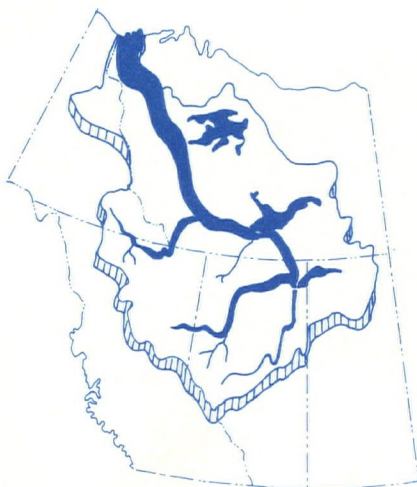


Mackenzie River Basin

CANADA - NORTHWEST TERRITORIES - YUKON - BRITISH COLUMBIA - ALBERTA - SASKATCHEWAN

ASSESSMENT OF MIGRATORY BIRD RESOURCES
IN THE SLAVE RIVER DELTA
FINAL REPORT PREPARED FOR
THE MACKENZIE RIVER BASIN TASK FORCE
TASK 4B. STUDY PROGRAM



A report under the 1978-81 Federal - Provincial
Study Agreement respecting the water and
related resources of the Mackenzie River Basin.

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ASSESSMENT OF MIGRATORY BIRD RESOURCES
IN THE SLAVE RIVER DELTA
FINAL REPORT PREPARED FOR
THE MACKENZIE RIVER BASIN TASK FORCE
TASK 4B, STUDY PROGRAM

Prepared by:

R.G. Thompson, R.W. Quinlan and K. Ambrock

Canadian Wildlife Service

Edmonton, Alberta

December, 1979



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WLU 401-4
Slave River Delta

Canadian Wildlife Service Service canadien de la faune

Room 1000, 9942 - 108 Street
EDMONTON, Alberta
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November 27, 1979

Mr. R.A. Hale
Slave River Delta Study Coordinator
Mackenzie River Basin Task Force
Department of Indian Affairs and Northern Development
P.O. Box 1500
YELLOWKNIFE, NWT
X1A 2R3

Dear Mr. Hale:

Enclosed please find a final report entitled "Assessment of Migratory Bird Resources in the Slave River Delta" by R.G. Thompson, R.W. Quinlan, and K. Ambrock. The report summarizes the results of a two-year migratory bird study conducted in the Slave River Delta, NWT in 1978 and 1979. The study was funded by DIAND under the auspices of the Mackenzie River Basin Study Program. It was conducted in accordance with the terms specified in the May 4, 1978 Letter of Agreement between DIAND and CWS.

I wish, once again, to thank you for funding and coordinating studies in the Slave River Delta. I sincerely hope that this report will be useful for purposes of future water resource planning in the Mackenzie River Basin.

Yours sincerely,

M.R. Robertson
Regional Director

Encls.

SYNOPSIS

As part of the federal-provincial Mackenzie River Basin Study Program, a two-year study of the Slave River Delta, N.W.T. was completed in order to obtain baseline information on the area's migratory bird resources. The study was funded jointly by Department of Indian Affairs and Northern Development and Inland Waters Directorate, Department of Environment.

Aerial and ground surveys of waterfowl, passerines (perching birds), shorebirds, and raptors were conducted during the spring, summer, and fall of 1978, and spring of 1979.

The estimated 1978 duck breeding population of the Slave River Delta was 5,218 pairs or 16.8 pairs per square kilometre. The estimated duck production however was much lower than expected. Only 47 broods (201 ducklings) were counted. Factors affecting production estimates are discussed. Most ducks began incubation between 28 May and 24 June. The main hatching period occurred between 23 June and 17 July. Geese did not breed on the Delta in 1978.

The Slave River Delta is of primary value as a spring and fall migration stop for waterfowl, particularly swans and geese. While duck production and migration (staging) use was low compared to Mills-Beaver Lakes and the Peace-Athabasca Delta, the Slave River Delta was utilized as a staging area by large numbers of Whistling Swans and geese. The Delta was considered to be a component of a much larger staging area extending along the south shore of Great Slave Lake between Fort Resolution, NWT and Talston Bay. The peak number of waterfowl estimated on the Slave River Delta in fall, 1978 was 7,600. Another 7,700 swans

and 4,700 geese were recorded between the Delta and Talston Bay. In the following spring, the south shore of the lake (including the Delta) supported a peak number of 21,000 waterfowl consisting of 10,300 geese, 5,400 swans, and 5,300 ducks.

Common passerine birds breeding on the Slave River Delta were Yellow Warbler, Common Snipe, White-throated Sparrow, Tree Sparrow, Least Flycatcher, Yellow-rumped Warbler and Red-eyed Vireo. Colonies of Arctic Terns and California Gulls were located on the sandspits of the "outer delta". Two active Bald Eagle and one active Osprey nests were found. Shorebird use of the Delta was particularly high in the fall when as many as 3,000 individuals were recorded.

In terms of migratory birds the Slave River Delta is important on a local, regional, and international scale. Substantial numbers of migratory game birds are harvested by the residents of Fort Resolution.

The biological productivity of the Slave River Delta is highly dependent on the water regime. Since plant succession, and hence migratory bird utilization is dependent on the timing, magnitude, and duration of flooding, any modifications to existing water regime would have direct effects on the Delta's migratory bird resources.

ACKNOWLEDGEMENTS

The study was initiated and funded under the auspices of the Mackenzie River Basin Study Program, a joint federal-provincial program established to obtain resource information on the basin. Special thanks go to Ernie Kuyt and Brian Johnson of CWS for their advice, hospitality, and assistance with accommodation and logistic support in Fort Smith.

Glen Wakal and Ian Ross, survey pilots with Buffalo Airways Ltd, Fort Smith, were especially appreciated for their skilled flying of survey routes and for their interest in the project. Water Survey of Canada and Northern Affairs, Fort Smith, provided logistical support. Brian Chubb of Canada North Graphics, and Susan Popowich of CWS drafted the figures for the report.

Kevin Menicoche, a summer student employed through the N.W.T. Science Advisory Board, helped to collect field data. Ken Bodden of the University of Alberta, helped solve logistical problems. Gabe Lafferty and the town council of Fort Resolution were appreciated for their cooperation.

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CHAPTER I

INTRODUCTION

"Recently the Slave River Delta has become recognized as a potentially sensitive and ecologically important area. Located 325 kilometres downstream of the Peace-Athabasca Delta, the Slave River Delta has been formed where the Slave River discharges into Great Slave Lake just 10 kilometres north of the settlement of Fort Resolution. Residents of Fort Resolution rely on the delta to provide a part of their income through the sale of pelts as well as to provide a source of food. The resources upon which the residents rely are themselves dependent on the natural regime of the delta, (Mac. Riv. Basin Com. Study Prog. 1978)."

The Slave River Delta is the only major delta in the Mackenzie River drainage basin between the Peace-Athabasca Delta in northern Alberta and the Mackenzie River Delta in the Northwest Territories. Since it is much smaller than these deltas, the Slave River Delta, until recently, has been overlooked by environmentalists. No previous intensive ornithological studies of the Slave River Delta have been conducted.

In the past, the Slave River was part of the main route used to penetrate Canada's northern frontier. Explorers such as Samuel Hearne, Peter Pond, Alexander Mackenzie, John Franklin, George Back, and other early adventurers passed through this area. However, very little was written about the Slave River Delta. In later years, naturalists such as David Hanbury, J.W. Tyrell, Ernest Thompson Seton, and Edward Preble travelled through the delta on their scientific voyages in the north (Preble 1908). Not until the twentieth century were studies done on the biological

resources of the delta itself. J. Dewey Soper, Dominion Wildlife Officer for Alberta and the Territories, conducted most of the investigations at that time.

Soper (1949, 1952a, 1952b, 1957) stated that the delta supported "a substantial waterfowl population". Soper (1952a, 1952b) proposed that the Slave River Delta, together with Egg Island, located off the shore of the delta, be established as bird sanctuaries.

As a result of the Migratory Bird Act of 1917, which created closed hunting seasons and licensed hunting, a portion of the Slave River Lowlands and the delta was set aside in 1923 as the Slave River Preserve, an area established exclusively for native hunting and trapping. During the following three decades amendments were made in order to allow the resident white population to hunt and trap in the delta. In 1955, the status of the Slave River Delta as a preserve was repealed due to public demand (Hunt 1976).

Although waterfowl production in Canada's boreal forest is not as great as in the prairie pothole region of North America, it is felt that the northern lands of Canada are underestimated for their importance as waterfowl habitat (Welleim and Lumsden 1964; Bellrose 1976). During years of drought on the prairies large numbers of waterfowl move north to the more stable ponds and sloughs in the boreal forest.

River deltas, where large amounts of sediments are deposited annually, represent some of the most biologically productive aquatic and semi-aquatic habitats. Alterations in water regime or water quality can seriously affect the biological productivity of deltas, as documented in

the Peace-Athabasca Delta (Townsend 1972). The sensitivity of the Slave River Delta to any changes in the river regime must be considered.

In May of 1978, an inventory of waterfowl and other migratory birds occurring on the Slave River Delta was initiated by the Canadian Wildlife Service, under the auspices of the Mackenzie River Basin Study Program. The goals of the study were:

"to compile a list of bird species using the area and their relative status, and to document the area's potential for maintaining rare species."

"to document the use of the area by migratory birds during the spring staging, breeding, production and fall staging periods in relation to existing habitat conditions (Mac. Riv. Basin Com. Study Prog. 1978)."

During the summer and fall of 1978, and spring of 1979, aerial surveys were conducted to assess use of the delta by waterfowl. A summer field camp was established on the delta from 12 June to 25 August, to observe and document use of the delta by waterfowl, other water-oriented birds, raptors, passerines, and passerine-like birds. Based on these data and available vegetative and hydrologic information, the relationship between the delta's migratory bird utilization and hydrologic regime was assessed.

CHAPTER II

DESCRIPTION OF STUDY AREA

A. Location and Physiography

The Slave River Delta (61°15'N lat, 113°40'W long) is located 200 km downstream of Fort Smith on the Slave River (Figure 1). It is situated 2 kilometres northeast of Fort Resolution, at an elevation a few metres higher than that of Great Slave Lake (156 m asl). The area of the delta is 310 km².

The Slave River drainage includes a large area of northern British Columbia, Alberta, and Saskatchewan, as well as the Slave River Lowlands in the Northwest Territories. The delta is situated within the Upper Mackenzie Boreal Forest Region (Rowe 1972). This area is characterized by alluvial flats bordered by low benchlands and terraces which grade to undulating terrain with isolated ridges and low hills.

B. Geology, Soils, and Permafrost

The Slave River Delta lies within the Slave River Lowlands, an area designated as a former south arm of Great Slave Lake which was filled in by sedimentation (Day 1972). As the lake receded during the post-glacial period, the Slave River became established. Devonian and Cretaceous bedrock is buried deeply under glacial till and lacustrine and

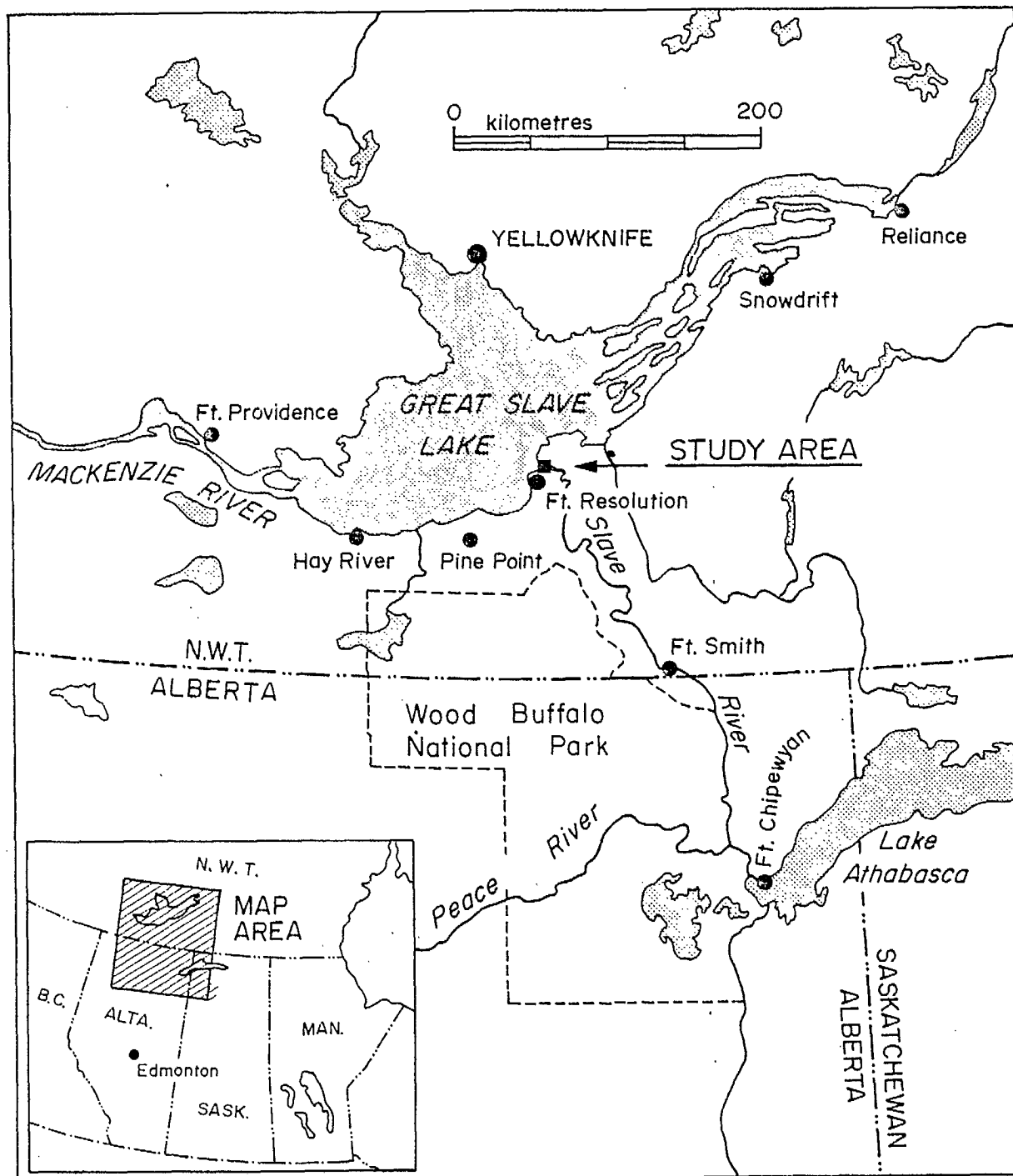


Figure 1. Location of the study area, 1978/79.

alluvial materials (Rowe 1972). The Precambrian Shield is exposed within 25 kilometres east of the delta at such outcrops as Stoney Island on Great Slave Lake.

The majority of the delta is of the alluvium land type. The soils are Cumulic Regosols, whose composition ranges from a grayish-brown, calcareous, loamy sand to a silty clay loam (Day 1972). These soils occur in siltbars and siltflats of the delta (Plate 1), less than three m above average river level, and are frequently flooded (Day 1972). In more stable parts of the delta, in particular the Nagle Channel area, the Iche and Jerome soil series occur (Day 1972). These are Cryic Cumulic Regosols found in moderately to well-drained areas. They have a thin organic layer over calcareous loam, and permafrost below 80 cm. In poorly drained areas of Nagle Channel and other older delta areas, Rego Gleysols and Rego Humic Gleysols of the Taltson soil series are present (Day 1972).

C. Vegetation

Riparian vegetation growing on large areas of alluvial soil in the Slave River Delta is characterized by species such as horsetail (Equisetum fluviatile), cattail (Typha latifolia), and sedges (Carex spp.). The outer portion of the delta is mainly vegetated by these species (Plate 2). In less frequently flooded areas, and beyond the ice scour zone, willows (Salix spp.) predominate (Plates 3 and 4). Higher above the water levels and levees and uplands are balsam poplar (Populus balsamifera), alder (Alnus sp.), and other woodland species. In the more stable localities small stands of white spruce (Picea glauca) and black



Plate 1. Siltbar located near the mouth of Steamboat Channel, Slave River Delta, N.W.T., July 1978.



Plate 2. Mouth of Signal Channel, Slave River Delta, N.W.T., July 1978.



Plate 3. Big Rat Lake, Slave River Delta, N.W.T., July 1978.



Plate 4. Willow Lake, Slave River Delta, N.W.T., July 1978.

spruce (P. mariana) occur. Some ponds and perched basins are present, the more isolated ones having a well developed aquatic plant community consisting primarily of pondweed (Potamogeton spp.), arrowhead (Sagittaria sp.), milfoil (Myriophyllum sp.), mare's-tail (Hippuris sp.), bladderwort (Utricularia sp.), Ranunculus sp., yellow water-lily (Nuphar variegatum), and white water-lily (Nymphaea tetragona) (Plates 4 and 5). The shores of these ponds are composed of a floating vegetation mat of sedge and cattail. The shoreline vegetation of the ponds which receives a yearly influx of floodwaters, however, is predominantly horsetail (Plate 6). Aquatic vegetation in the river channels and shallow shoreline waters of Great Slave Lake is poorly developed, although in Nagle Bay and some other shallow areas in the outer delta scattered stands of Richardson's pondweed (Potamogeton richardsonii) and bulrush (Scirpus sp.) are present. A detailed description of the delta's vegetation is given in English (1979).

D. Climate

The Slave River Delta is located within the sub-arctic climatic zone (Atlas of Can. 1957). This zone is characterized by cold winters. The mean temperature of the coldest month in the sub-arctic zone is below -3°C . Summers are cool and short with only one to three months having a mean temperature above 10°C . In Fort Resolution the mean daily temperature of the coldest month (January) is -26.3°C (Atm. Environ. Serv. 1973a). June (11.8°C), July (15.7°C), and August (14.3°C) have mean daily temperatures above 10°C (Atm. Environ. Serv. 1973a). Mean



Plate 5. Willow Lake, Slave River Delta, N.W.T., July 1978.



Plate 6. Lake #2, Slave River Delta, N.W.T., July 1978.

total precipitation for Fort Resolution is 28.57 cm (Atm. Environ. Serv. 1973b). The number of days having frost total 227 in Fort Resolution with July and August usually frost-free (Atm. Environ. Serv. 1973b).

E. Hydrology

The water regime of the Slave River is one of the major factors determining the physical and biological characteristics of the Slave River Delta. Spring floods provide deposition of alluvium, dilution of acidic organic compounds, and the filling of perched basins. The fertility of the flood plains is thus maintained, permitting successional plant growth and preventing the establishment of muskeg conditions (Stevens 1971). The slowing down of river water as it reaches Great Slave Lake results in greater deposition of silt. As the sediments continue to be deposited, the delta grows in the direction of the lake. The extent of this growth is determined by the amount of sediment deposited, and by the rate of sediment loss due to wave action and lake currents (Reid and Wood 1976, Bardach 1964).

Frequent spring flooding has resulted in the buildup of levees along major channels. Behind these levees occur alluvial lowlands with occasional oxbow ponds and perched basins, which require spring floods to retain their water levels.

CHAPTER III

WATERFOWL BREEDING, 1978

A. Introduction

In order to estimate the importance of the Slave River Delta as breeding habitat for waterfowl, indicated breeding pair (IBP) surveys were flown during early June.

} Previous evaluation of the breeding habitat and its use by waterfowl was described by Soper (1949):

"Small ponds and lakes, within the limits of the delta, are relatively not nearly as numerous as in either the Athabasca, or Mackenzie Deltas."

Soper (1949) quotes C. Law, then of the Federal Wildlife Division:

"It is asserted that a fair breeding population of sporting ducks and other wildfowl resorts to the delta. The total per acre, or square mile, however, is relatively paltry as compared with really high-class breeding areas."

In Soper's (1952a) proposal for Slave River Delta bird sanctuary he states:

"Nevertheless, the waterfowl breeding population is only moderate in size. While numerous species resort to it during the nesting season, the overall aggregate is clearly much smaller per square mile than in either of the two deltas mentioned above [Athabasca and Mackenzie Deltas]."

B. Methods

A reconnaissance survey was flown by K. Ambrock on 23 May 1978, over the "outer delta". The area censused for waterfowl covered approximately 55 kilometres of shoreline. Due to the late breakup on Great Slave Lake, the first breeding pair survey was delayed until 1 June. Subsequent surveys were carried out on 4 June and 7 June. These dates were similar to those of the United States Fish and Wildlife Service (USFWS) waterfowl breeding population surveys in bush transects, which are performed every year during the period 12 May to 12 June (USFWS 1977). The primary criteria used by USFWS for initiation of surveys in bush units are ice breakup, the buildup of representative waterfowl species in traditional breeding areas, and the dispersal of paired waterfowl onto breeding territories. A buildup on breeding pairs, along with apparent absence of spring migrants, was observed by 1 June.

Survey flights were initiated by 0900 and completed by 1100 hrs. On all three surveys, weather conditions were favourable, visibility was good, and winds were light.

Transects were flown at an altitude of 30 to 45 m above ground level (agl). The ground speed did not exceed 160 kmph. Transects were oriented NE to SW except for Transect A which followed the shoreline of the outer region of the delta (Figure 2). All transects, except Transect A, were parallel and located 1.6 km apart on 4 and 7 June, and 8 km apart on 1 June. Seven ponds were also surveyed (Figure 2).

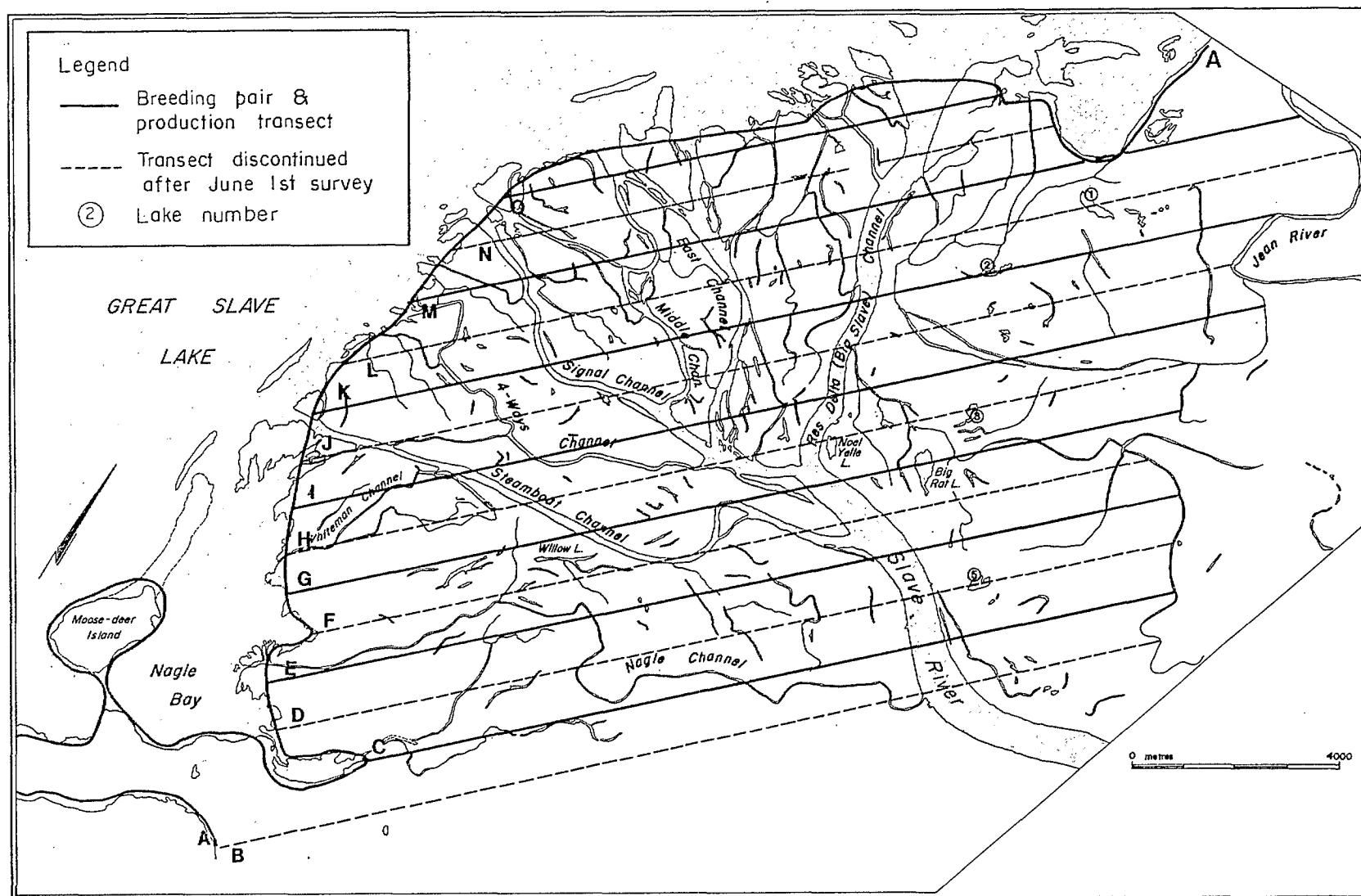


Figure 2. Locations of breeding pair and production transects and ponds surveyed, Slave River Delta, N.W.T., 1978.

On 1 June, all transects flown were 0.2 km wide with observations restricted to one side of the aircraft only. On the 4 June and 7 June surveys, every second transect was flown (Transects A, C, E, G, I, K, M, O). Observations were made from both sides of the aircraft, providing coverage of a 0.4 km wide strip along each transect. This provided for coverage of 19% (1 June) and 22% (4 and 7 June) of the delta's surface area, respectively. All data were recorded on Sony TC-45 tape recorders and later transcribed onto breeding pair data forms. The data were summarized according to criteria outlined in USFWS Standard Procedures (1977).

C. Results and Discussion

No breeding geese were observed on the delta in 1978. Based on aerial surveys, the estimated duck breeding population was 5,218 pairs (Table 1) or 16.8 pairs/km². Dabblers comprised 52% (2,227) of all indicated breeding pairs while divers comprised 48% (2,037). The more common breeders were: Lesser Scaup (768 pairs) followed by Mallard (726 pairs), American Widgeon (494 pairs), Bufflehead (379 pairs), and Blue-winged Teal (221 pairs).

Overall, breeding ducks were distributed relatively uniformly throughout the delta. The mean number of pairs sighted per km of transect varied from 2.7 on Transect E to 4.0 on Transect G. The mean number of pairs per km for all transects were 3.5. The outer delta, (Transect A) yielded 3.2 pairs per km. There were, however, marked differences in habitat preference by species. Dabblers such as Mallard and Widgeon

Table 1. Duck breeding pair estimates, Slave River Delta, N.W.T., 1978.

Species	Optimum census date	Number of pairs*	Density
Mallard	June 1	726	2.3/km ²
Pintail	June 7	77	0.2/km ²
Gadwall	June 4	41	0.1/km ²
American widgeon	June 1	494	1.6/km ²
Shoveler	June 7	100	0.3/km ²
Blue-winged teal	June 1	221	0.7/km ²
Green-winged teal	June 1	42	0.1/km ²
Teal sp.	June 1	205	0.7/km ²
Unid. dabbling	June 1	321	1.0/km ²
Total dabbling		2227	7.1/km ²
Scaup	June 1	768	2.5/km ²
Ring-necked duck	June 1	37	0.1/km ²
Redhead	June 4	23	0.1/km ²
Canvasback	June 4	109	0.4/km ²
Goldeneye sp.	June 4	82	0.3/km ²
Bufflehead	June 1	379	1.2/km ²
Ruddy duck	June 7	50	0.2/km ²
White-winged scoter	June 7	5	0.1/km ²
Surf scoter	June 4	32	0.1/km ²
Scoter sp.	June 1	5	0.1/km ²
Unid. diver	June 1	547	1.8/km ²
Total divers		2037	6.9/km ²
Unid. ducks	June 1	952	3.1/km ²
Total ducks		5216	16.8/km ²

* Estimates for entire delta based on percentage of area sampled (see Appendices - Table A-2).

tended to prefer the outer, less stable portion of the delta while divers such as the Bufflehead and Ring-necked duck preferred the inner, more stable, boreal-type ponds.

The results of surveys on the Slave River Delta cannot be validly compared to those of other areas studied (eg. Peace-Athabasca Delta) because of variations in survey techniques, weather, timing, observer efficiency, etc. However, some general inferences can be made regarding the relative value of the Slave River Delta as a waterfowl breeding area. The delta does not appear to support the high breeding duck utilization recorded in the parklands of Alberta where densities of up to 116 pairs per km^2 (compared to 16.8 pairs/ km^2 in the Slave River Delta) have been observed (Turner and Weaver 1978). On the other hand, breeding pair densities estimated in the Peace-Athabasca Delta for the period, 1971 to 1976 (Hennan 1972, 1974, 1975; Hennan and Ambrock 1977), are similar, on the average, to those obtained for the Slave River Delta. The Slave River Delta is much smaller than the Peace-Athabasca Delta (310 km^2 compared to 3820 km^2) and, as such, its overall contribution as a breeding area is understandably lower. It should be noted that the Slave River Delta nevertheless represents a small area of relatively good breeding habitat in comparison to the surrounding boreal forest. It should also be noted that further inferences cannot be drawn based on only a single year of survey data.

CHAPTER IV

WATERFOWL PRODUCTION, 1978

A. Introduction

Although breeding pair and brood surveys are useful in assessing the value of habitat for waterfowl, brood surveys are a more direct measurement of productivity. Brood surveys include only those birds that nest in the study area, whereas breeding pair surveys include birds that may disperse to other areas to raise young.

As stated previously, the Slave River Delta is not considered to be a highly productive area for waterfowl in comparison to other major deltas. Although waterfowl densities of the woodlands and tundra are comparatively low, waterfowl habitat (i.e. ponds and streams) is much more stable in Canada's north than in the prairie pothole area of central North America. This northern habitat is not subjected to the occasional drought which occurs in the prairies. Thus the importance of the north to waterfowl production becomes greater during dry years on the prairies.

B. Methods

Production surveys were flown on 18 and 27 July, and 11 August. Surveys commenced between 0730 and 0900 hours and ended by about 1000 hours. The first survey was flown primarily to determine dabbling duck

production, while the 27 July survey was flown to assess diving duck production which normally occurs later (Hochbaum 1944). The 11 August survey was flown in order to determine production of re-nesting or late nesting birds. The first survey was flown in a Bell 206B helicopter, but the second and third surveys were flown in a fixed-wing Cessna 185. Financial constraints necessitated the use of a fixed-wing aircraft.

The helicopter survey was flown at 30 m agl and 80 kmph. The fixed-wing surveys were flown at the same altitude but at speeds up to 160 kmph. Surveys were flown along the same routes as the second and third breeding pair surveys (Figure 2).

Broods sighted from the air were counted and identified according to species and assigned to age classes (Gollop and Marshall 1954). Because two different types of aircraft were used, no comparisons between the first and subsequent surveys were made.

Two different enumeration techniques were used on each survey. One was to determine the density of broods along the transects; the other to determine the density of broods along the shorelines of the seven ponds. Transects flown covered an area of 67.7 km², while 16.5 km of pond shoreline were surveyed.

Ground truthing of four ponds (Willow Lake, Noel Yelle Lake, Big Rat Lake, and Lake #2) was conducted in conjunction with each survey flight.

Data from surveys and incidental sightings were used to back-date broods in order to determine dates of incubation and hatching (Gollop and Marshall 1954).

C. Results and Discussion

Forty-seven broods and 201 ducklings were observed during the first production survey, on 18 July (Table 2). Based on the percentage of the area sampled, the estimated production for the delta was 123 broods and 495 ducklings. The average brood size for all ducks was 4.3 ducklings. On the second survey, 23 broods (90 ducklings) were recorded, while on the third survey 12 broods (41 ducklings) were sighted. Numbers of moulting ducks on the first, second and third surveys were 588, 469 and 1,632, respectively. On all three surveys, dabbling broods accounted for between 65 and 73% of all broods sighted, while the diver component approximated 25 to 30% of all broods counted. The most common dabbling species produced on the delta were Teal sp., American Widgeon, and Mallard; common diver species were Bufflehead, Scaup sp., Goldeneye sp., and Canvasback.

Highest brood densities (Table 3) were recorded on lakes having heavily vegetated shorelines and relatively stable water supplies. While breeding pairs of waterfowl tended to be distributed randomly throughout the delta, hens with broods, not surprisingly, depended on the more permanent water bodies for cover and food. The results support those found by Nieman and Dirschl (1973) on the Peace-Athabasca Delta. They found that dabbling breeding pairs were attracted to shallow lakes, perched basins and small streams with adequate emergent cover whereas potholes and lakes with relatively stable water levels were required for brood rearing. Diver breeding pairs, on the other hand, preferred larger lakes and deep, slow-moving streams as did hens with broods.

Table 2. Results of waterfowl production surveys conducted on the Slave River Delta, N.W.T., 1978.

Date	Dabblers		Divers		Unidentified		Total Ducks	
	Broods (young)	Mean brood size	Broods (young)	Mean brood size	Broods (young)	Mean brood size	Broods (young)	Mean brood size
18 July (B206)	34(141)	4.1	12(58)	4.8	1(2)	2.0	47(201)	4.3
27 July (C185)	15(63)	4.2	7(24)	3.4	1(3)	3.0	23(90)	3.9
11 August (C185)	8(29)	3.6	3(11)	3.7	1(1)	1.0	12(41)	3.4

21

	<u>Number of Moulters</u>			
18 July (B206)	277	209	102	588
27 July (C185)	190	132	147	469
11 August (C185)	653	112	867	1632

Table 3. Brood densities, Slave River Delta, N.W.T., 1978.

	Dabblers	Divers	Unid. Ducks	Total ducks
July 18 (B206)				
<u>Transects</u>				
Total broods/67.7 sq km	19	7	1	27
broods/ 1.0 sq km	.3	.1	.1	.4
<u>Lakes</u>				
Total broods/16.47 km of shoreline	15	5		20
broods/ 1.00 km of shoreline	.9	.3		1.2
July 27 (C185)				
<u>Transects</u>				
Total broods/67.7 sq km	14	6	1	2
broods/ 1.0 sq km	.2	.1	.1	.3
<u>Lakes</u>				
Total broods/16.47 km of shoreline	1	1		2
broods/ 1.00 km of shoreline	.1	.1		.1
August 11 (C185)				
<u>Transects</u>				
Total broods/67.7 sq km	8	3	1	12
broods/ 1.0 sq km	.1	.1	.1	.2
<u>Lakes</u>				
	NO BROODS			

Most ponds on the Slave River Delta were surrounded by relatively homogeneous habitat consisting of horsetail. Only a few ponds, such as Willow Lake, had a more diverse community structure with shorelines of boreal forest, willow and cattail. These areas tended to provide more diverse cover and food for ducklings. Overall, there were no major differences in brood production between transects. The "outer delta" was utilized more by moulters, but not preferred over the "inner delta" by broods. There were, however, variations in brood cover preferences between species. For example, Bufflehead and Goldeneye tended to prefer ponds with wooded shorelines in the coniferous portion of the delta.

Based on the earlier breeding pair surveys, the total number of ducklings recorded on all three production surveys was much lower than expected. This discrepancy was probably the result of several factors:

- 1) counts were extremely conservative due to the inefficiencies inherent in aerial surveys, particularly over heavily-vegetated areas;
- 2) breeding pairs of waterfowl dispersed from the delta prior to nesting. It is possible that the delta provided the last migration stop for waterfowl breeding in the general area but not in the delta itself;
- 3) water conditions in the delta were not conducive to optimum production. Water levels were considered low on the delta in 1978;

- 4) the delay of spring migration into the delta as a result of late break-up may have affected the reproductive success of late nesters or re-nesters.

In any event the production figures obtained for the Slave River Delta in 1978 were felt to be very conservative. For reasons noted above these data cannot be validly compared to the results of other studies conducted in the boreal forest. Superficially, however, brood densities obtained in the Slave River Delta were similar to those found at Utikuma Lake, Alberta (Donaghey 1974) and Mills-Beaver Lakes, N.W.T. (Kemper et al. 1975). It should be noted that, according to local residents, delta waterfowl populations in 1978 were lower than normal. Habitat conditions in prairie Canada were more favourable for waterfowl, perhaps indicating that fewer ducks overflowed the prairie pothole region in 1978.

By backdating the broods of known age-classes it was determined that most species of ducks began incubation between 28 May and 24 June (Figure 3). The main hatch on the delta was between 23 June and 17 July (Figure 3). Murdy (1965) estimated species hatching dates for the Yellowknife area. Murdy's dates for the mean hatching periods of American Widgeon, Mallard and Teal sp. were ten days to two weeks earlier than those obtained for the Slave River Delta. This variation is attributed to the late spring which forced the dabbling ducks to delay nesting. As a result, dabblers and divers (which are normally later nesters) nested at approximately the same time.

Backdating is based on the assumptions that: all broods have been identified correctly; broods are at the mid-point within the plumage

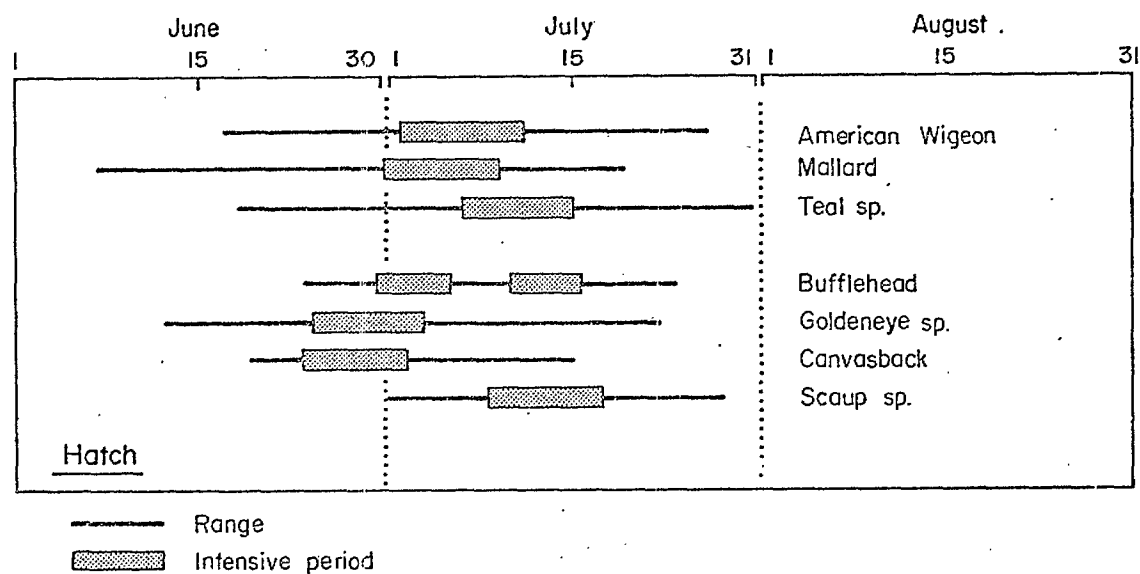
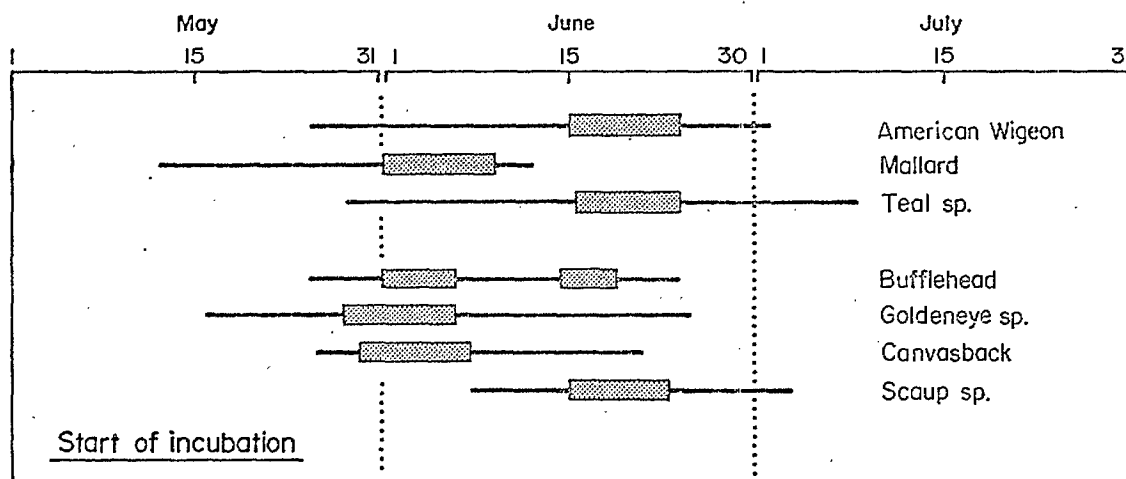


Figure 3. Dates of start of incubation and of hatch for waterfowl found nesting on the Slave River Delta, N.W.T., 1978.

sub-class; and development of ducklings to the flying stage in the Fort Resolution area corresponds to the development indicated in Gollop and Marshall (1954). Ducklings reared in high latitudes are thought to reach the flight stage faster than those reared in temperate latitudes.

CHAPTER V

WATERFOWL FALL MIGRATION, 1978

A. Introduction

In order to document the fall waterfowl migration through the delta, and to determine the relative importance of the delta on a continental, regional, and local basis, aerial surveys were undertaken during August and September 1978.

B. Methods

Staging of waterfowl or the grouping together of birds during migration, began in the third week of August when flocks of several hundred American Widgeon were observed in the outer Steamboat Channel area. Also during this period the first small flocks of Canada Geese (Branta canadensis) were observed on the delta. Survey flights began on 21 August, with the intention of conducting flights every four days thereafter. Weather caused this schedule to be modified slightly. Ten surveys were completed, on 21, 25, 28 August, 2, 6, 11, 16, 23, 26, and 30 September. Survey flights were discontinued after 30 September when waterfowl numbers declined drastically.

Most surveys were initiated by 0930 hours and completed by 1130 hours. Weather conditions and hence efficiency of observation, were variable on the surveys.

As in the breeding pair surveys, transects were flown at an altitude of 30 to 45 m agl and at speeds not exceeding 160 kmph. Transect A, along the "outer delta", was flown, as well as major channels including Res-Delta ("Big Slave"), East, Middle, Signal, 4-ways, and Steamboat channels (Figure 2). In addition, the seven lakes surveyed for breeding pairs and broods were surveyed during fall migration.

Transect A was the only transect on which a 0.4 km wide survey strip was maintained. The remaining transects followed river channels rather than straight lines. On large channels the aircraft was flown along the centre of the channel and waterfowl were counted on each side, whereas the narrower channels were surveyed from one side only.

C. Results and Discussion

Fall migration data have been presented as the total number of waterfowl counted (Table 4, Figure 4). Total numbers of waterfowl were highest on 16 September (7,634). Duck numbers peaked on 16 September (3,957). Between 21 August and 11 September, fall migrating ducks were mainly dabblers. The number of diving ducks increased from 155 to 1,058 between 11 September and 16 September, whereas dabbler numbers remained relatively stable (1,413 on 11 September, 1,569 on 16 September). Common duck species during the survey period were American Widgeon, Mallard, Teal sp., and Goldeneye sp.

Most geese observed were Canada Geese. Goose numbers peaked on 11 September (2,147) and 16 September (2,169). White geese were observed in a bay to the northeast of the delta on 16 September. No White-fronted

Table 4. Estimated numbers of ducks, geese, and swans recorded during fall aerial surveys, Slave River Delta, N.W.T., 1978.

Date	Number of			Total No. of Waterfowl
	Ducks	Geese	Swans	
21. August	1,923	29	0	1,952
25 August	3,016	122	0	3,138
28 August	2,094	310	0	2,404
2 September	2,326	214	7	2,547
6 September	2,478	425	49	2,952
11 September	2,053	2,147	536	4,736
16 September	3,957	2,169	1,508	7,634
23 September	1,670	423	1,799	3,892
26 September	1,215	0	210	1,425
30 September	547	1	108	656

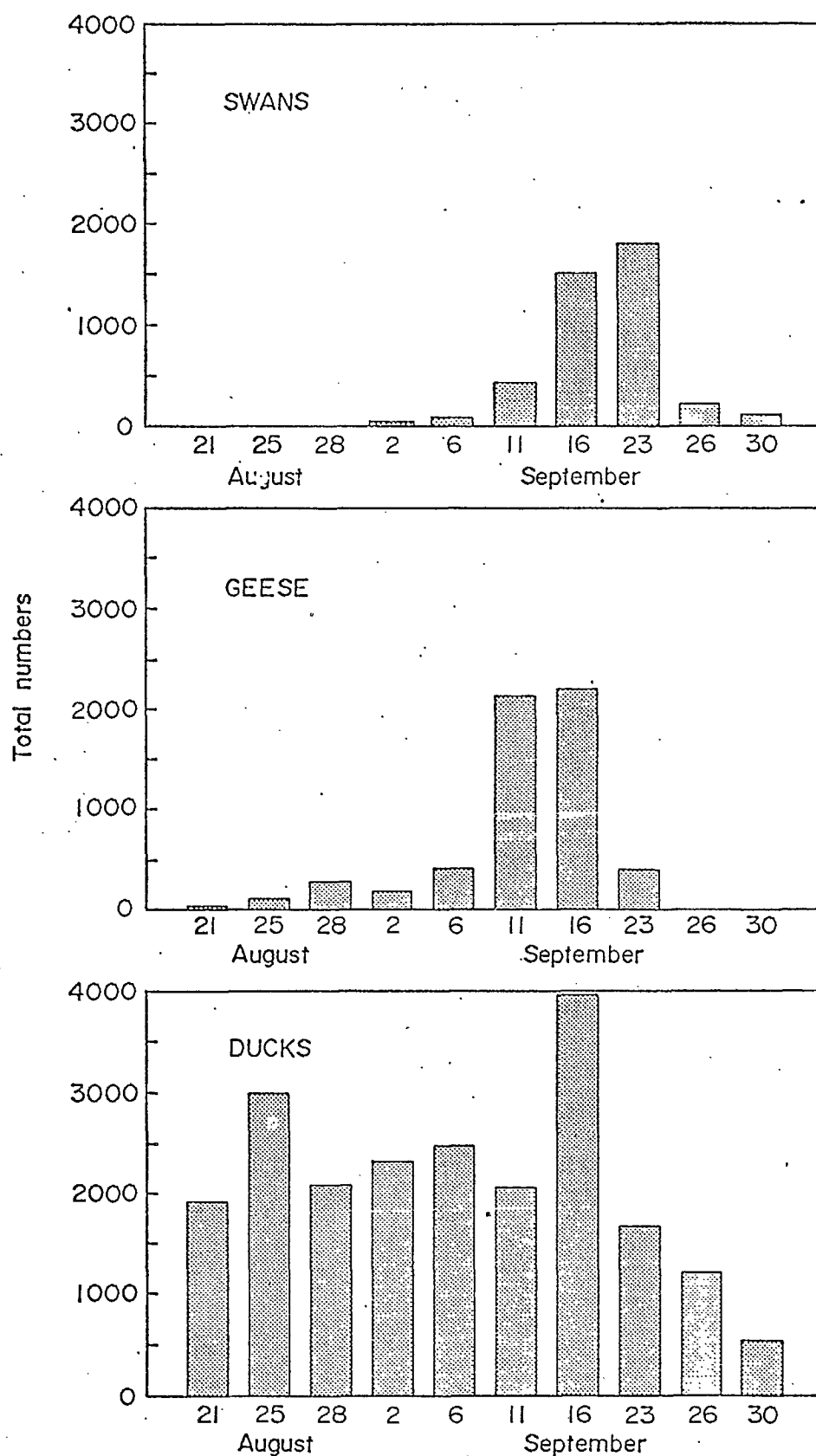


Figure 4. Estimated numbers of ducks, geese, and swans recorded during fall aerial surveys, Slave River Delta, N.W.T., 1978

Geese (Anser albifrons) were sighted. All swans were presumed to be Whistling Swans (Olor columbianus). Swan numbers peaked on 23 September (1,799). During the later part of the swan migration, immature birds were noted. This indicated that breeding swans, which leave their nesting grounds last, were passing through the delta.

Since the areas of major concentration of waterfowl on the delta were surveyed, it is assumed that most of the waterfowl present on the delta were included in the estimates. This was the case for geese and swans, which preferred the "outer delta" and silt bars on the inner channels. For ducks, however, the numbers are undoubtedly conservative as numerous small ponds, snyes, and oxbows not included in the census contained small groups of ducks.

The relative importance of the delta from a regional standpoint might be indicated by comparison to the Mills-Beaver Lakes area, N.W.T. Canadian Wildlife Service (Karasiuk 1977) conducted aerial surveys of the Mills-Beaver Lakes area at approximately the same period that surveys were flown on the Slave River Delta in 1978. Although direct comparison may not be valid because of the many differing factors which affected each series of surveys, it does give an idea of the relative degree of utilization of the two regions. The Slave River Delta is of moderately low importance as a staging area to migrating ducks compared to the Mills-Beaver Lakes area (Figure 5). In terms of utilization by geese the delta is more prominent, although it still does not support the numbers of the Mills-Beaver Lakes area (Figure 6). Swan numbers however were higher throughout September in the Slave River Delta (Figure 7). In the Mills-Beaver Lakes area there was a large increase in swan numbers on the 6 October survey.

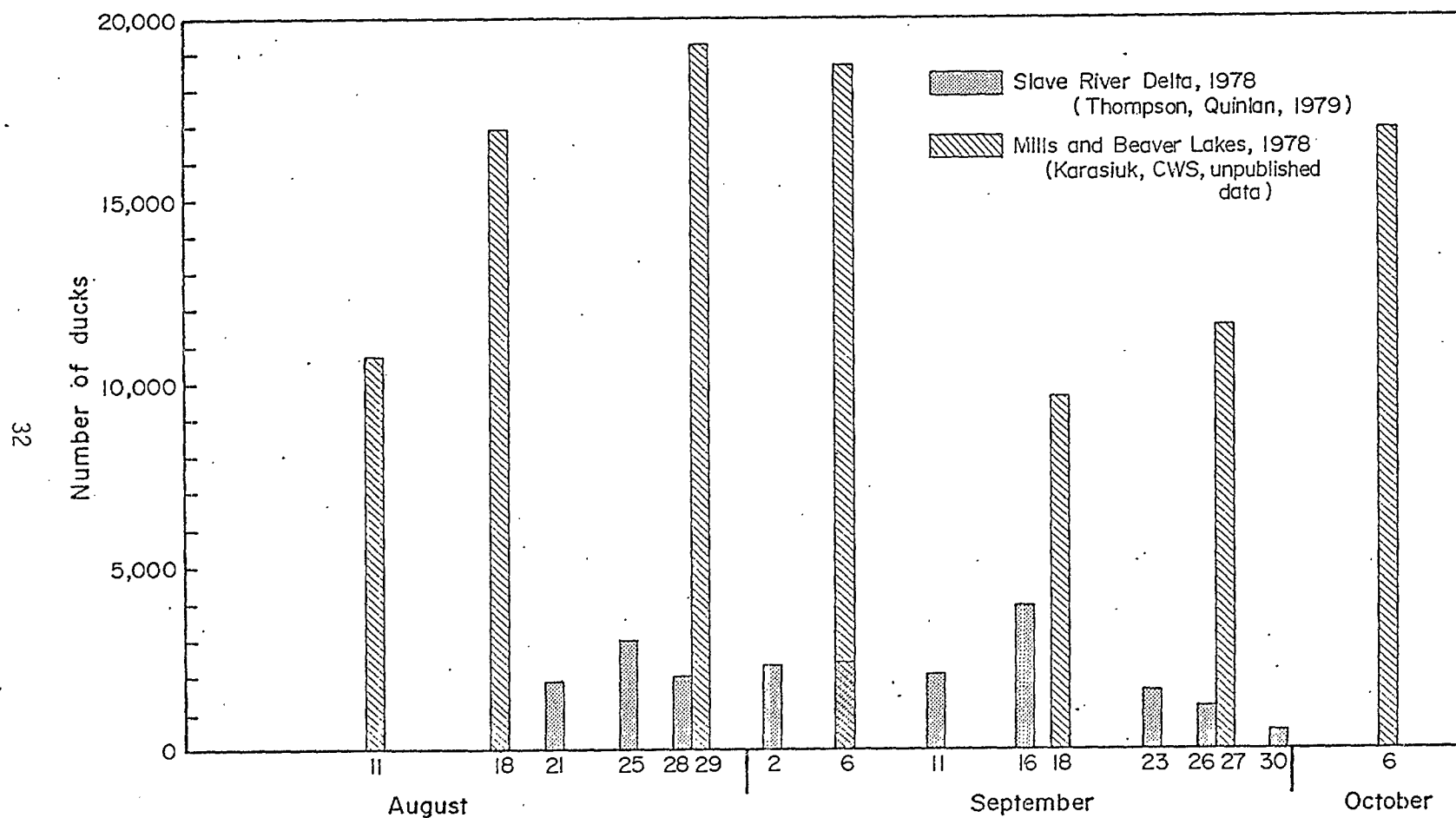


Figure 5. Estimated number of ducks observed on fall aerial surveys, Slave River Delta and the Mills-Beaver Lakes, N.W.T., 1978.

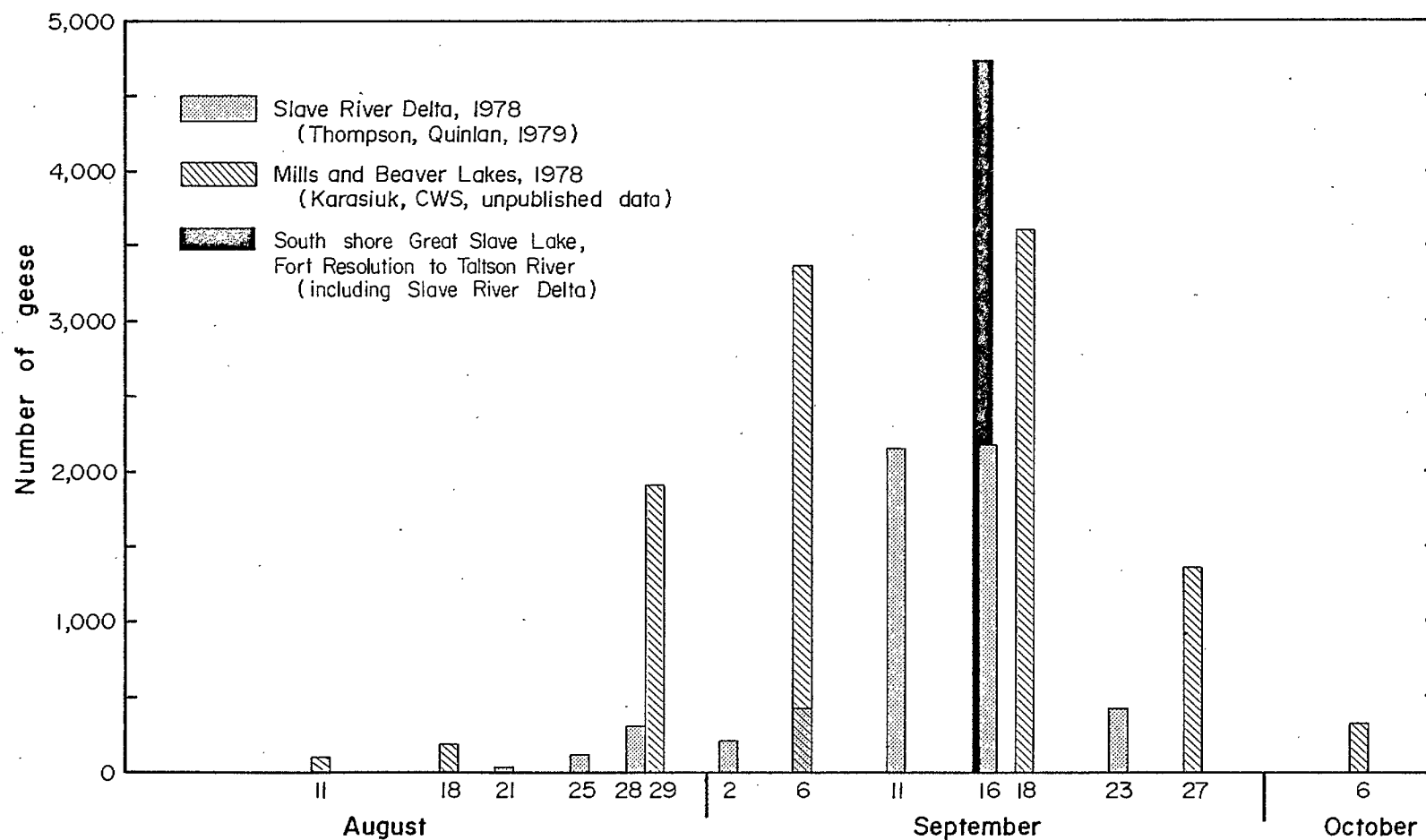


Figure 6. Estimated number of geese observed on fall aerial surveys, Slave River Delta, the "south shore" of Great Slave Lake, the Mills-Beaver Lake, N.W.T., 1978.

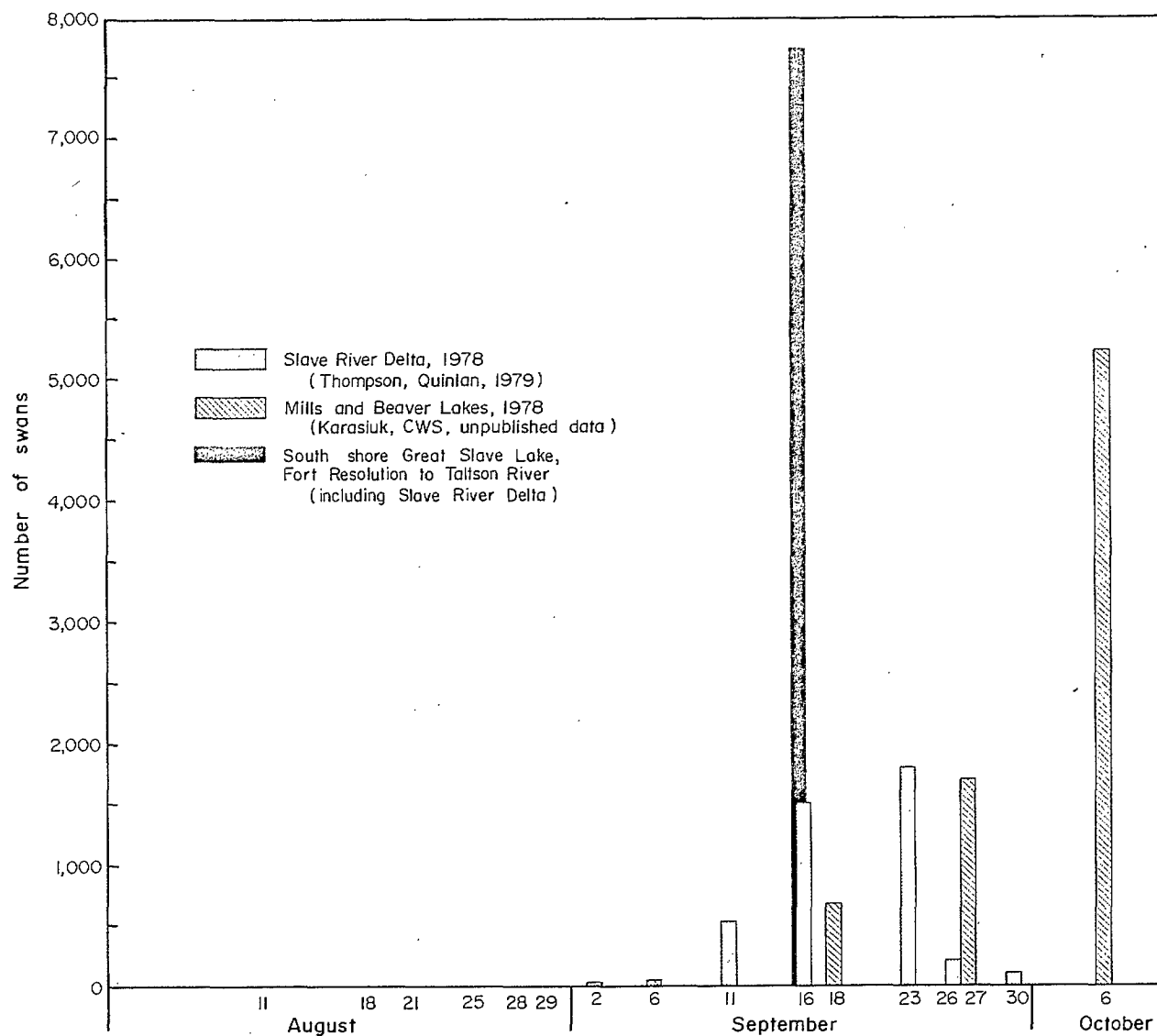


Figure 7. Estimated number of swans observed on fall aerial surveys, Slave River Delta, the "south shore" of Great Slave Lake, and the Mills-Beaver Lake, N.W.T., 1978.

The other major staging area in the region is the Peace-Athabasca Delta. Fall migration surveys in this area were conducted from 1971 to 1976 (Hennan 1972, 1973, 1974, 1975; Hennan and Ambrock 1977). Duck use of the Slave River Delta was much less than in the Peace-Athabasca Delta, where as many as 106,200 ducks have been seen in a single survey (1971). Goose and swan numbers in the Slave River Delta were approximately half of the Peace-Athabasca Delta average numbers, although the 1978 figures for the Slave River Delta are comparable to those of low years in the more southerly delta. As many as 16,500 geese and swans have been observed in one survey in the Peace-Athabasca Delta (in 1972).

The Slave River Delta is only part of a much larger fall migration area extending along the south shore of Great Slave Lake to the Taltson River Delta, approximately 80 km northeast of Fort Resolution. The south shore of Great Slave Lake, between the mouth of the Jean River, and the Taltson River consists of a series of large, shallow bays which were used by large numbers of geese, swans, and diving ducks during the 1978 fall migration. On 16 September, a cursory survey of this area was flown. Approximately 6,200 swans, 2,200 dark geese, and 350 white geese were seen. A few large flocks of diving ducks were present, one consisting of 700 Scaup sp. The survey of this area was incomplete, especially in the Caudet Bay and Taltson Bay areas where many swans and geese were not counted. By conservative estimates, this section of the south shore of Great Slave Lake, including the Slave River Delta supported more than 7,700 swans and 4,400 dark geese on 16 September.

Speculation as to the origin of the large numbers of swans and geese was made by Soper (1949, 1952b):

"During the autumn migration the birds evidently funnel into the delta from a wide area to the northward, some of them, ostensibly, coming from the mainland arctic coast and perhaps Victoria Island."

"The delta lies in a principal migration route along, or near, Slave River between the noted Peace-Athabasca Delta and points to the northward in the Mackenzie District."

In conclusion, the Slave River Delta is best considered as a component of a larger fall staging area, occurring along the south shore of Great Slave Lake. When considered as a whole, this staging area may be comparable to Mills-Beaver Lakes in utilization by geese, and equal to or greater than Mills-Beaver Lakes in utilization by swans.

CHAPTER VI

WATERFOWL SPRING MIGRATION, 1979

A. Introduction

In year two of the study, aerial surveys were conducted over the Slave River Delta and a section of the south shore of Great Slave Lake to determine the use of the area by ducks, geese, and swans during spring migration. Due to a very late spring there was no open water in Slave River Delta until 14 May, 1979. Breakup did not occur until the 21 or 22 May, 1979.

B. Methods

Aerial survey techniques were similar to those used during the fall migration surveys. However, the routes flown were altered, where necessary, to correspond to the progression of spring breakup. The 14 May survey transects were similar to transects flown in the fall surveys of 1978. On 17 May an additional transect was flown, approximately 0.4 km inside Transect A. On 25 May the flights along channels were discontinued because very few waterfowl were using these areas for staging. By this time the ice on Great Slave Lake deteriorated to the extent that a lead of open water was present along the shoreline. Surveys were then initiated along the south shore from the Jean River to Taltson Bay (Figure 8).

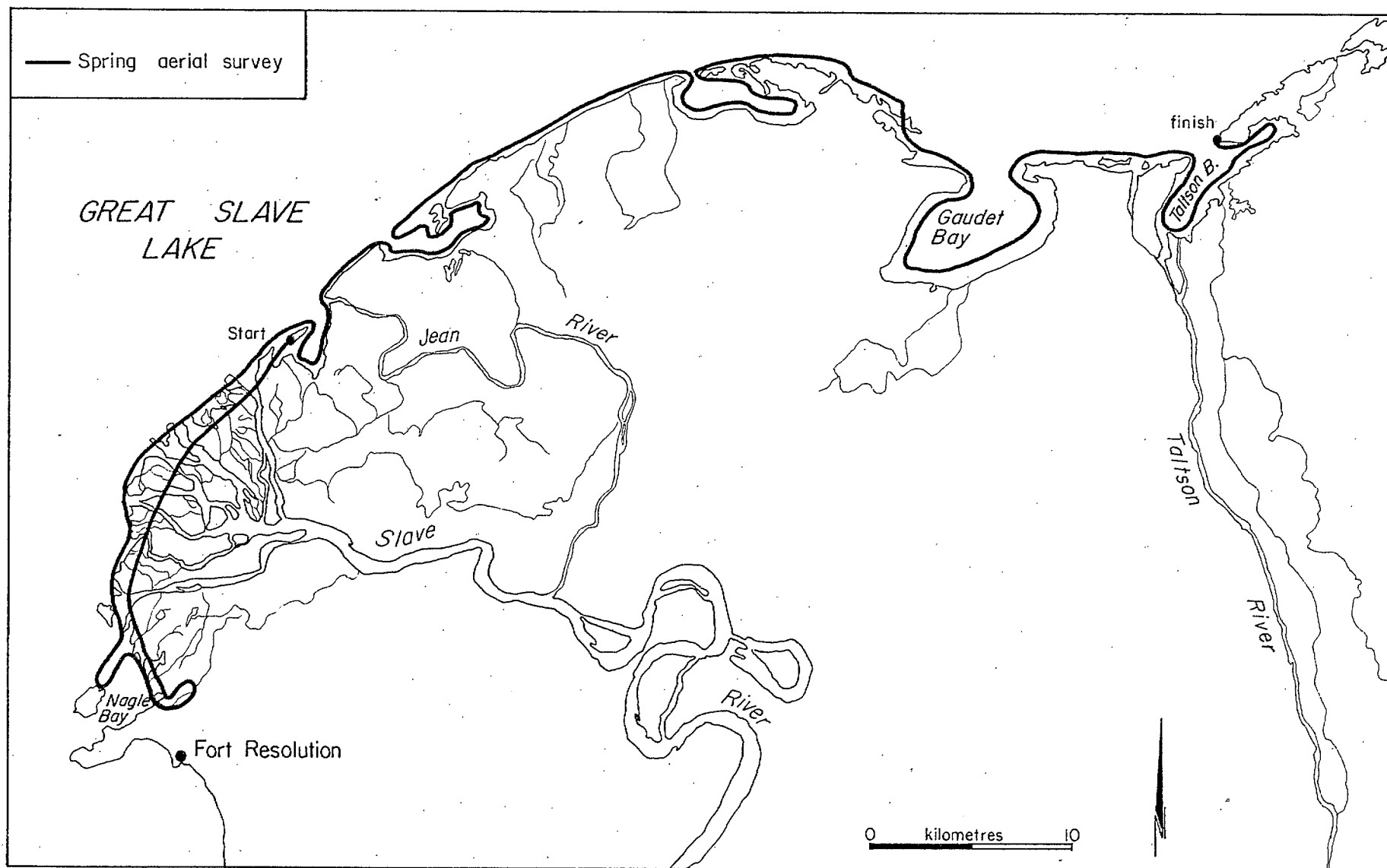


Figure 8. Spring aerial survey route, south shore of Great Slave Lake, N.W.T., 1979.

Survey flights were undertaken on 9, 14, 17, 20, 22, 24, 25, 30 May and 2 June. On the 24 May survey, heavy fog prevented a survey of the Slave River Delta, and the area censused was restricted to the Jean River-Talston Bay area. By 2 June a noticeable drop in numbers of migrants was observed and survey flights were therefore discontinued.

C. Results and Discussion

Spring migration data have been presented as total numbers of waterfowl counted (Tables 5, 6 and Figures 9, 10). No waterfowl were seen on the 9 May survey. No open water on the delta existed at that time. Peak numbers of waterfowl on the Slave River Delta occurred on 20 May (5,674). Duck numbers peaked on 14 May (3,435) when the first open water was observed. American Widgeon, Mallard, and Scaup sp. were the most numerous spring migrants. Goose numbers peaked on 20 May (3,715), just before Slave River breakup. An estimated 3,265 dark geese and 450 white geese were observed on this date. Swan numbers increased steadily to a peak of 1,339 on 30 May. Swans staged over a longer period than geese with small numbers using the first available water. The peak occurred after the delta was free of ice.

The greatest numbers of ducks, most of which were dabblers, used the first open water on 14 May (Figure 9). The largest numbers of divers however (1,313 Scaup sp.) were present on 30 May.

The use of the delta habitats by waterfowl varied with the appearance of open water. On the early surveys, waterfowl were found to be using any lakes and protected areas of the outer delta. Geese and swans showed preference for the outer delta at all times.

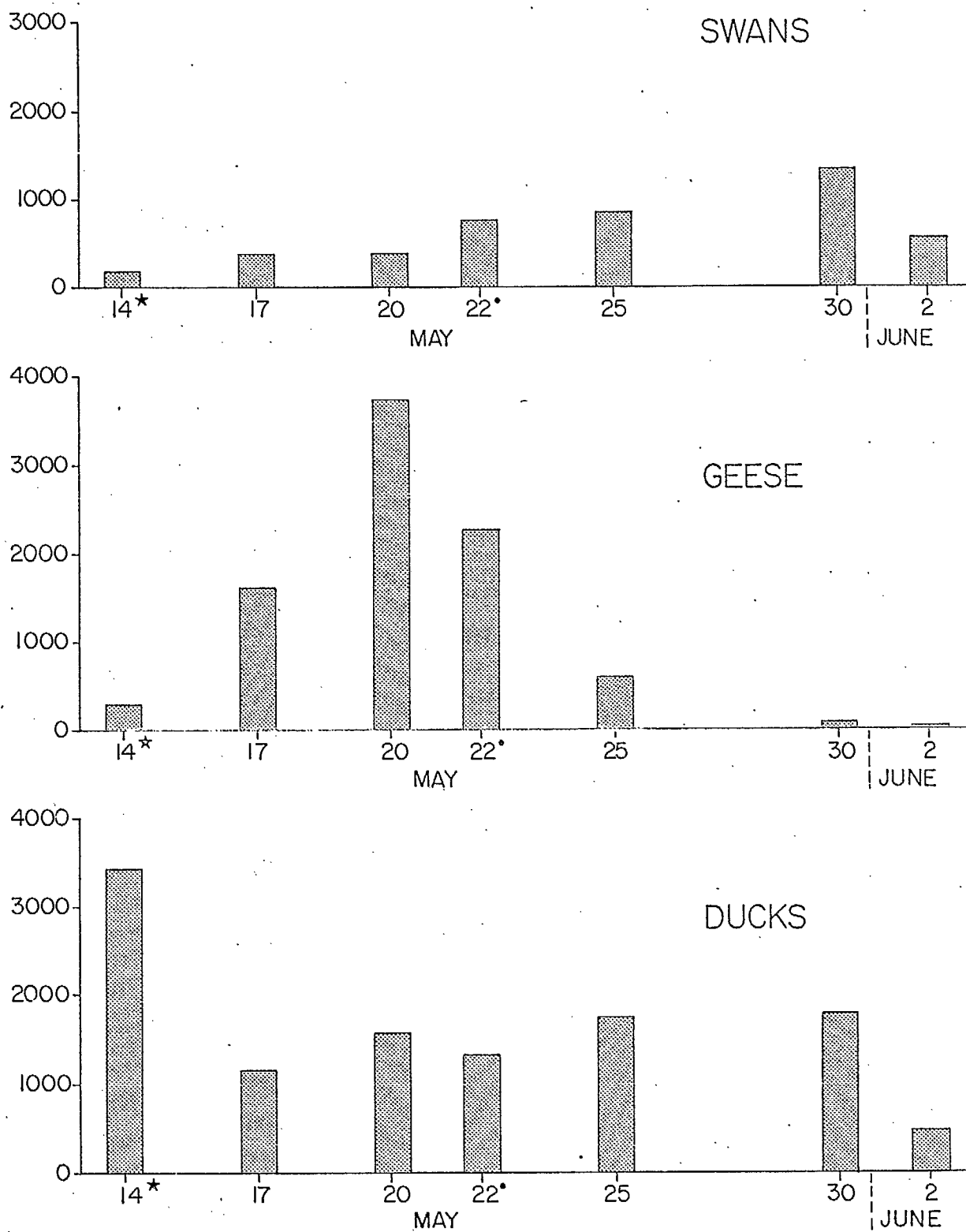
Table 5. Estimated numbers of ducks, geese, and swans recorded during spring aerial surveys, Slave River Delta, N.W.T., 1979.

Date	Number of			Total No. of Waterfowl
	Ducks	Geese	Swans	
14 May	3435	292	174	3901
17 May	1166	1607	386	3159
20 May	1569	3715	390	5674
22 May	1320	2255	752	4327
25 May	1724	593	837	3154
30 May	1779	75	1339	3193
2 June	472	17	548	1037

Table 6. Estimated numbers of ducks, geese, and swans recorded during spring aerial surveys, south shore of Great Slave Lake (Slave River Delta to Taltson Bay inclusive) N.W.T., 1979.

Date	Number of			Total No. of Waterfowl
	Ducks	Geese	Swans	
24 25 May*	3161	7060	4250	14471
25 May	5319	10257	5405	20981
30 May	3705	2620	4100	10425
2 June	1630	327	1931	3888

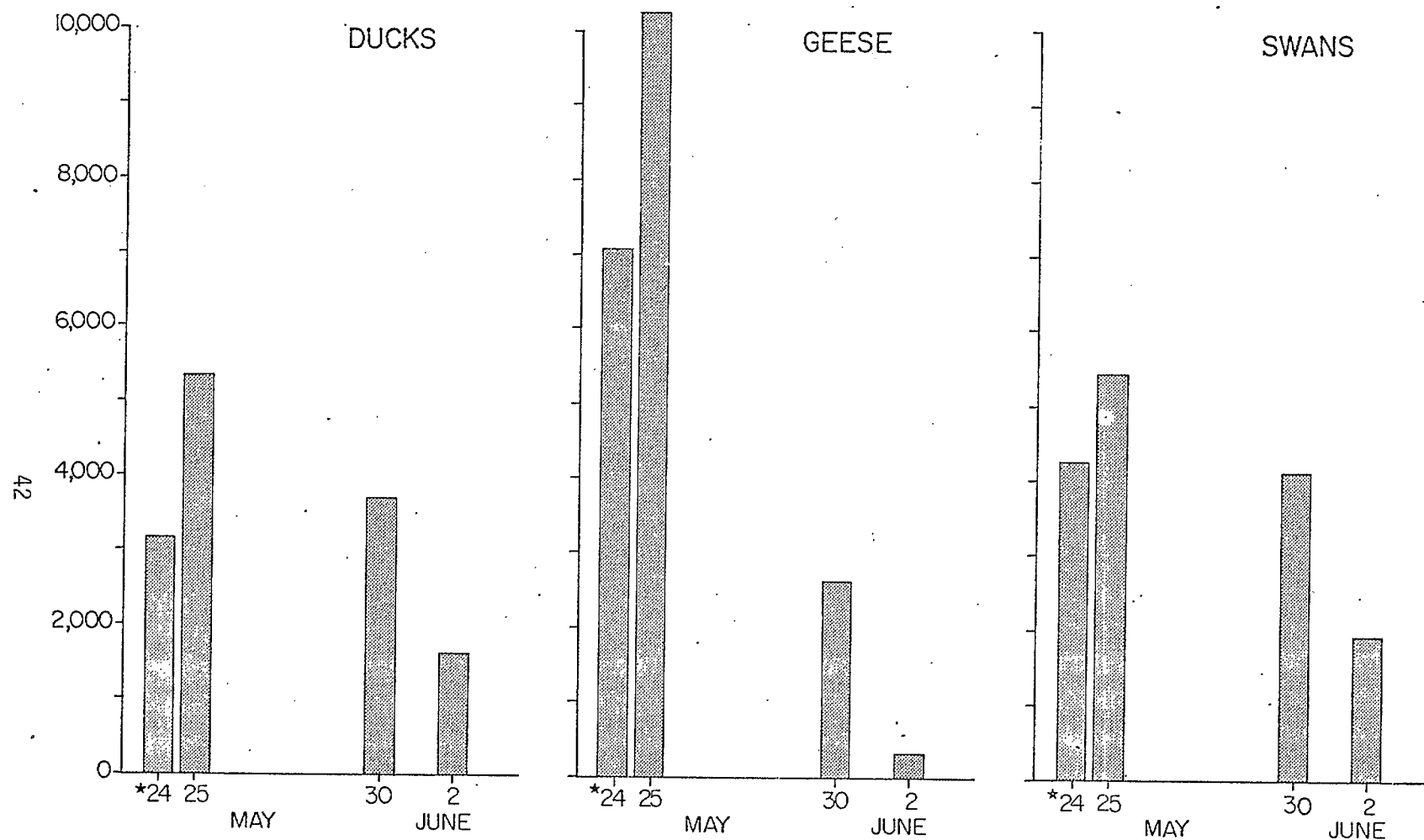
* 24 May survey did not include Slave River Delta.



★ First open water along channels and Great Slave Lake shoreline.

• Breakup on Slave River Delta.

Figure 9. Estimated numbers of ducks, geese, and swans recorded during spring aerial surveys, Slave River Delta, N.W.T., 1979.



*24 May survey did not include Slave River Delta.

Figure 10. Estimated numbers of ducks, geese, and swans recorded during aerial surveys, south shore of Great Slave Lake, Slave River Delta to Talison Bay inclusive, N.W.T., 1979.

As in the fall of 1978, the Slave River Delta was found to be a component of a larger spring staging area extending from Fort Resolution to Taltson Bay. Total waterfowl numbers along the south shore peaked on 25 May (20,981). The peak number of migrants of all species consisted of 5,319 ducks, 10,257 geese, and 5,405 swans (Table 6, Figure 10). The ducks consisted of mainly divers, particularly Scaup sp. (1,989). Geese observed were classified as unidentified dark geese (8,409), White-fronted Geese (602), unidentified white geese (520) and Canada Geese (83).

The Slave River Delta is located in the migration corridor of the Whistling Swans. Hence all swans recorded were assumed to be of this species. The most heavily utilized sections of the south shore and the Slave River Delta were Taltson Bay, Gaudet Bay, Jackfish Bay, Nagle Bay, and two unnamed bays northeast of Jean River.

Canada Geese using the Slave River Delta are of the short-grass prairie population (Bellrose 1976), which consists of approximately 125,000 geese, most of which are Lesser Canada Geese (Branta cariadensis parvipes). They winter in Colorado, Texas, and Nebraska and breed in the Mackenzie Delta and central Arctic (Bellrose 1976). For White-fronted Geese, the migration corridor closest to the Slave River Delta passes through the Mills Lake area, N.W.T. (Bellrose 1976). Bellrose estimates that approximately 51,000-100,000 White-fronted Geese use this corridor. Further to the east, a corridor used by 13,000 to 25,000 White-fronted Geese passes over the Thelon Game Sanctuary. White-fronted Geese using the Slave River Delta and south shore may be from either of these populations.

Bellrose (1976) estimates that the Slave River Delta and south shore of Great Slave Lake are used by 101,000 to 250,000 Lesser Snow Geese enroute from Peace-Athabasca Delta to the Mackenzie Delta, Anderson River, and Banks Island breeding areas. The low numbers of Snow Geese observed during spring surveys in 1979 suggests that their major migration corridor may not be through the Slave River Delta. However, such a speculation cannot be corroborated from one year's data. Furthermore, 1979 was atypical in having an abnormally late spring. The major flyway for Ross' Geese extends through the east arm of Great Slave Lake. Small numbers of Ross' Geese were seen amongst Snow Geese in Gaudet Bay on 24 May.

The major Whistling Swan migration corridor passes over the Slave River Delta enroute from the Peace-Athabasca Delta to the Mackenzie Delta and Alaska. The population using the corridor is estimated at 30,000 to 60,000 (Bellrose 1976). The Slave River Delta and south shore appear to be slightly less important for swan utilization than is the Peace-Athabasca Delta. The peak number of swans observed in the Peace-Athabasca Delta in 1971 was 7,619 (Hennan 1971) compared to 5,405 observed on the Slave River Delta and south shore in 1979. Based on Hennan's study, goose utilization of the Peace-Athabasca Delta was much higher than that observed on the Slave River Delta. In comparison to the Mills Lake area (Kemper et al. 1974), however, the Slave River Delta assumes much greater prominence.

In conclusion, the Slave River Delta forms a portion of a larger spring staging area located along the south shore of Great Slave Lake from Fort Resolution to Taltson Bay. The delta provides open water

early in the spring for dabbling ducks. The ensuing breakup and spring flood probably helps to provide early open water along the adjacent shoreline and bays of Great Slave Lake. Taltson Bay, Gaudet Bay, and two unnamed bays along the south shore, along with Jackfish Bay, Magle Bay and the "outer delta" in the Slave River Delta were felt to provide optimum spring staging habitat for geese and swans.

CHAPTER VII

NON-GAME MIGRATORY BIRDS

A. Introduction

Although the main emphasis of this study was to evaluate the delta in terms of waterfowl utilization, efforts were also made to study the non-game migratory birds using the delta. This included raptors, water-oriented birds, passerines and "passerine-like" birds (eg. woodpeckers, kingfishers).

Only by studying all birds occurring in the area can the real importance of the delta be evaluated in the context of migratory birds. The delta, due to its diverse vegetation types, hosts varied groups of bird species, the majority of which are not usually found in the coniferous sections of the boreal forest which dominate the surrounding areas. Large areas of silt flats and sandspits provide suitable habitat for the fall flight of shorebirds.

B. Methods

Several different techniques were used to evaluate non-game migratory bird use of the delta. Nest searches on the sandspits of the "outer delta" were conducted for colonies of Arctic Terns (Sterna paradisea) and California Gulls (Larus californicus). Nests and eggs

were counted. Eggs were floated and aged according to Westerkov (1950) in order to predict hatching dates.

Nesting raptors were monitored and nest site data were collected. Nest heights were determined by use of a clinometer on a Silva Compass (Ranger model). All sightings of raptors were mapped to determine areas used by these birds.

Migrating shorebirds were counted during fall migration aerial surveys for waterfowl. Ground censuses were conducted on 20 August, 4, 5, and 6 September in order to determine the species composition of shorebird flocks. Incidental sightings of the other birds were recorded during fall and spring aerial surveys.

A modification of the Breeding Bird Survey (Robbins and Van Velzen 1967) was used to evaluate the delta in terms of breeding use by passerine and "passerine-like" birds (Figure 11). Seven transects, of length varying from 3.2 to 14.5 km were surveyed seventeen times (Table 7). In total, 50.2 km of transects were surveyed with 38 stops. The stops were spaced about 1.25 km apart. At each stop, all species heard and seen during a ten minute interval were recorded. Cassette recordings of a Field Guide to Western Bird Songs (Peterson 1962a) and a Field Guide to Eastern Bird Songs (Peterson 1962b) were used to identify unknown bird songs. Robbins et al. (1966) and Peterson (1961) were also used to identify unknown birds. The direction of each bird in relation to an observation stop was noted to prevent the same individual from being recorded twice. Fifty-five percent of all surveys were conducted in the early morning, 25% in the late evening, and 20% in the mid-afternoon. All surveys were stopped whenever weather conditions became windy or rainy. No attempt was made to estimate the absolute density of the species recorded on the transects.

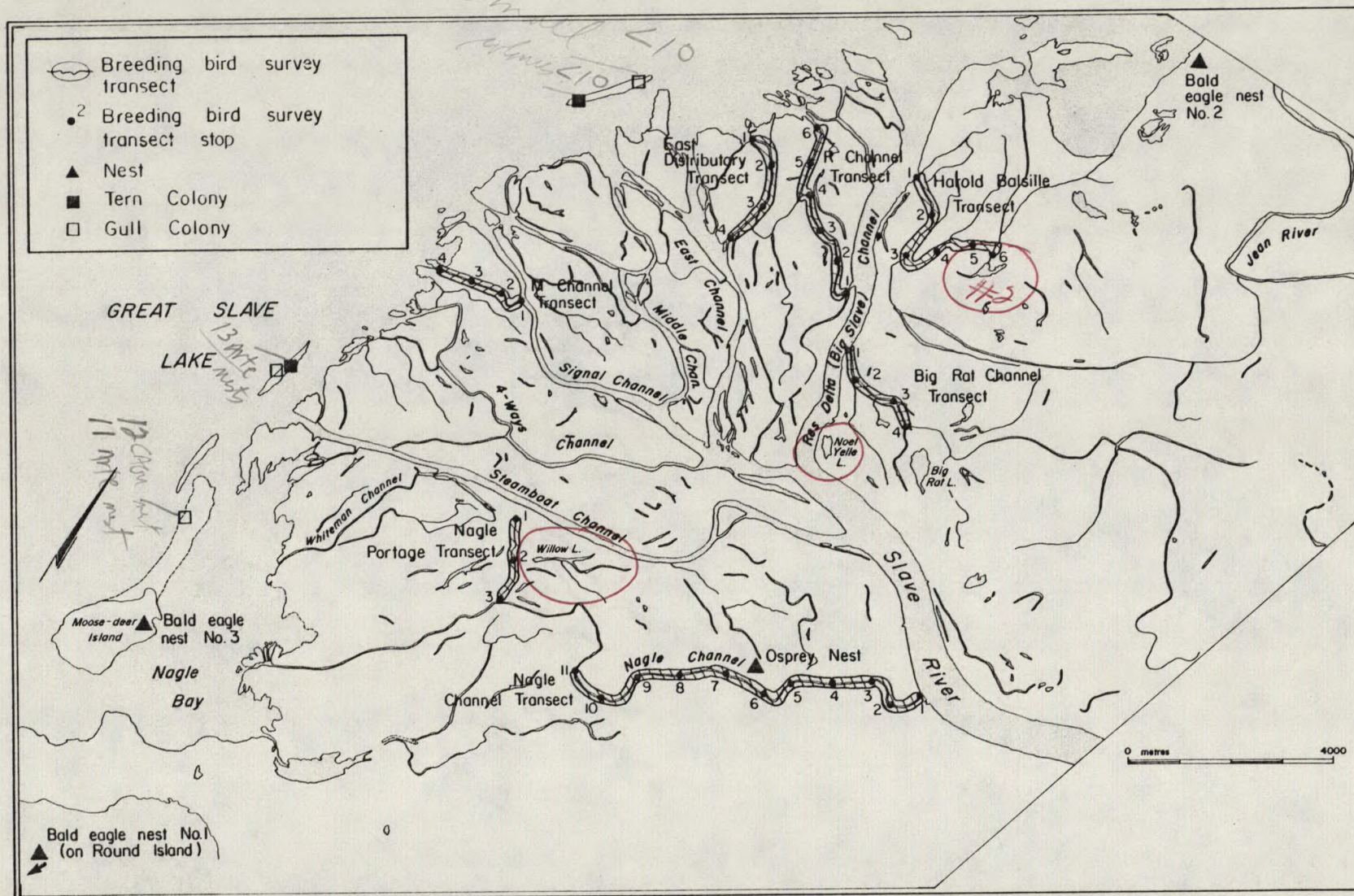


Figure 11. Locations of Breeding Bird Survey transects and raptor nests, Slave River Delta, N.W.T., 1978.

Table 7. Breeding bird survey transects, Slave River Delta, N.W.T., 1978.

Transect	Transect Lengths (km)	No. of Stops	Replicates
I (Nagle Channel)	14.5	11	4
II (Nagle Portage)	3.2	3	3
III (Big Rat Channel)	5.0	4	2
IV (Harold Balsillie Channel)	8.0	6	2
V (M Channel)	5.0	4	2
VI (R Channel)	8.0	6	2
VII (East Distributary)	6.5	4	2
TOTALS	50.2	38	17

An index of frequency of occurrence for each species was computed by dividing the number of stops at which a species was observed by the total number of stops on all transects. This index was used to assess the relative abundance of species breeding on the delta. Vegetation communities at each stop along the transects were noted according to English (1979).

C. Results and Discussion

Observations of various species and groups of non-game birds were recorded as follows:

C.1 Raptors

Sharp-shinned Hawk (Accipiter striatus)

This raptor was sighted once, on 20 June on an abandoned channel northeast of Big Rat Lake. The habitat was of thick deciduous and mixed-wood forest which is generally preferred by this species (Salt and Salt 1976).

Red-tailed Hawk (Buteo jamaicensis)

A pair of Red-tailed Hawks nested near the Jean River, approximately seven km inland from Great Slave Lake. Only one sighting of this species was recorded on the delta, near stop #2 on R Channel Transect on 23 May 1978.

Rough-legged Hawk (Buteo lagopus)

Three individuals which remained on the delta throughout the summer were observed. Their feeding territories covered areas between 4-ways and Steamboat channels, and included the mouth of Whiteman

Channel, and the area along the southwest shore of Steamboat Channel. Rough-legged Hawks breed in the arctic from Newfoundland to northern Yukon and Alaska (Salt and Salt 1976). Those hawks seen on the delta are believed to have been non-breeding immatures.

Golden Eagle (Aquila chrysaetos)

In 1978, one sighting of this raptor was recorded on 23 May in the "outer delta" area. In 1979, two Golden Eagles were sighted on the Slave River Delta on 14 May. On spring surveys of the "south shore" eight Golden Eagles (3 immatures, 5 adults) were recorded on 24 May.

Bald Eagle (Haliaeetus leucocephalus)

Three Bald Eagle nests were found on the delta (Figure 11). Nest #1, on Round Island near Fort Resolution, was located at the top of a 12 m black spruce tree. On 4 June, two eggs were seen in the nest. Two young were later sighted on 18 July.

Nest #2 was located near the mouth of the Jean River. Two eggs were observed in this nest on 7 June. On 18 July, two young of the year were sighted. Between 25 August and 26 September, the young of the year were seen in areas adjacent to the nest site. By 30 September, no eagles were observed in the area.

In spring of 1979, this nest was checked during aerial surveys. On 9 May, one adult Bald Eagle was incubating an unknown number eggs. Both adult birds were seen at the nest site on 14 May.

A third Bald Eagle nest was sighted on Moose-Deer Island on 8 July. The nest was empty. While two adult eagles remained near the nest throughout the summer, they did not successfully breed. No nest or eagles could be found in the spring of 1979.

Ten Bald Eagles (5 immatures, 5 adults) were sighted on 24 May along the south shore of Great Slave Lake.

Osprey (Pandion haliaetus)

One nest having two eggs was sighted on 7 June near Nagle Channel between stops #6 and #7 of Nagle Channel Transect (Figure 12). On 18 July, two young were sighted. Only one fully feathered young was seen in the nest on 25 August. By 2 September, no adult or immature birds were observed in the area.

No evidence of Ospreys was seen on the first spring survey of 1979. By 14 May, however, two Ospreys had returned to the nest site, and incubation of two eggs had begun by 20 May.

Marsh Hawk (Circus cyaneus)

Marsh Hawks were commonly seen on foraging flights over the "outer delta" during the summer. During fall surveys large numbers of this species were sighted migrating through the delta.

Merlin (Falco columbarius)

A total of six sightings of this falcon were recorded. Nagle Channel Transect and Willow Lake were the only two areas in which these birds were observed. Both of these areas have stands of black spruce which could provide suitable nesting habitat.

American Kestrel (Falco sparverius)

This falcon was recorded four times. It was usually seen close to the "outer delta" where large insects, their major food source, were abundant.

Great Horned Owl (Bubo virginianus)

A family group of Great Horned Owls, including one adult and two young, was sighted on Nagle Portage Transect on 22, 27 June, and 9 July. Two adults and one downy young bird were sighted on 20 June on an old river channel northeast of Big Rat Lake. On 15 July, one adult and one young Great Horned Owl were seen at stop #2 of R Channel Transect.

Short-eared Owl (Asio falimneus)

This species commonly hunted over the horsetail stands of the "outer delta". The habitat of the delta is suitable for this species as it prefers marshes and wet meadows. However, it is not common in the northern forested regions (Salt and Salt 1976).

C.2 Transients and Visitants

Incidental sightings of spring and fall transient non-game migratory birds were recorded (Table 8). Most of these birds were shorebirds on migration. One sighting was noteworthy. On 1 June 1979 three American Avocet (Recurvirostra americana) were sighted close to stop #1 on R Channel Transect. These birds generally breed in the prairie region and are rare in the northern forests. Formerly, however, they bred as far north as the southern Mackenzie region, and were observed at Fort Rae around 1861 (Godfrey 1966). Specimens were taken in the nineteenth century at Fort Rae and Fort Resolution (Godfrey 1966).

A sighting of the rare Caspian Tern (Hydroprogne caspia) occurred on 18 July 1978 on a sandspit in the "outer delta". Preble (1908) recorded a Caspian Tern between the Slave River Delta and Stoney

Table 8. Spring and fall migratory non-game birds sighted on the Slave River Delta, N.W.T., 1978.

Spring Transients

Common Loon (Gavia immer)

Red-necked Grebe (Podiceps grisegena)

Semipalmated Plover (Charadrius semipalmatus)

American Golden Plover (Pluvialis dominica)

Black-bellied Plover (P. squatarola)

Yellowlegs (Tringa sp.)

Red Knot (Calidris canutus)

Baird's Sandpiper (C. bairdii)

Stilt Sandpiper (Micropalama himantopus)

Semipalmated Sandpiper (Calidris pusillus)

American Avocet (Recurvirostra americana)

Parasitic Jaeger (Stercorarius parasiticus)

Lapland Longspur (Calcarius lapponicus)

Snow Bunting (Plectrophenax nivalis)

Fall Transients

Sandhill Crane (Grus canadensis)

Semipalmated Plover (Charadrius semipalmatus)

American Golden Plover (Pluvialis dominica)

Black-bellied Plover (P. squatarola)

Yellowlegs (Tringa sp.)

Pectoral Sandpiper (Calidris melanotos)

Baird's Sandpiper (C. bairdii)

Least Sandpiper (C. minutilla)

Dowitcher (Limnodromus sp.)

Stilt Sandpiper (Micropalama himantopus)

Semipalmated Sandpiper (Calidris pusillus)

Western Sandpiper (C. mauri)

Buff-breasted Sandpiper (Tryngites subruficollis)

Hudsonian Godwit (Limosa haemastica)

Sanderling (Calidris alba)

Northern Phalarope (Lobipes lobatus)

Parasitic Jaeger (Stercorarius parasiticus)

Horned Lark (Eremophila alpestris)

Lapland Longspur (Calcarius lapponicus)

Snow Bunting (Plectrophenax nivalis)

Island in 1901 and saw several at Fort Resolution in 1908. Soper (1942) saw two individuals near Fort Resolution. Trauger and Bromley (1976) reported three breeding pairs on the West Mirage Islands, Great Slave Lake in 1956. Weller et al. (1969) states that other colonies may exist on Great Slave Lake but they have not been surveyed.

Spring migrants in 1978 were scarce and only Baird's Sandpipers (Calidris bairdii) were frequently sighted. All other spring migrants were sighted once or twice (Table 8).

Large flocks of shorebirds were seen moving through the delta in August. Fall migrating shorebirds were surveyed from 21 August to 30 September (Figure 12). The peak of the shorebird flight occurred on 11 September when 3,101 shorebirds were recorded. The majority of these birds passed through the delta between 6 September and 16 September. These flocks were composed primarily of Pectoral (Calidris melanotos), Semipalmated (C. pusillus), and Baird's Sandpipers. Dowitchers (Limnodromus sp.) and Least Sandpipers (Calidris minutilla) were also seen, but were much less abundant. Yellowlegs (Tringa sp.) and Hudsonian Godwits (Limosa haemastica) were occasionally seen in these flocks. A few sightings were made of the American Golden Plover (Pluvialis dominica), Black-bellied Plover (P. squatorola), Semipalmated Plover (Charadrius semipalmatus), Buff-breasted Sandpiper (Trygites subruficollis), Stilt Sandpiper (Micropalama himantopus), Sanderling (Calidris alba), Western Sandpiper (C. mauri), and Northern Phalarope (Lobipes lobatus). The silt flats along the channels provided excellent habitat for these species. The peak of migration occurred in September.

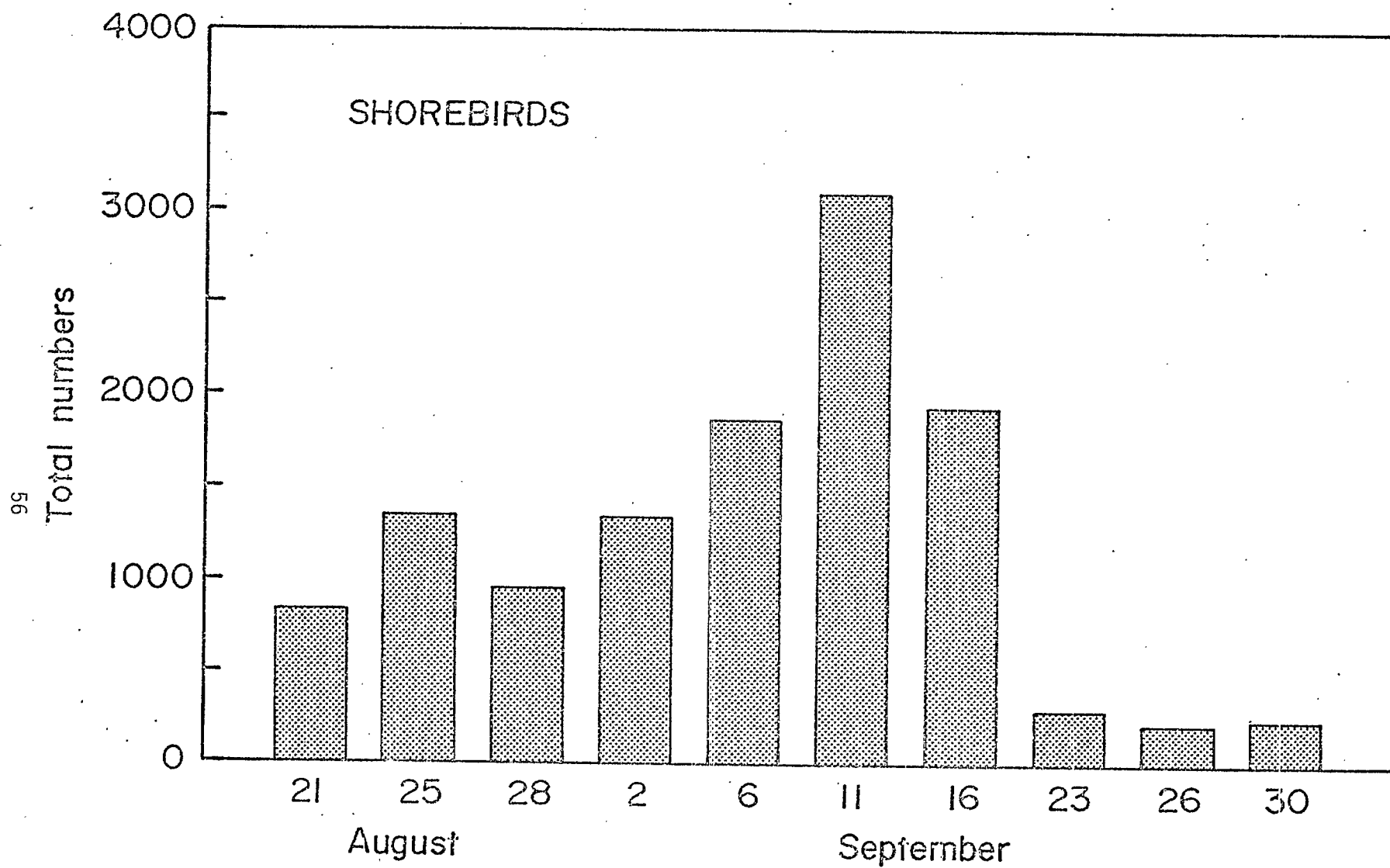


Figure 12. Estimated numbers of shorebirds recorded during fall aerial surveys, Slave River Delta, N.W.T., 1978.

Several flocks of Sandhill Cranes (Grus canadensis) were sighted migrating over the delta in August. There was a resident population of between three and seven birds commonly seen near the airport runway in Fort Resolution. Occasional sightings of a pair of Sandhill Cranes occurred in the Steamboat Channel area and near the mouth of Nagle Channel. It was not determined if these birds were breeding.

C.3 Residents

Based on the calculation of frequency of occurrence indices, the most common breeding non-game bird was the Yellow Warbler [(Dendroica petechia) (.354)] (Table 9). Other common species on the delta were the Common Snipe [(Capella gallinago) (.304)], White-throated Sparrow [(Zonotricha albicollis) (.299)], Tree Sparrow [(Spizella arborea) (.268)], Horned Grebe [(Podiceps auritus) (.256)], and Least Flycatcher [(Empidonax minimus) (.256)], Yellow-rumped Warbler [(Dendroica coronata) (.244)], Red-eyed Vireo [(Vireo olivaceus) (.238)], Swainson's Thrush [(Catharus ustulata)], and Common Yellowthroat [(Goethlypis trichas) (.226)], Tennessee Warbler [(Vermivora peregrina) (.213)] and Spotted Sandpiper [(Acititis macularia) (.152)]. Birds with the highest ranking reflect not only their relative abundance, but also reflect the larger amount of specific habitat types surveyed.

Nine different vegetation communities (English 1979) were sampled along the breeding bird survey transects: 39.5% of all transect stops were of Alnus-Salix habitat; Populus habitat was sampled at 21.1% of stops; Salix-Equisetum at 15.8%, successional stages of Picea at 7.9%; and Salix-Alnus at 5.3% of all stops. Four community types, Equisetum, Salix, decadent Populus, and climax Picea were sampled at 2.6% each.

Table 9. Relative abundance of non-game birds breeding on the Slave River Delta, N.W.T., 1978.

.000 - frequency of occurrence*		Ranking (1) - most common (25) - least common	
Horned Grebe	.256 (5)	American Robin	.073 (14)
Pied-billed Grebe	.018 (23)	Hermit Thrush	.030 (21)
		Swainson's Thrush	.226 (8)
American Bittern	.024 (22)		
		Ruby-crowned Kinglet	.012 (24)
Sora	.018 (23)		
American Coot	.024 (22)	Starling	.037 (26)
Spotted Sandpiper	.152 (10)	Red-eyed Vireo	.238 (7)
Common Snipe	.304 (2)	Warbling Vireo	.043 (19)
→ Herring Gull	Colonial nester		
→ California Gull	Colonial nester	Black-and-white Warbler	.043 (19)
→ Bonaparte's Gull	Colonial nester	Tennessee Warbler	.213 (9)
→ Arctic Tern	Colonial nester	Yellow Warbler	.354 (1)
→ Black Tern	Colonial nester	Yellow-rumped Warbler	.244 (6)
		Northern Waterthrush	.049 (18)
Common Nighthawk	.043 (19)	Yellowthroat	.226 (8)
Belted Kingfisher	.018 (23)	Wilson's Warbler	.030 (21)
		American Redstart	.055 (17)
Common Flicker	.079 (13)		
Yellow-bellied Sapsucker	.012 (24)	Red-winged Blackbird	Group nester
Hairy Woodpecker	.030 (21)	Rusty Blackbird	.018 (23)
Downy Woodpecker	.006 (25)	Common Grackle	.061 (16)
Eastern Kingbird	.049 (18)	Western Tanager	.006 (25)
Alder Flycatcher	.061 (16)		
Least Flycatcher	.256 (5)	Rose-breasted Grosbeak	.018 (23)
Western Wood Peewee	.006 (25)		
Tree Swallow	.268 (4)	Savannah Sparrow	.079 (13)
Bark Swallow	.061 (16)	Sharp-tailed Sparrow	.012 (24)
		Dark-eyed Junco	.079 (13)
Gray Jay	.043 (19)	Tree Sparrow	.055 (17)
		White-throated Sparrow	.299 (3)
Common Raven	.128 (11)	Lincoln's Sparrow	.006 (25)
		Swamp Sparrow	.067 (15)
Black-capped Chickadee	.018 (23)	Song Sparrow	.110 (12)
Boreal Chickadee	.066 (16)		

* Frequency of occurrence = $\frac{\text{no. of transect stops sp. present}}{\text{total no. of transect stops}}$

It should be noted that identification of small birds by song is a skill that is developed over many years of experience. Many biases are involved in this type of survey work. On breeding bird surveys some factors that affect the conspicuousness of a species are the physical characteristics of size, colour, and form; the behaviour of the species, including the duration and frequency of its songs and calls, its reproductive patterns, flight characteristics, and wariness; and the environment in which the bird is found (Howell 1951). The transect method may overestimate the density of conspicuous species while underestimating the densities of less detectable species (Davis et al. 1975).

Nest searches of colonial Arctic Terns and California Gulls were conducted on 13 June, and 18 July. On 13 June Moose-Deer sandspit and Steamboat sandspit had 12 gull nests and 11 tern nests. Of the 12 gull nests, seven had eggs and five were abandoned. Because of the territorial behaviour of the adult birds (i.e. scolding), active nests were more easily located than abandoned ones. On 18 July, Steamboat sandspit was once again searched and 13 tern nests were found, ten of which were active. However, 14 one week-old terns were found wandering over the sandspit. Three dead chicks were also found. No gull nests were counted on the second survey. Small California Gull and Arctic Tern colonies were also located on the sandspit near the mouth of East Channel. Stelfox and Brewster (1979) indicate that smaller sized gull and tern colonies are characteristic for more northern latitudes.

Groups of nesting Black Terns (Chilodnias niger) were found on Willow Lake on 17 June, Big Rat Lake on 22 June, Noel Yellie Lake on 7 July and Lake #2 on 22 June. These birds were found nesting in horsetail bordering the lakes.

Red-winged Blackbird (Agelaius phoeniceus) nesting groups at Willow Lake, Big Rat Lake, and Lake #2 were surveyed on 17, 20, and 22 June respectively. Numbers of territorial males and nests were recorded. Territorial male Red-winged Blackbirds were found in lower densities in the "outer delta" area than on the lakes. This was probably due to the lack of extensive cattail areas in the "outer delta". A total of 70 territorial males were seen on these lakes, which had a combined shoreline length of 11.2 km. The linear density of male Red-winged Blackbirds was 6.52 per km. Sixteen nests were found. Average clutch size was 4.1.

No unique bird populations occurred on the delta. However, the delta does provide habitat for birds such as the Yellow Warbler, American Redstart, Red-eyed Vireo, which are not normally found in the coniferous areas of the boreal forest of this region. Sightings of American Avocets and a Caspian Tern were of notable importance. A breeding range extension of the Common Yellowthroat was also verified.

CHAPTER VIII

GEOGRAPHICAL SIGNIFICANCE OF THE SLAVE RIVER DELTA

A. Local Significance

In terms of habitat suitable for waterfowl production, the Slave River Delta is superior to the boreal forest which surrounds it. Habitat diversity in the delta is much greater than that of the surrounding areas and thus provides much more attractive habitat for nesting passerines and waterfowl.

As a staging area for migrating waterfowl, the delta is an important sub-unit of a larger staging area extending from Fort Resolution along the south shore of Great Slave Lake to Taltson Bay. The "outer delta" in particular is a very important component of this staging area. Due to the presence of large mudflats created by spring sediment deposition followed by low water levels, the delta is also an important migration stop for fall migrating shorebirds.

The residents of Fort Resolution harvest a substantial portion of the delta's game resources. The hunting of migratory waterfowl is significant. Bodden (1979) in his socio-economic study of the natives of Fort Resolution (1975 to 1977) collected data on the importance of wild game in their diet. Waterfowl comprised approximately 39% of the total weight of all wild game consumed by the residents of the village. A total of 3,865 ducks and 616 geese in 1976, and 4,101 ducks and 494 geese in 1977, were taken by six to ten hunters of Fort Resolution (Bodden 1979).

B. Regional Significance

Situated in the southern Mackenzie District and northern Alberta regions, the Slave River Delta is one of the few major breeding areas in the boreal forest. In a regional context, duck utilization during the breeding and migration periods appears to be much higher in the Peace-Athabasca Delta and Mills-Beaver Lakes areas. This is not surprising since the Slave River Delta is much smaller and limited in habitat diversity than the latter two areas. It is noteworthy, however, that on a per unit area basis, the Slave River Delta's utilization by migrating geese and swans is possibly higher than the Mills-Beaver Lakes area and certainly comparable to that of the Peace-Athabasca Delta. In any event, these three biologically-rich areas tend to provide "oases" of waterfowl habitat in comparison to the much less productive boreal forest.

C. Continental Significance

The Slave River Delta is located on three of the four major waterfowl flyways of North America. The flyways are Central, Mississippi, and Atlantic (Linduska 1964). Bellrose (1976) estimates that the duck population that passes through the Slave River Delta and the south shore totals between 50,000 and 225,000, the goose population is up to 300,000 and the Whistling Swan population is between 30,000 and 60,000.

The Slave River Delta does not produce a large number of ducks each year. However, as part of the northern boreal forest region, the delta provides available breeding habitat for waterfowl when dry years

occur on the prairies. The prairie pothole region is the most important waterfowl production area on the continent. In low water years, when the ponds and sloughs of the prairies dry up, large numbers of adult ducks move northward to the Mackenzie District, N.W.T. where more stable water conditions occur. Some of these displaced ducks breed in the north, however, success is lower (Hanson and McKnight 1964; Smith 1970). The delta, with its rich diverse habitat compared to the surrounding boreal forest, will increase in value at these times.

On a continental basis, the Slave River Delta is of greatest significance as a spring and fall migration stop for Whistling Swans and geese. During migration periods, it probably receives use from the major proportion of the North American Whistling Swan population.

CHAPTER IX

SENSITIVITY TO ENVIRONMENTAL CHANGE

Because of its tremendous hydro-electric potential, future development affecting the Slave River, and hence the Slave River Delta, is a distinct possibility. While the intent, here, is not to look at impact of specific development options, the following discussion attempts to elucidate the relationships between the delta's water regime characteristics and resultant use by migratory birds. Such information may be useful in future impact studies.

The Slave River Delta exists as a result of fluvial deposition caused by reduced velocity and carrying capacity of sediment of the Slave River as it flows into Great Slave Lake (Reid and Wood 1976). The heavier particles of silt settle out near the mouth while the lighter ones are carried out to settle in the lake bottom. In order for the delta to continue forming, the river must be contributing sediments faster than they are washed away by lake currents and waves. A continuous deposition of sediments causes a lakeward growth of the delta, and the amount of suspended material determines how fast the delta grows (Reid and Wood 1976; Bardach 1964). Because of the tendency of channels to flare into plumes upon entering the lake, mid-channel deposition occurs giving rise to shoals which ultimately form lenticular-shaped islands. This action results in the formation of deltas characterized by branching and occasional rejoining of channels separated by islands (Lauff 1967).

If a reduction in sediment load were to occur upstream of the delta, the buildup of shoals and bars which are used by geese, swans, and shorebirds for feeding and for protection would be stopped (Stevens 1971). In the long run a decrease in the size of the delta would occur due to erosion by lake waves and currents.

Spring floods flush ice from the river channels and provide open water which is occupied by migrating waterfowl early in the spring (Stevens 1971). Ice jams in some years cause further increases in delta water levels. The floods allow vegetation in large areas of the delta to be retained at an early successional stage characterized by species such as horsetail (Stevens 1971). These plants are eaten by migrating geese and ducks (Gill et al. 1977). The elimination or reduction of spring floods would delay both the breakup and the resultant early use by waterfowl. If such natural flooding did not occur, colonization by willows and other woody plants in the areas presently restricted to early successional species would take place (Peace-Athabasca Delta Project Group 1972; Stevens 1971). The replacement of early successional species by non-digestible shrubs could reduce the use of these areas by migrating and breeding waterfowl, although for the first two or three years of low water, the feeding areas would be temporarily extended (Peace-Athabasca Delta Project Group 1972). The preferred habitat of waterfowl in the Slave River Delta is that occupied by primary levels of plant succession, which is retained at such early stages by flooding and sediment deposition (Stevens 1971). Perched basins and snyes are important habitat for brood production. They could eventually dry up and become overgrown by vegetation if Slave River floods were reduced. Boreal forest vegetation

would extend over a greater area of the delta at the expense of early successional vegetation (Stevens 1971).

With the change to boreal-type ponds, different species of birds would use the area. Bufflehead and Goldeneye sp. would replace American Widgeon and Mallard as common ducks. Habitat for passerines would become less diverse, resulting in the loss of certain species and noticeable changes in species composition. In general, plant and animal diversity of the delta would decrease because of less variety of habitat types. Persistantly high levels on the delta would have similar affects.

In summary, it is evident that a change in the water regime of the Slave River would have significant effects on the flora, fauna, and physical characteristics of the Slave River Delta. The populations of waterfowl and shorebirds are sensitive to changes that may occur as a result of natural or man-induced alterations in the water regime.

CHAPTER X

SUMMARY AND CONCLUSIONS

1. The objectives of the study were:

"to compile a list of bird species using the area and their relative status, and to document the area's potential for maintaining rare species."

"to document the use of the study area by migratory birds during the spring staging, breeding, production and fall staging periods in relation to existing habitat conditions, (Mac. Riv. Basin Com. Study Prog. 1978)."

2. The Slave River Delta (61°15'N lat, 113°40'W long) is located 200 km downstream of Fort Smith on the Slave River. The area of the delta is 310 km². The Slave River drainage includes large areas of northern British Columbia, Alberta, and Saskatchewan as well as the Slave River Lowlands in the Northwest Territories. Large areas of riparian vegetation occur on the Alluvium land type. The Slave River Delta is located within the sub-arctic climatic zone.

3. The Slave River Delta provides superior breeding habitat for ducks compared to the surrounding boreal forest. The estimated duck breeding population in 1978 was 5,218 pairs of 16.8 pairs per km². Common breeding species were, in order of abundance: Lesser Scaup, Mallard, American Widgeon, Bufflehead, and Blue-winged Teal.

4. Brood counts were low relative to breeding pair estimates. During the peak survey, 47 broods (201 ducklings) were recorded. Low brood numbers were attributed to several factors ranging from aircraft

inefficiency to dispersal of breeding pairs to surrounding areas. Most incubation started between 28 May and 24 June 1978. Delayed nesting of dabbling duck species occurred because of the late spring. The main hatch period for all species occurred between 23 June and 17 July 1978. Common brood species were Teal sp., American Widgeon, Mallard, Bufflehead, Scaup sp., Goldeneye sp., and Canvasback. 1,632 moulters were seen on 11 August.

5. The Slave River Delta is a sub-unit of an important fall staging area existing along the south shore of Great Slave Lake between Fort Resolution and Taltson Bay. By conservative estimates the south shore of Great Slave Lake supported more than 7,700 swans and 4,400 dark geese on 16 September 1978. In addition, estimated waterfowl numbers of the delta, itself, reached a peak of 7,634 on that date consisting of 3,957 ducks, 2,169 geese, and 1,508 swans. The delta and the south shore of Great Slave Lake were felt to be most important as a migration stop for Whistling Swans and to a lesser extent, geese. The delta's staging value to ducks was considered to be much lower than either the Peace-Athabasca Delta or the Mills-Beaver Lakes.

6. The south shore of Great Slave Lake including the Slave River Delta was also found to be an important spring staging area for swans, geese, and to a lesser extent, ducks. On 25 May 1978, 20,981 waterfowl were counted consisting of 10,257 geese, 5,405 swans and 5,319 ducks. Waterfowl numbers on the delta, itself, reached a peak of 5,674 on 20 May consisting of 1,569 ducks, 3,715 geese, and 390 swans.

7. The diversity of habitat in the Slave River Delta compared to the surrounding boreal forest makes it important to many species of

raptors, passerines, and shorebirds. Raptors sighted were Sharp-shinned Hawk, Red-tailed Hawk, Rough-legged Hawk, Golden Eagle, Bald Eagle, Osprey, Marsh Hawk, Merlin, American Kestrel, Great Horned Owl and Short-eared Owl. Three Bald Eagle nests (including one abandoned), one Osprey nest and one Red-tailed Hawk nest were found. Two significant sightings were recorded of American Avocet and Caspian Tern which would be considered rare in the area. Fall staging shorebirds were counted on aerial surveys, the peak occurring on 11 September (3,101). Colonies of Arctic Terns and California Gulls were found on the sandspits of the "outer delta". A modification of the Breeding Bird Survey (Robbins and Van Velsen 1966) was used to evaluate the delta in terms of breeding use by passerines and other birds. In order of abundance, the most common breeders were Yellow Warbler, Common Snipe, White-throated Sparrow, Tree Sparrow, Horned Grebe and Least Flycatcher, Yellow-rumped Warbler, Red-eyed Vireo, Swainson's Thrush and Common Yellowthroat, Tennessee Warbler, and Spotted Sandpiper.

8. In terms of migratory birds, the Slave River Delta is locally, regionally, and internationally important. Its prime value is as a spring and fall migration stop for swans and geese moving to and from their breeding grounds further north. Migratory birds contribute a large portion of the game harvested by residents of Fort Resolution, N.W.T.

9. Populations of migratory birds would be especially sensitive to any changes that would occur as a result of modifications to the Slave River Delta water regime. For example, a reduction in water

levels and sediment load could affect plant succession and, in turn, utilization by migratory birds. As with other northern deltas, the Slave River Delta is biologically productive because of its naturally fluctuating water regime.

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APPENDIX A

Breeding Pair Data

Table A-1. 23 May reconnaissance flight, waterfowl survey, Slave River Delta, N.W.T., 1978.

Aircraft: Cessna 185 (floats). 450 m at 160 km.

Pilot: Glenn Wakal, Buffalo Airways Ltd., Ft. Smith, N.W.T.

Observers: K. Ambrock, E. Kuyt, K. Bodden

Time: 1330 hrs - 1630 hrs.

Weather: Overcast, ceiling 1200 ft, intermittent rain. Wind northwest 5-10 mph.

General Comments: Great Slave Lake still 95% frozen. Breakup is approximately 10 days later than average. Average breakup date is 11-12 May. All inland sloughs and tributaries open. Shoreline of Great Slave Lake open approximately 20 yards plus large "bay" of open water at Delta.

Results: Survey of "outer delta" only.

Ducks	Geese	Swans	Total
4380	790 (75% Canada geese and 25% White-fronted)	750	5920

Ducks: Most common were Mallard, Lesser Scaup, Ring-necked Duck, and American Widgeon. Other species observed were Pintail, Green-winged Teal (also common), Shoveler, Redhead, Canvasback, Bufflehead, White-winged Scoter, Surf Scoter, and Gadwall.

Other species: Bald Eagle (1 active nest site), Golden Eagle (1), Marsh Hawk, Red-tailed Hawk, Sandhill Crane (3), Coot (common), Black-bellied or Golden Plover, Mew Gulls, California or Ring-billed Gulls (175), Terns, Bonaparte's Gulls, Ravens (common).

Table A-2. Areas censused on breeding pair surveys, Slave River Delta, N.W.T., 1978.

Transects	Length (km)	Area (km)	
		1 June	4 & 7 June
A	54.9	11.0	22.0
B	18.4	3.7	-
C	15.9	3.2	6.4
D	17.6	3.5	-
E	18.0	3.6	7.2
F	16.4	3.3	-
G	17.3	3.4	6.8
H	17.8	3.6	-
I	19.0	3.8	7.6
J	18.8	3.8	-
K	19.1	3.8	7.6
L	19.6	3.9	-
M	15.9	3.2	6.4
N	14.1	2.8	-
O	9.7	1.9	3.8
Ponds	-	-	0.7
Total	-	58.5 km ²	67.8 km ²

Area of Delta (Bodden pers. comm.) = 310 km²

Percent of area sample (1 June) = 19% (extrapolation factor = 5.26)
 (4 & 7 June) = 22% (extrapolation factor = 4.57)

Table A-3. 1 June breeding pair survey, Slave River Delta, N.W.T., 1978.

Aircraft: Cessna 185 (floats)

Pilot: Glenn Wakal, Buffalo Airways Ltd., Ft. Smith, N.W.T.

Observers: R. Quinlan, R. Thompson, (K. Ambrock navigating)

Time: 0730 hrs - 1300 hrs. (Survey time 3 hrs.)

Weather: 1/10 cloud. Wind light and variable.

Results:

Species	Pairs	Lone Male	Lone Female	Lone Duck	Total Pairs
Mallard	51	53	9	25	138
Pintail	1	4	-	-	5
Gadwall	4	-	-	-	4
Widgeon	28	10	5	51	94
Shoveler	2	3	1	-	6
Blue-winged Teal	7	2	-	33	42
Green-winged Teal	4	-	-	4	8
Unid. teal	11	28	-	-	39
Unid. dabbler	-	-	-	61	61
Scaup	90	20	-	35	146
Ring-necked Duck	6	-	-	1	7
Redhead	2	-	-	1	2
Canvasback	4	-	-	2	6
Goldeneye	3	-	-	1	4
Bufflehead	36	19	-	17	72
Ruddy Duck	-	5	-	-	5
Unid. scoter	1	-	-	-	1
Unid. dabbler	-	-	-	104	104
Unid. duck	-	-	-	181	181
Total	-	-	-	-	925

Table A-4. 4 June breeding pair survey, Slave River Delta, N.W.T., 1978.

Aircraft: Cessna 185 (floats)

Pilot: Glenn Wakal, Buffalo Airways Ltd., Ft. Smith, N.W.T.

Observers: R. Quinlan, R. Thompson, (K. Ambrock navigating)

Time: 0810 hrs - 1325 hrs. (Survey time 2 hrs.)

Weather: 9/10 cloud, occasional showers; wind 16 kph from south. Temp. approx. 13°C.

Results:

Species	Pairs	Lone Male	Lone Female	Lone Duck	Total Pairs
Mallard	62	59	11	19	151
Pintail	1	-	-	-	2
Gadwall	1	-	-	8	9
Widgeon	19	12	-	20	51
Shoveler	1	6	-	-	7
Blue-winged Teal	3	1	1	5	10
Unid. teal	3	-	-	15	18
Unid. dabblers	-	-	-	30	30
Scaup	58	40	2	9	109
Ring-necked Duck	1	3	-	-	4
Redhead	-	5	-	-	5
Canvasback	7	16	-	-	24
Goldeneye	3	11	2	2	18
Bufflehead	20	40	5	-	65
Surf Scoter	-	3	-	4	7
Unid. divers	-	-	-	26	26
Unid. ducks	-	-	-	64	64
Total	-	-	-	-	619

Table A-5. 7 June breeding pair survey, Slave River Delta, N.W.T., 1978.

Aircraft: Cessna 185 (floats)

Pilot: Glenn Wakal, Buffalo Airways Ltd., Ft. Smith, N.W.T.

Observers: R. Quinlan, R. Thompson, (K. Ambrock navigating)

Time: 0730 hrs - 1130 hrs. (Survey time 2 hrs.)

Weather: 5/10 cloud, wind 10 mph from east.

Results:

Species	Pairs	Lone Male	Lone Female	Lone Duck	Total Pairs
Mallard	30	75	16	6	126
Pintail	4	9		4	17
Gadwall		2			2
Widgeon	4	12	1	15	32
Shoveler	5	15		2	22
Blue-winged Teal	3	2		13	18
Green-winged Teal				1	1
Unid. teal	2			6	8
Unid. dabbling				62	62
Scaup	51	34	8	19	112
Ring-necked Duck	1	6			7
Redhead	1	2			3
Canvasback	6	1		6	13
Goldeneye	2	8	1	1	12
Bufflehead	18	40	8	8	74
Ruddy Duck		11			11
White-winged Scoter		1			1
Unid. diver				47	47
Unid. ducks				131	131
TOTAL					699

APPENDIX B

Brood Production Data

Table B-1. 18 July brood survey, Slave River Delta, N.W.T., 1978.

Aircraft: Bell 206B helicopter
Time: 0745 hrs - 1025 hrs.

Weather: Temp 7°C, wind N 15 kph, cloud 9/10 cover,
precip. 0, good visibility

Age Class	Dabblers					Divers					Unid. Ducks	TOTAL
	Mal	Widg	Shov	Teal	Unid.	Scaup	Canv	OE	Buff	Ruddy	Unid.	
1a									1(4)*			1(4)
1b	3(14)	1(6)	1(6)	7(32)	1(4)	2(21)		1(1)	3(10)		1(5)	21(101)
1c	1(2)	3(14)		2(17)	2(9)	1(3)	1(2)		1(7)			11(54)
11a		3(8)			2(6)							5(14)
11b		2(4)			2(4)							4(8)
11c	1(2)											1(2)
111												
Unknown class				1(1)	2(12)	1(5)						4(18)
Moulters	93	77	1	24	82	59		11	18	2	119	588
TOTAL	5(18)	9(32)	1(6)	10(50)	9(35)	4(29)	1(2)	1(1)	5(21)		1(5)	47(201)

* 1 = total number of broods per subclass per species.
(4) = total number of ducklings per subclass per species.

Table B-2. 27 July brood survey, Slave River Delta, N.W.T., 1978.

Aircraft: Cessna 185 fixed-wing
Time: 0722 hrs - 0945 hrs.

Weather: Temp 14°C, wind E 12 kph, cloud 1/10 cover,
precip. 0, good visibility

Age Class	Dabblers					Divers						Unid. Ducks	TOTAL
	Mal	Widg	Shov	Teal	Unid.	Scaup	Canv	CE	Puff	Ruddy	Unid.		
1a													
1b					1(6)*								1(6)
1c	1(1)	1(5)		1(6)	1(4)	1(3)					3(8)		8(27)
11a	1(4)	1(5)		1(1)	4(16)							1(3)	8(20)
11b					1(1)		1(4)		1(2)		1(7)		4(14)
11c													
111	1(10)				1(4)								2(4)
Unknown class													
Moulters	71	7	30	1	81	36	5	2	7		82	147	469
TOTAL	3(15)	2(10)		2(7)	8(31)	1(3)	1(4)		1(2)		4(15)	1(3)	23(90)

* 1 = total number of broods sighted per subclass per species.
(6) = total number of ducklings per subclass per species.

Table B-3. 11 August brood survey, Slave River Delta, N.W.T., 1978.

Aircraft: Cessna 185 fixed-wing
Time: 0800 hrs - 1000 hrs.

Weather: Temp 12°C, wind E 12 kph, cloud 2/10 cover,
precip. 0, good visibility

Age Class	Dabblers					Divers					Unid. Ducks	TOTAL	
	Mal	Widg	Shov	Teal	Unid.	Scaup	Canv	GE	Buff	Ruddy			Unid.
1a													
1b					1(6)*							1(6)	
1c		1(5)		1(4)							1(1)	3(10)	
11a		1(4)						1(2)				2(6)	
11b		1(1)										1(1)	
11c					2(5)	2(9)						4(14)	
111					1(4)							1(4)	
Unknown class													
Moulters	187	3		287	176	90		1		6	15	867	1632
TOTAL		3(10)		1(4)	4(15)	2(9)		1(2)				1(1)	12(41)

* 1 = total number of broods per subclass per species.
(6) = total number of ducklings per subclass per species.

APPENDIX C

Spring Migration Data

Table C-1. Spring migration surveys - species compilation, Slave River Delta,
N.W.T., 1979.

Species	14 May	17 May	20 May	22 May	25 May	30 May	2 June
Arctic Loon			1				
Unid. loon						2	
Red-necked Grebe		2	4		1		
Horned Grebe			4				
Whistling Swan	174	386	390	752	837	1339	548
Canada Goose		33	10				
White-fronted Goose		900		3			
"Dark" Goose	137	673	3255	2152	518	75	17
"White" Goose	155	1	450	104	75		
Mallard	330	169	70	40	45	40	36
Pintail	25	1	8	1	5	4	
Blue-winged Teal		1					
Green-winged Teal	8	1					
Unid. teal	5		21	1		4	
American Widgeon	568	63	94	12	38	17	19
Shoveler		1	16		2	2	5
Ring-necked Duck		13	3			2	3
Canvasback	19	49	5	8	7	26	11
Unid. scaup	102	363	432	489	1051	1313	160
Unid. goldeneye	12	14	44	43	20	10	12
Bufflehead	39	36	34	14	12	15	10
Oldsquaw	1						
White-winged Scoter				4	2		
Surf Scoter			60	57	2	73	2
Unid. scoter				49	50	12	1
Ruddy Duck				1			1
Unid. merganser							
Rough-legged Hawk	1	1				1	
Golden Eagle	1						
Bald Eagle	5	3	1	1		1	
Unid. eagle	1						
Marsh Hawk	1	2	7	3	19	2	
Unid. buteo	1	2	1				
Kestrel		1					
Sandhill Crane		1		6		15	
American Coot					1		
"Shorebirds"	332	51	1	30	4	176	761
"White-headed" Gull	62	83	124	49	227	36	49
Bonaparte's Gull	3				1		1
Unid. tern				4		25	28
Black Tern						1	2
Great Horned Owl	1			1			
Short-eared Owl	2		3		1		
Raven	29	33	8	11	6	8	1

APPENDIX D

Breeding Birds

Appendix D-1. Species with known breeding distribution (Godfrey 1966)
in the study area.

* - found breeding on study site in summer 1978

Common Loon	<u>Gavia immer</u>	
Arctic Loon	<u>G. arctica</u>	
Red-throated Loon	<u>G. stellata</u>	
Red-necked Grebe	<u>Podiceps grisegena</u>	
Horned Grebe	<u>P. auritus</u>	*
Pied-billed Grebe	<u>Podilymbas podiceps</u>	*
American Bittern	<u>Botaurus lentiginosus</u>	*
Canada Goose	<u>Branta canadensis</u>	
Mallard	<u>Anas platyrhynchos</u>	*
Pintail	<u>A. acuta</u>	
Green-winged Teal	<u>A. crecca</u>	*
Blue-winged Teal	<u>A. discors</u>	*
American Widgeon	<u>A. americana</u>	*
Northern Shoveller	<u>A. clypeata</u>	*
Redhead	<u>Aythya americana</u>	
Ring-necked Duck	<u>A. collaris</u>	*
Canvasback	<u>A. valisineria</u>	*
Greater Scaup	<u>A. marila</u>	
Lesser Scaup	<u>A. affinis</u>	*
Common Goldeneye	<u>Bucephala clangula</u>	*
Bufflehead	<u>B. albeola</u>	*
White-winged Scoter	<u>Melanitta deglandi</u>	
Surf Scoter	<u>M. perspicillata</u>	
Ruddy Duck	<u>Oxyura jamaicensis</u>	*
Common Merganser	<u>Mergus merganser</u>	
Red-breasted Merganser	<u>M. serrator</u>	
Coshawk	<u>Accipiter gentilis</u>	
Sharp-shinned Hawk	<u>A. striatus</u>	*
Red-tailed Hawk	<u>Butea jamaicensis</u>	*
Bald Eagle	<u>Haliaeetus leucocephalus</u>	*
Marsh Hawk	<u>Circus cyaneus</u>	*
Osprey	<u>Pandion haliaetus</u>	*
Merlin	<u>Falco columbarius</u>	*
American Kestrel	<u>Falco sparverius</u>	*
Spruce Grouse	<u>Canachites canadensis</u>	
Ruffed Grouse	<u>Bonasa umbellus</u>	
Sharp-tailed Grouse	<u>Pedioecetes phasianellus</u>	
Sora	<u>Porzana carolina</u>	*
Yellow Rail	<u>Coturnicops noveboracensis</u>	
American Coot	<u>Fulica americana</u>	*

Appendix D-1 continued.

Semipalmated Plover	<u>Charadrius semipalmatus</u>	
Killdeer	<u>C. vociferus</u>	
Common Snipe	<u>Capella gallinago</u>	*
Spotted Sandpiper	<u>Acititis macularia</u>	*
Solitary Sandpiper	<u>Tringa solitaria</u>	
Lesser Yellowlegs	<u>T. falvipes</u>	
Short-billed Dowitcher	<u>Limnodromus griseus</u>	
Herring Gull	<u>Larus argentatus</u>	*
California Gull	<u>L. californicas</u>	
Mew Gull	<u>L. canus</u>	
Bonaparte's Gull	<u>L. philadelphia</u>	*
Common Tern	<u>Sterna hirundo</u>	
Arctic Tern	<u>S. paradisaea</u>	*
Black Tern	<u>Childonias niger</u>	*
Great Horned Owl	<u>Bubo virginianus</u>	*
Hawk Owl	<u>Surnia ulula</u>	
Great Gray Owl	<u>Strix nebulosa</u>	
Long-eared Owl	<u>Asio otus</u>	
Short-eared Owl	<u>A. flammeus</u>	*
Boreal Owl	<u>Aegolius funereus</u>	
Common Nighthawk	<u>Chordeiles minor</u>	*
Belted Kingfisher	<u>Megaceryle alcyon</u>	*
Common Flicker	<u>Colaptes auratus</u>	*
Pileated Woodpecker	<u>Dryocopus pileatus</u>	
Yellow-bellied Sapsucker	<u>Sphyrapicus varius</u>	*
Hairy Woodpecker	<u>Picoides villosus</u>	*
Downy Woodpecker	<u>P. pubescens</u>	*
Black-backed Three-toed Woodpecker	<u>P. arcticus</u>	
Northern Three-toed Woodpecker	<u>P. tridactylus</u>	
Eastern Kingbird	<u>Tyrannus tyrannus</u>	*
Eastern Phoebe	<u>Sayornis phoebe</u>	
Say's Phoebe	<u>S. saya</u>	
Yellow-bellied Flycatcher	<u>Empidonax flaviventris</u>	
Traill's Flycatcher	<u>E. traillii</u>	*
Alder Flycatcher	<u>E. alnorum</u>	*
Least Flycatcher	<u>E. minimus</u>	*
Western Wood Peewee	<u>Cantopus sordidulus</u>	
Olive-sided Flycatcher	<u>Nuttallornis borealis</u>	
Horned Lark	<u>Eremophila alpestris</u>	
Tree Swallow	<u>Tridoprocne bicolor</u>	*
Bank Swallow	<u>Riparia riparia</u>	*

Appendix D-1 continued.

Barn Swallow	<u>Hirundo rustica</u>	*
Cliff Swallow	<u>Petrochelidon pyrrhonota</u>	
Gray Jay	<u>Perisoreus canadensis</u>	*
Common Raven	<u>Corvus corax</u>	*
Common Crow	<u>C. brachyrhynchos</u>	
Black-capped Chickadee	<u>Parus atricapillus</u>	*
Boreal Chickadee	<u>P. hudsonicus</u>	*
Red-breasted Nuthatch	<u>Sitta canadensis</u>	
American Robin	<u>Turdus migratorius</u>	*
Hermit Thrush	<u>Catharus guttata</u>	*
Swainson's Thrush	<u>C. ustulata</u>	*
Gray-cheeked Thrush	<u>C. minima</u>	
Ruby-crowned Kinglet	<u>Regulus calendula</u>	*
Bohemian Waxwing	<u>Bombycilla garrulus</u>	
Northern Shrike	<u>Lanius excubitor</u>	
Common Starling	<u>Sturnus vulgaris</u>	*
Solitary Vireo	<u>Vireo solitarius</u>	
Red-eyed Vireo	<u>V. olivaceus</u>	*
Warbling Vireo	<u>V. gilvus</u>	*
Black-and-white Warbler	<u>Mniotilta varia</u>	*
Tennessee Warbler	<u>Vermivora peregrina</u>	*
Orange-crowned Warbler	<u>V. celata</u>	
Yellow Warbler	<u>Dendroica petechia</u>	*
Magnolia Warbler	<u>D. magnolia</u>	
Cape May Warbler	<u>D. tigrina</u>	
Yellow-rumped Warbler	<u>D. coronata</u>	*
Blackpoll Warbler	<u>D. striata</u>	
Palm Warbler	<u>D. palmarum</u>	
Ovenbird	<u>Seiurus aurocapillus</u>	
Northern Waterthrush	<u>S. noveboracensis</u>	*
Wilson's Warbler	<u>Wilsonia pusilla</u>	*
American Redstart	<u>Setophaga ruticilla</u>	*
Red-winged Blackbird	<u>Agelaius phoeniceus</u>	*
Rusty Blackbird	<u>Euphagus carolinus</u>	*
Common Grackle	<u>Quiscalus quiscula</u>	*
Brown-headed Cowbird	<u>Molothrus ater</u>	
Western Tanager	<u>Piranga ludoviciana</u>	*
Rose-breasted Grosbeak	<u>Pheucticus ludovicianus</u>	*
Purple Finch	<u>Carpodacus purpureus</u>	
Pine Grosbeak	<u>Pinicola enucleator</u>	
Common Redpoll	<u>Carduelis flammea</u>	
Pine Siskin	<u>C. Pinus</u>	
Red Crossbill	<u>Loxia curvirostra</u>	
White-winged Crossbill	<u>L. leucoptera</u>	
Savannah Sparrow	<u>Passerculus sandwichensis</u>	*
Le Conte's Sparrow	<u>Ammodramus lecontei</u>	
Sharp-tailed Sparrow	<u>A. caudacuta</u>	*
Vesper Sparrow	<u>Poocetes gramineus</u>	

Appendix D-1 continued.

Dark-eyed Junco	<u>Junco hyemalis</u>	*
Tree Sparrow	<u>Spizella arborea</u>	*
Chipping Sparrow	<u>S. passerina</u>	
Clay-colored Sparrow	<u>S. pallida</u>	
White-crowned Sparrow	<u>Zonotricha leucophrys</u>	
White-throated Sparrow	<u>Z. albicollis</u>	*
Fox Sparrow	<u>Passerella iliaca</u>	
Lincoln's Sparrow	<u>Melospiza lincolni</u>	*
Swamp Sparrow	<u>M. georgiana</u>	*
Song Sparrow	<u>M. melodia</u>	*
Common Yellowthroat	<u>Geothlypis trichas</u>	*
	- not delineated in Godfrey (1966)	

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