INVENTORY STUDIES OF BIRDS ON AND NEAR CROWN LEASE NUMBER 17, ATHABASCA TAR SANDS, 1974

By **P.L. Sharp, D.A. Birdsall, W.J. Richardson**

L.G.L. LIMITED
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FOREWORD

Syncrude's studies of the baseline environment of the Athabasca Tar Sands include a three-year survey of the types and habitat preferences of birds using the area of Lease #17. The earliest study results were reported in Syncrude Environmental Research Monograph 1973-3, "Migratory Waterfowl and the Syncrude Tar Sands Lease: A Report". The 1974 phase of the inventory was contracted to LGL Limited, Environmental Research Associates, and this monograph consists of their final report to Syncrude. The results of the whole survey will be used to assist in the design of experimental studies and the assessment of impact.

It is Syncrude's policy to publish its consultants' final reports as they are received, withholding only proprietary technical information or that of a financial nature. Because we do not necessarily base our decisions on just one consultant's opinion, recommendations found in the text should not be construed as commitments to action by Syncrude.

Syncrude Canada Ltd. welcomes public and scientific interest in its environmental activities. Please address any questions or comments to Syncrude Environmental Affairs, Box 5790, EDMONTON, Alberta, T6C 4G3.

ABSTRACT

An inventory study of water-associated birds occurring on and near the Syncrude Canada Ltd. Lease #17 in the Athabasca oil sands was conducted during the period of July 8 to November 15, 1974.

Regular ground surveys were conducted of 30 water bodies on and near the lease, including lakes, ponds, the Athabasca River, roadside borrow pits, and shallow marshes created by clearing and water diversion on the Syncrude construction site. Detailed descriptions of the habitat characteristics of the water bodies were made, and the habitats that birds occupied were recorded during all surveys. Daily migration watches were conducted near the Athabasca River during the period from August 26 to November 15. Casual observations (those not made during surveys or watches) were recorded in an annotated list.

The common and widely-distributed nesting species were the common loon, red-necked grebe, American wigeon, ring-necked duck, common goldeneye, bufflehead, sora, spotted sandpiper, lesser yellowlegs, eastern kingbird, red-winged blackbird, and common grackle.

Local increases in the numbers of mallards, pintails, and green-winged teal in late summer indicated that the study area may have been used as a moulting area by these species.

Large numbers of migrating Canada and white-fronted geese flew over the area without stopping during late August and September. Large numbers of migrating waterfowl, mainly scaup spp., mallards, and American coots stopped over on some of the lakes during September and October. Large numbers of migrating shorebirds were observed on the shallow marshes on the Syncrude site

during July and August. Migrating water pipits, warblers, sparrows, blackbirds, Lapland longspurs, redpolls, and snow buntings were commonly observed during autumn. Migrating bald eagles were frequently observed during September. One observation of an adult and an immature whooping crane was made during October.

The habitat preferences of the common species, or groups of closely related species, were examined quantitatively by means of Stepwise Multiple Discriminant Analysis (SMDA) and Stepwise Multiple Regression Analysis (SMRA). SMDA was used to identify those species which occupied similar and dissimilar habitats during the summer (July-August) and autumn (September-October). Comparisons of the differences between species during these two time periods indicated that there was a general reduction in habitat specificity during the autumn period. SMRA was used to determine the habitats that each common species or species group was associated with during the period from July to November.

Some ecological problems that could result from the Syncrude development were discussed.

Keywords: Athabasca oil sands
Birds
Migration
Nesting
Moulting
Multivariate analysis
Habitat preferences

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1. INTRODUCTION

The Peace-Athabasca Delta, located 100 miles north of Fort McMurray, Alberta (Figure 1), is an important staging area for waterfowl. It has been estimated that during the spring and autumn of each year approximately 400,000 and 1,000,000 (respectively) waterfowl stage on this delta (Hennan 1972).

The results of aerial surveys conducted by the Canadian Wildlife Service (Schick and Ambrock 1974) and by Renewable Resources Consulting Services Limited (Syncrude Canada Ltd. 1973) indicate that large numbers of waterfowl and some large waterbirds migrate through the area of the Syncrude lease (Figures 1 and 2) and that more of these birds use this area in the fall than in the spring. Because these surveys were conducted from an aircraft, the major waterbird groups detected were geese, swans, diving and dabbling ducks, and coots.

Densities of breeding ducks have been calculated for some lakes on and adjacent to the Syncrude lease area (Schick and Ambrock 1974) and for some lakes in similar boreal forest habitats elsewhere in Alberta (Trauger 1971, Donaghey 1974). These studies indicate that some lakes in the area are potentially as productive as the prairie wetlands, which are considered to be the most productive of waterfowl habitats (Schick and Ambrock 1974).

Because most of the information on birds in the Syncrude lease area has been gathered during aerial surveys in spring and autumn (Schick and Ambrock 1974, Syncrude Canada Ltd. 1973), detailed data on the species and densities of breeding and moulting waterfowl are lacking. Additionally, the data gathered during these aerial surveys were not checked against and corrected according to the results of concurrently conducted ground surveys.

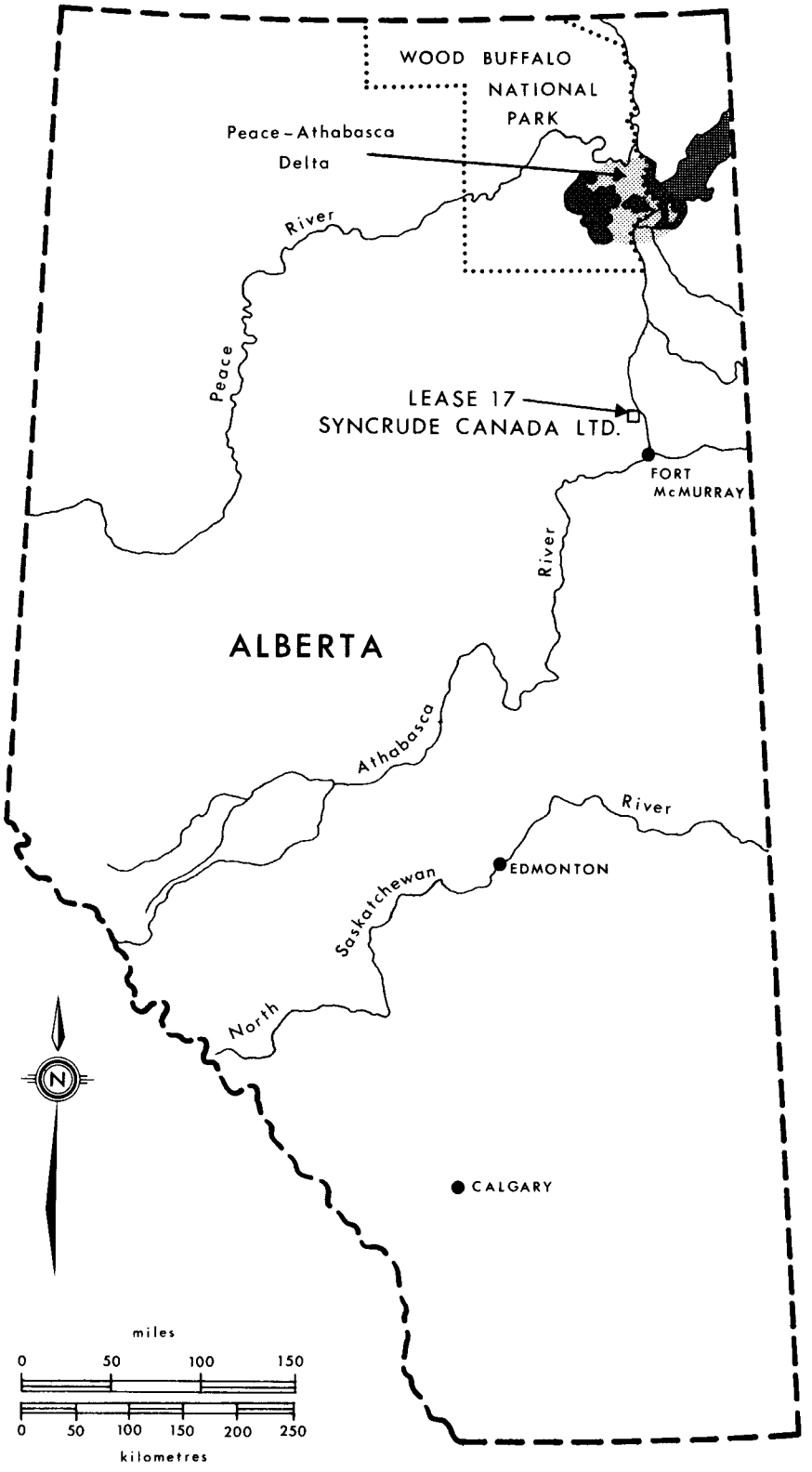

Fig. 1 - Map of Alberta Showing Syncrude Lease #17 in Relation to the Peace-Athabasca Delta

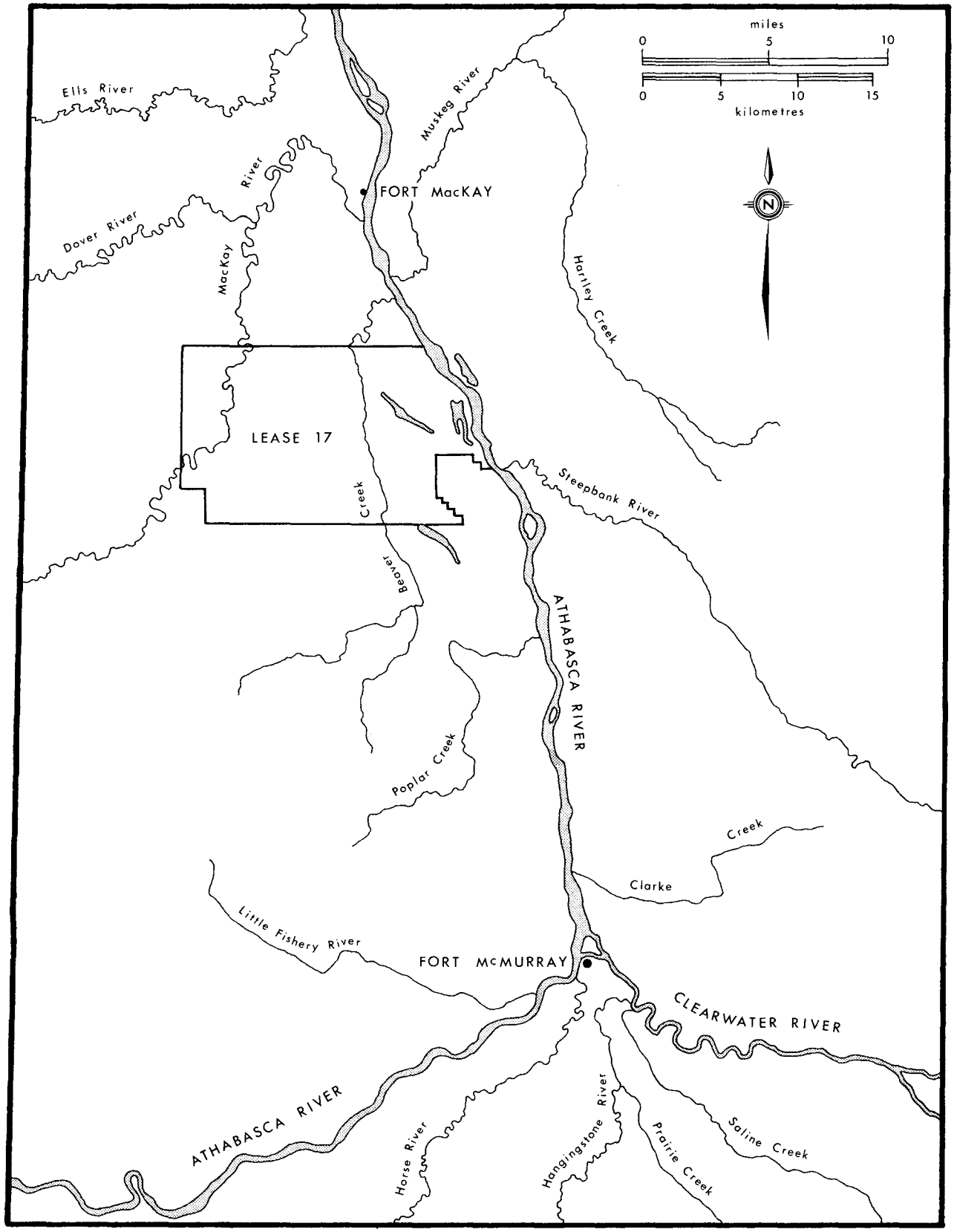

Fig. 2 - Map of Syncrude Lease #17 and the Surrounding Area

Consequently, they include potential inaccuracies related to the numbers of birds present, due to conspicuousness of each species relative to other species, and to the vegetation of the water bodies which might conceal birds (Rowinski 1958, Martinson and Kaczynski 1967). Also lacking are detailed data on the following: the waterfowl species present during the summer; the specific habitat requirements of waterfowl that migrate through, nest in, or moult in this area; the productivity of waterfowl that breed in this area; and the uses that moulting waterfowl make of this area.

There is an almost complete absence of information on water-associated species other than waterfowl. These water-associated species belong to the following groups: shorebirds, cranes, rails, herons and bitterns, blackbirds, a variety of other passerines, aquatic predators and scavengers (such as kingfishers, gulls, and terns), and some raptors. Many of these species are inconspicuous or rare and cannot, consequently, be censused reliably from an aircraft.

The ecological changes that will result from the Syncrude development will be diverse in nature and in magnitude. These changes will include alteration of terrestrial and aquatic habitats, increased human and human-associated disturbance of nearby unaltered areas, the creation of garbage disposal sites, and creation of artificial and potentially lethal habitats that may be attractive to some species of wildlife.

As mentioned above, it is known that the Syncrude lease area is important to staging, migrating, and breeding waterfowl and to large waterbirds; however, detailed information concerning the use of this area by birds is not yet available. Without these data, the effects that the Syncrude development will have upon water-associated birds that use the lease area cannot be assessed accurately. Because of the potential effects of the Syncrude development upon water-associated birds and their habitats,

and because of the lack of sufficient baseline data, there is a a need for an inventory of the water-associated birds that use the Syncrude lease area and for a study of the particular uses that these species make of this area.

The 1974 phase of the inventory and study of birds on and around Lease #17 had the following objectives:

1. To gather data on the species and numbers of water-associated birds on and near the Syncrude lease;
2. To determine the productivity of water-associated birds that breed on and near the lease;
3. To determine the seasonal variation in species and numbers of water-associated birds on and near the Syncrude lease, including the variation due to migration of water associated birds through the area; and
4. To determine the influences of the types of habitats present on the occurrence and distribution of water-associated birds on and near the lease.

In addition, the data gathered during this study will provide a basis for some preliminary recommendations and conclusions pertaining to ecological problems that could result from the Syncrude development, such as waste disposal, the effects of changes in the hydrology of nearby lakes on birds and mammals, the management of habitats altered or created by this development, and the management of nearby natural habitats that could be adversely affected by increased human disturbance.

2. DESCRIPTION OF STUDY AREA

The physiography, drainage pattern, climate, soils, and vegetation of Lease #17 have been described in detail by Carrigy (1959), Renewable Resources Consulting Services Limited (1972), Carrigy and Kramers (1973), and Integ (1973). The following general description of the study area is derived from these reports and from observations made during this study.

The topography of Lease #17 varies between flat and gently rolling, and the area contains a number of lakes, marshes, and muskeg areas. The Athabasca River flows northward along the eastern edge of part of the lease; the river is approximately 200 feet (60 m) below the surrounding countryside. The study area is drained by Beaver and Poplar creeks and by the MacKay River (Figure 3).

Glacial drift covers the area and is underlain by Lower Cretaceous shale and sand, which contain the overburden and bituminous sands (tar sands). The tar sands are underlain by Devonian limestone. Over most of the area of Lease #17, the depth of the overburden is 200 feet or less. In some areas, the Athabasca and MacKay rivers and Beaver Creek are bounded by outcrops of bituminous sand.

Organic soils are present in the lowlands, and a variety of grey-wooded soils are present in upland areas.

Old sand dunes, now stabilized by vegetation, are present to the south and west of Mildred Lake (Integ 1973).

Boreal mixed wood forest, dominated by poplars *(Populus tremuloides* and *P. balsamifera)* and white spruce *(Picea glauca)*, occurs along the Athabasca River and in upland areas. Black spruce *(Picea mariana)* and shrub birches *(Betula* spp.*)*

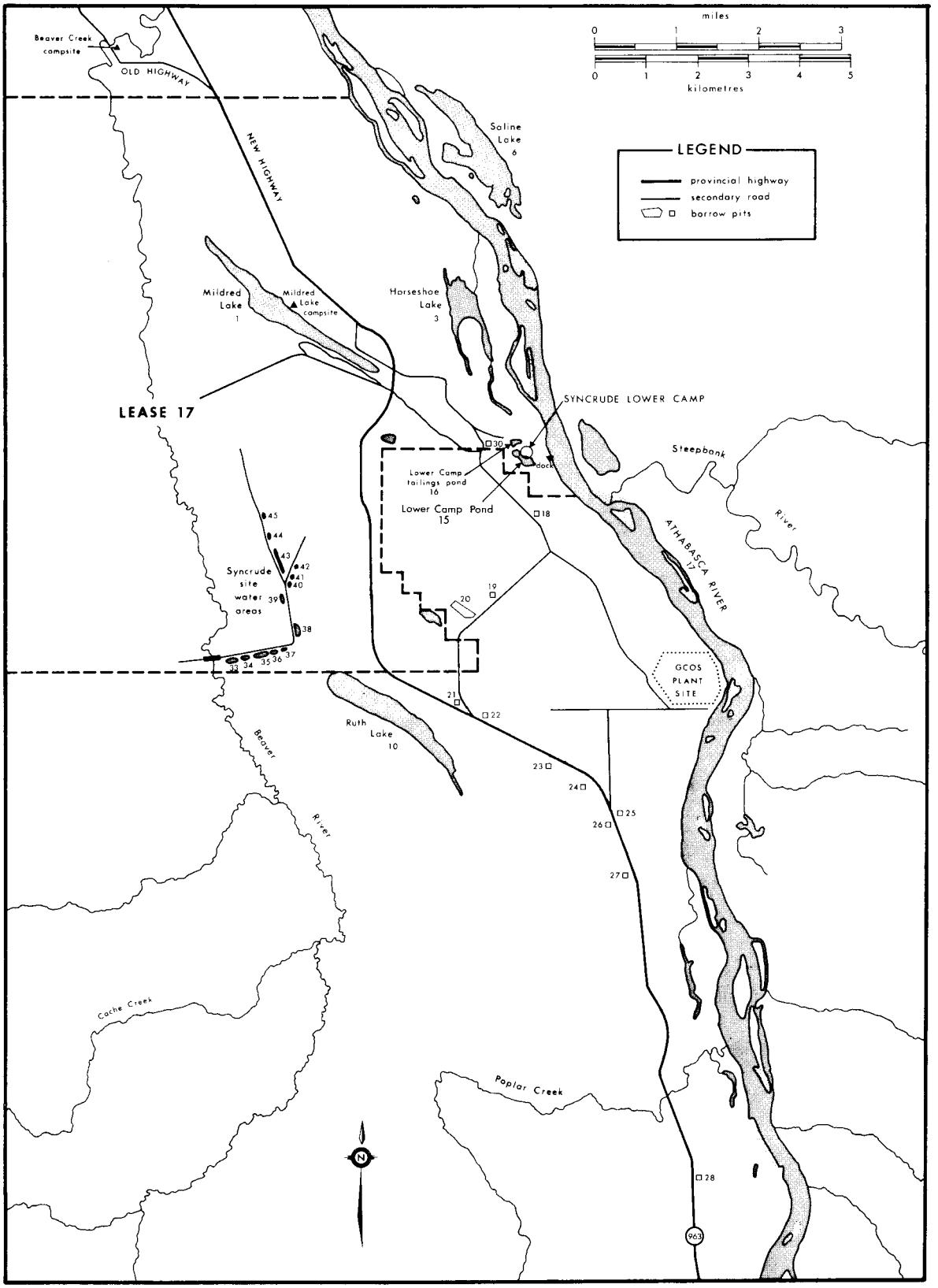

Fig. 3 - Detailed Map of the Study Area Showing the Water Bodies Surveyed During 1974

dominate low-lying areas; scattered patches of tamarack *(Larix laricina)* also occur in such areas. The sand dunes are covered by open stands of jackpine *(Pinus banksiana)*.

The lakes in the area are relatively shallow and support abundant submerged and floating vegetation; this vegetation includes water lilies *(Nuphar variegatum)*, pondweed *(Potamogeton* spp.*)*, and water milfoil *(Myriophyllum* spp.*)*. Patches of bullrushes *(Scirpus* spp.*)* occur in shallower areas. Where the shorelines are gently sloping, the lakes are bordered by bands of cattails *(Typha latifolia)*, sedges *(Carex* spp.*)*, and arrowhead *(Saggitaria* spp.*)*. Flat areas adjacent to portions of Mildred, Horseshoe, Saline, and Ruth lakes support extensive marshes that are dominated by sedges.

3. METHODS

3.1 Literature Search

The literature search was initiated in June, 1974. Studies conducted in the study area and in areas that are possibly on the same migratory pathway as Fort McMurray (e.g., the Peace-Athabasca Delta and Cold Lake) were reviewed.

The libraries used were those of the University of Alberta, the Boreal Institute, the Provincial Museum of Alberta, the Canadian Wildlife Service and the Provincial Fish and Wildlife Division.

Computerized data retrieval systems were used through the cooperation of the Research Council of Alberta.

3.2 Field Studies

3.2.1 Surveys of Water Bodies

Surveys of water bodies were conducted by two observers who used a canoe, or truck, or travelled on foot, depending on the type of water body and logistic constraints.

A total of 30 water bodies on and near the Syncrude lease were surveyed (Figure 3); these water bodies include four lakes (Mildred, Ruth, Horseshoe, and Saline), one pond (#15), the Athabasca River, 11 sandy or gravelly borrow pits (#'s 18-28 and 30), and 13 shallow marsh-pond complexes (#'s 33-45) that have been created by clearing and water diversion in the area of the initial mine site.

The surveys were initiated on July 8 and terminated on November 15, by which time water bodies were at least partially

frozen and unnavigable and most water-associated birds had left the area.

Data Recorded

For each survey, the following weather and descriptive information was recorded:

-- Date of survey
-- Time at which survey began and ended
-- Type of survey (canoe, foot, truck)
-- Observers
-- Name of water body
-- Type of water body
-- Associated water bodies (if applicable)
-- Coverage of water body (i.e., total, partial)
-- Visibility
-- Precipitation
-- Wave height
-- Turbidity of water
-- Depth of water
-- Number of islands
-- Disturbances
-- Width of river or stream (where applicable)
-- Percentage of snow cover
-- Percentage of ice cover
-- Percentage of cloud cover
-- Wind speed
-- Wind direction
-- Temperature
-- Miscellaneous comments

A detailed description of the vegetation and

physical characteristics of each water body that was surveyed was made by recording a number of parameters that described these characteristics at 100-yard intervals around the shore of the water body. Because the year's vegetation growth was nearly complete by July, these characteristics were described once for each water body, with the exception of the Athabasca River. The shore characteristics of the Athabasca River were recorded more often because fluctuations in water level altered the shoreline and the route that could be taken during surveys. A system based on the work of Fosberg (1967) was used to classify vegetation (Appendix 1). At each 100-yard shoreline interval, the following information was recorded:

-- Interval (yardage point)
-- Height of trees (first dryland community inland from shore)
-- Spacing of trees
-- Species of trees (dominant species, which were defined as those that comprised at least 30% of the total trees)
-- Height of shrubs (or herbs)
-- Spacing of shrubs (or herbs)
-- Species of dominant shrubs (or herbs) recorded as for trees
-- Vegetation classification of tree-shrub-herb community
-- Height of emergent vegetation
-- Spacing of emergent vegetation
-- Species of dominant emergent vegetation (recorded as for trees)
-- Width of the marsh (if applicable)
-- Vegetation classification of marsh community
-- Percentage cover of submerged/floating vegetation
-- Spacing of submerged/floating vegetation
-- Species of dominant submerged/floating vegetation (recorded as for trees)
-- Vegetation classification of submerged/floating community

-- Number of islands within the 100-yard sector of shore
-- Slope of the shore
-- Rockiness of the shore
-- Sandiness of the shore
-- Density of flooded dead willows along the shore

During the surveys of water bodies, observers recorded each bird or group of birds (and mammals) that they sighted on the water bodies or along their shorelines. For each sighting, the following information was recorded:

-- Species (or most accurate identification possible)
-- Total number in group
-- Number of adult males identified in group
-- Number of adult females identified in group
-- Number of young identified in group
-- Estimated age of young
-- Location (yardage point) of individual or group when first sighted
-- Distance from shore of individual or group when first sighted (recorded as (+) when in the water, and as (-) when on land)
-- Number of nearby islands
-- Distance from any nearby islands of individual or group when first sighted
-- The characteristics of the habitat in which the individual or group was first sighted, including:
   (a) Vegetation classification
   (b) Height of the vegetation
-- Habitat characteristics of the shore nearest the individual or group when first sighted, including:
   (a) Width of marsh
   (b) Amount of emergent shoreline vegetation

(c) Slope of shore
(d) Amount of rocky or sandy shore
(e) Density of flooded dead willows on or near shore

-- Flight capabilities of adults and young
-- Behaviour of individual or group when first sighted
-- Reactions of individual or group to observers
-- Miscellaneous comments

Casual sightings (those not made during a survey or watch) were recorded in an annotated list.

The location of each bird or group of birds sighted was determined as follows: flags were placed at intervals of 200 yards along the shoreline of each pond and lake, and the locations of birds were recorded in relation to these yardage points. The shorelines of borrow pits were paced and the borrow pits themselves were mapped; the locations of birds sighted were recorded in relation to the yardages marked on these maps. The locations of birds sighted on or along the Athabasca River were recorded in relation to 100-yard shoreline intervals marked on 1:50,000 maps. The locations of birds sighted in the artificial marshes were not recorded because these marshes usually lacked distinct shorelines.

Scheduling of Surveys

Throughout the period of study, Mildred, Ruth, and Horseshoe lakes were surveyed once a week; Saline Lake and the pond located at the Syncrude lower camp (Lower Camp Pond) were surveyed every two to four weeks. These surveys were conducted by two observers in a canoe; the observers censused the entire perimeter of each water body and maintained a distance of 5 to 20 yards from the shoreline or border of closed emergent vegetation.

The 22-mile portion of the Athabasca River from the bridge at Fort McMurray to the dock at the Syncrude lower camp was surveyed every two to four weeks by two observers in a canoe.

From July 13 to August 2, the borrow pits were surveyed twice a week by two observers on foot; after August 17 and for the remainder of the study period, these water bodies were surveyed once a week. (No surveys of borrow pits were conducted between August 2 and 17.)

From July 18 to August 18, the marsh-pond complexes were surveyed twice a week by two observers who counted birds from a truck (in this case, the technique that least disturbed birds). Between August 18 and September 3, the marsh-pond complexes were surveyed once; and between September 3 and the end of the study period, these water bodies were surveyed at intervals of three to four days (with some exceptions). Only part of the marsh-pond complex was visible to observers who used this technique.

3.2.2 Migration Watch

From August 26 to October 30, migration watches were conducted from a blind at a site located at the Syncrude lower camp tailings pond (Figure 2). This site was sufficiently close to the Athabasca River to allow one observer to gather data on birds that migrated along the corridor formed by this river and its valley. A second observer in the blind gathered data pertinent to a preliminary study of the effectiveness of a device for deterring birds from landing at the lower camp tailings pond.

After October 30, the migration watch site was moved to the dock on the Athabasca River at the Syncrude lower camp. This relocation was necessary because of disturbances caused by construction activities. Migration watches were conducted from this site until November 15.

Migration watches were conducted daily (except on October 5, 6, 24, 26, and 31, and on November 1, 6, and 7) from pre-dawn light to 1100 (MDT and MST). During these watches, all flying birds sighted were recorded.

At the beginning of each watch-hour, the following information was recorded:

-- Date
-- Time
-- Site location
-- Observers
-- Temperature
-- Wind direction
-- Wind speed
-- Cloud cover
-- Visibility
-- Precipitation
-- Percentage of ground covered by snow
-- Percentage of water covered by ice
-- Miscellaneous comments

When weather conditions changed markedly within an hour, the new weather conditions were recorded when first noticed.

For each individual or flock of birds sighted, the following information was recorded:

-- Species (or most accurate identification possible)
-- Total number in flock
-- Number of adult males identified in flock
-- Number of adult females identified in flock
-- Number of young identified in flock
-- Direction and height of flight of individual or flock

-- Distance of individual or flock at closest approach to observer
-- Number of birds in flock that landed nearby (if applicable)
-- Habitat in which birds landed (if applicable)
-- Number of birds in flock that took to flight (if applicable)
-- Habitat from which the birds flew (if applicable)
-- Time at which the sighting was made
-- Miscellaneous comments

The above-mentioned habitats were classed as water, shrubs, trees, gravelly shore, or sandy shore.

Casual sightings (not made during migration watches) of flocks of migrating birds were recorded in an annotated list.

3.2.3 Level of Identification of Birds

Throughout this report, the groups (for example, diving duck spp., white-headed gull spp.) are composed entirely of birds that could not be identified at the species level but could be assigned to a group. These groups do not include any birds that could be identified to species. For example, the numbers of white-headed gulls do not include identifications of herring and California gulls.

There was one exception to this practice. Although all the waxwings that were identified to the species level were cedar waxwings, there remains the possibility that some of the waxwings which could not be identified to species were bohemian waxwings. To simplify the consideration of waxwings in this report, all waxwings observed have been described as waxwing spp.

When total numbers of species and species groups are given in the following sections, these totals do not include species groups unless none of the species within those groups were identified. For example, scaup spp. were not counted in the

total of species and species groups if lesser scaup were identified at the particular water body in question.

Data-Handling Procedures

The data gathered during surveys of water bodies and migration watches were initially recorded in field notebooks. The data were then coded numerically on data forms suitable for key-punching. Separate forms were used for the data gathered during surveys and watches. The data recorded on these sheets were checked against the data recorded in field notebooks and then key-punched and key-verified. The data were then rechecked through use of a validation program capable of detecting certain key-punching and other errors.

The methods by which the data were tabulated and analyzed with computer assistance are outlined in subsequent sections and in Appendices 2 and 7.

4. RESULTS

4.1 Species and Numbers of Water-Associated Birds Observed On and Near the Syncrude Lease

4.1.1 Surveys of Water Bodies

For consideration in this report, the water bodies surveyed during 1974 have been divided into four types: lakes and ponds; the Athabasca River; artificial marshes on the Syncrude site; and borrow pits.

Each type of water body was characterized by a basic combination of vegetation, shoreline, depth and size, and each hosted a somewhat distinct species composition and density of birds. Thus, the results are presented separately for each of these four types of water bodies.

A distinction is made here between waterbirds and other species, and these two groups are treated separately. Waterbirds include loons, grebes, herons and bitterns, swans, geese, ducks, cranes, rails, coots, gulls, terns, and shorebirds. The other species are more terrestrial and include kingfishers, woodpeckers, nighthawks, raptors, owls, and passerines.

A list of the species of birds observed in the study area during 1974 is presented in Appendix 8. An annotated list of mammal observations is presented in Appendix 9.

Most species that breed in the Fort McMurray area have wide breeding distributions, and large numbers of migrants from other areas appear in late summer or autumn. For this reason, a distinction between the breeding season and the migration period has been made on the basis of the phenology of the breeding and migration periods of each species. For example, green-winged teal and pintail are known to migrate in mid or late summer (Bent 1923),

and such migrants appeared in the area when some duck broods were still flightless. In this report, summer is defined as July and August, and fall is defined as September to mid-November.

Mildred Lake

The results of the surveys of Mildred Lake are presented in Table 1. This table includes both adult and young birds. Table 2 presents the sizes of broods and numbers of decoying adults* observed on Mildred Lake.

Waterbirds - A total of 35 species and species groups of waterbirds were observed during surveys of Mildred Lake conducted during 1974. These species belonged to the following groups: grebes, ducks, shorebirds, gulls, and terns.

Nineteen species were seen during two or more surveys in the summer. Of these 19 species, seven nested at Mildred Lake (common loon, red-necked grebe, mallard, American wigeon, ring-necked duck, lesser scaup and Bonaparte's gull). In addition to these species, the green-winged teal, sora, common snipe, and lesser yellowlegs were thought to nest at this lake.

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* When nesting or accompanied by young, many species of birds will try to attract or drive a potential predator away from the nest or young. The birds do this by feigning injury or flightlessness (ducks, killdeer), by calling repeatedly and remaining agitated as long as the observers are near (red-winged blackbirds, yellowlegs spp., sparrows, warblers), or by attacking or threatening the observers (gulls, hawks, swallows). All these behaviours were included in the "decoying" category. A decoying adult was included in the results only when it was not accompanied by a brood, and when its nest was not observed.

Table 1. Numbers of Birds Observed During Surveys of Mildred Lake in 1974.*

SPECIES/GROUP	JULY			AUGUST			SEPTEMBER				OCTOBER						NOVEMBER	
	11	21	30	4	12	22	1	8	15	22	1	7	13	20	24	27	5	10
Common loon	2	4	4	4	4	3		2	2	1				1				
Loon spp.									1							1		
Red-necked grebe	3	3				5	5	2		1	1		2	2				
Horned grebe												9						
Eared grebe				1														
Pied-billed grebe												1						
Mallard		2	3	14	91	522	274	158	173	38	108	13	12			4		
Gadwall					2													
Pintail				25	4	20	82		1		29							
Green-winged teal					1			3	4									
Blue-winged teal							3		1		10							
Teal spp.									3									
American wigeon	3	3		13	5		12					1						
Northern shoveler					1		7				5							
Dabbling duck spp.	10						26			390	143			9				
Ring-necked duck	3	2	46	36	14	8					2	1						
Canvasback			1									1						
Greater scaup					1							3						
Lesser scaup		5			6	28					3	1						
Scaup spp.				1				19	29	35	1234	492	806	517	437	530	12	
Aythya spp.		31		18						41	3							
Goldeneye spp.	1		2			1		16	21		20	20		2	1	2		
Bufflehead	1					1	6	3	6	35	8	27	2	17				
Bucephala spp.													7					
White-winged scoter											3	2	1	2	1	1		
Surf scoter												2						
Scoter spp.													1					
Ruddy duck								1		4		14	11					
Red-breasted merganser								2										
Diving duck spp.	27	36	5	31		28	97	18	40	183	143		20					
Duck spp.	9	14	24	10	30	80	39	259	26	67	24							
Red-tailed hawk		3								1								
Rough-legged hawk								1										
Buteo spp.												1						
American kestrel	1	2	3	2	3	2	1			1								
Hawk spp.										1								
Sora	4	6	2	3														
American coot												58	66	36	2			
Common snipe		1	1															
Spotted sandpiper				1	4	2	3											
Solitary sandpiper					1													
Greater yellowlegs		5	6	5	4	1		1										
Lesser yellowlegs	24	10			7	1												
Yellowlegs spp.				3														
Pectoral sandpiper		7	1															

Tabl[illegible] (cont[illegible])

SPECIES/GROUP	JULY			AUGUST			SEPTEMBER				OCTOBER						NOVEMBER	
	11	21	30	4	12	22	1	8	15	22	1	7	13	20	24	27	5	10
Least sandpiper		6	1															
Dowitcher spp.	1	2																
Semipalmated sandpiper		4																
'Peep' sandpiper spp.		5																
Shorebird spp.						1												
Bonaparte's gull	12	16	3	6	5	1												
Gull spp.	16	2	3		3	5	12	6	4	47	8	4	2					
Black tern			1	27	3													
Common nighthawk			1	2														
Belted kingfisher					1	1	1	1	1	1	1							
Pileated woodpecker														1		2		
Hairy woodpecker												1						
Eastern kingbird	5	4	5	5	4	5												
Empidonax spp.		1	1															
Western wood pewee			1		1													
Olive-sided flycatcher				2														
Flycatcher spp.		1																
Tree swallow		2																
Barn swallow		2			1	2												
Cliff swallow	1				30													
Swallow spp.			26					7										
Gray jay		3	2	2	3		7	6		4	3	1	1	1	2	3		
Black-billed magpie													1					
Common raven			4		1		9	11	22	2		4	12	9	1	21		
Common crow			1															
Black-capped chickadee		2											2					
American robin	3			2														
Water pipit										15								
Waxwing spp.	9	3	6	2	2													
Warbler spp.	2				2													
Red-winged blackbird	62	39	17	10	7	2												
Rusty blackbird									5	1	2							
Common grackle	33	18	24	3	2	2												
Blackbird spp.			19			4				1	1							
Redpoll spp.													10			1		
Savannah sparrow												1						
LeConte's sparrow		1	1															
Chipping sparrow		1																
Lincoln's sparrow	2	1	1															
Swamp sparrow	2		1															
Sparrow spp.	2	3	5		1		1	1				2						
Passerine spp.	1	6	9	5	7	2	1	4	7		1	1		19				

* includes both adult and young birds

Table 2. Sizes of Broods and Numbers of Decoying Adults Observed During Surveys of Mildred Lake in 1974. Numbers of Decoying Adults Appear in Parentheses.

SPECIES/GROUP	JULY 11	JULY 21	JULY 30	AUGUST 4	AUGUST 12	AUGUST 22	SEPTEMBER 1	SEPTEMBER 8
Common loon	(2)		1	1,1	1	1		1
Red-necked grebe	1					1,2		2
Mallard		(1)		4				
American wigeon	2	(1)		9				
Green-winged teal								2
Dabbling duck spp.	9						1	
Aythya spp.		9,11,8		6,7,2				
Ring-necked duck			10,9,8,14-2F†	9,8,5,8	8,2			
Lesser scaup					5	4		
Diving duck spp.	11,10,(1)	6,3,9,12		7,8,12		14-2F†		
Duck spp.	8	8,4	7,7,7	5	5,20ε	8		
Sora				(2)				
Bonaparte's gull	(1)		(3)	3,(3)		1		
Lesser yellowlegs	(3)							
Black tern				2,19α	1			
Eastern kingbird	(3)	(3)	(2)	1,(2)				
Red-winged blackbird	9,1,2,1,4,1,5,1,2,(11)	1,2,4,(7)	1,1	1				
Common grackle	8,2,1,7,(2)	1,2,(1)				2		
Lincoln's sparrow	(2)							
Swamp sparrow	(2)							

† - a creche, F denotes the number of adult females accompanying the creche

ε - a creche, no females accompanying it

α - flock of adults and young, probably from Horseshoe or Ruth Lake. Note that black terns were not seen on Mildred Lake until August 4.

A detailed examination of the observations of broods, including consideration of the level of identification, age class, and date of each observation, revealed that there were at least two broods of loons, two broods of red-necked grebes, one brood of mallard, two broods of American wigeon, one brood of unidentified dabbling duck, six broods of ring-necked ducks, two broods of lesser scaup, three broods of *Aythya* spp., four broods of unidentified diving ducks, and six broods of unidentified ducks on Mildred Lake in 1974.

Scaup and mallard were the most abundant duck species observed on Mildred Lake. Pintails, goldeneyes, buffleheads, and coots were less numerous, but still fairly common. The number of scaup observed was largest on October 1, with another peak October 13; peak numbers of mallards were seen August 22, with a smaller peak October 1; pintails peaked September 1; buffleheads and goldeneyes peaked between September 22 and October 7; and coots peaked during October 1-13.

Overall, the maximum numbers of dabbling ducks were seen on August 22 and September 22, and of diving ducks on October 1 and 13. The maximum number of ducks of all species was seen on October 1.

During July and August, shorebirds were frequently sighted at Mildred Lake, and the numbers of these birds peaked on July 21.

Other Species - Twenty-nine other species were observed at Mildred Lake. Of these, American kestrels, belted kingfishers, eastern kingbirds, *Empidonax* flycatchers (least and/or alder), western wood pewees, barn swallows, cliff swallows, gray jays, common ravens, American robins, waxwings, red-winged blackbirds, common grackles, Lincoln's sparrows, swamp sparrows, and LeConte's sparrows were seen on two or more surveys during summer and were considered to be summer residents. Eastern kingbirds, red-winged

blackbirds, and common grackles were known to nest at Mildred Lake, and Lincoln's and swamp sparrows were thought to be nesting there. The most common species were eastern kingbirds, waxwings, red-winged blackbirds, and common grackles. Few observations were made of sparrows, warblers, and flycatchers, undoubtedly because the peak of their nesting activity occurred before the beginning of this study, and because of their terrestrial habitat preferences.

Only a few migrating rusty blackbirds, water pipits, and redpolls were seen at Mildred Lake.

Horseshoe Lake

Results of the weekly surveys of Horseshoe Lake are presented in Table 3. Table 4 includes the numbers and sizes of all broods seen and the numbers of decoying adult birds seen.

Waterbirds - Twenty-seven species of waterbirds were sighted during surveys of Horseshoe Lake in 1974; included were grebes, bitterns, ducks, rails, coots, shorebirds, gulls, and terns.

Fifteen of these 27 species were seen on two or more surveys during the breeding season. Six species or species groups (red-necked grebe, green-winged teal, American wigeon, common goldeneye, bufflehead, and black tern) were known to nest there. Five other species (mallard, ring-necked duck, sora, solitary sandpiper, and lesser yellowlegs) were thought to nest there. A detailed examination of the observations of broods revealed that there were at least one brood of red-necked grebe, five broods of American wigeon, one brood of green-winged teal, two broods of buffleheads, two broods of common goldeneyes, two broods of *Bucephala* spp., eleven broods of unidentified diving ducks, and two broods of unidentified ducks on Horseshoe Lake in 1974. The American wigeon was the most common nesting duck. Black

Table 3. Numbers of Birds Observed During Surveys of Horseshoe Lake in 1974.*

SPECIES/GROUP	JULY			AUGUST				SEPTEMBER			OCTOBER		
	10	17	25	3	11	19	29	12	19	26	3	10	17
Red-necked grebe	1	3											
American bittern										1			
Mallard	3	4	3	29	70	155	262	151	312	192	221	73	53
Gadwall	3								1			3	
Pintail			2			4		3	5	1		14	
Green-winged teal	2	2	7		3	5			4				
Blue-winged teal			2				4	1		2	50		
Teal spp.						11			5				
American wigeon	17	13	6	2	2		5		92	6	75		
Northern shoveler	8	1									6		
Dabbling duck spp.	16		6					17	102	67	134	35	
Ring-necked duck	2			4	2								
Canvasback									3				
Scaup spp.	94							15	113		2		8
Aythya spp.									1				
Goldeneye spp.	5	7		8	1			2	11			6	
Bufflehead	10	11	3	6	1		20		1				
Bucephala spp.	8												
Diving duck spp.	15		12			1	2			11		22	
Duck spp.	35	17	3	10	12	29	51	191	5	420	7	5	9
Red-tailed hawk			1										
Bald eagle										1			
Marsh hawk					1			1	1			1	
American kestrel		1	3										
Hawk spp.										1			
Sora	6	3											
American coot							7	2	264	166			
Spotted sandpiper				2	5								
Solitary sandpiper	1		2										
Lesser yellowlegs	1	29			8								
Yellowlegs spp.		5											
Pectoral sandpiper		28								1			
Baird's sandpiper		1											
Least sandpiper		4											
Dowitcher spp.		2											
Stilt sandpiper		3											
Semipalmated sandpiper		3											
'Peep' sandpiper spp.		13											
Shorebird spp.	3												
White-headed gull spp.		1					3	2					
Bonaparte's gull		4											
Black tern	3	8	31										
Common nighthawk						19							
Belted kingfisher							1						
Yellow-bellied sapsucker		2											
Eastern kingbird		1											
Alder flycatcher		1											
Tree swallow		2											
Bank swallow			1										
Barn swallow			1	2	2	6							
Cliff swallow		22	13										
Swallow spp.		1	1										
Gray jay											1	1	1
Black-billed magpie			2										
Common raven					1								
Black-capped chickadee		2											
American robin		4											
Waxwing spp.		5	2			6							
Vireo spp.			1										
Tennessee warbler		3											
Yellow warbler		1											
Northern waterthrush		1											
Wilson's warbler		3											
Warbler spp.		1	1										
Red-winged blackbird	17	18	1	16	1								
Common grackle		1											
Brown-headed cowbird									7				
Blackbird spp.		66		6	13		18			1	7		
Evening grosbeak					7		6						
LeConte's sparrow		1											
Tree sparrow												1	
Sparrow spp.		1					3						
Passerine spp.		4	3	1	1			7		3		3	3

* includes both adult and young birds

Table 4. Sizes of Broods and Numbers of Decoying Adults Observed During Surveys of Horseshoe Lake in 1974. Numbers of Decoying Adults Appear in Parentheses.

SPECIES/GROUP	JULY 10	JULY 17	JULY 25	AUGUST 3	AUGUST 11	AUGUST 19	AUGUST 29
Red-necked grebe		1					
Mallard		(1)					
American wigeon	3,5,(3)	4,5,(2)	2,(2)				
Green-winged teal	(2)	(2)			2,(3)		
Dabbling duck spp.	13-2F†						
Ring-necked duck	(2)						
Bufflehead	7,(1)	1,2,5					
Goldeneye spp.	4	1					
Bucephala spp.	3,5						
Diving duck spp.	6-9Fε,(3)		8-2F†				
Duck spp.	7,24α	1,6,4		4		1	
Sora	(6)						
Lesser yellowlegs	(1)						
Solitary sandpiper			(2)				
Black tern	(3)		1,20β				
Yellow-bellied sapsucker		1					
Tennessee warbler		2					
Wilson's warbler		2					
Red-winged blackbird	2,2,(11)	(1)		2			

† - creche, F denotes the number of adult females accompanying it

ε - creche--the eight extra females were included only in overall duck calculations (Table 15), as probably associated with the creche of 24

α - this creche was formed as a result of our survey route--these broods were driven into the far arm of Horseshoe Lake as we conducted the survey, and the females (many of them) remained near the mouth of the arm

β - group of fledged young accompanied by adults

tern were also common nesters there.

Mallards, American coots, and scaup spp. were the most common species or species groups of migrant waterfowl. The number of mallards peaked September 19 but fluctuated throughout mid-August to September. The numbers of scaup spp. and American coots peaked September 19. An influx of mallards in early August indicated that Horseshoe Lake may have been used as a moulting area by this species.

Other Species - Thirty-two other species were seen at Horseshoe Lake, of which six (American kestrel, barn swallow, cliff swallow, waxwing spp., red-winged blackbird, and evening grosbeak) were seen on more than two surveys during July and August. The yellow-bellied sapsucker, Tennessee warbler, Wilson's warbler, and red-winged blackbird were known to nest there. Again, because of the late date of initiation of this study, very little information on warblers, sparrows, and flycatchers was obtained.

Small groups of common nighthawks, blackbirds (probably rusty), and brown-headed cowbirds were the only migrants observed.

Saline Lake

The numbers of birds observed during surveys of Saline Lake during 1974 are presented in Table 5. The sizes of broods and the numbers of decoying adults are presented in Table 6.

Waterbirds - A total of 31 species or species groups of waterbirds were observed at Saline Lake during 1974. These species included grebes, swans, ducks, rails, coots, shorebirds, and terns.

Twenty-four species were observed at Saline Lake in late July. Seven species (red-necked grebe, horned grebe, goldeneye spp., bufflehead, ruddy duck, Bonaparte's gull, and

Table 5. Numbers of Birds Observed During Surveys of Saline Lake in 1974.*

SPECIES/GROUP	JULY 27	AUGUST 31	SEPTEMBER 14	SEPTEMBER 29	OCTOBER 4	OCTOBER 9	OCTOBER 19	OCTOBER 24
Common loon	2							
Red-necked grebe	5	1	1					
Horned grebe	7	2						
Grebe spp.	1							
Whistling swan				4	4			
Mallard	37	86	126	307	85	61	91	120
Gadwall	1					1		
Pintail	21	69	4	24		2		
Green-winged teal	6	13		1				
Blue-winged teal	2	3	9	2		1		
American wigeon	13	52	1	84		3	2	
Northern shoveler	2							
Dabbling duck spp.	5	48		40			44	210
Ring-necked duck	1							
Canvasback				3				
Lesser scaup		1						
Scaup spp.		210	30	811	15	297	572	18
Aythya spp.				13				
Goldeneye spp.	13	25	4	68		5	21	
Bufflehead	18	10	4	20		31	2	2
Bucephala spp.	2	4						
Ruddy duck	9	4		10				
Diving duck spp.		38		120		73	2	
Duck spp.	237	177	444	110	40	91		45
Merlin	1							
Falcon spp.						1		
Sora	3							
American coot				45	134	621	449	14
Common snipe	1			1				
Spotted sandpiper	2							
Greater yellowlegs	9	6	2					
Lesser yellowlegs	11	2	2					
Yellowlegs spp.	21	5						
Pectoral sandpiper	2	4						
Baird's sandpiper		1						
Least sandpiper		1						
Long-billed dowitcher			1					
Dowitcher spp.	3	1						
Stilt sandpiper		1						
Semipalmated sandpiper		1						
'Peep' sandpiper spp.		1						
Shorebird spp.	8	2			8			
Northern phalarope	2							
Bonaparte's gull	3							
Gull spp.	1	1						
Black tern	34							
Belted kingfisher	2		1					
Common flicker	1							
Northern three-toed woodpecker	2							
Woodpecker spp.	1							
Eastern kingbird	11							
Empidonax spp.	3	2						
Western wood pewee	3							
Gray jay	1						3	1
Black-billed magpie							2	
Common raven		3		1			2	5
Boreal chickadee	4							
Water pipit			5	1				
Waxwing spp.	18							
Red-eyed vireo	1							
Northern waterthrush	1							
Red-winged blackbird	182							
Rusty blackbird	2			14				
Common grackle	62							
Blackbird spp.		1	1	2				
Western tanager	1							
Savannah sparrow			2					
White-throated sparrow	1							
Snow bunting						1		
Passerine spp.	25			1			1	1

* includes both adult and young birds

Table 6. Sizes of Broods and Numbers of Decoying Adults Observed During Surveys of Saline Lake in 1974. Numbers of Decoying Adults Appear in Parentheses.

SPECIES/GROUP	JULY 27	AUGUST 9	SEPTEMBER 12
Red-necked grebe	1,1		
Horned grebe	5		
Grebe spp.	1		
Green-winged teal	(1)		
American wigeon	(3)		
Bufflehead	4,2,5	5-2Fε,(1)	
Goldeneye spp.	6,3		
Bucephala spp.	2		
Ruddy duck	7		
Duck spp.	7		
Sora	(3)		
Lesser yellowlegs	(2)		
Bonaparte's gull	3		
Black tern	2,3,12†		
Northern three-toed woodpecker	1		
Eastern kingbird	2(5)		
Empidonax spp.	(2)	(2)	
Gray jay	1		
Boreal chickadee	(2)		
Red-winged blackbird	3,2,5,5,9†,10†,2,6,3,3,1,2,1,1,2,(55)		
Common grackle	3,2,1,1,3,1,10†,3		

† - two or more broods, number of females not known

ε - creche, F denotes the number of adult females accompanying it

black tern) are known to have nested there, and five others (common loon, green-winged teal, American wigeon, sora and lesser yellowlegs) were thought to have nested there. Diving ducks were more common than dabbling ducks (10 of 15 observations of broods and decoying females). Bufflehead and American wigeon appeared to be the most common breeding species.

The most abundant migrants at Saline Lake were scaup spp., mallards, and American coots. American wigeons, pintails, goldeneye spp., and buffleheads were also fairly common migrants. Mallards, scaup spp., and goldeneye spp. numbers were highest on September 29; buffleheads and coots were most numerous on October 9.

Fairly large numbers of shorebirds were present on July 27.

Other Species - Because only one survey was conducted on Saline Lake during midsummer, we do not have reliable information on which water-associated species were summer residents. Twenty-two such species were seen at Saline Lake, and 17 of these were observed on this first survey (merlin, belted kingfisher, common flicker, northern three-toed woodpecker, eastern kingbird, *Empidonax* spp., western wood pewee, gray jay, boreal chickadee, waxwing spp., red-eyed vireo, northern waterthrush, red-winged blackbird, rusty blackbird, common grackle, western tanager, and white-throated sparrow). The northern three-toed woodpecker, eastern kingbird, gray jay, red-winged blackbird, and common grackle were known to nest there (Table 6). *Empidonax* spp. and boreal chickadees were suspected to nest there. The breeding season for warblers, vireos, and sparrows occurred prior to the beginning of the study.

A few migrating water pipits and rusty blackbirds were observed at Saline Lake.

Ruth Lake

Table 7 presents the numbers of each species or species group that were observed during surveys of Ruth Lake in 1974. Table 8 presents the numbers of broods and decoying adults.

Waterbirds - A total of 29 species of waterbirds were observed at Ruth Lake. These species included loons, grebes, ducks, cranes, rails, coots, shorebirds, gulls, and terns.

Ten of these species were sighted during more than two surveys during July and August. Of the ten summer resident species, the common loon, red-necked grebe, ring-necked duck, lesser scaup, goldeneye spp., and bufflehead nested at Ruth Lake during 1974. The redhead, greater yellowlegs, and lesser yellowlegs were thought to have nested there. Adult individuals of these three species were either observed regularly in one location or area, or adult birds were seen performing distraction displays. The maximum number of duck broods (14) was seen on July 22. A detailed examination of the observations of broods revealed that there were at least two broods of loons, six broods of red-necked grebes, one brood of unidentified grebe, three broods of ring-necked ducks, one brood of lesser scaup, eight broods of *Aythya* spp., one brood of common goldeneye, seven broods of buffleheads, three broods of unidentified diving ducks, and three broods of unidentified ducks on Ruth Lake in 1974.

The most common migrants at Ruth Lake were scaup spp., which were observed in greatest numbers during October 1-8.

On October 8, two whooping cranes (one adult and one immature) were observed as they flew from a cattail marsh bordering the west end of Ruth Lake, at a distance of approximately 300 yards from the observers.

On September 3, a group of 14 cranes was observed flying southward at an altitude of between 1,000 and 2,000 feet and approximately one-half mile east of Ruth Lake. Because the

Table 7. Numbers of Birds Observed During Surveys of Ruth Lake in 1974.*

SPECIES/GROUP	JULY			AUGUST				SEPTEMBER				OCTOBER						NOVEMBER
	16	22	29	5	13	21	27	3	10	17	24	1	8	16	22	24	29	6
Common loon	7	8	7	3	3	4	2	3	1	2					1			
Loon spp.									1									
Red-necked grebe	34	40	39	10	19	30			2	2		2	1		1			
Horned grebe	2							7										
Grebe spp.	1		1				7				1	4			1			
Mallard	3	11	17	15	20	4	2	4	8	10	10	25		10				
Gadwall		1																
Pintail				1				1										
American wigeon		1				2	1	1			5	1						
Northern shoveler		4		8														
Dabbling duck spp.		2					2	1				1						
Redhead		1							1									
Ring-necked duck	6		19	6	14	1						30						
Canvasback														10				
Greater scaup								1										
Lesser scaup			3		1		2	8										
Scaup spp.	6						2	55	23	4		214	114	14	37		10	
Aythya spp.		73								1								
Goldeneye spp.	13				6	10		6	1				15		1		1	
Bufflehead	28	25	11	16	14		30	9	2	1		10	10					
Bucephala spp.		3																
White-winged scoter												2	10				3	
Ruddy duck													2					
Diving duck spp.	72		32	9			4		3		1	15	74	67			18	17
Duck spp.	8	24	14	7	35	7	40	5	7	12	22	38	100	31	15	9	1	
Sharp-shinned hawk					1													
Red-tailed hawk	1	1		1														
Broad-winged hawk					1													
Rough-legged hawk											3							
Bald eagle														2				
Marsh hawk				1														
American kestrel	2	1							1									
Hawk spp.											1		1					
Whooping crane													2					
Sandhill crane							3											
Sora	1																	
American coot												71	1					
Common snipe	3				1													
Spotted sandpiper				1														
Greater yellowlegs	1	2	1	5	5	1												
Lesser yellowlegs	1			3														
Yellowlegs spp.		10																
Dowitcher spp.		1																
'Peep' sandpiper spp.				3														
Shorebird spp.							12											

Table 7 (cont'd)

SPECIES/GROUP	JULY			AUGUST				SEPTEMBER				OCTOBER						NOVEMBER
	16	22	29	5	13	21	27	3	10	17	24	1	8	16	22	24	29	6
Wilson's phalarope				1														
Gull spp.			1												3			
Black tern	4	5	11	2	9													
Great horned owl						1												
Hawk owl															1			
Common nighthawk							2											
Belted kingfisher									1	1								
Common flicker		1																
Eastern kingbird	6	5																
Empidonax spp.		2																
Flycatcher spp.	3																	
Bank swallow				2														
Gray jay		2		1		1	3	3	1		1		6	7	1	1	1	
Common raven	1							2	2	3	1	3	5	1	4	8		
Black-capped chickadee		4	2												1			
Boreal chickadee		2	3										5					
Chickadee spp.							8									2		
American robin	1	1										1						
Water pipit									1									
Waxwing spp.	7	10	3	1														
Vireo spp.		1																
Yellow-rumped warbler	1							4										
Yellow-headed blackbird	2																	
Red-winged blackbird	34	122	29	4	8													
Rusty blackbird										11		2						
Common grackle	21	2	1	2														
Blackbird spp.		1		11		47	1	4				3						
White-winged crossbill		4																
White-throated sparrow			1															
Swamp sparrow	2	1																
Sparrow spp.	4						1			1								
Snow bunting																	2	
Passerine spp.	3	7			1				1				1	1	1			

* includes both adult and young birds

Table 8. Sizes of Broods and Numbers of Decoying Adults Observed During Surveys of Ruth Lake in 1974. Numbers of Decoying Adults Appear in Parentheses.

SPECIES/GROUP	JULY 16	JULY 22	JULY 29	AUGUST 5	AUGUST 13	AUGUST 21	AUGUST 27	SEPTEMBER 3	SEPTEMBER 10
Common loon	1,(1)	1,2	2,(1)	1	1			1,(1)	1,(1)
Red-necked grebe	3,2,1	1,4,2,2,4,(1)	4	2					
Grebe spp.							2		
Ring-necked duck	5		9,7,(1)	4	2,8,(1)	(1)			
Lesser scaup			2						
Aythya spp.		8,3,8,5,5,9,7,(3)ε							
Goldeneye spp.	8								
Bufflehead	4,1,2,6,2	4,2,4,4,3-2F†	7,2	4					(1)
Bucephala spp.		3							
Diving duck spp.	3,8,8,12-2F†		8,1,6-2F†,(3)						
Duck spp.	7	1	7,5	6			4		
Black tern			8,1α	1,(1)					
Greater yellowlegs	(1)	(2)							
Lesser yellowlegs	(1)								
Eastern kingbird	(2)	2,(1)							
Red-winged blackbird	(9)	6,(92)							
Common grackle	(2)								
Swamp sparrow	(2)								

† - creche, F denotes the number of females accompanying it

ε - one female a redhead (from later examination of a photograph taken of the bird)

α - from Horseshoe or Ruth Lake

sun was behind the group, a diagnostic color pattern could not be seen. Two flight calls that resembled those of whooping cranes (W.W.H. Gunn, F. Lahrman, pers. comm.) more closely than those of sandhill cranes were heard. This observation was recorded as a possible sighting of whooping cranes.

Few shorebirds were observed at Ruth Lake. The most common species, the greater yellowlegs, was thought to have nested there.

Other Species - Thirty-two other species and species groups were observed at Ruth Lake. Eleven of these were observed on two or more surveys during July and August (red-tailed hawk, American kestrel, eastern kingbird, gray jay, black-capped chickadee, boreal chickadee, American robin, waxwing spp., red-winged blackbird, common grackle, and swamp sparrow). The eastern kingbird was known to nest there, and the red-winged blackbird, common grackle, and swamp sparrow were suspected to nest there. Eastern kingbirds, waxwing spp., red-winged blackbirds, and common grackles were the most common resident species.

A few migrating rusty blackbirds were observed at Ruth Lake.

Lower Camp Pond

The results of regular surveys at the Lower Camp Pond and daily counts of adult birds made from shore between 0800-0830 MDT during September 2 - October 30 are presented Table 9. The numbers and sizes of broods and the number of decoying adults are presented in Table 10.

Waterbirds - A total of 18 species of waterbirds were observed at this pond, including loons, grebes, ducks, coots, and shorebirds.

Table 9. Numbers of Birds Observed During Surveys and Daily Counts From Shore at the Lower Camp Pond in 1974.[1]

SPECIES/GROUP	JULY	AUGUST			SEPTEMBER																										
	18*	20*	28*	2	3	4	5	6	7	8	9	10	11	11*	12	13	14	15	16	17	18	18*	19	20	21	22	23	24	25	26	27	28	29	30
Common loon	2	1		1	1				1		1	1	1	1																			
Red-necked grebe	4																																
Horned grebe																																	
Pied-billed grebe																																	
Grebe spp.	1																																
Mallard								1			1															1					1		3	4
American wigeon																																	
Dabbling duck spp.									1																								
Canvasback																																	
Redhead																																	
Ring-necked duck		1																															
Scaup spp.							2																										9
Aythya spp.													1																				
Bufflehead															3															1			
Ruddy duck												3														2							1
Diving duck spp.																																	
Duck spp.							1																										
American kestrel																	1																
American coot																																	
Lesser yellowlegs	4																																
Yellowlegs spp.	3																																
Solitary sandpiper	1																																
Spotted sandpiper	5																																
Killdeer	2																																
'Peep' sandpiper spp.	4																																
Shorebird spp.		2																															
Belted kingfisher																																	
Eastern kingbird	3	8																															
Alder flycatcher	1																																
Least flycatcher	1																																
Tree swallow	1																																
Bank swallow	1																																
Barn swallow	2	1	2																														
Cliff swallow	80																																
Gray jay																							1									1	
Common raven	1																					1		1									
American robin	2																																
Water pipit					4									6											2								
Waxwing spp.	2																																
Tennessee warbler	2																																
Yellow warbler	2																																
Ovenbird	2																																
Canada warbler	1																																
House sparrow	2																																
Red-winged blackbird	11																																
Common grackle	4																																
Blackbird spp.		1																															
Pine siskin	1																																
White-crowned sparrow														1																			
Fox sparrow																															1		
Song sparrow	1							2																							2		
Sparrow spp.	1																																
Snow bunting																																	
Passerine spp.																														2		2	

[1] adults and young included
* canoe surveys
** 20% ice cover

Table 9 (cont'd)

SPECIES/GROUP	OCTOBER																								
	1	2	3	4	7	8	9	10	11	12	13	14**	15	16	16*	17	18	19	20	21	22	23	25	27	28	29	30	31
Common loon																								------FROZEN------				
Red-necked grebe																								------FROZEN------				
Horned grebe										2									1					------FROZEN------				
Pied-billed grebe																	1	1						------FROZEN------				
Grebe spp.																								------FROZEN------				
Mallard	4			3								1	1				1	2					2	------FROZEN------				
American wigeon																	1							------FROZEN------				
Dabbling duck spp.																								------FROZEN------				
Canvasback															1	1								------FROZEN------				
Redhead											1	1			1				2					------FROZEN------				
Ring-necked duck																								------FROZEN------				
Scaup spp.	11	11	19	8	63	92	71	44	50	29	27	28	51	35	57	33	12		14	8	9	2		------FROZEN------				
Aythya spp.																								------FROZEN------				
Bufflehead																								------FROZEN------				
Ruddy duck																								------FROZEN------				
Diving duck spp.		2		1																				------FROZEN------				
Duck spp.																								------FROZEN------				
American kestrel																								------FROZEN------				
American coot							23	16	7	22	6	15	11	10	17	8	14		5	3	1			------FROZEN------				
Lesser yellowlegs																								------FROZEN------				
Yellowlegs spp.																								------FROZEN------				
Solitary sandpiper																								------FROZEN------				
Spotted sandpiper																								------FROZEN------				
Killdeer																								------FROZEN------				
'Peep' sandpiper spp.																								------FROZEN------				
Shorebird spp.																								------FROZEN------				
Belted kingfisher																								------FROZEN------				
Eastern kingbird																								------FROZEN------				
Alder flycatcher																								------FROZEN------				
Least flycatcher																								------FROZEN------				
Tree swallow																								------FROZEN------				
Bank swallow																								------FROZEN------				
Barn swallow																								------FROZEN------				
Cliff swallow																								------FROZEN------				
Gray jay							2								3							2		------FROZEN------				
Common raven																		4						------FROZEN------				
American robin																				1				------FROZEN------				
Water pipit																								------FROZEN------				
Waxwing spp.																								------FROZEN------				
Tennessee warbler																								------FROZEN------				
Yellow warbler																								------FROZEN------				
Ovenbird																								------FROZEN------				
Canada warbler																								------FROZEN------				
House sparrow																								------FROZEN------				
Red-winged blackbird																								------FROZEN------				
Common grackle																								------FROZEN------				
Blackbird spp.																								------FROZEN------				
Pine siskin																								------FROZEN------				
White-crowned sparrow																								------FROZEN------				
Fox sparrow																								------FROZEN------				
Song sparrow																								------FROZEN------				
Sparrow spp.																								------FROZEN------				
Snow bunting												29					16			15		1		------FROZEN------				
Passerine spp.	3																	1						------FROZEN------				

1 adults and young included
* canoe surveys
** 20% ice cover

Table 10. Sizes of Broods and Numbers of Decoying Adults Observed at the Lower Camp Pond in 1974. Numbers of Decoying Adults Appear in Parenthesis.

SPECIES/GROUP	JULY 18	AUGUST 20	AUGUST 28	SEPTEMBER 5	SEPTEMBER 6	SEPTEMBER 7	SEPTEMBER 8	SEPTEMBER 9
Common loon	2†			1	1	1	1	
Pied-billed grebe	ε							
Ring-necked duck		7						2
Ruddy duck	α							
Eastern kingbird	1							
Tree swallow	1,(3)							
American robin	1							
Ovenbird	1							
Canada warbler	(1)							
Common grackle	1							

† - one of these young was found on the shore, and had been dead for several days. The cause of its death is not known--a gross examination showed no evidence of wounds. Both young loons were alive on July 8, according to residents of the lower camp.

ε - a brood was seen there in late July or early August by C. and L. Weseloh (pers. comm.)

α - a female and brood were seen on or about July 20 by C. and L. Weseloh (pers. comm.)

Eight species (common loon, pied-billed grebe, ring-necked duck, ruddy duck, killdeer, spotted sandpiper, solitary sandpiper, and lesser yellowlegs) were observed during July and August and were considered to be summer residents. The red-necked grebe was a possible summer resident. Only the common loon, pied-billed grebe, ring-necked duck, and ruddy duck were known to nest there.

The most common migrants were scaup spp. and American coots.

Other Species - Twenty-five other species were seen at the Lower Camp Pond. Nine species were known or thought to nest nearby (eastern kingbird, barn swallow, cliff swallow, tree swallow, American robin, ovenbird, Canada warbler, red-winged blackbird, and common grackle). The barn and cliff swallows nested on towers, sheds, and tanks of the old pilot plant; and the buildings of the lower camp.

A few migrant snow buntings and water pipits were observed at the Lower Camp Pond.

Athabasca River

The results of surveys conducted on the Athabasca River are presented in Table 11. These numbers include breeding birds because few broods and decoying adults were seen.

Waterbirds - Twenty species or species groups were observed during surveys of the Athabasca River in 1974. Included were loons, grebes, geese, ducks, shorebirds, and gulls.

The Canada goose, mallard, spotted sandpiper, yellowlegs spp., and gull spp. were sighted during the August survey and may have been summer residents. Only the spotted sandpiper was known to nest along the river. Most of the gulls

Table 11. Numbers of Birds Observed During Surveys of 22 Miles of the Athabasca River in 1974.* Sizes of Broods Appear in Parentheses.

SPECIES/GROUP	AUGUST 1	SEPTEMBER 8	SEPTEMBER 21	OCTOBER 2	OCTOBER 12	OCTOBER 27	NOVEMBER 7
Loon spp.						1	1
Red-necked grebe			1	1			
Canada goose	7	45					
Mallard	31		2	1	11		4
Pintail			1				
Green-winged teal					1		
Blue-winged teal		3					
Northern shoveler				11			
Ring-necked duck		2					
Lesser scaup			1				
Scaup spp.					6		1
Goldeneye spp.				5	13		
Oldsquaw						1	
Surf scoter			1				
Common merganser						20	1
Merganser spp.					4	3	8
Diving duck spp.					1		
Duck spp.						2	
Goshawk	2						
Rough-legged hawk				1			
Golden eagle				2			
Bald eagle				1	2		
Marsh hawk			1				
Hawk spp.		1					
Grouse spp.				1			
Plover spp.			1				
Spotted sandpiper	21(2)						
Greater yellowlegs			1	2	2		
Lesser yellowlegs			6				
Yellowlegs spp.	6						
Pectoral sandpiper			1				
'Peep' sandpiper spp.	2						
Sandpiper spp.	1						
Herring gull			1				
Gull spp.	40	122	34	38	34		
Larid spp.			30				
Snowy owl							1
Belted kingfisher		2	4				
Pileated woodpecker		4(2)					
Yellow-bellied sapsucker	1						
Hairy woodpecker			2				
Alder flycatcher	1						
Horned lark			2				
Gray jay			1	1	3	2	
Blue jay	3	1					
Common raven	1	6	14	18	33	18	40
Common crow	2	4					
Chickadee spp.					1		
American robin			1				
Ruby-crowned kinglet			1				
Water pipit		1	37	3			
Rusty blackbird			27	7			
Blackbird spp.		1	5				
Evening grosbeak		3					
Song sparrow	1						
Lapland longspur			2				
Snow bunting					91	9	31
Passerine spp.		4	24	5	3		4

* includes both adult and young birds

(predominantly herring and California gulls) sighted were sub-adults and therefore were not breeding birds. These gulls fed regularly at the local garbage disposal areas and, according to local residents, were present throughout the summer. The river was not heavily used by migrant waterfowl; the most commonly seen migrants were mergansers.

Other Species - Twenty-five other species or species groups were observed along the Athabasca River. Eight species were seen during the August survey (goshawk, belted kingfisher, yellow-bellied sapsucker, alder flycatcher, blue jay, common raven, common crow, and song sparrow). The kingfishers probably nested on the bluffs along the river; young birds were seen with adults during casual observations in early September. The pileated woodpeckers seen in early September were a pair of adults and two young. There were no indications that the other species mentioned nested along this river.

The bald eagles seen were probably migrants. However, two sightings of adults during midsummer near Fort McMurray indicated that a pair may have resided in the area.

Small numbers of shorebirds, water pipits, rusty blackbirds, and snow buntings were observed migrating along the river.

Syncrude Site Water Areas

The combined results of the surveys of these water areas are presented in Table 12, by species or species group, and date. Table 12 is summarized from Appendix 3, in which surveys of each individual water area are presented.

Due to road construction and draining operations during the summer, the surface area of the water bodies that were surveyed declined by 65% between July 18 and September 10. Of

Table 12. Numbers of Birds Observed During Surveys of the Water Areas on the Syncrude Site in 1974. Sizes of Broods Observed are in Parentheses.

TOTAL AREA SURVEYED																									
mi^2	.07				.07	.06	.05						.04			.04							.04		
(Km^2)	(.17)				(.16)	(.15)	(.13)						(.11)			(.11)							(.11)		
SPECIES/GROUP	JULY				AUGUST					SEPTEMBER								OCTOBER							NOVEMBER
	18	22	26	29	5	9	13	18	27	3	7	10	14	17	20	24		1	4	8	15	19	29		10
Mallard	3	17	13	10	7	2	10	12	3	2										2			2		
Pintail	5	24	66	28	2	4	5	5	11	1	3		3	6	1	3									
Green-winged teal	1	8	12	41	165	285	58,(6)	101,(6)	6	8	30	23	10	2	9	14									
Blue-winged teal			3				1		3																
Teal spp.			5							1															
American wigeon										3															
Northern shoveler	3	3	4	3			7	4	9																
Dabbling duck spp.	4	1								21															
Duck spp.	2	1			25	2,(2)	2,(2)																		
Rough-legged hawk											1			1					1				1	
American kestrel							1	1			1	1													
Marsh hawk			1				3	1			1														
Semipalmated plover	4	11	11	5	8	8	13	4	8	3	1														
Killdeer	23	7	7	14	17	49	40	15			2	1				1									
American golden plover			3	2			1						1	7	12	4									
Black-bellied plover						1							2		2										
Plover spp.			1										3		12	9									
Common snipe	11	5		5	5	11	8	1		1	2		3		3	7		1		1	1				
Solitary sandpiper	2		1		1																				
Greater yellowlegs	4	1	7	7	6	3	2	1	3	1		2		6											
Lesser yellowlegs	101	77	131	71	9	59	5	11	23	3			1	7											
Yellowlegs spp.	22	62		4	9	10	20	2		2	1			4											
Pectoral sandpiper	161	97	71	57	56	39	45	19	32	31	15	4	26	2	20	13		3							
Baird's sandpiper	9	18	4	18				9		2															
Least sandpiper	8	11	7	14	15	18	47	31	4	4					3										
Short-billed dowitcher		1													2										
Long-billed dowitcher		16													3										
Dowitcher spp.	24	29	12	27	10	12	14	1	4	10	11	6	4	15	4	1					1				
Stilt sandpiper	30			1			15			1		1													
Semipalmated sandpiper	11	22	5	9	3	23	51	10																	
'Peep' sandpiper spp.	158	78	65	13	10	21	80	45		4	1			10											
Buff-breasted sandpiper								1																	
Sandpiper spp.	16	36				6	26								2										
Sanderling														2											
Wilson's phalarope					1		1	9	2																
Northern phalarope	17	7	2	9	9	3	3		1																
Shorebird spp.	103	48		124	29	14	44	9	8							13		1	1						
Horned lark											17				1										
Common raven					5											1						1			
Water pipit											16	8	15	2	11	1									
Red-winged blackbird		7		2		6		3																	
Rusty blackbird		11		6	3										4			1							
Blackbird spp.		30		8	3		24	16				3		4		2									
Savannah sparrow	4										1														
Lapland longspur											8														
Snow bunting																			3		14	3	4		
Passerine spp.											31			3				3							

the original 13 areas, nine were eliminated or completely dry by October 19.

Waterbirds - Twenty-five species of waterbirds were recorded on these water areas. These birds consisted only of ducks and shorebirds.

The green-winged teal was the only species known to nest on these water areas. A few mallards, pintails, northern shovelers, killdeers, common snipe, solitary sandpipers, greater yellowlegs, lesser yellowlegs, short-billed dowitchers, and Wilson's phalaropes may have been summer residents. Because these areas were surveyed from a truck to minimize disturbance and thus get accurate counts, there were no opportunities to observe decoying adult birds. Hence, little information on nesting activity was obtained.

The most common ducks were pintails and green-winged teal. Pintails were most numerous during late July, and green-winged teal were most numerous during early August.

The pectoral sandpiper was the most numerous shorebird species, and "peep" sandpipers (Baird's, least, and semipalmated) formed the most abundant species group. Other common species and species groups were killdeer, yellowlegs spp., and dowitcher spp. The numbers of shorebirds were generally high from mid-July to mid-August as birds returned from the Arctic in the early stages of autumn migration. Many of the species or groups of shorebirds appeared to arrive in the area in two or more distinct waves throughout July to September (Table 13).

Other Species - Twelve other species were observed at the water areas. Five species (marsh hawk, American kestrel, red-winged blackbird, rusty blackbird, and savannah sparrow) were probably summer residents. During the summer, casual observations were

Table 13. Numbers of Birds Observed During Surveys of the Borrow Pits in 1974.*

SPECIES/GROUP	JULY						AUGUST			SEPTEMBER				OCTOBER				
	13	15	19	23	25	30	2	17	28	4	11	18	25	2	9	16	23	30
Mallard	4		1		2	2		19	9	6	7	2	5	12	1			
Pintail								34	12		1	3	4	1				
Green-winged teal	15	16	4	8		13		21	28		5		6	1				
Blue-winged teal			1															
Teal spp.								8										
American wigeon								2										
Northern shoveler			1															
Ring-necked duck	11	11	11		1													
Scaup spp.	1										1				3	3		
Bufflehead		2	2	4	2	3	1											
Diving duck spp.				1														
Duck spp.																	1	
Red-tailed hawk													1					
Marsh hawk			1		1													
Merlin	1																	
American kestrel				2				2	1		1							
Ruffed grouse		3																
Sora	5	4	6	1				1										
Semipalmated plover			3	1				4										
Killdeer	7	4	8		4								1					
Plover spp.			1															
Common snipe	4					3		2	3		3	1	1	2				
Spotted sandpiper	13	17	13	14	13	7	4	4	3		1							
Solitary sandpiper	9	2	16	4	1	2			1									
Greater yellowlegs	3	3	9	8	7	4	1	4	1	1		2			1			
Lesser yellowlegs	8	1	10	9	18	1	1	10	1									
Yellowlegs spp.		5		1														
Pectoral sandpiper			1					2			3							
Baird's sandpiper			1	1	1			1										
Least sandpiper	3		1	5		2	1											
Dowitcher spp.			2		2													
Semipalmated sandpiper	2		5		1													
'Peep' sandpiper spp.	10			8	2		1	2										
Sandpiper spp.			18															
Wilson's phalarope	1																	
Shorebird spp.			1										1					
Bonaparte's gull		2																
Gull spp.					1													
Flycatcher spp.								2										
Bank swallow	5	3	5	21	1													
Gray jay		1	4			1				6		6	1	1	3	2	1	
Common raven	3		1		1	1			2			3	1			2	3	3
American robin	1	1		1														
Hermit thrush	1	1																
Water pipit										10	27	5						
Waxwing spp.			1	16	2		1											
Mourning warbler				1		1												
Warbler spp.													1					
Red-winged blackbird	8	14	17	16	8	3												
Rusty blackbird														2	1			
Common grackle				3		2	2	12										
Blackbird spp.					1		1	2		1								
Western tanager				2														
Savannah sparrow	1	2	3						1									
LeConte's sparrow	1	1	1															
Dark-eyed junco		4																
Chipping sparrow	4		1	2	6													
Clay-colored sparrow		1		1														
White-throated sparrow	2	1	6	2														
Lincoln's sparrow							1											
Swamp sparrow						2												
Song sparrow	1					1												
Sparrow spp.			2	9		2		1	6	4								
Lapland longspur											1	6	4					
Snow bunting															67	15	8	2
Passerine spp.					2	2	2		1	3	1	3	7	2				2

* includes both adult and young birds

Table 14. Sizes of Broods and Numbers of Decoying Adults Observed at the Borrow Pits in 1974. Numbers of Decoying Adults Appear in Parentheses.

SPECIES/GROUP	JULY 13	JULY 15	JULY 19	JULY 23	JULY 25	JULY 30	AUGUST 2	AUGUST 17	AUGUST 28
Mallard	1								
Green-winged teal	7	7,(1)	(2)					8	
Ring-necked duck	10	10	10						
Bufflehead			(1)		(3)				
Sora	(5)	(4)	1,(3)						
Spotted sandpiper	(11)	1,(5)	1,1,(4)	2,1	1,1		1		
Solitary sandpiper	(3)	(1)							
Killdeer	(5)	(1)							
Greater yellowlegs	(1)	(1)							
Mourning warbler				(1)					
Red-winged blackbird	(1)	4-5F†,(1)	(1)	10-4F†,(1)	(1)				
Savannah sparrow	(1)	(1)							
LeConte's sparrow		(1)							
Dark-eyed junco		2							
Chipping sparrow	2,3				4				
White-throated sparrow			3						

† - two or more broods, F denotes the number of adult females present

often made of kestrels and marsh hawks hunting over the cleared area. Red-winged blackbirds probably nested in the tall vegetation in the marsh south of the water areas which were surveyed, and rusty blackbirds may have nested in the conifers near Ruth Lake. The savannah sparrows (all singing males) were seen in the scattered low shrubs remaining near water area 41 (see Figure 3).

Migrating horned larks, water pipits, blackbirds, Lapland longspurs, and snow buntings made some use of the shores and floating islands in the water areas.

Borrow Pits

The results of the surveys of all the borrow pits are combined and presented in Table 13. These are summarized from Appendix 4, which includes the numbers of birds seen at each borrow pit during the surveys. Information about nesting is summarized in Table 14.

Waterbirds - Twenty-four species of waterbirds were observed during surveys in 1974. These species belonged to the following groups: ducks, rails, shorebirds, and gulls.

Eleven of the 24 species were seen regularly during July and August and were considered to be summer residents (mallard, green-winged teal, ring-necked duck, bufflehead, sora, killdeer, common snipe, spotted sandpiper, solitary sandpiper, greater yellowlegs, lesser yellowlegs).

Mallards, green-winged teal, ring-necked ducks, soras, and spotted sandpipers were known to nest at the borrow pits; and buffleheads, killdeers, solitary sandpipers, and greater yellowlegs were thought to nest there (Table 14). The spotted sandpiper was the most common nesting species and was observed on all but one of the 11 borrow pits.

A few migrating mallards, pintails, and green-winged teal were observed at the borrow pits. These pits were also used by a few migrant shorebirds, notably semipalmated plovers, yellowlegs spp., and "peep" sandpiper spp.

Other Species - Twenty-eight other species were seen at the borrow pits, of which 17 species were probably summer residents (marsh hawk, American kestrel, bank swallow, gray jay, common raven, American robin, hermit thrush, waxwing spp., mourning warbler, red-winged blackbird, common grackle, savannah sparrow, LeConte's sparrow, dark-eyed junco, chipping sparrow, clay-colored sparrow, and white-throated sparrow). Red-winged blackbirds, dark-eyed juncos, chipping sparrows, and white-throated sparrows were known to nest near the borrow pits, and mourning warblers, savannah sparrows, and LeConte's sparrows were thought to nest there.

During late autumn, moderate numbers of water pipits, Lapland longspurs, and snow buntings stopped at the borrow pits while migrating through the area.

4.1.2 Summary of Nesting Activity

The maximum observed densities of nesting waterbirds, in terms of the number of broods and decoying adults per mile of shoreline of each lake, are presented in Table 15. Broods accompanied by more than one female (creches) were, depending on the number of females present, counted as two or more broods.

These results indicate that Ruth Lake supported the highest numbers of nesting diving ducks and red-necked grebes, and that Horseshoe Lake supported a lower density of nesting diving ducks, the highest density of nesting dabbling ducks, and a lower overall density of nesting waterbirds than Ruth Lake.

Red-winged blackbirds, common grackles, and

Table 15. Maximum Densities of Breeding Waterbirds Observed Per Mile of Shoreline of the Lakes and Ponds Surveyed During 1974. Numbers of Broods or Decoying Adults Appear in Parentheses.

WATERBODY (Perimeter)	GROUPS										
	LOONS	GREBES	DABBLING DUCKS	DIVING DUCKS	UNIDENTIFIED DUCKS	TOTAL DUCKS	TOTAL DUCKS, LOONS AND GREBES	SORAS	SHOREBIRDS	TERNS	GULLS
MILDRED LAKE (5.6 mi)											
Broods	0.36(2)	0.36(2)	0.36(2)	1.79(10)	0.18(1)	2.32(13)	3.04(17)				
Decoying Adults								0.36(2)	0.54(3)		0.54(3)
Total	0.36(2)	0.36(2)	0.36(2)	1.79(10)	0.18(1)	2.32(13)	3.04(17)	0.36(2)	0.54(3)		0.54(3)
RUTH LAKE (4.9 mi)											
Broods	0.41(2)	1.02(5)		2.86(14)	0.20(1)	3.06(15)	4.49(22)		0		
Decoying Adults		0.20(1)		0.41(2)	0	0.41(2)	0.61(3)		0.41(2)		
Total	0.41(2)	1.22(6)		3.27(16)	0.20(1)	3.47(17)	5.10(25)		0.41(2)		
HORSESHOE LAKE (5.0 mi)											
Broods		0.20(1)	0.80(4)	1.20(6)	0.40(2)	2.40(12)	2.60(13)			2.0(10*)	
Decoying Adults		0	1.00(5)	2.20(11)		3.20(16)	3.20(16)	1.20(6)	0.40(2)		
Total		0.20(1)	1.80(9)	3.40(17)	0.40(2)	5.60(28)	5.80(29)	1.20(6)	0.40(2)	2.0(10*)	
SALINE LAKE (5.8 mi)											
Broods		0.69(4)		1.21(7)	0.17(1)	1.38(8)	2.07(12)			1.38(8*)	0.34(2?)
Decoying Adults			0.69(4)			0.69(4)	0.69(4)	0.52(3)	0.34(2)		
Total		0.69(4)	0.69(4)	1.21(7)	0.17(1)	2.07(12)	2.76(16)	0.52(3)	0.34(2)	1.38(8*)	0.34(2?)
LOWER CAMP POND (0.9 mi)											
Broods	1.11(1)	1.11(1)		2.22(2)		2.22(2)	4.44(4)				
Decoying Adults											
Total	1.11(1)	1.11(1)		2.22(2)		2.22(2)	4.44(4)				

* approximated $\left(\frac{\text{number of young}}{2} = \text{broods}\right)$

eastern kingbirds were the most common other nesting species observed during surveys.

A number of casual observations of nests or young, or of adults either carrying food or decoying, were made during the survey period. Many of these observations were of species that were not previously known to nest in the area. Appendix 5 consists of an annotated list of the observations of these species.

The following casually-observed species nested in the study area: American kestrel, spruce grouse, ruffed grouse, sandhill crane, killdeer, common nighthawk, common flicker, black-billed magpie, and warbling vireo. The following species were thought to nest in the area: marsh hawk, Swainson's thrush, and western tanager.

4.1.3 Comparisons of Waterbird Densities

Table 16 presents the relative distribution and abundance of the common species or groups of water-associated birds observed on the lease. During July and August, mallards were somewhat more abundant on Mildred Lake than on Horseshoe and Saline lakes. All of these lakes had fairly extensive areas of emergent vegetation. During September and October, the average numbers of mallards were highest on Horseshoe and Saline lakes.

The average numbers of pintails were highest on Saline Lake during July and August; relatively few pintails were seen in the study area during September and October. Pintails tend to begin migrating in late August (Bent 1923).

The average numbers of green-winged teal were highest on the Syncrude site during July and August. Relatively few birds of this species were seen in September and October.

American wigeon were most numerous on Saline Lake

Table 16. Numbers of Common Waterbirds Observed During Surveys of Water Bodies in 1974, Expressed as the Mean Number of Each Species or Group Seen Per Survey. Dashes Indicate That the Average Number was Less Than One.

SPECIES/GROUPS	MILDRED LAKE		HORSESHOE LAKE		SALINE LAKE		RUTH LAKE		ATHABASCA RIVER		BORROW PITS		SYNCRUDE SITE	
	JULY-AUGUST	SEPTEMBER-OCTOBER	JULY-AUGUST	SEPTEMBER-OCTOBER	JULY-AUGUST	SEPTEMBER-OCTOBER	JULY-AUGUST	SEPTEMBER-OCTOBER	JULY-AUGUST	SEPTEMBER-OCTOBER	JULY-AUGUST	SEPTEMBER-OCTOBER	JULY-AUGUST	SEPTEMBER-OCTOBER
Mallard	105	10	75	167	62	132	10	7	31	3	4	3	8	-
Pintail	8	11	1	4	45	5	-	-	-	-	5	1	17	1
Green-winged teal	-	-	3	1	10	-	-	-	-	-	12	1	75	7
American wigeon	4	1	6	29	32	15	1	1	-	-	-	-	-	-
Scaup spp.	7	411	13	23	106	290	2	48	-	1	-	-	-	-
Goldeneye spp.	1	8	3	3	19	16	4	2	-	4	-	-	-	-
Bufflehead	-	10	7	-	14	10	18	3	-	-	2	-	-	-
Total Dabbling ducks	120	151	92	243	179	203	13	8	31	6	22	6	106	11
Total Diving ducks	55	490	30	32	167	354	34	24	-	11	6	1	-	-
American coot	-	16	1	72	-	210	-	7	-	-	-	-	-	-
Total Shorebirds	17	-	15	-	42	-	7	-	30	3	38	2	341	25

during July and August and most numerous on Horseshoe Lake in September and October.

Saline Lake had the highest average numbers of scaup spp. during July and August, and Mildred Lake had the highest average number during September and October, followed by Saline Lake.

Neither goldeneyes nor buffleheads were very abundant at any time, although both species were fairly numerous at Saline Lake in late summer and autumn.

Overall, Saline Lake had the highest numbers of dabbling ducks and diving ducks during July and August. During September and October, Horseshoe Lake had the highest numbers of dabbling ducks, and Mildred Lake had the highest numbers of diving ducks, followed by Saline Lake for both diving and dabbling ducks. Saline Lake also had the highest average number of American coots in autumn. Shorebirds were much more abundant at the Syncrude site water areas than elsewhere on the lease.

4.1.4 Migration Phenology

The total numbers of each species or species group observed on each day of the migration watch are presented in Appendix 6. The following data are summarized from this appendix, from other survey information, and from pertinent casual observations.

Cranes and Swans

Table 17 is a summary of the observations made in 1974 of migrating cranes and whistling swans. These species were rarely observed, and we did not observe large numbers of them passing through the study area.

The details of the two sightings of whooping

Table 17. Migrating Cranes and Whistling Swans Observed During 1974.

SPECIES	DATE	NUMBER OBSERVED	
		MIGRATION WATCH	CASUAL AND OTHER SURVEYS
Whooping crane	September 3		14 (unconfirmed identification)
	October 8		2 (1 adult, 1 immature, confirmed identification)
Sandhill crane	August 16		16*
	August 24		38
	August 27		57
	August 28		68
	August 31	6	
	September 4	77	18
Whistling swan	September 6	9	
	September 24	1	
	September 28	1	112
	October 4		4
	October 10	4	

* could be local birds

cranes have been described previously.

Sandhill cranes passed through the area during the last week of August and the first week of September.

One major diurnal flight of whistling swans was observed on September 28. Much of the migration of whistling swans takes place at night (Sladen *et al.* 1970), and large numbers of swans may have passed over the area without being detected. A family group of two adults and two small young was observed on Saline Lake September 29 and October 4.

Geese

Figures 4 and 5 show, by species, the numbers of migrating geese observed in 1974. Most of the casual observations were made at Mildred Lake between 1100 hours and 1700 hours, and are complementary to the migration watch data. The data on the goose migration gathered during casual observations closely agrees with the data from the migration watch. Geese also migrate at night, and the numbers considered here are an incomplete estimate of the number of geese that passed over the area.

Canada and white-fronted geese were the most common geese observed. Most white-fronted geese came through the area between August 31 and September 7. Canada geese were most numerous slightly later, during the period September 4-7, with a smaller peak during September 15-16. Snow geese were observed on three occasions: the September 27 observation was of one flock of 110 birds that arose from Horseshoe Lake at dawn. A few flocks of Canada geese landed on sandbars near the lower camp, particularly in the evening, but never stayed long because they were disturbed by the frequent appearance of small craft and barges, and by hunting activities along the river.

Migrating flocks of the uncommon Ross' goose were

Fig. 4 - Numbers of Geese Observed During Migration Watches in 1974

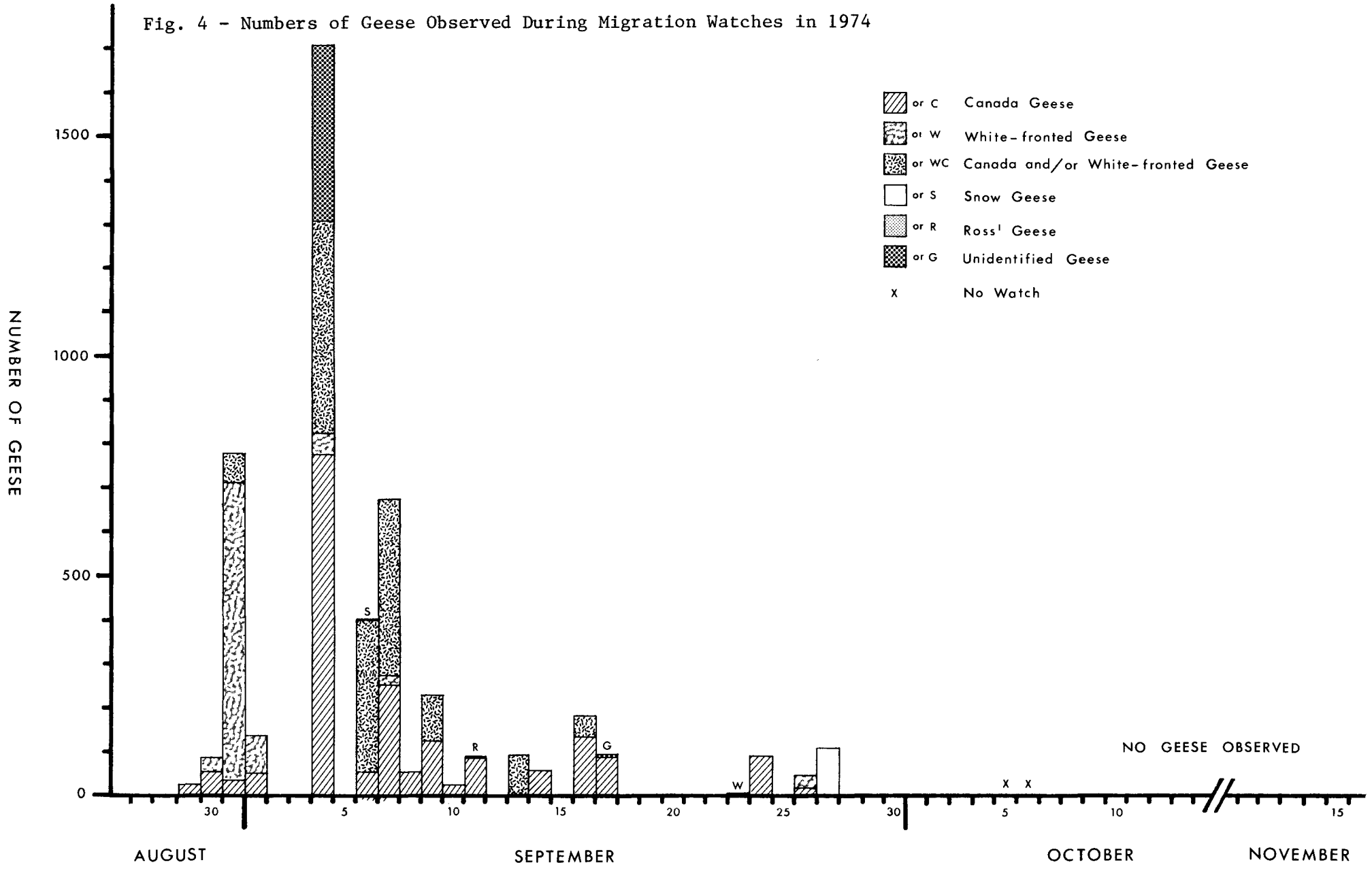
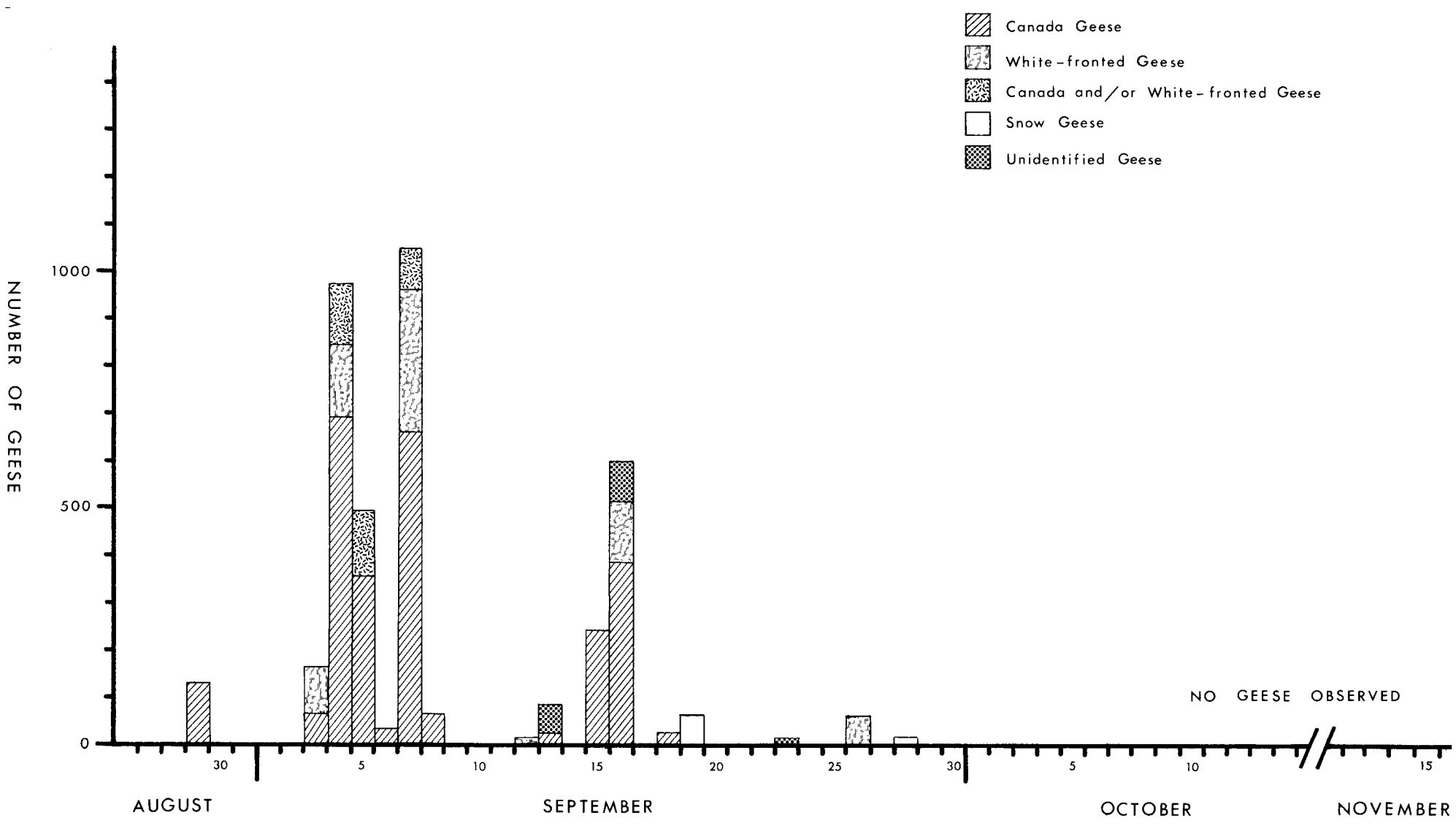


Fig. 5 - Numbers of Geese Observed During Casual Observation in 1974



not observed. One immature Ross' goose was observed at the Syncrude lower camp on September 7 and 11, and reports were received from construction workers that one Ross' goose and seven white-fronted geese were feeding and resting at the Syncrude site water areas during the evening of September 7.

Ducks

The numbers of ducks observed during the migration watches and other surveys from late August to early November are presented in Figure 6. The largest diurnal movements of ducks detected on the migration watch were seen on September 27 and October 3. This is consistent with the great increase and subsequent decrease in numbers of ducks observed during other surveys in the area between these dates.

The numbers of ducks observed during surveys in the area began to rise in mid-August. Numbers remained fairly constant until after mid-September. A large influx of migrants then occurred sometime between September 27 and 29. Peak numbers were reached about the first of October. These birds departed, probably *en masse*, on the evening of October 2 or on October 3. More migrants appeared soon after, and their numbers remained fairly constant until the end of October.

Figures 7 and 8 illustrate the changes in numbers of the common migrant species--mallard, pintail, green-winged teal, American wigeon, and scaup--observed during surveys of the lakes and Syncrude site water areas. Buffleheads and goldeneyes were also fairly common, but their numbers did not fluctuate greatly in autumn, and they were not plotted.

Large numbers of green-winged teal appeared on the Syncrude site in early August; these were either moulting or (immediately) post-moulting birds. Pintails showed a similar but earlier pattern of appearance at the Syncrude site and may also

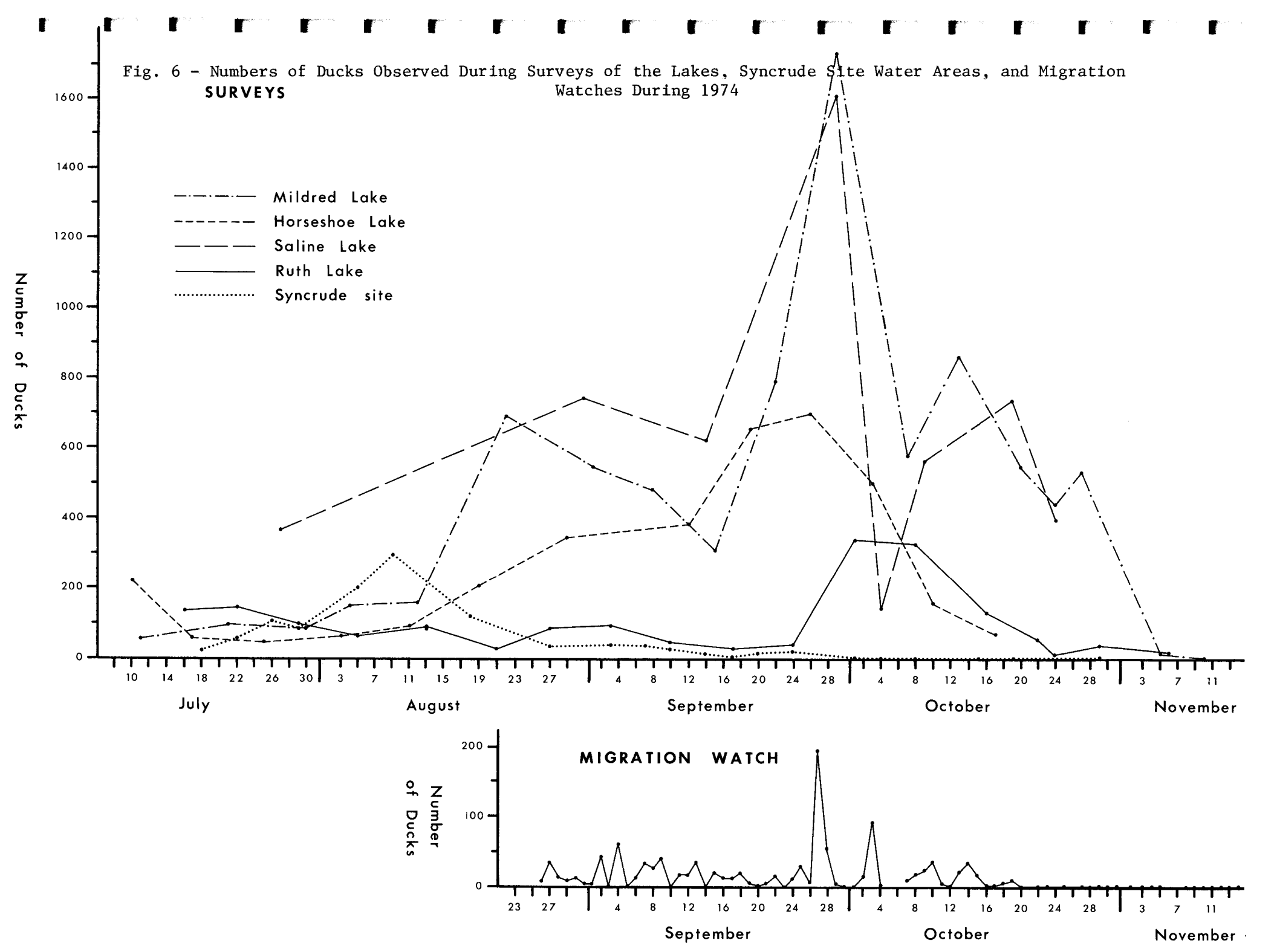


Fig. 6 - Numbers of Ducks Observed During Surveys of the Lakes, Syncrude Site Water Areas, and Migration Watches During 1974

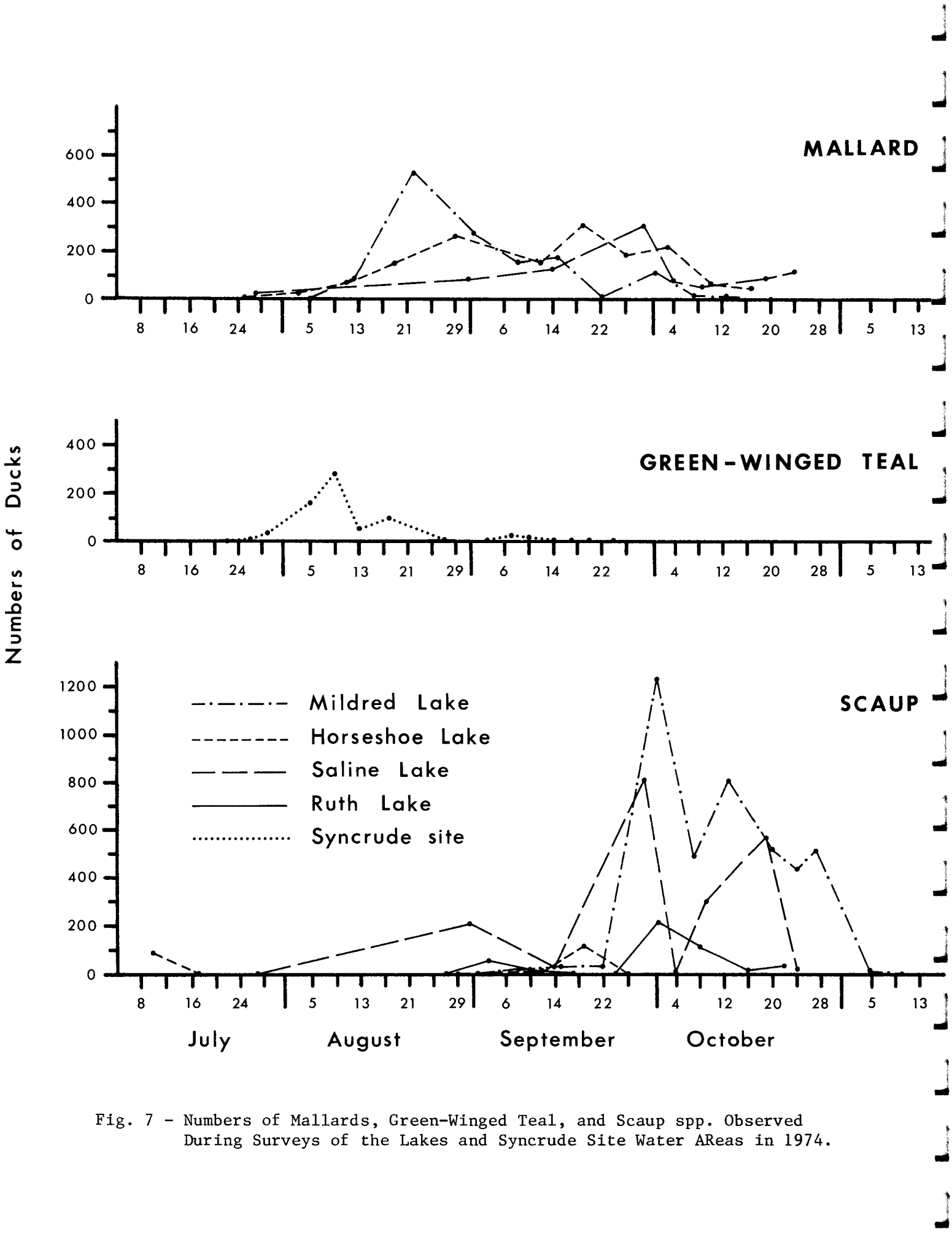


Fig. 7 - Numbers of Mallards, Green-Winged Teal, and Scaup spp. Observed During Surveys of the Lakes and Syncrude Site Water AReas in 1974.

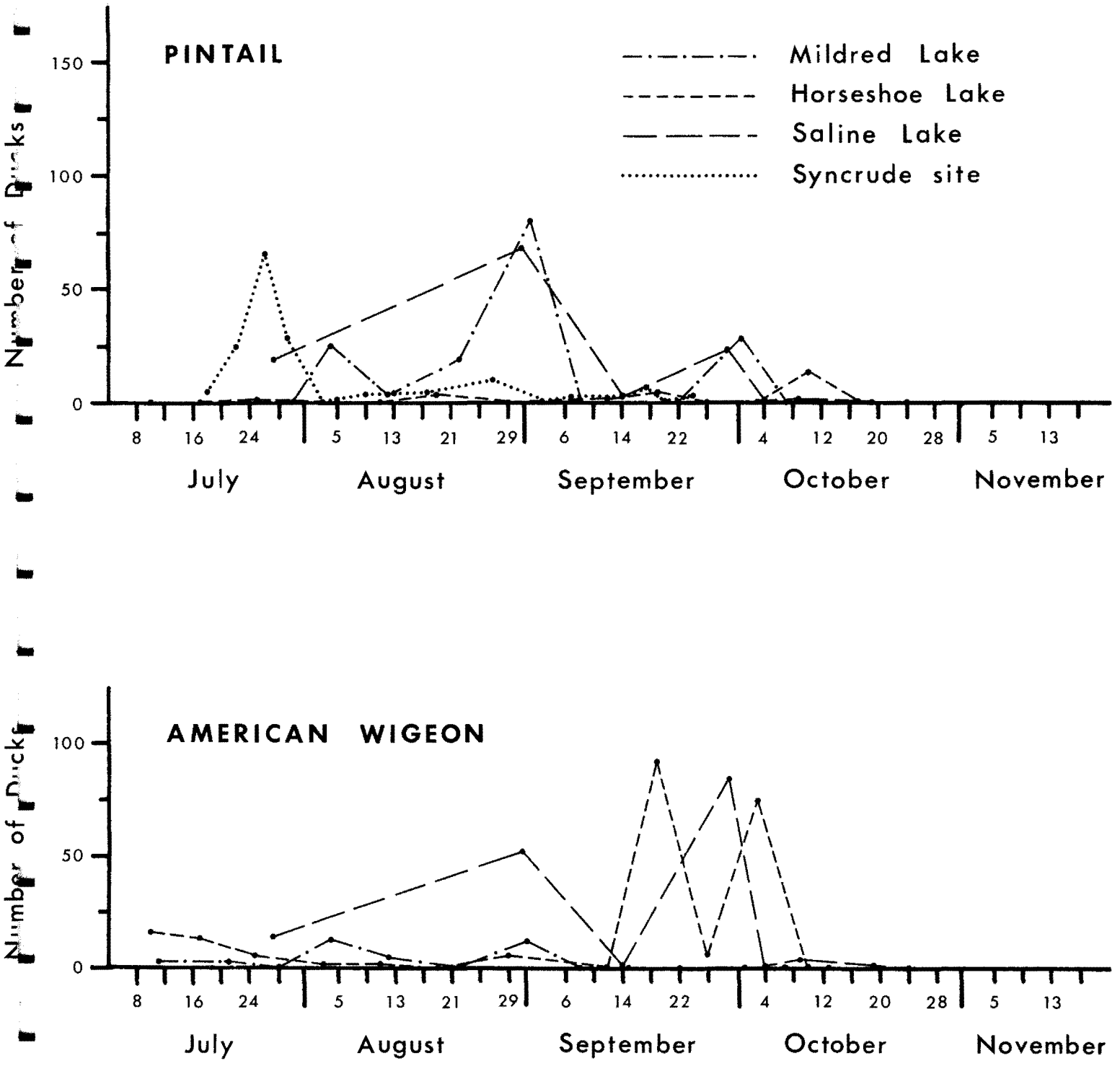


Fig. 8 - Numbers of Pintails and American Wigeons Observed During Surveys of the Lakes and Syncrude Site Water Areas in 1974

have been moulting there. Mallard numbers increased during mid to late August, and then declined gradually until mid-September. It appeared that two waves of migrants arrived in mid to late September (or the same birds moved between lakes). American wigeon became fairly numerous at Saline Lake in late August. Their numbers then declined until mid-September, when another increase occurred.

The very large increase in duck numbers in late September and early October was due primarily to an influx of migrating scaup, apparently in two waves. The first stopped briefly around the first of October, and the second, somewhat smaller, wave appeared in mid-October. This second wave of migrant scaup remained in the area longer than the first. Most of these birds had left the area by November 1.

American Coots

Figure 9 presents the numbers of American coots observed during surveys of the lakes in 1974. There were two peaks in the numbers of coots observed--a smaller peak at Horseshoe Lake during mid-September, and a larger peak at Saline Lake during mid-October.

Shorebirds

Figure 10 presents the numbers of shorebirds observed during the migration watch and at the Syncrude site during this study. Few shorebirds were seen during the migration watch, and these data do not give much useful information about shorebird migration. This was expected, however, because most shorebirds migrate at considerable altitude and on a broad front; they rarely follow rivers (Richardson 1972, L.G.L. Limited 1974). Furthermore, much of the "autumn" migration of shorebirds occurs in

Fig. 9 - Numbers of American Coots Observed During Surveys of the Lakes in 1974

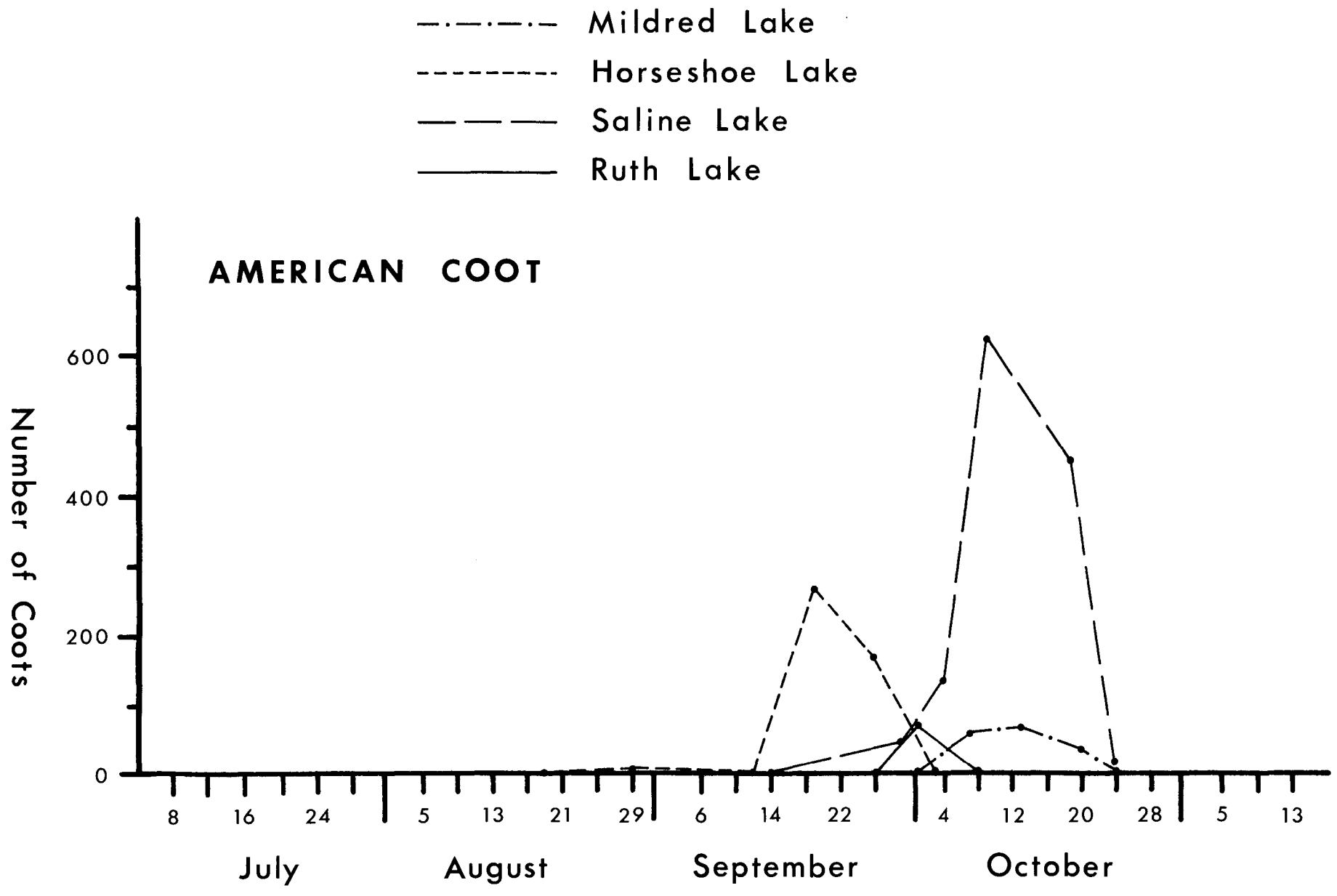
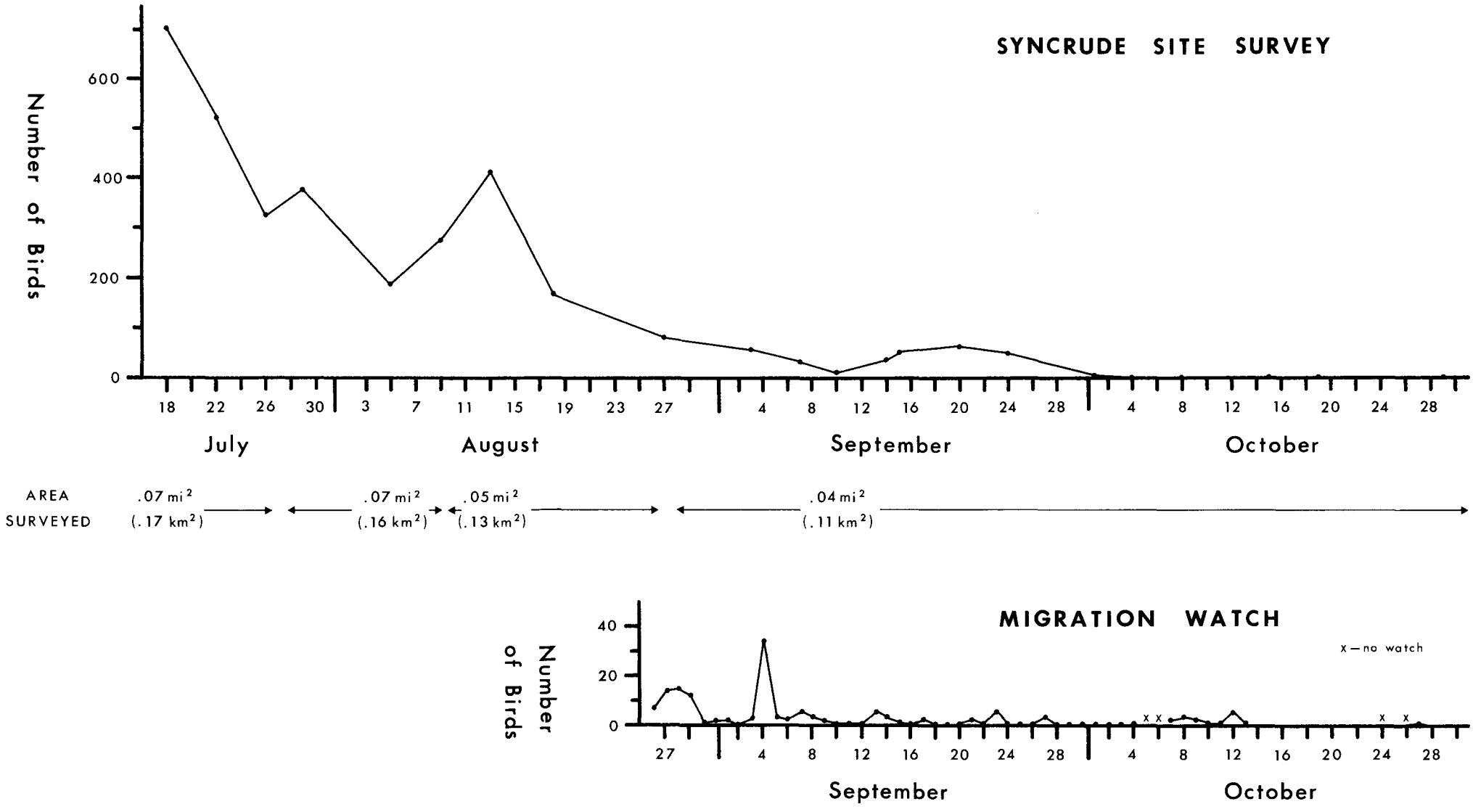


Fig. 10 - Numbers of Shorebirds Observed During Surveys of the Syncrude Site Water Areas and Migration Watches in 1974



July and August. The numbers of shorebirds on the lease area, as indicated by the Syncrude site data, were highest at the beginning of the surveys, declined gradually through early August, and then rose quickly to a smaller peak in mid-August.

Passerines

Figure 11 presents the phenology and species composition of the passerine migration, as observed on the migration watch. The data in Figure 11 have been condensed from Appendix 6. Blackbirds passed through the area throughout late August and all of September, and their numbers peaked on September 2 and September 14-20. Water pipits were seen throughout September, and were most numerous from September 10 to 15. The large numbers of passerines seen in early September and from September 13 to 19 were mixed flocks of warblers, vireos, and sparrows. Lapland longspurs and horned larks moved through the area sporadically during September and early October. Snow buntings and redpolls appeared during October. Redpolls were most numerous from October 13 to 18 and snow buntings were most numerous on October 14 and 19, although both species were seen regularly throughout October.

Most species of passerines migrate at night (Brewster 1886) and, on the average, the total number of passerines aloft over Alberta by night far exceeds that by day (Richardson 1970). Thus the diurnal migration watches undoubtedly detected a very small and biased fraction of the actual passerine migration.

Raptors

Table 18 presents the numbers of raptors observed during the migration watches, casual observations, and other surveys.

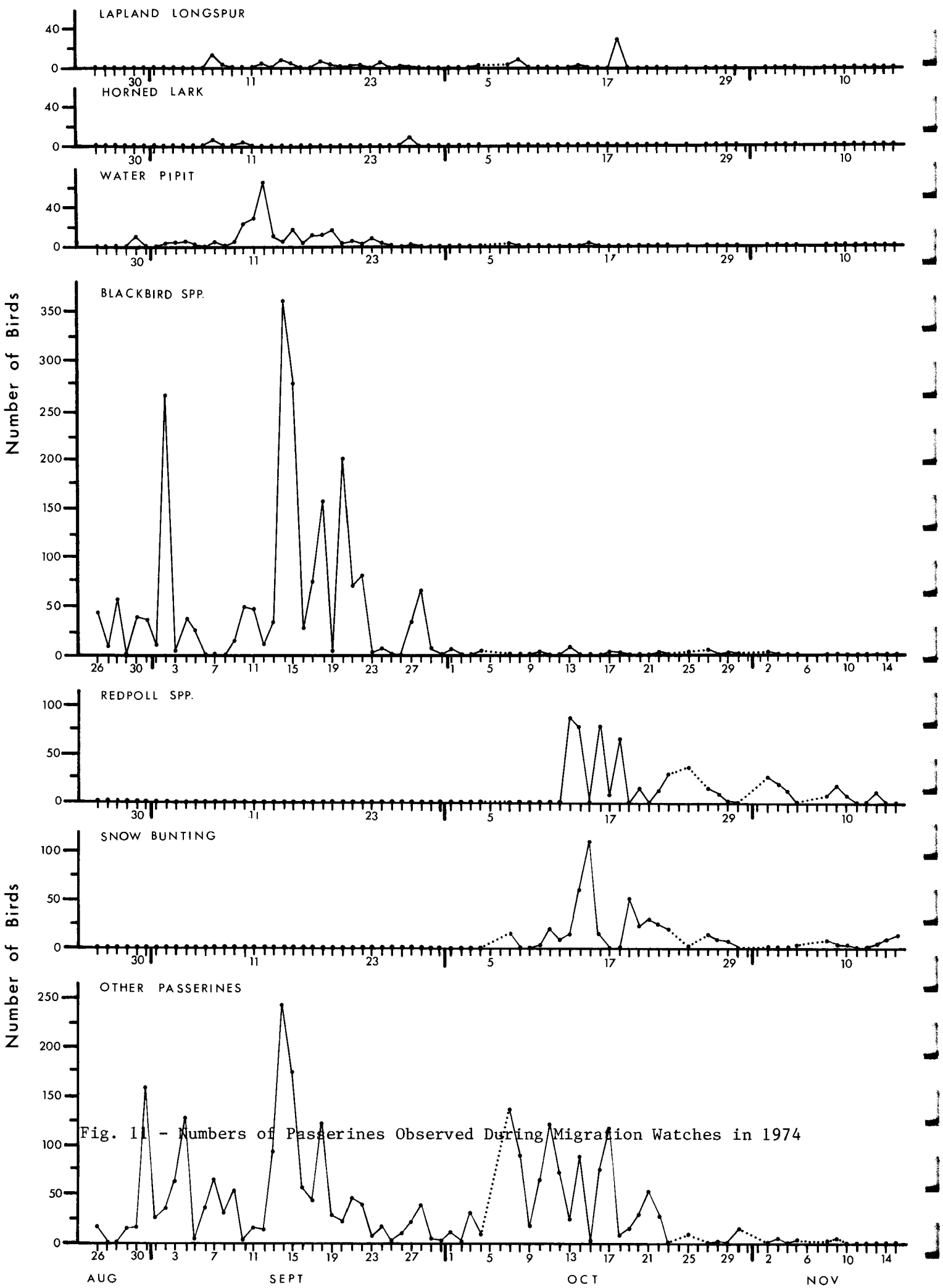


Fig. 11 - Numbers of Passerines Observed During Migration Watches in 1974

Table 18. Numbers of Raptors Observed During Migration Watches, Casual Observations, and Other Surveys in 1974.*

SPECIES	DATE	NUMBER OBSERVED	
		MIGRATION WATCH	CASUAL AND OTHER SURVEYS
Red-tailed hawk	September 14		1
Rough-legged hawk	September 14		3
	September 17		1
	September 18	1	
	September 19	1	
	September 20	1	
	September 22	2	
	October 9		1
	October 27	1	
	October 29	1	
Golden eagle	October 2		2 (adult, immature)
Bald eagle	September 5	1	
	September 27	1	
	October 2		1 (adult)
	October 7	1	5 (4 adult, 1 immature)
	October 10	26 (16 adult, 5 immature)	
	October 16	2 (adult)	
	October 24		2
	October 27	1	
	November 8	1 (adult)	
Marsh hawk	September 18		1
	October 16		1
American kestrel	August 26	1	
	August 27	6	
	September 7	1	
	September 10	1	
Unidentified large falcon	October 24		1

* the age of these raptors was unknown unless otherwise stated

The red-tailed hawk, bald eagle, marsh hawk, merlin, and American kestrel were probable or known summer residents, and some of the observations may, therefore, have been of resident birds.

Bald eagles and rough-legged hawks were fairly common migrants. Most (26) of the migrating bald eagles were seen on October 10 during a two and one-half hour period in the morning. Most of the eagles seen were soaring along the river bluffs. Rough-legged hawks were less common, and were seen mainly between mid and late September; some were noted hunting over the Syncrude construction site, as well as soaring along the river bluffs.

Single observations of an adult and an immature golden eagle and of a large falcon (peregrine or gyrfalcon) were also made during autumn.

Migrating raptors, although they often concentrate their movements along leading lines (linear topographic features such as ridges), also often move on broad fronts (Heintzelman 1975, Richardson 1975). More particularly, raptors that migrated through the area of the Syncrude lease probably concentrated their movements along the edge of the Athabasca River valley; it is possible, however, that some raptors moved across the area away from the river.

4.2 Habitat Preferences of Water-Associated Birds

The nature of the habitat preferences of different species of birds was examined by multivariate analyses that considered 36 habitat variables that were measured, or were derived from those measured, during the lake surveys. The original variables describing the dominant plant species and the classification of trees, shrubs, emergents, and submerged and floating vegetation were replaced by 22 variables that described the

vegetation using scales amenable to multivariate analysis. This derivation is explained in detail in Appendix 1. Shore rockiness was recorded, but was constant, and was not used in this analysis.

Because of the preliminary nature of these studies and the paucity of data about the habitat requirements of the birds in the study area, few formal hypotheses about interrelationships were proposed before the field program. Thus, the multivariate techniques were equally important as methods of summarizing the large pool of data and of identifying interrelationships among the many variables as they were for testing pre-formed hypotheses.

The following three techniques of multivariate analysis were used (see also Appendix 2):

(a) Factor Analysis provided a method of assessing the interrelationships among the habitat parameters. This type of analysis also identified a small number of basic characteristics of the habitats; each of these characteristics was reflected by a variety of the 36 habitat parameters included in the analysis. Once these few factors were identified, it was possible to examine the distribution of birds in relation to a small number of basic habitat characteristics; this technique of comparison is simpler than that of examination of distribution in relation to a large number of potentially intercorrelated original variables.

(b) Stepwise Multiple Discriminant Analysis (SMDA) was used to determine the habitat characteristics that were most useful in distinguishing the locations where different species occurred. SMDA also revealed which pairs of species had similar or different habitat requirements. Most of these similarities and differences are generally accepted as occurring, based on the unpublished experience of many field observers and on anecdotal reports, but have never been documented quantitatively.

(c) Stepwise Multiple Regression Analysis (SMRA) was used to relate total counts of various species observed in 100-yard sectors along the shore of the lakes to the habitat characteristics of those sectors. SMRA provided an indication of the relative importance of each habitat characteristic to each species.

Factor analysis was also used to define the habitat characteristics used for both the SMDA and SMRA. For SMDA, each sighting was considered to be a unit of observation. For SMRA, the observations made throughout the field season adjacent to each 100-yard segment of shoreline constituted a unit of observation.

The results of the lake surveys conducted during July and August and during September and October were subjected to separate discriminant analyses. These two time periods approximate the latter part of the breeding season and the autumn migration, and it was thought that habitat preferences during these two stages of the annual cycle might be different. It was not possible to perform separate regression analyses for these two time periods because of the effects that the limited sample sizes would have had upon the degree to which certain assumptions of the SMRA procedure were met.

4.2.1 Comparison of Habitats at Locations Where Various Species and Groups Were Sighted

Observations of birds farther than 100 yards from shore (in either direction) and of flying birds (except those that were flushed) were excluded from these analyses because such birds were not associated with a particular shoreline habitat type. Distances from shore were recorded as positive when birds were in the water, and as negative when birds were on land.

Breeding Season (July-August)

Habitat Factors - The measurements of 36 habitat variables that were recorded at the 784 locations where various species and groups of species were sighted were subjected to factor analysis (see Appendix 2 for procedures). This analysis revealed eight basic habitat factors, each of which was in some way measured by several of the original 36 habitat variables.

Table 19 shows the simple correlation between each factor and each original variable. Through examination of the pattern of correlations between original variables and each factor, the basic characteristics of the habitat that are measured by each factor can be assessed. The following paragraphs describe these basic habitat characteristics; the mnemonics at the bottom of Table 19 are used in subsequent sections to refer to these characteristics.

Factors 1, 3, 4, and 5 describe dry-land communities bordering a shoreline; and factors 2, 6, 7, and 8 describe shore characteristics, emergent vegetation, and submerged and floating vegetation.

Factor 1 reflects the degree to which the shore supports coniferous trees and is marshy. Negative values reflect the presence of coniferous trees and marsh; positive values reflect their absence.

Factor 2 reflects the abundance and diversity of graminoid emergent vegetation and, to a lesser degree, submerged broad-leafed vegetation. Such communities tended to occur along shorelines that lacked sand and dead willows. Positive values of this factor reflect abundant emergents; negative values reflect absence of emergents.

Factor 3 is a measure of the presence of deciduous trees; deciduous forest tended to occur in upland areas that also supported shrubs. Negative values of factor 3 reflect the

Table 19. Correlations Between 36 Original Habitat Variables and Habitat Factors Derived by Factor Analysis of Those Variables Recorded at Locations Where Birds Were Sighted During July and August, 1974[1].

HABITAT VARIABLE	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8
Distance from shore	-0.057	-0.062	0.001	-0.008	0.002	0.038	-0.115	-0.127
Trees								
-height	-0.456†	0.140	-0.375†	0.053	0.039	0.002	-0.557††	0.109
-spacing	-0.401†	0.058	-0.046	0.247	0.033	0.358†	-0.174	0.008
Shrubs								
-height	0.245	0.185	-0.262†	0.282†	0.280†	-0.069	-0.474†	-0.201
-spacing	-0.159	0.024	-0.024	0.070	0.454†	0.219	0.078	-0.019
Marsh width	-0.070	0.218	-0.041	-0.043	-0.046	-0.141	0.408†	0.043
Emergents								
-height	-0.100	0.828†††	0.042	-0.017	-0.063	-0.085	0.088	0.136
-spacing	-0.066	0.637††	0.034	0.027	0.083	-0.049	0.136	-0.078
Shore								
-steepness	-0.098	-0.028	-0.147	0.057	-0.290†	-0.494†	-0.485†	0.478†
-sandiness	-0.006	-0.305†	0.086	-0.052	-0.520††	-0.203	-0.005	0.146
Dead willows	0.008	-0.257†	-0.040	-0.026	0.109	0.715††	-0.216	0.105
Number of islands	-0.063	0.016	-0.139	-0.051	0.045	0.073	0.340 †	0.151
Submerged/Floating								
-% cover	0.088	-0.001	-0.013	0.091	0.104	0.377 †	0.132	0.130
-spacing	-0.152	-0.123	0.140	-0.063	-0.279 †	-0.031	-0.063	0.136
Trees								
-deciduous	0.068	0.016	-0.943 †††	0.122	0.115	0.114	-0.199	-0.014
-coniferous	-1.002†††[2]	0.028	-0.018	-0.055	0.035	-0.034	0.063	0.006
-both	-0.555††	-0.042	-0.668 ††	-0.007	0.074	-0.183	0.204	-0.125
-orthophyll	0.068	0.016	-0.943 †††	0.122	0.115	0.114	-0.199	-0.014
-sclerophyll	-1.005†††[2]	0.029	-0.022	-0.057	0.036	-0.028	0.060	0.004
-both	-0.554††	-0.040	-0.670 ††	-0.010	0.074	-0.175	0.200	-0.127
Upland	-0.072	0.010	-0.444 †	-0.073	-0.054	0.173	-0.783 †††	0.001
Swampy	-0.428 †	0.076	0.106	0.171	0.166	0.079	0.544 ††	0.117
Shrubs								
-deciduous	-0.064	-0.038	-0.059	-0.111	0.952 †††	-0.044	0.006	-0.015
-coniferous	0.116	0.112	-0.090	0.741 ††	-0.254 †	0.109	-0.146	-0.007
-both	0.024	-0.044	-0.023	0.690 ††	0.083	-0.058	-0.102	0.068
-orthophyll	-0.032	-0.107	-0.052	-0.172	0.813 †††	-0.110	-0.063	-0.040
-sclerophyll	-0.008	0.125	-0.058	0.824 †††	-0.192	0.113	0.099	0.006
-both	-0.124	-0.071	-0.034	0.777 †††	0.149	-0.090	0.084	0.040
Emergents								
-cattail type	-0.006	0.523 ††	-0.097	0.025	0.032	-0.368 †	-0.248	-0.090
-sedge type	0.157	0.374 †	-0.010	0.150	0.150	-0.471 †	0.224	0.143
-arrowhead type	0.084	-0.064	-0.068	-0.052	0.036	0.183	-0.065	-0.063
-rush type	0.102	0.237	-0.011	-0.042	0.011	-0.111	-0.070	-0.640 ††
-number of types	0.161	0.711 ††	-0.081	0.072	0.120	-0.546 ††	-0.077	-0.340 †
Submerged/Floating								
-macrophyllous	-0.043	-0.045	-0.136	0.010	0.162	-0.134	-0.146	-0.626 ††
-broad-leafed	0.212	0.326 †	-0.070	0.274 †	-0.066	0.005	-0.405 †	0.457 †
-microphyllous	-0.158	-0.135	0.038	0.135	-0.127	0.680 †	0.088	0.539 ††

INTERPRETATION OF FACTOR	CONIFEROUS TREES (-) OR NOT (+)	EMERGENTS (+) OR NOT (-)	DECIDUOUS TREES (-) OR NOT (+)	CONIFEROUS SHRUBS (+) OR NOT (-)	DECIDUOUS SHRUBS (+) OR NOT (-)	COMPLEX FACTOR SEE TEXT	MARSH AND ISLANDS (+) OR NOT (-)	RUSHES AND WATER LILIES (-) OR NOT (+)

[1] Each value is a simple correlation between an original habitat variable and a factor; the degree to which each original variable is weighted by a factor is proportional to the absolute value of the simple correlation between that variable and the factor. The asterisks identify variables that are strongly (†††; $r \geq 0.75$), moderately (††; $.5 \leq r < 0.75$), or lightly (†; $.25 \leq r < .5$) weighted.

[2] Correlations whose absolute values slightly exceed 1.0 represent rounding errors by the computer, and actually equal about 1.0.

presence of deciduous trees; positive values reflect their absence.

Factor 4 is a measure of the presence of coniferous shrubs; such shrubs tended to occur along shores with submerged broad-leafed vegetation. Positive values reflect the presence of coniferous shrubs; negative values reflect their absence.

Factor 5 is a measure of the presence of deciduous shrubs; deciduous shrubs tended to occur along gently sloping shores lacking sand. Positive values reflect the presence of deciduous shrubs; negative values reflect their absence.

Factor 6 is a complex factor reflecting a variety of interrelated variables. Positive values of this factor represent locations with gently sloping shores, dead willows, closed forest, microphyllous submerged vegetation, and little emergent vegetation. Negative values represent locations with steep shores, no dead willows, a few trees, and with emergent vegetation present and microphyllous submerged vegetation absent.

Factor 7 reflects the presence (+) or absence (-) of marsh and islands. Areas with marsh and islands tended to have few trees or shrubs, a gently-sloping shore, and little broad-leafed submerged vegetation.

Factor 8 reflects gently sloping shores bordered by rushes and water lilies. Positive values reflected a steep shoreline with few types of emergents (lacking rushes in particular), with broad-leafed and microphyllous submerged vegetation present, and with water lilies absent.

Discriminant Analysis - SMDA was used to examine the similarities and differences in habitat near the locations where different species and groups of species were sighted. Only species and groups represented by at least ten sightings were considered; 26 such species and groups, which were sighted a total of 784 times, were considered. The decision to include

only those species and groups represented by at least ten sightings was based on prior experience, which has shown that inclusion of smaller groups causes radical deviations from the assumptions of the tests. Nine parameters--the eight habitat factors identified by the factor analysis and the distance from shore--were used as the bases for the discrimination. A rigorous criterion for significance ($P \leq 0.01$) was used because of the large sample size. Appendix 7A summarizes the technical details of the SMDA model.

Seven of the nine parameters were of significant utility ($P \leq 0.01$) in separation of the locations at which the different species and groups of species occurred. These parameters and the statistical significances of their value as discriminators were as follows:

Distance from shore -- $P << 0.001$
Factor 6 (see above)-- $P << 0.001$
Coniferous trees (Factor 1) -- $P < 0.001$
Emergents (Factor 2) -- $P < 0.001$
Marsh and islands (Factor 7) -- $P < 0.001$
Rushes and water lilies (Factor 8) -- $P < 0.001$
Deciduous trees (Factor 3) -- $P < 0.01$

The coniferous shrub factor (factor 4) was of only marginally significant utility ($0.05 > P > 0.01$) in discrimination of the locations at which the various species and groups tended to occur. The deciduous shrub factor (factor 5) was of no value ($P > 0.01$).

The differences in habitat characteristics and distance from shore between the locations where different species occurred were small in the cases of some pairs of species (e.g., mallard and American wigeon ($P > 0.01$)) and large in the cases of others (e.g., common loon and red-winged blackbird ($P << 0.001$)). These comparisons are based on simultaneous consideration of the

seven parameters recognized as important by the SMDA procedure. Although the latter pair of species would obviously occur in habitats and locations that differ to greater extents than those in which the former pair would occur, the results are less predictable and more interesting in other cases. Table 20 summarizes the degree of difference between the habitat preferences of all pairs of species.

It should be noted that the SMDA included "distance from shore" as a predictor variable and that this variable was, of the seven significant predictors, by far the most useful as an indicator of the species most likely to occur with a given combination of predictors. Hence, the predictive power of the discriminant functions would have been much lower (although still very significant) if this one variable had not been considered.

Autumn Migration (September-October)

Habitat Factors - Twelve species were sighted at least ten times (a total of 450 sightings) during lake surveys conducted in September and October. The 36 original habitat variables measured at the locations of these 450 sightings were subjected to factor analysis.

The factor analysis reduced the 36 original habitat variables to eight uncorrelated habitat factors. Table 21 presents the structure of these eight derived factors in the form of a matrix of simple correlations between derived factors and original variables. These correlation coefficients also reflect the weight applied to each original variable by each derived factor.

The following description of the basic environmental characteristics measured by these factors is based on Table 21.

Table 20. Significance of Multivariate Difference Between Habitats at Locations Where Various Species Were Sighted During July and August, 1974.

	Red-necked grebe	Common loon	Bonaparte's gull	Mallard	American wigeon	Pintail	Scaup spp.	Ring-necked duck	Goldeneye spp.	Bufflehead	Sora	Pectoral sandpiper	'Peep' sandpiper spp.	Greater yellowlegs	Lesser yellowlegs	Eastern kingbird	Flycatcher spp.	Gray jay	Red-winged blackbird	Common grackle	LeConte's, Lincoln's, Swamp sparrow	Waxwing spp.	Chickadee spp.	Duck spp.	*Aythya* spp.
Common loon	***																								
Bonaparte's gull	**	****																							
Mallard	****	*****	***																						
American wigeon	**	****	*	-																					
Pintail	-	**	-	*	-																				
Scaup spp.	-	**	*	****	**	-																			
Ring-necked duck	**	****	-	*	-	-	*																		
Goldeneye spp.	-	**	-	*	-	-	-	-																	
Bufflehead	****	****	**	****	*	-	***	**	-																
Sora	****	*****	**	**	*	***	****	*	***	****															
Pectoral sandpiper	***	****	*	-	-	-	**	*	-	*	**														
'Peep' sandpiper spp.	***	****	*	-	-	-	**	*	-	**	**	-													
Greater yellowlegs	****	*****	-	****	***	*	**	**	-	**	***	*	*												
Lesser yellowlegs	****	*****	*	-	*	*	****	**	*	***	*	-	-	**											
Eastern kingbird	****	*****	-	****	***	**	***	**	*	***	***	***	***	*	***										
Flycatcher spp.	****	*****	-	****	***	***	****	**	**	***	**	***	***	*	***	-									
Gray jay	****	*****	*	****	***	****	****	***	***	***	***	****	****	***	****	-	-								
Red-winged blackbird	*****	*****	*	*****	**	***	****	**	***	****	-	***	****	***	****	***	*	**							
Common grackle	****	*****	-	*****	***	***	****	**	**	****	***	****	****	***	****	-	-	-	**						
LeConte's, Lincoln's, Swamp sparrow	****	*****	-	***	***	***	***	**	**	****	**	***	***	*	**	-	-	**	**	**					
Waxwing spp.	***	*****	-	***	*	*	***	-	*	**	*	**	**	-	**	-	-	-	-	-	-				
Chickadee spp.	****	*****	**	***	**	***	****	**	**	***	***	***	****	***	***	-	-	-	**	-	**	-			
Duck spp.	****	*****	-	-	-	-	***	-	-	**	*	-	-	***	-	***	***	****	****	****	***	**	***		
Aythya spp.	*	***	***	****	***	*	-	**	*	***	****	****	****	****	****	****	****	****	****	****	****	***	****	****	
Diving duck spp.	**	*****	-	***	-	-	-	-	-	**	***	*	*	*	**	-	**	***	***	**	*	-	**	*	***

Significance levels:

- $P > 0.05$
- * $.05 \geq P > 0.01$
- ** $.01 \geq P > 0.001$
- *** $P \leq 0.001$ (F ratio ≥ 3.5; df=7,752)
- **** $P << 0.001$ (F ratio ≥ 5.0; df=7,752)
- ***** $P <<< 0.001$ (F ratio ≥ 10.0; df=7,752)

Table 21. Correlations Between 36 Original Habitat Variables and Habitat Factors Derived by Factor Analysis of Those Variables Recorded at Locations Where Birds Were Sighted During September and October, 1974[1].

HABITAT VARIABLE	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8
Distance from shore	-0.198	-0.033	0.078	0.093	0.014	-0.026	-0.099	0.002
Trees								
-height	0.200	0.521††	0.003	0.162	-0.674††	0.230	-0.003	0.038
-spacing	-0.182	0.579††	0.189	0.142	-0.269†	-0.083	-0.078	0.041
Shrub								
-height	0.200	-0.076	0.251†	0.387†	-0.615††	0.137	-0.029	0.263†
-spacing	-0.141	0.272†	0.021	0.526††	-0.016	-0.055	-0.086	0.010
Marsh width	0.086	-0.140	-0.070	-0.225	0.168	0.072	0.268†	0.236
Emergent								
-height	-0.033	-0.004	0.001	-0.188	0.014	-0.011	0.969†††	-0.046
-spacing	0.144	-0.007	0.061	0.085	0.147	0.021	0.651††	0.090
Shore								
-steepness	0.479†	0.086	0.123	-0.168	-0.464†	0.094	-0.032	-0.539††
-sandiness	0.223	0.067	-0.028	-0.454†	0.006	-0.091	-0.209	-0.174
Dead willows	-0.819††	0.003	-0.047	-0.050	-0.006	-0.076	-0.063	-0.268†
Number of islands	-0.177	-0.038	-0.039	0.060	-0.026	0.020	-0.218	0.013
Submerged/Floating								
-% cover	-0.334†	-0.048	0.085	0.076	0.079	-0.102	-0.037	0.017
-spacing	0.011	0.192	-0.020	-0.274†	-0.014	-0.038	-0.111	-0.172
Trees								
-deciduous	0.028	-0.162	0.177	0.138	-0.562††	0.709††	-0.035	0.110
-coniferous	0.096	0.960†††	-0.110	0.090	0.043	0.230	0.035	0.012
-both	0.198	0.322†	-0.013	0.032	-0.018	0.905†††	0.073	0.059
-orthophyll	0.028	-0.162	0.177	0.138	-0.562††	0.709††	-0.035	0.110
-schlerophyll	0.096	0.960†††	-0.110	0.090	0.043	0.230	0.035	0.012
-both	0.198	0.322†	-0.013	0.032	-0.018	0.905†††	0.073	0.059
Upland	-0.003	0.205	0.008	0.060	-0.875†††	0.177	-0.053	0.079
Swampy	-0.075	0.355†	0.074	0.175	0.415†	-0.025	-0.029	-0.018
Shrubs								
-deciduous	0.105	0.192	-0.087	0.936†††	-0.112	0.103	-0.168	0.012
-coniferous	-0.063	-0.050	0.862†††	-0.159	-0.180	-0.028	0.025	0.015
-both	0.010	-0.014	0.792†††	0.067	-0.033	0.027	0.018	-0.094
-orthophyll	0.134	0.141	-0.091	0.866†††	-0.096	0.090	-0.181	-0.001
-schlerophyll	-0.050	0.006	0.910†††	-0.111	-0.069	0.017	0.027	0.032
-both	0.028	0.040	0.835†††	0.107	0.067	0.099	0.018	-0.062
Emergent								
-cattail type	0.239	-0.028	-0.011	-0.020	-0.299†	0.054	0.609††	0.115
-sedge type	0.590††	-0.230	0.161	0.274†	-0.068	0.103	0.172	-0.026
-arrowhead type	-0.106	-0.051	-0.033	0.039	-0.044	0.066	-0.052	-0.006
-rush type	0.146	0.054	-0.050	0.056	-0.131	0.011	0.149	0.702††
-number of types	0.563††	-0.135	0.059	0.191	-0.293†	0.076	0.560††	0.430†
Submerged/Floating								
-water lilies	0.332†	0.117	-0.016	0.166	-0.140	0.269†	-0.050	0.503††
-broad-leafed	-0.021	-0.102	0.321†	0.060	-0.420†	-0.158	0.123	-0.311†
-microphyllous	-0.657††	0.121	0.163	-0.133	0.125	-0.230	-0.101	-0.442†
INTERPRETATION OF FACTOR	COMPLEX FACTOR SEE TEXT	CONIFEROUS TREES (+) OR NOT (-)	CONIFEROUS SHRUBS (+) OR NOT (-)	DECIDUOUS SHRUBS (+) OR NOT (-)	DECIDUOUS TREES (-) OR NOT (+)	TREES DECIDUOUS (+) OR MIXED (-)	EMERGENTS (+) OR NOT (-)	RUSHES AND WATER LILIES (+) OR NOT (-)

[1] Each value is a simple correlation between an original habitat variable and a factor; the degree to which each original variable is weighted by a factor is proportional to the absolute value of the simple correlation between that variable and the factor. The asterisks identify variables that are strongly (†††; $r \geq 0.75$), moderately (††; $.5 \leq r < 0.75$), or lightly (†; $.25 \leq r < .5$) weighted.

Factor 1 is rather complex. Positive values reflect steep shores without deadwood or microphyllous submerged vegetation but with emergent vegetation (particularly sedges). Negative values reflect gentle shores with deadwood and microphyllous vegetation but with few emergents. This factor is very similar to factor 6 derived from the July-August analysis; it has, however, opposite polarity (i.e., opposite signs on each weighting coefficient; see Tables 19 and 21).

Factor 2 reflects the degree to which the shore supports coniferous trees and is marshy. This factor is very similar in structure to factor 1 derived from the July-August analysis, although it also has opposite polarity.

Factor 3 represents the presence (+) or absence (-) of coniferous shrubs. Locations with coniferous shrubs on shore tend to have broad-leafed submerged vegetation in the water nearby. The structure of this factor is very similar to that of factor 4 derived from the July-August analysis.

Factor 4 represents the presence (+) or absence (-) of deciduous shrubs, which tended to occur on shores that were not sandy. The comparable factor derived from the July-August analysis is factor 5.

Factor 5 represents the presence (-) or absence (+) of deciduous trees in upland areas. It is comparable to factor 3 derived from the July-August analysis.

Factor 6 represents whether (+) or not (-) any trees that were present were deciduous or mixed. This factor does not, however, place significant weight on the abundance of trees. No directly comparable factor was derived from the July-August analysis.

Factor 7 represents the presence (+) or absence (-) of a gently sloping shore with rushes and water lilies. Such shores tend to lack broad-leafed or microphyllous submerged

vegetation. This factor was similar in structure (although opposite in polarity) to factor 8 derived from the July-August analysis.

Seven of the eight habitat factors that were derived from the data collected during the late summer and fall periods were similar. One factor that was derived from the autumn data was not derived from the late summer data; this factor was "whether any trees that were present were deciduous". The "abundance of deciduous trees", however, was a factor that was derived from data collected during both periods. The "marsh and islands" factor derived from the late summer data was not derived from the fall data. No factor placed heavy weighting upon either marsh or islands in autumn. The probable explanation is that fewer sightings near marshes were considered in autumn than in late summer because fewer red-winged blackbirds, soras, and dabbling ducks were present.

Discriminant Analysis - SMDA was applied to the 12 species and groups of species that were represented by at least ten sightings. As in July and August, distance from shore and the eight habitat factors were used as predictor variables. Because the sample size obtained in autumn was smaller than that obtained in late summer (450 *vs* 784), a more liberal criterion for significance ($P < 0.1$) was used to control the entry of predictor variables into the SMDA model. However, for purposes of biological interpretation, relationships that were weak ($0.1 \geq P > .01$) should be considered as inconclusive and probably as less important than the stronger relationships. Appendix 7B summarizes the technical details of the SMDA model.

Five of the nine parameters were of at least marginal utility in separating the locations at which the different species and species groups occurred. These parameters and the statistical significance of their value as discriminators

were as follows:

Distance from shore -- $P < 0.001$

Factor 1 (see text) -- $P < 0.001$

Rushes and water lilies (Factor 8) -- $P < 0.01$

Deciduous trees (Factor 5) -- $P < 0.05$

Emergent vegetation (Factor 7) -- $P < 0.1$

As was the case in July and August, the two parameters that differed most between species were (a) distance from shore, and (b) the one complex factor that included positive weighting on sedges, diversity of emergents, and water lilies and negative weighting upon dead willows, the percent of cover of submergent vegetation, and the presence of microphyllous submergents. The "rushes and water lilies" factor was also quite different between species during the late summer and fall periods.

There were less clear-cut differences between the habitat preferences of various species during the fall than during late summer. This difference between the fall and late summer was at least partially a result of the fact that a wider variety of species was considered in late summer. Waterbirds (ducks, coots, and grebes) constituted 11 of the 12 species and groups considered during fall; during late summer, however, several additional species of marsh and land birds were sufficiently abundant to be considered.

Table 22 shows the degrees of similarity between the habitats occupied during autumn by each combination of species. Not surprisingly, in light of anecdotal descriptions of their respective habits, red-necked grebes and diving ducks tended to occur in different areas than dabbling ducks and coots.

The pattern of weights applied by the one significant discriminant function to the significant predictor variables revealed that species that occurred far from shore tended to occur off shores that had flooded willows and microphyllous submerged vegetation but that lacked emergents, rushes, and

Table 22. Significance of Multivariate Difference Between Habitats at Locations Where Various Species Were Sighted During September and October, 1974.

	Red-necked grebe	Mallard	American wigeon	Pintail	Scaup spp.	Goldeneye spp.	Bufflehead	American coot	Gray jay	Duck spp.	Dabbling duck spp.
Mallard	***										
American wigeon	***	-									
Pintail	**	(*)	-								
Scaup spp.	(*)	****	***	-							
Goldeneye spp.	(*)	***	**	-	*						
Bufflehead	*	***	***	**	(*)	**					
American coot	***	***	(*)	(*)	*	***	*				
Gray jay	***	**	-	*	**	***	(*)	-			
Duck spp.	***	-	-	-	**	*	***	-	(*)		
Dabbling duck spp.	***	-	-	-	*	(*)	**	-	(*)	-	
Diving duck spp.	-	***	**	*	-	*	-	(*)	*	*	*

Significance levels:

- \- $P > 0.1$
- (*) $.1 \geq P > 0.05$
- * $.05 \geq P > 0.01$
- ** $.01 \geq P > 0.001$
- *** $P < 0.001$ (F ratio ≥ 4.3; df=5,434)
- **** $P << 0.0001$ (F ratio ≥ 8.0; df=5,434)

water lilies (e.g., scaup spp., goldeneyes, buffleheads, diving duck spp. and, especially, red-necked grebes)*. In contrast, species that occurred near shore tended to be in or near emergents, rushes, and water lilies but not near deadwood or microphyllous vegetation (e.g., mallards, American wigeons, dabbling duck spp.). The characteristics of locations where pintails, coots, and goldeneyes were sighted tended to be intermediate. It should be noted that the birds did not necessarily respond directly to all of the variables listed above. It is not possible to separate actual habitat preferences from apparent associations that were the result of intercorrelations between the original habitat variables. The results simply describe the habitats in which various species occurred.

Summary of Results of SMDA

Tables 20 and 22 can be scanned to extract generalizations concerning the relative amounts of overlap between the habitat preferences of different species or species groups. During July and August (Table 20), for example, the habitats in which red-necked grebes occurred were unlike those in which most other species occurred; the habitats in which Bonaparte's gulls were observed, however, were not significantly different from those in which many other species were observed. The habitats in which pectoral sandpipers and "peep" sandpipers occurred were, as might be expected, very similar.

4.2.2 Counts of Individual Species Relative to Habitat

Preceding sections have identified the habitat preferences that differed most and least between species, and

* This interpretation is based upon consideration of the coefficients of discriminant function #1 and upon the mean values of this function for each species (Appendix 7B).

have identified the groups of species that occurred in similar and different habitats.

The present section examines the characteristics of habitats that were most closely related to the numbers of individuals of particular species observed at different locations. It was anticipated that these analyses would show not only that different species preferred different habitats, but also that the various habitat factors are weighted in different ways by different species. It is possible, for example, that the numbers of a terrestrial species might be strongly influenced by the presence of deciduous trees and whether the shore was of upland nature, whereas the numbers of an aquatic species might be unaffected by these factors but strongly affected by the amount of emergent vegetation present.

Habitat Factors

As in previous analyses, eight significant habitat factors were identified among the 36 original variables* (Table 23). These factors were similar in structure to those derived from the records of sightings.

Factor 1 was the complex factor in which positive values reflected the presence of dead willows and submerged microphyllous vegetation along a gently sloping shore than lacked emergent vegetation; negative values reflected steeper shores without dead willows or microphyllous vegetation but with emergents.

Factor 2 represented the presence (positive values) or absence (negative values) of coniferous trees.

Factor 3 represented the presence (-) or absence (+) of coniferous shrubs. When coniferous shrubs were present, broad-leafed submerged vegetation also tended to be present.

* Based on a standard criterion for accepting factors as significant (Cooley and Lohnes 1962:160): factors that had eigenvalues of 1.0 or greater were accepted.

Table 23. Correlations Between 36 Original Habitat Variables and Habitat Factors Derived by Factor Analysis of Those Variables Recorded in the 370 Intervals of Shoreline Along the Lakes During 1974[1].

HABITAT VARIABLE	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8
Trees								
-height	0.098	0.486†	-0.035	-0.460†	-0.168	-0.304†	-0.040	0.308†
-spacing	0.156	0.310†	-0.180	-0.195	-0.150	-0.046	-0.005	0.043
Shrubs								
-height	-0.282†	-0.198	-0.239	-0.443†	-0.343†	-0.223	-0.024	-0.090
-spacing	0.137	0.211	-0.064	0.068	-0.410†	0.061	-0.010	-0.038
Marsh width	-0.121	0.027	0.048	0.324†	0.104	-0.052	-0.244	-0.066
Emergent								
-height	-0.137	0.027	-0.029	0.058	0.096	0.043	-0.869†††	0.038
-spacing	-0.034	-0.035	-0.051	0.124	-0.084	-0.029	-0.793†††	-0.099
Shore								
-steepness	-0.260†	0.114	-0.075	-0.285†	0.141	-0.159	0.019	0.635††
-sandiness	-0.055	-0.017	0.029	0.022	0.290†	0.032	0.131	0.104
Dead willows	0.740 ††	-0.007	0.001	-0.122	-0.091	0.006	0.160	0.048
Number of islands	0.131	-0.010	0.027	0.224	-0.044	-0.120	-0.010	0.018
Submerged/Floating								
-% cover	0.393†	-0.050	-0.075	0.041	0.016	-0.088	0.021	0.006
-spacing	0.183	0.079	0.020	-0.047	0.159	0.057	0.018	0.020
Trees								
-deciduous	0.158	-0.141	-0.126	-0.243	-0.137	-0.903†††	-0.032	0.054
-coniferous	-0.020	0.999 †††	0.057	0.071	-0.053	-0.004	0.048	0.052
-both	-0.152	0.533††	0.002	0.156	0.015	-0.748††	0.039	-0.118
-orthophyll	0.158	-0.141	-0.126	-0.243	-0.137	-0.903†††	-0.032	0.054
-sclerophyll	-0.013	1.001 †††[2]	0.059	0.068	-0.053	-0.008	0.045	0.048
-both	-0.144	0.532††	0.004	0.150	0.014	-0.748††	0.036	-0.122
Upland	0.259†	0.174	0.020	-0.829 †††	-0.060	-0.413†	0.013	0.112
Swampy	0.046	0.311†	-0.112	0.560††	-0.170	0.178	-0.030	0.111
Shrubs								
-deciduous	-0.080	0.070	0.093	-0.027	-0.939†††	-0.108	0.099	-0.047
-coniferous	0.035	-0.050	-0.880 †††	-0.116	0.153	-0.056	-0.058	0.071
-both	-0.010	-0.018	-0.836 †††	-0.062	-0.082	-0.059	0.014	0.041
-orthophyll	-0.117	0.016	0.111	-0.053	-0.808 †††	-0.087	0.139	-0.022
-sclerophyll	0.047	0.015	-0.868 †††	0.054	0.120	-0.025	-0.088	0.065
-both	-0.012	0.058	-0.851 †††	0.066	-0.122	-0.027	0.000	0.037
Emergents								
-cattail type	-0.479†	-0.039	-0.025	-0.252†	0.105	0.028	-0.513††	0.028
-sedge type	-0.443†	-0.112	-0.139	0.195	-0.166	-0.048	-0.384†	0.141
-arrowhead type	0.193	-0.076	0.037	-0.046	-0.069	-0.072	-0.015	-0.084
-rush type	-0.357†	-0.096	0.028	-0.166	-0.039	-0.018	-0.256	-0.577††
-number of types	-0.668 ††	-0.137	-0.071	-0.128	-0.071	-0.026	-0.660 ††	-0.196
Submerged/Floating								
-water lilies	-0.203	-0.099	0.017	-0.177	-0.154	-0.209	-0.059	-0.524 ††
-broad-leafed	-0.008	-0.210	-0.303†	-0.247	0.062	-0.066	-0.188	0.516††
-microphyllous	0.812 †††	0.137	-0.142	0.120	0.105	0.084	0.132	0.340†
INTERPRETATION OF FACTOR	COMPLEX FACTOR SEE TEXT	CONIFEROUS TREES (+) OR NOT (-)	CONIFEROUS SHRUBS (-) OR NOT (+)	UPLAND (-) OR SWAMP (+)	DECIDUOUS SHRUBS (-) OR NOT (+)	DECIDUOUS TREES (-) OR NOT (+)	EMERGENTS (-) OR NOT (+)	RUSHES AND WATER LILIES (-) OR NOT (+)

[1] Each value is a simple correlation between an original habitat variable and a factor; the degree to which each original variable is weighted by a factor is proportional to the absolute value of the simple correlation between that variable and the factor. The asterisks identify variables that are strongly (†††; $r \geq 0.75$), moderately (††; $.5 \leq r < 0.75$), or lightly (†; $.25 \leq r < .5$) weighted.

[2] Correlations whose absolute values slightly exceed 1.0 represent rounding errors by the computer, and actually equal about 1.0.

Factor 4 reflected the wetness of the shore: that is, whether the onshore area was a swamp without tall trees or shrubs (-) or an upland area with tall trees and shrubs (+).

Factor 5 measured the presence (-) or absence (+) of deciduous shrubs, which tended to occur where the shoreline was not sandy.

Factor 6 measured the presence (-) or absence (+) of deciduous trees, which tended to occur in upland areas.

Factor 7 measured the presence (-) or absence (+) of emergent vegetation. Emergent vegetation, when abundant, tended to be tall, closed, and comprised of several graminoid types.

Factor 8 measured the presence (-) or absence (+) of rushes and water lilies. Such vegetation tended to occur in areas that had gently sloping shorelines and no broad-leafed or microphyllous submerged vegetation and that were adjacent to shores with no trees.

Regression Analyses

Stepwise multiple regression analyses were applied to the 370 counts of each species or group of species. The dependent variable was the total number of individuals adjacent to each 100-yard section of shoreline from July to October. As was the case in the discriminant analysis, observations of birds that were more than 100 yards from shore (either on water or land) and of flying birds that had not been observed to flush in response to the observers were omitted from these counts. The predictor variables were the eight habitat factors described above; these variables were evaluated from the measurements of the 36 original habitat variables at each 100-yard interval.

Appendix 2 gives further details concerning the methods of analysis.

In order to meet certain assumptions of the SMRA procedure (see Appendix 2), it was necessary to transform the counts before analysis. A logarithmic transformation of the counts proved to be the most satisfactory technique used for all species*. Use of this transformation satisfied the homogeneity of variance assumption, but the normality assumption could not be satisfied because of the high frequency of zero counts. The results, therefore, must be considered as suggestive rather than conclusive; in particular, weak relationships (e.g., $0.1 \geq P \geq 0.01$) should be interpreted with caution.

The numbers of 23 of the 26 species and groups were significantly ($P \leq 0.05$) related to at least one of the derived habitat factors (Table 24).

The two species whose numbers were most closely related to habitat variables were mallard and red-winged blackbird; the multiple correlation coefficients between numbers and habitat variables for these species were 0.373 and 0.287 (respectively). Although the numbers of both of these species were strongly affected by habitat ($P < 0.001$), the differences in habitats between 100-yard sections accounted for a relatively small percentage of the variance in counts (13.9% in the case of mallards and 8.2% in the case of red-winged blackbirds). The values for the other species that were less closely related to habitats were even lower. Thus, even though the distribution of most species was significantly affected by habitat variables, the counts were strongly affected by factors not considered in these analyses. Such factors possibly include the inability of observers to detect all birds that were present, imprecise measurements of habitat variables, seasonal differences in habitat preferences,

* Each count was incremented by one (1) before transformation in order to avoid taking logarithms of zero. The appropriateness of each transformation was assessed through analysis of residuals (Draper and Smith 1966).

failure to measure all relevant habitat variables, and confounding variables such as human disturbance.

Table 24 also shows that each of the eight habitat factors was significantly related to the numbers of at least one species. Some factors, however, were related to the counts of many species, whereas others were related to the counts of few. Four factors were related to the counts of numerous species: the complex factor 1 (see interpretation above), factor 4 (upland *vs* marsh), factor 7 (emergents), and factor 8 (rushes and water lilies). The other four factors were measurements of trees and shrubs on the shore. Because almost all of the species that were considered were water or marsh-associated species, it is not surprising that these four factors were less closely related to the counts. Factor 3 (coniferous shrubs) was the habitat characteristic least frequently related to the counts.

The following subsections describe the habitat preferences of each species or group. These descriptions are based on the significance and sign of the relationships of the counts to the eight derived habitat factors. As was the case in the discriminant analyses based on derived habitat factors, it must be kept in mind that each factor reflects a general feature of the habitat and that each factor is strongly correlated with several of the original habitat variables. The occurrence of a significant relationship between the counts and a particular factor does not necessarily mean that the birds respond to each original habitat variable that is heavily weighted by that factor. In fact, the birds may not respond to any of the measured variables, but rather to a habitat characteristic that was not measured but that was correlated with the general habitat characteristics reflected by the factor. This characteristic of analyses based on derived factors is often of considerable advantage because it allows identification of important general

Table 24. Summary of Stepwise Multiple Regression Analysis of Counts of 26 Species and Groups Relative to Eight Habitat Factors[1].

SPECIES/GROUP	FACTORS								MULTIPLE CORRELATION COEFFICIENT (R)
	1	2	3	4	5	6	7	8	
	SEE TEXT	CONIFEROUS TREES (+) OR NOT (-)	CONIFEROUS SHRUBS (-) OR NOT (+)	UPLAND (-) OR SWAMP (+)	DECIDUOUS SHRUBS (-) OR NOT (+)	DECIDUOUS TREES (-) OR NOT (+)	EMERGENTS (-) OR NOT (+)	RUSHES AND WATER LILIES (-) OR NOT (+)	
Common loon	(+)*	(-)(*)							.1521
Red-necked grebe	(+)**	(+)*					(-)*		.2102
Mallard	(-)***					(-)**	(-)***		.3734
Pintail								(+)*	.1046
American wigeon	(-)*								.1143
Dabbling duck spp.	(-)*		(-)(*)					(+)(*)	.1688
Ring-necked duck			(-)*	(+)*			(-)(*)	(+)(*)	.2053
Scaup spp.				(+)*				(+)**	.1838
Aythya spp.	(+)**								.1561
Goldeneye spp.					(+)*				.1022
Bufflehead	(+)(*)						(+)(*)	(-)(*)	.1602
Diving duck spp.				(+)**				(+)(*)	.1695
Sora							(-)*	(+)*	.1703
American coot							(+)*	(+)*	.1698
Greater yellowlegs				(+)**	(+)*		(+)*		.2332
Lesser yellowlegs	(-)*	(-)(*)		(+)*					.1897
Pectoral sandpiper	(-)*	(-)(*)							.1529
'Peep' sandpiper spp.				(+)(*)					.0895
Bonaparte's gull						(+)*		(+)*	.1509
Eastern kingbird	(+)*			(+)**					.1849
Flycatcher spp.									
Gray jay	(+)**								.1666
Chickadee spp.	(+)(*)	(+)(*)						(-)*	.1569
Waxwing spp.									
Red-winged blackbird	(+)(*)			(+)(*)	(+)*	(-)(*)	(-)**	(+)**	.2869
Common grackle	(+)**		(-)(*)					(+)*	.2039
LeConte's, Lincoln's, Swamp sparrow				(+)*		(+)*			.1666

[1] The sign and significance level of the partial correlation between the transformed counts (see text) and the eight habitat factors are given. Significance levels are coded as follows:

(*) $0.10 \geq P > 0.05$ *** $P \leq 0.001$

* $0.05 \geq P > 0.01$ Blank $P > 0.10$

** $0.01 \geq P > 0.001$

relationships even though the most relevant single variable may not have been measured. This characteristic may also account for the appearance of certain otherwise uninterpretable relationships between the counts of some species and particular habitat factors.

Common Loon - The counts of common loons were weakly and positively correlated with factor 1, which suggests that loons prefer areas near submerged microphyllous vegetation and dead willows to areas near emergent vegetation. In fact, common loons, while swimming, tended to avoid areas with much aquatic vegetation.

Red-necked Grebe - The counts of red-necked grebes were positively correlated with factor 1. This correlation indicates that red-necked grebes were most numerous in areas that had abundant submerged microphyllous vegetation that were near dead willows, but tended to avoid emergent vegetation.

The weak positive correlation with factor 2 and the negative correlation with factor 8 suggest that these grebes also had a slight preference for areas bounded by coniferous and mixed trees and for areas with abundant emergent vegetation.

The apparently contradictory relationships to vegetation can possibly be explained by the fact that red-necked grebes feed and loaf in open water areas but usually nest in emergent vegetation (Palmer 1962).

Mallard - That the counts of mallards were negatively and strongly correlated with factors 1, 6, and 7 indicates that mallards strongly preferred areas with abundant emergents, with deciduous trees on the shore, with few or no dead willows, and with little or no microphyllous vegetation.

Pintail - The counts of pintails were positively correlated with factor 8, but this correlation was not highly significant. This suggests that pintails slightly preferred areas with rather steep shorelines, no rushes, no water lilies,

and abundant submerged broad-leafed and microphyllous vegetation.

American Wigeon - The weak correlation between the counts of wigeon and factor 1 suggests that wigeon had a slight preference for areas with abundant emergent vegetation to areas with submerged microphyllous vegetation and flooded willows.

Dabbling Duck spp. - The counts of unidentified dabbling ducks were negatively but weakly correlated with factor 1. This correlation suggests a slight preference of this group for areas having emergents but lacking deadwood or submerged microphyllous vegetation.

Red-necked Duck - The counts of ring-necked ducks were positively correlated with factor 4 and negatively correlated with factor 3; both correlations were weak.

These correlations suggest that ring-necked ducks tended to occur near swampy shorelines that supported coniferous shrubs. The shrubs along swampy shorelines were not generally tall.

Scaup spp. - The counts of scaup were positively correlated with factors 4 and 8. The correlation with factor 8 indicates that scaup preferred areas with steep shorelines, without rushes or water lilies, and with submerged microphyllous and broad-leafed vegetation.

The positive but weak relationship to factor 4 suggests that scaup had a slight preference for areas bounded by swampy terrain. This preference, because it seems to contradict the apparent (and stronger) preference of this group for areas with steep shores, may be spurious.

Aythya spp. - Factor 1 was strongly and positively correlated with the counts of *Aythya* spp. This correlation indicates that these ducks preferred areas with plentiful submerged microphyllous vegetation and deadwood and little emergent vegetation along the shore.

Goldeneye spp. - Factor 5 was positively but weakly correlated with the counts of goldeneyes($P < 0.05$). This correlation suggests that this group had a slight tendency to occur near shorelines where deciduous shrubs were absent. The meaning of this correlation is unclear, but the absence of strong correlations to other habitat factors shows that this species was widely distributed.

Bufflehead - The counts of buffleheads were marginally correlated with three factors, but the relationships were too weak to be reliable ($0.10 > P > 0.05$). The absence of clear relationships to habitat suggests that buffleheads also occurred in a wide variety of aquatic habitats.

Diving Duck spp. - The counts of diving ducks were positively and strongly correlated with factor 4. This correlation indicates that diving ducks tended to occur along shorelines that lacked upland trees and shrubs.

Sora - The counts of soras were negatively but weakly correlated with factor 7 and positively but weakly correlated with factor 8. These correlations suggest that soras tended to occur in or near dense graminoid emergents (but not rushes) and along steep shorelines, where submerged microphyllous and broad-leafed vegetation was abundant but where rushes or water lilies were scarce. It is unlikely, however, that all of these habitat characteristics would occur together. Soras nest in dense emergents (Godfrey 1966).

American Coot - The counts of American coots were positively correlated with factors 7 and 8; both correlations were weak. These correlations suggest that American coots preferred areas lacking emergents and steep shorelines, and with plentiful submerged microphyllous and broad-leafed vegetation.

Greater Yellowlegs - The counts of greater yellowleggs were positively correlated with factor 4 and positively

but weakly correlated with factors 5 and 7. These correlations indicate that greater yellowlegs had a strong preference for swampy areas, which tended to have no (or, at most, short) trees and shrubs. This species also had a slight preference for areas lacking deciduous shrubs and emergents. Greater yellowlegs were thought to breed in the area, and they usually nested in wet habitats (Bent 1927).

Lesser Yellowlegs - The counts of lesser yellowlegs were negatively but weakly correlated with factors 1 and 2 and positively but weakly correlated with factor 4. These correlations suggest that lesser yellowlegs had a slight tendency to occur near areas having emergents but lacking microphyllous submerged vegetation and in or near areas of swampland that did not support coniferous trees or flooded willows.

Pectoral Sandpiper - The counts of pectoral sandpipers were negatively but weakly correlated with factors 1 and 2. These correlations indicate that these birds tended to occur near areas with abundant emergents but not near flooded willows or submerged microphyllous vegetation. This species was often seen feeding along the borders of floating mats of emergents.

"Peep" Sandpiper spp. - The counts of "peeps" were marginally and positively correlated with factor 4 (swamp), and were unrelated to other variables. "Peeps" used a variety of areas: the edges of emergent vegetation, floating mats of emergents or organic material, and open shorelines lacking emergents.

Bonaparte's Gull - The counts of Bonaparte's gulls were positively correlated with factors 6 and 8. These correlations suggest that the gulls tended to occur along steep shorelines that lacked deciduous trees, rushes, and water lilies but that supported abundant submerged microphyllous and broad-leafed vegetation. However, the relationships to both factors were weak ($P < 0.05$).

Eastern Kingbird - Factors 4 ($P < 0.01$) and 1 ($P < 0.05$) were positively correlated with the counts of eastern kingbirds. This species preferred swampy areas where trees and shrubs were short or absent. The apparent preference for areas with dead willows and submerged microphyllous vegetation probably reflected the occurrence of several nests in dead willows, which tended to occur along shores adjacent to submerged microphyllous vegetation.

Flycatcher spp. (Excluding Eastern Kingbirds) - The counts of other flycatchers were not significantly correlated with any factor. This group of birds occupied a wide range of shoreline types. It is to be expected that the counts of a group comprised of several species of birds with different habitat preferences would be uncorrelated with particular habitat factors.

Gray Jay - Factor 1 ($P < 0.01$) was positively correlated with the counts of gray jays. Jays were observed in concentrations along shorelines where dead willows and submerged microphyllous vegetation were abundant and emergents absent. Although these locations may have been used as feeding areas, the correlation possibly merely reflects the conspicuousness of jays that perched in the dead willows.

Chickadee spp. - The counts of chickadees were weakly and negatively related to factor 8 and weakly and positively related to factors 1 and 2. These correlations suggest that chickadees had a slight preference for gradual shorelines that were bordered by rushes and water lilies, that had coniferous trees and deadwood, but that lacked extensive emergent vegetation. Chickadees were seen in a variety of habitats during casual observations and may have been more detectable along the above-described shorelines.

Waxwing spp. - The counts of waxwings were not significantly related to any factor. Waxwings occupied a wide range of shoreline habitats.

Red-winged Blackbird - The counts of red-winged blackbirds were negatively correlated with factor 7 and positively correlated with factor 8 ($P < 0.01$). Like soras, red-winged blackbirds tended to occur near areas with dense emergent vegetation (but not rushes) and along fairly steep shores having submerged microphyllous and broad-leafed vegetation but lacking rushes and water lilies. As in the case of soras, it is unlikely that all of these habitat characteristics would occur together.

A weak positive correlation with factor 5 and very weak negative correlations with factors 4 and 6 suggest that the blackbirds had a weak preference for swampy terrain with few trees and shrubs and for deciduous trees. These correlations probably reflect the fact that although red-winged blackbirds nested in emergent vegetation, groups of adults and fully fledged young occupied a wider range of habitats.

Common Grackle - The counts of common grackles were significantly and positively correlated with factor 1 and to a lesser degree with factor 8. These correlations indicate that this species preferred areas with plentiful submerged microphyllous vegetation and dead willows. These birds may also have preferred steep shorelines lacking rushes and water lilies.

LeConte's, Lincoln's, and Swamp Sparrow - The counts of this group were positively related to factors 4 and 6 ($P < 0.05$). These correlations indicate that these sparrows tended to occur in swampy areas that supported short shrubs but that lacked deciduous trees.

5. DISCUSSION

5.1 Timing of the Study

The field portion of this study was begun July 8 and ended November 15. Hence, we observed only part of the annual cycle of activity. For example,

(a) Information is available about the movements of birds into, through, and out of the area only during summer and autumn.
(b) The only available data relating to breeding success are counts of the number of broods and decoying adults. Thus, breeding success cannot be estimated, because no comparable information about the number of pairs of birds present at the onset of the breeding season is available. The breeding pair counts from previous aerial surveys are not directly comparable.
(c) Possible movements of post-breeding and moulting waterfowl were not identifiable because it was not known what the local populations were in May and June.
(d) The peak of the shorebird migration occurred either before or at the time the site surveys were begun in mid-July. It was often difficult or impossible to distinguish migrant and resident individuals of species known or thought to breed locally. These species include killdeer, common snipe, spotted sandpiper, solitary sandpiper, greater yellowlegs, lesser yellowlegs, and short-billed dowitcher.
(e) The period of conspicuous breeding displays by virtually all species had already concluded.
(f) Information about the spring migration is lacking.

Disturbances caused by clearing and construction at or near Ruth and Mildred lakes were already evident, and increased gradually throughout the summer. The relationships of such disturbances to the populations of birds either residing in or moving through the area cannot be defined because few comparative data were gathered before development began.

5.2 Assessment of Results

5.2.1 Lake Surveys

Through the cooperation of the Canadian Wildlife Service, concurrent aerial and ground surveys of the lakes were conducted in 1974, on October 1 and 24. The results of these surveys are compared in Table 25.

As expected (Diem and Lu 1960, Martinson and Kaczynski 1967), the ground counts were consistently higher than the aerial counts. Accurate estimation of the total numbers of large waterbirds within the study area on any one day requires that the aerial surveys be corrected by comparison with sample ground counts made concurrently. This procedure may be usefully applied during future studies, in order to gain information about the numbers of large waterbirds both in and around Lease #17. This information would aid in the interpretation of the movements of birds on the lease itself.

5.2.2 Syncrude Site and Borrow Pit Surveys

The site surveys provided an indication of the numbers and species of migrant shorebirds that land in the area of the Syncrude lease, and of the phenology of the autumn migration of these species. The site surveys also provided some information about the mid-summer distribution and numbers of green-winged

Table 25. Numbers of Loons, Grebes, Swans, Ducks, and Coots Observed During Canoe (This Study) and Aerial (K. Ambrock, pers. comm.) Surveys of the Study Area on October 1 and 24, 1974.

	OCTOBER 1			OCTOBER 24		
LAKE	ICE COVER	GROUND	AERIAL*	ICE COVER	GROUND	AERIAL
Mildred	20%	1736	1261	45%	441	306
Horseshoe	90%	Not Surveyed	34	100%	Not Surveyed	75-100 (mallard)**
Saline	35%	***	2076	15%	409	134
Ruth	5%	413	301	10%	9	2

* aerial counts on this date were considered to be conservative because of high winds

** these birds were circling the frozen lake. The ground observers at Saline Lake counted a group of 200 ducks, mostly mallards, that left Saline Lake as the survey was begun. The aircraft surveyed Horseshoe Lake, and then Saline Lake, reaching Saline Lake when the ground survey was half completed. On the basis of this, it is almost certain that these birds at Horseshoe Lake had come from Saline Lake.

*** surveyed September 29--1662 counted

teal and pintails. Large movements of shorebirds can occur overhead without noticeable changes in the numbers on the ground. Hence the site surveys did not provide any direct indication of the day-to-day variations in the amount of migration over the area.

The information from the borrow pit surveys was not as extensive, although some useful information about nesting birds was obtained.

5.2.3 Migration Watch

Although many water-associated species migrate at least partly at night and often at heights of several thousand feet, movements of geese and raptors and some diurnal, local movements of passerines, ducks, and shorebirds were documented. The migration watch documented the phenology of the autumn migration of the more conspicuous species, but it could not identify the relative amount of migration each day and night because observers cannot visually detect migrants at night and at high altitudes.

5.3 Patterns of Autumn Migration

5.3.1 Waterfowl

The phenology of the migration of waterfowl and other large waterbirds through the study area during the period from September 18 to October 26, 1972 (Syncrude Canada Ltd. 1973) was similar to that found in this study. In both years, there was a very large peak around the end of September or early October, followed by a smaller peak that lasted throughout October. Comparable information is not available from 1973.

During 1972, peak numbers of ducks on the four lakes totalled approximately 3,200 and 2,200-1,700 in early

October and mid-October, respectively (Syncrude Canada Ltd. 1973); during 1974, peak numbers on the four lakes were approximately 4,100 and 1,000-1,700 in early October and mid-October, respectively (this study).

The Peace-Athabasca Delta is a major staging area for migrating geese and swans, particularly in autumn (Hennan 1972), but relatively few individuals of these species were seen passing through the study area in 1974. There are two possible reasons for this:

(a) The autumn migration of most waterfowl over Alberta and Saskatchewan is to the southeast and not to the south (Richardson and Gunn 1971). Hence, birds that took off over the Peace-Athabasca Delta would migrate east of the study area. Schick and Ambrock (1974) reported that in the autumn of 1972 several thousand whistling swans were present east of the study area, mostly on McClelland and Gordon lakes.

(b) The waterfowl migration at any one location is usually a small fraction of that over the area because most waterfowl movements at inland localities occur on a broad front, with considerable movement at high altitude and at night. Schick and Ambrock (1974) reported that in 1972, large flocks of Canada and snow geese passed over the area without stopping, and Richardson and Gunn (1971) found that most waterfowl movements over east-central Alberta were on a broad front and that many were at night.

5.3.2 Shorebirds

Large numbers of shorebirds migrated through the area, and stopped over at the cleared areas on the Syncrude site. Peak numbers were observed during the first survey on July 18, and they may have been even more numerous prior to that date. The species that nest in the arctic and subarctic (semipalmated plover, American golden plover, black-bellied plover, pectoral sandpiper,

Baird's sandpiper, least sandpiper, long-billed dowitcher, stilt sandpiper, semipalmated sandpiper, buff-breasted sandpiper, sanderling, and northern phalarope) were present in large numbers on that first survey. Although direct evidence is not available, it is probable that most of these birds had returned from the north and had not been present throughout the summer. If so, the large southward movements of shorebirds during mid-July may have occurred in part because of unfavourable nesting conditions in the arctic in 1974. Many of the lakes on the Yukon and Alaska north slopes remained frozen until July. However, substantial southward migration of shorebirds normally begins earlier in the summer than that of other groups, and large flights are common in eastern Canada by late July (L.G.L. Limited 1974, J. Burton pers. comm.).

5.3.3 Other Species

Raptors, particularly eagles, were fairly common autumn migrants. Migrating eagles were also observed along the Athabasca River in 1972 (Syncrude Canada Ltd. 1973). Very little comparative information on the migration of other species through the area is available.

5.4 Breeding Season

Schick and Ambrock (1974) reported the results of an aerial survey of breeding pairs that included the study area in 1973. Their results, and the maximum brood counts for 1974 (from this study), are presented in Table 26.

Assuming that 51% of the pairs of dabbling ducks and 38% of the pairs of diving ducks produced broods (calculated from Donaghey 1974), the number of breeding ducks on the lease in

Table 26. Numbers of Breeding Pairs Observed During Aerial Surveys in 1973 and Maximum Numbers of Broods Observed During Ground Surveys in 1974, on the Lakes in the Study Area.

	AERIAL SURVEYS 1973			GROUND SURVEYS 1974		
	Number of Breeding Pairs			Number of Broods and Decoying Females		
LAKE	DABBLING DUCKS	DIVING DUCKS	TOTAL* DUCKS	DABBLING DUCKS	DIVING DUCKS	TOTAL* DUCKS
Mildred	23	19	42	2	10	13
Horseshoe	60	12	78	9	17	28
Saline	18	42	69	4	7	12
Ruth	8	15	23	-	16	17

* these totals include unidentified ducks

1974 appears to have been lower than it was in 1973. Larger numbers of dabbling ducks were observed on the lease in 1973 than in 1974 in spite of the fact that they were less likely to be detected by the aerial survey method used in 1973 than by the ground survey method used in 1974. The numbers of diving ducks on the lakes were higher, with the exception of Saline Lake. The large drop in breeding activity (or success) on Saline Lake is perhaps attributable to the intensive hunting that took place there throughout the summer and autumn of 1974. However, we do not know the extent of hunting activities on Saline Lake during previous years.

The dabbling ducks present in 1973 could have been birds that normally nest in parkland and prairie potholes further south, but that moved north into boreal regions due to low water levels in those areas during 1973. Such movements have been reported in previous years with low water levels further south (Hansen and McKnight 1964, Henney *et al* 1972). Water levels on the parkland and prairies were very high during 1974, and these dabbling ducks could have remained there to breed, rather than moving northward.

5.5 Comparison of the Water Bodies on the Study Area

5.5.1 Breeding

Common loons nested and reared young on Mildred and Ruth lakes, and on the Lower Camp Pond, and probably nested on Saline Lake. Red-necked grebes were nesting or suspected to be nesting on all the lakes, but were most numerous at Ruth Lake. Nesting red-necked grebes were also noted on Ruth Lake during 1972 (Syncrude Canada Ltd. 1973).

Dabbling ducks were most numerous on Horseshoe Lake, and diving ducks were most numerous on Ruth and Horseshoe lakes. Horseshoe Lake is very shallow, and, as a consequence, is

more attractive to dabbling ducks. Ruth Lake is deeper, and was preferred by diving ducks. The two southern arms of Horseshoe Lake are fairly deep, and were used by diving ducks.

Red-winged blackbirds and common grackles were numerous along the shorelines of all the lakes. Soras were present in dense cattails along the shores of Mildred, Horseshoe, and Saline lakes. Black terns nested at Horseshoe and Saline lakes, probably near the mouths of creeks. Bonaparte's gulls nested at Mildred and Saline lakes.

During this study, 15 species of birds were known to have nested or thought to have nested at Mildred and Horseshoe lakes, 19 were known to have nested at Saline Lake, and 12 were known to have nested at Ruth Lake.

5.5.2 Moulting Activity

The apparent local increases observed in the numbers of green-winged teal (Syncrude site), mallards (Horseshoe Lake), and pintails (Syncrude site) in mid-summer suggests that the study area may have been used as a moulting area in 1974. Because baseline information on the number of ducks present in the area in spring and early summer is lacking, it is not certain that the area was used as a moulting area; and, if it was, the extent to which it was used by moulting birds.

5.5.3 Autumn Migration

Saline and Mildred lakes were most heavily used by migrant waterfowl and large waterbirds. During the peak migration period, Horseshoe Lake remained at least partially frozen, and few birds were seen there.

5.6 Habitat Preferences

Red-necked grebes, common loons and, to a lesser extent *Aythya* spp. and diving duck spp. occupied similar habitats: they preferred areas with submerged vegetation, but no water lilies, and tended to occur far from shore.

Mallards and American wigeons preferred emergent vegetation or areas adjacent to those with emergent vegetation, as did soras, pectoral and "peep" sandpipers, lesser yellowlegs, and red-winged blackbirds. These species all tended to occur on or near shore.

Pintails, ring-necked ducks, goldeneye spp., buffleheads, and American coots were somewhat intermediate between the first and second groups--ring-necked ducks and goldeneyes seemed to prefer shorelines bounded by swampy terrain.

Bonaparte's gulls occupied a wide range of habitats, as did flycatchers and waxwings.

Greater and lesser yellowlegs and LeConte's, Lincoln's, and swamp sparrows preferred swampy shorelines--these species nest in swampy areas. Eastern kingbirds tended to occur in similar areas, probably because these areas were open and had relatively few trees.

Common grackles and gray jays appeared to prefer shorelines with dead willows; this conclusion may be partially a function of their conspicuousness when perched on dead willows. From our other observations, both species seemed to occupy a wide range of forest and shrub habitats, as did chickadees.

There were fewer significant differences between the habitats in which species were observed during the September-October period than during the July-August period. This indicates that they occupied a wider range of habitats during migration than they did during the breeding season. Many species have fairly specific habitat requirements for nesting, as opposed to

more general requirements during non-breeding periods.

5.7 Effects of Habitat Alteration

5.7.1 Syncrude Site Water Areas

The clearing of the site and alterations in its drainage patterns created the water areas that were used heavily by shorebirds and some dabbling ducks in the summer and early autumn of 1974. It is doubtful whether large numbers of migrating shorebirds stopped over in this area prior to a few years ago, because there was a scarcity of attractive habitat available before the area was cleared. This area may be increasingly used by shorebirds as a stopover area during migration. Additionally, these shallow ponds will thaw earlier than the lakes and may be used in the spring by large numbers of migrating ducks if there is little open water available on the lakes and marshes elsewhere in the area.

Tundra-nesting passerines, such as horned larks, water pipits, and snow buntings, were frequently observed on the drier areas of the Syncrude site during autumn migration.

The overall effect of clearing operations has been to increase the attractiveness of the area to shorebirds and tundra-frequenting passerines.

The number of shorebirds observed can be taken only as an index of the actual numbers there, because only a small portion of the extensive flooded area was surveyed. On several occasions, low-flying ravens caused large flocks of shorebirds to rise from marshy areas adjacent to the areas surveyed and also from other similar areas several hundred yards from the main roads on the site.

The clearing operation has eliminated habitat suitable to a variety of birds that nest in boreal and mixed wood

forest and in muskeg. The most pertinent example of this is the definite elimination of the nesting ground of one pair of sandhill cranes and the probable elimination of the nesting ground of at least one other pair. There were at least two pairs of cranes in the immediate vicinity of the cleared area, according to observations and reports received from people working on the site. One of the pairs was located on the site in late July; the adults were accompanied by a three-quarter grown chick. Upon being informed of this, Syncrude postponed further construction activity in that area until August 31, when the birds had left. These cranes may belong to the subspecies *Grus canadensis tabida* (Godfrey 1966), which is considered to be endangered (Godfrey 1970). Walkinshaw (1965) includes the study area within the range of the newly described subspecies *G. canadensis rowani*. However, more recent work by Stephen (1967) indicates that *rowani* is not a valid subspecies.

5.7.2 Mildred and Ruth Lakes

These lakes are already subject to constant disturbance from construction activities. A drilling barge was present on Mildred Lake during late summer and autumn, and a small boat serviced this barge regularly. The effect that the disturbances have had on the numbers of waterbirds that breed on these lakes cannot be assessed because previous information is too limited for comparison.

5.7.3 Lower Camp Tailings Pond

The bitumen-covered carcasses of 20 to 30 birds (shorebirds and ducks) and two bitumen-covered ducks, still alive, were discovered at this small (two to four acres) pond on August 6, 1974. This pond had been in existence for about 12 years. It

is contaminated with bitumen and was lethal to at least some of the waterbirds that contacted it. Following the discovery of bitumen-covered birds, a prototype method of deterring birds from landing on this pond was tested in the autumn of 1974 (see Dyke *et al* 1975).

Other partially oiled birds that may have come from the lower camp tailings pond were observed on the study area. These are summarized below.

SPECIES	DATE	LOCATION	EXTENT OF OIL AND COMMENTS
Sandpiper spp.	*July 19*	*Borrow pit 28*	*belly, trouble flying*
"Peep" sandpiper spp.	*July 19*	*Borrow pit 28*	*neck, belly, tail coverts*
Semipalmated plover	*July 23*	*Borrow pit 28*	*left leg, thigh, side*
Pectoral sandpiper	*July 25*	*E. end of Mildred Lake*	*belly, breast, undertail coverts*
2 Lesser yellowlegs	*July 29*	*Syncrude site water area 35*	*bellies*
Greater yellowlegs	*July 30*	*Borrow pit 21*	*belly, undertail coverts*
Yellowlegs spp.	*Aug. 5*	*Water area 34*	*belly*
2 Lesser yellowlegs	*Aug. 17*	*Borrow pit 28*	*bellies*
Lesser yellowlegs	*Aug. 27*	*Water area 33*	*legs and belly*
Mallard	*Aug. 29*	*Horseshoe Lake*	*belly, legs, undertail coverts--lethargic*
Stilt sandpiper	*Sept. 3*	*Water area 34*	*belly, legs*
Semipalmated plover	*Sept. 3*	*Water area 34*	*feathers of one leg*
"Peep" sandpiper spp.	*Sept. 7*	*Water area 34*	*belly*
Plover spp.	*Sept. 24*	*Water area 34*	*breast*

5.8 Effects of Future Habitat Alterations

The levels of Ruth and Mildred lakes will be raised approximately 15 feet higher than their present levels by water diversion and water storage operations. This may cause both lakes to become more attractive to diving ducks, loons, grebes, and perhaps dabbling ducks after this change, if these lakes do not become contaminated.

At Ruth and Saline lakes, beavers have dammed the outlet creeks in recent years, and these lakes have risen about three feet. As a result, parts of their shorelines are bordered by flooded dead willows; and although the lakes are deeper, there are very extensive floating mats of sedge and cattail along some shorelines. Removal of the trees along the shorelines to be flooded at both lakes would probably facilitate the rapid re-establishment of emergent vegetation along the new shorelines.

The cleared area of the lease between the Beaver Creek dam and Ruth Lake, which contains most of the water areas surveyed in 1974, may eventually become part of Ruth Lake. It will probably become more attractive to waterbirds, particularly during the early spring in years when there is little other open water.

The large tailings pond will cover 9.3 square miles (24.1 km^2) when full and will undoubtedly be hazardous to water-associated birds. The development and testing of a method of preventing birds from contacting water bodies was initiated during 1974 and should be a high priority in subsequent years.

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APPENDICES

APPENDIX 1. Outline of the Vegetation Classification System Used in the Field, and the Derivation of the More Detailed Habitat Parameters Used in Multivariate Analyses.

A. Glossary of Terms (from Fosberg 1967)

broad-leafed
- leaves other than linear in outline, as opposed to grass-like or graminoid

closed
- individual plants mostly touching

graminoid
- resembling grasses in appearance

macrophyllous
- applies only to aquatic plants, round leaves 10 cm across or larger

mesophyllous
- leaves of ordinary size

microphyllous
- very small leaves, maximum leaf diameters for trees 25 mm, for shrubs 10 mm, for dwarf shrubs 5 mm

narrow sclerophyll
- vegetation with needle-like leaves

open
- individual plants mostly not touching, generally separated by less than their diameters

orthophyll

- vegetation with leaves mostly of ordinary texture, as opposed to sclerophyll

scattered

- individual plants separated by more than twice their diameters

scrub

- woody vegetation predominantly of shrubs, which range between 0.5 m and 5 m in height

thalliform

- plants whose shoots are not clearly differentiated into stem and leaves

very scattered

- individual plants separated by more than ten times their crown diameter

APPENDIX 1 (cont'd)

B. Key to the Vegetation Classification System, and Description of Each of the Classifications Used in This Study (Adapted from Fosberg 1967).

1. FORESTS: trees present, trees closed or open

A. Trees Deciduous

Trees closed
--winter deciduous orthophyll forest

Trees open, shrubs closed
--open deciduous orthophyll forest
--open deciduous narrow sclerophyll forest

B. Trees Coniferous

Trees closed
--resinous evergreen narrow sclerophyll forest
--resinous evergreen narrow sclerophyll swamp forest

Trees open, shrubs closed
--open narrow sclerophyll swamp
--resinous open evergreen narrow sclerophyll forest

C. Trees Mixed

Trees closed
--coniferous and deciduous orthophyll forest
--coniferous and deciduous narrow sclerophyll forest

Trees open, shrubs closed
--open coniferous and deciduous orthophyll forest
--open coniferous and deciduous narrow sclerophyll forest

2. SHRUB HABITATS: shrubs present, shrubs closed or open. Trees may be scattered, very scattered, or not present.

A. Shrubs Deciduous

Trees scattered, shrubs closed
--deciduous orthophyll scrub with trees
--deciduous narrow sclerophyll scrub with trees

Trees absent or nearly absent, shrubs closed
--mesophyllous deciduous orthophyll scrub
--mesophyllous deciduous orthophyll swamp scrub
--micophyllous deciduous swamp scrub

Shrubs open, herbs closed
--open deciduous orthophyll shrub savannah

Shrubs open, herbs open (ground showing)
--deciduous orthophyll desert scrub

B. Shrubs Coniferous

Trees scattered, shrubs closed
--evergreen narrow sclerophyll scrub with trees

Trees absent or nearly absent, shrubs closed
--evergreen narrow sclerophyll swamp

C. Shrubs Mixed

Trees scattered, shrubs closed
--coniferous and deciduous orthophyll scrub
--coniferous and deciduous narrow sclerophyll scrub

Trees absent or nearly absent, shrubs closed
--coniferous and deciduous orthophyll scrub
--coniferous and deciduous narrow sclerophyll scrub

3. HERB HABITATS: shrubs very scattered or not present, herbs present

A. Herbs Seasonal

Shrubs very scattered, herbs closed
--seasonal broad-leafed herb meadow

Herbs open, ground showing
--seasonal desert grass

4. EMERGENT VEGETATION

A. Graminoid Marsh
--tall seasonal graminoid closed marsh
--tall seasonal graminoid open marsh
--tall seasonal graminoid scattered marsh

B. Dead Willows
--open dead flooded willows

5. AQUATIC COMMUNITIES

A. Water Lilies Present
--closed macrophyllous seasonal submerged meadows
--open macrophyllous seasonal submerged meadows
--closed microphyllous/open macrophyllous seasonal submerged meadows
--closed microphyllous/closed macrophyllous seasonal submerged meadows
--closed broad-leafed/open macrophyllous seasonal submerged meadows

B. No Water Lilies Present
--closed broad-leafed seasonal submerged meadows
--closed microphyllous seasonal submerged meadows
--open broad-leafed seasonal submerged meadows
--open microphyllous seasonal submerged meadows
--thalliform seasonal floating meadow

C. Open Water, No Vegetation Present
--open water, no vegetation, over six inches deep
--open water, no vegetation, less than six inches deep
--ice

APPENDIX 1 (cont'd)

6. OPEN SHORELINES
   --floating mud with scattered herbaceous vegetation
   --rock and mud with scattered herbaceous vegetation
   --open sandy shore
   --open gravel shore
   --open rock and mud shore
   --slash and mud (with scattered herbaceous vegetation)

C. Derivation of More Detailed Habitat Parameters From Classification and Dominant Species of Vegetation.

Each of the classifications was given a numeric code, and this code was recorded on the data sheets where the vegetation was surveyed, and when the habitat in which a bird was observed was recorded. The various combinations of dominant species (of trees, shrubs, herbs, emergents, and submerged vegetation) were also given numeric codes and recorded as such on the data sheets.

These classifications and dominant species parameters were complex and not in an order suitable for multivariate analysis. Therefore, these two variables were broken down into a larger number of simpler categories, each of which described one component of the original classification.

TREES AND SHRUBS

Fourteen simple parameters were derived for purposes of statistical analysis from the more complex habitat classification and identification of dominant species that had been recorded on vegetation surveys. These new parameters identified whether the trees and shrubs were deciduous, coniferous, or mixed; the leaf shape and size; and the terrain of the tree and shrub community. All 14 new parameters were binary in nature (yes = 1, no = 0).

The following parameters were recorded for both trees, and then shrubs:

Deciduous

Coniferous

Both

Orthophyllous leaves

Sclerophyllous leaves

Both

The terrain was described as:

Upland

Swamp

EMERGENTS

Five parameters, four of them binary, were derived from the classification of emergents and identification of dominant emergent species that had been recorded on vegetation surveys:

Cattail-type (cattails, burr reed)

Sedge-type (sedges, grasses)

Arrowhead-type (Arrowhead)

Rush-type (bullrushes, horsetail)

Total number of types (sum of preceding four parameter values)

APPENDIX 1 (cont'd)

FLOATING/SUBMERGED VEGETATION

Three binary parameters were derived from the species and classifications of floating and submerged vegetation that had been recorded on the vegetation surveys:

Macrophyllous (water lilies)

Broad-leafed *(Potamogeton*, eelgrass*)*

Microphyllous *(Chara, Myriophyllum)*

These parameters were all coded as one if the characteristic was present, and zero if the characteristic was absent, except for the "Total number of types" in emergents--this was the sum of the four previous parameters. These 22 additional parameters replaced the six original 'vegetation classification' and 'dominant species' parameters in the analysis.

APPENDIX 2. Outline of Multivariate Statistical Procedures Used in the Data Analyses.

When the distribution or number of a particular species of bird is affected simultaneously by a number of factors (such as the amount and character of aquatic, emergent, and terrestrial vegetation around the shore of a lake), but only one of these factors is considered at a time, biologically meaningful relationships do not always become apparent. This is especially true when some of the factors--which may be called predictor variables--are intercorrelated. Multivariate procedures permit consideration of the simultaneous interrelationships of the dependent variable and numerous predictor variables. These procedures are useful not only in testing hypotheses about relationships between variables, but also for examining a large pool of data in an exploratory manner. The latter approach is especially appropriate in preliminary studies; it often yields information about previously unsuspected relationships and suggests productive new lines of research (Tukey 1962, 1969).

Stepwise multiple regression analysis (SMRA) and stepwise multiple discriminant analysis (SMDA) were used in this study.

SMRA is used when a dependent variable that has been measured on a finely graduated scale is thought to be affected by a number of predictor variables. SMRA was applied to counts of 26 species and groups of species of birds that occurred in 370 intervals (each 100 yards long) of lake shore surveyed in 1974.

SMDA is applicable when a dependent variable that was measured on a categorical or coarsely graduated scale is thought to be affected by a number of predictor variables. SMDA was applied to the 26 species and groups of species of birds that were observed more than ten times during surveys during July and August 1974 and to the 12 species and groups that were observed more than ten times during September and October, 1974.

In the initial analyses, 36 predictor variables were considered. Many of these predictor variables were intercorrelated, which made the interpretation of such data difficult. To reduce this large number of intercorrelated predictor variables to a smaller and more manageable number, factor analysis was used. This procedure derives from the original variables a smaller number of uncorrelated factors, each of which is a function of all of the original predictor variables. The correlation coefficient between a factor and an original variable indicates the relative amount of weight given to that original variable by that factor. Thus, the basic characteristic of the habitat that is measured by a factor can be determined from an examination of the matrix of correlations between factors and original variables. Once this has been done, the relationships of avian distribution and numbers to habitats can be assessed by consideration of a few factors, rather than many original variables.

SMRA and SMDA make various assumptions about the nature of the relationships between variables; both procedures assume that these are

linear, additive relationships.

SMRA also assumes that the differences between observed and predicted variables (the residuals) are normally distributed with similar variance across the range of all relevant variables. Analysis of residuals (Draper and Smith 1966) will indicate whether the assumptions of SMRA are met, and transformations (e.g., square root, logarithmic) of the data can often be used to compensate satisfactorily for violations of these assumptions.

SMDA also assumes that all species have similar variance-covariance matrices. Analysis of residuals is not as powerful in the SMDA setting and was not useful in this study.

It must be remembered that SMRA and SMDA methods do not distinguish between the effects of highly correlated predictor variables, and it is likely that only one of a set of highly interrelated predictor variables will enter an SMRA or SMDA model when standard stepwise methods are used. This was seen when the 36 original variables were considered but, as expected, not when the eight uncorrelated factors were used. Additionally, the SMRA and SMDA methods describe the nature of interrelationships between variables; they cannot reveal which (if any) relationships are causal. Also, these models assume that there are no interactions between the dependent variables; they assume, for example, that the number or presence of breeding loons on a lake does not affect the number or presence of ducks.

From all of the above, it is apparent that the results of these analyses must be interpreted carefully. In this study, only highly significant relationships are accepted as valid. Relationships of marginal statistical significance (e.g., $0.1 > P > 0.01$) must be recognized as being no more than suggestive.

The regression and discriminant analyses were performed in a stepwise manner, whereby one predictor variable at a time entered the model, in order of decreasing statistical relationship to the dependent variable. Predictor variables were added until the inclusion of any other predictor variable would not significantly improve the predictive ability of the model. A liberal $P \leq 0.1$ criterion was used in the regression analyses; a $P < 0.05$ criterion was used in discriminant analyses. The computations were done through use of the BMD03R and BMD07M computer programs, respectively (Dixon 1968).

Factor analyses were done with the BMD07M program (formerly BMDX72) using standard procedures. Principal components were extracted using Kaiser normalization and iterating from R^2 for communalities. Principal components with eigenvalues of 1.0 or more were accepted. The rotated factors were then derived by use of the Varimax procedure (see Cooley and Lohnes 1971 for details).

APPENDIX 3. Numbers of Birds Observed on Surveys of the Syncrude Site Water Areas in 1974.

List of abbreviations of species/group names used in this list:

N. shoveler	-	Northern shoveler
Puddle duck	-	Dabbling duck spp.
Unid. duck	-	Duck spp.
Rough-leg. hawk	-	Rough-legged hawk
Am. kestrel	-	American kestrel
Semipal. plover	-	Semipalmated plover
Am. golden plover	-	American golden plover
Blk-bel. plover	-	Black-bellied plover
Less. yellowlegs	-	Lesser yellowlegs
Baird. sandpiper	-	Baird's sandpiper
S-bil. dowitcher	-	Short-billed dowitcher
L-bil. dowitcher	-	Long-billed dowitcher
Semipal. sandpiper	-	Semipalmated sandpiper
Sm./Peep shorebird	-	'Peep' sandpiper spp.
Buffbr. sandpiper	-	Buff-breasted sandpiper
Plover/L. shorebird	-	Large shorebird spp.
North. phalarope	-	Northern phalarope
Rd-wing. blackbird	-	Red-winged blackbird
LeCont. sparrow	-	LeConte's sparrow
sp.	-	spp.

APPENDIX 3 (cont'd)

WATER AREA 33

	JUL 18	JUL 22	JUL 26	JUL 29	AUG 5	AUG 9	AUG 13	AUG 18	AUG 27	SEP 3	SEP 7	SEP 10	SEP 14	SEP 17	SEP 20	SEP 24	OCT 1	OCT 4	OCT 8	OCT 15	OCT 19	OCT 29	NOV 10
MALLARD	1	0	5	0	0	0	5	3	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
PINTAIL	0	0	21	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GREEN-WINGED TEAL	0	0	0	38	84	35	7	0	0	0	30	12	8	0	9	0	0	0	0	0	0	0	0
BLUE-WINGED TEAL	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TEAL SP.	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N. SHOVELER	0	0	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROUGH-LEG. HAWK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MARSH HAWK	0	0	0	0	0	0	1	1	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0
AM. KESTREL	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SEMIPAL. PLOVER	3	6	8	5	2	0	3	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
KILLDEER	6	0	0	2	3	5	9	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
AM. GOLDEN PLOVER	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
COMMON SNIPE	4	1	0	0	0	2	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
GREATER YELLOWLEGS	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LESS. YELLOWLEGS	31	42	29	17	2	10	3	1	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0
YELLOWLEGS SP.	7	10	0	0	0	10	15	2	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0
PECTORAL SANDPIPER	32	20	21	18	3	9	13	4	24	0	10	0	8	0	7	11	3	0	0	0	0	0	0
BAIRD. SANDPIPER	0	1	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LEAST SANDPIPER	0	0	3	3	0	3	7	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DOWITCHER SP.	11	17	4	7	1	3	4	0	0	0	0	0	2	4	0	0	0	0	0	0	0	0	0
STILT SANDPIPER	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SEMIPAL. SANDPIPER	0	8	0	7	1	1	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SM./PEEP SHOREBIRD	53	12	38	5	0	2	0	45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
SANDPIPER SP.	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	3
SHOREBIRD SP.	78	40	0	123	10	11	35	0	8	0	0	0	0	0	1	0	0	0	0	0	0	0	0
PLOVER/L. SHOREB.	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0
WILSON'S PHALAROPE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
NORTH. PHALAROPE	17	7	0	8	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HORNED LARK	0	0	0	0	0	0	0	0	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0
COMMON RAVEN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
WATER PIPIT	0	0	0	0	0	0	0	0	0	0	9	8	3	1	2	0	0	0	0	0	0	0	0
RD-WING. BLACKBIRD	0	4	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BLACKBIRD SP.	0	0	0	0	1	0	4	16	0	0	0	3	0	3	0	2	0	0	0	0	0	0	0
SAVANNAH SPARROW	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
LAPLAND LONGSPUR	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0
SNOW BUNTING	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0
PASSERINE SP.	0	0	0	0	0	0	0	0	0	0	1	0	0	3	0	0	3	0	0	0	0	0	0

APPENDIX 3 (cont'd)

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	JUL 18	JUL 22	JUL 26	JUL 29	AUG 5	AUG 9	AUG 13	AUG 18	AUG 27	SEP 3	SEP 7	SEP 10	SEP 14	SEP 17	SEP 20	SEP 24	OCT 1	OCT 4	OCT 8	OCT 15	OCT 19	OCT 29	NOV 10
MALLARD	0	17	5	1	3	0	0	2	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0
PINTAIL	1	15	30	5	0	0	1	0	11	1	0	0	0	6	0	0	0	0	0	0	0	0	0
GREEN-WINGED TEAL	0	0	0	3	32	5	14	70	6	8	0	5	2	2	0	14	0	0	0	0	0	0	0
AMERICAN WIGEON	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0
N. SHOVELER	2	1	0	0	0	0	2	2	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PUDDLE DUCK	4	0	0	0	0	0	0	0	0	21	0	0	0	0	0	0	0	0	0	0	0	0	0
UNID. DUCK	0	1	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROUGH-LEG. HAWK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
MARSH HAWK	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
SEMIPAL. PLOVER	0	0	2	0	3	0	1	0	8	2	0	0	0	0	0	0	0	0	0	0	0	0	0
KILLDEER	2	0	0	0	0	3	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
AM. GOLDEN PLOVER	0	0	1	0	0	0	0	0	0	0	0	0	1	7	4	4	0	0	0	0	0	0	0
BLK.-BEL. PLOVER	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0
PLOVER SP.	0	0	0	0	0	0	0	0	0	0	0	0	3	0	8	9	0	0	0	0	0	0	0
COMMON SNIPE	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	6	0	0	1	1	0	0	0
GREATER YELLOWLEGS	0	0	0	0	0	0	0	0	3	0	0	2	0	6	0	0	0	0	0	0	0	0	0
LESS. YELLOWLEGS	15	2	16	0	3	0	0	1	15	3	0	0	1	7	0	0	0	0	0	0	0	0	0
YELLOWLEGS SP.	0	19	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
PECTORAL SANDPIPER	7	4	2	3	1	5	5	0	8	31	0	4	14	2	12	2	0	0	0	0	0	0	0
BAIRD. SANDPIPER	1	0	0	2	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
LEAST SANDPIPER	1	0	3	7	0	0	8	8	4	4	0	0	0	0	3	0	0	0	0	0	0	0	0
S-BIL. DOWITCHER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
L-BIL. DOWITCHER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
DOWITCHER SP.	0	8	0	0	0	1	10	0	0	10	1	6	2	11	3	1	0	0	0	1	0	0	0
STILT SANDPIPER	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
SEMIPAL. SANDPIPER	0	0	1	0	0	4	21	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SM./PEEP SHOREBIRD	8	0	12	3	0	6	19	0	0	4	1	0	0	0	0	0	0	0	0	0	0	0	0
SANDERLING	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
SANDPIPER SP.	0	1	0	0	0	4	26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SHOREBIRD SP.	0	5	0	0	0	3	0	7	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0
NORTH. PHALAROPE	0	0	0	0	1	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COMMON RAVEN	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WATER PIPIT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	1	0	0	0	0	0	0	0
RD-WING. BLACKBIRD	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BLACKBIRD SP.	0	0	0	0	2	0	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SNOW BUNTING	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	1	0	0
PASSERINE SP.	0	0	0	0	0	0	0	0	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0

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	JUL 18	JUL 22	JUL 26	JUL 29	AUG 5	AUG 9	AUG 13	AUG 18	AUG 27	SEP 3	SEP 7	SEP 10	SEP 14	SEP 17	SEP 20	SEP 24	OCT 1	OCT 4	OCT 8	OCT 15	OCT 19	OCT 29	NOV 10
MALLARD	0	0	2	3	4	2	5	7	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
PINTAIL	4	9	13	11	0	3	3	2	0	0	3	9	0	0	1	3	0	0	0	0	0	0	0
GREEN-WINGED TEAL	0	1	12	0	36	235	26	37	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
BLUE-WINGED TEAL	0	0	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N. SHOVELER	1	2	1	1	0	0	5	2	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PUDDLE DUCK	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MARSH HAWK	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KILLDEER	0	0	0	0	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
AM. GOLDEN PLOVER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0
BLK.-BEL. PLOVER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
PLOVER SP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
COMMON SNIPE	0	0	0	0	1	5	2	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0
GREATER YELLOWLEGS	1	0	4	3	6	3	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
LESS. YELLOWLEGS	9	4	45	8	3	5	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
YELLOWLEGS SP.	0	4	0	4	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PECTORAL SANDPIPER	1	0	35	0	4	11	6	0	0	0	3	0	3	0	1	0	0	0	0	0	0	0	0
DOWITCHER SP.	0	1	8	12	0	1	0	0	0	0	8	0	0	0	1	0	0	0	0	0	0	0	0
SM./PEEP SHOREBIRD	0	0	5	0	0	4	8	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0
SHOREBIRD SP.	0	0	0	0	19	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
WILSON'S PHALAROPE	0	0	0	0	1	0	0	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
NORTH. PHALAROPE	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WATER PIPIT	0	0	0	0	0	0	0	0	0	0	7	0	7	1	0	0	0	0	0	0	0	0	0
RD-WING. BLACKBIRD	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RUSTY BLACKBIRD	0	0	0	6	0	0	0	0	0	0	0	0	0	0	4	0	1	0	0	0	0	0	0
BLACKBIRD SP.	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
SNOW BUNTING	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	3	0

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	JUL 18	JUL 22	JUL 26	JUL 29	AUG 5	AUG 9	AUG 13	AUG 18	AUG 27	SEP 3	SEP 14	SEP 17	SEP 24	OCT 1	OCT 8	OCT 15	OCT 19	NOV 10
MALLARD	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PINTAIL	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0
MARSH HAWK	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AM. KESTREL	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
KILLDEER	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COMMON SNIPE	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOLITARY SANDPIPER	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
GREATER YELLOWLEGS	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LESS. YELLOWLEGS	1	5	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
YELLOWLEGS SP.	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PECTORAL SANDPIPER	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BAIRD. SANDPIPER	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WILSON'S PHALAROPE	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0
COMMON RAVEN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
WATER PIPIT	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0
RD-WING. BLACKBIRD	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RUSTY BLACKBIRD	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BLACKBIRD SP.	0	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

APPENDIX 3 (cont'd)

WATER AREA 37

	JUL 18	JUL 22	JUL 26	JUL 29	AUG 5	AUG 9	AUG 13	AUG 18	AUG 27	SEP 3
KILLDEER	0	0	0	0	0	2	0	0	0	0
BAIRD. SANDPIPER	0	0	0	0	0	0	0	6	0	0
LEAST SANDPIPER	0	0	0	0	0	0	0	8	0	0

WATER AREA 38

	JUL 18	JUL 22	JUL 26	JUL 29	AUG 5
KILLDEER	9	2	0	0	0
LESS. YELLOWLEGS	4	3	0	0	0
PECTORAL SANDPIPER	4	1	0	0	0
BAIRD. SANDPIPER	7	0	0	0	0
LEAST SANDPIPER	4	0	0	0	0
STILT SANDPIPER	14	0	0	0	0
SEMIPAL. SANDPIPER	1	2	0	0	0
SM./PEEP SHOREBIRD	1	1	0	0	0

WATER AREA 39

	JUL 18	JUL 22	JUL 26	JUL 29	AUG 5
KILLDEER	1	0	0	0	0
COMMON SNIPE	1	0	0	0	0
LESS. YELLOWLEGS	1	0	0	0	0
PECTORAL SANDPIPER	2	0	0	0	0

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	JUL 18	JUL 22	JUL 26	JUL 29	AUG 5	AUG 9	AUG 13	AUG 18	AUG 27	SEP 3	SEP 10	SEP 17	SEP 20	OCT 1	OCT 15	OCT 19	OCT 29
PINTAIL	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0
GREEN-WINGED TEAL	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SEMIPAL. PLOVER	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
KILLDEER	1	0	0	0	0	1	3	5	0	0	0	0	0	0	0	0	0
COMMON SNIPE	1	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0
SOLITARY SANDPIPER	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GREATER YELLOWLEGS	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0
LESS. YELLOWLEGS	4	12	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
YELLOWLEGS SP.	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PECTORAL SANDPIPER	3	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
LEAST SANDPIPER	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
DOWITCHER SP.	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
STILT SANDPIPER	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SEMIPAL. SANDPIPER	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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	JUL 18	JUL 22	JUL 26	JUL 29	AUG 5	AUG 9	AUG 13	AUG 18	AUG 27	SEP 3	SEP 7	SEP 10	SEP 17	SEP 20	SEP 24	OCT 1	OCT 4	OCT 8	OCT 15	OCT 19	OCT 29
PINTAIL	0	0	0	4	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GREEN-WINGED TEAL	1	0	0	0	7	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TEAL SP.	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
UNID. DUCK	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MARSH HAWK	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SEMIPAL. PLOVER	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KILLDEER	0	2	0	3	3	8	7	0	0	0	1	0	0	0	0	0	0	0	0	0	0
COMMON SNIPE	1	1	0	1	4	2	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
LESS. YELLOWLEGS	18	0	0	2	1	5	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0
YELLOWLEGS SP.	1	3	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
PECTORAL SANDPIPER	19	38	0	1	8	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
LEAST SANDPIPER	2	0	0	1	12	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DOWITCHER SP.	1	1	0	5	3	0	0	0	4	0	2	0	0	0	0	0	0	0	0	0	0
STILT SANDPIPER	2	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SEMIPAL. SANDPIPER	0	0	0	0	1	3	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SM./PEEP SHOREBIRD	11	40	0	1	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SANDPIPER SP.	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SHOREBIRD SP.	6	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NORTH. PHALAROPE	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HORNED LARK	0	0	0	0	0	0	0	0	0	0	3	0	0	1	0	0	0	0	0	0	0
COMMON RAVEN	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RUSTY BLACKBIRD	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

WATER AREA 42

	JUL 18	JUL 22	JUL 26	JUL 29	AUG 5	AUG 9	AUG 13	AUG 18	AUG 27	SEP 10	SEP 14	SEP 17	SEP 24	OCT 1	OCT 4	OCT 8	OCT 15	OCT 19	OCT 29
MALLARD	1	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PINTAIL	0	0	0	3	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
GREEN-WINGED TEAL	0	0	0	0	6	7	0	0	0	0	0	0	0	0	0	0	0	0	0
SEMIPAL. PLOVER	1	5	1	0	3	2	9	3	0	0	0	0	0	0	0	0	0	0	0
KILLDEER	2	0	7	3	11	20	20	10	0	0	0	0	0	0	0	0	0	0	0
AM. GOLDEN PLOVER	0	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
BLK.-BEL. PLOVER	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
COMMON SNIPE	1	2	0	2	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
SOLITARY SANDPIPER	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GREATER YELLOWLEGS	1	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LESS. YELLOWLEGS	14	3	17	24	0	22	1	3	0	0	0	0	0	0	0	0	0	0	0
YELLOWLEGS SP.	13	15	0	0	1	0	5	0	0	0	0	0	0	0	0	0	0	0	0
PECTORAL SANDPIPER	74	7	5	25	40	4	21	15	0	0	1	0	0	0	0	0	0	0	0
BAIRD. SANDPIPER	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LEAST SANDPIPER	0	2	2	0	3	1	27	8	0	0	0	0	0	0	0	0	0	0	0
S-BIL. DOWITCHER	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L-BIL. DOWITCHER	0	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DOWITCHER SP.	12	2	0	1	6	3	0	0	0	0	0	0	0	0	0	0	0	0	0
STILT SANDPIPER	5	0	0	1	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0
SEMIPAL. SANDPIPER	10	1	4	0	1	4	10	4	0	0	0	0	0	0	0	0	0	0	0
SM./PEEP SHOREBIRD	23	8	3	4	10	9	28	0	0	0	0	0	0	0	0	0	0	0	0
BUFFBR. SANDPIPER	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
SANDPIPER SP.	0	35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SHOREBIRD SP.	0	0	0	0	0	0	8	2	0	0	0	0	0	0	0	0	0	0	0
WILSON'S PHALAROPE	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
NORTH. PHALAROPE	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
WATER PIPIT	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
RD-WING. BLACKBIRD	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0
BLACKBIRD SP.	0	0	0	8	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0

APPENDIX 3 (cont'd)

WATER AREA 43

	JUL 18	JUL 22	JUL 26	JUL 29	AUG 5	AUG 9	OCT 4
MALLARD	1	0	0	1	0	0	0
PINTAIL	0	0	0	1	0	0	0
GREEN-WINGED TEAL	0	0	0	0	0	3	0
KILLDEER	0	1	0	3	0	6	0
COMMON SNIPE	2	0	0	2	0	1	0
LESS. YELLOWLEGS	4	6	12	7	0	12	0
YELLOWLEGS SP.	1	0	0	0	2	0	0
PECTORAL SANDPIPER	16	18	8	10	0	10	0
BAIRD. SANDPIPER	0	2	0	0	0	0	0
LEAST SANDPIPER	0	4	2	3	0	7	0
DOWITCHER SP.	0	0	0	0	0	2	0
STILT SANDPIPER	2	0	0	0	0	0	0
SEMIPAL. SANDPIPER	0	10	0	1	0	9	0
SM./PEEP SHOREBIRD	2	2	0	0	0	0	0
SANDPIPER SP.	0	0	0	0	0	2	0
SHOREBIRD SP.	25	0	0	0	0	0	0
SAVANNAH SPARROW	3	0	0	0	0	0	0

WATER AREA 44

	JUL 18	JUL 22	JUL 26	JUL 29	AUG 5	AUG 9
SEMIPAL. PLOVER	0	0	0	0	0	4
KILLDEER	0	0	0	1	0	2
COMMON SNIPE	0	0	0	0	0	1
LESS. YELLOWLEGS	1	0	3	5	0	4
LEAST SANDPIPER	0	0	0	0	0	6
DOWITCHER SP.	0	0	0	2	0	2
SEMIPAL. SANDPIPER	0	0	0	0	0	2
SM./PEEP SHOREBIRD	0	0	1	0	0	0

WATER AREA 45

	JUL 18	JUL 22	JUL 26	JUL 29	AUG 5	AUG 9
KILLDEER	1	1	0	2	0	0
LESS. YELLOWLEGS	1	0	1	8	0	0
PECTORAL SANDPIPER	5	0	0	0	0	0
BAIRD. SANDPIPER	0	4	4	16	0	0
LEAST SANDPIPER	0	5	0	0	0	0
SEMIPAL. SANDPIPER	0	0	0	1	0	0
SM./PEEP SHOREBIRD	60	15	6	0	0	0
SAVANNAH SPARROW	2	1	0	0	0	0
LECONT. SPARROW	0	1	0	0	0	0

APPENDIX 4. Numbers of Birds Observed on Surveys of the Borrow Pits in 1974.

List of abbreviations of species/group names used in this list:

N. shoveler	-	Northern shoveler
Unid. duck	-	Duck spp.
Am. kestrel	-	American kestrel
Semipal. plover	-	Semipalmated plover
Am. golden plover	-	American golden plover
Less. yellowlegs	-	Lesser yellowlegs
Baird. sandpiper	-	Baird's sandpiper
Semipal. sandpiper	-	Semipalmated sandpiper
Sm./peep shorebird	-	'Peep' sandpiper spp.
Wh. head. gull sp.	-	Gull spp.
Rd-wing. blackbird	-	Red-winged blackbird
LeCont. sparrow	-	LeConte's sparrow
Clay-col sparrow	-	Clay-colored sparrow
Wh.-th. sparrow	-	White-throated sparrow
sp.	-	spp.

APPENDIX 4 (cont'd)

BORROW PIT 18

	JUL 13	JUL 15	JUL 19	JUL 23	JUL 25	JUL 30	AUG 17	AUG 28	SEP 4	SEP 11	SEP 18	SEP 25	OCT 2	OCT 9	OCT 16	OCT 23	OCT 30
MALLARD	0	0	0	0	0	0	8	0	1	0	0	4	7	1	0	0	0
PINTAIL	0	0	0	0	0	0	34	10	0	1	3	4	1	0	0	0	0
GREEN-WINGED TEAL	0	0	0	0	0	2	13	28	0	5	0	6	1	0	0	0	0
AMERICAN WIGEON	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
UNID. DUCK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
RED-TAILED HAWK	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
MARSH HAWK	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SORA RAIL	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPOTTED SANDPIPER	3	3	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0
SOLITARY SANDPIPER	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BANK SWALLOW	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
COMMON RAVEN	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MOURNING WARBLER	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
RD-WING. BLACKBIRD	8	11	16	3	0	0	0	0	0	0	0	0	0	0	0	0	0
COMMON GRACKLE	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
CHIPPING SPARROW	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPARROW SP.	0	0	2	0	0	0	0	2	2	0	0	0	0	0	0	0	0
PASSERINE SP.	0	0	0	0	0	1	0	1	0	1	0	7	2	0	0	0	0

BORROW PIT 19

	JUL 13	JUL 15	JUL 19	JUL 23	JUL 25	JUL 30	AUG 17	AUG 28	SEP 4	SEP 11	SEP 18	SEP 25	OCT 2	OCT 9	OCT 16	OCT 23	OCT 30
CLAY-COL SPARROW	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

APPENDIX 4 (cont'd)

BORROW PIT 20

	JUL 13	JUL 15	JUL 19	JUL 23	JUL 25	JUL 30	AUG 17	AUG 28	SEP 4	SEP 11	SEP 18	SEP 25	OCT 2	OCT 9	OCT 16	OCT 23	OCT 30
MALLARD	0	0	0	0	0	0	0	0	0	3	1	0	3	0	0	0	0
PINTAIL	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
BUFFLEHEAD	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
AM. KESTREL	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0
KILLDEER	3	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AM. GOLDEN PLOVER	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
PLOVER SP.	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COMMON SNIPE	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPOTTED SANDPIPER	2	3	2	2	2	1	0	0	0	0	0	0	0	0	0	0	0
GREATER YELLOWLEGS	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0
LESS. YELLOWLEGS	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
YELLOWLEGS SP.	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PECTORAL SANDPIPER	0	0	0	0	0	0	2	0	0	3	0	0	0	0	0	0	0
BAIRD. SANDPIPER	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
LEAST SANDPIPER	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SEMIPAL. SANDPIPER	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SM./PEEP SHOREBIRD	8	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
SANDPIPER SP.	0	0	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SHOREBIRD SP.	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
WH. HEAD. GULL SP.	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
BONAPARTE'S GULL	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BANK SWALLOW	5	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0
COMMON RAVEN	0	1	1	0	1	1	0	2	0	0	0	1	0	0	0	0	0
WATER PIPIT	0	0	0	0	0	0	0	0	0	17	5	0	0	0	0	0	0
RD-WING. BLACKBIRD	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0
DARK-EYED JUNCO	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CHIPPING SPARROW	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
SPARROW SP.	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
LAPLAND LONGSPUR	0	0	0	0	0	0	0	0	0	1	6	0	0	0	0	0	0
SNOW BUNTING	0	0	0	0	0	0	0	0	0	0	0	0	0	65	0	0	2
PASSERINE SP.	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0

APPENDIX 4 (cont'd)

BORROW PIT 21

	JUL 13	JUL 15	JUL 19	JUL 23	JUL 25	JUL 30	AUG 17	AUG 28	SEP 4	SEP 11	SEP 18	SEP 25	OCT 2	OCT 9	OCT 16	OCT 23	OCT 30
MALLARD	2	0	0	0	1	1	9	1	0	3	0	0	2	0	0	0	0
GREEN-WINGED TEAL	8	8	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TEAL SP.	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0
SCAUP SP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
BUFFLEHEAD	0	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
MARSH HAWK	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
SORA RAIL	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KILLDEER	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0
COMMON SNIPE	1	0	0	0	1	3	2	3	0	3	0	0	2	0	0	0	0
SPOTTED SANDPIPER	1	4	2	1	4	1	0	0	0	0	0	0	0	0	0	0	0
SOLITARY SANDPIPER	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
GREATER YELLOWLEGS	3	0	2	0	0	1	1	0	0	0	2	0	0	0	0	0	0
LESS. YELLOWLEGS	3	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0
YELLOWLEGS SP.	0	0	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0
BAIRD. SANDPIPER	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
DOWITCHER SP.	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
WILSON'S PHALAROPE	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
BANK SWALLOW	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GRAY JAY	0	1	0	0	0	1	0	0	0	0	3	0	0	0	0	0	0
COMMON RAVEN	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
AMERICAN ROBIN	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HERMIT THRUSH	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RD-WING. BLACKBIRD	0	0	0	0	1	3	0	0	0	0	0	0	0	0	0	0	0
BLACKBIRD SP.	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
SAVANNAH SPARROW	1	2	3	0	0	0	0	1	0	0	0	0	0	0	0	0	0
LECONT. SPARROW	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CLAY-COL SPARROW	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
SWAMP SPARROW	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
SPARROW SP.	0	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0
PASSERINE SP.	0	0	0	0	2	0	0	0	1	0	1	0	0	0	0	0	0

APPENDIX 4 (cont'd)

BORROW PIT 22

	JUL 13	JUL 15	JUL 19	JUL 23	JUL 25	JUL 30	AUG 17	AUG 28	SEP 4	SEP 11	SEP 18	SEP 25	OCT 2	OCT 9	OCT 16	OCT 22	OCT 23
MALLARD	0	0	0	0	0	1	0	8	4	1	0	1	0	0	0	0	0
GREEN-WINGED TEAL	0	1	1	8	0	11	0	0	0	0	0	0	0	0	0	0	0
N. SHOVELER	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RING-NECKED DUCK	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
SCAUP SP.	0	0	0	0	0	0	0	0	0	1	0	0	0	3	2	0	0
AYTHYA SP.	11	11	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BUFFLEHEAD	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0
DIVING DUCK	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
MERLIN	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KILLDEER	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COMMON SNIPE	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPOTTED SANDPIPER	4	3	2	3	3	3	2	2	0	1	0	0	0	0	0	0	0
SOLITARY SANDPIPER	2	0	10	2	0	2	0	1	0	0	0	0	0	0	0	0	0
GREATER YELLOWLEGS	0	0	2	4	0	0	2	1	0	0	0	0	0	1	0	0	0
LESS. YELLOWLEGS	4	0	0	2	0	0	3	1	0	0	0	0	0	0	0	0	0
YELLOWLEGS SP.	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PECTORAL SANDPIPER	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LEAST SANDPIPER	0	0	0	2	0	1	1	0	0	0	0	0	0	0	0	0	0
SM./PEEP SHOREBIRD	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
WILSON'S PHALAROPE	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BANK SWALLOW	0	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GRAY JAY	0	0	0	0	0	0	0	0	3	0	0	1	1	3	2	1	0
COMMON RAVEN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
RD-WING. BLACKBIRD	0	1	0	4	1	0	0	0	0	0	0	0	0	0	0	0	0
BLACKBIRD SP.	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0
CHIPPING SPARROW	4	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0
WH.-TH. SPARROW	1	0	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0
SONG SPARROW	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
SPARROW SP.	0	0	0	6	0	0	0	2	0	0	0	0	0	0	0	0	0
PASSERINE SP.	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0

APPENDIX 4 (cont'd)

BORROW PIT 23

	JUL 13	JUL 15	JUL 19	JUL 23	JUL 25	JUL 30	AUG 17	AUG 28	SEP 4	SEP 11	SEP 18	OCT 2	OCT 9	OCT 16	OCT 23	OCT 30
MALLARD	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
GREATER YELLOWLEGS	0	0	0	0	3	3	0	0	0	0	0	0	0	0	0	0
LESS. YELLOWLEGS	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0
WILSON'S PHALAROPE	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
COMMON RAVEN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
HERMIT THRUSH	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RD-WING. BLACKBIRD	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
WH.-TH. SPARROW	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPARROW SP.	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0
SNOW BUNTING	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	0
PASSERINE SP.	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0

BORROW PIT 24

	JUL 13	JUL 15	JUL 19	JUL 23	JUL 25	AUG 2	AUG 17	SEP 4	SEP 11	SEP 18	SEP 25	OCT 2	OCT 9	OCT 16	OCT 23	OCT 30
AM. KESTREL	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
KILLDEER	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPOTTED SANDPIPER	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
SOLITARY SANDPIPER	0	1	3	2	0	0	0	0	0	0	0	0	0	0	0	0
GREATER YELLOWLEGS	0	3	2	0	0	0	0	0	0	1	0	0	0	0	0	0
LESS. YELLOWLEGS	1	1	6	2	1	0	4	0	0	0	0	0	0	0	0	0
LEAST SANDPIPER	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DOWITCHER SP.	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
SM./PEEP SHOREBIRD	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
GRAY JAY	0	0	4	0	0	0	0	2	0	3	0	0	0	0	0	0
COMMON RAVEN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
WARBLER SP.	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
RUSTY BLACKBIRD	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
COMMON GRACKLE	0	0	0	1	0	2	10	0	0	0	0	0	0	0	0	0
LINCOLN'S SPARROW	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
LAPLAND LONGSPUR	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0
PASSERINE SP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2

APPENDIX 4 (cont'd)

BORROW PIT 25

	JUL 13	JUL 15	JUL 19	JUL 23	JUL 25	AUG 2	AUG 17	AUG 28	SEP 4	SEP 11	SEP 18	SEP 25	OCT 2	OCT 9	OCT 16	OCT 23	OCT 30
MALLARD	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0
BUFFLEHEAD	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
SORA RAIL	3	3	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0
KILLDEER	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPOTTED SANDPIPER	1	0	0	0	2	2	1	0	0	0	0	0	0	0	0	0	0
SOLITARY SANDPIPER	2	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0
GREATER YELLOWLEGS	0	0	3	0	1	0	0	0	1	0	0	0	0	0	0	0	0
LESS. YELLOWLEGS	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
YELLOWLEGS SP.	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
COMMON RAVEN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0
AMERICAN ROBIN	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
WAXWING SP.	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
RD-WING. BLACKBIRD	0	2	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0
COMMON GRACKLE	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
BLACKBIRD SP.	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
CHIPPING SPARROW	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPARROW SP.	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
SNOW BUNTING	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
PASSERINE SP.	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0

BORROW PIT 26

	JUL 13	JUL 15	JUL 19	JUL 23	AUG 2	AUG 17	AUG 28	SEP 4	SEP 11	SEP 18	SEP 25	OCT 2	OCT 9	OCT 16	OCT 23	OCT 30
MALLARD	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BUFFLEHEAD	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
SPOTTED SANDPIPER	0	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0
SOLITARY SANDPIPER	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SM./PEEP SHOREBIRD	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
SHOREBIRD SP.	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
WATER PIPIT	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0
CEDAR WAXWING	0	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0
RD-WING. BLACKBIRD	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0
WH.-TH. SPARROW	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0

APPENDIX 4 (cont'd)

BORROW PIT 27

	JUL 13	JUL 15	JUL 19	JUL 23	JUL 25	AUG 2	AUG 17	AUG 28	SEP 4	SEP 11	SEP 18	SEP 25	OCT 2	OCT 9	OCT 16	OCT 23	OCT 30
MALLARD	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
BLUE-WINGED TEAL	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SCAUP SP.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPOTTED SANDPIPER	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOLITARY SANDPIPER	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	(	0
CEDAR WAXWING	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
RD-WING. BLACKBIRD	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RUSTY BLACKBIRD	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
COMMON GRACKLE	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
WESTERN TANAGER	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
SPARROW SP.	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
PASSERINE SP.	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0

BORROW PIT 28

	JUL 13	JUL 15	JUL 19	JUL 23	JUL 25	AUG 2	AUG 17	AUG 28	SEP 4	SEP 11	SEP 18	SEP 25	OCT 2	OCT 9	OCT 16	OCT 23	OCT 30
RUFFED GROUSE	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SEMIPAL. PLOVER	0	0	3	1	0	0	4	0	0	0	0	0	0	0	0	0	0
KILLDEER	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
SPOTTED SANDPIPER	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOLITARY SANDPIPER	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GREATER YELLOWLEGS	0	0	0	4	2	1	0	0	0	0	0	0	0	0	0	0	0
LESS. YELLOWLEGS	0	0	3	4	1	1	0	0	0	0	0	0	0	0	0	0	0
BAIRD. SANDPIPER	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
LEAST SANDPIPER	0	0	1	3	0	1	0	0	0	0	0	0	0	0	0	0	0
SEMIPAL. SANDPIPER	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SM./PEEP SHOREBIRD	0	0	0	6	1	0	0	0	0	0	0	0	0	0	0	0	0
SANDPIPER SP.	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COMMON RAVEN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WATER PIPIT	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
WH.-TH. SPARROW	0	1	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0
SNOW BUNTING	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
																5	0

APPENDIX 4 (cont'd)

BORROW PIT 30

	JUL 15	JUL 19	JUL 23	JUL 25	JUL 30	AUG 17	AUG 28	SEP 4	SEP 11	SEP 18	SEP 25	OCT 2	OCT 9	OCT 16	OCT 23	OCT 30
BUFFLEHEAD	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
AM. KESTREL	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
KILLDEER	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPOTTED SANDPIPER	1	1	2	1	2	1	0	0	0	0	0	0	0	0	0	0
FLYCATCHER SP.	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
BANK SWALLOW	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
GRAY JAY	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
COMMON RAVEN	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
CEDAR WAXWING	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
RD-WING. BLACKBIRD	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
WH.-TH. SPARROW	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPARROW SP.	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
SNOW BUNTING	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0
PASSERINE SP.	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0

APPENDIX 5. Annotated List of Additional Species Known or Suspected to Nest in the Study Area (From Casual Observations).

Broad-winged hawk

- One immature bird seen at Ruth Lake on August 13. Adults seen regularly during the summer.

Marsh hawk

- A pair of adults was seen regularly in the area in July and August. Immature birds were seen in late August and early September.

American kestrel

- Several pairs of kestrels nested in old woodpecker holes in tall balsam poplars along the Athabasca River near the Great Canadian Oil Sands plant.

Spruce grouse

- A female and brood (four or more chicks) were seen in spruce forest near Ruth Lake on July 8.

Ruffed grouse

- A female and two chicks were seen July 15 near Borrow Pit 28. Another female with seven chicks was seen near Horseshoe Lake on July 27.

Sandhill crane

- On July 24, a pair of adults and their three-quarter grown chick were seen in a birch meadow bordering the northeastern edge of the cleared area of the Syncrude construction site. At least one other pair of sandhill cranes was also a summer resident, possibly breeding, near the cleared area.

Killdeer

- An adult and four young (10 to 14 days old) were seen along the road three miles north of Fort MacKay on July 13.

Common nighthawk

- Fledglings were seen at the lower camp August 1, and the Beaver Creek Provincial Campsite July 21.

Common flicker

- Fledged young were seen at the Beaver Creek Campsite July 7.

Eastern phoebe

- A family group of adults and fledglings were seen at the Syncrude lower camp July 18.

Cliff and Barn swallows

- Nests were common on buildings at the lower camp, and at the construction site.

Black-billed magpie

- An adult was seen feeding a fledged young July 17 at Horseshoe Lake.

American robin

- Several adults were seen carrying food at Mildred Lake and the Beaver Creek Campsite during July 7 to 11.

Swainson's thrush

- An adult was seen carrying food at the Beaver Creek Campsite.

Warbling vireo

- An adult and fledged young were seen at Mildred Lake.

Western tanager

- Adults carrying food were observed at the Beaver Creek Campsite July 10, and at Horseshoe Lake July 14.

APPENDIX 6. Numbers of Birds Observed on the Migration Watch in 1974.

List of abbreviations of species/group names used in this list:

Wht.-front. goose	-	White-fronted goose
Wh.-fr. + Can. geese	-	White-fronted and Canada geese
Semipal. sandpiper	-	Semipalmated sandpiper
White-headed gull	-	Gull spp.
Blk-billed magpie	-	Black-billed magpie
Blk-cap chickadee	-	Black-capped chickadee
Whitecrown sparrow	-	White-crowned sparrow

APPENDIX 6 (cont'd)

	AUG 26	AUG 27	AUG 28	AUG 29	AUG 30	AUG 31	SEP 1	SEP 2	SEP 3	SEP 4	SEP 5	SEP 6	SEP 7	SEP 8	SEP 9
COMMON LOON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
WHISTLING SWAN	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0
CANADA GOOSE	0	0	0	27	57	37	52	0	0	775	0	55	250	54	125
WHI.-FRONT. GOOSE	0	0	0	0	17	675	85	0	0	52	0	0	24	0	0
WH.-FR.+CAN. GEESE	0	0	0	0	0	65	0	0	0	481	0	80	400	0	101
DARK GOOSE SPP.	0	0	0	0	0	0	0	0	0	0	0	259	0	0	0
SNOW GOOSE	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0
ROSS' GOOSE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WHITE AND DARK GEESE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOOSE SPP.	0	0	0	0	0	0	0	0	0	399	0	0	0	0	4
MALLARD	0	6	0	3	0	2	0	0	0	1	0	0	0	2	2
PINTAIL	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0
GREEN-WINGED TEAL	0	0	0	1	11	0	0	0	0	0	0	0	2	0	0
BLUE-WINGED TEAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TEAL SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DABBLING DUCK SPP.	0	19	0	0	0	0	1	1	1	0	0	0	10	7	2
SCAUP SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOLDENEYE SPP.	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0
BUFFLEHEAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RUDDY DUCK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIVING DUCK SPP.	0	8	0	7	0	0	1	0	0	0	0	0	1	0	0
DUCK SPP.	6	2	16	0	3	1	4	46	1	47	3	16	20	18	39
ACCIPITER SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROUGH-LEGGED HAWK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BUTEO SPP.	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
BALD EAGLE	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
EAGLE SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MARSH HAWK	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MERLIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
AMERICAN KESTREL	1	6	0	0	0	0	0	0	0	0	0	0	1	0	0
HAWK SPP.	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GROUSE SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PTARMIGAN SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SANDHILL CRANE	0	0	0	0	0	6	0	0	0	77	0	0	0	0	0
SEMIPAL. PLOVER	0	0	0	2	0	0	0	0	0	0	1	0	3	1	0
KILLDEER	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
PLOVER SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COMMON SNIPE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOLITARY SANDPIPER	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
GREATER YELLOWLEGS	0	5	3	1	0	0	2	0	0	0	0	0	2	0	0
LESSER YELLOWLEGS	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
YELLOWLEGS SPP.	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
PECTORAL SANDPIPER	5	1	9	0	0	1	0	0	3	0	1	0	0	0	0
SEMIPAL. SANDPIPER	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PEEP SANDPIPER SPP.	1	0	0	6	0	0	0	0	0	3	0	0	0	0	0
SANDPIPER SPP.	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0
SHOREBIRD SPP.	0	6	0	0	0	0	0	0	0	32	0	2	1	2	0
WHITE-HEADED GULL	80	41	4	11	0	4	2	9	6	20	1	0	0	1	3
BELTED KINGFISHER	0	0	1	0	0	0	0	1	0	1	1	0	0	0	0
COMMON FLICKER	0	0	0	0	0	1	0	0	0	0	0	0	1	0	5
HAIRY WOODPECKER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WOODPECKER SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HORNED LARK	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0
GRAY JAY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BLK-BILLED MAGPIE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COMMON RAVEN	1	5	9	0	0	0	0	0	3	0	0	0	0	0	0
COMMON CROW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BLK-CAP CHICKADEE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMERICAN ROBIN	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0
THRUSH SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WATER PIPIT	0	0	0	0	10	0	0	3	3	4	1	0	3	1	5
CEDAR WAXWING	0	0	0	0	0	0	0	0	12	0	0	0	0	0	0
WAXWING SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
MYRTLE WARBLER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PALM WARBLER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WARBLER SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RUSTY BLACKBIRD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COMMON GRACKLE	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0
BLACKBIRD SPP.	42	6	55	0	39	35	8	265	3	35	23	0	0	0	13
EVENING GROSBEAK	0	0	0	0	0	0	0	0	12	0	0	18	0	0	0
PINE GROSBEAK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
REDPOLL SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SAVANNAH SPARROW	0	0	0	0	0	0	4	0	0	0	0	0	0	1	0
DARK-EYED JUNCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TREE SPARROW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WHITECROWN SPARROW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SWAMP SPARROW	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPARROW SPP.	0	0	0	0	4	2	0	0	4	0	0	0	0	0	0
LAPLAND LONGSPUR	0	0	0	0	0	0	0	0	0	0	0	0	12	1	0
SNOW BUNTING	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PASSERINE SPP.	17	0	0	15	4	150	22	36	36	128	5	20	65	29	54

APPENDIX 6 (cont'd)

	SEP 10	SEP 11	SEP 12	SEP 13	SEP 14	SEP 15	SEP 16	SEP 17	SEP 18	SEP 19	SEP 20	SEP 21	SEP 22	SEP 23	SEP 24
COMMON LOON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WHISTLING SWAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
CANADA GOOSE	26	85	0	1	60	0	135	90	0	0	0	0	0	0	90
WHT.-FRONT. GOOSE	0	0	0	95	0	0	0	0	0	0	0	0	0	1	0
WH.-FR.+CAN. GEESE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DARK GOOSE SPP.	0	0	0	0	0	0	48	0	0	0	0	0	0	0	0
SNOW GOOSE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROSS' GOOSE	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
WHITE AND DARK GEESE	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0
GOOSE SPP.	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0
MALLARD	0	0	2	0	1	5	0	1	0	0	0	3	0	0	0
PINTAIL	0	0	0	1	0	0	0	0	4	1	0	0	0	0	0
GREEN-WINGED TEAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BLUE-WINGED TEAL	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
TEAL SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DABBLING DUCK SPP.	0	0	3	1	1	0	0	4	1	6	0	0	1	0	0
SCAUP SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOLDENEYE SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BUFFLEHEAD	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
RUDDY DUCK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
DIVING DUCK SPP.	0	3	0	1	0	2	0	0	0	0	0	0	0	0	0
DUCK SPP.	1	16	10	33	1	16	14	10	16	0	3	3	18	0	11
ACCIPITER SPP.	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
ROUGH-LEGGED HAWK	0	0	0	0	0	0	0	0	1	1	1	0	2	0	0
BUTEO SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BALD EAGLE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EAGLE SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MARSH HAWK	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MERLIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMERICAN KESTREL	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAWK SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GROUSE SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PTARMIGAN SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SANDHILL CRANE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SEMIPAL. PLOVER	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
KILLDEER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PLOVER SPP.	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
COMMON SNIPE	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
SOLITARY SANDPIPER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GREATER YELLOWLEGS	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0
LESSER YELLOWLEGS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
YELLOWLEGS SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PECTORAL SANDPIPER	0	0	0	4	2	0	0	0	0	0	0	1	0	6	0
SEMIPAL. SANDPIPER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PEEP SANDPIPER SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SANDPIPER SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SHOREBIRD SPP.	0	0	0	0	0	0	0	3	0	0	0	1	0	0	0
WHITE-HEADED GULL	0	4	6	0	1	1	3	22	0	1	2	0	0	1	0
BELTED KINGFISHER	0	0	0	1	1	1	1	0	1	0	0	0	0	0	0
COMMON FLICKER	0	1	0	2	0	0	0	1	0	0	0	0	0	0	0
HAIRY WOODPECKER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WOODPECKER SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HORNED LARK	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GRAY JAY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BLK-BILLED MAGPIE	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0
COMMON RAVEN	0	0	1	0	0	0	0	0	0	0	5	0	0	3	0
COMMON CROW	3	0	0	0	0	0	0	2	0	0	0	0	0	0	0
BLK-CAP CHICKADEE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMERICAN ROBIN	0	0	0	0	0	0	0	26	0	0	0	1	0	0	0
THRUSH SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WATER PIPIT	23	29	65	10	6	18	2	12	13	16	3	5	2	7	4
CEDAR WAXWING	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WAXWING SPP.	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
MYRTLE WARBLER	0	0	0	23	0	0	0	0	2	0	0	0	0	0	0
PALM WARBLER	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
WARBLER SPP.	0	0	0	15	0	0	0	0	0	0	0	0	0	0	0
RUSTY BLACKBIRD	0	0	2	0	0	0	0	0	61	0	65	0	17	0	0
COMMON GRACKLE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BLACKBIRD SPP.	49	46	3	34	360	277	26	74	96	2	136	69	63	2	5
EVENING GROSBEAK	0	0	3	0	0	4	0	0	0	0	0	0	0	0	0
PINE GROSBEAK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
REDPOLL SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SAVANNAH SPARROW	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
DARK-EYED JUNCO	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
TREE SPARROW	0	0	0	0	0	1	0	0	5	0	0	0	0	0	0
WHITECROWN SPARROW	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
SWAMP SPARROW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPARROW SPP.	0	0	0	6	0	0	13	0	1	0	0	0	0	0	0
LAPLAND LONGSPUR	0	0	3	0	9	6	0	0	6	3	1	1	1	0	6
SNOW BUNTING	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PASSERINE SPP.	0	16	11	45	242	167	54	15	117	28	22	45	40	6	18

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APPENDIX 6 (cont'd)

	SEP 25	SEP 26	SEP 27	SEP 28	SEP 29	SEP 30	OCT 1	OCT 2	OCT 3	OCT 4	OCT 7	OCT 8	OCT 9	OCT 10	OCT 11
COMMON LOON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WHISTLING SWAN	0	0	0	1	0	0	0	0	0	0	0	0	0	4	0
CANADA GOOSE	0	0	18	0	0	0	0	0	0	0	0	0	0	0	0
WHT.-FRONT. GOOSE	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0
WH.-FR.+CAN. GEESE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DARK GOOSE SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SNOW GOOSE	0	0	110	0	0	0	0	0	0	0	0	0	0	0	0
ROSS' GOOSE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WHITE AND DARK GEESE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOOSE SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MALLARD	0	0	44	0	0	0	0	0	6	0	0	0	0	0	0
PINTAIL	5	0	0	0	0	0	0	1	0	0	0	0	0	0	0
GREEN-WINGED TEAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BLUE-WINGED TEAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TEAL SPP.	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
DABBLING DUCK SPP.	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0
SCAUP SPP.	0	0	0	0	0	0	0	0	0	0	7	2	0	0	1
GOLDENEYE SPP.	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0
BUFFLEHEAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RUDDY DUCK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIVING DUCK SPP.	0	0	0	0	0	0	0	0	0	0	0	1	23	18	0
DUCK SPP.	25	7	152	56	4	0	1	11	83	0	0	14	1	18	2
ACCIPITER SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROUGH-LEGGED HAWK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BUTEO SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BALD EAGLE	0	0	1	0	0	0	0	0	0	0	1	0	0	26	0
EAGLE SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MARSH HAWK	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
MERLIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMERICAN KESTREL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAWK SPP.	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
GROUSE SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0
PTARMIGAN SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SANDHILL CRANE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SEMIPAL. PLOVER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KILLDEER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PLOVER SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COMMON SNIPE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOLITARY SANDPIPER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GREATER YELLOWLEGS	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0
LESSER YELLOWLEGS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
YELLOWLEGS SPP.	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
PECTORAL SANDPIPER	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0
SEMIPAL. SANDPIPER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PEEP SANDPIPER SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SANDPIPER SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SHOREBIRD SPP.	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
WHITE-HEADED GULL	0	0	2	0	0	0	1	0	0	0	0	0	0	8	0
BELTED KINGFISHER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COMMON FLICKER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAIRY WOODPECKER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WOODPECKER SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
HORNED LARK	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0
GRAY JAY	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
BLK-BILLED MAGPIE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COMMON RAVEN	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
COMMON CROW	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
BLK-CAP CHICKADEE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMERICAN ROBIN	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
THRUSH SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WATER PIPIT	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0
CEDAR WAXWING	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WAXWING SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MYRTLE WARBLER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PALM WARBLER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WARBLER SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RUSTY BLACKBIRD	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
COMMON GRACKLE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BLACKBIRD SPP.	0	0	32	64	6	0	4	0	0	3	0	0	0	1	0
EVENING GROSBEAK	0	0	0	0	0	0	0	0	0	0	0	5	4	0	0
PINE GROSBEAK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
REDPOLL SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SAVANNAH SPARROW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DARK-EYED JUNCO	0	0	0	0	0	0	0	0	0	0	14	0	0	0	0
TREE SPARROW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WHITECROWN SPARROW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SWAMP SPARROW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPARROW SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LAPLAND LONGSPUR	0	1	1	0	0	0	0	0	0	1	2	8	0	0	0
SNOW BUNTING	0	0	0	0	0	0	0	0	0	0	16	0	0	4	20
PASSERINE SPP.	2	11	19	39	4	3	12	1	33	11	124	85	15	66	122

APPENDIX 6 (cont'd)

	OCT 12	OCT 13	OCT 14	OCT 15	OCT 16	OCT 17	OCT 18	OCT 19	OCT 20	OCT 21	OCT 22	OCT 23	OCT 25	OCT 27	OCT 28
COMMON LOON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WHISTLING SWAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CANADA GOOSE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WHT.-FRONT. GOOSE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WH.-FR.+CAN. GEESE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DARK GOOSE SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SNOW GOOSE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROSS' GOOSE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WHITE AND DARK GEESE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOOSE SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MALLARD	0	0	21	0	0	0	0	0	0	0	0	0	0	0	0
PINTAIL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GREEN-WINGED TEAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BLUE-WINGED TEAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TEAL SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DABBLING DUCK SPP.	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
SCAUP SPP.	0	2	0	0	0	0	3	3	0	0	0	0	0	0	0
GOLDENEYE SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BUFFLEHEAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RUDDY DUCK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIVING DUCK SPP.	0	0	1	7	0	2	0	0	0	0	0	0	0	0	0
DUCK SPP.	3	21	13	11	0	0	2	6	0	0	0	0	1	0	0
ACCIPITER SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROUGH-LEGGED HAWK	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
BUTEO SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BALD EAGLE	0	0	0	0	2	0	0	0	0	0	0	0	0	1	0
EAGLE SPP.	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
MARSH HAWK	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
MERLIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMERICAN KESTREL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAWK SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GROUSE SPP.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PTARMIGAN SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SANDHILL CRANE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SEMIPAL. PLOVER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KILLDEER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PLOVER SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COMMON SNIPE	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
SOLITARY SANDPIPER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GREATER YELLOWLEGS	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LESSER YELLOWLEGS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
YELLOWLEGS SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PECTORAL SANDPIPER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SEMIPAL. SANDPIPER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PEEP SANDPIPER SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SANDPIPER SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SHOREBIRD SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WHITE-HEADED GULL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BELTED KINGFISHER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COMMON FLICKER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAIRY WOODPECKER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WOODPECKER SPP.	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0
HORNED LARK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GRAY JAY	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BLK-BILLED MAGPIE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COMMON RAVEN	0	0	0	0	0	0	0	0	0	3	27	0	0	0	0
COMMON CROW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BLK-CAP CHICKADEE	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0
AMERICAN ROBIN	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0
THRUSH SPP.	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0
WATER PIPIT	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
CEDAR WAXWING	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WAXWING SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MYRTLE WARBLER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PALM WARBLER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WARBLER SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RUSTY BLACKBIRD	0	0	0	0	0	0	1	0	0	0	0	0	1	2	0
COMMON GRACKLE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BLACKBIRD SPP.	0	7	0	0	0	1	0	0	0	0	1	0	0	0	0
EVENING GROSBEAK	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0
PINE GROSBEAK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
REDPOLL SPP.	0	89	80	0	80	8	66	0	18	0	13	29	38	16	9
SAVANNAH SPARROW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DARK-EYED JUNCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TREE SPARROW	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
WHITECROWN SPARROW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SWAMP SPARROW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPARROW SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LAPLAND LONGSPUR	0	0	1	0	0	0	29	0	0	0	0	0	0	0	0
SNOW BUNTING	10	14	60	111	14	0	1	52	22	30	27	20	1	14	10
PASSERINE SPP.	74	26	89	2	75	117	9	13	30	56	28	0	9	0	1

APPENDIX 6 (cont'd)

	OCT 29	OCT 30	NOV 2	NOV 3	NOV 4	NOV 5	NOV 6	NOV 9	NOV 10	NOV 11	NOV 12	NOV 13	NOV 14	NOV 15
COMMON LOON	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WHISTLING SWAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CANADA GOOSE	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WHT.-FRONT. GOOSE	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WH.-FR.+CAN. GEESE	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DARK GOOSE SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SNOW GOOSE	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROSS' GOOSE	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WHITE AND DARK GEESE	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOOSE SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MALLARD	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PINTAIL	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GREEN-WINGED TEAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BLUE-WINGED TEAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TEAL SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DABBLING DUCK SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SCAUP SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOLDENEYE SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BUFFLEHEAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RUDDY DUCK	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIVING DUCK SPP.	1	0	0	0	0	0	0	0	0	0	0	0	0	0
DUCK SPP.	0	0	0	0	0	0	1	1	0	2	0	0	0	0
ACCIPITER SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROUGH-LEGGED HAWK	1	0	0	0	0	0	0	0	0	0	0	0	0	0
BUTEO SPP.	0	0	0	0	1	0	0	0	0	0	0	0	0	0
BALD EAGLE	0	0	0	0	0	0	1	0	0	0	0	0	0	0
EAGLE SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MARSH HAWK	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MERLIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMERICAN KESTREL	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAWK SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GROUSE SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PTARMIGAN SPP.	0	0	0	0	0	0	1	0	0	0	0	0	0	0
SANDHILL CRANE	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SEMIPAL. PLOVER	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KILLDEER	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PLOVER SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COMMON SNIPE	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOLITARY SANDPIPER	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GREATER YELLOWLEGS	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LESSER YELLOWLEGS	0	0	0	0	0	0	0	0	0	0	0	0	0	0
YELLOWLEGS SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PECTORAL SANDPIPER	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SEMIPAL. SANDPIPER	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PEEP SANDPIPER SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SANDPIPER SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SHOREBIRD SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WHITE-HEADED GULL	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BELTED KINGFISHER	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COMMON FLICKER	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAIRY WOODPECKER	0	1	0	0	1	0	0	0	0	0	0	0	0	0
WOODPECKER SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HORNED LARK	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GRAY JAY	0	3	0	0	0	0	0	0	0	0	0	0	0	0
BLK-BILLED MAGPIE	0	0	0	0	0	1	0	0	0	0	0	0	0	0
COMMON RAVEN	2	3	0	0	0	0	0	0	0	0	0	0	0	0
COMMON CROW	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BLK-CAP CHICKADEE	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMERICAN ROBIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0
THRUSH SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WATER PIPIT	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CEDAR WAXWING	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WAXWING SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MYRTLE WARBLER	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PALM WARBLER	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WARBLER SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RUSTY BLACKBIRD	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COMMON GRACKLE	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BLACKBIRD SPP.	1	0	1	0	0	0	0	0	0	0	0	0	0	0
EVENING GROSBEAK	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PINE GROSBEAK	0	0	0	8	0	0	0	0	0	0	0	0	0	0
REDPOLL SPP.	1	0	27	20	12	0	7	18	7	0	0	11	0	0
SAVANNAH SPARROW	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DARK-EYED JUNCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TREE SPARROW	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WHITECROWN SPARROW	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SWAMP SPARROW	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPARROW SPP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LAPLAND LONGSPUR	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SNOW BUNTING	8	1	1	0	0	2	8	5	5	0	0	4	9	12
PASSERINE SPP.	0	16	0	6	0	2	1	3	0	0	0	0	0	0

α - White-fronted and Canada geese and dark geese spp. were combined in Figures 4 and 5 and classified as White-fronted and/or Canada geese. The only other species in western Canada is the Brant *(Branta nigricans)*, which does not occur in Alberta.

APPENDIX 7. Technical Details of Multiple Discriminant Analysis of Habitat Preferences of Different Species.

The SMDA procedure finds the coefficients for a series of uncorrelated discriminant functions. When a large number of species or groups of species are being compared, as was the case in this study, there are as many discriminant functions as there are significant predictor variables. These functions can be used to predict the probability that a given species will occur at a location with specific habitat characteristics. Each function includes a specific weighting upon each of the predictor parameters accepted as significant. Each function is of the form

$$\text{Discriminant Score} = B_1X_1' + B_2X_2' + \ldots + B_nX_n'$$

where B_i is the weighting factor applied to variable X_i'*.

It is possible to determine the number of discriminant functions that are of significant value in predicting from a set of habitat characteristics the probability that each species will occur (Cooley and Lohnes 1971:249).

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* As used here, the variables X_i' are expressed relative to their means i.e. $X_i' = X_i - \bar{X}_i$ where $\bar{X}_i$ is the mean value of X_i over all cases.

APPENDIX 7 (cont'd)

A. SMDA Model for Analysis of Sightings in July and August

Based on $P \leq 0.01$ criteria for accepting predictor variables and discriminant functions as significant, seven of the nine predictors and three of the resultant functions were significant.

The following Table presents:

a) the coefficients B_i (see above) for each of these seven variables and three functions,

b) the mean value of each discriminant function for each species and species group, and

c) three types of statistics that summarize the relative utility of each function for purposes of discrimination (*viz.*, the eigenvalues; the proportion of the dispersion accounted for by all seven functions that was accounted for by the first, the first two, and the first three functions; and the canonical correlation coefficient between each function and the species).

APPENDIX 7 (cont'd)

Summary of the SMDA Model of the Distribution of 26 Species and Species Groups During July and August Relative to Nine Predictor Variables.

	FUNCTION 1	FUNCTION 2	FUNCTION 3
Eigenvalues	0.436	0.273	0.119
Cumulative proportion of total dispersion	0.434	0.706	0.825
Canonical correlations	0.551	0.463	0.326

Coefficients for discriminant functions:

ORIGINAL VARIABLE	FUNCTION 1	FUNCTION 2	FUNCTION 3
Distance from shore	-0.060	0.005	-0.003***
Coniferous trees (-) or not (+)	-0.261	-0.315	-0.092***
Emergents (+) or not (-)	-0.048	-0.242	-0.809***
Deciduous trees (-) or not (+)	-0.035	0.136	0.595**
Factor 6 (see text)	0.049	0.933	-0.097***
Marsh and islands (+) or not (-)	-0.150	-0.299	0.324***
Rushes and water lilies (-) or not (+)	0.018	0.425	-0.269***

Mean values of discriminant functions for each species/group:

SPECIES/GROUP	FUNCTION 1	FUNCTION 2	FUNCTION 3
Common loon	-2.422	0.928	-0.255
Red-necked grebe	-1.074	0.527	-0.124
Mallard	-0.035	-0.697	-0.100
Pintail	-0.987	-0.068	0.239
American wigeon	-0.266	-0.270	-0.200
Ring-necked duck	-0.216	0.033	-0.184
Scaup spp.	-1.026	0.578	-0.016
Aythya spp.	-0.860	0.913	-0.797
Goldeneye spp.	-0.906	0.176	0.438
Bufflehead	-0.434	0.048	0.487
Diving duck spp.	-0.183	0.218	0.210
Unidentified duck spp.	-0.243	-0.482	0.010
Sora	0.444	-0.445	-0.649
Greater yellowlegs	0.088	0.105	0.917
Lesser yellowlegs	0.039	-0.876	0.360
Pectoral sandpiper	-0.618	-0.990	0.329
'Peep' sandpiper spp.	-0.497	-0.842	0.320
Bonaparte's gull	0.088	0.401	0.428
Eastern kingbird	0.479	0.574	0.487
Flycatcher spp. (except Eastern kingbird)	1.008	0.468	0.387
Gray jay	1.309	0.861	0.268
Chickadee spp.	0.782	0.418	0.218
Waxwing spp.	0.500	0.352	0.186
Red-winged blackbird	0.582	0.093	-0.335
Common grackle	0.555	0.632	0.027
LeConte's, Lincoln's, Swamp sparrows	0.728	0.204	0.531

** $0.01 \geq P > 0.001$

*** $P \leq 0.001$

APPENDIX 7 (cont'd)

B. SMDA Model for Analysis of Sightings in September and October

Based on a $P \leq 0.1$ criterion for accepting predictor variables and discriminant functions as significant, five of the nine predictors and only one of the resultant discriminant functions were significant. (Three variables and one function were significant if a $P < 0.01$ criterion was used.)

The following Table presents the coefficients of the first three functions, the mean values of these functions for each species, and various summary statistics. The second and third functions were not of significant utility as predictors.

APPENDIX 7 (cont'd)

Summary of the SMDA Model of the Distribution of 12 Species and Species Groups During September and October Relative to Nine Predictor Variables.

	FUNCTION 1	FUNCTION 2	FUNCTION 3
Eigenvalues	0.292	0.093	0.043
Cumulative proportion of total dispersion	0.641	0.844	0.939
Canonical correlations	0.476	0.292	0.203

Coefficients for discriminant functions:

ORIGINAL VARIABLE	FUNCTION 1	FUNCTION 2	FUNCTION 3
Distance from shore	0.028	-0.033	0.004***
Factor 1 (see text)	-0.651	-0.408	0.345***
Deciduous trees (-) or not (+)	0.232	0.419	-0.629*
Emergents (+) or not (-)	-0.231	-0.440	-0.322(*)
Rushes and water lilies (+) or not (-)	-0.359	-0.412	-0.730**

Mean values of discriminant functions for each species/group:

SPECIES/GROUP	FUNCTION 1	FUNCTION 2	FUNCTION 3
Red-necked grebe	1.316	-0.623	-0.112
Mallard	-0.504	-0.050	-0.093
Pintail	-0.092	-0.325	0.520
American wigeon	-0.489	0.066	-0.062
Dabbling duck spp.	-0.356	-0.134	0.161
Scaup spp.	0.626	-0.059	0.167
Goldeneye spp.	0.306	-0.647	-0.236
Bufflehead	0.756	0.387	-0.463
Diving duck spp.	0.824	0.200	-0.145
Unidentified duck spp.	-0.219	-0.080	0.281
American coot	0.132	0.465	0.230
Gray jay	-0.048	0.842	-0.079

(*) $0.1 \geq P > 0.05$
* $0.05 \geq P > 0.01$
** $0.01 \geq P > 0.001$
*** $P \leq 0.001$

APPENDIX 8. List of the Common Names, Scientific Names, and Status of All Species of Birds Observed in the Study Area During 1974.

The species names and the order of the list have been taken from the Checklist of the American Ornithologists' Union (1937) and its revision (1973). In addition, the order and family and subfamily of the bird species observed have been indicated.

Asterisks denote species or subspecies considered to be endangered in Canada (Godfrey 1970).

The occurrence and breeding status of each species are abbreviated as:

OCCURRENCE

R--year-round resident

SR--summer resident

M--migrant

?--not known

E--extralimital record

The summer resident category includes all species that occurred regularly in the study area during the summer. Many of these species were also very common autumn migrants.

APPENDIX 8 (cont'd)

BREEDING STATUS

*** Known to breed from observations of nests or young,

** suspected to breed from our observations, but nests or young were not seen,

* known breeding range includes the study area according to Godfrey (1966), but evidence of breeding was not observed in 1974,

- not known or suspected to breed, known breeding range does not include the study area, according to Godfrey (1966).

COMMON NAME	SCIENTIFIC NAME	OCCURRENCE	BREEDING STATUS
Order GAVIIFORMES (Loons)			
Family GAVIIDAE			
Common loon	*Gavia immer*	SR	***
Order PODICIPEDIFORMES (Grebes)			
Family PODICIPEDIDAE			
Red-necked grebe	*Podiceps grisegena*	SR	***
Horned grebe	*Podiceps auritus*	SR	***
Eared grebe	*Podiceps nigricollis*	?E	-
Pied-billed grebe	*Podilymbus podiceps*	SR	***
Order CICONIIFORMES (Herons, Bitterns)			
Family ARDEIDAE			
Great blue heron	*Ardea herodias*	?E	-
American bittern	*Botaurus lentiginosus*	?	*
Order ANSERIFORMES (Swans, Geese, Ducks)			
Family ANATIDAE			
Subfamily CYGNINAE (Swans)			
Whistling swan	*Olor columbianus*	M	-
Subfamily ANSERINAE (Geese)			
Canada goose	*Branta canadensis*	SR?	*
White-fronted goose	*Anser albifrons*	M	-
Snow goose	*Chen caerulescens*	M	-
Ross' goose	*Chen rossii*	M	-
Subfamily ANATINAE (Dabbling ducks)			
Mallard	*Anas platyrhynchos*	SR	***
Gadwall	*Anas strepera*	SR?E	-
Pintail	*Anas acuta*	SR	*
Green-winged teal	*Anas crecca*	SR	***
Blue-winged teal	*Anas discors*	SR	*
American wigeon	*Anas americana*	SR	***
Northern shoveler	*Anas clypeata*	SR	*
Subfamily AYTHYINAE (Diving ducks)			
Redhead	*Aythya americana*	SR	***
Ring-necked duck	*Aythya collaris*	SR	***
Canvasback	*Aythya valisineria*	SR?	*
Greater scaup	*Aythya marila*	M	-
Lesser scaup	*Aythya affinis*	SR	***
Common goldeneye	*Bucephala clangula*	SR	***
Bufflehead	*Bucephala albeola*	SR	***
Oldsquaw	*Clangula hyemalis*	M	-
White-winged scoter	*Melanitta deglandi*	?	*
Surf scoter	*Melanitta perspicillata*	?	*
Subfamily OXYURINAE (Ruddy and Masked ducks)			
Ruddy duck	*Oxyura jamaicensis*	SR	***
Subfamily MERGINAE (Mergansers)			
Common merganser	*Mergus merganser*	SR?	*
Red-breasted merganser	*Mergus serrator*	?	*

APPENDIX 8 (cont'd)

COMMON NAME	SCIENTIFIC NAME	OCCURRENCE	BREEDING STATUS
Order FALCONIFORMES (Hawks, Eagles)			
Family ACCIPITRIDAE (Accipiters, Buteos, Eagles, Harriers)			
Goshawk	*Accipiter gentilis*	R	*
Sharp-shinned hawk	*Accipiter striatus*	SR	*
Red-tailed hawk	*Buteo jamaicensis*	SR	*
Broad-winged hawk	*Buteo platypterus*	SR E	**
Rough-legged hawk	*Buteo lagopus*	M	-
Golden eagle	*Aquila chrysaetos*	?	*
Bald eagle*	*Haliaeetus leucocephalus*	SR	*
Marsh hawk	*Circus cyaneus*	SR	**
Family PANDIONIDAE (Ospreys)			
Osprey*	*Pandion haliaetus*	SR?	*
Family FALCONIDAE (Falcons)			
Merlin	*Falco columbarius*	SR	**
American kestrel	*Falco sparverius*	SR	***
Order GALLIFORMES (Grouse, Quail, Pheasants)			
Family TETRAONIDAE (Grouse)			
Spruce grouse	*Canachites canadensis*	R	***
Ruffed grouse	*Bonasa umbellus*	R	***
(Willow or Rock) ptarmigan	*Lagopus* sp.	M	-
Order GRUIFORMES (Cranes, Rails, Coots)			
Family GRUIDAE (Cranes)			
Whooping crane*	*Grus americana*	M	-
Sandhill crane	*Grus canadensis*	SR	***
Family RALLIDAE (Rails, Coots)			
Sora	*Porzana carolina*	SR	***
American coot	*Fulica americana*	SR?	*
Order CHARADRIIFORMES (Shorebirds, Gulls, Terns)			
Family CHARADRIIDAE (Plovers)			
Semipalmated plover	*Charadrius semipalmatus*	M	-
Killdeer	*Charadrius vociferus*	SR	***
American golden plover	*Pluvialis dominica*	M	-
Black-bellied plover	*Pluvialis squatarola*	M	-
Family SCOLOPACIDAE (Snipe, Sandpipers, Yellowlegs, Dowitchers, Sanderling)			
Common snipe	*Capella gallinago*	SR	**
Upland sandpiper	*Bartramia longicauda*	?	*
Spotted sandpiper	*Actitis macularia*	SR	***
Solitary sandpiper	*Tringa solitaria*	SR	**
Greater yellowlegs	*Tringa melanoleuca*	SR	**
Lesser yellowlegs	*Tringa flavipes*	SR	**
Pectoral sandpiper	*Calidris melanotos*	M	-
Baird's sandpiper	*Calidris bairdii*	M	-
Least sandpiper	*Calidris minutilla*	M	-
Semipalmated sandpiper	*Calidris pusilla*	M	-
Sanderling	*Calidris alba*	M	-
Short-billed dowitcher	*Limnodromus griseus*	SR?	*
Long-billed dowitcher	*Limnodromus scolopaceus*	M	-
Stilt sandpiper	*Micropalama himantopus*	M	-
Buff-breasted sandpiper	*Tryngites subruficollis*	M	-

APPENDIX 8 (cont'd)

COMMON NAME	SCIENTIFIC NAME	OCCURRENCE	BREEDING STATUS
Family PHALAROPODIDAE (Phalaropes)			
Wilson's phalarope	*Steganopus tricolor*	?E	-
Northern phalarope	*Lobipes lobatus*	M	-
Family LARIDAE (Gulls, Terns)			
Glaucous gull	*Larus hyperboreus*	M	-[1]
Herring gull	*Larus argentatus*	SR	-
California gull	*Larus californicus*	SR	*
Ring-billed gull	*Larus delawarensis*	SR	*
Bonaparte's gull	*Larus philadelphia*	SR	***
Common tern	*Sterna hirundo*	?	*
Black tern	*Chlidonias niger*	SR	***
Order STRIGIFORMES (Owls)			
Family STRIGIDAE			
Great horned owl	*Bubo virginianus*	R	*
Snowy owl	*Nyctea scandiaca*	M	-
Hawk owl	*Surnia ulula*	?	-
Short-eared owl	*Asio flammeus*	SR?	*
Order CAPRIMULGIFORMES (Goatsuckers, Nighthawks)			
Family CAPRIMULGIDAE			
Common nighthawk	*Chordeiles minor*	SR	***
Order CORACIIFORMES (Kingfishers)			
Family ALCEDINIDAE			
Belted kingfisher	*Megaceryle alcyon*	SR	***
Order PICIFORMES (Woodpeckers)			
Family PICIDAE			
Common flicker	*Colaptes auratus*	SR	***
Pileated woodpecker	*Dryocopus pileatus*	R	***
Yellow-bellied sapsucker	*Sphyrapicus varius*	SR	***
Hairy woodpecker	*Dendrocopos villosus*	R	*
Downy woodpecker	*Dendrocopos pubescens*	R	*
Black-backed three-toed woodpecker	*Picoides arcticus*	R	*
Northern three-toed woodpecker	*Picoides tridactylus*	R	***
Order PASSERIFORMES (Perching birds, Passerines)			
Family TYRANNIDAE (Flycatchers)			
Eastern kingbird	*Tyrannus tyrannus*	SR	***
Eastern phoebe	*Sayornis phoebe*	SR	**
Alder flycatcher	*Empidonax alnorum*	SR	*
Least flycatcher	*Empidonax minimus*	SR	*
Western wood pewee	*Contopus sordidulus*	SR	*
Olive-sided flycatcher	*Nuttalornis borealis*	SR	*
Family ALAUDIDAE (Larks)			
Horned lark	*Eremophila alpestris*	M	-
Family HIRUNDINIDAE (Swallows)			
Tree swallow	*Iridoprocne bicolor*	SR	***
Bank swallow	*Riparia riparia*	SR	*
Barn swallow	*Hirundo rustica*	SR	***
Cliff swallow	*Petrochelidon pyrrhonota*	SR	***

APPENDIX 8 (cont'd)

COMMON NAME	SCIENTIFIC NAME	OCCURRENCE	BREEDING STATUS
Family CORVIDAE (Crows, Jays)			
Gray jay	*Perisoreus canadensis*	R	***
Blue jay	*Cyanocitta cristata*	R	*
Black-billed magpie	*Pica pica*	R	***
Common raven	*Corvus corax*	R	*
Common crow	*Corvus brachyrhynchos*	SR	*
Family PARIDAE (Chickadees, Titmice)			
Black-capped chickadee	*Parus atricapillus*	R	*
Boreal chickadee	*Parus hudsonicus*	R	**
Family SITTIDAE (Nuthatches)			
Red-breasted nuthatch	*Sitta canadensis*	R	*
Family TURDIDAE (Thrushes)			
American robin	*Turdus migratorius*	SR	**
Hermit thrush	*Catharus guttatus*	SR	*
Swainson's thrush	*Catharus ustulatus*	SR	**
Family SYLVIIDAE (Old world warblers, Kinglets)			
Ruby-crowned kinglet	*Regulus calendula*	SR	*
Family MOTACILLIDAE (Pipits and Wagtails)			
Water pipit	*Anthus spinoletta*	M	-
Family BOMBYCILLIDAE (Waxwings)			
Cedar waxwing	*Bombycilla cedrorum*	SR	*
Family VIREONIDAE (Vireos)			
Red-eyed vireo	*Vireo olivaceus*	SR	*
Warbling vireo	*Vireo gilvus*	SR	***
Family PARULIDAE (Wood warblers)			
Black-and-white warbler	*Mniotilta varia*	SR	*
Tennessee warbler	*Vermivora peregrina*	SR	***
Orange-crowned warbler	*Vermivora celata*	SR	*
Yellow warbler	*Dendroica petechia*	SR	*
Magnolia warbler	*Dendroica magnolia*	SR	*
Yellow-rumped warbler	*Dendroica coronata*	SR	*
Chestnut-sided warbler	*Dendroica pensylvanica*	?E	-
Bay-breasted warbler	*Dendroica castanea*	SR	*
Palm warbler	*Dendroica palmarum*	?	*
Ovenbird	*Seiurus aurocapillus*	SR	*
Northern waterthrush	*Seiurus noveboracensis*	SR	*
Mourning warbler	*Oporornis philadelphia*	SR	**
Common yellowthroat	*Geothlypis trichas*	SR	*
Wilson's warbler	*Wilsonia pusilla*	SR	***
Canada warbler	*Wilsonia canadensis*	SR	**
American redstart	*Setophaga ruticilla*	SR	*
Family PLOCEIDAE (Weaver finches)			
House sparrow	*Passer domesticus*	R?	*
Family ICTERIDAE (Blackbirds, Orioles)			
Yellow-headed blackbird	*Xanthocephalus xanthocephalus*	SR?	*
Red-winged blackbird	*Agelaius phoeniceus*	SR	***
Rusty blackbird	*Euphagus carolinus*	SR	*
Brewer's blackbird	*Euphagus cyanocephalus*	SR?	*
Common grackle	*Quiscalus quiscula*	SR	***
Brown-headed cowbird	*Molothrus ater*	SR?	*

APPENDIX 8 (cont'd)

COMMON NAME	SCIENTIFIC NAME	OCCURRENCE	BREEDING STATUS
Family THRAUPIDAE (Tanagers)			
Western tanager	*Piranga ludoviciana*	SR	**
Family FRINGILLIDAE (Grosbeaks, Finches, Sparrows, Buntings, and Allies)			
Rose-breasted grosbeak	*Pheucticus ludovicianus*	SR?	*
Evening grosbeak	*Hesperiphona vespertina*	R	*
Purple finch	*Carpodacus purpureus*	SR	*
Pine grosbeak	*Pinicola enucleator*	M?	-
Redpoll spp.	*Acanthis* spp.	M	-
Pine siskin	*Spinus pinus*	SR	*
White-winged crossbill	*Loxia leucoptera*	R	*
Savannah sparrow	*Passerculus sandwichensis*	SR	**
LeConte's sparrow	*Ammospiza leconteii*	SR	**
Vesper sparrow	*Pooecetes gramineus*	SR	*
Dark-eyed junco	*Junco hyemalis*	SR	***
Tree sparrow	*Spizella arborea*	M	-
Chipping sparrow	*Spizella passerina*	SR	***
Clay-colored sparrow	*Spizella pallida*	SR	*
White-crowned sparrow	*Zonotrichia leucophrys*	SR?	*
White-throated sparrow	*Zonotrichia albicollis*	SR	***
Fox sparrow	*Passerella iliaca*	SR?	*
Lincoln's sparrow	*Melospiza lincolnii*	SR	**
Swamp sparrow	*Melospiza georgiana*	SR	**
Song sparrow	*Melospiza melodia*	SR	*
Lapland longspur	*Calcarius lapponicus*	M	-
Snow bunting	*Plectrophenax nivalis*	M	-

[1] edge of known breeding range very close to the study area

APPENDIX 9. Annotated List of Mammals Observed in 1974.

Cinerous shrew *(Sorex cinereus)*

- Two small shews, probably this species, observed at Mildred Lake on October 6.

Water shrew *(Sorex palustris)*

- Observed by H. Bain and P. Whitney (Aquatic Environments Limited, Calgary) September 4.

Bat (probably Hoary bat [*Lasiurus cinereus*])

- Observed at Mildred Lake twice in August.

Varying hare *(Lepus americanus)*

- Sign observed on a few occasions in the study area. Hares did not appear to be common during 1974.

Least chipmunk *(Eutamias minimus)*

- Common in wooded and brushy areas.

Woodchuck *(Marmota monax)*

- Several seen along highway from Fort McMurray to Syncrude Lower Camp. Breeding under buildings at Lower Camp.

Red squirrel *(Tamiasciurus hudsonicus)*

- Common in coniferous and mixed forest throughout the study area.

Northern flying squirrel *(Glaucomys sabrinus)*

- Observed several times at Mildred Lake.

Beaver *(Castor canadensis)*

- Common throughout the study area. Active lodges were present at all the lakes in and near the study area.

White-footed mouse *(Peromyscus maniculatus)*

- Commonly seen at Mildred Lake.

Red-backed vole *(Clethrionomys gapperi)*

- Commonly seen at Mildred Lake.

Meadow vole *(Microtus pennsylvanicus)*

- Abundant in grassy areas.

Muskrat *(Ondatra zibethicus)*

- Common on water bodies surveyed. Many houses were seen in late October on all the lakes surveyed.

Hudson Bay jumping mouse *(Zapus hudsonius)*

- Observed once in mid-August at Mildred Lake.

Coyote *(Canis latrans)*

- Several sightings were made during the study period, tracks were regularly seen at the Syncrude dump, the borrow pits, and along the Athabasca River.

Wolf *(Canis lupus)*

- Fairly common, tracks were seen regularly, and several sightings were made along or near the Athabasca River.

Red fox *(Vulpes fulva)*

- One set of tracks was seen along the Athabasca River.

Black bear *(Ursus americanus)*

- Very common in the study area.

Short-tailed weasel *(Mustela rixosa)*

- Seen regularly at Mildred Lake.

Mink *(Mustela vison)*

- Observed at Ruth Lake October 24. Tracks seen along the Athabasca River September 19.

White-tailed *(Odocoileus virginianus)* and mule deer *(Odocoileus hemoinus)*

- A few sets of tracks were observed at the borrow pits. Local residents informed us that there were a few white-tailed and mule deer in the area.

Moose *(Alces alces)*

- Fairly common in the area. Several sightings were made, and tracks were locally abundant in some areas.

APPENDIX 10. Annotated List of Rare and Endangered Species Observed On or Near the Study Area in 1974.

A number of observations were made of species of birds that are considered to be rare and endangered (Godrey 1970) in Canada.

Bald eagle

- Adult bald eagles were observed twice during mid-summer near Fort McMurray, and were possibly breeding residents. Migrating bald eagles were fairly common in autumn.

Osprey

- One osprey was observed by H. Bain and M. Jones (Aquatic Environments Limited, Calgary) along the Athabasca River near the Great Canadian Oil Sands Plant on September 1.

Whooping crane

- During autumn 1974, one definite and one possible sighting were made of whooping cranes at or near Ruth Lake.

Greater sandhill crane

- The sandhill cranes which nested on the Syncrude construction site may belong to this subspecies *(Grus canadensis tabida)* (see page 114).

APPENDIX 11. Glossary of Terms Used in This Report. (See Appendix 1 for glossary of terms describing vegetation.)

Aythya spp.

- Ducks of the genus *Aythya*--includes canvasback, ring-necked duck, redhead, and greater and lesser scaup. Ring-necked duck and redhead females were difficult to separate in the field, especially under bad light and choppy water conditions.

Borrow pit

- Areas where road-building crews have dug out sand or gravel for road bases. In the Fort McMurray areas, many of these dug-outs have filled with water.

Breeding season

- For most species of birds, the spring and summer (July and August in this report). Includes courtship, nesting, raising young, and defense of territory (in some species).

Bucephala spp.

- Ducks of the genus *Bucephala*; either goldeneyes or buffleheads. This was applied to a few observations of broods of ducklings that were not accompanied by females.

Creche

- Several combined broods of (generally) ducks. Commonly seen in some diving ducks.

Dabbling duck

- Those ducks that feed on the water's surface or "tip up" while feeding. They are common in shallows, ponds, and marshes. Includes mallard, teal spp., pintail, American wigeon, gadwall, and northern shoveler.

Decoying adult (distraction displays)

- Any adult bird whose behaviour indicates that there may be a nest or young nearby. In this situation, birds will attempt to lure or drive potential predators (people) away, or the birds will remain agitated, giving alarm calls as long as the potential predator is nearby. All of these activities can be described as distraction displays.

Diving duck

- Those ducks that dive regularly for their food, and generally require a short run across the water before becoming airborne (their legs are further back on their bodies than dabbling ducks). Includes canvasback, ring-necked duck, redhead, scaup spp., goldeneye spp., bufflehead, and scoter spp.

Duck brood

- A group of ducklings that were hatched from one nest.

Eigenvalue

- From matrix algebra, a latent root of a matrix.

Empidonax spp.

- Members of the genus *Empidonax*; small flycatchers including the least, dusky, Hammond's, alder, willow, western, and yellow-bellied flycatchers. These species are very similar in appearance and size. Most species can be only identified by song, rather than appearance.

Larid

- Members of the Family Laridae--gulls and terns.

Migration season

- For most migrant bird species, the spring and fall (September to November in this report). In waterfowl, there are also migrations in summer to areas traditionally used for moulting.

Moult

- The process of feather loss and replacement in birds (also fur in mammals). In waterfowl, all of the flight feathers are lost at once and the birds undergo a flightless period while the new feathers are developing. In most other species, the flight feathers are lost one at a time, and these species do not lose their powers of flight.

Passerines

- Those birds belonging to the Order Passeriformes, the perching birds. Includes all songbirds, crows, jays, swallows, flycatchers, thrushes, blackbirds, sparrows, finches, chickadees, warblers, vireos.

'Peep' sandpipers

- The smallest shorebirds. In the study area, includes five species: the least, Baird's, semipalmated, western, and white-rumped sandpipers.

Phenology

- Study of the timing of naturally recurring phenomena, such as breeding, migration, etc. in birds.

Rail

- A small marsh-dwelling bird of the Order Gruiformes, Family Rallidae, including the sora, yellow rail, virginia rail, and clapper rail.

Raptors

- Birds of prey. Includes hawks, falcons, eagles, ospreys, and owls.

Shorebird

- Suborder Charadrii, part of the Order Charadriiformes. Waders that generally feed on invertebrates in or near water. Some probe the mud, others pick insects, etc. off the surface. Includes killdeer, snipe, plovers, sandpipers, dowitchers, phalaropes, curlews, godwits, and yellowlegs.

Staging area

- Areas traditionally used as stop-over habitat during migration by large numbers of waterfowl and other waterbirds.

Subadult

- In species that have slow development, young birds that have not yet attained full adult plumage (two to three years old). This term is not generally applied to species which reach full maturity within one year.

Tailings pond

- A pond in which wastes (tailings) from industrial extraction processes are deposited, usually to allow solid wastes to settle out, rather than being introduced into local watersheds.

Tundra-nesting passerines

- In this report, includes several species of passerines which nest on the arctic or alpine tundra of the Yukon and Alaska and further south. Includes Lapland longspurs, Smith's longspurs, water pipits, horned larks, and snow buntings.

Waterbirds

- In this report, loons, grebes, swans, geese, ducks, cranes, rails, coots, shorebirds, gulls, terns, herons, and bitterns.

Waterfowl

- In this report, includes ducks, geese, and swans (Family Anatidae). These species undergo a complete moult of the wing feathers during summer and become temporarily flightless.

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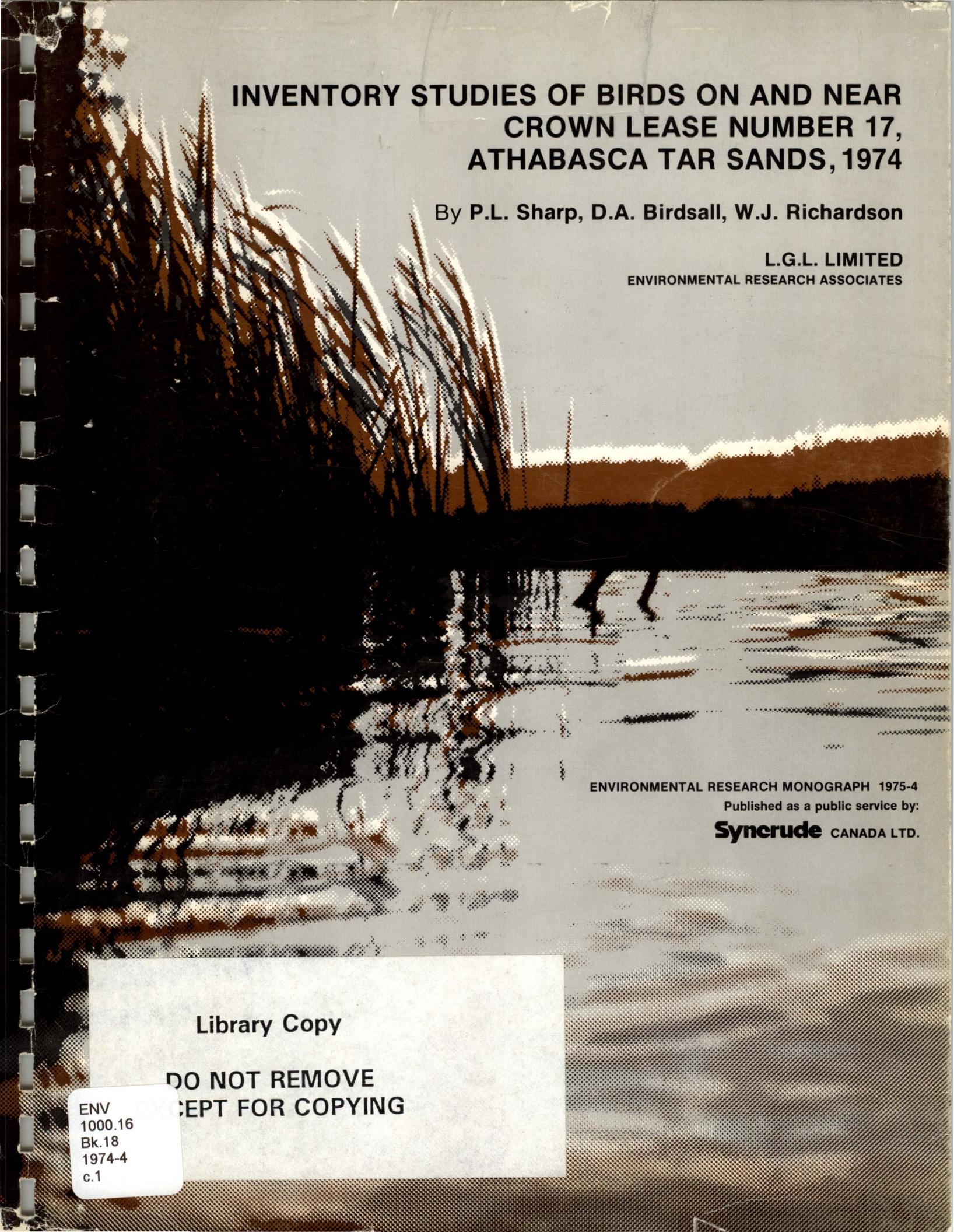
Plate 1
Horseshoe Lake is shallow, and supports abundant growths of submerged, floating, and emergent vegetation

Plate 2
This view of the extensive sedge marsh at the southeast end of Ruth Lake includes a red-necked grebe nest in the foreground

Plate 3
Flooded areas on substrates of peat and slash were formed as a result of clearing and water diversion on the construction site

Plate 4
Migrating pintails were fairly common on the study area during late summer



INVENTORY STUDIES OF BIRDS ON AND NEAR CROWN LEASE NUMBER 17, ATHABASCA TAR SANDS, 1974

By **P.L. Sharp, D.A. Birdsall, W.J. Richardson**

L.G.L. LIMITED
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Plate 5
Pectoral sandpipers, migrating southward from their Arctic breeding grounds in July and August, were abundant on the Syncrude Site Water Areas

Plate 6
This photo of an adult and immature whooping crane was taken at their wintering grounds near Aransas, Texas. Two whooping cranes, also an adult and immature, were observed on October 8, 1974 at Ruth Lake

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