

1110-4-2

WATERBIRD SURVEYS OF MCKINLEY BAY
NORTHWEST TERRITORIES, 1983

by

Beth J. Cornish

and

D. Lynne Dickson

Canadian Wildlife Service

Edmonton, Alberta

Prepared for:

CANADIAN WILDLIFE SERVICE

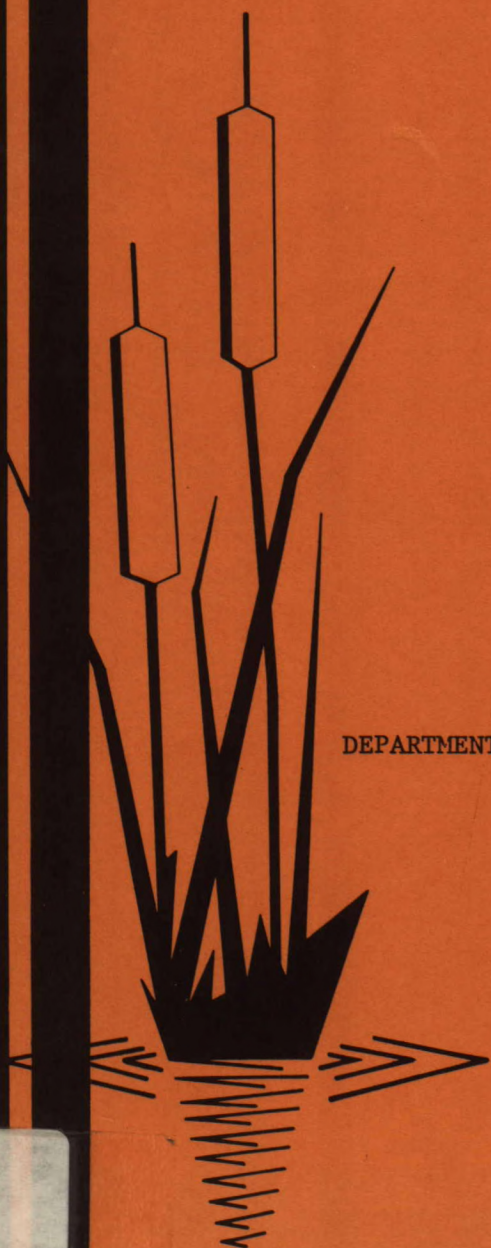
DOME PETROLEUM LIMITED

and

DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

January 1984

CANADIAN WILDLIFE SERVICE —



R1160

WATERBIRD SURVEYS OF MCKINLEY BAY
NORTHWEST TERRITORIES, 1983

by

Beth J. Cornish

and

D. Lynne Dickson

Canadian Wildlife Service

Edmonton, Alberta

Prepared for:

CANADIAN WILDLIFE SERVICE

DOME PETROLEUM LIMITED

and

DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

January 1984

SUMMARY

In anticipation of development of a medium draft harbour in McKinley Bay to support future oil and gas production in the Beaufort Sea, a study to monitor the abundance and distribution of birds in McKinley Bay was initiated in 1981 (Scott-Brown et al. 1981) and continued in 1982 and 1983. Emphasis was placed on determining the natural annual fluctuation in numbers of moulting diving ducks. In 1982 and 1983, Hutchison Bay was also surveyed as a control.

The aerial surveys in 1983 were conducted on August 5, 6 and 8. On August 5, the day when survey conditions were best, the number of diving ducks at McKinley Bay was estimated to be $12\ 799 \pm 2299$, while at Hutchison Bay on the same day the estimated number was $13\ 635 \pm 2488$ diving ducks. Scoter and Oldsquaw, in that order of abundance, were the two most common species observed at both bays.

No significant change in the total number of diving ducks at either bay was detected ($p > 0.05$) between the years 1981, 1982 and 1983. However, significantly more scaup were present in McKinley Bay on August 10, 1981 than on August 10, 1982 or August 5, 1983 ($p < 0.05$), and there were significantly more scoter on August 5, 1983 than on August 10, 1981 ($p < 0.05$). The variation in the number of moulting scoter and scaup seen in McKinley Bay between the three years may be related to the timing and success of breeding each year.

In 1983, as in previous studies at McKinley Bay, concentrations of diving ducks were consistently seen in the area south of the spit at Atkinson Point. The highest concentrations of scoter were seen at the

south end of the bay. Unlike other years, concentrations of diving ducks were also seen just south of the artificial island in 1983.

Brant, Greater White-fronted Geese, and Tundra Swans were observed at both bays, primarily on the terrestrial component. At McKinley Bay, geese occurred especially in the small embayments near Atkinson Point and on the lagoon system south of the bay, whereas swans were widely scattered on lakes and ponds as well as on the lagoon.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the following persons for their contribution to the study in 1983: H. Loney Dickson who assisted with the aerial surveys, G.E. John Smith who provided assistance with the data analysis, Roger Edwards, Brad Arner, Arni Goodman and John Ward who edited the manuscript, Susan Popowich who drafted the figures and Laurie Peck who typed the manuscript.

This study was jointly funded by the Canadian Wildlife Service, the Department of Indian Affairs and Northern Development and Dome Petroleum Limited. Polar Continental Shelf Project of the Department of Energy, Mines and Resources provided logistical support.

TABLE OF CONTENTS

	Page
SUMMARY	i
ACKNOWLEDGEMENTS	iii
LIST OF TABLES	v
LIST OF FIGURES	vi
1.0 INTRODUCTION	1
2.0 METHODS	2
2.1 Aerial Surveys	2
2.2 Analysis of Data	7
3.0 RESULTS	9
3.1 Survey Conditions	9
3.2 Abundance	10
3.2.1 Marine Component	10
3.2.2 Terrestrial Component	20
3.3 Comparison of Surveys - 1981, 1982, 1983	24
3.4 Distribution	27
3.4.1 Marine Component	27
3.4.2 Terrestrial Component	35
3.5 Flock Size	37
4.0 DISCUSSION	37
5.0 LITERATURE CITED	41
APPENDIX A	43
APPENDIX B	45
APPENDIX C	55

LIST OF TABLES

Table	Page
1. Division of the McKinley Bay and Hutchison Bay study areas into three components for the 1983 aerial surveys.	6
2. Number and density of birds observed on the marine component during aerial surveys at McKinley Bay, 1983.	11
3. Number and density of birds observed on the marine component during aerial surveys at Hutchison Bay, 1983.	12
4. Estimated populations of birds on the marine component at McKinley Bay based on aerial surveys, 1983	14
5. Estimated populations of birds on the marine component at Hutchison Bay based on aerial surveys, 1983	15
6. Species composition and density of diving ducks observed on the marine component during aerial surveys at McKinley Bay, 1983.	16
7. Species composition and density of diving ducks observed on the marine component during aerial surveys at Hutchison Bay, 1983.	17
8. Population estimates of the diving ducks on the marine component at McKinley Bay and Hutchison Bay, August 5, 1983 based on aerial survey data.	18
9. Number and density of birds observed on the terrestrial component during aerial surveys at McKinley Bay, 1983.	21
10. Number and density of birds observed on the terrestrial component during aerial surveys at Hutchison Bay, 1983.	22
11. Comparison of results of aerial surveys conducted August 10 in 1981 and 1982 and August 5 in 1983 on the marine component, McKinley Bay.	25
12. Comparison of results of aerial surveys conducted August 10 in 1982 and August 5 in 1983 on the marine component, Hutchison Bay.	26

LIST OF FIGURES

Figure	Page
1. Aerial transects flown at McKinley Bay, August 5, 6 and 8, 1983, showing the divisions of the study area into marine, terrestrial and outside components.	3
2. Aerial transects flown at Hutchison Bay, August 5, 6 and 8, 1983, showing the divisions of the study area into marine, terrestrial and outside components.	4
3. Distribution of waterfowl observed on aerial transects at McKinley Bay, August 5, 1983.	28
4. Distribution of waterfowl observed on aerial transects at McKinley Bay, August 6, 1983.	29
5. Distribution of waterfowl observed on aerial transects at McKinley Bay, August 8, 1983.	30
6. Distribution of waterfowl observed on aerial transects at Hutchison Bay, August 5, 1983.	32
7. Distribution of waterfowl observed on aerial transects at Hutchison Bay, August 6, 1983.	33
8. Distribution of waterfowl observed on aerial transects at Hutchison Bay, August 8, 1983.	34

1.0 INTRODUCTION

McKinley Bay is a shallow protected bay on the north side of Tuktoyaktuk Peninsula, NWT, in the eastern Beaufort Sea. Since 1979 it has been the site of a winter harbour and support base used by Dome Petroleum Limited for oil and gas exploration in the Beaufort Sea. Dredging in the bay began in September of 1979 with construction of an entrance channel and mooring basin in the northeast portion of the bay. Storm-driven ice shoved against the ships moored in this basin the following winter. Consequently in 1980 another mooring basin was dredged in a more sheltered location to the southwest. An island to the north of the basin was created with the dredged spoils to further protect the moored ships from storms and ice movement. In 1981, docking facilities were constructed, and the artificial island and the basin were expanded. Major activity directed towards continuing the development of the harbour did not occur in 1982 or 1983.

Vessels that were overwintered in McKinley Bay in 1982-83 included a drydock, 4 drillships, 2 icebreakers, 8 supply vessels, 1 floating personnel camp, 1 cutter suction dredge, 3 suction hopper dredges and the Canmar Shuttle fuel barge. In the 1983 summer months, the Canmar Shuttle fuel barge, the drydock and the Single Steel Drill Caisson were in McKinley Bay. There was other vessel traffic, as well as aircraft traffic, to and from the harbour throughout the summer.

In the future, McKinley Bay may become a major year-round support base for Beaufort Sea oil and gas development (Dome, Esso and Gulf 1982). Proposals for development of the harbour could include an airstrip, expanded accommodation for up to 500 personnel, a floating topping plant,

power generators, a marine maintenance and repair facility, an expanded mooring basin, equipment storage and fuel storage to refuel the drill-ships.

The Canadian Wildlife Service was concerned that these developments could adversely affect the migratory bird usage of the area. A bird monitoring study involving aerial surveys with joint government and industry participation was therefore initiated in 1981 (Scott-Brown et al. 1981), and continued in 1982 (Cornish and Allen 1983) to describe waterbird usage of McKinley Bay prior to extensive development. Several years of monitoring were needed to establish natural annual fluctuations in the number of birds in the bay, in order that possible changes in bird usage of the bay as a result of further development could be detected. This report presents the results of the 1983 continuation of the study. As in 1982, Hutchison Bay, a relatively undeveloped area on the Tuktoyaktuk peninsula 45 km west of McKinley Bay was used as a control. Emphasis remained on documenting the number and distribution of moulting diving ducks due to their vulnerability to oil if spilled and their abundance in McKinley Bay.

2.0 METHODS

2.1 Aerial Surveys

The aerial surveys of McKinley Bay and Hutchison Bay in 1983 were carried out using the same study design as in 1982 (Cornish and Allen 1983) and 1981 (Scott-Brown et al. 1981) to allow a statistical comparison between the three years of data. East-west transects were flown 2 km apart (Figs. 1 and 2) in a Cessna 185 with floats at an elevation of 20-30 m above ground level (agl) at an average speed of 145 km/h. One observer on each side of the aircraft counted all birds seen within 180 m

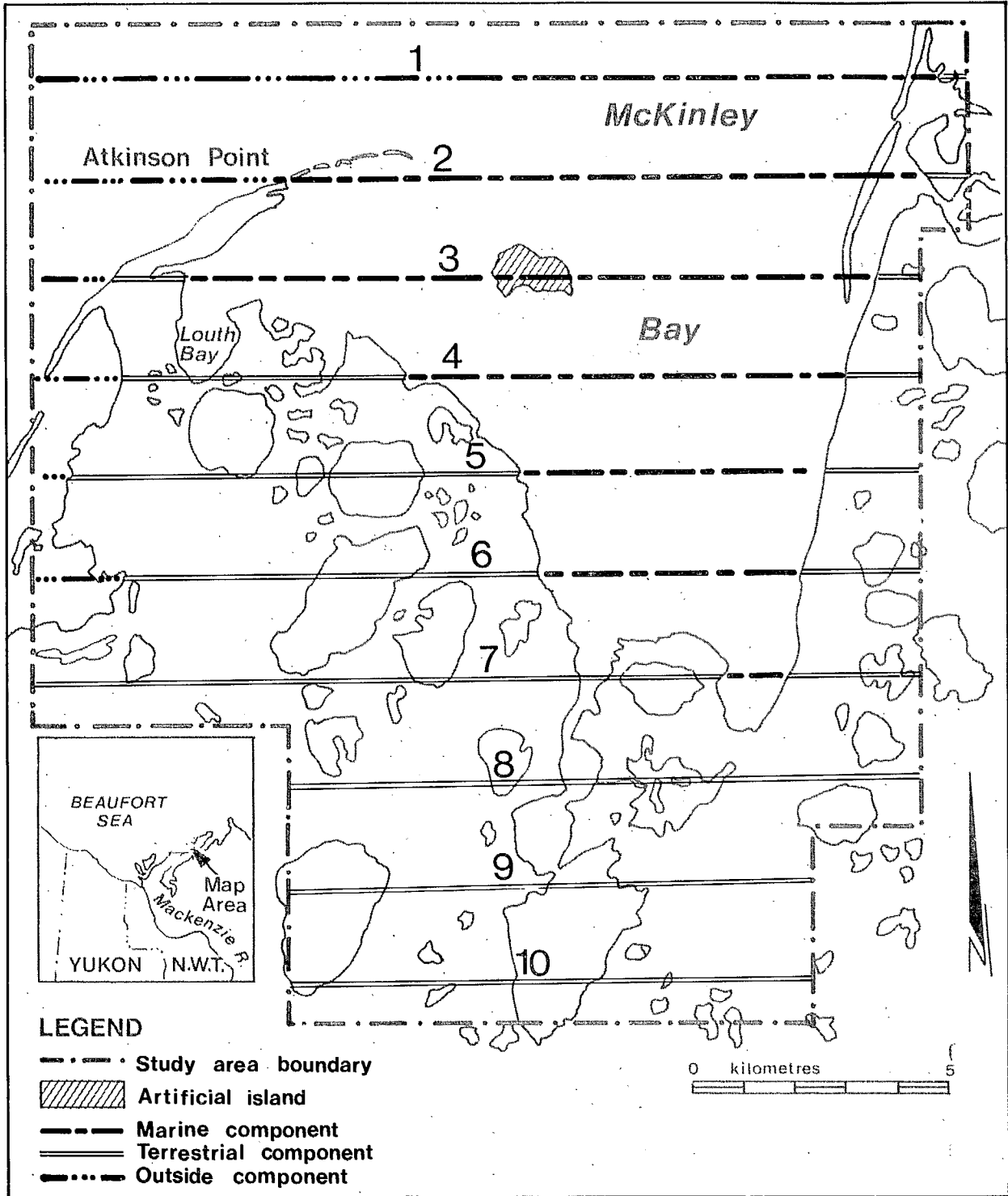


Figure 1. Aerial transects flown at McKinley Bay, August 5, 6 and 8, 1983, showing the divisions of the study area into marine, terrestrial and outside components.

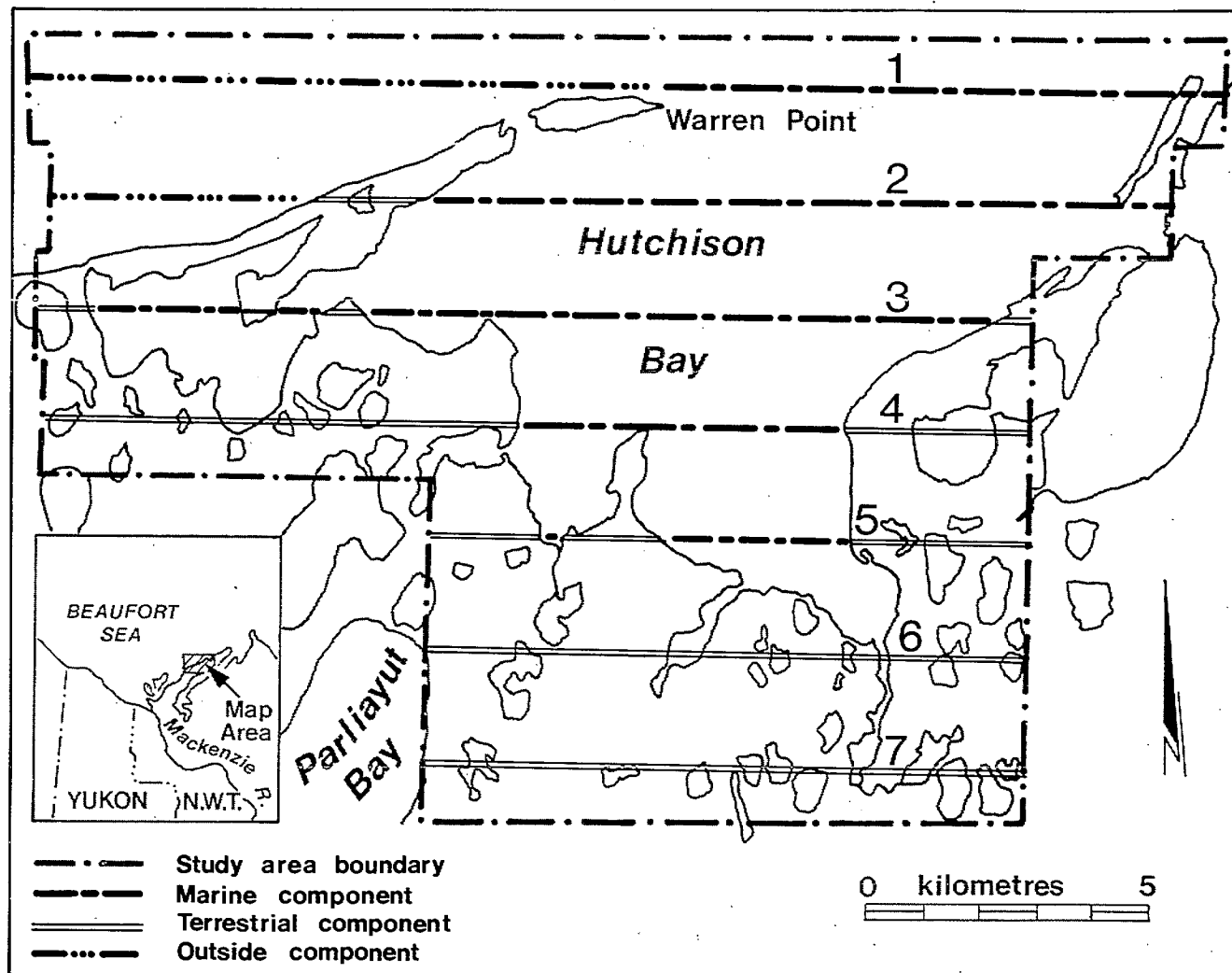


Figure 2. Aerial transects flown at Hutchison Bay, August 5, 6 and 8, 1983, showing the divisions of the study area into marine, terrestrial and outside components.

of that side, so that the total transect width was 360 m. When time permitted, "off transect" birds, more than 180 m from the plane, were also recorded, but were not included in calculations. Observations were dictated into tape recorders so that observers never had to look away from the transect.

In 1981 and 1982, the surveys were flown at 10-day intervals to measure seasonal variations in abundance. The surveys by boat in 1982 showed that in a typical year the first half of August was the peak period of moult for diving ducks in the bay. Also, it became apparent that good survey conditions were imperative for accurate survey results. Thus, in 1983, starting at the beginning of August, we waited to survey only on days when it appeared survey conditions would be good. Accordingly, aerial surveys were flown on August 5, 6 and 8.

As in previous years, the study area at McKinley Bay was divided into three components: a marine component inside McKinley Bay, a terrestrial component, and a section of marine habitat outside McKinley Bay called the outside component (Fig. 1). The marine component encompassed all saltwater areas within McKinley Bay including exposed sandspits which were intermittently washed over by tides. The terrestrial component covered all land areas including inland lakes and the lagoon system at the south end of the bay. The area west of Atkinson Point, the small bay at the west end of transects 4 to 6, and the western half of transect 1 were considered the outside component and were omitted from the data analysis. The areas of each component and the proportions surveyed are listed in Table 1. The total size of the study area was 305 km². The area of the marine section of McKinley Bay was 108.5 km² and the terrestrial section was 158.5 km².

Table 1. Division of the McKinley Bay and Hutchison Bay study areas into three components for the 1983 aerial surveys.

Component	McKinley Bay		Hutchison Bay	
	Total area (km ²)	Area surveyed (km ²)	Total area (km ²)	Area surveyed (km ²)
Marine	108.5	19.6	100.5	17.8
Terrestrial	158.5	28.3	91.0	16.3
Outside	38.0	6.9	31.5	5.8
TOTAL	305.0	54.8	223.0	39.9

As in 1982, aerial surveys were conducted at Hutchison Bay on the same day as McKinley Bay was surveyed, using identical procedures.

The study area at Hutchison Bay was divided into marine, terrestrial and outside components comparable to the McKinley Bay components (Fig. 2). Sandspits intermittently washed over by tides were considered marine. Other land areas and all inland lakes were part of the terrestrial component. The saltwater areas west of Warren Point and the area covered by the western half of transect 1 were considered outside of Hutchison Bay. Table 1 presents the areas of the components at Hutchison Bay and proportions surveyed.

The terms "diving ducks" and "divers", which are used throughout this report in tables and discussions, refer to ducks belonging to both subfamilies Aythyinae and Merginae.

2.2 Analysis of Data

- (1) Since transects were of varying length in the survey, the mean density \hat{R} was found by using the ratio estimate:

$$\hat{R} = \bar{y}/\bar{x}$$

where \bar{y} = average count of birds on the transects

\bar{x} = average area of the transects

- (2) Population estimates were calculated by multiplying the mean density of birds counted (\hat{R}) by the total area of the study component.

(3) Standard errors of the population estimates were calculated using the method by Kingsley and Smith (1980) for systematic surveys with transects of varying length. This method is based on examples that show that since systematic surveys are by design usually more efficient than random surveys, their precision is underestimated if the results are analyzed as though from a random survey.

$$\text{Standard error} = \sqrt{\text{Variance}} = \sqrt{S_1^2}$$

$$S_1^2 = \frac{(1-f) \sum_{i=1}^{n-1} (d_i - d_{i+1})^2}{2 \cdot (n-1) \cdot n \cdot \bar{x}^2}$$

where

d_i = modified count = $y_i - \hat{R} x_i$

\hat{R} = density estimate

y_i = count on the i th transect

x_i = area of the i th transect

f = the fraction of the entire study area sampled = $\frac{n}{N}$

n = number of transects sampled

N = number of transects possible in the population

- (4) Three aerial surveys were conducted each year from 1981 to 1983. Survey conditions varied for each survey, and the survey with the best conditions was chosen from each year for comparison with other years. The August 10 surveys in 1981 and 1982 and the August 5 survey in 1983 were chosen for comparison because on these dates the survey conditions were regarded as "good". The differences and standard errors of the changes in population estimates between the three years were calculated using the same formula as above. The y_i value then became the difference between years of counts on each transect for the value y_i . The confidence intervals were calculated at the 0.10 and 0.05 levels of significance. The difference in population estimates between years was considered significant if the confidence interval did not include zero.

3.0 RESULTS

3.1 Survey Conditions

On August 5, the aerial surveys of McKinley Bay and Hutchison Bay were conducted between the hours of 1145 and 1410. Survey conditions on this day were regarded as "good". There was 50% cover of low clouds plus a broken layer of cirrus. These cloud conditions sometimes resulted in a mild glare that made bird identifications difficult. However, glare was not considered a serious problem. The temperature was 14°C and there was no precipitation. Winds were light (0 to 8 km/h) from the northeast and sea conditions were almost calm.

The aerial surveys on August 6 were conducted from 1050 to 1317. The only cloud present was a broken cover of thin cirrus which resulted in a bright haze. Visibility for observers was restricted in one direction due to glare from the sun. There was no precipitation, the temperature was 12°C and winds were 15-25 km/h from the south. There were moderate waves at both bays with occasional whitecaps. Conditions on August 6 were described as "fair".

Survey conditions during the August 8 surveys varied between McKinley Bay and Hutchison Bay. For the survey at McKinley Bay, conducted from 1220 to 1405, conditions were "fair to good" with 80-100% cloud cover, no precipitation, temperatures at 17°C and winds at 15-20 km/h. Waves were moderate, and glare was not a serious problem. By the time the survey at Hutchison Bay began at 1405, cloud cover had decreased to 10% and glare off the water now made counts and identification difficult in one direction. Also, winds had increased to 25-30 km/h causing waves with occasional whitecaps. Overall conditions for the survey at Hutchison Bay on August 8 were described as "poor to fair".

3.2 Abundance

3.2.1 Marine Component

Numbers and densities of birds seen on the marine components of McKinley and Hutchison bays are presented in Tables 2 and 3 respectively. At both bays, the largest number of birds were observed on the August 5 survey; this was also considered the best survey, in terms of weather conditions, of the three days of surveys. At Hutchison Bay, the total number of birds seen on the marine component on August 5 was about three

Table 2. Number and density of birds observed on the marine component during aerial surveys at McKinley Bay, 1983. Area of marine component surveyed = 19.6 km².

Species	August 5		August 6		August 8	
	Number	Density (birds/km ²)	Number	Density (birds/km ²)	Number	Density (birds/km ²)
Loons	31	1.58	8	0.41	13	0.66
Swans	0	-	0	-	0	-
Geese	0	-	0	-	8	0.41
Dabbling ducks	1	0.05	0	-	1	0.05
Diving ducks	2312	117.96	1443	73.62	1908	97.35
Unidentified ducks	14	0.71	52	2.65	11	0.56
Shorebirds	81	4.13	63	3.21	44	2.24
Jaegers	0	-	0	-	0	-
Gulls	47	2.40	82	4.18	13	0.66
Terns	4	0.20	11	0.56	4	0.20
TOTAL BIRDS	2490	127.04	1659	84.64	2002	102.04

Table 3. Number and density of birds observed on the marine component during aerial surveys at Hutchison Bay, 1983. Area of marine component surveyed = 17.8 km².

Species	August 5		August 6		August 8	
	Number	Density (birds/km ²)	Number	Density (birds/km ²)	Number	Density (birds/km ²)
Loons	17	0.95	13	0.73	7	0.39
Swans	0	-	1	0.06	8	0.45
Geese	35	1.97	37	2.08	30	1.68
Dabbling ducks	0	-	5	0.28	8	0.45
Diving ducks	2415	135.67	1642	92.25	732	41.12
Unidentified ducks	7	0.39	0	-	6	0.34
Shorebirds	0	-	8	0.45	4	0.22
Jaegers	0	-	0	-	0	-
Gulls	23	1.29	78	4.38	25	1.40
Terns	1	0.06	2	0.11	13	0.73
TOTAL BIRDS	2498	140.34	1786	100.34	833	46.80

times the number of birds seen on August 8 when surveying conditions were "poor to fair".

Estimates of the number of each species group using the marine component of each bay are given in Tables 4 and 5. No estimates are given for swans, dabbling ducks, or jaegers because observations of these birds were rare on the marine component. The population of diving ducks on the marine component on August 5 was estimated to be $12\ 799 \pm 2299$ (standard error) at McKinley Bay and $13\ 635 \pm 2488$ at Hutchison Bay. Standard errors are high for some groups, such as geese and terns, as a result of the high variation in the numbers of these birds seen per transect.

Tables 6 and 7 give the species composition and densities of diving ducks observed at each bay. From the aerial surveys, it was found that scoter and Oldsquaw were the most common species of waterfowl using McKinley and Hutchison bays. Population estimates of diving duck species observed on the marine component of both bays are given in Table 8.

Scoter outnumbered Oldsquaw in both bays on all three surveys. At McKinley Bay, scoter represented more than 50% of all diving ducks observed on all three surveys, while about 41% of diving ducks observed were Oldsquaw. For the three aerial surveys at Hutchison Bay, the average number of scoter observed was more than three times the average number of Oldsquaw.

At both bays, Surf Scoter were more common than White-winged Scoter. At Hutchison Bay on all surveys, the ratio of Surf Scoter to White-winged Scoter was about 9:1, while at McKinley Bay it was about 3:1.

Table 4. Estimated populations of birds on the marine component at McKinley Bay based on aerial surveys, 1983.

Species	August 5		August 6		August 8	
	Population estimate	Standard error	Population estimate	Standard error	Population estimate	Standard error
Loons	171	39	44	15	72	21
Geese	0	-	0	-	44	42
Diving ducks	12 799	2299	7988	660	10 562	2486
Unidentified ducks	77	64	288	260	61	38
Shorebirds	448	276	348	101	243	100
Gulls	260	80	454	162	72	35
Terns	22	16	61	46	22	16

Table 5. Estimated populations of birds on the marine component at Hutchison Bay based on aerial surveys, 1983.

Species	August 5		August 6		August 8	
	Population estimate	Standard error	Population estimate	Standard error	Population estimate	Standard error
Loons	95	43	73	22	39	6
Geese	198	214	209	226	169	183
Diving ducks	13 635	2488	9271	2639	4132	848
Unidentified ducks	39	25	0	-	34	26
Shorebirds	0	-	45	45	22	24
Gulls	130	41	440	178	141	36
Terns	6	5	11	6	73	66

Table 6. Species composition and density of diving ducks observed on the marine component during aerial surveys at McKinley Bay, 1983.

Species	August 5			August 6			August 8		
	Number	Percent	Density (birds/km ²)	Number	Percent	Density (birds/km ²)	Number	Percent	Density (birds/km ²)
Oldsquaw	814	42.9	41.53	566	41.3	28.88	657	38.7	33.52
Scoter	990	52.2	50.51	752	54.9	38.37	977	57.6	49.85
Scaup	93	4.9	4.74	20	1.5	1.02	39	2.3	1.99
Merganser	0	0	0	32	2.3	1.63	23	1.4	1.17
TOTAL IDENTIFIED DIVING DUCKS	1897	100.0	96.78	1370	100.0	69.90	1696	100.0	86.53
Unidentified diving ducks	415	-	21.17	73	-	3.72	212	-	10.82

Table 7. Species composition and density of diving ducks observed on the marine component during aerial surveys at Hutchison Bay, 1983.

Species	August 5			August 6			August 8		
	Number	Percent	Density (birds/km ²)	Number	Percent	Density (birds/km ²)	Number	Percent	Density (birds/km ²)
Oldsquaw	578	25.6	32.47	236	14.8	13.26	111	18.2	6.24
Scoter	1571	69.5	88.26	1259	78.7	70.73	414	67.9	23.26
Scaup	99	4.4	5.56	89	5.6	5.00	85	13.9	4.78
Merganser	13	0.6	0.73	15	0.9	0.84	0	-	-
TOTAL IDENTIFIED DIVING DUCKS	2261	100.0	127.02	1599	100.0	89.83	610	100.0	34.27
Unidentified diving ducks	154	-	8.65	43	-	2.42	122	-	6.85

Table 8. Population estimates of the diving ducks on the marine component at McKinley Bay and Hutchison Bay, August 5, 1983 based on aerial survey data.

Species	Location	Total count on all transects	Density (birds/km ²)	Population estimate (\hat{Y})	Standard error of \hat{Y}
Oldsquaw	McKinley Bay	814	41.53	4506	1364
	Hutchison Bay	578	32.47	3263	1117
Scoter	McKinley Bay	990	50.51	5480	1007
	Hutchison Bay	1571	88.26	8870	1532
Scaup	McKinley Bay	93	4.74	514	347
	Hutchison Bay	99	5.56	559	322
Merganser	McKinley Bay	0	-	-	-
	Hutchison Bay	13	0.73	73	33
Unidentified diving ducks	McKinley Bay	415	21.17	2297	1058
	Hutchison Bay	154	8.65	869	619
TOTAL DIVERS	McKinley Bay	2312	117.96	12 799	2299
	Hutchison Bay	2415	135.67	13 635	2488

The abundance of the two most common species varied between the two bays (Tables 6 and 7). Except for the August 8 survey, when survey conditions were "poor to fair" at Hutchison Bay, densities of scoter were higher at Hutchison Bay than at McKinley Bay, while densities of Oldsquaw were always greater at McKinley Bay than at Hutchison Bay.

The density of scaup observed on aerial surveys at McKinley Bay was highest on August 5, when 4.74 scaup/km² were observed, representing about 5% of total observed diving ducks. At Hutchison Bay, scaup were seen in fairly consistent densities on all three surveys, about 5 birds/km². On the average, more scaup were seen at Hutchison Bay than at McKinley Bay (5.11 birds/km² and 2.58 birds/km² respectively).

No mergansers were seen at McKinley Bay on the August 5 survey, but for the two surveys on August 6 and 8, densities of mergansers were comparable to scaup densities at McKinley Bay, with an average density of 1.40 birds/km². Fewer mergansers were seen at Hutchison Bay and they represented less than 1% of total observed divers on any survey.

The only sighting of geese on the marine component at McKinley Bay was a small flock of eight Brant on August 8. At Hutchison Bay, 30 to 40 geese were always seen on the marine component. Whenever these geese were identified, they were Brant.

A list of common and scientific names of all species observed is presented in Appendix A.

3.2.2 Terrestrial Component

Tables 9 and 10 list the densities of birds observed on the terrestrial components of McKinley Bay and Hutchison Bay respectively.

McKinley Bay

Overall densities of birds using the terrestrial component at McKinley Bay were greater than at Hutchison Bay for all three surveys. At McKinley Bay, loons, swans and geese were more frequently seen on the terrestrial component than on the marine component. Loon densities averaged 0.98 birds/km² and just over half were Red-throated Loons while the rest were Arctic Loons. Both species were sometimes seen with one or two young. Tundra Swans were seen scattered in small groups on lakes and ponds and the lagoon system, and observed densities ranged from a low of 1.31 swans/km² on August 5 to a maximum of 2.44 swans/km² on August 8 when 69 swans were counted. Numbers of geese observed on the terrestrial component at McKinley Bay also varied greatly, from 1.84 birds/km² on August 5 to 4.31 birds/km² on August 6. The species of geese observed were Brant and Greater White-fronted Geese, with Brant the more common species.

Three species of diving ducks were observed on the terrestrial component: Red-breasted Merganser, Oldsquaw and a few scaup. On August 5 at McKinley Bay, diving ducks accounted for 20% of the total birds observed on the terrestrial component with a density of 5.86 divers/km². Densities of divers were much lower on the August 6 and August 8 surveys.

Dabbling ducks were widely scattered on lakes and ponds near McKinley Bay, in observed densities of 2.76, 5.86 and 5.26 birds/km² on

Table 9. Number and density of birds observed on the terrestrial component during aerial surveys at McKinley Bay, 1983. Area of terrestrial component surveyed = 28.3 km².

Species	August 5		August 6		August 8	
	Number	Density (birds/km ²)	Number	Density (birds/km ²)	Number	Density (birds/km ²)
Loons	40	1.41	21	0.74	22	0.78
Swans	37	1.31	53	1.87	69	2.44
Geese	52	1.84	122	4.31	63	2.23
Dabbling ducks	78	2.76	166	5.86	149	5.26
Diving ducks	166	5.86	24	0.85	56	1.98
Unidentified ducks	215	7.60	173	6.11	66	2.33
Raptors	3	0.11	2	0.07	1	0.04
Ptarmigan	0	-	0	-	0	-
Cranes	6	0.21	4	0.14	14	0.49
Shorebirds	122	4.31	389	13.74	268	9.47
Jaegers	3	0.11	1	0.04	1	0.04
Gulls	58	2.05	48	1.70	76	2.68
Terns	35	1.24	42	1.48	49	1.73
Passerines	10	0.35	9	0.32	58	2.05
TOTAL BIRDS	825	29.15	1054	37.24	892	31.52

Table 10. Number and density of birds observed on the terrestrial component during aerial surveys at Hutchison Bay, 1983. Area of terrestrial component surveyed = 16.3 km².

Species	August 5		August 6		August 8	
	Number	Density (birds/km ²)	Number	Density (birds/km ²)	Number	Density (birds/km ²)
Loons	25	1.53	9	0.55	12	0.74
Swans	17	1.04	59	3.62	37	2.27
Geese	0	-	0	-	94	5.77
Dabbling ducks	21	1.29	12	0.74	15	0.92
Diving ducks	189	11.60	20	1.23	0	-
Unidentified ducks	61	3.74	15	0.92	13	0.80
Raptors	1	0.06	0	-	1	0.06
Ptarmigan	0	-	0	-	0	-
Cranes	5	0.31	5	0.31	0	-
Shorebirds	46	2.82	33	2.02	31	1.90
Jaegers	0	-	1	0.06	1	0.06
Gulls	48	2.94	35	2.15	37	2.27
Terns	23	1.41	18	1.10	22	1.35
Passerines	0	-	9	0.55	22	1.35
TOTAL BIRDS	436	26.75	216	13.25	285	17.48

August 5, 6 and 8 respectively. Northern Pintail and American Wigeon were the only dabbling ducks identified to species.

Shorebirds were on the average the most abundant species group observed on the terrestrial component at McKinley Bay. The maximum number seen on a survey was 389 on August 6, accounting for 37% of total birds observed.

The most common gull identified on the surveys at McKinley Bay was the Glaucous Gull. The average density of gulls on the three surveys was 2.14 birds/km². Arctic Terns were noted in fewer numbers than gulls, with an average density of 1.48 terns/km² over the three surveys. Raptors, cranes, jaegers and passerines were also recorded on the survey in relatively low numbers at McKinley Bay (Table 9; Appendix A).

Hutchison Bay

In general, lower densities of waterfowl were found on the terrestrial component at Hutchison Bay than at McKinley Bay, with the exception of August 6 when the density of swans at Hutchison Bay was nearly twice the density at McKinley Bay. No geese were observed on the terrestrial component at Hutchison Bay on August 5 or 6. However, a total of 94 geese were observed on August 8, including a flock of 50 Greater White-fronted Geese, one Snow Goose, 8 Brant and 35 unidentified "dark geese". On August 5, a total of 189 diving ducks or 11.60 birds/km² were counted on the terrestrial component at Hutchison Bay; this included two large flocks of 50 and 65 scaup. Relatively few diving ducks were observed on the terrestrial component on the August 6 survey (1.23 birds/km²) and none were seen on August 8 (Table 10).

The average density of gulls observed on the three surveys at Hutchison Bay was 2.45 birds/km², slightly more than at McKinley Bay. Raptors, cranes, shorebirds, jaegers, loons, terns and passerines were seen in lower numbers on the terrestrial component at Hutchison Bay than McKinley Bay.

3.3 Comparison of Surveys - 1981, 1982 and 1983

Diving duck populations on the marine component of the study area were compared between the three years of surveys. Since survey conditions were best on August 5 in 1983, survey results from that day were selected for comparison with the data collected August 10, 1982 and August 10, 1981 (Table 11). This study could not detect any change in numbers of total diving ducks, although the relative abundance of scaup and of scoter varied throughout the 3-year study period. Significantly fewer scaup were estimated to be present in McKinley Bay on August 5, 1983 ($p < 0.05$) and on August 10, 1982 ($p < 0.05$) than on August 10, 1981. Also, the population estimate for scoter in McKinley Bay on August 5, 1983 was significantly greater ($p < 0.05$) than on August 10, 1981. At Hutchison Bay, which was not surveyed in 1981, no significant difference in population estimates for any observed species of diving duck was detected between the August 5 survey in 1983 and the survey on August 10, 1982 (Table 12).

Table 11. Comparison of results of aerial surveys conducted August 10, 1981 and 1982 and August 5, 1983 on the marine component, McKinley Bay.

Species	Year	Density (birds/km ²)	Population estimate Ŷ	Standard error of population estimate	Change in population estimate from prev- ious year	Standard error of change
Oldsquaw	1981	46.43	5038	777	...	...
	1982	54.23	5884	2153	846	2351
	1983	41.53	4506	1364	-1378	2339
	Change 1983-1981	...	...	...	-532	1759
Scoter	1981	31.22	3387	469	...	...
	1982	40.05	4345	1023	958	993
	1983	50.51	5480	1007	1135	1200
	Change 1983-1981	...	...	...	2093**	1055
Scaup	1981	18.77	2036	836	...	...
	1982	1.73	188	71	-1849**	864
	1983	4.74	514	347	326	383
	Change 1983-1981	...	...	...	-1522**	567
Merganser	1981	0	0	...	...	...
	1982	0.41	44	24	44*	24
	1983	0	0	...	-44*	24
	Change 1983-1981	...	...	...	0	...
Unidentified divers	1981	14.39	1561	535	...	...
	1982	18.16	1970	1276	409	1733
	1983	21.17	2297	1058	327	372
	Change 1983-1981	...	...	...	736	1518
TOTAL DIVERS	1981	110.82	12 024	959	...	...
	1982	114.59	12 433	1639	409	1259
	1983	117.96	12 799	2299	366	3462
	Change 1983-1981	...	...	...	775	2545

*Indicates difference is significant, $p < 0.10$

**Indicates difference is significant, $p < 0.05$

Table 12. Comparison of results of aerial surveys conducted August 10, 1982 and August 5, 1983 on the marine component, Hutchison Bay.

Species	Year	Total count on all transects	Density (birds/km ²)	Population estimate Y	Standard error of population estimate	Change in population estimate from prev- year	Standard error of change
Oldsquaw	1982	778	43.71	4393	419	...	...
	1983	578	32.47	3263	1117	1130	725
Scoter	1982	1156	64.94	6527	4143	...	...
	1983	1571	88.26	8870	1532	2343	5159
Scaup	1982	122	6.85	689	282	...	...
	1983	99	5.56	559	322	-130	432
Merganser	1982	157	8.82	886	665	...	...
	1983	13	0.73	73	33	-813	635
Unidentified	1982	172	9.66	971	221	...	...
	1983	154	8.65	869	619	-102	821
TOTAL DIVERS	1982	2385	133.99	13 461	3075	...	...
	1983	2415	135.67	13 635	2488	169	4613

3.4 Distribution

3.4.1 Marine Component

McKinley Bay

The distribution of waterfowl observed on the aerial surveys of McKinley Bay is presented in Figures 3, 4 and 5 for August 5, 6 and 8 respectively. For all three survey dates, diving ducks were concentrated in the area just southeast of the spit at Atkinson Point and in the southern section of the bay. On August 5, observers saw large concentrations of diving ducks on transect 4 south of the artificial island. Large flocks of diving ducks were also observed in the northeast section of the bay on August 6 and 8.

The concentrations of diving ducks that were consistently seen in the south section of the bay were mainly scoters. On August 5 and 6, about 50% of total observed scoters were in this area of the bay on transects 5, 6, and 7, and on August 8 this area contained 32% of total observed scoters. In contrast, no more than 7% of total Oldsquaw observed on any survey were in the south section of the bay.

For all three surveys, small groups of divers were observed inside a long spit on the east side of the bay. The divers observed at this location on August 6, which was the only day they were identified to species, were 20 scaup and 30 Red-breasted Mergansers. Groups of Oldsquaw and scoter were also recorded just west of the spit on all three survey dates.

Geese were less frequently observed on the marine component than on the terrestrial component. On the marine component, 8 Brant were observed at the head of Louth Bay on the August 8 survey. No swans were observed on the marine component.

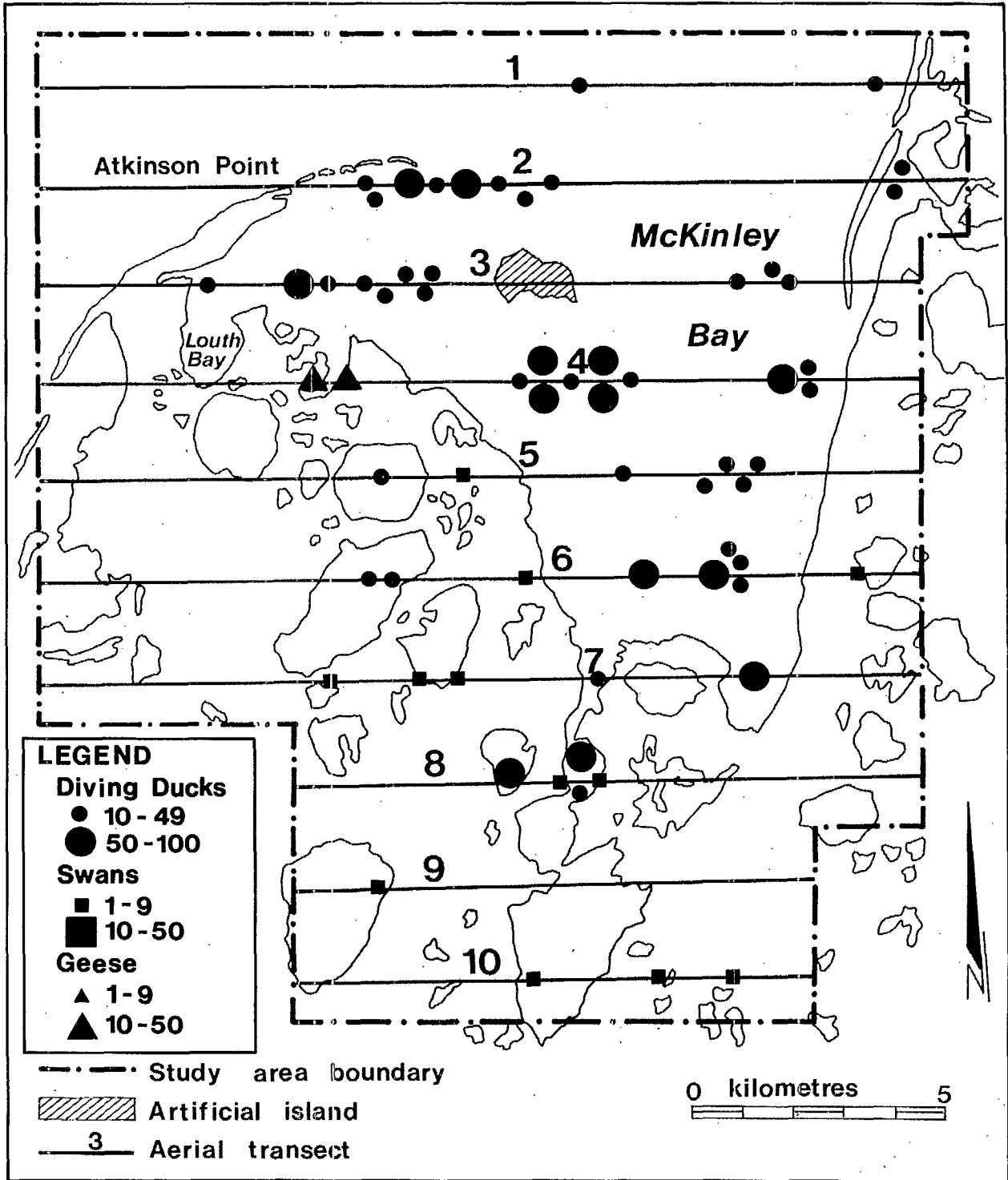


Figure 3. Distribution of waterfowl observed on aerial transects at McKinley Bay, August 5, 1983.

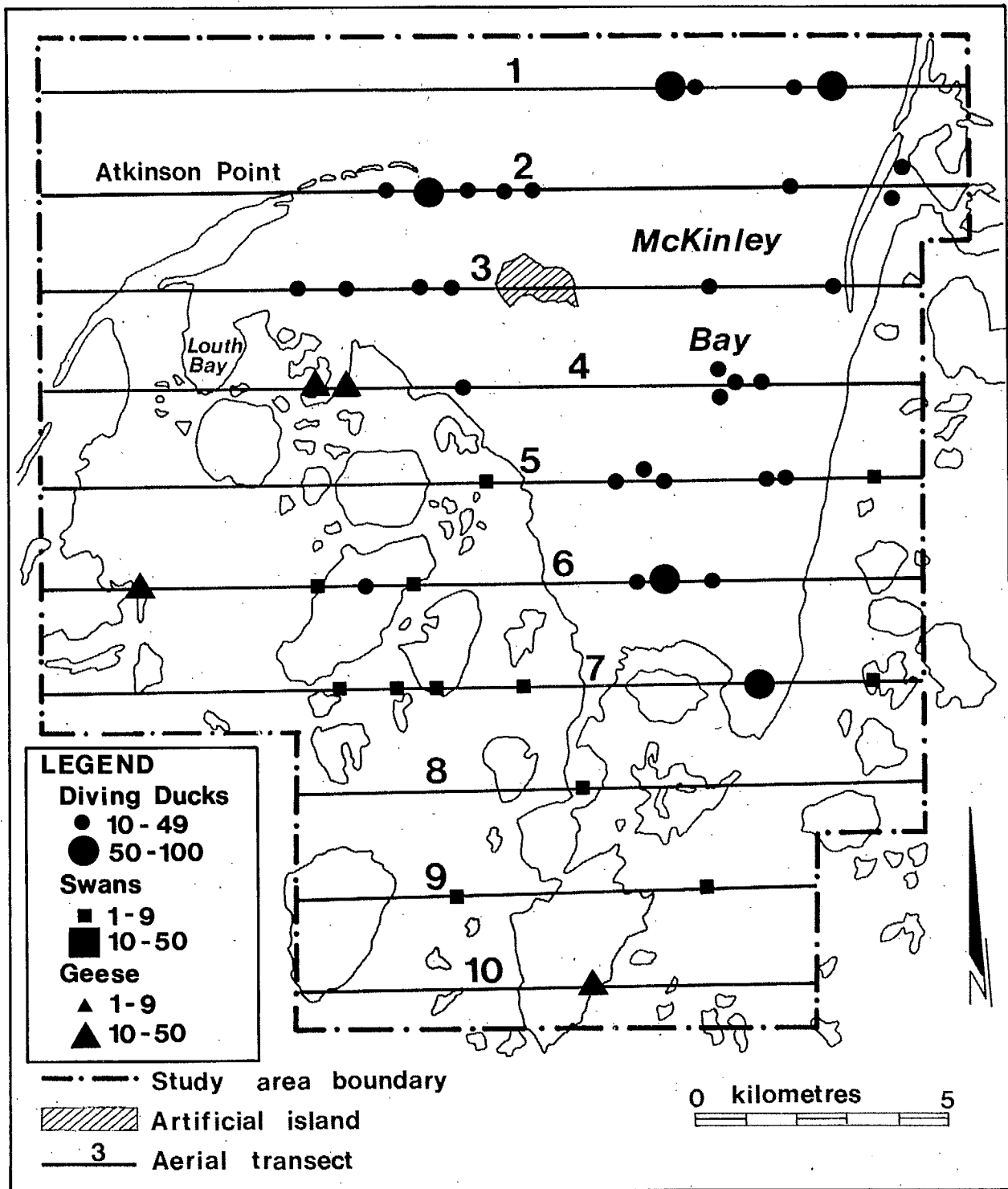


Figure 4. Distribution of waterfowl observed on aerial transects at McKinley Bay, August 6, 1983.

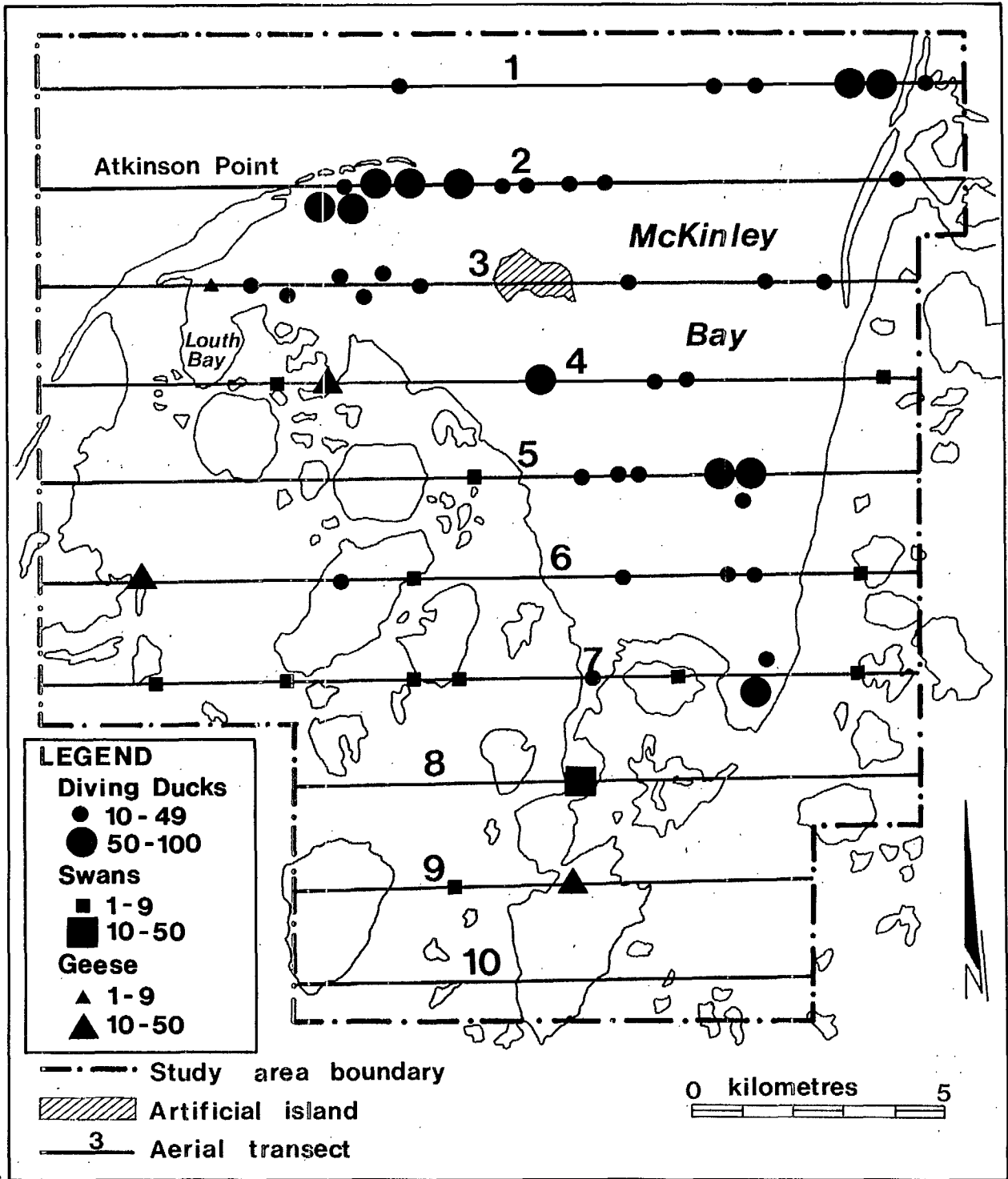


Figure 5. Distribution of waterfowl observed on aerial transects at McKinley Bay, August 8, 1983.

Hutchison Bay

Figures 6, 7 and 8 show the distribution of waterfowl observed on the marine component during aerial surveys on August 5, 6 and 8 at Hutchison Bay.

The distribution of diving ducks varied for the three days of surveys, although divers were consistently seen in the northeast section of the bay and in the western arm of the bay. On August 5, diving ducks were distributed in several large groups in the open central sections of Hutchison Bay, and in the northeast section. These were mainly scoters. Concentrations of divers were also observed in the western arm of the bay at the base of Warren Point, including over 100 Oldsquaw, 140 scoters and 30 scaup.

Most diving ducks were closer to the eastern shoreline of Hutchison Bay on August 6. Again, large flocks of scoters were observed in the northeast section of the bay on that survey. Oldsquaw were scattered in small flocks. Scaup were seen in small groups averaging about 30 ducks near the western arm of the bay and just off the peninsula that juts into the southwest corner of the bay. Also on August 6, a group of about 15 Red-breasted Mergansers was observed at the south end of the bay near the eastern shoreline.

On August 8, much lower numbers of diving ducks were counted and these were fairly evenly distributed. Scoter and Oldsquaw were scattered across the bay, mainly in small groups except for a large group of 75 Surf Scoters observed in the northeast section of the bay. A large group of 77 scaup was observed in the narrows at the base of Warren Point.

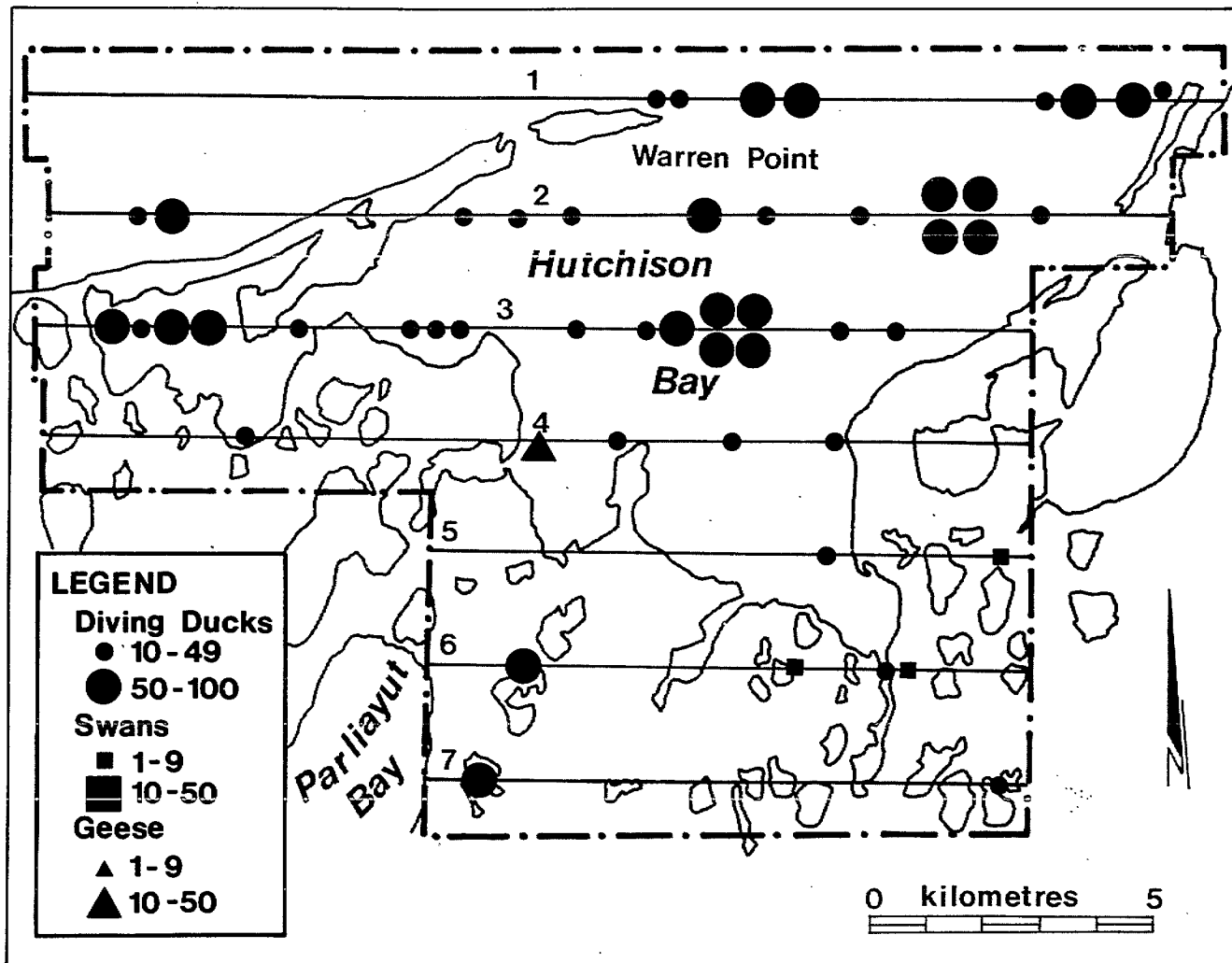


Figure 6. Distribution of waterfowl observed on aerial transects at Hutchison Bay, August 5, 1983.

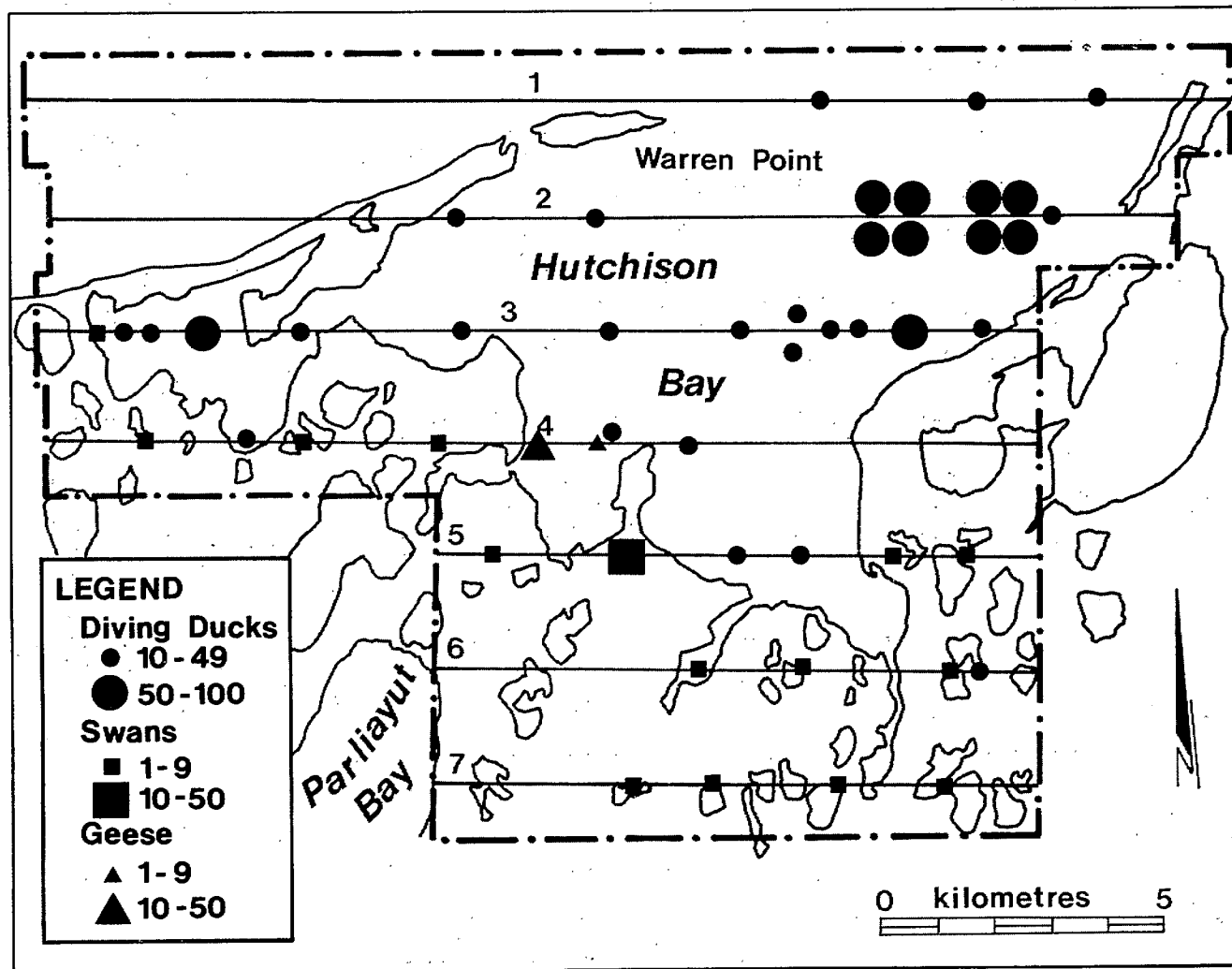


Figure 7. Distribution of waterfowl observed on aerial transects at Hutchison Bay, August 6, 1983.

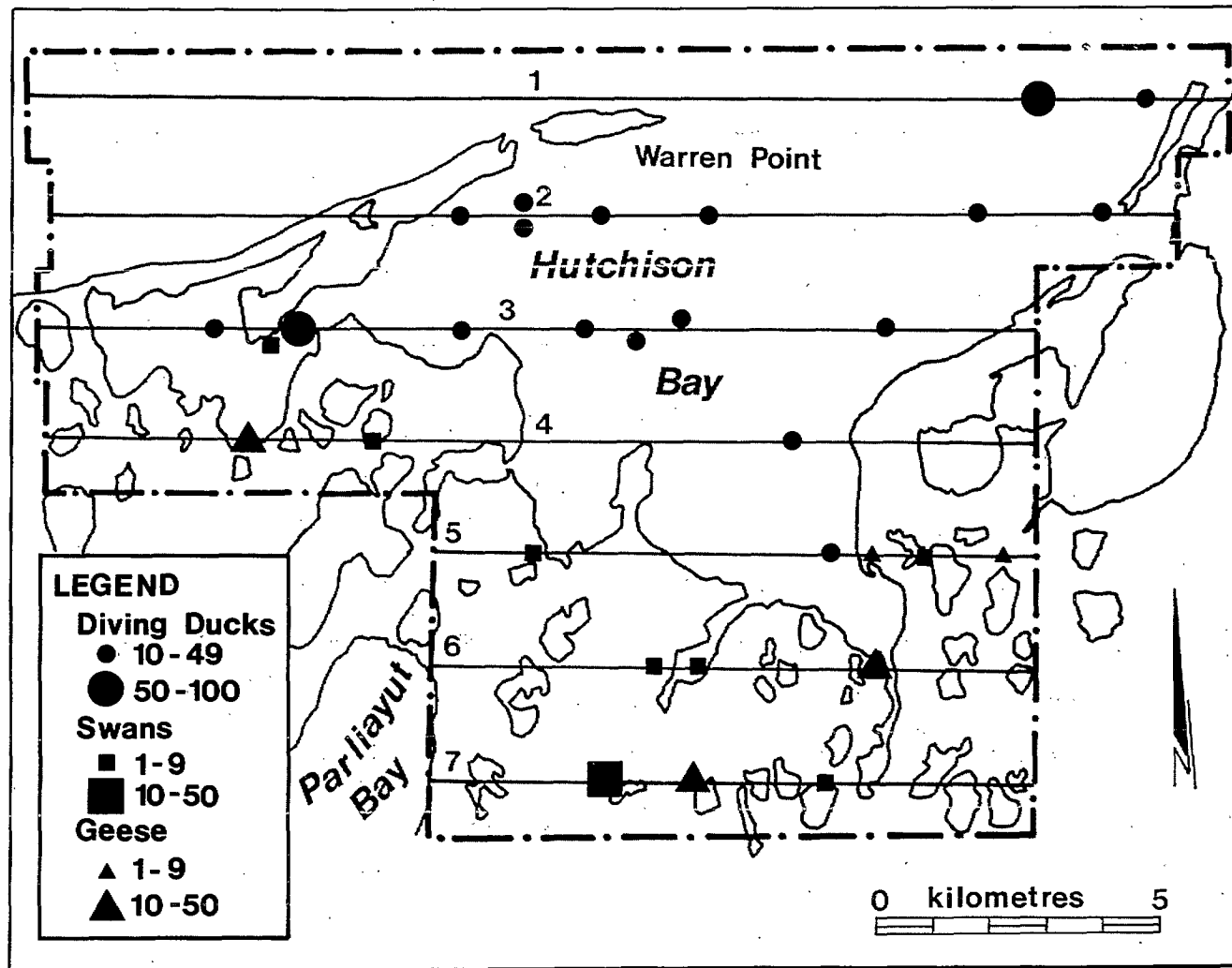


Figure 8. Distribution of waterfowl observed on aerial transects at Hutchison Bay, August 8, 1983.

Flocks of geese were observed at Hutchison Bay at the same location for two of the surveys. On August 5, 35 dark geese were seen in the small bay west of the peninsula in the southwest section of the bay, and on August 6, 37 Brant were identified in this location. A flock of 30 dark geese was counted on August 8 farther to the west of this area, in the western arm of the bay.

Tundra Swans were rarely observed on the marine component. A group of 8 swans was observed in the narrows at the base of Warren Point on August 8. Swans were much more frequently observed on the terrestrial component.

3.4.2 Terrestrial Component

McKinley Bay

The most common species utilizing the lakes and ponds in the McKinley Bay study area were diving ducks, dabbling ducks, shorebirds, gulls and geese. The distribution of diving ducks, geese and swans observed on the terrestrial component for all three surveys is plotted on Figures 3, 4 and 5.

Diving ducks were observed on large lakes south and west of McKinley Bay and on the lagoon system emptying into the south end of the bay. Geese occurred fairly consistently in three areas. Concentrations of 20 to 70 Brant were observed in the vicinity of a small inlet east of Louth Bay (Fig. 1) on all three days of surveys. On August 5, a group of 30 Greater White-fronted Geese was also observed in this area. On the littoral flats near a protected embayment southwest of McKinley Bay observers saw 12-15 Greater White-fronted Geese during the August 6 and

August 8 surveys. Groups of 40 Brant on August 6 and 20 Greater White-fronted Geese on August 8 were also observed on the lagoon that enters the south end of McKinley Bay. Swans were dispersed on small ponds and lakes and on the lagoon system. Swans were seen mainly in family groups consisting of 2 adults and up to 4 young, although on occasion larger groups were observed. A single group of 11 swans was observed on the lagoon on August 8.

Hutchison Bay

Figures 6, 7 and 8 show the distribution of divers, geese and swans on the terrestrial component at Hutchison Bay. Two large groups of scaup, numbering 50 and 65, were seen on larger lakes south of the bay on August 5, but only 20 divers in total were seen on the terrestrial component on August 6 and none on the August 8 survey. No geese were seen on the terrestrial component on August 5 and 6. However, on August 8, Brant occurred in small numbers on ponds east of the bay on transect 5, 35 dark geese were at the head of the lagoon at the south end of the bay on transect 6 and a flock of 50 Greater White-fronted Geese and one Snow Goose was seen by a large pond on transect 7. Tundra Swans were scattered on lakes and ponds usually in family groups, although larger groups of swans were occasionally observed (for example, one group of 30 adult and 5 young seen off transect 5 near Parlaiyut Bay, and one group of 13 adults near a lake on transect 7).

3.5 Flock Size

During the aerial surveys, it was noted that Oldsquaw tended to remain in small flocks of 10 birds or less. At McKinley Bay on August 6 and 8, more than 50% of observed Oldsquaw were in flocks of 10 birds or less. At Hutchison Bay, the number of Oldsquaw observed in these small flocks was at least 65% of the total Oldsquaw seen on any survey.

In comparison, scoter were commonly seen in large flocks of more than 50 birds. On August 5 and 6 at Hutchison Bay, more than 50% of scoter were in large flocks including flocks of 150 and 200 scoter observed on both days. Numerous flocks of 30-50 scoter were observed at McKinley Bay on August 5 and 6, while on August 8, about 50% of the total scoter were in flocks of more than 50 birds.

4.0 DISCUSSION

No significant increase or decrease in the total population of diving ducks in McKinley Bay was detected ($p > 0.10$) between the years 1981, 1982, and 1983 at the level of precision achieved in this study. The population estimates of diving ducks were $12\ 024 \pm 959$ (standard error), $12\ 433 \pm 1639$ and $12\ 799 \pm 2299$ in 1981, 1982 and 1983 respectively. However, the relative abundance of some species of diving duck in the bay did change between some years of surveys. There were significantly more scaup in McKinley Bay in 1981 than in 1982 or 1983 ($p < 0.05$), as well as significantly more scoter ($p < 0.05$) in McKinley Bay in 1983 than in 1981. At Hutchison Bay, no significant differences in the population of diving ducks were detected between the two years that surveys were conducted there ($p > 0.05$).

It is unknown why there were more scaup in McKinley Bay in 1981 or why there were more scoter in 1983. However, the timing of the moult of a species will vary from year-to-year depending on the timing of breeding and nest initiation (Salomonsen 1968). Also, in years of low nesting success, the moulting flocks of male and nonbreeding ducks may be augmented by failed-nesting birds. Hence, the size of the population of moulting ducks in McKinley Bay at any time may reflect the timing of breeding and the nesting success in that year. It is essential that enough years of data are collected to establish these natural annual fluctuations in numbers of birds in McKinley Bay, so that possible changes due to future development can be detected.

In 1983 at McKinley Bay, concentrations of diving ducks were consistently seen in the area south of the spit at Atkinson Point. This observation concurred with Cornish and Allen (1983), Scott-Brown et al. (1981), Sharp (1977) and Ward (1981) who also observed large numbers of Oldsquaw in this area of the bay, as well as Karasiuk and Boothroyd (1982) who observed concentrations of both Oldsquaw and scoter there. In both 1982 (Cornish and Allen 1983) and 1983, scoter appeared to favour the south end of the bay. Unlike other years, in 1983 larger concentrations of diving ducks were also seen just south of the artificial island.

As in 1982, it appeared that the tidal flats in the lagoon east of Louth Bay were an important feeding area for Brant.

At Hutchison Bay in both 1982 and 1983, concentrations of divers were most frequently observed in the northeast section of the bay and near the western arm of the bay (Cornish and Allen 1983).

In 1983, Oldsquaw occurred more frequently in small flocks of less than 10 birds in both bays than scoter, while scoter were more heavily represented in large flocks of more than 50 birds. This was also evident during aerial surveys and boat surveys at McKinley Bay and Hutchison Bay in 1982 (Cornish and Allen 1983). However, during helicopter surveys between 1800 and 2200 hours on three calm evenings in 1982, Oldsquaw were frequently in large flocks (Cornish and Allen 1983).

Several factors may bias the results of a seabird monitoring study. These factors include variability in observer skill, possible movement of birds in and out of the bay, differences in bird densities due to flocking behaviour, and survey conditions such as amount of glare and sea state.

To avoid bias due to differences in observer skill, the same observers were used for all three years of the study with the exception of one of the observers in 1981. Also, only observers with current experience in aerial surveys were used. LeResche and Rausch (1974) found that current experience significantly affected accuracy and precision of counts during aerial surveys of a known population of moose.

It is possible that the diving ducks drift from one bay to the next. However, daily shoreline surveys during July and August, 1982, along a section of shoreline near Atkinson Point in McKinley Bay showed no sudden large change in the number of divers (Cornish and Allen 1983). Nor have large offshore movements between bays been reported in previous reports on the distribution of moulting diving ducks along the Tuktoyaktuk Peninsula (Barry et al. 1981; Barry and Barry 1982).

The tendency for some ducks species to aggregate into large flocks may affect variability of aerial survey results. Stott and Olson (1972) noted that large flocks were more visible than small flocks, especially

when conditions were less than favourable. In a comparison between observers' estimates on several aerial surveys of waterfowl, Savard (1982) found that bird densities affected accuracy of observer estimates, and the differences between estimates were larger for species that aggregated into flocks than for species with a more scattered distribution.

Survey conditions seem to be a crucial factor affecting survey results. Diving duck counts in 1983 were lowest when there was severe glare off the water and there were whitecaps on the bay (August 6 in McKinley Bay and August 8 in Hutchison Bay). Conversely, the highest counts were obtained on a relatively calm day with a light overcast (August 5).

Stott and Olson (1972) discussed the effects of weather on aerial surveys of a population of sea ducks on the New Hampshire coastline. Aerial surveys were compared with ground surveys which were assumed to count 100% of the population. They found that scoter counts during aerial surveys were significantly more accurate ($p < 0.05$) when done on overcast days. From the air on clear or partly cloudy days, the accuracy of aerial surveys of scoters ranged from 6.5% to 73.6%. Also, Oldsquaw were more difficult to count on a day when the ocean was turbulent, because of their light colour and tendency to stay in small flocks (Stott and Olson 1972).

In conclusion, the discrepancy in counts made between surveys on August 5, 6 and 8 at both bays was probably due mainly to survey conditions. Since only the results from surveys with good conditions were chosen for comparing diving duck counts between years, survey techniques were consistent, observers were currently experienced and the same for all surveys with the exception of one observer in 1981, the results of these aerial surveys should be reasonable estimators of trends in populations.

5.0 LITERATURE CITED

- Barry, T.W., S.J. Barry and B. Jacobson. 1981. Sea-bird surveys in the Beaufort Sea, Amundsen Gulf, Prince of Wales Strait and Viscount Melville Sound - 1980 season. Can. Wildl. Serv., Unpubl. Rep. Edmonton. 69 pp.
- Barry, S.J. and T.W. Barry. 1982. Sea-bird surveys in the Beaufort Sea, Amundsen Gulf, and Prince of Wales Strait - 1981 season. Can. Wildl. Serv., Unpubl. Rep. Edmonton. 52 pp.
- Cornish, B. and L. Allen. 1983. Waterbird surveys of McKinley Bay, Northwest Territories, 1982. Can. Wildl. Serv., Unpubl. Rep. Edmonton. 77 pp.
- Dome Petroleum Limited, Esso Resources Limited and Gulf Canada Resources Inc. 1982. Environmental Impact Statement for Hydrocarbon Development in the Beaufort Sea - Mackenzie Delta Region. Vol. 4. Calgary.
- Karasiuk, D.J. and P.N. Boothroyd. 1982. Preliminary environmental assessment of proposed harbour sites at McKinley Bay and Baillie Islands, Northwest Territories. Vol. 1. Migratory bird habitat and bird use, 1980. Can. Wildl. Serv., Unpubl. Rep. Yellowknife. 91 pp.
- Kingsley, M. and J. Smith. 1980. Analysis of data arising from systematic transect surveys. Pp. 40-47 in Proc. Symposium on Census and Inventory Methods for Populations and Habitats. April 10, 1980, Banff, Alberta. Northwest Section, The Wildlife Society.

- LeResche, R.E. and R.A. Rausch. 1974. Accuracy and precision of aerial moose censusing. *J. Wildl. Manage.* 38(2):175-182.
- Salomonsen, F. 1968. The moult migration. *Wildfowl* 19:5-24.
- Savard, J.P. 1982. Variability of waterfowl aerial surveys: observer and air-ground comparisons - a preliminary report. *Can. Wildl. Serv. Prog. Notes* No. 127, March 1982. Delta, B.C.
- Scott-Brown, M., L. Allen and N.A. Roe. 1981. 1981 Waterbird surveys, McKinley Bay, Northwest Territories. *Can. Wildl. Serv. Rep. Yellowknife.* 31 pp.
- Sharp, P.L. 1977. Preliminary tests of bird scare devices on the Beaufort Sea coast Canadian Marine Drilling Ltd.; Unpubl. Rep. Calgary. 54 pp.
- Stott, R.S. and D.P. Olson. 1972. An evaluation of waterfowl surveys on the New Hampshire coastline. *J. Wildl. Manage.* 36(2):468-477.
- Ward, J. 1981. Wildlife observations during dredging operations in McKinley Bay, July-August, 1980. Dome Petroleum; Unpubl. Rep. Calgary. 56 pp.

APPENDIX A. Scientific names of species of birds observed at McKinley Bay and Hutchison Bay during aerial surveys in 1983.

Appendix A. Scientific names of species of birds observed at McKinley Bay and Hutchison Bay during aerial surveys in 1983.

Common name	Scientific name
Arctic Loon	<u>Gavia arctica</u>
Red-throated Loon	<u>G. stellata</u>
Tundra Swan	<u>Cygnus columbianus</u>
Brant	<u>Branta bernicla nigricans</u>
Greater White-fronted Goose	<u>Anser albifrons</u>
Lesser Snow Goose	<u>Chen caerulescens</u>
Northern Pintail	<u>Anas acuta</u>
American Wigeon	<u>A. americana</u>
Scaup sp.	<u>Aythya sp.</u>
Eider sp.	<u>Somateria sp.</u>
Oldsquaw	<u>Clangula hyemalis</u>
White-winged Scoter	<u>Melanitta fusca</u>
Surf Scoter	<u>M. perspicillata</u>
Red-breasted Merganser	<u>Mergus serrator</u>
Rough-legged Hawk	<u>Buteo lagopus</u>
Northern Harrier	<u>Circus cyaneus</u>
Sandhill Crane	<u>Grus canadensis</u>
Lesser Yellowlegs	<u>Tringa flavipes</u>
Phalarope sp.	<u>Phalaropus sp.</u>
Parasitic Jaeger	<u>Stercorarius parasiticus</u>
Long-tailed Jaeger	<u>S. longicaudus</u>
Glaucous Gull	<u>Larus hyperboreus</u>
Herring/Thayer's Gull	<u>Larus sp.</u>
Sabine's Gull	<u>Xena sabini</u>
Bonaparte's Gull	<u>Larus philadelphia</u>
Arctic Tern	<u>Sterna paradisaea</u>
Short-eared Owl	<u>Asia flammeus</u>
Common Raven	<u>Corvus corax</u>

APPENDIX B. Birds observed on aerial fixed-wing surveys at
McKinley Bay in August, 1983.

TABLE B4. Birds observed on terrestrial component of aerial transects at McKinley Bay on August 5, 1983.

Species	Transect number										Total on all transects	
	1	2	3	4	5	6	7	8	9	10		
Yellow-billed Loon												
Arctic Loon					8	3	5					16
Red-throated Loon					1			7	1			9
Loon sp.				1	3		3	2	3	3		15
Whistling Swan					5	6	11	6	1	8		37
Brant				22								22
White-fronted Goose				30								30
Dark Goose												
Pintail				1	1		32		6			40
American Wigeon					1				4			5
Dabbling duck					11	2	2	13		5		33
Eider sp.												
Scaup sp.							2					2
Oldsquaw						43		20				63
Scoter sp.												
White-winged Scoter												
Surf Scoter												
Red-breasted Merganser					14	2	14	70				100
Diving duck						1						1
Unidentified duck				8	20	6	6	164	6	5		215
Raptor				1		1	1					3
Ptarmigan sp.												
Sandhill Crane				2	2		2					6
Shorebird			4	51	8	13	9	19	3	15		122
Jaeger sp.					1	1			1			3
Glaucous Gull				4	21	4	24	1	3			57
Sabine's Gull							1					1
Arctic Tern				1	4	3	1		24	2		35
Common Raven												
Passerine					1	6	3					10

TABLE B5. Birds observed on terrestrial component of aerial transects at McKinley Bay on August 6, 1983.

Species	Transect number										Total on all tran- sects	
	1	2	3	4	5	6	7	8	9	10		
Yellow-billed Loon												
Arctic Loon					2		2					4
Red-throated Loon				2	1	2	3	5				13
Loon sp.					1		1	1	1			4
Whistling Swan					6	5	25	7	10			53
Brant				70							40	110
White-fronted Goose						12						12
Dark Goose												
Pintail		1		16	11	2	40	10	5	3		88
American Wigeon					12		4	2				18
Dabbling duck				2	4	2	40	1	10	1		60
Eider sp.												
Scaup sp.						4						4
Oldsquaw						10						10
Scoter sp.												
White-winged Scoter												
Surf Scoter												
Red-breasted Merganser								7	3			10
Diving duck												
Unidentified duck				4	38		9	120	2			173
Raptor							2					2
Ptarmigan sp.												
Sandhill Crane							4					4
Shorebird			21	80	3	128	45	24	88			389
Jaeger sp.					1							1
Glaucous Gull				1	9	5	18	4	3	1		41
Sabine's Gull								7				7
Arctic Tern				4	3			14	21			42
Common Raven												
Passerine						3	2	4				9

TABLE B6. Birds observed on terrestrial component of aerial transects at McKinley Bay on August 8, 1983.

Species	Transect number										Total on all transects	
	1	2	3	4	5	6	7	8	9	10		
Yellow-billed Loon												
Arctic Loon						2			4	1		7
Red-throated Loon				2	6			3				11
Loon sp.				2				2				4
Whistling Swan				5	3	8	32	16	5			69
Brant				25								25
White-fronted Goose						15			20			35
Dark Goose												
Snow Goose									3			3
Pintail		1		13	18	8	9	8	4	3		62
American Wigeon							16	4				20
Dabbling duck				4			8	45	10			67
Eider sp.												
Scaup sp.						8						8
Oldsquaw						33						33
Scoter sp.												
White-winged Scoter												
Surf Scoter												
Red-breasted Merganser							15					15
Diving duck												
Unidentified duck					13		6	40		7		66
Raptor								1				1
Ptarmigan sp.												
Sandhill Crane				4			6		2	2		14
Shorebird		2		53	1	9	67	117	15	4		268
Jaeger sp.								1				1
Glaucous Gull				2	3	4	37	12	2	1		61
Sabine's Gull								15				15
Arctic Tern								28	21			49
Common Raven												
Passerine		3		3	6	42	4					58

APPENDIX C. Birds observed on aerial fixed-wing surveys at Hutchison Bay in August, 1983.

TABLE C5. Birds observed on terrestrial component of aerial transects at Hutchison Bay on August 6, 1983.

Species	Transect number										Total on all tran- sects	
	1	2	3	4	5	6	7	8	9	10		
Yellow-billed Loon												
Arctic Loon							6					6
Red-throated Loon							1					1
Loon sp.					1	1						2
Whistling Swan				15	18	18	8					59
Brant												
White-fronted Goose												
Dark Goose												
Pintail												
American Wigeon				4								4
Dabbling duck					7		1					8
Eider sp.												
Scaup sp.												
Oldsquaw						20						20
Scoter sp.												
White-winged Scoter												
Surf Scoter												
Red-breasted Merganser												
Diving duck												
Unidentified duck						15						15
Raptor												
Ptarmigan sp.												
Sandhill Crane							5					5
Shorebird			9	2	17		5					33
Jaeger sp.							1					1
Glaucous Gull				4	21	2	8					35
Sabine's Gull												
Arctic Tern				1	1	4	12					18
Common Raven						3	2					5
Passerine				1	1	2						4

TABLE C6. Birds observed on terrestrial component of aerial transects at Hutchison Bay on August 8, 1983.

Species	Transect number										Total on all transects	
	1	2	3	4	5	6	7	8	9	10		
Yellow-billed Loon												
Arctic Loon					3		5					8
Red-throated Loon												
Loon sp.					3	1						4
Whistling Swan				5	9	9	14					37
Brant					8							8
White-fronted Goose							50					50
Dark Goose						35						35
Snow Goose								1				1
Pintail				5			2					7
American Wigeon												
Dabbling duck				3	3	2						8
Eider sp.												
Scaup sp.												
Oldsquaw												
Scoter sp.												
White-winged Scoter												
Surf Scoter												
Red-breasted Merganser												
Diving duck												
Unidentified duck				13								13
Raptor						1						1
Ptarmigan sp.												
Sandhill Crane												
Shorebird		20		5	1		5					31
Jaeger sp.		1										1
Glaucous Gull		4		2	18	5	8					37
Sabine's Gull												
Arctic Tern		2		2	1	3	14					22
Common Raven												
Passerine				4	2	10	6					22

