POPULATION STATUS OF MIGRATORY WATERBIRDS ON THE YUKON COASTAL PLAIN AND ADJACENT MACKENZIE DELTA

J.S. Hawkings

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ABSTRACT

The status of waterbird (loons, swans, geese, ducks, cranes, jaegers, gulls, shorebirds, and seabirds) populations is summarized for the coastal plain of northern Yukon, and the Yukon portion of the Mackenzie Delta. Estimates of bird density and total population size during spring, summer and fall are presented and discussed, based on research in the area during the period 1971-1985. The waterbird fauna of the area is well known as a result of these fifteen years of research. The most significant components of this avifauna from a national perspective are the fall concentrations of lesser snow geese (potentially the entire western Canadian arctic population) throughout the coastal plain, and a midsummer concentration of 10,000-15,000 molting seaducks at Herschel Island. Nesting shorebirds on the coastal plain may also be of national significance. Of lesser significance are a glaucous gull colony at Escape Reef, and tundra swans nesting and molting on the Babbage River Delta and the Yukon part of the Mackenzie Delta. A breeding colony of black guillemots at Pauline Cove, Herschel Island, is also a unique feature. As a breeding ground for ducks, geese, and swans, the area is of minor importance compared with the Old Crow Flats or entire Mackenzie Delta. Although the avifauna is well known, the sizes of breeding populations of many species on the coastal plain are still poorly known. This is largely due to a lack of effort in determining (1) densities of breeding birds in particular habitats, and (2) the amount and distribution of those habitats throughout the coastal plain.

RESUME

Le situation des populations d'oiseaux aquatiques (huarts, cygnes, oies, canards, grues, labbes, goélands, oiseaux de rivage et oiseaux de mer) est résumée pour la plaine côtière du nord du Yukon ainsi que pour la partie du Yukon située dans le delta du Mackenzie. Le rapport présente et analyse les estimations de la densité des oiseaux et de la taille des populations totales au printemps, en été et en automne à partir de recherches faites dans cette région de 1971 à 1985. La faune des oiseaux aquatiques de cette région est bien connue grâce à ces quinze années de recherches. A l'échelle nationale, les éléments les plus importants de cette avifaune sont les concentrations automnales de la petite oie des neiges (éventuellement toute la population de l'ouest de l'Arctique canadien) dans toute la plaine côtière, et une concentration de 10 000 à 15 000 canards marins en période de mue à l'île Herschel vers le milieu de l'été. Les oiseaux de rivage qui nichent sur la plaine côtière peuvent également présenter une certaine importance nationale. La colonie de goélands bourgmestres à Escape Reef ainsi que les cygnes siffleurs en période de nidification et de mue dans le delta de la rivière Babbage et la partie du delta du Mackenzie au Yukon sont de moindre importance. Une colonie de quillemots à miroir en période de reproduction à Pauline Cove sur l'île Herschel constitue également une caractéristique unique. En tant qu'aire de reproduction pour les canards, les oies et les cygnes, cette région a moins d'importance que les vasières de Old Crow ou que tout le delta du Mackenzie. Bien que l'avifaune soit bien connue, il reste encore à évaluer la taille des populations de nombreuses espèces en période de reproduction sur la plaine côtière. Cela est principalement dû au numbre insuffisant d'études visant à déterminer (1) les densités des oiseaux en période de reproduction dans des habitats donées, et (2) le nombre et la répartition de des habitats dans toute la plaine côtière.

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1.0 INTRODUCTION

This document is a summary of information on populations of migratory waterbirds (loons, swans, geese, ducks, cranes, jaegers, gulls, terns, shorebirds, and seabirds) using the Yukon coastal plain and the Yukon portion of the Mackenzie Delta (Fig. 1) during spring, summer, and fall. It is intended to serve as a first reference for information on migratory waterbirds in this area. It is not intended to be an exhaustive review of all literature on the subject (such reviews are already provided by Johnson et al. 1975, LGL Limited 1982, Goodwin and Howard 1984), but concentrates on studies published since 1970 which contain population level information. Neither is it intended to be a complete status report on all bird species in the area, as it does not include those which are not water-oriented, or which occur only as uncommon or rare visitors with no record of breeding. More complete status reports are available elsewhere (eg. Johnson et al. 1975, Salter et al. 1980). Geographically, the emphasis here is placed on the coastal plain and coast, where the greatest numbers and diversity of waterbirds are found and where most research has been conducted, rather than the drier foothills and mountains.

There is a large volume of literature available on the birds of this area, much in the form of unpublished reports. To increase the utility of this review, a chronological summary of field studies is provided dating from 1971 to 1985 and the resulting reports and formal publications (Appendix I).

The document is organized on a species or species group basis, depending on the level of information available. Each account is divided into sections on spring migration, breeding, in some cases molting, and fall migration. In some cases (eg. ducks) there are several sources of information which can form the basis of a population estimate for part or all of the area of interest. These estimates are provided, and where possible, there is some discussion of which is the best estimate. Where necessary, the final entry in each account is a brief discussion of the adequacy of the current knowledge for that species or species group and the needs for further research. Another document aimed at identifying key areas for birds in coastal regions of the Beaufort Sea (Smyth et al. 1986) contains some of the same information, presented on a geographic basis, and has accompanying maps outlining important areas and the species using them during spring, summer, and fall.

Survey data cited in this report vary widely in quality owing to differences in objectives, survey methodology, and data analysis. As a result many of the estimates derived from those data, particularly those of density and total population, are far from precise, and many are biased. However, these imperfections were often impossible to quantify. The conclusions contained herein were made by the author of this review, unless otherwise noted. The reader is cautioned against drawing further conclusions from these data without careful consideration of their source(s) and quality; it is strongly recommended that the original documents be consulted.

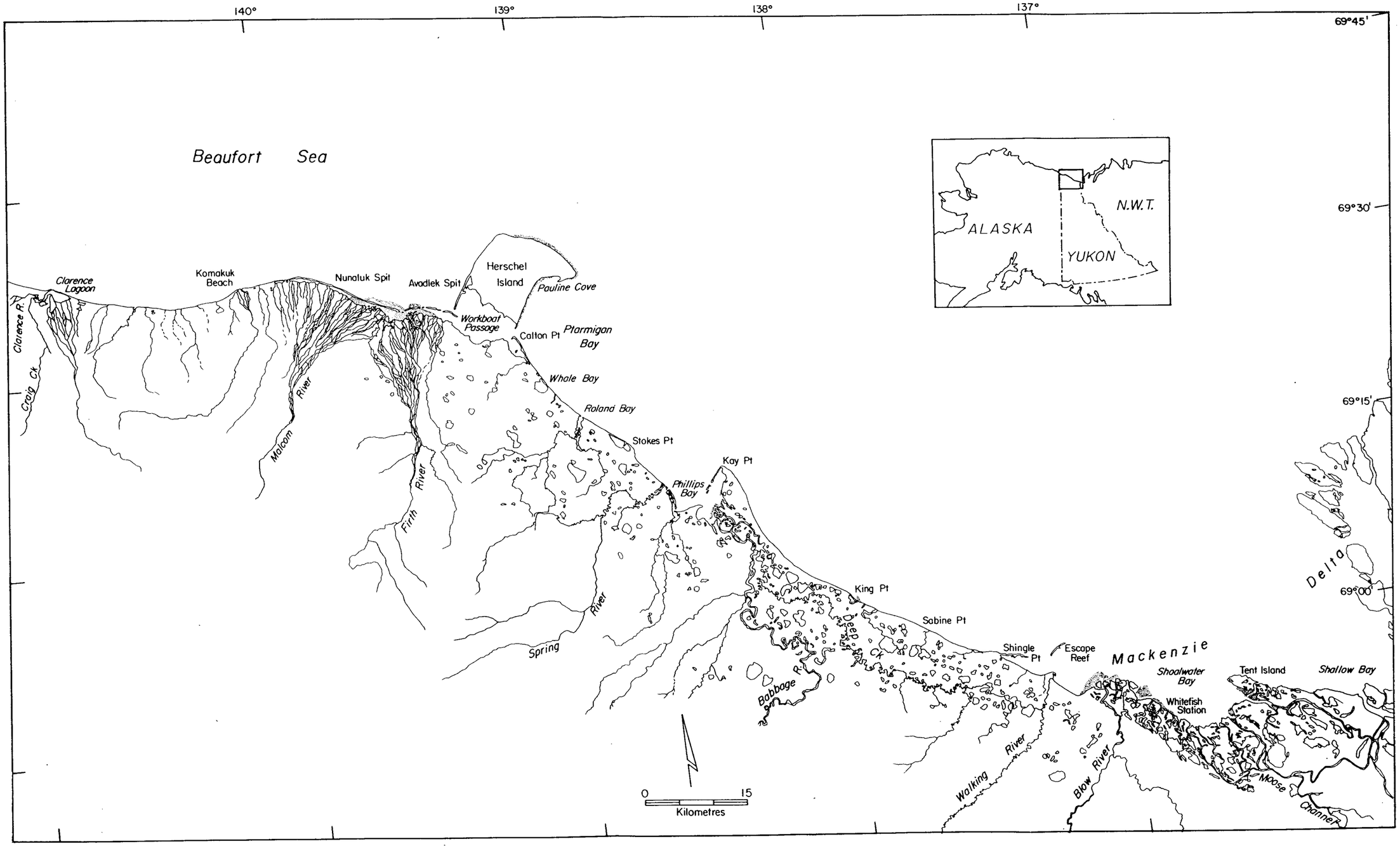

Figure 1. The Yukon coastal plain area and adjacent Mackenzie Delta, showing locations of places mentioned in the text.

2.0 SPECIES ACCOUNTS

2.1 LOONS

2.1.1 Spring Migration

Relatively few loons migrate east along the Yukon coast in spring (estimated 402 red-throated, 295 arctic, and 52 yellow-billed loons in spring 1975), far fewer than nest in the Canadian arctic and far fewer than return westward past Point Barrow, Alaska in the fall (Richardson and Johnson 1981). A few loons, especially yellow-billed loons, appear to migrate eastward along offshore leads in the ice. All three species apparently also fly overland through interior Alaska and Yukon from the Pacific Ocean. Loons use shoreleads and early-melting areas of river deltas along the Beaufort Sea coast as soon as these are available in spring.

2.1.2 Breeding

Red-throated and arctic loons breed on the Yukon coastal plain, while yellow-billed and common loons are uncommon visitants with no record of breeding. Loons nest within a few meters of freshwater ponds and lakes; therefore their breeding distribution is closely tied to the distribution of those waterbodies. Red-throated loons generally nest on smaller waterbodies than arctic loons (Davis 1972, Bergman and Derksen 1977). Fewer red-throated loons than arctic loons are seen during aerial surveys of the coastal plain (0.02-0.13/km^2 vs. 0.05-0.39/km^2 respectively, Table 1), but it is unclear from ground surveys which species is most abundant. Dickson (1985) reported average densities (loons/km^2) of 1.4 for each species during ground transects at 4 sites in the King Point area in 1981. In 1983, average densities were 0.7 arctic and 2.4 red-throated loons at 8 study sites near Stokes Point, Phillips Bay, and King Point (Dickson, unpubl. data). Estimates derived from counts of birds on various sizes of lakes throughout the coastal plain in late July 1973 (Table 2) suggest that arctic loons are by far the most abundant, and that few of the red-throated loons which are present actually breed. However, that study was biased because it did not include very small waterbodies. Only 17 of the 28 "Class A" lakes in that study were less than 25 ha, and none were smaller than 2.5 ha. Ponds of about 0.5 ha are considered ideal for nesting red-throated loons (Davis 1972), and Dickson (1985) found all red-throated loons on waterbodies of less than 25 ha in the King Point area.

2.1.3 Fall Migration

Red-throated, arctic, and yellow-billed loons move primarily eastward in small numbers along the Yukon coast during July and August. Eastward movement then ceases and there is a slight westward movement (estimated total 35 in 1972) in mid September (Gollop and Davis 1974a). This is a surprisingly small westward movement considering Timson's (1976) estimate of about 50,000 loons migrating west past Point Barrow, Alaska during 27 August-16 September 1975. It is most likely that loons seen at Point Barrow migrate offshore in the Beaufort, as loons are broadly distributed in small numbers (density ca. 0.015/km^2 in August and 0.025/km^2 on 10 September) in the offshore Beaufort Sea during the period in which migrants are observed in the nearshore waters (data from Searing et al. 1975). The study area covered by the 1974 surveys from which those data came was 184,000 km^2, which would indicate total numbers

Table 1. Numbers and densities of loons observed during aerial surveys of the Yukon coast and coastal plain during late spring, summer, and fall. Values in parentheses are actual numbers observed.

Source	Year	Date	Habitat[a]	Area Surveyed (km^2)	Birds/km^2 (actual numbers observed) Red-throated Loon	Arctic Loon	Unid. Loon	Total Loons
Vermeer and Anweiler 1975	1973	9-12 Aug	C	?	(60)	(6)		(69)
		23-24 Aug	C	?	(14)	(4)		(19)
		1 Sept	C	?	(51)	(3)		(60)
		10 Sept	C	?	(5)			(7)
		14 Sept	C	?	(4)	(12)		(16)
		21 Sept	C	?		(4)		(4)
Barry et al. 1981	1980	13-17 Jul	C	48.4				0.10 (5)
		29-31 Jul	C	48.4				0.52 (25)
		16-18 Aug	C	48.4				0.19 (9)
Barry and Barry 1982	1981	18 July	C	88.4				0.59 (52)
		2 Aug	C	88.4				0.30 (27)
		11 Sept	C	40.4				0.03 (1)
Dickson 1985	1981	19 June	U + L	96.0	0.02	0.11	0.10	0.24 (23)
		24 July	U + L	36.0	0.08	0.31	0.44	0.83 (30)
			C	24.4			0.12	0.12 (3)
		3 Sept	C	46.4	0.04	0.06	0.41	0.52 (24)
Dickson unpubl. data	1983	21 June	U + L	55.0	0.06	0.09		0.18 (10)
		2 Aug	U + L	55.0				0.75 (41)
		16 Aug	C	22.8	0.48	0.39	0.44	1.32 (30)
		26 Aug	C	153.0	0.14	0.10	0.25	0.48 (74)
		1 Sept	C	153.0	0.39	0.17	0.42	0.97 (149)
		7 Sept	C	153.0	0.13	0.11	0.18	0.43 (66)
McKelvey 1986	1985	27 June	L	7.6		0.26	0.13	0.39 (3)
			U	39.1	0.05	0.05	0.10	0.20 (8)
			C	5.6		0.17	0.36	0.53 (3)
		3 July	L	7.6	0.13	0.39		0.53 (4)
			U	39.1	0.02	0.36	0.08	0.46 (18)
			C	5.6	0.71	0.35		1.07 (6)
			C	29.2	0.10	0.17	0.72	0.99 (29)
Alexander 1986	1985	26 July	C	125	0.12	0.04	0.01	0.21 (26)
		21 Aug	C	92	0.09 (8)	0.01	0.03	0.15 (14)
		12 Sept	C	128	0.06 (8)	0.01		0.07 (9)

[a] L-Lowland, U-Upland, C-Coastal marine.

Table 2. Estimated populations of loons on Yukon coastal plain lakes, derived from ground counts at 60 lakes during July 1973 (data from Sharp et al. 1974: 45, 49).

Lake Size Class (km^2)	Number of Lakes: Minimum Number on Coastal Plain[a]	Number of Lakes: No. Surveyed	Birds	Common Loon: Adult	Arctic Loon: Adult	Arctic Loon: Brood	Red-throated Loon: Adult	Red-throated Loon: Brood	Total Loons: Adult	Total Loons: Brood
	480	18	No. seen		35	2	7		45	2
<0.26			Mean/Lake		1.94	0.11	0.39		2.50	0.11
			Est. Total		**933**	**53**	**187**		**1,200**	**53**
			CI[b]		**421**	**76**	**243**		**490**	**76**
	70	28	No. seen	1	84	10	2		87	10
0.26–			Mean/Lake	0.04	3	0.36	0.07		3.11	0.36
1.28			Est. Total	**2**	**210**	**25**	**5**		**218**	**25**
			CI	**4**	**46**	**13**	5		**46**	**13**
	9	6	No. seen	3	28	1			32	1
1.28–			Mean/Lake	0.50	4.67	0.17			5.33	0.17
1.92			Est. Total	**4**	**42**	**2**			**48**	**2**
			CI	**5**	**29**	**2**			**29**	**2**
	12	8	No. seen		66	7	6		73	7
>1.92			Mean/Lake		8.25	0.88	0.75		9.13	0.88
			Est. Total		**99**	**10**	**9**		**109**	**10**
			CI		**39**	**8**	5		**38**	**8**
			Grand Total	**6**	**1,284**	**89**	**201**		**1,575**	**89**
			CI	**9**	**535**	**99**	**253**		**603**	**99**

[a] Estimated by J. Hawkings from 1:500,000 topographic map.
[b] Confidence Interval. 95% confidence limits for the estimated total are Est. Total ± CI.

of 2,760-4,600 loons, repectively, at the moment of each survey. If loons do normally disperse far offshore prior to fall migration, it is unlikely that coastal concentration of migrants would occur except in a few places such as Point Barrow.

Substantial westward migration of loons from the Beaufort Sea after mid September appears unlikely as densities of loons drop off sharply after mid September in both nearshore and offshore waters (Searing et al. 1975, Vermeer and Anweiler 1975). However, there is evidence of a southward migration, particularly of arctic loons, via the Mackenzie Valley (Gollop and Davis 1974a). This and other overland routes may be taken by many of the loons nesting on the Yukon coastal plain and Mackenzie Delta.

Loons commonly use nearshore marine waters for feeding during and after the breeding season, but there are no notable concentration areas along the Yukon coast. Numbers in nearshore areas peak in early July and again in mid-August and decline sharply in September (Searing et al. 1975, Vermeer and Anweiler 1975). Red-throated loons are more common than arctic loons in marine waters during this time. Peak densities of loons in nearshore marine waters are about 1.5/km^2 (Table 1), and a maximum of 149 (0.97/km^2) have been counted along the Yukon coast between Nunaluk Spit and Shingle Point. Mossop (1975) counted 75 in the Workboat Passage area alone on 5 August 1975.

2.2 TUNDRA SWAN

2.2.1 Spring Migration

An estimated 3,000-4,000 tundra swans nest on the entire Alaska coastal plain (Pacific Flyway Study Committee 1983), and all of these winter on the Atlantic coast. Most swans in this population are thought to migrate down the Mackenzie Valley and along the Yukon coast in spring, rather than northwestward from the Mackenzie Valley through interior Alaska (Richardson and Johnson 1981). An estimate of only 512 was obtained from visual migration watches at Komakuk and Clarence Lagoon in 1975 (Richardson and Johnson 1981), suggesting that this species either migrates at high altitude, across a broad front, or both. Migrants do not appear to stop in any numbers in the area in spring as most of the coast is snow and ice-bound (Richardson and Johnson 1981).

2.2.2 Breeding

Tundra swans breed throughout the coastal plain in Alaska and Yukon, and on the Mackenzie Delta. It is difficult to determine the breeding population in the Yukon because there has never been a complete survey of the area in June. The only attempt to completely census this area was by Mossop (1974) in August 1974, by which time immigration and emigration had probably changed the total population and distribution within the area compared to June. Other aerial surveys conducted in June (Calef and Lortie 1971, Schweinsburg 1974a, Wiseley et al. 1977, Dickson 1985, McKelvey 1986) have employed low level aerial transect methods designed to detect a variety of waterbirds, rather than being designed specifically for swans (higher altitude, wider transects). As a result of these problems the most obvious way to estimate the total population in the area is from density estimates provided by previous surveys.

Estimates of June and July swan populations in this area vary greatly (Table 3). Most of the variation appears to be due to the failure of many surveys to stratify by habitat. There are large differences in the density of swans in lowland versus upland habitats. In the lowlands of the Babbage River Delta and the Yukon part of the Mackenzie Delta, most density estimates are 0.5-1.5 swans/km^2, whereas in the uplands of the coastal plain east of the Firth River, most surveys indicate 0.1-0.2/km^2, with densities much lower beyond 10 km inland (Dickson 1985). One aerial survey (Calef and Lortie 1971) indicated an extremely high density for which there is no obvious explanation. Surveys including part of the Babbage River Delta (eg. Schweinsburg 1974a) have probably been affected by molting swans which begin to gather there in July. Relative to his survey area, Schweinsburg (1974a) said that swans "are not plentiful in this area, most being found on the delta of the Babbage River where a few pairs raised broods among approximately 50 non-breeders." The most recent and most complete data are those of McKelvey (1986), who surveyed transects which zig-zagged across the coastal plain from Tent Island to Herschel Island on 27 June and 3 July 1985. The resulting estimates, stratified by habitat, were 695 swans on 27 June and 1,207 on 3 July. However, both of these estimates are very imprecise because of the high inter-transect variation in numbers of swans. For example, on 3 July, 12 of the 20 swans sighted were on one of the 10 transects.

Another crude estimate of the swan breeding population can be obtained from the data of Sharp et al (1974). This estimate (Table 4), which is also very imprecise, is biased by the exclusion of small waterbodies (see Loons).

There are three estimates of nest density, all from the Mackenzie Delta area. In a 93 km^2 portion of his study area centered near the mouth of Moose Channel, Campbell (1973) found 25 nests (0.26/km^2) by combined ground and aerial survey techniques. Hawkings (1986) found 10 nests in a 25-35 km^2 study area (0.29-0.4/km^2) nearby at Whitefish Station. Over the entire Mackenzie Delta southwest of Shallow Bay and west of Hvatum Channel (1,108 km^2) Campbell (1973) found 107 nests (0.10/km^2) by aerial survey alone.

Based on late August surveys, Mossop (1975) estimated a breeding density of 0.027 pairs/km^2 for the coastal plain and 0.21 pairs/km^2 for the Yukon part of the Mackenzie Delta, but he did not describe how these were derived.

In the most productive areas of the coastal plain of the Arctic National Wildlife Refuge in Alaska, recent estimates of swan populations averaged 0.16 and 0.25 swans/km^2 in 1983 and 1984 respectively (Brackney *et al.* 1985). Those data came from surveys specifically for swans.

2.2.3 Molting

Swans molt throughout the area. Adults with young molt in the general vicinity of their nesting grounds. The only significant concentrations of molting birds are on the Babbage River Delta and the Mackenzie Delta. On the Babbage Delta, flocked birds (primarily adults without young) increase from approximately 20 in June to over 100 in August (Table 5). On the Yukon part of the Mackenzie Delta, swans gather to molt in the Tent Island and Moose Channel area (D. Mossop, pers. comm.; T.W. Barry unpubl. data), and possibly elsewhere. Smyth *et al.* (1986) considered a sighting of 25 swans on the deltas of the Firth and Malcolm Rivers in mid-July 1974 sufficient to annotate that as a molting area as well.

Table 3. Results of aerial surveys of swans during the breeding season on the Yukon coastal plain and adjacent Mackenzie Delta.

Year	Date	Source[a]	Location of Survey	Total Area Surveyed (km^2)	Swans No. Counted	Swans Density ($/km^2$)
1971	6 June	1	Coastal plain: Malcolm	51	15	0.27
	17 July	"	R. to Babbage R.		51	0.50
	17 June	2	1 transect: Coal Mine L.-Bloomfield L.	41	131	3.2
1972	24 June	3	Mackenzie Delta: West Channel to Trent Bay	1,108	837	0.75
	12 July	3	"	"	1045	0.93
1975	5 June	4	1 transect: NWT border	19.2	0	
	20 June	"	to Conglomerate Creek	16.1	0	
	31 July	"	"	19.2	2	0.1
	30 Aug	"	"	9.7	2	0.2
	5 June	"	Mackenzie Delta transect NWT border to Ellice Is.	33.5	54	1.6
	20 June	"	"	"	13	0.39
	31 July	"	"	"	48	1.4
	30 Aug	"	"	16.8	8	0.48
1981	19 June	5	transects 1-3 (20-30 km inland from King Pt)	30	1	0.03
	19 June	"	transects 4-11 (0-20 km inland from King Pt)	96	19	0.2
	24 July	"	transects 25-27 (2-14 km inland from King Pt)	36	12	0.33
	24 July	"	transects 3-8 (Phillips Bay and Babbage R. Delta)	33.2	35	1.1
1983	21 June	6	3 transects 2-14 km inland near Stokes Pt.	30	4	0.13
			2 transects near King Point	24	3	0.13
1985	27 June	7	coastal sections	5.6	0	0
		"	lowland sections	7.6	8	1.0
		"	upland sections	39.1	4	0.1
	3 July	"	coastal sections	5.6	0	0
		"	lowland sections	7.6	12	1.6
		"	upland sections	39.1	8	0.2

[a] 1 Schweinsburg 1974a, 2 Calef and Lortie 1971, 3 Campbell and Weber 1973, 4 Wiseley et al. 1977, 5 Dickson 1985, 6 Dickson unpubl. data, 7 McKelvey 1986.

Table 4. Tundra Swan population estimates for the Yukon coastal plain[a] derived from ground counts of 60 lakes during July 1973 (data from Sharp et al. 1974).

Lake Size Class	Area (km^2)	Total No. on Coastal Plain[b]	Number Surveyed	Swans Counted		Esitmates for Entire Coastal Plain ±95% Confidence Limits	
				Adults	Broods	Adults	Broods
A	<0.26	480	18	7	1	187 ±215	27 ±55
B	0.26-1.28	70	28	19	3	48 ±24	7 ±7
C	1.28-1.92	9	6	8	1	12 ±10	1 ±2
D	>1.92	12	8	5	1	8 ±5	1 ±2
TOTAL			60	39	6	255 ±254	36±66

[a] Excluding Yukon portion of Mackenzie Delta.
[b] Estimated from 1:500,000 scale topographic map.

Table 5. Numbers of tundra swans observed and estimated on late summer and fall aerial surveys of the Yukon coastal plain, 1973-1976. Observed numbers in parentheses.

		August					September				
Source	Year	6-10	11-15	16-20	21-25	26-31	1-5	6-10	11-15	16-20	21-25
1	1973					(45)					
2	1973		(49)			(29)		(40)	(7)		(19)
3	1973				(0)	(0)	(0)		(134)680		(51)259
4	1974					(357)		(55)			
5	1975				(200)?	(35+)35+		(35+)35+	(3)15	(2)10	
6	1975				(255)						
7	1975					(210)					
8	1976			(115)		(259)692		(117)390	(116)386	(136)453	
9	1976			(143)							

Sources

1 Koski 1975b. Aug 30. coastal survey Herschel Island to Alaska, broken down as follows: S. of Herschel Island 5, Roland Bay 1, Kay Pt. 1, Babbage River Delta 25, Spring R. Delta 2, Firth R. Delta 11

2 Vermeer and Anweiler 1975. Aug 12, 31, Sept 10, 14, 21.

3 Koski 1975b. Aug 24, 31, Sept 5, 11, 16, 22. Including Yukon portion of Mackenzie Delta.

4 Mossop 1974. Aug 30, Sept 8. total count between Komakuk and NWT border, broken down as follows: Komakuk-King Pt. 140, King Pt-NWT 217. Includes 67 juveniles.

5 Koski 1977a. August 20-25, 28, Sept 8, 11-14, 17-18. Including Yukon portion of Mackenzie Delta.

6 Koski 1977a. August 25. coastal survey NWT-Alaska, broken down as follows: Tent Island and vicinity 102, Blow R. Delta 13, Shingle Pt. 2, Babbage R. Delta 79, Spring R. Delta 6, Stokes Pt. 11, Roland Bay 12, Catton Pt. 3, Firth R. Delta 5, Malcolm R. Delta 15, Clarence Lagoon 7.

7 Mossop 1975. Aug 30. total count Clarence Lagoon-Shingle Pt., broken down as follows: Clarence Lagoon-Komakuk 30, Firth and Malcolm Deltas 18, Stokes Pt. 25, Phillips Bay 129, Kay Pt.-Shingle Pt. 8.

8 Koski 1977b. Aug 16-20, 29-31, Sept 4-6, 10-13, 18-21.

9 Koski 1977b. Aug 16. Reconnaissance survey Shingle Pt.-AK border, broken down as follows: S. of Shingle Pt. 4, Phillips Bay 30, W. of Phillips Bay 4, Stokes Pt. 6, Firth R. Delta 4, Nunaluk Spit 18, W. of Komakuk 2.

2.2.4 Fall Migration

Fall populations of tundra swans appear to be similar in size to summer populations, with peak numbers present between mid-July and early September.

Mossop (1974) attempted a total count of swans between Alaska and NWT in 1974. In the area between Clarence lagoon and King Point (survey area approx. 1,100 km^2) he counted 62-119 swans (density 0.06-0.11/km^2) on each of 4 surveys during 17-30 August. Between King Point and the NWT border, including the Yukon part of the Mackenzie Delta (survey area ca. 360 km^2), he counted 217 swans (0.60/km^2) on 30 August (Table 5). The largest number of swans actually counted in the area in one survey is 357 by Mossop (1974), and the largest number estimated is 692 by Koski (1977b). The concentration areas are the Babbage River Delta-Phillips Bay (max. count 129 on 30 August 1975, Mossop 1975) and the Tent Island area (max. count 102 on 25 August 1975). The entire Yukon part of the Mackenzie Delta continues to support large numbers of swans in the fall: Campbell and Weber (1973) counted 778 (0.70/km^2) in their 1,108 km^2 study area (see above) on 2-3 September 1972, but this was a decrease of 25% from mid July.

Swans have been counted routinely during many of the fall surveys for snow geese on the Mackenzie Delta and coastal plains of Alaska and Yukon (e.g. Koski 1977a,b). Unfortunately, the transects used in these surveys are inappropriate for sampling the swan population because the swans are clumped and not distributed randomly on the coastal plain. Some of the results reflect this. For example in 1973 Koski (1975b) estimated a population of 0 swans on the Yukon coastal plain during the periods 23 Aug - 3 Sept and 4-6 Sept (Table 5), a time when numbers should still be quite high.

It is not clear how many fall migrants pass through the area. Some migration may take place in late September, but no migration watches have extended beyond 19 September. During migration watches at Nunaluk Spit in 1972, only 89 swans were observed and 175 estimated to have passed heading east during 10 July-17 Sept. (Gollop and Davis 1974a). At Moose Channel the same year there was a much more obvious migration observed during 11-19 September (no observations 14-16 September or after 19 September), during which at least 10 swans/hr passed on 3 separate days (Searing *et al.* 1975). If those birds were moving SE (direction is not specified in the report) for 12 h/day, the total volume of migration would have exceeded 330 on those 3 days alone.

2.2.5 Discussion

There are few data on swans available since 1976, and there has never been a comprehensive survey specifically for swans during the nesting season. No reports have provided map locations of swans or nests at any time of year. To respond to site-specific concerns, this level of information is necessary. A baseline survey for swans should be conducted between the Alaska and NWT border, ideally in conjunction with similar surveys in the Arctic National Wildlife Refuge. In the first year this survey should be in the form of a nesting survey in mid-June, and a production/molting survey in early to mid August. After the initial year's data, updates should be obtained at least every few years to monitor changes in the population. Initially, surveys

could be flown at relatively high altitude (1,000+ ft) and aim for total coverage, until meaningful strata can be delineated to form the basis of a sampling survey.

2.3 LESSER SNOW GOOSE

2.3.1 Spring Migration

The majority of snow geese nesting at Kendall Island, Anderson River, and Banks Island migrate from their California wintering grounds north through Montana and Alberta, and down the Mackenzie Valley. Depending on their destination, and weather and snow conditions, some follow the Mackenzie all the way to its delta, while others leave the Mackenzie River between Little Chicago and the Travaillant River to move north through the Anderson River area (Barry et al. in prep).

Bellrose (1976) suggested that more than 10,000 snow geese migrate west in spring through northern Yukon towards breeding grounds on Wrangel Island, Siberia. Recent evidence, however, indicates that few (perhaps several hundred) pass through northern Yukon in spring. Some birds pass along the Beaufort Sea coast (Searing et al. 1975, Salter et al. 1980, Richardson and Johnson 1981), and some move north through interior Alaska and Yukon via major river valleys and mountain passes (Barry 1967, D. Mossop unpubl. data, CWS Whitehorse unpubl. data). There is no evidence that any of those geese belong to the Wrangel Island population.

2.3.2 Breeding

Snow geese do not breed in the Yukon. Several hundred breed on the Alaska coast of the Beaufort Sea, primarily the deltas of the Sagavanirktok and Canning rivers. In NWT there are breeding colonies on Kendall Island, the Anderson River Delta, and by far the largest is near the Egg River on Banks Island. The estimated breeding populations at the latter three colonies in 1981 were 1,042, 8,360, and 174,252-221,998 respectively (Kerbes 1986). Non-breeding birds from these three colonies were estimated at an additional 100,000 in 1981 (Barry 1981).

2.3.3 Molting

No molting occurs on the Yukon coastal plain. Most non-breeding geese from the three above-mentioned colonies molt on Banks Island, while the adults with young molt near their respective breeding colonies. Small groups of snow geese are occasionally seen along the Yukon Beaufort coast during the last week of June (Salter et al. 1980, Hawkings and Mossop 1985); those are likely non-breeding birds en route to molting areas in Alaska or N.W.T.

2.3.4 Fall Migration

2.3.4.1 Staging Chronology and Distribution

The Yukon coastal plain, Alaska coastal plain as far west as the Canning River, and the outer Mackenzie Delta are traditionally used as a fall feeding area by most if not all Canadian western arctic snow geese prior to the southward migration to northern Alberta. The exact areas used vary from year

to year, but it appears that virtually the entire Yukon coastal plain below the 1000 ft (300 m) contour has been used, and some flocks have been sighted at higher elevations in the foothills. The Yukon and Alaska coastal plains normally receive the greatest use, while the Mackenzie Delta is used later -- as freezing weather forces birds off the coastal plain -- and by smaller numbers of birds.

Migration is primarily up the Mackenzie Valley, but there may be substantial flights direct from north slope staging areas over the mountains of northern Alaska and Yukon to Alberta (Koski and Gollop 1974).

In a normal fall, the first geese arrive on the Yukon north slope 15-25 August and major arrivals are 25 Aug-5 Sept. Major depatures occur 15-25 Sept, and the last birds are seen 20-30 Sept. In some years (eg. 1975, and 1981) adverse weather conditions have forced geese to alter their normal staging patterns. In 1975 large numbers of geese moved westward (having bypassed the snow-free Mackenzie Delta) as far as Komakuk, despite snow storms during Sept. 5-7, before being forced back to the Mackenzie Delta. No geese reached Alaska. After a slight thaw approximately 50,000 geese moved west onto the partially snow-covered coastal plain until freezing conditons again forced them back to the Delta. This suggested to Koski (1977a) that the coastal plain is the traditional and preferred fall staging area geese tried to use it rather than the Delta where conditions were much less severe. Another unusual year was 1981, when an early snowfall covered much of the Parry and Bathurst Penninsulas and apparently caused most of the breeding birds from the Banks Island colony to move south and east to stage in the vicinity of Paulatuk. Prior to this most of the geese from Kendall Island, Anderson River, and the non-breeders from Banks Island had already reached the Mackenzie Delta, and followed the normal pattern of movement. This segregation persisted throughout the staging period (Barry 1981).

The distribution of geese among the three staging areas (Alaska, Yukon, Mackenzie Delta) fluctuates through the fall according to the progression of westward movement, staging, and eastward movement. Thus the numbers of geese in each area at the time of a simultaneous survey of all three may not be indicative of the relative use each area received over the whole staging period. For example Koski (1975b) documented major shifts in the distribution of geese over a two week period in 1974: during 4-6 Sept an estimated 19,000 geese were in Yukon and 112,500 in Alaska, whereas a week later there were 119,900 in Yukon and 25,700 in Alaska.

2.3.4.2 Abundance and Productivity

Over the years, estimates of the total number of snow geese staging in all three areas have ranged from 163,198 to 597,000 (Garner and Reynolds 1986). Most of this variation has been attributed to year-to-year variations in breeding success, but a significant amount may be due to sampling and estimation error (see below). In some years (eg. 1981) the end result of fall surveys was a "guesstimate" pieced together from various sources (eg. Barry 1981, Spindler 1983a).

Over all the years of surveys, productivity estimates have varied from 1-54% juvenile birds in the fall population, but the estimates are of varying precision. There are always a large number of non-breeding adult-plumaged birds in the population, and these do not always mix homogeneously with family

groups on the staging grounds. As a result, it is particularly difficult to estimate productivity precisely in years of good production because flocks will vary from 0 to 50 or 60% young birds. For example in 1982 the estimate was 4.6% ±0.7% (standard deviation [SD]) juveniles, and in 1983 it was 36.5 ±14.0% (Spindler 1983b, 1984). As with total population, the geographic distribution of this parameter can fluctuate widely during the staging period. For example on 9 Sept 1983, 30.0 ±8.6% of the geese in Alaska were juveniles, but 3 days later the percentage had dropped to 19.0 ±5.5% (Spindler 1984).

2.3.4.3 Survey Methods: Coverage, Timing, and Analysis

The number, timing, and coverage of surveys has varied from one-time only coverage of part of the area (1978-80), to complete and fairly frequent coverage (1973-76, 1982-83).

Most surveys of staging snow geese on the Yukon and Alaska coastal plain have been conducted using fixed-wing aircraft carrying 1-3 observers and flown at 500 ft (150 m) agl. During 1973-1975 goose surveys of the Yukon and Alaska north slope utilized a series of 1.6 km wide, (9.6 km) long transects laid out along the north-south grid lines (which are 9.5-10 km apart) on a 1:250,000 topographic map. In order to make the survey continuous, flightlines between adjacent north-south gridlines (alternately following the coastline or foothills) also formed transects. Total population on the study area during any one survey was extrapolated from visual estimates of the number of geese seen on-transect, based on approximately 20% coverage of the coastal plain (Koski and Gollop 1974, Koski 1975b, 1977a). A slightly modified design was used for the Mackenzie Delta area because most geese were close to the coast. In 1976, transects were widened to 2.4 km (treated as 25% coverage) to obtain better estimates (Koski 1977b).

Aerial photography has been used by USFWS and CWS since 1978 to check the accuracy of visual estimates of large flocks, and since 1979 to provide better estimates of adult:juvenile ratios in flocks (Spindler 1978, 1979, 1980, 1983a, 1983b, 1984, Oates *et al.* 1985). Aerial photography proved to be a valuable refinement in the surveys. Each year visual estimates were regressed against photo-counts of the same flocks and the resulting correction factor applied to all visual estimates to obtain a corrected population estimate. Photographs demonstrated that observers usually underestimated large flocks, the degree of underestimation varying among observers. For example in 1979 observers overestimated flocks by 100%, while they underestimated by 19% in 1982, 13% in 1983, and 70% in 1984. The resulting imprecision in the total population estimates was substantial in some of these years (eg. 1984). Vertical and oblique aerial photography were tried from much higher altitude (up to 5,000 ft agl) on an experimental basis in 1976 (Koski 1977b), but were judged to be impractical because (1) geese flushed and tended to leave the photo area before the aircraft passed over them, even at 5000 ft. agl, (2) age ratios could not easily be determined from photos of geese on the ground, and (3) weather conditions rarely would permit such photography on the coastal plain during September.

2.3.5 Discussion

The objectives of the fall snow goose surveys need to be more clearly defined and the survey methods evaluated and continually modified to meet those objectives. Presently the estimates of total staging population are of

limited use because they are so imprecise, and they represent only one point in the entire staging period. The age-ratio data are frequently imprecise as well, but they are certainly useful for distinguishing years of good production from years of very poor production.

2.4 BRANT

2.4.1 Spring Migration

Most of the Pacific Flyway brant that nest in Canada pass eastward through the Yukon coast area in spring en route to their breeding grounds in the western arctic. Many migrate through interior Alaska rather than following the coastline from the Bering Sea (Cade 1955, Irving 1960, CWS Whitehorse unpubl. data), but most appear to reach the Beaufort coast west of Komakuk and may follow it for some distance east (Richardson and Johnson 1981). In some years they migrate along a broader front, including the nearshore Beaufort Sea and possibly offshore open water leads. Generally, brant do not linger in Yukon during spring migration and may even pass nonstop.

The best estimate of the number of brant passing through the Yukon each spring is 25,946, based on visual watches in 1975 (Richardson and Johnson 1981). Barry (1976) estimated that during 29 May-16 June 1972, 21,885 brant passed Cape Dalhousie (direction not specified, but presumably eastward and northward). There is some question about this figure however, as it was an extrapolation of numbers seen within .8 km of shore to a broad corridor (methods not specified), based on several unproven assumptions, as pointed out by Richardson and Johnson (1981).

2.4.2 Breeding

Brant have been found nesting in only four places in northern Yukon: (1) an island east of Nunaluk Spit (2 nests 23 June 1972, Gollop et al. 1974d); (2) Phillips Bay (21 adults with 34 flightless young 15 August 1986, J. Hawkings unpubl. data); (3) Escape Reef (1 hatched nest 20 July 1972, R. W. Campbell unpubl. data; 12 nests late June 1974, T.W. Barry unpubl. data; 7 nests late June 1984, L. Dickson unpubl. data); (4) Blow River Delta -- Whitefish Station (51 nests at Whitefish Station June 1985, Hawkings 1986). There may be some breeding at other salt marsh areas, such as Clarence Lagoon, but a reasonable estimate of the total breeding population in Yukon is about 200 birds.

2.4.3 Molting

Aside from breeding birds and non-breeders associated with them at the breeding colonies, brant are not known to molt in Yukon, and there is no discernable molt migration in Yukon.

2.4.4 Fall Migration

Most fall migrants pass through northern Yukon from mid-August to the first week of September, with the peak occuring during the last week of August (Gollop and Davis 1974a, Koski 1975b, Koski 1977b) . Virtually all fall migration follows the Yukon coast of the Beaufort, and brant regularly stop to

rest and feed at various locations. They are only found in coastal areas, notably the Blow and Malcolm River Deltas and Phillips Bay. Unlike snow geese, however, they do not stay for an extended period but press on to staging grounds further west and south.

Estimates of the number of migrants passing along and using the Yukon coast come from migration watches and aerial surveys. Observers counted 14,806 brant flying west past Nunaluk Spit during 24 Aug-6 Sept 1971 (12 h observation per day), with a peak of 3,301 on 31 August (Schweinsburg 1974a). In 1972, 3,551 brant were observed and 7,201 estimated passing Nunaluk Spit during fall migration (Gollop and Davis 1974a). Both these are underestimates of the true migration, because the population probably numbers 25,000-30,000 based on observations of spring migration (Richardson and Johnson 1981).

Koski (1977b) estimated a peak staging population of 12,000 brant (7,078 in Yukon) on the Alaska and Yukon coastal plain and Mackenzie Delta during fall aerial surveys 1973-76, but felt this was a serious underestimate of the total population passing through the area. Barry et al. (1981:23) remarked that "In Phillips Bay, from Kay Point to Stokes Point, 12,000 Pacific Brant were observed feeding on the low tidal flats," during an aerial survey on 8 or 9 Sept 1980. Mossop (1974, 1975) counted 7,000 on the Yukon coast between Komakuk and the NWT border on 21 August 1974, and 2,210 in the same area on 30 Aug 1975 (Firth/Malcolm Delta:815; Firth to Stokes Pt:190; Phillips Bay:1,175; Kay-Shingle Point:30).

Based on the above, it would seem that there is no single area which consistently holds large numbers of brant in the fall. But, under certain conditions of weather at certain times in the fall, concentrations can occur, such as that observed by Barry et al. (1981) at Phillips Bay in 1980.

2.5 CANADA GOOSE

2.5.1 Spring Migration

Canada geese are uncommon spring migrants along the Yukon coast. Migration watches in spring at Komakuk and Clarence Lagoon estimated a net westward movement of less than 100 birds in 1975 (Richardson and Johnson 1981).

2.5.2 Breeding

This species is a very rare breeder in the coastal plain area, and perhaps only breeds in some years. The only definite evidence of breeding was a brood seen on 24 July 1981 in the Phillips Bay area (Dickson 1985), and 2 nests found there in 1983 (L. Dickson, unpubl. data). Godfrey (1986) lists Herschel Island as a breeding locale, but this may have been on the basis of a small group of molting adults recorded by Brooks (1915). Salter et al. (1980) suspected breeding in the Blow River area on the basis of 1 pair observed on 10 June and 2 pairs on 4 July 1974. Hawkings (1985) found less than 20 on the coast near Whitefish Station in June 1985, but did not suspect breeding. Canada geese become increasingly more common breeders west of the Jago River in Alaska, and eastward from Richards Island in the Mackenzie Delta.

2.5.3 Molting

Very small numbers (total less than 100) have molted along the Yukon coast at Herschel Island (Brooks 1915) and inland just west of the Walking River (30 flightless adults 14 August 1986, J. Hawkings unpubl. data). No other sightings of Canada geese in the Blow River Delta or Whitefish Station areas have been well enough into July to indicate flightless birds. Most Canada geese seen in June on the western Mackenzie Delta and at Phillips Bay (Dickson 1985, McKelvey 1985) may migrate to other molting areas during late June and early July. Searing et al. (1975) observed some Canada geese on "bays and beaches ... near Herschel island during the [August?] 1974 aerial surveys...," but did not provide details on dates or locations.

2.5.4 Fall Migration

Canada geese are uncommon fall migrants on the coastal plain. In fall 1971, 119 were observed passing Nunaluk Spit during 29 Aug - 5 Sept (Schweinsburg 1974a), but in 1972 none were observed during 10 July-17 Sept with the exception of "several" in a flock of snow geese on 15 Sept (Gollop and Davis 1974a). At Moose Channel, 164 were observed passing east during 13-15 Sept 1971 (Schweinsburg 1974a), but apparently none were seen there in fall 1972 (Searing et al. 1975).

Koski (1977a) found that this species formed only 0.03% of the dark geese (brant, white-fronted, and Canada geese) that were identified to species during aerial surveys in Alaska, Yukon, and the Mackenzie Delta. His off-transect observations and those of others suggest that Canada geese are rarely present in fall staging flocks of other geese. A few hundred Canada geese are sometimes present on the Babbage River Delta and on the Yukon part of the Mackenzie Delta (Koski 1977a; T.W. Barry unpubl. data; J. Hawkings unpubl. data)

2.6 GREATER WHITE-FRONTED GOOSE

2.6.1 Spring Migration

Very few white-fronts pass through the coastal plain area in spring. Richardson and Johnson (1981) estimated the visible migration at less than 200 birds in 1975, with the net movement west. Some stop briefly on the mainland tundra and ponds (Salter et al. 1980).

2.6.2 Breeding

The white-fronted goose is a widespread breeder on the Alaska coastal plain and on the Mackenzie Delta, but in the Yukon there are only a few nesting records, from Moose Channel (2 nests and 4 broods 1973, Campbell 1973) and Phillips Bay (1 nest 1983, L. Dickson unpubl. data; 23 adults 30 flightless young 1982, Hogg et al. 1986). On other parts of the Yukon coastal plain this species is an uncommon summer visitant with no evidence of breeding. However, white-fronts tend to be fairly solitary, dispersed nesters and could be overlooked easily, so these few breeding records could indicate the scattered nesting of perhaps a hundred birds across the coastal plain.

2.6.3 Fall Migration

During late August and the first half of September there is a prominent eastward migration of this species along the Yukon coastal plain from breeding and molting areas on the Alaska coastal plain. In 1973 a spectacular migration of at least 10,000 birds was observed on 10-11 September 1973 by observers at Komakuk, Bloomfield Lake, and Shingle Point (a total of 20,000 was reported for Komakuk, but this is likely a printing error; Salter et al. 1980). The visible migration is not always so large however: in 1971, only 2,209 were observed passing Nunaluk Spit 24 Aug - 6 Sept (12 h observation/day), with a peak 29 Aug (Schweinsburg 1974a), and in 1972 1,664 were counted during 10 July-17 Sept and a total of 3,535 estimated (Gollop and Davis 1974a). In 1986 conspicuous waves of migrants passed Phillips Bay on 2 Sept (1,500 in 2 hours), 3 Sept (3,180 in 2 hours), and 8 Sept. (880 in 1 hour; J. Hawkings, unpubl. data). Koski (pers. comm. cited in Searing et al. 1975) estimated that 30,000-40,000 geese move eastward across the coastal plain in fall.

White-fronts comprised 60% of the dark geese identified to species by Koski (1977b) during fall aerial surveys 1973-76 on the Yukon coastal plain and Yukon part of the Mackenzie Delta. Normally most birds gather on the Mackenzie Delta and there is little staging on the Yukon coastal plain; but in some years white-fronts are present in mixed flocks with snow geese on the coastal plain (Koski 1977b). The highest estimate of white-fronted geese on the Yukon portion of the staging grounds at one time was 18,010 during 4-6 Sept. 1976, when the total number on the Alaska and Yukon coastal plain and the Mackenzie Delta was estimated at 31,300 (Koski 1977b). In the Yukon, staging concentrations tend to occur on the Blow and Mackenzie Deltas, the coastal plain in the vicinity of the Blow and Walking Rivers (Koski 1977b), and the Babbage River Delta (D. Mossop unpubl. data, J. Hawkings unpubl. data).

2.7 DUCKS

2.7.1 Spring Migration

Most ducks enter the region in spring via the Mackenzie Valley. Notable exceptions are oldsquaws and eiders, most of which arrive from the west via offshore leads in the Beaufort Sea ice. Smaller numbers of oldsquaws may fly overland across Alaska from the Chukchi Sea or North Pacific Ocean and some migrate via the Mackenzie Valley (Salter 1974a, Richardson and Johnson 1981). Most duck migration occurs from mid May to mid June. There was an estimated net eastward movement of 13,000 oldsquaws and 600 eiders along the Yukon coast at Komakuk in spring 1975, while 1,300 pintails and 1,300 scoters passed travelling west (Richardson and Johnson 1981). Some migrant ducks use meltwater ponds on the mainland and along the coast during spring, but only after late May; the largest concentrations are of eiders and oldsquaws in offshore leads during late May and early June (Richardson and Johnson 1981).

2.7.2 Breeding

Aerial surveys of ducks on the coastal plain are summarized in Table 6. Oldsquaw, northern pintail, and scaup spp. are the most common species on the coastal plain based on aerial surveys (Table 6). Duck densities (uncorrected for sightability bias) vary widely from one survey to another, but throughout

Table 6. Results of aerial surveys of ducks during the breeding season on the Yukon coastal plain and adjacent Mackenzie Delta.

Year	Date	Source[a]	Location of Survey	Total Area Surveyed (km^2)	Total Ducks Counted	Density (ducks/km^2) Total	Species Composition[b]
1971	6 June	1	Coastal plain: Malcolm	51	15	0.29	OLDS 0.15, NOPI 0.13
	17 July	"	R. to Babbage R.				
	17 June	2	1 transect: Coal Mine L.-Bloomfield L.	41	234 (56)[c]	5.7	SCAU 1.73, MALL 0.97, SCOT 0.87, AMWI 0.76
1972	24 June	3	Mackenzie Delta: West Channel to Trent Bay	1,108	1,529 (457)	1.38	SCAU 0.52, SUSC 0.11, SCOT 0.11, OLDS 0.07, NOPI 0.06, AMWI 0.03, WWSC 0.02, RBME 0.01, CANV 0.01, COEI 0.005, MALL 0.005, COME <0.005, NOSH <0.005, Also GWTE, COGO, KIEI
	12 July	3	"	"	665 (185)	0.60	NOPI 0.17, SCAU 0.14, WWSC 0.04, AMWI 0.03, SUSC 0.02, RBME 0.008, MALL 0.003
1975	5 June	4	1 transect: NWT border	19.2	3	0.16	OLDS 0.1, RBME 0.05
	20 June	"	to Conglomerate Creek	16.1	16 (1)	0.99	SCAU 0.37, NOPI 0.19, OLDS 0.12, KIEI 0.12, WWSC 0.06, MALL 0.06
	31 July	"	"	19.2	23 (6)	1.19	OLDS 0.78, SCAU 0.10
	30 Aug	"	"	9.7	36	3.7	OLDS 3.7
	5 June	"	Mackenzie Delta transect NWT border to Ellice Is.	33.5	149 (2)	4.4	SCAU 3.07, NOPI 0.89, WWSC 0.26 MALL 0.06, SCOT 0.06, RBME 0.03
	20 June	"	"	"	155 (2)	4.6	SCAU 1.85, WWSC 1.6, NOPI 0.72, OLDSQ 0.39
	31 July	"	"	"	51 (30)	1.5	SCAU 0.24, NOPI 0.15, RBME 0.11, OLDS 0.06, SCOT 0.06
	30 Aug	"	"	16.8	108 (23)	6.4	AMWI 3.8, SCOT 0.82, SCAU 0.41
1981	19 June	5	transects 1-3 (20-30 km inland from King Pt)	30	18 (7)	0.6	OLDS 0.17, SCSP 0.10, RBME 0.07, NOPI 0.03
	19 June	"	transects 4-11 (0-20 km inland from King Pt)	96	198 (40)	2.06	OLDS 0.98, SCAU 0.42, NOPI 0.09, AMWI 0.08, RBME 0.06
	24 July	"	transects 25-27 (2-14 km inland from King Pt)	36	168 (103)	4.67	OLDS 1.39, SCAU 0.22, NOPI 0.08, RBME 0.08, GWTE 0.03
	24 July	"	transects 3-8 (Phillips Bay and Babbage R. Delta)	33.2	390 (95)	11.7	SCOT 2.4, SUSC 2.1, OLDS 1.8 RBME 1.4, NOPI 0.96, SCAU 0.18

Table 6. (continued)

Year	Date	Source	Location of Survey	Total Area Surveyed (km^2)	Total Ducks Counted	Density (ducks/km^2) Total	Species Composition[b]
1983	21 June	6	3 transects 2-14 km inland near Stokes Pt.	30	16 (?)	0.53	NOPI 0.13, AMWI 0.06, OLDS 0.03, WWSC 0.03
			2 transects near King Point	24	56 (?)	2.25	SCAU 1.25, NOPI 0.29, OLDS 0.25, RBME 0.16, WWSC 0.16, AMWI 0.13
1985	27 June	7	coastal sections	5.6	67 (23)	11.9	OLDS 6.8, SCOT 0.9, SCAU 0.18
		"	lowland sections	7.6	80 (7)	10.5	NOPI 7.5, OLDS 0.66, MALL 0.52, SCOT 0.65, SCAU 0.26
		"	upland sections	39.1	53 (16)	1.4	SCAU 0.43, SCOT 0.28, OLDS 0.20
	3 July	"	coastal sections	5.6	339 (0)	60.5	SCOT 55.1, OLDS 3.8, AMWI 2.1, COEI 0.35, SCAU 0.18
		"	lowland sections	7.6	6 (1)	0.8	AMWI 0.5, OLDS 0.1
		"	upland sections	39.1	44 (14)	1.12	SCAU 0.38, OLDS 0.23, HADU 0.08, AMWI 0.05, SUSC 0.03

[a] 1 Schweinsburg 1974a, 2 Calef and Lortie 1971, 3 Campbell and Weber 1973, 4 Wiseley *et al.* 1977, 5 Dickson 1985, 6 Dickson unpubl. data, 7 McKelvey 1986.

[b] MALL mallard, NOPI northern pintail, NOSH northern shoveler, AMWI American wigeon, GWTE green-winged teal, SCAU scaup sp., COEI common eider, KIEI king eider, HADU harlequin duck, OLDS oldsquaw, WWSC white-winged scoter, SUSC surf scoter, SCOT scoter sp., COGO common goldeneye, RBME red-breasted merganser.

[c] Number of unidentified ducks in parentheses.

much of the coastal plain most surveys have yielded density estimates of 0.5 - 2 ducks/km^2 in June (Wiseley et al. 1977, Dickson 1985, Dickson unpubl. data, McKelvey 1986; Table 6).

The aerial survey data of Dickson (1985) and Wiseley et al. (1977) suggest that the Yukon part of the Mackenzie Delta and some portions of the coastal plain have densities of 2-5 ducks/km^2 while the remainder has much lower densities (<0.5/km^2). This is probably due to the prevalence of wet tundra, lakes and ponds near the coast and on the Mackenzie Delta. The standard USFWS aerial transect surveys in the Mackenzie Delta also suggest comparatively high densities of ducks. During 1948-54 these surveys estimated an average density of 11.5 ducks/km^2 for the treeless northern part of the Delta (Martell et al. 1984). The transects were modified after this and ground/air visibility ratios were applied on a routine basis, resulting in density estimates of 13-70/km^2 (depending on the year) during 1974-1985 (Table 7). There are no estimates of variability available for any aerial surveys, but some measure of variability can be obtained, for example, by treating McKelvey's (1986) transects as a random sample in upland and lowland strata. Using a ratio estimator, both the total population and density have estimated 90% confidence limits of ±45-50% in upland areas and ±130-150% for lowland (Table 8).

Ground surveys (Table 9) also indicate a much higher density of ducks in wet lowland habitats than in drier upland areas. Dickson's (1985) ground transects at four sites inland from King Point in 1981 included a large proportion of wet tundra habitats (wet sedge, wet sedge - patterned ground, and wet dwarf shrub totalled about 20% of the sample), as well as numerous lakes and ponds interspersed in some of the drier habitats (e.g. dwarf shrub - patterned ground). She found densites of 10.2, 13.4, 26.5, and 23.8 ducks/km^2 at those sites, with the overall average being 18.8 (Table 9). In 1983 she reported densities of 45.4 ducks/km^2 in lowland and only 5.9 in upland habitat (Dickson, unpubl. data).

The most extensive ground survey data for the Yukon coastal plain were collected in late July 1973 by Sharp et al. (1974). Again they found oldsquaw, scaup spp. (the great majority being greater scaup), and northern pintail most abundant in terms of both adults and broods. I derived another estimate of the total duck population of the coastal plain by exptrapolating those data to all the similar-sized lakes on the coastal plain (Tables 10, 11). Although that survey was biased by the exclusion of small waterbodies (see comments under Loons), the large ratio of adults to broods suggests that most of the ducks present on the coastal plain in July are there to molt rather than breed. The broad confidence limits on those estimates reflect high among-waterbody variability in numbers of ducks.

All the above data are very difficult to integrate owing to a lack of consistency in timing, coverage, aircraft type and altitude, transect length and width, observers, purpose of the survey, data analysis, and presentation of results. Some surveys were stratified by habitat, while others were not, and only the USFWS surveys on the Mackenzie Delta have corrected for sightability bias (failure to see all ducks on the transects). For example, Schweinsburg (1974a) failed to distinguish between birds seen in marine vs. upland vs. lowland habitats; Campbell and Weber (1973) flew at 200 ft rather than the standard 100 ft and tried to count birds 550 m on either side of the aircraft rather than the standard 200 m; Dickson (1985) used a helicopter

Table 7. Population indices (X 1000) of waterfowl in the Mackenzie Delta, 1974-1985. Data from U.S. Fish and Wildlife Service annual aerial surveys[a].

	Ground/Air Visibility Ratio	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Mallard	3.1625	6.9	15.6	22.5	69.8	16.9	19.9	81.1	41.6	10.4	17.3	67.6	15.6
Gadwall	4.7773				1.3		1.3				1.3		
Northern Pintail	3.8748	30.8	22.3	43.0	89.8	24.4	14.9	112.1	37.2	15.9	19.7	228.9	14.9
American Wigeon	5.3988	29.6	17.8	51.1	74.0	47.4	19.2	80.7	75.5	36.3	38.5	171.1	8.9
Green-winged Teal	9.5255	7.8	2.6	2.6	5.2	5.2	18.3	57.5	15.7	2.6	7.8	31.3	5.2
Blue-winged Teal	10.4047				2.9								
Northern Shoveler	3.8377	2.1	1.1	2.1	7.9	1.1	1.1	13.2	18.9		1.1	24.2	
Total Dabbling Ducks		77.2	59.4	121.3	249.6	96.3	73.4	345.9	188.9	65.2	84.4	525.0	44.6
Redhead	5.3645						1.5		1.5			2.9	
Ring-necked Duck	3.9608	3.8	2.2	1.1	3.3	13.0	1.6	3.8	3.3	3.3		2.2	4.9
Canvasback	2.4263	2.0	1.3	2.0	4.7	2.7	11.3	12.0	20.3	4.7	17.9	23.0	7.3
Scaup sp.	2.6882	52.7	67.1	96.2	56.4	59.7	80.3	142.2	169.9	84.8	84.8	183.5	70.8
Goldeneye sp.	5.5000		1.5		4.5		24.1	25.6	6.0	10.6	1.5	21.1	3.0
Bufflehead	2.7000	0.7				0.7	0.7	1.5	1.5		2.2		1.5
Oldsquaw	6.5000	23.2	26.7	16.9	1.8	28.5	9.8	40.1	22.3	3.6	1.8	28.5	1.8
Scoter sp.	1.3000	22.8	7.8	10.2	13.2	17.5	29.2	40.3	40.8	34.0	15.3	81.3	15.0
Merganser sp.	2.0000	2.7	2.2	5.2	3.3	3.8	6.0	6.3	3.8	1.6	3.8	3.3	
Eider sp.	3.6000												6.9
Total Divers		107.9	108.8	131.6	87.2	125.9	164.5	271.8	269.4	142.6	127.3	345.8	87.5
Total Ducks		185.1	168.2	252.9	336.8	222.2	237.9	617.7	458.3	207.8	211.7	870.8	155.8
Ducks/km^2		14.6	13.3	20.2	26.7	17.6	18.8	49.9	36.3	16.5	16.8	68.9	12.3

area of stratum(km^2)	12,634
area of sample transects(km^2)	92
length of sample transects(km)	369

[a] Voelzer and Jensen 1974, Voelzer and Jensen 1975, Smith et al. 1976, Smith et al. 1977, Smith et al. 1978, Smith et al. 1979, Smith et al. 1980, Voelzer et al. 1981, Voelzer et al. 1982, Goldsberry and Fuller 1983, King and Stotts 1984, Goldsberry et al. 1985.

Table 8. Estimates of precision for duck population estimates from the aerial survey results of McKelvey (1986), obtained by treating the transects as a random sample in Upland and Lowland strata.

	Date (1985)	
	27 June	3 July
Sampling Intensity		
Upland		
n[1]	10	10
N[1]	816	816
Lowland		
n	3	3
N	138	138
Total Duck Population Estimate and 90% Confidence Limits[2]		
Upland	4,337 ±1,734	3,601 ±1,613
Lowland	3,684 ±5,084	276 ± 414
Combined	8,021 ±6,818	3,877 ±2,027

[1] n = number of units sampled in stratum.
N = Number of possible sample units in stratum.

[2] Confidence limits on the density (ie. Tables 6, 12) are the same percentage.

Table 9. Ground counts of breeding ducks on the Yukon coastal plain and adjacent Mackenzie Delta.

Year	Date	Source[a]	Type and Location of Survey	Total Area Surveyed (km^2)	Total Counted	Density (birds or nests/km^2) Total	Species Composition[b]
1972	23-29 July	1,2	adult ducks on 22 lakes	N/A[c]	657 (56)[d]	N/A	OLDS 365, SCAU 190, NOPI 32, GWTE 4, AMWI 4, RBME 4, MALL 4, HADU 1.
		1,2	duck broods on 22 lakes	"	39[e](5)	N/A	OLDS 14, SCAU 9, NOPI 4, GWTE 3, AMWI 3, RBME 1
1973	24-29 July	3,2	adult ducks on 60 lakes	"	2080 (565)	N/A	OLDS 1046, SCAU 221, NOPI 161, RBME 26, GWTE 21, AMWI 20, WWSC 13, MALL 4, CANV 2, NOSH 1.
		3,2	duck broods on 60 lakes	"	68 (8)	N/A	OLDS 33, SCAU 10, NOPI 9, GWTE 5, AMWI 2, NOSH 1.
1981	11-26 June	4	ducks on-transect at 4 sites in King Pt. area	3.67	69 (4)	18.8	OLDS 7.36, NOPI 5.45, SCAU 2.73, GWTE 1.36, MALL 1.36.
			total nests found	(3.67?)	6	1.64	OLDS 1.09, SCAU 0.27, NOPI 0.27.
1983	9-29 June	5	ducks on-transect at 8 sites near King Point and Stokes Pt.	8.34	332	39.8	NOPI 21.3, OLDS 12.5, RBME 2.16, GWTE 1.44, GRSC 1.32, NOSH 0.72, COEI 0.12, MALL 0.12, WWSC 0.1.
			total nests found	(8.34?)	7	0.84	NOPI 0.60, SCAU 0.12, COEI 0.12.
			ducks on-transect (lowland)	7.09	322	45.4	?
			ducks on-transect (upland)	1.68	10	5.9	?
1985	19 June-3 July	6	nests on 6 plots	0.6	5	8.3	GRSC 3.3, NOPI 1.7, NOSH 1.7, LESC 1.7.

[a] 1 Gollop and Davis 1974b, 2 Salter et al. 1980, 3 Sharp et al. 1980, 4 Dickson 1985, 5 L. Dickson unpubl. data, 6 Hawkings 1986.

[b] MALL mallard, NOPI northern pintail, NOSH northern shoveler, AMWI american wigeon, GWTE green-winged teal, SCAU scaup sp., GRSC greater scaup, LESC lesser scaup, CANV canvasback, COEI common eider, KIEI king eider, HADU Harlequin duck, OLDS oldsquaw, WWSC white-winged scoter, SUSC surf scoter, SCOT scoter sp., COGO common goldeneye, RBME red-breasted merganser.

[c] Not applicable. For counts of birds on lakes, density is not determined and species composition is ranked on total numbers.

[d] Number of unidentified ducks or broods in parentheses.

[e] Number of broods.

Table 10. Ducks counted during ground surveys of lakes on the Yukon coastal plain, July 1972 and 1973 (data from Sharp et al. 1974), and estimates of total numbers of adults and broods on the Yukon coastal plain derived from the 1973 data.

Lakes					Ducks Counted				Total Estimated Population in 1973 ± 95% Confidence Limits	
		Estimated	Number Surveyed		Adults		Broods			
Size Class	Area (km^2)	Number on Coastal Plain	1972	1973	1972	1973	1972	1973	Adults	Broods
A	<0.256	480	5	18	41	98	9	10	2,613 ±2,243	267 ±382
B	0.26-1.28	70	8	28	20	657	4	32	1,642 ± 776	80 ± 37
C	1.28-1.92	9	4	6	43	234	12	14	351 ± 319	21 ± 14
D	>1.92	12	5	8	553	1,090	14	11	1,635 ±1,410	16 ± 10
TOTALS					657	2,079	41	67	6,241 ±4,748	384 ±450

Table 11. Estimated species compostion of ducks on the Yukon coastal plain[a], derived from ground counts at 60 lakes during July 1973 (data from Sharp et al. 1974:46-47).

Lake Size Class	Species: Mallard	N. Pintail		G.-winged Teal		American Wigeon		Unidentified		Scaup spp.		Oldsquaw		Unid. Diver	R.B. Merganser	TOTAL	
	Adult	Adult	Brood	Adult	Brood	Adult	Brood	Adult	Brood	Adult	Brood	Adult	Brood	Adult	Adult	Adult	Brood
A																	
No. seen	2	24	3	5	1	20	2	5	1	12	2	28	1		2	98	10
Mean/Lake	0.11	1.33	0.17	0.28	0.06	1.11	0.11	0.28	0.06	0.67	0.11	1.56	0.06		0.11	5.44	0.56
Est. Total	53	640	80	133	27	533	53	133	27	320	53	747	27		53	2,613	267
CI[b]	110	424	90	176	55	1104	110	176	55	550	110	701	55		76	2,243	382
B																	
No. seen	1	68	2	5	2			81	3	80	5	390	20	5	13	657	32
Mean/Lake	0.04	2.43	0.07	0.18	0.07			2.89	0.11	2.86	0.18	13.9	0.71	0.18	0.46	23.5	1.14
Est. Total	2	170	5	13	5			202	8	200	13	975	50	13	33	1,642[c]	80
CI	4	94	5	12	5			209	7	157	8	653	29	20	22	776	37
C																	
No. seen	1	28	3	3				10	2	5	1	104	6	83		234	14
Mean/Lake	0.17	4.67	0.50	0.50				1.67	0.33	0.83	0.17	17.3	1.00	13.8		39.0	2.33
Est. Total	2	42	5	5				15	3	8	2	156	9	125		351[d]	21
CI	2	30	5	7				22	4	5	2	99	11	182		319	21
D																	
No. seen		41	1	8	2			381		124	2	524	6		11	1,090	11
Mean/Lake		5.12	0.13	1.00	0.25			47.6		15.5	0.25	65.5	0.75		1.38	136	1.38
Est. Total		62	2	12	3			572		186	3	786	9		17	1,635[e]	17
CI		49	2	10	3			597		159	3	843	9		16	1,410	10
TOTAL	57	914	91	162	35	533	53	922	38	713	70	2,787	95	138	102	6,241[f]	385
CI	117	597	102	205	63	1,104	110	1,004	66	871	123	2,296	103	202	114	4,748	450

[a] See Table 10 for details of size and number of lakes surveyed and number of each size on the coastal plain.
[b] Confidence Interval. 95% Confidence Limits for the estimated total are the estimated total ± this amount.
[c] Total includes 5±8 adult canvasbacks from a count of 2 adults, 33±37 adult white-winged scoters from a count of 13 adults, and 3±4 adult surf scoters from a count of 1 adult.
[d] Total includes 3±5 broods of unidentified divers from a count of 2 broods.
[e] Total includes 2±2 adult surf scoters from a count of 1 adult.
[f] Total includes additional adults and broods as outlined above.

rather than a fixed-wing aircraft. The need to correct aerial surveys for sightability is demonstrated by Dickson's (1985) estimate of 18.8 ducks/km^2 from ground surveys, which is 9 times larger than her estimate from aerial surveys by helicopter at the same time in the same general vicinity (2 - 3 ducks/km^2 on 19 June, Table 3). This confirms the need for some kind of visibility ratios to correct aerial survey data if the data are intended to indicate the true population or if they are to be compared with ground surveys from other areas. The USFWS breeding pair surveys also have methods of data analysis which have seldom been used in other surveys and make comparisons difficult: in calculating the breeding population index, USFWS procedures (1) do not consider lone females seen on transects, (2) double numbers of lone males of most species, and (3) do not include groups of more than 5 males.

It is especially difficult to integrate the results of surveys conducted in different years because duck populations in far northern areas fluctuate widely from one year to another: the standardized USFWS surveys in the Mackenzie Delta (1974-1985) have indicated a low index of 155,800 ducks in 1985 and a high of 870,800 in 1984, a difference of 558% (Table 7). Much of this variation is commonly attributed to influxes of drought-displaced ducks from the prairie region. Strangely, population indices of oldsquaws, which do not breed on the prairies, seem to follow the same pattern -- an indication that some other factor plays a role. Whatever the cause, these fluctuations do offer some explanation for the year to year variation in survey results from the coastal plain.

To make a rough comparison of the USFWS data from the Mackenzie Delta with aerial survey data from the coastal plain, and to obtain a more accurate estimate of the true population of ducks on the coastal plain, I applied the USFWS ground/air visibility ratios to the results of McKelvey (1986). Because sex and group size data were not readily availible, I made a blanket application of these ratios with no omission of lone females, doubling of lone males, or omission of males in groups greater than 5. The results (Table 12) suggest densities of at least 3 ducks/km^2 in McKelvey's designated upland areas and 4-37 ducks/km^2 in lowland areas. Based on these two survey flights the total duck population was 11,810-24,086 (confidence limits not calculated).

The net result of the three factors which contribute to the variability in survey data (sightability, precision, and year to year variation) is that it is impossible to estimate the population size with much confidence based on the available data. Perhaps the most useful aspect of the data is that we can put upper limits on the sizes of the populations, which can be used for evaluation on a regional or continental basis. Relative to other years, it appears that populations were relatively low on the coastal plain in 1985, if we use trends in the Mackenzie Delta as indicators (Table 7). In some years, we could expect populations of ducks on the coastal plain to be as much as 500% higher than 1985 estimates, based on the fluctuations in that area.

Salter et al. (1980) summarized the breeding status of ducks on the Yukon coastal plain and adjacent Beaufort Sea area. In addition to species whose breeding is confirmed in Table 11, they provided evidence of limited breeding by the following species: mallard, northern shoveler, common eider, and red-breasted merganser. Additionally, some harlequin ducks at least raise their broods on the coastal plain (female with 5 flightless young on the Babbage

Table 12. Results of aerial surveys for ducks on the Yukon coastal plain, 27 June and 3 July 1985 (data from McKelvey 1986), and estimates of total populations.

Species	Ground/Air Visibility Ratio[b]	Number Counted		Uncorrected Density(/km^2)		Uncorrected Population		Corrected[a] Density		Corrected[a] Population	
		Upland	Lowland	Upland	Lowland	Upland	Lowland	Upland	Lowland	Upland	Lowland
27 June											
Mallard	3.1625	1	4	0.03	0.52	82	185	0.08	1.66	259	583
Northern Pintail	3.8377	0	57	0	7.5	0	2,625	0	28.8	0	10,074
Scaup spp.	2.6882	17	2	0.43	0.26	1,391	92	1.17	0.71	3,740	248
Oldsquaw	6.50	8	5	0.20	0.66	655	230	1.33	4.28	4,256	1,497
Scoter spp.	1.30	11	5	0.28	0.65	900	230	0.37	0.86	1,170	299
Unidentified Duck	-	16	7	0.41	0.92	1,309	322	0.41+	0.92+	1,309+	322+
Total Ducks		53	80	1.4	10.5	4,337	3,684	3.36+	37.2+	10,734+	13,352+
3 July											
American Wigeon	5.3988	2	4	0.05	0.53	164	184	0.28	2.84	885	995
Scaup spp.	2.6882	15	0	0.38	0	1,228	0	1.03	0	3,300	0
Oldsquaw	6.50	9	1	0.23	0.13	737	46	1.50	0.85	4,788	299
Scoter spp.	1.30	1	0	0.03	0	82	0	0.03	0	106	0
Harlequin Duck	-	3	0	0.08	0	245	0	0.08+	0	245+	0
Unidentified Duck	-	14	1	0.36	0.13	1,146	46	0.36+	0.13+	1,146+	46+
Total Ducks		44	6	1.12	0.79	3,601	276	3.28+	3.82+	10,470+	1,340+

	Upland	Lowland[c]
Area in stratum(km^2)	3,200	350
Area in sample(km^2)	39.1	7.6
Expansion factor	81.8	46.0

[a] Corrected for ground/air visibility bias.
[b] Ratios obtained from U.S. Fish and Wildlife Service, Juneau, Alaska.
[c] Estimated 100 km^2 lowland in Babbage River Delta, 250 km^2 in Mackenzie River Delta.

River near Phillips Bay, 7 Sept. 1986, J. Hawkings unpubl. data), although they may nest exclusively in the foothills or mountains.

The status of common eider on the coastal plain deserves special mention because this species breeds only along the coast. The documented populations and breeding locations to date are: (1) Komakuk (1 nest at a lake edge, Salter et al. 1980); (2) Nunaluk Spit (1 nest on the spit and 20-34 nests on a barrier island east of the spit (Schweinsburg 1974a, Gollop et al. 1974d); (3) Pauline Cove, Herschel Island (as many as 6 nests, Salter et al. 1980, Ward and Mossop 1986); (4) Stokes Point (1 nest in 1983, L. Dickson unpubl. data); (5) Phillips Bay (10+ nests on barrier islands and spits in 1986, R. Hunka unpubl. data); (6) Escape Reef (5 nests mid July 1962, T. W. Barry unpubl. data). It is likely that common eiders nest from time to time on most of the gravel spits and barrier islands along the Yukon coast.

2.7.3 Molting

In July and August, seaducks gather in places along the Yukon coast to molt. Others migrate westward through the area in late June and early July to molt along the Alaska coast. Along the Yukon coast the movement is primarily composed of surf and white-winged scoters (estimated 8,000 past Komakuk) with lesser numbers of oldsquaws, but there are much larger migrations of eiders and probably oldsquaws well offshore in the Beaufort Sea (Johnson and Richardson 1982).

The largest concentration of molting seaducks along the Yukon coast occurs in the protected waters of Workboat Passage, between Herschel Island and the mainland. Estimates of the maximum populations there range from 5,000-15,000 (Gollop et al. 1974a, Mossop 1974, 1975, Vermeer and Anweiler 1975, Salter et al. 1980, Barry et al. 1981, Barry and Barry 1982). None of those estimates have any measures of precision. Oldsquaw and surf scoters comprise the majority of those concentrations, but the proportions and total numbers vary from year to year, and the distribution of birds within the area changes according to weather and season (Gollop et al. 1974a, Mossop 1974, Vermeer and Anweiler 1975, Barry and Barry 1982). Virtually all the scoters are male surf scoters. White-winged scoters are common in June and early July, but apparently do not actually molt on this part of the Beaufort coast. Some scoters move south from the Beaufort coast through the Babbage River area during July, presumably heading for molting areas in the Old Crow Flats. Five such flocks were observed in flight on 28 July 1972 (Gollop and Davis 1974a), and another on 8 July 1985 (CWS Whitehorse, unpubl. data). As many as 800 scaup spp., 25 red-breasted mergansers, and 80 common eiders are also found in the Workboat Passage area during midsummer. The largest counts ever made in this area were by Mossop (1975), who counted 8,600 scoters and 5,700 oldsquaws on 5 August 1975, and Barry et al. (1981), who counted 8,745 scoters and 5,570 oldsquaws on 29-31 July, 1980. The density of ducks on this latter survey was 1,400/km^2 (based on 10.2 km^2 of transects), at least twice as great a density as recorded by any other surveys. In 1981, Barry and Barry (1982) repeated the survey of 1980 but observed far fewer ducks (maximum 3,417 oldsquaw and 2,250 scoters, density 154/km^2, on 1 August).

This concentration of ducks is present from late June until late August, with peak numbers probably in late July and early August. Mossop (1974) found that numbers decreased during 21-25 August, then increased again until at

least 4 September. He speculated this represented the beginning of fall migration. Searing et al. (1975) also noted a decrease in numbers from mid to late August and an increase again by 10 September in 1972. Vermeer and Anweiler (1975) noted a steady decrease in numbers of both scoters and oldsquaws from 20 August to 4 September 1973.

The only other marine areas mentioned as having significant numbers of molting ducks are Phillips Bay (Mossop 1975, Barry et al. 1981, Dickson 1985) and the waters between Kay Point and Shingle Point (Dickson 1985). On 24 July 1981 Dickson (1985) found 11.9 ducks/km^2 in Phillips Bay, and 32.5/km^2 (610 ducks on transect) near Shingle Point. The same year, Barry and Barry (1982) reported several hundred (9.7/km^2) scaup, oldsquaws, scoters and mergansers in the Phillips Bay area on 18 July, and 29/km^2 on 1 August, but only 0.2/km^2 and 9.8/km^2 between Kay Point and Shingle Point. In 1980 neither area had consistent concentrations (Barry et al. 1981). Mossop (1975) found 1,000 oldsquaws in Phillips Bay on 30 Aug 1975. Clearly both of those areas receive modest use compared to the Workboat Passage area. This is confirmed by Searing et al. (1975).

Smyth et al. (1986) considered several coastal areas to be significant molting areas for dabbling ducks, but the documented numbers are not substantial (lagoons behind Nunaluk Spit - 20; lagoon and ponds near mouth of Spring River - 45; Phillips Bay - 19).

Freshwater habitats are also used by molting ducks to some extent. Most of the several thousand adult oldsquaws on coastal plain lakes in late July 1973 (Table 11) appeared to be molting (Sharp et al. 1974). Numbers of both dabbling and diving ducks peak in freshwater habitats in the area during mid July to mid August (Searing et al. 1975), and most of the adult ducks present at this time are probably molting. Most diving ducks found in mid-summer are on the larger lakes, but dabblers frequent smaller waterbodies. Dickson (1985) found several hundred ducks (21.7/km^2) molting in the vicinity of Deep Creek during an aerial survey on 24 July 1981. Most of those were dabbling ducks (northern pintail, American wigeon, mallard, and green-winged teal). This may have been a larger number than usual because population indices of ducks in the north were much higher than usual in 1981 (Table 7). T.W. Barry (unpubl. data) reported 1,400 dabbling ducks in the Tent Island - Moose Channel area in July and August 1971, suggesting that area may be important for molting.

2.7.4 Fall Migration

Oldsquaws and eiders exit the region to the west via the Beaufort Sea, while most other ducks probably migrate south via the Mackenzie Valley. Oldsquaws move west in small numbers prior to early September (Gollop and Davis 1974a); after that, migration appears to be sporadic but occasionally large numbers of birds are present along the coast. For example Mossop (1974) and Vermeer and Anweiler (1975) found 2,000-7,000 diving ducks, primarily oldsquaws, along the coast at various times during 1-21 September. Ward and Mossop (1986) counted 6,060 oldsquaws and 3,685 scoters at Workboat Passage on 2 September 1985. On 8-9 September 1980 Barry et al. (1981:23) reported "oldsquaws and scoters .... in large spread out flocks of 500 to 2,000" along the coast between the Mackenzie Delta and Herschel Island, but did not provide densities or total numbers observed. Some of those scoters were likely en route from northwest to southeast, as indicated by the behaviour of a flock

of 800-1,000 scoters just west of Phillips Bay on the evening of 13 Sept. 1986. That flock repeatedly took flight, circled, and landed, finally departing at dusk in an easterly direction, continuing to gain altidude until out of sight. The following day an aerial survey revealed that few scoters remained at Workboat Passage compared to 4 days earlier (J. Hawkings unpubl. data).

Their are indications of significant migrations of seaducks, particularly eiders and oldsquaws, in the Beaufort Sea after mid-September (S. R. Johnson pers. comm.), but the extent of that migration and use of nearshore waters at that time are poorly documented.

Most movements of dabbling ducks eastward toward the Mackenzie River occur during the last half of August. Peak movements of pintails in 1972 were 50/hr past Nunaluk Spit on 20 August and 132/hr past Moose Channel on 15 August (Searing et al. 1975). Few dabbling ducks are present in the area beyond the end of August (Searing et al. 1975, Dickson 1985).

2.7.5 Discussion

There is constant reference to the ducks present during June on the coastal plain as "breeding" or "nesting" ducks, but it has never been determined how many actually attempt to nest or what kind of production results. It is likely that many do not nest, especially in very late springs and during years when drought on the prairies causes large influxes of ducks. This should be kept in mind when the terms breeding and nesting are used in reference to the coastal plain.

2.8 LESSER SANDHILL CRANE

2.8.1 Spring migration

The few sandhill cranes present on the Yukon coastal plain in summer are part of the Central Flyway Population and likely migrate north via the Mackenzie Valley or parts of interior Yukon and Alaska.

2.8.2 Breeding

This species has been considered an uncommon summer visitant on the coastal plain (Salter et al. 1980) and the only confirmed records of breeding are at Komakuk (July 1974, D. Mossop pers. comm.), and Phillips Bay (1986, R. Hunka pers. comm.). On the Yukon portion of the Mackenzie Delta cranes are common breeders (Campbell 1973, Hawkings 1986). Estimates of density there are 3.3 nests/km^2 based on ground surveys (Hawkings 1986) and 0.05-0.2 birds/km^2 based on aerial surveys (Campbell and Weber 1973, Wiseley et al. 1977). Many of the cranes in the Mackenzie Delta area during summer are non-breeders which gather in flocks of up to 100 birds (Campbell and Weber 1973).

2.8.3 Fall Migration

Small numbers of sandhill cranes migrate east across the coastal plain in fall (maximum 5.2/h at Moose Channel on 16 August 1972, Campbell 1973). There is up to a ten-fold increase in numbers of cranes on the Yukon portion of the Mackenzie Delta in early September compared to June, indicating its possible

use as a staging area. Campbell and Weber (1973) counted 491 (0.45/km^2) in their Shallow Bay study area on 2 September 1972.

2.9 SHOREBIRDS

2.9.1 Spring Migration

In spring shorebirds enter the region during mid May to mid June in a northwest direction from the interior of North America, probably along the Mackenzie Valley, and also in a NE direction from the interior of Yukon and Alaska (Richardson and Johnson 1981). Shorebirds do not use coastal habitats of the Beaufort Sea during spring migration and are inconspicuous migrants, most probably passing at high altitudes. A few hundred phalaropes were the only significant visual evidence of shorebird migration observed during spring 1975 on the Yukon coast (Richardson and Johnson 1981).

2.9.2 Breeding

Information on shorebirds breeding in the area comes primarily from ground surveys because shorebirds on the tundra are generally not visible from aircraft. The available information is insufficient to estimate the size of any populations. The breeding densities of shorebirds vary greatly according to habitat, and although most surveys were stratified by habitat to some extent, different studies have used different habitat classification systems, and there are presently no estimates of total area of each habitat on the coastal plain. An additional problem is that breeding populations of some species fluctuate greatly from one year to the next within the same area.

The data of Schweinsburg (1974a), Koski (1975a), and Dickson (1985, and unpubl. data) provide the best indication of the relative abundance of breeding shorebirds on the coastal plain (Tables 13-15), while Salter et al. (1980) summarized the breeding status of shorebirds based on all the Arctic Gas field studies from 1971 through 1976.

Generally, the most abundant breeding shorebirds on the coastal plain are red-necked phalarope, semipalmated sandpiper, pectoral sandpiper, and lesser golden plover, but the relative abundance of these varies according to the year, specific location, and habitat covereage of surveys. Breeding populations of pectoral sandpipers in particular are known to be subject to wide fluctuations from year to year (Pitelka 1959). Dickson's findings (Table 15) are probably most representative of the Yukon coastal plain, except that she felt whimbrels and stilt sandpipers were more abundant in her King Point area than elsewhere on the coastal plain.

The shorebird fauna of Herschel Island and the Yukon portion of the Mackenzie Delta differ somewhat from that of the coastal plain. Ruddy turnstones and Baird's sandpipers breed commonly on the dry tundra of Herschel Island, whereas wet tundra species such as red-necked phalarope, pectoral sandpiper, and stilt sandpiper breed rarely or not at all (Hawkings and Mossop 1985, Ward and Mossop 1986). On the Yukon portion of the Mackenzie Delta, the tundra lacks the mosaic of wet, moist, and dry habitats which is present in patterned-ground areas of the coastal plain. The only shorebirds commonly breeding there, based on Hawkings (1986) and Campbell (1973), are red-necked phalarope and semipalmated sandpiper.

Table 13. Numbers and densities of shorebirds observed on ground transects[a] at 5 locations on the Yukon coastal plain, 21-27 June 1971 (data from Schweinsburg 1974a).

	Blow River 68° 46'N 137° 10'W		Phillips Bay 69° 05'N 138° 25'W		Firth River 69° 23'N 139° 23'W		Clarence Lagoon 69° 02'N 140° 47'W		Nunaluk Spit 69° 36'N 139° 45'W	
Species	number	density[b]	number	density	number	density	number	density	number	density
Red-necked phalarope	12	23	5	13	7	18				
Lesser golden plover			9	23	1	3	2	3	2	4
Semipalmated sandpiper	5	10	12	31	5	13	3	4	2	3
Whimbrel										
Pectoral sandpiper	3	6			8	21				
Stilt sandpiper					5	13				
Long-billed dowitcher										
Common snipe										
Semipalmated plover										
Least sandpiper										
Red phalarope										
Buff-breasted sandpiper									5	9
Unidentified shorebird	5	10	5	13	1	3				
Totals	25	49	31	80	27	71	5	7	9	16
Area of Transects(km^2)	0.512		0.384		0.384		0.726		0.576	

[a] Transects 18.5 m wide
[b] Birds/km^2

Table 14. Numbers and densities of shorebirds observed on ground transects[a] at 4 locations on the Yukon coastal plain, 7-15 June 1974 (data from Koski 1975a).

Species	A3 Blow River 68° 46'N 137° 10'W			A4 Babbage River 69° 05'N 138° 25'W			A5 Firth River 69° 23'N 139° 23'W			A6 Clarence Lagoon 69° 02'N 140° 47'W		
	number	density[b]	rank	number	density	rank	number	density	rank	number	density	rank
Red-necked phalarope	20	76	2	18	44	1	10	31	1	4	24	5
Lesser golden plover	1	4	8	17	42	2	2	6	4	7	42	3
Semipalmated sandpiper	11	42	3	7	17	4	8	25	2	11	66	2
Whimbrel				3	7	6						
Pectoral sandpiper	33	125	1	12	30	3	5	15	3	12	72	1
Stilt sandpiper							2	6	4	1	6	6
Long-billed dowitcher	6	23	4									
Common snipe	6	23	4	4	10	5						
Semipalmated plover							1	3	6			
Least sandpiper	2	8	7	1	3	8						
Red phalarope										6	36	4
Totals	82	311		63	156		28	86		49	295	
Total Area of Transects (km^2)	0.2639			0.4046			0.3241			0.1658		

[a] Transects 18.5 m wide
[b] Birds/km^2

Table 15. Numbers and densities of shorebirds observed on and off ground transects[a] in the King Point, Stokes Point, and Phillips Bay areas of the Yukon coastal plain during June 1981 and 1983 (data from Dickson 1985, Dickson unpubl. data).

	1981					1983				
	on transect			off transect		on transect			off transect	
Species	number	density[b]	rank	number	rank	number	density	rank	number	rank
Red-necked phalarope	76	20.7	1	113	1	147	16.7	3	110	4
Lesser golden plover	26	7.1	2	35	2	109	12.4	4	125	3
Semipalmated sandpiper	14	3.8	3	34	3	167	19.0	2	191	1
Whimbrel	13	3.5	4	31	4	5	0.6	10	26	7
Pectoral sandpiper	8	2.2	5	11	7	252	28.7	1	166	2
Stilt sandpiper	5	1.4	6	23	5	36	4.1	6	81	5
Long-billed dowitcher	3	0.8	7	2	9	45	5.1	5	26	7
Common snipe	2	0.5	8	15	6	5	0.6	10	77	6
Semipalmated plover	2	0.5	8	2	9	13	1.5	8	6	10
Least sandpiper	1	0.3	10	2	9	0	0.0	-	0	-
Hudsonian godwit	0	0.0	-	0	-	6	0.7	9	1	11
Lesser yellowlegs	0	0.0	-	10	8	3	0.3	12	0	-
Baird's sandpiper	0	0.0	-	0	-	3	0.3	12	0	-
Spotted sandpiper	0	0.0	-	0	-	0	0	-	1	11
Red Phalarope	0	0.0	-	0	-	14	1.6	7	16	9
TOTALS	150	40.9		278		805	91.7		826	

[a] Transects 55 m wide. Total area of transects 3.6685 km^2 in 1981 and 8.7786 km^2 in 1983.
[b] birds/km^2

Inland of the coastal plain, in the foothills and mountains, wandering tattler and spotted sandpiper probably breed along the rivers, in addition to some of the species found on the coastal plain (eg. lesser golden plover, Baird's sandpiper).

Several species have been found breeding on the coastal plain and adjacent Mackenzie Delta which were not noted by Salter et al. (1980):

Semipalmated plover. Confirmed breeding at Herschel Island (Hawkings and Mossop 1985, Ward and Mossop 1986).
Ruddy Turnstone. Confirmed breeding at Herschel Island (Hawkings and Mossop 1985).
Common Snipe. Comfirmed breeding at Herschel Island (Ward and Mossop 1986) and at Moose Channel (Campbell 1973).
Baird's Sandpiper. Confirmed breeding at Herschel Island (Hawkings and Mossop 1985, Ward and Mossop 1986) and Demarcation Bay (Burgess 1984).
Least Sandpiper. Confirmed breeding at Trout Lake (CWS Whitehorse unpubl. data) and Moose Channel (Campbell 1973).
Long-billed Dowitcher. Confirmed breeding at Moose Channel (Campbell 1973) and Stokes Point (Dickson unpubl. data).
Hudsonian Godwit. Confirmed breeding at Moose Channel (Campbell 1973).

2.9.3 Fall Migration

Post-breeding shorebirds of several species gather on the wetlands of the coastal plain during July and August. Early in that period most flocked birds are adults. Depending on the year and species, those are either failed breeders or sexes which normally have no role in incubation or rearing of young (eg. male pectoral sandpipers, female red-necked phalaropes). Later, a large proportion are juveniles.

Most fall migration of shorebirds along the coast is eastward. The most abundant migrants on the Yukon coast are red-necked phalaropes, pectoral sandpipers, golden plovers, and semipalmated sandpipers (Table 16). Most migration occurs during August, and numbers of shorebirds in most marine and freshwater habitats reach a seasonal peak in late August (Searing et al. 1975). To date, studies of fall migration have revealed few concentrations of staging or migrating shorebirds. It appears that many shorebirds disperse from the coastal plain overland to the south and/or pass unnoticed at high altitudes as in the spring.

Following are accounts of several species whose fall migration in the area has significant features. Estimated amount of visible migration at Nunaluk Spit during 10 July-17 September 1972 (Gollop and Davis 1974a) is given for each species and each flight direction, east (E) and west (W). Actual numbers observed are given in parentheses. Some figures for rates and amounts of migration observed at Moose Channel in 1972 are mentioned, but these do not consider direction of flight (Searing et al. 1975).

American Golden Plover E 2,253 (1,090); W 379 (186)

The above figures are actually for both lesser golden and black-bellied plovers, but the great majority of those identified by observers were the

Table 16. Estimated monthly totals[a] of shorebirds passing Nunaluk spit, 10 July - 17 September 1972 (data from Gollop and Davis 1974a).

Species	East				West			
	July	August	September	Total	July	August	September	Total
Plover spp.	63	1,920	269	2253	27	351	1	379
Dowitcher spp.	0	735	2,278	3,013	0	7	4	11
Phalarope spp.	3,480	14,340	1,890	19,710	1,492	7,723	85	9,300
Misc. and Unid. Shorebirds	1,076	4,381	3,827	9,284	897	2,209	197	3,303
Total Shorebirds	4,619	21,376	8,264	34,259	2,416	10,290	287	12,993

[a] Numbers observed during daily migration watches were extrapolated to total daylight hours of each week. These totals were then summed to obtain monthly totals.

former. Most migration occurred from 6 to 30 August, with a peak on 20 August at Nunaluk Spit (25.7/h) and at Moose Channel (269/h). Vermeer and Anweiler (1975) noted "thousands....migrating eastward over Avadlek Spit from 20 to 25 August 1973". They also noted one flock of 500 which stopped to roost at Avadlek Spit on 20 August.

Pectoral Sandpiper E 1,654 (407); W 52 (20)

Flocks of post-breeding adults appear commonly in wet habitats on the coastal plain and Shoalwater Bay portion of the Mackenzie Delta as early as the first week of July. On the coast observed movement of migrants is primarily east in the fall, from 30 July to 5 September, with a peak in early September (Gollop and Davis 1974a). Peak movement in 1972 was 114/h past Moose Channel on 16 August (over 2,330 were counted that day).

Semipalmated Sandpiper

Flocks gather on the coastal plain during July and along the coast thoughout July and August. Fall migration was most notable at Moose Channel in 1972, with a peak 30 July-1 August (24, 12, 30 birds/h on these three days).

Long-billed Dowitcher E 3,013 (783); W 11 (5)

This species was observed at Nunaluk Spit from 20 August to mid September. Peak movements were on 26 August at Nunaluk Spit (5.8/h) and 5 September at Moose Channel (19.4/h).

Sanderling E 113 (23); W 373 (163)

Sanderlings migrated between 17 July and 5 September. They are the only shorebird species with a definite tendency to migrate west rather than east along the Beaufort Coast in the fall, suggesting an affinity to the Pacific coast population (Gollop and Davis 1974a).

Red-necked Phalarope and Red Phalarope E 19,710 (6,149); W 9,300 (3,484)

Red-necked phalaropes gather in post-breeding flocks on coastal plain waterbodies during July. Most phalaropes migrated on the coast during August and until 5 September in 1972. The peak was in the first week of August at Nunaluk Spit. Thousands gather to rest and feed, particularly in August, in lagoons at Nunaluk Spit, Workboat Passage, and Stokes Point. Vermeer and Anweiler (1975) estimated that numbers along the south shore of Herschel Island peaked at about 5,000 on 10 August 1973. They estimated that 2.5% of all phalaropes were red phalaropes, while Gollop and Davis (1974a) estimated 5%.

2.10 JAEGERS, GULLS, and TERNS

2.10.1 Spring Migration

Jaegers are more abundant than gulls or terns in spring migration on the Yukon coast. Pomarine jaegers are the most common jaegers observed, migrating first eastward in late May and early June, then westward in mid to late June.

Few long-tailed jaegers are seen on the coast, probably because most migrate north through interior Alaska and Yukon (Kessel and Cade 1958, Dean et al. 1976). Parasitic jaegers may move eastward in significant numbers, but they do not appear to concentrate along the coast (Richardson and Johnson 1981). Richardson and Johnson (1981) estimated 3,632 pomarine jaegers moved east and 200 west along the coast in spring 1975, but net movement of the other two species was less than 100. Glaucous gulls migrate eastward from late May to early June both coastally (est. 2,466 in 1975) and offshore. Small numbers of arctic terns (est. 787) and a few Sabine's gulls (est. 73) and Thayer's/herring gulls (est. 37) also passed east along the coast in 1975. Some arctic terns, and gulls of all 3 species probably migrate overland from the Pacific Ocean in spring (Richardson and Johnson 1981). Glaucous gulls are the only species which commonly uses marine shorelines and open water leads along the Yukon coast during spring migration (Richardson and Johnson 1981).

2.10.2 Breeding

Parasitic and long-tailed jaegers commonly breed on the Yukon coastal plain, while pomarine jaegers are rare visitants (Salter et al. 1980). Dickson (1985, and unpubl. data) found the two breeding species nearly equal in abundance (1.4/km^2) on ground transects near King Point in 1981, and near Stokes Point, King Point and Phillips Bay in 1983 (1.0 long-tailed, 0.9 parasitic/km^2). Aerial surveys in June have indicated densities of 0.2-0.3 jaegers/km^2, with the exception of Dickson's (1985) survey of 19 June 1981, which suggested much lower densities (Table 17). Densities on the Yukon part of the Mackenzie Delta (Wiseley et al. 1977) appear to be similar to those on the coastal plain, though the species composition may be more biased in favour of parasitic jaegers. On Herschel Island, long-tailed jaegers are the only species which breeds and parasitic jaegers are uncommon visitants.

The glaucous gull is the only gull which presently breeds on the Yukon coastal plain, although Sabine's gulls have been reported breeding on islands in Workboat Passage and on Escape Reef in past years (T.W. Barry, pers. comm). Most glaucous gull nests are located in colonies on barrier islands and islands in lakes, while smaller numbers nest in isolated pairs on the shorelines of, or on islets in, lakes and ponds. The total population of glaucous gulls in the major colonies in the area is at least 422 nests (844 adults, Table 18). There is no estimate of the number of glaucous gulls nesting in isolated pairs, but from aerial surveys (Table 17) it would appear to be fairly small (less than 0.06 birds/km^2, or 145 birds in the 2,450 km^2 of coastal plain within 10 km of the coast). Many of the gulls observed inland during aerial surveys of the coastal plain are probably foraging adults from the coastal colonies. This is borne out by the few adult gulls and total lack of broods seen on coastal plain lakes in late July of 1973 (Table 19). The Beaufort Sea coast in the vicinity of the Mackenzie Delta is a zone in which a few glaucous X herring hybrids occur in the glaucous gull population (Spear 1987).

Arctic terns breed colonially or singly on barrier islands and various other marine and freshwater shorelines (Salter et al. 1980). The breeding population on barrier islands and other documented colonies (Table 18) is rather small in comparison to the total number of adults and broods estimated on the coastal plain in late July (Table 19), suggesting that most breed on inland waterbodies.

Table 17. Numbers and densities of jaegers, gulls, and terns observed during aerial surveys of the Yukon coast and coastal plain during late spring, summer, and fall. Values in parentheses are actual numbers observed.

Source	Year	Date	Habitat[a]	Area Surveyed (km^2)	Birds/km^2 (actual numbers observed)		
					Jaegers	Glaucous Gull	Arctic Tern
Vermeer and Anweiler 1975	1973	9-12 Aug	C	?	(6)	(281)	(116)
		23-24 Aug	C	?	(9)	(293)	(28)
		1 Sept	C	?	(1)	(475)	
		10 Sept	C	?		(281)	
		14 Sept	C	?		(222)	
		21 Sept	C	?		(400)	
Barry et al. 1981	1980	13-17 Jul	C	48.4		2.44 (118)	
		29-31 Jul	C	48.4		2.29 (111)	
		16-18 Aug	C	48.4		3.04 (147)	
Barry and Barry 1982	1981	18 July	C	88.4		10.40 (919)	
		2 Aug	C	88.4		9.37 (828)	
		11 Sept	C	40.4		19.41 (784)	
Dickson 1985	1981	19 June	U + L	96.0	0.07 (7)	0.04 (4)	0.32 (31)
		24 July	U + L	36.0	0.08 (3)	0.08 (3)	0.36 (13)
			C	24.4		14.06 (343)	0.70 (17)
		3 Sept	C	46.4	0.04 (2)	4.16 (193)	
Dickson unpubl. data	1983	21 June	U + L	55.0	0.29 (16)	0.13 (7)	0.36 (20)
		2 Aug	U + L	55.0	0.16 (9)	0.02 (1)	0.31 (17)
		16 Aug	C	22.8	0.04 (1)	4.25 (97)	0.48 (11)
		26 Aug	C	153.0	0.02 (3)	7.77 (1189)	1.69 (258)
		1 Sept	C	153.0	0.05 (8)	4.46 (683)	0.93 (142)
		7 Sept	C	153.0	0.01 (1)	3.14 (480)	0.46 (70)
McKelvey 1986	1985	27 June	L	7.6	0.26 (2)	2.37 (18)	0.39 (3)
			U	39.1	0.23 (9)	0.10 (4)	0.56 (22)
			C	5.6		0.18 (1)	
		3 July	L	7.6	0.26 (2)	0.53 (4)	
			U	39.1	0.18 (7)	0.03 (1)	0.28 (11)
			C	5.6			
			C	29.2		3.25 (95)	0.34 (10)
Alexander 1986	1985	26 July	C	125	0.01 (1)	4.06 (508)	0.53 (66)
		21 Aug	C	92		6.41 (590)	6.24 (574)
		12 Sept	C	128		2.75 (352)	

[a] L-Lowland, U-Upland, C-Coastal marine.

Table 18. Reported size of glaucous gull and arctic tern colonies on the Yukon coastal plain.

Location	Reported Size: Gulls Adults	Gulls Nests	Gulls Young	Terns Adults	Terns Nests	Terns Young	Date	Year	Source
Four barrier islands east of Nunaluk Spit		18		50+	7+		25 June	1971	Schweinsburg 1974a
	46		8	50+		25	7 August	1971	Schweinsburg 1974a
	108[a]						18-21 July	1973	Gollop and Richardson 1974
		39			11		June, July	1972	Gollop and Richardson 1974
Barrier islands southwest of Kay Point	60	17	12				June	1981	Dickson 1985
Island on west side of Phillips Bay	42	"some"					June	1981	Dickson 1985
Escape Reef	150	+					20 July	1973	Gollop and Richardson 1974
	110						June	1974	T.W. Barry (Unpubl. data)
	300+						June	1979	T.W. Barry (Unpubl. data)
	313			12			24 July	1981	Dickson 1985
	300						13-17 July	1980	Barry et al. 1981
		278					late June	1984	L. Dickson (Unpubl. data)
Whitefish Station area		78			1		June	1985	Hawkings 1985
Moose Channel area		10+			24+		June	1972	Campbell 1973
Deep Creek and Lower Babbage River area				33+			June	1981	Dickson 1985
Total	523+	422+		95+	36+				

[a] One island not checked in 1972.

Table 19. Estimated populations of gulls and terns on Yukon coastal plain lakes, derived from ground counts at 60 lakes during July 1973 (data from Sharp et al. 1974: 45, 49).

Lake Size Class (km^2)	Number of Lakes: Minimum Number on Coastal Plain[a]	Number of Lakes: No. Surveyed	Birds	Gull sp. Adult	Arctic Tern Adult	Arctic Tern Brood
<0.26	480	18	No. seen	3	115	2
			Mean/Lake	0.17	6.39	0.11
			Est. Total	80	3,066	53
			CI[b]	166	1,689	110
0.26-1.28	70	28	No. seen	4	124	5
			Mean/Lake	0.14	4.43	0.18
			Est. Total	10	310	12
			CI	9	105	14
1.28-1.92	9	6	No. seen	3	59	
			Mean/Lake	0.50	9.83	
			Est. Total	4	88	
			CI	5	48	
>1.92	12	8	No. seen	8	133	
			Mean/Lake	4.25	16.6	
			Est. Total	51	199	
			CI	60	101	
			Grand Total	145	3,663	65
			CI	240	1,943	124

[a] Estimated by J. Hawkings from 1:500,000 topographic map.
[b] Confidence Interval. 95% confidence limits for the estimated total are Est. Total ± CI.

2.10.3 Fall Migration

The parasitic jaegers is the most common jaeger on the Yukon coast during fall migration, perhaps because they are involved in hunting shorebirds such as red-necked phalaropes which also gather in places along the coast. Migration watches in 1972 were conducted at Nunaluk Spit, which is one of those gathering places. Parasitic jaegers moved both east (est. 639) and west (est. 408) past this point, with a net movement to the east. A few long-tailed jaegers moved west in mid July, but almost none were seen along the coast after that (Gollop and Davis 1974a).

Glaucous gulls migrate westward along the Yukon coast, beginning in mid September and continuing into October. Prior to mid September nearly equal numbers move east and west along the coast (Gollop and Davis 1974a, Searing et al. 1975). The maximum counts of this species along the Yukon coast are 475 on 31 August 1973 (Vermeer and Anweiler 1975), and 575 on 21 August 1974 (Mossop 1974). In mid August 1986 Hawkings (unpubl. data) counted 450 - 500 glaucous gulls in Phillips Bay, where they were feeding on carcasses of beluga whales.

A few Thayer's/herring gulls are present in the area in fall migration (est. 459 east, 73 west in 1972), with most eastward movement during the first week of September.

Arctic terns migrate mostly westward along the coast during mid August, and are rare in the Beaufort by the beginning of September (est. 1,678 moving east and 1,921 west in 1972 [Gollop and Davis 1974a]). Vermeer and Anweiler (1975) counted a maximum of 116 terns along the coast on 9-12 August 1973, and saw none after 1 September. Mossop (1974) counted 400 between Komakuk and the NWT border on 27 August 1974, but only 2 on 21 August, 76 on 25 August, and 10 on 30 August.

During late fall and winter (November to February) ivory gulls have been reported in open water around drilling rigs offshore from the Yukon coast (T.W. Barry pers. comm.).

2.11 BLACK GUILLEMOT

2.11.1 Spring Migration

Little is known about the spring migration of this species in the Beaufort because there are so few present. Presumably they enter the region from the west along offshore leads in the same manner as eiders.

2.11.2 Breeding

In the Canadian Beaufort Sea, the townsite of Herschel on Herschel Island is the only confirmed breeding place of this species, although some probably nest at Cape Parry, Amundsen Gulf (Johnson and Ward 1985). The Herschel colony was first described in detail by Kuyt et al. (1976). The maximum number of nests located there was about 30 in 1985, of which 13 were inside the roof of the old Anglican mission, 5 under piles of debris or driftwood adjacent to the mission, 4 in an artifical nesting structure attached to the roof of the mission, 1 on the floor of a warehouse, and as many as 6 under the floors of 2

other buildings. Although the nesting population is only about 60 birds, as many as 120 were present around Pauline Cove in 1984, and 83 in 1985 (Hawkings and Mossop 1985, Ward and Mossop 1986).

2.11.3 Fall Migration

Nothing is known about the fall migration of this species in the Canadian Beaufort. Presumably fall migration is westward to wintering areas in the Chukchi Sea. Like ivory gulls, guillemots have been seen in open water around offshore drilling rigs during fall and winter (T.W. Barry, pers. comm.).

3.0 CONCLUSIONS

3.1 Significance of Populations

The avifauna of the Yukon coastal plain is very well known and has been intensively studied relative to that of other areas of similar size in the Canadian arctic. This is largely due to the very intense research activity during 1971-1975 and since 1980. It is unlikely that any major phenomena of nesting, migrating, or staging waterbirds have gone undetected.

While it is probably safe to say that waterbird populations on the Yukon coastal plain are generally small on a national and international scale, two significant features should be highlighted: the fall concentration of staging snow geese, and molting seaducks at Herschel Island. Nesting shorebirds throughout much of the coastal plain are certainly unique in a Yukon context, but there are insufficient data to fit them into a national or North American perspective. Of minor importance on a national scale, but still noteworthy, are: the glaucous gull colony on Escape Reef, tundra swans breeding and molting on the Babbage River Delta and Yukon part of the Mackenzie Delta, and the black guillemot colony on Herschel Island. Overall, the coastal plain is of minor importance as a breeding ground for ducks, geese, and swans when compared with the Old Crow Flats or the entire Mackenzie Delta.

3.2 Limitations of the Data

The integration of waterbird population information for this area is difficult because of the many sources of information and the diversity of objectives, design, implementation, data analysis, and data presentation.

The net result is that, for most species, we know the breeding density or total breeding population on the coastal plain only within broad limits. Nonetheless, that is a typical situation in migratory bird management, and need not be cause for concern so long as those estimates provide an adequate database. On the coastal plain the lack of precise estimates is not a serious limitation, because we can be reasonably sure that the maximum possible populations of most birds are small enough to be considered of minor significance on an international, national, or regional scale. Estimates are generally better for those few species which are present in larger concentrations (snow geese and molting sea ducks).

3.3 Suggestions for Future Surveys

In the future, more precise estimates of bird populations will probably only be obtained through improved design of both aerial and ground surveys. This would simply come from the application of existing sampling techniques which have been used elsewhere to allocate survey effort where it will produce the best results. In particular, that can be achieved by first recognizing the different habitats which comprise the coastal plain. Previous work has shown that populations of tundra birds vary greatly according to habitat, particularly in relation to such features as moisture level, size and type of waterbodies, microrelief, height and density of shrubs, and interspersion of microhabitats (Moiteret et al. 1985). Because of this, the only way to obtain reasonably precise estimates of total bird populations on the Yukon coastal plain is to estimate populations within different habitats. There have been extensive studies with this aim on the Alaska coastal plain, especially in the Arctic National Wildlife Refuge (eg. Moiteret et al. 1985). So far, these studies indicate that the chief problem is developing a habitat classification which is complex enough to reflect most habitat preferences of individual species, yet which can be readily applied over large areas such as the entire coastal plain.

The mapping method which is being applied in the Arctic National Wildlife Refuge (ANWR) is digital analysis of Landsat Multispectral Scanner (MSS) imagery (Walker et al. 1982). Even with some modifications, the Landsat classification presently used in ANWR is incapable of consistently distinguishing habitats with high vs. low bird density for even the most common species of birds. This is largely because birds, particularly shorebirds and passerines, are probabably responding to habitat features which are beyond the resolution capability of MSS imagery (for example tundra polygons). Improvements in widely available Landsat technology (particularly Thematic Mapper imagery, which has 30 m resolution vs. 90 m for MSS) may significantly improve this situation.

Despite the present difficulties with Landsat-derived habitat classifications, they offer overwhelming advantages over conventional methods of mapping the large, remote areas which typify northern Canada. The task ahead is to relate data on bird populations to the habitats. Some previous surveys (e.g. ground surveys of Dickson [1985] and Koski [1975a]) have classified habitats in considerable detail, but these classifications have not been consistent from study to study. In addition, most ground surveys have used transect methods, which yield biased estimates of density and tend to underestimate the abundance of inconspicuous or less mobile species relative to conspicuous or highly mobile ones (Richardson and Gollop 1974). Transects have the advantage over plots of easily covering a wide variety of habitats, and their greatest utility is in determining indices of abundance for common species. Transect data may be useful over the long term in detecting changes in populations, but are not appropriate for estimating absolute bird densities within habitats. Most previous studies using plots on the Yukon coastal plain (Gollop et al. 1974b,c; Koski 1975a, Richardson and Gollop 1974) have had primary objectives other than habitat-specific estimates of bird density, and consequently have used few plots, have not included a variety of habitats, or have other features which make the data insufficient for this purpose.

We are thus in a situation where habitat-specific survey data and a habitat map are necessary to significantly improve our knowledge of breeding populations of birds on the Yukon coastal plain.

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Appendix I. Summary of migratory waterbird population field studies in the Yukon coastal plain region, 1971-1985.

Dates	Study Type	Coverage/Location	Publication
1971			
Jun 18,20, Aug 6,24,30, Sep 2,20	aerial surveys to identify important breeding, molting, and staging areas	Yukon coast and proposed pipeline route across Yukon coastal plain	Schweinsburg 1974a
Jun 6,Jul 17, Aug 6,Sep 9	aerial transects to determine use of areas by waterfowl	Yukon coast and coastal plain, Komakuk to Kay Point	"
Jun 21-27, Jul 25-Aug 8	ground surveys of breeding and post-breeding birds	Cache Creek, Blow R., Phillips Bay, Firth R., Nunaluk Spit, Clarence Lagoon	"
Jun 17	Aerial survey for waterfowl	coastal plain from Mackenzie Delta to Bloomfield Lake	Calef and Lortie 1971
Aug 24-Sep 6	visual counts of fall migrants	Nunaluk Spit	Schweinsburg 1974a
Sep 13-17	"	Moose Channel	"
1972			
May 20-Jul 25	study plots to assess effects of noise on nesting birds	Babbage River 19 km SE of Phillips Bay	Gollop et al. 1974b
May 24-Jul 7	study plots to assess effects of aircraft and humans on nesting terrestrial birds	Firth River (MacNeish Lake)	Gollop et al. 1974c
Jun 20-25	Visual observ. of waterfowl disturbance by aircraft	5 lakes between Phillips Bay and Blow River	Schweinsburg 1974b
Jul 10-Sep 17	Visual counts of fall migrants	Nunaluk Spit	Gollop and Davis 1974a

Appendix I. (continued)

Dates	Study Type	Coverage/Location	Publication
1972			
Jun 11-Jul 12	Visual obs. of disturbance to nesting waterbirds by aircraft and humans; nest monitoring	Nunaluk Spit, Phillips Bay	Gollop et al. 1974d
Jun 17-Sep 4	ground surveys for breeding birds	92 km sq. area surrounding Moose Channnel mouth	Campbell 1973
Jun 24,Jul 12, Sep 2,3	Complete coverage aerial surveys for swans; also noted location of tern and gull colonies	1100 km sq. area of Mackenzie Delta S. and W. of Shallow Bay, including entire Yukon portion	Campbell 1973, Campbell and Weber 1973
Jul 30-19 Sep	Visual counts of fall migrants	Moose Channel	Campbell 1973, Searing et al. 1975
Jun	Comparative aerial and ground surveys of tundra birds	Alaska coastal plain east of Canning River	Bartels 1973
Jun, Jul	Aerial transect surveys for birds	Yukon coastal plain, treeless Mackenzie Delta (routes and dates not specified)	Campbell and Weber 1973
Jul 19,21	ground reconnaissance for birds	Herschel Island	Interdisciplinary Systems 1972
Jul 23-29	Ground obs. to determine pop. and productivity of waterbirds on various types of lakes	23 lakes on coastal plain between Firth and Walking Rivers	Gollop and Davis 1974b
Aug 6-14	Visual observations of behavior of molting sea ducks and of effects of aircraft overflight	South shore of Herschel Island	Gollop et al. 1974a
Sep 3-4	Visual observations of reactions of staging snow geese to aircraft overflights	West of Komakuk	Schweinsburg 1974c

Appendix I. (continued)

Dates	Study Type	Coverage/Location	Publication
1972			
Sep 7-10	Visual observations of reactions of staging snow geese to gas compressor simulator noise	4 km SE of Komakuk	Gollop and Davis 1974c
1973			
May 30-Jun 25	Comparison of plot vs. transect census methods for breeding terrestrial birds	Babbage River 35 km SE of Phillips Bay	Richardson and Gollop 1974
June 21-26	Ground surveys of breeding birds along strip transects in various habitats	Blow River, Phillips Bay, Firth River, Nunaluk Spit, Clarence Lagoon	Tull et al. 1974
July 9, 14	Ground transects through 1972 breeding terrestrial bird disturbance and control plots	Babbage River 19 km SE of Phillips Bay, Firth River at MacNeish Lake	Gunn et al. 1974
July 24-29	Ground observ. to determine pops. and productivity of waterbirds on various types of lakes	60 Yukon coastal plain lakes between Firth and Blow Rivers	Sharp et al. 1974
July 17-21	Aerial surveys to inventory characteristics and use of breeding and molting areas	Beaufort Sea coastline from Prudhoe Bay to Shingle Point	Gollop and Richardson 1974
Aug 2-15	Visual observations of molting sea duck behaviour and of effects of aircraft overflights	South shore of Herschel Island	Ward and Sharp 1974
Aug 23-Sep 30	Aerial surveys to determine migration and distribution of staging snow geese	transect grid on Yukon and Alaska coastal plains and Mackenzie Delta; coast Herschel Is.-Icy Reef	Koski and Gollop 1974 Koski 1975b

Appendix I. (continued)

Dates	Study Type	Coverage/Location	Publication
1973			
Aug 25-Sept 28	Visual obs. of reactions of snow geese and other large waterfowl to simulated gas compressor noise	2 km S of Komakuk	Wiseley 1974
Aug 9-12,23-24 Aug31-Sep 1, Sep 10,14,21	Aerial surveys for waterbirds	Yukon coastline Demarcation Bay to NWT border.	Vermeer and Anweiler 1975
Aug 1-Sep 8	Ground observations of waterbirds	South shore of Herschel Island	Vermeer and Anweiler 1975
Aug 30-Sep 21	Visual obs. of normal behavior of staging snow geese and their reactions to overflights.	Blow River, Shingle Point, Komakuk, and Demarcation Bay, Bloomfield Lake	Davis and Wiseley 1974
Sep 1-26	Physiological study of staging snow geese	Shingle Point(Jacob's Lake)	Patterson 1974
1974			
Apr 21-24, May 1-5,13-15, 21-27,29-31, Aug 13-22,	offshore aerial surveys for seabirds Jun 6-8,20-23,25-26,Jul 3-7,15-18,23-24, 25-30,Sep 10,26-28,Oct 6,14-18	Beafort Sea, Banks Island to Demarcation Bay	Searing et al. 1975
Jun 14,25,Jul 23,Aug 21, Sep 26	Aerial reconnaissance surveys to document breakup and freeze-up; locate major bird concentrations	Beaufort Sea coast: Demarcation Bay to Liverpool Bay	Searing et al. 1975
Jul 1-8,14-19, 25-30,Aug 7-14, 24-28,Sep 6-10	6 detailed aerial surveys of 90 coastal waterbodies and lakes	Beaufort Sea coast: Demarcation Bay to Liverpool Bay	Searing et al. 1975
Jun 10-15, Jul 5-11	Ground surveys of breeding birds along strip transects in various habitats	Cache Creek, Blow River, Babbage River, Clarence Lagoon	Koski 1975a

Appendix I. (continued)

Dates	Study Type	Coverage/Location	Publication
1974			
July 4-11	Ground observations of birds	Komakuk, Sheep Ck., Herschel Is.	Mossop 1974
Aug 14,21,22, 25,27,30,Sep 8	Aerial counts of waterfowl	coastal plain from Komakuk to NWT border	"
Aug 24-Sep 30	Aerial surveys for distribution and movements of snow geese, other geese, and swans	transect grid on Yukon and Alaska coastal plains and Mackenzie Delta; coastline Inuvik-Camden Bay	Koski 1975b
1975			
May 9-July 9	Radar and visual observations of spring migrants	Komakuk, Clarence Lagoon	Richardson et al. 1975, Richardson and Johnson 1981 Johnson and Richardson 1982
May 14,28, Jun 5,15,26	aerial surveys of birds in open water areas	Beaufort Sea offshore Clarence Lagoon -- Herschel Island	Richardson et al. 1975, Richardson and Johnson 1981
Jun 5,20, Jul 31,Aug 30	Aerial transect surveys for birds	transect across coastal plain, NWT border to Conglomerate Creek.	Wiseley et al. 1977
July 8-9	Ground transects for breeding birds in various habitats	1 site at Blow River	Patterson et al. 1977
Jun 11,20, Aug 5,11,30	Aerial counts of waterfowl and other wildlife	Beafort Sea coast Shingle Point-Komakuk; emphasis on Herschel Is. and Phillips Bay; ground visits at Herschel Is. and Komakuk	Mossop 1975
Aug 20-25 Sep	Aerial surveys for distribution and movements of snow geese, other geese, and swans	transect grid on Yukon and Alaska coastal plains and Mackenzie Delta	Koski 1977a

Appendix I. (continued)

Dates	Study Type	Coverage/Location	Publication
1976			
Aug 16,22,25, 29-31,Sep 4-6, 10-13,18-21, 30-Oct 2	Aerial surveys for distribution and movements of geese and swans (Aug 16,22,25,Sep 30 Recon. only)	transect grid on Yukon and Alaska coastal plains and Mackenzie Delta	Koski 1977b
Aug 26-28,Sep Sep 14-16	Ground-based studies of snow goose age ratios, movements, brood sizes	camp located near Shingle Point	Koski 1977b
1978			
Sep 5,13,14	Aerial surveys for distribution and movements of snow geese	transect grid on Alaska coastal plain	Spindler 1978
1979			
Sep 7-13	Aerial surveys for distribution and movements of snow geese	transect grid on Alaska coastal plain and Yukon coastal plain W of Kay Point	Spindler 1979
1980			
Jun 9	Aerial surveys for marine birds	open water leads Herschel Is. to Banks Island	Barry et al. 1981
Jun 21-23	Aerial surveys for coastal bird habitat evaluation	coastline Herschel Island to Victoria Island	"
Jul 13-17, Aug 6,16-18	3 aerial surveys for molting marine birds	coastline Herschel Island to Cape Bathurst	"
Sep 8-9	Aerial survey for fall migrants	Herschel Is. to Cape Bathurst	"
Sep 9	Aerial surveys for distribution and movements of snow geese	transect grid on Alaska coastal plain and Yukon coastal plain W of Kay Point	Spindler 1980
1981			
Jun 19,Jul 24, Sep 3	Aerial surveys for breeding, molting, and fall migrant birds	transect grid on Yukon coastal plain Stokes Point - Shingle Point	Dickson 1985

Appendix I. (continued)

Dates	Study Type	Coverage/Location	Publication
1981			
June 11-26	Ground surveys for breeding birds	4 sites on Yukon coastal plain: 3 near King Point, 1 on Babbage R.	Dickson 1985
Jul 22-23, Aug 1-2,11-12	Aerial surveys for molting marine birds	coastline Herschel Island to Baillie Islands	Barry and Barry 1982
Sep 3	Aerial surveys for distribution of snow geese	3 transects betweeen Kay Point and Sabine Point; transects parallel to coast 2, 14, and 26 km inland	Dickson 1985
Sep 11-14?	Aerial survey for fall migrants	coastline Herschel Is.-Baillie Is.	Barry and Barry 1982
Sep 11,12,16, 24	Aerial census for distribution and movements of snow geese	Mackenzie Delta and Yukon coastal plain, route not specified	Barry 1981
1982			
Jul 21-Aug 12	Ground surveys to determine use of coastal habitat by birds	Phillips Bay, Blow River Delta	Hogg et al. 1986
Aug 29,31, Sep 3,21,22	Aerial reconnaissance for snow goose distribution and age ratio	Arctic National Wildlife Refuge coastal plain	Spindler 1983
Sep 14,15	Aerial census for distribution and age ratio of snow geese	survey grid on ANWR and Yukon coastal plain east to Tent Island	Spindler 1983
Sep 9,10	Aerial survey for distribution and age ratio of snow geese	Bathurst Peninsula, Mackenzie Delta west to Tent Island	T. Barry Unpubl. data
1983			
Jun 9-29	ground surveys for breeding birds	4 sites near Stokes Pt., 3 near Phillips Bay, 1 near King Pt.	L. Dickson Unpubl. data
Jul 19-27	ground observations of birds	Herschel Island	R. Cannings Unpubl. notes
Jun 21,Aug 2	Aerial surveys for breeding, molting, and brood rearing birds	Yukon coastal plain between Stokes Point and Shingle Point	L. Dickson Unpubl. data

Appendix I. (continued)

Dates	Study Type	Coverage/Location	Publication
1983			
Aug 16	Aerial survey for birds	coast Stokes Pt.-Shingle Pt.	L. Dickson Unpubl. data
Aug 26,Sep 1,7	Aerial surveys for migrant birds	coast Shallow Bay-Nunaluk Spit	"
Aug 22	Aerial recon. for snow geese	Barter Island to Mackenzie River	Spindler 1984, Barry and Barry 1984
Aug 25	Aerial census for snow geese	Demarcation Bay to Tuktoyaktuk	"
Aug 28	Aerial census for snow geese	Tuktoyaktuk to Banks Island	"
Sep 1	Aerial census for snow geese	Tuktoyaktuk to Parry Penninsula	"
Sep 8,26	Aerial recon. for snow geese	Barter Island to Demarcation Bay	"
Sep 10	Aerial census for snow geese	Tent Island to Nicholson	"
Sep 12	Aerial census for snow geese	Demarcation Bay to Cape Bathurst	"
Sep 9,12,21	Aerial census for distribution and age ratio of snow geese	ANWR coastal plain (Barter Island to Demarcation Bay)	"
Sep 25	Aerial census for snow geese	Tuktoyaktuk to Komakuk Beach	"
1984			
Jun 25-Jul 17	Ground survey of breeding birds	Herschel Island	Hawkings and Mossop 1985
Jun 22-Jul 4	Ground observations of birds	several locations on Firth River,	S. Cannings Unpubl. notes
Jul 4-20	"	Komakuk, Clarence Lag. Trout L. Blow R., Summit L.	"
Aug 9-31	Observations of gull hybrids	Kay Pt., Escape Reef, Herschel Is.	Spear 1987
Aug 28	Aerial recon. for snow geese	Hulahula R. to Demarcation Bay	Oates et al. 1985

Appendix I. (continued)

Dates	Study Type	Coverage/Location	Publication
1984			
Sep 13,21	Aerial census for distribution and age ratio of snow geese	Hulahula R. to Demarcation Bay	"
1985			
Jun 15-Aug 15	Studies of distribution and biology of birds	Herschel Island	Ward and Mossop 1986
Jun 19-Jul 4	Ground surveys of abundance and breeding biology of birds	Whitefish Station area, Mackenzie Delta	Hawkings 1986
Jun 25,Jul 3	Aerial surveys of breeding birds	coastal plain, Shingle Point to Herschel Island	McKelvey 1986
Jul 25,Aug 21, Sep 12	Coastal aerial surveys for marine birds	Yukon coastline - Komakuk Beach to NWT border (and east)	Alexander 1986
Aug-Sep	Aerial surveys for snow geese	coastal plain of Arctic National Wildlife Refuge	Oates et al. 1986
Aug-Sep	Aerial surveys for snow geese	Yukon coastal plain, Mackenzie Delta	T. Barry Unpubl. data

Appendix II. Scientific names of bird species mentioned in the text.

Yellow-billed Loon	*Gavia adamsii*
Arctic Loon	*Gavia arctica*
Red-throated Loon	*Gavia stellata*
Tundra swan	*Cygnus columbianus*
Brant	*Branta bernicla*
Canada Goose	*Branta canadensis*
Greater White-fronted Goose	*Anser albifrons*
Snow Goose	*Chen caerulescens*
Mallard	*Anas platyrhynchos*
Northern Pintail	*Anas acuta*
Northern Shoveler	*Spatula clypeata*
American Wigeon	*Anas americana*
Green-winged Teal	*Anas crecca*
Greater Scaup	*Aythya marila*
Lesser Scaup	*Aythya affinis*
Common Eider	*Somateria molsissima*
King Eider	*Somateria spectabilis*
Harlequin Duck	*Histrionicus histrionicus*
Oldsquaw	*Clangula hyemalis*
White-winged Scoter	*Melanitta fusca*
Surf Scoter	*Melanitta perspicillata*
Common Goldeneye	*Bucephala clanguala*
Barrow's Goldeneye	*Bucephala islandica*
Red-breasted Merganser	*Mergus serrator*
Sandhill Crane	*Grus canadensis*
Black-bellied Plover	*Pluvialis squatarola*
Lesser Golden Plover	*Pluvialis dominica*
Semipalmated Plover	*Charadrius semipalmatus*
Lesser Yellowlegs	*Tringa flavipes*
Wandering Tattler	*Heteroscelus incanus*
Spotted Sandpiper	*Actitis macularia*
Whimbrel	*Numenius phaeopus*
Hudsonian Godwit	*Limosa haemastica*
Ruddy Turnstone	*Arenaria interpres*
Semipalmated Sandpiper	*Calidris pusilla*
Least Sandpiper	*Calidris minutilla*
Baird's Sandpiper	*Calidris bairdii*
Pectoral Sandpiper	*Calidris melanatos*
Stilt Sandpiper	*Calidris himantopus*
Buff-breasted Sandpiper	*Tringites subruficollis*
Long-billed Dowitcher	*Limnodromus griseus*
Common Snipe	*Gallinago gallinago*
Red-necked Phalarope	*Phalaropus lobatus*
Red Phalarope	*Phalaropus fulicaria*
Pomarine Jaeger	*Stercorarius pomarinus*
Parasitic Jaeger	*Stercorarius parasiticus*
Long-tailed Jaeger	*Stercorarius longicaudus*
Thayer's Gull	*Larus thayeri*
Glaucous Gull	*Larus hyperboreus*
Sabine's Gull	*Xema sabini*
Arctic Tern	*Sterna paradisaea*
Black Guillemot	*Cepphus grylle*