El Paso Alaska Company, et al.
Docket Nos. CP75-96, et al.
Exhibit AA-___ (RGG-6)

A STUDY OF THE DISTRIBUTION AND MOVEMENTS OF SNOW GEESE, OTHER GEESE, AND WHISTLING SWANS ON THE MACKENZIE DELTA, YUKON NORTH SLOPE, AND ALASKAN NORTH SLOPE IN AUGUST AND SEPTEMBER, 1975.

By

W.R. KOSKI

LGL LIMITED

environmental research associates

December, 1975

ABSTRACT

Aerial transect surveys and reconnaissance surveys were flown of the outer Mackenzie Delta, Yukon North Slope, and eastern Alaskan North Slope from August 20 to September 25, 1975. The surveys were flown to determine (1) the numbers of geese and swans that used the study area during the fall staging period, (2) the concentration sites of these birds, (3) the chronology according to which the geese and swans used the study area, (4) the brood sizes and adult to juvenile ratios of these birds, and (5) the year-to-year variations in these variables.

In 1975, large numbers of Snow Geese used the study area between September 3 and September 24. The peak number of Snow Geese present was 375,000. Because of adverse weather conditions few Snow Geese used the North Slope; instead most were concentrated around Shallow Bay in the Mackenzie Delta. Production of young Snow Geese in 1975 was very good.

White-fronted Geese used the Mackenzie Delta from August 20 to September 19. A peak number of 23,700 was present on September 10. Between August 25 and 28, 12,200 Black Brant were sighted along the coast between Kittigazuit Bay and Camden Bay. The peak number of Whistling Swans present in the area was 3400 on August 20. Swans were present in the area until September 23. Production of young swans was similar to production in previous years.

ACKNOWLEDGEMENTS

The field portion of this study was carried out by W.R. Koski and L.D. Roy. Special thanks go to T.W. Barry, P.L. Sharp, and C.E. Tull who aided in the collection of data concerning family group size and adult to juvenile ratios.

W.W.H. Gunn, W.J. Richardson, and C.E. Tull made useful comments and assisted in the preparation of this report.

The Arctic Gas Biological Report Series, of which this report is part, is a series of consultant project reports presenting data based on field and laboratory studies. The format and presentation varies among reports in accordance with the author's discretion.

The data for this work were obtained as a result of investigations carried out by LGL Limited for Alaska Arctic Gas Study Company and Canadian Arctic Gas Study Limited. The text of this report may be quoted provided the usual credits are given.

TABLE OF CONTENTS

TABLE OF CONTENTS CONT'D

LIST OF TABLES

LIST OF TABLES CONT'D

LIST OF FIGURES

LIST OF APPENDICES

INTRODUCTION

Previous studies (Barry, 1967; Campbell, 1973a; Campbell 1973b; Campbell and Weber, 1973; Koski and Gollop, 1974; Patterson, 1974; Schweinsburg, 1974; and Koski, 1975) indicate that the Yukon and eastern Alaskan North Slope and the Mackenzie Delta are important fall staging areas for large numbers of Snow Geese (*Chen caerulescens*) and lesser numbers of White-fronted Geese (*Anser albifrons*), Canada Geese (*Branta canadensis*), Black Brant (*Branta bernicla*), and Whistling Swans (*Olor columbianus*). Some of these studies further suggest that there is a great deal of year-to-year variation in the numbers of birds using each area, in the areas used, and in the duration of the period for which these areas are used by each of these species.

To further document this variation aerial surveys were again conducted in 1975 along the Yukon and eastern Alaskan North Slope and in the outer Mackenzie Delta (Figures 1, 2, 3, and 4).

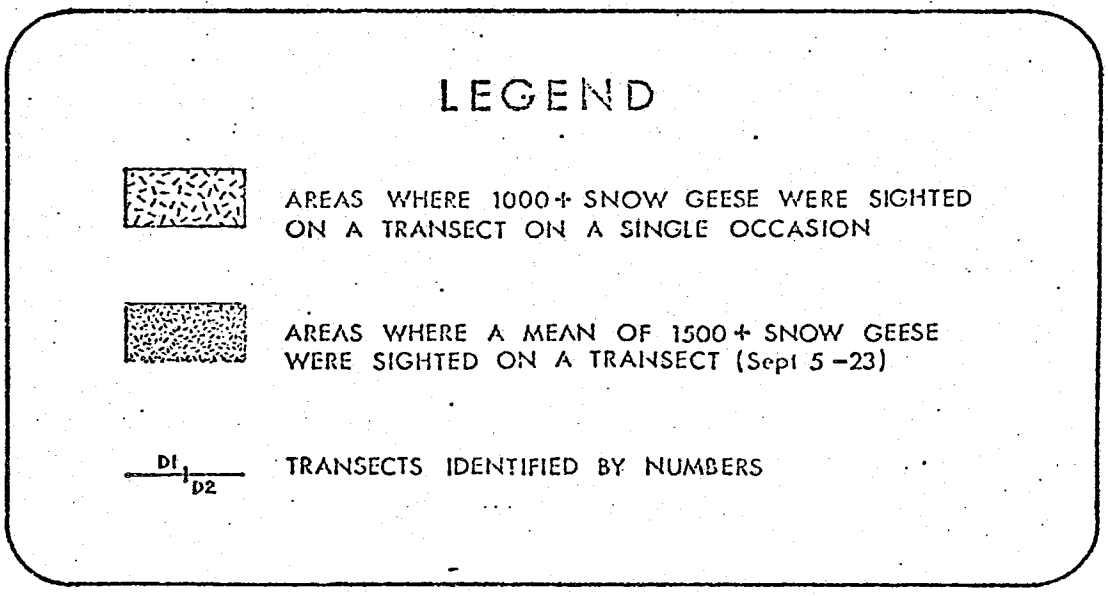
The objectives of this study were to determine the following:

1) the numbers of geese and swans that use the study area during the fall staging period;

2) the concentration sites of these birds;

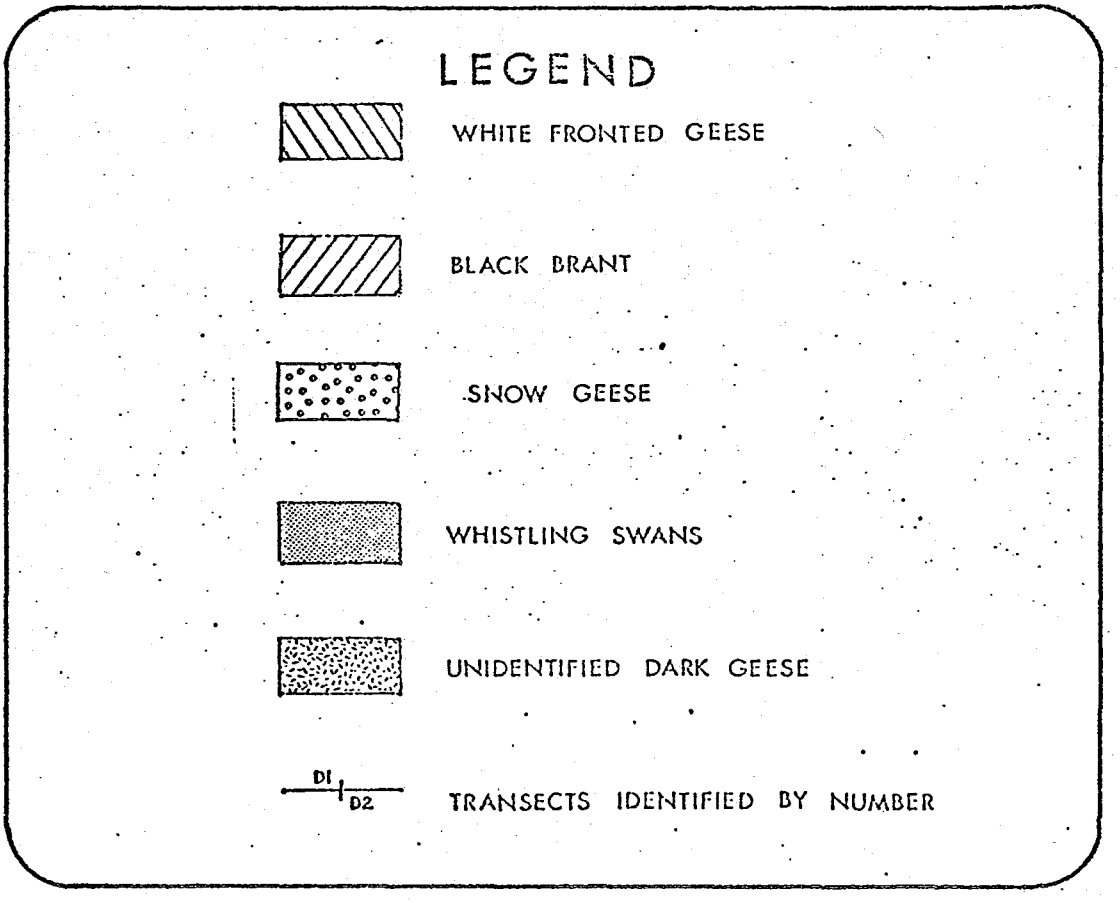
3) the seasonal chronology according to which the geese and swans use the study area and the concentration sites;

FIGURE 1. Transects Flown During Aerial Surveys of the Mackenzie Delta and Concentration Sites of Snow Geese as Determined by Aerial Surveys: August and September, 1975.



WEST SHALLOW BAY
OLIVIER-ELLICE ISLAND
MACKENZIE BAY
SCALE 1:100000

FIGURE 2. Transects Flown During Aerial Surveys of the Yukon North Slope and Concentration Sites of Snow Geese, Black Brant, and White-fronted Geese: August and September, 1975.



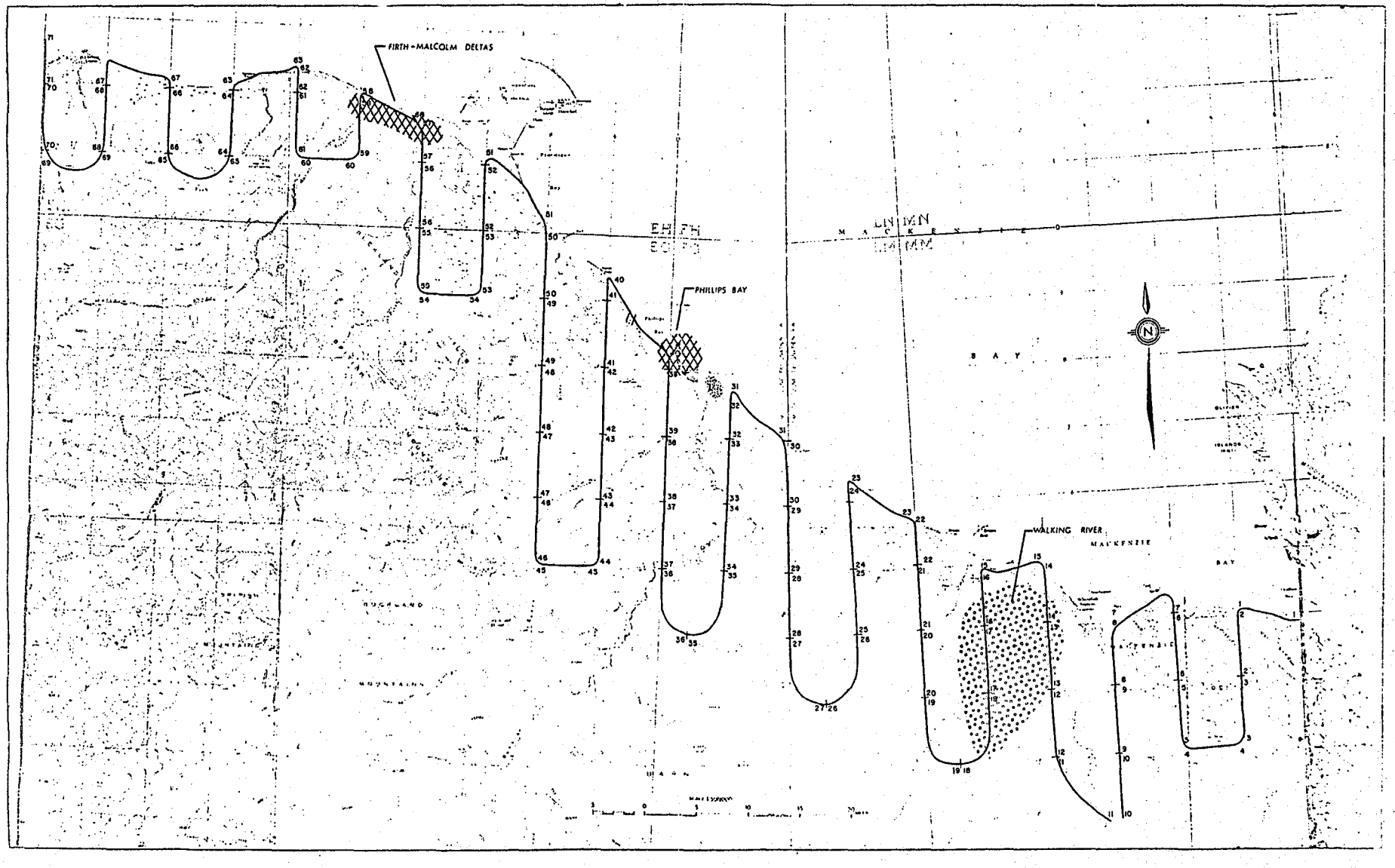
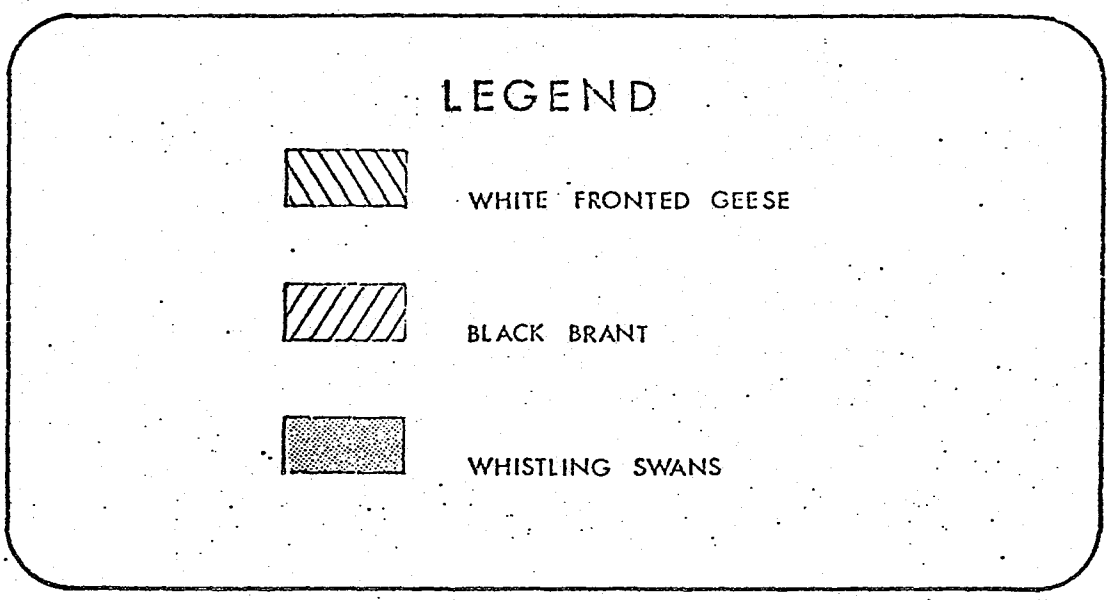

FIRTH-MALCOLM DELTAS
PHILLIPS BAY
WALKING RIVER
MACKENZIE
BAY
N

FIGURE 3. Concentration Sites of White-fronted Geese, Black Brant, and Whistling Swans as Determined by Reconnaissance Surveys of the Eastern Alaskan North Slope: August and September, 1975.



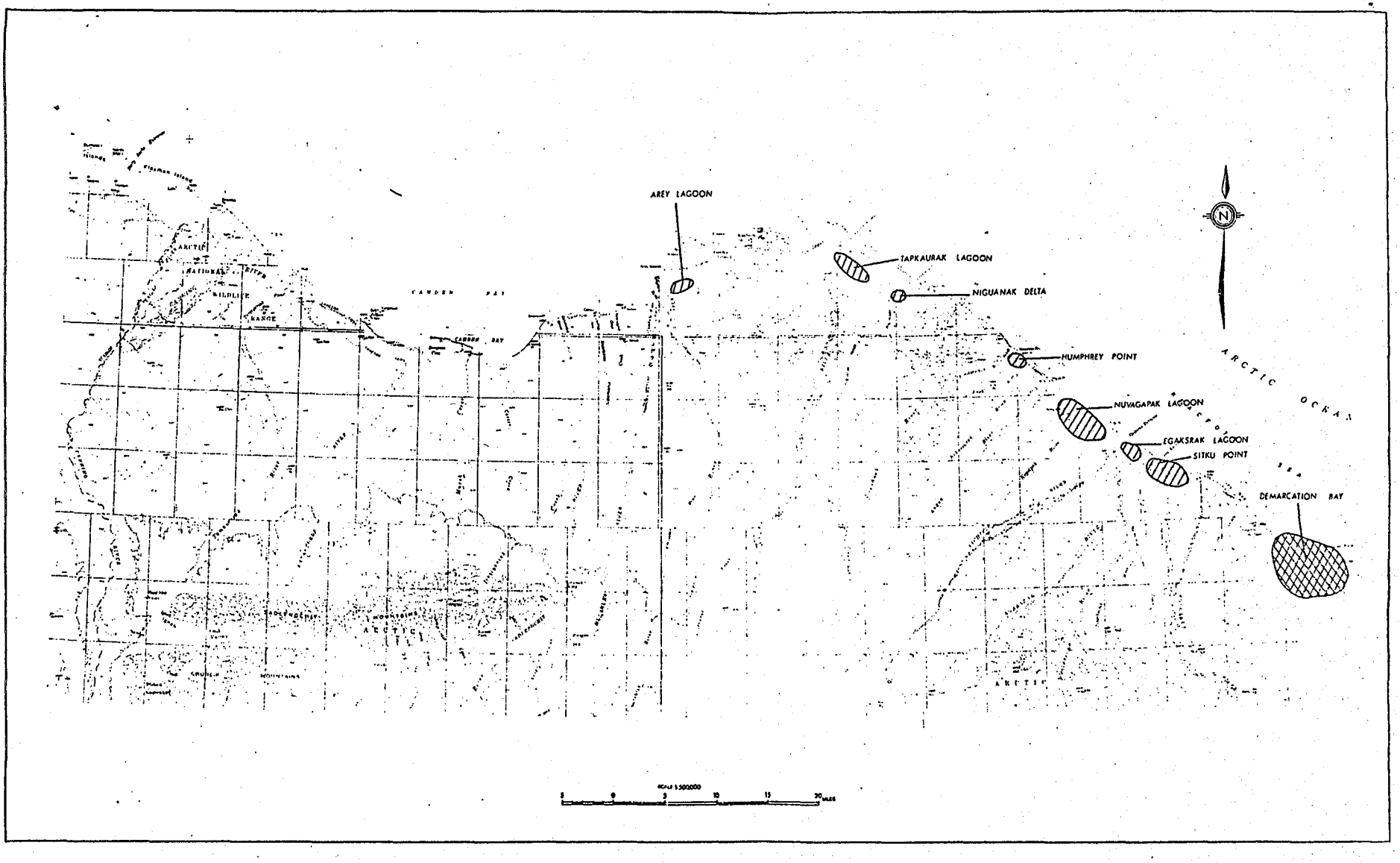
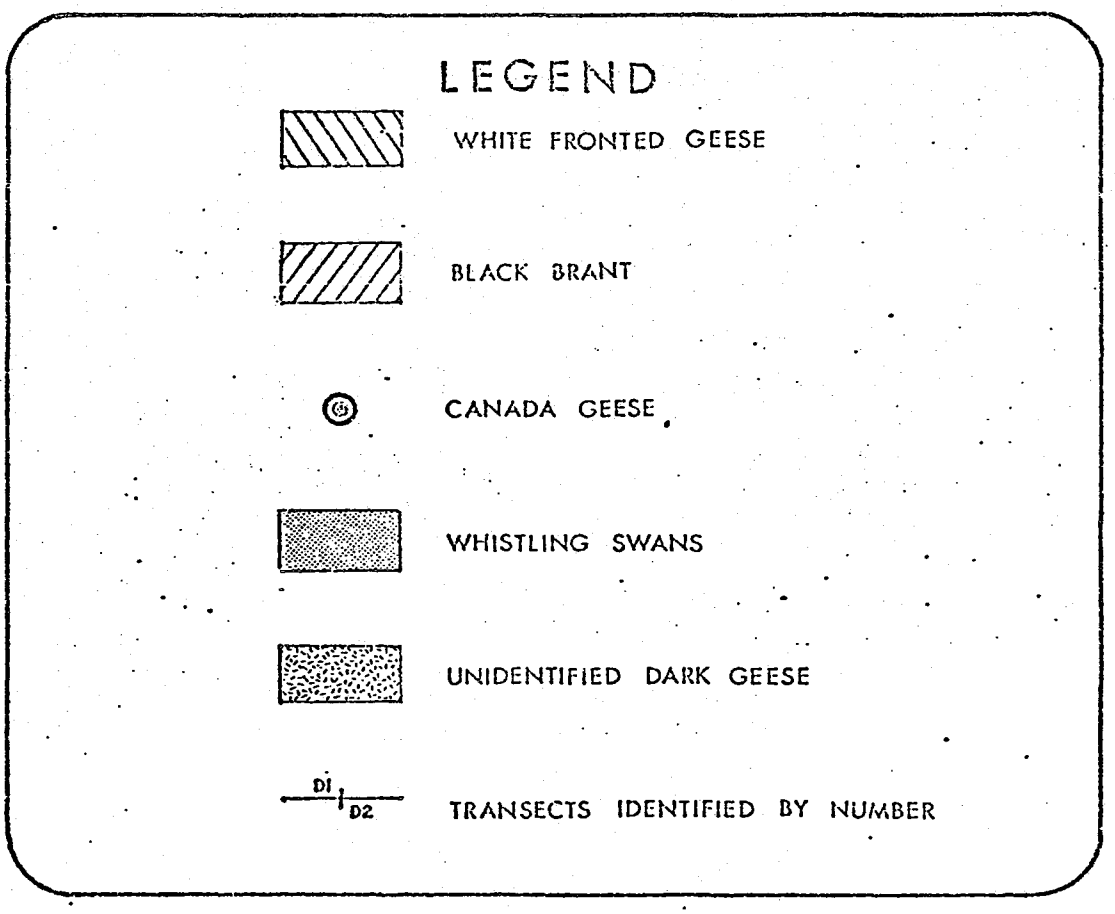
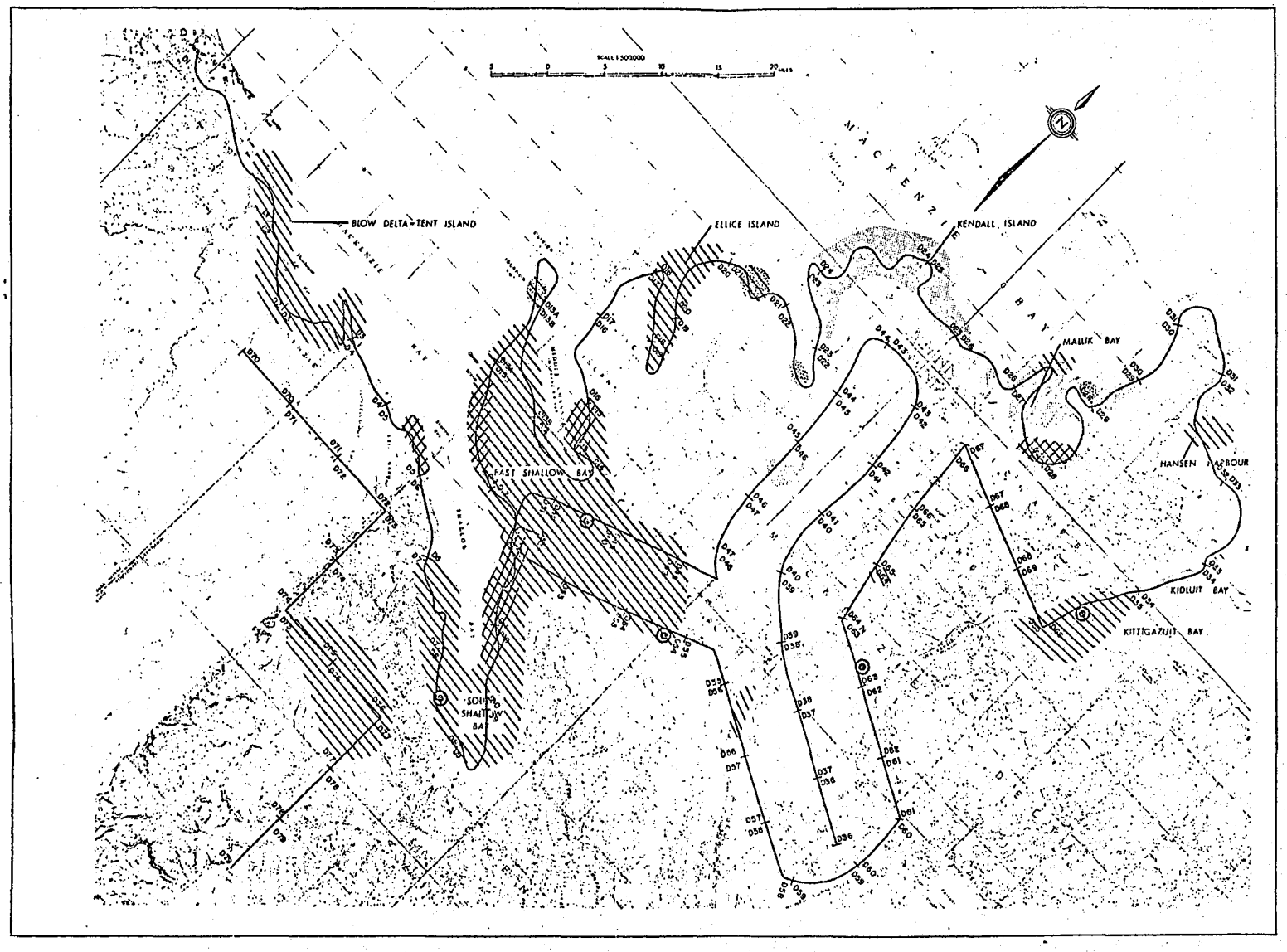

AREY LAGOON
TAPKAURAK LAGOON
NIGUANAK DELTA
HUMPHREY POINT
NUVAGAPAK LAGOON
EGAKSRAK LAGOON
SITKU POINT
DEMARCATION BAY
ARCTIC OCEAN
ARCTIC NATIONAL WILDLIFE RANGE
CAMDEN BAY
N
SCALE 1:500000
0 5 0 5 10 15 20 MILES

FIGURE 4. Transects Flown During Aerial Surveys of the Mackenzie Delta and Concentration Sites of White-fronted Geese, Black Brant, Canada Geese, and Whistling Swans: August and September, 1975.




SCALE 1:500000
5 0 5 10 15 20 MILES
MACKENZIE BAY
BLOW DELTA-TENT ISLAND
ELLICE ISLAND
KENDALL ISLAND
MALLIK BAY
HANSEN HARBOUR
KIDLUIT BAY
KITTIGAZUIT BAY
EAST SHALLOW BAY
SOUTH SHALLOW BAY
SHALLOWS
MACKENZIE DELTA
N

4) the brood sizes and the adult to juvenile ratios of these birds; and

5) the year-to-year variation in each of the above variables.

Data gathered during this study and previous studies should contribute to a fund of baseline information that will be used to develop environmental recommendations with respect to the proposed Arctic Gas pipeline and to assess the possible impact of the pipeline upon species of birds that use the Mackenzie Delta and the North Slope.

METHODS

Between August 20 and September 25, 1975, both reconnaissance surveys and transect surveys were conducted of the study area. Transect surveys were flown along the prearranged transect grid that was flown in 1973 and 1974 (Koski and Gollop, 1974; Koski, 1975); these transects are shown in Figures 1 and 2. The prearranged transect route was flown in the Mackenzie Delta between August 20 and September 23. On the Yukon North Slope only part of the transect grid was surveyed on September 14 and September 18. On the remainder of the Yukon and eastern Alaskan North Slope the regular transect grid was not flown because Snow Geese used these areas only briefly in 1975. Ten additional transects were flown along the west side of the Mackenzie Delta after large numbers of geese were sighted there on September 8 (Figure 1).

Reconnaissance surveys were flown both along the coast and over inland areas that were used by geese or swans in previous years. On August 25 a reconnaissance survey was flown from Shallow Bay to Camden Bay. This survey was flown to check for the arrival of Snow Geese and to count Black Brant along the Yukon and Alaskan North Slope. Other reconnaissance surveys were flown to monitor the arrival of Snow Geese, their general movements within the study area, and their departure from the area.

Surveys were conducted from a Cessna 185 or Piper Aztec fixed-wing aircraft and at an altitude of 150 metres (500 feet) above ground level. Some reconnaissance surveys were conducted at lower altitudes because

weather conditions did not permit flying at 150 metres.

Two observers, one stationed on each side of the aircraft, recorded all geese and swans that they sighted. Because Snow Geese were considered to be the most important species, the collection of other data was suspended for those periods during which Snow Geese numbers were too large to permit recording of all other data. Wing struts were marked to allow the observers to estimate whether sightings were within or farther than one-half mile from the aircraft; birds that were sighted within one-half mile of the aircraft were recorded as on transect, and birds that were sighted farther than one-half mile from the aircraft were recorded as off transect. A third observer recorded the sizes of family groups and/or the adult to juvenile ratios for Snow Geese and for Whistling Swans as well as any other pertinent data.

Additional data on the movements of the geese were collected from people camped on or flying over the study area.

The method of calculating the total number of geese or swans present on the study area during each survey period was the same as the method used by Koski (1975) with the following modification in the Mackenzie Delta. Concentration transects were considered to be areas, whether on or off transect, where 2000 or more Snow Geese, 500 or more White-fronted Geese, or 50 or more Whistling Swans were sighted on any one survey. These concentration transects were treated according to the modification described by Koski (1975) for the Mackenzie Delta. The change in the definition of concentration transects from 1000 to 2000

Snow Geese for purposes of calculating total numbers of Snow Geese in the Mackenzie Delta was due to the extremely large concentrations of geese in the area in 1975. With such large numbers of birds to count observers could easily miss off transect flocks of up to 2000 Snow Geese. (Flocks of 1000 Snow Geese can be seen at 3 or 4 miles from a height of 150 metres, and large flocks can be seen at greater distances.)

Concentration transects were defined for White-fronted Geese and Whistling Swans in order to calculate total numbers present because the intensive surveys of 1975 indicated that large aggregations of these species, like Snow Geese, favoured certain areas in the Delta. The method of correcting for these concentrations that was used by Koski (1975) was also adopted for these species.

As in 1974 (Koski, 1975), unidentified dark geese were included with White-fronted Geese in order to calculate the total number of White-fronted Geese present. Black Brant can be differentiated readily from White-fronted and Canada Geese, so that whenever geese were recorded as dark geese they were probably either White-fronted or Canada Geese. Since Canada Geese formed only slightly more than 1% (157 of 14,423) of the total identified Canada and White-fronted Geese in 1974 (Koski, 1975), the bias involved by considering all of the unidentified dark geese White-fronted Geese was probably very small. As a result, the numbers of Canada Geese in the area may have been underestimated. However, the small number of flocks of Canada Geese that were sighted suggests that any underestimation (if it did occur) was probably also small.

RESULTS

Snow Geese

Arrival, General Movements, and Departure

The first flock of Snow Geese was detected on the study area on August 18 (Appendix 1). Small numbers were seen as far west as Nuvagapak Lagoon on a reconnaissance survey of the North Slope on August 25 (Appendix 2). During a regular transect survey of the Mackenzie Delta on August 28, 147 Snow Geese were sighted (Table 1). On September 3, large numbers of Snow Geese first started to appear in the Mackenzie Delta region (Appendix 1); and a reconnaissance survey on September 4 of the Shallow Bay area and the Yukon North Slope from Shingle Point to Phillips Bay detected over 15,000 Snow Geese (Appendix 3). As only a small section of the North Slope could be surveyed because the visibility was severely reduced by fog and snow, there were probably several tens of thousands of Snow Geese present at this time. Despite snow storms on September 4, 5, and 6, a few thousand geese were seen flying and feeding behind the DEW site at Komakuk (Appendix 1).

On September 8, when the North Slope was 98% snow-covered, only 41 Snow Geese were sighted between Shingle Point and Demarcation Bay (Appendix 4), but over 140,000 were sighted on transect in the Mackenzie Delta (Table 1), where the snow cover varied from 50% around Shallow Bay to 98% on Richards Island. Large numbers of Snow Geese (284,000 to 375,000) remained in the Mackenzie Delta from September 8 to September 20.

TABLE 1. Numbers of Snow Geese Sighted On Transect (During Each Aerial Survey Period) on the Mackenzie Delta, Yukon North Slope, and Eastern Alaskan North Slope: August 25 to September 23, 1975.

DATE	AUGUST 25-28			SEPTEMBER 8			SEPTEMBER 10			SEPTEMBER 11		
AREA	MACKENZIE DELTA	YUKON	ALASKA	MACKENZIE DELTA	YUKON	ALASKA	MACKENZIE DELTA	YUKON	ALASKA	MACKENZIE DELTA	YUKON	ALASKA
Number of Birds Seen On Transect	147	211	220	144267	34	7+	111621	N/A	N/A	89928	N/A	N/A
Number of Transects	32	-Recon. Survey--		52	-Recon. Survey--		21	0	0	30	0	0
Average Number of Birds Per Transect	4.59	*N/A	N/A	2774.37	N/A	N/A	5315.29	N/A	N/A	2997.60	N/A	N/A
Extrapolated Population	326	211+	220+	284039	34+	7+						
TOTAL	757+			**284080			≃300000			≃350000		

DATE	SEPTEMBER 13			SEPTEMBER 17-18			SEPTEMBER 20			SEPTEMBER 23		
AREA	MACKENZIE DELTA	YUKON	ALASKA	MACKENZIE DELTA	YUKON	ALASKA	MACKENZIE DELTA	YUKON	ALASKA	MACKENZIE DELTA	YUKON	ALASKA
Number of Birds Seen On Transect	95759	9675	N/A	123005	11297	N/A	80277	N/A	N/A	40301	N/A	N/A
Number of Transects	71	24	0	81	14	0	24	0	0	30	0	0
Average Number of Birds Per Transect	1348.72	403.13	N/A	1518.58	806.93	N/A	3344.88	N/A	N/A	1343.37	N/A	N/A
Extrapolated Population	**325981	48425	0	319561	56485	0						
TOTAL	**374406			376046			≃320000			≃120000		

*N/A no data available for this date

** includes transects 70-79 from September 11, as they were not flown at this time

≃ The number of transects surveyed was not sufficient to allow extrapolation as described in 'Methods'. The number present represents an estimation which compared transects on this date with the same transects on the nearest complete survey.

On September 13, 9675 Snow Geese were sighted on transect on the Yukon North Slope in the Walking River concentration site. At this time the Slope was only 60% snow covered in the Blow River and Walking River areas. A total of 11,297 Snow Geese were seen there again on September 18. A reconnaissance survey on September 20 detected no geese in this area.

On September 19 several hundred Snow Geese were sighted flying south past Inuvik. By September 25 only about 1000 geese were left on the southeast edge of Shallow Bay.

Total Numbers

Between August 25 and September 23, 1975, a total of 706,277* Snow Geese were sighted on 379 transects for an average of 1864 Snow Geese per transect (Table 2). Table 1 gives the results of these surveys according to the study areas surveyed and the dates or periods when the surveys were conducted.

The peak number of birds sighted on the Alaskan North Slope was 220 birds on August 25.

The peak number of birds on the Yukon North Slope occurred on September 17 and 18, when 11,297 birds were sighted on transect. The

---

* The total density of 706,277 does not represent 706,277 different birds because many birds were counted on more than one survey.

TABLE 2. Total Numbers of Snow Geese Sighted On Transect on the Mackenzie Delta, Yukon North Slope, and Eastern Alaskan North Slope: August and September, 1973, 1974, and 1975.

DATE	MACKENZIE DELTA			YUKON NORTH SLOPE			ALASKAN NORTH SLOPE			TOTAL		
	TRANSECTS FLOWN	GEESE SEEN	GEESE/ TRANSECT	TRANSECTS FLOWN	GEESE SEEN	GEESE/ TRANSECT	TRANSECTS FLOWN	GEESE SEEN	GEESE/ TRANSECT	TRANSECTS FLOWN	GEESE SEEN	GEESE/ TRANSECT
1973	148	86520	585	301	126960	422	197	44037	224	646	257517	399
1974	275	28913	105	286	37435	131	213	48591	228	774	114939	149
1975	341	685305	2010	38	20972	552	0	0	*N/A	379	706277	1864

*N/A-no data available, only reconnaisance surveys were flown in Alaska

extrapolated population for the Yukon at this time was 56,485 birds (Table 1).

The peak number of Snow Geese extrapolated for the Mackenzie Delta was 325,981 on September 13; this peak closely approximated the extrapolation for September 17 and 18 which was 319,561 (Table 1).

The peak number of Snow Geese using the entire study area was sighted during the September 13 and the September 17 and 18 surveys, at which time the extrapolated population was 375,000 (Table 1).

Concentration Sites

Figures 1 and 2 show the concentration sites used by Snow Geese during 1975. The only site used extensively on the North Slope was the Walking River site, where a large number of birds was sighted on a reconnaissance survey on September 4 (Appendix 3) and where about 48,000 birds were estimated to be present on September 14 and September 18.

The concentration sites in the Mackenzie Delta were extensively used during 1975 (Table 3). The Olivier-Ellice Island concentration site and the West Shallow Bay concentration site had mean numbers of 56,739 and 19,581 on transect birds (Table 3). Maximum numbers using these sites were estimated to be 233,000 on September 17 (Olivier-Ellice Island site) and 175,000 on September 8 (West Shallow Bay site).

TABLE 3. Numbers of Snow Geese Sighted On Transect on Concentration Sites on the Yukon North Slope and Mackenzie Delta: August and September, 1975.

LOCATION	DATE									MEAN
	AUGUST	SEPTEMBER								
	28	8	10	11	13-14	17-18	20	23	25	
Blow Delta	N.S.*	105	528	786	1235	5452	2369	1775	N.S.	1750
West Shallow Bay	0	77578	30442	28507	11073	6805	2168	76	***0	19581
Olivier-Ellice Island	0	55961	80651***	41712***	80640	89643	75740	38450	≈1000***	56739
Kendall Island	142	0	N.S.	N.S.	730	2545	N.S.	N.S.	N.S.	854
Kittigazuit Bay	0	3350	N.S.	N.S.	1038	1965	N.S.	N.S.	N.S.	1588
Walking River	***0	**6	N.S.	N.S.	9510	9765	N.S.	N.S.	N.S.	6427

* N.S. not surveyed on this date (not included in mean)

** reconnaisance survey (included in mean because representative of numbers using the area)

*** incomplete survey (not included in mean)

Adult to Juvenile Ratios and Brood Sizes

During the 1975 surveys, 25,861 Snow Geese were classified as either adults or juveniles; 12,223 were adults and 13,638 were juveniles (Table 4). This gives an adult to juvenile ratio of 1.00 to 1.12 as compared with 1.00 to 1.19 in 1973 (Koski and Gollop, 1974) and 1.00 to .001 in 1974 (Koski, 1975). When the numbers of adults and juveniles in 1973 and 1975 were tested through use of a chi-square test, they were found to be significantly different ($G = 7.59$, $df = 1$, $P < .01$).

In 1975, 831 family groups were counted with a mean of $3.10 \pm .04$ young per brood (Table 5). The difference from the mean brood size in 1973 ($2.99 \pm .04$) was almost significant by normal criteria (Student's $t = 1.92$, $df = 1673$, $P = 0.063$).

The distributions of brood sizes for 1973 and 1975 are presented in Table 5.

The percentage of the adult Snow Geese that were either non-breeders or unsuccessful breeders was calculated from data presented in Tables 4 and 5. In 1975, 28% of the adults were either non-breeders or unsuccessful breeders; this number was 20% in 1973 and almost 100% in 1974.

TABLE 4. Adult to Juvenile Ratios of Snow Geese as Determined by Surveys of the Mackenzie Delta, Yukon North Slope, and Eastern Alaskan North Slope: August and September, 1973, 1974, and 1975.

YEAR	ADULTS	JUVENILES	RATIO ADULT/JUVENILE
1973	4533	5399	1.00/1.19
1974	28647	29	1.00/0.001
1975	12223	13638	1.00/1.12

TABLE 5. Distribution of Brood Sizes of Snow Geese as Determined by Surveys of the Mackenzie Delta, Yukon North Slope, and Eastern Alaskan North Slope: September, 1973 and 1975.

DATE	NUMBER OF BROODS SIGHTED								TOTAL NUMBER OF BROODS	MEAN BROOD SIZE ± S.E.
BROOD SIZE	1	2	3	4	5	6	7	8		
1973	84	219	257	210	57	12	3	2	844	2.99 ± .04
1975	52	205	295	196	58	18	6	1	831	3.10 ± .04

Dark Geese

In 1975 a total of 42,721* dark geese was sighted during surveys of 445 transects; the average number of geese sighted per transect was 96.00 (Table 6). As in 1973 and 1974, the highest densities of dark geese were sighted in the Mackenzie Delta, where 42,190 geese were sighted on 407 transects; the average number of geese per transect in the Mackenzie Delta was 103.66.

The number of dark geese sighted on transect during each survey of the study area is given in Table 7. Peak numbers of dark geese were extrapolated for the August 25-28, September 8, and September 10 surveys, when 25,600, 24,400, and 24,900 birds, respectively, were estimated to be present.

Table 8 gives the total numbers of White-fronted Geese, Black Brant, Canada Geese, and unidentified dark geese which were sighted on transect each year in the Mackenzie Delta and the Yukon and eastern Alaskan North Slope. The most abundant species of dark goose is the White-fronted Geese, which formed 67% of the dark geese that were identified and virtually all of the unidentified geese (see methods). Black Brant formed 31% and Canada Geese formed 1.2% of the identified dark geese.

Figures 2, 3, and 4 show the concentration sites used by each species of dark goose.

---

* see footnote on page 16

TABLE 6. Total Numbers of Dark Geese Sighted On Transect on the Mackenzie Delta, Yukon North Slope, and Eastern Alaskan North Slope: August and September, 1973, 1974, and 1975.

DATE	MACKENZIE DELTA			YUKON NORTH SLOPE			ALASKAN NORTH SLOPE			TOTAL		
	TRANSECTS FLOWN	GEESE SEEN	GEESE/ TRANSECT	TRANSECT FLOWN	GEESE SEEN	GEESE/ TRANSECT	TRANSECTS FLOWN	GEESE SEEN	GEESE/ TRANSECT	TRANSECTS FLOWN	GEESE SEEN	GEESE/ TRANSECT
1973	173	10557	61.02	291	793	2.73	227	675	2.97	691	12025	17.40
1974	219	8326	38.02	251	1791	7.14	213	550	2.58	683	10667	15.62
1975	407	42190	103.66	38	531	13.97	0	0	*N/A	445	42721	96.00

*N/A-no data available, only reconnaisance surveys were flown in Alaska

TABLE 7. Total Numbers of Dark Geese Sighted On Transect (During Each Survey Period) on the Mackenzie Delta, Yukon North Slope, and Eastern Alaskan North Slope: August and September, 1975.

DATE	AUGUST 20			AUGUST 28 & 25			SEPTEMBER 8			SEPTEMBER 10		
AREA	MACKENZIE DELTA	YUKON	ALASKA	MACKENZIE DELTA	YUKON	ALASKA	MACKENZIE DELTA	YUKON	ALASKA	MACKENZIE DELTA	YUKON	ALASKA
Number of Birds Seen on Transect	4,495	N/A*	N/A	2,635	1,866	10,037	6,248	1,067	412	7,798	N/A	N/A
Number of Transects	66	0	0	32	-Recon. Survey-		52	Recon. Survey		21	0	0
Average Number of Birds Per Transect	68.11	N/A	N/A	82.34	N/A	N/A	120.5	N/A	N/A	371.33	N/A	N/A
Extrapolated Population	9,032	N/A	N/A	13,691	1,866+	10,037+	22,884	1,067+	412+	24,851	N/A	N/A
TOTAL		9,032+			25,594			24,363			24,851	

DATE	SEPTEMBER 11			SEPTEMBER 13			SEPTEMBER 17-18			SEPTEMBER 20	SEPTEMBER 23
AREA	MACKENZIE DELTA	YUKON	ALASKA	MACKENZIE DELTA	YUKON	ALASKA	MACKENZIE DELTA	YUKON	ALASKA	MACKENZIE DELTA	MACKENZIE DELTA
Number of Birds Seen on Transect	5,878	N/A	N/A	6,781	0	N/A	6,934	531	N/A	977	444
Number of Transects	30	0	0	71	24	0	81	14	0	24	30
Average Number of Birds Per Transect	195.93	N/A	N/A	95.51	0	N/A	85.60	37.93	N/A	40.71	14.80
Extrapolated Population	19,490	N/A	N/A	18,706	0+	N/A	12,469	1,095+	N/A	1,324	1,058
TOTAL		19,490			18,475			13,564		1,324	1,058

* N/A - no data available for this date

TABLE 8. Total Numbers of White-fronted Geese, Black Brant, Canada Geese, and Unidentified Dark Geese Sighted On Transect on the Mackenzie Delta, Yukon North Slope, and Eastern Alaskan North Slope: August and September, 1973, 1974, and 1975.

SPECIES	DATE	MACKENZIE DELTA			YUKON NORTH SLOPE			ALASKAN NORTH SLOPE			TOTAL		
		TRANSECTS FLOWN	GEESE SEEN	GEESE/ TRANSECT	TRANSECTS FLOWN	GEESE SEEN	GEESE/ TRANSECT	TRANSECTS FLOWN	GEESE SEEN	GEESE/ TRANSECT	TRANSECTS FLOWN	GEESE SEEN	GEESE/ TRANSECT
White-fronted Geese	1973	173	6736	38.96	291	230	0.79	227	0	0.00	691	6966	10.08
	1974	219	7530	34.38	251	1791	7.14	213	550	2.58	683	9871	14.45
	1975	407	13126	32.25	38	71	1.87	0	0	*N/A	445	13197	29.66
Black Brant	1973	173	1575	9.10	291	437	1.50	227	375	1.65	691	2387	3.45
	1974	219	720	3.29	251	0	0.00	213	0	0.00	683	720	1.05
	1975	407	6112	15.02	38	390	10.26	0	0	0.00	445	6502	14.61
Canada Geese	1973	173	105	.61	291	1	0.00	227	0	0.00	691	106	.15
	1974	219	52	.24	251	0	0.00	213	0	0.00	683	52	.08
	1975	407	237	.58	38	0	0.00	0	0	N/A	445	237	.53
Unidentified dark geese	1973	173	2141	12.38	291	125	0.43	227	300	1.32	691	2566	3.71
	1974	219	24	.11	251	0	0.00	213	0	0.00	683	24	.04
	1975	407	22715	55.81	38	70	1.84	0	0	N/A	445	22785	51.20

*N/A-no data available

White-fronted Geese

Table 9 gives the number of White-fronted Geese seen on transect during each survey period and the exrapolated populations for each period. Peak numbers of White-fronted Geese used the study area from September 8 to 10, when about 23,700 White-fronted Geese were estimated to be present. Appendix 5 presents the results for transects D70 to D79, which were surveyed only in 1975. These transects were not included in any of the above calculations in order to keep the data consistent with those collected during previous years.

During 1975, three family groups of White-fronted Geese were identified; they contained six, three, and one young.

Black Brant

Table 8 gives the number of Black Brant sighted on transects during aerial surveys in 1975, and Appendices 2, 3, and 4 give the numbers of Black Brant sighted during reconnaissance surveys. Largest numbers of Black Brant were sighted in the Mackenzie Delta on August 20 (1863), on the Yukon North Slope on August 25 (1866), and on the eastern Alaskan North Slope on August 28 (10,037). The highest number seen during one complete survey of the study area was 12,185 for the August 25-28 period. As in 1973 and 1974, numbers of Black Brant seen during September surveys were considerably lower than those seen during August surveys (Koski, 1975). However, unlike 1973 and 1974, a small number (≈ 1000) were present on the Blow River Delta until September 23.

TABLE 9. Numbers of White-fronted Geese Sighted On Transect (During Each Survey Period) on the Mackenzie Delta, Yukon North Slope, and Eastern Alaskan North Slope: August and September, 1975.

DATE	AUGUST 20			AUGUST 25-28			SEPTEMBER 8			SEPTEMBER 10		
AREA	MACKENZIE DELTA	YUKON	ALASKA	MACKENZIE DELTA	YUKON	ALASKA	MACKENZIE DELTA	YUKON	ALASKA	MACKENZIE DELTA	YUKON	ALASKA
Number of Birds Seen on Transect	2,631	N/A*	N/A	2,328	25	0	5,922	832	343	6,702	N/A	N/A
Number of Transects	66	0	0	32	-Recon. Survey-		52	-Recon. Survey-		21	0	0
Average Number of Birds Per Transect	39.86	N/A	N/A	72.75	N/A	N/A	113.88	N/A	N/A	319.14	N/A	N/A
Extrapolated Population	7,164	N/A	N/A	13,384	25+	0+	22,558	832+	343+	23,743	N/A	N/A
TOTAL	7,164			13,409+			23,733+			23,743		

DATE	SEPTEMBER 11			SEPTEMBER 13			SEPTEMBER 17-18			SEPTEMBER 20	SEPTEMBER 23
AREA	MACKENZIE DELTA	YUKON	ALASKA	MACKENZIE DELTA	YUKON	ALASKA	MACKENZIE DELTA	YUKON	ALASKA	MACKENZIE DELTA	MACKENZIE DELTA
Number of Birds Seen on Transects	5,653	N/A	N/A	6,256	0	N/A	4,306	141	N/A	110	125
Number of Transects	30	0	0	71	24	0	81	14	0	24	30
Average Number of Birds Per Transect	188.43	N/A	N/A	88.11	0	N/A	53.16	10.07	N/A	4.58	4.17
Extrapolated Population	19,265	N/A	N/A	18,025	0+	N/A	10,797	705	N/A	550	625
TOTAL	19,265			18,025			11,502			550	625

* N/A - no data available for this date

Canada Geese

Only small numbers of Canada Geese were sighted during aerial surveys (Table 8). The peak number was seen on September 17 and 18, when the extrapolated number present was 1065. All of the Canada Geese sighted were in the Mackenzie Delta.

Whistling Swans

Numbers and Distribution

Table 10 gives the total numbers of Whistling Swans sighted on transect in the Mackenzie Delta, Yukon North Slope, and eastern Alaskan North Slope during 1975 and compares these data with similar data for 1973 and 1974. In 1975, 1981* Whistling Swans were sighted on 289.5 transects for an average of 6.84 birds per transect. The peak number of swans in the Mackenzie Delta was sighted on August 20, at which time the estimated number of Whistling Swans present was 3118 (Table 11). The number of Whistling Swans on the whole study area was estimated to be 3400 at this time. The highest density of swans (8.1/sq. mi.) was recorded on August 20, on 12 miles of transect around Mallik Bay in the Mackenzie Delta.

Figures 2, 3, and 4 show the concentration sites for Whistling Swans during 1975.

---

* see footnote on page 16

TABLE 10. Numbers of Whistling Swans Sighted On Transect on the Mackenzie Delta, Yukon North Slope, and Eastern Alaskan North Slope: August and September, 1973, 1974, and 1975.

DATE	MACKENZIE DELTA			YUKON NORTH SLOPE			ALASKAN NORTH SLOPE			TOTAL		
	TRANSECTS FLOWN	GEESE SEEN	GEESE/ TRANSECT	TRANSECTS FLOWN	GEESE SEEN	GEESE/ TRANSECT	TRANSECTS FLOWN	GEESE SEEN	GEESE/ TRANSECT	TRANSECTS FLOWN	GEESE SEEN	GEESE/ TRANSECT
1973	147	705	4.80	291	219	.75	227	39	.17	665	963	1.45
1974	100	524	5.24	0	*N/A	N/A	34	26	.76	134	550	4.10
1975	289.5	1981	6.84	38	5	.13	0	N/A	N/A	327.5	1986	6.06

*N/A-no data available

TABLE 11. Numbers of Whistling Swans Sighted On Transect (During Each Survey Period) on the Mackenzie Delta, Yukon North Slope, and Eastern Alaskan North Slope: August and September, 1975.

DATE	AUGUST 20 & 25			AUGUST 28			SEPTEMBER 8			SEPTEMBER 11-14		
AREA	MACKENZIE DELTA	YUKON	ALASKA	MACKENZIE DELTA	YUKON	ALASKA	MACKENZIE DELTA	YUKON	ALASKA	MACKENZIE DELTA	YUKON	ALASKA
Number of Birds Seen on Transect	696	200	79	**421	N/A	N/A	129	35+	0	247	3	N/A
Number of Transects	66	-Recon. Survey-		32	0	0	23.5	-Recon. Survey-		61.5	24	0
Average Number of Birds Per Transect	10.55	*N/A	N/A	13.16	N/A	N/A	5.49	N/A	N/A	4.02	.13	N/A
Extrapolated Population	3,118	200+	79+	***2,400	35+	N/A	N/A	35+	0	1,427	15	N/A
TOTAL	3,397+			***2,435			N/A			1,442		

DATE	SEPTEMBER 17-18			SEPTEMBER 20			SEPTEMBER 23		
AREA	MACKENZIE DELTA	YUKON	ALASKA	MACKENZIE DELTA	YUKON	ALASKA	MACKENZIE DELTA	YUKON	ALASKA
Number of Birds Seen on Transect	333	2	N/A	42	N/A	N/A	113	N/A	N/A
Number of Transects	64.5	14	0	12	0	0	30	0	0
Average Number of Birds Per Transect	5.16	.14	N/A	3.50	N/A	N/A	3.76	N/A	N/A
Extrapolated Population	1,832	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A
TOTAL	1,842			N/A			N/A		

* N/A - No data available on this date

** This compares with 547 for the same transects on August 20 (the highest density of swans was sighted on the outer Mackenzie Delta).

*** estimated by comparing the number of birds sighted on transects surveyed with the number sighted on the same transects flown on August 20

Adult to Juvenile Ratios and Brood Sizes

In the Mackenzie Delta the mean brood size for 213 family groups of Whistling Swans was 2.22 ± 0.7 (Table 12). On the Yukon-Alaskan North Slope the mean brood size was 2.57 ± .24 for 21 family groups (Table 12). There was no significant difference between brood sizes on the Mackenzie Delta and on the Yukon-Alaskan North Slope (G test: G = 2.71, df = 1, P > .50).

On August 20, 554 Whistling Swans in the Mackenzie Delta were classified as either adults or juveniles; 438 were adults and 116 were juveniles, which gives an adult to juvenile ratio of 1.00 to .26 (Table 13). On August 25, 94 Whistling Swans on the Yukon and eastern Alaskan North Slope were aged; 68 were adults and 26 were juveniles, which gives an adult to juvenile ratio of 1.00 to .38.

On September 17, 18, and 20, 364 Whistling Swans in the Mackenzie Delta were aged; 229 were adults and 135 were juveniles, which gives an adult to juvenile ratio of 1.00 to .59 (Table 13). On September 23, 121 Whistling Swans in the Mackenzie Delta were aged; 77 were adults and 44 were juveniles (19 family groups), which gives an adult to juvenile ratio of 1.00 to .57.

There was a significant difference between the ratios of adults to juveniles present in mid-August and mid-September (G test: G = 28.43, df = 1, P < .005) in the Mackenzie Delta.

TABLE 12. Brood Sizes of Whistling Swans as Determined by Aerial Surveys of the Mackenzie Delta, Yukon North Slope, and Eastern Alaskan North Slope: August and September, 1974 and 1975.

LOCATION	DATE	NUMBER OF BROODS SIGHTED						MEAN BROOD SIZE ± S.E.
		BROOD SIZE 1	2	3	4	5	TOTAL	
Mackenzie Delta	1974	11	16	9	4	1	41	2.22 ± 0.16
Mackenzie Delta	1975	54	81	58	17	3	213	2.22 ± 0.07
Yukon-Alaskan North Slope	1975	4	6	7	3	1	21	2.57 ± 0.24

TABLE 13. Adult to Juvenile Ratios of Whistling Swans as Determined by Aerial Surveys of the Mackenzie Delta, Yukon North Slope, and Eastern Alaskan North Slope: August and September, 1973, 1974, and 1975.

LOCATION	DATE	ADULTS	JUVENILES	ADULT/JUVENILE RATIO
Mackenzie Delta	August 20, 1975	438	116	1.00/.26
	September 17, 18, 20, 1975	229	135	1.00/.59
	September 23, 1975	77	44	1.00/.57
	*September 6, 1974	200	62	1.00/.31
Yukon-Alaskan North Slope	August 25, 1975	68	26	1.00/.38
	*August 30, 1973	58	27	1.00/.46

* from unpublished LGL data

There was no significant difference between the adult to juvenile ratios in the Mackenzie Delta for August 20, 1975 and September 6, 1974 (G test: G = .767, df = 1, P > .10) or the adult to juvenile ratios for the Yukon-Alaskan North Slope on August 30, 1973 and August 25, 1975 (G test: G = 0.36, df = 1, P > .50); these were the earliest dates for each year and each region for which such ratios were available.

The percentages of the adult population which were either non-breeders or unsuccessful breeders during the year were calculated from the adult to juvenile ratios and mean brood sizes. In the Delta (using the August 20 data) 76% of the adult Whistling Swans were either non-breeders or unsuccessful breeders; on the North Slope 71% were either non-breeders or unsuccessful breeders.

DISCUSSION

Snow Geese

Arrival, General Movements, and Departure

In 1975 the arrival of the first flock of Snow Geese on the Mackenzie Delta (August 18) coincided with the departure of the Snow Geese from the Anderson River breeding grounds (T.W. Barry, pers. comm.), and these birds probably originated from the Anderson River. Sightings of large numbers of Snow Geese on the Parry Peninsula and in the vicinity of the Horton River suggest that in 1975 the majority of the Anderson River birds flew east and mixed with the birds from Banks Island and that they staged in this general area for a short period of time before they moved to the North Slope. T.W. Barry (pers. comm.) reports that he noted the same pattern of movement in 1973.

On September 2 the Snow Geese started to leave the eastern staging areas, and by September 3 large numbers of geese were seen flying westward past Tuktoyaktuk on the east side of the Mackenzie Delta. It appears that the birds flew directly from eastern staging areas to the Yukon North Slope as, on September 4, only small numbers of birds were seen in the Delta but large numbers were seen between Shingle Point and Babbage River. Despite snow storms on September 5, 6, and 7, several thousand Snow Geese moved as far west as Komakuk DEW site; but by September 8 virtually all geese had retreated to the Shallow Bay portion of the Mackenzie Delta. A few days of slightly warmer weather

resulted in a partial thaw of the North Slope, and about 50,000 geese moved onto the Yukon North Slope southeast of Shingle Point until freezing conditions forced the birds from this area on or about September 19. The birds also started to leave the Mackenzie Delta at this time. Freezing weather and snow storms on September 22 hastened departure, and after similar weather on September 24 to 25 the study area was frozen over and completely snow-covered. By September 25 virtually all of the geese had departed from the study area.

The date of arrival of the first flock of Snow Geese (August 18) was intermediate among arrival dates from 1971 to 1975 (Table 14). The commencement of the major arrival (September 3 to 7) was later than in previous years, but the arrival period was shorter than in 1973; hence the major arrival was completed earlier than in 1973. The two years during which the greatest number of young were produced (1973 and 1975) had the latest date of major arrival, and the two years during which virtually no young were produced (1972 and 1974) had the earliest dates of major arrival. These data suggest that adults with young may move more slowly from the breeding colonies and may stop longer at eastern staging areas to allow the young birds to build up strength.

The peak staging period in 1975 was 16 days as compared with 13 days in 1971, 12 days in 1972, 17 days in 1973, and 26 days in 1974.

The movement of Snow Geese from eastern staging areas directly onto the North Slope (which was partially snow-covered) without first stopping in the Mackenzie Delta (which was snow-free) supports the premise that

TABLE 14. Peak Numbers of Geese and Swans Extrapolated from Numbers Sighted During Transect and Reconnaisance Surveys: August and September, 1973, 1974, and 1975.

DATE	SNOW GEESE	WHITE-FRONTED GEESE	BLACK BRANT	CANADA GEESE	WHISTLING SWANS
1973	400000	25200	*4150	750	2000
1974	163000	22200	*2000	200	1900
1975	375000	23700	12200	1050	**3400 (2435)

* these values are known to be very low as only the last part of the migration was detected on surveys

** this value was obtained on a survey August 20 which is earlier than previous surveys were flown--2435 is the highest number during the period when surveys were flown in previous years (August 25-September 30)

birds traditionally use the North Slope as a staging area. Moreover, after being forced into the Mackenzie Delta by adverse weather conditions, some geese returned to the Walking River concentration site on the Yukon North Slope although the area never thawed competely.

The dates of major departure in 1975 were comparable to those of 1973 and were later than those of 1971, 1972, and 1974. Since departure from the staging areas is determined by the onset of heavy snow-fall and adverse weather conditions (Barry, 1967; Gollop and Davis, 1974), the dates of major departure are less predictable than the dates of major arrival.

Peak Numbers

The peak number of Snow Geese that used the study area in 1975 was estimated to be 375,000 (Table 15). This compares with estimates of 200,000 to 300,000 in 1972 (Schweinsburg, 1974), 400,000 in 1973 (Koski and Gollop, 1974), and 163,000 in 1974 (Koski, 1975).

Concentration Sites

Despite the fact that snow persisted on the North Slope throughout the staging period approximately 50,000 Snow Geese used the Walking River concentration site from September 12 to September 19. The Walking River concentration site was the only site on the North Slope which was used by geese for more than 3 or 4 days.

TABLE 15. Dates of Arrival and Departure for Snow Geese on the Mackenzie Delta, Yukon North Slope, and Eastern Alaskan North Slope: August and September, 1971-1975*.

YEAR	DATE FIRST FLOCK SIGHTED	DATES OF MAJOR ARRIVAL	DATES OF MAJOR DEPARTURE	DATE LAST FLOCK SIGHTED
1971	August 15	August 31-September 2	September 12-16	September 17
1972	August 17	August 27-29	September 7-10	September 15
1973	August 23	September 1-12	September 22-25	October 4**
1974	August 21	August 22-25	September 17-21	September 30
1975	August 18	September 3-5, 6, or 7	September 19-24	September 25

* estimated from page 19, Koski and Gollop (1974) and from Koski (1975)

** from Slaney (1974)

The main concentration sites used by Snow Geese during 1975 were those bordering Shallow Bay in the Mackenzie Delta. The West Shallow Bay concentration site was most heavily used by Snow Geese when they were first forced off the North Slope on September 8; at this time over 77,000 geese were sighted on transect and 175,000 geese were estimated to be present. Table 3 shows that this site gradually declined in usage throughout the staging period and that birds from the West Shallow Bay site probably moved to both the Walking River and Olivier-Ellice Island sites.

The Olivier-Ellice Island site had the largest numbers of Snow Geese (56,739 on transect Snow Geese per survey) and was used the most continuously of all the concentration sites (September 8 to September 25). The peak number of birds that used this area was on September 17 to 18, when 233,000 were estimated to be present. One flock of feeding birds sighted in this concentration site on September 17 was estimated to have contained over 60,000 Snow Geese.

The Blow Delta and Kittigazuit Bay concentration sites were both used continuously by small numbers of Snow Geese. The Kendall Island site received only a small amount of use in 1975. This was probably due to the presence of more snow in this area than around Shallow Bay.

The general staging pattern for Snow Geese in 1975 differed from the pattern noted from 1971 to 1974. In past years Snow Geese have staged primarily on the Yukon and eastern Alaskan North Slope. During these years the Mackenzie Delta served primarily as a late season

staging area where lesser numbers of birds spent a few days after they had been forced from the North Slope by adverse weather conditions.

In 1975, severe weather conditions forced most of the Snow Geese to stage in the Mackenzie Delta. Extremely large numbers of Snow Geese were concentrated in a very small area as compared with the area which they used in previous years on the North Slope. It is unlikely that the small area which Snow Geese used during 1975 could support such numbers of birds every year. However, during years such as 1975, the Mackenzie Delta is extremely important as an area where Snow Geese can build up the energy reserves that they require for their southward migration.

Adult to Juvenile Ratios and Brood Sizes

The average brood size (3.10 ± 0.4) and adult to juvenile ratio (1.00/1.12) both indicate that 1975 was an extremely good year for the production of young Snow Geese. The adult to juvenile ratio was significantly higher in 1975 than in 1973, but there was no significant difference in mean brood size. The difference in the adult to juvenile ratios is explained by the number of non-breeding and unsuccessfully breeding birds which was probably higher in 1975 than in 1973. In both 1972 and 1974 virtually no young were produced. This meant that in 1973 and in 1975 almost all birds returning to the breeding colonies were potential breeders. However, in 1975 a considerably higher proportion of the adult birds were two year old birds because of the extremely good production in 1973. Many two year old birds may not nest even under ideal

conditions (Barry, 1967), and the rate of nesting failure is higher among first time breeders (Cooch, 1958; Prevett, 1973). Therefore, a larger proportion of the 1975 population than of the 1973 population would be expected to be non-breeding or unsuccessfully breeding birds, and, as the survey results show, there would be a higher proportion of adults in the total population given the same average brood size for the two years. In 1976, because there was no recruitment in 1974, we can expect a reduction in the number of breeding pairs due to mortality between the 1975 and 1976 breeding seasons. We can also expect a large number of non-breeding birds because of the large number of young produced in 1975.

White-fronted Geese

The peak number of White-fronted Geese present in the study area occurred from September 8 to 10 when 23,700 were estimated to be present. This number closely approximates the 25,200 (1973) and 22,200 (1974) estimated by Koski (1975) to use the study area (Table 14). About 7000 White-fronted Geese were present on the study area on August 20 when surveys were commenced. At this time migrants from areas such as Anderson River were probably already present (Barry, 1967). A large influx of White-fronted Geese arrived in the Mackenzie Delta about September 8, and this influx probably coincided with a general migration from Alaska as described by Barry (1967) and Koski (1975). During a reconnaissance survey of the North Slope on September 8 (Appendix 4), several flocks of White-fronted Geese were sighted migrating southeastward along the coastal plain.

Throughout the study period White-fronted Geese were sighted south of the study area along the major river channels in the Mackenzie Delta. From this area many were seen to move farther southward. It is therefore probable that the overall numbers of White-fronted Geese using the study area are considerably higher than the number using the area at any one time.

Data from transects 70 to 79 (Figure 1) were not included in the extrapolation for the study area in order that the results would be comparable with results from 1973 and 1974. Extrapolations for this area indicate that an additional 3150 and 3950 White-fronted Geese were present in this area on September 11 and September 17 to 18, respectively (Appendix 5). If one assumes that the White-fronted Geese sighted on September 10 on the regular transect route did not move into this newly-surveyed area on September 11, then the peak number of geese in the area surveyed (including the additional transects 70 to 79) was about 27,000.

The major concentration sites used by White-fronted Geese were along the southern and eastern sections of Shallow Bay, on northern Ellice Island, on the islands in Kittigazuit Bay, and in the Blow River Delta-Tent Island area.

Black Brant

In 1975 the greatest number of Black Brant sighted during a single survey was 12,200 on August 25 to 28. The largest concentrations of Black Brant were sighted at Demarcation Bay and Beaufort Lagoon. The

figure of 12,200 represents a very minimal estimate of total numbers of Black Brant using the study area even though it is considerably higher than the numbers sighted in 1973 and 1974. The distribution of the birds indicates that although the centre of their westward migration was in the Beaufort Lagoon-Demarcation Bay area (Appendix 2), several thousand Black Brant had probably passed through the study area previous to this first survey. Later surveys indicate that some birds still had not arrived on the study area at this time. Most of the birds were sighted in river deltas and lagoons where they were probably resting and feeding. Godfrey (1966) and Schweinsburg (1974) report similar habitat usage by Black Brant.

A small concentration of about 1000 Black Brant was seen in the Blow River Delta during all surveys up to and including September 23. At this time the Beaufort Sea coast was frozen, and, if the birds had migrated along the coast, no open water areas would have existed until they reached the western coast of Alaska. It is therefore suspected that these birds may have migrated overland *via* the Blow River pass and down the Yukon River to the Yukon River Delta. Cade (1955) states that this route is used by Black Brant during spring migration, but no evidence exists for use of this route during fall migration.

Canada Geese

Only small numbers of Canada Geese were sighted during 1975. The largest number sighted in the Mackenzie Delta was on September 17 and 18 when 1065 were estimated to be present. These data support other

studies (Gollop and Davis, 1974; Koski, 1975) which have found that only small numbers of Canada Geese use the Yukon-Alaskan North Slope and Mackenzie Delta during fall migration.

Whistling Swans

In 1975 a peak number of 3400 Whistling Swans was estimated for the study area during the period August 20 to 25. These surveys were earlier than comparable surveys in previous years. On August 28, 2435 Whistling Swans were estimated to be present, and this number compares with 1900 and 2000 for 1973 and 1974. The peak density of swans (8.1 swans/sq. mi.) was recorded around the shore of Mallik Bay on August 20. Slaney (1974) reports a peak density of 16 birds/sq. mi. in the Mallik Bay area during mid-July but does not give a comparable figure for mid-August.

There was a significantly higher ratio of adults to juveniles on transects flown on August 20 than on the same transects on September 17, 18, and 20. This supports the findings of Slaney (1974), which state that adult birds without broods leave the outer Delta before those with young. However, not all non-breeding or unsuccessfully breeding adults left the Delta before the families with young, because on September 23 approximately half of the adults sighted (39 of 77) were not associated with broods.

The mean brood size on the Mackenzie Delta in 1975 was 2.22 ± .07 which was the same as in 1974 (2.22 ± .16; Koski, 1975). Slaney (1974) reports average brood sizes of 2.2 in 1972 and 2.5 in 1973 for part of

this study area (Richards Island) while Campbell (1973a) reports average brood sizes of 1.8 (Moose Channel area) and 2.3 (Kittigazuit Bay) for other parts of this study area.

The mean brood size on the North Slope was 2.57 ± .24 which compares with a figure of 2.2 for the Arctic Slope of Alaska in 1966 (King, 1970).

In 1975 concentrations of Whistling Swans were found on Sitku Point on the eastern Alaskan North Slope and on the Babbage River Delta on the Yukon North Slope. In the Mackenzie Delta major concentrations were found around Mallik Bay, the outer section of Kendall Island Bird Sanctuary, and the east side of Shallow Bay. Smaller concentrations were found south of Kidluit Bay, north of Hope Lake, southwest of Tent Island, and at Whitefish Station.

In 1975, 76% of the adult Whistling Swans in the Mackenzie Delta were either non-breeders or unsuccessful breeders; in 1974, 72% were in this category (calculated from data in Table 13). Data presented by Campbell (1973) suggest that in 1972, 67% of the Whistling Swans in the Moose Channel and Kittigazuit Bay areas were non-breeders or unsuccessful breeders.

On the Yukon and eastern Alaskan North Slope 71% of Whistling Swans were non-breeders or unsuccessful breeders in 1975, and this compared with 85% for Whistling Swans in Alaska during 1966 (from data presented in King, 1970).

Since Whistling Swans do not breed until their fifth or sixth season (Delacour, 1954) one would expect a high proportion of the adult birds to be non-breeders as these data suggest. The high proportion of non-breeding birds and the long time that it takes the birds to become potential breeders suggests that a small increment in mortality rates could cumulatively cause a substantial reduction in the number of birds that reach sexual maturity.

SUMMARY

In 1975 the major arrival of Snow Geese on the study area occurred from September 3 to 7, and the major departure was from September 19 to 24. The peak staging population was about 375,000 Snow Geese.

The pattern of usage of concentration sites differed from other years because of an early freeze-up on the North Slope. Most of the Snow Geese (up to 325,000) staged in the Mackenzie Delta--primarily on the east and west sides of Shallow Bay--but about 50,000 birds used the Walking River concentration site even though snow persisted in this area throughout the staging period.

An average brood size of 3.10 ± .04 and an adult to juvenile ratio of 1.00 to 1.12 indicated that 1975 was a good production year for Snow Geese.

White-fronted Geese used the Mackenzie Delta portion of the study area from August 20 to September 19. The peak number of 23,700, which used the area September 8 to 10, probably coincided with an influx of birds from Alaska. The most important area to White-fronted Geese was along the southern and eastern sections of Shallow Bay.

On August 25 and 28, 12,200 Black Brant were sighted between Kittigazuit Bay and Camden Bay; the largest concentrations of this species were detected on August 25 at Demarcation Bay and Beaufort Lagoon. About 1000 Black Brant were present on the Blow River Delta

until September 23.

Only small numbers of Canada Geese were sighted during aerial surveys, and the peak number present was estimated to be 1065.

Whistling Swans used the study area from the commencement of surveys on August 20 until freeze-up on September 23. The peak number of swans (3400) was present on August 20, and the largest concentrations of birds were sighted around Mallik Bay, on the outer fringe of Kendall Island Bird Sanctuary, and along the eastern shore of Shallow Bay.

Non-breeding and unsuccessfully-breeding Whistling Swans formed 76% of adult birds. These birds started to leave the study area before the birds with young. The average brood size of 2.22 ± .07 and adult to juvenile ratio of 1.00 to .26 indicate that production in 1975 was similar to that of previous years.

LITERATURE CITED

Barry, T.W. 1967. Geese of the Anderson River Delta, N.W.T. Ph.D. thesis, unpublished, University of Alberta, Edmonton.

Cade, T.J. 1955. Records of Black Brant in the Yukon Basin and the question of a spring migration route. J. of Wildl. Mgt. 19:321-324.

Campbell, R.W. 1973a. Baseline study of selected nesting waterbirds on the western Mackenzie Delta, N.W.T. and Yukon Territory 1972. Section 3, Appendix III. Ornithology, *to* Interim Report No. 3. Towards an environmental impact assessment of the portion of the Mackenzie gas pipeline from Alaska to Alberta. Environment Protection Board, Winnipeg, Manitoba.

Campbell, R.W. 1973b. Fall migration of birds in the Mackenzie Delta and lower Mackenzie River, 1972. Section 5, Appendix III. Ornithology, *to* Interim Report No. 3. Towards an environmental impact assessment of the portion of the Mackenzie gas pipeline from Alaska to Alberta. Environment Protection Board, Winnipeg, Manitoba.

Campbell, R.W., and W.C. Weber. 1973. Abundance and species composition of birds in selected areas along the pipeline route. Section 4, Appendix III. Ornithology, *to* Interim Report No. 3. Towards an environmental impact assessment of the portion of the Mackenzie gas pipeline from Alaska to Alberta. Environment Protection Board, Winnipeg, Manitoba.

Cooch, F.G. 1958. The breeding biology and management of the blue goose *Chen caerulescens*. Ph.D. thesis. Cornell Univ., Ithaca, N.Y. 235p.

Delacour, J. 1954. The waterfowl of the world. Vol. I. Country Life, London.

Godfrey, W.E. 1966. The Birds of Canada. National Museum of Canada Bulletin No. 203. Ottawa, Ontario. 428p.

Gollop, M.A., and R.A. Davis. 1974. Autumn bird migration along the Yukon Arctic Coast; July, August, September, 1972. *In:* W.W.H. Gunn and John A. Livingston (eds.), Bird Migration on the North Slope and in the Mackenzie Valley Regions. CAGSL Biol. Report Series, Vol. XIII, Chapt. 3.

King, J.G. 1970. The swans and geese of Alaska's Arctic Slope. Wildfowl 21:11-17.

Koski, W.R. 1975. A study of the distribution and movement of Snow Geese, other geese, and Whistling Swans on the Mackenzie Delta, Yukon North Slope, and Alaskan North Slope in August and September, 1974, including a comparison with similar data from 1973. *In:* W.W.H. Gunn, R.E. Schweinsburg, C.E. Tull, and T.D. Wright (eds.), Ornithological studies conducted in the area of the proposed gas pipeline route: Northwest Territories, Yukon Territory and Alaska, 1974. Arctic Gas Biol. Report Series, Vol. XXX, Chapt. 1.

Koski, W.R., and M.A. Gollop. 1974. Migration and distribution of staging snow geese on the Mackenzie Delta, Yukon and eastern Alaskan North Slope, August and September, 1973. *In:* W.W.H. Gunn, W.J. Richardson, R.E. Schweinsburg, and T.D. Wright (eds.), Studies on snow geese and waterfowl in the Northwest Territories, Yukon Territory, and Alaska. CAGSL Biol. Report Series, Vol. XXVII, Chapt. 1.

Patterson, L. 1974. An assessment of the energetic importance of the North Slope to snow geese (*Chen caerulescens*) during the staging period, September, 1973. *In:* W.W.H. Gunn, W.J. Richardson, R.E. Schweinsburg, and T.D. Wright (eds.), Studies on snow geese and waterfowl in the Northwest Territories, Yukon Territory, and Alaska. CAGSL Biol. Report Series, Vol. XXVII, Chapt. 4.

Prevett, J.P. 1973. Familial and age-dependent behavior of blue geese, *Anser caerulescens*. Unpub. Ph.D. thesis. Univ. Western Ontario, London. 194p.

Schweinsburg, R.E. 1974. An ornithological study of alternate gas pipeline routes in Alaska, Yukon Territory and the Northwest Territories, 1971. CAGSL Biol. Report Series, Vol. X.

Slaney, F.F. and Company Limited. 1974. Environmental program Mackenzie Delta, N.W.T. Volume 4-Birds. 124p.

APPENDIX 1. Important Sightings which Document Snow Goose Movements: August and September, 1975.

August 18:	Dirk DeGraaf (A.E.L.) sighted the first flock of Snow Geese in the Mackenzie Delta near West Channel.
September 2:	Willard Hagan (pilot for Corridor Air) sighted several tens of thousands of Snow Geese on the Parry Peninsula and in the vicinity of Horton River.
September 3:	Willard Hagan sighted several thousand Snow Geese flying westward near Tuktoyaktuk.
September 4, 5, and 6:	A few thousand Snow Geese were sighted both flying by and feeding near the DEW site at Komakuk Beach. Personnel working there report that this was the only time period during which they sighted Snow Geese in 1975.
September 19:	Several hundred Snow Geese were seen flying south past Inuvik.
September 23:	Several thousand Snow Geese were seen flying south from Shallow Bay area.
September 25:	A reconnaisance survey of Shallow Bay area detected approximately 1000 geese on the southeast edge of the bay.

APPENDIX 2. Coastal Survey from Shallow Bay to Camden Bay: August 25, 1975.

	BLACK BRANT	WHITE-FRONTED GEESE	UNIDENTIFIED DARK GEESE	SNOW GEESE	SWANS	SANDHILL CRANES
West Side of Shallow Bay	0	15	0	0	25	7
Tent Island & Vicinity	80	389	25	0	102	6
Blow River Delta	33	0	0	6	13	0
Shingle Point	6	0	0	0	2	0
Babbage River Delta	765	0	0	0	79	2
Spring River Delta	225	0	0	0	6	3
Stokes Point	140	0	0	0	11	0
Roland Bay	0	0	0	0	12	0
Catton Point	77	0	0	0	3	1
Firth River Delta	310	0	0	50	5	0
Malcolm River Delta	248	0	0	155	15	0
Vicinity of Komakuk	0	0	25	0	0	0
Clarence Lagoon	37	0	0	0	7	0
Demarcation Bay	2,435	0	0	0	0	0
Sitku Point	1,350	0	0	0	47	0
Egaksrak Lagoon	695	0	0	0	2	0
Nuvagapak Lagoon	2,335	0	0	220	5	0
Humphrey Point	700	0	0	0	0	0
Niguanak River Delta	675	0	0	0	0	0
Tapkaurak Lagoon	1,325	0	0	0	0	0
South of Barter Island	75	0	0	0	5	0
Hulahula River Delta	14	0	0	0	10	0
Arey Lagoon	415	0	0	0	0	0
Vicinity of Kajutakrok Creek	18	0	0	0	10	0
Return Inland Malcolm Delta to Shingle Point	0	0	0	0	47	0

APPENDIX 3. Reconnaissance Survey Shallow Bay to Phillips Bay: September 4, 1975.

LOCATION	BLACK BRANT	WHITE-FRONTED GEESE	CANADA GEESE	UNIDENTIFIED DARK GEESE	SNOW GEESE	SANDHILL CRANES
Shallow Bay	269	108	0	78	0	2
Whitefish Station	600	20	0	300	28	0
Blow River Delta	359	92	0	85	126	0
Inland between Shingle Point and Babbage River	0	40	3	0	15,699	0

APPENDIX 4. Reconnaissance Survey Aklavik to Demarcation Bay: September 8, 1975*.

LOCATION	SNOW GEESE	WHITE-FRONTED GEESE	CANADA GEESE	BLACK BRANT	UNIDENTIFIED DARK GEESE	SWANS
Aklavik to Shingle Point following the edge of the delta	8473	459	11	133	75	not recorded
Near Shingle Point	6	0	0	15	45	0
East of Phillips Bay	0	0	0	0	210	0
Phillips Bay	0	51	0	220	57	27
Firth and Malcolm river deltas	28	212	0	0	197	4
Clarence Lagoon	0	60	0	0	0	4
Demarcation Bay	7	278	0	69	65	0

* The Yukon and Alaskan North Slope was 98% snow covered at this time.

APPENDIX 5. Numbers of White-fronted Geese and Unidentified Dark Geese Sighted on Transects D70-D79 in the Mackenzie Delta: September 11 and September 17-18, 1975.

TRANSECT NUMBER	SEPTEMBER 11	SEPTEMBER 17 AND 18
70	2 UD*	8 UD
71	18 WF** 8 UD	0
72	105 WF	100 UD
73	98 WF 3 UD	53 WF
74	100 UD	137 WF
75	0	238 WF
76	500 WF 425 UD	612 WF 100 UD
77	68 UD	110 WF 410 UD
78	0	0
79	0	0
EXTRAPOLATED NUMBER	3158	3957

*UD -unidentified dark geese

**WF-White-fronted Geese