622	6885
	% survey	7.7	23.6	100.0

flights were very frequent at that time (157.2 birds/hr; Table 5) and were primarily Brant (76.4%), which often landed at delta locations 1 to 4 km west of the observation post. Greater White-fronted Geese were recorded during watches from August 26 to 30 and only as migrants. Swans were observed regularly throughout the study period, but always in low numbers and generally as birds undergoing local flights (Appendix 4). Breeding pairs and young swans were observed on the river deltas at low densities during aerial surveys; these birds were the primary source of swans observed from Nunaluk Spit.

In contrast to the migration watches, ground surveys indicated a greater number of flights for Snow Geese (1015 birds) than for Brant (713 birds). This difference was due to the very high number of passage flights by Snow Geese recorded on August 31 (Appendix 4); approximately 98% of all Snow Goose migration flights occurred on that day.

4.1.3 Shorebirds (Excluding Phalaropes)

Shorebirds comprised about 18% of observations during migration watches (5789 birds; Table 4). Only about half of the observations were migration/passage flights (2895 birds; Table 5). Identified shorebirds (11 species, excluding phalaropes) accounted for only about 10% of all shorebird observations, and about 15% of migration/passage flights (Appendix 5).

Peak shorebird migration activity (35.2 birds/hr) occurred from August 6 to 10, which was early compared to other species groups. Fifty percent of the migration activity was observed prior to August 11. The peak periods of occurrence for the six most abundant shorebird species were: August 6 to 10 for Black-bellied Plovers and Ruddy Turnstones; August 16 to 20 for Lesser Golden-Plovers; August 21 to 25 for Long-billed Dowitchers and Pectoral Sandpipers; and August 26 to 30 for Sanderlings.

Ground surveys indicated a later overall peak in migration activity than suggested by migration watches. The peak number of flights (1000 birds) was recorded on August 16. However, that peak was largely unidentified shorebirds. Amongst the identified shorebirds, peak flight activity for the four predominant species was either at approximately the same time as, or earlier than that indicated by the migration watches. The periods of greatest flight activity for these species were: August 1 to 5 for Ruddy Turnstones (only five observations); August 16 to 20 for Lesser Golden-Plovers and Pectoral Sandpipers; and August 26 to 31 for Sanderlings.

4.1.4 Phalaropes

In total, 11 536 phalaropes were observed during migration watches, of which 98.4% were Red-necked Phalaropes and 0.8% were Red Phalaropes (Table 8). For the analysis of migration/passage flights, all flights, except those for which a flight direction was not determined, were included. This was necessary because the phalaropes' habit of briefly alighting on the water to forage while maintaining a gradual movement past the observation post made it difficult to differentiate local flights from

Table 8. Summary of all observations[a] of phalaropes made during migration watch periods on Nunaluk Spit, July 27 to August 30, 1987.

Species	Survey Period: July 27-31	August 1-5	August 6-10	August 11-15	August 16-20	August 21-25	August 26-30	Total
Red-necked Phalarope								
all	1292	2731	5286	1700	253	64	31	11357
% spp	100.0	100.0	100.0	97.1	78.8	69.6	49.2	98.4
Red Phalarope								
all	0	0	0	1	52	14	25	92
% spp	0	0	0	0.1	16.2	15.2	39.7	0.8
Phalarope unidentified								
all	0	0	0	50	16	14	7	87
% spp	0	0	0	2.9	5.0	15.2	11.1	0.8

[a]all - the total number of birds observed during each survey period.
% spp - percent of observations for each survey period that were of birds of each species.

possible migration flights. In total, 11 102 migration/passage flights were recorded, and the estimated total during daylight hours was 42 639 birds. The average frequency of 51.4 birds/hr was greater than for any other species group (Table 5).

Most Phalarope flight activity occurred prior to that of other species groups. About 85% of all flight activity was recorded before August 11, and peak flight frequency (163.8 birds/hr) was during the period August 6 to 10. Red Phalaropes were not identified during migration watches prior to the August 11 to 15 survey period (Table 8). Peak Red Phalarope activity (1.5 birds/hr) was observed from August 16 to 20.

Observations made during ground surveys generally supported the results of migration watches. The total of 7590 observations of phalaropes (Table 6) consisted of 98.6% Red-necked Phalaropes, 1.1% Red Phalaropes and 0.3% unidentified phalaropes (Appendix 6). Eighty percent of all phalarope observations were made before August 12, while over 80% of phalarope flights occurred prior to August 16 (Appendix 6). Red Phalaropes were first identified on August 11, and peak numbers were recorded on August 20.

4.1.5 Larids

Gulls, terns and jaegers were commonly observed in the vicinity of Nunaluk Spit. In total, 2846 observations of birds were made during migration watches, representing an estimated 10 451 birds over the daylight hours of the study (Table 4). Only about 10% (316 flights) of the observations were migration/passage flights (Table 5). Resident gulls and terns, including several breeding pairs, undertook numerous local flights for foraging adjacent to the spit.

Larids generally migrated later than most of the other species (Table 5). Peak periods of migration/passage flights were July 27 to 31 (Glaucous Gulls), August 16 to 20 (Arctic Terns), and August 21 to 25 (Arctic Terns, Glaucous Gulls, and Parasitic Jaegers) (Appendix 7). Herring/Thayer's Gulls, Long-tailed Jaegers, and Black-legged Kittiwakes were also observed but in numbers too small to assess migration.

The number of Larids observed during each ground survey was similar, likely reflecting the large proportion of local residents. The lowest number of birds observed was reported August 25, reflecting the departure of resident Arctic Terns and of many Glaucous Gulls. The increase in number of gulls recorded during the last ground survey on August 31 was due to birds foraging upon a whale carcass, beached near the tip of Nunaluk Spit by a storm on August 28th.

4.1.6 Sparrows

There was a low to moderate frequency of flights by sparrows and sparrow-like passerines (Lapland Longspur, Savannah Sparrow, Snow Bunting, Water Pipit, White-crowned Sparrow) during migration watches (Tables 4 and 5). In total, 1402 birds were seen yielding an estimate of 4224 birds for the daylight hours of the study. Migration/passage flights accounted for

84% of the observations, representing an estimated 3527 birds during daylight hours. Rates of migration/passage flights ranged from 0.1 birds/hr to 17.3 birds/hr, and peak flights occurred August 21 to 25.

Lapland Longspurs and Snow Buntings were the only abundant species in this group (comprising 81% and 10% of the observations, respectively) (Appendix 8). The remainder were Savannah Sparrows, White-crowned Sparrows, Water Pipits, and unidentified sparrows. Peak Snow Bunting migration/passage flights occurred August 1 to 10, with a secondary peak August 26 to 30. Peak Lapland Longspurs flights occurred August 21 to 25 when over 50% of the longspurs passed the spit.

Ground survey data differed somewhat from migration watch data. Lapland Longspurs accounted for over 90% of all observations, while Snow Buntings accounted for fewer than 10%. Migration peaks, as indicated by flying birds, occurred on August 16 (Lapland Longspur), and August 25 (Snow Bunting) (Appendix 9). The large passage of longspurs on August 16 represented a significant migration wave for that species. Detection of sparrows may have been inconsistent on ground surveys because they flew low over the middle of the spit whereas observer attention was focused mainly on the edges of the spit.

4.1.7 Other Species

A total of 16 observations of species not discussed above were made during migration watches. Species included, in decreasing abundance: Peregrine Falcon, Gyrfalcon, Bank Swallow, and Thick-billed Murre. A Northern Harrier was the only bird in this species group recorded during ground surveys. Observations were too few to assess migration chronology. However, later observations of falcons included flying young, indicating post-breeding flights.

4.2 Direction of Migration

All data for the following discussion come from migration watches. In general, westward migration/passage flights were slightly more common than eastward flights, and few birds flew north or south (Table 9). Results of a chi-square test for trends in east versus west flights by individual species are given in Table 10.

4.2.1 Ducks and Loons

Overall, Ducks and Loons tended to fly eastward, but this was not true of all species (Table 10). Eastward migration was determined for American Wigeon, unidentified dabbling ducks, unidentified ducks, Northern Pintails, and White-winged Scoters. Westward migrants were Common Eiders, Mallards, Oldsquaw, and Surf Scoters. No clear preference for a flight direction was evident for unidentified eiders, Red-throated Loons, and unidentified waterfowl. Since fewer than 10 observations were available for the remaining species, flight direction was not assessed.

Table 9. Summary of directions of migration/passage flights recorded during migration watch periods on Nunaluk Spit, July 27 to August 30, 1987.

Species Group	Direction of Travel			Total
	East	West	Other	
Ducks and Loons	1890	881	2	2773
Geese and Swans	879	5144	65	6088
Shorebirds (Excluding Phalaropes)	1456	1411	28	2895
Phalaropes	6131	4924	47	11102
Larids	91	218	7	316
Sparrows	389	687	104	1180
Others	5	1	0	6
TOTAL	10841	13266	253	24360

Table 10. Number of birds making migration/passage flights in major directions past Nunaluk Spit during migration watch periods, July 27 to August 30, 1987.

Species	Flight Direction East	West	Other	Total	X^2	Sign.[a]
Ducks and Loons						
American Wigeon	144	26	0	170	81.9	*
Black Scoter	3	2	0	5	N/A	--
Common Eider	13	30	0	43	6.7	0.01
Common Loon	3	0	0	3	N/A	--
Dabbler (unid)	215	28	0	243	143.9	*
Duck (unid)	124	77	0	201	10.0	*
Eider (unid)	10	9	0	19	<0.1	N.S.
Loon (unid)	1	1	0	2	N/A	--
Mallard	3	27	0	30	19.2	*
Northern Pintail	1015	130	0	1145	684.0	*
Oldsquaw	103	287	1	391	86.8	*
Pacific Loon	4	1	0	5	N/A	--
Red-breasted Merganser	3	6	0	9	N/A	--
Red-throated Loon	8	11	1	20	0.5	N.S.
Scoter (unid)	0	9	0	9	N/A	--
Surf Scoter	3	15	0	18	8.0	*
Waterfowl (unid)	189	200	0	389	0.3	N.S.
White-winged Scoter	49	20	0	69	12.2	*
Yellow-billed Loon	0	2	0	2	N/A	--
Geese and Swans						
Brant	74	4719	65	4858	4501.6	*
Dark Goose (unid)	554	2	0	556	548.0	*
Greater White-fronted Goose	241	0	0	241	241.0	*
Snow Goose	10	419	0	429	389.9	*
Tundra Swan	0	4	0	4	N/A	--
Shorebirds Excl. Phalaropes						
Baird's Sandpiper	0	8	0	8	N/A	--
Black-bellied Plover	43	0	0	43	43.0	*
Hudsonian Godwit	1	0	0	1	N/A	--
Long-billed Dowitcher	76	4	1	81	64.8	*
Lesser Golden-Plover	32	1	0	33	29.1	*
Peep	308	115	0	423	88.1	*
Pectoral Sandpiper	64	38	8	110	6.6	0.01
Plover (unid)	39	0	0	39	39.0	*
Ruddy Turnstone	38	17	0	55	8.0	*
Sanderling	7	75	0	82	56.4	*
Semipalmated Sandpiper	2	1	0	3	N/A	--
Shorebird (unid)	818	1149	19	1986	55.7	*
Stilt Sandpiper	17	0	0	17	17.0	*
White-rumped Sandpiper	11	3	0	14	4.6	0.03

Table 10. (cont.)

Species	Flight Direction East	West	Other	Total	X^2	Sign.
Phalaropes						
Phalarope (unid)	66	18	3	87	27.4	*
Red Phalarope	18	71	0	89	31.6	*
Red-necked Phalarope	6047	4835	44	10926	135.0	*
Larids						
Arctic Tern	30	68	0	98	14.7	*
Black-legged Kittiwake	0	24	0	24	24.0	*
Glaucous Gull	51	118	1	170	26.6	*
Gull (unid)	3	0	0	3	N/A	--
Herring Gull	0	1	0	1	N/A	--
Larid (unid)	0	3	0	3	N/A	--
Long-tailed Jaeger	0	0	1	1	N/A	--
Parasitic Jaeger	7	4	5	16	0.82	N.S.
Sparrows						
Lapland Longspur	305	596	75	976	94.0	*
Savannah Sparrow	0	3	0	3	N/A	--
Snow Bunting	58	38	0	96	4.2	0.04
Sparrow (unid)	26	48	29	103	6.5	0.01
Water Pipit	0	1	0	1	N/A	--
White-crowned Sparrow	0	1	0	1	N/A	--
Others						
Bank Swallow	2	0	0	2	N/A	--
Peregrine Falcon	3	1	0	4	N/A	--

[a]Sign. - significance of chi-square test made on difference between east and west components of the migration/passage flights:
N.S. - not significant
0.04 - probability 0.04
* - probability less than 0.01

4.2.2 Geese and Swans

Brant and Snow Geese flew predominantly westward, whereas Greater White-fronted Geese and unidentified dark geese (likely white-fronts) flew eastward (Table 10).

4.2.3 Shorebirds (Excluding Phalaropes)

In general, observations of migrating shorebirds appeared to be equally divided between eastward and westward flying birds. However, 9 out of 11 species and species groups flew predominantly eastward: Black-bellied Plover, Long-billed Dowitcher, Lesser Golden-Plover, unidentified peeps (mostly calidrids), unidentified plovers, Pectoral Sandpiper, Ruddy Turnstone, Stilt Sandpiper, and White-rumped Sandpiper (Table 10). Westward flying species included only Sanderlings and unidentified shorebirds. The latter group included a single flock of 1000 unidentified shorebirds that was observed flying west over a kilometre north of the observation post on August 6. These birds were likely a different species than most unidentified shorebirds. Most of the identified shorebirds flew towards the east, either above the spit, above the lagoon, or above the delta to the south of the observation post.

4.2.4 Phalaropes

Migration/passage flights by phalaropes were predominantly eastward (Table 9), reflecting the large component of Red-necked Phalaropes, which flew towards the east more frequently than to the west (Table 10). In contrast, Red Phalaropes mostly flew westward. Most of the small number of unidentified phalaropes flew towards the east suggesting that most were Red-necked Phalaropes.

The predominant direction of Red-necked Phalarope flights changed over the study period (Table 11). During three of the seven survey periods, significantly more Red-necked Phalaropes flew west than east: July 27 to 31, August 11 to 15, and August 25 to 30. During the August 1 to 5 period eastward flights were more numerous than westward flights. For all other survey periods, predominant flight directions could not be detected statistically.

In Tables 11 and 12, a X^2 test was applied to the first four survey periods and the last three survey periods as separate groups. This separation was necessary because of the large difference in numbers of birds seen during the periods of each group (average number of birds for the first four periods was 2645 versus 115 for the last three periods). Also, corrections to the number of birds seen were made to allow for differences in number of observation hours between survey periods. This resulted in doubling the number of observations for the first survey period (July 17 to 31). Nearly all of the first survey period's migration watches were held during westerly winds. As discussed below, Red-necked Phalaropes tend to fly in opposition to east and west winds; therefore, standardizing the number of observation hours may have added a

Table 11. Numbers of Red-necked Phalaropes, categorized by flight direction, that were observed during each migration watch period on Nunaluk Spit, July 27 to August 30, 1987; plus results of X^2 tests.

Flight Direction	Survey Period: July 27-31	August 1-5	August 6-10	August 11-15	August 16-20	August 21-25	August 26-30	Total
North	7	8	0	0	0	2	0	17
East	303	1977	2916	719	110	19	3	6047
South	2	20	0	0	5	0	0	27
West	855	503	2324	948	137	43	25	4835
TOTAL	1167	2508	5240	1667	252	64	28	10926
Contribution to X^2								
East	330.7	344.6	3.3	35.9				
West	386.9	403.1	3.9	42.0				
Total X^2 =1550.5								
d.f. =3								
significant	Yes	Yes	No	Yes				
Contribution to X^2								
East					2.0	1.2	6.1	
West					1.3	0.7	3.9	
Total X^2 =15.1								
d.f. =2								
significant					No	No	Yes	

disproportionate number of westward flights to the total for the first survey period.

Flocks of Red-necked Phalaropes (ranging from 1 to 130 birds) flew, on the whole, east and west with similar frequencies (Table 12). However, westward movements predominated during the period July 27 to 31, and eastward movements predominated during the periods August 1 to 5 and 16 to 20.

Red-necked Phalarope flight direction varied with wind direction during each hour of observation (Table 13). When winds blew from the east or west, Red-necked Phalaropes tended to fly in opposition to the wind. When winds blew from the south or north, no difference between east and west flights was identified. When winds were calm, more flights were made to the east than to the west. Red Phalarope flight direction did not appear to be related to wind direction (Table 13).

4.2.5 Larids

The predominant direction of migration/passage flights for Larids was westward (Table 9). Glaucous Gulls, Black-legged Kittiwakes and Arctic Terns all flew to the west more often than towards the east (Table 10). Parasitic Jaegers, the only other species sufficiently sampled for analysis, were found to fly east and west with similar frequency.

4.2.6 Sparrows

The predominant direction of flight for the Sparrow species group was westward (Table 9). Lapland Longspurs and unidentified sparrows flew to the west more often than to the east (Table 10). In contrast, Snow Buntings flew to the east more frequently than to the west. All of the remaining identified species (Savannah Sparrows, White-crowned Sparrows, and Water Pipits) flew to the west, with no flights recorded to the east; however, sample sizes were too small to test.

4.3 Spatial Distribution, Habitat Use and Behaviour

The local distributions of all birds observed during ground surveys were examined for variation between species groups and for indications of habitat selection. Only birds recorded as not flying were used to examine the relationship between bird distribution and habitat features of Nunaluk Spit.

The eastern tip of Nunaluk Spit was much more heavily used than the remainder of the spit. Forty-five percent of all birds and 66% of all non-flying birds were observed within the first kilometre of the spit (Table 14). This pattern was evident in (from most pronounced to least pronounced) Ducks and Loons, Phalaropes, Shorebirds, and Larids. Most geese were observed on kilometre 7, whereas most sparrows occurred in kilometre 2.

Table 12. Number of flocks of Red-necked Phalaropes, categorized by flight direction, that were observed during each migration watch period on Nunaluk Spit, July 27 to August 30, 1987; plus results of X^2 tests.

Flight Direction	Survey Period: July 27-31	August 1-5	August 6-10	August 11-15	August 16-20	August 21-25	August 26-30	Total
North	1	2	0	0	0	1	0	4
East	72	187	256	123	37	12	2	689
South	1	1	0	0	2	0	0	4
West	171	75	242	163	30	19	10	710
TOTAL	245	265	498	286	69	32	12	1407
Contribution to X^2								
East	31.3	37.1	2.3	1.0				
West	27.8	33.0	2.0	0.9				
Total X^2 = 135.3								
d.f. = 3								
significant	Yes	Yes	No	No				
Contribution to X^2								
East					7.8	0.1	1.2	
West					4.2	0.1	0.7	
Total X^2 = 14.1								
d.f. = 2								
significant					Yes	No	No	

Table 13. Wind direction versus flight direction for phalaropes flying past Nunaluk Spit during migration watch periods, July 27 to August 30, 1987; plus results of X^2 tests.

Red-necked Phalarope

Flight Direction		Wind Direction East	South	West	North	Calm	Total
East	observed	3979	65	732	404	867	6047
	expected	2999.6	57.2	1799.3	420.1	770.7	
	X^2 value	319.8	1.1	633.1	0.6	12.0	
West	observed	1419	38	2506	352	520	4835
	expected	2398.4	45.8	1438.7	335.9	616.3	
	X^2 value	399.9	1.3	791.8	0.8	15.0	
TOTAL	observed	5398	103	3238	756	1387	10882
	X^2 value						2175.5

p(no relationship between flight direction and wind direction) < 0.01; d.f.=4. Greatest contribution to the X^2 value is in cells representing birds flying in opposition to the wind.

Red Phalarope

Flight Direction		Wind Direction East	South/North	West	Total
East	observed	0	7	11	18
	expected	2.0	4.04	11.9	
	X^2 value	2.0	2.17	0.07	
West	observed	10	13	48	71
	expected	8.0	15.96	47.1	
	X^2 value	0.5	0.55	0.02	
TOTAL	observed	10	20	59	89
	X^2 value				5.3

X^2 test not significant; d.f.=2. Red Phalaropes do not appear to fly in response to wind direction.

Table 14. Percentage of non-flying birds, by species group, that occurred in each kilometre of Nunaluk Spit during ground surveys, July 27 to August 31, 1987.

Species Group	Kilometer Survey Units										Total
	1	2	3	4	5	6	7	8	9	10	
Ducks and Loons	85.3	4.6	2.4	2.0	0.9	1.4	1.3	0.9	0.4	0.7	1514
Geese and Swans	4.7	0	0	1.3	4.0	0.3	87.0	0.6	0	2.1	632
Shorebirds (Excl. Phalaropes)	60.0	4.1	19.3	9.6	2.4	1.3	1.3	0.2	0.4	1.2	820
Phalaropes	73.9	4.7	5.0	11.0	1.4	1.9	1.1	0.5	0.4	0	5979
Larids	27.9	11.8	13.7	8.6	14.7	5.9	7.7	7.3	1.9	0.5	743
Sparrows	30.1	41.1	9.6	4.1	9.6	5.5	0	0	0	0	73
TOTAL	66.2	5.2	6.2	8.6	2.7	2.0	7.2	1.1	0.5	0.4	9761

Table 15. Percentage of non-flying birds, by species group, that occurred at different locations across Nunaluk Spit during ground surveys, July 27 to August 31, 1987.

Species Group	Location Across Spit[a]			Total
	North	South	Middle of Spit	
Ducks and Loons	16.8	81.6	1.6	1514
Geese and Swans	2.4	97.2	0.5	632
Shorebirds (Excluding Phalaropes)	5.9	60.1	34.0	820
Phalaropes	41.2	29.8	28.9	5979
Larids	39.2	26.2	34.6	743
Sparrows	1.4	17.8	80.8	73
TOTAL	31.5	44.4	24.1	9761

[a] Includes all birds within 100 m of Nunaluk Spit that were not flying. North and South classifications refer to birds either along or off the north and south shores. Middle of Spit includes birds on the spit.

The north side, south side, and middle of the spit were used to various degrees by different species (Table 15). More birds used the south side of the spit and adjacent lagoon, than the north side of the spit and adjacent ocean. The middle of the spit was used least of all. Geese and Swans, Ducks and Loons, and Shorebirds were most abundant along the south side; Phalaropes and Larids were most abundant along the north side; and Sparrows were most abundant along the middle of the spit.

Nearly 85% of the birds observed were located within 10 m of the spit (Table 16). However, 90% of the Geese and Swans, 33% of the Ducks and Loon, and 33% of the Larids were observed at distances greater than 10 m from the spit.

The distributions of non-flying birds were compared with distributions of vegetation, ponds, and driftwood along the spit. Eighty-one percent of birds were associated with segments having moderately abundant driftwood, 18% with abundant driftwood, and only 0.3% with sparse driftwood (Table 17). This is in contrast to the distribution of driftwood: 59% of the segments had abundant driftwood, 39% had moderately abundant driftwood, and 2% had sparse driftwood. Most of the segments with moderately abundant driftwood occurred in the first 5 km of the spit, which is also where bird observations were most concentrated (Table 14). Segments with a high number of ponds or embayments were used very intensively (59% of birds) relative to their availability (8% of segments) (Table 17). Similarly, segments with moderate amounts of vegetation were also used very intensively (33% of birds) relative to their availability (4% of segments) (Table 17). Use of different segments of the spit varied with species groups and the nature of their behaviour while either staging or engaged in breeding-related activities.

The three most commonly observed activities of all birds along Nunaluk Spit were flying (41%; largely migratory, but some local), loafing (25%), and feeding (20%) (Table 18).

4.3.1 Ducks and Loons

Most of the Ducks and Loons (85%) were associated with kilometre 1 of the spit, and this affinity was more pronounced in Ducks and Loons than in other species groups (Table 14). Loons were not so closely associated with the tip of the spit, whereas ducks of all species were (Appendix 10). This species group showed a clear preference for the south side of the spit (82%), versus the north side (17%), and negligible use of the middle of the spit (Table 15). This preference was similar for both loon and duck subgroups. Almost two-thirds of the birds were along the edge of the spit or within 10 m of it; however, sizeable proportions were observed swimming 50 m or more away from the spit (Table 16).

Ducks and Loons were most commonly associated with segments containing moderately abundant driftwood (92% of birds), abundant ponds and embayments (75%), no vegetation (37%), and 1-5% vegetation cover (30%) (Table 17).

The primary activity of all Ducks and Loons was swimming (46%), followed by flying (31%) and loafing (21%) (Table 18). A number of the swimming birds observed during ground surveys were wary of the observer

Table 16. Percentage of non-flying birds, by species group, that occurred at various distances from Nunaluk Spit during ground surveys, July 27 to August 31, 1987.

Species Group	Distance from Spit[a]							Total
	Middle	Shoreline	<10m	10-25m	25-50m	>50m	n.d.	
Ducks and Loons	10.8	20.5	44.6	13.7	10.8	17.6	12.0	1514
Geese and Swans	1.7	7.9	0.2	0	0	90.2	0	632
Shorebirds (Excluding Phalaropes)	9.9	90.1	0	0	0	0	0	820
Phalaropes	10.4	44.8	41.5	1.9	0.3	<0.1	1.1	5979
Larids	33.5	21.7	11.0	15.3	11.4	6.6	0.4	743
Sparrows	80.8	19.2	0	0	0	0	0	73
TOTAL	10.6	40.5	33.1	4.5	2.8	7.5	1.0	9761

[a]Middle - includes all birds on dry land (or above in the case of gulls and terns defending nest sites). Does not include birds in or alnog shores of ponds or embankments.
Shoreline - includes all birds within a metre of shoreline of spit and birds in ponds or along the edges of ponds and ambankments.
n.d. - not determined.

Table 17. Percent occurrence of non-flying birds, by species group, in various habitat types during ground surveys along Nunaluk Spit, July 27 to August 31, 1987.

Habitat Feature	Species Group: Ducks and Loons	Geese and Swans	Shorebirds (Excluding Phalaropes)	Phalaropes	Larids	Sparrows	All Species Groups	%[a]
Driftwood								
Sparse	0.7	0.0	0.7	0.1	0.0	5.5	0.3	2.0
Moderately Abundant	92.5	77.7	73.2	83.2	56.0	76.7	81.3	39.0
Abundant	6.9	22.3	26.1	16.7	44.0	17.8	18.4	59.0
Ponds and Embayments								
None	11.7	95.3	38.8	23.8	65.1	32.9	31.0	85.0
<5% cover	2.4	0	1.1	2.2	6.3	30.1	2.5	4.0
5-25% cover	10.7	0	7.0	7.5	6.2	6.8	7.3	3.0
>25% cover	75.2	4.7	53.2	66.5	22.3	30.1	59.0	8.0
Vegetation								
None	37.3	2.4	14.1	11.0	19.7	9.6	15.4	15.0
<1% cover	28.7	94.0	78.4	44.7	57.6	20.5	49.0	76.0
1-5% cover	30.3	3.6	5.6	42.0	15.7	30.1	32.6	4.0
5-40% cover	3.0	0	0.5	2.3	5.7	34.2	2.6	3.0
40-75% cover	0	0	0.7	<0.1	1.3	2.7	0.2	1.0
>75% cover	0.6	0	0.6	0.1	0	2.7	0.2	1.0
TOTAL	1514	632	820	5979	743	73	9761	

[a]Percent occurrence of each habitat type.

Table 18. Percentage of birds, by species group, that exhibited various behaviours during ground surveys on Nunaluk Spit, July 27 to August 31, 1987.

Species Group	Behaviour[a]							Total
	N.D.	Feeding	Loafing	Swimming	Flying	Terr.	Other	
Ducks and Loons	0.8	0.2	21.1	46.2	31.4	0.3	0	2206
Geese and Swans	0.1	0.5	24.0	0.1	74.6	<0.1	0.7	2486
Shorebirds (Excl. Phalaropes)	0.2	27.6	6.2	0	65.4	0	0.6	2370
Phalaropes	0	33.4	37.0	4.5	21.2	0.2	3.6	7590
Larids	0.3	13.6	6.6	15.1	35.7	28.2	0.5	1156
Sparrows	0.4	5.4	2.3	0	91.3	0	0.7	837
Others	0	0	0	0	100.0	0	0	1
TOTAL	0.2	20.5	24.7	9.2	41.4	2.1	1.9	16646

[a]N.D. – behaviour not determined.
Loafing – includes sleeping.
Terr. – Territorial behaviour: nest and brood defense, often directed towards observers.

and were likely resting along the spit's shore prior to being recorded.

Moulting Oldsquaw were the most abundant ducks (85%) recorded during ground surveys; they spent much of their time swimming or loafing along the south side near the tip of the spit.

4.3.2 Geese and Swans

Geese, though rarely observed along the spit, occurred at scattered locations. Most observations came from a flock of Snow Geese that had landed briefly near the spit at kilometre 7, roughly opposite a site on the Malcolm River delta that attracted geese for staging (both Snow Geese and Brant). The remaining goose observations were primarily of Brant, just along the water's edge on the south side (Tables 15 and 16, and Appendix 10). Some attraction to the ponds and embayments near the tip of the spit was also evident (Table 17). Only eight swan observations were associated with the spit, and these were near the shore on the south side.

Most birds in this species group were observed flying (75%) (Table 18), although a large flock of Snow Geese was observed loafing briefly before continuing on to the staging grounds.

4.3.3 Shorebirds (Excluding Phalaropes)

Shorebirds concentrated near the tip of the spit (60%), along the south side (60%), and along the water's edge (90%) (Tables 14, 15 and 16). Shorebirds were also abundant in kilometre 3 (19%) and along the middle of the spit (34%).

Like many of the other species groups, shorebirds were much more frequently associated with segments having moderately abundant driftwood (73%) than abundant driftwood (26%) (Table 17). Shorebirds appeared to select for ponds and embayments: 53% of observations occurred on the few segments (8%) that featured greater than 25% pond cover (Table 17). Shorebird distribution was random with respect to vegetation cover (Table 17).

Most shorebirds observed during ground surveys were flying (65%). Other commonly observed activities were feeding (28%; primarily along edges of ponds and the south side of the spit), and loafing (6%) (Table 18). There were often small groups of shorebirds huddled resting amongst driftwood in the middle of the spit, particularly when the wind was strong from the northwest.

4.3.4 Phalaropes

Concentrations of phalaropes (74%) within the first kilometre of the spit was second only to Ducks and Loons in relative proportions (Table 14). Phalaropes were, however, by far the most numerous birds in actual numbers (Table 14). A minor concentration (11%) was observed at kilometre 4 whereas the remaining segments were rarely used, especially west of the mid-point (Table 14). Many phalaropes (41%) were observed along the north

side of the spit, as well as along the south side (30%) and middle of the spit (29%) (Table 15). Phalaropes were usually found close to the edge of either the spit or ponds: 45% of the birds were at water's edge, while 41% were less than 10 m from shore (Table 16). A number were also found on dry land in the middle of the spit (10%) (Table 16). Often these birds were near ponds but resting out of the water (Table 17).

Phalaropes most commonly used segments of the spit with moderately abundant driftwood (83%), with the greatest abundance of ponds (66%), and with 1-5% vegetation cover (42%) (Table 17). Phalaropes were observed using ponds for foraging and loafing, and at times the use was very intense. Thus the distribution of ponds may influence the distribution of phalaropes.

Phalaropes spent almost equal time loafing (37%) and feeding (33%), while flying accounted for only 21% of the observations (Table 18). Swimming (4%) and other activities (4%) (largely preening) were occasionally noted.

4.3.5 Larids

Larids were more evenly dispersed along the spit than all other species groups (Table 14); however, 28% were in kilometre 1 and 49% were in kilometres 2 to 5. This was largely a reflection of the distribution of nesting and broodrearing territories. (Terns and Glaucous Gulls nested either in very small groups or singly; jaegers did not nest on the spit in 1987). Larid distribution was also affected by their foraging habits: solitary birds or small groups would generally fly up and down the spit stopping periodically to feed. Gulls would mob when food was particularly abundant, as was the case during the last survey when a dead whale was beached in kilometre 1. (Flying birds are usually excluded from these analyses; however, observations of flying gulls and terns that were clearly defending a nesting territory are included).

Larids were distributed fairly evenly across the spit: 39% were associated with the north side, 35% with the middle of the spit, and 26% with the south side (Table 15). Most birds (66%) were either on the spit or in the water less than 10 m from shore (Table 16).

Larids were less frequently associated (56%) with segments having moderately abundant driftwood (39% of segments) than any other species group, which reflects their more even distribution along the spit (Table 17). However, 22% of observations were associated with abundant pond cover, whereas only 8% of the spit had abundant pond cover (Table 17). Larids were, for the most part, distributed at random with respect to vegetation, although 16% of the observations were in segments with 1-5% vegetation cover (4% of segments) (Table 17).

Many Larids (36%) were observed flying during ground surveys (Table 18). The next highest proportion (28%) was of disturbed birds, which were also flying, but primarily in response to observer disturbance around breeding territories. Swimming and feeding were also major activities. Relatively few birds were loafing (Table 18).

4.3.6 Sparrows

Most sparrows counted during ground surveys were flying. Of those that were not flying, most were concentrated in the first 2 kilometres (71%), whereas none were observed west of kilometre 6 (Table 14). Most sparrows were associated with the middle of the spit (81%) (Tables 15 and 16).

Sparrows were most commonly associated with segments having moderately abundant driftwood (77%), and segments with at least a little pond coverage (30%) or substantial pond coverage (30%) (Table 17). Vegetation was important to these terrestrial birds: whereas 64% of the sparrows were observed on segments with from 1 to 40% vegetation cover, such segments constituted only 7% of the spit (Table 17).

Most sparrows observed during ground surveys were flying (91%) (Table 18). Among the remaining birds, feeding was the predominant activity, and loafing and preening were secondary activities.

4.4 Distribution of Phalaropes in Fall along the Yukon Coast

Phalaropes, during fall migration in 1987, used few sites along the Yukon coastline for staging (Table 19). Phalaropes were observed along nearly every portion of the coast in at least low numbers. From 100 to 500 phalaropes were observed during a single survey at five locations: Escape Reef, Kay Point Spit, the shore along Stokes Point Lagoon, the middle island of the three Nunaluk Islands, and Nunaluk Spit from the promontory west to the spit's base. Greater than 500 phalaropes were observed during a single survey at four locations: Shingle Point spit, Avadlek Spit, Nunaluk Spit tip (east of the promontory), and the long coastline from the base of Nunaluk Spit to Komakuk Beach (Table 19).

Table 19. Summary of aerial, ground and boat surveys for phalaropes along the Yukon Territory coastline, July 27 to September 2, 1987.

	Date of Survey								
	July		August						
	27/28	31	5	8	8	11	13	13	16
Survey Type[a]	gs	gs	gs	gs	as	gs	gs	as	gs
Location									
Escape Reef	--	--	--	--	188	--	--	0	--
Shingle Spit	--	--	--	--	552	--	--	806	--
Shingle Pt to Kay Pt	--	--	--	--	35	--	--	0	--
Kay Pt. Spit	--	--	--	--	0	--	--	159	--
Babbage Delta	--	--	--	--	0	--	--	0	--
Phillips Bay to Stokes Pt.	--	--	--	--	0	--	--	10	--
West of Stokes	--	--	--	--	82	--	--	184	--
East of Roland Bay	--	--	--	--	0	--	--	1	--
Roland Bay to Whale Bay	--	--	--	--	3	--	--	0	--
Whale Bay	--	--	--	--	68	--	--	0	--
Calton Pt.	--	--	--	--	13	--	--	10	--
Workboat Passage	--	--	--	--	0	--	--	0	--
Avadlek Spit E.	--	--	--	--	--	--	404	0	--
Avadlek Spit W.	--	--	--	--	--	--	873	2170	--
Avadlek to Lopez Pt.	--	--	--	--	--	--	569	0	--
Lopez Pt to Osborn Pt	--	--	--	--	--	--	--	0	--
E. Nunaluk Is.	--	--	--	--	0	--	--	0	--
Mid-Nunaluk Is.	--	--	--	--	310	--	--	23	--
W. Nunaluk Is.	--	--	--	--	60	--	--	0	--
Nunaluk Tip (2 km)	595	51	1541	2106	340	128	597	375	29
Nunaluk West	249	168	339	506	80	368	502	75	104
Malcolm and Firth Deltas	--	--	--	--	0	--	--	0	--
Nunaluk to Komakuk	--	--	--	--	1272	--	--	6	--
W. of Komakuk	--	--	--	--	0	--	--	--	--
Clarence Lagoon	--	--	--	--	0	--	--	--	--
TOTAL	844	219	1880	2612	2985	496	2945	3816	133
% Red-necked Phal[b]	100	100	100	100	nd[c]	99.6	100	nd	99.2
% Juveniles[d]	nd	0	nd	nd	nd	>25	nd	nd	nd

[a]Survey Type: g.s. - ground survey
b.s. - boat survey
a.s. - aerial survey

[b]% Red-necked Phalaropes: proportion of identified phalaropes that were Red-necked Phalaropes.

[c]nd: not determined.

[d]% Juveniles: proportion of aged phalaropes that were juveniles.

Table 19. (cont.)

	Date of Survey							
	August						September	
	17	20	21	25	25	31	1	2
Survey Type	bs	gs	bs	gs	as	gs	bs	as
Location								
Escape Reef	--	--	--	--	40	--	--	0
Shingle Spit	--	--	--	--	0	--	--	0
Shingle Pt to Kay Pt	--	--	--	--	--	--	--	--
Kay Pt. Spit	--	--	--	--	--	--	--	--
Babbage Delta	--	--	--	--	--	--	--	--
Phillips Bay to Stokes Pt.	--	--	--	--	--	--	--	--
West of Stokes	--	--	--	--	--	--	--	--
East of Roland Bay	--	--	--	--	--	--	--	--
Roland Bay to Whale Bay	--	--	--	--	--	--	--	--
Whale Bay	--	--	--	--	--	--	--	--
Calton Pt.	--	--	--	--	0	--	--	--
Workboat Passage	--	--	--	--	--	--	--	--
Avadlek Spit E.	13	--	90	--	0	--	17	--
Avadlek Spit W.	0	--	5	--	0	--	18	--
Avadlek to Lopez Pt.	2	--	4	--	--	--	0	--
Lopez Pt to Osborn Pt	--	--	--	--	--	--	--	--
E. Nunaluk Is.	--	--	50	--	--	--	--	--
Mid-Nunaluk Is.	--	--	--	--	--	--	--	--
W. Nunaluk Is.	--	--	--	--	--	--	--	--
Nunaluk Tip (2 km)	--	93	--	0	--	40	--	--
Nunaluk West	--	139	--	0	--	35	--	--
Malcolm and Firth Deltas	--	--	--	--	--	--	--	--
Nunaluk to Komakuk	--	--	--	--	--	--	--	--
W. of Komakuk	--	--	--	--	--	--	--	--
Clarence Lagoon	--	--	--	--	--	--	--	--
TOTAL	15	232	244	0	40	75	35	0
% Red-necked Phal.	100	74.8	94.7	nd	nd	59.1	66.7	nd
% Juveniles	nd	100	nd	nd	nd	100	nd	nd

5.0 DISCUSSION AND CONCLUSIONS

5.1 Migration/Passage Movements: Abundance, Chronology and Direction

Observations of migration abundance, chronology and direction for various species groups were generally consistent with previous studies in the vicinity of Nunaluk Spit. Gollop and Davis (1974b) undertook a series of migration watches from July 10 through September 17, 1972 at the base of Nunaluk Spit. Most of the more common species had comparable peak periods of migration, made flights in the same predominant directions, and occurred in the same relative abundance (Table 20). We compared only equivalent time periods and were unable to compare our data with the earlier (July 10 to 23) and later (September 3 to 17) periods studied by Gollop and Davis, at which times different components of breeding populations were likely moving past Nunaluk Spit.

Some notable differences were identified between the two study years. American Wigeon were substantially more abundant in 1987 than in 1972, and this species predominant migration direction was east, like the majority of dabbling ducks, not west as in 1972. Bellrose (1976) noted that the annual local abundance of wigeon along migration corridors varies more than for many dabblers, which he suggested may imply an occasional change in migration patterns by parts of the population.

The greatest movement of Oldsquaw to the west in 1987 occurred from August 16 to 20, and was likely an early post-moult migration movement. In 1972, peak movement was observed at the end of July, and was considered a late phase of movement towards western moulting areas. Such a movement was not detected in 1987 prior to the moulting of a small group of Oldsquaw in Nunaluk Lagoon, but the peak movement that was recorded occurred before most of these local birds were flying. In both years, the bulk of the Oldsquaw population may not have migrated west from the extensive breeding areas to the east of the Mackenzie River delta until well into September as these birds are generally late migrants (Bellrose 1976). Thompson and Person (1963) and Johnson (1971) recorded very few Oldsquaw during studies at Barrow, Alaska, which lasted until September 7, whereas Timson (1976) estimated a passage of 240 000 birds during studies at Barrow which lasted until September 16, 1975. Timson first observed migration flights on September 5.

The Snow Goose was second in abundance (after Brant) in 1987, in contrast to being first amongst Geese and Swans during the comparable period in 1972 (Table 20). Observations indicated that peak migration/passage flights, for Snow Geese heading west to staging areas, began later in 1987 than in 1972; thus the large numbers of Snow Geese may have been missed in 1987 due to our earlier departure from the study area.

Glaucous Gull migration occurred about one week later in 1987 than in 1972 (August 21 to 25 compared to August 14 to 20). The much earlier peak that was noted July 27 to 31, in 1987, was likely the result of the local breeding population and its activities.

Table 20. Peak periods of bird flights, by species, between late July and late August at Nunaluk Spit, 1972 and 1987[a].

Species	Peak Periods		Relative Abundance[b]		Predominant Direction	
Ducks and Loons	1972	1987	1972	1987	1972	1987
Loons	Jly 24–30	Aug 11–15	4	7	E	E/W
American Wigeon	Aug 14–20	Aug 11–15 Aug 21–25	8	4	W	E
Northern Pintail	Aug 14–20	Aug 11–15	1	1	E	E
Scaup	Jly 24–30	not ident.	7	---	W	---
Oldsquaw	Jly 24–30	Aug 16–20	3	3	W	W
Eiders	Jly 24–30	Jly 27–31	6	6	W	W
Scoters	Jly 24–30	Aug 11–15	5	5	W	E/W
Red-breasted Merganser	Jly 24–Aug 6	Aug 25–30[c]	9	8	E	E/W
Misc. & unid. ducks	Aug 14–20	Aug 16–20	2	2	E	E
Geese and Swans						
Brant	Aug 21–27	Aug 25–30	2	1	W	W
Greater White-fronted Goose	Aug 28–Sep 3	Aug 25–30	3	3	E	E
Snow Goose	Aug 21–Sep 3	Aug 25–30	1	2	W	W
Tundra Swan[d]	Aug 28–Sep 3	Aug 25–30	4	4	E	W
Shorebirds Excl. Phalaropes						
Plovers[e]	Aug 14–20	Aug 16–25	3	3	E	E
Dowitchers	Aug 28–Sep 3	Aug 21–25	4	4	E	E
Misc. & unid. shorebirds	Jy 31–Ag 6 Ag 21–Sep 3	Aug 6–10	2	2	E	E
Phalaropes						
Phalaropes	Jly 31–Aug 6	Aug 6–10	1	1	E	E
Larids						
Parasitic Jaeger	Jly 24–30	Aug 21–25	3	3	E/W	E/W
Glaucous Gull	Aug 14–20	Jly 27–31 Aug 21–25	1	1	W	W
Arctic Tern	Aug 7–20	Aug 16–25	2	2	W	W
Sparrows						
Snow Bunting	(after Sep 3)	Aug 1–10 Aug 26–30	2	2	E	E
Unid. fringillids & Lapland Longspur	Aug 21–27	Aug 21–25	1	1	E/W	E/W

[a] 1972 data from Gollop and Davis (1974b); 1987 data from this study.
[b] Relative abundance: 1 is most abundant species.
[c] Very small sample size in 1987.
[d] Very small sample size in both years.
[e] Lesser Golden- and Black-bellied Plovers.

All Snow Bunting movements in 1972 occurred in early to mid-September (4th to 17th), when over 1800 buntings were estimated to fly past the spit (Gollop and Davis 1974b). Only 96 Snow Buntings were observed making migration/passage flights throughout the 1987 study period, and amounted to fewer than 350 estimated flights during daylight hours. Major migration waves likely occurred after our departure in 1987.

Ground-based visual observation of migration/passage movements along coastlines, particularly of birds that are pelagic or birds that often migrate at high altitudes or at night, is of limited value in documenting the true extent, pattern and dynamics of migration activities past a region (Johnson et al. 1975, Richardson et al. 1975). However, visual observations are productive for the purposes of identifying periods of peak movements, the relative abundance of various species, and their use of a region in contrast with their passage past a site. The onset and duration of breeding and hence the timing of subsequent moult migrations and post-breeding migrations and staging of various cohorts of arctic waterbird and shorebird populations are influenced greatly by the extreme variations in arctic weather and ice conditions (Snyder 1957). Despite this potential for substantial differences across years, the broad similarities in patterns of migration/passage flights observed between 1972 and 1987 studies at Nunaluk Spit confirm many of the patterns thus established.

5.2 Phalarope Migration and Staging

Migration and staging of phalaropes after the breeding period differs for age and sex-specific cohorts of the population (Hayman et al. 1986). Adult females leave the breeding grounds first, generally departing while males are still incubating the eggs. Females gather in small flocks near the breeding area, and subsequently form the first staging concentrations along the coast. Adult males gather along the coast after brood-rearing, and form the second wave of staging concentrations. Some juveniles often accompany the adult males, but the bulk of the juveniles stage even later along the coast. Migration/passage flights by these different components of phalarope populations occur in a complex pattern of movements to and between staging areas and subsequently to wintering areas.

Patterns of migration and staging in the vicinity of Nunaluk Spit have emphasized that area's relative importance to phalaropes as part of the Canadian Beaufort Sea coastline (Alexander et al. 1988).

Primarily eastward movements have been documented at Nunaluk Spit in both 1972 and 1987 (Gollop and Davis 1974b, this study). Also, Red-necked Phalaropes were found to be among the most abundant species flying past the spit in both years. Substantial movement towards the west was observed in both years and has been suggested to represent local flights between feeding areas (Gollop and Davis 1974b). The clear response of phalaropes to wind direction (this study) supports the conclusion that much of the activity observed was local flights. Nonetheless, overall migration of Red-necked Phalaropes appears to have been toward the east. Further support for an eastward migration is provided by observations at Stokes Point, where migrating Red-necked Phalaropes flew southeast (71%) substantially more often than northeast (26%) or southwest (2%), in the

fall of 1983 (Dickson et al. 1988). A westward migration direction for Red-necked Phalaropes past Herschel Island's Avadlek Spit has been claimed by Vermeer and Anweiler (1975); however, they do not provide any supporting data or citations.

Although observations of marked or banded Red-necked Phalaropes have not been made which would establish clearly the fall migration route from staging concentrations at Nunaluk Spit and Avadlek Spit, a probable route is implied from studies conducted at Nunaluk Spit, along the Mackenzie River, and through Alberta. Movement trends suggesting eastward migration at the spits, and probable southeastward migration movements past Shingle Point Spit have been discussed above. Observations of late summer and early fall migration flocks staging in central and southern Alberta (Sadler and Myres 1976, Steeves and Steeves 1985) strongly suggest that the Red-necked Phalaropes undertake an overland migration route, perhaps initially following the Mackenzie River valley southwards. This appears to be the reverse of a northward spring migration route through central and southern Alberta (Sadler and Myres 1976, Steeves and Steeves 1985). Similar overland migration routes have been suggested for eastern arctic populations of Red-necked Phalaropes, due to their absence along the oversea route identified for Red Phalaropes (Orr et al. 1982), and for northwestern Europe (Hilden and Vuolanto 1972).

Study of Red-necked Phalarope migration patterns at locations along the Beaufort Sea coast to the east of the Mackenzie River delta would be expected to show a westward fall migration movement leading to the delta and then heading southward. The degree of staging along that portion of the Beaufort Sea coast by Red Phalaropes moving west from the Arctic Archipelago has not been examined. Some use of the Cape Dalhousie coast by staging Red Phalaropes has been suggested by Barry et al. (1981). However, information to date has not revealed significant phalarope staging concentration areas along the Beaufort Sea coast east of the Mackenzie River delta (Alexander et al. 1988). Considerable work remains to be done on phalarope species in that area to clarify the migration and staging patterns.

Peak periods of staging and migration/passage flights for phalaropes at Nunaluk Spit have tended to be in early to mid-August. Peak observations occurred July 31 to August 6 in 1973 and August 6 to 10 in 1987 (Gollop and Davis 1974b, this study). Observations in 1985 and 1986 may indicate a more variable peak period, as over 50 000 phalaropes were estimated along Nunaluk Spit on August 21 and 19, respectively (Alexander et al. 1988). However, despite the fact that these are substantially greater and later concentrations than seen in 1972 and 1987, it is unknown what numbers occurred earlier in August of 1985 and 1986.

Timing of staging concentrations and peak movements at other sites in the vicinity show a comparable timing to that at Nunaluk Spit. Peak staging occurred from August 6 to 14 in 1973 along the shore of southern Herschel Island near Avadlek Spit (Vermeer and Anweiler 1975). At Stokes Point and Shingle Point, between Herschel Island and the Mackenzie River delta, phalarope staging (only Red-necked Phalaropes identified during ground surveys) was substantially greater at mid-August than late August (Dickson et al. 1988). Peak observations of Red-necked Phalaropes, based on fall sightings recorded for 1985 to 1987, occurred during the week of

August 10 to 16 at Toker Point near the east side of Mackenzie River delta (Sirois and Dickson in prep.).

Duration of staging appears to have been consistently short in the above studies. The largest concentrations on Nunaluk Spit in 1987 appeared to occur over a period of no more than 10 days. Individual birds probably stayed for much less time; however, observations of known birds were not achieved. Relative proportion of the staging population that was juveniles changed rapidly between August 11 and August 20 during the 1987 surveys at Nunaluk Spit (Table 19), suggesting a rapid turnover in staging birds. Marked Red Phalaropes observed during a study along the Alaskan Beaufort coast showed much day-to-day turnover during fall staging (Connors and Risebrough 1977, 1978).

Abundance of staging phalaropes in the vicinity of Nunaluk Spit has varied substantially. In 1987, the maximum number of phalaropes recorded adjacent a 10 km portion of Nunaluk Spit (most of the spit that extends out from its mainland attachment) was 2612. Numbers of phalaropes staging along primarily the windward side of Nunaluk Spit have ranged from "in the thousands" in 1972 (Gollop and Davis 1974b) to over 50 000 in mid-August of 1985 and 1986 (Alexander et al. 1988). Use in 1973 was apparently fairly low, given a total count of phalaropes for the entire Yukon coast of only 2600 birds during an aerial survey on August 9th and 12th (Vermeer and Anweiler 1975). However, Vermeer and Anweiler made ground counts of Avadlek Spit to Lopez Point alone that amounted to 5000 phalaropes (August 11) and 3000 (August 14). Therefore, they likely underestimated the number of phalaropes during the aerial survey.

The other major sites along the Yukon coast for phalaropes include Shingle Point Spit, Avadlek Spit, and the portion of the coast from the west end of Nunaluk Spit to Komakuk Beach. Phalaropes were observed at Shingle Point Spit in substantial numbers in 1983 (mid-August, 1000+ birds; early September, 550+ birds) (Dickson et al. 1988) as well as in 1987 (Table 19), but not in 1985 or 1986 (Alexander 1986, Alexander unpubl. data). However, in 1985 and 1986, observer attention was focused on the abundant gulls and terns at these sites, and had phalaropes been present in low or even moderate numbers, they would probably have been missed because of their relative inconspicuousness. (Our experiences have shown that shorebirds can be surveyed most effectively from the air only if specific efforts are made to concentrate on shorebirds alone.) Avadlek Spit and the south side of Herschel Island between the base of Avadlek Spit and Lopez Point, have been used by large numbers of phalaropes. Concentrations have varied from 2000 in late July, 1985 (Alexander 1986) to 5000 in mid-August, 1973 (Vermeer and Anweiler 1975), to 2020 in late August, 1986 (Talarico and Mossop 1986). Although numbers are not as high as along Nunaluk Spit, observations of concentrations of phalaropes at Avadlek have been recorded much later in August. The portion of the Yukon coast between Nunaluk Spit and Komakuk Beach was also identified as a potentially important staging area in early August, 1987 with a total of 1272 phalaropes sparsely distributed (Table 19); no other surveys have identified large numbers of phalaropes along that portion of the coast (Gollop and Davis 1974b, Alexander unpubl. data).

Red-necked Phalaropes comprise the vast majority of phalaropes staging along the Yukon coast, particularly during late July through mid-August at

Nunaluk Spit (95-100%) (this study, Gollop and Davis 1974b) and at Avadlek Spit (97-99%) (Vermeer and Anweiler 1975, Talarico and Mossop 1986). Red Phalaropes occur at proportions as high as 30-40% in late August along Nunaluk Spit and Avadlek Spit (Table 19); however, actual numbers were very low, with the greatest number of Red Phalaropes seen being 59 on August 20. Studies based on late summer and fall aerial surveys have stated that large numbers of Red Phalaropes occur at Nunaluk Spit and Avadlek Spit (Barry et al. 1981, Barry and Barry 1982), but did not indicate the occurrence of Red-necked Phalaropes. Given the extensive ground counts from other studies, which show an overwhelming predominance of Red-necked Phalaropes, it appears possible that the fall aerial surveys mis-identified the phalaropes.

The migration and staging dynamics of phalaropes at Nunaluk Spit fit into a pattern described from a number of studies along the Beaufort Sea coastal plain, including investigations along the Yukon Territory coastal plain, and others in Alaska on the Arctic National Wildlife Refuge, at Simpson Lagoon and at Point Barrow.

Breeding populations along the coastal plain reflect the composition of the staging populations along the adjacent shore to a considerable degree. South of Nunaluk Spit along the Firth River and southeast along the Babbage River, Red-necked Phalaropes are confirmed breeders and occur in substantial numbers up to 37 birds/km^2 in early July, while Red Phalaropes are not known to breed and have rarely been recorded (Campbell and Weber 1973, Gollop and Davis 1974a, Gollop et al. 1974a,b, Gunn et al. 1974, Richardson and Gollop 1974). Ground surveys at Stokes Point, Phillips Bay, and King Point yielded Red-necked Phalarope densities of 12.2 to 20.2 birds/km^2, whereas Red Phalarope densities were zero to 2.4 birds/km^2 (Dickson et al. 1988).

Along the coastal plain of the Arctic National Wildlife Refuge (ANWR), both Red and Red-necked Phalaropes were reported as breeders and as fall coastal staging birds (Miller et al. 1985, Garner and Reynolds 1986). Relative proportions of breeding phalarope species varied somewhat with habitat differences from one river delta to the next. However, an overall ratio of 1:1, or 50% Red-necked Phalaropes, occurred over the breeding range within the ANWR (Garner and Reynolds 1986). Fall staging concentrations were not identified to species (Brackney et al. 1985).

At Simpson Lagoon, just west of the ANWR, the overall ratio of Red-necked to Red Phalaropes was 1:4 or 20% Red-necked Phalaropes amongst the fall staging flocks of juveniles (Johnson and Richardson 1980). Salter and Davis (1974) recorded significantly more Red Phalaropes than Red-necked Phalaropes on breeding habitat inland from Prudhoe Bay (near Simpson Lagoon) in early July. Red Phalaropes did not occur during the summer at locations to the east or south of the Prudhoe Bay site (the survey route extended from Prudhoe Bay to, and upstream along, the Mackenzie River (Salter and Davis 1974).

The pattern and timing of fall staging and migration of unidentified phalaropes at Simpson Lagoon also suggest a predominance of Red Phalaropes. Peak staging abundance occurred in middle and late August in 1978 and 1977, respectively. The primary direction of migrating phalaropes was westward (Johnson and Richardson 1980), similar to the

predominant direction observed at Nunaluk Spit for Red Phalaropes (Table 10).

At Point Barrow, Alaska, Red Phalaropes are the primary species whereas Red-necked Phalaropes are rarely observed (Connors and Risebrough 1977, 1978, Connors et al. 1979). Phalarope migration is westward at this point. Very large numbers of Red Phalaropes stage in various habitats near Point Barrow and they occur throughout August and into early September.

Red-necked Phalarope habitat use during fall staging at Nunaluk Spit was similar to that of phalaropes studied at Simpson Lagoon (Johnson and Richardson 1980). Shorelines were found to be important feeding habitats for shorebirds in August at Simpson Lagoon, particularly for juvenile phalaropes of both species. The seaward shores of islands were most important, followed by the lagoonward shores and finally by mainland shores. Our observations of Red-necked Phalaropes agreed with these general conclusions in relation to Nunaluk Spit. Furthermore, at Stokes Point Red-necked Phalaropes were most commonly observed in the surf seaward of spits and barrier beaches (Dickson et al. 1988:64). Casual observations near the field camp showed that, occasionally, ponds and the spit's south shores were places of refuge for phalaropes during the severest gales from the north and northwest (this study).

Phalarope diets and feeding strategies at Simpson Lagoon were found to be somewhat specialized within each season (Johnson and Richardson 1980). In one fall, phalaropes fed mainly upon copepods, while in the second fall studied, phalaropes fed mainly upon amphipods. It could not be established if the phalaropes were responding to a real difference in availability of these invertebrates; however, such a response to prey availability and flexibility in diet would be adaptive, allowing the birds to concentrate on an abundant food source when it became available. At Nunaluk Spit, in addition to foraging extensively along the seaward side of the spit, frequent foraging in ponds at the spit's tip was noted. An extremely abundant invertebrate population was found in the ponds, and although the invertebrates were very small, they were easily accessible to the birds.

The concentration of phalaropes within two kilometres of the tip of Nunaluk Spit appears to reflect the conclusions reached by Johnson and Richardson (1980) about the physiological and trophic significance of lagoons and barrier islands to these arctic species. Accumulation of substantial fat deposits, essential for successful fall migration, was noted for Red Phalaropes using the Simpson Lagoon. The Red-necked Phalaropes examined had already accumulated their fat reserves before reaching Simpson Lagoon, but likely used other lagoon and barrier island complexes along their migration route. The mixing of warm, nutrient-laden waters from rivers entering lagoon systems with cold ocean waters results in productive invertebrate communities (Griffiths et al. 1975). At Nunaluk Spit, the influence of waters flowing out of the Nunaluk Lagoon can be clearly seen for a few kilometres out into the ocean, forming a pattern similar to the shallow bench shown in navigation charts (see Figure 1). Invertebrates may respond to these rich waters by flourishing within the plume and around the tip of Nunaluk Spit. Consequently, phalaropes, which feed on invertebrates, would also be expected to

concentrate more around the tip than in areas towards the base of the spit, as was the case in 1987. The additional attraction of the abundant invertebrate communities in ponds at the tip of the spit, and the shelter offered by those ponds at times of gales, likely worked in concert to influence the phalarope distribution. Further work on the distribution of prey species relative to concentrations of feeding phalaropes would help elaborate the significance of such fall staging locations.

6.0 LITERATURE CITED

Alexander, S.A. 1986. Beaufort Sea coastal bird surveys, 1985 season. Canadian Wildlife Service, unpubl. report, Edmonton. 80 pp.

Alexander, S.A., T.W. Barry, D.L. Dickson, H.D. Prus and K.E. Smyth. 1988. Key areas for birds in coastal regions of the Canadian Beaufort Sea. Canadian Wildlife Service, Edmonton. 146 pp.

Barry, S.J. and T.W. Barry. 1982. Sea-bird surveys in the Beaufort Sea, Amundsen Gulf, and Prince of Wales Strait 1981 season. Unpubl. report for Dome Petroleum Ltd., Esso Resources Canada Ltd., Canadian Wildlife Service. 52 pp.

Barry, T.W., S.J. Barry and B. Jacobson. 1981. Sea-bird surveys in the Beaufort Sea, Amundsen Gulf, Prince of Wales Strait and Viscount Melville Sound -- 1980 season. Unpubl. report for Dome Petroleum Ltd. and Esso Resources Canada Ltd., Calgary. 69 pp.

Bellrose, F.C. 1976. Ducks, geese and swans of North America. Wildlife Management Institute and Illinois Natural History Survey, Stackpole Books. 544 pp.

Brackney, A.W., J.M. Morton and J.M. Noll. 1985. Migratory bird use of the coastal lagoon system of the Beaufort Sea coastline within the Arctic National Wildlife Refuge, Alaska, 1984. ANWR Progress Report Number FY85-11. pp. 309-349. in: G.W. Garner and P.E. Reynolds. 1984 Update report baseline study of the fish, wildlife, and their habitats. Arctic National Wildlife Refuge Coastal Plain Resource Assessment. Vol.I.

Burns, B.M. 1973. The climate of the Mackenzie Valley-Beaufort Sea. Vol. I. Can. Atmos. Environ. Serv. Stud. 24: 227 pp.

Campbell, R.W. 1973. Baseline study of selected nesting waterbirds on the northwestern MacKenzie Delta, N.W.T. and Y.T. 1972. in: Towards an environmental impact assessment of the portion of the Mackenzie gas pipeline from Alaska to Alberta. Interim Rep. No. 3, Appendix 3, Ornithology. Environmental Protection Board, Winnipeg. 33 pp.

Campbell, R.W. and W.C. Weber. 1973. Abundance and species composition of birds in selected areas along the pipeline route 1972. in: Towards an environmental impact assessment of the portion of the Mackenzie gas pipeline from Alaska to Alberta. Interim Rep. No. 3, Appendix 3, Ornithology. Environmental Protection Board, Winnipeg. 42 pp.

Canadian Hydrographic Service. 1986. Chart 7601, Siku Point to Kay Point, Beaufort Sea. 14 April 1986 edition.

Connors, P.G., J.P. Myers and F.A. Pitelka. 1979. Seasonal habitat use by arctic Alaskan shorebirds. Studies in Avian Biology. 2:101-111.

Connors, P.G. and R.W. Risebrough. 1977. Shorebird dependence on arctic littoral habitats. pp. 402-524. in: Environmental Assessment of the

Alaskan Continental Shelf. Vol. 2. Annual Reports of Principal Investigators, October 1977. U.S. Bureau of Land Management and National Oceanic and Atmospheric Administration. Boulder, Colorado.

Connors, P.G. and R.W. Risebrough. 1978. Shorebird dependence on arctic littoral habitats. pp. 84-167. in: Environmental Assessment of the Alaskan Continental Shelf. Vol. 2. Annual Reports of Principal Investigators, October 1978. U.S. Bureau of Land Management and National Oceanic and Atmospheric Administration. Boulder, Colorado.

Dickson, D.L., H.L. Dickson and G. Aiudi. 1988. Bird surveys at Stokes Point and Phillips Bay, Yukon, in 1983. Technical Report Series No.40. Canadian Wildlife Service, Western and Northern Region, Alberta.

Garner, G.W. and P.E. Reynolds. (eds.) 1986. Final report baseline study of the fish, wildlife, and their habitats. Arctic National Wildlife Refuge Coastal Plain Resource Assessment. 2 vols. 695 pp.

Gollop, M.A. and R.A. Davis. 1974a. Studies of bird populations and productivity on lakes on the Yukon North Slope, July, 1972. Chap. I. pp. 1-35. in: Gunn, W.W.H. and J.A. Livingston. Bird distribution and populations ascertained through ground survey techniques, 1972. Prep. by L.G.L. Limited, Environmental Research Associates. Arctic Gas Biological Report Series Volume 12. 384 pp.

Gollop, M.A. and R.A. Davis. 1974b. Autumn bird migration along the Yukon Arctic Coast; July, August, September 1972. Chap. III. pp. 83-162. in: Gunn, W.W.H. and J.A. Livingston (eds.). Bird migration on the North Slope and in the Mackenzie Valley regions. Prep. by L.G.L. Limited, Environmental Research Associates. Arctic Gas Biological Report Series Volume 13.

Gollop, M.A., R.A. Davis, J.P. Prevett, and B.E. Felske. 1974a. Disturbance studies of terrestrial breeding bird populations: Firth River, Yukon Territory, June 1972. Chap. III. pp. 97-152. in: Gunn, W.W.H., and J.A. Livingston. (eds.). Disturbance to birds by gas compressor noise simulators, aircraft and human activity in the Mackenzie Valley and the North Slope, 1972. Arctic Gas Biological Report Series. Volume 14.

Gollop, M.A., J.R. Goldsberry, and R.A. Davis. 1974b. Effects of gas compressor noise simulator disturbance to terrestrial breeding birds, Babbage River, Yukon Territory, June 1972. Chap. II. pp. 49-96. in: Gunn, W.W.H., and J.A. Livingston. (eds.). Disturbance to birds by gas compressor noise simulators, aircraft and human activity in the Mackenzie Valley and the North Slope, 1972. Arctic Gas Biological Report Series. Volume 14.

Griffiths, W., P. Craig, G. Walder and G. Mann. 1975. Fisheries investigations in a coastal region of the Beaufort Sea (Nunaluk Lagoon, Yukon Territory). in: P.C. Craig (ed.). Fisheries investigations in a coastal region of the Beaufort Sea. Arctic Gas Biological Report Series. Volume 34 (2): 219 pp.

Gunn, W.W.H., R. Hansma and P.E. Taylor. 1974. Transect surveys of bird populations in control and disturbance plots at the Babbage and Firth Rivers, 1973. Chap. IV. 19 pp. in: Gunn, W.W.H., W.J. Richardson, R.E. Schweinsburg and T.D. Wright. (eds.). Ornithological studies conducted in the area of the proposed gas pipeline, 1973. Prep. by L.G.L. Limited, Environmental Research Associates. Arctic Gas Biological Report Series Volume 26.

Hayman, P., J. Marchant, and T. Prater. 1986. Shorebirds. An identification guide to the waders of the world. Houghton Mifflin Company, Boston. 412 pp.

Hawkings, J.S. 1987. Population status of migratory waterbirds on the Yukon Coastal Plain and adjacent Mackenzie Delta. Technical Report Series No. 28, Pacific and Yukon Region 1987, Canadian Wildlife Service. 65 pp.

Hilden, O. and S. Vuolanto. 1972. Breeding biology of the Red-necked Phalarope Phalaropus lobatus in Finland. Ornis Fenn. 49:57-85.

Johnson, L.L. 1971. The migration, harvest, and importance of waterfowl at Barrow, Alaska. M.Sc. Thesis. Univ. Alaska, Fairbanks. 87 pp.

Johnson, S.R., W.J. Adams and M.R. Morrell. 1975. Birds of the Beaufort Sea. Can. Dept. Environment, Victoria, B.C. 310 pp.

Johnson, S.R. and W.J. Richardson. 1980. Part 3. Birds. pp. 109-383. in: Environmental Assessment of the Alaskan Continental Shelf. Final Reports of Principal Investigators. Vol. 7, Biological Studies. February 1981. U.S. Office of Marine Pollution Assessment and Bureau of Land Management.

Miller, P.A. C.S. Moitoret and M.A. Masteller. 1985. Species accounts of migratory birds at three study areas on the coastal plain of the Arctic National Wildlife Refuge Alaska, 1984. ANWR Progress Report Number FY 85-14. pp. 447-484. in: G.W. Garner and P.E. Reynolds. 1984 Update report baseline study of the fish, wildlife, and their habitats. Arctic National Wildlife Refuge Coastal Plain Resource Assessment. Vol.II.

Orr, C.D., R.M.P. Ward, N.A. Williams and R.G.B. Brown. 1982. Migration patterns of Red and Northern Phalaropes in southwest Davis Strait and in the northern Labrador Sea. Wilson Bull. 94(3):303-312.

Pilot of Arctic Canada. 1968. Pilot of Arctic Canada. Vol. III. Canadian Hydrographic Service, Dept. Energy, Mines and Resources. 398 pp.

Richardson, W.J. and M.A. Gollop. 1974. Populations of birds at Babbage River, Y.T. during the breeding season, 1973: a monitoring and methodological study. Chap. II. 66 pp. in: Gunn, W.W.H., W.J. Richardson, R.E. Schweinsburg and T.D. Wright. (eds.). Ornithological studies conducted in the area of the proposed gas pipeline, 1973. Prep. by L.G.L. Limited, Environmental Research Associates. Arctic Gas Biological Report Series Volume 26.

Richardson, W.J., M.R. Morrell and S.R. Johnson. 1975. Bird migration along the Beaufort Sea coast: radar and visual observations in 1975. Beaufort Sea Tech. Rep. 3c. Can. Dept. Env. Victoria. 131 pp.

Sadler, T.S. and M.T. Myres. 1976. Alberta Birds 1961-1970. Occasional Paper No. 1, Provincial Museum of Alberta, Natural History Section. 304 pp.

Salter, R. and R.A. Davis. 1974. Surveys of terrestrial bird populations in Alaska, Yukon Territory, Northwest Territories and northern Alberta, May, June, July, 1972. Chap. II. pp. 36-384. in: Gunn, W.W.H. and J.A. Livingston. Bird distribution and populations ascertained through ground survey techniques, 1972. Prep. by L.G.L. Limited, Environmental Research Associates. Arctic Gas Biological Report Series Volume 12. 384 pp.

Sirois, J. and D.L. Dickson. in prep. The avifauna of Toker Point, Tuktoyaktuk Peninsula, Northwest Territories, 1985-1987. Canadian Wildlife Service, Yellowknife.

Snyder, L.L. Arctic birds of Canada. University of Toronto Press, Toronto. 310 pp.

Steeves, J.B. and M.E. Steeves. 1985. A five-year shorebird migration study at Calgary, Alberta. Alberta Bird Record 3(4):64-71.

Talarico, D. and D. Mossop. 1986. Herschel Island avifauna and interpretive report 1986. Unpubl. report, Yukon Dept. Renewable Resources. 78 pp.

Thompson, D.Q. and R.A. Person. 1963. The eider pass at Point Barrow, Alaska. J. Wildl. Manage. 27: 348-356.

Timson, R.S. 1976. Late summer migration at Barrow, Alaska. pp. 364-399. in: Environmental Assessment of the Alaskan Continental Shelf. Vol. 1. Principal Investigators' Reps., April-June 1976. Environmental Research Laboratories, Boulder, CO, for U.S. National Oceanic and Atmospheric Administration.

Vermeer, K. and G.G. Anweiler. 1975. Oil threat to aquatic birds along the Yukon coast. Wilson Bull. 87:467-480.

Ward, R. and D. Mossop. 1985. The birds of Herschel Island relative to its use as a territorial park. Yukon Dept. Renewable Resources, Whitehorse. 40 pp.

7.0 APPENDICES

Appendix 1. Species names and status of birds observed during the study in the vicinity of Nunaluk Spit.

Common Name	Code	Scientific Name	Status/Loc[a]	
Red-throated Loon	RTLO	Gavia stellata	C	N.S.
Pacific Loon	PALO	Gavia pacifica	O	N.S.
Common Loon	COLO	Gavia immer	O	N.S.
Yellow-billed Loon	YBLO	Gavia adamsii	O	N.S.
Tundra Swan	TUSW	Cygnus columbianus	FC	N.S.
Greater White-fronted Goose	GWFG	Anser albifrons	R	N.S.
Snow Goose	SNGO	Anser caerulescens	FC	N.S.
Brant	BRAN	Branta bernicla	C	N/H
Canada Goose	CAGO	Branta canadensis	R	N.S.
Mallard	MALL	Anas platyrhynchos	O	N.S.
Northern Pintail	NOPI	Anas acuta	FC	N.S.
American Wigeon	AMWI	Anas americana	O	N.S.
Common Eider	COEI	Somateria mollissima	FC	N.S.
King Eider	KIEI	Somateria spectabilis	H(1)	N.S.
Oldsquaw	OLDS	Clangula hyemalis	C	N/H
Black Scoter	BLSC	Melanitta nigra	R	N.S.
Surf Scoter	SUSC	Melanitta perspicillata	O	N.S.
White-winged Scoter	WWSC	Melanitta fusca	O	N.S.
Common Goldeneye	COGO	Bucephala clangula	H(1)	N.S.
Red-breasted Merganser	RBME	Mergus serrator	O	N.S.
Northern Harrier	NOHA	Circus cyaneus	R	N/M
Rough-legged Hawk	RLHA	Buteo lagopus	O	H.I.
Merlin	MERL	Falco columbarius	H(1)	H.I.
Peregrine Falcon	PEFA	Falco peregrinus	R	N.S.
Gyrfalcon	GYRF	Falco rusticolus	R	N.S.
Willow Ptarmigan	WIPT	Lagopus lagopus	C	M.R.
Rock Ptarmigan	ROPT	Lagopus mutus	R	H.I.
Black-bellied Plover	BBPL	Pluvialis squatarola	O	N.S.
Lesser Golden-Plover	LGPL	Pluvialis dominica	FC	N/M
Whimbrel	WHIM	Numenius phaeopus	R(1)	H.I.
Hudsonian Godwit	HUGO	Limosa haemastica	R	N.S.
Ruddy Turnstone	RUTU	Arenaria interpres	O	N.S.
Sanderling	SAND	Calidris alba	FC	N.S.
Semipalmated Sandpiper	SESA	Calidris pusilla	FC	N.S.
Western Sandpiper	WESA	Calidris mauri	R	N.S.
Least Sandpiper	LESA	Calidris minutilla	O	N.S.
White-rumped Sandpiper	WRSA	Calidris fuscicollis	O	N.S.
Baird's Sandpiper	BASA	Calidris bairdii	O	N.S.
Pectoral Sandpiper	PESA	Calidris melanotos	C	N.S.
Dunlin	DUNL	Calidris alpina	R	N.S.
Stilt Sandpiper	STSA	Calidris himantopus	FC	N.S.
Buff-breasted Sandpiper	BBSA	Tryngites subruficollis	R(1)	N.S.
Long-billed Dowitcher	LBDO	Limnodromus scolopaceus	FC	N.S.
Red-necked Phalarope	RNPH	Phalaropus lobatus	C	N.S.
Red Phalarope	REPH	Phalaropus fulicaria	O	N.S.

Appendix 1. (cont.)

Common Name	Code	Scientific Name	Status/Loc
Pomarine Jaeger	POJA	Stercorarius pomarinus	R N.S.
Parasitic Jaeger	PAJA	Stercorarius parasiticus	FC N.S.
Long-tailed Jaeger	LTJA	Stercorarius longicaudus	O N.S.
Mew Gull	MEGU	Larus canus	H(1) N.S.
Herring/Thayer's Gull	HEGU	Larus argentatus/glaucoides	R N.S.
Glaucous Gull	GLGU	Larus hyperboreus	C N.S.
Black-legged Kittiwake	BLKI	Rissa tridactyla	R(19) N.S.
Sabine's Gull	SAGU	Xema sabini	R(1) N.S.
Arctic Tern	ARTE	Sterna paradisaea	C N.S.
Thick-billed Murre	TBMU	Uria lomvia	R(1) N.S.
Black Guillemot	BLGU	Cepphus grylle	FC H.I.
Snowy Owl	SNOW	Nyctea scandiaca	O H.I.
Horned Lark	HOLA	Eremophila alpestris	R N.S.
Bank Swallow	BASW	Riparia riparia	R N.S.
Common Raven	CORA	Corvus corax	R N.S.
American Robin	AMRO	Turdus migratorius	R F.R.
Water Pipit	WAPI	Anthus spinoletta	R N.S.
American Tree Sparrow	ATSP	Spizella arborea	R N/F
Savannah Sparrow	SASP	Passerculus sandwichensis	R N/F
White-crowned Sparrow	WCSP	Zonotrichia leucophrys	R(1) N.S.
Lapland Longspur	LALO	Calcarius lapponicus	C N.S.
Snow Bunting	SNBU	Plectrophenax nivalis	FC N.S.
Common Redpoll	CORE	Carduelis flammeus	FC M.R.

[a] Status Codes: C - Common; FC - Fairly Common; O - Occasional; R - Rare; H - Hypothetical. These classifications of status are based on observations during aerial surveys, ground surveys, boat surveys and casual study during the period July 26 to September 2, 1987. No attempt was made to reconcile our status attribution with that of more extensive studies (e.g. Talarico and Mossop 1986).

Location: N.S. - Nunaluk Spit; N/H - Nunaluk Spit and Herschel Island; N/M - Nunaluk and Malcolm River; H.I. - Herschel Island; M.R. - Malcolm River; F.R. - Firth River; N/F - Nunaluk and Firth River.

Appendix 2. Code sheets for migration watches and ground censuses.

Migration Watch Code Sheet

Column	Data Type	Range of Values and Data Key
1 - 3	Survey Number	001 to 112 (each two-hour watch)
5 - 7	Date (Month-Day)	Month- 0 -July, 1 -August, 2 -September Day- 01 to 31
9	Location of bird(s) observed	0 - N side Nunaluk, 1 - S side Nunaluk, 2 - Middle of Spit.
11 -12	Time of Day	00 to 23 (i.e. 00:00 to 23:00)
13	Observer	0 - Ealey, 1 - Croft, 2 - Alexander
15	Temperature Sign	0 - positive, 9 - negative (below zero)
16 -17	Temperature	00 to 15 °C
19 -20	Wind Speed	00 to 08 Beaufort Scale (see below)
21 -22	Wind Direction	01 to 36 (x 10°C = compass bearing from which the wind blows)
24	Cloud Type	0 to 9 (see list below)
25	Cloud Height	0 to 9 (see list below)
26	Cloud Cover	0 - no cover, 1 to 8 (x 10% gives amount of cover), 9 equals 90% up to 100% cover
27	Precipitation	0 to 7 (see list below)
29 -30	Visibility	01 -v. poor (< 200m); 02 - poor (200 m to 1 km); 03 - moderate (1 to 5 km); 04 -good (5 to 20 km)
31	Snow/Ice Cover	0 to 9 (x 10% gives amount of cover)
36 -38	Flock Number	001 to 999 (potentially); sequential number for each sighting of single birds and flocks, within each hour
40 -43	Species Name	4-letter code (see Appendix 1)
45 -48	Numbers	0001 to 9999 (potentially); number of birds in flock
50 -51	Age	00 - undetermined; 01 - 100% adult; 02 - >75% ad.; 03 - 50 to 75% ad.; 04 - 25 to 50% ad.; 05 - <25% ad.; 06 - 100% juvenile
53 -54	Sex	00 - undetermined; 01 - 100% male; 02 - >75% m.; 03 - 50 to 75% m.; 04 - 25 to 50% m.; 05 - <25% m.; 06 - 100% female
56 -57	Height of Flight	00 - land on water; 01 - < 2 m; 02 - 2 to 5 m; 03 - 5 to 10 m; 04 - 10 to 25 m; 05 - 25 to 50 m; 06 - 50 to 100 m; 07 - 100 to 250 m; 08 - 250 to 500 m; 09 - >500 m; 10 - undetermined
59 -60	Distance from Spit	00 - overland; 01 - < 10 m; 02 - 10 to 100 m; 03 - 100 to 500 m; 04 - 500 m to 1 km; 05 - >1 km; 99 - undetermined
62 -63	Flight Direction	00 - not determined; 01 to 36 (x 10°)
65	Flight Type	0 - probable migrant; 1 - possible migrant; 2 - local flight
66 -80	Comment	Comment on behaviour or significant obs'ns

Note that column numbers not listed were left blank.

Ground Census Code Sheet

Column	Data Type	Range of Values and Data Key
1 - 2	Survey Number	01 to 10 (consecutive numbers)
3 -10	Date and Time	(see Migration Watch Codes)
11	Location	1 - North side Nunaluk; 2 - South side Nunaluk; 3 - mainland shore; 4 - middle Nunaluk
13 -15	Survey Segment	000 to 100 - sequential numbered 100 m segments, beginning from tip and heading west
17 -20	Species Name	4-letter code (see Appendix 1)
22 -26	Numbers	00001 to 99999 (potentially); number of birds in flock
28 -29	Behaviour	00 - undetermined; 01 - feeding; 02 - sleeping/resting or loafing; 03 - swimming; 04 - flying; 05 - territoriality; 06 - other activities (preening)
33 -45	Weather	(see Migration Watch Codes)
46	Distance	0 - on middle of spit, specif. dry land; 1 - along water edge or in pond; 2 - 0 to 10 m; 3 - 10 to 25 m; 4 - 25 to 50 m; 5 - >50 m; 9 - undetermined

Cloud Type

0 - feather; 1 - feather; 2 - heap; 3 - layer, some feather of heap; 4 - feather, some layer; 5 - feather, some heap; 6 - feather, some layer and heap; 7 - heap, some layer; 8 - heap, some feather; 9 heap, some layer and feather.

Cloud Height

0 - low (<8000 ft); 1 - medium (8000 to 18 000 ft); 2 - high (>18 000 ft); 3 - low, some medium or high; 4 - medium, some low; 5 - medium, some high; 6 - medium, some low and high; 7 - high, some low; 8 - high, some medium; 9 - high, some low and medium

Precipitation

0 - none; 1 - intermittent, light rain; 2 - drizzle; 3 - steady rain; 4 - heavy rain; 5 - fog; 6 - sleet; 7 - light snow

Beaufort Wind Scale

Beaufort #	Range in Knots	Descriptive Terms
00	less than 1	Calm
01	1 to 3	Light air
02	4 to 6	Light breeze
03	7 to 10	Gentle breeze
04	11 to 16	Moderate breeze
05	17 to 21	Fresh breeze
06	22 to 27	Strong breeze
07	28 to 33	Near gale
08	34 to 40	Gale
09	41 to 47	Strong gale

Appendix 3. Observations[a] of Ducks and Loons during migration watch periods on Nunaluk Spit, July 27 to August 30, 1987.

Species		Survey Period: July 27-31	August 1-5	August 6-10	August 11-15	August 16-20	August 21-25	August 26-30	Total
American Wigeon	All				62	41	56	11	170
	%				36.5	24.1	32.9	6.5	4.2
	Mig./Pass.				62	41	56	11	170
	%				36.5	24.1	32.9	6.5	6.1
Black Scoter	All			5					5
	%			100.0					0.1
	Mig./Pass.			5					5
	%			100.0					0.2
Common Eider	All	45	83	72	25	6	1		232
	%	19.4	35.8	31.0	10.8	2.6	0.4		5.7
	Mig./Pass.	22	11	9			1		43
	%	51.2	25.6	20.9			2.3		1.6
Common Loon	All			3			1		4
	%			75.0			25.0		0.1
	Mig./Pass.			3					3
	%			100.0					0.1
Dabbling Ducks	All				53	190			243
	%				21.8	78.2			6.0
	Mig./Pass.				53	190			243
	%				21.8	78.2			8.8
Ducks (Unidentified)	All	4	5	10	70	33	74	24	220
	%	1.8	2.3	4.5	31.8	15.0	33.6	10.9	5.4
	Mig./Pass.	2	5	2	61	33	74	24	201
	%	1.0	2.5	1.0	30.3	16.4	36.8	11.9	7.2
Eider (Unidentified)	All		3	1	9	8	2		23
	%		13.0	4.3	39.1	34.8	8.7		0.6
	Mig./Pass.		2		7	8	2		19
	%		10.5		36.8	42.1	10.5		0.7
Loons (Unidentified)	All	1	1		1	7			10
	%	10.0	10.0		10.0	70.0			0.2
	Mig./Pass.	1	1						2
	%	50.0	50.0						0.1
Mallard	All	20	25	8					53
	%	37.7	47.2	15.1					1.3
	Mig./Pass.	20	10						30
	%	66.7	33.3						1.1

Appendix 3. (cont.)

Species		Survey Period: July 27-31	August 1-5	August 6-10	August 11-15	August 16-20	August 21-25	August 26-30	Total
Northern Pintail	All		216	68	914	104	13	14	1329
	%		16.3	5.1	68.8	7.8	1.0	1.1	32.9
	Mig./Pass.		51	54	913	103	10	14	1145
	%		4.5	4.7	79.7	9.0	0.9	1.2	41.3
Oldsquaw	All	100	85	129	49	230	96	80	769
	%	13.0	11.1	16.8	6.4	29.9	12.5	10.4	19.0
	Mig./Pass.	65	20	17	20	137	70	62	391
	%	16.6	5.1	4.3	5.1	35.0	17.9	15.9	14.1
Pacific Loon	All	1	4			1	1	1	8
	%	12.5	50.0			12.5	12.5	12.5	0.2
	Mig./Pass.		4				1		5
	%		80.0				20.0		0.2
Red-breasted Merganser	All	2	1		1			6	10
	%	20.0	10.0		10.0			60.0	0.2
	Mig./Pass.	2			1			6	9
	%	22.2			11.1			66.7	0.3
Red-Throated Loon	All	18	92	83	74	58	50	64	439
	%	4.1	21.0	18.9	16.9	13.2	11.4	14.6	10.9
	Mig./Pass.	2	2	1	10		4	1	20
	%	10.0	10.0	5.0	50.0		20.0	5.0	0.7
Scoter (Unidentified)	All	2				4	3		9
	%	22.2				44.4	33.3		0.2
	Mig./Pass.	2				4	3		9
	%	22.2				44.4	33.3		0.3
Surf Scoter	All	24	2		1		10	4	41
	%	58.5	4.9		2.4		24.4	9.8	1.0
	Mig./Pass.	4					10	4	18
	%	22.2					55.6	22.2	0.6
Waterfowl (Unidentified)	All			30		359			389
	%			7.7		92.3			9.6
	Mig./Pass.			30		359			389
	%			7.7		92.3			14.0
White-winged Scoter	All	1	12	13	51	1		1	79
	%	1.3	15.2	16.5	64.6	1.3		1.3	2.0
	Mig./Pass.	1	2	13	51	1		1	69
	%	1.4	2.9	18.8	73.9	1.4		1.4	2.5

Appendix 3. (cont.)

Species		Survey Period: July 27-31	August 1-5	August 6-10	August 11-15	August 16-20	August 21-25	August 26-30	Total
Yellow-billed Loon	All		4					2	6
	%		66.7					33.3	0.1
	Mig./Pass.							2	2
	%							100.0	0.1
TOTAL	All	218	533	422	1310	1042	307	207	4039
	%	5.4	13.2	10.4	32.4	25.8	7.6	5.1	100.0
TOTAL	Mig./Pass.	121	108	134	1178	876	231	125	2773
	%	4.4	3.9	4.8	42.5	31.6	8.3	4.5	100.0

[a]All - all birds observed during each survey period.
Mig./Pass. - number of birds making migration/passage flights.
% - proportion of the species' observations that were in each survey period; in Total column it is proportion of the total Duck and Loon observations that were of each species.

Appendix 4. Observations[a] of Geese and Swans during migration watch periods on Nunaluk Spit, July 27 to August 30, 1987.

Species		Survey Period: July 27-31	August 1-5	August 6-10	August 11-15	August 16-20	August 21-25	August 26-30	Total
Brant	All		2		134	671	319	3981	5107
	%		<0.1		2.6	13.1	6.2	78.0	79.8
	Mig./Pass.		2		124	602	319	3811	4858
	%		<0.1		2.6	12.4	6.6	78.4	79.8
Dark Geese	All				2			554	556
	%				0.4			99.6	8.7
	Mig./Pass.				2			554	556
	%				0.4			99.6	9.1
Greater White-fronted Goose	All							241	241
	%							100.0	3.8
	Mig./Pass.							241	241
	%							100.0	4.0
Snow Goose	All					10	45	419	474
	%					2.1	9.5	88.4	7.4
	Mig./Pass.					10		419	429
	%					2.3		97.7	7.0
Tundra Swan	All			2				19	21
	%			9.5				90.5	0.3
	Mig./Pass.			0				4	4
	%			0.0				100.0	0.1
TOTAL	All	0	2	2	136	681	364	5214	6399
	%	0	0.0	0.0	2.1	10.6	5.7	81.5	100.0
TOTAL	Mig./Pass.	0	2	0	126	612	319	5029	6088
	%	0	0.0	0	2.1	10.1	5.2	82.6	100.0

[a]All - all birds observed during each survey period.
Mig./Pass. - number of birds making migration/passage flights.
% - proportion of the species' observations that were in each survey period; in Total column it is the proportion of the total Geese and Swans observations that were of each species.

Appendix 5. Observations[a] of Shorebirds (Excluding Phalaropes) during migration watch periods on Nunaluk Spit, July 27 to August 30, 1987.

Species		Survey Period: July 27-31	August 1-5	August 6-10	August 11-15	August 16-20	August 21-25	August 26-30	Total
Baird's Sandpiper	All							8	8
	%							100.0	0.1
	Mig./Pass.							8	8
	%							100.0	0.3
Black-bellied Plover	All		7	30		5	6	1	49
	%		14.3	61.2		10.2	12.2	2.0	0.8
	Mig./Pass.		2	29		5	6	1	43
	%		4.7	67.4		11.6	14.0	2.3	1.5
Hudsonian Godwit	All		1						1
	%		100.0						<0.1
	Mig./Pass.		1						1
	%		100.0						<0.1
Long-billed Dowitcher	All					17	95		112
	%					15.2	84.8		1.9
	Mig./Pass.					17	64		81
	%					21.0	79.0		2.8
Lesser Golden-Plover	All	1	2	2	4	23	2		34
	%	2.9	5.9	5.9	11.8	67.6	5.9		0.6
	Mig./Pass.	1	2	1	4	23	2		33
	%	3.0	6.1	3.0	12.1	69.7	6.1		1.1
Peep (unidentified calidrid)	All		240	1214	154	37	93	84	1822
	%		13.2	66.6	8.5	2.0	5.1	4.6	31.5
	Mig./Pass.		101	48	87	12	91	84	423
	%		23.9	11.3	20.6	2.8	21.5	19.9	14.6
Pectoral Sandpiper	All				4	19	90	8	121
	%				3.3	15.7	74.4	6.6	2.1
	Mig./Pass.				4	19	79	8	110
	%				3.6	17.3	71.8	7.3	3.8
Plovers (Unidentified)	All					6	34		40
	%					15.0	85.0		0.7
	Mig./Pass.					6	33		39
	%					15.4	84.6		1.3
Ruddy Turnstone	All		16	48	21	7	1	5	98
	%		16.3	49.0	21.4	7.1	1.0	5.1	1.7
	Mig./Pass.			26	18	7	1	3	55
	%			47.3	32.7	12.7	1.8	5.5	1.9

Appendix 5. (cont.)

Species		Survey Period: July 27-31	August 1-5	August 6-10	August 11-15	August 16-20	August 21-25	August 26-30	Total
	All	8			1	13	8	63	93
Sandpipers	%	8.6			1.1	14.0	8.6	67.7	1.6
(Unidentified)	Mig./Pass.				1	12	8	61	82
	%				1.2	14.6	9.8	74.4	2.8
	All		40	21		21			82
Semipalmated	%		48.8	25.6		25.6			1.4
Sandpiper	Mig./Pass.			1		2			3
	%			33.3		66.7			0.1
	All	5	203	2001	158	415	371	144	3297
Shorebirds	%	0.2	6.2	60.7	4.8	12.6	11.3	4.4	57.0
(Unidentified)	Mig./Pass.		8	1020	104	389	321	144	1986
	%		.4	51.4	5.2	19.6	16.2	7.3	68.6
	All		17	1					18
Stilt	%		94.4	5.6					0.3
Sandpiper	Mig./Pass.		17						17
	%		100.0						0.6
	All		11				3		14
White-rumped	%		78.6				21.4		0.2
Sandpiper	Mig./Pass.		11				3		14
	%		78.6				21.4		0.5
TOTAL	All	14	537	3317	342	563	703	313	5789
	%	0.2	9.3	57.3	5.9	9.7	12.1	5.4	100.0
TOTAL	Mig./Pass.	1	142	1125	218	492	608	309	2895
	%	<0.1	4.9	38.9	7.5	17.0	21.0	10.7	100.0

[a]All - all birds observed during each survey period.
Mig./Pass. - number of birds making migration/passage flights.
% - proportion of the species' observations that were in each survey period; in Total column it is the proportion of the total Shorebird observations that were of each species.

Appendix 6. Observations[a] of Phalaropes during ground surveys on Nunaluk Spit, July 27 to August 31, 1987 .

		Survey Period										
		July		August								
		27 - 31		1-5	6-10	11 - 15		16 - 20		21-21	26-31	
		Survey Date										
Species		27/28	31	5	8	11	13	16	20	25	31	
Red-necked Phalarope	All	844	219	1880	2612	494	1099	131	166		39	7484
	%	11.3	2.9	25.1	34.9	6.6	14.7	1.8	2.2		0.5	98.7
	Fly	113	16	152	387	325	274	107	125		13	1572
	%	7.2	1.0	9.7	24.6	24.5	17.4	6.8	8.0		0.8	97.6
Red Phalarope	All					2		1	56		27	86
	%					2.3		1.2	65.1		31.4	1.1
	Fly					0		1	22		7	30
	%					0		3.3	73.3		23.3	1.9
Phalarope (Unid.)	All							1	10		9	20
	%							5.0	50.0		45.0	0.3
	Fly							0	0		9	9
	%							0	0		100.0	0.6
TOTAL	All	844	219	1880	2612	496	1099	133	232		75	7590
	%	11.1	2.9	24.8	34.5	6.5	14.5	1.8	2.9		0.1	
	Fly	113	16	152	387	385	274	108	147		29	1611
	%	7.0	1.0	9.4	24.0	23.9	17.0	6.7	9.1		1.8	

[a]All - total number of birds seen during each census.
Fly - total number of flying birds seen during each census.
% - proportion of the species' observations that were in each census; in Total column it is the proportion of all Phalarope observations that were of each species.

Appendix 7. Observations[a] of Larids during migration watch periods on Nunaluk Spit, July 27 to August 30, 1987.

Species		Survey Period: July 27-31	August 1-5	August 6-10	August 11-15	August 16-20	August 21-25	August 26-30	Total
Arctic Tern	All	64	80	116	235	196	86	13	790
	%	8.1	10.1	14.7	29.7	24.8	10.9	1.6	27.8
	Mig./Pass.	4	0	1	1	37	42	13	98
	%	0.4	0	1.0	1.0	37.8	42.9	13.3	31.0
Black-legged Kittiwake	All					24			24
	%					100.0			0.8
	Mig./Pass.					24			24
	%					100.0			7.6
Glaucous Gull	All	309	299	369	338	153	130	350	1948
	%	15.9	15.3	18.9	17.4	7.9	6.7	18.0	68.4
	Mig./Pass.	81	0	3	4	11	48	23	170
	%	47.6	0	1.8	2.4	6.5	28.2	13.5	53.8
Gull (unid.)	All	3			1	3			7
	%	42.9			14.3	42.9			0.2
	Mig./Pass.	0			0	3			3
	%	0			0	100.0			0.9
Herring/ Thayer's Gull	All				1				1
	%				100.0				<0.1
	Mig./Pass.				1				1
	%				100.0				0.3
Jaeger (Unid.)	All					2			2
	%					100.0			0.1
	Mig./Pass.					0			0
	%					0			0
Larid (unid.)	All	3							3
	%	100.0							0.1
	Mig./Pass.	3							3
	%	100.0							0.9
Long-tailed Jaeger	All		1	4	1	1			7
	%		14.3	57.1	14.3	14.3			0.2
	Mig./Pass.		0	0	0	1			1
	%		0	0	0	100.0			0.3
Parasitic Jaeger	All		4	22	10	5	15	8	64
	%		6.3	34.4	15.6	7.8	23.4	12.5	2.2
	Mig./Pass.		0	4	2	1	7	2	16
	%		0	25.0	12.5	6.3	43.8	12.5	5.1
TOTAL	All	379	384	511	586	384	231	371	2846
	%	13.3	13.5	18.0	20.6	13.5	8.1	13.0	100.0
	Mig./Pass.	88	0	8	8	77	97	38	316
	%	27.8	0	2.5	2.5	24.4	30.7	12.0	100.0

[a]See Appendix 5 footnote, and substitute word Larids for Shorebirds.

Appendix 8. Observations[a] of Sparrows during migration watch periods on Nunaluk Spit, July 27 to August 30, 1987.

Species		Survey Period: July 27-31	August 1-5	August 6-10	August 11-15	August 16-20	August 21-25	August 26-30	Total
Lapland Longspur	All				147	226	575	188	1136
	%				12.9	19.9	50.6	16.5	81.0
	Mig./Pass.				92	155	542	187	976
	%				9.4	15.9	55.5	19.2	82.7
Savannah Sparrow	All		3						3
	%		100.0						0.2
	Mig./Pass.		3						3
	%		100.0						0.3
Snow Bunting	All	5	39	29	20	11	16	20	140
	%	3.6	27.9	20.7	14.3	7.9	11.4	14.3	10.0
	Mig./Pass.	1	28	26	13	2	8	18	96
	%	1.0	29.2	27.1	13.5	2.1	8.3	18.8	8.1
Sparrows (Unidentified)	All		18	23	2	6	1	71	121
	%		14.9	19.0	1.7	5.0	0.8	58.7	8.6
	Mig./Pass.		18	6	1	6	1	71	103
	%		17.5	5.8	1.0	5.8	1.0	68.9	8.7
Water Pipit	All						1		1
	%						100.0		0.1
	Mig./Pass.						1		1
	%						100.0		0.1
White-crowned Sparrow	All						1		1
	%						100.0		0.1
	Mig./Pass.						1		1
	%						100.0		0.1
TOTAL	All	5	60	52	169	243	594	279	1402
	%	0.4	4.3	3.7	12.1	17.3	42.4	19.9	100.0
TOTAL	Mig./Pass.	1	49	32	106	163	553	276	1180
	%	0.1	4.2	2.7	9.0	13.8	46.9	23.4	100.0

[a]All - all birds observed during each survey period.
Mig./Pass. - number of birds making migration/passage flights.
% - proportion of the species' observations that were in each survey period; in Total column it is the proportion of all Sparrow observations that were of each species.

Appendix 9. Observations of Sparrows during ground surveys on Nunaluk Spit, July 27 to August 31, 1987.

		Survey Period									
		July		August							
		27 - 31		1-5	6-10	11 - 15		16 - 20		21-21	26-31
		Survey Date									
Species		27/28	31	5	8	11	13	16	20	25	31	Total
Lapland Longspur	All				40	95	50	426	50	29	50	740
	%				5.4	12.8	6.8	57.6	6.8	3.9	6.8	
	Fly				40	95	28	412	49	24	45	693
	%				5.8	13.7	4.0	59.5	7.1	3.5	6.5	
Savannah Sparrow	All			1								1
	%			100.0								
	Fly			0								0
	%			0								
Snow Bunting	All		1	3	6	20	1	7	2	35	2	77
	%		1.3	3.9	7.8	26.0	1.3	9.1	2.6	45.5	2.6	
	Fly		0	0	0	13	1	2	2	35	2	55
	%		0	0	0	23.6	1.8	3.6	3.6	63.6	3.6	
Sparrow (Unid.)	All				7				5	7		19
	%				36.8				26.3	36.8		
	Fly				4				5	7		16
	%				25.0				31.3	43.8		
TOTAL	All		1	4	53	115	51	433	57	71	52	837
	%		0.1	0.5	6.3	13.7	6.1	51.7	6.8	8.5	6.2	
	Fly		0	0	44	108	29	414	56	66	47	764
	%		0	0	5.8	14.1	3.8	54.2	7.3	8.6	6.2	

[a] All - total number of birds seen during each census.
Fly - total number of flying birds seen during each census.
% - proportion of the species' observations that were in each census; in Total column it is the proportion of all Sparrow observations that were of each species.

Appendix 10. Number of birds[a] of various species within kilometre survey units during ground surveys on Nunaluk Spit, July 27 to August 31, 1987.

Species	Kilometre Survey Units[b] 1	2	3	4	5	6	7	8	9	10	Total
Ducks and Loons											
American Wigeon	6	--	--	--	--	--	--	--	--	--	6
Common Eider	53	16	6	5	11	2	7	5	2	1	108
Common Loon	--	--	--	--	--	--	--	3	1	--	4
Duck (Unidentified)	20	--	--	--	--	--	--	--	--	--	20
Eider (Unidentified)	4	--	--	--	--	--	--	--	--	--	4
Northern Pintail	35	7	1	--	--	--	--	--	--	--	43
Oldsquaw	1167	38	24	24	3	14	11	--	3	10	1294
Pacific Loon	--	--	--	--	--	--	--	2	--	--	2
Red-Breasted Merganser	2	7	--	--	--	--	--	4	--	--	13
Red-Throated Loon	4	2	5	1	--	5	1	--	--	--	18
Surf Scoter	--	--	1	--	--	--	--	--	--	--	1
Yellow-billed Loon	--	--	--	1	--	--	--	--	--	--	1
Geese and Swans											
Brant	30	--	--	8	25	--	--	--	--	--	63
Snow Goose	--	--	--	--	--	--	550	--	--	--	550
Tundra Swan	--	--	--	--	--	2	--	4	--	13	19
Shorebirds (Excluding Phalaropes)											
Baird's Sandpiper	4	2	1	5	--	--	--	--	--	--	12
Black-bellied Plover	4	--	--	--	--	--	--	--	--	--	4
Dunlin	9	--	--	2	3	--	--	--	--	--	14
Least Sandpiper	5	--	--	--	--	--	--	--	--	--	5
Lesser Golden-Plover	--	--	--	--	--	--	--	--	3	3	6
Peep (Unid. calidrid)	5	--	8	--	--	--	--	--	--	--	13
Pectoral Sandpiper	--	--	--	--	--	--	--	--	--	7	7
Ruddy Turnstone	31	6	2	11	3	--	--	1	--	--	54
Sanderling	41	3	34	6	7	7	11	1	--	--	110
Semipalmated Sandpiper	285	16	110	49	6	2	--	--	--	--	468
Shorebird (Unid.)	--	--	--	--	--	2	--	--	--	--	2
Stilt Sandpiper	11	--	--	--	--	--	--	--	--	--	11
Western Sandpiper	7	--	3	1	--	--	--	--	--	--	11
White-Rumped Sandpiper	90	7	--	5	1	--	--	--	--	--	103
Phalaropes											
Phalarope (unid.)	10	--	1	--	--	--	--	--	--	--	11
Red Phalarope	39	9	4	--	--	2	--	--	2	--	56
Red-necked Phalarope	4368	275	295	657	84	112	67	31	23	--	5912

Appendix 10. (cont.)

Species	Kilometre Survey Units 1	2	3	4	5	6	7	8	9	10	Total
Larids											
Arctic Tern	88	27	31	43	47	1	3	--	6	--	246
Glaucous Gull	119	61	71	21	62	43	54	54	8	4	497
Sparrows											
Lapland Longspur	22	11	5	1	4	4	--	--	--	--	47
Savannah Sparrow	--	--	--	1	--	--	--	--	--	--	1
Snow Bunting	--	19	--	--	3	--	--	--	--	--	22
Sparrow	--	--	2	1	--	--	--	--	--	--	3
TOTAL	6459	506	604	842	259	196	704	105	48	38	9761

[a] - Only birds that were not flying are tallied.
[b] - Consecutive one-kilometre sections that extend westward from tip of Nunaluk Spit.