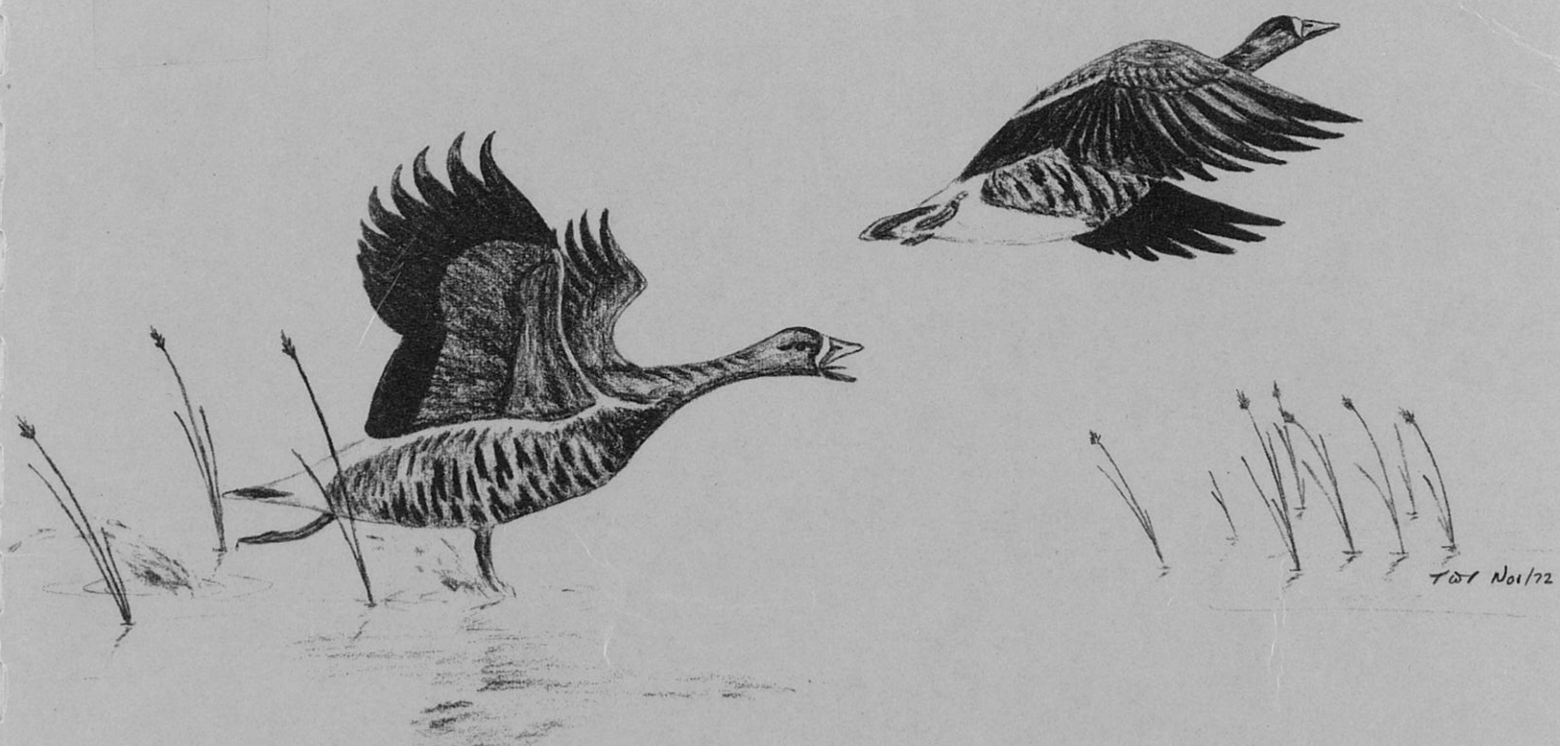

AVIAN DISTURBANCE STUDIES IN THE MACKENZIE DELTA REGION

RENEWABLE RESOURCES CONSULTING SERVICES LTD

NOVEMBER, 1972

Renewable Resources Consulting Services Ltd.
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December 7, 1972.

Mr. D.C. Surrendi,
Canadian Wildlife Service,
5th Floor,
10015 - 103 Ave.,
EDMONTON, Alberta.

Dear Mr. Surrendi:

We are pleased to enclose our report on the Avian Disturbance Study conducted this past summer.

As you are aware, we encountered several problems in replicating observations as a result of low bird populations and the fact that the study was dependent on the activities of the seismic operation. While these problems existed, there was considerable value in the approach taken. The circumstances more closely reflect a normal sequence in northern industrial operations and provide insights into the significance of operations in non-critical or low density habitats. As such, the study is likely more representative of the majority of operations and ecological circumstances in the north.

However, many questions remain and we have discussed these in the report. Your request for a discussion of the ALUR report on summer seismic operations has been carried out and is presented in Appendix I.

I would be pleased to discuss the report with you once you have had an opportunity to review it.

Sincerely yours,

RENEWABLE RESOURCES
CONSULTING SERVICES LTD.

R.D. Jakimchuk,
President.

Encl.
RDJ/cm.

ABSTRACT

In the summer of 1972 a survey was carried out in the Parsons Lake area N.W.T. to determine what impacts summer seismic operations have on waterfowl. The survey was conducted on four major activities, ground seismic work, water seismic work, helicopter and fixed-wing aircraft disturbance. The survey commenced on August 2 and was concluded on September 15, and therefore did not include the early part of the reproductive cycle which is the time when disturbances could be most critical to waterfowl.

No observable detrimental effects as a result of human activity were displayed by any waterfowl with the possible exception of the non-breeding adult white-fronted geese.

As the Parsons Lake area was one of low waterfowl numbers, and because only the latter part of the reproductive cycle was studied, further studies are necessary before any definite conclusions as to the total effect of summer seismic work on waterfowl can be drawn.

ACKNOWLEDGEMENTS

We wish to thank the following people who assisted in the carrying out of this study:

Canadian Wildlife Service

Gulf Oil Canada Ltd.

Department of Indian Affairs and Northern Development

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Globe Universal Sciences

LGL Ltd.

Inuvik Research Laboratory

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INTRODUCTION

Recent concern over the ecological impacts of summer seismic activity in Arctic regions has resulted in the development of new techniques for this work. During the summer of 1971, Gulf Oil Canada Ltd. obtained permission to experimentally perform summer seismic work on the tundra. During these operations, which were carried out in the Jimmy Lake area, research was conducted on terrain disturbance (Kerfoot, 1971). Based on the results of this research, permission was granted to continue summer seismic operations in the Parsons Lake area during 1972.

Coincident with the 1972 summer seismic project, a study on avian disturbance was initiated to assess the effects of operations on the bird population in the area. The study was jointly financed by Gulf Oil Canada Ltd., the Canadian Wildlife Service and the Department of Indian Affairs and Northern Development.

OBJECTIVES

The following were the principal objectives of the study:

1.) To assess the nature and intensity of responses by selected species of waterfowl to various types of aircraft during their brooding, molting and staging periods.

2.) To assess the cumulative effects of aircraft disturbance and attempt to establish threshold levels for waterfowl.

3.) To assess disturbance by all terrain vehicles on waterfowl behavior and distribution.

4.) To assess the impact of barge and boat traffic on waterfowl populations of Parsons Lake.

DESCRIPTION OF STUDY AREA

The base camp (Globe Camp 3) was located on the Caribou Hills at the edge of the Mackenzie Delta (68°56'N, 134°35'W) 22 miles north-west of Reindeer Depot. A satellite camp was located 22 miles to the east of the base camp on the shore of Parsons Lake (68°57'N, 133°42'W). The seismic activities were located largely on a broad ridge extending in a south-westerly direction from Parsons Lake toward the delta (Figure 1).

This area varied from 150 feet above sea level at Parsons Lake to 850 feet above sea level on top of the ridge. The areas immediately to the west and south-east of Parsons Lake, on which the helicopter disturbance survey was conducted, were of a considerably flatter topography. The local relief varied a maximum of 100 feet in this region.

The entire study area is Arctic tundra. Lakes and ponds were numerous throughout the area, but decidedly less so on the ridge on which the seismic activity was concentrated. On either side of the ridge, lakes and ponds also tended to provide more gradual shorelines with accompanying marshy area and mud flats, conditions which were more attractive to waterfowl than water bodies on the ridge.

The area is approximately 167 miles north of the Arctic Circle and thus receives continuous insolation during the brief summer. By mid June the ice has thawed on most lakes (Mackay,

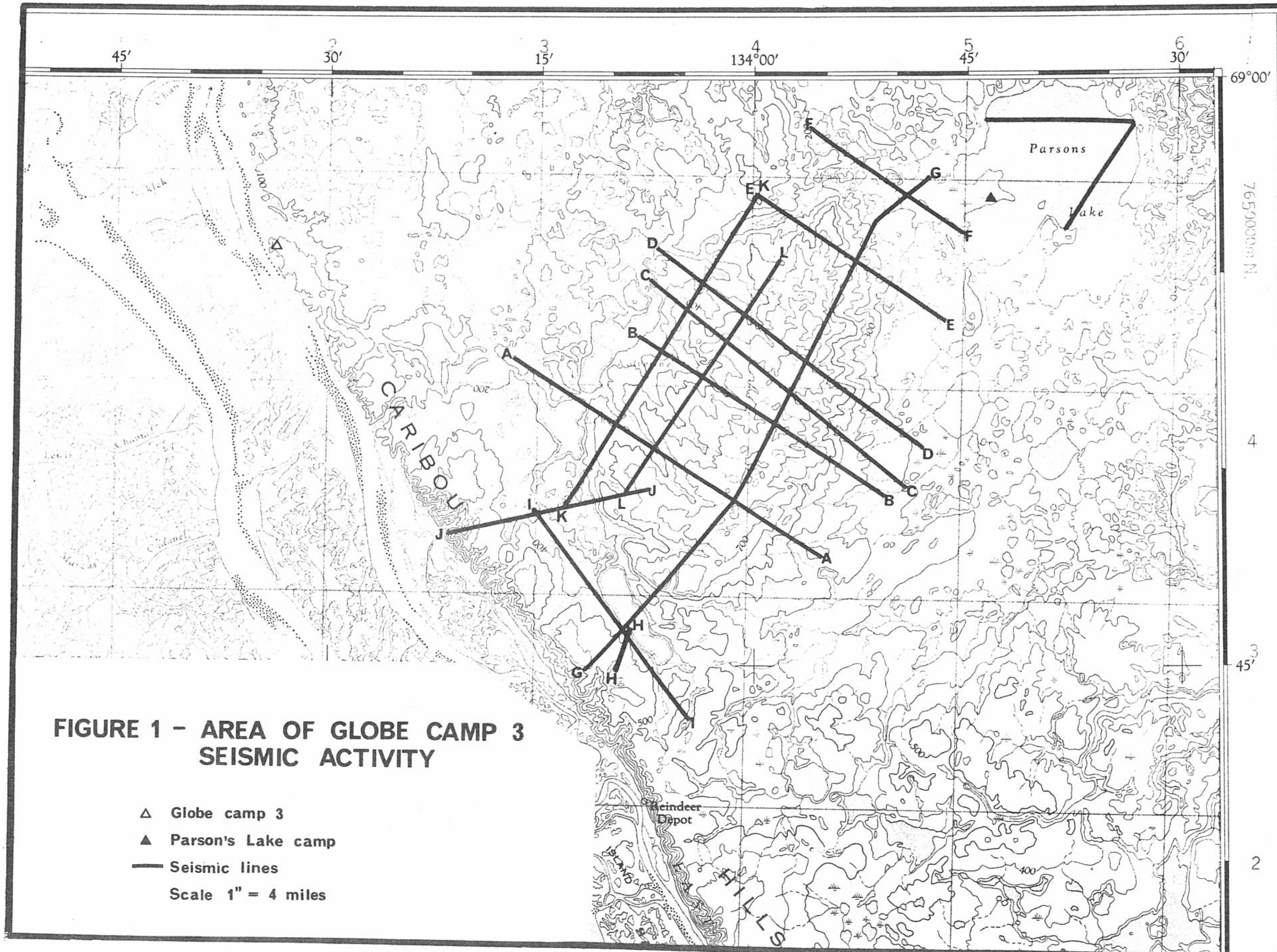


FIGURE 1 - AREA OF GLOBE CAMP 3 SEISMIC ACTIVITY

1963) and by mid September it has started to form again. July and August are the warmest months, but air masses tend to be less stable and fogs are common. Most of the rainfall is during these two months when plant growth is most active (Hernandez, 1972). Table 1 gives precipitation and temperature data for Tununuk Point six miles NNW of Globe Camp 3. Hernandez (1972) gives a description of the cottongrass-sedge-heath tussock tundra community of Tununuk Point. This plant community was predominant in the study area.

TABLE 1: Annual Precipitation and Temperature Data * For Tununuk Point (69°01'N,134°41'W).

Mean Total Precipitation (cm.)	16.9
Rainfall (cm.)	10.2
Snowfall (cm.)	67.1
Mean Daily Temperature (°C)	-10.1
Mean Daily Maximum (°C)	- 6.5
Mean Daily Minimum (°C)	-13.7
Maximum Recorded Temperature (°C)	27.8
Minimum Recorded Temperature (°C)	-48.3

* Data Adapted from Canada Department of Transport Meteorological Branch, 1967.

METHODS

In an attempt to fulfill the objectives, field efforts were directed into five areas of study:

1.) preliminary aerial survey

2.) ground seismic activities

3.) water seismic activities

4.) helicopter disturbance

5.) fixed-wing aircraft disturbance

All data gathered were recorded in the following manner:

1.) immediate reaction to disturbance

2.) change in behavioral pattern as a result of disturbance

3.) fluctuations in waterfowl numbers

The methods used for this study were designed to allow the data gathered to be subjected to a quantitative as well as qualitative analysis. Unfortunately, owing to low bird populations, the quantity precluded quantitative analysis of results and all conclusions had to be based on descriptive observations.

The initial aerial surveys were conducted on July 21 and 22.

The work on ground and water seismic activities and helicopter disturbance commenced on August 2 and was concluded on August 28. The fixed-wing aircraft disturbance survey commenced August 28 and was terminated on September 15.

Preliminary Aerial Survey:

Before any seismic work commenced, a series of aerial surveys were made over the area proposed for seismic activity and all observable waterfowl were counted. The purpose of these surveys was to determine relative waterfowl distribution and densities. All surveys were conducted with four people, the pilot, two observers and a navigator/timer. The surveys were flown at 100 feet above ground level and approximately 100 miles per hour. One minute intervals were recorded on each transect flight to better determine densities of birds along segments of the transect. All birds in a 1/8 mile strip on either side of the aircraft were recorded. Other forms of wildlife also were recorded when observed. On July 21, the proposed seismic lines totalling 105 miles were flown in a Cessna 185. On this same date, four transects covering 17 miles were flown over Parsons Lake. On July 22, 29 predetermined transects were flown, over the study area at 1/2 mile intervals covering 290 miles. A Dehaviland Beaver was used in the latter survey.

Ground Seismic Activities:

The method established for the ground seismic activities was to locate several experimental and control lakes with comparable populations of waterfowl, both as to numbers and species composition. The experimental lakes would be observed prior to during and following all periods of seismic activity to obtain quantitative data on behavioral patterns. The experimental and control lakes would be subjected to complete census prior to any disturbance and then following each disturbance. This would allow a comparison to determine if the seismic activity had any effects on total waterfowl numbers.

On August 2 and 3, three seismic lines were surveyed on foot to locate experimental lakes with adequate numbers of waterfowl to permit observations during ground seismic activities. Only one suitable lake (68°51'20"N, 134°57'30"W) was located.

On August 4, prior to the passage of the drilling crew, all waterfowl were observed for several hours during which time a complete record was kept of all activities including feeding, loafing, not visible, clumping, distance from shore and on shore. On August 6, these observations were repeated when the drilling crew was active in the area. On August 8, a total waterfowl count was obtained. On August 24, observations were taken on the same lake as the recording crew went by.

On August 3 and 8, a comparable population of waterfowl on a control lake (68°55'15"N, 135°09'56"W) was counted to compare with that on the experimental lake. Lack of time did not permit the observation of the waterfowl on this lake after August 24.

On August 12, waterfowl were observed on a lake (68°55'15"N, 133°45'W) while a ground crew working in conjunction with a Bell (piston) 3B1 helicopter, laid down cables to measure the shock waves of a charge being set off in Parsons Lake. During this time all activities were recorded, including swimming, diving, loafing and distance from shore.

Water Seismic Activity:

On August 5 and 7 about one quarter of the shoreline of Parsons Lake was surveyed on foot in an attempt to find sufficient numbers of waterfowl to provide an adequate sample size for study. On August 7 one of the seismic lines was traversed by boat with the same intent. On August 17 a verbal report on waterfowl densities on a second line was obtained from one of the surveyors. On August 18 a third line was covered by helicopter from 200 feet above the water.

Helicopter Disturbance:

The method for the helicopter disturbance study was to establish experimental and control areas. Each area was to contain a series of lakes, relatively isolated from other lakes to eliminate as much movement of waterfowl to and from the area as possible. Comparable populations of birds which should include the more common breeding species of the region were sought. A waterfowl census would then be conducted on both areas prior to any seismic activity. The two helicopters assigned to the seismic operation, a Bell 3B1 and a Bell 204, were directed to fly over the experimental area in a pattern to include most of the lakes, and to completely avoid the control area. The initial flights were at the 500 foot level.

Two days were devoted to observing the reactions of waterfowl to the helicopter flights. During this time particular attention was placed on the degree and duration of reactions of waterfowl to disturbance. In addition, data on differences of reactions between species and to the two types of helicopters were recorded. Waterfowl census were then conducted on both areas to determine the effect of the helicopter activity on the total numbers of each species.

The foregoing procedure was planned for overflight elevations of 400, 300, 200, 100 and 50 feet in order to determine a threshold level for flights for the two types of helicopters. It would also allow an assessment of the cumulative effects of helicopter flights on the waterfowl.

On August 9 the experimental and control areas were established to the west and south-east respectively of Parsons Lake

(Figures 2 and 3). Following a ground waterfowl census on both areas by August 11, all helicopter flights were directed over the experimental lake.

Observations and counts were obtained for the 500 foot level. However, as a result of a shortage of time before the seismic operation ceased in the area, and misunderstandings in flight procedure, waterfowl observations from the ground were made only through the 200 foot level and then with less than intended time at the 300 and 200 foot levels. Two flights with the 3B1 were made at the 100 foot level with observations of waterfowl response being made from the helicopter.

Fixed-Wing Aircraft Disturbances:

Since the only fixed-wing aircraft available for this portion of the study were based in Inuvik and reports indicated that the Mackenzie Delta was used extensively by waterfowl as a staging area, this phase of the study was conducted on the delta.

Predetermined transects were flown in an effort to locate four lakes of desirable size and shape with suitable waterfowl numbers. A preferred lake was one small enough and of a shape to permit identification and observation of activities of waterfowl from one location. To allow ease of observations, 100 to 200 waterfowl per lake would be required.

After the lakes had been located, the following procedure

FIGURE 2 - EXPERIMENTAL AREA

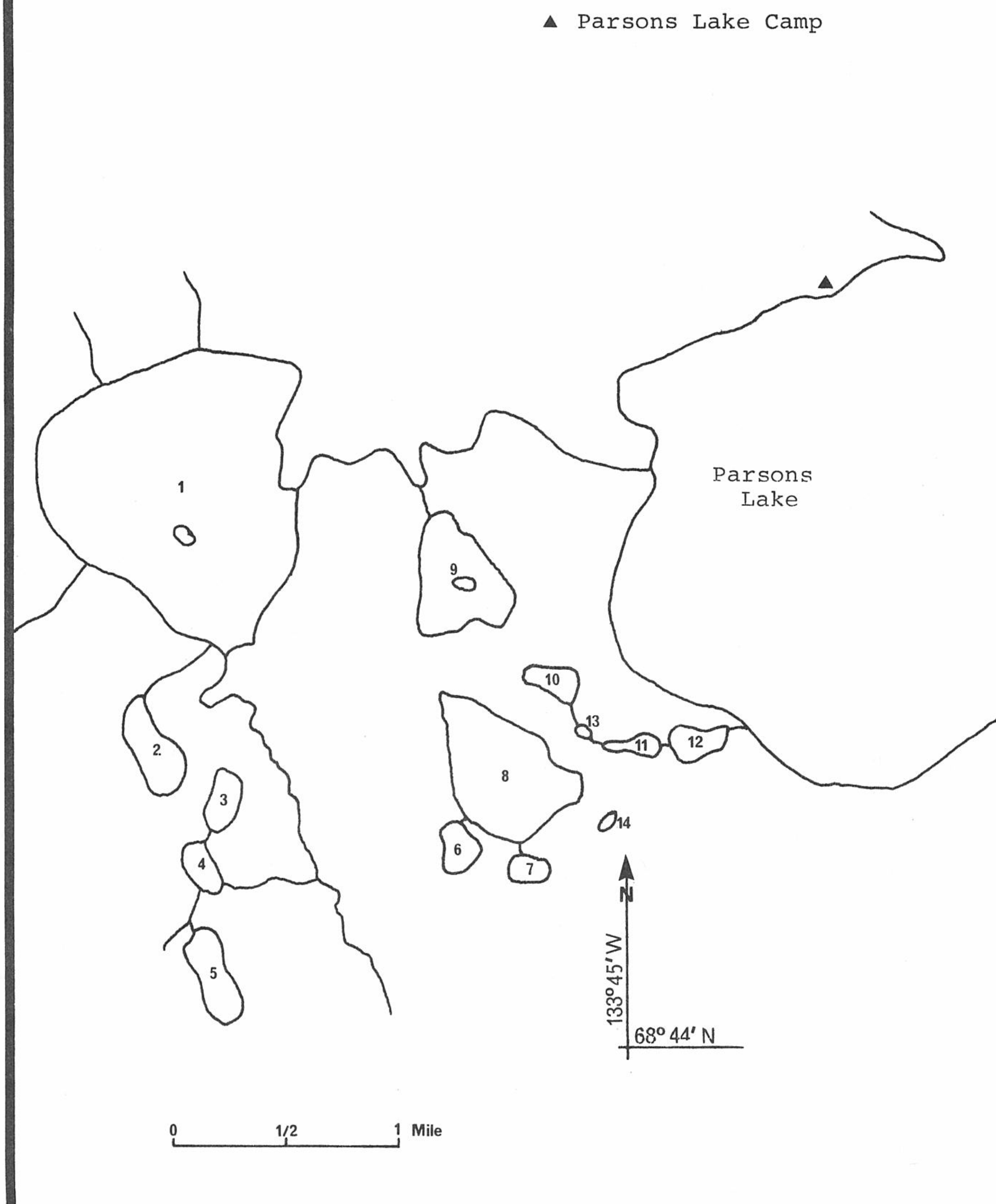
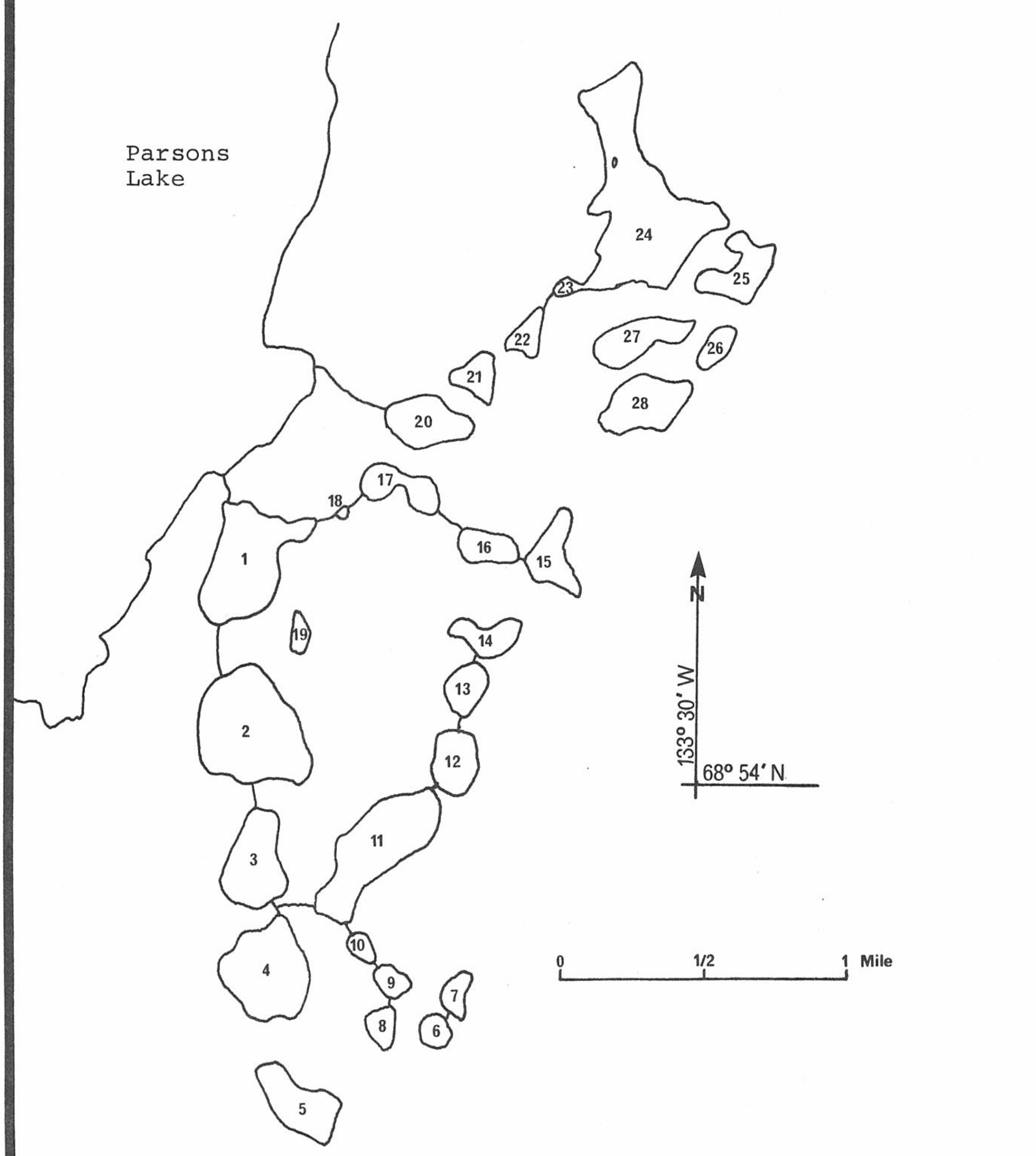


FIGURE 3 - CONTROL AREA



was attempted. A daily activity pattern was to be determined by observing waterfowl activities for a full day, recording at 15 minute intervals the numbers of birds by species which were feeding, loafing or flying.

Each lake was then to be subjected to two flights at 300 feet, on a given day, one each during the peaks of feeding and loafing periods respectively. A different type of aircraft was to be used at each lake, the four types being a Beaver, Cessna 185, a single and a twin engine Otter.

The 300 foot level for the flights was selected on the basis of the reactions of waterfowl to helicopter flights at that level during the earlier portion of the study, and the frequency of routine flights over the delta at the 500 foot level. As with the helicopter disturbance, data was gathered on immediate reactions and changes in behavioral pattern as a result of the flights.

Due to the lateness of the season and resulting transient nature of waterfowl numbers, only the preflight observations and the post-flight observations using a Beaver aircraft were obtained.

RESULTS

Preliminary Aerial Survey:

The number of waterfowl observed on the aerial transects covering the area of seismic activity are shown in Tables 2, 3 and 4. Data indicated that the area contained relatively low waterfowl densities. The density of 1.6 birds per mile of transect strongly indicated that aerial surveys would be inadequate to measure changes in waterfowl numbers with any degree of accuracy. Data would be even less meaningful if the samples were reduced to specific segments representing areas of seismic activity and non-activity.

Ground Seismic Activity:

The experimental lake was approximately 1/2 mile long by 700 yards wide. The active seismic line (Seismic line G - Figure 1) passed within 100 yards of the shoreline, perpendicular to the long axis of the lake.

On August 6, the drilling crew was visibly active at the lake from 1140 until 1720 hours. On August 24, the recording crew was visibly active from 0840 until 1110 hours and again from 1420 until 1740 hours. Only two seismic shots visible from the lake were fired. During the course of this day, the 3Bl helicopter made several flights in the general vicinity.

TABLE 2: Table of Waterfowl Seen on Aerial Survey of Seismic Lines. Total - 101 Miles.

SPECIES	NUMBER
Arctic Loon	5
Red-Throated Loon	5
Unidentified Loon	3
Whistling Swan	19
Mallard	8
American Widgeon	3
Oldsquaw	20
Red-Breasted Merganser	2
Unidentified Waterfowl	15
TOTAL	80

TABLE 3: Table of Waterfowl Seen on Aerial Transects of Parsons Lake. Total - 17 Miles.

SPECIES	NUMBER
Arctic Loon	4
Unidentified Loon	1
Whistling Swan	2
Scaup (Sp.)	25
Red-Breasted Merganser	2
TOTAL	34

TABLE 4: Table of Waterfowl Seen on Aerial Transects of Summer Seismic Area. Total - 290 Miles.

SPECIES	NUMBER
Arctic Loon	21
Red-Throated Loon	8
Unidentified Loon	7
Whistling Swan	41
Canada Goose	6
White-Fronted Goose	125
Mallard	6
American Widgeon	5
Scaup (Sp.)	250
Oldsquaw	39
Scoter (Sp.)	6
TOTAL	514

The total number of waterfowl observed on the experimental lake on August 4, 8 and 24 were 52, 51 and 37 respectively. Comparable data for the control lake for August 3 and 8 were 37 and 50.

Scaup* and oldsquaw were the only waterfowl species present in sufficient numbers on August 4 and 6 to make observations meaningful, while on August 24, the species present were oldsquaw and Arctic loon. A comparison of waterfowl activity data showed no pronounced differences in patterns as a result of the seismic activity.

Observations on August 12, at the lake (68°55'30"N, 133°46'W) were from 1245 to 1315 hours, while six men on the ground in conjunction with the 3Bl helicopter laid cables to record a seismic shot being fired on Parsons Lake. This lake was considerably smaller (300' X 200') than the experimental lake mentioned above. The men were working right on the north shore of the lake, and the 3Bl made a total of eight passes over the lake between 50 and 150 feet above the water, landing within 50 feet of the northeast corner of the lake. These activities had started some time before the arrival of the observer. During this period all the waterfowl (11 adult scaup and 3 adult oldsquaw) continued feeding and diving, even when the helicopter flew directly over them. The birds stayed at the widest part of the lake during this activity

*Appendix VII - SCIENTIFIC NAMES OF BIRDS IN REPORT and moved west to the narrower end of the lake after the seismic crew had left the north shore. Later (1515 to 1545) the same day, the birds were again observed feeding at the narrow end.

Water Seismic Activity:

Insufficient numbers of waterfowl and the large size of Parsons Lake prevented any quantitative evaluation of this phase of seismic activity on waterfowl. The few observations which were made suggested that the effect of this seismic activity on the waterfowl was negligible in that the birds had ample opportunity and space to move away from such activity.

Helicopter Disturbance:

The data obtained relative to helicopter disturbance were of two types; the cumulative effects of continuous flights on waterfowl numbers and the immediate reactions of waterfowl to flights from 500 to 100 feet above ground level.

Table 5 shows the number and altitudes of flights of the two types of helicopters over the experimental area from August 9 to 28. Also shown are the days on which observations and counts were taken. The flights were not always flown in an identical pattern, but as such, probably more nearly simulated normal flight activities associated with seismic operations.

Figures 4 through 11 show the results of waterfowl counts

TABLE 5: Flights over Experimental Area from August 9 to August 28, Showing the Number of Flights for each type of Helicopter with Altitude in Brackets. * Indicates Days on Which counts were Conducted. + Indicates Days on Which Observations were Taken.

	3B1	204
AUGUST 9*	4(500)	-
10	-	-
11*	4(500)	-
12*	4(500)	4(500)
13+	6(500)	6(500)
14+	6(500)	2(500)
15	2(500)	-
16	-	2(500)
17*	6(500)	4(500)
18*	6(500)	-
19+	6(400)	2(400)
20	2(400)	-
21+	5(400)	-
22	4(400)	2(300)
23*	8(400)	-
24*	-	8(300), 4(200)
25+	-	6(300)
26+	-	8(200), 1(300)
27*	3(200), 1(100)	-
28*	3(200), 1(100)	-

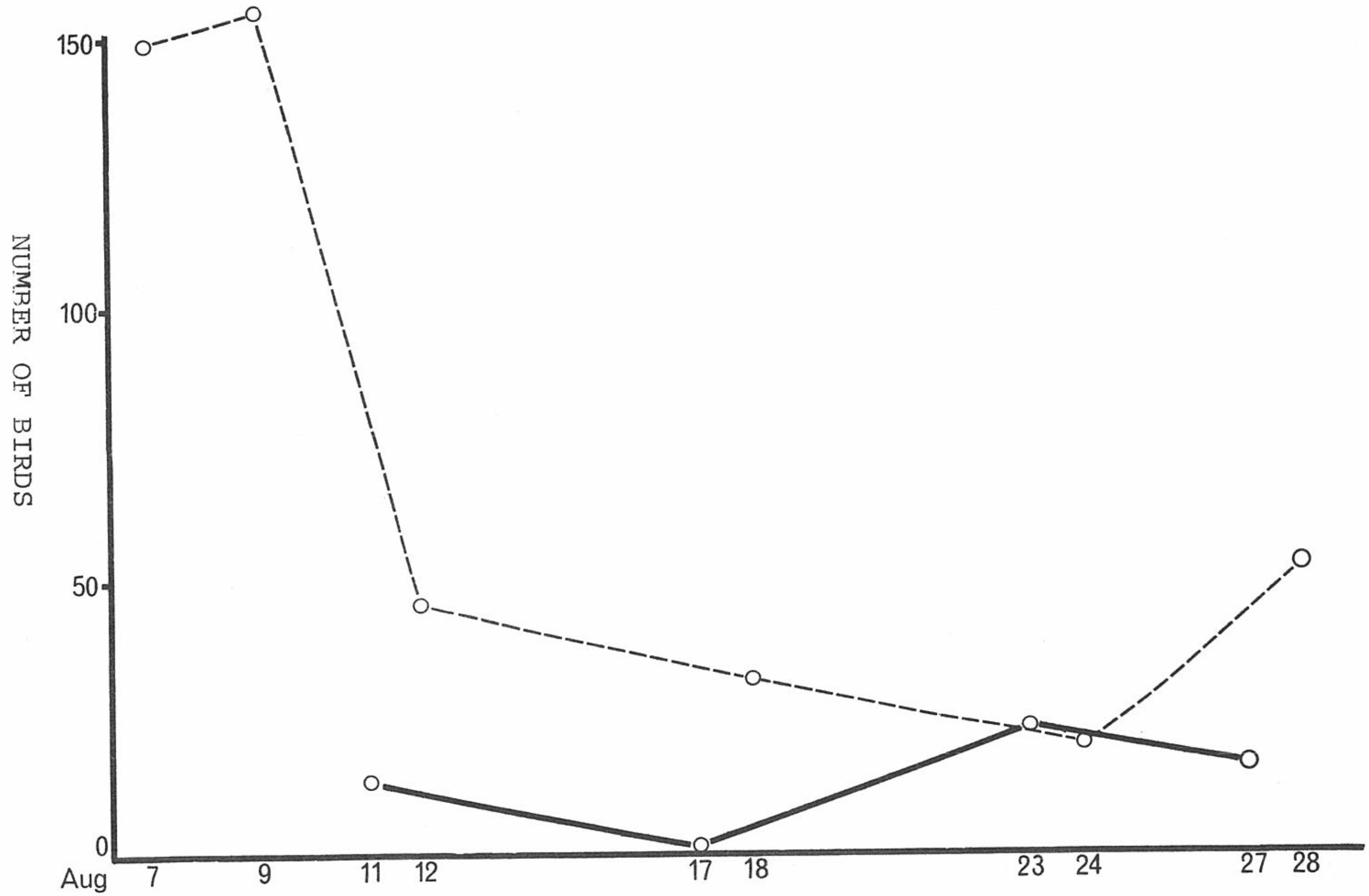


FIGURE 4: White-Fronted Goose Number Fluctuations in Experimental Area ----- and in Control Area ▬▬▬

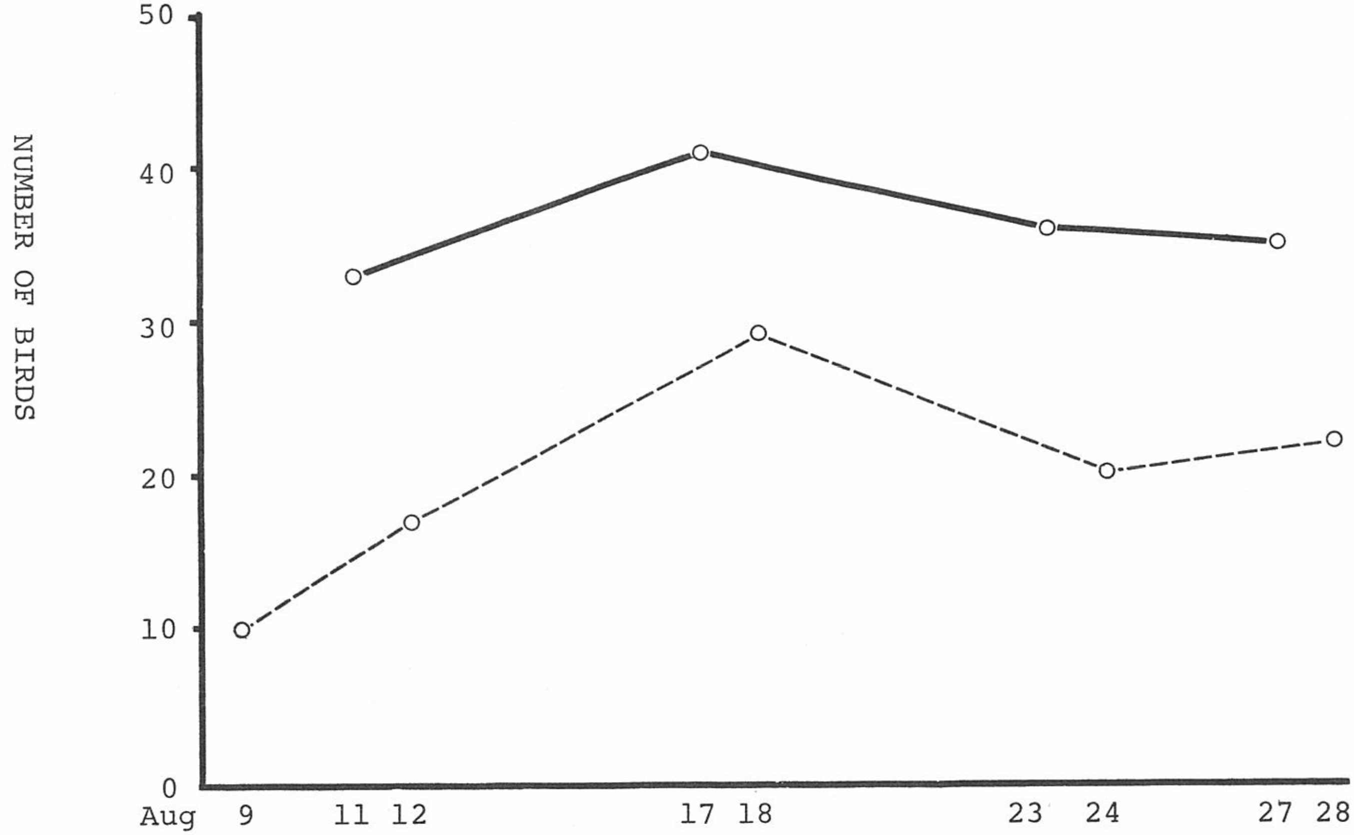


FIGURE 5: Arctic Loon Number Fluctuations in Experimental Area ----- and in Control Area ▬▬

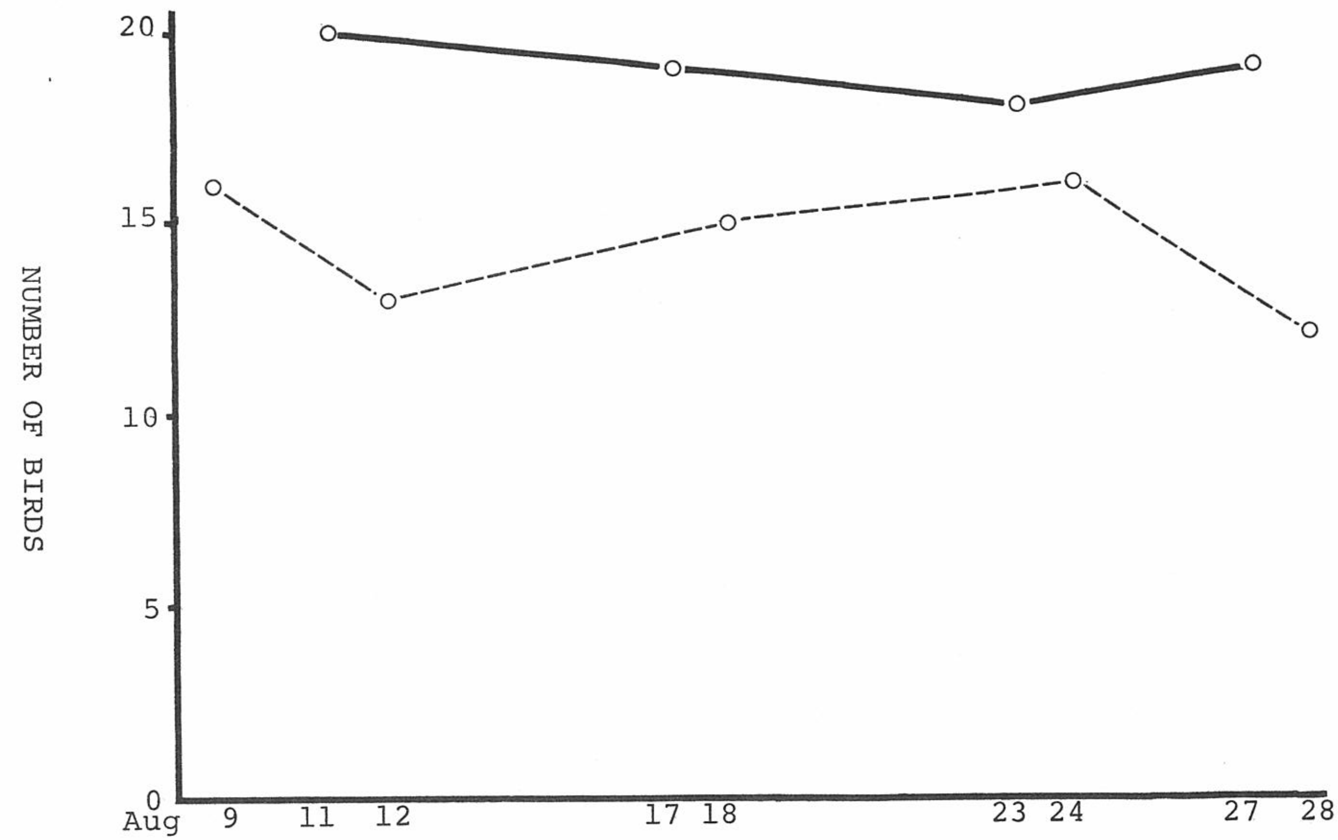


FIGURE 6: Whistling Swan Number Fluctuations in Experimental Area ----- and in Control Area ▬▬▬

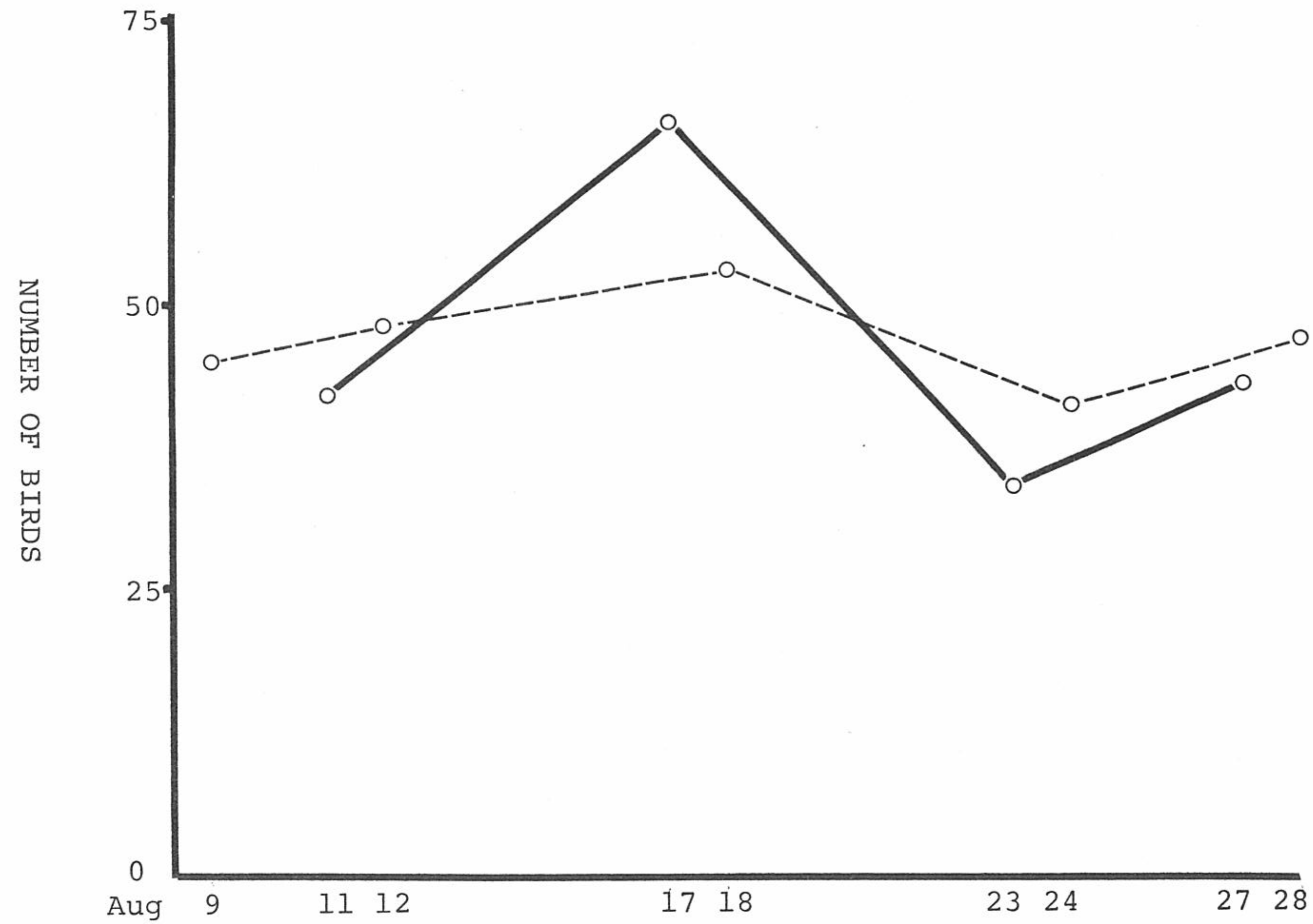


FIGURE 7: Pintail Number Fluctuations in Experimental Area ------ and in Control Area ▬▬

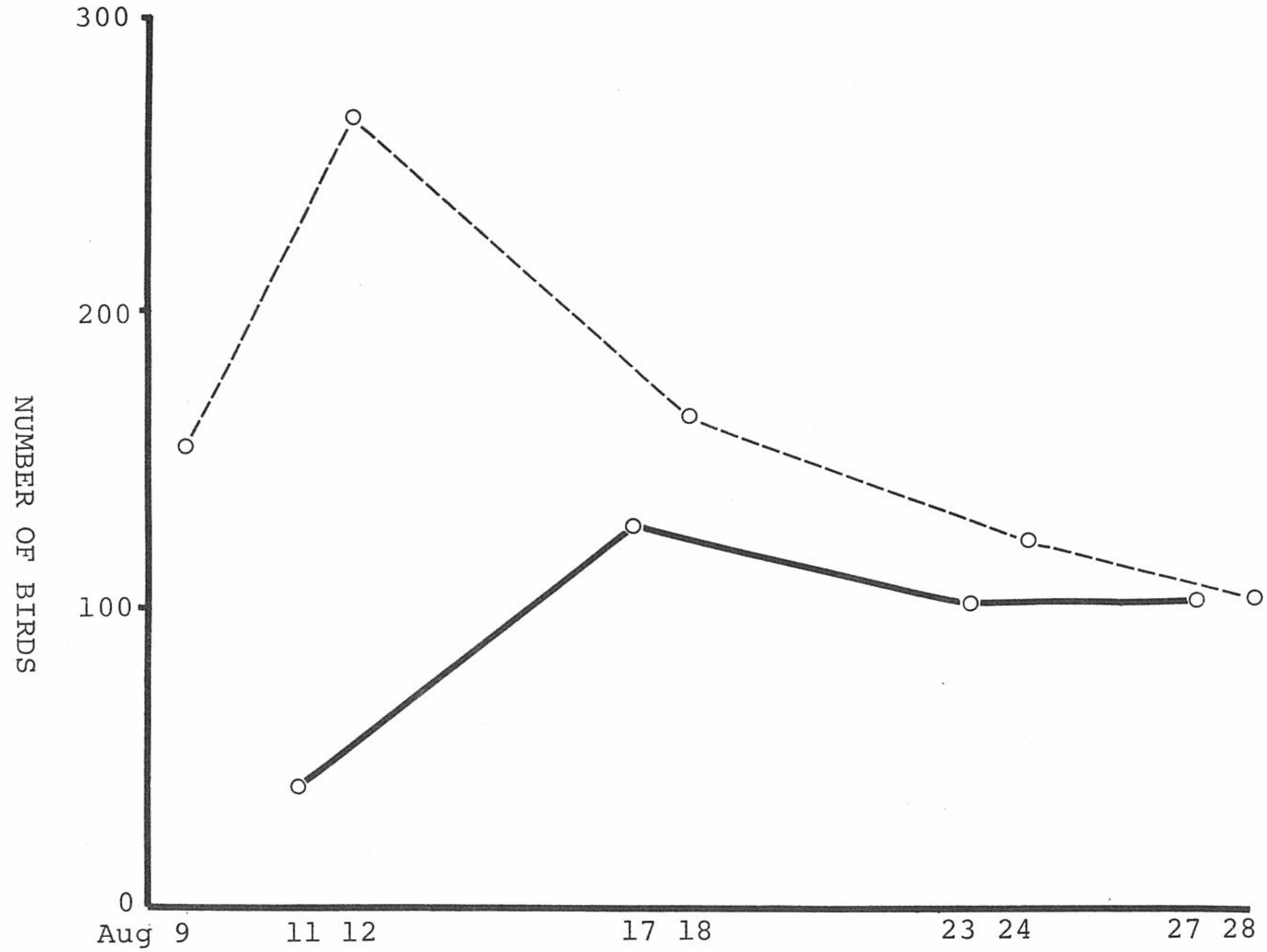


FIGURE 8: American Widgeon Number Fluctuations in Experimental Area ----- and in Control Area ▬▬▬

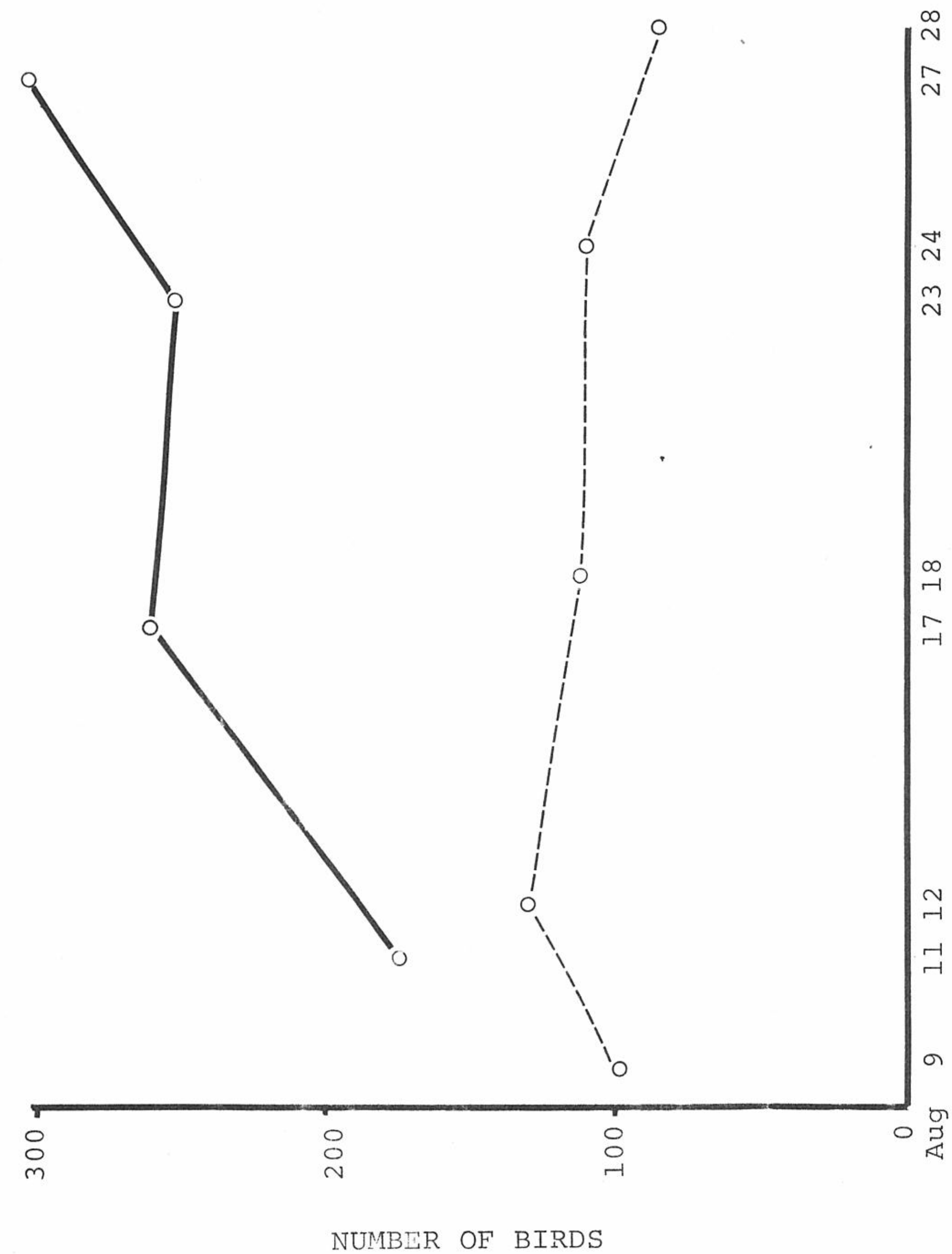


FIGURE 9: Scaup Number Fluctuations
in Experimental Area ------
and in Control Area ▬

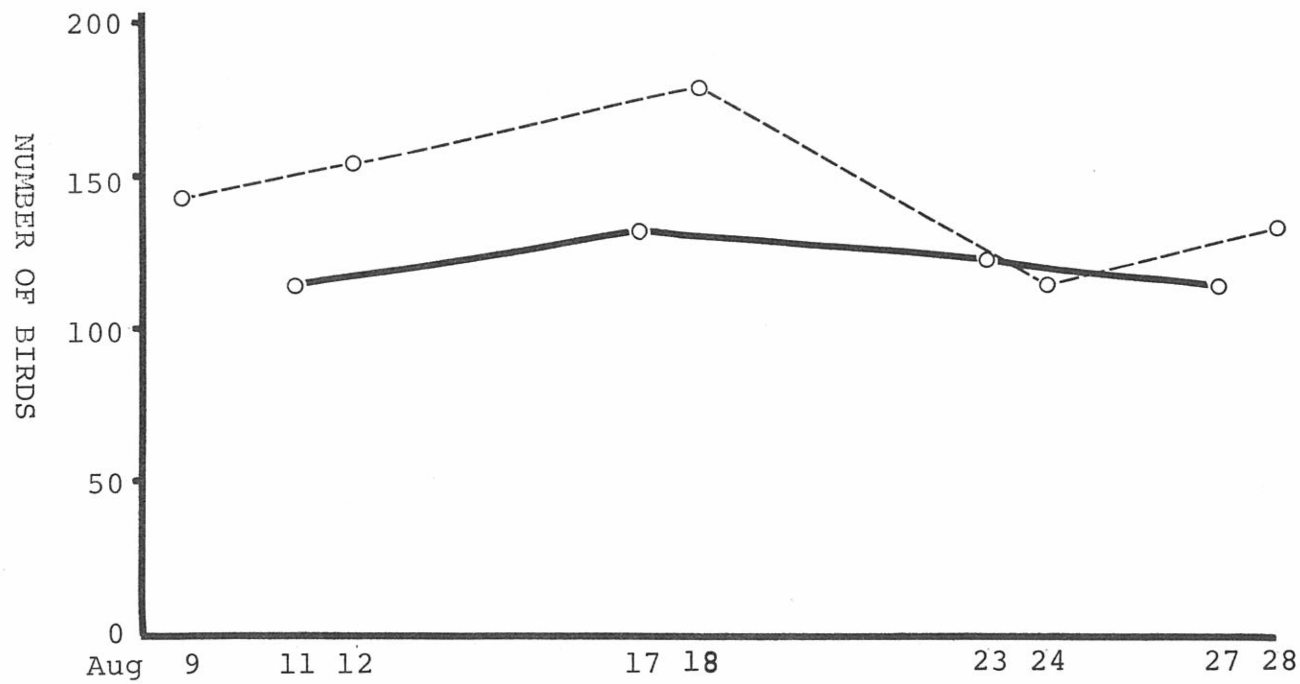


FIGURE 10: Oldsquaw Number Fluctuations in Experimental Area ----- and in Control Area ▬▬

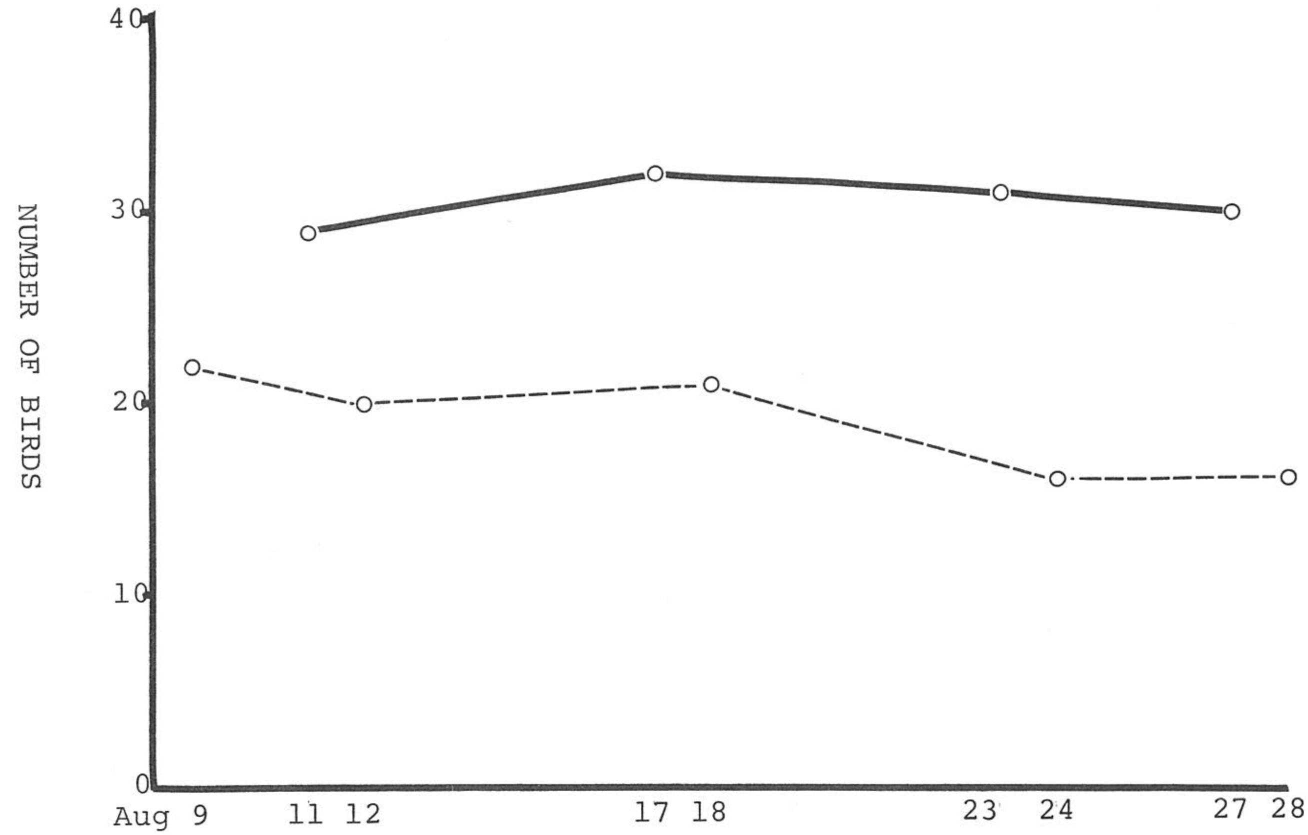


FIGURE 11: White-winged Scoter Number Fluctuations
in Experimental Area -----
and in Control Area ▬▬▬

in the experimental and control areas for species present in sufficient numbers to permit a comparison. The following species were also observed but not presented in graphical form: red-throated loon, Canada goose, mallard, shoveler, green-winged teal, canvasback and surf scoter.

The white-fronted goose was the only species which showed a marked reaction to the flights, (Figure 4). After two days of flights, there was a marked reduction in the numbers on the experimental areas and the numbers remained quite low for the duration of the experiment. The reduction occurred primarily on Lake 1 (Figure 3), the only lake on either area which had a sizeable number (approximately 125) of non-breeding, flying adults. Most of the other geese observed were adults with young.

On the control area, a temporary drop in numbers of white-fronted geese was recorded on August 17. This drop may reflect the small population of white-fronted geese in the area and their apparent movement between lakes.

None of the other species showed any great disparity in total numbers between the two areas. If any conclusion is drawn from these data, it is that there was no marked exodus as a result of continuous flights.

The observations of the immediate reactions of waterfowl to helicopter flights reveal that white-fronted geese responded most vigorously to the disturbances. This was the only species that consistently flew as a result of helicopter overflights. This reaction was characteristic of non-breeding adults and was recorded on ten different occasions.

Breeding geese with young reacted to a helicopter by moving from land to water or in a reverse fashion, depending upon their location at the time of the initial disturbance. On one instance, on August 26, a small group of adults and young were observed to take flight as a helicopter flew over.

Other waterfowl species did not show any appreciable increase in response as the flights were dropped from 500 through 200 feet. In fact there was some indication of less reaction, which suggested a degree of habituation. The most marked reaction observed was by two broods of downy young scaup. On August 13 the Bell 204 flew directly over these birds at 500 feet causing them to move very rapidly to cover near the shore. The broods were back out feeding within five minutes of the disturbance. Adult scaup and oldsquaw in the same area did not show any observable response.

When two flights were carried out over waterfowl at 100 feet elevation during the last two days of the study, an increase in reaction was noticed. During these flights, widgeon and pintails were observed to swim rapidly away from the line of flight.

Frequently the reaction of waterfowl was greater to natural stimuli than to helicopters. Jaegers, gulls and eagles all created disturbance on waterfowl. On three occasions bald eagles caused many waterfowl in the immediate vicinity to take flight. On one occasion, an Arctic loon aggressively pursued a group of about 40 adult and young oldsquaw, causing them to bunch up and swim rapidly to shore. For 15 minutes the loon harassed the oldsquaw, keeping them on shore. After the loon left, the oldsquaw stayed on shore for 35 minutes before returning to the lake.

Fixed-Wing Aircraft Disturbance:

Two days of observations on a single lake were recorded. The first was to establish the waterfowl activity pattern and the second to record the reaction of the waterfowl to the two Beaver flights.

Although the Mackenzie Delta is used in the fall as a staging area by large numbers of waterfowl, because of the vast number of lakes on the delta the population is widely dispersed. During the survey it was discovered that most of the lakes had no waterfowl or so few waterfowl, that data collection would be precluded. Unfortunately, lakes containing waterfowl were usually so large, or of such an odd shape, that observation was impossible.

The dynamic nature of waterfowl distribution presented a major problem. Table 6 is presented in order to illustrate the variability observed. These observations were made on the control lake at 68°13'N, 134°06'W. Since observations were not started until 1015 on September 5, the observations for the second day up to 1015 hours are included, to provide a full day of activity

TABLE 6: Daily Activity of Waterfowl on the Lake on Mackenzie Delta

SPECIES	SEPT. 5 ACTIVITY	1015	1030	1045	1100	1115	1130	1145	1200	1215	1230	1245	1300	1315	1330	1345	1400
Mallard	Feeding								1	1							
	Loafing					1		1									
	Flying																
Pintail	Feeding	3	11	20		12	13	13	13	10	13	13	3	12	13	13	
	Loafing	3		2						3			10	1			
	Flying	2			22												
Widgeon	Feeding	79	95	7		37	60	68	71	51	40	46	16	50	55	64	
	Loafing					1		2		20		7	40	6	5	6	
	Flying	6			8												
Scaup	Feeding																
	Loafing																
	Flying																
Common Goldeneye	Feeding																
	Loafing																
	Flying																
White-Winged Scoter	Feeding																
	Loafing																
	Flying																
Red-Breasted Merganser	Feeding																
	Loafing																
	Flying																

TABLE 6: Daily Activity of Waterfowl on the Lake on Mackenzie Delta (cont'd).

SPECIES	SEPT. 5 ACTIVITY	1415	1430	1445	1500	1515	1530	1545	1600	1615	1630	1645	1700	1715
Mallard	Feeding													
	Loafing													
	Flying													
Pintail	Feeding	2	9	9	9				7		10	10		9
	Loafing	3								10				
	Flying					9								
Widgeon	Feeding	66	81	16	86			10	16	18	30	36		33
	Loafing			70						22				
	Flying					86								
Scaup	Feeding													
	Loafing													
	Flying													
Common Goldeneye	Feeding													
	Loafing													
	Flying													
White-Winged Scoter	Feeding													
	Loafing													
	Flying													
Red-Breasted Merganser	Feeding													
	Loafing													
	Flying													

TABLE 6: Daily Activity of Waterfowl on the Lake on Mackenzie Delta (cont'd)

SPECIES	SEPT. 5 ACTIVITY	1730	1745	1800	1815	1830	1845	1900	1915	1930	1945	2000	2015	2030
Mallard	Feeding													
	Loafing													
	Flying													
Pintail	Feeding	10	10	12	12	12	11	11	6	9	9	6	8	10
	Loafing						1		3			3	1	
	Flying													
Widgeon	Feeding	37	45	45	45	54	25	20	57	70	66	64	71	80
	Loafing	8				6	35	45	10	6	28	30	31	16
	Flying												1	
Scaup	Feeding													
	Loafing													
	Flying													
Common Goldeneye	Feeding													
	Loafing													
	Flying													
White-Winged Scoter	Feeding													
	Loafing													
	Flying													
Red-Breasted Merganser	Feeding													
	Loafing													
	Flying													

TABLE 6: Daily Activity of Waterfowl on the Lake on Mackenzie Delta (cont'd).

SPECIES	SEPT 5. ACTIVITY	2045	2100	2115	2130	2145	SEPT.6	0800	0815	0830	0845	0900	0915	0930	0945	1000	1015
Mallard	Feeding		1														
	Loafing																
	Flying																
Pintail	Feeding	10	10	4	4	10		15	7	7	7		4	11	11	11	11
	Loafing			6	6												
	Flying											5					
Widgeon	Feeding	8	105	58	10	84		106	106	106	106		75	85	86	70	70
	Loafing	20	1	20												20	20
	Flying											4					
Scaup	Feeding							6	6	6	6						
	Loafing																
	Flying																
Common Goldeneye	Feeding							2	2	2	2						
	Loafing																
	Flying																
White-Winged Scoter	Feeding							1	1								
	Loafing																
	Flying																
Red-Breasted Merganser	Feeding							3	3	3	3	3	3				
	Loafing													3			
	Flying														3		

patterns. All of these observations were made prior to the first flight over the lake.

As Table 6 shows, on three occasions on September 5, no waterfowl were present on the lake. Two of these occasions (1355 and 1515 hours), occurred shortly after a bald eagle flew over the lake. On another occasion, a bald eagle flew over the lake (1035), all waterfowl departed, however, some had returned by the time of the next count (1045). Examples of the birds leaving the lake for no observable reason were documented at 1100 hours and 1700 hours on September 5, and 0900 hours on September 6. Similarly, at intervals large portions of the flock would leave the water and fly around the lake, only to settle back down again for no apparent reason other than perhaps a pre-migratory restlessness.

Table 6 indicates a certain amount of natural movement to and from the lake. Diving ducks were observed on the lake only early in the morning, suggesting its use primarily as a roosting place at night. As stated earlier, the survey procedure was to carry out two flights over each lake, one during the peak of the loafing period, and one during the peak of the feeding period. However, there was no definite distinction between these activities which occurred interchangeably throughout the day.

It was observed that both the widgeon and pintail assumed a loafing attitude, with the bill tucked under the wing, immediately following a disturbance. This was particularly evident following the activity of the observers and immediately after the two flights of the Beaver. The birds usually resumed feeding about five minutes after the disturbance. Cornwell and Bartonex (1962) describe this as a pseudo-sleeping attitude probably more akin to an alert attitude in the event of further disturbance.

After this first lake was surveyed, first as a control lake, and then as an experimental lake, it was observed that the numbers of waterfowl on the delta were decreasing rapidly, and the populations became even less static. The other three lakes chosen for observations were found to be void of water-fowl, and on a subsequent lake on which a survey was attempted, the bird population dropped from over 100 ducks and 75 swans to 15 ducks overnight. During this period of searching for water-fowl, it was also found that the composition of populations varied considerably from lake to lake. One lake might be composed mostly of swans with a few dabblers, another of mostly dabblers, and a third composed mainly of diving ducks. Even between two lakes with predominantly dabbling ducks, composition could be quite different. The first lake observed with waterfowl present, con-tained a predominance of widgeon, but another had a large per-centage of mallards and shovelers.

Whereas widgeon were very tolerant to disturbance mallards were much less tolerant. Usually, when mallards flew they also initiated flight in the widgeon as well. Swans were very easily disturbed, to the extent that it was almost impossible to take observations on a lake containing swans. The presence of the observers alone would flush swans, and in turn other waterfowl in the vicinity. This susceptibility to disturbance may be a seasonal attribute in swans since Barry (1972) reported that they they were highly tolerant during nesting. This likely reflects a survival mechanism of aggressiveness during the nesting period.

Approximately 100 ducks (widgeon and pintails) were present during the two flights undertaken. The first flight at 1155 hours caused a moderate reaction. The birds ceased feeding and loafing and assumed an alert attitude for about 15 to 20 seconds before resuming previous activities.

The flight at 1350 hours produced reactions similar to the first flight. The birds feeding and loafing in the center of the lake assumed alert attitude for about 15 seconds, then resumed previous activities. Birds feeding along the south shore of the lake flushed and flew about 15 to 20 yards towards the center of the lake. Within two minutes all birds were back to previous activities. The difference in reaction was probably a result of the location of the birds on the lake. The south shore of the lake was heavily wooded with spruce trees to within 15 feet of the shore, and the flight over the lake was from south to north. The birds flushed at the moment the plane cleared the trees, and it was evident that the effect of the plane was far more sudden on these birds than on those in the center of the lake.

DISCUSSION

By the time this study was initiated, all waterfowl which would contribute to the seasons reproductive success were in the brood stage. Due to the strong parental attachment and the relative immobility of broods, escape reactions to disturbance are more limited at this stage than at any other time. However, unsuccessful and non-breeding adults were not subject to the above constraints.

The likelihood of predation is greatest in the early part of the reproductive cycle, particularly on eggs in the nest and recently hatched young. Such predation is common in tundra areas where the nest is likely to be in a more open and vulnerable situation. Predation is also enhanced since predators such as jaegers, herring, and glaucous gulls, and Arctic foxes *(Alopex lagopus)* are attracted by human activity.

MacInnes and Misra (1972) found that 22% of the 1048 Canada goose eggs that they monitored at the McConnell River, N.W.T., during a five year period (1965 to 1969) were destroyed. Of these losses, 55% were directly attributed to human-assisted predation. This doubling of losses resulting from human activity must be considered significant, particularly in areas with high breeding densities of waterfowl.

The foregoing results followed an average of 3.5 short duration visits per nest. With ground seismic activity it is possible that disturbances could be more frequent and of a longer duration. This would likely increase egg losses as a result of human-assisted predation to an even higher level. The abundance of predators and visibility and location of nest could also affect losses substantially . The latter is largely determined by the habits of the species involved.

The opportunity to observe disturbance as a result of ground seismic activity was only afforded on two lakes, and in both cases only diving ducks were involved. No lasting detrimental effects were noted. There were indications that these conclusions could be altered, depending upon the size of the lake and the location of the seismic activity with respect to the lake. In both cases, the most important factor governing disturbance susceptibility was adequate security (water) between ducks and the source of disturbance.

A different reaction to ground disturbance could be anticipated from dabbling ducks, geese and swans. These birds frequently react to disturbance by retreating to shore and appear more prone to leave the area of disturbance and move to another body of water. Induced movements could subject these species to actual hazards such as predation.

It is probable that frequency of disturbance has a greater influence than the type or degree of given disturbance. This was suggested by the short duration of reactions observed following a disturbance.

During this study, water based seismic activities had no apparent effects on waterfowl. Again, this could vary considerably with the number and species of waterfowl, and the type of habitat involved. Detrimental effects might occur, for example, on a lake with a small segment of high quality habitat favored by waterfowl for a particular activity.

No apparent detrimental effects to waterfowl were noted in the area which was subjected to continuous helicopter traffic, with the possible exception of non-breeding white-fronted geese.

The marked reduction in geese from the area can be attributed to the movement of one flock of non-breeding birds. Observations along the shore of the lake (Lake No. 1 and Experimental Area) from which they moved indicated that this lake was used for molting. Future use of this lake by members of the displaced flock may depend considerably on the degree of change in seasonal activities precipitated by the disturbance. Since the molt had been completed, and the birds were flying out to feed on the tundra, a lake for resting would be a suitable replacement. It is possible that the disturbance may have initiated the southward migration a week or two early since non-breeding adults are usually among the first to migrate toward staging areas to the south. In either case, the lasting effect of disturbance on this flock appears to be negligible.

That portion of the study dealing with fixed-wing aircraft over staging areas was inconclusive. The difficulties in locating adequate samples of birds, and the disturbance caused by observers getting into position to record reactions of the birds preparing for southward migrations, all contributed to the ineffectiveness of this portion of the study.

It is likely that as birds progress through the reproductive cycle from establishment of territories through the fledging of young, an increasing degree of tolerance to disturbance is exhibited. This may result from:

1.) the behavioral pattern and physiological make-up of the species at the time.

2.) a survival mechanism to ensure the successful breeding of the species.

3.) it may also be partly attributed to a lesser amount of cover available earlier in the season.

Once the staging period is reached, this pattern is reversed, and the birds rapidly become less tolerant to disturbance, as witnessed by the reaction of the whistling swans on the delta in August.

A disturbance causing the abandonment of the effort early in the reproductive cycle may simply mean a repeated effort a short time later. However, Arctic nesting waterfowl are subject to severe time constraints for successful breeding. Any deterrent to a rather rigid schedule can result in a total failure in the reproductive effort. Consequently the most critical time for potentially detrimental effects to successful breeding, lies at early stages of the breeding cycle.

Data collected in this study indicate that during the latter stage in the breeding cycle no pronounced degree of disturbance occurred with the level of seismic activity undertaken. However, as stated earlier, the forced tolerance of birds in the brood stage coupled with the relatively short duration of the disturbance on any given segment of birds were factors which governed the data acquired. Under these conditions and the scope of the study, it was not possible to measure any mortality that may have resulted directly or indirectly from the disturbances noted. In this context, changes in behavior were criteria for disturbance assessment.

Since seismic activities are now being conducted throughout most of the summer, it would be highly desirable to measure the effects of human disturbance on bird populations throughout the entire breeding cycle. At least two study sections should be selected in an area with moderate to high nesting densities. One year of pre-disturbance study should be undertaken on each area. The species composition, relative density, breeding chronology and success, and the distribution of breeding birds should be determined as well as the number of non-breeders inhabiting the area.

This should be followed by a year of study during which similar data are gathered on both areas but disturbances applied to one. If such a study is coordinated closely, the experimental plot could be established in an area with planned seismic activities scheduled for the second year. If not, exploration activities could be simulated on the experimental plot. The latter method would permit greater control and would provide an opportunity to vary the duration and intensity of disturbance on specific areas.

Both areas should then be studied a third year to assess the relative numbers of breeding birds on the experimental and control units. If a noticeable change in breeding success of geese or swans was observed on the experimental plot during the second year, a measure of breeding pairs should probably be made on both plots the fourth and fifth years, since that is when a loss in recruitment to the breeding populations would occur.

Habitat studies should be initiated, particularly on breeding habitat of species which nest exclusively in the Arctic, (i.e. white-fronted and snow geese, whistling swans). Such studies would be invaluable in assessing the effects of displacement in local situations and in evaluating the use of certain areas by birds with respect to habitat availability and traditions. The study would entail quantitative measurements from a series of lakes being used by a species as well as from a series not being used. The measurements would be subjected to a discriminate function analysis (Martinka 1972). Several habitat measurements could be facilitated by use of infra-red photos.

An attempt should also be made to quantitatively identify habitat included in "staging areas". This term has frequently been applied to a general area, but such areas should be defined and should be considered inviolate, unless a staging area consists of a large geographical unit where localized disturbance would have limited overall adverse effects. In view of the seasonal importance of staging areas for large numbers of waterfowl, a better understanding of this habitat component is required.

With recent reports of increasing snow goose numbers and locations of previously unreported breeding colonies, (~~Pyler~~ Ryder 1971) the possibility of establishing new colonies is recommended. The high degree of homing which Canada geese display for natal areas is seemingly geared to that area from which they first take flight (Surrendi, 1971). Perhaps establishment of new snow goose colonies could be achieved by a similar transplant of goslings. Prior to any transplant attempt, means of accurately identifying potential nesting should be developed. If the establishment of new colonies is feasible, this would provide a means of mitigation on existing colonies which were rendered unproductive or removed by unavoidable human activity.

One of the major objectives of the present study was to establish a minimum altitude for routine aircraft flights over tundra areas. From discussions with helicopter pilots it was discovered that during routine activities they prefer to fly from 500 to 1000 feet above ground level. As disturbance of waterfowl was minimal at the 500 foot level, this is probably a satisfactory minimum ceiling to establish as it pertains to post nesting waterfowl. It is quite possible that future studies will necessitate raising this level during the nesting period.

An important consideration relating to the effects of summer seismic activity in tundra areas is the large variation in waterfowl densities. Similar levels of seismic activity may exert impacts according to the density of waterfowl in the area. Therefore, it is recommended that prior to the granting of any summer seismic work permit, a preliminary aerial survey should be conducted in the spring of the proposed year of activity (by June 30) in order to identify important waterfowl concentrations.

The fixed-wing aircraft disturbance investigation on the Mackenzie Delta posed major problems which could be overcome by carrying out a similar study on the tundra. However, it is important to establish threshold levels for various aircraft types on existing staging areas. Prior to additional studies, it is essential that the use of the delta by staging waterfowl is more clearly defined.

CONCLUSIONS

1.) The area of seismic activity south-west of Parsons Lake was one of low waterfowl density during the 1972 season.

2.) No lasting detrimental effects of disturbance on diving ducks were noted during ground seismic activity.

3.) The distance between the duck and the source of disturbance was an important factor in the degree of response.

4.) While ground seismic activity did not afford an opportunity to observe dabbling ducks, geese,or swans during a period of disturbance, a more pronounced reaction is anticipated from these species than diving ducks.

5.) Water seismic activity had a negligible effect on the waterfowl of Parsons Lake. Low numbers with ample escape opportunity were observed.

6.) On a lake that was highly favored by waterfowl for particular activity, water seismic activity may be detrimental where habitat is restricted.

7.) Non-breeding adult white-fronted geese responded to the helicopter disturbance by taking flight. Data obtained indicates that most of these birds vacated the area after two days of disturbance.

8.) White-fronted geese broods were disturbed to a greater extent by helicopters than any other waterfowl broods.

9.) Natural stimuli elicited a greater degree of response from waterfowl than did human activity.

10.) This study must be considered preliminary because it encompassed only the brood rearing portion of the reproductive cycle.

11.) As waterfowl progress through the reproductive cycle an increased degree of tolerance to disturbance is exhibited.

12.) The frequency of disturbance had a greater influence than the type or degree of a given disturbance.

13.) Helicopter flights over tundra areas from 500 feet upwards had minimal effects on the waterfowl at the time of year this study was conducted.

14.) Fixed-wing aircraft surveys on the Mackenzie Delta indicated a moderate reaction of widgeon and pintails to flights at the 300 foot level.

15.) Whereas whistling swans were most tolerant of all waterfowl to disturbance while on the tundra during the brood rearing period, during the staging period on the delta they were the species most susceptible to disturbance.

RECOMMENDATIONS

1.) A three year disturbance study is recommended in an area with moderate to high nesting densities as described in the discussion. Quantitative measurements should be made of long-term effects of disturbance on nesting waterfowl as well as response to birds to disturbance stimuli.

2.) Studies should be initiated, on the breeding habitat of exclusively Arctic nesting species.

3.) Research into the feasibility of establishing new snow goose colonies is recommended.

4.) A minimum altitude of 500 feet should be established for all routine flights over tundra areas.

5.) Prior to the granting of any summer seismic work permit, a preliminary aerial survey should be conducted in the spring of the proposed year of activity to identify key waterfowl areas.

6.) A thorough survey should be conducted to delineate waterfowl staging areas on the Mackenzie Delta.

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APPENDIX I

COMMENTS ON TERRAIN DISTURBANCE

During the summer of 1971, Kerfoot observed the combined effects of three types of seismic vehicles on several tundra surfaces in the Jimmy Lake area of Tuktoyaktuk Peninsula (Summer Seismic Operations in Tundra Disturbance Studies in the Western Canadian Arctic, D.E. Kerfoot - ALUR 71-72-11).

Some observations from eight transects in various terrain and vegetation types were as follows:

In a shrub heath community in irregular high and low earth hummock terrain, damage consisted of:

1. "a maximum lowering of the surface of 18 to 20 cms. mainly by compression of the organic layer."

2. "some local removal of the lichen mat and some exposure of bare mineral soil in the deeper cleat marks of the tracks."

3. "large blocks of vegetation and mineral soil one or two metres across and 20 cms. thick were peeled from the surfaces of hummocks" by the undersides of some vehicles.

In a wet sedge-moss tussock community in an old lake bottom damage consisted of:

1. "compression (of organic material) produced a lowering of the ground surface in the order of 10-15 cms. and the impressions of the tracks were filled with shallow pools of water 5-10 cms. deep" and

2. "flattening of the sedges."

On slightly higher ground than the above with "subdued earth hummocks interspersed with tussocks forms of Sheathed Cotton - grass *(Eriophorum vaginatum)*" damage included:

1. "average depression of ground surface of about 10-15 cms."

2. "a few broken limbs of the Mountain Alder *(Alnus crispa)* and Glandular Birch *(Betula glandulosa)*."

3. "a flattening of many of the tussocks."

On the floor of an infilled lake in which the substrate was saturated organic material, the surface consisted of low mounds of peaty material and vegetation was *Carex aquatilis, Potentilla palustris* and mosses, damage included:

1. "the ground surface was depressed by amounts ranging from 5-10 cms. as a result of a compression of the organic layer under the main lines of the tracks."

2. "ground surface in the inter-track areas of the route was actually raised in places, as some of the mounds were flatteded across the intervening depressions and some organic material was squeezed up from beneath the track areas."

3. "most of the vegetation was flattened along each route but very few plants were either broken or uprooted."

The addition of "the line crew and recording unit produced an additional lowering of the ground surface, ... and a further flattening of the vegetation" with "maximum net change in the position of the ground surface was only 10-15 cms."

In an adjacent area consisting of a low ridge vegetated with White Spruce *(Picea glauca)* dense Diamond-leaf Willow *(Salix pulchra)* and Glandular Birch *(Betula glandulosa)* and surface vegetation consisting of tussocks of Sheathed Cotton - grass, *Sphagnum*, Arctic Blueberry *(Vaccinium uliginosum)*and Common Horsetail *(Equisetum arvense)* net damage from all vehicle passage included:

1. main lines of tracks transformed "into more distinct rut-like features which were filled with pools of standing water 8-10 cms. deep."

2. "Many of the species in the ground cover were crushed and submerged in these pools of water."

3. ". . . . more extensive damage to the shrub layer in that more of the willows and ground birch showed the effects of scraping, more twigs were stripped of their leaves, and there was an increase in the number of crushed and broken branches."

The investigation concludes that:

"The cumulative evidence from each of the eight transects indicates that, on a short-term basis at least, the minimal amount of terrain disturbance involved establishes the feasibility of this method of summer seismic operation in the type of terrain found in the Jimmy Lake area. Indeed, because of the low level of terrain damage incurred along the 1971 summer seismic lines, there would appear to be every indication that similar operations, perhaps also incorporating an experimental approach, could be permitted in other, adjacent areas, without involving any greater risks of severe damage to the tundra."

Discussion:

The foregoing study establishes the feasibility of this method of summer seismic operation almost entirely on the basis that compression of the organic layer constitutes minimal disruption of terrain. However without the evidence of follow-up studies (in 1972) on the 1971 transects the longer term ramifications of this compression have not been established. Permanent damage in the years following disturbance taking the form of subsidence due to thermokarst, changes in vegetative cover, alterations of surface drainage, slumping and erosion resulting from summer traffic over tundra are well know (Hok 1969, Bellamy et al 1971, Pruitt 1970).

The assumption that compression of the organic layer without removal will not cause damage is open to questions. The effects of snow roads and winter seismic roads where no vegetation was removed are clearly visible on many areas throughout permafrost regions in Canada and Alaska.

The foregoing conclusions are therefore considered premature to establish whether or not the longer term ramifications of disturbance is negligible and if widespread summer seismic activities are desirable. In some cases the report states that damage observed was not widespread or was an exception. However, quantitative data concerning the extent of damage to surface or vegetation where it did occur are not provided, which suggests a need for caution in the application of conclusions in a long term context.

Widespread operations covering miles of terrain would represent a cumulative disturbance over time which could not be considered negligible, if thermokarst and other changes were initiated.

Therefore we would urge that follow-up studies be initiated within the 1971 study area to further assess the foregoing factors prior to establishing summer seismic operations on a wide scale or as a routine practice.

APPENDIX II

CLASSIFICATION OF YOUNG WATERFOWL

Throughout this portion of the report the terms Class I, II and III are used in reference to the young of any waterfowl observed. To clarify the meaning of these terms a brief description taken from Gallop and Marshall (1954), is herewith given:

Class I - Downy young from the time they first hatch to just before the first contour feathers are visible.

Class II - Young birds from the time the first contour feathers appear until just before the last down feathers disappear.

Class III - Young birds from the time no down is visible to just prior to their attaining flight.

These classifications are broken down even further but were not used for this report.

In the appendices waterfowl broods are shown as 1(6), the first number indicating the number of adults present, and the number in bracket indicating young.

APPENDIX III

GENERAL OBSERVATIONS DURING GROUND SEISMIC ACTIVITY

AUGUST 3, 1972:

Walked seismic line B. Waterfowl were counted on a lake* located approximately 1/4 mile N of line B and about 100 yards E of line G.

Waterfowl observed at 1145

Whistling Swan	2	
Oldsquaw	1 Female, 1 young	All Young Class II
Oldsquaw	1 Female, 33 young	All Young Class II
Oldsquaw	2 - 3 young	All Young Class II
Scaup	1 Female, 10 young	
Arctic Loon	3	

Small adjacent pond:

Pintail	1 Female, 4 young	Class III
Oldsquaw	1 Female, 2 young	Class II
Scaup	1 Female, 7 young	Class I

* Initial intent - Experimental lake for observation on waterfowl reaction to human disturbance.

A second lake was also counted with intent to use it as a control. Lake was located at 68°55'15"N, 134°9'56"W.

Waterfowl observed:

Scaup	1 Female, 8 young	Class I
Scaup	2 Female, 12 young	Class I
Scaup	1 Female	
Oldsquaw	1 Female, 1 young	Class II
Oldsquaw	5 Adults	
Oldsquaw	2 Young	
White-winged Scoter	2 Adults	
Arctic Loon	2 Adults	
Phalarope	3 Unidentified	

<u>AUGUST 4, 1972</u>:

Returned to Experimental Lake (August 3), 0800

Waterfowl observed:

Whistling Swan	2 Adults	
Scaup	2 Female, 7 young	Class I
Oldsquaw	1 Adult	
Oldsquaw	1 Female, 10-20 young	) Class II
Oldsquaw	1 Female, 21 young	)
Pintail	1 Adult	
Arctic Loon	1 Adult	

One brood of scaup was observed and clumping (C) (distance between extreme members of brood) was observed at 15 minute intervals and averaged for an hourly mean. On certain occasions, four observations/hour were not possible because brood was not visible. At the same time, distance from shore (D) was also recorded. These data were recorded on this date and again on August 6 when the drilling crew was active in the area, coming into full view of the pond at 1140 and remaining so until 1720. The following data were recorded:

SCAUP - Clumping/Distance (C = Clumping, D = Distance)

Mean of as many observations as were available.

TIME	AUG. 4 C	AUG. 4 D	AUG. 6 C	AUG. 6 D	
0900					SEISMIC ACTIVITY
1000	10	10	5	1	
1100	10	2	4.3	1	
1200	10	5	12.5	3.3	
1300	10	5	10	5	
1400	10	5	10	2	
1500	10	5			
1600	10	5			
1700	10	5			
1800					

During these same periods and dates the brood was recorded at 15 minute intervals as not being visible (NV), on shore (OS), or swimming and diving (S/D). The following data were recorded:

SCAUP ACTIVITY

	AUGUST 4			AUGUST 6		
TIME	NV	OS	S/D	NV	OS	S/D
0900	4					
1000	2		2	3		1
1100	3		1	1		3
1200	3		1	1		3
1300	3		1	1	1	2
1400	1		3	1		3
1500			4	4		
1600	1	1	2	4		
1700	1		3	3		1

Also recorded during these same periods and dates were the number of dives (indicating feeding activity) per 10 minute periods for duckling and adult female scaup and oldsquaw. The following data were recorded:

SCAUP

Dives/10 Minute Period

	AUGUST 4		AUGUST 6	
TIME	Juv.	Ad.F	Juv.	Ad.F
0900				
1000	24	6	22	0
1100				
1200			22	0

SCAUP

Dives/10 Minute Period (cont'd)

	AUGUST 4		AUGUST 6	
TIME	Juv.	Ad.F	Juv.	Ad.F
1300	12	2	0	0
1400	19.5		21.5	22
1500	17	0		
1600	22	0		
1700				
1800				

OLDSQUAW

Dives/10 Minute Period

	AUGUST 4		AUGUST 6	
TIME	Juv.	Ad.F	Juv	Ad.F
0900		0		
1000			23.5	
1100	20	4	16.5	
1200	22.5	14	4	
1300			19	
1400			17	16
1500			17	
1600			13.5	
1700			12	
1800				

It was the observer's opinion based on the days observation that the drilling crew's activities produced no noticeable effect on the birds actions.

AUGUST 8, 1972:

Counted experimental lake (See August 4 and 6) at 1130

Scaup	1 Female, 7 young
Oldsquaw	1 Female, 30 young
Pintail	2 Adults
Pintail	1 Female, 8 young (flying)
Arctic Loon	2 Adults
Phalarope	26

On pond - 1 oldsquaw duckling.

Counted control lake 1100 (See August 4 and 6).

Scaup	1 Female, 7 young	Class I - II
Scaup	1 Female, 4 young	Class II
Scaup	1 Female, 8 young	Class I
Scaup	1 Female, 7 young	Class II
Scaup	1 Female, 5 young	Class II
Oldsquaw	1 Female, 6 young	Class II
Oldsquaw	1 Female, 1 young	
Oldsquaw	5 Adults	
Phalarope	15	

AUGUST 24, 1972:

Continued observations at experimental lake where effect of drilling on waterfowl was observed - this time the recording crew goes past.

Figure 12 is a summary of behavioral observations. There is no certain indication of disturbance and this accords with general observations. For example, the birds were not concentrated at the end of the lake most remote from the seismic line.

Number of oldsquaw present - at least one female and 20 nearly full-grown ducklings, 6 pintail were seen but so irregularly as to make useful observations impossible. A maximum of 10 Arctic loons were also present.

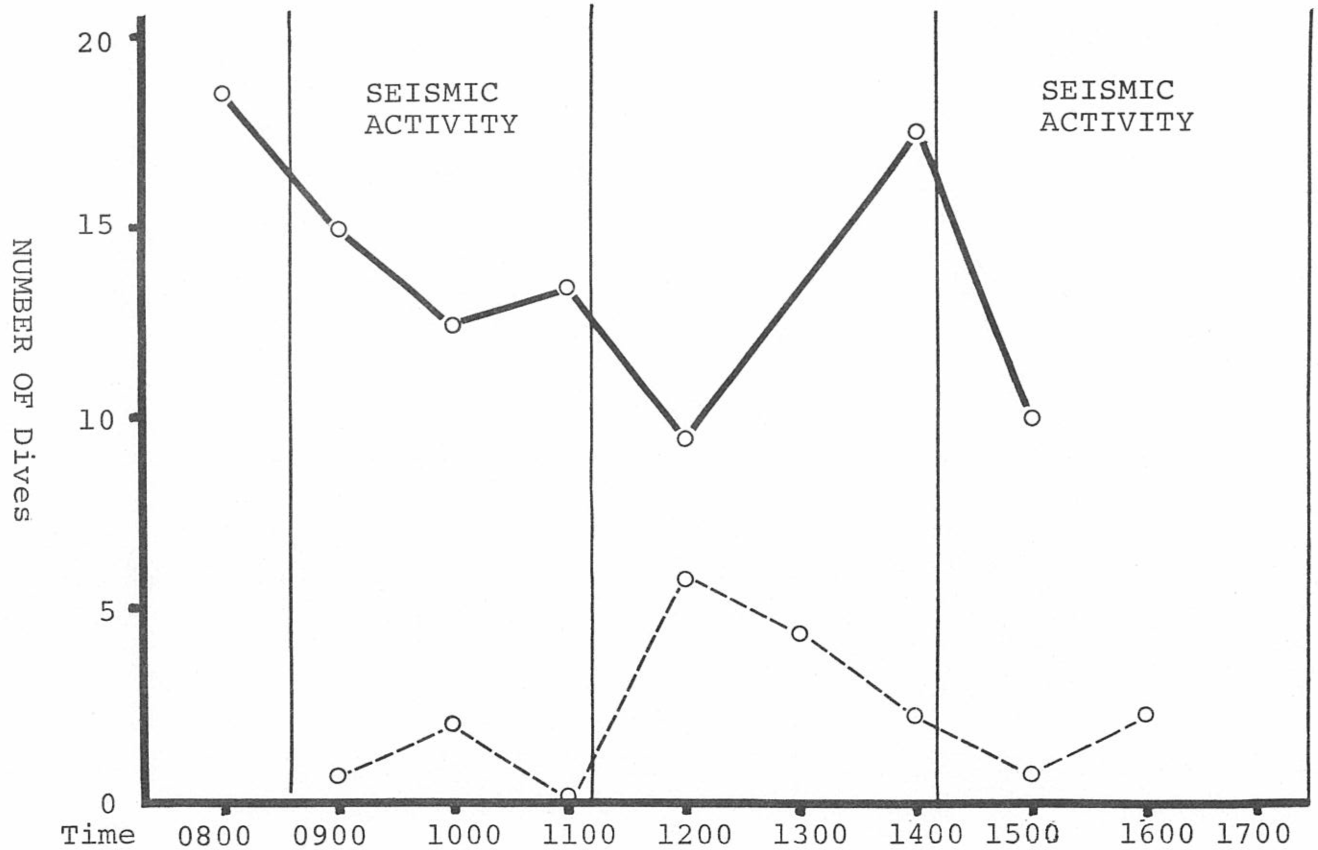

FIGURE 12: Mean Number of Arctic Loon and Oldsquaw Dives Per 10 Minutes in Stated Hour
Arctic Loon ——
Oldsquaw - - - - -

APPENDIX IV

GENERAL OBSERVATIONS DURING HELICOPTER DISTURBANCE STUDY

AUGUST 7, 1972:

On Lake 1 in experimental area there were approximately 125 white-fronted geese present at 1600 hours. Also 15 white-fronted geese were observed in the area of the camp bay on Parsons Lake.

AUGUST 9, 1972 - EXPERIMENTAL AREA:

1150 125 to 150 white-fronted geese observed flying very low toward Lake 1 from SE of lake. Birds landed in the middle of the lake, slightly west of island. Two large helicopters were observed in the air approximately 1 1/2 to 2 miles to the east. Some redistribution of geese on the water was observed and soon after (approximately one minute) geese were observed in the air to the N of the lake, flying in a NNE direction.

AUGUST 11, 1972:

As of this date, the experimental and control areas were established. Helicopters flying from Globe 3 to Parsons Lake Camp were instructed to fly over lakes in the experimental area. Parsons camp had been in operation since August 9.

AUGUST 12, 1972 - EXPERIMENTAL AREA:

Lake 10:

1221 to 1315 observed Lake 10 for 1/2 hour during which time six men worked far (north) shore and Bell 3B1 helicopter made eight flights over Lake at 50' to 150' landing four times 50' from NE corner of Lake. (Activity began before arrival of observer). No reaction on part of ducks (adult scaup and old-squaw) as they continued to swim back and forth in centre of lake, on occasion diving for food, even when helicopter went over. They stayed in widest part of lake, but as soon as activity stopped, went to narrower end to feed where they stayed until observer left 20 minutes later.

1515, all ducks feeding at narrow end of lake during 1/2 hour of observation.

AUGUST 13, 1972 - EXPERIMENTAL AREA:

Crew moved to experimental area for two days of observations relative to aircraft disturbance.

Lake 2:

Observed Lake 2 arriving at 1600. Group of eight oldsquaw feeding out in front of observer. Birds fed continuously by diving until 1830. Flock was very loose knit, extending over an area of about 100' to 125' across. The oldsquaw ceased feeding, gathered into a compact group as the helicopter passed. In about two - three minutes the birds began to spread out and feeding and diving resumed in much the fashion as before.

Lake 9:

Arrived 1315 loose flock of 40 oldsquaw 200 yards off shore moved to left away from observer when he arrived. Two swans and three Arctic loons in mid lake no reaction. Forty plus scaup, three scaup broods and two widgeon broods at SE end of lake. All swam casually to the right and away from observer, and continued to feed. Scaup and widgeon tended to feed in weeds close to shore and on shore, oldsquaw fed in open portion of lake.

1415 Bell 204 helicopter flew by 1/4 mile away and about 700' up. No observable reaction.

1520 Bell 204 helicopter flew W to E directly over S end of lake. No response from adult scaup or oldsquaw, but the scaup broods swam frantically for shore. Within five minutes they were out and feeding again.

1555 Violent reaction on part of young oldsquaw as Arctic loon came around corner of island with just its bill and bit of head above water. Oldsquaw bunched together and swam frantically for shore of island. Just as oldsquaw got amongst weeds, loon made a dash and disappeared amongst weeds too, coming out a few seconds later. For next 15 minutes loon continued to stay close to shore harassing ducks. After loon moved to another portion of lake, the oldsquaw stayed close to island for 35 minutes before moving to center of lake.

1745 Bell 204 helicopter flew S to N over center of lake. No reaction from oldsquaw could not locate scaup broods. About one minute after flight noticed brood of one (six) scaup on S shore of lake feeding about 20' from weeds.

1830 Bell 204 helicopter flew N to S over center of lake at 500'. No reaction from oldsquaw, one widgeon brood or two visible scaup broods.

NOTE: Except for the one occasion when a scaup brood was seen in the center of the S shore of lake, all scaup broods stayed near SE end of lake. These broods were Class I - II. The widgeon moved from S-E corner along the center of S edge of lake on occasion. This brood was Class III. The oldsquaw (Class III) moved around the open portions of the lake quite a bit in one or two loose flocks.

Lake 6:

Observations only made at this lake and concentrated on 13 white-fronts (one Adult + four Young, 2 Adult + six Young) the young being Class III. On arrival at 1230 observer flushed the geese from the S end of the lake to the N end where they remained until his departure at 1930. For most of the time the young were grazing on lakeside vegetation, never more than about 15' from the shore while the adults, although occasionally grazing, mostly stood on the shore watching, with necks erect.

At 1400 the Bell 204 helicopter arrived from the S and the white-winged scoter brood possibly aggregated very slightly when the helicopter was 1/2 mile distant. However, as the helicopter was overhead they continued diving and swimming without apparent concern. Again there was no discernible reaction as the 204 returned to Inuvik at 1510. This later flight flushed 20 phalaropes from the water (when helicopter was directly overhead), they realighted within five seconds.

1722 All geese ashore.

1730 The four young of the water, necks submerged.

1732 These four young land, with chopper noise audible in the distance to the south.

1735 All geese on water as 204 helicopter becomes visible.

1737 They go to land again.

1738 All geese visibly disturbed as 204 comes within 1/2 mile move on to the water.

1740 204 nearly at Parsons Lake camp. Geese start ducking their heads (puddle-duck style). The tight grouping is loosened.

1743 They are back on land and all young are feeding again.

1823 204 starts engine at camp. Four geese are ducking their heads near the shore.

1825 Helicopter flies over. The geese again all swim out onto the water.

Scaup young carry on as normal, diving frequently and regularly while the male swimming on the water, is not visibly agitated.

1829 Geese all ashore again.

AUGUST 14, 1972 - EXPERIMENTAL AREA:

Lake 6:

Observations made from channel between Lakes 6 and 8.

1415 3B1 helicopter was heard.

1422 Helicopter flew by west to east through center of Lake 6. White-winged scoter young (already bunched quite tightly following the recent passage of raven) continue unconcernedly to screen and wingflap on the water. The female, 50 yards distant and diving, makes no attempt to gather them to her.

1426 3B1 heard again.

1430 Helicopter flew directly over Lake 6. Oldsquaw female continues swimming and diving without obvious reaction. The young of the brood also do not react and the phalaropes with which they are associated do not take off.

Lake 9:

1425 3B1 helicopter flew over east end of lake at 500'. No reaction from three broods of scaup feeding at east end of lake or any of the other ducks on the lake.

1430 3B1 helicopter flew north to south over lake. Again no reaction from waterfowl.

NOTE: Although some adult scaup can and do fly at this time, others cannot, as indicated when four individuals of a group of eight wingflapped on the water, displaying very short primaries.

AUGUST 19, 1972 - EXPERIMENTAL AREA:

Lake 9:

Arrived 1110 Four pintail, 46 scaup, 24 widgeon, 50 oldsquaw. Broods of one (six), one (five), one (four). Scaup all swam away from SW corner of lake, adult scaup moved to middle of west side of lake, all others settled back.

1510 204 helicopter flew over at 400' from W to E. Observed large group of scaup, pintail and widgeon on west side of lake. Birds stopped feeding and swam away from edge of lake, bunching together as helicopter approached. As helicopter passed over and flew away, birds swam back in direction of shore. Normal activity resumed three to five minutes after flight.

1557 Frantic bunching effect and scramble for shore observed amongst scaup, oldsquaw, pintail and widgeon as glaucous gull flew directly overhead at about 20'.

1605 204 flew N to S over lake. No reaction from scaup, pintail and widgeon on west shore.

1900 3Bl flew over SW corner of lake. White-fronts feeding on tundra at edge of lake (west shore) immediately took to water. No reaction from other waterfowl.

1903 3Bl returned going over NW corner, geese huddled in close to shore.

1912 Geese moved back on shore.

1915 3Bl flew over SE corner of lake. No observable reaction from geese or other waterfowl.

Lake 6 and 8:

Observations made from channel between two lakes:

1500 204 helicopter visible and audible at Parsons Tower.

1509 - 10 204 circled Lake 8. On Lake 8 near the channel were one female and 8 Class III young oldsquaw. They were already grouped and resting on the water when helicopter was 200 yards away from overhead position, they started to swim but stopped as soon as helicopter had passed. No diving occurred and their swimming only took them 20 yards.

1602 204 audible again. Two swans were resting on water, heads in bodies and 10 yards from shore of Lake 6. They had been in this posture and position for at least five minutes.

1603 204 flew over center of both Lakes 6 and 8. Swans lifted their heads and swam gently (no panic) away from shore.

1606 Swans were still swimming.

1616 The swans were feeding in the middle of the lake.

1856 3Bl helicopter heard and seen.

1901 3Bl flew over center of Lakes 6 and 8. On Lake 6 there was no reaction from some swimming white-winged scoter (female and 7 young Class II).

1914 3Bl flew over N end of Lake 8 only. Adult female scaup and Class II young continued swimming and diving without obvious concern.

Lake 1:

1508 Bell 204 helicopter flew over carrying two drums no visible effect. One glaucous gull flew up then came back again. Loons did not appear to dive and swans seemed to head to shore.

NOTE: Widgeon flock was disturbed and sent flying by parasitic jaegers and bald eagle. Once the birds took to the air with nothing visible in the sky.

1603 204 helicopter flew over, no noticeable effect on duck or geese populations. Loons became more vociferous.

1857 3Bl helicopter flew over. No noticeable effect.

1905 3Bl flew over. No noticeable effect.

AUGUST 12, 1972 - EXPERIMENTAL AREA:

Lake 6 and 8:

Observations made from channel between lakes:

0843 3B1 helicopter was visible and audible near Parsons Tower.

0848 3B1 flew over Lake 6. Widgeon (female and four young, Class II) continued preening and grazing on shore. Only female was looking and listening. They made no move towards the water, and some young which had been dabbling close to the shore landed with 3B1 1/2 mile away.

0855 3B1 drops stores at our camp site and flies along west shore of lakes 6 and 8. Scaup continue diving and the female swimming on the water, with no visible reaction.

1118 3B1 seen and heard.

1120 3B1 circled the shore of Lake 8. No visible reaction from two Arctic loons on Lake 6.

1131 3B1 heard.

1133 3B1 circled Lake 8, female scaup and six + young, Class II. All ashore on the west side of Lake 6 did not move. The young continued preening.

1522 3Bl seen 1/2 distance between Parsons Tower and observer.

1557 3Bl circled Lake 8. Oldsquaw on Lake 6 continued diving during flyover and the phalaropes with which they were associated continued feeding.

1712 3Bl appeared while two swans on Lake 8 continued feeding as they had been since at least 1610, upending and just neck-stretching.

1713 3Bl flew 1/2 mile to N of Lake 8. The swans swam S.

1714 3Bl flew over northern half of Lake 8. The swans swam S.

1716-18 Swans were preening, standing, swimming very close to shore.

1738 Both resting in same spot.

Lake 9:

Arrived 0855 Most ducks were at SW corner of lake. All swam away, scaup again being most nervous and swimming farthest.

1115 3Bl helicopter flew over west end of lake at 400'. No reaction observed from either group of ducks except slight bunching tendency. One group was mostly scaup with a few dabblers, other mostly oldsquaw with a few dabblers.

1130 3Bl flew E to W directly over scaup group, no noticeable reaction.

1550 3Bl flew over SE corner of lake. All ducks at SW end no reaction.

1707 3Bl flew directly over mixed group (scaup, oldsquaw, widgeon and pintail) at SW end of lake. Brief cessation of feeding and slight bunching tendency was observed.

Lake 1:

0845 Helicopter departing after letting observer off flushed white-fronted geese.

NOTE: It was later discovered that during this period from the 21st to 24th when both helicopters were supposed to fly at 300', only the 204 was doing so, the 3Bl was still at the 400' level.

AUGUST 24, 1972 - EXPERIMENTAL AREA:

Lake 1:

Flight 1 (No time) 204 helicopter flew over at about 200' flushed four of 15 white-fronted geese. Birds flew towards land then returned. Eleven stayed on water.

Flight 2 (Returned with cargo) entire flock of geese flew from land further towards center of lake.

Flight 3 About seven or eight geese left lake and did not return. No noticeable effect on other species of waterfowl.

Flight 4 (Return from Parsons with cargo) Six geese flying south towards center of lake. No others in sight.

Four long-billed dowitchers switched flight direction from north to south.

AUGUST 25, 1972 - EXPERIMENTAL AREA:

Lake 6:

1500 204 helicopter over lake. White-winged scoter (female and six young, Class II) were swimming on the water. Some, including the female were "asleep". All momentarily raised their heads during fly past, but then the heads, including the female's, were dropped quickly into the body again.

1650 204 flew over. White-winged scoter female and broods identical situation and reaction to 1500, except that female was a little longer, 20-30 seconds before putting her head down again. Female scaup with 10 young were swimming on water. There was little visible reaction although there may have been a little more diving in the two minutes after flyover.

Lake 9:

1255 204 helicopter flew over west shore of lake at 300'.

No reaction from oldsquaw and scaup and pintail and widgeon directly below.

1450 204 flew over west shore of lake. No reaction from oldsquaw.

1855 204 flew over west shore of lake. No reaction from oldsquaw and scaup.

Lake 1:

1250 204 flushed 18 white-fronted geese from North side of lake. These later returned when the aircraft disappeared.

1450 No effect from 204. Did not fly directly over flock.

1645 204 flushed all geese on water. They all returned later.

1850 Five geese were flying when 204 went over. No noticeable effect.

No time: 204 flushed two geese away from lake about 20 remained on the mud flats to feed. The aircraft had no effect on the two swans feeding, one bird did not even look up.

AUGUST 26, 1972:

Lake 6 and 8:

All observations are on Lake 6 unless otherwise stated.

0828-29 204 helicopter flew to base camp, 3/4 mile to the north. Female widgeon and young dabbling/swimming remained apparently undisturbed.

1239 204 seen and heard.

1241 204 flew over towards Parsons Lake camp. A feeding snipe froze.

1325 204 seen and heard.

1327 204 approached from south. Single adult scaup (a newcomer to the lake) took off, flying 50 yards and then landing.

1328 204 flew over. This scaup appeared agitated, swimming on the water making exaggerated backward and forward movements of the head and neck.

1331 Scaup was sleeping.

1340 Heard 204.

1344 204 seen to the east of Lake 8.

1346 204 flew over SE corner of Lake 6 carrying cabin. The same scaup (greater) took off, flew in a circle remaining over water all the time, and landed close to the take-off point by which time the helicopter was no more than 600 yards away.

1350 Four white-fronted geese (two adults + two young) arrived.

1402 Three white-fronted geese (two adults + one young) arrived.

1409 Geese ashore in SE corner. Some were grazing, the adults were watching with heads up.

1412 The geese were swimming. 204 heard.

1414 Geese ashore in SE corner as 204 flew past NW corner of lake. One or two geese were grazing. The adults were watching but made no move to fly.

1424 204 heard as geese continued to graze in SE corner.

1427 Twin Otter passed 1/2 mile to NW of lake. No reaction from the watching or grazing geese.

1432 204 seen heading for camp (Parsons 2).

1434 Geese on water in SE corner. They took flight as helicopter flew along W shore and head north. Unfortunately observer had to move to see the geese and cannot be certain that this movement was not responsible for the departure of geese.

1451 204 heard from Parsons Lake camp - this one was carrying a cabin.

1455 The other 204 heard to the south.

1459 They flew simultaneously along the west and east shores of the lake. Scaup female with 10 Class II young, continued swimming and diving without apparent concern during this traffic.

1545 204 flew 1/4 mile NW of lake, heading towards Parsons Lake camp. No birds seen to react.

1557 204 heard from camp.

1559 204 flew directly over lake. Fifteen oldsquaw sleeping, preening and swimming in the water, did not visibly react. A single scaup which, on plumage characteristics, may well have been the individual which reacted to previous flights, did not take flight.

1620 204 heard to the south.

1626 204 seen.

1631 204 flew over. No visible reaction from phalarope feeding by walking (not swimming) close to emergent vegetation.

1636 Second 204 heard to the south.

1641 Second 204 seen.

1643 204 flew over northwest corner of Lake 6 and along N shore of Lake 8. On the latter, two swans, which had been feeding on the shore since 1639, continued to do so. This flight was much higher than the others have been - 500'?

1701 204 heard at Parsons Lake camp.

1703 204 flew from east to west one mile N of Lake 6 and then turned S to pass 1/2 mile to W of Lake 6. No visible reaction from one pintail resting asleep ashore under the willows at the inter-lake channel. The generator was slung from the 204 on this flight.

1706 204 heard at Parsons Lake camp.

1709 204 flew directly over channel at 400' carrying fuel drums. Same non-reaction from single pintail asleep ashore in the channel.

1808 204 heard.

1820 204 seen to the south.

1821 204 arrived to pick up observer, scaring 17 oldsquaw off the sandbanks on which they were preening, but only when the helicopter had dropped to about 50'.

<u>Lake 9</u>:

1403 Fixed-wing Twin Otter on floats flew over west shore of lake at 300'. No reaction from widgeon.

1412 204 with load flew over at 200'. No reaction from oldsquaw directly below.

1425 Fixed-wing (Twin Otter) flew over at 500'. No reaction.

1435 204 flew over at 200'. Some of the scaup directly below dived. No other ducks (oldsquaw, widgeon) reacted.

1500 204 flew at 200' over SW corner of lake. Scaup reacted by sinking in water and turning about nervously as if looking for source of sound. No reaction from oldsquaw.

1547 204 flew at 200' over SE corner of lake. No reaction from brood of one female and six (Class II) young scaup.

1630 204 flew at 200' over SW corner of lake. No reaction from oldsquaw or scaup.

1710 204 flew over SE corner of lake. No reaction from brood of one female and six young scaup (Class II).

AUGUST 27, 1972 - EXPERIMENTAL AREA:

Lake 1:

On return flight to camp 3B1 flew over Lake 1 at 100' flushing white-fronted geese and causing widgeon to swim frantically away (observed from helicopter).

AUGUST 28, 1972 - EXPERIMENTAL AREA:

Lake 9:

1715 3B1 flew over Lake 9 at 100'. Widgeon swam frantically to shore (observed from helicopter).

APPENDIX V

WATERFOWL COUNTS IN EXPERIMENTAL AND CONTROL AREAS

AUGUST 9, 1972. EXPERIMENTAL AREA

LAKE NO.	1	2	3	4	5	6
Arctic Loon				1	2(2)	
Red-throated Loon	2					
Whistling Swan			2			4
White-fronted Goose	2(4), 125				2(3)	4(6)
Mallard				3		
Pintail	1(3), 17			1		
	1(6),					
Green-winged Teal	2, 12					
American Widgeon	1(9), 1(8)					
	1(5), 126					
Shoveler	4					
Scaup	1(5)					1(6)
Oldsquaw	3					1(3)
White-winged Scoter		NOT COUNTED				1(7)
Snipe	3					
Spotted Sandpiper	1					
Pectoral Sandpiper	4					
Least Sandpiper	2					
Dunlin						1
Short-billed Dowitcher	3					
Long-billed Dowitcher	1					
Stilt Sandpiper	5					
Semipalmated Sandpiper	12					1
Phalarope						5

AUGUST 11, 1972 CONTROL AREA

LAKE NO:	1	2	3	4	5	6	7
Arctic Loon	1	2		7			
Red-throated Loon							
Whistling Swan		2		2(4)			
White-fronted Goose							1, 2(3) 2(5)
Mallard							
Pintail	15, 1(3)			14	1		
Green-winged Teal	2, 1(11)						
American Widgeon	1(8), 1(5)			1(4), 1(5)			
Shoveler	2						
Scaup		11, 1(2) 1(10)	1(5), 1(6) 1(8), 33	1, 1(4) 1(5), 1(2) 5(9)			
Oldsquaw	1(4)	24	6, 1(2)	2(6), 8(11)			1
White-winged Scoter			1(12), 1(5) 1(5)				
Semipalmated Plover			1	1			
Whimbrel							
Lesser Yellowlegs				10			
Pectoral Sandpiper			2				
Stilt Sandpiper			3	16			
Semipalmated Sandpiper				38			
Phalarope	1		9	220			

AUGUST 11, 1972. (cont'd) CONTROL AREA

LAKE NO.	8	9	10	11	12	13	14	15	16
Arctic Loon	2(2)			1			2	4	1(1)
Red-throated Loon									
Whistling Swan				2				1	
White-fronted Goose									
Mallard									
Pintail				1(3)	1	1			
Green-winged Teal						1			
American Widgeon					1(6)				
Shoveler									
Scaup		15			5				
Oldsquaw		4	3, 1(5)		15				
White-winged Scoter									
Semipalmated Plover									
Whimbrel									
Lesser Yellowlegs									
Pectoral Sandpiper									
Stilt Sandpiper									
Semipalmated Sandpiper									
Phalarope									

AUGUST 11, 1972 (cont'd) CONTROL AREA

LAKE NO.	17	18	19	20	21	22	23	24	25	26	27	28
Arctic Loon			1(1)	2(1)				1	1(1)		2	
Red-throated Loon												
Whistling Swan			2	1					2(3)		1	
White-fronted Goose												
Mallard												
Pintail					2							
Green-winged Teal		1(11)			1							
American Widgeon												
Shoveler												
Scaup	1(5), 1(6)				6(7)	1(6)			1(2)	8		
Oldsquaw					1(5)	1(5)				2(7)		
White-winged Scoter						1(3)						
Semipalmated Plover												
Whimbrel									8			
Lesser Yellowlegs												
Pectoral Sandpiper												
Stilt Sandpiper												
Semipalmated Sandpiper												
Phalarope												

AUGUST 12, 1972.

EXPERIMENTAL AREA

LAKE NO.	1	2	3	4	5	6	7	8
Arctic Loon	3	2	1		1	2		2
Red-throated Loon	6							
Whistling Swan	2				2		2	5
White-fronted Goose	43		2			2		
Mallard	1							
Pintail	11	1, 1(4)						
Green-winged Teal	1(2)							
American Widgeon	184, 2(6) 1(5), 1(6) 1(7), 8						1(3)	
Shoveler								
Scaup		1				1(7), 1	8(6)	
Oldsquaw	5	4(10)		2		10	1(11)	2
White-winged Scoter						1(6)	2(11)	
Golden Plover	1							
Snipe	6							
Pectoral Sandpiper	6, 2							
Least Sandpiper	2							
Long-billed Dowitcher	3							
Stilt Sandpiper	7							
Semipalmated Sandpiper	4							
Phalarope						32		

AUGUST 12, 1972 (cont'd) EXPERIMENTAL AREA

LAKE NO.	9	10	11	12	13
Arctic Loon	4			2	
Red-throated Loon					
Whistling Swan	2				
White-fronted Goose					
Mallard	2				1
Pintail	1(6), 15	9			
Green-winged Teal					
American Widgeon	1(4), 1(6) 1(6), 1(6), 15				
Shoveler					
Scaup	1(5), 1(6), 1(7) 1(3), 1(2), 1(6) 1(3), 1(3), 34	11	16		
Oldsquaw	90, 2(4)	3	11		1
White-winged Scoter					
Golden Plover					
Snipe					
Pectoral Sandpiper					
Least Sandpiper					
Long-billed Dowitcher					
Stilt Sandpiper					
Semipalmated Sandpiper					
Phalarope	87		35		6

AUGUST 17, 1972

CONTROL AREA

LAKE NO.	1	2	3	4	5	6	7	8	9	10
Arctic Loon		4			2		1	1(2)		
Red-throated Loon										
Whistling Swan		2		2(4)						
White-fronted Goose										
Mallard										
Pintail	37		2	18			1		6	
Green-winged Teal	3, 1(3)									
American Widgeon	72(30)			6, 1(6) 2(10)						
Shoveler	1(3)									
Scaup	4	23	1(4), 1(5) 1(3), 1(2) 1(5), 45	1(3), 1(2) 1(5), 1(6) 1(4), 15			8		14	3
Oldsquaw		26	12(5)	30, 1(8)			1		1	
White-winged Scoter	1(4)		1(12), 3							
Surf Scoter										
Snipe				2						
Pectoral Sandpiper		2		7	3					
White-rumped Sandpiper				1						
Baird's Sandpiper				5						
Stilt Sandpiper				20						
Semipalmated Sandpiper				8						
Sanderling				1						
Phalarope			52	81						

AUGUST 17, 1972 (cont'd)

CONTROL AREA

LAKE NO.	11	12	13	14	15	16	17	18	19	20	21	22
Arctic Loon	1		2(1)	2	2	2(1)			1(1)	2(1), 1	1	
Red-throated Loon								2				
Whistling Swan				2	2					1		
White-fronted Goose			1									
Mallard											1	
Pintail			1									
Green-winged Teal							1					
American Widgeon	1											
Shoveler												
Scaup	1(6), 1(5) 5, 4(35)	1					4(17)				1(4), 4	1(1)
Oldsquaw	17	9					2				1(5)	(5)
White-winged Scoter	1(6)											1(3)
Surf Scoter					1							
Snipe												
Pectoral Sandpiper												
White-rumped Sandpiper												
Baird's Sandpiper												
Stilt Sandpiper												
Semipalmated Sandpiper												
Sanderling												
Phalarope												

AUGUST 17, 1972 (cont'd) CONTROL AREA

LAKE.NO.	23	24	25	26	27	28
Arctic Loon		7	1(1)			1
Red-throated Loon						
Whistling Swan		1	2(3)			
White-fronted Swan						
Mallard						
Pintail						
Green-winged Teal						
American Widgeon						
Shoveler						
Scaup				8		
Oldsquaw				6	3	
White-winged Scoter						
Surf Scoter						
Snipe						
Pectoral Sandpiper						
White-rumped Sandpiper						
Stilt Sandpiper						
Semipalmated Sandpiper						
Sanderling						
Phalarope						

AUGUST 18, 1972. EXPERIMENTAL AREA

LAKE NO.	1	2	3	4	5	6	7	8	9
Arctic Loon	12	2	2		2(2)	1		2	2
Red-throated Loon	14			1					
Whistling Swan	6		3	1			2		3
White-fronted Goose	6(10)		1(4) OR 2(3)					11	
Mallard									
Pintail	12								10, 1(6) 14,
Green-winged Teal	15								
Widgeon	145, 1(7)						1		1(6), 1(4)
Shoveler									
Scaup	5	1				1(5)	5	1(7)	1, (5), 1(5), 1(3) 1(2), 30, 1(7), 1(6) 1(5)
Oldsquaw	7	15		2		13	14	1(9)	90, 1(10)
White-winged Scoter							1(11), 1	1(7)	
Snipe	3								
Long-billed Dowitcher	11								
Stilt Sandpiper	7								
Semipalmated Sandpiper	1								
Phalarope	1					17	39		

AUGUST 18, 1972 (cont'd). EXPERIMENTAL AREA

LAKE NO.	10	11	12	13	14
Arctic Loon		2	2		
Red-throated Loon					
Whistling Swan					
White-fronted Goose					
Mallard				1	
Pintail	8				2
Green-winged Teal					
Widgeon					
Shoveler					
Scaup	6	8			3
Oldsquaw	3	12		1	1
White-winged Scoter					
Snipe				1	
Long-billed Dowitcher					
Stilt Sandpiper					
Semipalmated Sandpiper					
Phalarope				14	

AUGUST 23, 1972

CONTROL AREA

LAKE NO.	1	2	3	4	5	6	7	8	9	10
Arctic Loon	2	6			NOT COVERED			2(2)		
Red-throated Loon		2								
Whistling Swan	1	2	1	2(4)						
White-fronted Goose										
Mallard										
Pintail	20			6					1	
Green-winged Teal	8									
Widgeon	1(9), 90									
Scaup	1(4)	6(9), 1(3)	95	1(6) 22					5	2
Oldsquaw	1	40	10	32					1	
White-winged Scoter			1(7)							
Whimbrel		7								
Lesser Yellowlegs			2							1
Pectoral Sandpiper	4		3							
Phalarope			32							

AUGUST 23, 1972 (cont'd)

CONTROL AREA

LAKE NO.	11	12	13	14	15	16	17	18	19	20
Arctic Loon			1(1)	2	2	2(1)	2		2	2(1)
Red-throated Loon								2		
Whistling Swan					2					
White-fronted Goose	14			9						
Mallard										
Pintail			1							
Green-winged Teal								1		
Widgeon										
Scaup	1(5), 1(7)				1(10or11)		1(6)			
	1(8), 2(20)									
	1(2), 1(4)									
	(3), (5), 2									
Oldsquaw	10	8					3			
White-winged Scoter	1(11), 1(6)									
Surf Scoter					1					
Whimbrel										
Lesser Yellowlegs								1		
Pectoral Sandpiper										
Phalarope										

AUGUST 23, 1972 (Cont'd)

CONTROL AREA

LAKE NO.	21	22	23	24	25	26	27	28
Arctic Loon				4	1(1)			2
Red-throated Loon								
Whistling Swan		1		2(3)				
White-fronted Goose								
Mallard								
Pintail			M		6			
Green-winged Teal	1		1					
Widgeon						1(1)		
Scaup	3,1(1)	1(1)				6	(1)	
Oldsquaw	4	5	L			5	1,1(3)	
White-winged Scoter		1(3)						
Surf Scoter								
Whimbrel								
Lesser Yellowlegs								
Pectoral Sandpiper								
Phalarope								

AUGUST 24, 1972

EXPERIMENTAL AREA

LAKE NO.	1	2	3	4	5	6	7	8	9
Arctic Loon			6		2,1(1)			4	4
Red-throated Loon	12								2
Whistling Swan	5		5					2	2
White-fronted Goose	15				5				
Mallard				6					
Pintail	2	4		1	1		10		14
Green-Winged Teal	12								
Widgeon	29,52,1(7)								35
Scaup	5	1				1(7),7	22,1(2)		30,1(6), 1(6),1(4
Oldsquaw	1	12		3		11	12		65
White-Winged Scoter							1	1(6),1(7)	
Snipe	8								
Whimbrel	16								
Pectoral Sandpiper	2								
Long-billed Dowitcher	4								
Stilt Sandpiper	1								
Phalarope						64			

AUGUST 24, 1972 (Cont'd)

LAKE NO.	EXPERIMENTAL AREA 10	11	12	13	14
Arctic Loon			2		
Red-throated Loon					
Whistling Swan		2			
White-fronted Goose					
Mallard				1	
Pintail				7	2
Green-winged Teal				2	3
Widgeon					
Scaup	6	4			5
Oldsquaw	4	9		2	3
White-winged Scoter					
Snipe					
Whimbrel					
Pectoral Sandpiper					
Long-billed Dowitcher					
Stilt Sandpiper					
Phalarope		12			1

AUGUST 27, 1972

CONTROL AREA

LAKE NO.	1	2	3	4	5	6	7	8	9	10	11
Arctic Loon		2						2(2)			2
Red-throated Loon		1									
Whistling Swan		2		2(4)							
White-fronted Goose	8										
Mallard											
Pintail	20		1	14	1(3)		1				
Green-winged Teal											
Widgeon	80	1		21							2
Scaup		39	130(1) 1(3)	1(6),5		1	2		5	2	24,7(33), 1(6),1(5) 1(2)
Oldsquaw		24	20	42	1	1			1	1	6
White-winged Scoter		1(4),2									1(12),1
Snipe			2		1						
Pectoral Sandpiper	10										
Phalarope											

AUGUST 27, 1972 (Cont'd)

CONTROL AREA

LAKE NO.	12	13	14	15	16	17	18	19	20	21	22	23
Arctic Loon		1(1)	2	2	4			2(1)	1		6	
Red-throated Loon												
Whistling Swan								2				
White-fronted Goose							7					
Mallard										N		N
Pintail			1									
Green-winged Teal							(5)			I		I
Widgeon												
Scaup	1(6)				1(6)	2	1(4)			L	1	L
Oldsquaw	4										3	
White-winged Scoter											1(3)	
Snipe												
Pectoral Sandpiper												
Phalarope												

AUGUST 27, 1972 (Cont'd)

CONTROL AREA

LAKE NO.	24	25	26	27	28
Arctic Loon	5	1(1)			
Red-throated Loon					
Whistling Swan		1		2	2(3)
White-fronted Goose					
Mallard					
Pintail			1		1
Green-winged Teal					
Widgeon					
Scaup			2	(1)	
Oldsquaw			4	7	
White-winged Scoter					
Snipe					
Pectoral Sandpiper					
Phalarope		1			

AUGUST 28, 1972

EXPERIMENTAL AREA

LAKE NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Arctic Loon	2	3	3	4	2(2)			2	2			2		
Red-throated Loon	10								1(2)					
Whistling Swan	4		2					2	2		2			
White-fronted Goose	52													
Mallard		6												
Pintail	25	6		1	1				5	2			7	
Green-winged Teal	15													
Widgeon	26		15				3		55,1(5)					
Canvasback	3													
Scaup	20	5				1(7),8	10		7,1(4), 1(8)	5	2			5
Oldsquaw	10	10		3		11	19		46	4	16		1	4
White-winged Scoter							1	1(6),1(7)						
Snipe	3												1	
Pectoral Sandpiper	7		1								2		1	
Long-billed Dowitcher	12													
Phalarope	1					1	9				13			

APPENDIX VI

RAPTOR SIGHTINGS DURING SURVEY OF SEISMIC ACTIVITY

DATE	NO.	SPECIES	LOCATION
July 21	1	Rough-legged hawk	Seismic Line G.
July 22	2	Marsh Hawk	Transects over Seismic area.
August 2	2	Golden Eagle	Seismic Line H.
August 10	1	Gyrfalcon	1/2 mile south of Parsons Lake.
August 11	1	Golden Eagle	
	1	Rough-legged Hawk	Control Area.
	1	Marsh Hawk	
August 13	1	Marsh Hawk	Experimental Area.
August 15	1	Bald Eagle	Globe Camp 3.
August 16	1	Golden Eagle	Caribou Hills one mile south of Globe Camp 3.
	1	Rough-legged Hawk	
August 17	2	Bald Eagle	
	1	Short-eared Owl	Control Area.
	1	Rough-legged Hawk	
August 18	1	Bald Eagle	Experimental Area.
	1	Eagle Sp.	
August 19	1	Bald Eagle	Experimental Area.
August 22	1	Marsh Hawk	Globe Camp 3.
August 24	1	Bald Eagle	Experimental Area.
	1	Gyrfalcon	Experimental Area.
	1	Rough-legged Hawk	Seismic Line B.
August 25	1	Bald Eagle	
	1	Gyrfalcon	Experimental Area.
	1	Hawk Sp.	
August 26	1	Pigeon Hawk	Experimental Area.
	1	Bald Eagle	
August 27	1	Marsh Hawk	Control Area
	2	Bald Eagle	
August 28	2	Bald Eagle	Experimental

APPENDIX VII

SCIENTIFIC NAMES OF BIRDS MENTIONED IN REPORT

Arctic Loon	*Gavia arctica*
Red-throated Loon	*Gavia stellata*
Whistling Swan	*Olor columbianus*
Canada Goose	*Branta canadensis*
White-fronted Goose	*Anser albifrons*
Snow Goose	*Chen hyperborea*
Mallard	*Anas platyrhynchos*
Pintail	*Anas acuta*
Green-winged Teal	*Anas carolinensis*
American Widgeon	*Mareca americana*
Shoveler	*Spatula clypeata*
Canvasback	*Aytha valisineria*
Greater Scaup	*Aythya marila*
Lesser Scaup	*Aythya affinis*
Common Goldeneye	*Bucephala clangula*
Oldsquaw	*Clangula hyemalis*
White-winged Scoter	*Melanitta deglandi*
Surf Scoter	*Melanitta perspicillata*
Red-breasted Merganser	*Mergus serrator*
Rough-legged Hawk	*Buteo lagopus*
Golden Eagle	*Aquila chrysaetos*
Bald Eagle	*Haliaeetus leucocephalus*

Marsh Hawk	*Circus cyaneus*
Gyrfalcon	*Falco rusticolus*
Pigeon Hawk	*Falco columbarius*
Semipalmated Plover	*Charadrius semipalmatus*
American Golden Plover	*Pluvialis dominica*
Common Snipe	*Capella gallinago*
Whimbrel	*Numenius phaeopus*
Spotted Sandpiper	*Actitis macularia*
Lesser Yellowlegs	*Totanus flavipes*
Pectoral Sandpiper	*Erolia melanotos*
White-rumped Sandpiper	*Erolia fuscicollis*
Baird's Sandpiper	*Erolia bairdii*
Least Sandpiper	*Erolia minutilla*
Dunlin	*Erolia alpina*
Short-billed Dowitcher	*Limnodromus griseus*
Long-billed Dowitcher	*Limnodromus scolopaceus*
Stilt Sandpiper	*Micropalama himantopus*
Semipalmated Sandpiper	*Ereunetes pusillus*
Sanderling	*Crocethia alba*
Northern Phalarope	*Lobipes lobatus*
Parasitic Jaeger	*Stercorarius parasiticus*
Long-tailed Jaeger	*Stercorarius longicaudus*
Glaucous Gull	*Larus hyperboreus*
Herring Gull	*Larus argentatus*
Short-eared Owl	*Asio flammeus*
Raven	*Corvus corax*