Seabirds of the Southeastern Beaufort Sea: Aircraft and Ground Observations in 1972 and 1974

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A STUDY OF SEABIRDS IN THE COASTAL BEAUFORT SEA AREA, 1972 AND 1974*

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Data Collection: During 1972 numerous personnel of various organizations collected data that are part of this report. These people have been acknowledged elsewhere. The following persons conducted the field studies during 1974: B.E. Johnson, E. Kuyt, J. Land, C. Sinotte, R. Sinotte, T. Thormin.

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* This technical report is based on a larger report submitted by LGL Limited to the Canadian Wildlife Service. Much of the data that appeared in appendices have not been included in this report because of technical problems and cost constraints. These appendices are available in the libraries of LGL Limited in Edmonton and Toronto and in the library of the Canadian Wildlife Service in Edmonton.

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SUMMARY

Data on the distribution and movements of seabirds and other birds in the southeastern Beaufort Sea area were gathered during 1972 and 1974. Data collected during offshore aerial surveys conducted over the Beaufort Sea during 1974 were analysed in relation to ice-cover conditions; the results of such analyses indicated the distributions and movements of birds offshore during a year of above-average ice cover. It was found that the distributions of most species are related to the amount of ice cover present and that birds generally prefer areas of at least partly open water. Maps of species distributions and abundances in relation to ice-cover conditions were prepared for offshore areas.

Densities were calculated for all species and species groups observed during aerial transect surveys. Densities of ducks were found to decrease radically after June; it was speculated that this decrease was related to the timing of the initiation of nesting activities, at which time many ducks move ashore. An overabundance of males in the male/female ratio of eiders remaining offshore after June supported this speculation.

Shipboard observations were also planned for 1974, but due to the extensive ice cover, movement by boat was possible only in the Mackenzie Delta area. Shipboard observations in the study area were made during only two days.

Aerial surveys conducted over the coastal Beaufort Sea area during 1974 provided information on the distribution of some avian species along the coast and in different habitat types. Multiple regression analysis techniques were applied to the results of these surveys in order to develop prediction equations for the number of individuals and number of species occurring on various waterbodies along the coast of the Beaufort Sea; these equations were based on the following variables: date, waterbody type, distance from the coast, and waterbody size.

The results of migration watches conducted during 1972 along the coast, primarily during fall, provided a general overview of the migrational patterns along the coast of many of the species present in the Beaufort Sea area. These data are presented in relation to the wind conditions that prevailed. Birds that were migrating into headwinds were observed more frequently and in greater numbers than were birds that were migrating with tailwinds. Reasons for this apparent relationship between migrating birds and winds are considered. The limitations of migration watches of this type are discussed. The data were summarized and analysed on a species-by-species basis and are presented in an annotated list of species.

INTRODUCTION

Knowledge of the seabirds that occur near the coast of the eastern Beaufort Sea has to date been largely anecdotal. Until recently, the offshore distribution of birds in the Beaufort Sea was virtually unknown. The sources of information about birds near this coast consist of numerous reports of observations, but as a body this knowledge has lacked systematic organization.

The discovery of oil at Prudhoe Bay in 1968, the plans for offshore drilling (with its potential for environmental disruption), and the need for reliable biological information brought to light the paucity of knowledge of seabird ecology and population dynamics in the Beaufort Sea. In 1972, the Canadian Wildlife Service, in cooperation with private groups, began the systematic collection of data on birds along the coast of the portions of the Beaufort Sea in the Yukon and Northwest Territories. An intensive study was initiated in 1974. During this study, aerial surveys were conducted over coastal and offshore areas in order to gain a knowledge of activities, movements, populations, and overall ecology of birds associated with the Beaufort Sea.

In view of present plans to begin offshore drilling in the Beaufort Sea in 1976 (and along the entire outer continental shelf of Alaska in the near future), a knowledge of the life histories and ecology of seabirds is essential in order to predict and hopefully avoid the harmful effects of oil spills and industrial disturbance on these birds. A knowledge of the movements and areas of concentration of birds at various times of the year is important if these birds are to be wisely managed and if the impacts of oil spills (should they occur) on these birds are to be prevented or reduced.

The purpose of this report is to analyse the data collected in the Beaufort Sea during 1972 and 1974; this report is particularly concerned with the movements and distributions of seabirds in the southeastern portion of the Beaufort Sea. Data collected on avian species other than seabirds have been included where appropriate.

The life histories of seabirds in the Beaufort Sea area are related to various environmental factors. Of these, ice conditions play a critical role in the ecology of the Beaufort Sea and must, therefore, be considered as an integral part of the analysis of distributional data.

Many breeding colonies of waterfowl, gulls, and terns occur along the Beaufort Sea coastline. In addition, the coastal plain is used extensively for nesting by these species and by loons, shorebirds, jaegers, and several species of passerines. Many of these birds, both adults and young, use the sea during late summer for feeding and migration. The variety of uses made of the Beaufort Sea by birds (e.g., breeding, feeding, moulting, migrating) must all be considered in the event of an oil spill. Several of these uses have only been touched upon in this report, and it is apparent that future studies are necessary in view of the potential for human disturbance in the Beaufort Sea area in the immediate future.

Three major types of data are considered in this report:

1. results of 1974 aerial surveys--conducted by Renewable Resources Consulting Services Ltd. on behalf of the Canadian Wildlife Service (CWS)--of the southeastern portion of the Beaufort Sea;

2. results of 1974 aerial surveys--conducted by CWS personnel--of waterbodies along the south coast of the Beaufort Sea between Nunaluk Spit, Y.T. and the eastern tip of the Tuktoyaktuk Peninsula, N.W.T.;

3. results of systematic watches--conducted during 1972 by LGL Limited (Gollop and Davis 1974a), by CWS, and by Templeton Engineering (Campbell 1973)--for birds at or passing seven locations in the Mackenzie Delta and along the portion of the coast between Nunaluk Spit and Cape Dalhousie.

The data gathered during the above-mentioned surveys and watches were transferred to LGL Limited for analysis under contract to CWS.

This report includes (1) a description of the study area, (2) summaries of the methods of analysis applied to the three types of survey data and of the major results of these analyses, and (3) a series of species accounts that summarize the data from each of the three survey methods on a species-by-species basis and that relate these results to previous knowledge of each species in the Beaufort Sea area.

Other available information on birds of the Beaufort Sea and physical factors relevant to these birds are summarized in four companion reports:

1. a literature review and annotated bibliography of the distributions and breeding biologies of species that occur in the Beaufort Sea (Johnson *et al.* In Press);

2. a description of the unpublished sources of data on the distributions and movements of birds in the Beaufort Sea (Searing 1975);

3. a review of climatological and oceanographic conditions in the Beaufort Sea that are relevant to birds (Hansen 1975);

4. a study of spring migration along the north coast of the Yukon Territory and over the adjacent parts of the Beaufort Sea in 1975 (Richardson *et al.* 1976).

STUDY AREA

Topography and Description

The study area includes both onshore and offshore areas from Nunaluk Spit, Y.T., over 800 km east to Cape Parry, N.W.T., and north to the northwest tip of Banks Island, N.W.T. The southeastern shore of the Beaufort Sea is formed by the north coast of the mainland of Canada. Numerous small bays and several large bays, notably Liverpool Bay in the east and Kugmallit Bay and Mackenzie Bay farther west, indent the coastline.

With the exception of the Mackenzie Delta--a region of sparse northern coniferous woodland--the coastal area from the Yukon-Alaskan border to Cape Parry and north to Sachs Harbour (Banks Island) consists primarily of low-arctic tundra. Descriptions of the southern shore of the Beaufort Sea are few, and most concentrate on the areas surrounding settlements. In recent years, however, an effort has been made to classify in detail the environment of the Mackenzie Delta and Yukon coast (Welsh and Rigby 1971; Crampton 1973).

The portion of the Yukon coast included in the study area forms part of the Arctic Coastal Plain. This plain is a relatively flat area that slopes from 300 m elevation in the south to sea level along the coast (Hettinger *et al.* 1973). Several large river deltas and many lakes are present on the formerly glaciated plain. The smaller lakes are characteristically shallow and have emergent vegetation; the larger lakes are deep and have sedge-marsh shorelines (Gollop and Davis 1974b; Sharp *et al.* 1974). Along the coast and offshore, numerous low-lying islands and spits have been formed by riparian deposits (sand and/or gravel). The islands in the river deltas usually consist of low mudflats (Gollop and Richardson 1974). Herschel Island--a large, flat, offshore island on the Yukon coast--rises to 180 m ASL; a large gravel spit (Avadlek Spit) protrudes from the southeastern end of this island. Habitat in raised areas of the Yukon North Slope consists predominantly of dry, sedge-herbaceous tundra (Richardson and Gollop 1974); in low-relief areas, habitat primarily consists of tussock tundra. Vegetation along streams is taller and more lush (Gollop *et al.* 1974a).

Although much of the Mackenzie Delta is sparse boreal forest, the northern portion is forest-tundra that gives way to scrub-tundra and finally to low-arctic tundra near the coast (MacKay 1963). The 160 km-wide delta is dissected by many channels of the Mackenzie River, contains many sand bars, and is dotted with islands composed of interstratified mud, sand, and gravel. Numerous large and small lakes are present on the islands. The fluvial deposits of the Mackenzie River have formed a chain of outlying islands of higher elevation than the rest of the delta. The eastern portion of Mackenzie Bay is shallow, and the coastline is very low (barely above sea level).

East of the Mackenzie Delta, the coastal area is generally low, flat, and wet. However, at the Parry Peninsula (on the extreme eastern edge of the study area) low-lying sand and gravel bars in the south give way to coastal cliffs and numerous offshore islands in the north. Cape Dalhousie and Maitland Point also have steep shoreline cliffs and a series of small, raised mounds (pingoes) on the Tuktoyaktuk Peninsula break the flat, prairie-like appearance of the eastern Beaufort Sea coastline (Mines and Technical Surveys 1959).

Climate

The climate of the study area is polar continental and is characterized by long, cold winters and by short, cool summers. In winter, temperatures may fall below -50°C. The humidity is very low, and little snow falls

on the area. Summers are cloudy and wet. An extreme high temperature of 34°C was recorded at Aklavik; offshore, however, temperatures remain cold throughout the season (Burns 1973). The growing season is short--less than 75 days (Canada Department of Transport 1967). Spring break-up typically occurs over most of the coastal area during May or June, and the area freezes again in September or October. Occurrences of break-up and freeze-up are more variable on the sea. Though it lasts only a few months, the growing season is effectively lengthened by continuous daylight, which continues from 25 May to 19 July at the latitude of Inuvik and from 9 May to 4 August at Sachs Harbour (Banks Island).

Oceanography and Ice Conditions

Currents in the southern Beaufort Sea follow the continental shelf in a counter-clockwise direction. Beyond the outer continental shelf, currents are primarily wind-driven and predominantly clockwise in direction. Gale winds blow frequently over the sea and occasionally reach hurricane force along the shores. These high-speed winds govern ice degradation and are responsible for alterations of the coast and of the bottom topography (Wiseman *et al.* 1974; Kovacs and Mellor 1974; Hansen 1975).

Ice conditions, although generally correlated with season, are largely governed by wind and as a result are variable from day to day. The Beaufort Sea includes three zones of ice conditions (1) fast ice, (2) seasonal pack ice, and (3) polar pack ice (Kovacs and Mellor 1974). Although shore-fast and pack ice typically break up during the summer, onshore winds may move the polar pack ice near the coast and may severely limit the extent of open water even during the height of the summer season. In 1974, ice cover during the summer was more extensive than average. Much of the Beaufort Sea remained ice-covered throughout the entire season. A more detailed summary of 1974 ice conditions is presented in the 'Results' section and in Appendix 2 of this report.

A report by Hansen (1975) contains a review of the oceanography of the Beaufort Sea in relation to birds in this area; the reader is referred to the portion of this report entitled "The Marine Environment of the Beaufort Sea" for a description and documentation of extant studies of and information on the oceanography of this area.

TRANSECT SURVEYS CONDUCTED DURING 1974

Introduction

Most previous investigations of pelagic seabirds have been conducted from shipboard. Shipboard observations, however, do not allow the rapid coverage of large areas that can be achieved from the air and they are biased by responses of some seabirds to ships. In addition, a large portion of the Beaufort Sea is ice-bound during all or much of the year, and it is possible to survey seabirds in these areas only through use of aerial techniques. Information on the importance of ice coverage--or lack of it--to seabird distributions and movements in these areas can be obtained only through use of aerial surveys.

The objectives of the offshore aerial transect surveys conducted in 1974 were to provide reliable estimates of the size, distribution, species composition, and seasonal variation of the seabird population in the southeastern Beaufort Sea during 1974.

Methods

Aerial surveys of offshore portions of the Beaufort Sea were conducted in 1974 by Renewable Resources Consulting Services Ltd. under contract to the Canadian Wildlife Service.

Surveys in Early Spring

Aerial surveys of the ice-free portions of the southern and southeastern Beaufort Sea were initiated on 21 April 1974. Flights from this date until 31 May essentially consisted of random searches for open water leads. When encountered, open water was surveyed according to normal transect techniques (i.e., coverage of a 1/4 mi-wide area).

Five surveys, each of which required three days of flying, were conducted during April and May through use of a Cessna 337 aircraft. The dates of each flight are listed in Table 1, and the routes followed are shown in Figures 1 through 5. Surveys were flown at a speed of 100 mph (160 km/hr) and at an altitude of 150 ft (45 m) ASL. The aircraft was equipped with a Global Navigation System in order to facilitate navigation and determination of the locations of birds sighted far offshore. Two observers (stationed in rear seats, one on each side of the plane) recorded all birds seen on their sides of the plane and whether or not the birds were within 1/8 mi (0.2 km) of the plane. A third observer (stationed in the front seat) acted as navigator and recorded ice and weather conditions. The same observer sat in the same seat during all surveys and the same pilot was used for these surveys. The date, time, weather and ice conditions were recorded for each 5-mi (8-km) segment of each aerial transect. When birds were observed, the observers recorded the species or species group, the number of individuals (or estimated number), and, where possible, the sex and age of each bird; also recorded was information on the degree of flocking, the activity of the birds, whether or not birds were paired, the number of broods, the number of young per brood, and whether the birds occurred on or off the 1/4 mi-wide transect.

Surveys During June-October

Twelve aerial surveys were conducted between 6 June and 17 October 1974. Each survey was conducted over a period of several days and covered from 4 to 13 of a possible 15 defined transects of various lengths. Each transect was divided into 5-mi (8-km) segments. The date intervals and transects surveyed during each period are given in Table 2. Figure 6 consists of a map of the transects. Survey methods and data-recording techniques were the same as those used during the early spring surveys.

TABLE 1. Dates for Each of Three Flights for Five Surveys Conducted from 21 April to 31 May 1974.

SURVEY NUMBER	FLIGHT NUMBER		
	1	2	3
1	21 April	22 April	24 April
2	1 May	4 May	5 May
3	13 May	14 May	15 May
4	21 May	24 May	27 May
5	29 May	30 May	31 May

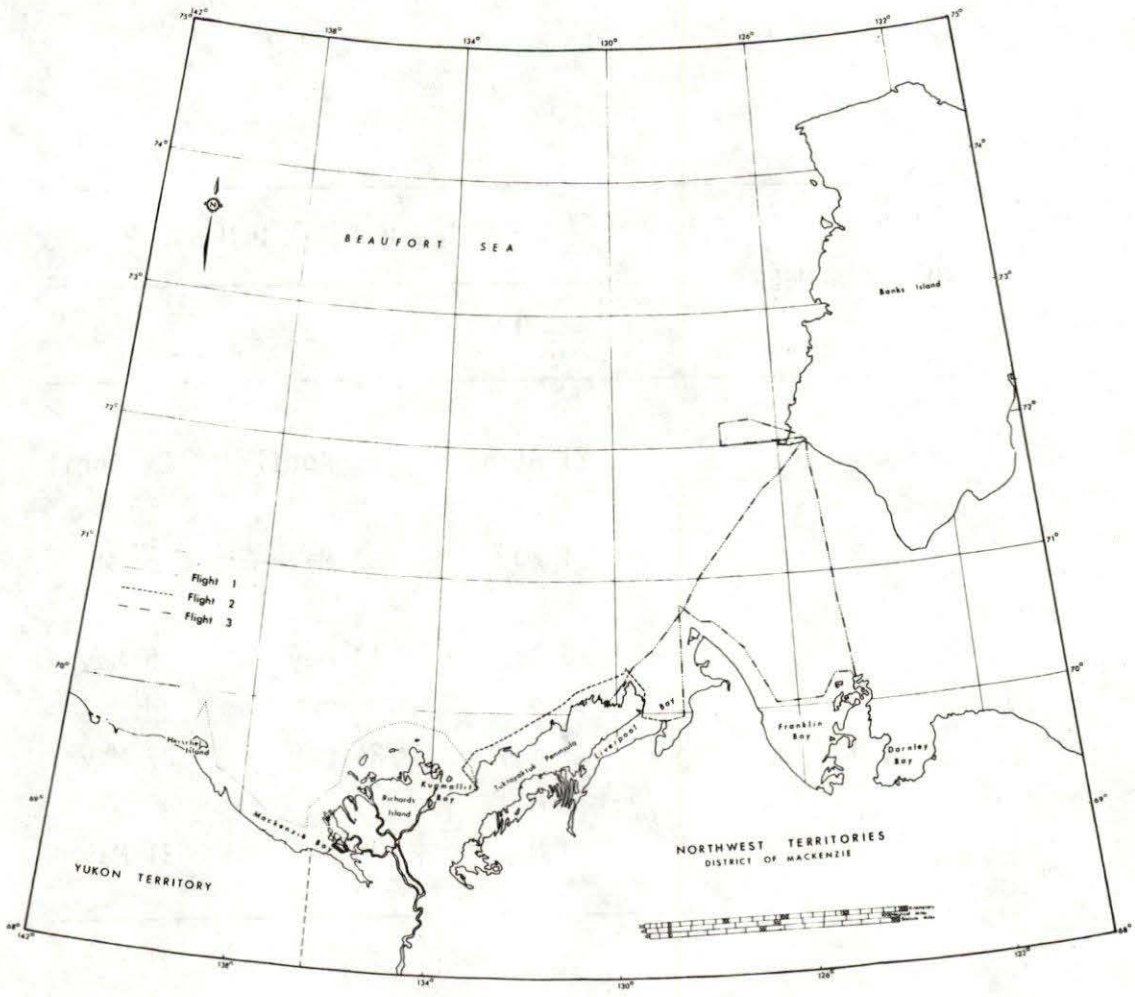

FIGURE 1. Map Of The Southeastern Portion of the Beaufort Sea Showing the Flight Path Followed During Survey 1 Conducted from 21 to 24 April 1974.

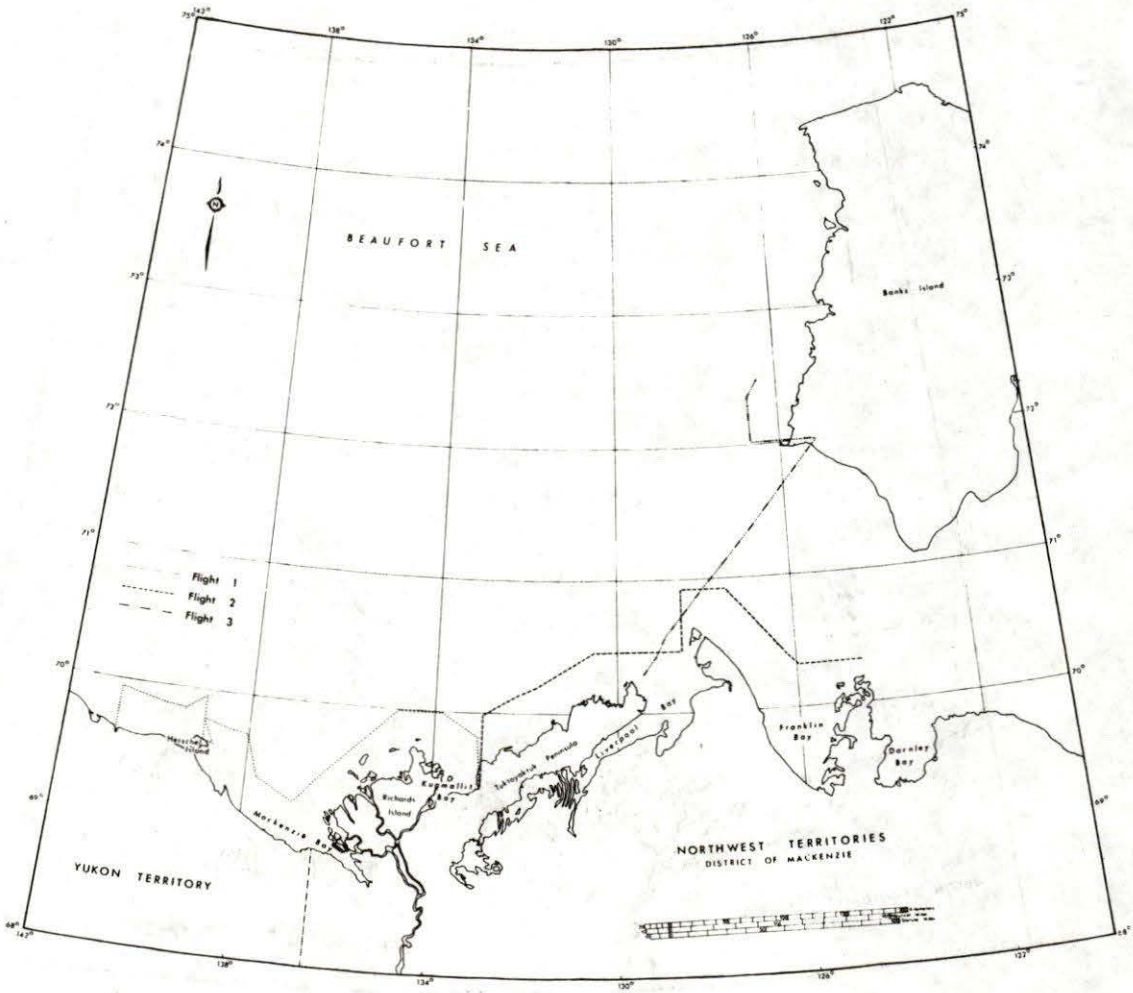

FIGURE 2. Map of the Southeastern Portion of the Beaufort Sea Showing the Flight Path Followed during Survey 2 Conducted from 1 to 5 May 1974.

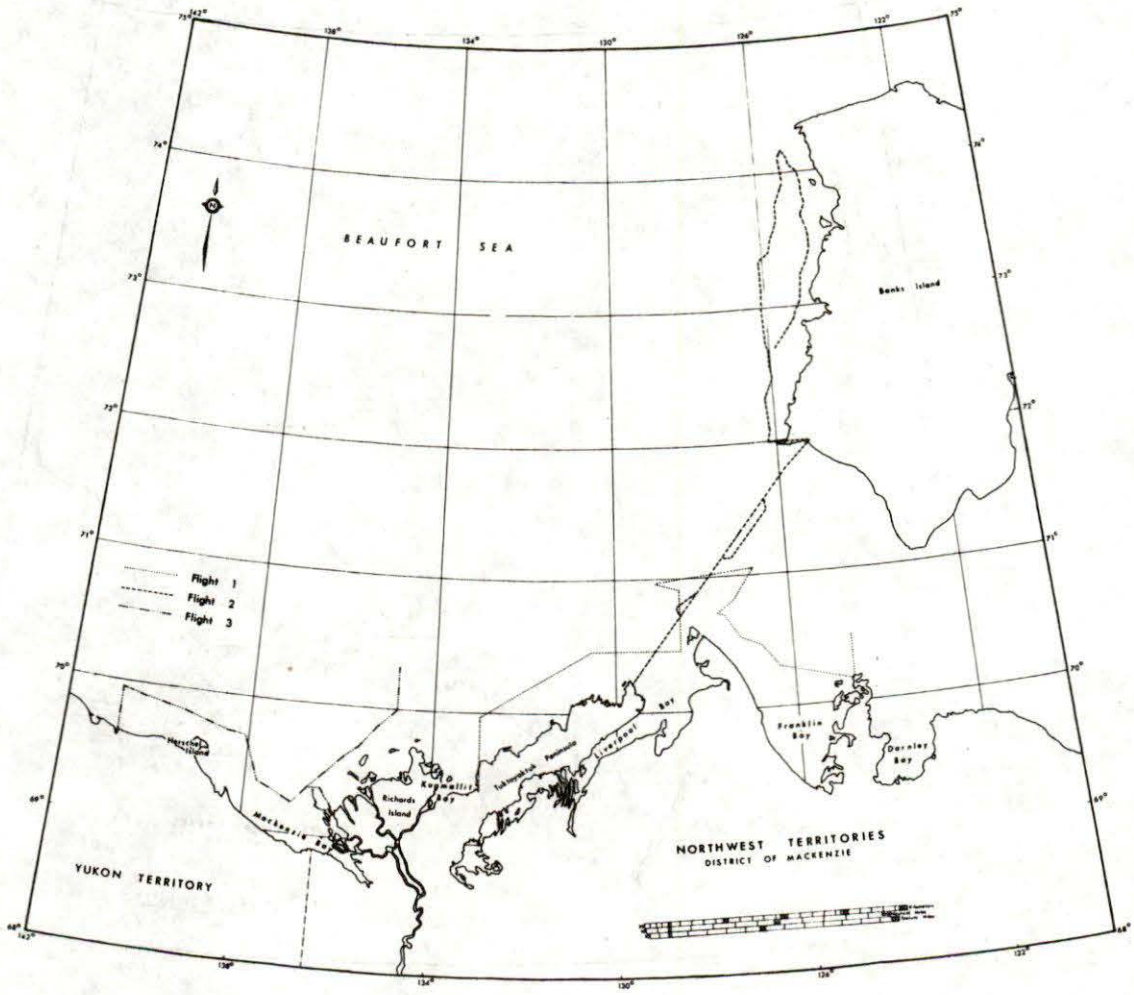

FIGURE 3. Map of the Southeastern Portion of the Beaufort Sea Showing the Flight Path Followed During Survey 3 Conducted from 13 to 15 May 1974.

FIGURE 4. Map of the Southeastern Portion of the Beaufort Sea Showing the Flight Path Followed During Survey 4 Conducted from 21 to 27 May 1974.

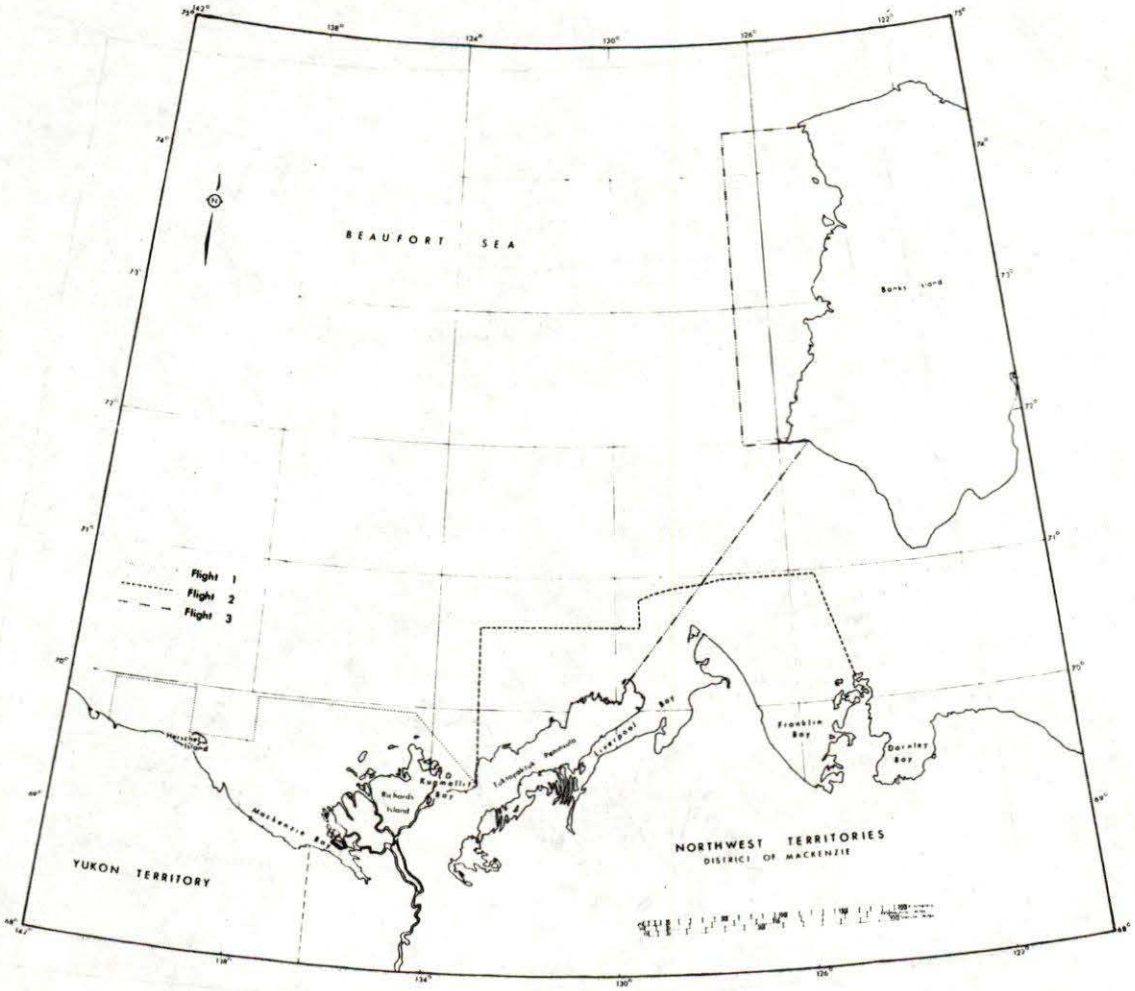

FIGURE 5. Map of the Southeastern Portion of the Beaufort Sea Showing the Flight Path Followed During Survey 5 Conducted from 29 to 31 May 1974.

TABLE 2. Transects Surveyed During Census Intervals from June to October 1974.

DATE	TRANSECT*														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
6-8 June	X	X	X	X	X	X	X	X	X	X	X	X	X		
20-23 June	X	X	X	X	X	X	X		X	X	X	X	X	X	
25-26 June	X								X	X	X	X	X		
3-7 July	X	X	X	X	X	X	X	X	X	X	X	X	X		
15-18 July	X	X	X	X	X	X		X	X	X	X	X	X	X	
23-24 July	X	X	X	X	X	X		X	X	X	X	X	X	X	
13-22 August	X		X	X				X	X	X	X	X	X	X	
25-30 August	X	X	X	X	X			X	X	X	X	X	X	X	
10 September	X		X	X				X					X	X	X
26-28 September	X	X	X	X				X	X	X	X		X	X	
6 October												X	X	X	
14-18 October	X	X	X	X							X	X	X		
NUMBER OF FIVE-MILE SEGMENTS IN TRANSECT	26	23	10	16	22	19	23	66	27	32	26	18	23	10	10

* see Figure 6 for transect locations

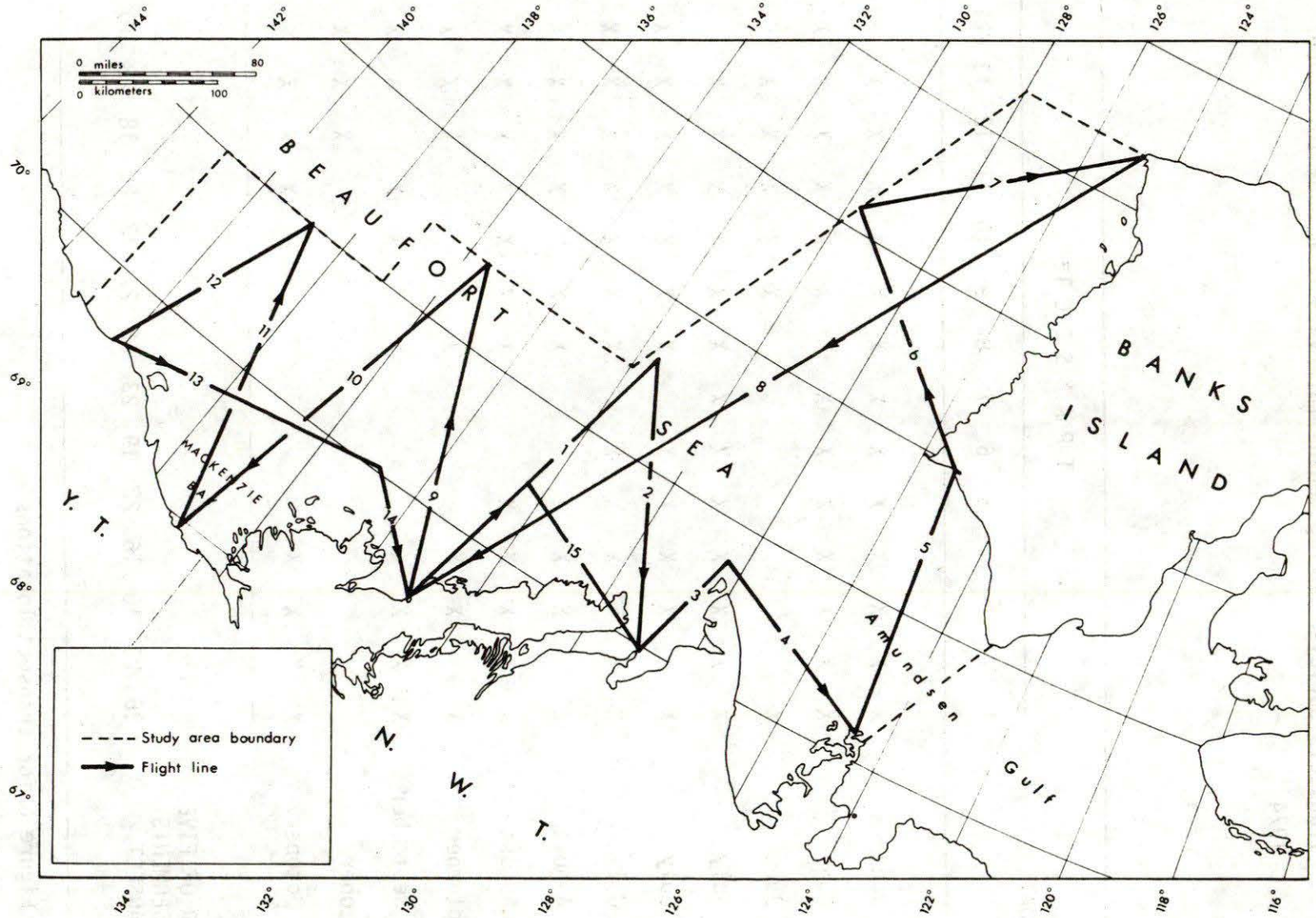

FIGURE 6. Map of the Beaufort Sea Showing Transects Flown in 1974.

Table 3 presents a monthly summary of the sampling efforts. The variability between efforts in the areas surveyed was largely the result of limitations imposed by the prevailing weather conditions and the availability of manpower. The lack of standardization of survey effort between surveys reduces the reliability of month-to-month comparisons of the distributions and relative numbers of birds in the Beaufort Sea and of estimates of absolute numbers of birds in the area. Also, the number of surveys conducted during the fall migration period was insufficient to permit reliable estimation of the volume of offshore migration during this period.

Tabulation and Analysis of Data

During each aerial survey, the time and location, ice and water conditions, and the meteorological and ornithological data were recorded through use of portable tape recorders. At the beginning of each survey, the day, month and year were noted. The transect number was recorded before a survey of a new transect was initiated, and a segment number was assigned to each 5-mi section of each transect. When areas other than preplanned transects were being covered, compass coordinates were recorded at specific checkpoints. At the start of each transect segment or compass-coordinate checkpoint, the time (24-hr clock) was also noted.

The following ice and water conditions were recorded once for each segment:

1. percent ice cover;

2. predominant ice arrangement and the proportion of the segment covered by the predominant ice arrangement--ice arrangements include

   a. pack ice,
   b. fast ice,
   c. total open water,
   d. refrozen open water;

3. predominant ice form and the proportion of the segment covered by the predominant ice form--ice forms include

   a. pancake,
   b. floe,
   c. big floe,
   d. ice cake,
   e. brash ice,
   f. melt-water,
   g. refrozen melt-water,

TABLE 3. Area and Percent of Study Area Surveyed During Each Month.

MONTH	NUMBER OF SEGMENTS SURVEYED	AREA SURVEYED (mi^2)	PERCENT SURVEYED
June	737	920	1.3
July	967	1200	1.7
August	553	690	1.0
September	420	525	0.7
October	118	150	0.2

* total study area = approximately 72,000 mi^2

h. fracture,
i. refrozen fracture,
j. lead,
k. refrozen lead,
l. shore lead,
m. refrozen shore lead,
n. polynya,
o. refrozen polynya;

4. orientation of the ice edge; and

5. water colour, as one of
   a. clear,
   b. mildly turbid,
   c. very turbid, or
   d. dark brown.

At the beginning of each transect survey and each time a change in weather was noticed, the following meteorological data were recorded:

1. light conditions on each side of the plane, as one of
   a. back lighting,
   b. side lighting, or
   c. front lighting;

2. percent cloud cover;

3. precipitation, as one of
   a. clear,
   b. rain,
   c. snow,
   d. ice, or
   e. fog;

4. wind speed (Beaufort Scale);

5. the number of individuals of each sex (sexed when possible) and whether this number was based on an actual or estimated count;

6. the age of birds sighted as one of
   a. immature,
   b. adult, or
   c. unknown;
7. whether the birds were paired;
8. the type of aggregation the birds were in, as one of
   a. tight flock,
   b. loose flock, or
   c. scattered individuals;
9. the number of broods of each species and the number of young per brood;
10. the activity of the birds sighted, as one of
   a. feeding in open water,
   b. feeding on land,
   c. feeding behind a whaling boat,
   d. feeding behind a fishing boat,
   e. resting on ice,
   f. resting on water,
   g. resting on land,
   h. flying, or
   i. sitting near a kill of a polar bear;
11. the direction of flight if flying (to the nearest 45° azimuth); and
12. whether the birds were moulting.

All data were then transcribed onto coding forms.

After the coding forms were received by LGL Limited, the data were keypunched, keyverified, and checked for impossible or implausible records through application of a validation program. Such errors were corrected, and the data were then tabulated for each 5-mi segment of each transect and each survey on a species-by-species basis. In all tabulations, birds were counted regardless of whether they were at rest or flying when sighted. The tables included for each species or group both the numbers of birds on transect (i.e., in 0.25 x 5-mi areas) and the total number seen both on and off the central 0.25-mi-wide strip.

This tabulation for 14 common species and species group was presented to CWS with this report as an appendix (bound separately) and is also filed both on paper and on magnetic tape in the library of LGL Limited in Edmonton, Alberta.

In a second tabulation, the data from several (usually three)* adjacent 5-mi-long transect segments were grouped. The percent of ice cover for each group of segments was averaged and included in this tabulation.

In order to determine the relationship during the study period between the distributions and concentrations of birds and ice-cover conditions as it existed in 1974, plots of the sightings of loons, eiders, and Oldsquaws (see species accounts for scientific nomenclature) in the Beaufort Sea and the ice conditions present there, were constructed for each aerial survey during which these species were seen (see Appendix 1). The tabulation by several-segment (usually three segments, i.e., 15 mi) intervals was used to prepare these maps; the values plotted are total numbers of birds on and off transect within each group of segments.

Maps of percent of ice cover, tabulated by several-segment intervals, were also prepared for each survey (Appendix 2). These maps permit analysis of distributions of birds in relation to the presence or absence of open water.

Results and Discussion

Distribution and Numbers

The total number of individuals of each species and species group observed during each survey is presented in Table 4.

In order to summarize the distribution of each common species or group of species in relation to ice cover, the Spearman rank correlation coefficient between the percent of ice cover and the total numbers sighted on the 15-mi segments (both on and off transect) were calculated. This calculation was done separately for each survey, and the results of each calculation are given in Table 5. None of the species or groups of species occurred in significantly ($P \leq 0.05$) *greater* numbers in relation to high rather than to low percentages of ice cover. Several species or groups tended to occur in areas with high percen-

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* During Surveys 1-5 (conducted during April and May), the data were not originally recorded by 5-mi segments or on straight-line transects; it was not possible to assign all of the data to 15-mi intervals for which ice cover was known. It was therefore necessary to group the data gathered during April and May into segments of length 5-25 mi on the basis of intervals for which ice conditions were recorded. Data gathered from June to October were grouped by 15-mi intervals in the second tabulation.

TABLE 4. Number of Birds Seen Both On and Off Transect During Each Offshore Survey of the Southeastern Beaufort Sea during 1974.

SPECIES	DATE																	
	APRIL	MAY				JUNE			JULY			AUGUST		SEPTEMBER		OCTOBER	
	21-24	1-5	13-15	21-27	29-31	6-8	20-23	25-26	3-7	15-18	23-24	13-22	25-30	10	26-28	6	14-18
Yellow-billed Loon	0	0	0	13	0	17	0	3	1	1	0	0	0	0	1	0	0
Arctic Loon	0	0	0	0	0	4	1	7	0	2	0	5	6	3	0	0	0
Red-throated Loon	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0
Total loons	0	0	0	19	0	34	11	12	17	24	5	22	22	8	1	0	0
Whistling Swan	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0
Canada Goose	0	0	0	4	0	0	0	0	0	0	0	2	0	0	0	0	0
Snow Goose	0	0	0	0	0	360	0	0	0	0	0	400	430	75	0	0	0
Total geese	0	0	0	5	0	890	1	0	0	0	0	402	430	75	0	0	0
Scaup spp.	0	0	0	152	0	0	0	4	100	0	4	0	0	0	0	0	0
Goldeneye spp.	0	0	0	0	0	0	0	0	29	66	78	50	37	9	21	0	2
Oldsquaw	0	0	0	17454	11353	586	563	43	478	86	8	9	14	46	0	0	0
Common Eider	0	0	0	56280	1950	267	0	141	408	0	2	0	0	0	0	0	0
King Eider	0	0	0	10	140	433	66	634	249	141	40	0	0	75	0	0	0
Total eiders	0	0	0	57301	7977	4844	101	815	721	201	42	15	1	75	60	212	0
White-winged Scoter	0	0	0	0	0	0	0	0	35	46	0	1	0	0	0	0	0
Surf Scoter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0
Total scoters	0	0	0	240	28	11	155	0	36	94	46	7	3	0	0	20	0
Red-breasted Merganser	0	0	0	0	0	0	0	0	0	40	0	0	0	10	0	0	0
Total diving ducks	0	0	0	87233	40336	9285	1416	1602	2195	1124	763	605	224	654	375	240	37
Marsh Hawk	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Phalarope	0	0	0	0	0	0	0	0	0	0	0	0	0	100	0	0	0
Total sandpipers	0	0	0	0	0	0	0	0	0	0	4	0	29	101	0	0	0
Pomarine Jaeger	0	0	0	0	0	2	0	0	1	0	0	0	1	0	0	0	0
Parasitic Jaeger	0	0	0	0	0	6	0	0	2	0	1	1	0	0	0	0	0
Long-tailed Jaeger	0	0	0	0	0	2	3	0	8	0	4	0	0	0	0	0	0
Total jaegers	0	0	0	0	0	16	5	1	22	6	8	3	1	0	0	0	0
Glaucous Gull	0	0	15	190	60	39	25	7	67	267	31	37	69	52	42	0	0
Herring-Thayer's Gull	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0
Mew Gull	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Sabine's Gull	0	0	0	0	0	0	0	0	0	0	0	14	0	0	0	0	0
Total gulls	0	0	15	191	81	70	25	32	85	278	151	171	89	77	85	0	0
Arctic Tern	0	0	0	0	0	1	1	0	0	0	0	19	7	0	0	0	0
Snowy Owl	0	0	0	0	2	1	0	0	0	0	0	0	2	0	0	0	0
Short-eared Owl	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total raptors	0	0	1	0	2	3	0	0	0	0	0	0	2	0	0	0	0
Common Raven	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0
Total passerines	0	0	0	0	0	0	0	0	2	0	0	0	1	2	0	0	0

TABLE 5. Degree of Association Between the Number of Birds Sighted and the Ice Cover Conditions Present.*

SURVEY NUMBER	DATE	SPECIES													
		YELLOW-BILLED LOON	TOTAL LOONS	SNOW GOOSE	TOTAL GEESE	GOLDEN-EYE	OLD-SQUAW	COMMON EIDER	KING EIDER	TOTAL EIDERS	TOTAL SCOTERS	TOTAL DIVING DUCKS	TOTAL JAEGERS	GLAUCOUS GULL	ARCTIC TERN
1	21-24 April	-	-	-		-	-	-	-	-	-	-	-	-	-
2	1-5 May	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	13-15 May	-	-	-	-	-	-	-	-	-	-	-	-	**	-
4	21-27 May	**	*	-	0	-	***	***	-	***	**	***	-	***	-
5	29-31 May	-	-	-	-	-	***	***	-	***	***	**	-	***	-
6	6-8 June	**	***	0	0	-	***	***	***	***	*	***	**	**	-
7	20-23 June	-	0	-	-	-	**	-	**	**	-	***	*	(*)	-
8	25-26 June	-	*	-	-	-	0	-	0	(*)	-	0	-	-	-
9	3-7 July	-	0	-	-	(*)	0	-	*	(*)	0	*	(*)	-	-
10	15-18 July	-	0	-	-	-	0	-	0	*	-	0	0	***	-
11	23-24 July	-	(*)	-	-	0	-	-	-	-	**	0	0	***	-
12	13-22 August	-	0	-	*	0	-	-	-	-	-	*	*	***	**
13	25-30 August	-	0	-	-	0	0	-	-	-	-	0	-	***	0
14	10 September	-	+(*)	-	-	0	0	-	-	-	-	0	-	0	-
15	26-28 September	-	-	-	-	0	-	-	-	-	-	0	-	0	-
16	6 October	-	-	-	-	-	-	-	-	-	-	0	-	-	-
17	14-18 October	-	-	-	-	-	-	-	-	-	-	0	-	-	-

* the Spearman Rank Correlation between the number of birds and the ice cover conditions near which the birds were sighted. All correlations are negative except where noted.

Significance levels:
- \- less than three sightings on survey; not tested
- 0 not significant
- (*) $0.1 > P > 0.05$
- * $0.05 \geq P > 0.01$
- ** $0.01 \geq P > 0.001$
- *** $P \leq 0.001$

tages of ice cover (but not 100%). This tendency was particularly evident early in the year, when many or most survey segments were totally covered by ice and when virtually all birds were observed on or flying over the few segments that had small areas of open water.

The distributions of the major species and species groups in relation to ice-cover conditions are discussed briefly below. A more extensive discussion of the distribution of birds in the Beaufort Sea, based on all of the types of data that are available, is presented in the annotated list of species.

Loons

Loons were observed during aerial surveys conducted over the Beaufort Sea from 27 May until 27 September; these birds were broadly distributed throughout the eastern Beaufort Sea during this period. The small amount of pertinent data gathered indicated that loons were frequently associated with small open-water leads (> 80% ice cover) and that they showed little preference for extensive areas of open water. After mid-July, when open water areas formed along the southern coast of the Beaufort Sea, loons were not observed significantly more often in these waters than in the less open areas. Yellow-billed Loons were sighted in low numbers along small leads from May to July. One Yellow-billed Loon was seen during late September in 30% open water in Liverpool Bay, along the west coast of the Bathurst Peninsula.

Geese

Few sightings of geese were made during aerial surveys conducted offshore during 1974; of the 1803 geese sighted, 1265 (70%) were Snow Geese. Although during spring geese were observed flying over areas completely covered by ice, the few geese observed during autumn were scattered throughout predominantly coastal areas that had little or no ice cover.

Diving Ducks

Open water was not encountered during offshore aerial surveys until Survey 3 (13-15 May). The first diving ducks were not seen offshore in the eastern Beaufort Sea until 21 May (during the fourth survey). These early-spring arrivals consisted primarily of Common Eiders and Oldsquaw and of a relatively small number of scoters (species unidentified); these birds were observed in a large lead off Liverpool Bay and in a smaller lead off Banks Island; in numbers, they exceeded 50,000 eiders, 17,000 Oldsquaw, and 200 scoters (species not recorded).

The above-mentioned leads had closed by the time Survey 5 was conducted (between 29 and 31 May). During this period, fewer birds were observed and fewer areas of major concentrations were found--although both Oldsquaw and eiders showed a more widespread distribution.

Following this period, ice cover was nearly complete on the Beaufort Sea until mid-July, when some open water appeared along the coastal areas. These shoreline areas remained fairly open until mid-September, after which ice again covered most of the study area. During the aerial surveys conducted between 6 June and 18 July, Oldsquaw, eiders, and diving ducks were observed in low to moderate numbers and were widely dispersed.

Goldeneye were not identified to species level during offshore surveys. Although both goldeneye species, Common Goldeneye and Barrow's Goldeneye, are rare in the eastern Beaufort Sea, the Common Goldeneye occurs in small numbers in the Mackenzie Delta (Porsild 1943) and occasionally elsewhere in the Arctic, whereas the Barrow's Goldeneye has not been recorded in the eastern Beaufort Sea (Johnson *et al.* In Press). It is probable, therefore, that goldeneyes observed during this study were Common Goldeneyes.

During 1974, goldeneyes were first observed offshore on 3 July. This species group was widely distributed in small numbers throughout the remainder of the study period. During July, goldeneyes were often observed in areas where there was little open water (> 80% ice cover) and where larger areas of open water were not readily available.

Previous to Survey 11 (conducted on 23 and 24 July), the numbers of Oldsquaws and eiders declined to a low level; these numbers remained at a near-zero level for the duration of the study. Goldeneyes, on the other hand, remained broadly distributed in small numbers until the end of September. Goldeneyes appeared to show little preference for areas of extensive open water; however, very few were seen near areas of total ice cover. Scoters were never seen in large numbers; nor were they widely distributed. Most scoters observed were in the large bays along the coast and in relatively open water; few scoters were sighted after July. Diving ducks in general were observed in low to moderate numbers from 6 June until 10 September, when their numbers approached zero; few were observed thereafter.

Jaegers

The distribution of jaegers that were observed offshore showed little relationship to ice conditions--except during June and mid-August. During this period, jaegers were observed 5 to 170 km offshore; half of the jaegers seen were more than 100 km from the coast in areas of low ice cover. During July, jaegers were distributed nearly as widely as during the above-mentioned period and were seen from 6 to 140 km from shore. However, nearly half (44%) of the jaegers seen during this month were between 50 and 75 km from shore. During mid-August, observed jaegers showed an apparent tendency to occur in areas with little or no ice cover; however, a definite preference for such areas cannot be attributed to jaegers on the basis of the few that were sighted during this period.

Glaucous Gulls

Glaucous Gulls were widely distributed across the southeastern Beaufort Sea but were most frequently seen where open water was available. As did diving ducks, Glaucous Gulls made use of the large lead that formed off Liverpool Bay during late May; these birds also dispersed during June. Very little open water was available during June, and gulls were frequently seen during this month in areas with fairly high percentages of ice cover (at times over 200 km from shore). When extensive shore leads developed during July along the south shore of the Beaufort Sea, nearly all sightings of Glaucous Gulls were recorded in such areas. The last gulls seen during offshore surveys in 1974 were sighted in Kugmallit Bay during late September, when the bay began to freeze.

Movements of Glaucous Gulls during the study period appeared to be highly regulated by ice cover. It is speculated that ice cover affects the distribution of Glaucous Gulls mainly by affecting their food resources: that the availability of food increases with decreases in ice cover and decreases with increases in ice cover.

Arctic Terns

Because very few Arctic Terns (28) were sighted offshore during 1974, it is difficult to assess the degree to which their distribution and movements are governed by sea ice. Whether their relative scarcity over the Beaufort Sea was a result of the extreme ice conditions in 1974 is unknown. Most of the Arctic Terns that were sighted during aerial surveys were in nearshore areas during August after shore leads had developed.

Densities Based on Observations

The densities of waterfowl and water-associated birds based on numbers of these birds sighted during surveys conducted from June through October 1974 are given in Figure 7. Data gathered during April and May are not included because the survey effort during these months was concentrated in areas of open water and because the results of these surveys are therefore not representative of the southeastern Beaufort Sea as a whole.

During June, the density of ducks (mostly of diving ducks) calculated from sightings was 12.8 birds/mi^2 (4.9 birds/km^2)--more than five times greater than the density during any subsequent month. These birds probably represented migrating or recently-arrived birds that were awaiting snow-melt on their nesting areas. The rapid decrease in densities of diving ducks during late June and July was probably due to an onshore movement of these ducks during the breeding season.

The sexes of birds sighted during this period were recorded infrequently, but the ratios available for eiders during June and July indicate a pronounced shift in the sex ratios of eiders recorded off-

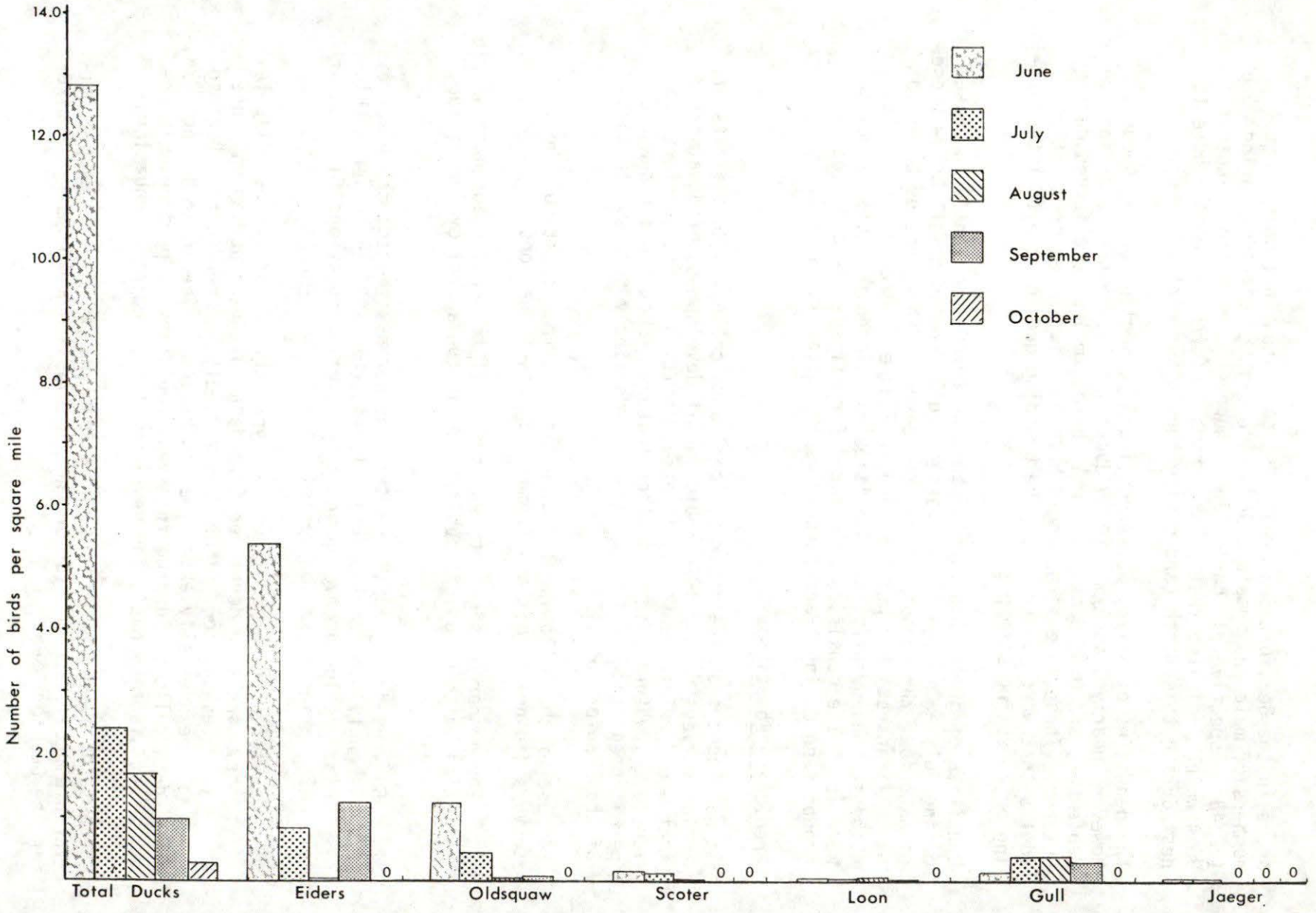

FIGURE 7. Observed Densities of Birds on Aerial Surveys in June Through October in the Beaufort Sea.

shore in the Beaufort Sea area. The data show that nearly equal numbers of male and female eiders were sighted offshore during June (52:48; respectively); during July, however, the ratio changed to 96:4 which indicated that a large number of females went ashore to nest during this month (and during the latter part of June).

The densities of diving ducks continued to decline during August; however, nearly 1 duck/mi^2 (0.39 ducks/km^2) was observed during September, and 0.30 ducks/mi^2 (0.12 birds/km^2) were observed during October. These late birds could have been immatures or moulting adults that were lingering on the breeding grounds due to late nesting or renesting attempts.

Densities of gulls (based on numbers observed) apparently increased during July--although the numbers of gulls remained well below those of waterfowl throughout the entire season. Other species observed on the transects but not included in Figure 7 were present in low numbers; consequently, the densities calculated for these species were low. The densities calculated for all species and species groups seen during transect surveys are given in Table 6.

Predictive Equations

It was hoped that the distributional data collected during offshore aerial surveys during 1974 would permit development of equations that would relate densities to date, position in the Beaufort Sea, ice cover, water depth, and other factors. Such equations would permit prediction of the number of birds likely to occur in parts of the Beaufort Sea.

Because of the following limiting factors, the results of the 1974 surveys did not permit development of these equations:

1. The number of sightings was too small to provide adequate sample sizes within logical subdivision of the annual cycles of the birds.

2. Surveys during April and May were not systematic; these surveys strongly oversampled areas of less than 100% ice cover. This bias precluded development of prediction equations for much of the spring migration period.

3. If forecasting models of the type required are to be reliable, they cannot be developed from data collected during only one year because conditions vary markedly between years. Because of the unusually extensive and prolonged ice cover during 1974, data collected during this year would form a particularly unsatisfactory basis for development of prediction equations.

Because of these limitations, no attempt was made to develop multivariate prediction models for the distribution and numbers of birds in the Beaufort Sea.

TABLE 6. Density of Birds Observed on Transect During Each Offshore Survey of the Southeastern Beaufort Sea during 1974.*

SPECIES	DATE																
	APRIL	MAY				JUNE			JULY			AUGUST		SEPTEMBER		OCTOBER	
	21-24	1-5	13-15	21-27	29-31	6-8	20-23	25-26	3-7	15-18	23-24	13-22	25-30	10	26-28	6	14-18
Yellow-billed Loon	0.0	0.0	0.0	0.05	0.0	0.02	0.0	0.02	Trace	Trace	0.0	0.0	0.0	0.0	Trace	0.0	0.0
Arctic Loon	0.0	0.0	0.0	0.0	0.0	0.01	Trace	0.04	0.0	0.01	0.0	0.02	0.02	0.0	0.0	0.0	0.0
Red-throated Loon	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Trace	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total loons	0.0	0.0	0.0	0.05	0.0	0.03	0.01	0.06	0.02	0.03	0.01	0.04	0.04	Trace	Trace	0.0	0.0
Whistling Swan	0.0	0.0	0.0	0.0	0.0	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Canada Goose	0.0	0.0	0.0	Trace	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Snow Goose	0.0	0.0	0.0	0.0	0.0	0.12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total geese	0.0	0.0	0.0	0.01	0.0	0.12	Trace	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Scaup spp.	0.0	0.0	0.0	0.57	0.0	0.0	0.0	0.02	0.24	0.0	0.01	0.0	0.0	0.0	0.0	0.0	0.0
Goldeneye spp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.01	Trace	0.02	0.01	0.01	Trace	0.0	0.0
Oldsquaw	0.0	0.0	0.0	35.62	28.23	1.26	1.49	0.24	1.09	0.19	0.02	0.03	0.04	0.22	0.0	0.0	0.0
Common Eider	0.0	0.0	0.0	154.51	6.74	0.63	0.0	0.83	0.49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
King Eider	0.0	0.0	0.0	0.04	0.54	1.04	0.13	3.14	0.60	0.31	0.10	0.0	0.0	0.37	0.0	0.0	0.0
Total eiders	0.0	0.0	0.0	154.55	22.54	6.57	0.13	3.97	1.14	0.31	0.10	0.0	Trace	0.37	0.19	3.33	0.0
White-winged Scoter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.04	0.12	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Surf Scoter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.31	0.0
Total scoters	0.0	0.0	0.0	0.14	0.10	0.01	0.01	0.0	0.04	0.24	0.07	0.02	0.01	0.0	0.0	0.31	0.0
Red-breasted Merganser	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.10	0.0	0.0	0.0	0.05	0.0	0.0	0.0
Total diving ducks	0.0	0.0	0.0	203.01	53.00	8.68	1.66	4.24	2.56	0.95	0.26	0.15	0.11	1.18	0.29	3.64	0.0
Marsh Hawk	0.0	0.0	0.0	0.0	0.0	Trace	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phalarope	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total sandpipers	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.01	0.0	0.08	Trace	0.0	0.0	0.0
Pomarine Jaeger	0.0	0.0	0.0	0.0	0.0	Trace	0.0	0.0	Trace	0.0	0.0	0.0	Trace	0.0	0.0	0.0	0.0
Parasitic Jaeger	0.0	0.0	0.0	0.0	0.0	0.01	0.0	0.0	Trace	0.0	Trace	Trace	0.0	0.0	0.0	0.0	0.0
Long-tailed Jaeger	0.0	0.0	0.0	0.0	0.0	Trace	0.01	0.0	0.02	0.0	0.01	0.0	0.0	0.0	0.0	0.0	0.0
Total jaegers	0.0	0.0	0.0	0.0	0.0	0.03	0.01	0.0	0.03	Trace	0.01	0.01	Trace	0.0	0.0	0.0	0.0
Glaucous Gull	0.0	0.0	0.05	0.45	0.19	0.06	0.07	0.04	0.14	0.45	0.05	0.10	0.10	0.09	0.05	0.0	0.0
Herring-Thayer's Gull	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.01	0.0	0.0	0.0	0.0	0.0	0.0
Mew Gull	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sabine's Gull	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.04	0.0	0.0	0.0	0.0	0.0
Total gulls	0.0	0.0	0.05	0.45	0.19	0.06	0.07	0.04	0.14	0.45	0.06	0.16	0.11	0.09	0.05	0.0	0.0
Arctic Tern	0.0	0.0	0.0	0.0	0.0	Trace	Trace	0.0	0.0	0.0	0.0	0.03	0.01	0.0	0.0	0.0	0.0
Snowy Owl	0.0	0.0	0.0	0.0	0.01	Trace	0.0	0.0	0.0	0.0	0.0	0.0	0.01	0.0	0.0	0.0	0.0
Short-eared Owl	0.0	0.0	Trace	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total raptors	0.0	0.0	Trace	0.0	0.01	Trace	0.0	0.0	0.0	0.0	0.0	0.0	0.01	0.0	0.0	0.0	0.0
Common Raven	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Trace	0.0	0.0	0.0	0.0
Total passerines	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Trace	0.0	0.0	0.9	Trace	0.0	0.0	0.0	0.0

* surveys during April and May were not conducted in a random or systematic manner, hence, they are less representative of avian density than later surveys.

Previous to the initiation of the project, it was also hoped that observations of the activities of birds observed during surveys offshore in 1974 could serve as the basis for development of multivariate prediction equations for flock size and behaviour. However, limited sample sizes, limited information about environmental variables, and limited discrimination of activities precluded meaningful analysis. In the absence of a sufficient number of sightings of any one species, we attempted to use multiple regression techniques to develop a prediction equation for the flock sizes of diving ducks encountered offshore; however, the resultant equation was not a successful predictor and it gave no new insight into factors affecting flock size. Therefore, no further analyses of this nature were attempted.

SHIPBOARD OBSERVATIONS

Introduction

Shipboard observations were conducted in 1974 in Mackenzie Bay in order to obtain additional information about the distribution of birds offshore and that would provide a basis of comparison with aerial survey data. Similar cruises have been conducted in the study area in earlier years (Frame 1973; Watson and Divoky 1974); however, data gathered during cruises are of limited value in a determination of overall distributions and movements of seabirds. Because shipboard observations are restricted to relatively open water, data gathered during such observations give little indication of the distributions and movements of birds in areas of extensive ice cover.

Methods

Shipboard observations were conducted by personnel of Canadian Wildlife Service as part of a cruise from Vancouver, British Columbia, to the eastern Beaufort Sea. Offshore observations were conducted in the Beaufort Sea east to Mackenzie Bay; however, observations were conducted in the study area during only two days (31 August and 1 September 1974). Observations were conducted during 10 min of every daylight hour; during these observations, the number of birds sighted both on and off a 1/2 mi-wide (0.8 km-wide) transect, the time and date of each sighting, and weather and ice conditions were recorded.

Results and Discussion

During these shipboard observations, extensive ice conditions prohibited coverage of the majority of the Beaufort Sea. In the limited part of the study area covered, only three or four species of birds were seen: Glaucous Gull, Herring and/or Thayer's Gull, and Parasitic Jaeger. Figure 8 shows the location and number of individuals of each species that were sighted.

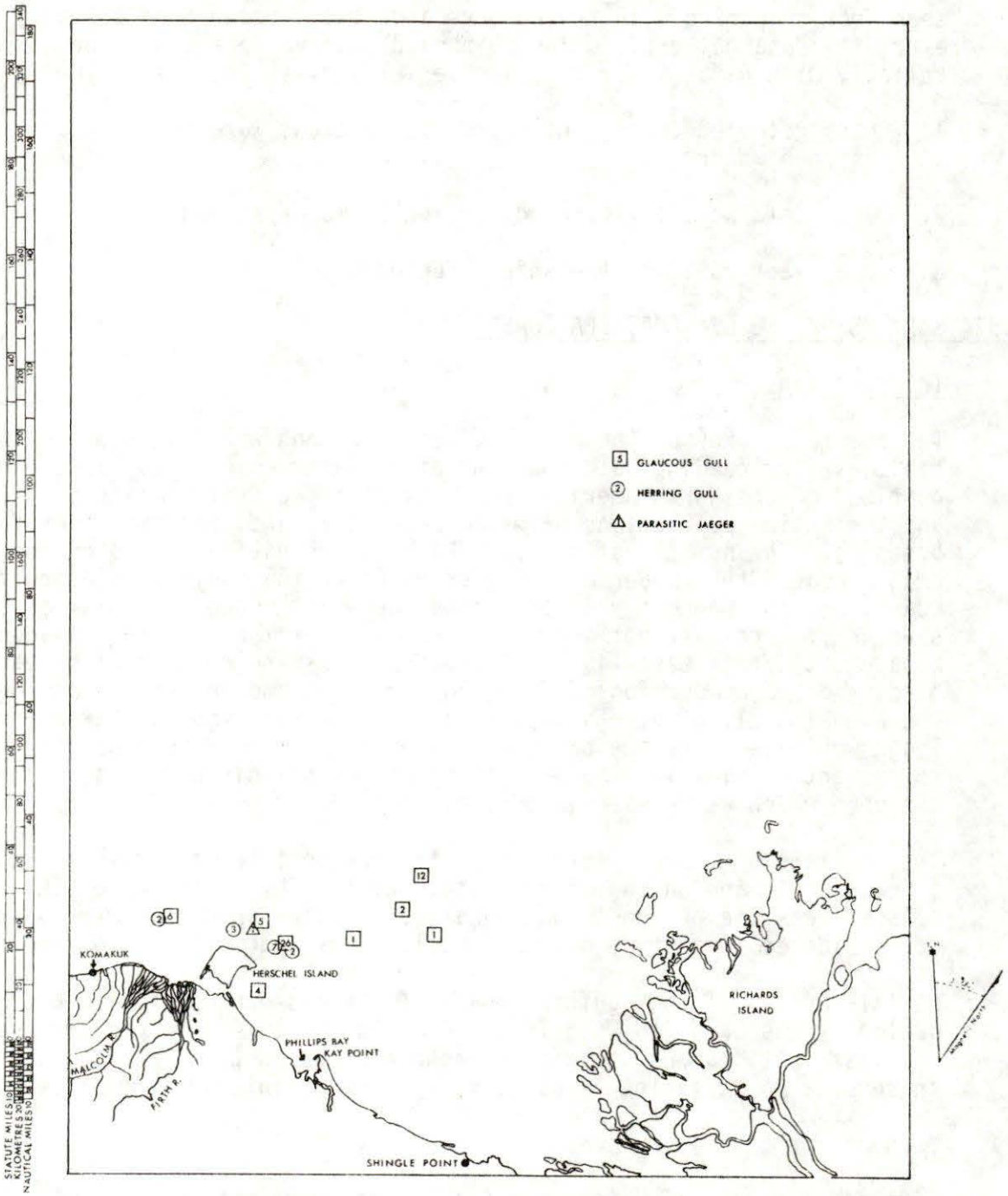

FIGURE 8. Birds Observed During a Cruise of the Beaufort Sea in 1974.

The major purpose of this cruise was to 'ground-truth' the results of the aerial transect surveys (i.e., to compare numbers of birds and species seen from shipboard with the numbers and species seen from the air). However, the data gathered during shipboard observations cannot be compared reliably with data gathered during aerial surveys for the following reasons:

1. data gathered during shipboard observations were restricted to areas of open water;

2. such data were collected during only two days; and

3. the exact route of the ship is unknown.

1974 SURVEYS OF THE BEAUFORT SEA COAST

Introduction

The numerous lakes on the arctic coast of Canada and Alaska are prime habitats for breeding waterfowl and other water-associated birds. Major portions of the North American populations of several species of birds and the entire populations of other species depend upon this area for breeding. The numbers of breeding birds using various parts of the arctic coast, the number of young produced on the many lakes along the coast, and the phenology of the annual breeding process of many of these species of birds are not accurately known. For the purposes of sound management, it is essential that the locations and numbers of breeding birds and the production of young be monitored and that the phenology of the annual cycle of events of each species be well known; for such knowledge would serve as the basis of measures that could be taken in order to prevent or minimize the effects of man-caused disturbances to the habitat upon which water-associated birds depend.

The habitats of the coastal area of the Beaufort Sea are diverse on both a broad scale and on the microhabitat level. The diversity of these habitats affects the presence and abundance of avian species markedly and must be considered in a study of the distributions and movements of these species.

Aerial surveys of the southern coast of the eastern Beaufort Sea were conducted by the Canadian Wildlife Service during 1974 in order to assess the distributions and numbers of onshore birds in this area and to relate these data to variables of habitat type, location, and time of year.

Methods

Complete censuses of water-associated birds were attempted on 90 waterbodies located between Nunaluk Spit, Y.T., and the eastern tip of the Tuktoyaktuk Peninsula, N.W.T. From 1 July to 10 September 1974, all waterbodies but #8 and #75 were censused six times from the air through use of a Cessna 185 aircraft; waterbody #8 was surveyed four times and #75 five times (Table 7). The altitude maintained during censuses varied from 50 to 150 ft (15 to 45 m) above ground level. Censuses were flown in a circular pattern in an attempt to count all birds, including those on or over the waterbody and up to 10 m inland from the water's edge.

TABLE 7. Dates of Surveys of Waterbodies Near the Southeastern Coast of the Beaufort Sea.

SURVEY NUMBER	D A T E I N T E R V A L
1	1 July- 8 July
2	14 July-19 July
3	25 July-30 July (with supplementary flight on 3 August)
4	7 August-14 August
5	24 August-28 August
6	6 September-10 September

Locations of these waterbodies are shown in Figure 9. The waterbody locations shown in Figure 9 were numbered differently*in the original survey work but have been renumbered to arrange them into numerical order on an east to west basis. The key to the waterbody types is shown in Table 8.

Results and Discussion

Movements, Distributions, and Numbers

Post-breeding activities of birds can include moulting, staging, moult migration, and fall migration. Some or all of these activities--depending upon species, age, and sex--involve movement away from breeding areas and may occur at different times in different species and in different age and sex groups of particular species. In order to depict distributions and movements on an east-west gradient, histograms of the numbers of birds of a species or species group counted on different waterbodies have been constructed for each of the six survey periods. Previous to migration, however, local movements from one waterbody to another may occur. Detection of this type of movement is more difficult. Histograms of numbers of birds according to waterbody types (see section on Species Richness) and dates were designed for this purpose. Results of these analyses are given in the species account for the appropriate species or species group.

Sharp *et al.* (1974) have shown that knowledge of the habitat requirements of birds that nest on the Yukon coastal plain can be obtained by application of multiple regression techniques to the results of surveys of birds on waterbodies in this area. A similar analysis of the results of aerial surveys of waterbodies conducted during 1974 was attempted. Separate analyses were performed for each of 10 common species. For each species, one analysis considered all classes of waterbodies (lakes, bays, water adjacent to beaches, and water adjacent to islands), and another analysis considered fresh-water lakes alone. Unfortunately, three of the variables that Sharp *et al.* (1974) found to be related to distribution and productivity of birds on lakes of the Yukon coastal plain--shoreline characteristics, amount of emergent vegetation, and number of creeks--were not measured during the present study.

The following potential predictor variables were considerd for the first set of equations (total waterbodies):

1. date (from 1 to 365);

2. square of the date (consideration of this term as well as date *per se* permitted appropriate treatment of non-linear trends of numbers versus date);

3. whether (1) or not (0) the waterbody was a lake;

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* See APPENDIX 3, p 257 for a translation of old location numbers to new numbers.

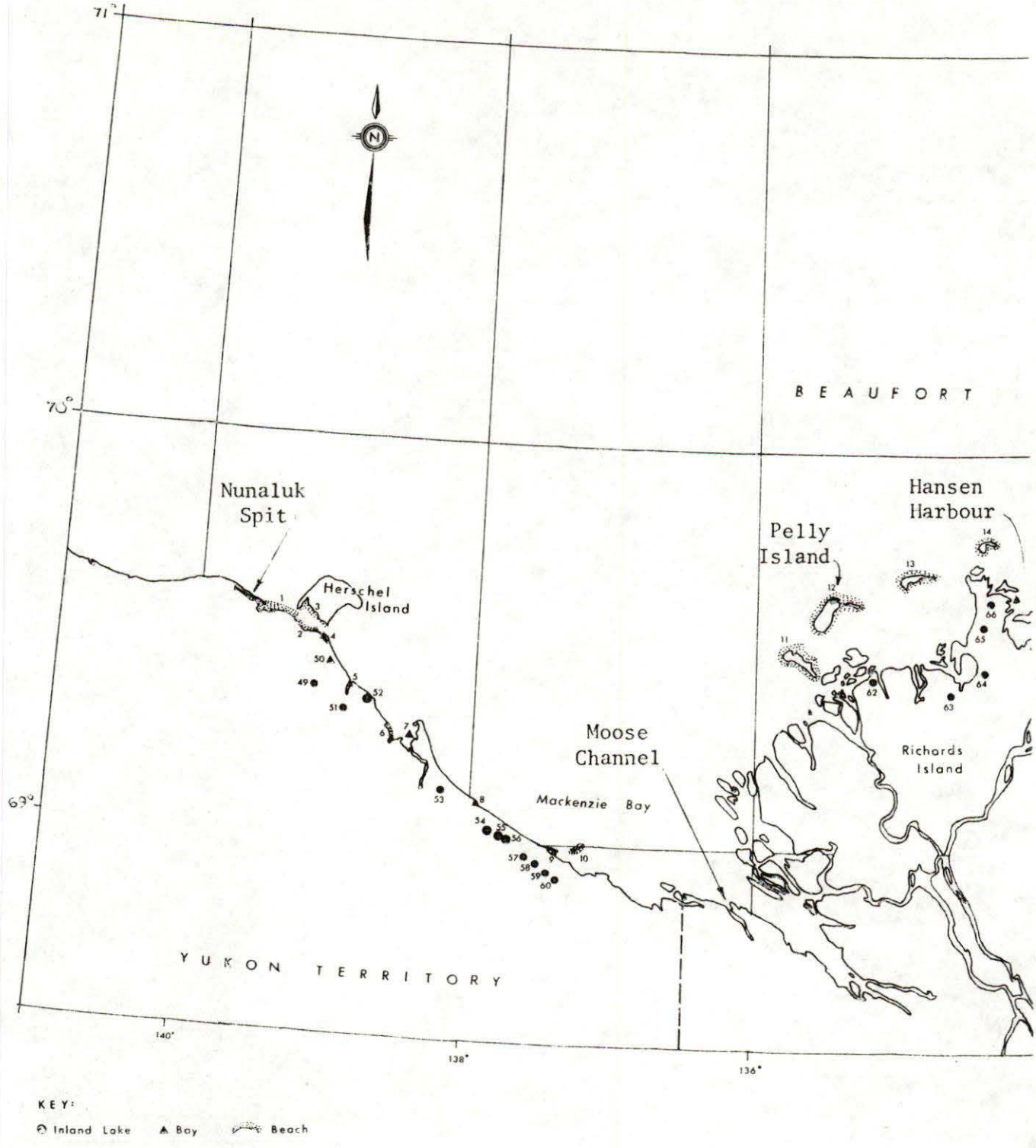

Figure 9. Map of the Beaufort Sea showing the location of the waterbodies which were censused.

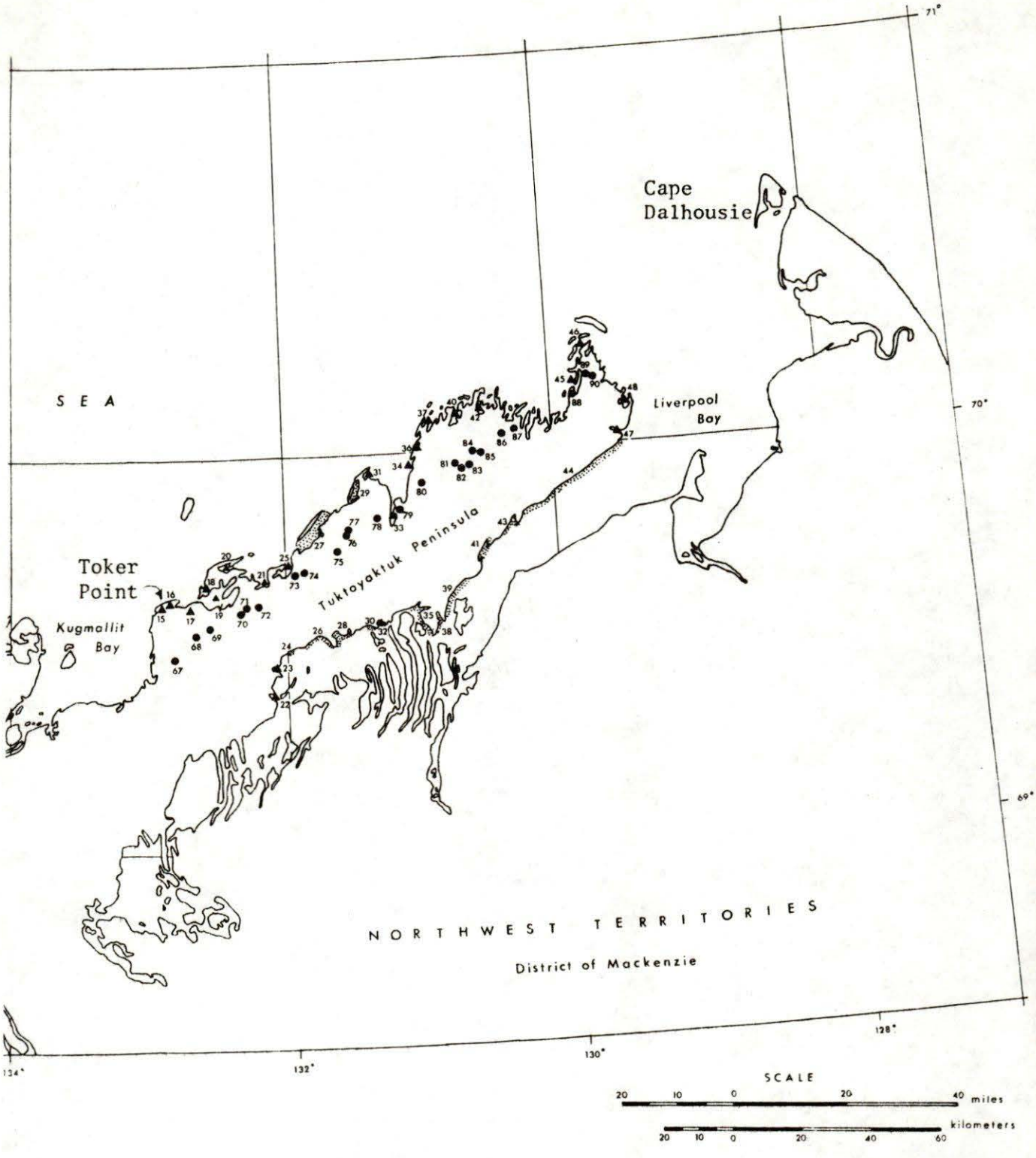

Figure 9. (Continued)

TABLE 8. Key to waterbody type for Figure 9.

LOCATION NUMBER	TYPE	LOCATION NUMBER	TYPE	LOCATION NUMBER	TYPE
1	Beach	31	Bay	61	Lake
2	Beach	32	Bay	62	Lake
3	Beach	33	Bay	63	Lake
4	Bay	34	Bay	64	Lake
5	Bay	35	Beach	65	Lake
6	Bay	36	Bay	66	Lake
7	Bay	37	Bay	67	Lake
8	Bay	38	Beach	68	Lake
9	Bay	39	Beach	69	Lake
10	Island	40	Bay	70	Lake
11	Island	41	Beach	71	Lake
12	Island	42	Bay	72	Lake
13	Island	43	Beach	73	Lake
14	Island	44	Beach	74	Lake
15	Bay	45	Bay	75	Lake
16	Bay	46	Bay	76	Lake
17	Bay	47	Bay	77	Lake
18	Bay	48	Bay	78	Lake
19	Bay	49	Lake	79	Lake
20	Bay	50	Lake	80	Lake
21	Bay	51	Lake	81	Lake
22	Bay	52	Lake	82	Lake
23	Bay	53	Lake	83	Lake
24	Beach	54	Lake	84	Lake
25	Bay	55	Lake	85	Lake
26	Beach	56	Lake	86	Lake
27	Beach	57	Lake	87	Lake
28	Beach	58	Lake	88	Lake
29	Beach	59	Lake	89	Lake
30	Beach	60	Lake	90	Lake

4. whether or not the waterbody was a bay;

5. whether or not the waterbody was the sea adjacent to a coastal beach;

6. whether or not the waterbody was the sea adjacent to an island;

7. whether the waterbody was salt-water (1) or fresh-water (0);

8. the common logarithm of the area of the waterbody in square kilometers; and

9. the common logarithm of the circumference of the waterbody in kilometers.

The following five predictor variables were examined when lakes alone were considered:

1. date;

2. square of the date;

3. distance of the lake from the nearest coastal shoreline (in kilometers);

4. the common logarithm of the area of the lake; and

5. the common logarithm of the circumference of the lake.

The methods of stepwise multiple regression analysis (SMRA) are given in Richardson (1974).

The assumptions of SMRA were met for 5 of the 10 species and groups to which stepwise multiple regression analysis was applied. The following is a summary of these results.

Numbers of Red-throated Loons, Whistling Swans, and Glaucous Gulls increased slightly during the early part of the study period (July) but decreased during the later parts. Numbers of Arctic Loons and Oldsquaw were not significantly related to date during the course of this study.

All five species were seen in larger numbers and/or more frequently on large than on small waterbodies--other factors being equal ($P < 0.001$ for each species).

Arctic Loons and Whistling Swans were seen more frequently on lakes than on other types of waterbodies ($P < 0.001$), although swans also occurred on bays in greater numbers than near beaches or islands. In contrast, fewer Red-throated Loons and Glaucous Gulls were seen on lakes than were seen near beaches or in bays--other factors being equal. Also, fewer Red-throated Loons but more Glaucous Gulls were seen in areas around islands than in bays or near the shore. Old-

squaw were seen more often ($P < 0.001$) near beaches and in bays than on lakes.

When lakes alone were considered, it was evident that Red-throated Loons and Glaucous Gulls were seen in larger numbers on lakes near the sea than on lakes farther inland ($P < 0.001$ and $P < 0.01$, respectively). On the other hand, the opposite was true of Arctic Loons and Whistling Swans ($P < 0.05$ and $P < 0.001$, respectively).

The five species or species groups for which the assumptions of SMRA were too severely violated to permit reliable interpretations were Brant, White-fronted Goose, Pintail, scaup, and Arctic Tern. Data on these birds could have been re-analysed through use of techniques with less stringent assumptions (e.g., multiple discriminant analysis or multidimensional scaling). However, in the absence of more precise data on waterbody characteristics (*cf.* Sharp *et al.* 1974), these analyses were regarded as unwarranted and were not, therefore, attempted.

Species Richness

It is known that the number of species that occupy a particular area (i.e., the species richness of the area) is affected by the size of the area and by the nature and diversity of habitats within the area (e.g., MacArthur 1972). Species richness is one measure of the importance of an area to wildlife. Furthermore, changes in the species richness of a particular area from year to year may reflect changes--either natural or human-induced--in the nature and quality of the habitats of this area. It was of interest, therefore, to document the species richness during the study period of the coast of the Beaufort Sea and to assess the factors that were correlated with this species richness.

This section considers species richness of 90 waterbodies in relation to several factors. In order to best show trends in species richness in relation to selected factors, results are presented in graphic form.

Species richness was first considered in relation to presence or absence of direct access of waterbodies to the ocean. For this purpose, waterbodies were classed as either fresh-water or salt-water on the basis of an analysis of a series of maps of the area of scale 1:250,000. All lakes connected with the ocean only by streams were considered to be fresh-water.

In Figure 10, species richness during each survey period is related to presence or absence of direct ocean-access. During each survey period, the mean species richness was greater on waterbodies with ocean access than on those without such access. When the results of all six survey periods were combined, the difference between waterbodies with and without ocean access was highly significant (Student's $t = 8.22$; two-sided $P < 0.001$). The average number of species per

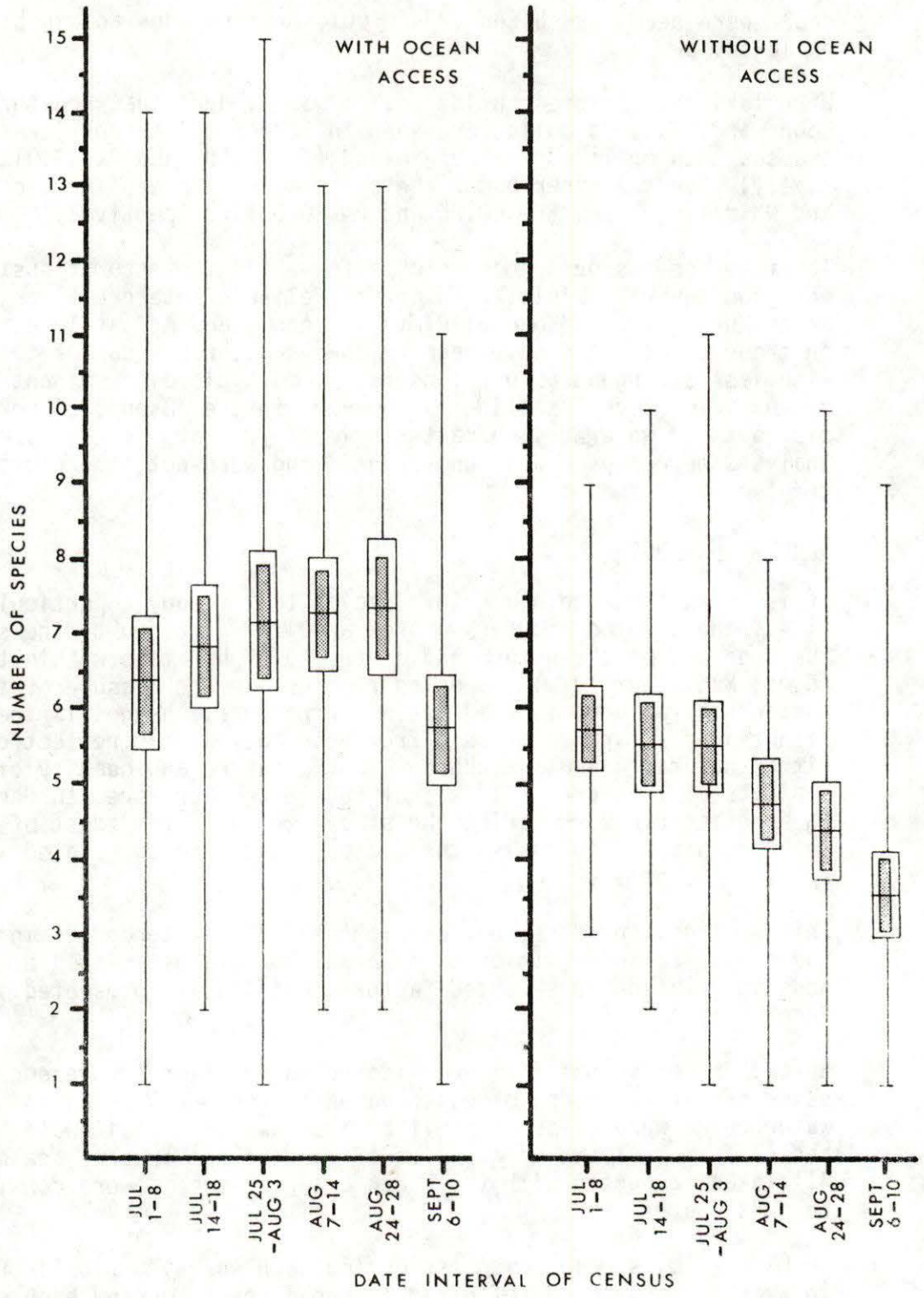

FIGURE 10. Average Number of Species Observed near Waterbodies with and without Ocean Access, July-September 1974. The mean is represented by the horizontal line bordered by a vertical stippled bar, the 95% Confidence Interval, and an unstippled bar, the 99% Confidence Interval. The range is represented by the horizontal lines.

salt-water body was 6.80 ± 2.85 (Mean ± Standard Deviation; n = 296); the average number of species per fresh-water body was 4.91 ± 2.00 (n = 245).

Species richness was next considered in relation to more specific waterbody types. These types were arbitrarily divided into four categories: lake, bay, island area, and beach area. Of the 90 waterbodies surveyed one conformed to none of the four categories, 41 were categorized as lakes, 28 as bays, 15 as beaches, and 5 as islands (Table 8). The average number of species observed on each of the four categories of waterbodies during each of the six survey periods are given in Figure 11.

When the results of all six census periods were combined, the average number of species per beach area was 7.49 ± 2.81 (Mean ± Standard Deviation; n = 90); per bay 6.55 ± 2.76 (n = 166); per island area 6.10 ± 3.49 (n = 30); and per lake 4.91 ± 2.00 (n = 245).

Species richness was also considered in relation to the distance of an inland waterbody from the nearest salt-water shoreline (Figure 12 and 13). In order to increase sample sizes, lakes were placed into the following four groups: (1) less than 1 km from coast, (2) 1 to 3 km from coast, (3) 3 to 5 km from coast, and (4) more than 5 km from coast. Although data were collected for waterbody number 61, this lake was not designated on any of the maps; therefore, it was not possible to include this lake in this analysis.

The previous analyses were based on considerations of the effects on species richness of one factor at a time. The techniques of multivariate analysis, however, can be used to assess the simultaneous relationships of several environmental parameters to species richness. Through use of stepwise multiple regression analysis the degree of correlation between species richness and nine potential predictor variables was assessed; the same predictors used in the previous section were considered. The following paragraph summarizes the results of the stepwise multiple regression analysis.

Species richness was strongly related to both the sizes of the waterbodies surveyed ($P < 0.01$) and to the parabolic function of date. The relationships to date and the square of the date indicate that species richness on the waterbodies tended to increase slightly during the early part of the survey period but decreased substantially near the end. Analysis of variance indicated a high degree of difference between the number of species on different types of waterbodies (see above); however, multivariate analysis revealed that consideration of waterbody type separately from waterbody size gave misleading results. Once the fact that more birds tended to occur on large waterbodies than on small waterbodies was considered and that some classes of waterbodies (e.g., beaches) tended to be larger than others (e.g., lakes), waterbody type was *not* strongly related to species richness--with the possible exception of a tendency for there to be fewer species near islands than elsewhere.

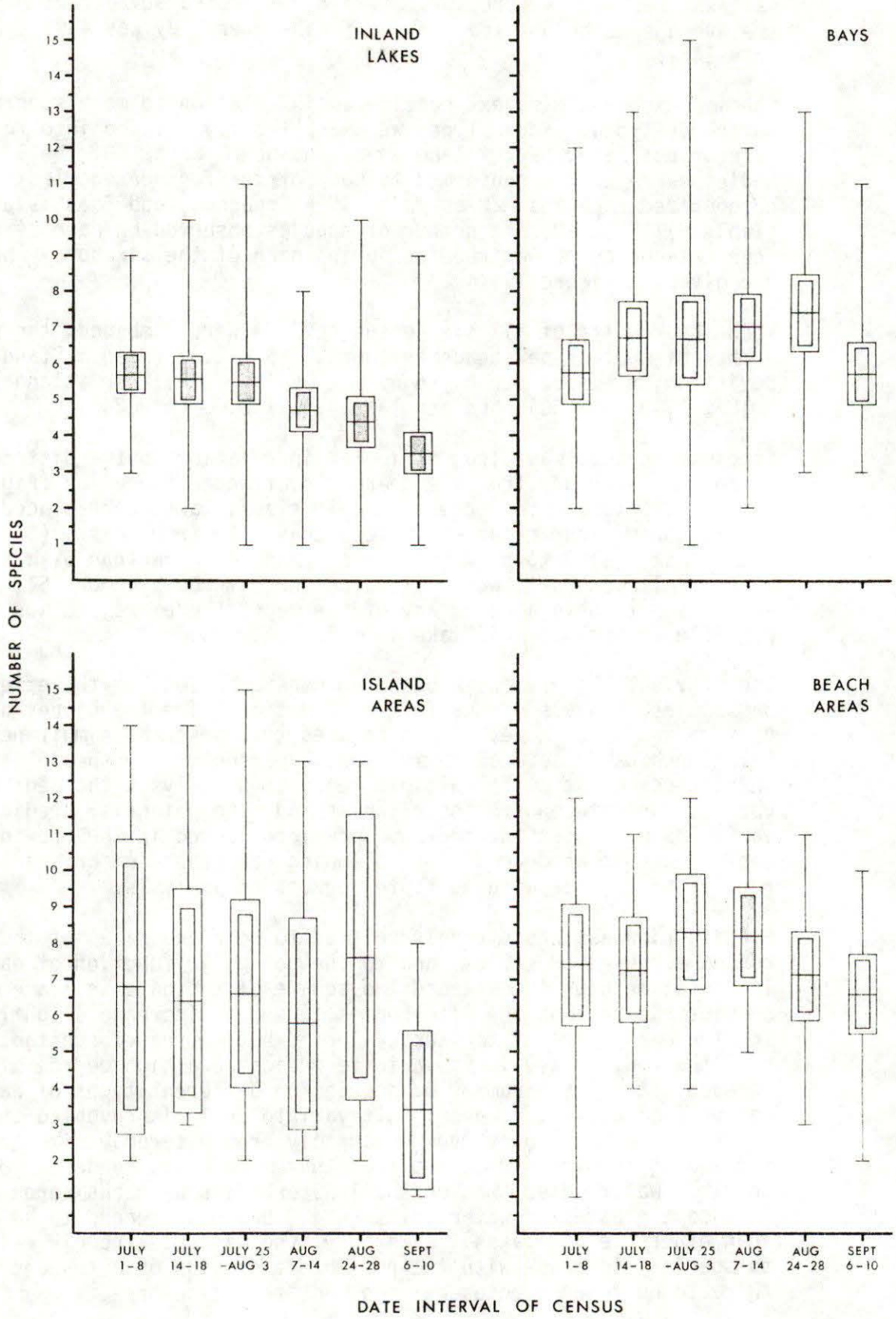

FIGURE 11. Average Number of Species Observed on the Four Waterbody Types, July-September 1974. Mean, 95% and 99% Confidence Intervals, and range represented as on Figure 10.

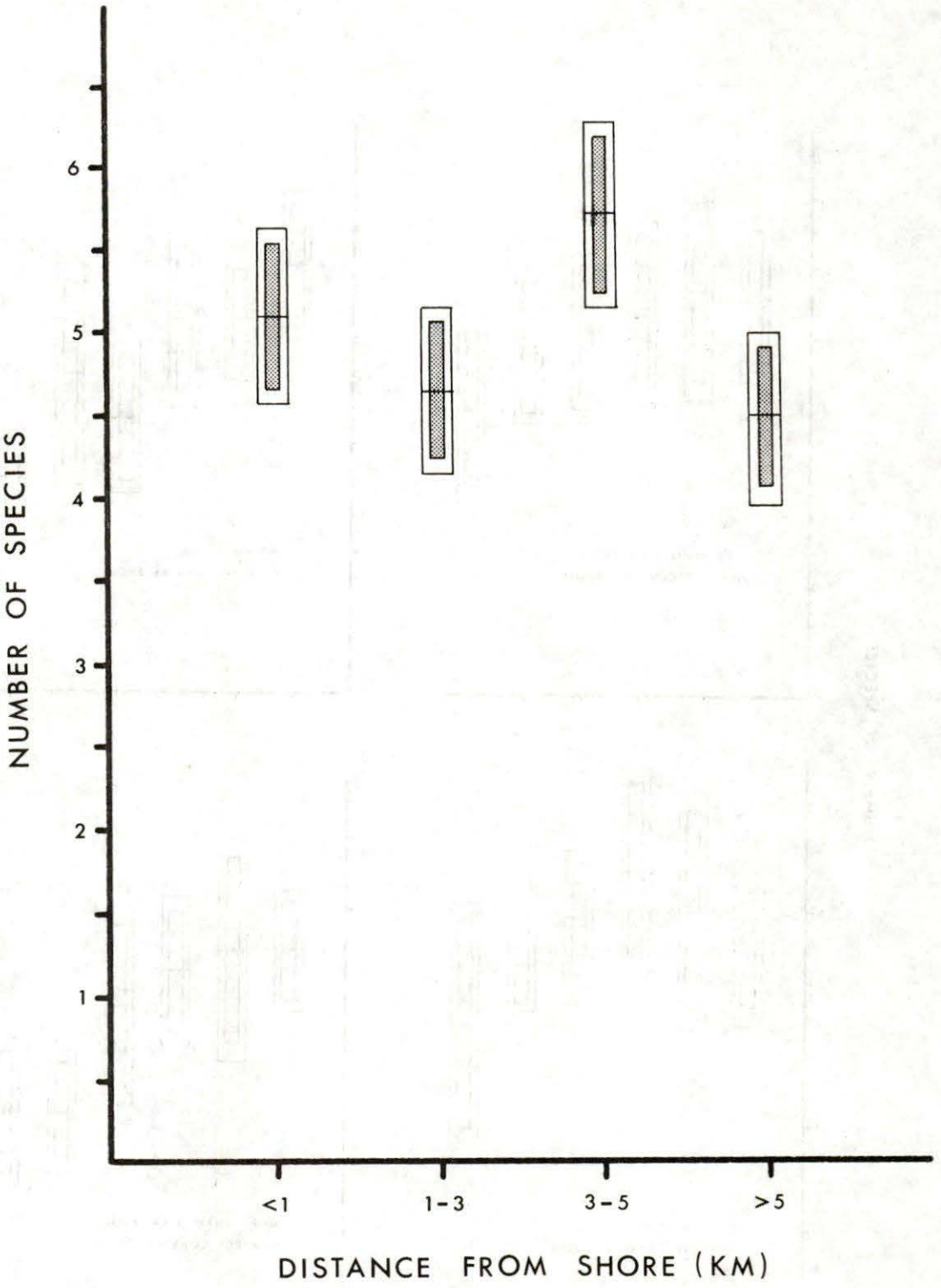

FIGURE 12. Average Number of Species Observed near Waterbodies of Varying Distances from the Coastal Shoreline, All Surveys Combined. Mean, and 95% and 99% Confidence Intervals represented as on Figure 10.

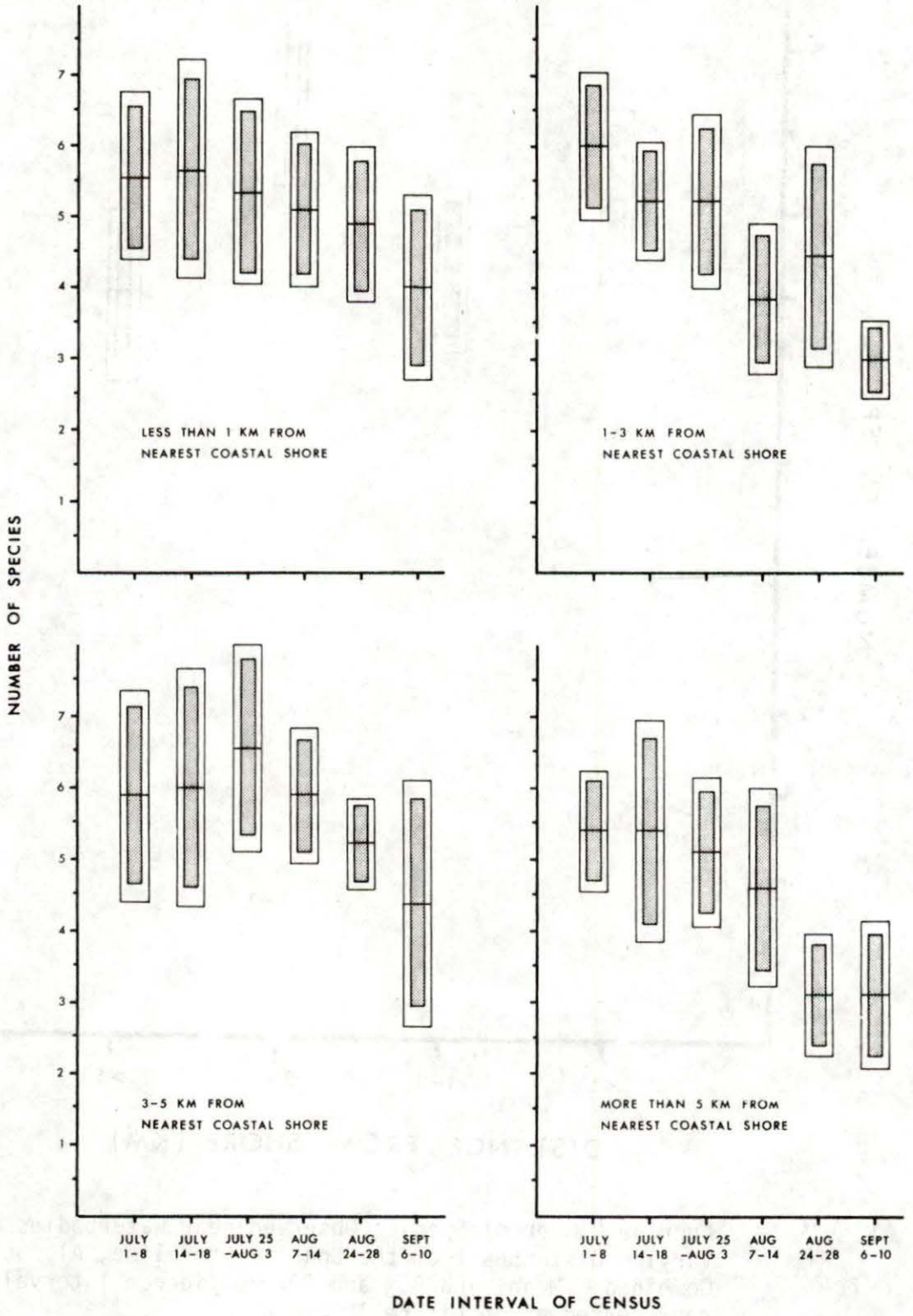

FIGURE 13. Average Number of Species Observed near Waterbodies of Varying Distances from Shore for each Survey, July-September 1974. Mean and 95% and 99% Confidence Intervals represented as on Figure 10.

Species Composition

The changing composition of the avian population in the Arctic Ocean during and after the breeding season reflects the phenology of the annual life cycles of these species and indicates the periods during which some of these species may be susceptible to the effects of environmental disruptions. The relative numbers of individuals of different species or species groups were calculated for each waterbody type and for lakes at different distances from the nearest coastal shoreline. This analysis was conducted separately for the results of each of the six aerial surveys.

The calculation of species composition on a percentage basis assumes that all individuals and all species were equally visible to the observer (i.e., that equal proportions of all species were counted) and that counts were accurate for large as well as small flocks. Because it is probable that these assumptions were incorrect to an unknown degree, the results are approximate. The degree of bias in the results varies with species, with the density of each species, and with characteristics of each survey (Martinson and Kaczynski 1967), with season and habitat (Smith cited by Martinson and Kaczynski 1967), and with environmental factors (Diem and Lu 1960). Martinson and Kaczynski (1967) found that air/ground detectability ratios for prairie waterfowl species normally varied from 0.10 to 0.60. Bartels (1973) and Davis *et al.* (1975) found that air/ground ratios of different species of waterbodies on the Alaskan North Slope and in the Canadian Arctic Archipelago (respectively) also varied considerably. The study reported by Davis *et al.* (1975) was conducted from slow-moving helicopters; use of fixed-wing aircraft would cause greater differences in detectability ratios.

Most of the birds that occur near the southern shore of the Beaufort Sea can be classified into one of 13 species groups* (see Appendix 3). In all but four instances (83.3%) during six surveys of each of four waterbody types, gulls and the four species groups that comprise the family Anatidae constituted more than 75% of the birds sighted. During the four exceptional surveys, these groups comprised 56%, 67%, 67%, and 73% (respectively) of the birds sighted.

The results of the relative abundance of various species groups by waterbody type and date are briefly summarized below.

Except during one survey (Survey 5), the species compositions of the avian populations in beach and bay habitats and to a lesser degree on lakes were dominated by diving ducks during most of the study

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* One or two individuals of species other than those included in these groups were sighted, but none of these other species accounted for more than 0.1% of the total birds sighted during any one date period; these species are, therefore, not included.

period. During Survey 5 (24 to 28 August) geese (predominantly Brant and Lesser Snow Geese) were more common both near beaches and on bays. The species compositions of the populations of birds on and near islands were less strongly dominated by any one species or species group. Gulls (predominantly Glaucous Gulls) were the most common birds on and near islands during July, but thereafter the dominant species group was variable.

Comparisons of species compositions on different waterbody types indicate the relative importance of these areas to particular species groups; comparisons of results of surveys of specific waterbody types may indicate the changing importance over a period of time of certain types of areas to a particular species group.

The observed compositions of the avian populations on and near lakes was further analyzed after stratification of these lakes according to their distances from the sea. Diving ducks were usually the dominant group--except during July and early August on lakes located 1 to 3 km from the coast. On these lakes, geese were slightly more common than diving ducks during July and early August. However, during late August and early September, diving ducks comprised over 80% of the birds sighted on these lakes.

It should be kept in mind that information about species composition does not indicate the number of individuals present. For example, if the absolute numbers of one species were to remain constant from week to week or from site to site but the numbers of other species were to change, the relative abundance of the first species would change. Information on absolute numbers gained from the results of the 1974 aerial surveys of coastal areas is presented in the 'Annotated list of Species' section below.

Species Associations

Similar habitat preferences of different species often result in strong correlations between the numbers of species present on different waterbodies. Such correlations can only be assessed after the effects of date and waterbody characteristics on number of species present have been accounted for. (For example, even if two species did not prefer similar habitats, these species might occur in large numbers on large lakes solely because of the effects of lake size on the number of birds present.) However, the degree to which different species occur together independently of variables such as date, waterbody size, and waterbody type can be assessed as follows: through examination of the degree to which predictability of the number of species 'A' on a waterbody can be improved by addition of the number of species 'B' present as an additional term to a multiple regression equation that already includes date, waterbody size, and waterbody type terms. Such regression analyses were performed for common species. Table 9 summarizes the degree of association (+) or disassociation (-) between species, which were considered in pairs.

TABLE 9. Degree of Association or Disassociation Between Number of Different Species Present on Waterbodies After Effects of Waterbody Size, Waterbody Type, and Date Have Been Considered*.

	RED-THROATED LOON	GLAUCOUS GULL	ARCTIC TERN	PINTAIL	OLDSQUAW	SCAUP	WHITE-FRONTED GOOSE	PACIFIC BRANT	WHISTLING SWAN
Arctic Loon	(+)---	(+)---	(+)---	(+)---	(+)***	(+)***	(-)*	(+)---	(+)**
Red-throated Loon		(+)***	(+)---	(+)---	(+)---	(+)***	(+)***	(+)**	(+)---
Glaucous Gull			(+)**	(+)**	(-)---	(-)---	(+)***	(+)***	(-)---
Arctic Tern				0	(-)---	0	0	0	(+)(*)
Pintail					(+)(*)	0	0	0	(+)***
Oldsquaw						(+)***	(-)---	(+)---	(-)*
Scaup							0	0	(-)*
White-fronted Goose								0	(+)***
Pacific Brant									(+)**

* direction of relationship indicated by (+) for association and (-) for disassociation

significance levels:
--- not significant
(*) $0.1 \geq P > 0.05$
* $0.05 \geq P > 0.01$
** $0.01 \geq P > 0.001$
*** $P > 0.001$
0 SMRA assumptions violated

Some very strong positive correlations between species were noted, but no strong negative correlations were evident. Generally, numbers of similar species tended to be correlated. For instance, numbers of geese and swans showed a high degree of correlation; gulls were correlated with terns; and diving ducks were correlated both with other diving ducks and with loons. The strongest correlation was between numbers of Oldsquaws and scaup.

Distribution of Broods

A limited amount of information was gathered on the number of broods sighted during the 1974 aerial surveys. This information was analysed in order to obtain an approximation of the 1974 breeding distribution of birds in the southern portion of the Beaufort Sea.

Total numbers of broods of all species were distributed evenly over the area surveyed--with the exception of the Mackenzie Delta and Herschel Island, where no broods were sighted. At least one brood was sighted on 44% of the surveyed waterbodies; Table 10 shows the percentages of waterbodies of each type that contained one or more broods during at least one survey period. Only Whistling Swan broods were observed frequently enough to be considered separately. Table 11 shows the percent of Whistling Swan broods that were located on the four waterbody types.

Although broods of many species are readily visible, this visibility factor varies from species to species and in the cases of particular species depends upon the size, behaviour, and age of the brood and upon weather conditions. Therefore, no attempt has been made to compare abundance of broods of different species or to draw conclusions of a quantitative nature.

MIGRATION WATCH

Introduction

The importance of arctic coastal areas to migrating birds has been previously documented in relation to the southern shore of the Beaufort Sea (Thompson and Person 1963; Barry 1968; Gollop and Davis 1974b). However, intelligent management of this migration corridor requires a comprehensive study of the coastal region in order to locate and to study the areas that are of greatest importance to birds during their migration. The objectives of this portion of the study were to gather information on movements of birds past various locations along the coast of the southeastern Beaufort Sea and to relate this information to various weather factors.

Methods

During 1972, migrating birds were observed from fixed locations on the coast, from shore, or from skiffs. Observation sites were located on the Tuktoyaktuk Peninsula (Liverpool Bay, Cape Dalhousie, and Toker Point), N.W.T., on the Mackenzie Delta (Hansen Harbour, Pelly Island, and Moose

TABLE 10. Frequency of Broods by Waterbody Type.

WATERBODY TYPE	PERCENT WITH BROOD DURING AT LEAST ONE SURVEY	NUMBER OF WATERBODIES
Lake	50	42
Bay	43	28
Near Beach	27	15
Near Island	60	5

TABLE 11. Distribution of Whistling Swan Broods by Waterbody Type.

WATERBODY TYPE	PERCENT OF WATERBODIES ON WHICH BROODS WERE SIGHTED	PERCENT OF TOTAL BROODS
Lake	47	53
Bay	31	17
Near Beach	17	4
Near Island	6	26

Channel), N.W.T., and at Nunaluk Spit, on the Yukon coast. Counts of birds were conducted at Nunaluk Spit throughout the breeding season and period of fall migration, at Cape Dalhousie during the spring, and at other locations during late July, August, and September.

At Nunaluk Spit, daily observations were conducted from 8 to 13 June, from 10 July to 18 August, and on every second day from 19 August to 17 September. Daily observations were conducted during five evenly-spaced 1-hr periods from 10 July to 1 August and during seven evenly-spaced 1-hr periods from 2 August to 15 August; observations were conducted continuously from first daylight until dark during observation days from 16 August to 17 September. The time, species, flock size, and flight direction were recorded for each flock that was seen. The results of the observations at Nunaluk Spit have been reported previously (Gollop and Davis 1974a).

Observations at the other sites were not as complete or as systematic as those at Nunaluk Spit; also, many of the data gathered during observations at these other sites were of limited use either because field observers failed to record the amount of time spent on the migration watches or the flight directions of the birds or because this information was not available for use by LGL Limited. A summary of observation dates and weekly time totals of observation periods is presented in Tables 12 and 13.

Results and Discussion

The limitations of the results of migration watches must be considered if these results are to be interpreted accurately. The probability that a bird or a flock will be detected varies with visibility, with the visual acuity of the observer, with the species, with the flock size, and with the horizontal and vertical distance of the bird or flock from the observer (see Richardson *et al.* 1976). A flock of geese is, for example, more likely to be detected than a single goose or a flock of shorebirds--other factors being equal. Furthermore, a movement of birds is rarely concentrated along a shoreline in a stream that is sufficiently narrow to allow an observer on the coast to detect the majority of individual birds involved in the movement. For example, migration that occurred parallel to the southern coast of the Beaufort Sea during 1975 was never confined to a narrow band but, rather, was usually spread over a band at least several tens of kilometers in width (Richardson *et al.* 1976). Thus, for species that are conspicuous and that tend to concentrate near coasts or elsewhere, the results of systematic migration watches can provide reliable information on the timing and direction of migration and a minimum estimate of the number of birds migrating. However, such results do not themselves constitute reliable data about actual population size, even for conspicuous species, or about the relative numbers of different species. The degree of reliability of data gathered during migration watches can be improved through consideration of other sources of data that indicate the degree of concentration of birds within visual range of the ground observer (e.g., aerial surveys, radar).

Within these limitations, the initiation date, relative rate, and duration of migration of the more conspicuous species can be determined from plots

TABLE 12. Weekly Total Number of Hours of Observation at Each Migration Watch Location From 27 May to 24 September 1972.

DATE	LOCATION						
	NUNALUK SPIT	PELLY ISLAND	CAPE DALHOUSIE	TOKER POINT	MOOSE CHANNEL	HANSEN HARBOUR	LIVERPOOL BAY
27 May-2 June	-	-	36.50	-	-	-	-
3-9 June	10.50	-	90.00	-	-	-	-
10-16 June	18.00	-	86.00	-	-	-	-
10-16 July	21.75	-	-	-	-	-	-
17-23 July	26.25	-	-	-	-	-	-
24-30 July	24.50	-	-	-	9.33	-	-
31 July-6 August	28.25	-	-	-	23.17	-	14.17
7-13 August	46.00	-	-	-	6.00	-	14.67
14-20 August	86.00	0.50	-	-	83.41	-	-
21-27 August	57.25	97.42	-	45.33	56.50	40.75	13.00
28 August-3 September	57.25	67.48	-	58.67	12.25	68.76	-
4-10 September	16.00	53.17	-	54.65	44.77	16.00	-
11-17 September	43.25	-	-	27.10	40.75	-	-
18-24 September	-	-	-	-	24.50	-	-

TABLE 13. Periods of Observation and Sampling Intensity During 1972 Migration Watch at Stations Along the Southern Coast of the Beaufort Sea.

LOCATION	DATE		SAMPLING INTENSITY
	START	END	
Nunaluk Spit	8 June	17 September	8-13 June, observations made daily 14 June-9 July, no observations made 10 July-18 August, observations made daily 19 August-17 September, observations made every second day
Moose Channel	30 July	19 September	30 July-2 August, observations made daily 3-11 August, no observations made 12-16 August, observations made daily 18-28 August, observations made every second day 29 August-6 September, no observations made 7-13 September, observations made daily 14-16 September, no observations made 17-19 September, observations made daily
Pelly Island	20 August	9 September	20-26 August, observations made daily 27 August-9 September, observations made every second day
Hansen Harbour	23 August	5 September	Observations made 23, 24, 26, 28, 29, and 30 August 1-5 September, observations made every second day
Toker Point	22 August	13 September	22-25 August, observations made every second day 27 August-5 September, observations made daily 6-13 September, observations made every second day
Cape Dalhousie	29 May	16 June	Observations made daily
Liverpool Bay	3 August	22 August	3-10 August, observations made daily except on 7 August when no observations were made 11-20 August, no observations made 21-22 August, observations made on both days

of the number of birds seen versus date at consecutive observation posts along the migration route. Preferably, the number of birds that passed per hour in each direction should be plotted against date, but such a plot was possible only for Nunaluk Spit. The movements of birds observed passing six other coastal locations have been plotted as the histograms of the total number of birds seen per hour versus date. The results are presented and discussed in the annotated list of species. Observations conducted at Nunaluk Spit from 8 to 13 June 1972 have not been incorporated into the histograms of 1972 migration because of the uncertainty about the number of hours of observation on individual days. However, the total number of each species (or species group) seen on each day of observation during June at Nunaluk Spit and the number of birds recorded per hour over the entire six day period are listed in Table 14. During this period, the numbers of birds observed were generally small and the heaviest movement was primarily eastward.

Weather Versus Amount and Direction of Migration

At temperate latitudes, there are strong correlations between the numbers of birds that migrate each day and various weather parameters (Lack 1960). In general, birds tend to migrate with following winds relative to their "preferred" directions of travel (Richardson 1975).

There have been no intensive studies of the timing of migration in the Arctic relative to weather. However, existing data gathered in the Arctic suggest that at least some species prefer to migrate with following winds (e.g., Thompson and Person 1963; Johnson 1971; Schmidt 1973).

The only data gathered during the 1972 migration watch program that permitted assessment relative to weather were those from Nunaluk Spit; these were the only data for which records of flight directions were available. However, even these data were of limited use in such an analysis because of the limited number of days during which observations were conducted. No species was observed moving past Nunaluk Spit over a sufficient period of time to justify multivariate analysis of daily numbers relative to daily weather conditions. (Richardson [1974] has outlined the requirements for such analysis.)

Eight species or groups of species were considered to have migrated past Nunaluk Spit in sufficient numbers over a sufficient time span to justify bivariate analysis*. Table 15 shows the relationship of

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* Because data were available for only 1 yr, it was not possible to correct for seasonal variation in the amount of migration (i.e., for the fact that more birds are expected near the middle parts of the migration periods than near the end parts). This uncorrected 'non-stationarity' in the expected volume of migration (Richardson 1974) obscures any possibly extant relationships of migration volume to weather. The effects of this limitation were reduced, however, through limitation of the ranges of dates considered in the analyses to those when considerable movement occurred.

TABLE 14. Summary of Bird Migration Observations at Nunaluk Spit, Y.T., June 1972 (adapted from Gollop and Davis 1974).

SPECIES	EASTWARD MOVEMENT							WESTWARD MOVEMENT						
	DATE (JUNE)						NUMBER PER HOUR	DATE (JUNE)						NUMBER PER HOUR
	8	9	10	11	12	13		8	9	10	11	12	13	
Arctic Loon	11	3	-	7	-	2	0.8	1	1	1	-	-	-	0.1
Red-throated Loon	10	11	-	9	-	9	1.4	1	2	2	-	-	-	0.2
Unidentified Loon	6	-	-	-	-	-	0.2	-	-	-	-	-	1	0.1
Whistling Swan	-	4	1	-	-	-	0.2	-	-	2	-	7	-	0.3
Canada Goose	-	2	-	-	-	-	0.1	-	2	-	-	-	-	0.1
Pacific Brant	20	45	-	16	-	-	2.8	11	50	2	10	7	-	2.8
White-fronted Goose	-	2	-	-	-	-	0.1	-	6	-	-	12	-	0.6
Snow Goose	-	-	-	-	-	-	-	-	17	-	5	-	-	0.8
Pintail	16	19	-	-	-	-	1.2	13	19	3	-	8	-	1.5
Northern Shoveler	-	2	-	-	-	-	0.1	-	-	-	-	-	-	-
Greater Scaup	-	4	-	-	-	-	0.1	2	-	-	-	-	-	0.1
Lesser Scaup	-	-	-	-	-	-	-	-	-	5	1	-	-	0.2
Oldsquaw	43	4	4	87	7	-	5.1	5	1	3	1	-	3	0.5
Common Eider	6	10	5	6	13	-	1.4	4	2	9	14	9	10	1.7
King Eider	-	-	2	-	1	-	0.1	-	-	-	2	-	-	0.1
White-winged Scoter	-	2	-	-	-	-	0.1	-	8	1	-	-	-	0.3
Surf Scoter	-	2	-	-	-	2	0.1	-	-	-	-	-	4	0.1
Red-breasted Merganser	-	4	5	2	-	1	0.4	1	1	-	-	-	-	0.1
Sandhill Crane	-	1	-	-	-	-	0.1	-	-	-	-	-	-	-
American Golden Plover	-	1	-	-	-	-	0.1	-	-	-	-	-	-	-
Knot	1	-	-	-	-	-	0.1	-	-	-	-	-	-	-
White-rumped Sandpiper	-	1	-	-	-	-	0.1	-	-	-	-	-	-	-
Long-billed Dowitcher	-	-	-	-	-	-	-	1	-	-	-	-	-	0.1
Stilt Sandpiper	-	-	1	-	-	-	0.1	-	-	-	-	-	-	-
Semipalmated Sandpiper	-	2	-	-	-	-	0.1	-	-	3	-	-	-	0.1
Sanderling	-	-	-	2	-	-	0.1	-	-	1	-	-	-	0.1
Red Phalarope	-	5	-	2	-	-	0.2	-	3	2	-	-	-	0.2
Northern Phalarope	-	5	-	9	-	-	0.5	-	-	-	-	-	-	-
Pomarine Jaeger	5	4	3	13	1	1	0.9	-	-	-	-	-	-	-
Parasitic Jaeger	-	1	1	-	-	1	0.1	1	-	-	-	-	-	0.1
Long-tailed Jaeger	1	3	3	1	-	-	0.3	1	-	-	-	-	-	0.1
Glaucous Gull	27	31	10	32	19	22	4.9	2	3	1	-	3	1	0.3
Sabine's Gull	-	-	1	-	-	-	0.1	7	24	15	-	-	4	1.8
Lapland Longspur	-	-	-	-	1	-	0.1	-	-	-	-	-	-	-
Snow Bunting	-	-	-	1	1	-	0.1	-	-	-	-	-	-	-

TABLE 15. Numbers and Directions of Movement at Nunaluk Spit Relative to Wind[1].

SPECIES	DATES CONSIDERED	EASTWARD MOVEMENT			WESTWARD MOVEMENT			EAST:WEST RATIO		
		r	P	n	r	P	n	r	P	n
Arctic Loon	10 July-14 August	0.199	-	29	-0.486	**	29	0.626	***	27
Pintail	10 August-17 September	-0.383	(*)	24	0.288	-	24	-0.407	(*)	19
Oldsquaw	10-30 July	Little Movement			-0.461	(*)	14	0.518	*	16
Total ducks	10-28 July	0.068	-	15	-0.196	-	15	0.336	-	15
Phalaropes	27 July-21 August	0.283	-	21	-0.254	-	21	0.463	*	21
Total shorebirds	28 July-5 September	0.183	-	29	-0.220	-	29	0.248	-	29
Total jaegers	10 July-30 August	0.207	-	40	0.150	-	40	-0.069	-	35
Arctic Tern	8-22 August	0.204	-	13	-0.548	*	13	0.615	*	13

[1] the Spearman rank correlation between the rate at which birds were seen each day (in birds per hr) and the east-west component of the surface wind is presented. Only days with at least 3 hr of observations were considered.

Significance levels (two-sided):

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

numbers of each species observed each day to the 'following versus opposing' component of the surface wind. Numbers were converted to a 'per hour' basis before analysis, and days during which less than 3 hr of observation were conducted were omitted. Wind data were extracted from the records of the Komakuk Beach DEW Station, located approximately 14 km west of the observation post. The direction and speed of the surface wind were resolved trigonometrically in order to obtain the component along an east-west axis--east was considered to be positive and west to be negative. The components at 03:00 and 15:00 YST (Yukon Standard Time) each day were averaged; these averages constituted the values used in the correlation analysis.

In the case of eastward migration, a positive correlation would imply that on the average more birds were seen with opposing easterly winds than with following westerly winds; a negative correlation would indicate that more birds were seen with following westerly winds than with opposing easterly winds. The Pintail was the only species for which the relationship of eastbound numbers and wind approached statistical significance ($0.1 > P > 0.05$); there was a slight tendency for more Pintails to be seen flying east on days with following westerly than on days with opposing easterly winds.

In the case of westward migration, a positive correlation would imply that more birds were seen with following easterly winds than with opposing westerly winds; a negative correlation would imply the opposite. The only significant correlations were negative (for Arctic Loon, $P < 0.01$; for Oldsquaw, $P < 0.1$; for Arctic Tern, $P < 0.05$). Westward movement of these species was, therefore, more conspicuous when the wind was opposing than when it was following.

The relative numbers observed flying east and west each day were also examined in relation to the east-west component of the surface wind. For Pintails, there was a marginally significant ($0.1 > P > 0.05$) tendency for eastbound movement to predominate with westerly (following) winds and for westbound movement to predominate with easterly (following) winds. However, for Arctic Loons, Oldsquaw, phalaropes, and Arctic Terns, eastbound movement tended to be more predominant with opposing easterly winds and westbound movement more predominant with opposing westerly winds.

The results of these analyses show that there was an apparent tendency for several species to migrate in greater numbers when the wind was opposing than when it was following. Such correlations have often been reported during previous visual studies of migration, especially during those conducted in Europe. Whenever such cases of an apparent preference for upwind movement have been investigated in detail, it has been found that this preference is largely an artifact. Birds tend to fly lower and to follow leading lines (e.g., coastlines) more closely when they are migrating upwind than when they are migrating downwind (e.g., van Dobben 1953; Ulfstrand 1960); because of these tendencies, birds concentrate within the range of vision of an observer on the coast during periods of upwind flight. Hence,

the results of watches along a coastline are likely to provide a biased indication of the relationship of total numbers aloft to weather conditions.

Comparison of the results of the analyses of numbers of birds seen at Nunaluk Spit versus wind with the results of pertinent studies conducted elsewhere suggest that the results of counts along the coast were not representative of the numbers in the area as a whole. Thus analysis of numbers seen relative to other weather variables would be of little interest and such analyses have not, therefore, been applied to the data.

ANNOTATED LIST OF SPECIES

This section consists of an annotated list of all bird species that were recorded during the field investigations conducted in 1972 and 1974 in the Beaufort Sea area. Each species account interprets pertinent data gathered during the 1972 and 1974 investigations in relation to relevant published and unpublished data. These accounts are structured according to the following format:

1. Species name--The scientific nomenclature used for most species in this list generally follows the A.O.U. Checklist (1957, 1973). In the cases of species for which taxonomic problems exist, nomenclature is based on that used in the pertinent literature. Some species were treated both independently and as part of a larger species group. During the field investigations, some species were difficult to positively identify and were therefore recorded according to their species group; these species are treated in accounts of their species groups. In such cases, however, one (or more) species of a group was (or were) usually rare in the Beaufort Sea area, and it was therefore possible to assume that most or all of the birds that were treated together as a group were of one species.

2. Arrival and departure dates--The dates of first and last records of bird species during the study period are shown on maps of the area of the Beaufort Sea in which these records were obtained; these dates overlay a map of the study area, which extends from Nunaluk Spit, Y.T., to Banks Island, N.W.T., and is divided into five major areas from left to right across the page: 1) the Herschel Island area, 2) the Mackenzie Delta area, 3) the Tuktoyaktuk area, 4) the Liverpool Bay area, and 5) the Banks Island area. First and last sightings of species during 1972 were recorded in shoreline areas; during 1974, such records were obtained during aerial surveys conducted both over the coastal plain and over the open ocean and sea ice. Early and late records of species are confined to records obtained during the period of the field investigation; Table 16 gives the first and last dates of field observations at selected locations in the Beaufort Sea area.

3. Status, relative abundance, and spring migration--In the cases of species on which sufficient data were gathered, general status (e.g., breeding or nonbreeding), relative abundance (e.g., common or scarce), spring migration route to the Beaufort Sea, and recorded timing and rate of

TABLE 16. Limits of Dates During Which Field Work was Conducted at Selected Locations in the Beaufort Sea[1].

LOCATION	DATE OF FIRST OBSERVATION	DATE OF LAST OBSERVATION
Herschel Island Area		
1972	8 June	17 September
1974 Offshore	21 April	6 October
1974 Onshore	8 July	10 September
Mackenzie Delta		
1972	30 July	19 September
1974 Offshore	21 April	6 October
1974 Onshore	8 July	10 September
Tuktoyaktuk Area		
1972	22 August	13 September
1974 Offshore	21 April	6 October
1974 Onshore	1 July	8 September
Liverpool Bay		
1972	29 May	22 August
1974 Offshore	22 April	18 October
1974 Onshore	1 July	7 September
Banks Island Area		
1972	--------No observations made--------	
1974 Offshore	22 April	28 September
1974 Onshore	--------No observations made--------	

[1] for more specific dates on which field work was conducted see Tables 1, 2, 7 and 13.

migratory movement during 1972 are briefly discussed. Accounts of species for which insufficient data were gathered include only the dates and locations of records obtained during this study.

The daily rates of migratory movements of several species and species groups during 1972 have been graphically depicted. A description of these figures (e.g., Figure 14) follows. Observations recorded between 29 May and 19 September 1974 are plotted for those sites at which a particular species or species group was recorded. Abundance is depicted as the number of birds observed per hour passing the observation posts averaged over a one-day period of observations. The observations recorded at Nunaluk Spit are divided into eastward and westward components. However, the directions of movement of birds were not available for the other observation posts; hence, observations recorded at these sites are plotted as the total number of birds seen per hour. The average number of birds seen per hour on days during which this average exceeded the limits of the scale are represented by an arrow with the average number of birds per hour printed beside it. Days on which observations were recorded are represented by vertically hatched base lines; days on which observations were not recorded are represented by open circles. These base lines are cross-hatched for every fifth day to enable the reader to follow the date across the page. Because records were not kept of the exact number of observation hours each day during June at Nunaluk, it was not possible to include the results of these observations in the histograms. These results are not included in the above-mentioned figures but are given in Table 14.

4. Distribution and numbers--Data from 1974 were analysed in order to determine the distributions and concentrations of important species throughout the season. Discussions of distribution and numbers are based on offshore distributional data collected during aerial surveys and on data gathered in onshore and nearshore areas and given in the "Barrier Beach" figures.

The distributional maps are described in Appendix 1. A description of the "Barrier Beach" histograms (e.g., Figure 15) follows. These figures give the numbers of individuals of many of the species and species groups that occur in the Beaufort Sea area and that were recorded during each aerial survey conducted from 1 July to 10 September 1974. The waterbodies that were surveyed during this period have been divided into two categories--*salt-water* and *fresh-water*--and have been numbered from west to east in increasing numerical order. For instance, of numbers 1 to 48, which represent salt-water bodies (i.e., bays, beaches, islands), waterbody Number 1 lies in the far western part of the study area and Number 48 in the eastern part of this area; of numbers 49 to 90, which represent fresh-water bodies, Number 49 lies in the western part of the study area and Number 90 in the eastern part. The location of each waterbody is shown in Figure 9.1; designations of waterbody types and the transformed waterbody numbers are given in Table 8.

5. Habitats and species associations--The habitat preferences of species recorded during the 1974 coastal surveys have been determined through use of multiple regression analysis (see "1974 Surveys of the Beaufort Sea Coast" section) and habitat distribution information contained in the figures prepared for several species and species groups.

   A description of these figures (e.g., Figure 16) follows. Waterbodies are classified into five types: *beach area*, *island area*, *bay*, *inland lake* (no direct ocean access), and *ocean habitat* (which comprehends the first three categories). These figures show the average number of birds recorded per waterbody type during each survey period.

   The habitat preferences that were derived from the results of the 1974 aerial surveys may not be representative of the habitat preferences of bird species that occur along the arctic coast. Because a large number of waterbodies of each type were not surveyed, the results may only be representative of the habitat preferences of species recorded on particular waterbodies. Furthermore surveys were restricted to the period from July to mid-September. Application of the results to a more general area and to a longer time-span is limited, therefore, by the bias that is probably caused by the aerial survey technique. For example, nesting birds are likely to be very inconspicuous and hence more likely to be overlooked during an aerial survey.

6. Fall migration--The following information on fall migratory movements is given and discussed in accounts of species on which such information was gathered: chronology, date and rate of peak movement, and route. The figures (described above) that show the migration patterns of birds recorded during 1972 also show these fall migration data.

   Loons

   All four species of loons occur as breeding birds in the southeastern portion of the Beaufort Sea; however, only the Arctic Loon and the Red-throated Loon are sufficiently numerous to be regarded as common. During the 1972 and 1974 phases of this study, loons were first observed in the Canadian portion of the Beaufort Sea on 8 June and 27 May, respectively.

   Although a substantial portion of the migratory movement of loons may have been overland across the Brooks Range in Alaska or up the Mackenzie River, most of the migratory movements of these birds that were observed in 1972 and 1974 occurred along the coast.

   Though the major movement of loons into the eastern Beaufort Sea occurred during May and June, observations at Nunaluk Spit suggested that these birds continued moving into this area throughout July (Figure 14). Apparently these birds were sub-adults and nonbreeding adults.

   Although loons typically nest on the shores of lakes, most birds of this group that were seen during the aerial surveys of waterbodies in the area of the Beaufort Sea coast in 1974 were in or near ocean habitats (Figures 15 and 16). This pattern of occurrence may have been due to the amount

TOTAL LOONS

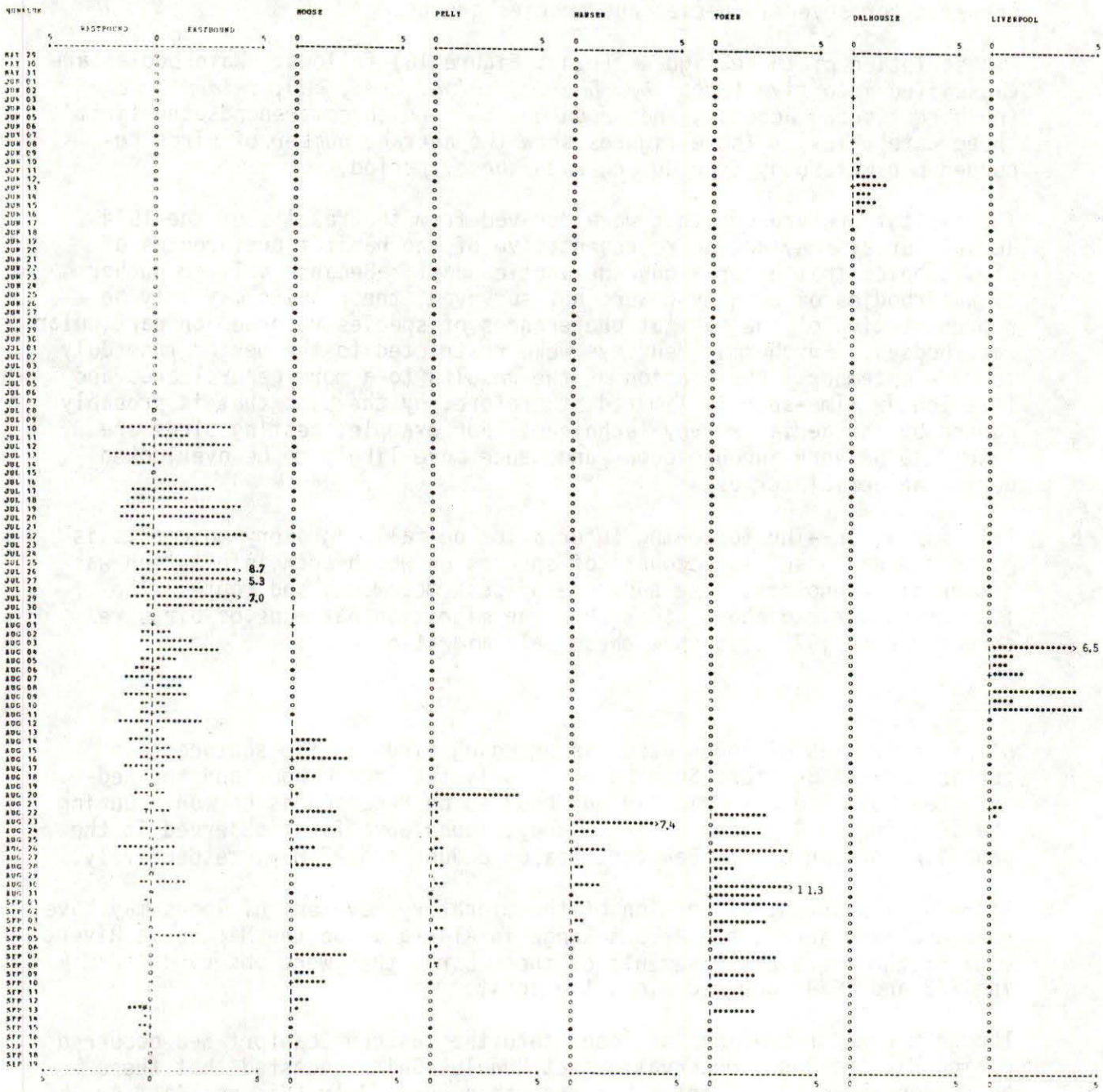
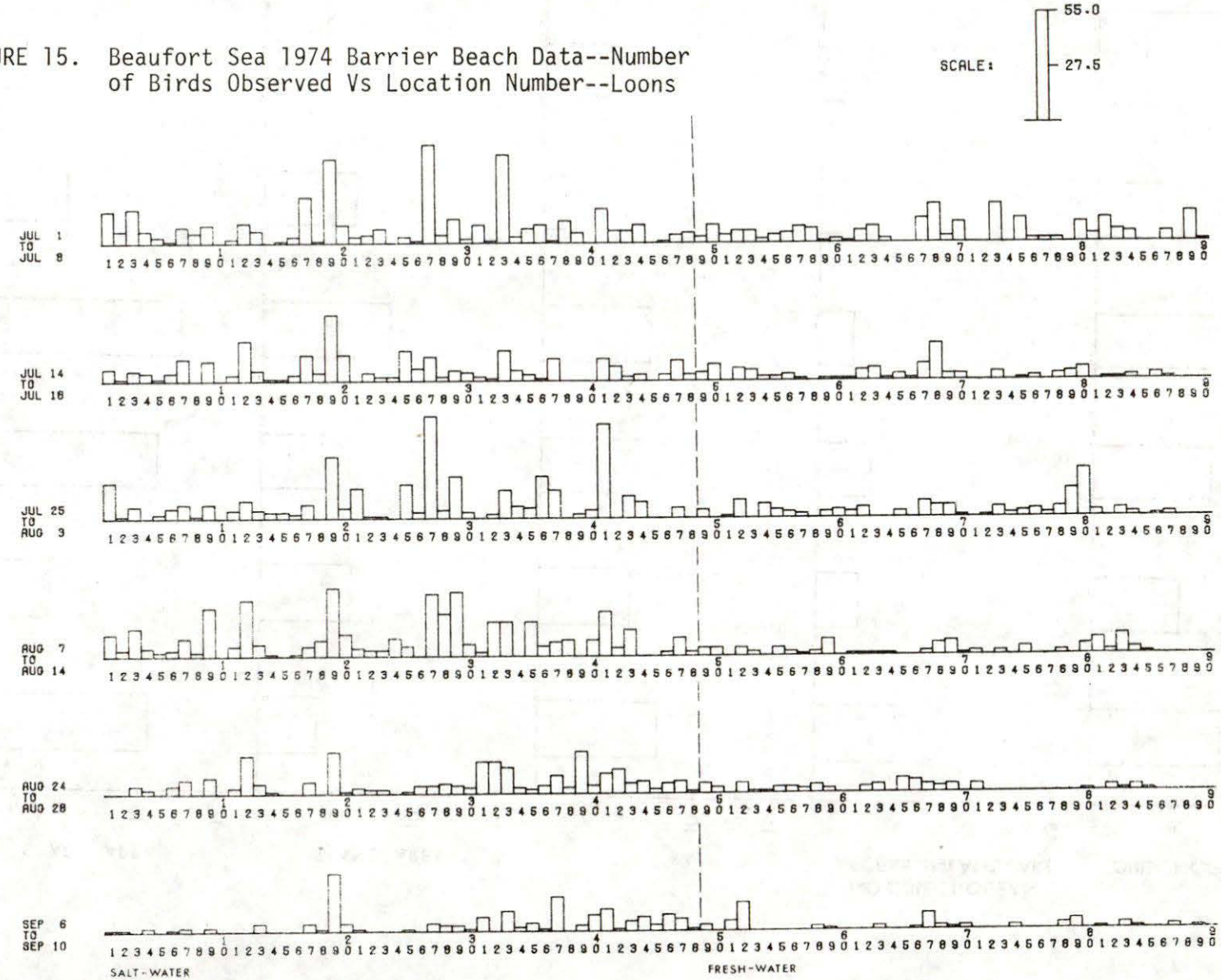


Figure 14. Number of Birds per Hour Observed Passing Coastal Migration Watch Stations in the Yukon and Northwest Territories in 1972. Only locations where birds were observed were presented.

FIGURE 15. Beaufort Sea 1974 Barrier Beach Data--Number of Birds Observed Vs Location Number--Loons



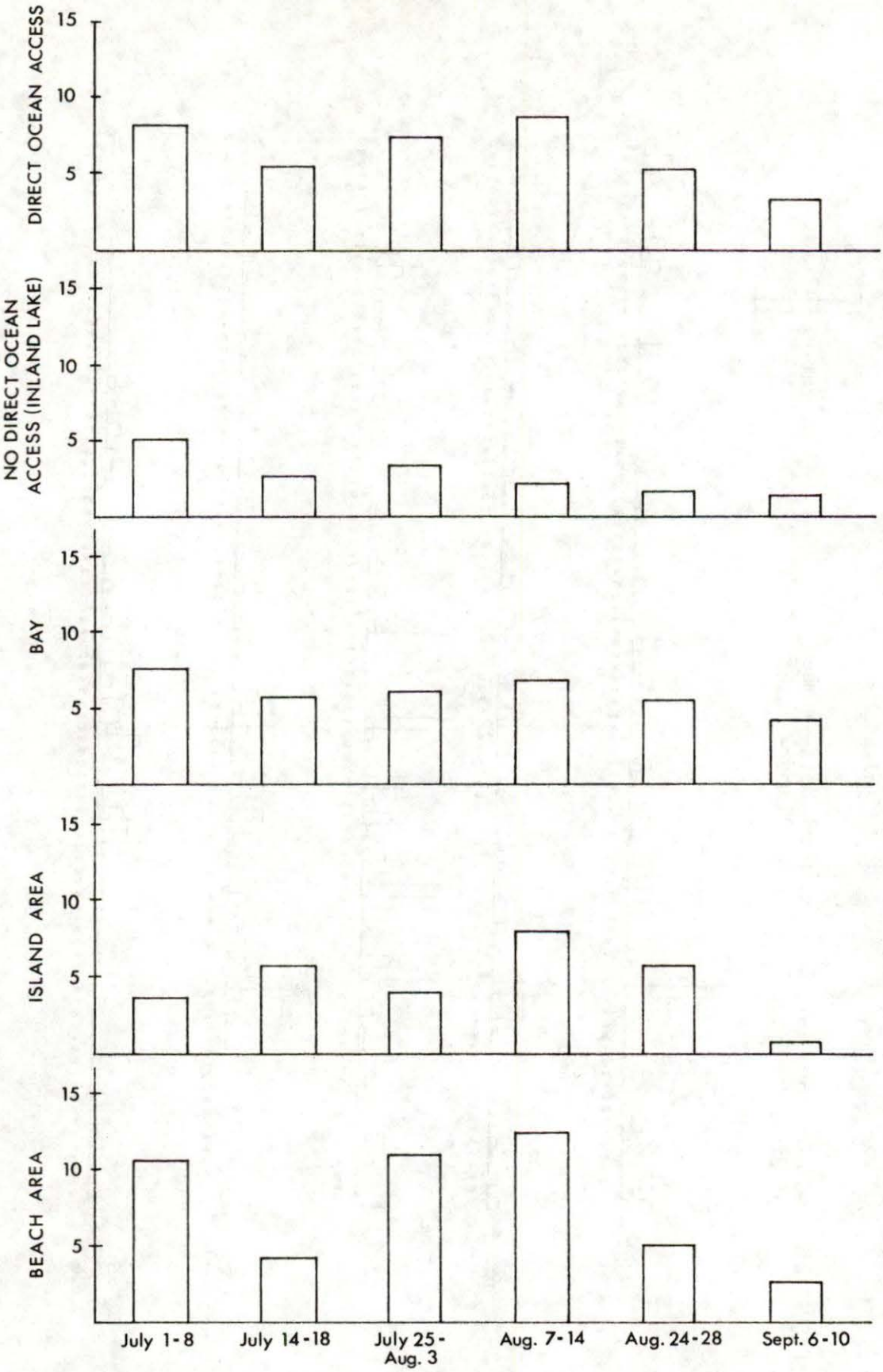


FIGURE 16. Average Number of Total Loons per Waterbody by Waterbody Type, 1 July to 10 September 1974.

of time that adults of some loon species spend feeding in salt-water areas during incubation (see Palmer 1962) and to the movement of family groups of loons to the sea after the young had fledged.

Fall migration of loons apparently began in late August and continued throughout September (Figure 14). There was evidence that during September proportionately greater numbers of loons were present on the coast of the Tuktoyaktuk Peninsula than farther west (Appendix 1). Although Red-throated Loons do gather into moderately sized groups, the general tendency of loons to gather into large flocks is low; consequently, migratory movement of these birds is gradual rather than *en masse*.

Gavia immer: Common Loon

Present Status and Spring Migration

According to Godfrey (1966), the breeding range of the Common Loon extends north to the Mackenzie Delta. The Common Loon occurs in the Beaufort Sea in small numbers (Anderson 1913; Porsild 1943; Gollop and Davis 1974a). Although scattered individuals of this species may occur in the study area as early as late May (Johnson *et al.* In Press; Richardson *et al.* 1976), this loon was not recorded during this study until early July.

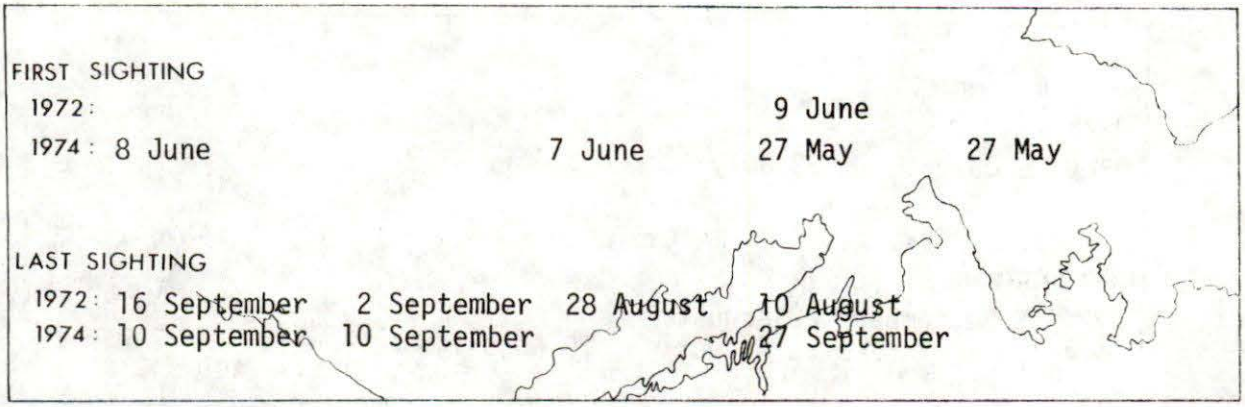
Summer Distribution

This species was occasionally seen in small numbers during shore-based migration watches conducted at Nunaluk Spit from mid to late August and during early September 1972 (Figure 17). Common Loons were recorded during July and August 1974; most of these birds were on bays and beach areas along the coast from Herschel Island to Toker Point. During other years Common Loons have been recorded as far east in the Beaufort Sea as Banks Island (A.O.U. 1957).

Fall Migration

During fall of 1972, Common Loons migrated in a primarily westward direction (Figure 17). However, only a small number of Common Loons were observed during this year; little, therefore, is known about the migration route these birds followed. Most migrating loons of this species were observed after the first week of August. The possible offshore movements of Common Loons mentioned by Gollop and Davis (1974a) were not detected during offshore aerial surveys conducted in 1974.

Gavia adamsii: Yellow-billed Loon



Present Status and Spring Migration

In the western Canadian Arctic, Yellow-billed Loons occur in the types of habitats that are occupied by Common Loons in the eastern Arctic (Godfrey 1966). Yellow-billed Loons breed in small numbers in the Beaufort Sea area (Höhn 1959; Palmer 1962). The Yellow-billed Loon arrives relatively early in the Beaufort Sea area; this species has been recorded at Banks Island as early as 26 May in 1953 (Manning *et al.* 1956). It is probable that most individuals of this species reach the Beaufort Sea *via* the coastline of Alaska (Dixon 1916; Gabrielson and Lincoln 1959; Palmer 1962), possibly having migrated well offshore (Johnson *et al.* In Press; Richardson *et al.* 1976). Bailey (1948) recorded these birds at Wainwright Lagoon on 22 May and mentioned that they were present in substantial numbers at Barrow, Alaska, by 26 June. The earliest spring records during the present study were obtained on 9 June 1972 at Cape Dalhousie and on 27 May 1974 at Cape Dalhousie and near Banks Island.

Distribution

During 1974, Yellow-billed Loons were regularly seen offshore and in small numbers; the majority were observed near small to medium-sized leads off the Tuktoyaktuk Peninsula and Liverpool Bay. Two notable exceptions were the following:

COMMON LOON

Nunaluk 65

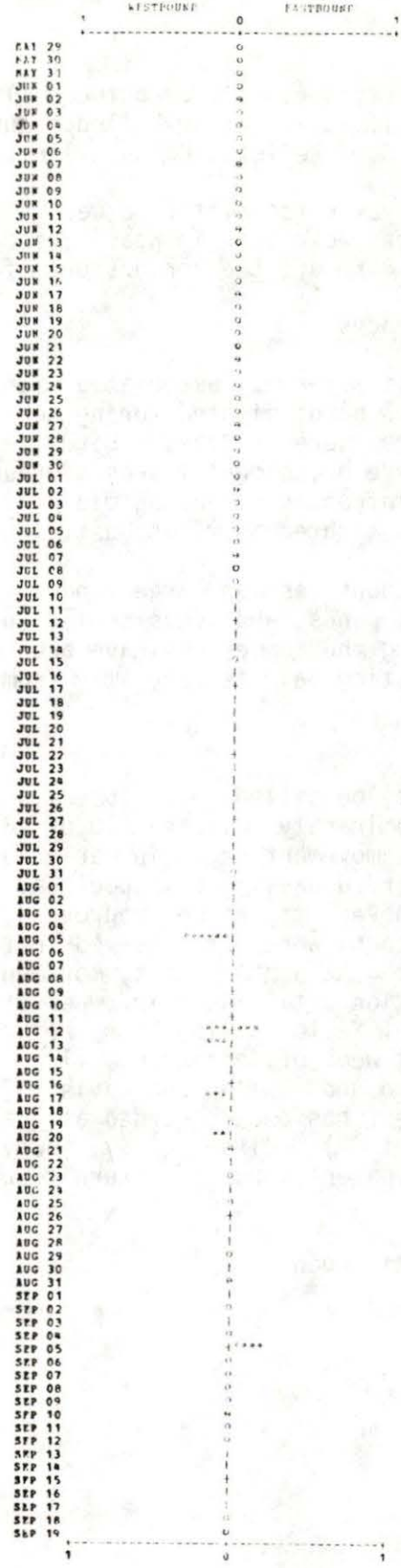


FIGURE 17. Number of Birds per Hour Observed Passing Coastal Migration Watch Stations in the Yukon and Northwest Territories in 1972. Only Locations Where Birds were Observed are Presented.

1. During Survey 4 (conducted between 21 and 27 May), 12 loons that were identified as Yellow-billed Loons were sighted approximately 45 km off Cape Kellett, Banks Island.

2. During Survey 6 (conducted between 6 and 8 June), seven Yellow-billed Loons were seen in heavy ice cover (only 10% open water) less than 8 km off the north shore of Herschel Island.

Habitat Preferences

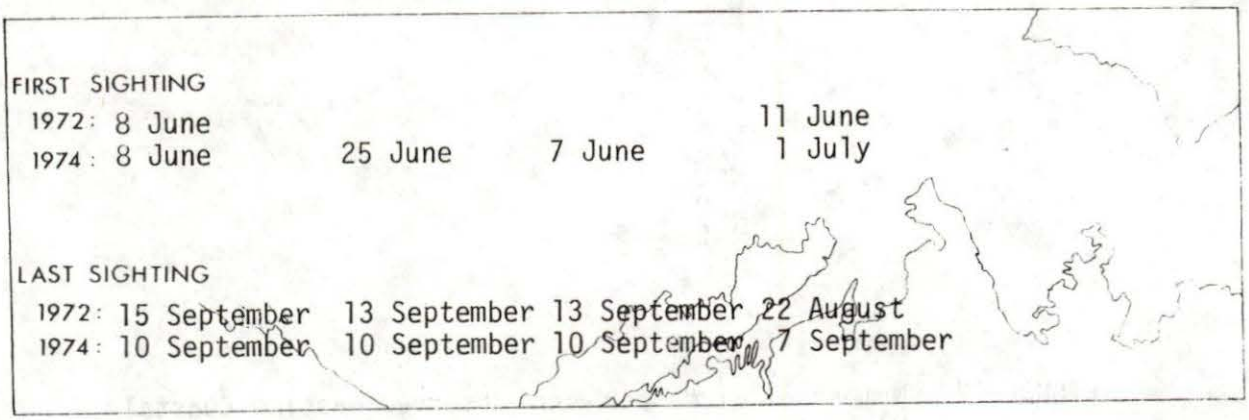
This species was primarily associated with salt-water areas; only three (6%) of 47 birds sighted during aerial surveys of the coastal Beaufort Sea area were on lakes. Birds were usually seen singly although pairs were occasionally seen. Groups of three or four birds were observed infrequently during mid-July, and one group of five individuals was sighted in mid-August.

Yellow-billed Loons nest on large tundra lagoons (Bailey 1948), on lakes and large ponds, and occasionally on large rivers (Palmer 1962); sightings during the summer may have been of nesting pairs or a single member of a nesting pair feeding away from the nest.

Fall Migration

Movements of Yellow-billed Loons observed at Nunaluk Spit during July 1972 were predominantly eastward (10 of 14 birds)(Figure 18). The major migratory movement began in early August. Sixteen Yellow-billed Loons were recorded passing Liverpool Bay in the first week of August; apparently, however, migration progressed leisurely at first, and Yellow-billed Loons were not observed in the Mackenzie Delta until early September. At Nunaluk Spit, movement continued in a primarily eastward direction until the third week of August; after this period, small numbers of Yellow-billed Loons began migrating to the west. After the first week of September, all of the few birds observed from shore were westbound (Gollop and Davis 1974a); during previous years, westward movement has been recorded at Franklin Bay, N.W.T., on 6 September (Palmer 1962). Dixon (1916), however, suggests that Yellow-billed Loons apparently do not return to wintering areas *via* the coast of Alaska.

Gavia arctica: Arctic Loon



YELLOW-BILLED LOON

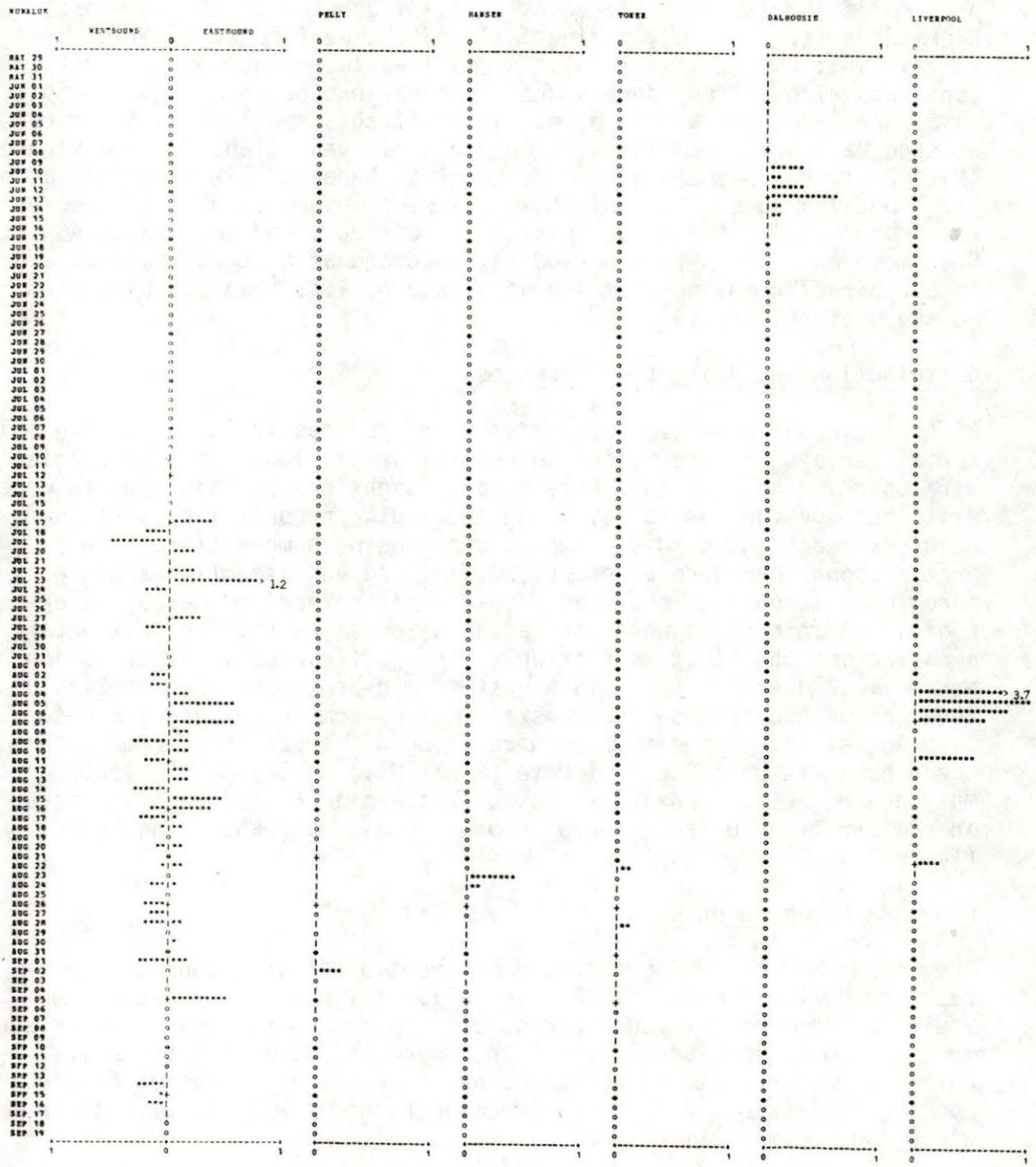


Figure 18. Number of Birds per Hour Observed Passing Coastal Migration Watch Stations in the Yukon and Northwest Territories in 1972. Only locations where birds were observed are presented.

Present Status and Spring Migration

The Arctic Loon occurs abundantly along most of the Arctic coast. During late May or early July, this species arrives in the southeastern portion of the Beaufort Sea (Porsild 1943; Johnson *et al.* In Press; Richardson *et al.* 1976), having followed the west coast of Alaska (Barry 1968; LGL Limited 1973). A small eastward movement of Arctic Loons was already in progress when observations began at Nunaluk Spit on 8 June 1972, and a wave of migration of this species was observed at Cape Dalhousie from 11 to 15 June of this year (Table 14 and Figure 19). Eastward movement of Arctic Loons at Nunaluk Spit continued at least until 3 June. Predominantly eastward movements of this species were noted again at Nunaluk Spit throughout July and into early August. Such movement during this period was recorded at a steady rate of 2.0 to 5.0 birds/hr moving east and at a rate of less than 0.5 birds/hr moving west (Figure 19).

Distribution and Habitat Preferences

No Arctic Loons were seen during offshore surveys in 1974. During 1974 aerial surveys of waterbodies in coastal areas, loons of this species were observed only in nearshore areas. Sightings of this species were distributed rather uniformly along the southern coastal area of the Beaufort Sea (Figure 20). Some waterbodies were more attractive to Arctic Loons than were other waterbodies and consistently harboured more loons throughout the season than similar types of nearby waterbodies. Arctic Loons were more abundant on lakes than on salt-water areas during the first week of July; this difference in distribution became less distinct from mid-August to mid-September (Figure 21). Movement of Arctic Loons to coastal regions commences during mid to late August, after their young have fledged. These loons remain in ocean habitats until they migrate (Bent 1919; Bailey *et al.* 1933). Multiple regression analysis showed that Arctic Loons tended to occur in similar types of areas as Oldsquaws, scaup, and Whistling Swans (Table 9).

Premigratory Movements

The steady and primarily eastward movement of Arctic Loons that was recorded during mid-July 1972 (Figure 19) may have consisted of subadult and nonbreeding adult birds (Johnson *et al.* In Press; Richardson *et al.* 1976). Immature Arctic Loons spend the summer on the ocean; unlike Common and Yellow-billed Loons, however, pre-breeding Arctic Loons are distributed over the breeding range as well as over their wintering areas (Palmer 1962).

Fall Migration

Fall migration of Arctic Loons probably begins during mid to late August and continues until mid-September. The peak of 1972 migration of this species, although it is difficult to determine from the data available, apparently occurred during the third week of August. During this period, 2.0 to 4.0 Arctic Loons/hr were seen moving past most

ARCTIC LOON

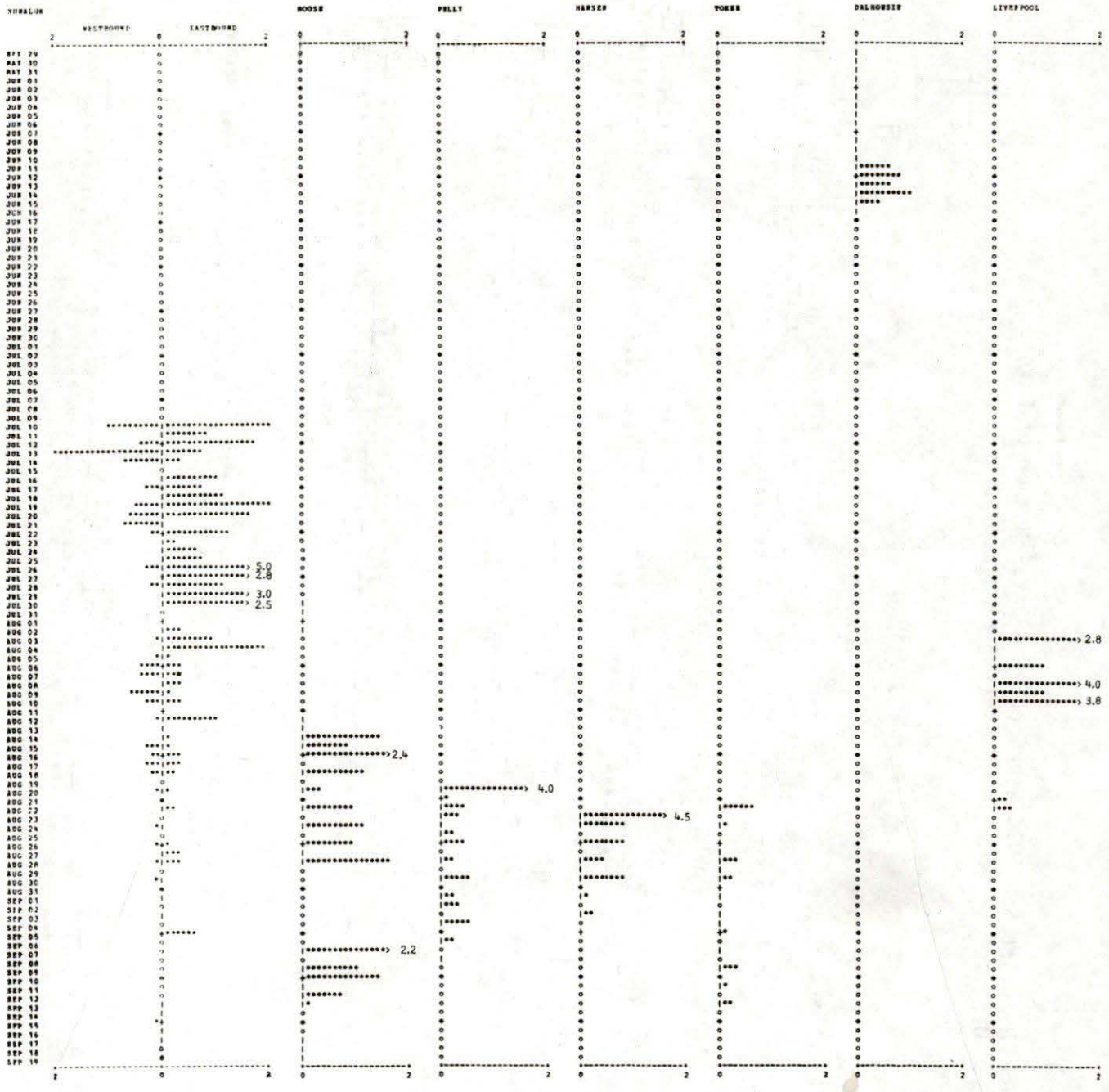
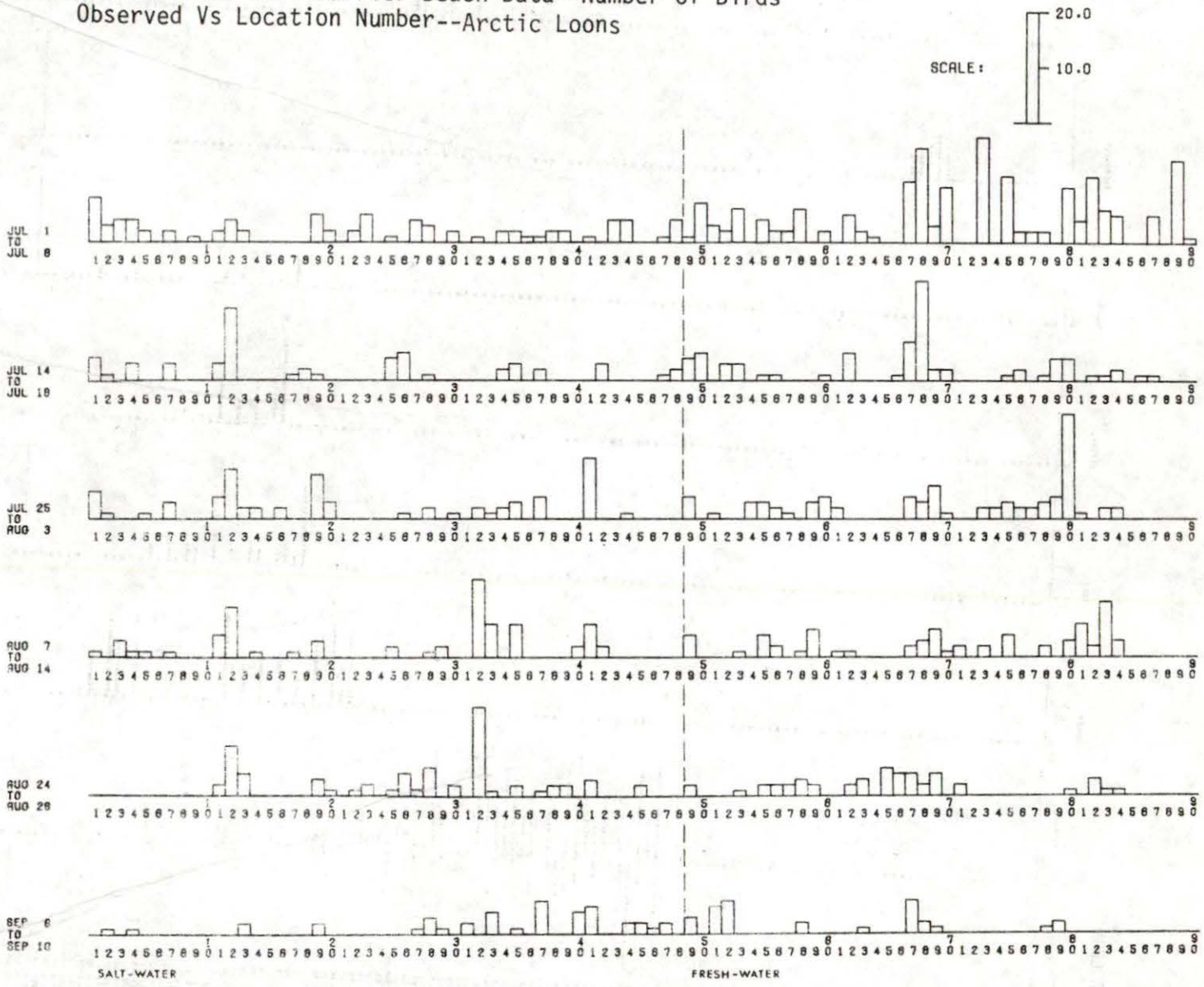


Figure 19. Number of Birds per Hour Observed Passing Coastal Migration Watch Stations in the Yukon and Northwest Territories in 1972. Only locations where birds were observed are presented.

FIGURE 20. Beaufort Sea 1974 Barrier Beach Data--Number of Birds Observed Vs Location Number--Arctic Loons



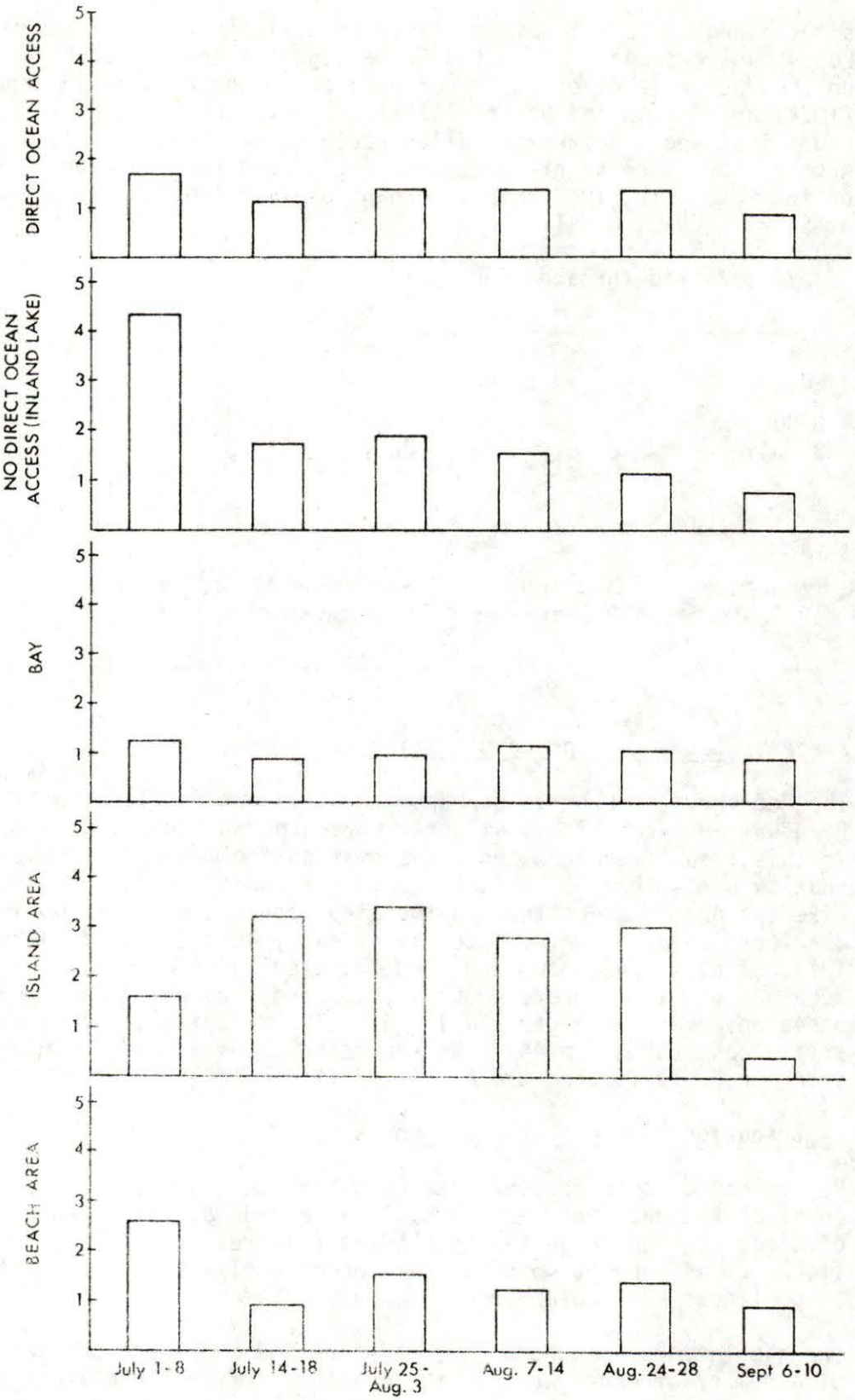
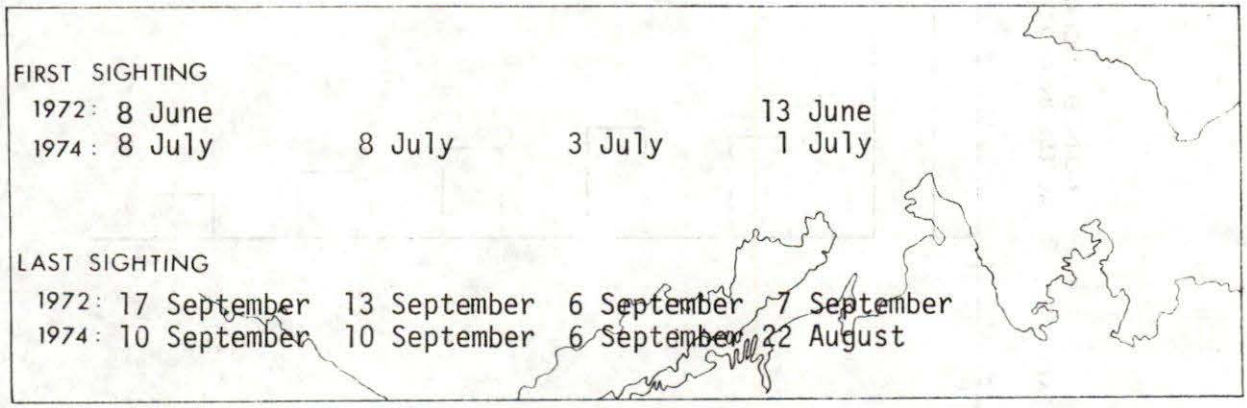


FIGURE 21. Average Number of Arctic Loons per Waterbody by Waterbody Type, 1 July to 10 September 1974.

sites along the coast (Figure 19). That little movement of Arctic Loons was recorded west of the Delta suggests that these birds migrated up the Mackenzie River Valley or offshore. Information in Schweinsburg (1974) and Gollop and Davis (1974a) supports the hypothesis that Arctic Loons followed a Mackenzie Valley route: on 23 September 1971, 250 Arctic Loons were sighted between Wrigley and Fort Simpson, N.W.T.; on the same date, 1000 loons, perhaps of this species, were recorded at Stewart Lake, N.W.T.

Gavia stellata: Red-throated Loon



Present Status and Spring Migration

The Red-throated Loon is perhaps the most abundant loon species in the Beaufort Sea area; it is slightly more abundant than the Arctic Loon in this area. Red-throated Loons nest on the many small lakes and shallow ponds that dot the arctic tundra (Godfrey 1966; Porsild 1943). Like the Arctic Loon, the Red-throated Loon begins arriving in the Beaufort Sea area during late May or early June (Porsild 1943; Barry 1974; Slaney 1974). In 1972, Red-throated Loons were seen passing Nunaluk Spit in moderate numbers (1.6 birds/hr) on 8 June, when shore-based observations began (Table 14). The majority of these birds were flying east (89%, n = 44). Red-throated Loons observed during this study probably reached the Arctic *via* the coast of Alaska.

Distribution and Habitat Preferences

Red-throated Loons occupy suitable habitats along the entire southern coast of the Beaufort Sea. Most 1974 records of this species consisted of birds sighted on salt-water bodies (Figures 23 and 24); feeding flocks of as many as 45 birds were occasionally sighted. Most of these large flocks were observed during July.

The habitat preferences of the Red-throated Loon were similar to those of a number of other arctic bird species. After the effects of habitat type, date, and waterbody size on the numbers of Red-throated Loons were considered through use of multiple regression analysis, the num-

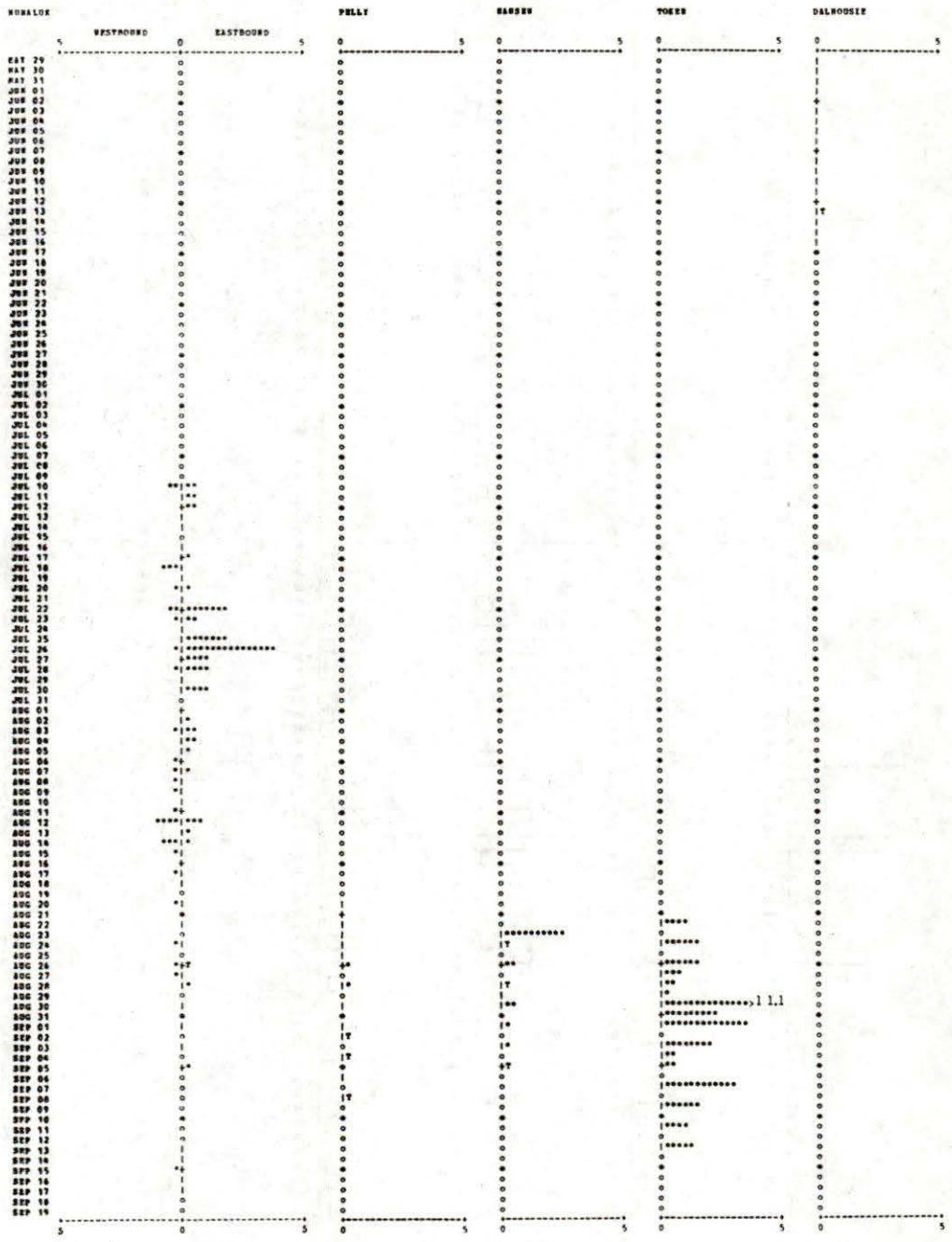
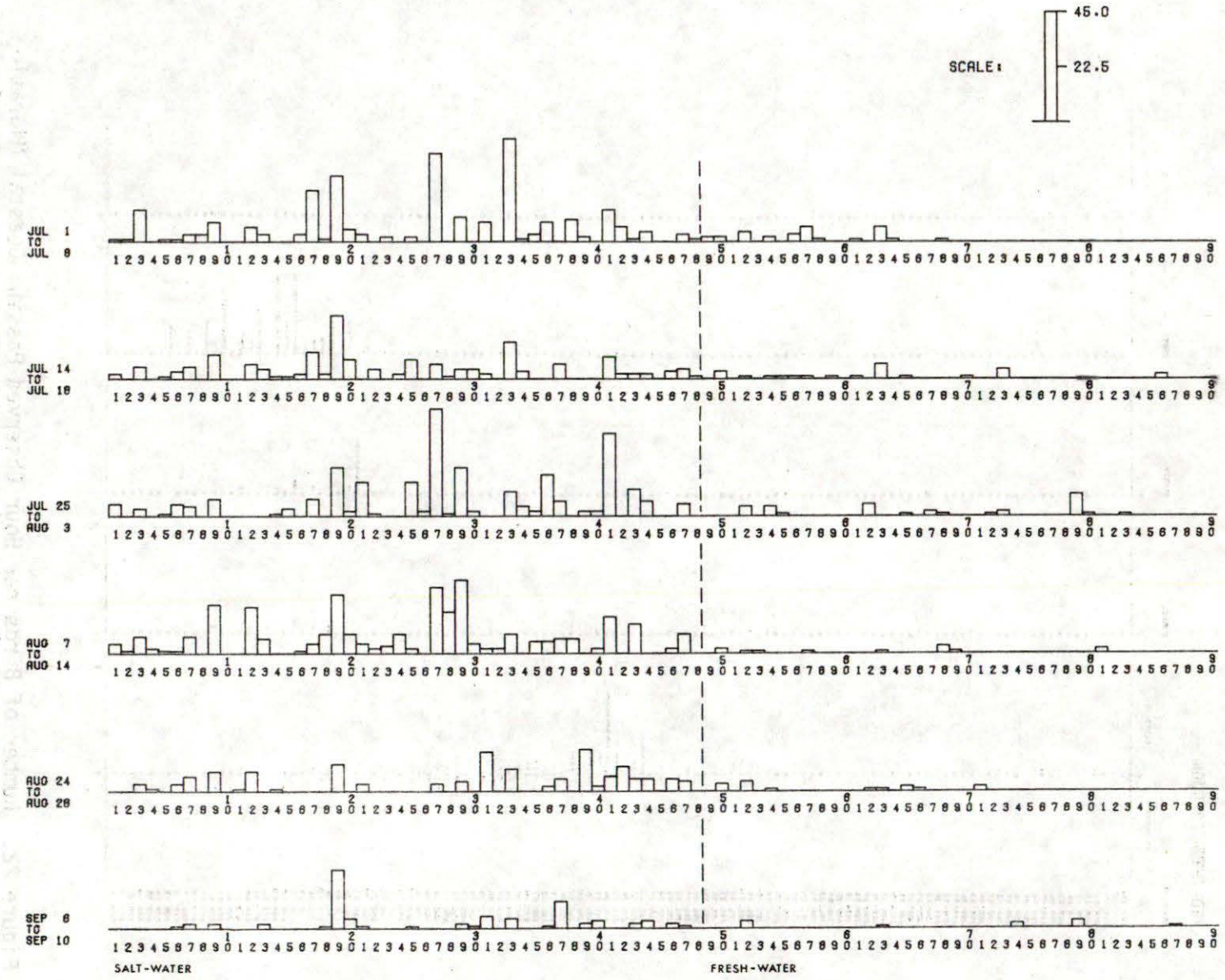


Figure 22. Number of Birds per Hour Observed Passing Coastal Migration Watch Stations in the Yukon and Northwest Territories in 1972. Only locations where birds were observed are presented.

FIGURE 23. Beaufort Sea 1974 Barrier Beach Data--Number of Birds Observed Vs Location Number-- Red-throated Loons



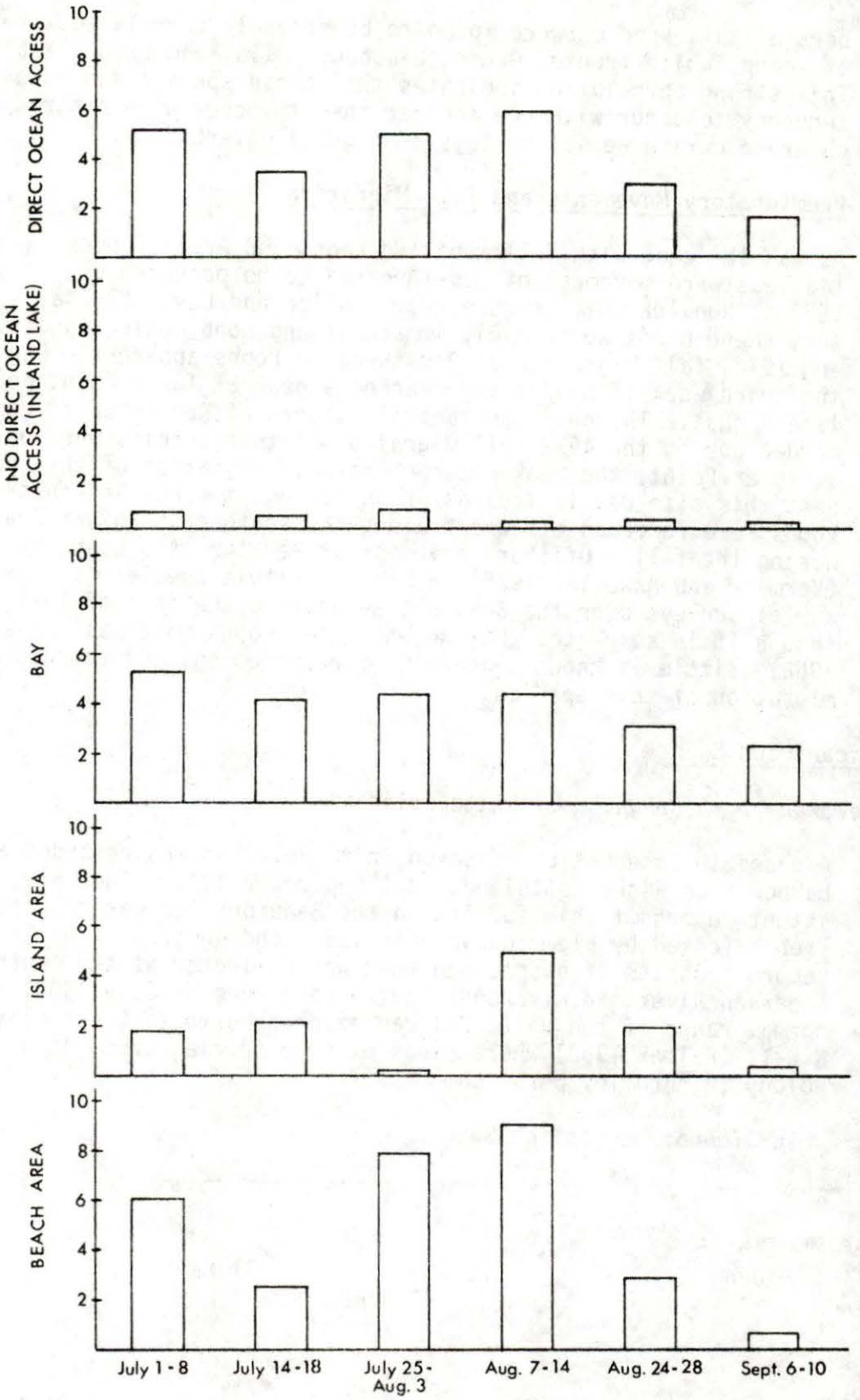


FIGURE 24. Average Number of Red-throated Loons per Waterbody by Waterbody Type, 1 July to 10 September 1974.

bers of this species were found to be strongly correlated with those of scaup, White-fronted Geese, Glaucous Gulls, and Brant (Table 9). This strong correlation indicates that these species showed a stronger tendency to occur with one another than to occur with other species observed during aerial surveys of coastal waterbodies.

Premigratory Movements and Fall Migration

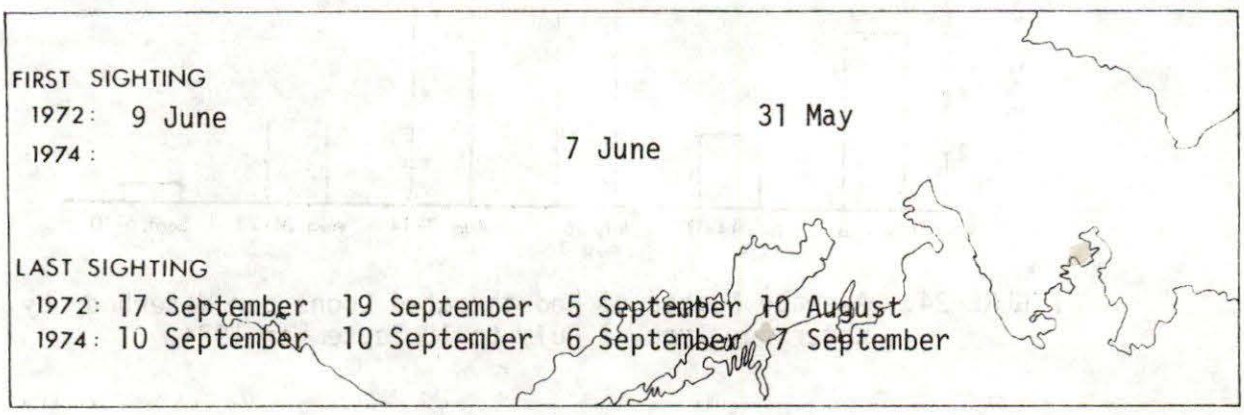
As was the case with Yellow-billed Loons and Arctic Loons, a substantial eastward movement of Red-throated Loons occurred during July 1972 at Nunaluk Spit (Figure 22). Gollop and Davis (1974a) suggested that these birds were mainly immatures and nonbreeding adults. During 1972, fall migration of Red-throated Loons apparently began during the third week of August and reached a peak at Toker Point during late August. The only substantial numbers of Red-throated Loons recorded during the 1972 fall migration of this species were observed at Toker Point; the peak recorded rate of migration of this species past this site was 11.1 birds/hr on 30 August. Few Red-throated Loons were recorded elsewhere along the southern Beaufort Sea coast during the fall. Offshore movement of Red-throated Loons is unlikely (Vermeer and Anweiler 1975); no loons of this species were seen during aerial surveys over the Beaufort Sea during the fall of 1974. Although it is suspected that Red-throated Loons move past Alaska (Palmer 1962), little is known concerning the chronology and route of autumn migration of this species.

Pelicans and Swans

Pelecanus erythrorhynchos: White Pelican

A possible observation of seven White Pelicans was recorded at Hansen Harbour, on Richards Island, on 1 September 1972. The only other existent record of this species in the Beaufort Sea was reported by Preble (cited by Flemming in Höhn 1959) and Anderson (1913); this record consists of a specimen that was collected at the mouth of the Anderson River, in Liverpool Bay, during June or July 1900. The normal range of the White Pelican extends north to Great Slave Lake, N.W.T. (Palmer 1962) where birds of this species breed in a small colony (R. Bromley pers. comm.).

Olor columbianus: Whistling Swan



Present Status and Spring Migration

The Whistling Swan occurs commonly and occasionally as an abundant breeder along the southern coast of the Beaufort Sea and on southern Banks Island (Barry 1961; Manning *et al.* 1956; Martel in prep.; Porsild 1943). Birds of this species that breed in the eastern Beaufort Sea region migrate primarily down the Mackenzie River (Banko and MacKay 1964; Brooks *et al.* 1971; Gunn 1973). Arrival dates of this species in the Beaufort Sea area range from early May to mid-June (Banko and MacKay 1964; Barry 1967; Höhn and Robinson 1951; Porsild 1943; Ryder 1971 1971; Johnson *et al.* In Press; Richardson *et al.* 1976). The first Whistling Swan recorded during the 1972 phase of this study was observed on 31 May at Cape Dalhousie. Whistling Swans were sighted near the Firth River, Y.T., on 28 May 1972 (Gollop *et al.* 1974a). During 1972, large numbers of migrating Whistling Swans were seen only on 6 June; the last swan of this species that was recorded during spring 1972 was observed at Cape Dalhousie on 14 June (Figure 25). Campbell and Shepard (1973) attributed this late arrival to the late break-up of ice in the Arctic in 1972. During offshore aerial surveys conducted during 1974, four Whistling Swans were seen on 7 June flying north from Tuktoyaktuk over open water.

Distribution and Habitat Preferences

According to Barry (1961), the area around the Eskimo Lakes and Liverpool Bay contains the highest nesting density of Whistling Swans in Canada. During 1974 aerial surveys of the coastal Beaufort Sea area, large concentrations of Whistling Swans were recorded in only a few locations; most of the records of this species obtained during these surveys consisted of observations of single or paired birds. Richards Island and the Barrier Beach islands to the north of Richards Island contained the highest observed concentrations of swans (see also Figure 27). Lake Number 63 hosted more than 300 Whistling Swans between 14 July and 14 August (Figure 26); these birds were probably nonbreeding adults and immatures. Whistling Swans normally do not breed until they are 5 or 6 yr old (Delacour 1959).

Whistling Swans were found to prefer habitats similar to those used by White-fronted Geese and Pintails; these swans preferred to a lesser extent habitats similar to those used by Arctic Loons and Brant (Table 9). Nests of Whistling Swans are typically built in wet-sedge tundra near water (Anderson 1913; Höhn 1959).

Fall Migration

Because 1972 shore-based observations probably terminated before major Whistling Swan movements began; few swans of this species were observed from shore during the fall of 1972. One notable exception was at Moose Channel. At this location, Whistling Swans were observed moving at a rate of 10 birds/hr or more on three dates between 11 September and the termination of observations on 19 September. It is probable that additional movements of this species occurred after

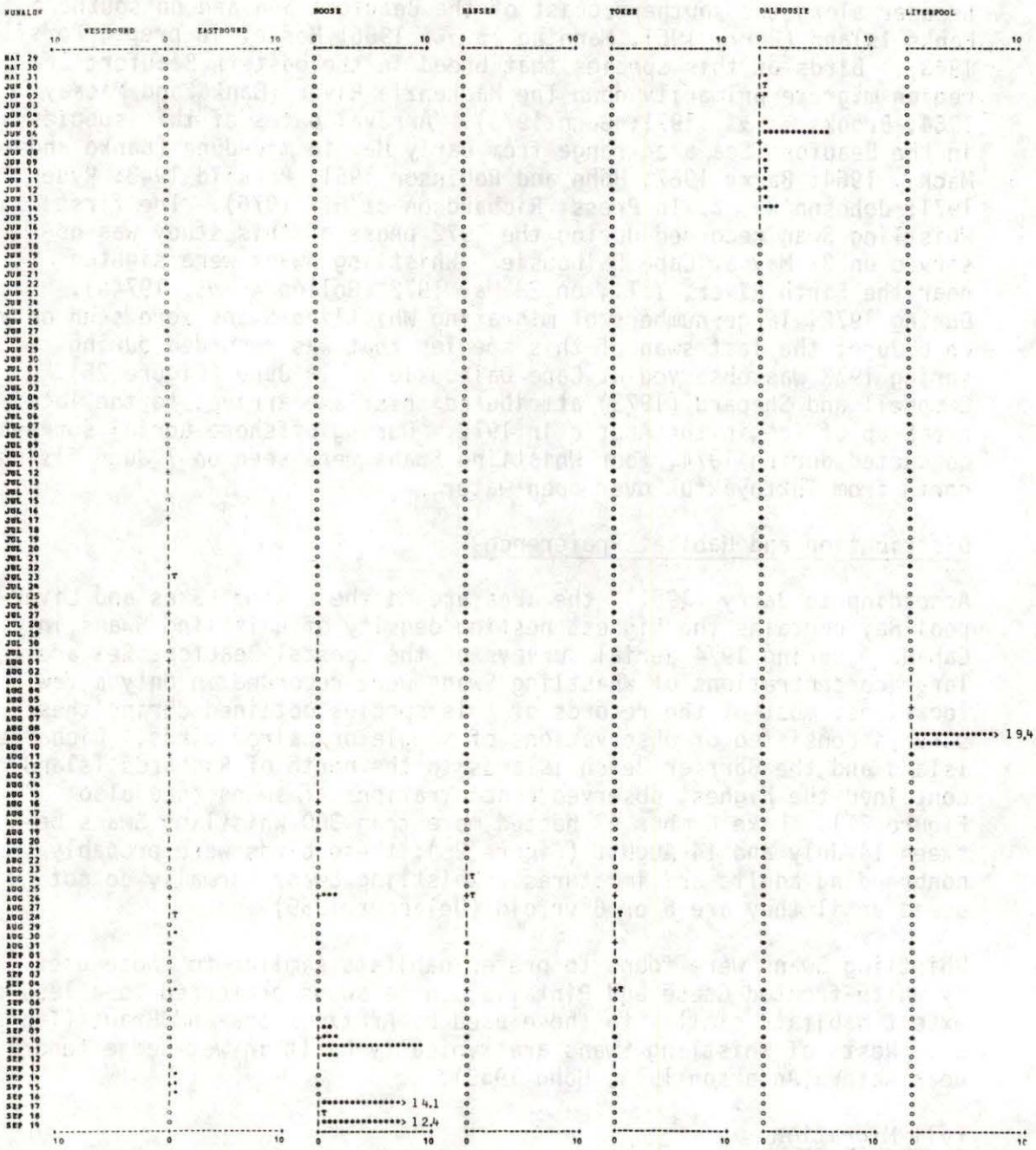
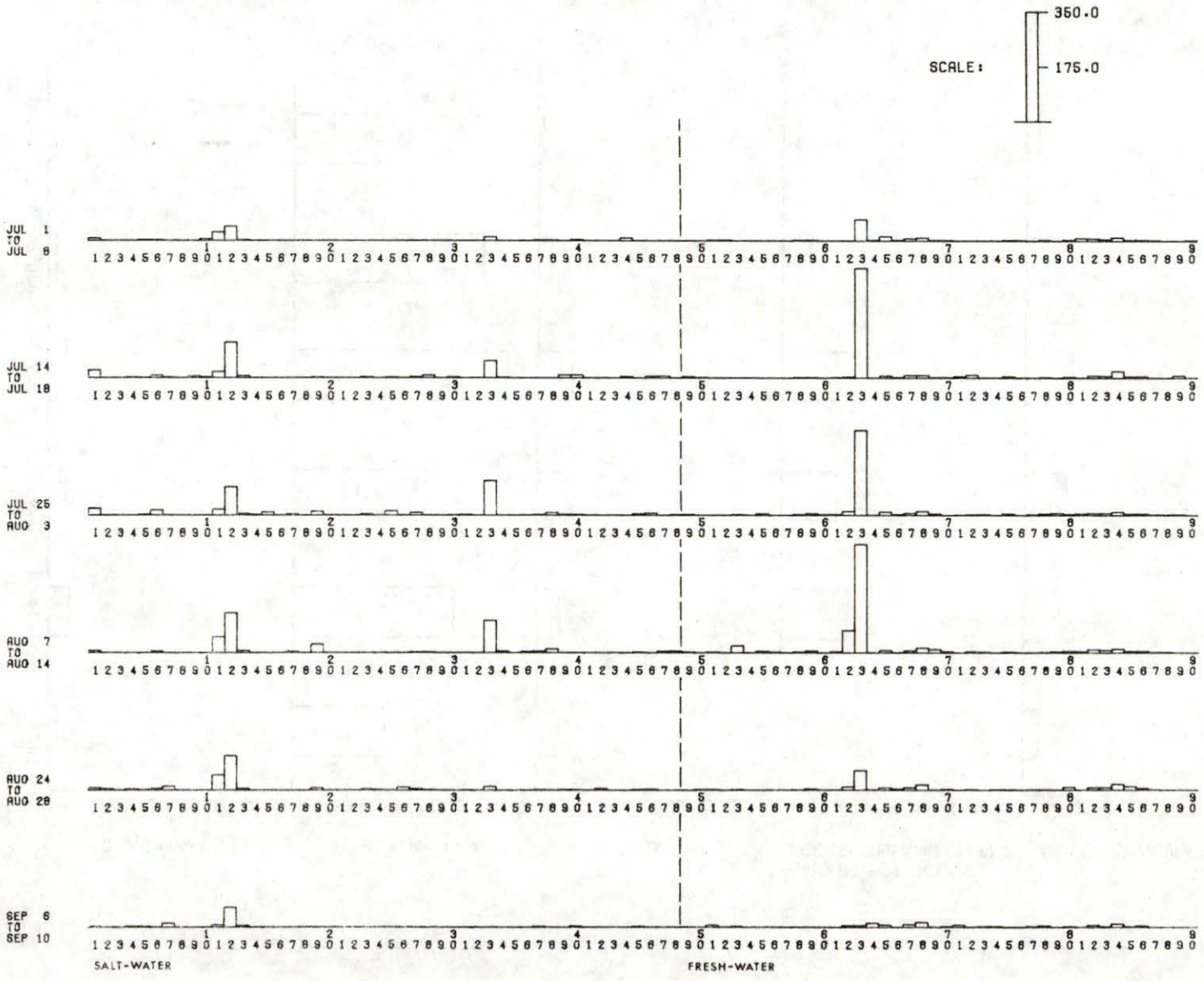


Figure 25. Number of Birds per Hour Observed Passing Coastal Migration Watch Stations in the Yukon and Northwest Territories in 1972. Only locations where birds were observed are presented.

FIGURE 26. Beaufort Sea 1974 Barrier Beach Data--Number of Birds Observed Vs Location Number-- Whistling Swans



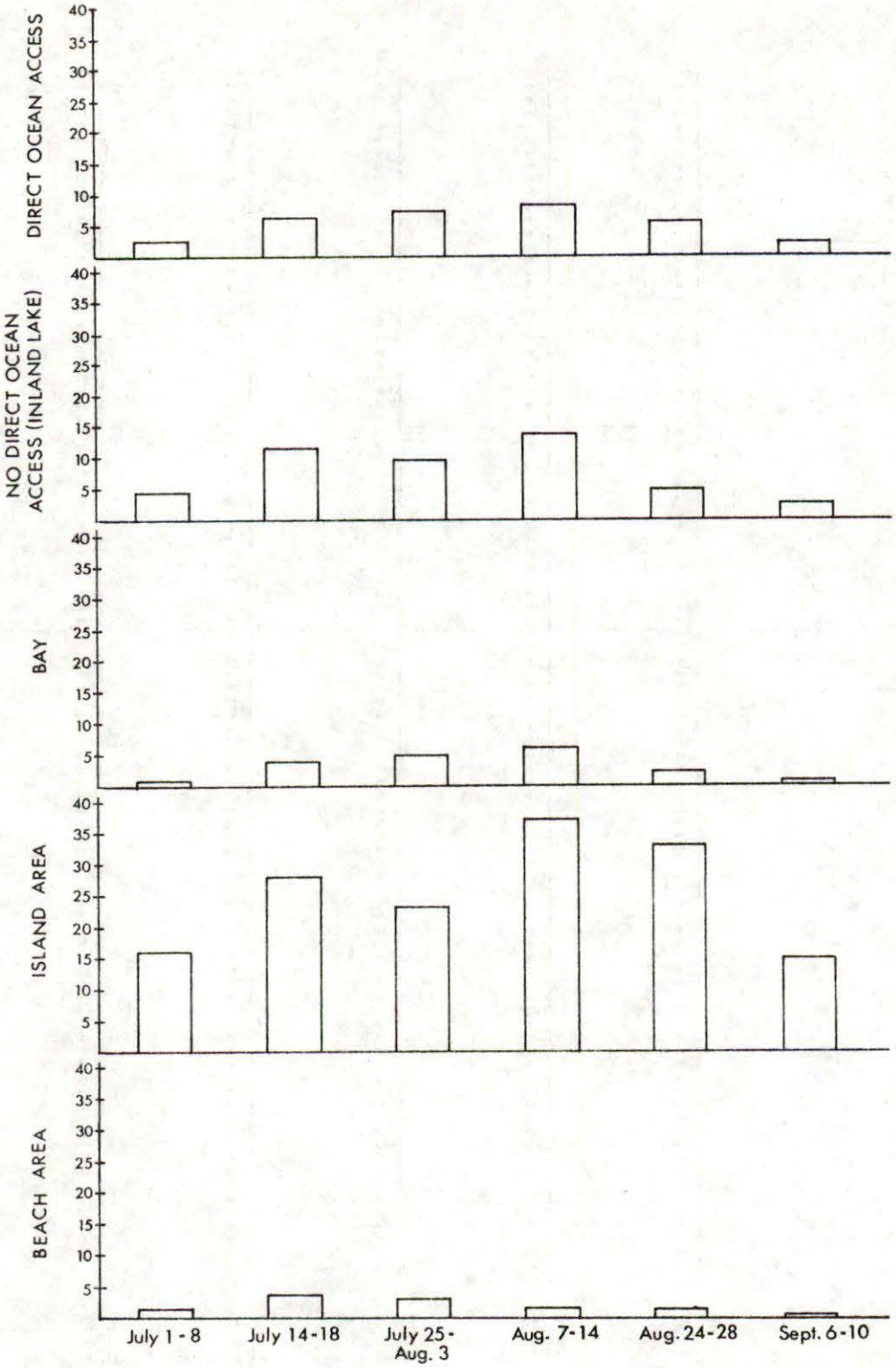


FIGURE 27. Average Number of Whistling Swans per Waterbody by Waterbody Type, 1 July to 10 September 1974.

this date. Small numbers of Whistling Swans were recorded at Nunaluk Spit during this period (Figure 25). Most movements of Whistling Swans from the eastern Beaufort Sea occur from mid to late September (Salter 1974b) and during early October (Slaney 1974); these birds follow the Mackenzie River Valley into Alberta and Saskatchewan and eventually migrate to the Atlantic Coast, where the Whistling Swans that nest in Canada winter (Gunn 1973; Sladen and Cochran 1969; Sladen 1973).

Geese

The coast of the Beaufort Sea is a major breeding area for four species of geese: Canada Geese, Brant, White-fronted Geese, and Snow Geese. Large numbers of these species of geese breed from the Mackenzie Delta east and north to Banks Island. These geese regularly arrive in the eastern Beaufort Sea during late May (Barry 1967). During 1972, the first geese were sighted on 31 May at Cape Dalhousie. During 1974, a flock of 25 "dark" geese was sighted on 6 June north of Cape Kellett, Banks Island; on the next day 500 geese were observed in Mackenzie Bay.

During surveys conducted during July 1974, the numbers of geese recorded were evenly divided between fresh-water and salt-water areas. During August, however, large numbers of geese were recorded in salt-water areas; during this month, exceptionally large, premigrational staging flocks formed in some areas (Figures 29 and 30). In 1974, the largest concentrations of geese gathered near bays during late August. Soon after this period, however, these large flocks left the Beaufort Sea area and migrated south. The migration of geese can reach impressive volumes, as was noted at Nunaluk Spit on 27 August 1972, when nearly 2200 geese/hr were seen moving past the beach (Figure 28). Much of the movement of geese from the eastern Beaufort Sea is inland. However, some birds (predominantly Brant) follow the coast of Alaska to wintering areas in the Pacific Ocean.

Branta canadensis: Canada Goose

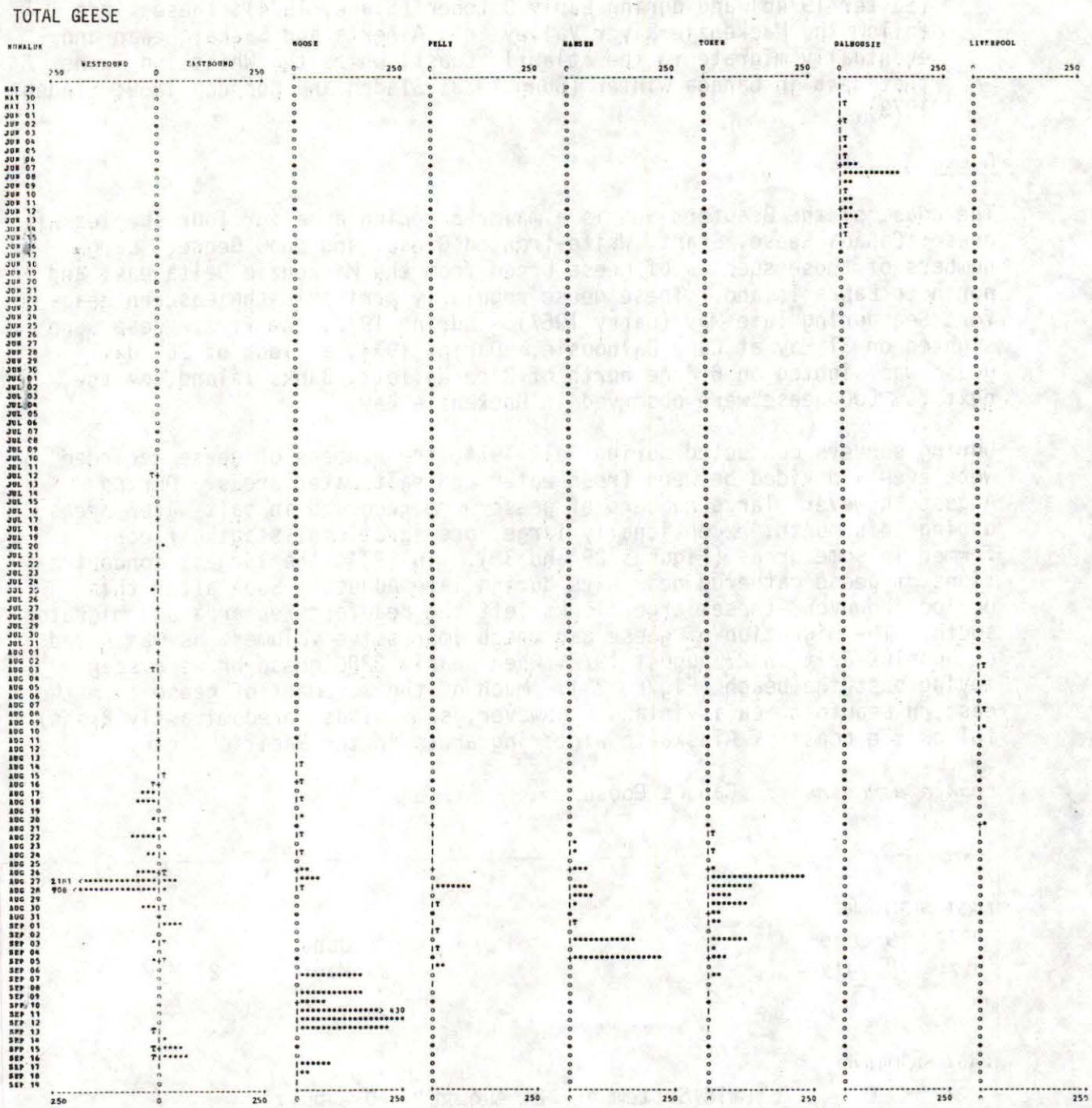
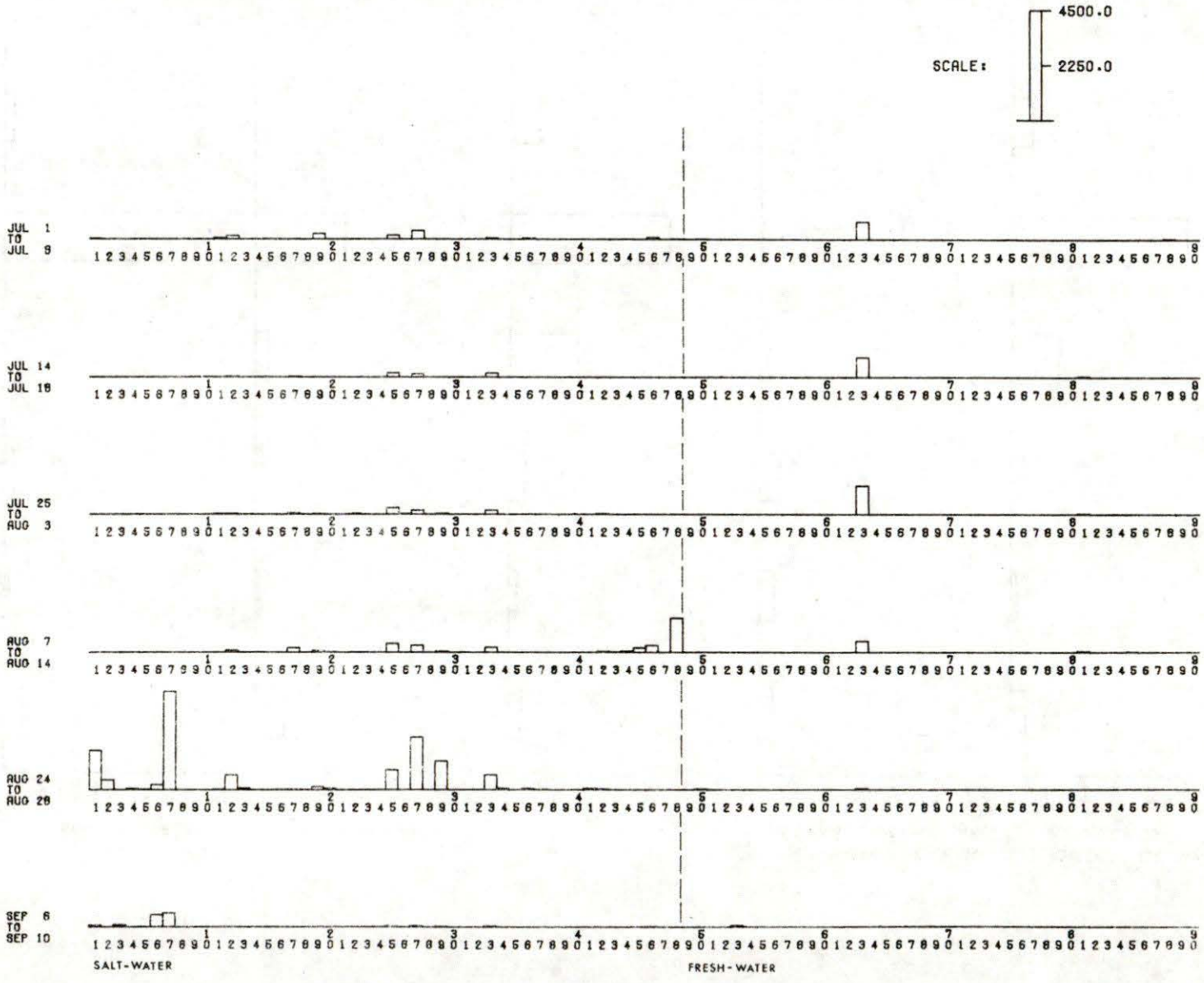


Figure 28. Number of Birds per Hour Observed Passing Coastal Migration Watch Stations in the Yukon and Northwest Territories in 1972. Only locations where birds were observed are presented.

FIGURE 29. Beaufort Sea 1974 Barrier Beach Data--Number of Birds Observed Vs Location Number-- Geese



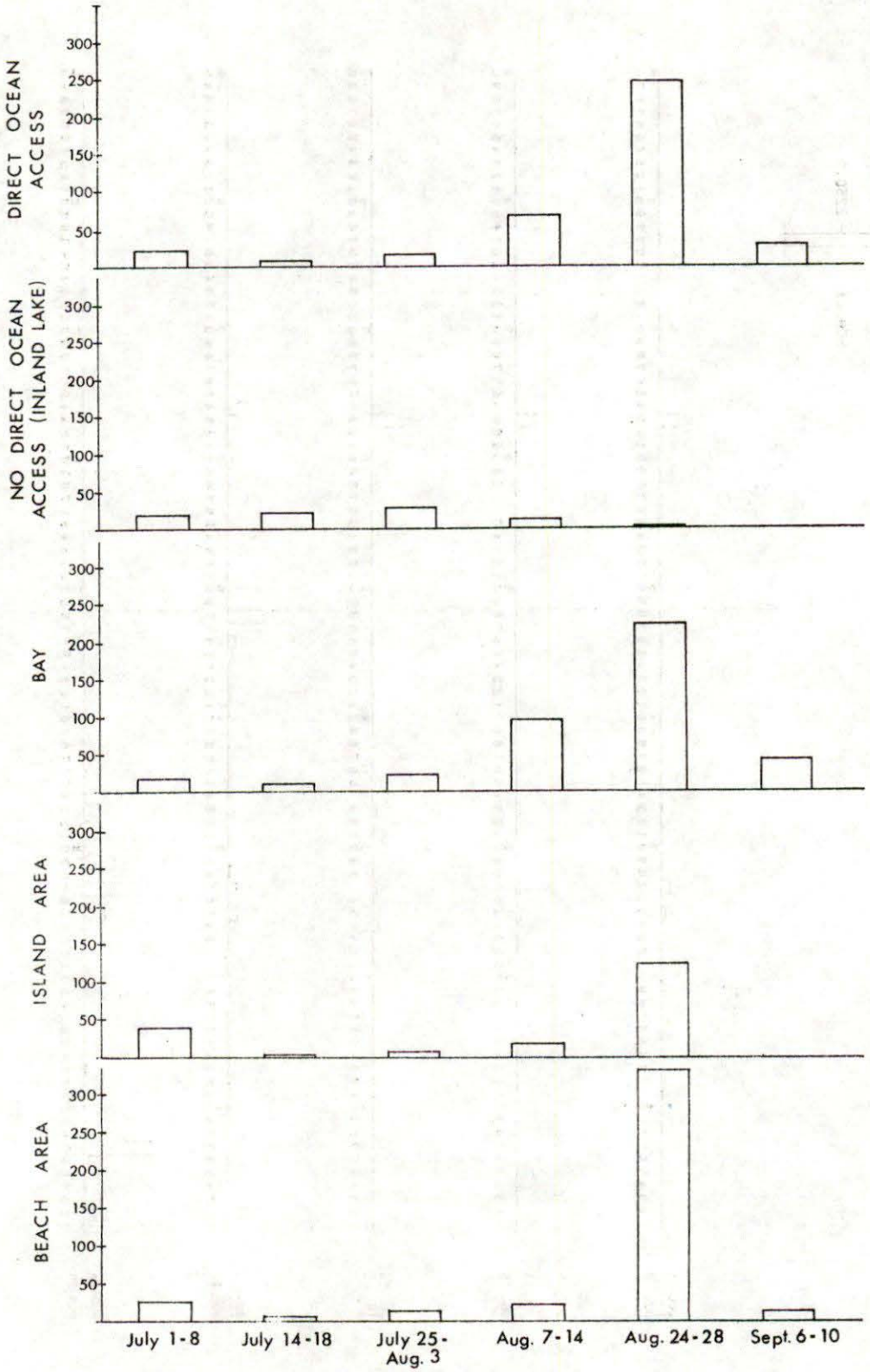


FIGURE 30. Average Number of Total Geese per Waterbody by Waterbody Type, 1 July to 10 September 1974.

Present Status and Distribution

Canada Geese are not abundant in the Beaufort Sea area; these geese are scattered along the southern coast and occur most commonly in the Liverpool Bay-Eskimo Lakes region. Birds of this species venture away from the coast only during migration to or from the Canadian Arctic Archipelago.

The Taverner's Canada Goose (*B. c. taverneri*) and the Lesser Canada Goose (*B. c. parvipes*) are the most abundant sub-species of the Canada Goose in the Arctic area (Hansen and Nelson 1964). The Canada Goose occurs as a fairly common nesting species on shores of shallow lakes in the tundra areas that are away from the coast; these geese also occur along much of the south coast of the Beaufort Sea (Godfrey 1966; Hansen and Nelson 1964; MacFarlane and Preble cited by Manning *et al.* 1956) and on Victoria Island (Parmelee *et al.* 1967; Smith 1973). Manning *et al.* (1956) reported no sightings of this species on Banks Island but did mention that a number of Eskimos had seen Canada Geese on this island. A single Canada Goose was observed flying off the coast of Banks Island near Cape Kellett on 27 May 1974.

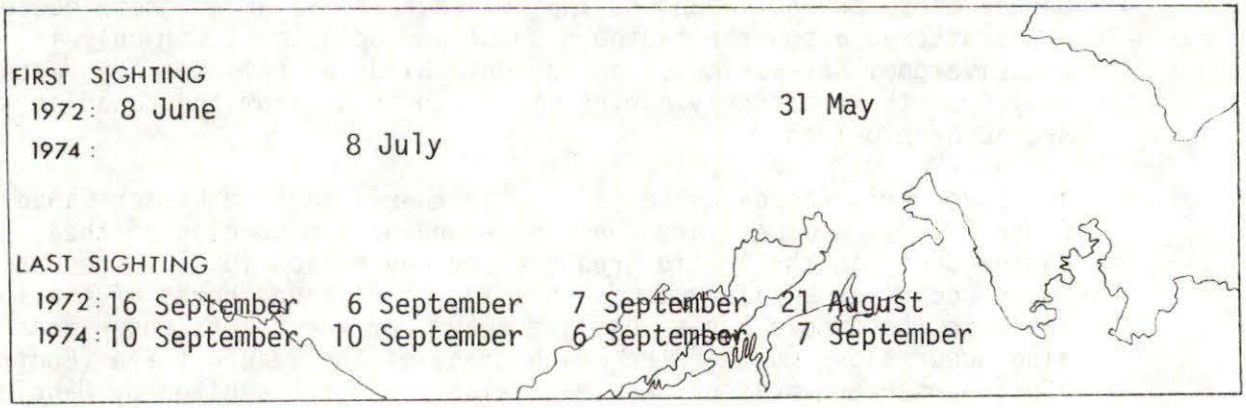
Spring Migration

During spring, Canada Geese *en route* to the Beaufort Sea migrate primarily down the Mackenzie River Valley (Campbell and Shepard 1973; Trennert cited in Salter 1974a); the earliest Canada Geese arrive in the Mackenzie Valley during mid-May. From Mackenzie Bay, these geese apparently disperse along the coast to their respective breeding areas; they reach the Firth River, Y.T. (to the west of Mackenzie Bay), by early June (Gollop *et al.* 1974a) and Tuktoyaktuk, N.W.T. (to the east), during late May or early June (Höhn and Robinson 1951). There are probably other migration routes to the Canadian Arctic of minor importance. The peak of migration of this species along the southeastern portion of the coast of the Beaufort Sea normally occurs in early June; during 1972, a small peak movement of Canada Geese occurred on 8 June, when 173 geese of this species were noted passing Cape Dalhousie.

Premigratory Movements and Fall Migration

During August, some of the dispersed individuals of this species gather into small groups that possibly include Canada Geese that have nested in more southern areas, that have not nested, and that have nested unsuccessfully and have moved to the arctic coast to moult (Jacobson 1974); a number of these groups were observed on bays and beaches in the Liverpool Bay-Eskimo Lakes area and near Herschel Island during the 1974 aerial surveys of coastal waterbodies. The return fall migration of Canada Geese up the Mackenzie Valley occurs during early to mid-September (Campbell 1973; Salter 1974b); these birds leave the Arctic by the end of September.

Branta bernicla: Brant



Present Status and Spring Migration

The Brant is one of the most common species of goose in the eastern Beaufort Sea (Bailey 1933; Barry 1974); in this area it is second in abundance only to the Snow Goose. Brant breed throughout the entire study area. In the western Canadian Arctic Brant are most abundant during the nesting season east of the Mackenzie River (Porsild 1943). Brant typically migrate to the Beaufort Sea *via* the coast of Alaska, but some geese of this species may reach the Arctic by following major river valleys in Alaska or by crossing the Brooks Range at Anaktuvuk Pass and by crossing other mountain passes (Bent 1923; Bailey 1948; Cade 1955; Gabrielson and Lincoln 1959; Irving 1960; Einarson 1965).

Though during the spring of 1972 Brant began arriving in the eastern Beaufort Sea region in late May, these geese did not arrive in peak numbers at Cape Dalhousie until the second week in June (Figure 31). At Nunaluk Spit, the numbers of Brant observed peaked on 9 June; however, only 95 geese of this species were seen on this date. During 1975, much larger numbers of Brant were seen moving east past Komakuk and Clarence Lagoon, Y.T.; average daily rates of over 100 birds/hr were recorded on several days (Johnson *et al.* In Press; Richardson *et al.* 1976). During 1972, the peak rate of observed Brant movement at Cape Dalhousie occurred on 13 June; on this date over 40 Brant/hr were recorded passing the cape in an unspecified direction (probably eastward).

Habitat Preferences

During 1974 aerial surveys of coastal areas, Brant were notably rare on fresh-water lakes--an average of less than one Brant per lake was recorded during these surveys (Figure 32 and 33). The greatest concentrations of Brant during spring and fall occur in river deltas. During migration, however, large numbers of Brant rest and loaf on spits and open gravel or mud beaches (Barry 1967; W. Koski pers. comm.);

PACIFIC BRANT

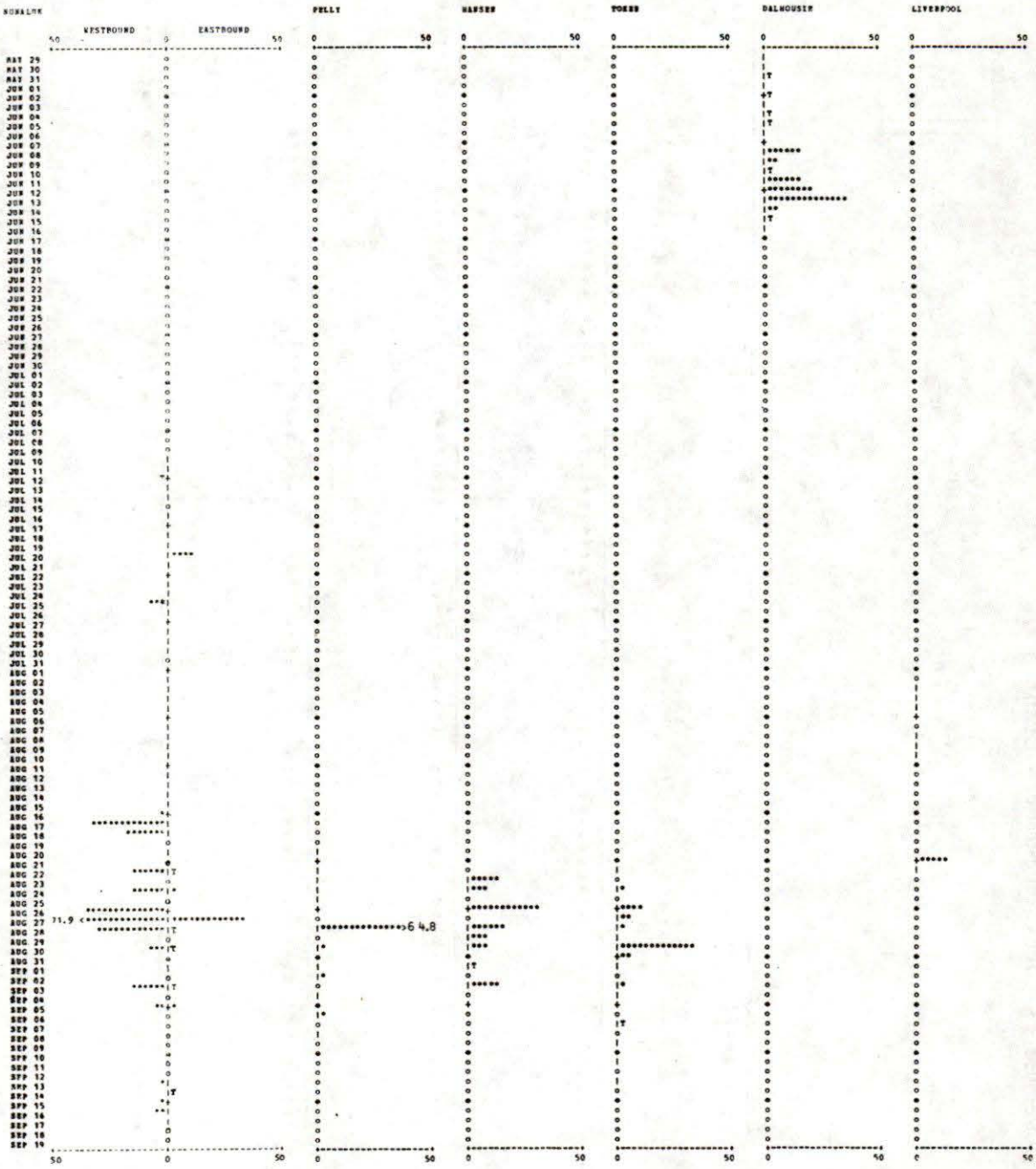
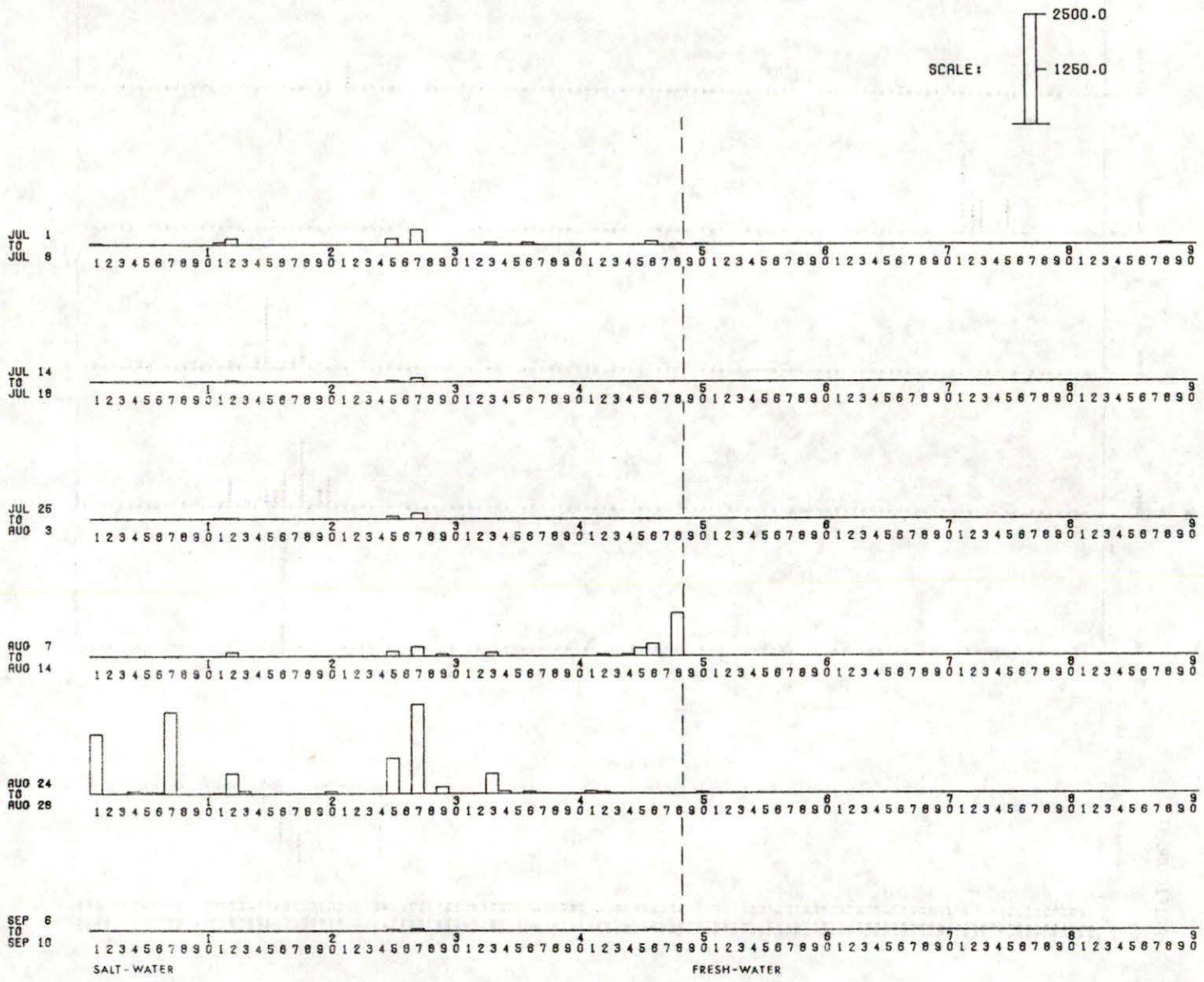


Figure 31. Number of Birds per Hour Observed Passing Coastal Migration Watch Stations in the Yukon and Northwest Territories in 1972. Only locations where birds were observed are presented.

FIGURE 32. Beaufort Sea 1974 Barrier Beach Data--Number of Birds Observed Vs Location Number--Brant



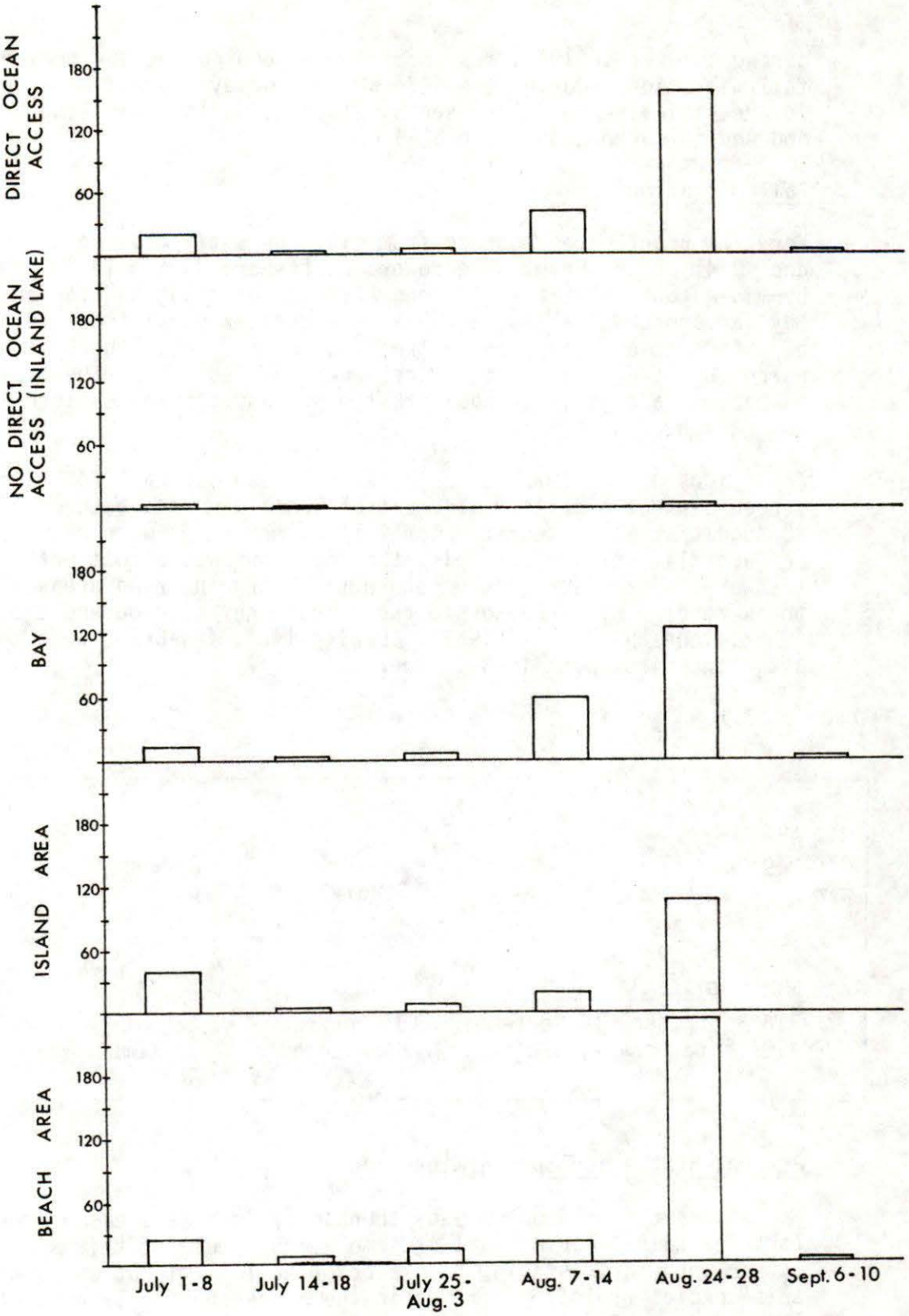


FIGURE 33. Average Number of Pacific Brant per Waterbody by Waterbody Type, 1 July to 10 September 1974.

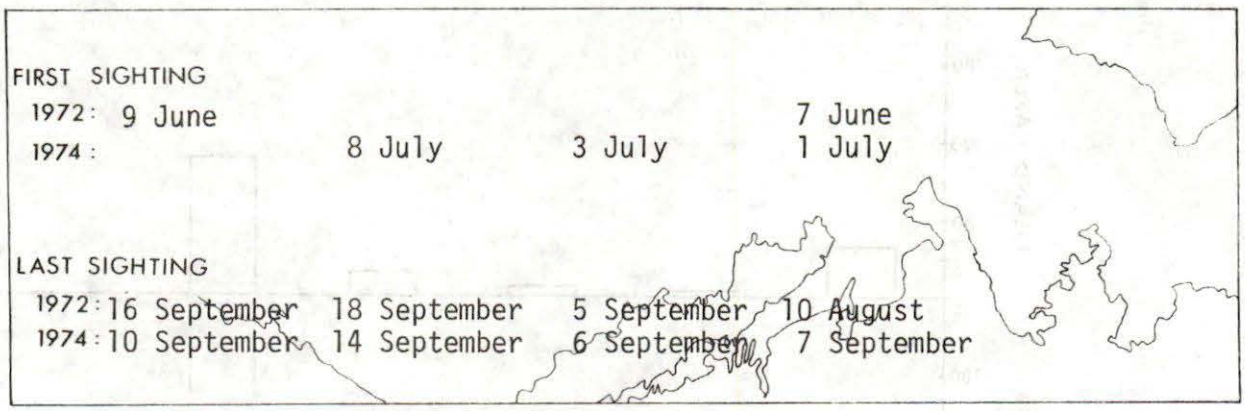
during surveys in 1974, most Brant were seen during the period of fall migration. During the 1974 aerial surveys, Brant were recorded in areas similar to those used by Glaucous Gulls, Whistling Swans, and Red-throated Loons (Table 9).

Fall Migration

Very few Brant were recorded from mid-June until mid-August in 1972 and 1974; and no Brant were recorded offshore during 1974. However, by mid-August 1974, a large concentration of Brant had formed in the bays around Cape Dalhousie; by late August, several thousand geese of this species were seen at the Nunaluk Spit, Phillips Bay, and Warren Point areas. By the first weeks of September, these birds had dispersed, and it is probable that most had left the eastern Beaufort Sea region (Figure 32).

Conditions during 1972 were similar to those during 1974. The observed peak of migratory movement of Brant occurred between 26 and 30 August at all sites at which fall observations were recorded (Figure 31). At Nunaluk Spit, this movement was almost entirely westward. Brant apparently return to their wintering areas along the same or similar routes to those that they used during the spring (Gabrielson and Lincoln 1959). During 1974, few Brant were seen after the first week in September.

Anser albifrons: White-fronted Goose



Present Status and Spring Migration

The White-fronted Goose breeds abundantly in some areas of the Beaufort Sea; also, during fall of some years, geese of this species gather into large staging flocks prior to fall migration. Though this species typically arrives in the Arctic during late May (Porsild 1943; Snyder 1957), during 1972 and 1974 it was not recorded until 7 June and 1 July, respectively; during both years, the first observations of this species were recorded near Cape Dalhousie. During 1975, White-fronted Geese were first observed near Komakuk, Y.T.,

on 15 May (Johnson *et al.* In Press; Richardson *et al.* 1976). Very few White-fronted Geese were seen in spring during this study--22 at Cape Dalhousie and 20 at Nunaluk Spit (Figure 34). Of the White-fronted Geese observed near Nunaluk Spit, most (90%) were heading west. A similar westward movement was also noted at Clarence Lagoon, Y.T., between 28 May and 1 June 1975 (Johnson *et al.* In Press; Richardson *et al.* 1976). These observations indicate that some of the White-fronted Geese that migrate down the Mackenzie River (Campbell 1973; Salter *et al.* 1974) move at least as far west as the Yukon-Alaskan border and that few (if any) of these geese of this species that migrate through interior Alaska to the Alaskan arctic slope move as far east as this border.

Summer Distribution and Habitat Preferences

No White-fronted Geese were seen during July 1972, and only 68 were seen previous to 11 August 1972. Similarly, during the early summer of 1975 few White-fronted Geese were seen at Clarence Lagoon and Komakuk after spring migration had terminated (Johnson *et al.* In Press; Richardson *et al.* 1976). During July 1974, however, geese of this species were seen regularly, occasionally in large numbers, along the southern coast of the Beaufort Sea. On the 21 waterbodies on which White-fronted Geese were sighted, large concentrations of this species occurred most often during the fourth week of July (on 33% of these waterbodies). The largest of these concentrations was recorded at Lake Number 63, on Richards Island. During early July, 715 White-fronted Geese were present on this lake. The number of this species present on this lake had increased to 1170 by the end of July and remained at over 450 birds into mid-August.

During 1974 aerial surveys of waterbodies, this species was most frequently observed near lakes until mid-August, after which all birds of this species sighted were associated with ocean areas; the majority of these geese observed was near bays (Figure 35). White-fronted Geese were frequently sighted near waterbody types used by other major waterbird species. Habitat-use correlations were found between the White-fronted Goose and four other species: Whistling Swan, Red-throated Loon, Arctic Loon, and Glaucous Gull (Table 9).

Fall Migration

The peak of fall migration of White-fronted Geese in the study area occurs approximately two weeks after that of Brant (Bailey 1933; Dixon 1943) and concurrently with or slightly earlier than that of Snow Geese (Salter 1974b). Data in Koski (1974b) indicate that during fall White-fronted Geese migrate in two waves. The first wave occurs during late August and probably consists of birds that breed east of Barrow, Alaska. Koski (pers. comm.) estimated that 30,000 to 40,000 White-fronted Geese move from the Barrow area, along the Yukon coast, and to the Mackenzie Delta. The second wave of migration usually occurs during mid-September and is largely composed of White-fronted Geese that nest in Canada.

WHITE-FRONTED GOOSE

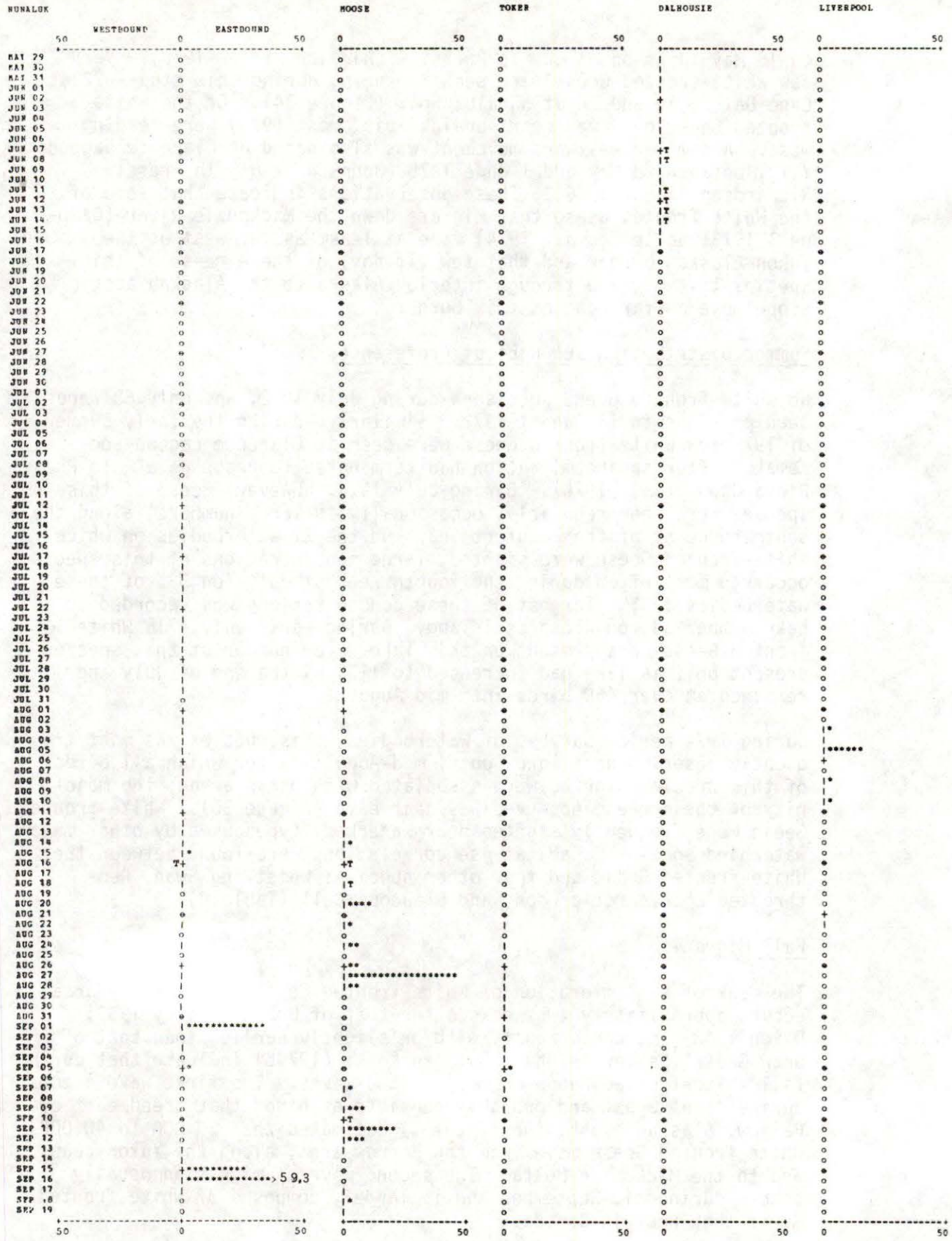


FIGURE 34. Number of Birds per Hour Observed Passing Coastal Migration Watch Stations in the Yukon and Northwest Territories in 1972. Only Locations Where Birds were Observed are Presented.

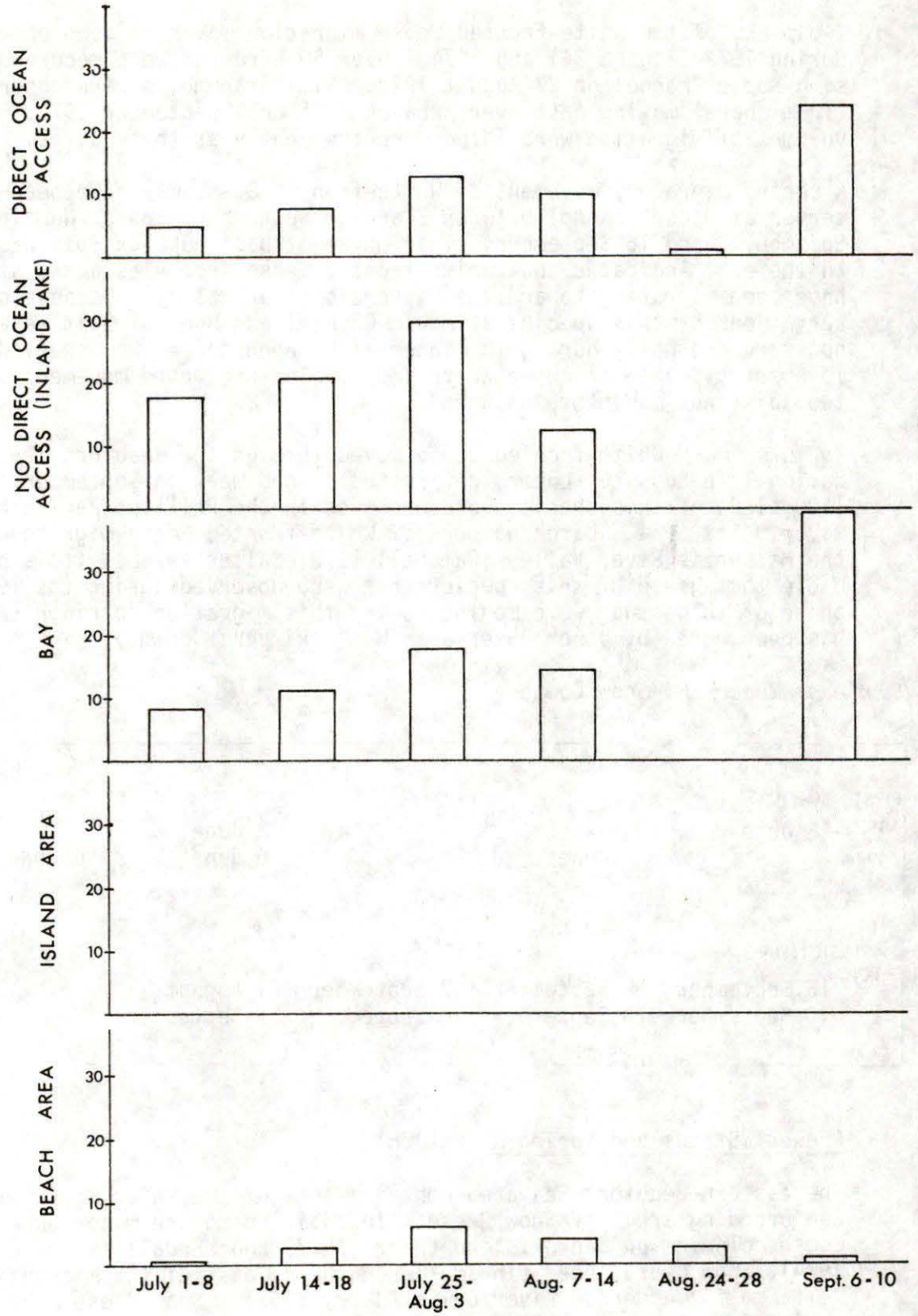


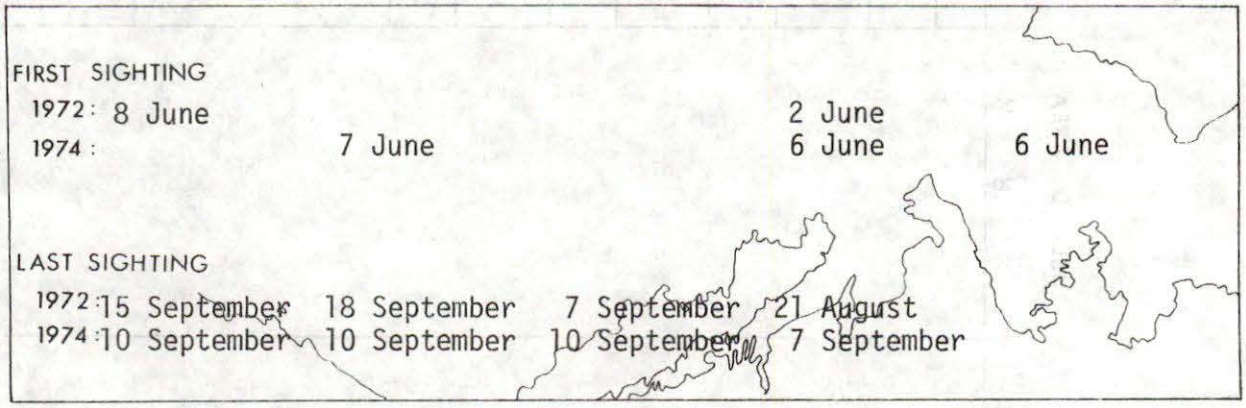
FIGURE 35. Average Number of White-fronted Geese per Waterbody by Waterbody Type, 1 July to 10 September 1974.

Two peaks of the White-fronted Goose migration may have been observed during 1972 (Figure 34) and 1974. Over 50 birds/hr were recorded passing Moose Channel on 27 August 1972. Similar numbers were observed (from shore) moving east over Nunaluk Spit on 1 September 1972. Lesser volumes of migration were noted more frequently at these sites.

A second migratory movement of White-fronted Geese may have been observed at Moose Channel between 7 and 18 September, and at Nunaluk Spit on 15 and 16 September. That movement past Nunaluk Spit was again to the east indicates that White-fronted Geese from Alaska may still have been migrating toward the Mackenzie River Valley. Because observations of this species at Moose Channel and Nunaluk Spit were not recorded daily during the interval between these two observed movements, it is not known whether a single, prolonged movement or two, distinct movements occurred.

In 1974, many White-fronted Geese moved through the Beaufort Sea area during late August. Later, during the second week in September, over 1600 birds of this species were observed in the Phillips Bay-Babbage River Delta area. Large numbers of White-fronted Geese migrate up the Mackenzie River Valley (Campbell 1973; Salter 1974b); it is probable that geese of this species that were observed during the 1974 phase of this study were moving toward this migration corridor (as has been noted by other observers; W. Koski pers. comm.).

Chen caerulescens: Snow Goose



Present Status and Spring Migration

The eastern Beaufort Sea area contains some of the major North American breeding areas of Snow Geese. In addition to the major Snow Goose colonies on Banks Island (Barry 1967) and Kendall Island (Slaney 1974), Snow Geese breed (in smaller numbers) east of the Mackenzie Delta to the Anderson River Delta (Barry 1967). Snow Geese usually arrive in the Beaufort Sea area during the last two weeks of May; geese of this species were first seen near the Kendall Island breeding colony on 18 May in 1972 and on 27 May in 1973 (Slaney 1974),

at the Anderson River colony on 15 to 19 May over a period of years (Barry 1967), and at the Egg River Colony on Banks Island on 17 May in 1955 (McEwen 1958). During 1972, this species was not seen at either Nunaluk Spit or Cape Dalhousie until early June (9 June at Nunaluk Spit; 2 June at Cape Dalhousie); however, observations were not initiated until 8 June at Nunaluk Spit and 29 May at Cape Dalhousie. During 1972, the observed peak of movement of Snow Geese was recorded on 8 and 9 June at Cape Dalhousie and Nunaluk Spit, respectively (Figure 36 and Table 14); all of the Snow Geese seen at Nunaluk Spit were heading west, probably after having migrated down the Mackenzie River (Salter *et al.* 1974). In 1975, however, some eastward as well as westward movement was recorded during spring at Clarence Lagoon, Y.T. Most movement past Komakuk, Y.T., was westward (Johnson *et al.* In Press; Richardson *et al.* 1976).

In 1974, three flocks of Snow Geese were sighted offshore during aerial surveys conducted on 6 and 7 June: a flock of 300 was sighted over 140 km north of Richards Island; one flock of 50 was sighted in Liverpool Bay; and one flock of 10 was sighted west of Banks Island, north of Cape Kellett.

Summer Distribution

In 1972, no Snow Geese were seen during the nesting and early hatching periods (from 15 June to 10 August). This lack of observations is not surprising in view of the fact that most Snow Geese that migrate through the study area nest to the east of this area. With the exception of a single Snow Goose sighted on 6 July on Garry Island, no Snow Geese were observed from 7 June to 21 August 1974. During late August, Snow Geese leave their nesting grounds, move to coastal areas, and then move westward along the coast (Barry 1967; Gollop and Davis 1974a; Schweinsburg 1974a; Koski and Gollop 1974).

Premigratory Movements and Fall Migration

Published literature contains little accurate information on the initial movements of Snow Geese from the Anderson River and Banks Island colonies. Barry and Koski (pers. comm.) have reported that from the breeding grounds, Snow Geese move during mid to late August to the Parry Peninsula area, N.W.T., where they gather in staging flocks; depending on the weather conditions, these geese remain at this location for one to two weeks.

The next stage of movement is westward, generally along the coasts of the Northwest Territories and the Yukon Territory and to the North Slope of Alaska (Koski and Gollop 1974). Here, these geese feed and rest for one to two weeks in favourable weather but only one or two days in unfavourable weather (W. Koski in prep.).

From the Alaskan North Slope, these geese undertake a return eastward movement. Some stage again in the Blow River and Shallow Bay areas. The final stop-over point on the arctic coast is the Mackenzie Delta.

LESSER SNOW GOOSE

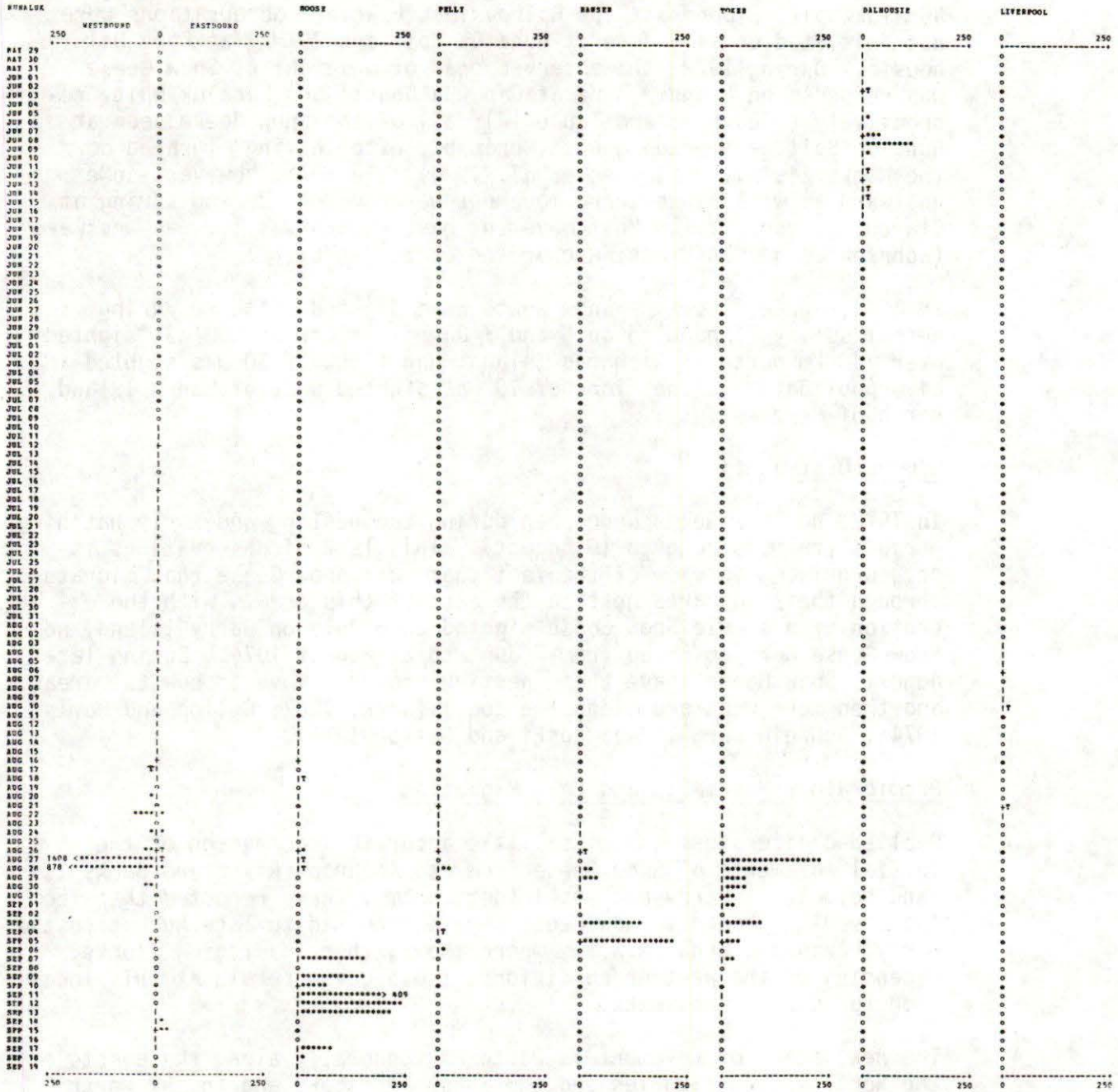


Figure 36. Number of Birds per Hour Observed Passing Coastal Migration Watch Stations in the Yukon and Northwest Territories in 1972. Only locations where birds were observed are presented.

After having fed and rested in this delta, Snow Geese leave the Beaufort Sea *via* the Mackenzie River Valley (Salter 1974b).

Results of the 1972 migration watches indicated that the peak of the premigratory coastal movement of Snow Geese (see above) took place on 27 August at Toker Point (250 birds/hr) and on 5 September at Hansen Harbour (200 plus birds/hr; Figure 36). This peak movement lasted approximately two weeks at each site. That no Snow Geese were recorded passing the Pelly Island station during 1972 indicates that the corridor of movement of this species along the coast was relatively narrow. Snow Geese pass over Richards Island from Hansen Harbour to Ellice Island and Olivier Island (W. Koski pers. comm.) on their way to the Yukon and Alaskan North Slope. Movement of Snow Geese past Nunaluk Spit during 1972 occurred almost entirely during a two-day period: 27 and 28 August. That most of this movement was to the west indicated that this passage of Snow Geese represented the westward movement onto the coast of Alaska. According to Gollop and Davis (1974a), some Snow Geese possibly move as far west as the Canning River in Alaska.

By 7 September 1972, Snow Geese had already arrived at Moose Channel, in the Mackenzie Delta; hence, Snow Geese may have been on the Alaskan North Slope for less than two weeks. The rate of passage of geese of this species observed at Moose Channel was greater than 200 birds/hr for at least one week (7 to 13 September; Figure 36). During 1972, the last record of a Snow Goose in the study area was obtained on 18 September; during 1974, the last record of this species in this area was obtained on 19 September; both records were obtained at Moose Channel, in the Mackenzie River Delta. During the last week of August 1974, two large concentrations of Snow Geese were sighted: a group of as many as 400 birds was observed north of Tuktoyaktuk, in Kugmallit Bay, and a smaller flock of 100 birds was observed on the east side of Liverpool Bay. At least 75 Snow Geese were still present in Kugmallit Bay as late as 10 September. Observations during 1974 were terminated prior to the returning eastward movement of Snow Geese to the Mackenzie Delta and previous to the subsequent migration of these geese up the Mackenzie River Valley (as described by Gollop and Davis 1974a; Koski 1974b; and Koski and Gollop 1974).

Dabbling Ducks

Few species and low numbers of dabbling ducks occur in the Beaufort Sea area. The Pintail, the most abundant dabbling duck species in this area, is generally restricted in the eastern portion of the Beaufort Sea to the Mackenzie Delta (as are most other dabbling duck species in this area).

Because ducks of this group are so closely associated with the Mackenzie Delta, it is not surprising that most of these birds migrate along the Mackenzie River Valley both during spring and fall (Salter 1974b; Salter *et al.* 1974). Large numbers of dabblers were seen migrating past Moose Channel during the last two weeks of August in 1972 (Figure 37). This migration was still in progress, but at a low rate, when observations ended on 19 September.

TOTAL DABBLING DUCKS

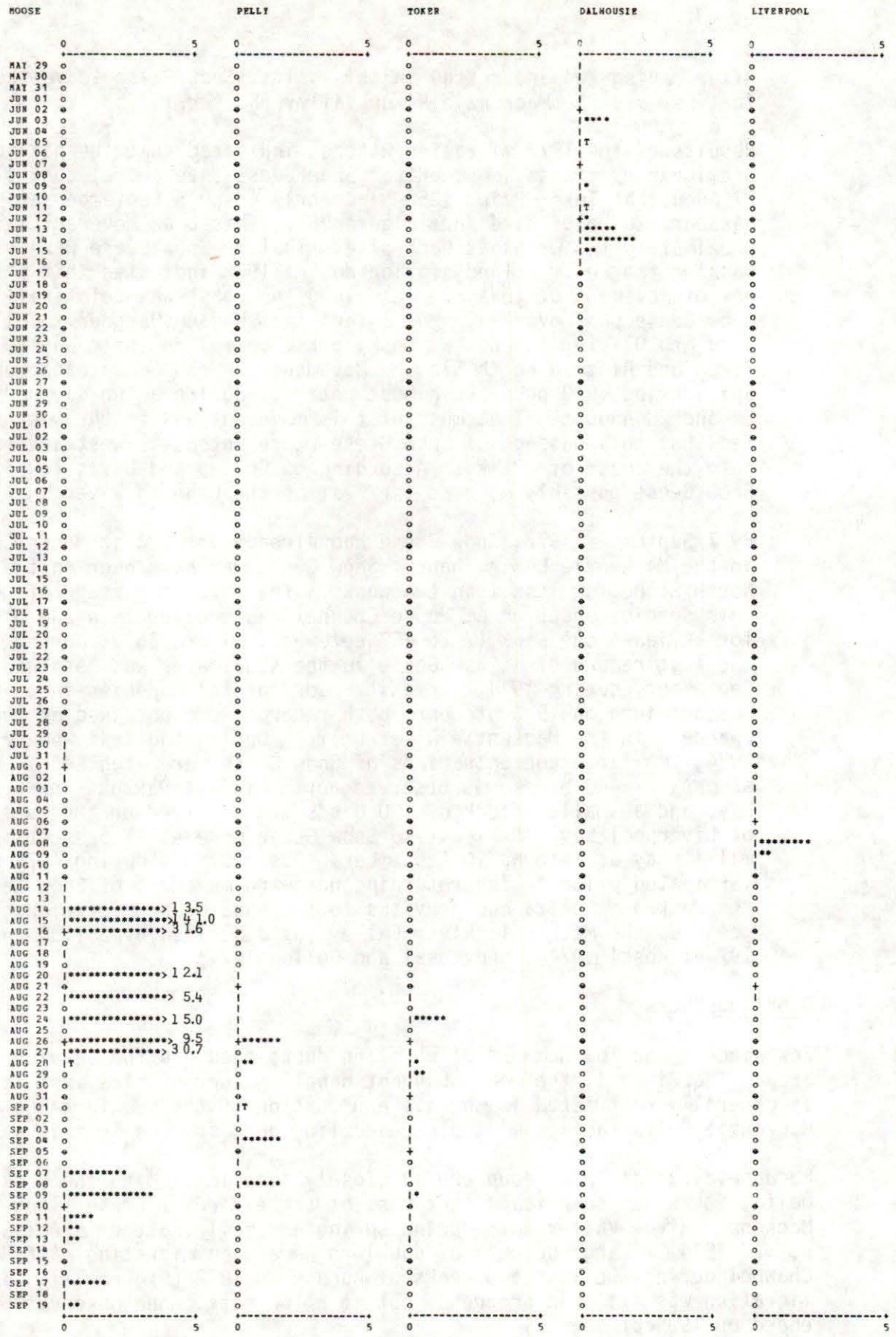


FIGURE 37. Number of Birds per Hour Observed Passing Coastal Migration Watch Stations in the Yukon and Northwest Territories in 1972. Only Location were Birds were Observed are Presented.

Several large concentrations of dabbling ducks were observed during August 1974 (Figures 38 and 39); flocks of as many as 400 ducks were recorded near Tuktoyaktuk and on Pelly Island.

Anas platyrhynchos: Mallard

Present Status and Spring Migration

The Mallard is relatively uncommon in the Beaufort Sea area; however, this species breeds in restricted areas well north of the tree limit in the Mackenzie Delta (Porsild 1943; Slaney 1974). Although Mallards have been recorded as early as the third week of May on Richards Island (Slaney 1974), they usually arrive in the study area in small numbers during late May to early June (Porsild 1943). These birds probably migrate overland down the Mackenzie River Valley (Salter 1974a).

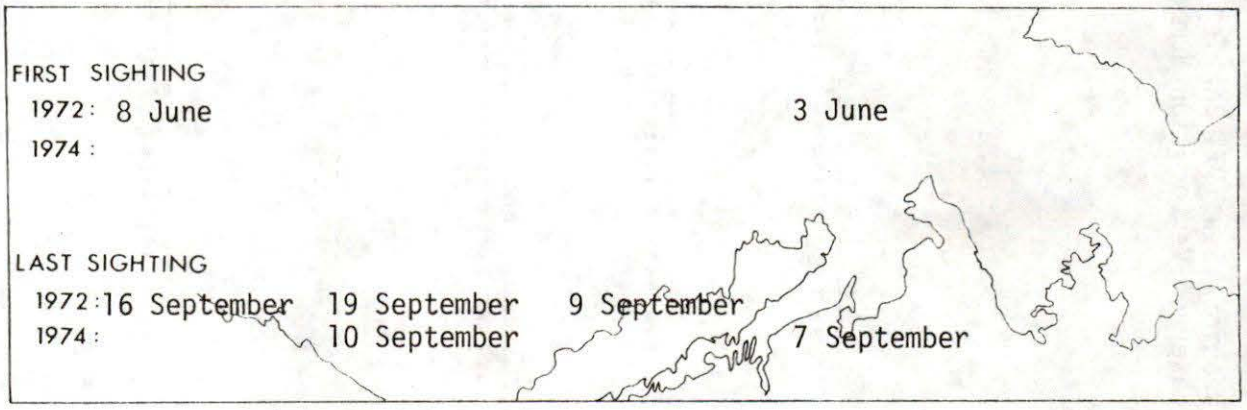
Distribution

Of the 35 Mallards that were observed during 1972 and 1974, 28 (80%) were sighted in the Mackenzie Delta area; five birds (14%) were sighted at Nunaluk Spit; and the remaining two were sighted on lakes in the vicinity of Tuktoyaktuk.

Fall Migration

Mallards are late to leave the Arctic; individuals of this species have been recorded in the Mackenzie Delta area as late as 29 September (Slaney 1974) and 12 October (Porsild 1943).

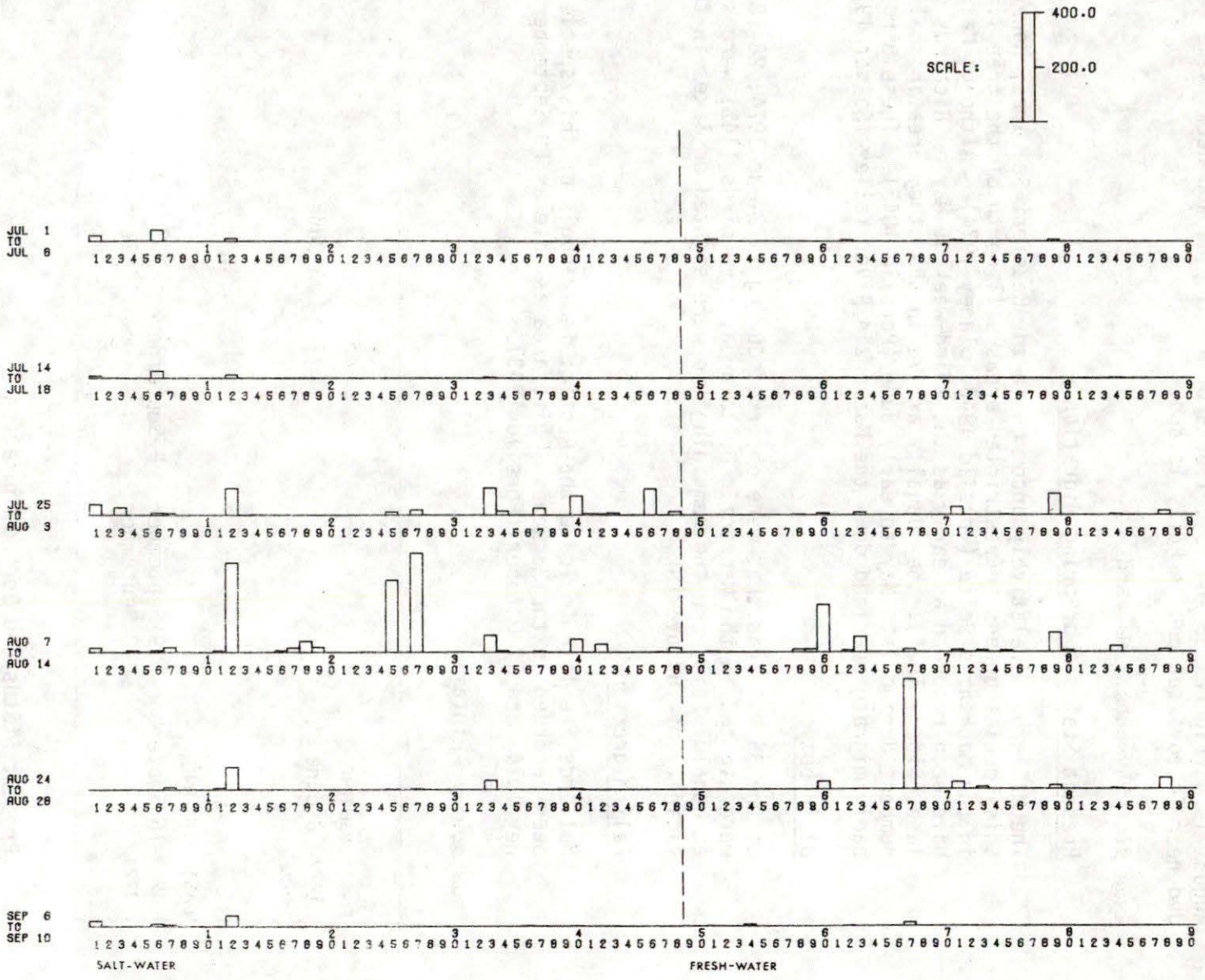
Anas acuta: Pintail



Present Status and Spring Migration

According to extant records, the Pintail is the most common dabbling duck in the Arctic (e.g., Anderson 1937; Schmidt 1973; Martel in prep.). During 1972 and 1974, this species was seen in moderate numbers after 3 June. Typically, Pintails begin arriving in the Mac-

FIGURE 38. Beaufort Sea 1974 Barrier Beach Data--Number of Birds Observed Vs Location Number--Dabbling Ducks



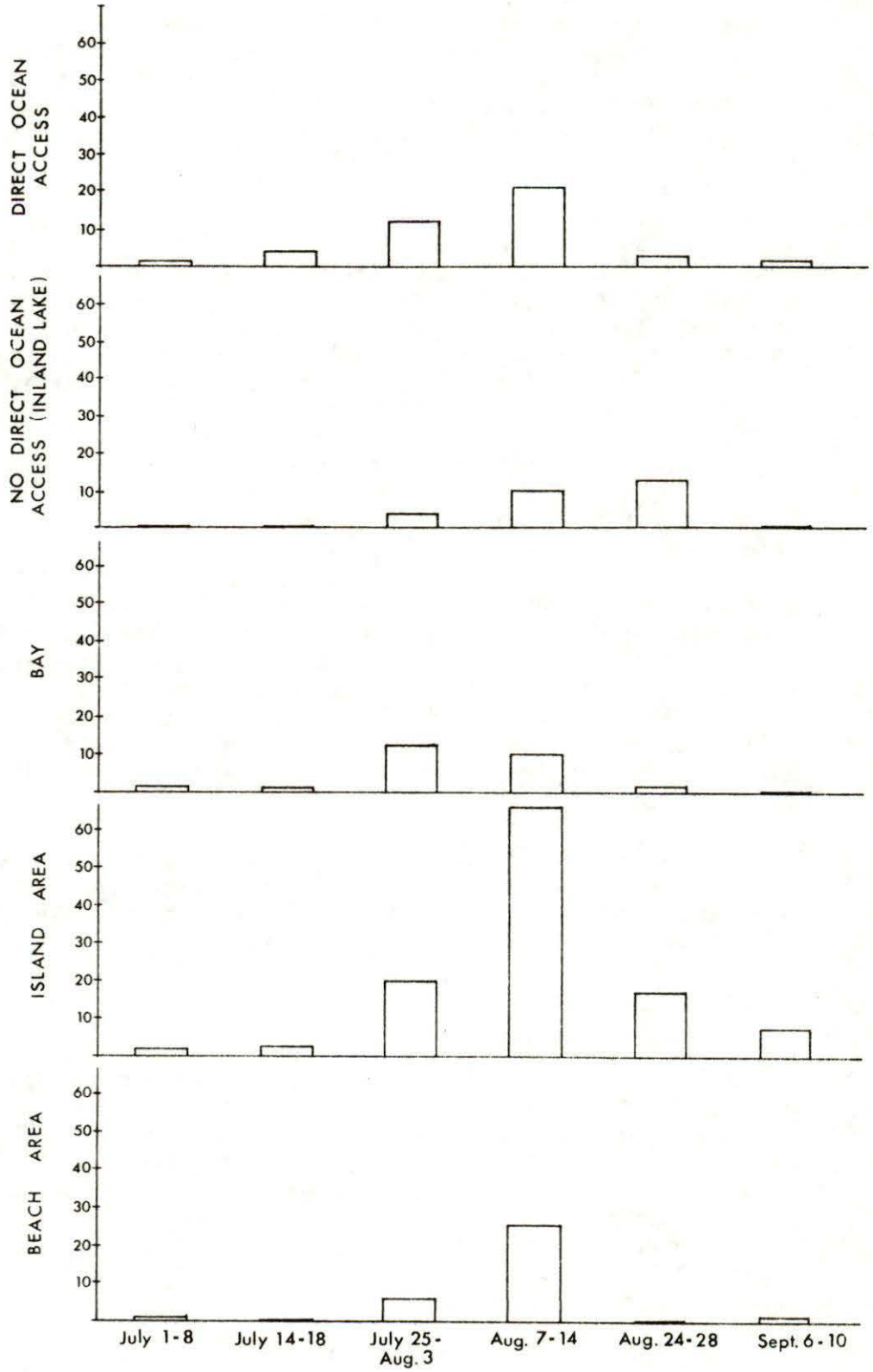


FIGURE 39. Average Number of Total Dabbling Ducks per Waterbody by Waterbody Type, 1 July to 10 September 1974.

kenzie Delta by the middle of May (Porsild 1943; Höhn and Robinson 1951; Slaney 1974). Pintails that migrate to the eastern portion of the Beaufort Sea apparently follow the Mackenzie River Valley (Campbell and Shepard 1973; Salter 1974a; Salter *et al.* 1974; Schweinsburg 1974b). Pintails that breed in Alaska probably travel across interior Alaska and over the Brooks Range (Gabrielson and Lincoln 1959; Irving 1960; Johnson 1971).

Results of spring observations at Nunaluk during 1972 and at Komakuk during 1975 indicated that Pintails flew past three sites in both easterly and westerly directions (Gollop and Davis 1974a; Johnson *et al.* In Press; Richardson *et al.* 1976). It is possible that some Pintails that migrate across the state of Alaska move east into the Yukon and that some of those that migrate down the Mackenzie Valley move west and breed on the Alaskan arctic coast.

Summer Distribution and Habitat Preferences

During 1974, few Pintails were observed before mid-July; after this date, considerably higher numbers of this species were observed (Figure 41 and 42). As many as 200 Pintails were observed on Lake Number 60 in the outer Mackenzie Delta during aerial surveys of the Beaufort Sea coast conducted during early August, but consistently large numbers (50 to 100) of this species were seen on salt-water bodies from mid-July to mid-August; these Pintails were probably moulting. These records of Pintails obtained in salt-water bodies indicate that Andersson's (1973) generalization that ducks of this species seldom alight on salt-water does not apply throughout the season to Pintails in the eastern Beaufort Sea area.

That the numbers of Pintails on the various waterbody types were strongly correlated with those of Whistling Swans and less strongly correlated with those of Glaucous Gulls indicates that these three species prefer similar habitats in the study area.

Fall Migration

Few Pintails were seen west of the Mackenzie Delta during the fall of 1972. Most of the migrating Pintails seen at Nunaluk Spit after mid-August were eastbound; these birds reached an observed peak of nearly 50 birds/hr on 20 August 1972. However, considerable numbers of Pintails were seen as late as 16 September (Figure 40). The highest rate of migration of Pintails--132 birds/hr--was recorded on 15 August at the coastal observation station at Moose Channel. This movement was of shorter duration than that recorded at Nunaluk Spit. The last significant movement of Pintails was recorded on 24 August at Moose Channel.

The route that Pintails follow during fall from the east to the Mackenzie River is unknown; apparently, however, these birds do not migrate to the Mackenzie River *via* the Beaufort Sea coastline. Movement of Pintails up the Mackenzie River continues well into October (Jacobson 1974; Salter 1974b).

PINTAIL

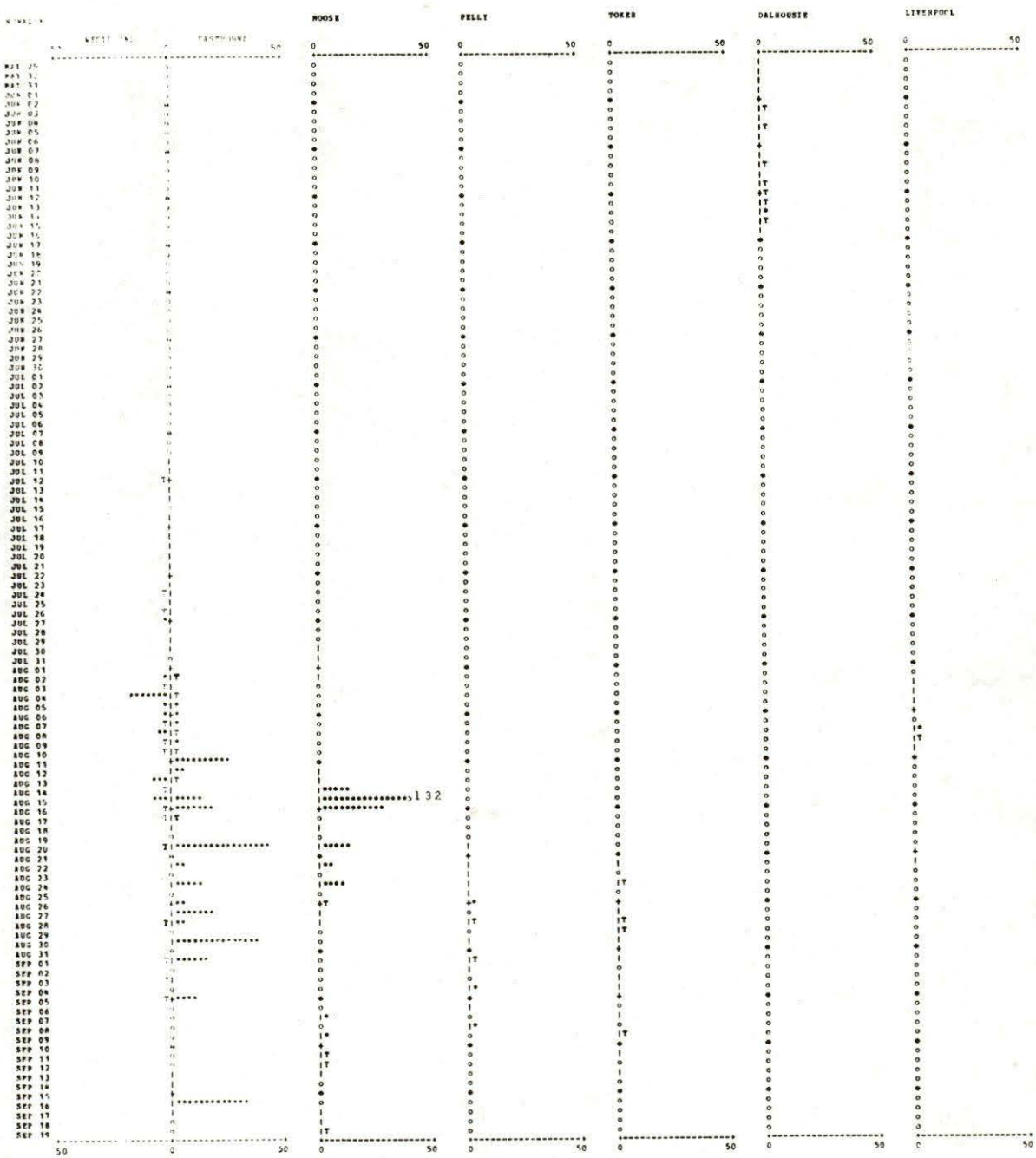
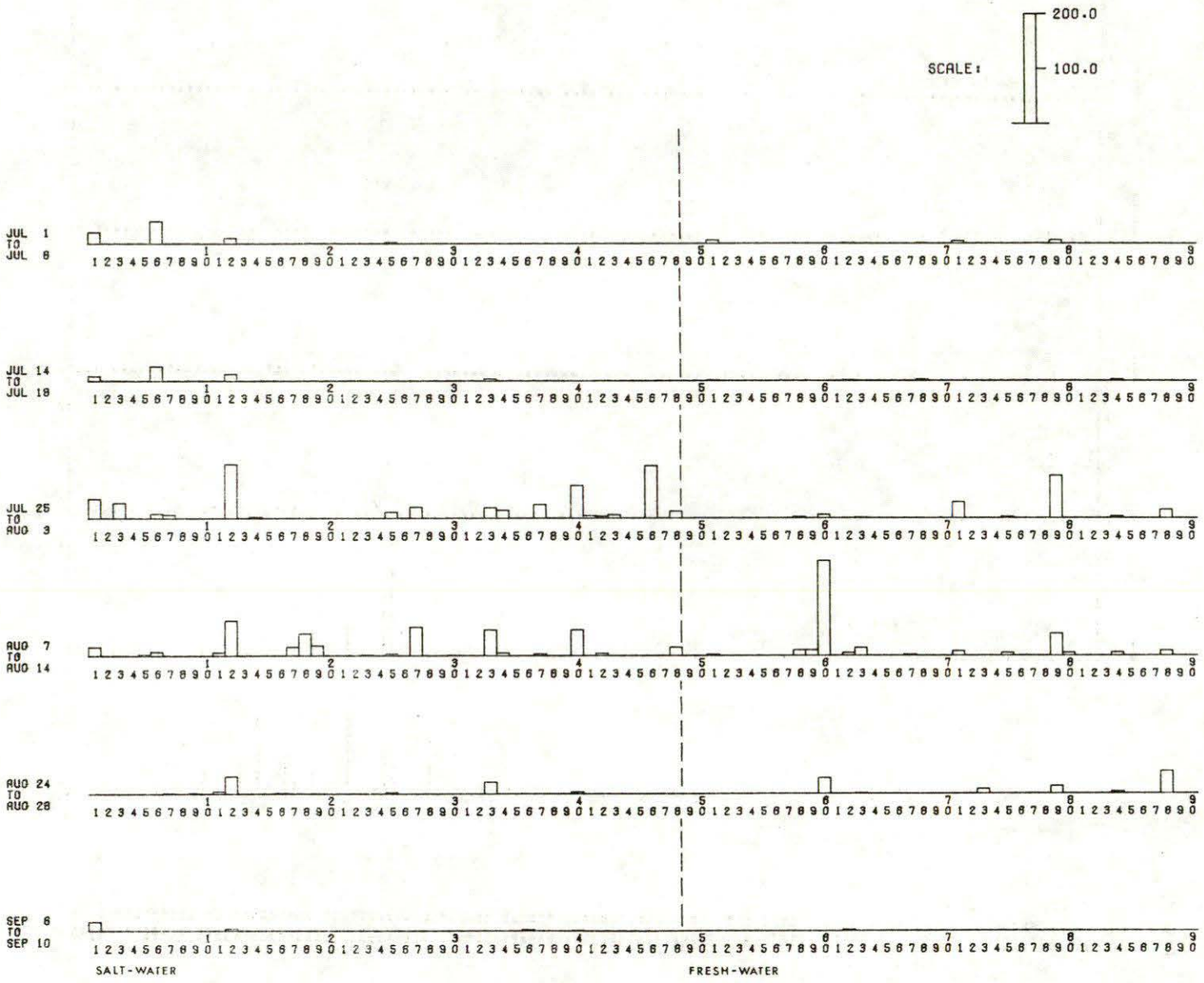


Figure 40. Number of Birds per Hour Observed Passing Coastal Migration Watch Stations in the Yukon and Northwest Territories in 1972. Only locations where birds were observed are presented.

FIGURE 41. Beaufort Sea 1974 Barrier Beach Data--Number of Birds Observed Vs Location Number--Pintail



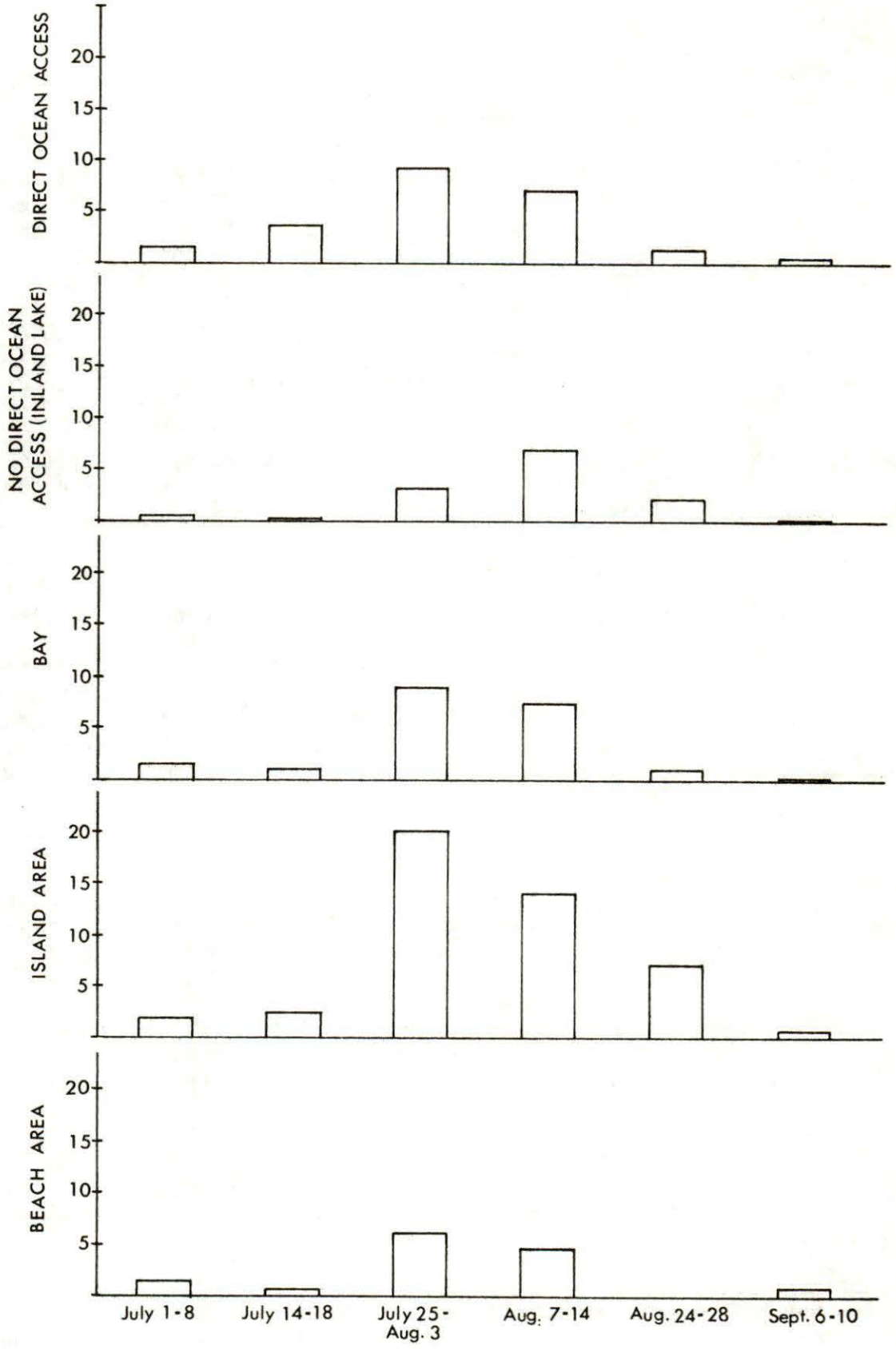


FIGURE 42. Average Number of Pintails per Waterbody by Waterbody Type, 1 July to 10 September 1974.

Anas americana: American Wigeon

Present Status and Spring Migration

The American Wigeon breeds along the south coast of the Beaufort Sea and possibly on Banks Island (Manning *et al.* 1956); however, non-breeders and males of this species which form large flocks (often with Surf Scoters, scaup, and goldeneye [Porsild 1943]), occur more commonly than breeders in this area. As do most other dabbling ducks that occur in the western Canadian Arctic, many American Wigeon migrate to the Beaufort Sea *via* the Mackenzie Valley (Salter 1974a). Birds of this species typically arrive on the Beaufort Sea coast during late May and early June (Porsild 1943; Slaney 1974; Johnson *et al.* In Press; Richardson *et al.* 1976).

No individuals of this species were seen at Nunaluk Spit or at Cape Dalhousie during the spring of 1972, and none were seen during offshore aerial surveys conducted during spring 1974.

Premigratory Movements

During 1974, American Wigeon were recorded along the entire surveyed portion of the coast of the Beaufort Sea (Nunaluk Spit to Cape Dalhousie) from 27 July to 10 September. During this period, large flocks were frequently observed; the largest flock (400 birds) was observed on 26 August on a lake near Tuktoyaktuk (see also Figure 44). Many of these flocks may have been composed of nonbreeders and males undergoing moult (see Porsild 1943); but is is probable that some of these wigeon were fall migrants.

Fall Migration

American Wigeon were not seen during fall 1972 at any coastal migration watch station east of the Mackenzie River. It appears that fall movements of American Wigeon during 1972 were not along the coast (Gollop and Davis 1974a); these movements appeared to be mainly up the Mackenzie River Valley (Salter 1974b). In 1972 few American Wigeon were recorded during migration watches at Nunaluk Spit; 50 birds were sighted between 16 and 20 August (Figure 43). At Moose Channel, however, several hundred American Wigeon were observed; the peak migratory movement of this species was recorded on 27 August. W. Koski (pers. comm.) reported his observation of large flocks (about 500) of American Wigeon in the Blow River Delta on 28 August 1975. During 1972, this species was last seen at Moose Channel on 9 September. American Wigeon were recorded at no other coastal migration watch stations during 1972.

Anas clypeata: Northern Shoveler

The Northern Shoveler is uncommon in the Beaufort Sea area. Fifteen birds of this species were seen in the study area during 1972, but none were identified in 1974. The above-mentioned 1972 records were obtained at Nunaluk Spit; two Northern Shovelers were observed on 9 June, and 13 were observed

AMERICAN WIGEON

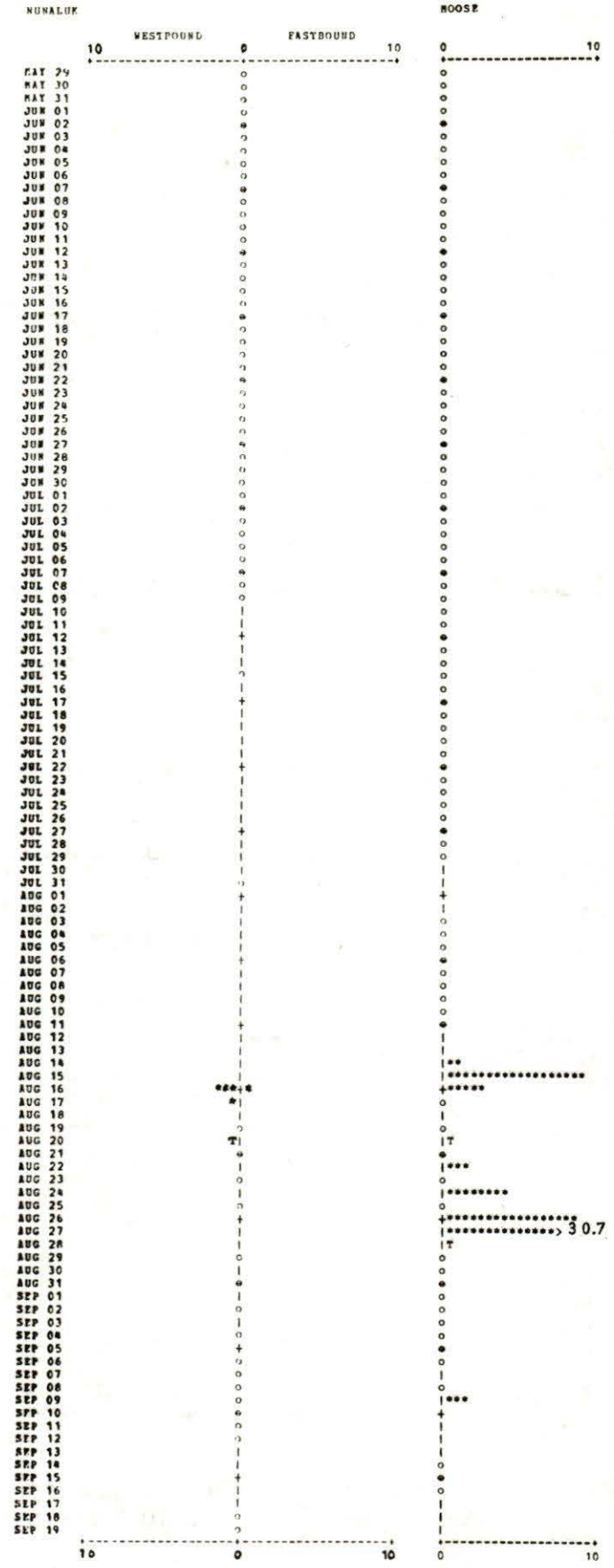


FIGURE 43. Number of Birds per Hour Passing Coastal Migration Watch Stations in the Yukon and Northwest Territories in 1972. Only Locations Where Birds were Observed are Presented.

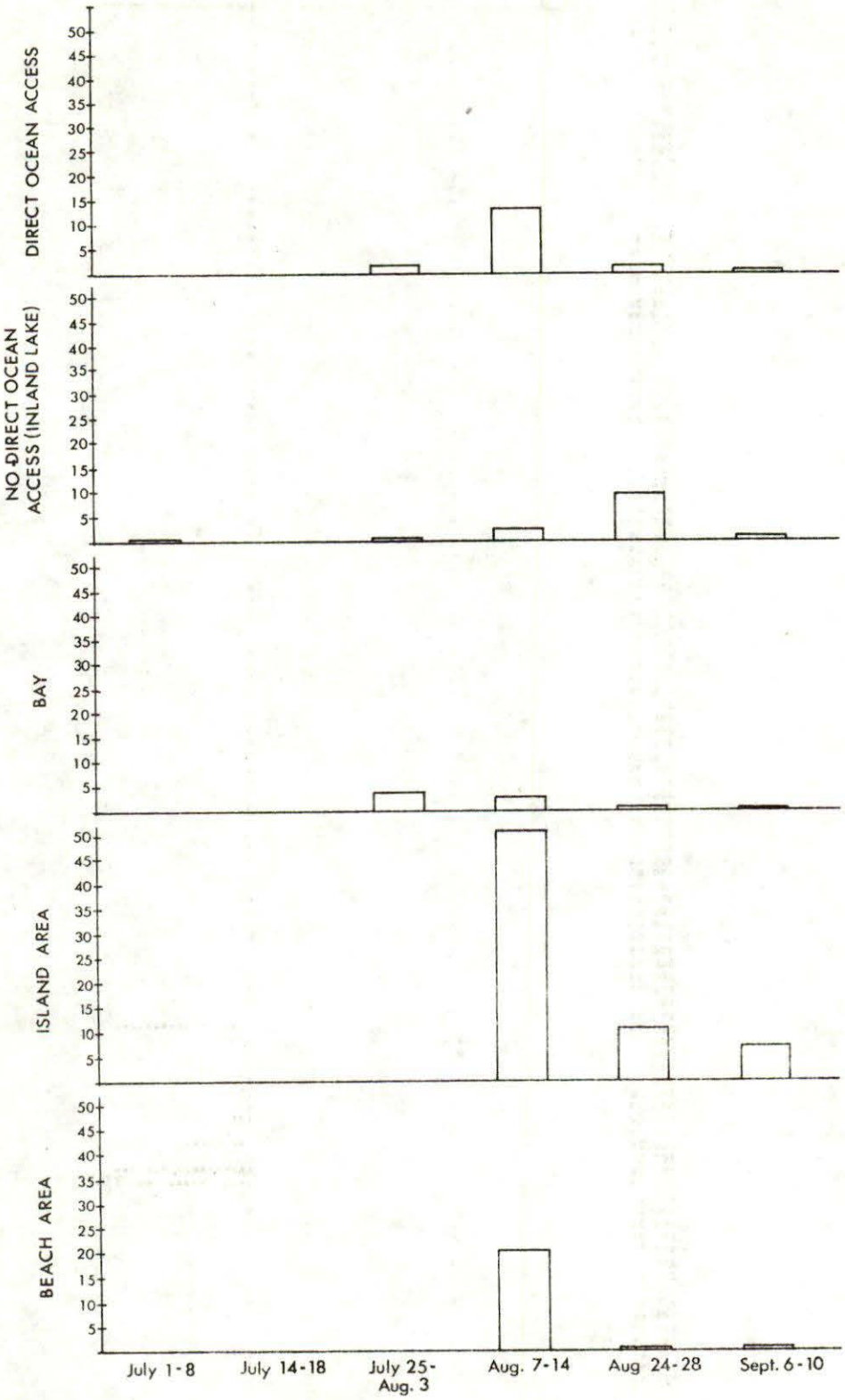


FIGURE 44. Average Number of American Wigeon per Waterbody by Waterbody Type, 1 July to 10 September 1974.

on 2 August. During a 1973 study conducted on Richards Island, N.W.T. (Slaney 1974), this species was first seen on 27 May and last seen on 18 September.

Diving Ducks

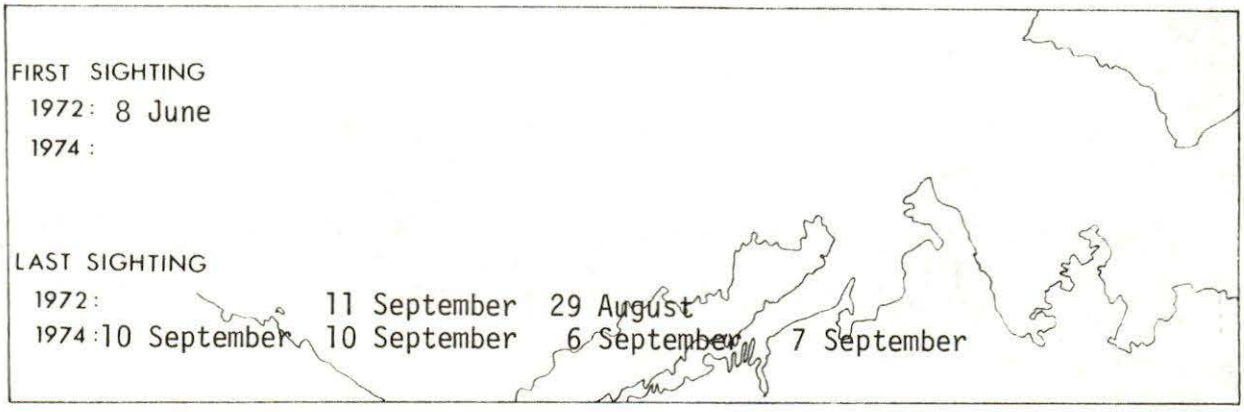
During this study, 14 species of diving ducks were observed in the eastern Beaufort Sea; these species represented six groups: scaup, goldeneye, Old-squaw, eider, scoter, and merganser. Because of this diversity of species it is impossible to draw any general conclusions that would be applicable to all diving ducks, but from the standpoint of management it may be useful to consider diving ducks as a single category. In addition, because a great many waterfowl were identified only as diving ducks, this category can be given a general treatment.

Diving ducks begin to move into the study area in mid-May, but peak rates of migration do not occur until late May (Johnson *et al.* In Press; Richardson *et al.* 1976). During 1972, 320 diving ducks/hr were recorded passing Cape Dalhousie on 29 May--the first day of observations at this site (Figure 45). Although the movements of diving ducks were not studied daily during 1974, results of aerial surveys conducted early in the spring revealed that over 100,000 diving ducks arrived in the study area on approximately 21 May; at this time, these birds occupied available open-water leads in this area (see Appendix 1).

Diving ducks used bays and beach areas to a much greater extent than they did either island areas or fresh-water lakes (Figures 46 and 47). During late June and early July, male eiders begin their movement to moulting areas on the northwest coast of Alaska and other species move to moulting areas along the coast of the southeastern Beaufort Sea (Johnson *et al.* In Press). Large flocks of moulting diving ducks were observed during July and early August 1974, and some large aggregations of staging diving ducks were present in the study area until mid-September.

Some diving ducks begin migrating from the study area as early as mid-August; the migration of these ducks from this area continued until mid to late September.

Aythya spp: Scaup



TOTAL DIVING DUCKS

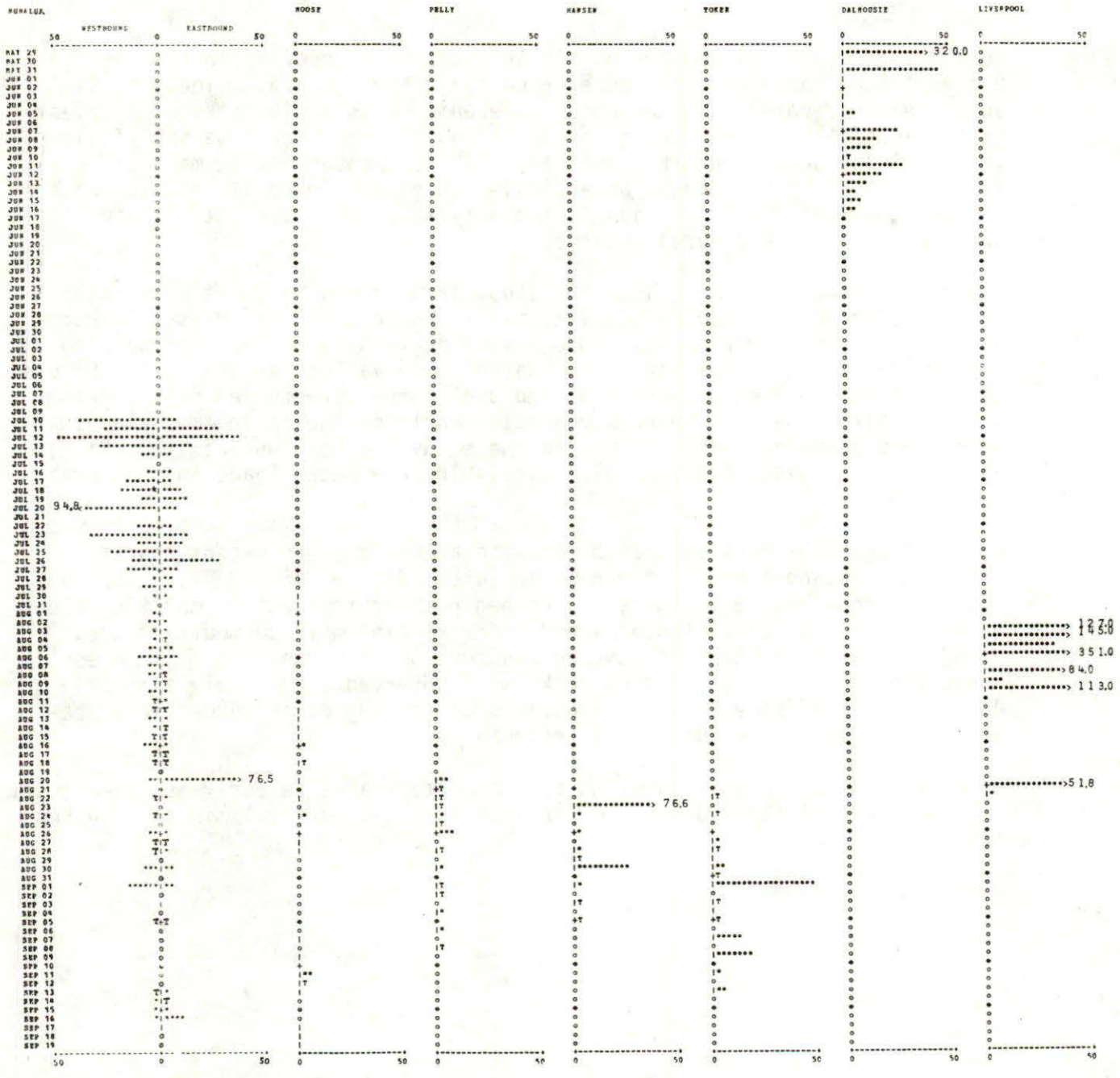
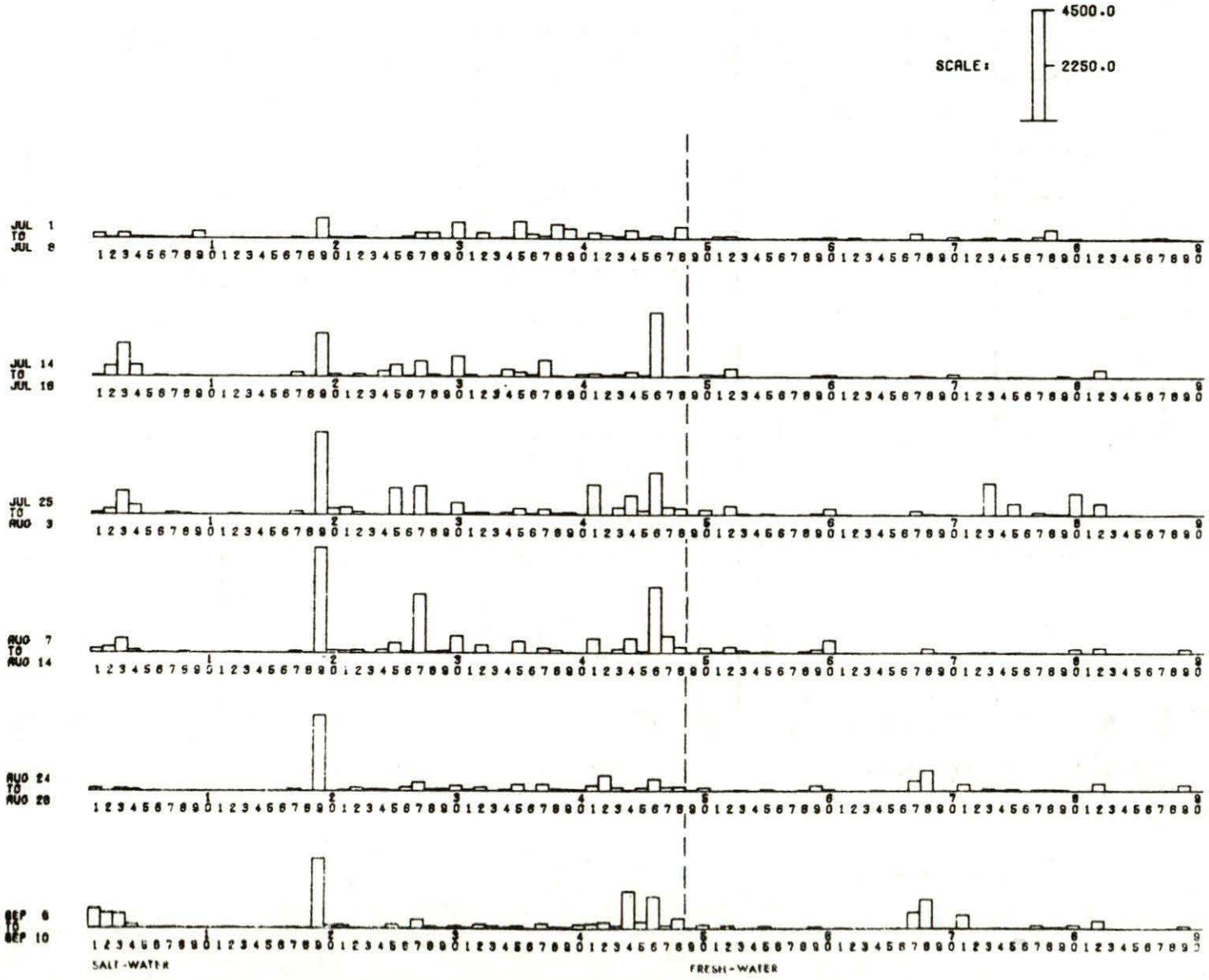


Figure 45. Number of Birds per Hour Observed Passing Coastal Migration Watch Stations in the Yukon and Northwest Territories in 1972. Only locations where birds were observed are presented.

FIGURE 46. Beaufort Sea 1974 Barrier Beach Data--Number of Birds Observed Vs Location Number--Diving Ducks



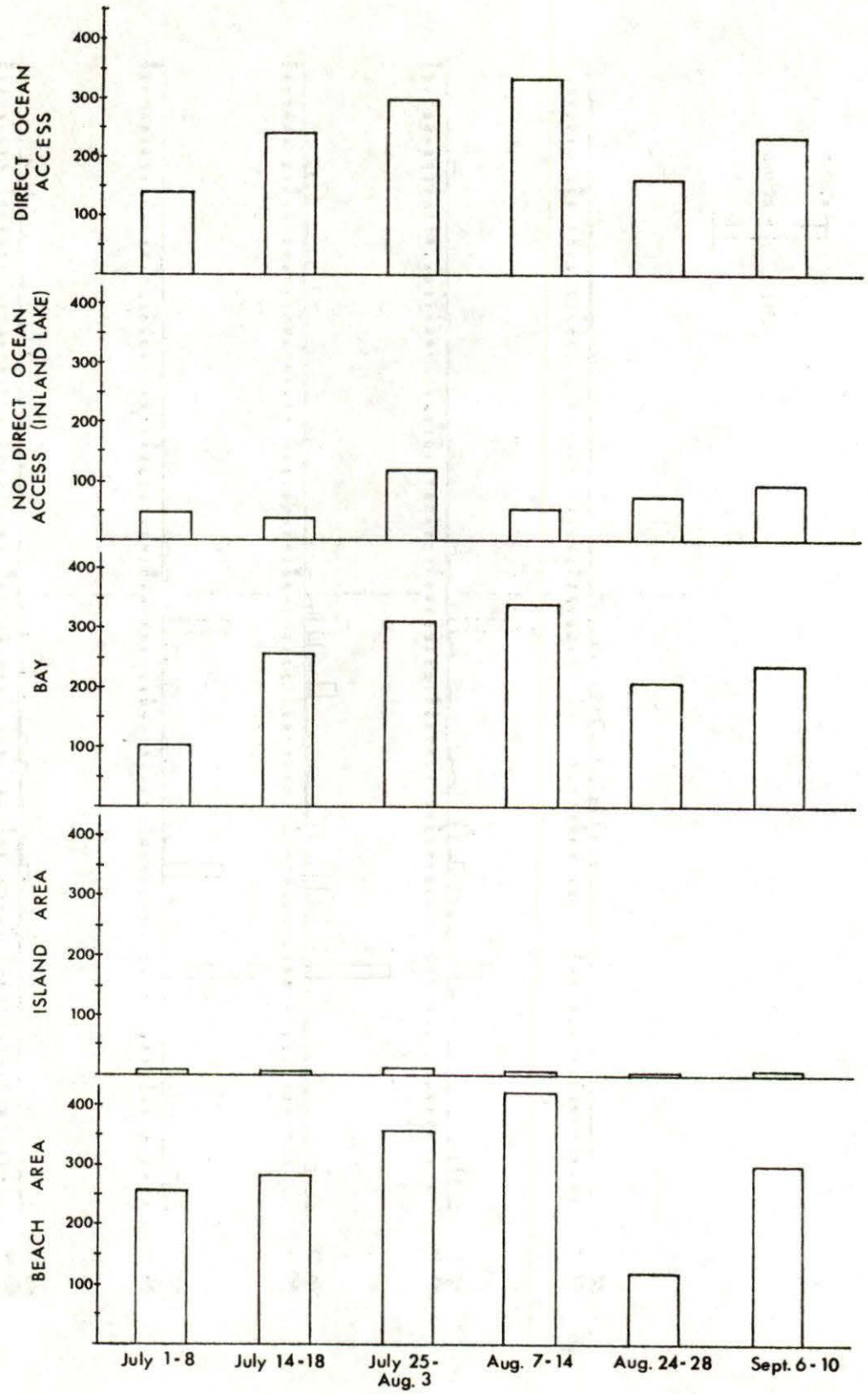


FIGURE 47. Average Number of Total Diving Ducks per Waterbody by Waterbody Type, 1 July to 10 September 1974.

Present Status and Spring Migration

Two species of scaup occur in the Beaufort Sea area: Greater Scaup commonly occur in the open arctic and salt-water areas (Godfrey 1966); Lesser Scaup occasionally occur as common summer residents in the Mackenzie Delta, where they have been recorded as far north as Tununuk (a small flock recorded on 10 June 1932; Porsild 1943).

Scaup arrive in the Beaufort Sea during late May and early June (Porsild 1943; Slaney 1974). Gollop and Davis (1974a) hypothesized that scaup arrive in the Beaufort Sea from the east coast (see also Bull 1974); however, during this study no data was gathered in support or contradiction of this assumption.

Very few scaup were seen from shore during spring 1972; eight of 12 birds observed at Nunaluk Spit between 8 and 11 June 1972 were moving west. Two scaup were sighted on 27 May 1974 north of Cape Dalhousie.

Habitat Preferences

Most scaup seen during this study were present on salt-water bodies during the summer and fall (Figure 49); these birds used bays and beaches to a greater extent than they used areas near islands (Figure 50). Lakes were occupied by a relatively large number of scaup; their use of lakes peaked during the fall. Scaup tended to occur in areas similar to those used by Oldsquaw and both Arctic and Red-throated Loons (Table 9). These three species typically occur in salt-water areas.

Premigratory Movements

Most of the scaup that were recorded at Nunaluk in 1972 were observed during July. It is probable that these birds were not migrating but were either undergoing moult or moving to moulting areas (see Vermeer and Anweiler 1975; Ward and Sharp 1974).

During offshore aerial surveys conducted during 1974, moulting male scaup may have been observed as early as 26 June; on this date, four scaup were sighted resting in the open ocean approximately 100 km north of Tuktoyaktuk. By 3 July 1974, a group of at least 100 scaup had gathered near Baillie Island, at the tip of Bathurst Peninsula, and approximately 450 scaup had concentrated in Bay Number 19, between Warren and Toker Points. The latter moulting flock eventually increased in size to nearly 3500 birds by mid-August; this flock still numbered over 2700 birds at the termination of observations at that site on 6 September.

Fall Migration

Daily rates of migration as high as 2.0 scaup/hr were occasionally recorded at Toker Point between 22 August and 11 September 1972, and a relatively high rate of scaup migration (9.1 birds/hr) was recorded on 23 August 1972 at Hansen Harbour. Many scaup migrate up the Mackenzie River Valley during fall; this movement reaches peak numbers by the third week in September (Salter 1974b). Some scaup, however, probably remain in the Beaufort Sea until the end of September (Porsild 1943; Bailey 1948; Slaney 1974).

SCAUP

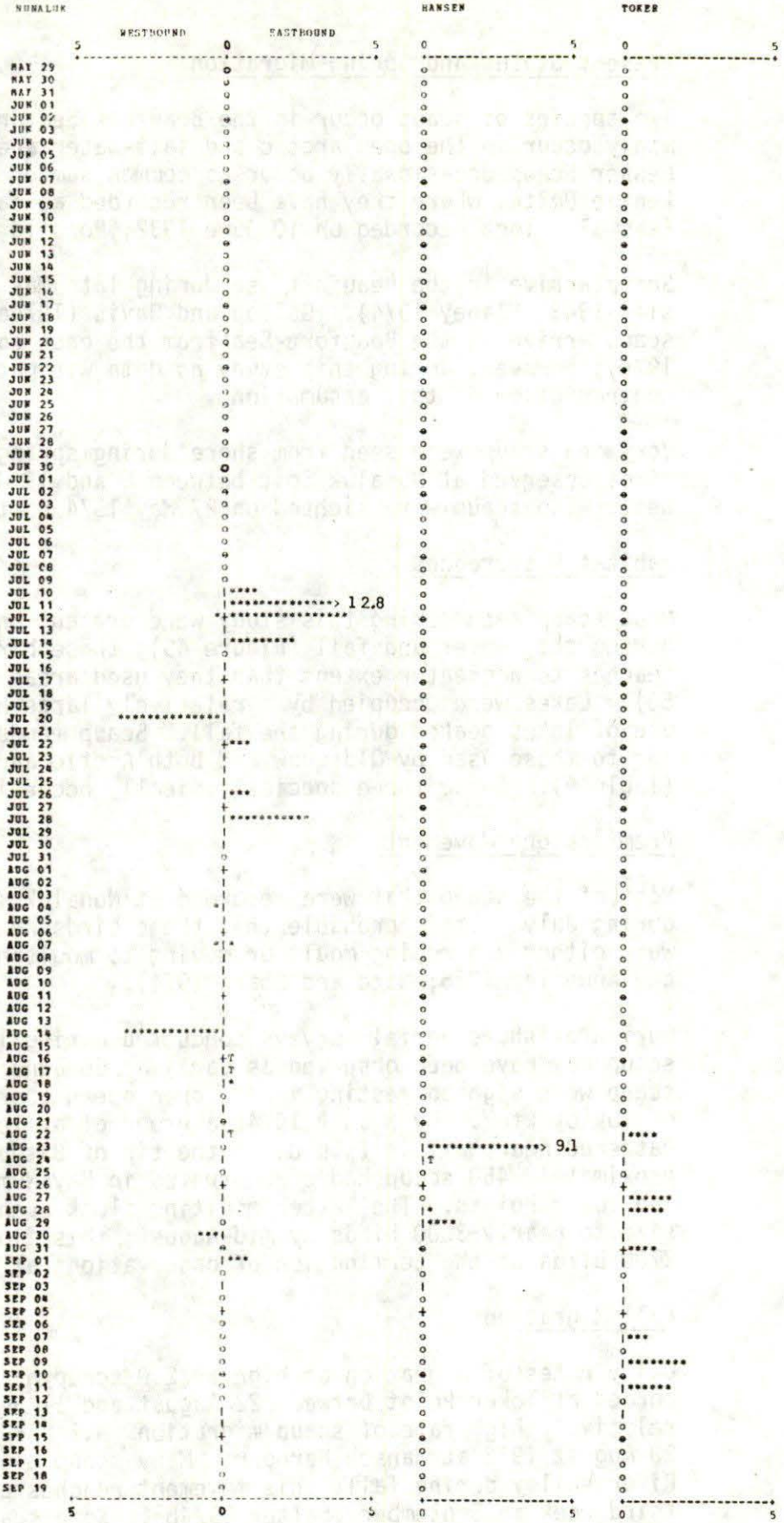
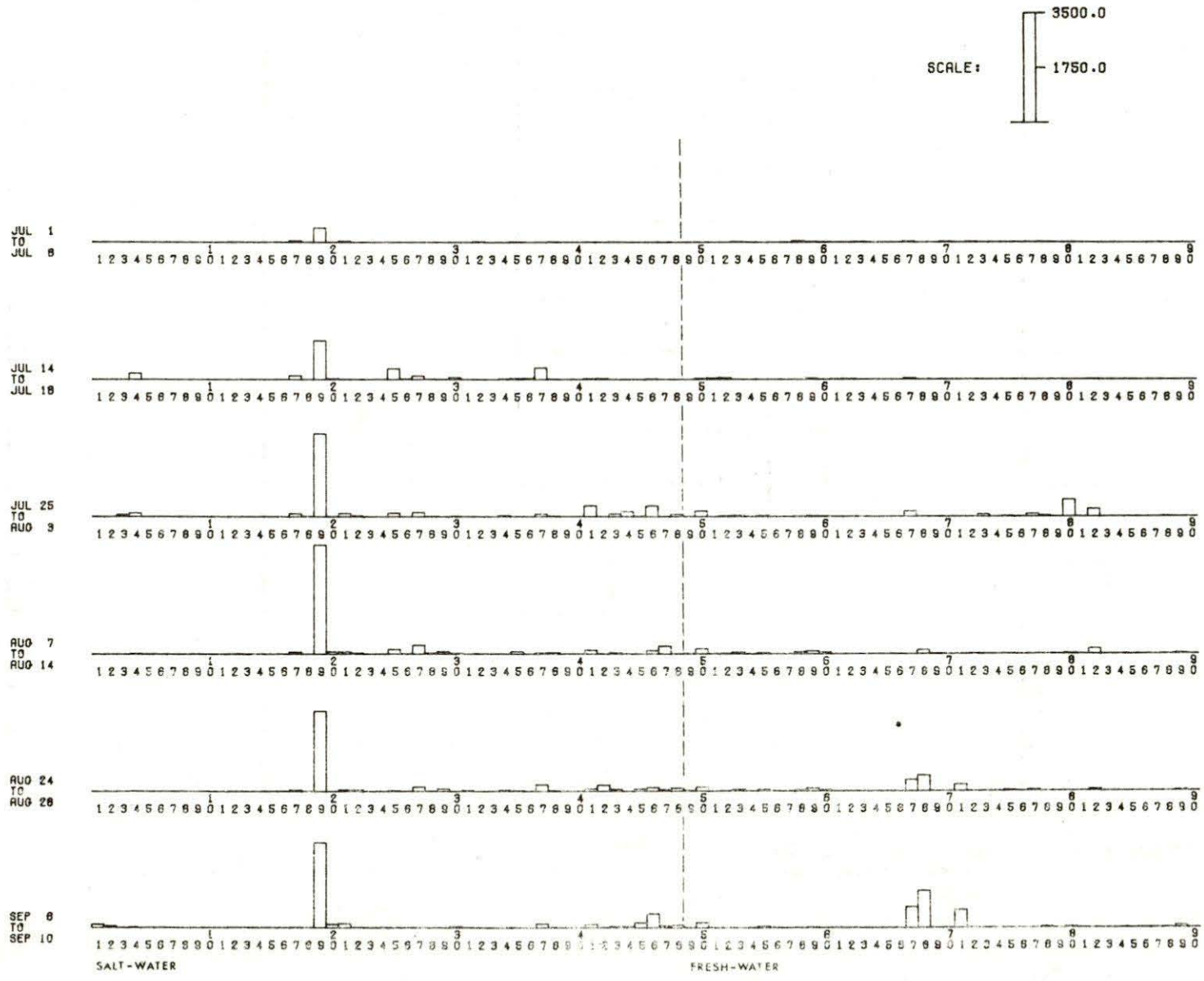


FIGURE 48. Number of Birds per Hour Passing Coastal Migration Watch Stations in the Yukon and Northwest Territories in 1972. Only Locations Where Birds were Observed are Presented.

FIGURE 49. Beaufort Sea 1974 Barrier Beach Data--Number of Birds Observed Vs Location Number--Scaup



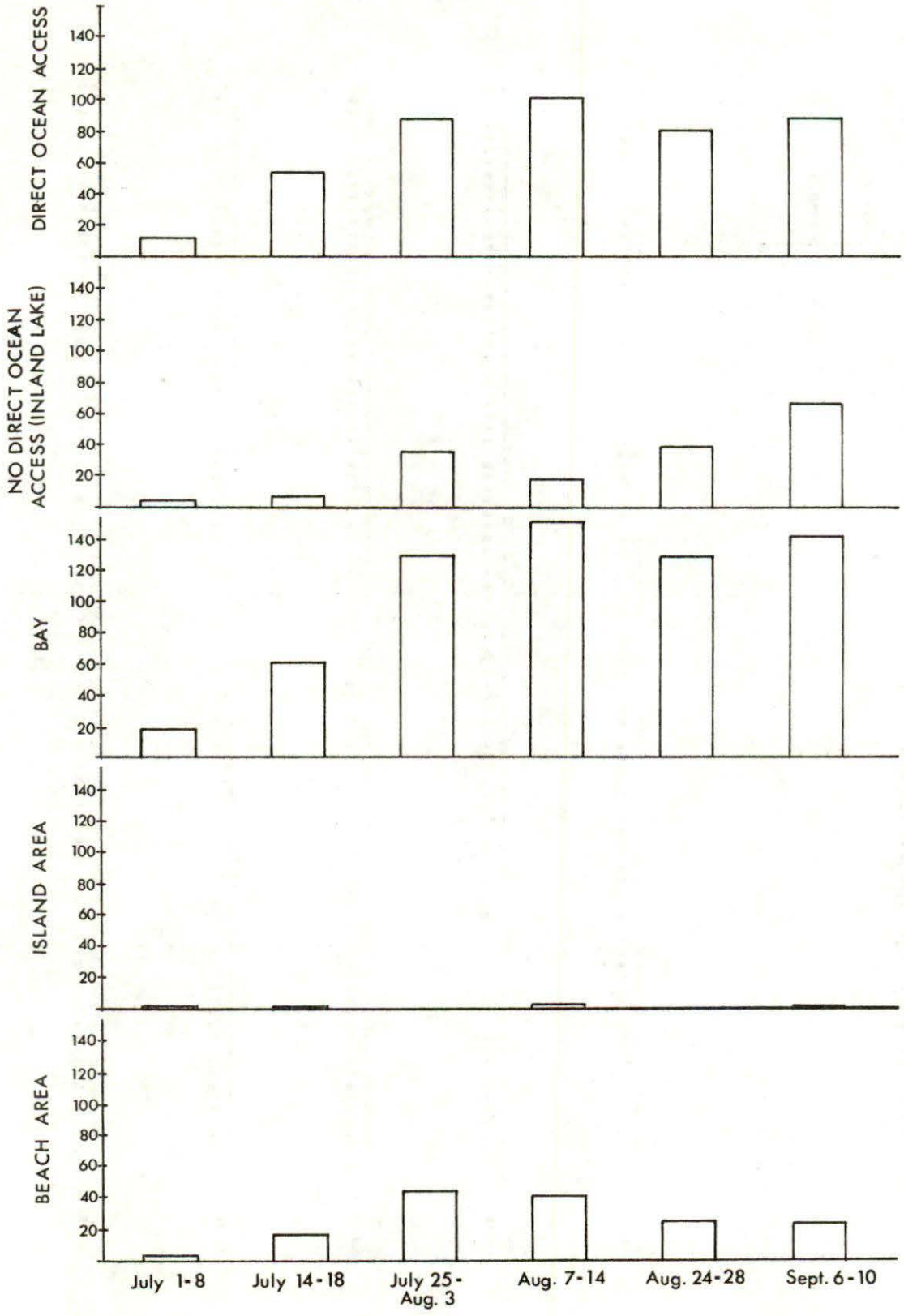
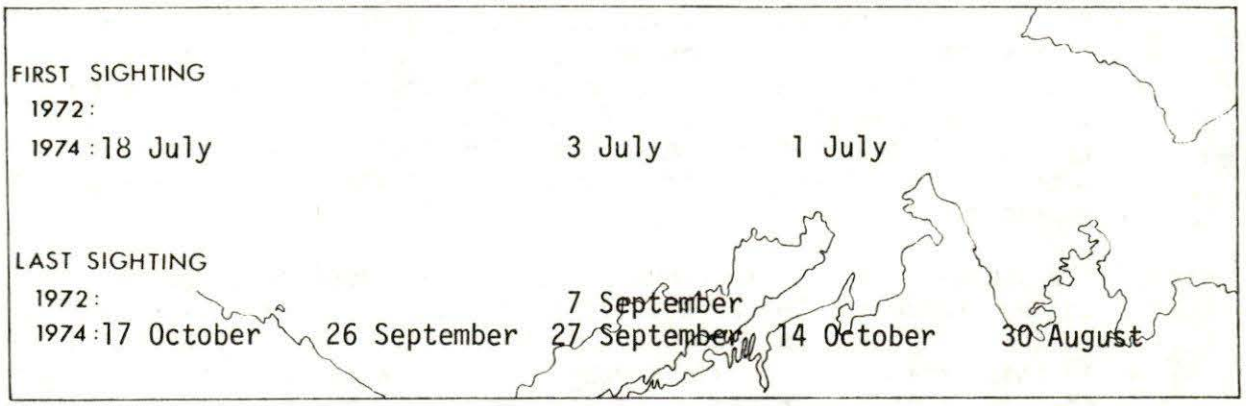


FIGURE 50. Average Number of Total Scaup per Waterbody by Waterbody Type, 1 July to 10 September 1974.

Bucephala spp: Goldeneye



Present Status

Both Common Goldeneyes (*B. clangula*) and Barrow's Goldeneye (*B. islandica*) are rare in the Beaufort Sea area: Common Goldeneyes occur in small numbers in the Mackenzie Delta (Porsild 1943) and occasionally in other areas of the Arctic; Barrow's Goldeneyes have not been seen in the eastern Beaufort Sea and occur as very rare breeders in the upper Anderson River (Bent 1925). Goldeneyes observed during this study were seldom identified to the species level; this account, therefore, concerns the *Bucephala* genus. It is, however, probable that most of the goldeneyes recorded during this study were Common Goldeneyes.

Distribution and Premigratory Movements

Goldeneyes have rarely been seen in the Beaufort Sea area previous to 1974. The only records of goldeneyes obtained during the 1972 migration watches consisted of an observation of two Common Goldeneyes at Toker Point on 7 September. Vermeer and Anweiler (1975) reported that only small numbers of goldeneyes were seen during August 1973 on the south side of Herschel Island; these birds were in a moulting flock with Oldsquaw and Surf Scoters.

During 1974, however, relatively large numbers of goldeneyes were observed both during the aerial surveys of waterbodies and during the aerial transect surveys over the Beaufort Sea.

During 1974, over 100 goldeneyes were sighted during coastal aerial surveys; most were sighted on the Tuktoyaktuk Peninsula between 1 July and 8 September. One goldeneye was seen on 18 July on a lake southeast of Herschel Island, and a pair of goldeneyes was observed on a lake on Richards Island on 9 September 1974. All other 1974 goldeneye records obtained during the waterbody surveys consisted of observations on the Tuktoyaktuk Peninsula.

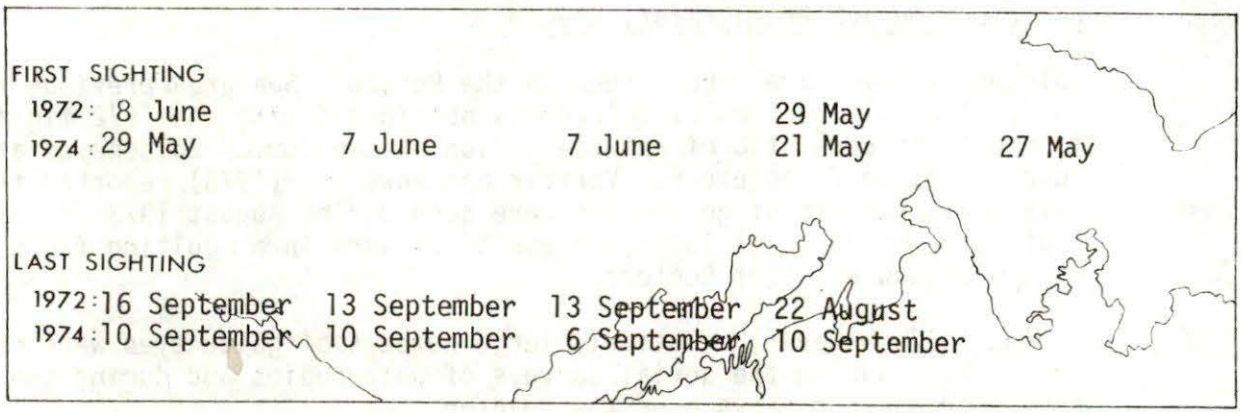
In offshore areas, however, the distribution of goldeneyes during 1974 was more scattered and wider in range than along the coast. Goldeneyes were first observed on 3 July. Most of these birds were sighted in singles or in small flocks, although a group of 70 goldeneyes was sighted off Cape Kellett on Survey 11 (23 to 24 July), and several sightings of 10 to 30 birds were also recorded. Goldeneyes were frequently seen as far as 150 km from shore and as far north as 74°N latitude--approximately the northern limit of the aerial surveys. A total of 292 goldeneyes were seen during offshore aerial surveys conducted during 1974.

The above-given distributional data probably represent moulting males and nonbreeders. The relatively large number of goldeneyes sighted in the study area during 1974 and the relative scarcity of these birds in this area during previous years is unexplainable. It is possible, however, that goldeneyes occur more regularly and more commonly in offshore areas of the Beaufort Sea than was previously known.

Fall Migration

The scarcity of autumn records of goldeneyes obtained in coastal locations in Alaska (Gabrielson and Lincoln 1959) indicate that it is unlikely that goldeneyes sighted offshore in the eastern Beaufort Sea migrated around Alaska. It is more probable that goldeneyes follow inland migration routes (Gabrielson and Lincoln 1959), perhaps up the Mackenzie River Valley or along other major drainages. During 1974, the last goldeneye seen was northwest of Herschel Island on 17 October.

Clangula hyemalis: Oldsquaw



Present Status and Spring Migration

The Oldsquaw is perhaps the most abundant breeding sea duck in the eastern Beaufort Sea (Barry 1974). This species usually arrives in the Arctic during late May or early June. Most Oldsquaws apparently follow the coast around Alaska; some, however, follow interior routes along major drainages in Alaska and Canada, including the Mackenzie

River Valley (Bailey *et al.* 1933; Cade 1955; Gabrielson and Lincoln 1959; Irving 1960; Salter 1974a; Salter *et al.* 1974; Johnson *et al.* In Press; Richardson *et al.* 1976; see Johnson *et al.* In Press for review).

During 1974, Oldsquaws were first sighted in the study area on 21 May; on this date large numbers of this species were sighted with King and Common Eiders on an open-water lead north of Liverpool Bay. By 24 May, over 200 individuals had been seen offshore during surveys conducted west of Storkersen Bay, Banks Island. Nearly 24,000 Oldsquaws were counted on the above-mentioned lead on 29 May; 10,000 were still present on this lead at the end of May. These birds probably dispersed soon thereafter; for few were seen during subsequent surveys over this area (Appendix 1).

Summer Distribution and Premigratory Movements

During June and early July, Oldsquaws were seen in flocks of as many as 300 birds; these flocks were present in widely separated areas (from Herschel Island to northern Banks Island) throughout the eastern Beaufort Sea area. After mid-July, however, most of the recorded Oldsquaws were sighted singly or in flocks near shore. Considerable numbers of Oldsquaws were seen during July near Herschel Island (1972 and 1974) and along Tuktoyaktuk Peninsula (1974)(Figure 52). Most of these birds were associated with ocean areas (Figure 53), although a few hundred Oldsquaws were present on several lakes throughout July and August. On 27 July 1972, over 1100 Oldsquaws were sighted on Lake Number 73; it is probable that the majority of these birds were moulting.

Although many Oldsquaws gathered in the Herschel Island area during July 1972, greater numbers were seen moving past this area toward other moulting areas (see also Vermeer and Anweiler 1975 and Ward and Sharp 1974). During 1972, similar numbers of Oldsquaws were observed moving east and west; two large groups were observed moving west on 18 and 20 July (Figure 51). Fewer Oldsquaws were seen at Nunaluk Spit during August and September than during July 1972; the primary direction of flight of birds observed during this period was westward.

A very large movement of Oldsquaws past Liverpool Bay was observed during early August 1972 (Figure 51). From 20 to 75 Oldsquaws/hr flew past the migration watch station here during four of the seven days on which observations were conducted. On 21 August, Oldsquaws were still moving past Liverpool Bay at the rate of 34.5 birds/hr.

Habitat Preferences

Oldsquaws and eiders commonly occur in mixed flocks during early spring. However, during breeding, moulting, and fall migration, Oldsquaws utilized areas similar to those used by scaup and Arctic Loons and, to a lesser extent, to those used by Whistling Swans (Table 9).

OLDSQUAW

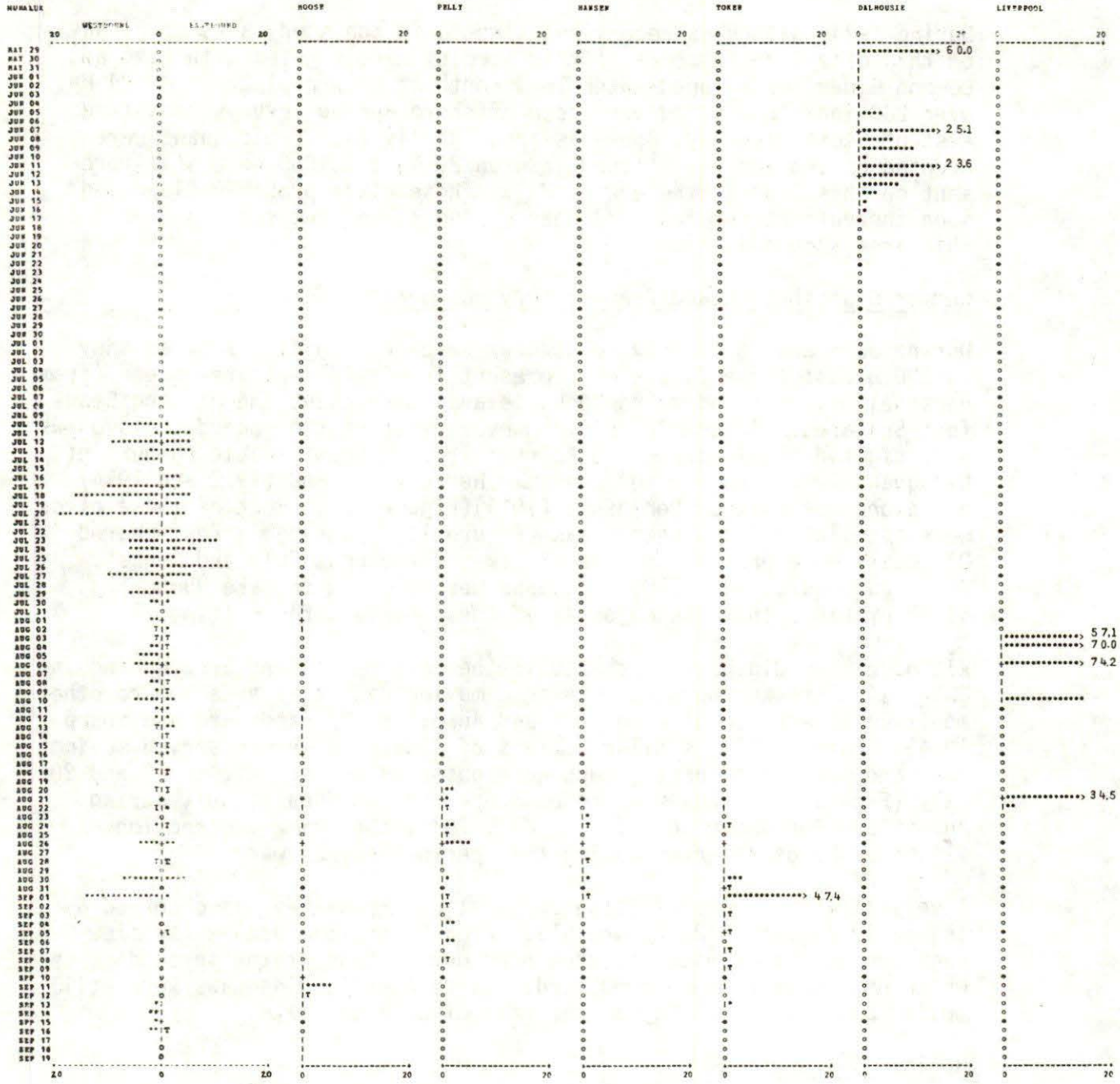
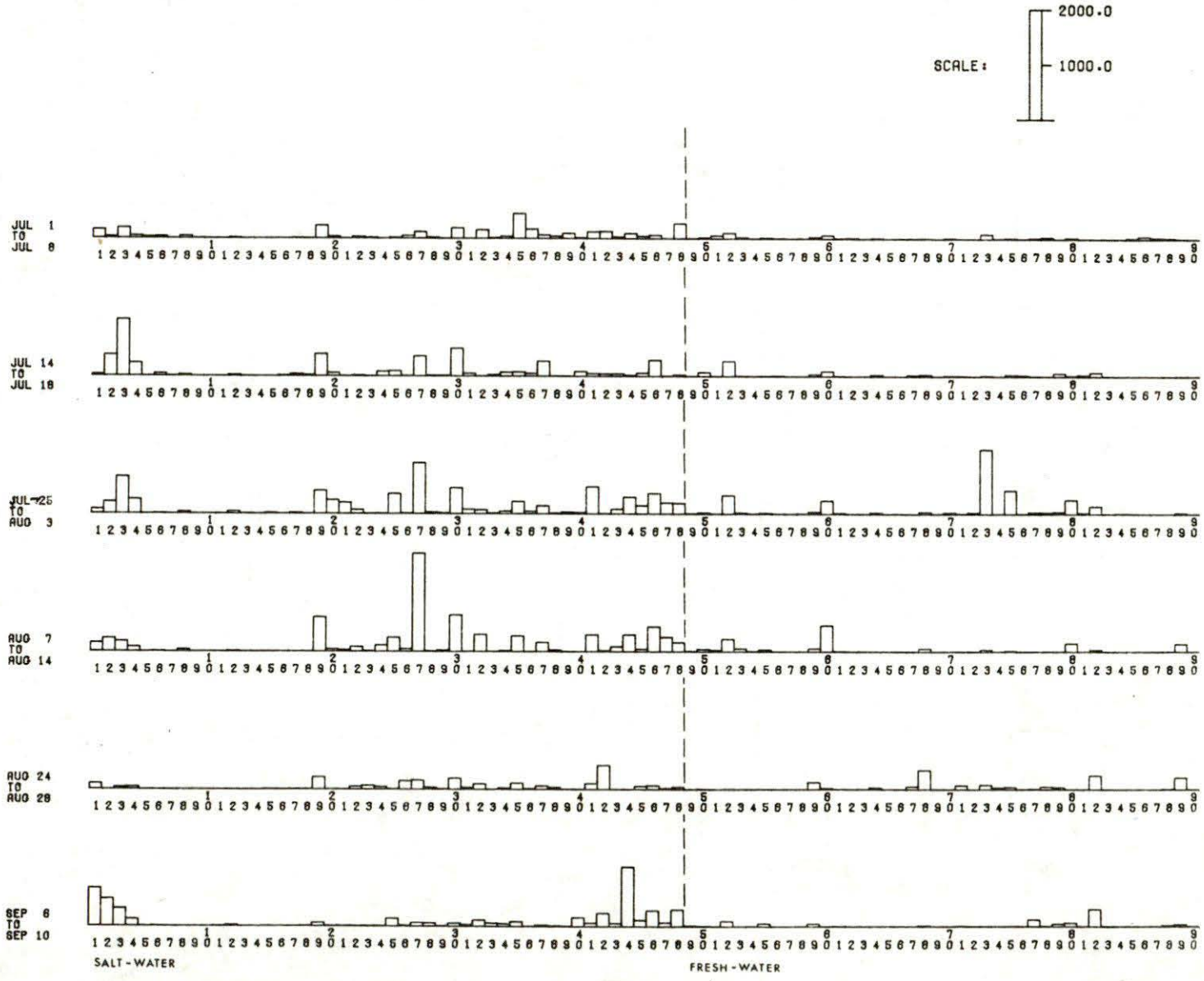


Figure 51. Number of Birds per Hour Observed Passing Coastal Migration Watch Stations in the Yukon and Northwest Territories in 1972. Only locations where birds were observed are presented.

FIGURE 52. Beaufort Sea 1974 Barrier Beach Data--Number of Birds Observed Vs Location Number--Oldsquaw



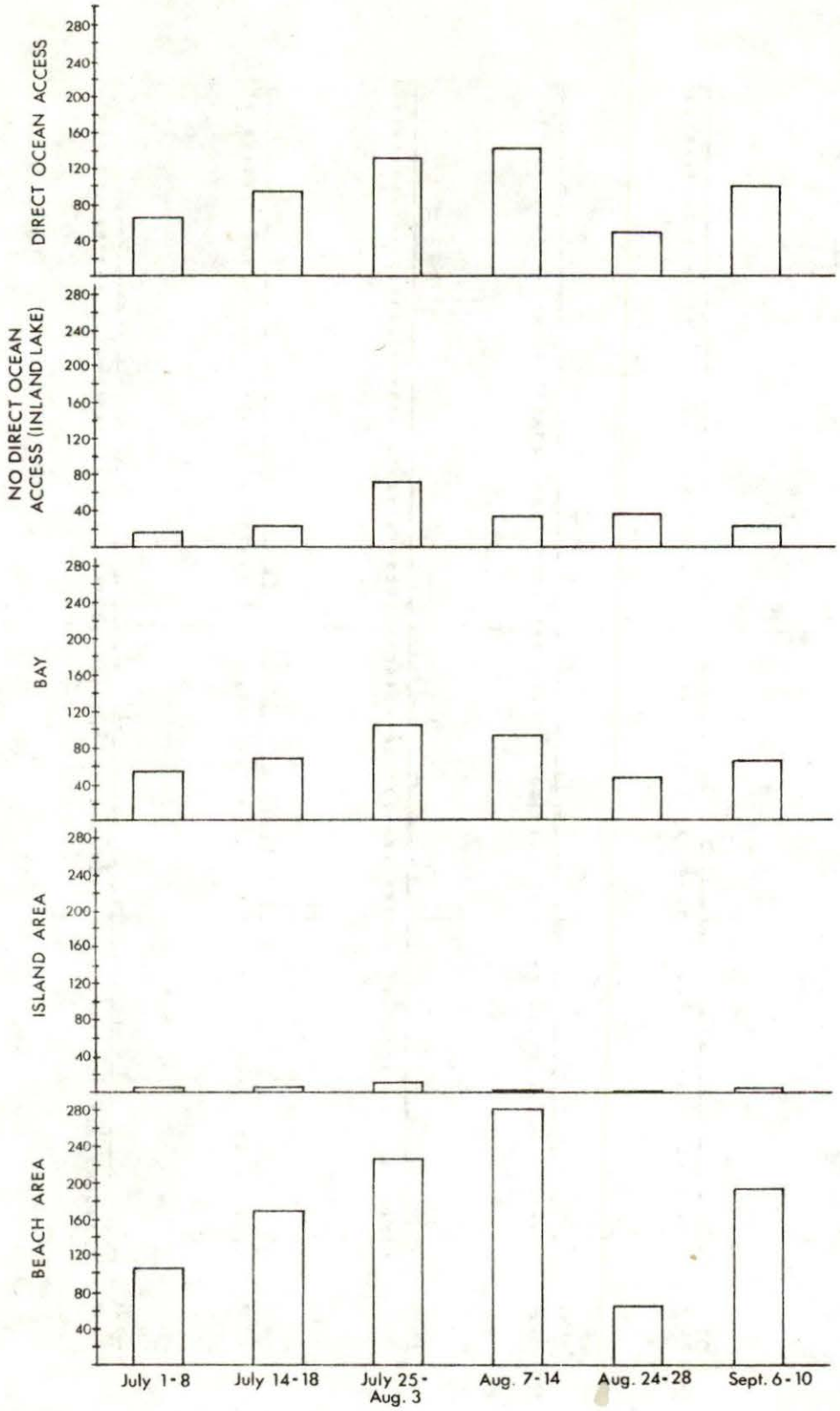


FIGURE 53. Average Number of Oldsquaw per Waterbody by Waterbody Type, 1 July to 10 September 1974.

Fall Migration

Few large-scale movements of Oldsquaws were recorded during the falls of 1972 or 1974, probably because field investigations were terminated before such movements occurred. The peak of fall migration of this species normally does not occur until well into September (Gabrielson and Lincoln 1959; Gollop and Davis 1974a); migrating Oldsquaws have been recorded passing Wainwright, Alaska, as late as 19 October (Bailey 1948). Large numbers of Oldsquaws were noted as they passed Toker Point on 1 September 1972 (47.4 birds/hr), and relatively small-scale westward movements of Oldsquaws were recorded at Nunaluk Spit on 30 August and 1 September 1972 (Figure 51).

No offshore movements of Oldsquaws were recorded during aerial surveys conducted during the fall migration of this species. Most Oldsquaws migrate westward across the Beaufort Sea and south along the coast of Alaska (Gabrielson and Lincoln 1959).

Histrionicus histrionicus: Harlequin Duck

The Harlequin Duck is uncommon in the southern Beaufort Sea area; apparently, this species occurs most frequently in this area during its moulting period in August. During the 1972 phase of this study, two birds of this species were recorded at Nunaluk Spit: one on 11 August and another on 24 August. During August 1973, small numbers of Harlequin Ducks were seen in flocks of Oldsquaw and Surf Scoters on the south side of Herschel Island (Vermeer and Anweiler 1975; Ward and Sharp 1974). During the spring and summer seasons prior to the period of moult, birds of this species occur on fast-flowing rivers, along which they build their nests. Harlequin Ducks have been recorded at the Babbage River, Y.T. as early as 1 June (Gollop *et al.* 1974b). Harlequin Ducks presumably follow the coast of Alaska during both spring and fall migration but may also migrate through the interior of Alaska (Gabrielson and Lincoln 1959; see review by Johnson *et al.* In Press).

Eiders

Only two species of eiders were identified during this study: the King Eider and Common Eider. During both 1972 and 1974, both species were abundant in the study area from late May until early August. Birds of these species migrate primarily offshore (see Johnson *et al.* In Press for review); hence, the bulk of their migration was not detected during the 1972 shore-based migration watches (Figure 54). Very large concentrations of both King and Common Eiders were observed during late May 1974 along open-water leads north of Liverpool Bay and along the west coast of Banks Island (Appendix 1). Few eiders were seen during August and September 1974 either nearshore or during offshore aerial surveys (Appendix 1 and Figure 55). Both species migrate along the coast around Alaska and winter primarily in the Bering Sea.

EIDERS

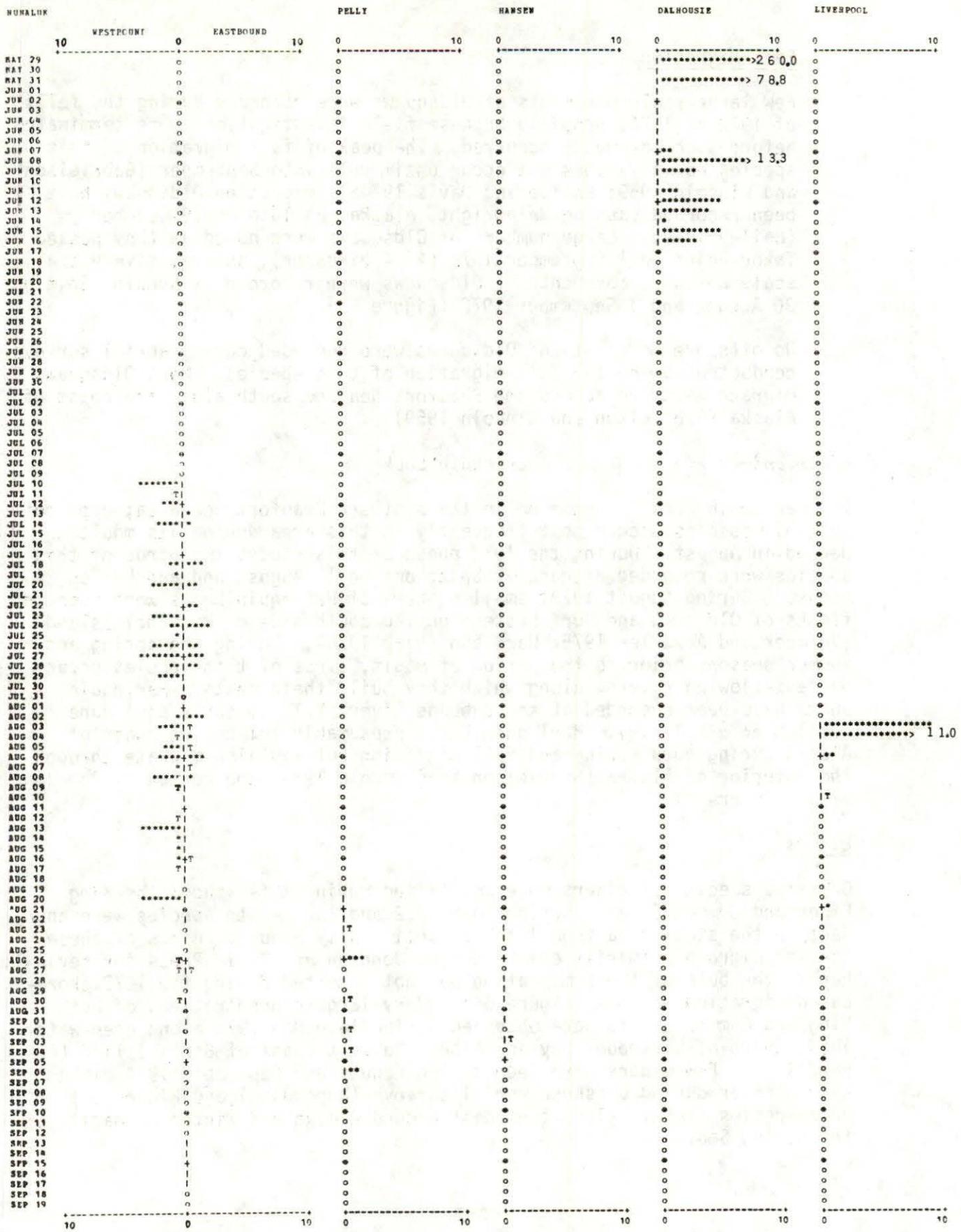
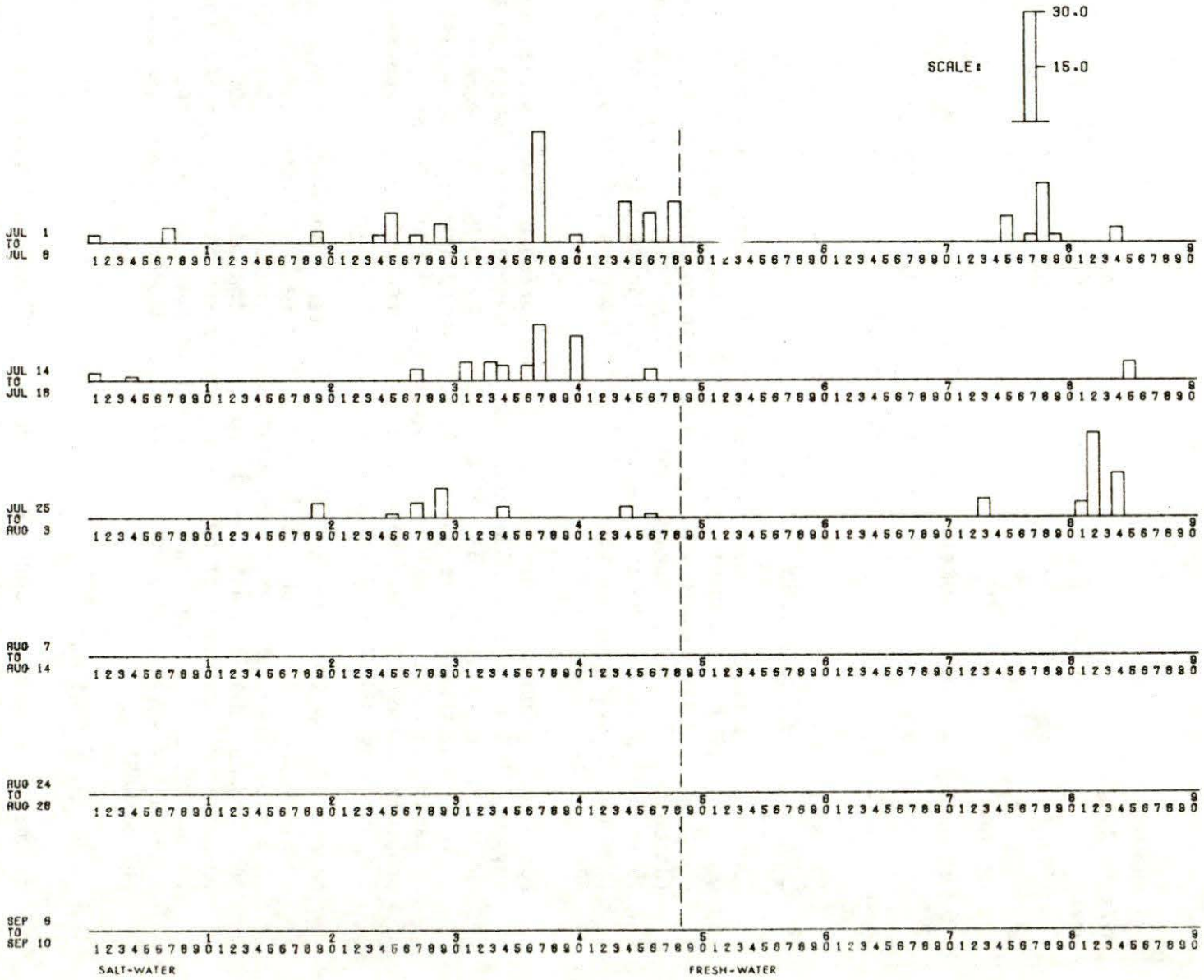
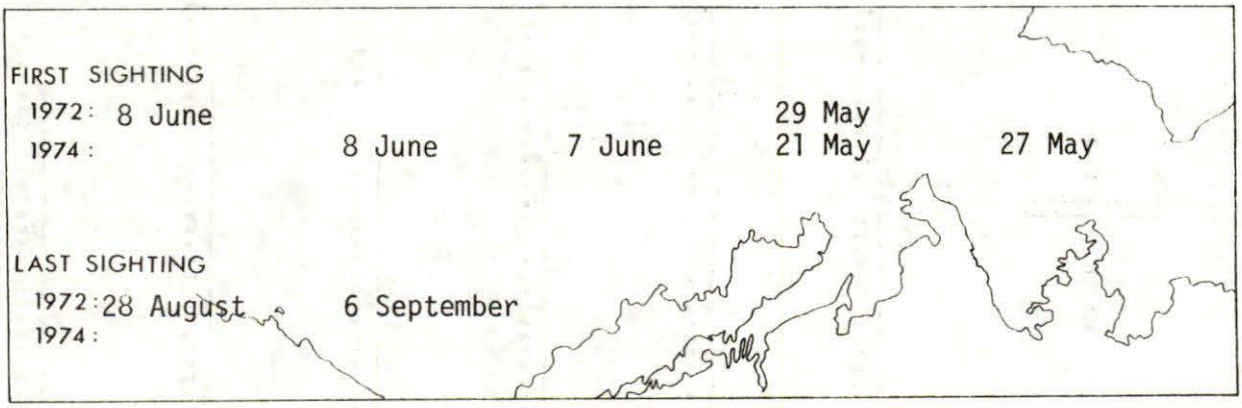


FIGURE 54. Number of Birds per Hour Passing Coastal Migration Watch Stations in the Yukon and Northwest Territories in 1972. Only Locations Where Birds were Observed are Presented.

FIGURE 55. Beaufort Sea 1974 Barrier Beach Data--Number of Birds Observed Vs Location Number--Eiders



Somateria mollissima: Common Eider



Present Status and Spring Migration

Common Eiders were seen more regularly and in greater numbers than were King Eiders both during 1972 and 1974. The Common Eider occurs abundantly in the Beaufort Sea and breeds in colonies on Banks Island (Jacobson 1974) and on Nunaluk Spit (R.W. Campbell cited by Jacobson 1974; Gollop *et al.* 1974c). Common Eiders migrate primarily offshore, from the west, along the coast of Alaska (Thompson and Person 1963; Johnson 1971; Flock 1973).

During 1974, Common Eiders were first seen during offshore aerial surveys on 21 May. Over 75,000 birds of this species were sighted on a large lead off Liverpool Bay on this date. By 30 May, the number of observed Common Eiders had declined to approximately 1500 birds; by early June, most Common Eiders had dispersed from this area, probably because the lead had closed to a large extent and because the birds had moved onshore to nest.

Moderate numbers of Common Eiders were sighted from shore at Cape Dalhousie between 29 May and 16 June 1972. These birds were seen passing at a rate of 40 birds/hr at the start of observations on 29 May and were probably moving past the site prior to that date. Common Eiders were seen at Nunaluk Spit on 8 June, when observations began (Figure 54 and Table 14). From this date until 13 June, only 88 birds were sighted flying in nearly equal numbers to the east and west (40 east and 48 west).

Summer Distribution

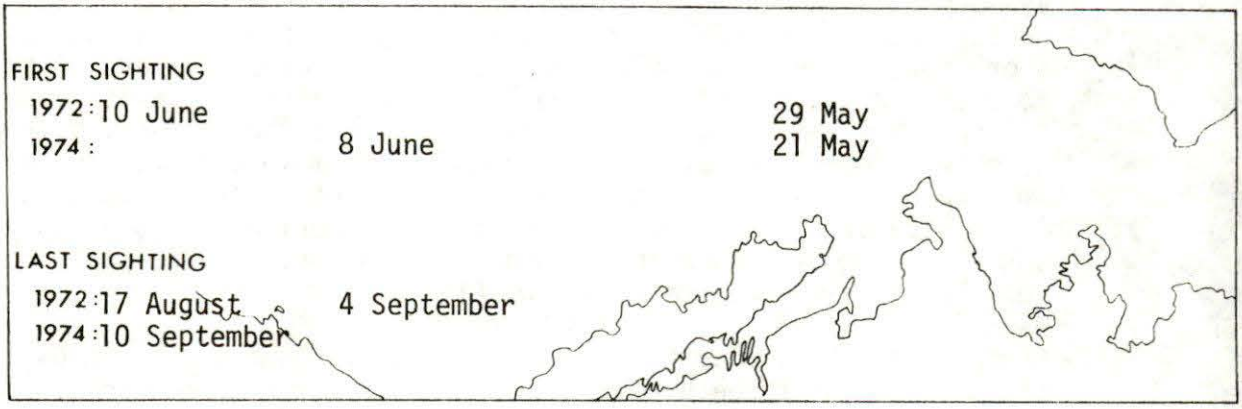
By the second week of June 1974, the large flocks of Common Eiders that had been seen during aerial surveys offshore had largely dispersed, and small groups and pairs of eiders were scattered from Richards Island to Banks Island. During 1974, very few Common Eiders were seen offshore after 8 June.

During 1972, small numbers of Common Eiders were seen at Nunaluk Spit throughout July and August and at Pelly Island during late August and early September. Common Eiders were identified on only three waterbodies (all bays) during 1974 aerial surveys of the Barrier Beaches.

Fall Migration

No large concentrations of Common Eiders were observed during the falls of 1972 and 1974; in fact, few birds of this species were sighted after June. The spectacular moult migrations of male Common Eiders that occur at Point Barrow, Alaska, and elsewhere (Joensen 1963; Thompson and Person 1963; Milne 1965; Salomonsen 1968; Johnson 1971) were not seen during either year. Common Eiders probably move along a broader front (hence at lower density) across the Canadian Beaufort Sea than they do farther west.

Somateria spectabilis: King Eider



Present Status and Spring Migration

The King Eider is reported to be more numerous than the Common Eider in the Beaufort Sea area (Barry 1974). During spring migration, this species was frequently seen in flocks with Common Eiders and less often with Oldsquaws. King Eiders arrive on the coast of the eastern Beaufort Sea during mid-June (Johnson *et al.* In Press) after having migrated north along the west coast of Alaska from the Bering and Chukchi Seas (Barry 1968; Johnson 1971) and then east across the Beaufort Sea. The east-northeast direction of departure of eiders from Barrow, Alaska (Flock 1973 pers. comm.) suggests that eiders occur far offshore in the Canadian portion of the Beaufort Sea.

Johnson *et al.* (In Press) provide evidence that King Eiders do not occur in large numbers along the coasts of the southeastern Beaufort Sea until early June. Data collected during this study, however, indicate that King Eiders may be present in nearshore areas as early as late May and that birds of this species are present in offshore areas by an earlier date. During 1972, 550 King Eiders were observed

at Cape Dalhousie on 29 May, and during 1974 a small flock of 17 birds of this species was sighted offshore at Cape Dalhousie on 21 May. By 29 May 1974, the number of King Eiders seen on this offshore lead had increased to nearly 150, and more than 400 of these birds were in this area during early June. Numbers of this species recorded in the Beaufort Sea north of the Tuktoyaktuk Peninsula continued to increase until the end of June, when more than 600 King Eiders were seen. Most birds of this species were observed farther than 30 km from shore, and it is apparent that the bulk of migration of this species occurred offshore.

Only five King Eiders were seen moving past Nunaluk Spit during early June 1972. With the exception of two large flocks seen at Cape Dalhousie on 29 and 31 May 1972, only small numbers of King Eiders were observed near the tip of the Tuktoyaktuk Peninsula.

Summer Distribution and Premigratory Movements

By late June and early July 1974, frequent observations of King Eiders, scattered in small numbers over the open ocean and at a number of nearshore sites, were recorded. These birds were probably part of a larger movement of males westward to moulting areas along the west coast of Alaska. Most sightings of this species were offshore and widely distributed, which indicates that a broad-front movement occurred well out from the coast. The bulk of this apparent moult migration took place between 20 June and 18 July, the same period during which Johnson (1971) and Thompson and Person (1963) observed large-scale movements of this species past Barrow, Alaska.

During 1972, King Eiders were seldom seen from shore after mid-June; one sighting of three birds of this species was recorded in mid-July at Nunaluk; three sightings of two to six individuals each were recorded in mid-August; and sightings of single King Eiders were recorded at Nunaluk Spit, Pelly Island, and Liverpool Bay. It is assumed that any large moult migration of King Eiders that may have occurred during 1972 was offshore and was, therefore, missed by shore-based observers.

Fall Migration

No large flocks of King Eiders were noted during the autumn migration period. According to Bailey (1933), females and young of the year of this species move west past Point Barrow at a more leisurely pace than do males, which pass by in the thousands. The last group of King Eiders sighted during 1974 was recorded offshore from Nunaluk Spit, northwest of Herschel Island, on 10 September; 75 birds were counted in this flock.

Scoters

Scoters, although they are not as numerous in the general Beaufort Sea area as eiders and Oldsquaws, occur abundantly at specific locations (Mackenzie Bay, Kugmallit Bay, and Liverpool Bay) in this area. White-winged Scoters

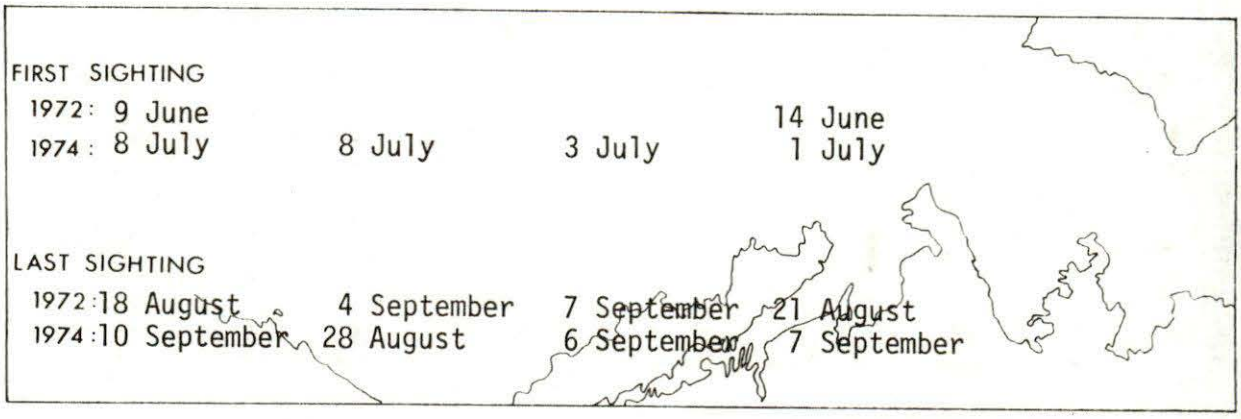
and Surf Scoters occur commonly in the Canadian portion of the Beaufort Sea; Black Scoters occur only in very small numbers in this portion (Johnson *et al.* In Press).

During spring of 1972, no migration of scoters was observed along the shore. It is probable that these birds enter the Beaufort Sea *via* overland routes through interior Canada and Alaska (Johnson *et al.* In Press). The first substantial movement of scoters recorded during this study occurred during mid-July, when as many as 66.8 birds/hr were noted flying west past Nunaluk Spit (Figure 56). It is probable that this movement consisted of immature and nonbreeding adult scoters that were *en route* to moulting areas.

During mid-July 1974, large flocks of scoters were recorded near Cape Dalhousie. An estimated 2500 scoters gathered in a small area off the cape; it is probable that more of these birds were present in nearby waters at this time. These moulting or staging scoters remained until mid-August and then left this area (Figure 57). During the summer of 1974, the largest numbers of scoters were recorded in salt-water areas (Figure 58).

Migration occurred somewhat earlier during 1972. Over 50 birds were recorded at the Liverpool Bay observation post during five of seven days on which migration watches were conducted. This movement continued until at least the third week in August. Fall migration of scoters is also overland: during the 1972 and 1974 fall migration of scoters from the Beaufort Sea area, few of these birds were seen at migration watch stations along the coast, and Salter (1974b) observed White-winged Scoters moving up the Mackenzie River past Fort Simpson in autumn 1972. Although most scoters have left the eastern Beaufort Sea by mid-September, some may remain until the end of this month.

Melanitta deglandi: White-winged Scoter



Present Status and Spring Migration

The White-winged Scoter occurs in low numbers throughout the general Beaufort Sea area; however, at specific locations in this area it

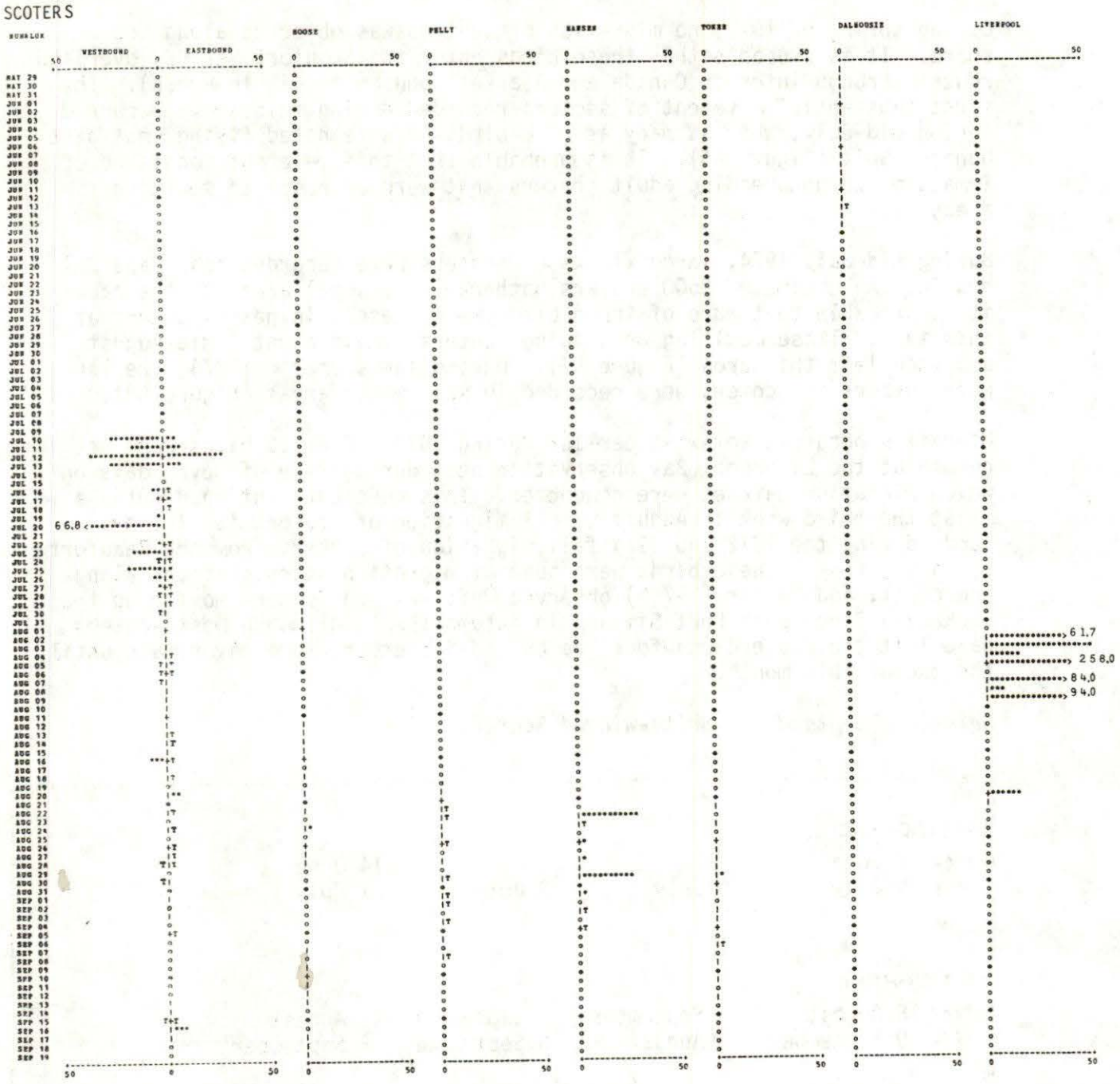
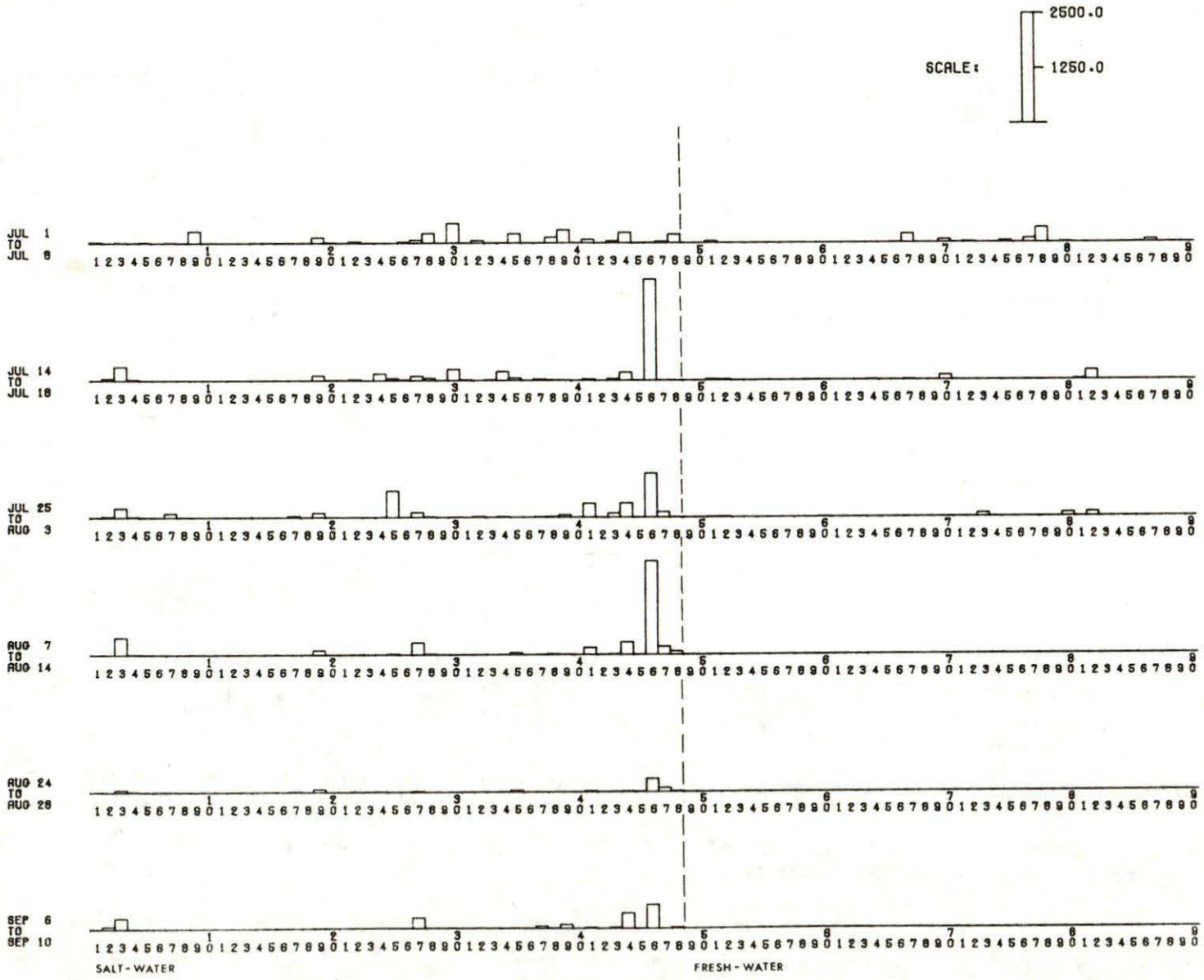


Figure 56. Number of Birds per Hour Observed Passing Coastal Migration Watch Stations in the Yukon and Northwest Territories in 1972. Only locations where birds were observed are presented.

FIGURE 57. Beaufort Sea 1974 Barrier Beach Data--Number of Birds Observed Vs Location Number--Scoters



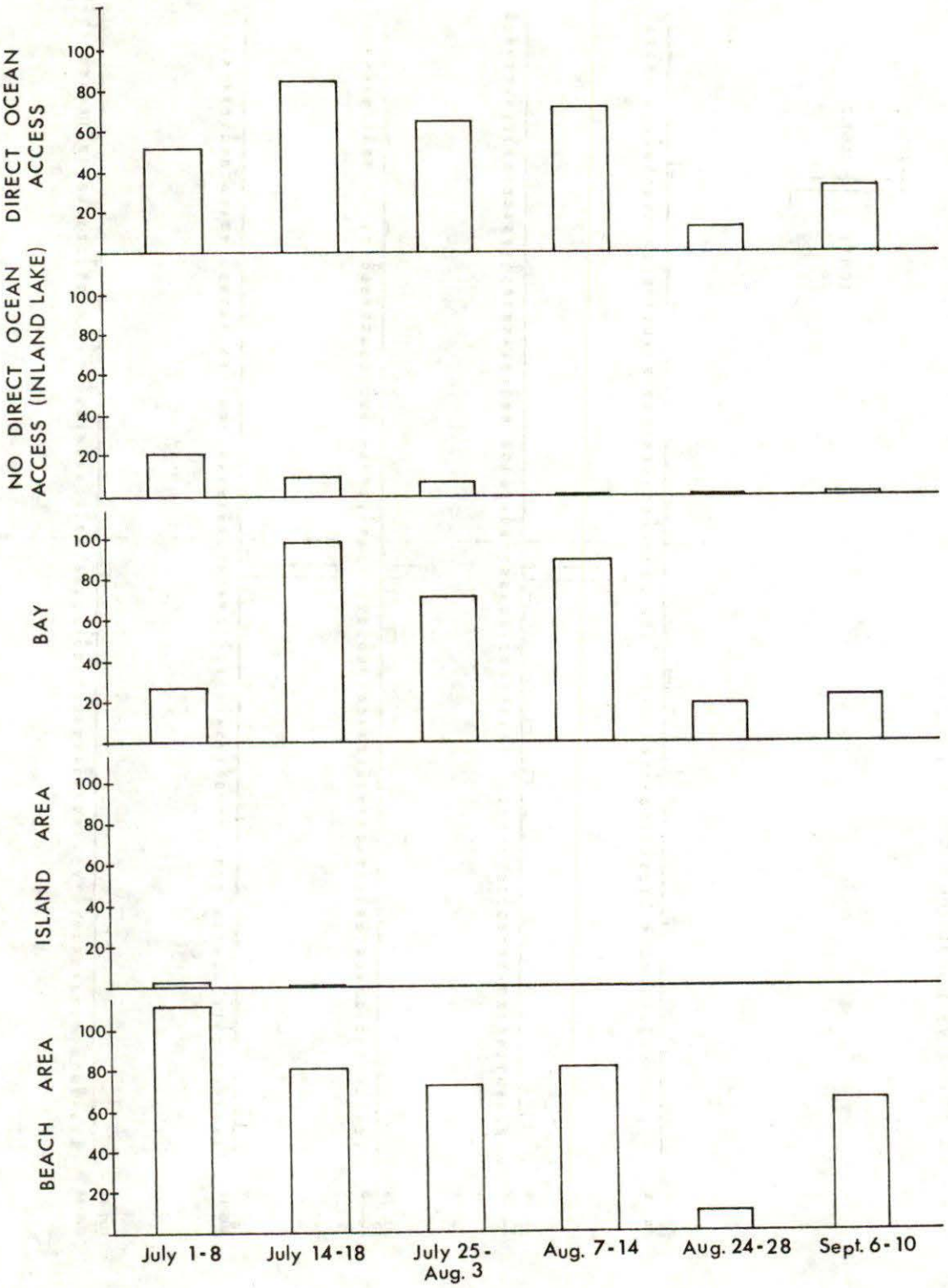


FIGURE 58. Average Number of Total Scoters per Waterbody by Waterbody Type, 1 July to 10 September 1974.

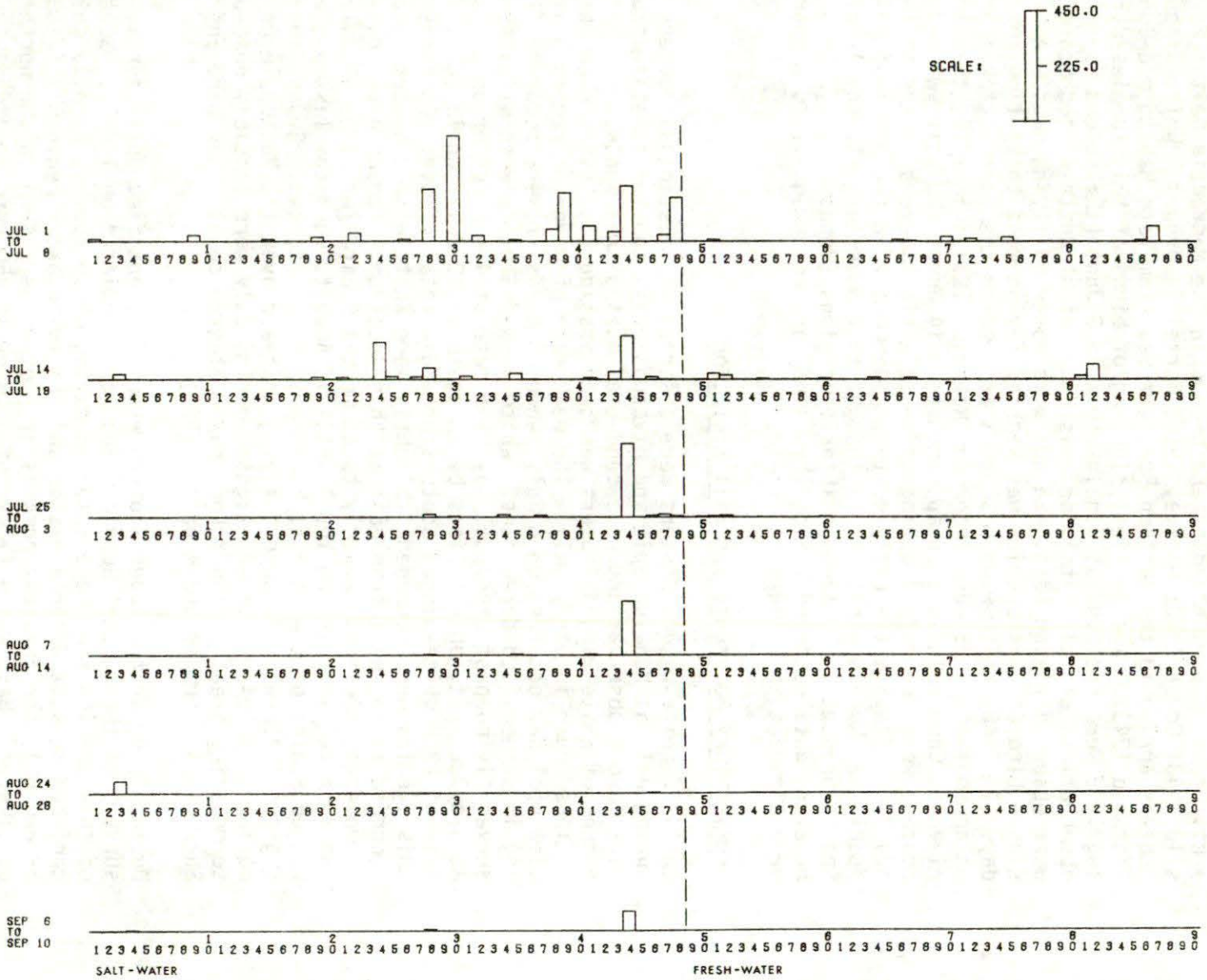
occurs very commonly. This species is not known to breed near the arctic coast but is abundant and breeds in the Mackenzie Delta (Porsild 1943; Cowan 1948; Godfrey 1966; Martel in prep.). White-winged Scoters arrive in the eastern Beaufort Sea from late May to mid-June (Porsild 1943). The earliest sighting of birds of this species during 1972 were recorded at Nunaluk Spit on 9 June (the second day of observations at this site); on this date, eight White-winged Scoters were observed flying west, and two were observed flying east. A single bird of this species was sighted flying west the following day. In 1948, White-winged Scoters arrived in the Tuktoyaktuk area on approximately 15 June (Höhn and Robinson 1951); in 1972, they arrived at Cape Dalhousie on approximately 14 June. No White-winged Scoters were identified during offshore aerial surveys in the spring of 1974. Despite the early westward movement of a few birds of this species at Nunaluk Spit, it is thought that movement into the Beaufort Sea is predominantly through interior regions (Johnson *et al.* In Press); however, data gathered during this study are not adequate to support or contradict this migration route.

Premigratory Movements and Fall Migration

In 1972, White-winged Scoters were observed in substantial numbers during July at Nunaluk Spit and Liverpool Bay, the two coastal locations where observations were conducted during this month. A small number of White-winged Scoters was seen passing both sites when observations began in early July. The peak rate of movement recorded at Liverpool Bay occurred on 8 July, when 84 birds/hr were recorded flying in unspecified directions. White-winged Scoters were still observed flying past Liverpool Bay at a rate of 4.5 birds/hr on 21 July. At Nunaluk Spit, observations began again on 10 July; on 12 July, a rate of 43.8 White-winged Scoters/hr and a total of over 200 birds of this species were recorded. Slightly more White-winged Scoters were recorded flying west than east at this location. The observed rate of movement declined markedly to at most 4.0 birds/hr after 12 July and remained at this low level until 18 August, when the last White-winged Scoter of the year at Nunaluk Spit was sighted. Cowan (1948) sighted White-winged Scoters flying westward over the Mackenzie Delta during July 1947. Scoters sighted during July were possibly headed to moulting areas on the Yukon and/or Alaskan coasts (see Ward and Sharp 1974; Vermeer and Anweiler 1975).

During 1974, White-winged Scoters were not identified until aerial surveys of the coastal Beaufort Sea were initiated on 1 July. Scoters of this species that were observed during these surveys were largely confined to salt-water areas around the Tuktoyaktuk Peninsula (Figures 59 and 60); the greatest numbers of scoters were seen on the north shore of Liverpool Bay, where flocks of as many as 450 were recorded. During 1974 aerial surveys in early and mid-July, White-winged Scoters were observed only in Kugmallit and Liverpool bays; flocks of 40 or fewer individuals were seen in these bays. During 1974, White-winged Scoters were seldom seen after August, although a few isolated observations and a small number of moderate-sized flocks were present in the study

FIGURE 59. Beaufort Sea 1974 Barrier Beach Data--Number of Birds Observed Vs Location Number--White-winged Scoters



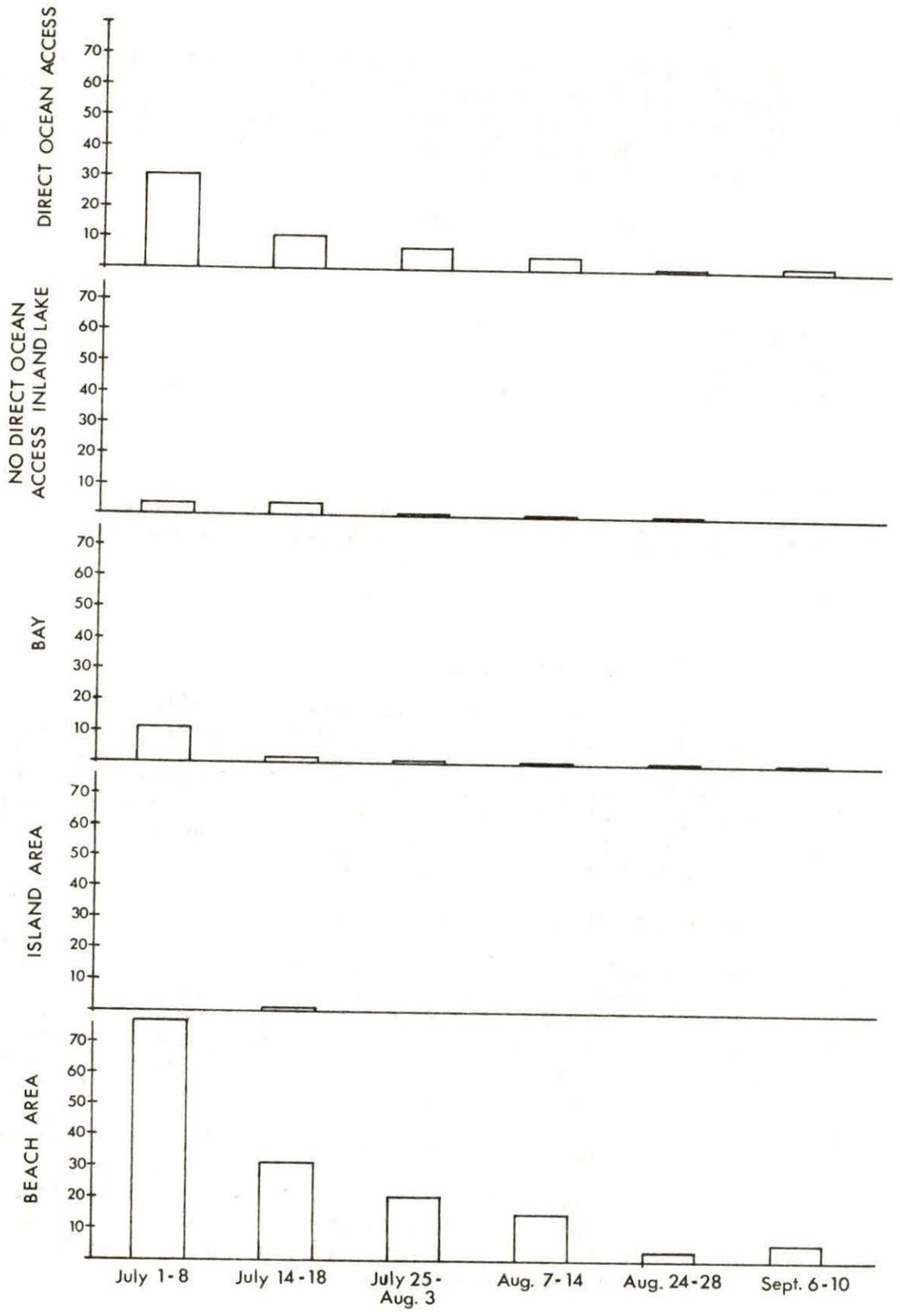


FIGURE 60. Average Number of White-winged Scoters per Waterbody by Waterbody Type, 1 July to 10 September 1974.

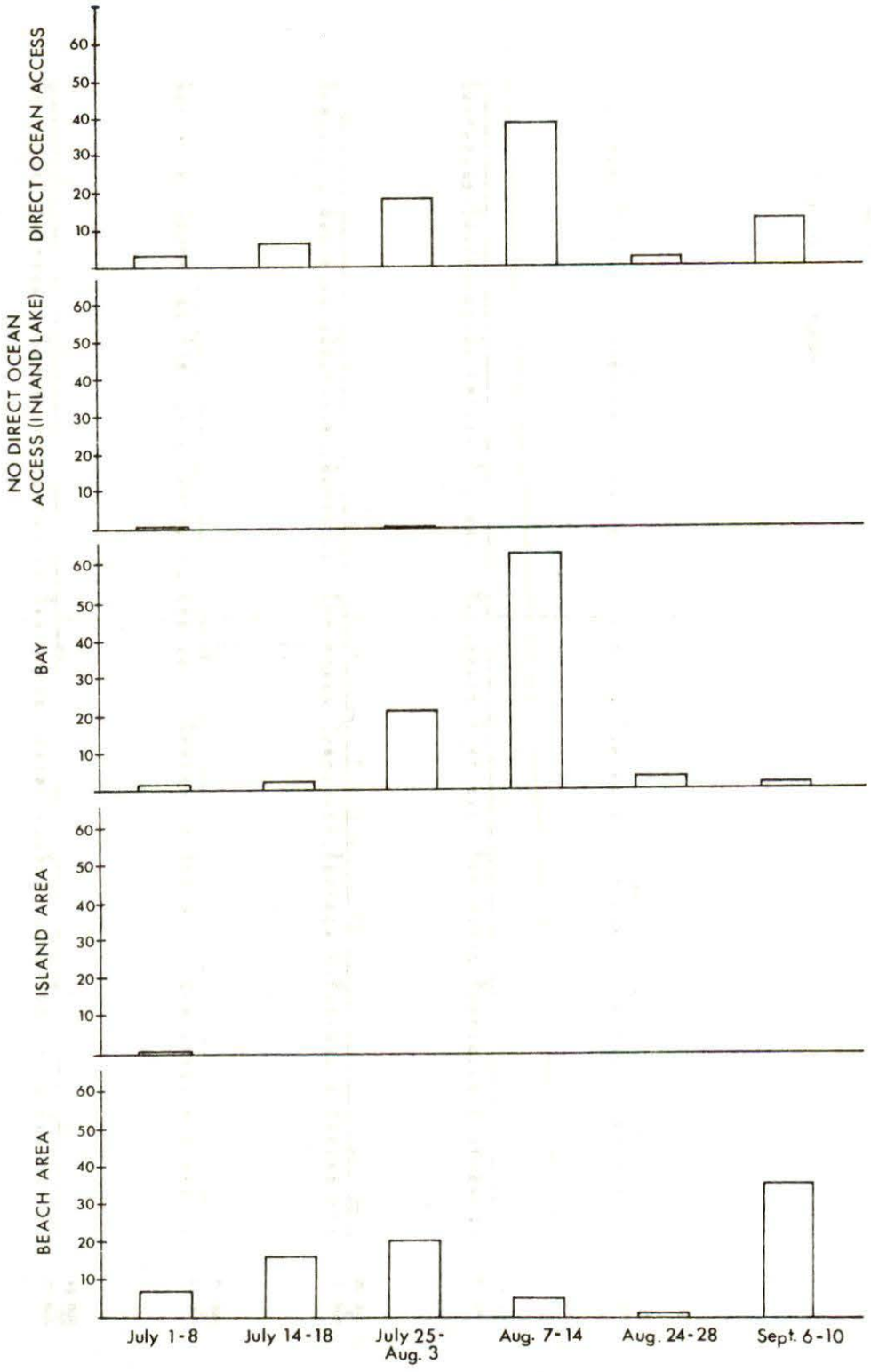


FIGURE 62. Average Number of Surf Scoters per Waterbody by Waterbody Type, 1 July to 10 September 1974.

Premigratory Movements and Fall Migration

In 1974, the largest concentration of Surf Scoters was sighted during the second week of August at Cape Dalhousie; during this period over 1700 birds of this species gathered briefly in a moulting or staging congregation. Several small flocks that numbered as many as 300 Surf Scoters were observed during July. These flocks were located on the north and south side of the Tuktoyaktuk Peninsula, on Phillips Bay, and on the south side of Herschel Island (where at least 250 birds remained into early September). According to Vermeer and Anweiler (1975), the annual concentration of Surf Scoters on the south side of Herschel Island is the largest concentration of moulting birds of this species on the Yukon coast (see also Ward and Sharp 1974).

Over 400 Surf Scoters were observed passing Hansen Harbour during the last week of August 1972, and small numbers of this species were seen passing all migration watch sites during late August and early September (with the exception of Cape Dalhousie).

During 1974, Surf Scoters were seen as late as 6 October, when a flock of 20 were sighted in Kugmallit Bay. The migration route of this species is probably similar to that used by White-winged Scoters (Johnson *et al.* In Press).

Melanitta nigra: Black Scoter

The Black Scoter occurs in the Beaufort Sea in relatively small numbers (Jacobson 1974). During aerial surveys conducted during July 1974, four birds of this species were sighted on the mainland bays and beaches near Herschel Island, and a total of 23 were sighted on two lakes on the Tuktoyaktuk Peninsula. However, the majority of Black Scoters recorded during this study were sighted along the beaches on the north shore of Liverpool Bay, which is possibly a premigratory staging area for this species; 90 birds of this species were seen there on 7 September. Little is known about the Black Scoter in the eastern Beaufort Sea, and whether birds of this species migrate to wintering areas on the east coast or join Black Scoters in the Pacific is unknown.

Mergansers

Previous to the 1974 phase of this study, the Red-breasted Merganser has been the only merganser species commonly recorded in the eastern Beaufort Sea; during 1974, however, large numbers of Common Mergansers were also observed in this area.

During 1974, mergansers were usually locally distributed in coastal areas (Figures 64 and 65) and were seen in small numbers except during the moulting period; at this time (typically during July and August) these birds gather into large flocks (Figure 64). Migration of mergansers from the Beaufort Sea area does not begin until late August or early September (Figure 63), and some of these birds may remain in the eastern Beaufort Sea area until freeze-up.

MERGANSERS

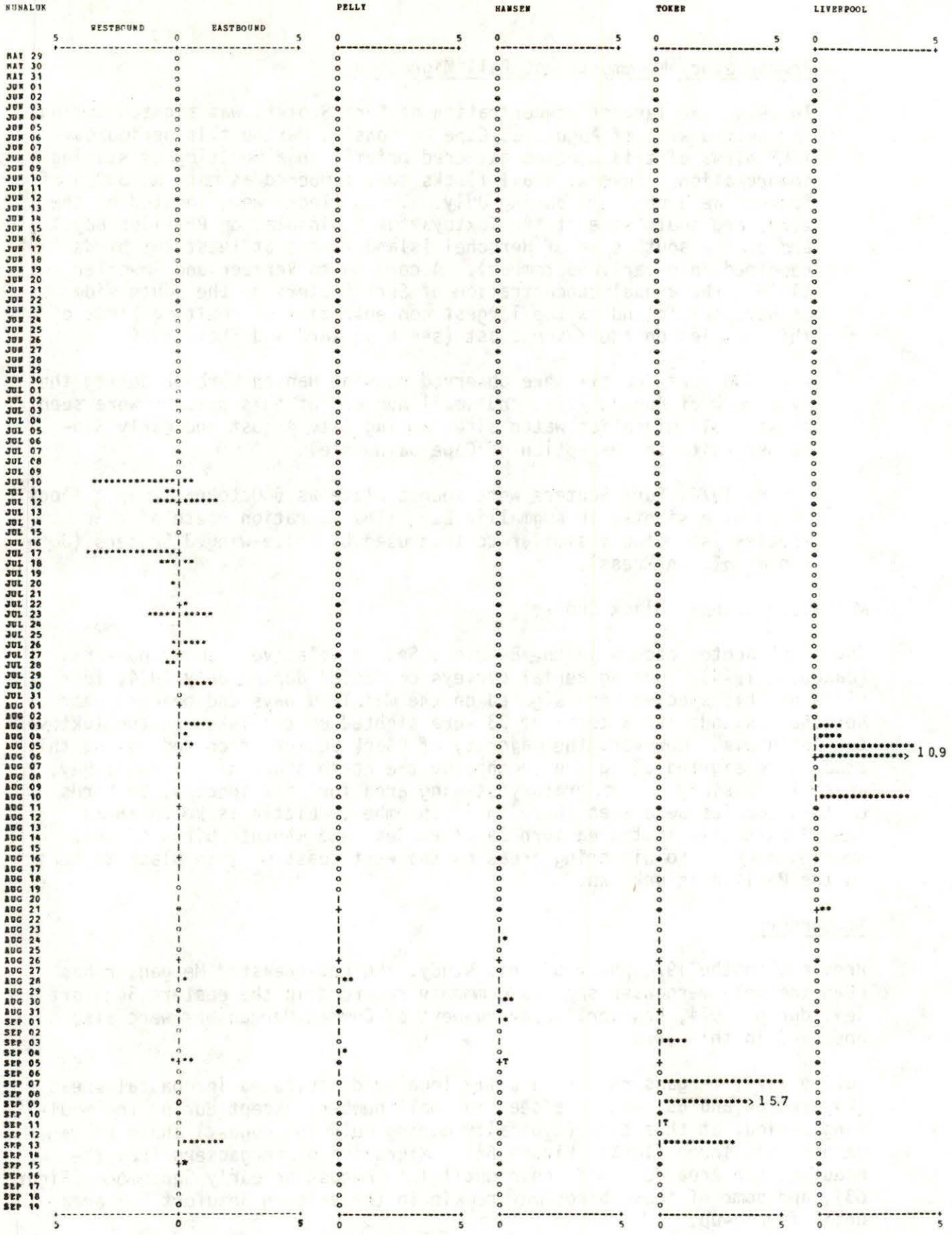
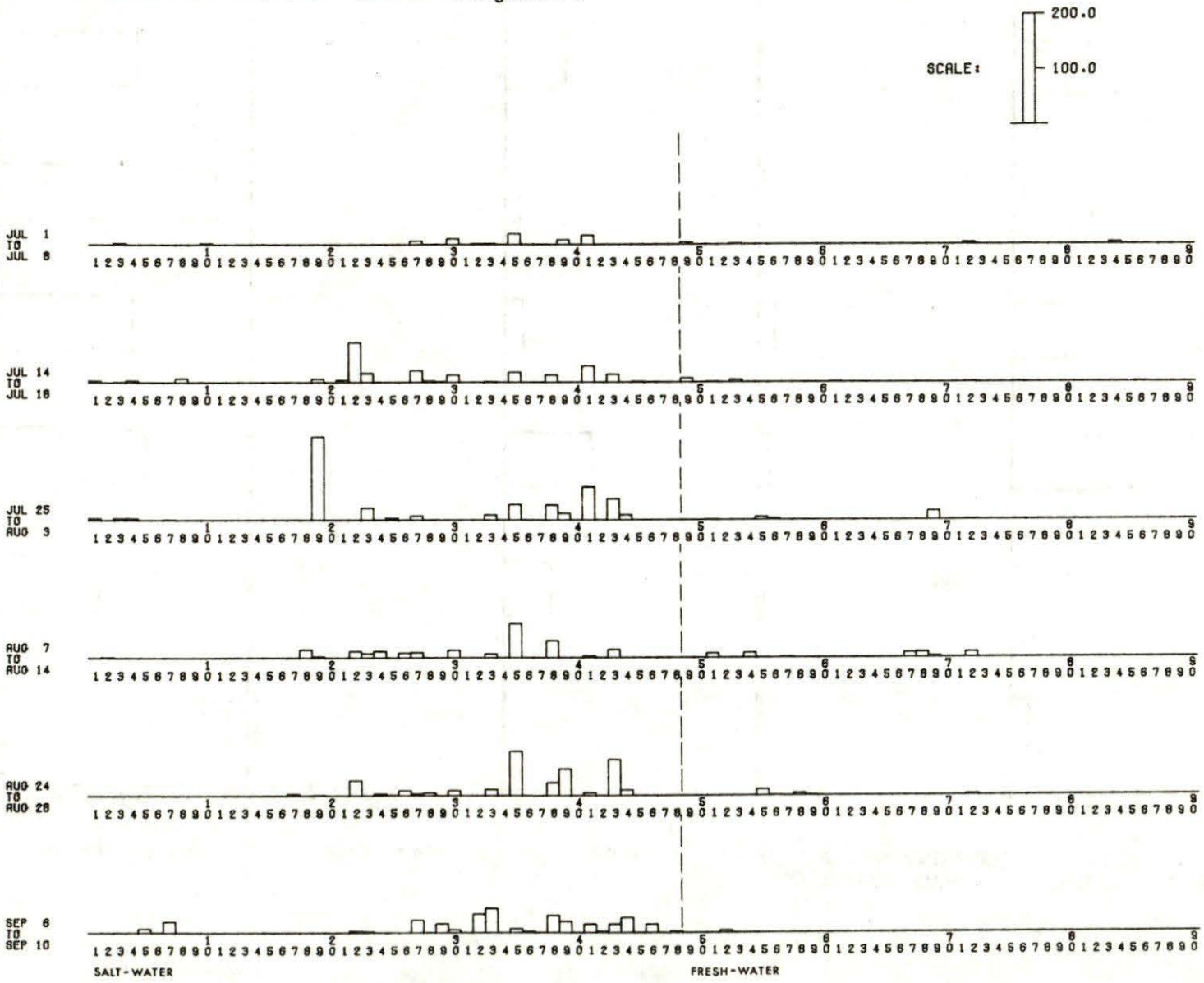


FIGURE 63. Number of Birds per Hour Observed Passing Coastal Migration Watch Stations in the Yukon and Northwest Territories in 1972. Only Locations Where Birds were Observed are Presented.

FIGURE 64. Beaufort Sea 1974 Barrier Beach Data--Number of Birds Observed Vs Location Number--Mergansers



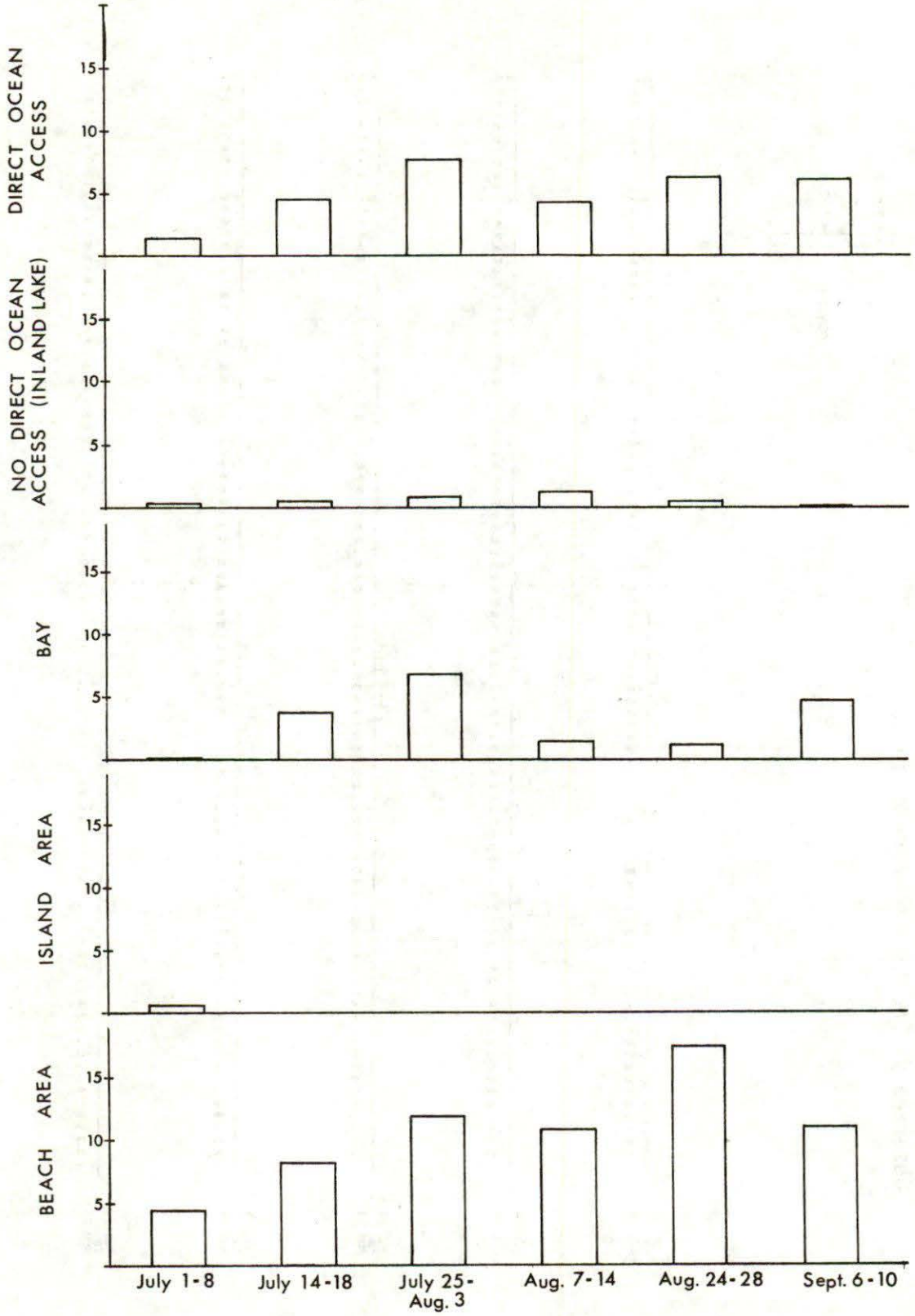
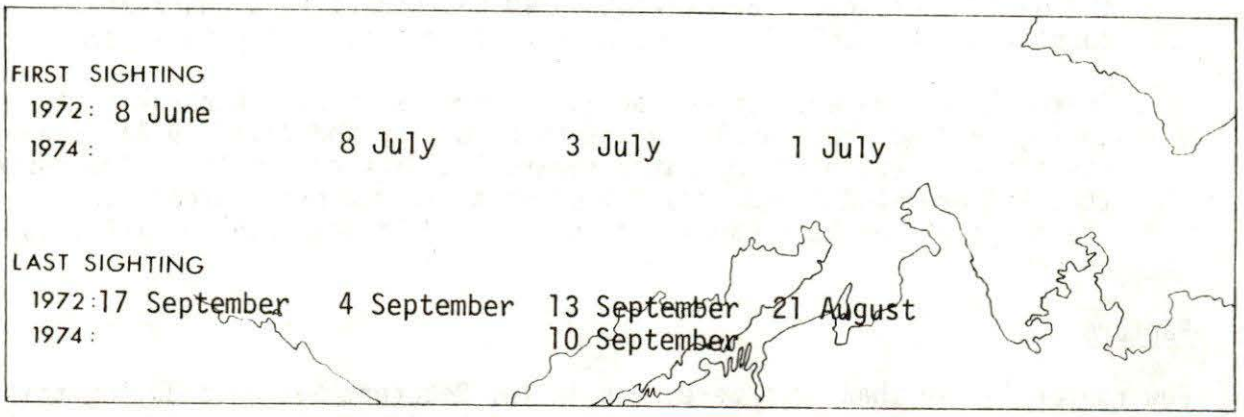


FIGURE 65. Average Number of Total Mergansers per Waterbody by Waterbody Type, 1 July to 10 September 1974.

Mergus merganser: Common Merganser

The first published record of a Common Merganser in the Beaufort Sea area consisted of a report of one bird of this species on the Babbage River on 1 June 1972 (Gollop *et al.* 1974b). This species typically breeds north to the southern Yukon Territory and Great Slave Lake, N.W.T. (Godfrey 1966). The year 1974 was unusual, however, because more than 2000 Common Mergansers were sighted during July in the eastern Beaufort Sea (T. Barry pers. comm.); also, two moulting birds of this species were collected during July and August of this year (Kuyt 1974). These records consisted of observations of males on the Tuktoyaktuk Peninsula; more particularly, the majority of these birds were sighted on the north shore of Liverpool Bay and on the Eskimo Lakes. None were seen offshore. The cause of this movement of Common Mergansers to the Arctic is unknown.

Mergus serrator: Red-breasted Merganser



Present Status and Spring Migration

This species occurs commonly in specific areas in the Beaufort Sea region although the published literature indicates that its numbers in these areas may fluctuate markedly from year to year (Gabrielson and Lincoln 1959; Porsild 1943; Gollop and Davis 1974a). Red-breasted Mergansers were seen in small numbers during spring migration in 1972. During 1972, the first record of a Red-breasted Merganser in the study area was obtained on 8 June at Nunaluk Spit. A small movement of these birds past Nunaluk was observed from this date until 13 June; most of these birds (12 of 14) flew east.

Summer Distribution and Premigratory Movements

In 1974, 70 of the Red-breasted Mergansers recorded were sighted during aerial surveys conducted during July in the Tuktoyaktuk area. Of these birds, 17 (24%) were seen south of Tuktoyaktuk in the Eskimo Lakes region; the rest were seen on lakes and ocean areas on the north side of the Tuktoyaktuk Peninsula. In 1972, moderate numbers of mergansers were also sighted during July at Nunaluk Spit. It is probable that

these birds were males that were gathering into moulting flocks or that were undergoing their post-nuptial moult. Forty moulting Red-breasted Mergansers were sighted off Tuktoyaktuk on 18 July 1974.

Large numbers of Red-breasted Mergansers were seen from a skiff on Liverpool Bay during early August 1972. These birds may have been either moulting or staging males.

Fall Migration

Red-breasted Mergansers begin their migration from the study area during late August or early September. During 1972 at Toker Point, the observed migratory movement of this species reached a peak rate of 15.7 birds/hr on 9 September (Figure 66). The last sighting was recorded on 17 September at Nunaluk Spit, but this species frequently remains in the Beaufort Sea until freeze-up, which in some years occurs well into the middle of October. During aerial transect surveys over the Beaufort Sea during 1974, 10 males of this species were seen flying offshore near Tuktoyaktuk on 10 September; this observation constituted the only fall record of this species during this year.

That autumn movements of Red-breasted Mergansers past Nunaluk Spit during 1972 were primarily to the east (Gollop and Davis 1974a) suggests that these birds migrated toward the Mackenzie Delta. The route that Red-breasted Mergansers follow to their wintering areas along the coast of southern Canada and the United States (Godfrey 1966) is unknown.

Raptors

Few raptors other than owls were seen in the Beaufort Sea area during this study. Of the records of raptors that were obtained, the majority consisted of observations of Rough-legged Hawks (*Buteo lagopus*). Accipiters and falcons were seen on less than 30% of the days during which observations were conducted (Figure 67). That no more than a single raptor was generally seen during any particular day of observation indicates a widespread distribution and low density of these birds in the study area. However, several raptors were observed on several days; most of these observations were recorded during migratory movements of these birds. During spring, raptors are among the earliest birds to arrive in the Arctic, and they may remain in this area until after freeze-up. Platt (In Press), in fact, has shown that many Gyrfalcons (*Falco rusticolus*) are year-round residents in the northern Yukon.

Buteo lagopus: Rough-legged Hawk

Present Status and Spring Migration

The Rough-legged Hawk is the most common *Buteo* species near the coast of the Beaufort Sea (Porsild 1943); the breeding range of this species in Canada is almost solely confined to areas north of the tree line and south of the high Arctic (Godfrey 1966).

RED-BREASTED MERGANSER

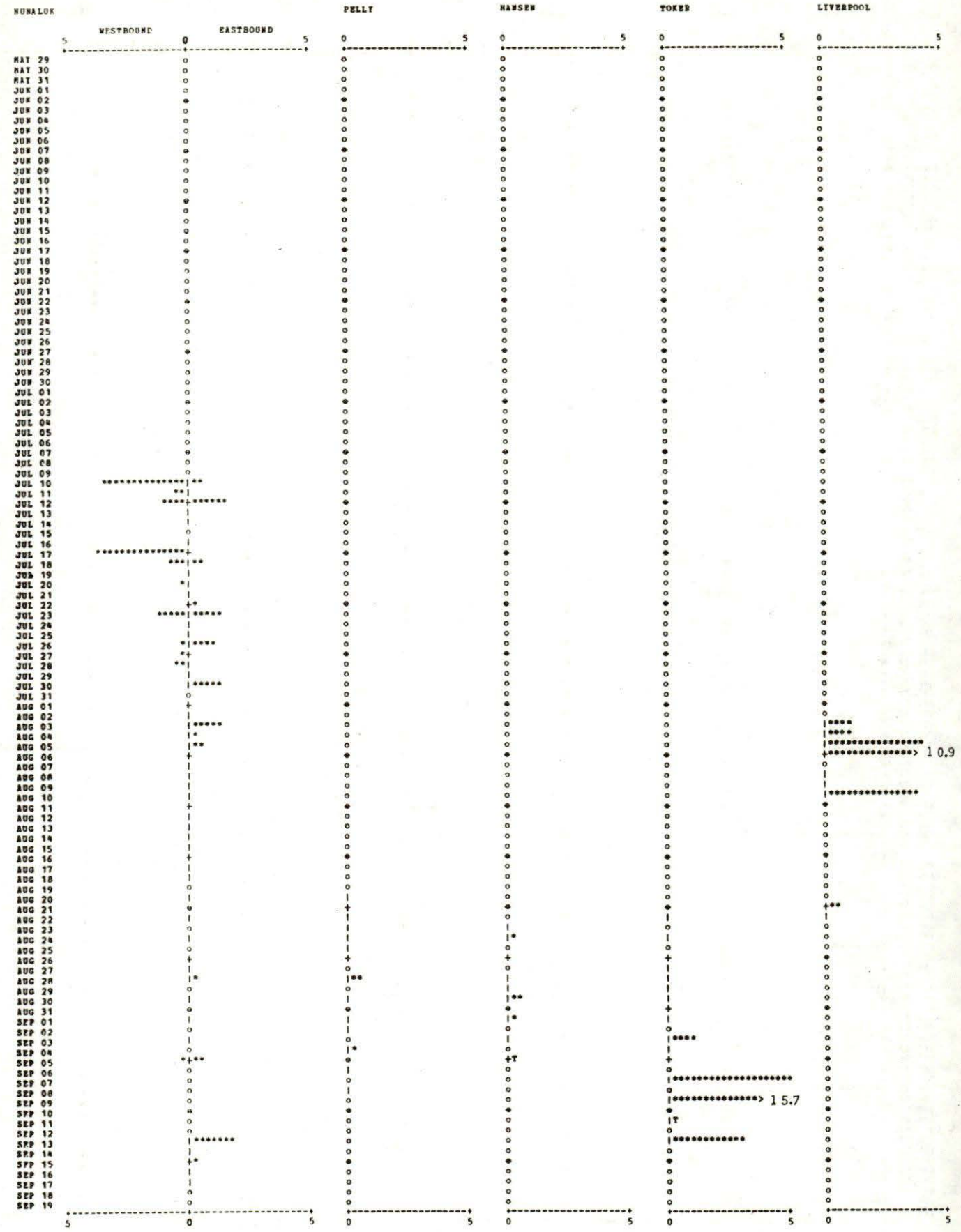


FIGURE 66. Number of Birds per Hour Passing Coastal Migration Watch Stations in the Yukon and Northwest Territories in 1972. Only Locations Where Birds were Observed are Presented.

RAPTORS (EXCLUDING OWLS)

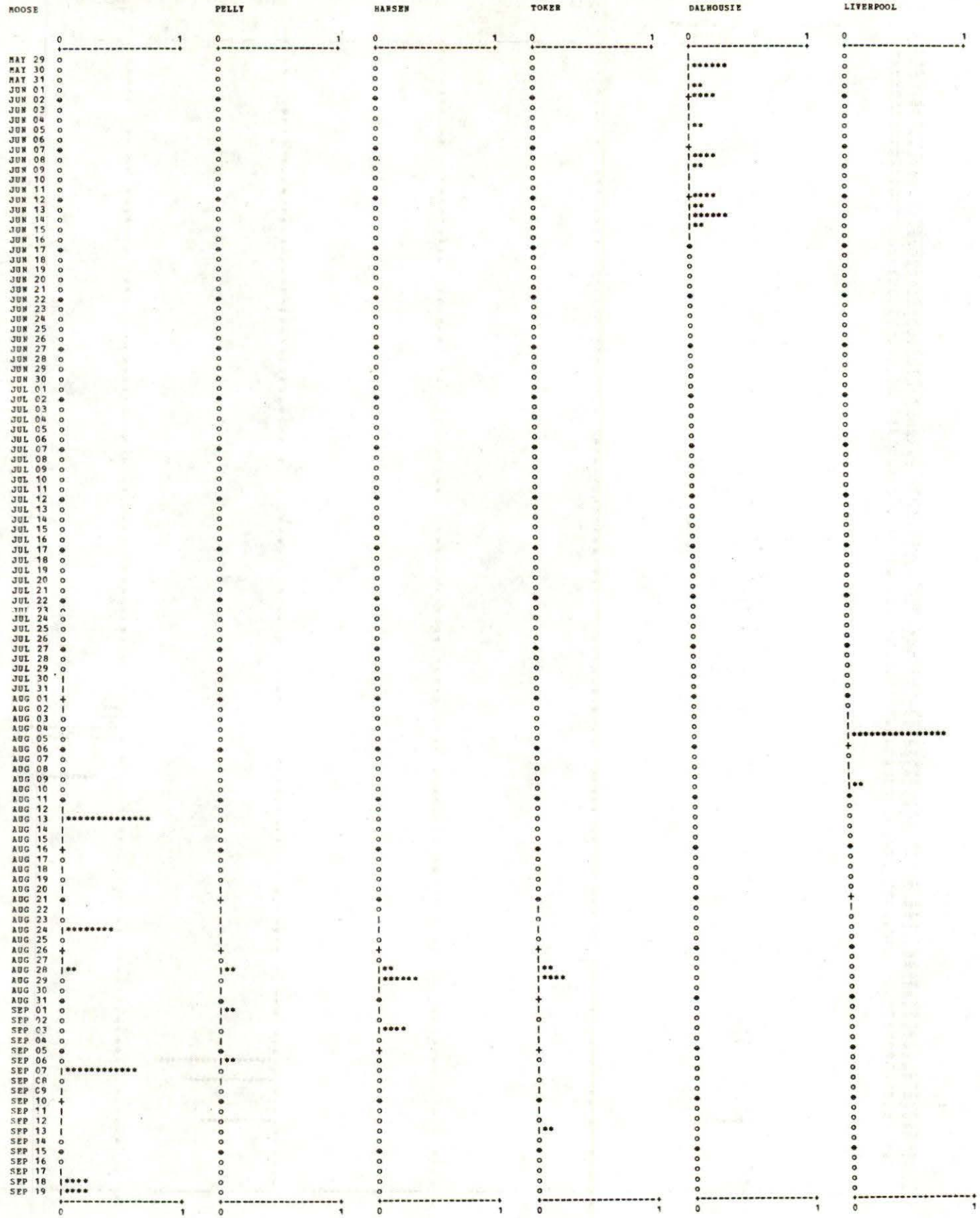


FIGURE 67. Number of Birds per Hour Observed Passing Coastal Migration Watch Stations in the Yukon and Northwest Territories in 1972. Only Locations Where Birds were Observed are Presented.

During 1972, the first sightings of Rough-legged Hawks during the present study were made on 30 May, when two of these hawks were seen at Cape Dalhousie. Sixteen Rough-legged Hawks were sighted at this location between 30 May and 14 June. However, Platt (1975) reported that egg laying by Rough-legged Hawks on the Yukon North Slope occurs in early May; hence sightings in late May and early June were probably not of migrating birds.

Summer Distribution and Fall Migration

Few mid-summer sightings of this species were obtained during this study; two Rough-legged Hawks were sighted in July 1974 during aerial surveys over Richards Island; and two were sighted on 5 August 1972 near Liverpool Bay.

Rough-legged Hawks were more frequently observed during late August and September. Single birds of this species were observed from shore at Nunaluk Spit (one sighting), Pelly Island (two sightings), and Cape Dalhousie (one sighting) during late August 1972. Three Rough-legged Hawks were sighted during September 1972 at Moose Channel; the latest 1972 record of this species was obtained on 19 September. The only autumn sighting of this species during 1974 was recorded at Phillips Bay on 10 September.

Aquila chrysaetos: Golden Eagle

According to Godfrey (1966), the Golden Eagle is a scarce, local resident in Canada; the breeding range of this species extends north to the coast of the Beaufort Sea. Platt (1975) has outlined the chronology of the annual cycle of Golden Eagles in the northern Yukon.

During the 1972 phase of this study, six Golden Eagles were observed from mid to late August; the locations of these sightings were widely spaced from Liverpool Bay to Nunaluk Spit. During 1974, 29 Golden Eagle sightings were made during aerial surveys of the coastal Beaufort Sea conducted between 4 July and 8 September. The locations of these sightings were also broadly distributed. These 1974 records represent a minimum of 16 and a possible maximum of 36 Golden Eagles. It is probable, however, that some of these birds were recounted during the 1974 study period.

Haliaeetus leucocephalus: Bald Eagle

The Bald Eagle nests in small numbers in the Mackenzie Delta; this species nests usually in trees (Godfrey 1966) but occasionally on the ground (Bromley and Trauger 1974). Two Bald Eagles were sighted during each year of this study. Two sightings of this species were recorded at Moose Channel during 1972: one on 24 August and another on 7 September. During 1974, two Bald Eagles were sighted from the air at lakes on opposite sides of the Mackenzie Delta: one was observed near Tuktoyaktuk on 8 September, and the other was seen on 8 July near Phillips Bay.

Circus cyaneus: Marsh Hawk

Although Marsh Hawks do not breed in the Beaufort Sea area, they have been recorded as far north as the Yukon coast (Godfrey 1966). During 1972, a Marsh Hawk was sighted on 9 June at Cape Dalhousie. During this study, most of the records of Marsh Hawks were obtained at Moose Channel, in the Mackenzie Delta; six birds of this species were observed at this location in 1972. One Marsh Hawk was sighted at Nunaluk Spit on 28 August 1972, and the latest 1972 sighting of this species was recorded on 13 September at Toker Point, on the Tuktoyaktuk Peninsula.

During the 1974 phase of this study, the first Marsh Hawk was seen flying southeast over open water in Liverpool Bay on 6 June. Only one other Marsh Hawk--a single bird in the outer Mackenzie Delta at a lake near Phillips Bay--was recorded during 1974.

Falco rusticolus: Gyrfalcon

Gyrfalcons breed sparsely on rock cliffs along river bluffs throughout the Arctic (Godfrey 1966). Platt (1974; in prep.) has studied this species on the Yukon North Slope. Falcons of this species were sighted from late August to mid-September during the 1972 phase of this study. On 28 August, two sightings of this species were recorded at Hansen Harbour, on Richards Island, and one was recorded at Cape Dalhousie. The latest 1972 record of this species in the study area consisted of a single bird observed at Moose Channel on 19 September.

Only one Gyrfalcon was observed in the study area during 1974. The Gyrfalcon was sighted at a lake near Tuktoyaktuk on 24 August.

Falco peregrinus: Peregrine Falcon

Peregrine Falcons breed in specific inland areas throughout the entire southeastern Beaufort Sea area (Godfrey 1966). Seven Peregrine Falcons were sighted in the study area during the period from mid-August to mid-September 1972. These sightings were limited to the region from the Mackenzie Delta west to Nunaluk Spit. No Peregrine Falcons were sighted during 1974.

Falco columbarius: Merlin

Merlins breed in particular wooded portions of the Mackenzie Delta and are widely distributed in these portions (Godfrey 1966). Three Merlins were sighted during late August and early September of 1972 at Moose Channel, in the Mackenzie Delta. No falcons of this species were observed in the study area during 1974.

Ptarmigan

Two species of ptarmigan--the Rock Ptarmigan (*Lagopus mutus*) and the Willow Ptarmigan (*Lagopus lagopus*)--occur along the coast of the eastern Beaufort Sea. The Rock Ptarmigan is the species that is most frequently associated with the high Arctic, and its year-round occurrence in the high Arctic makes it one of the few truly northern species. Although the Rock Ptarmigan is a common resident of the Beaufort Sea coast, it is not abundant in all areas along this coast (Porsild 1943), and in many areas of the Mackenzie Delta Willow Ptarmigan are more abundant. During the 1972 phase of this study, ptarmigan were recorded from 30 May to 15 June and only at Cape Dalhousie; as many as 12 ptarmigan were seen during a single day of observation. During 1974, observations of ptarmigan were more widely distributed both temporally and spatially but were still confined to the Tuktoyaktuk Peninsula. Sightings of these birds were recorded during the first two weeks of July and during the first half of September. A flock of 20 ptarmigan was sighted at Cape Dalhousie on 8 September 1974.

Cranes

Grus canadensis: Sandhill Crane

Present Status and Spring Migration

The Sandhill Crane breeds regularly but not in large numbers along the arctic coast of the Beaufort Sea (Martel in prep.). Large flocks of this species, however, occur in this area during migration. During 1972, the earliest sighting of Sandhill Cranes in this study area was recorded on 2 June at Cape Dalhousie. A small movement of this species past the cape commenced on 2 June, peaked on 8 June, and lasted until 14 June. Sandhill Cranes have been known to arrive in the study area in early May (Porsild 1943), and during aerial surveys conducted on 20 May 1975 several territorial pairs of this species were observed south and northeast of Big Lake, on Richards Island (W. Koski pers. comm.).

Summer Distribution and Habitat Preferences

During the 1974 phase of this study, small numbers of Sandhill Cranes were counted during July and August on the islands in Mackenzie Bay and along the Tuktoyaktuk Peninsula. One small concentration of 43 Sandhill Cranes was recorded at a lake near Tuktoyaktuk on 8 September. More Sandhill Cranes were seen on islands than in mainland habitats; these birds preferred lakes over coastal bays and beaches (Figure 69).

Fall Migration

The fall migration of this species from the study area apparently begins from early to mid-August; during 1972, this migration reached a peak on 16 August, when 5.2 birds/hr were recorded passing Moose Channel, in the Mackenzie Delta. The observed volume of migration had declined to 2.7 birds/hr by 20 August and fell to a very low level

SANDHILL CRANE

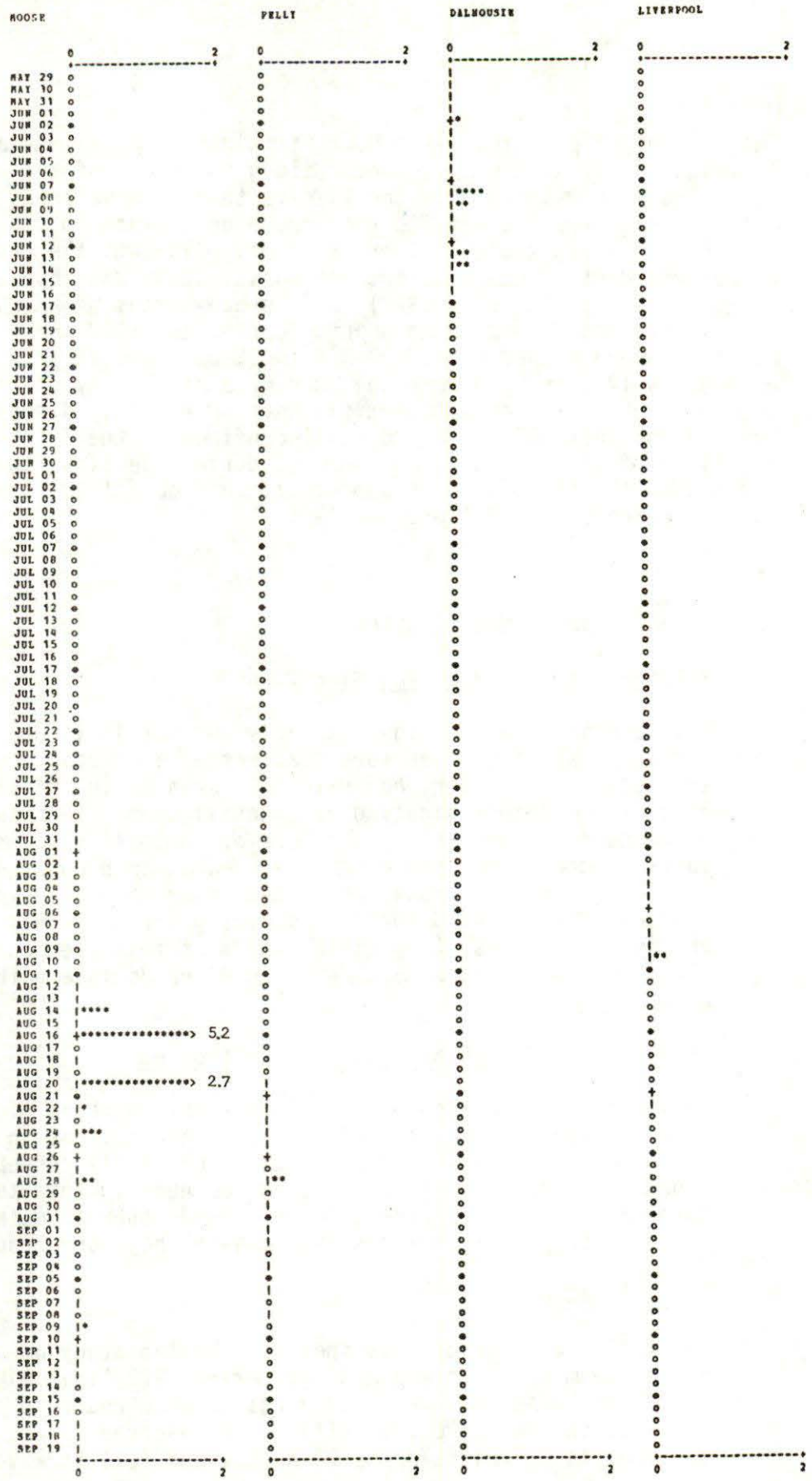


FIGURE 68. Number of Birds per Hour Observed Passing Coastal Migration Watch Stations in the Yukon and Northwest Territories in 1972. Only Locations Where Birds were Observed are Presented.

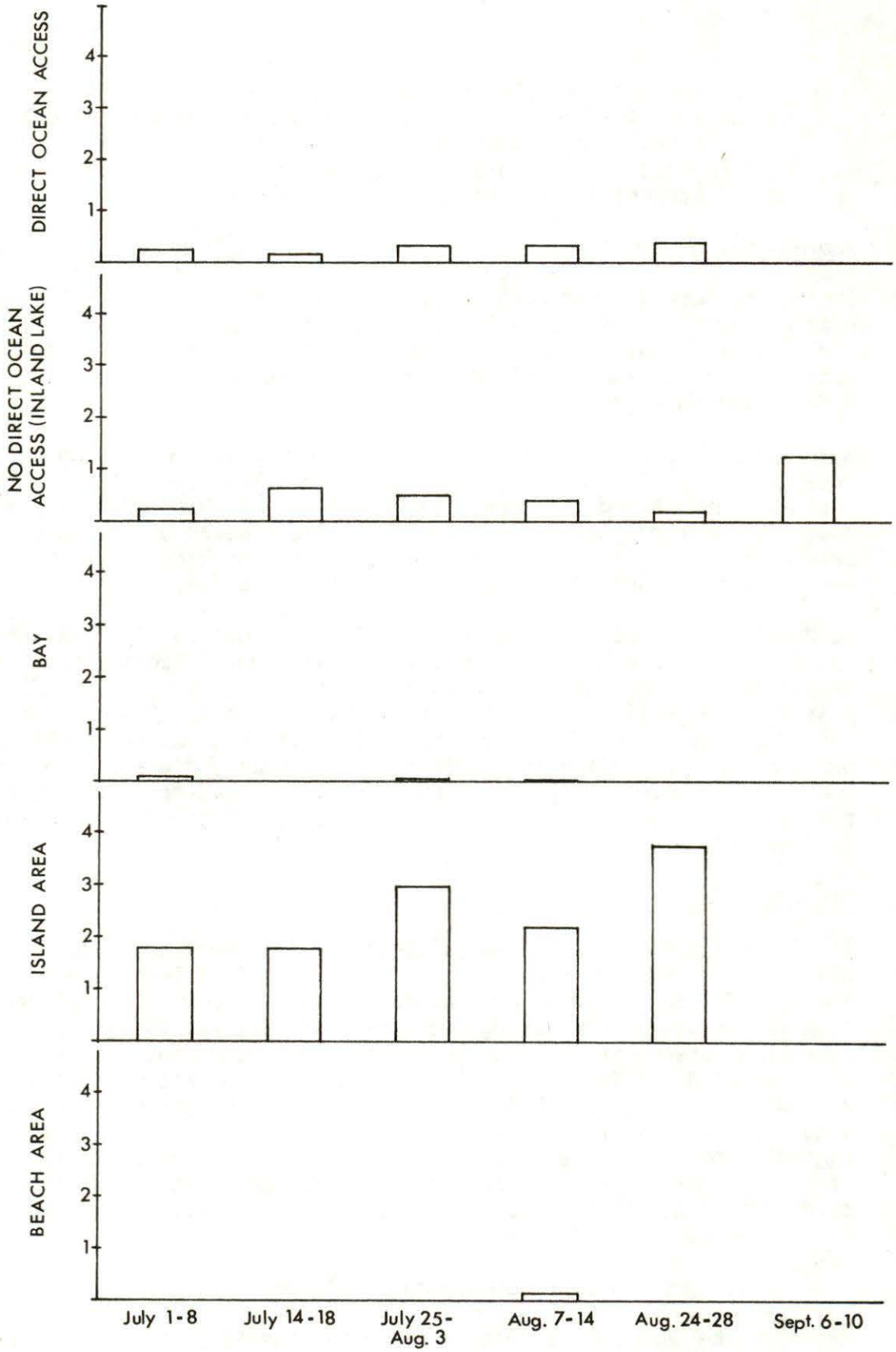


FIGURE 69. Average Number of Sandhill Crane per Waterbody by Waterbody Type, 1 July to 10 September 1974.

(less than 0.3 birds/hr) thereafter (Figure 68). The last 1972 sighting of this species in the study area was recorded on 9 September at Moose Channel. Few Sandhill Cranes were seen elsewhere along the southeastern Beaufort Sea coast. Birds of this species apparently migrate up the Mackenzie River Valley (Salter 1974b).

Shorebirds

Shorebirds form a major portion of the avifauna of the coastal areas of the Beaufort Sea. During 1972, 21 of 30 shorebird species known to occur regularly in the Beaufort Sea area were recorded. Unfortunately, spring observations were terminated before shorebird migration ceased; consequently, data on spring migration are incomplete.

Shorebirds were not very conspicuous from the ground or during aerial surveys during the July nesting season; as a result, few records of these birds were obtained during this month in both 1972 and 1974. By the end of July, however, and throughout all of August, large numbers of shorebirds were observed in the section of the Mackenzie Delta from Richards Island in the east to Nunaluk Spit in the west (Figures 70 and 71).

At Nunaluk Spit the volume of autumn migration was fairly constant throughout August (Figure 70). The amount of migration at Moose Channel rose to a marked peak during the third week in August; as many as 200 to 350 birds/hr passed the migration watch station during this week. Shorebird migrations continued until mid-September, but most of these birds leave the Arctic by early September. Although shorebirds occasionally migrate along coastlines, their normal mode of migration involves long, broad-front movements at high altitudes; these movements are very inconspicuous to ground observers (Richardson 1975).

Plovers

Three species of plovers--Semipalmated Plover, American Golden Plover, and Black-bellied Plover--occur in the eastern Beaufort Sea; however, only the American Golden Plover occurs abundantly in this area. Few plovers were seen in the study area during the spring of 1972 and 1974; the majority of plovers observed during this study were recorded during the fall migration of these birds in 1972; the bulk of this migration occurred during the second half of August. This migratory movement consisted mostly of American Golden Plovers and reached a peak during the third week of August. The highest number of plovers was seen in the Mackenzie Delta, where rates of from 25 to more than 250 birds/hr were recorded at three different sites on several days during this week (Figure 73). Few plovers were seen in the study area during September.

Charadrius semipalmatus: Semipalmated Plover

Although the Semipalmated Plover has been classified as a common breeder along the Beaufort Sea coast (Porsild 1943; Godfrey 1966), only one sighting of this species was made during this study: three Semipalmated Plovers were sighted on 16 August 1972 at Moose Channel, in the Mackenzie Delta.

TOTAL SHOREBIRDS

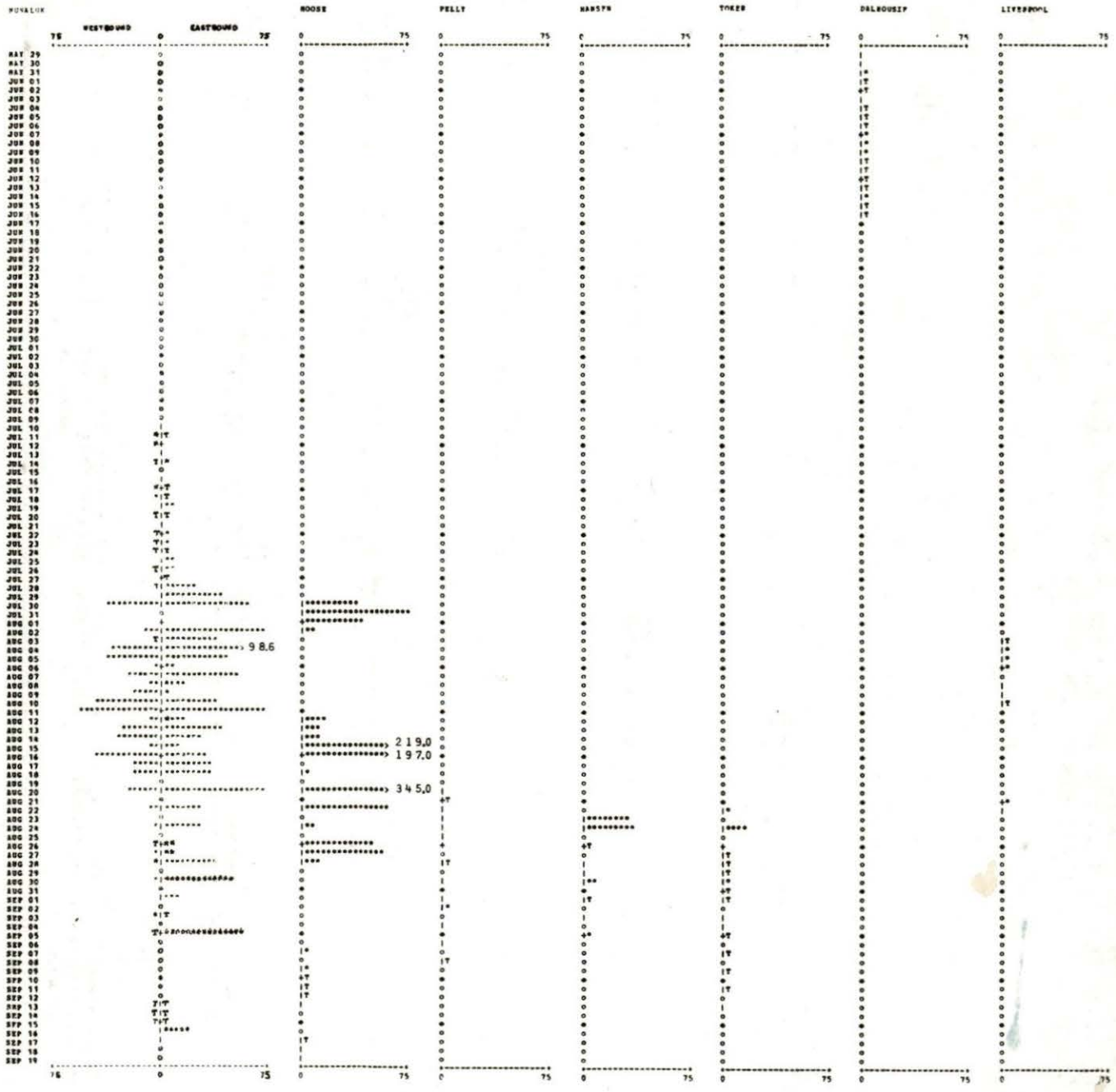
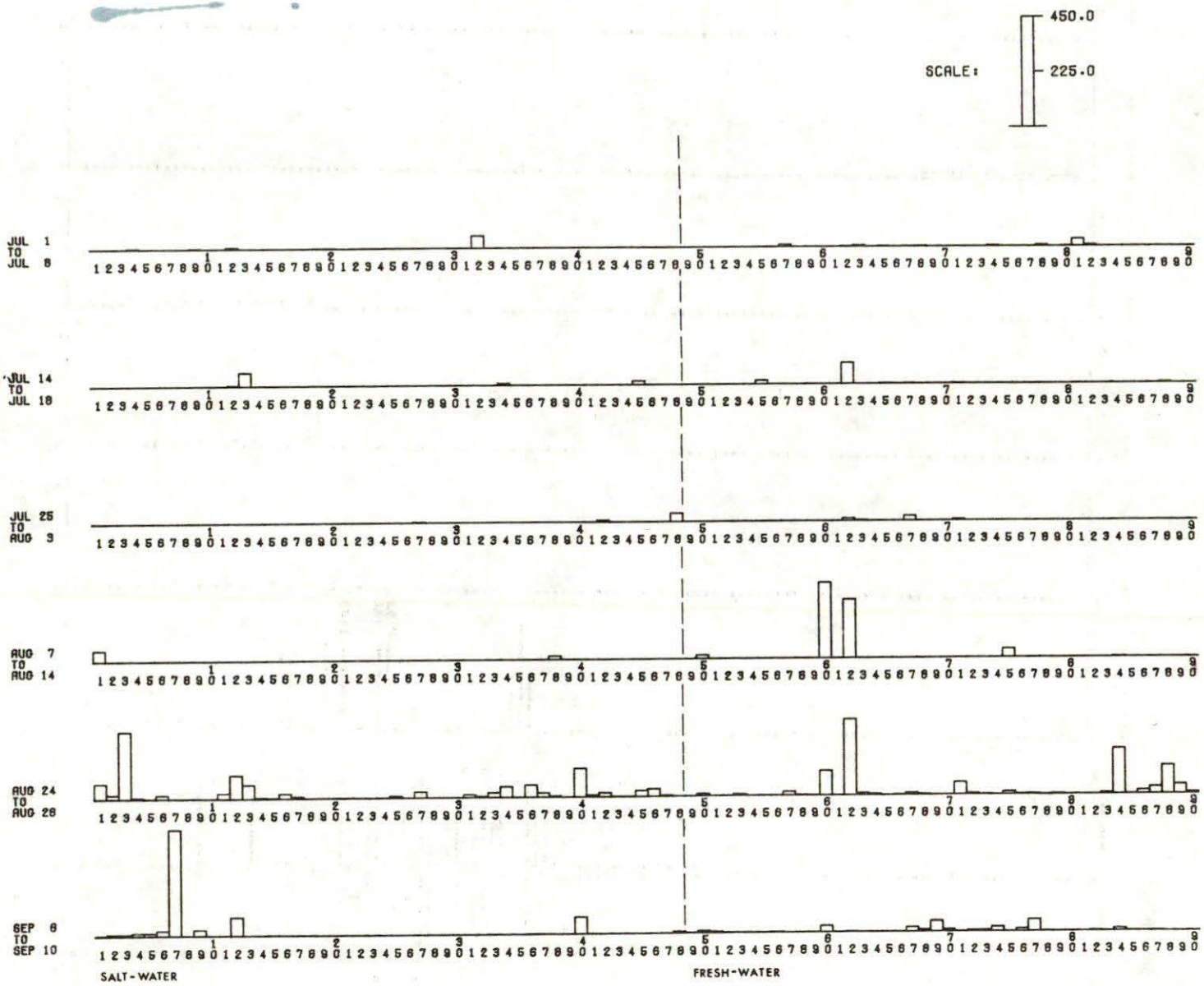


Figure 70. Number of Birds per Hour Observed Passing Coastal Migration Watch Stations in the Yukon and Northwest Territories in 1972. Only locations where birds were observed are presented.

FIGURE 71. Beaufort Sea 1974 Barrier Beach Data--Number of Birds Observed Vs Location Number--Shorebirds



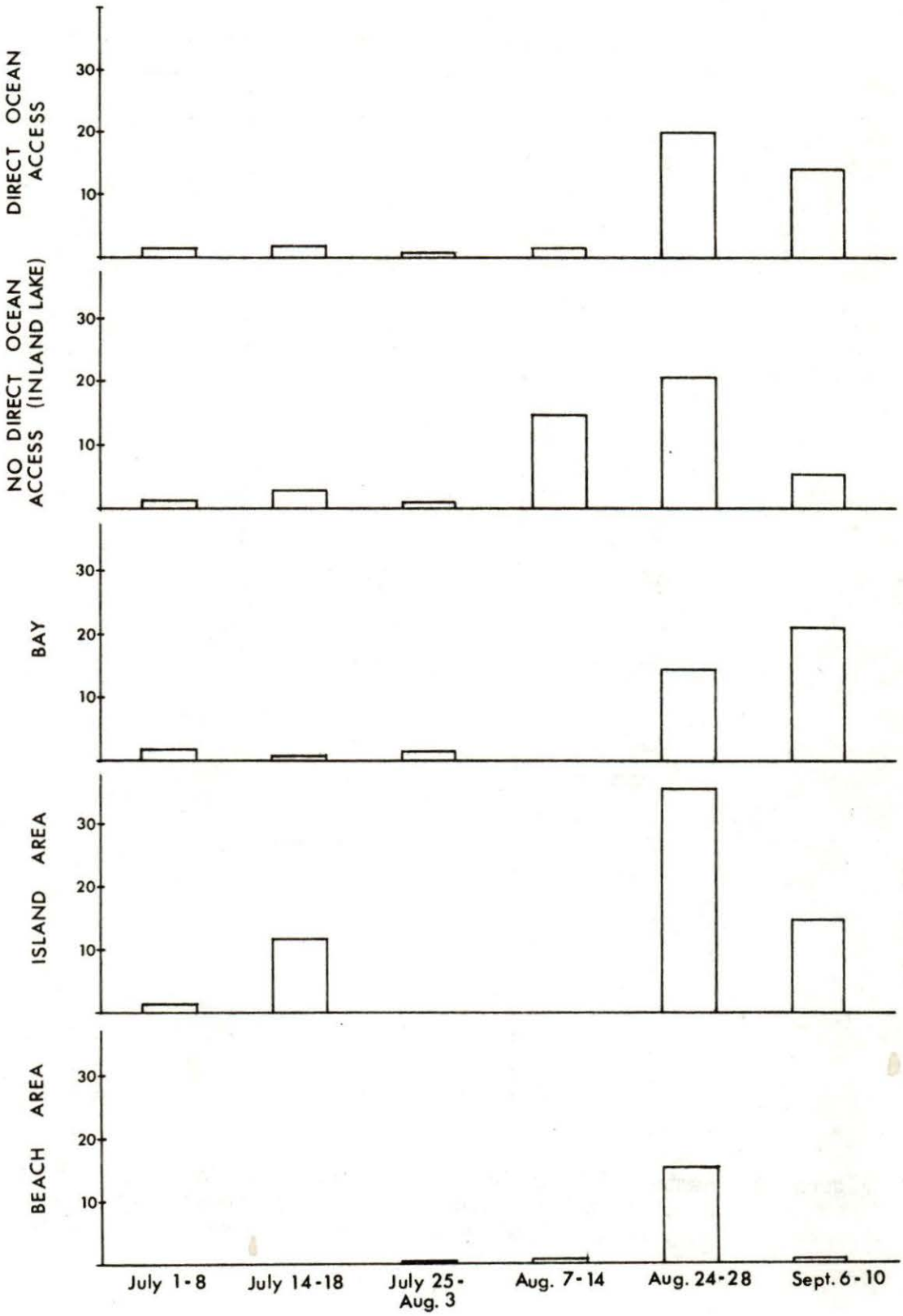


FIGURE 72. Average Number of Total Shorebirds per Waterbody by Waterbody Type, 1 July to 10 September 1974.

PLOVERS

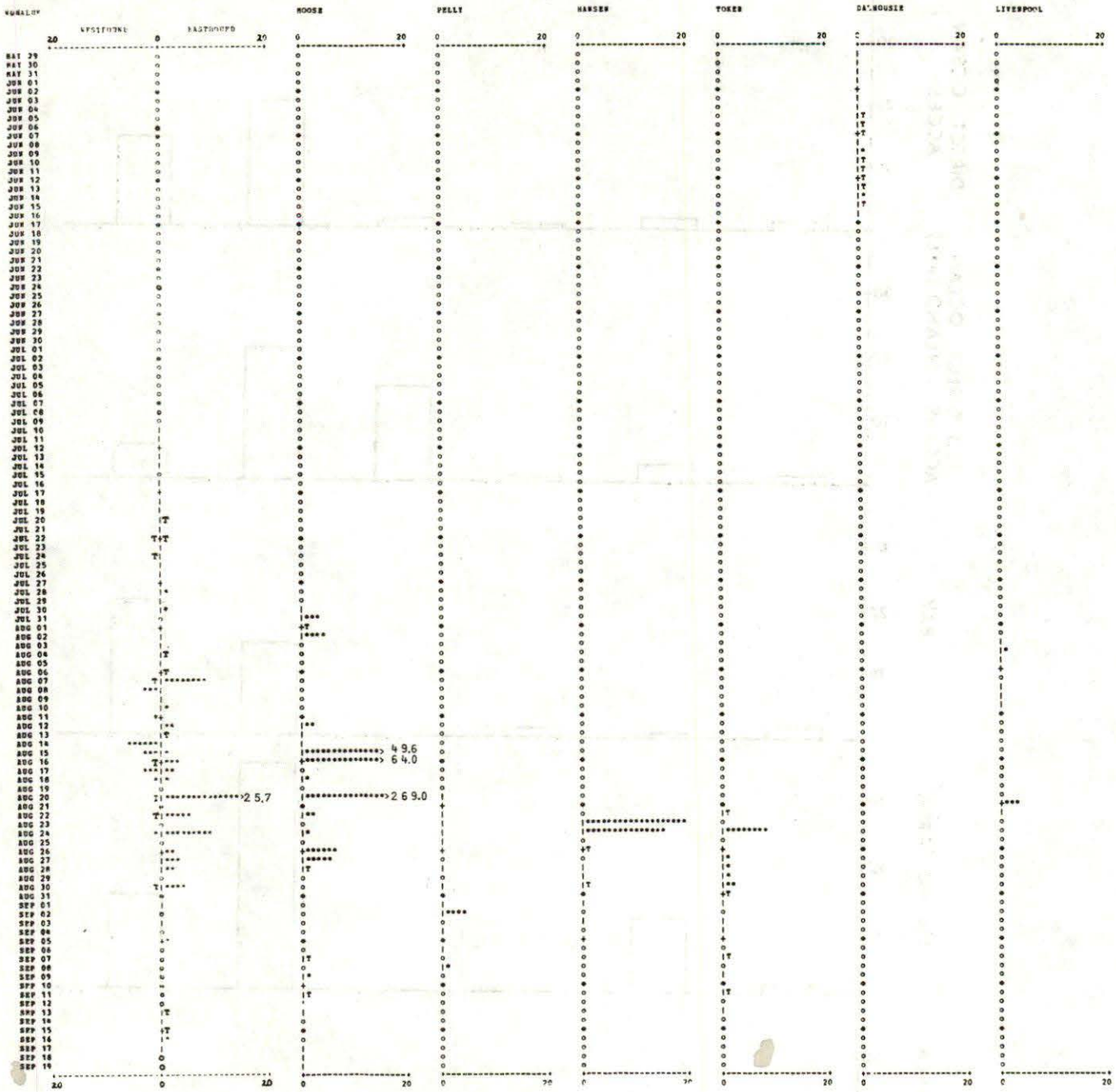


Figure 73. Number of Birds per Hour Observed Passing Coastal Migration Watch Stations in the Yukon and Northwest Territories in 1972. Only locations where birds were observed are presented.

Semipalmated Plovers were recorded on Richards Island as early as 28 May 1972 by Slaney (1974), and Porsild (1943) reported sightings of many small flocks of this species at Kittigazuit (Mackenzie Delta) between 30 September and 2 October 1934.

Pluvialis dominica: American Golden Plover

The American Golden Plover occurs as a common breeder on the coast of the Beaufort Sea (Porsild 1943; Gabrielson and Lincoln 1959). The earliest arrivals of this species in the study area reach the eastern Beaufort Sea by mid-May; however, the majority of these birds do not arrive in this area until early June (Johnson *et al.* In Press). Very small numbers of this species were detected at Cape Dalhousie and at Nunaluk Spit during the spring migration.

In 1972, no American Golden Plovers were sighted during the July nesting period; birds of this species were not sighted again until 4 August, and by mid-August relatively large numbers were seen daily. The largest observed migrational movement of American Golden Plovers was recorded at Moose Channel during mid-August. This large wave of migration reached a peak on 20 August, when 269 birds/hr were observed moving past the channel. At Nunaluk Spit, 25.8 birds/hr were recorded in migration on 20 August. This movement continued until 30 August; the last 1972 record of this species in the study area was obtained on 16 September. In 1972, American Golden Plovers were also observed in small to moderate numbers during late August at Hansen Harbour and Liverpool Bay and during early September at Pelly Island.

Golden Plovers evidently migrate on a broad front. During late August 1973, Vermeer and Anweiler (1975) observed thousands of Golden Plovers migrating eastward past the south side of Herschel Island; they also mentioned that M.A. Gollop had noted large numbers of American Golden Plovers along the Yukon North Slope. Because Porsild (1943) recorded no American Golden Plovers in the Mackenzie Delta during fall, it is possible that these birds move overland south of the Mackenzie Delta or possibly continue east along the coast of the Beaufort Sea (Gollop and Davis 1974a). Recent observations (Koski pers. comm.) indicate that some American Golden Plovers may migrate up the Mackenzie Valley.

Squatarola squatarola: Black-bellied Plover

Black-bellied Plovers occur in small numbers along the section of the Beaufort Sea coast from Nunaluk Spit to Cape Bathurst and north to Banks Island (Johnson *et al.* In Press). During the 1972 phase of this study, this species was first observed on 7 June at Cape Dalhousie; from this date until 15 June, from one to three birds of this species were sighted daily.

A small number of Black-bellied Plovers was seen frequently at Nunaluk Spit during late July and August 1972. Twenty-three birds of this species were sighted on 8 August, and 26 were sighted on 30 August; less than 15 birds of this species were sighted during most other days of the study period. During late August, Black-bellied Plovers were also sighted at Toker Point

and Moose Channel. The last records of Black-bellied Plovers obtained during 1972 consisted of six birds on 5 September at Nunaluk Spit and of two birds observed on 7 September at Toker Point.

Arenarius interpres: Ruddy Turnstone

Ruddy Turnstones occur commonly along much of the southern coast of the Beaufort Sea (Johnson *et al.* In Press). During this study, Ruddy Turnstones were seen only at Nunaluk Spit in 1972; these birds were observed frequently at this location throughout the month of August. Ruddy Turnstones were first sighted on 4 August; 14 birds of this species were detected on this date. The last Ruddy Turnstone recorded during 1972 was observed on 3 September.

Numenius phaeopus: Whimbrel

Whimbrels nest along the Arctic slope east to the Mackenzie Delta (Slaney 1974), where they commonly breed in upland tundra areas (Porsild 1943; Martel in prep.).

Whimbrels were observed in low numbers at Nunaluk Spit and Moose Channel during the fall of 1972. Eight birds of this species were sighted at Nunaluk between 20 and 30 August. However, Whimbrels were encountered more frequently at Moose Channel. Three Whimbrels were observed on 14 August, and from five to seven birds of this species were seen during each day of observation from 18 to 27 August. The last Whimbrel recorded during the 1972 study period was sighted on 11 September at Moose Channel.

Totanus flavipes: Lesser Yellowlegs

The Lesser Yellowlegs occurs as a common breeder in the Mackenzie Delta but is rare on the open tundra (Porsild 1943; Martel in prep.). During 1972, however, Lesser Yellowlegs were observed at Cape Dalhousie on 13 and 14 June (one and five individuals, respectively) and at Nunaluk Spit on 10 August (one bird). These records were obtained more than 200 km from the nearest northern limit of forest; Cape Dalhousie is 300 km from the forested portion of the Mackenzie Delta.

Calidris canutus: Red Knot

The Red Knot occurs as an occasional breeder and as an uncommon migrant along the southeastern coast of the Beaufort Sea (Johnson *et al.* In Press). This species was rarely seen during this study. Only two records of Red Knots were obtained during 1972: on 8 June, one bird was seen flying east at Nunaluk Spit, and on 26 August another was seen at Moose Channel.

Calidris acuminata: Sharp-tailed Sandpiper

According to Martel (in prep.), Sharp-tailed Sandpipers are accidental visitors to the Mackenzie Delta region. During this study, a single Sharp-tailed Sandpiper was sighted at Moose Channel on 28 August 1972. A second 1972 record of this species was obtained in the northern portion of Richards Island (Slaney 1974) during the fall migration of this species.

Calidris melanotos: Pectoral Sandpiper

The Pectoral Sandpiper is the most common shorebird on the Yukon North Slope (Johnson *et al.* In Press) and is especially abundant in the Beaufort Sea area during fall migration. During the spring of 1972, one bird of this species was seen on 14 June at Cape Dalhousie.

During 1972, large numbers of Pectoral Sandpipers began migrating prior to the middle of August, and a steady movement of this species was noted at Nunaluk Spit (eastward) and Toker Point during the remainder of this month and into the first week of September. The largest numbers of Pectoral Sandpipers, however, were recorded in the Mackenzie Delta. On 16 August 1972, a movement of 114 birds/hr was recorded passing Moose Channel; over 2330 birds of this species were counted during this day. Peak rates of migration of Pectoral Sandpipers began on 12 August and continued until the end of August--though sandpipers of this species were still seen on the channel until 17 September. Most movements past the Moose Channel migration watch station were to the east. Vermeer and Anweiler (1975) reported thousands of Pectoral Sandpipers moving east past Nunaluk Spit on 9 and 10 August 1973.

Calidris fuscicollis: White-rumped Sandpiper

This Arctic-breeding sandpiper occurs uncommonly throughout much of its range (Johnson *et al.* In Press). White-rumped Sandpipers were observed along the coast from Cape Dalhousie to Nunaluk Spit during 1972. Most of the White-rumped Sandpipers recorded during this study were observed at Cape Dalhousie between 7 and 11 June (15 individuals) and at Moose Channel on 16 and 20 August (13 birds). Single birds of this species were also sighted at Hansen Harbour on 24 August and at Nunaluk Spit on 9 June and 15 August. Two White-rumped Sandpipers were observed at Nunaluk on 16 June 1972.

Calidris bairdii: Baird's Sandpiper

The status of the Baird's Sandpiper varies markedly across the Arctic (Johnson *et al.* In Press). In some areas it is the commonest breeding sandpiper species. Although 52 Baird's Sandpipers were seen on 16 August 1972 at Moose Channel, this species was relatively uncommon during 1972 in the coastal area between Nunaluk Spit and Cape Dalhousie. No more than 11 individuals were seen during spring 1972 at Cape Dalhousie; the few sightings of Baird's Sandpipers recorded during late July and August at Nunaluk Spit and Toker Point indicate that this species occurs only in small numbers at both of these locations. Baird's Sandpipers may have been only slightly more abundant in the Mackenzie Delta than they were at the other migration-watch stations along the coast.

Calidris minutilla: Least Sandpiper

Pitelka (1974) considered the Least Sandpiper to be a scarce breeder in arctic Alaska. Few sightings of Least Sandpipers were recorded during this study in the Canadian Beaufort Sea area. In 1972, six individuals of this species were observed at Moose Channel during the first part of August; the latest of these sightings was recorded on 18 August.

Limnodromus scolopaceus: Long-billed Dowitcher

The Long-billed Dowitcher is the only species of dowitcher that occurs in the Beaufort Sea area (Godfrey 1966). This species is considered rare in this area by some researchers (Brooks 1915; Dixon 1943; Martel in prep.) and as common in this area, at least during migration, by others (Bailey 1933, 1948; Gollop and Davis 1974a). Data collected during 1972 suggest that Long-billed Dowitchers occur commonly in the eastern Beaufort Sea area; during late August and early September 1972 hundreds of Long-billed Dowitchers were counted passing Moose Channel and Nunaluk Spit. The observed peaks of the fall migration of this species from the study area occurred on 26 August at Moose Channel (5.8 birds/hr) and on 5 September at Nunaluk Spit (19.4 birds/hr)--although 10.0 birds/hr were seen moving past Nunaluk Spit on 28 August. During the fall migration of Long-billed Dowitchers, nearly all movement of this species past Nunaluk Spit was to the east (Figure 74). During 1972, Long-billed Dowitchers were seen until 13 September at Moose Channel (three birds) and until 15 September at Nunaluk Spit (five birds).

Micropalama himantopus: Stilt Sandpiper

Results of ground transect surveys conducted along the Yukon-Alaskan North Slope during 1974 indicated that Stilt Sandpipers were as common as dowitchers but perhaps were not as easily recognized during fall migration (Koski 1974a). The only record of Stilt Sandpipers obtained during this study consisted of a sighting of two birds of this species at Cape Dalhousie on 15 June 1972.

Calidris pusillus: Semipalmated Sandpiper

Semipalmated Sandpipers occur as very common breeders along the Beaufort Sea coastline (Porsild 1943). According to Koski (pers. comm.), these birds are almost as common as Pectoral Sandpipers along the Yukon coast. This species normally arrives in the study area during late May; the final 1972 observation of this species in the study area was recorded on 29 May at Richards Island (Slaney 1974).

During the present study, Semipalmated Sandpipers were first detected on 6 June in 1972 at Cape Dalhousie and were seen in small numbers daily until 16 June of this year. Only five birds of this species were seen during the 1972 spring migration period at Nunaluk; these birds were recorded on 9 and 10 June.

This species was rarely seen during most of July; three sightings that totalled eight birds were recorded at Nunaluk; it was frequently sighted during late July and throughout the month of August, especially in the Mackenzie Delta. A heavy movement of Semipalmated Sandpipers passed Moose Channel on 30 and 31 July and on 1 August; peak movements of 24.3, 12.0, and 30.0 birds/hr (respectively) were recorded on these dates. Although the numbers of observed Semipalmated Sandpipers declined after 1 August, a small to moderate amount of movement was observed at Moose Channel until 24 August. The last 1972 sighting of Semipalmated Sandpipers in the study area was of eight birds on 28 August at Pelly Island.

DOWITCHERS

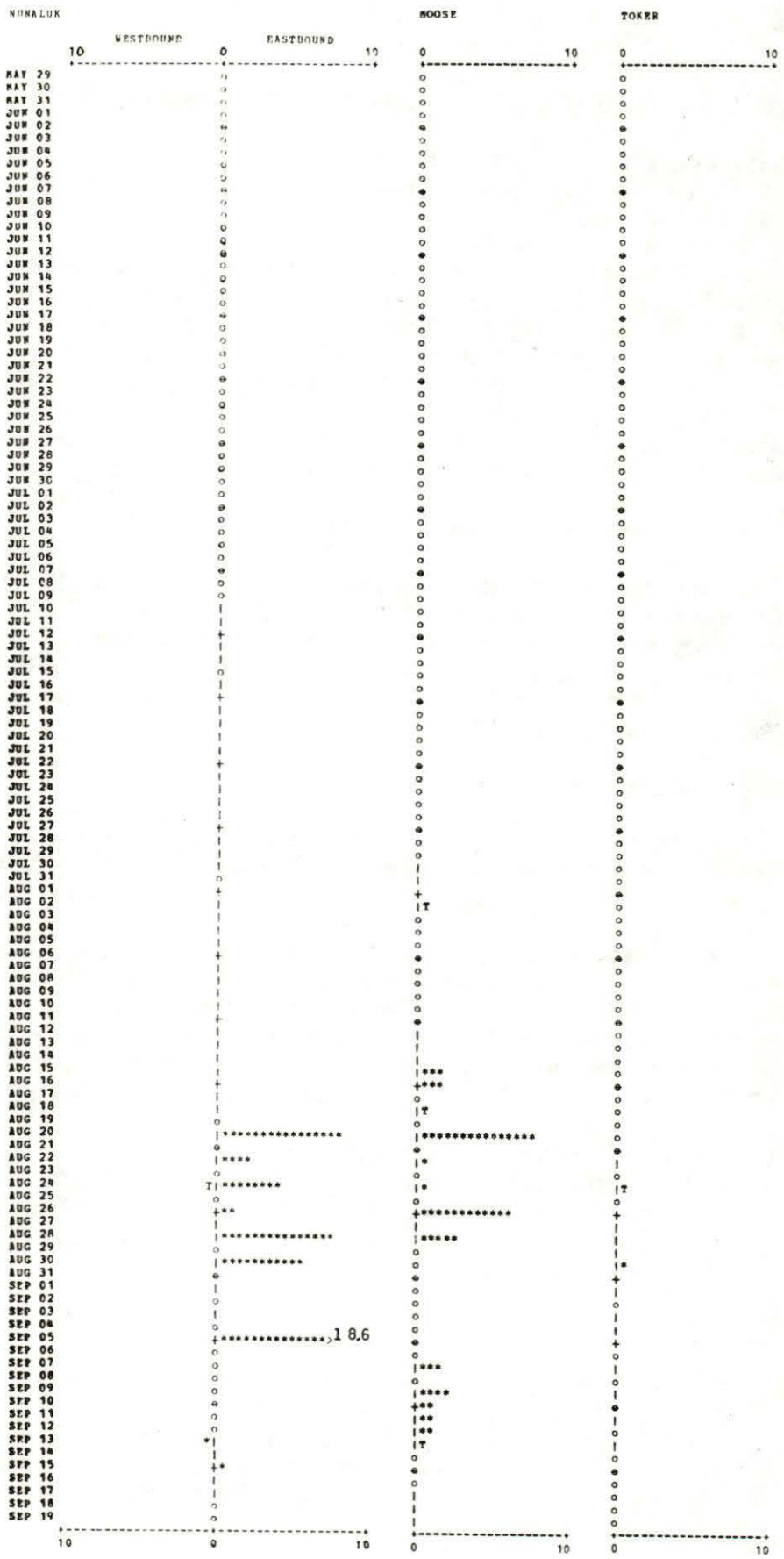


FIGURE 74. Number of Birds per Hour Observed Passing Coastal Migration Watch Stations in the Yukon and Northwest Territories in 1972. Only Locations Where Birds were Observed are Presented.

Tryngites subruficollis: Buff-breasted Sandpiper

Buff-breasted Sandpipers occur commonly in specific areas along the Yukon North Slope (Koski pers. comm.) and at Herschel Island and Banks Island (Godfrey 1966).

Few sightings of the Buff-breasted Sandpiper were recorded in the study area during 1972; the records of this species that were obtained were widely separated temporally and spatially. At Cape Dalhousie, three Buff-breasted Sandpipers were sighted on 9 June and four were sighted at this site four days later. Five and seven individuals were sighted at Nunaluk Spit on 10 and 22 August 1972, respectively. The latest 1972 sighting of this species in the study area was recorded at Hansen Harbour on 1 September, when five Buff-breasted Sandpipers were observed.

Limosa haemastica: Hudsonian Godwit

This species breeds in the Mackenzie (Slaney 1974; Martel in prep.) and Anderson River deltas (MacFarlane 1891 in Höhn 1959; Höhn 1959; Barry 1967) but does not occur commonly in the eastern Beaufort Sea. Seven Hudsonian Godwits were sighted during the 1972 phase of this study: two were observed on 10 August at Nunaluk Spit, and five were seen at Moose Channel, in the Mackenzie Delta, on 14 August.

Crocethia alba: Sanderling

According to Godfrey (1955), the Sanderling occurs as a regular breeder on Banks Island and rarely near Franklin Bay, N.W.T.; during migration, this species occurs as a common transient in the Beaufort Sea area.

In 1972, Sanderlings were infrequently seen in the Beaufort Sea region during spring and summer but were observed commonly in this area from mid-August to mid-September. The earliest 1972 sighting in the study area was recorded at Cape Dalhousie on 9 June. Three Sanderlings were also observed during the spring of 1972 at Nunaluk Spit; birds of this species were sighted at this site in small numbers from mid-July to the end of this month.

Fall observations of this species were recorded at all migration watch stations on the mainland coast. The number of Sanderlings observed per hour was never large (maximum was 2.8 birds/hr). Two Sanderlings observed at Toker Point on 11 September constituted the last 1972 records of this species in the study area.

Phalaropes

Of the two species of phalaropes that occur in the Beaufort Sea, the Northern Phalarope greatly outnumbers the Red Phalarope (Godfrey 1966). Estimates of the relative abundances of these species may be biased, however, because Red Phalaropes possibly move farther offshore than do Northern Phalaropes and, hence, would be less frequently observed from coastal observation posts.

During 1974, large numbers of unidentified phalaropes were seen on 27 and 28 August and on 10 September. These observations were recorded in the Mackenzie Delta from as far west as Nunaluk Spit and east to Richards Island. The large movements of phalaropes recorded during August at Nunaluk Spit in 1972 were not observed in 1974.

Phalaropus fulicarius: Red Phalarope

The Red Phalarope occurs as a fairly common breeder in the eastern Beaufort Sea but is not as common in this area as the Northern Phalarope (Johnson *et al.* In Press). During 1972, this species was first seen in the study area on 8 June at Cape Dalhousie and was sighted occasionally until 30 August at Nunaluk Spit. Only one Red Phalarope was sighted (on 20 August) in the Mackenzie Delta. This species probably migrates offshore (Bent 1927) during mid to late August. During 1971, large flocks of this species were seen migrating at sea near Point Barrow (Watson and Divoky 1974). It is probable that many of the Red Phalaropes that passed through the Beaufort Sea during this study were not detected from shore.

Lobipes lobatus: Northern Phalarope

The Northern Phalarope breeds along the mainland coast of the southeastern Beaufort Sea (Godfrey 1966). Like the Red Phalarope, the Northern Phalarope was observed only sporadically at Nunaluk Spit during the spring and part of the summer of 1972 (Figure 75). After 26 July, however, large numbers of this species were observed moving past Nunaluk Spit; these movements were both eastward and westward but eastward movement was the larger of the two. The largest movement was 128.3 birds/hr and occurred on 4 August. The large volume of movement continued until 20 August, after which only moderate numbers were recorded until 16 September. During a study at and near Herschel Island in 1973, Vermeer and Anweiler (1975) also observed fewer Northern Phalaropes after than before 20 August. A few Northern Phalaropes were observed during August at Moose Channel, Hansen Harbour, and Liverpool Bay, but major movements of this species were observed only at Nunaluk.

Jaegers

All three species of North American jaegers occur in the Beaufort Sea. The spring migration of jaegers past Nunaluk Spit and Cape Dalhousie during 1972 consisted primarily of Parasitic Jaegers and Pomarine Jaegers. However, the major eastward movements known to occur in late May and early June along the Beaufort Sea coast (Johnson *et al.* In Press; Richardson *et al.* 1976) were not recorded in 1972 at either Nunaluk or Cape Dalhousie.

Although jaegers are frequently associated with salt-water habitats, they nest on the Arctic Coastal Plain and use both tundra and ocean habitats during July (Figure 77). Within a couple of weeks after their young have fledged, adult jaegers begin their migration back to their pelagic wintering grounds (Johnson *et al.* In Press). Immature and nonbreeding jaegers, however, may begin their return migration during mid-June, well before the breeding

PHALAROPES

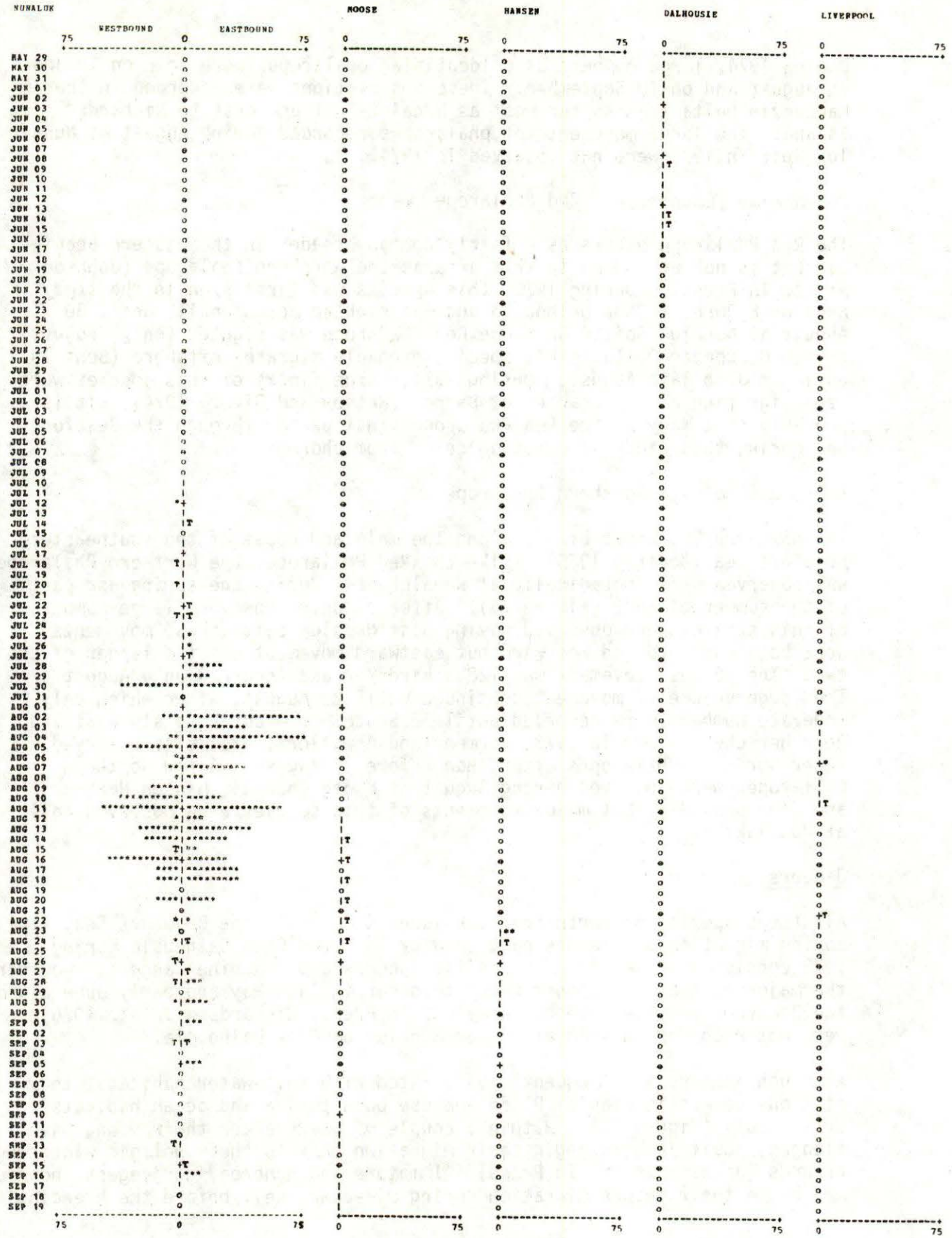


FIGURE 75. Number of Birds per Hour Observed Passing Coastal Migration Watch Stations in the Yukon and Northwest Territories in 1972. Only Locations Where Birds were Observed are Presented.

TOTAL JAEGERS

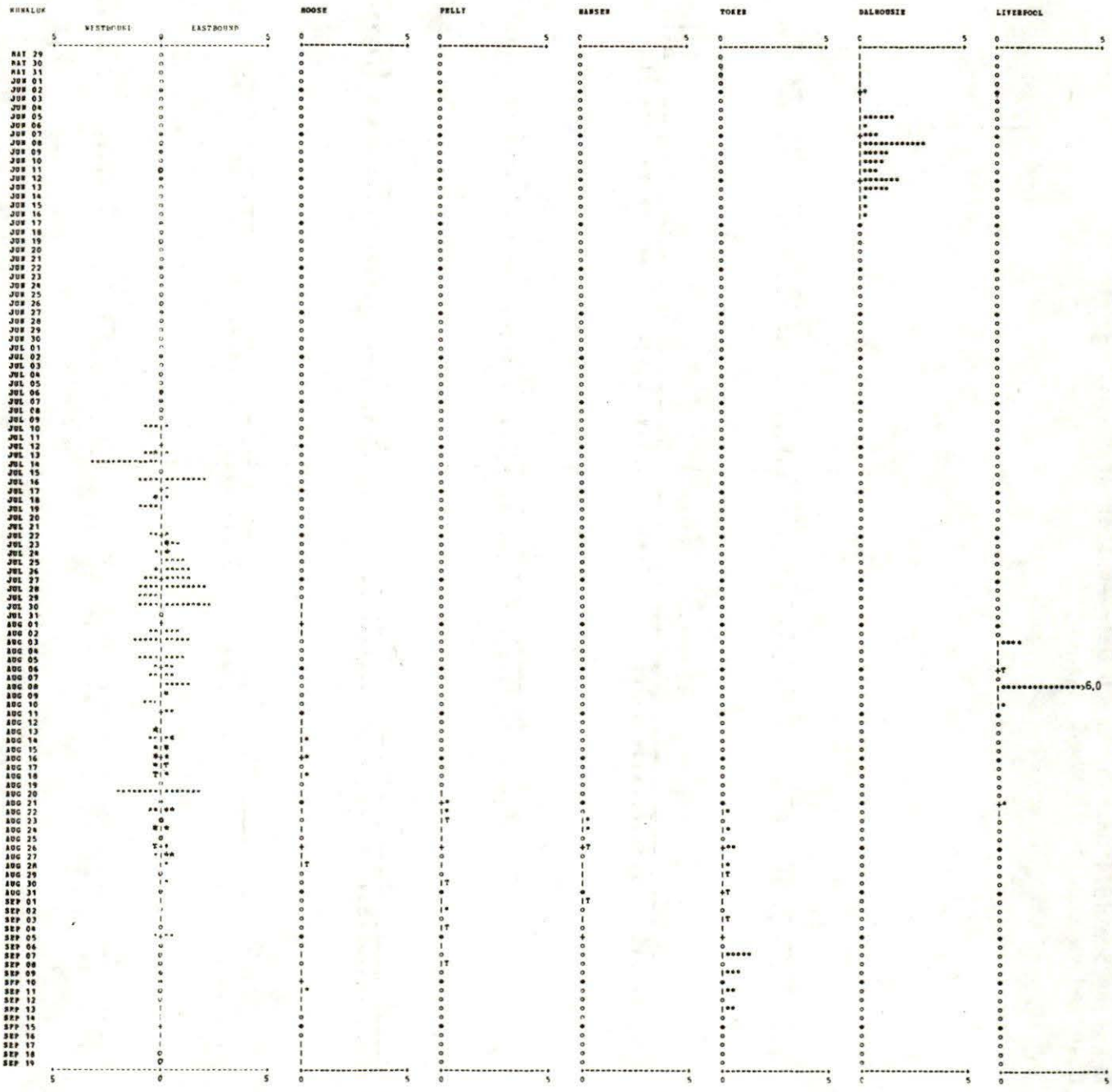
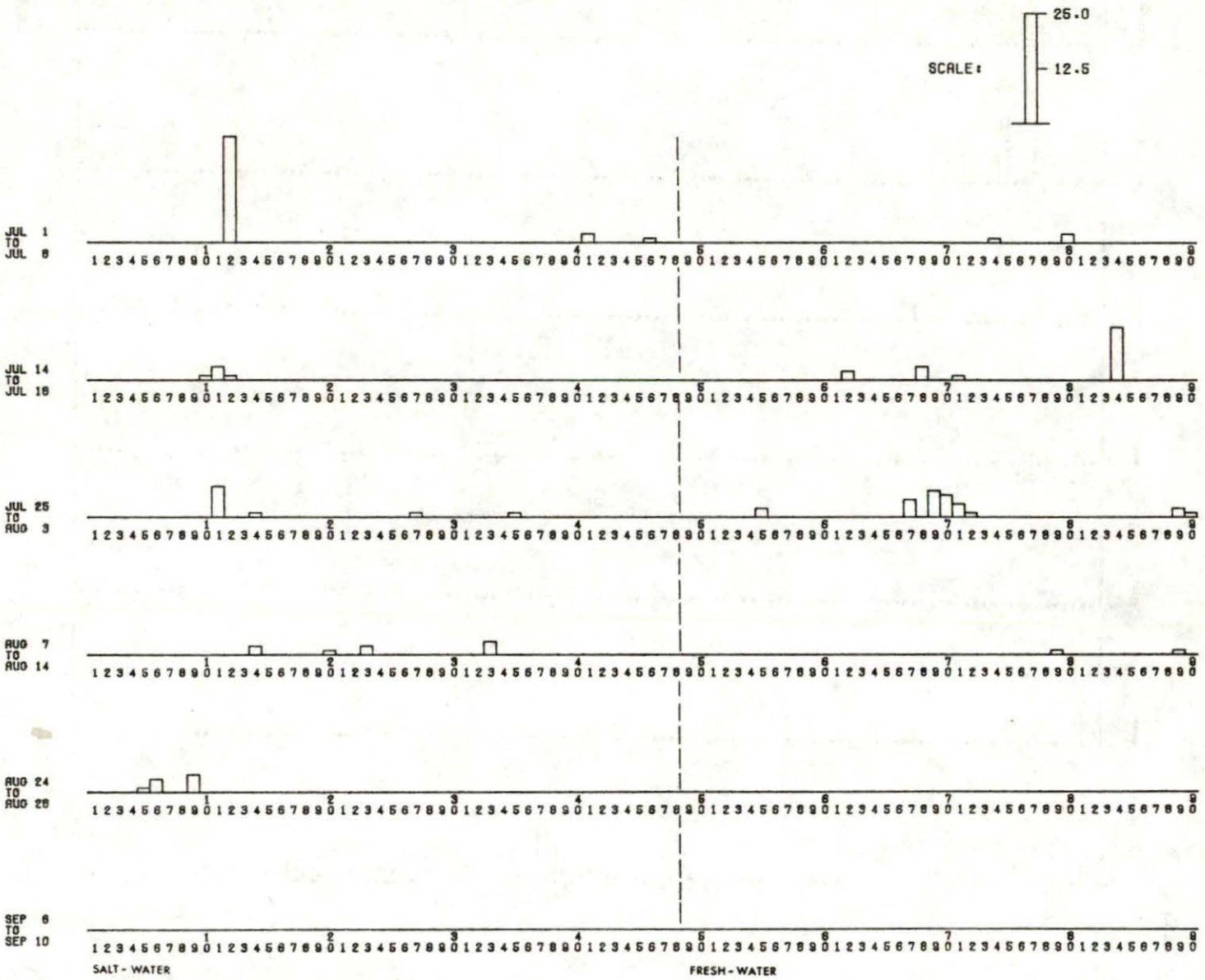


Figure 76. Number of Birds per Hour Observed Passing Coastal Migration Watch Stations in the Yukon and Northwest Territories in 1972. Only locations where birds were observed are presented.

FIGURE 77. Beaufort Sea 1974 Barrier Beach Data--Number of Birds Observed Vs Location Number--Jaegers



birds of this species (Johnson *et al.* In Press; Richardson *et al.* 1976). Few jaegers remain in the eastern Beaufort Sea after the first week in September (Figure 76)(Johnson *et al.* In Press).

Stercorarius pomarinus: Pomarine Jaeger

The main food of the Pomarine Jaeger is the Brown Lemming (*Lemmus sibiricus**; Pitelka 1955; Andersson 1973), and the numbers of jaegers present in a particular area reflect the abundance of this lemming species in this area. The numbers of Pomarine Jaegers in an area may, therefore, vary from year to year.

Few records of Pomarine Jaegers were obtained in the study area during 1972. Twenty-seven Pomarine Jaegers were recorded at Nunaluk Spit between 8 and 13 June 1972; all were seen flying east. Migrating birds of this species were recorded from 8 to 16 June flying past Cape Dalhousie at a rate of between 0.5 to 1.5 birds/hr (Figure 78). These numbers were much lower than those recorded along the Yukon coast in 1975 (Johnson *et al.* In Press; Richardson *et al.* 1976). That this species was not recorded later than 16 June during 1972 suggests that little or no breeding in this species occurred in the study area during this year.

Return movements of Pomarine Jaegers to the west during mid-June were noted at ground stations along the Yukon coast in 1975 (Johnson *et al.* In Press; Richardson *et al.* 1976). It was speculated that little breeding by this species occurred in the study area during 1975 and that these returning birds represented an early migration away from the Beaufort Sea. Maher (1974) reported similar movements from other breeding grounds. Return migration of this species was not observed during 1972; however, no observation periods were conducted from mid-June to mid-July, when such a movement probably would have occurred during a year these birds did not breed (Parmelee *et al.* 1967).

During the many hours of surveys conducted during 1974 over open ocean and onshore areas, only four Pomarine Jaegers were sighted; these birds were recorded more than 25 km offshore. The first sighting was of two individuals northwest of Herschel Island on 8 June and the last of a single bird in Mackenzie Bay on 25 August. A lone bird was also sighted in Thesiger Bay (Banks Island) on 3 July 1974. Apparently, the number of birds of this species present in the study area during 1974 was very low.

Stercorarius parasiticus: Parasitic Jaeger

Because Parasitic Jaegers are less dependent on a single food source than are Pomarine and Long-tailed Jaegers (Parmelee *et al.* 1967; Andersson 1973), their numbers in a particular area are more stable from year to year.

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* Nomenclature for mammals follows Banfield 1974.

POMARINE JAEGER

DALHOUSIE

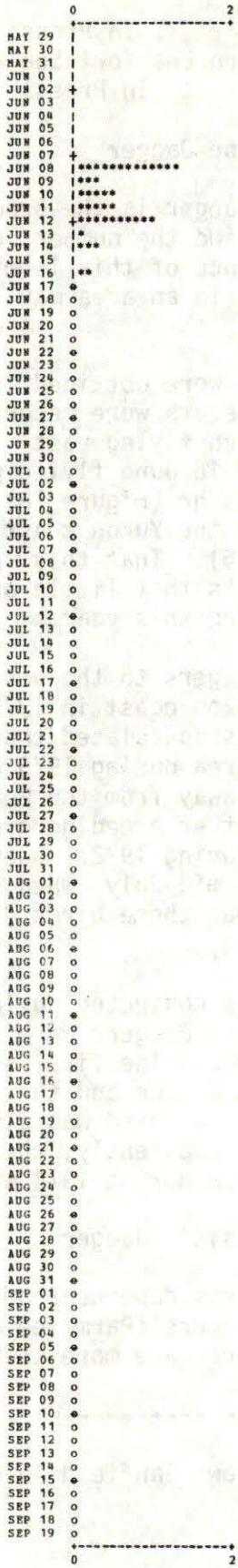


FIGURE 78. Number of Birds per Hour Observed Passing Coastal Migration Watch Stations in the Yukon and Northwest Territories in 1972. Only Locations Where Birds were Observed are Presented.

Parasitic Jaegers were not seen as commonly as Pomarine Jaegers in the study area during the spring of 1972; a small movement of Parasitic Jaegers (less than 1 bird/hr) was observed at Cape Dalhousie between 2 and 15 June, and four birds of this species were sighted at Nunaluk Spit between 8 and 13 June. (In 1975 small numbers also moved east along the Yukon coast in late May and early June [Johnson *et al.* In Press; Richardson *et al.* 1976].) However, from June through August 1972 movements of Parasitic Jaegers were frequently recorded at rates in excess of 1.0 bird/hr at Nunaluk and nearly as frequently but at lower rates at all other coastal migration watch stations (Figure 79).

In 1974, Parasitic Jaegers were the most abundant jaeger species identified during aerial surveys of offshore areas and of the barrier beach. Though Parasitic Jaegers were generally seen in small numbers (one to four birds), 24 were sighted on Pelly Island on 6 July 1974. During 1974, this species was last seen in the study area on 28 August; the last 1972 sighting of this species was recorded during mid-September.

Stercorarius longicaudus: Long-tailed Jaeger

The number of Long-tailed Jaegers present in the Beaufort Sea fluctuates markedly from year to year; these fluctuations have been attributed to the 'rise and fall' of the lemming population, the major food source of Long-tailed Jaegers (Bailey 1933; Andersson 1971). Little can be stated about the distribution and abundance of this species in the study area because so few observations of this species were recorded during this study and because these observations were widely spaced over the study period.

Long-tailed Jaegers were first sighted in the study area during the second week in June both in 1972 and 1974. The most consistent numbers of this species that were seen during the study were recorded at Cape Dalhousie between 5 and 13 June, when as many as 2.0 birds/hr were recorded during two days of peak movement. Movements of this species were also recorded during mid-July at Nunaluk Spit (westward: as many as 3.3 birds/hr) and early August at Liverpool Bay (Figure 80).

Frame (1973) reported that the Long-tailed Jaeger was the most common seabird offshore during his 1969 August cruise (3 to 15 August) in the western Beaufort Sea. Few Long-tailed Jaegers were identified offshore during aerial surveys in 1974, and none were seen offshore after 24 July 1974. A few Long-tailed Jaegers were seen onshore during July and early August; the majority (six birds) were recorded at Garry Island in Mackenzie Bay.

Gulls

Seven species of gulls (including one kittiwake) were observed during this study. The majority of these birds were Glaucous Gulls; hence, recorded movements of gulls (as a group) reflect those of Glaucous Gulls (Figure 81).

Gulls are among the first birds to arrive in the southeastern Beaufort Sea during spring; many of these birds remain in this area until late September or early October. Although the Mew Gull is most often seen in the lower

PARASITIC JAEGER

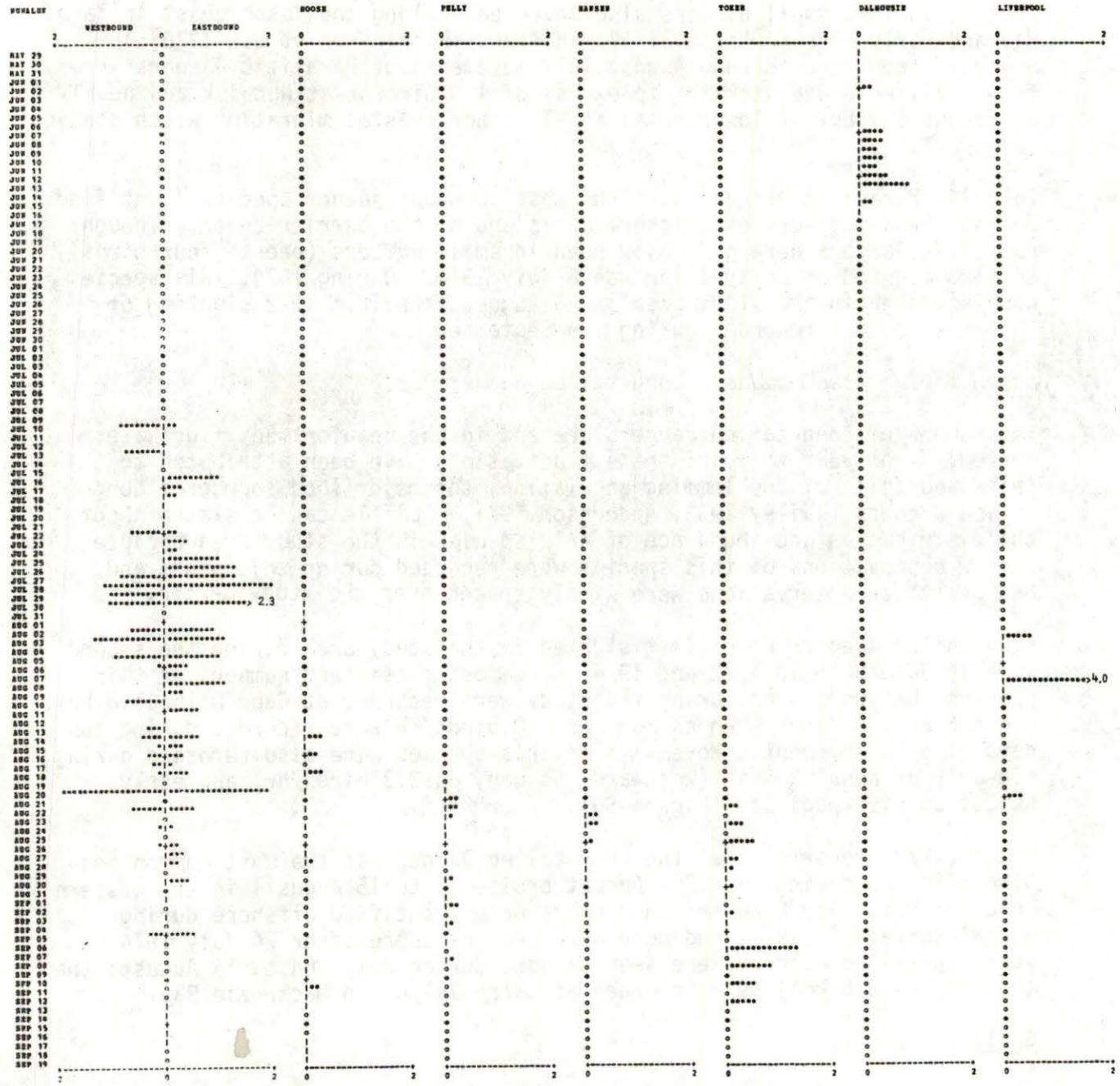


Figure 79. Number of Birds per Hour Observed Passing Coastal Migration Watch Stations in the Yukon and Northwest Territories in 1972. Only locations where birds were observed are presented.

LONG-TAILED JAEGER

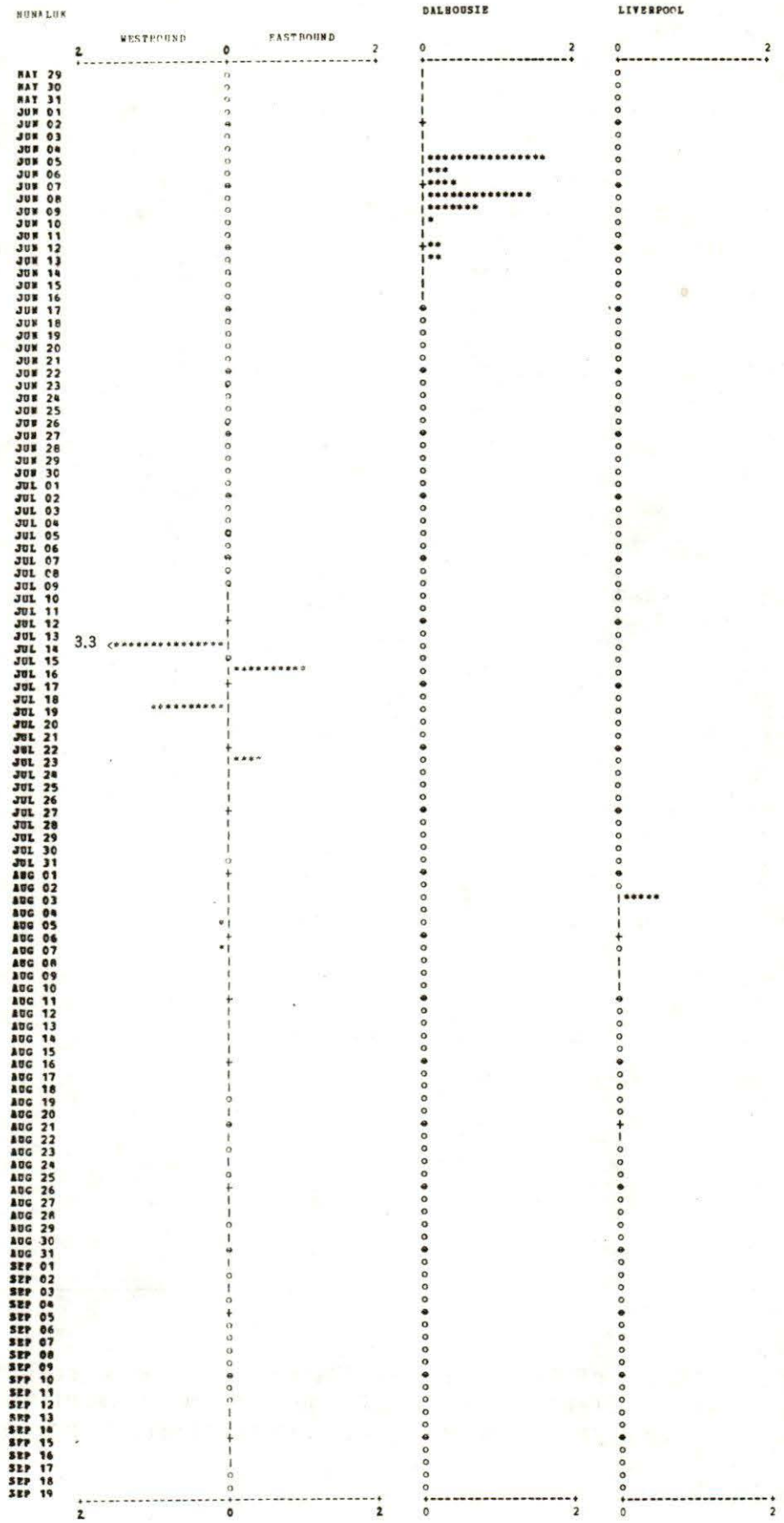


FIGURE 80. Number of Birds per Hour Observed Passing Coastal Migration Watch Stations in the Yukon and Northwest Territories in 1972. Only Locations Where Birds were Observed are Presented.

TOTAL GULLS

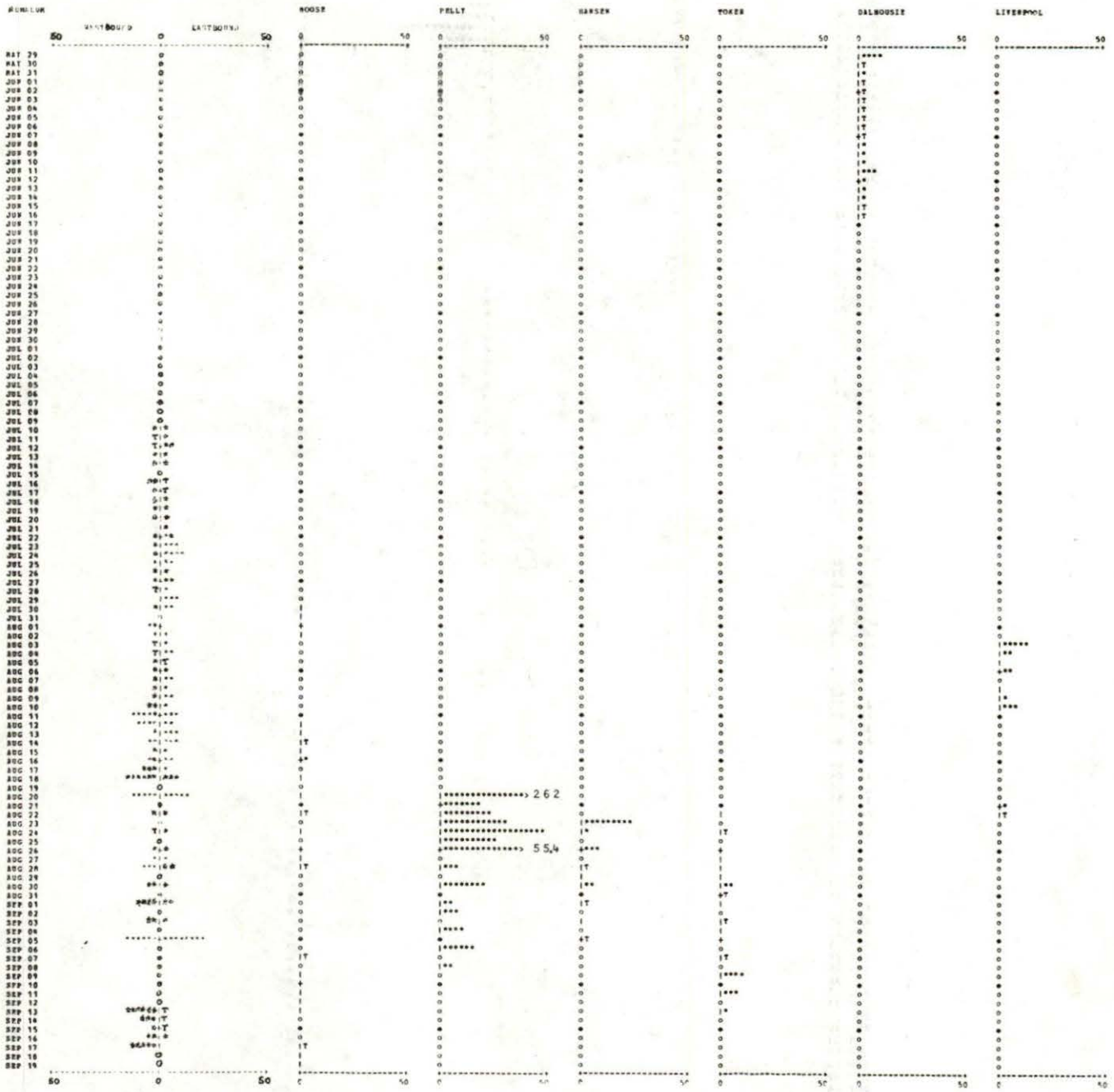
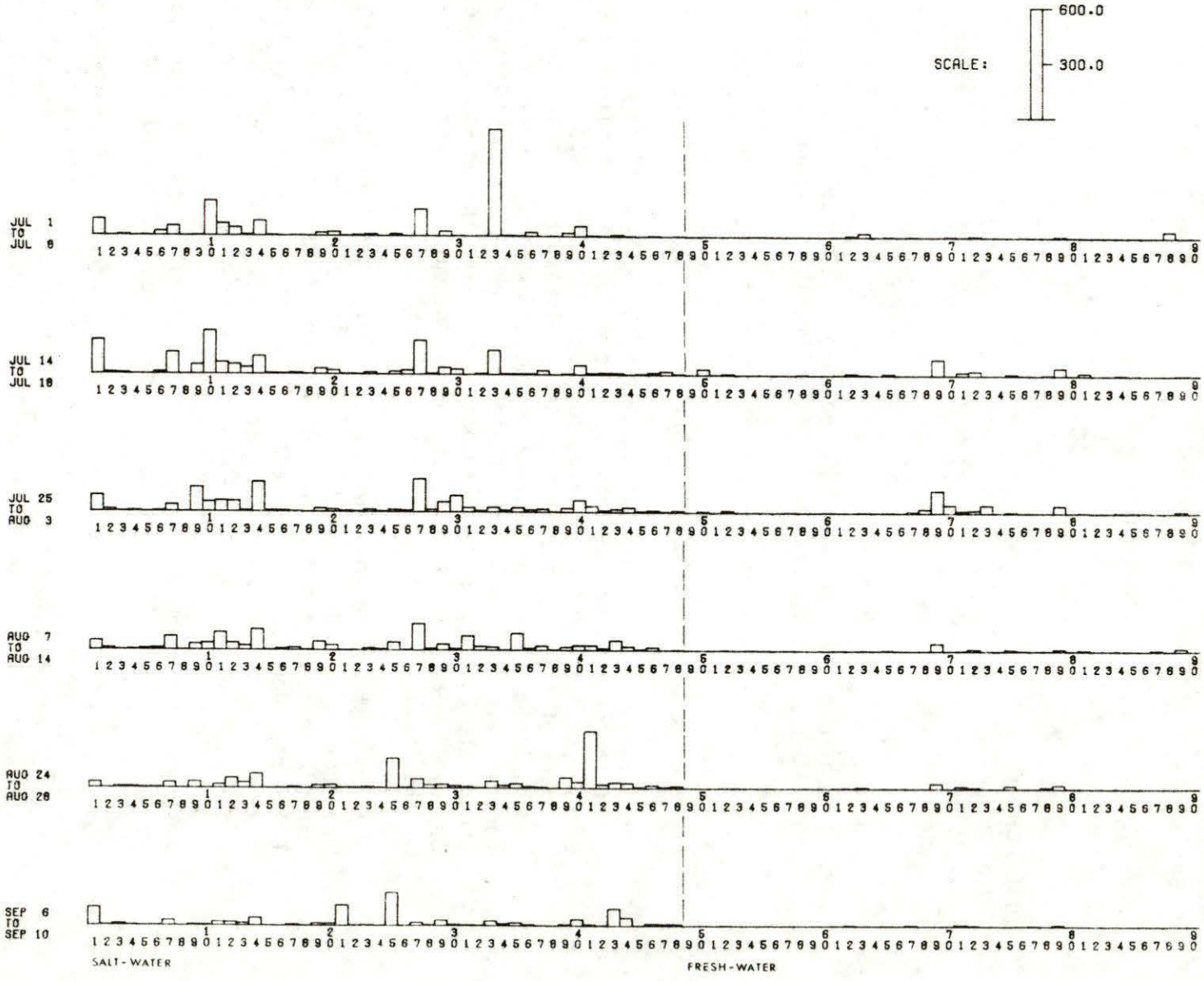


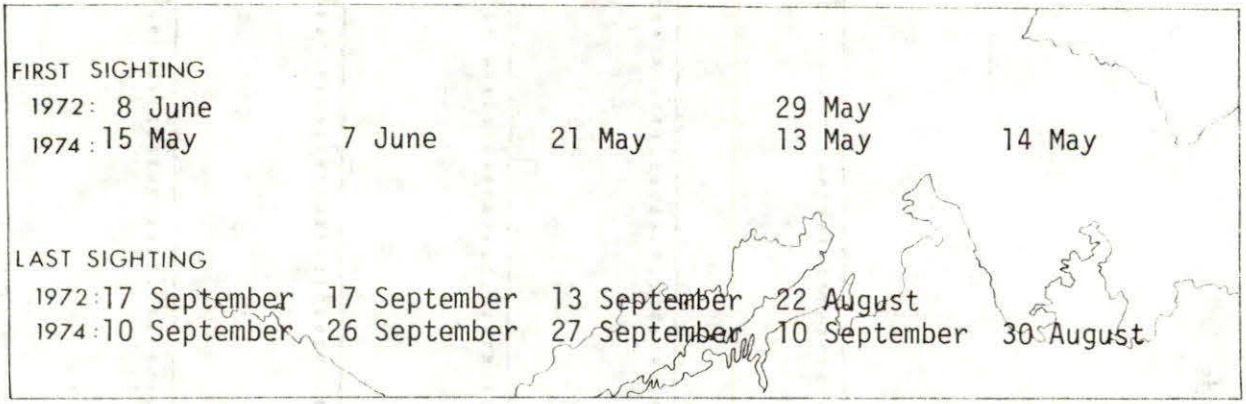
Figure 81. Number of Birds per Hour Observed Passing Coastal Migration Watch Stations in the Yukon and Northwest Territories in 1972. Only locations where birds were observed are presented.

FIGURE 82. Beaufort Sea 1974 Barrier Beach Data--Number of Birds Observed Vs Location Number--Gulls



Mackenzie Delta, most species of gulls in the Arctic are associated with salt-water areas (Figure 82); during this study concentrations of hundreds of gulls were observed in such areas.

Larus hyperboreus: Glaucous Gull



Present Status and Spring Migration

The Glaucous Gull is the most common gull species in the Arctic. It nests in single pairs and colonies along the entire arctic coast and barrier beaches (Anderson 1913; Johnson *et al.* In Press). The largest colonies of this species in the eastern Beaufort Sea area are located in the Eskimo Lakes and Cape Dalhousie areas of the Northwest Territories. Glaucous Gulls make their way to the Arctic by migrating around the coast of Alaska and begin to arrive in the eastern Beaufort Sea by mid-May; this species is one of the earliest migrants to arrive in the Arctic.

A large eastward movement of Glaucous Gulls was recorded at Nunaluk Spit between 8 and 13 June 1972 (Table 14). An average of over 5.0 birds/hr passed this site during this period; 94% of the 150 Glaucous Gulls recorded were flying east. This species was seen in very small numbers at Cape Dalhousie between 29 May and 16 June 1972; this low number of sightings at this location is surprising in view of its proximity to a large breeding Glaucous Gull colony (Figure 83). It is conceivable that much of the migration at this location took place prior to the start of observations on 29 May (discussed below).

During 1974, Glaucous Gulls were first sighted during offshore aerial surveys on 13 May; even at this early date, observations of this species were recorded from Herschel Island north and west to Storkersen Bay, Banks Island. By 21 May 1974, large numbers of Glaucous Gulls were concentrated in the same lead that held tens of thousands of diving ducks (mainly eiders and Oldsquaw). Over 185 Glaucous Gulls were counted on this lead between 21 and 27 May 1974. Another 20 gulls were located west of Cape Kellett during the same period. During the aerial survey conducted between 6 and 8 June 1974 Glaucous Gull sightings were widely spaced, and some were over 100 km from shore.

GLAUCOUS GULL

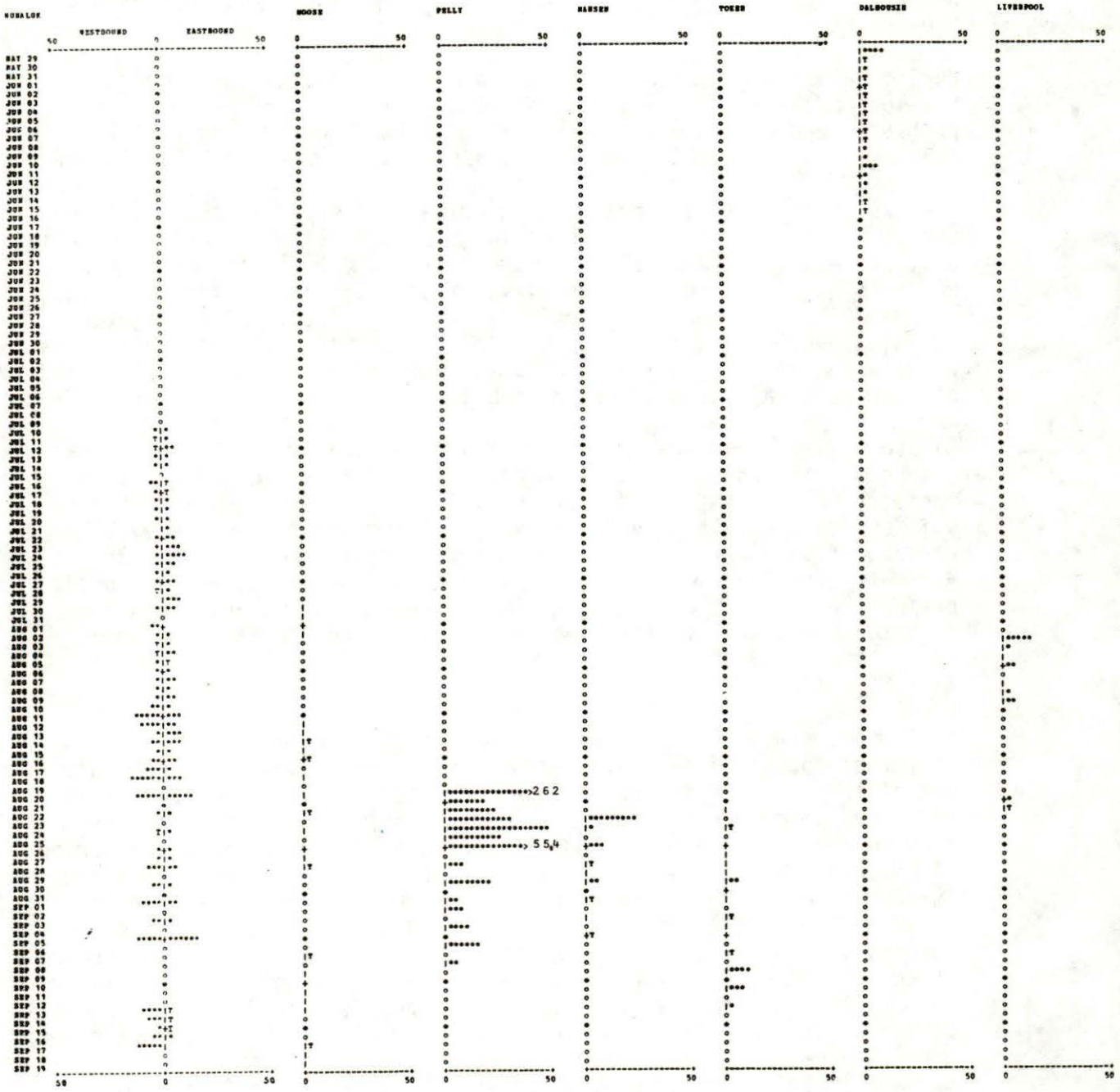


Figure 83. Number of Birds per Hour Observed Passing Coastal Migration Watch Stations in the Yukon and Northwest Territories in 1972. Only locations where birds were observed are presented.

Summer Distribution and Habitat Preferences

By the end of June 1974, Glaucous Gulls were more commonly observed nearer to shore (< 50 km) but were still dispersed along the coast of the entire study area.

During July and August of both 1972 and 1974, several large concentrations of Glaucous Gulls were sighted; these concentrations were probably recorded in areas near gull colonies. On 20 August 1972, a movement of over 250 Glaucous Gulls/hr was recorded at Pelly Island.

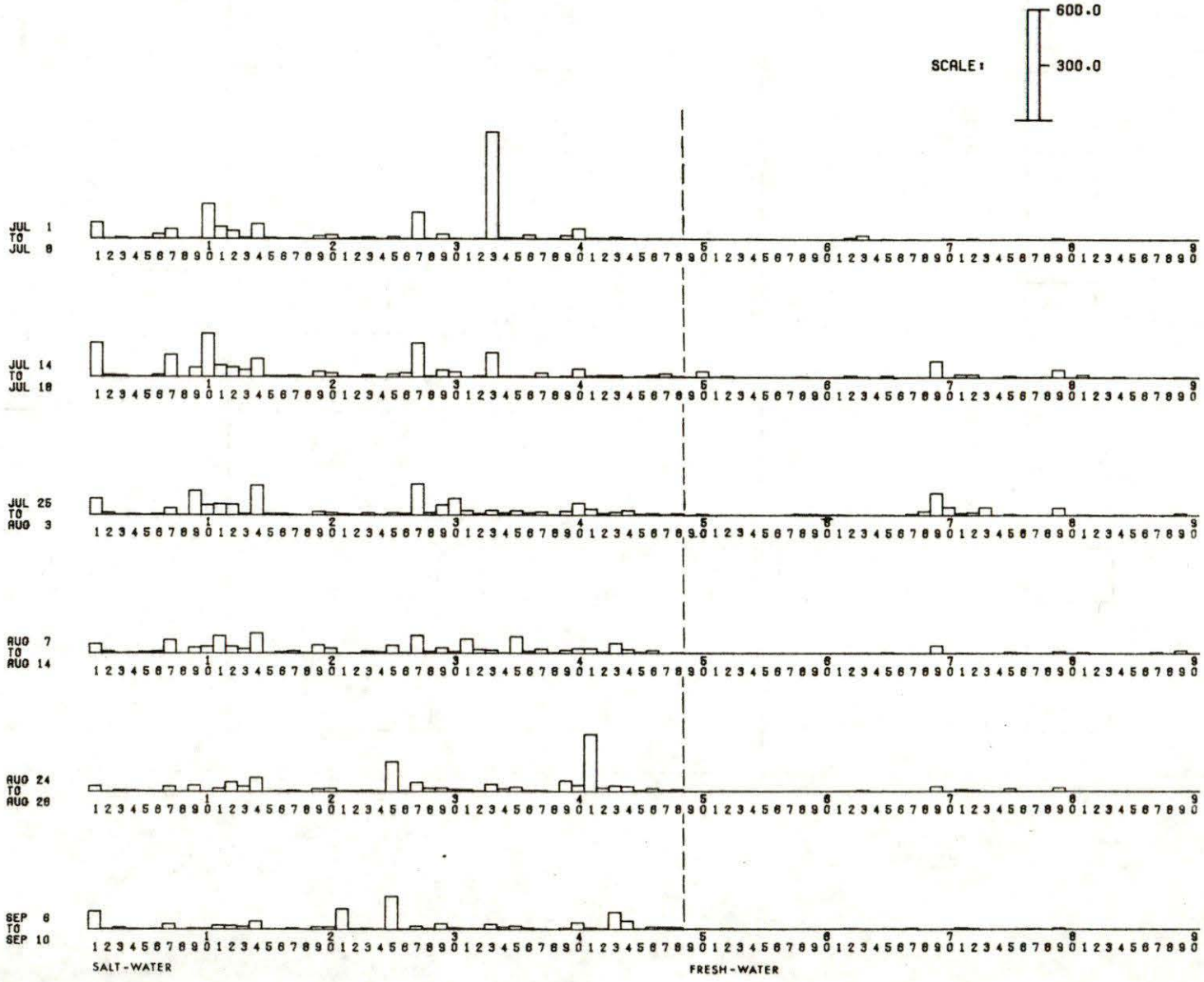
Over 25 gulls of this species per hour were observed at this location during the next five days. These large congregations of gulls undoubtedly represented newly-fledged young that had been raised on or near Pelly Island. During aerial surveys of coastal waterbodies conducted from 1 July to 10 September in 1974, several concentrations of over 100 Glaucous Gulls were detected. The largest of these concentrations was seen on McKinley Bay on 3 July and was estimated to have consisted of over 600 Glaucous Gulls (Figure 84).

Glaucous Gulls seen near lakes in 1974 were usually in singles or pairs. Glaucous Gulls showed a distinct preference for salt-water areas, especially islands and beaches (Figure 85). Multiple regression analysis showed that Glaucous Gulls use areas similar to those used by birds of five other species: Red-throated Loons, Arctic Terns, Brant, White-fronted Geese, and Pintails (Table 9). Similarities in habitat preference were found to be greatest between Glaucous Gulls and Red-throated Loons and least between these gulls and Pintails.

Fall Migration

Fall migration of Glaucous Gulls from the study area begins during mid-September and continues into October; thus, this species is not only one of the earliest to arrive in the Arctic but also one of the last to depart this area (Johnson *et al.* In Press). Glaucous Gulls were seen in moderate numbers at Nunaluk Spit in 1972 throughout the period of observation. Birds of this species were generally seen migrating in nearly equal numbers in both easterly and westerly directions during July and August 1972 (Figure 83). From 13 September until the end of observations on 17 September, however, a predominant westward movement of this species was recorded; it is probable that this movement was the start of the fall migration of this species around the west coast of Alaska to wintering areas in the north Pacific. Glaucous Gulls were also recorded during September at Moose Channel on 7 and 17 September, at Pelly Island on 1 to 8 September, at Hansen Harbour on 1 to 5 September, and at Toker Point on 3 to 13 September. That only small numbers of Glaucous Gulls were seen along the coast during the fall of 1972 suggests that most movement of this species occurred farther offshore or after coastal observations ceased. Results of aerial surveys during September and October 1974, however, did not indicate offshore movement of this species and, in fact, with the exception of one group of 16 birds, all Glaucous Gulls sighted during offshore aerial surveys conducted during September 1974 were less than 15 km from shore.

FIGURE 84. Beaufort Sea 1974 Barrier Beach Data--Number of Birds Observed Vs Location Number--Glaucous Gulls



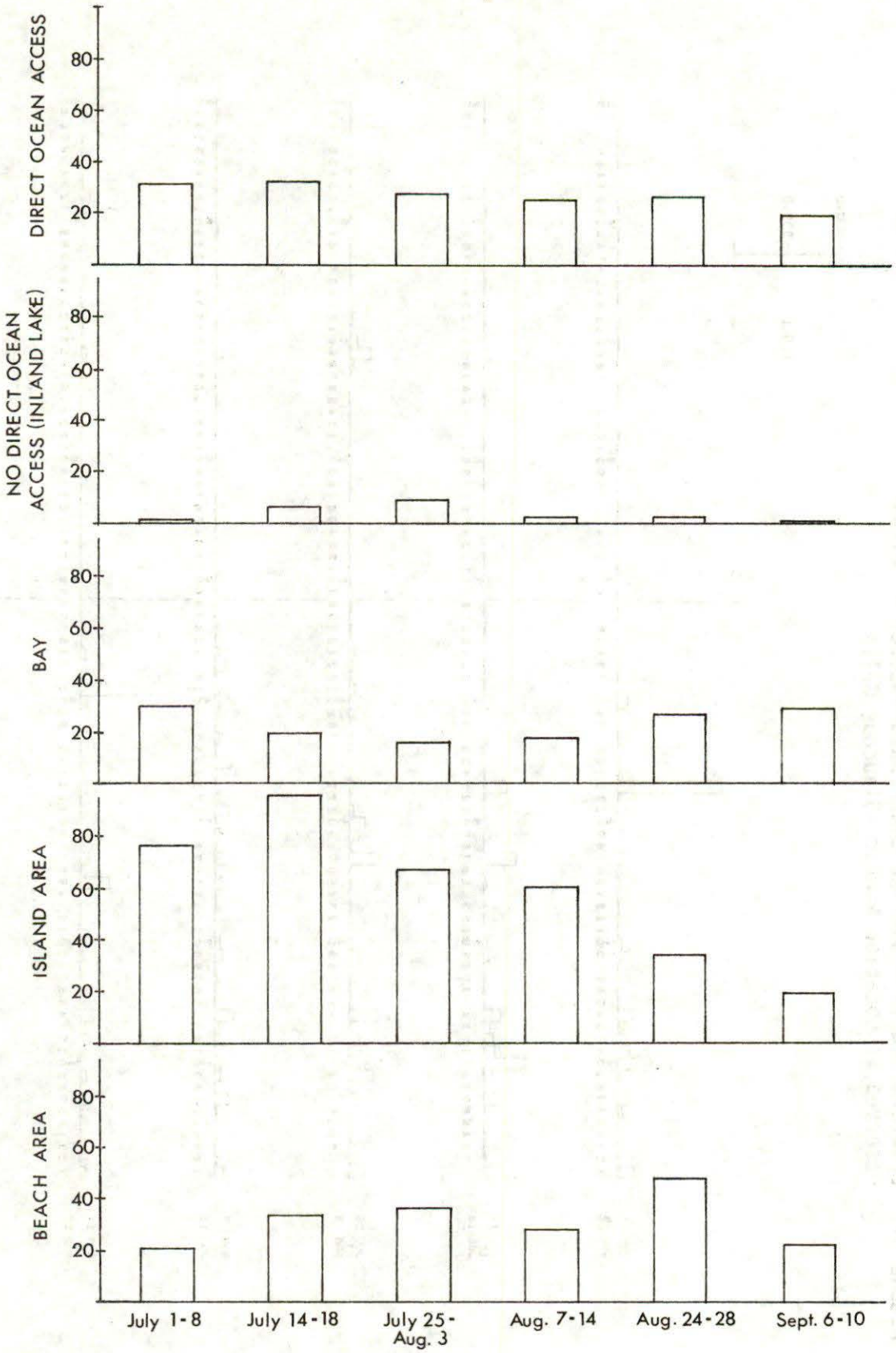


FIGURE 85. Average Number of Glaucous Gulls per Waterbody by Waterbody Type, 1 July to 10 September 1974.

Larus argentatus: Herring Gull; and

Larus thayeri: Thayer's Gull

Because it was not possible to distinguish between Herring and Thayer's Gulls during this study, these two species are considered together. The more northerly nesting Thayer's Gull (MacPherson 1961) is apparently more common in the Beaufort Sea than the Herring Gull, which is reported to be a common breeder only as far north as the Mackenzie Delta (Porsild 1943).

These two species were occasionally seen during shore-based observations. During 1974, however, only one of these gulls, identified as a Herring Gull, was recorded; this bird was observed flying across Liverpool Bay on 23 July. Most sightings of these gulls during 1972 were recorded at Nunaluk Spit, but two sightings of single gulls were recorded elsewhere: one on 16 August at Moose Channel and the other at Toker Point on 31 August. Herring Gulls and Thayer's Gulls were seen at Nunaluk Spit only during August and September (Figure 86). Apparently, these birds migrate through the eastern Beaufort Sea after having bred elsewhere (Watson and Divoky 1974). The largest numbers of these gulls were seen on 5 September; the latest sighting was recorded on 16 September.

Larus canus: Mew Gull

This species occurs as a common summer resident in the wooded portions of the Mackenzie Delta (Porsild 1943; Martel in prep.) but has rarely been recorded north of the tree line.

During this study, three records of Mew Gulls were obtained in areas well north of the tree line. During 1972, Mew Gulls were sighted at Liverpool Bay on two occasions: four birds of this species were seen on 10 August and a single Mew Gull was observed on 21 August. Only one Mew Gull was recorded in the study area during 1974; this bird was observed on 25 August in Kugmallit Bay, north of Tuktoyaktuk.

Pagophila eburnea: Ivory Gull

Although this species was reported to have bred as far south and west as Cape Parry (Swainson and Richardson cited by MacDonald and MacPherson 1962), it apparently no longer breeds in the Cape Parry area. The only known active colony of Ivory Gulls in Canada is located on Seymour Island (Nettleship and Smith 1975), although others probably exist.

This high arctic breeder rarely occurs in the eastern Beaufort Sea study area until autumn; at this time, numbers of Ivory Gulls may move west at least to Point Barrow, Alaska (Bailey 1948; Watson and Divoky 1974). Ivory Gulls occur in the Beaufort Sea more regularly after mid-August (Bailey 1948; Frame 1973; Watson and Divoky 1974). Moderate numbers of these birds may overwinter in the pack-ice of the Beaufort Sea (Watson and Divoky 1974). During this study, Ivory Gulls were seen on only one occasion: three were sighted at Moose Channel on 16 August 1972.

HERRING-THAYER'S GULL

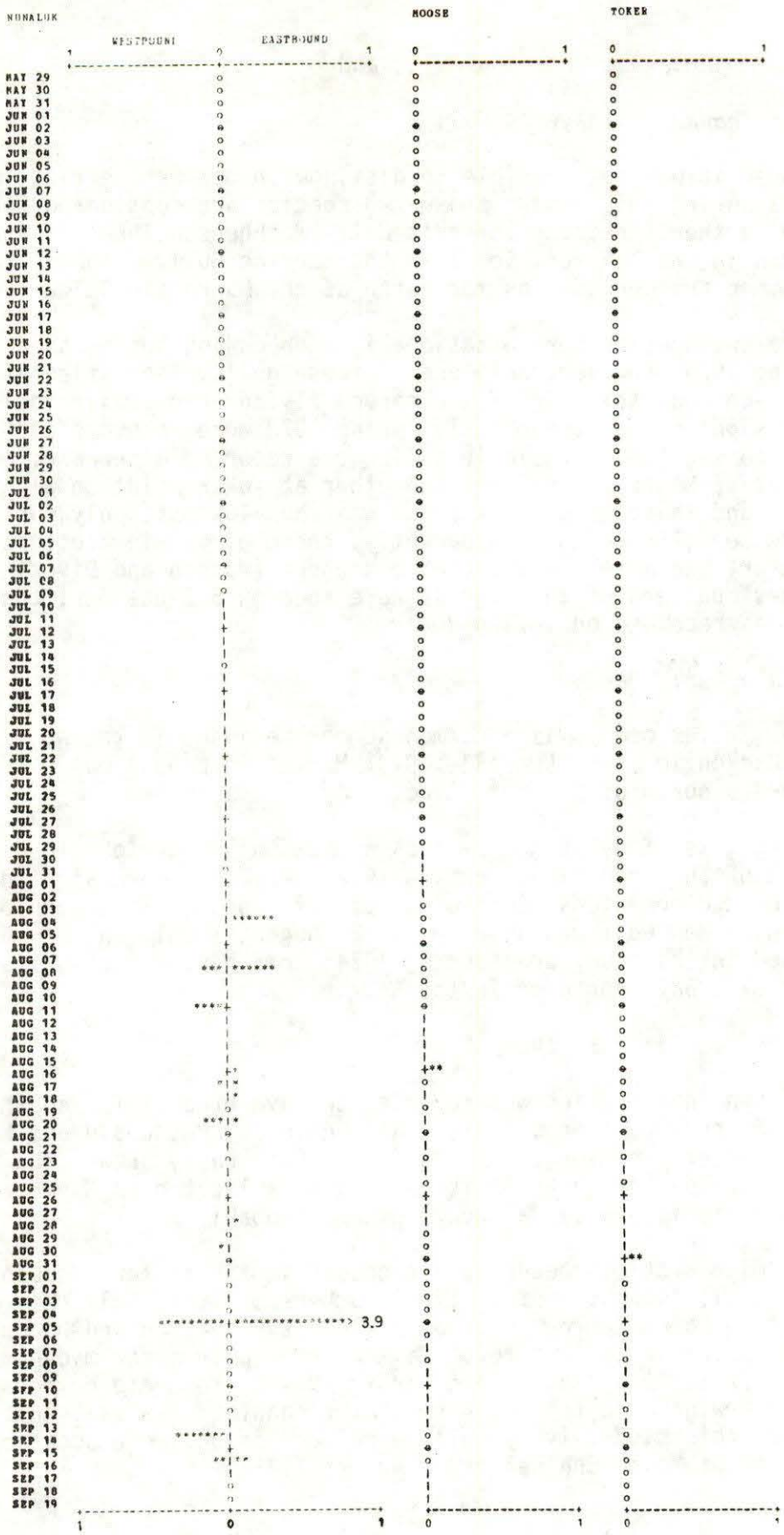


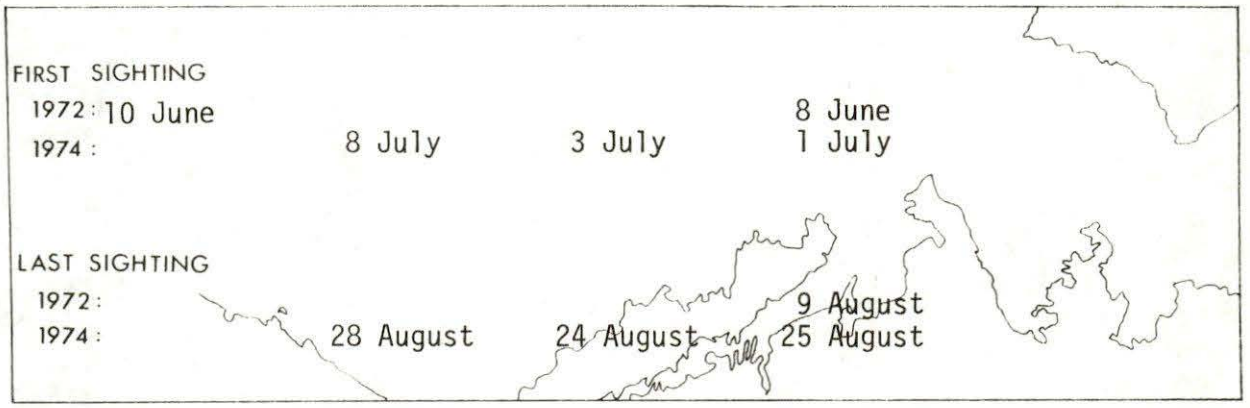
FIGURE 86. Number of Birds per Hour Observed Passing Coastal Migration Watch Stations in the Yukon and Northwest Territories in 1972. Only Locations Where Birds were Observed are Presented.

Rissa tridactyla: Black-legged Kittiwake

Apparently a common summer resident in offshore areas of the Beaufort Sea, the Black-legged Kittiwake most frequently occurs west of Herschel Island; in this area, flocks of this species usually consist of immature birds (Frame 1973; Watson and Divoky 1972, 1974).

During this study, Black-legged Kittiwakes were observed at Nunaluk Spit on 7 and 18 August 1972; on these dates six birds and one bird (respectively) were recorded at this location. No birds of this species were seen during offshore or nearshore surveys conducted during 1974.

Xema sabini: Sabine's Gull



The Sabine's Gull occurs as a common breeder east of the Mackenzie Delta (Porsild 1943); most sightings of this species in the study area during 1972 and 1974 were recorded in this area. Sabine's Gulls were, however, sighted at Nunaluk Spit between 8 and 13 June 1972: during this period 51 birds of this species of which 50 were flying to the west were sighted. (In 1975, however, Sabine's Gulls detected in spring along the Yukon coast were predominantly eastbound [Johnson *et al.* In Press; Richardson *et al.* 1976].) On 10 and 11 July 1972, five birds and one bird (respectively) were sighted.

Sabine's Gulls were sighted consistently at Cape Dalhousie between 8 and 16 June 1972 (Figure 87); a total of 62 birds was seen during this period. One bird of this species was also recorded at Liverpool Bay on 4 August 1972.

During 1974, the majority of sightings of Sabine's Gulls were recorded during aerial surveys of the coastal Beaufort Sea. To a large extent, these sightings were limited to the Tuktoyaktuk Peninsula. During 1974, only five sightings, all of single individuals of this species, were recorded away from the Tuktoyaktuk Peninsula. These five birds were recorded on Richards Island and Pelly Island, east of the Tuktoyaktuk Peninsula. Generally, fewer than 10 Sabine's Gulls were sighted on any one waterbody. However, substantial concentrations of this species were sighted on two waterbodies: Lake Number 88, near Cape Dalhousie, hosted 35 Sabine's Gulls

SABINE'S GULL

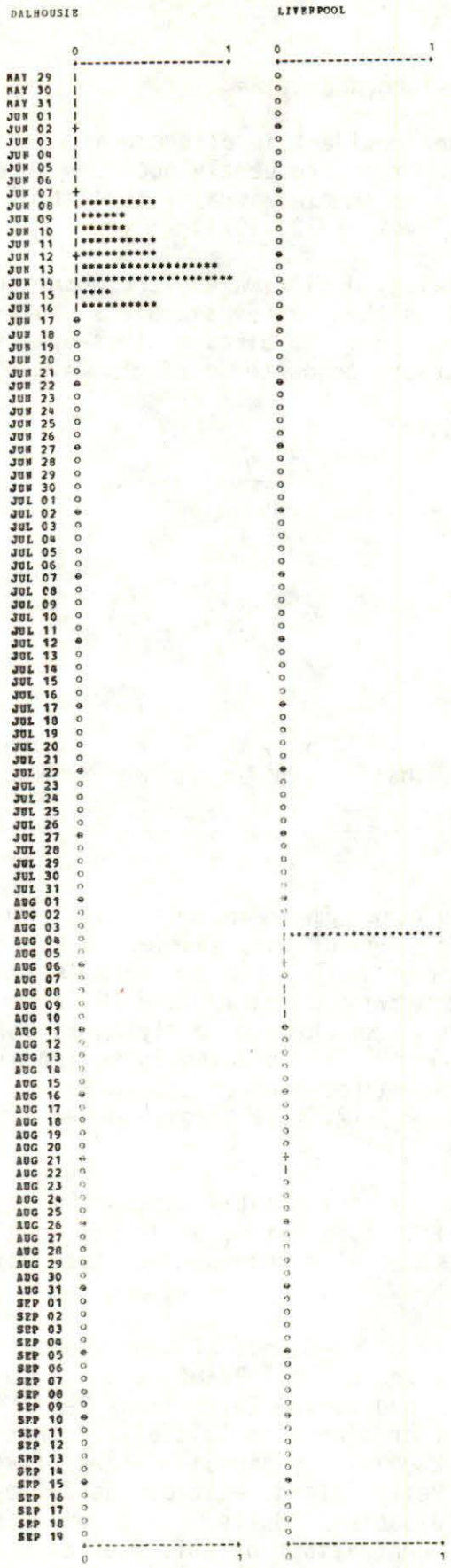
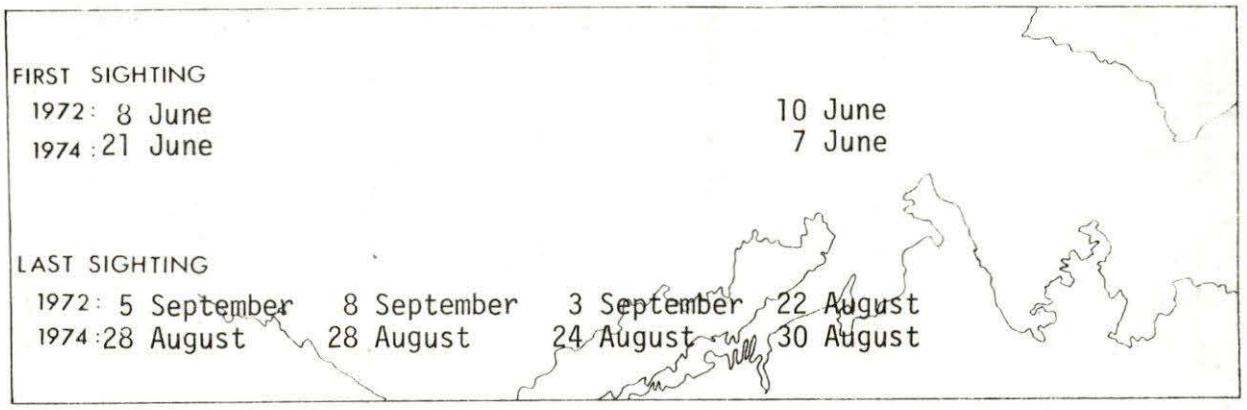


FIGURE 87. Number of Birds per Hour Observed Passing Coastal Migration Watch Stations in the Yukon and Northwest Territories in 1972. Only Locations Where Birds were Observed are Presented.

during early July, and Beach Number 27, near Atkinson Point, hosted 46 gulls of this species during early August 1974. Gulls of this species were also seen regularly in Liverpool Bay.

Sterna paradisaea: Arctic Tern



Present Status and Spring Migration

Arctic Terns occur as common nesters on the coast of the eastern Beaufort Sea. This species arrives in the Beaufort Sea shortly after the gulls: during the last week in May. Arctic Terns were first observed during this study, however, on 10 June in 1972 and on 7 June in 1974--although Slaney (1974) reported the presence of Arctic Terns on 28 May 1972 on Richards Island. Few Arctic Terns were observed migrating through the Beaufort Sea area during the springs of 1972 and 1974. No birds of this species were seen at Nunaluk Spit during the spring of 1972, and only a few Arctic Terns were seen daily from 10 to 15 June 1972 at Cape Dalhousie (Figure 88). The 1974 spring migratory movement of this species was equally sparse; only two Arctic Terns were seen during offshore aerial surveys in June: one was recorded at sea well over 100 km north of Cape Dalhousie on 6 June, and the other was recorded on 23 June approximately 25 km northeast of Herschel Island.

During 1975, strong eastward movements of this species were noted during the first two weeks of June at Clarence Lagoon and at Komakuk, Y.T. Peak movements of Arctic Terns were recorded on 11 June at both sites; approximately 9.0 birds/hr were observed at Komakuk and approximately 5.0 birds/hr at Clarence Lagoon (Johnson *et al.* In Press; Richardson *et al.* 1976).

Summer Distribution and Habitat Preferences

As was the case with Glaucous Gulls, Arctic Terns were, with a few exceptions, seldom seen in large numbers during July and August; on 15 July 1974, nearly 250 terns of this species were counted on a lake near Tuktoyaktuk; during a survey conducted two weeks later, over 75 Arctic Terns were sighted on a lake within a few kilometers of the

ARCTIC TERN

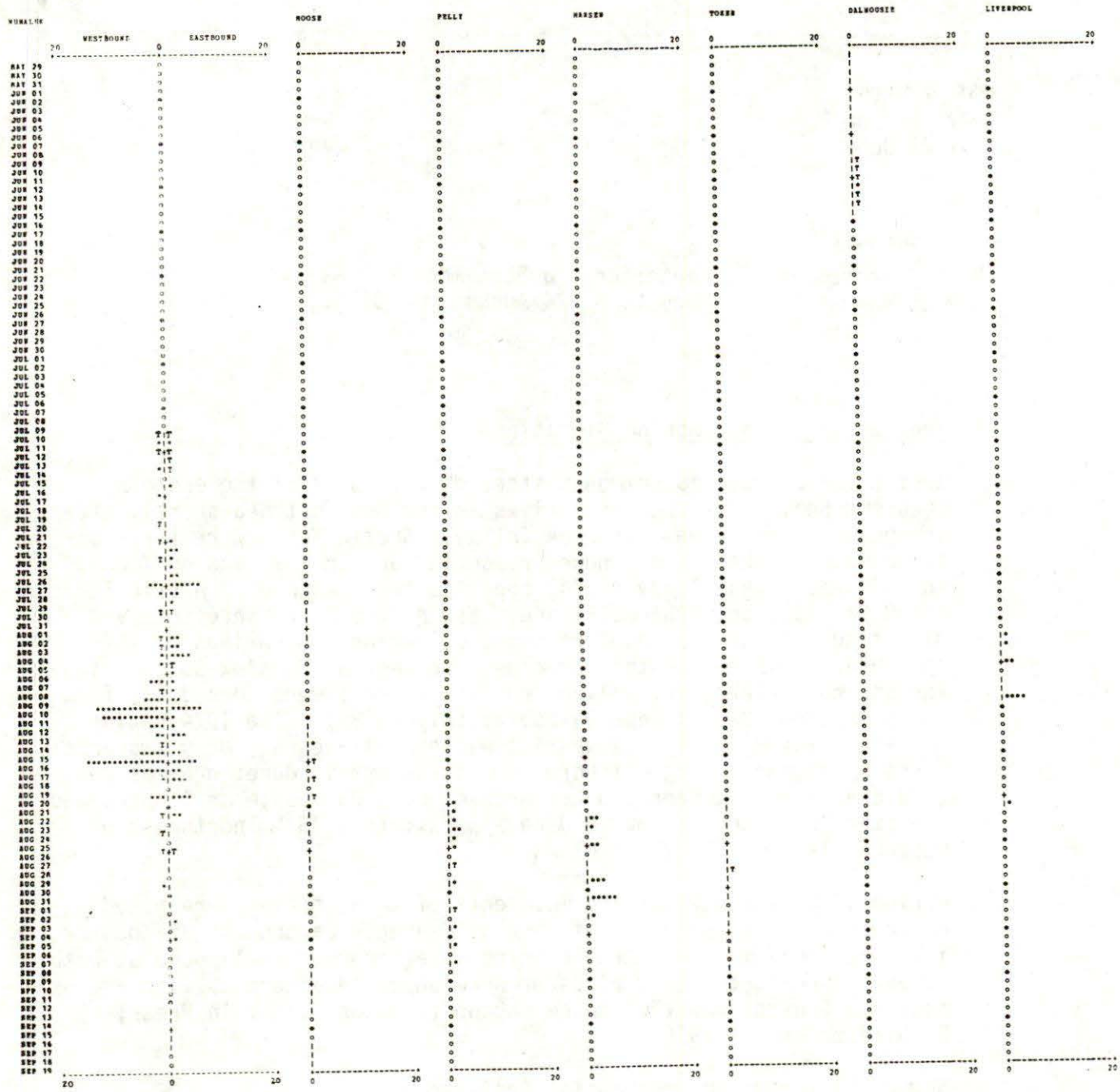


Figure 88. Number of Birds per Hour Observed Passing Coastal Migration Watch Stations in the Yukon and Northwest Territories in 1972. Only locations where birds were observed are presented.

above-mentioned lake. Also, as many as 75 terns were observed on Garry Island during this survey.

Other waterfowl species such as eiders, Brant, and Oldsquaw often nest in association with Arctic Terns (Anderson 1913; Hawksley 1957). Terns frequently nest in colonies with other Larids; and a high correlation in habitat utilization between Arctic Terns and Glaucous Gulls was found to exist in 1974 (Table 9). Terns were seen in similar numbers on fresh and salt-water during coastal surveys in 1974 (Figures 89 and 90); however, birds of this species seldom wander far from shore (Watson and Divoky 1974).

Fall Migration

Small numbers of Arctic Terns were seen at most migration watch sites along the coast during August 1972 (and during July at Nunaluk). However, at Cape Dalhousie no Arctic Terns were observed during August 1972. At Nunaluk, high numbers of Arctic Terns were observed as early as 10 August, when nearly 20 birds/hr were recorded moving west past the spit (Figure 88). An even higher rate of westward movement was recorded on 16 August. Terns were present at Nunaluk Spit until 5 September and at Pelly Island until at least 8 September. However, the bulk of migration of this species from the study area appeared to have occurred in mid-August.

Arctic Terns apparently migrate east into the Beaufort Sea area in spring (Johnson *et al.* In Press; Richardson *et al.* 1976) and west from this area during autumn. Arctic Terns that use the eastern Beaufort Sea, therefore, are presumably members of the population that migrate south along the west coast of the Americas to Antarctic wintering areas (Salomonsen 1967).

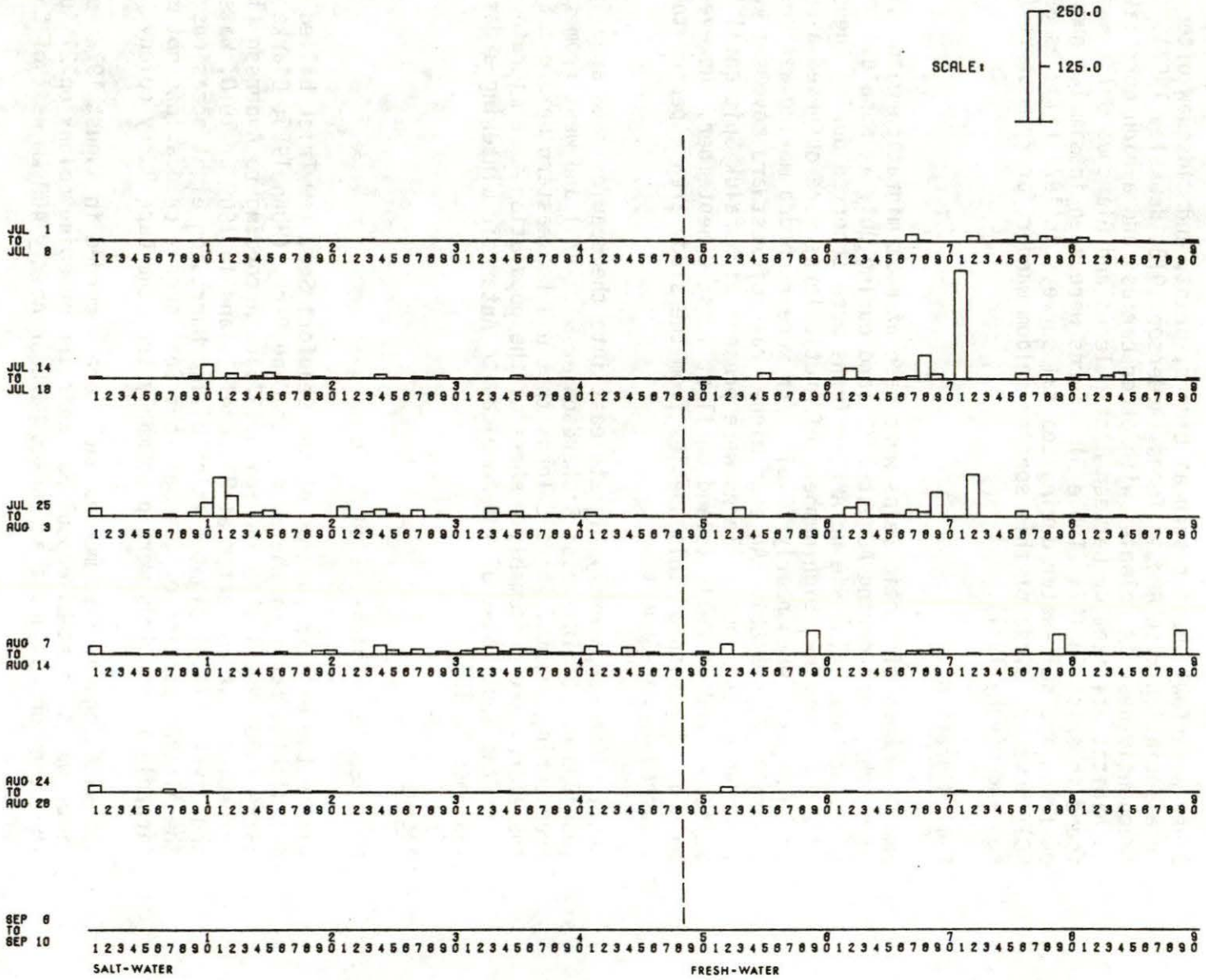
Alcids

Uria lomvia: Thick-billed Murre

Within the eastern portion of the Beaufort Sea, few Thick-billed Murres are sighted far from the colony at Cape Parry (Höhn 1955; Clarke 1944; Barry 1960; Nettleship and Smith 1975). According to Anderson (1913), a specimen was collected at Herschel Island in 1909 or 1910; Watson and Divoky (1974) sighted Thick-billed Murres on eight occasions (in the Alaskan portion of the Beaufort Sea, specific locations not mentioned)--these birds were presumably from the Cape Parry colony.

Two sightings of five murres each were recorded in August 1972: one group was seen at Liverpool Bay near the breeding colony on 21 August, the other on 23 August at Hansen Harbour nearly 400 km west of Cape Parry.

FIGURE 89. Beaufort Sea 1974 Barrier Beach Data--Number of Birds Observed Vs Location Number--Arctic Terns



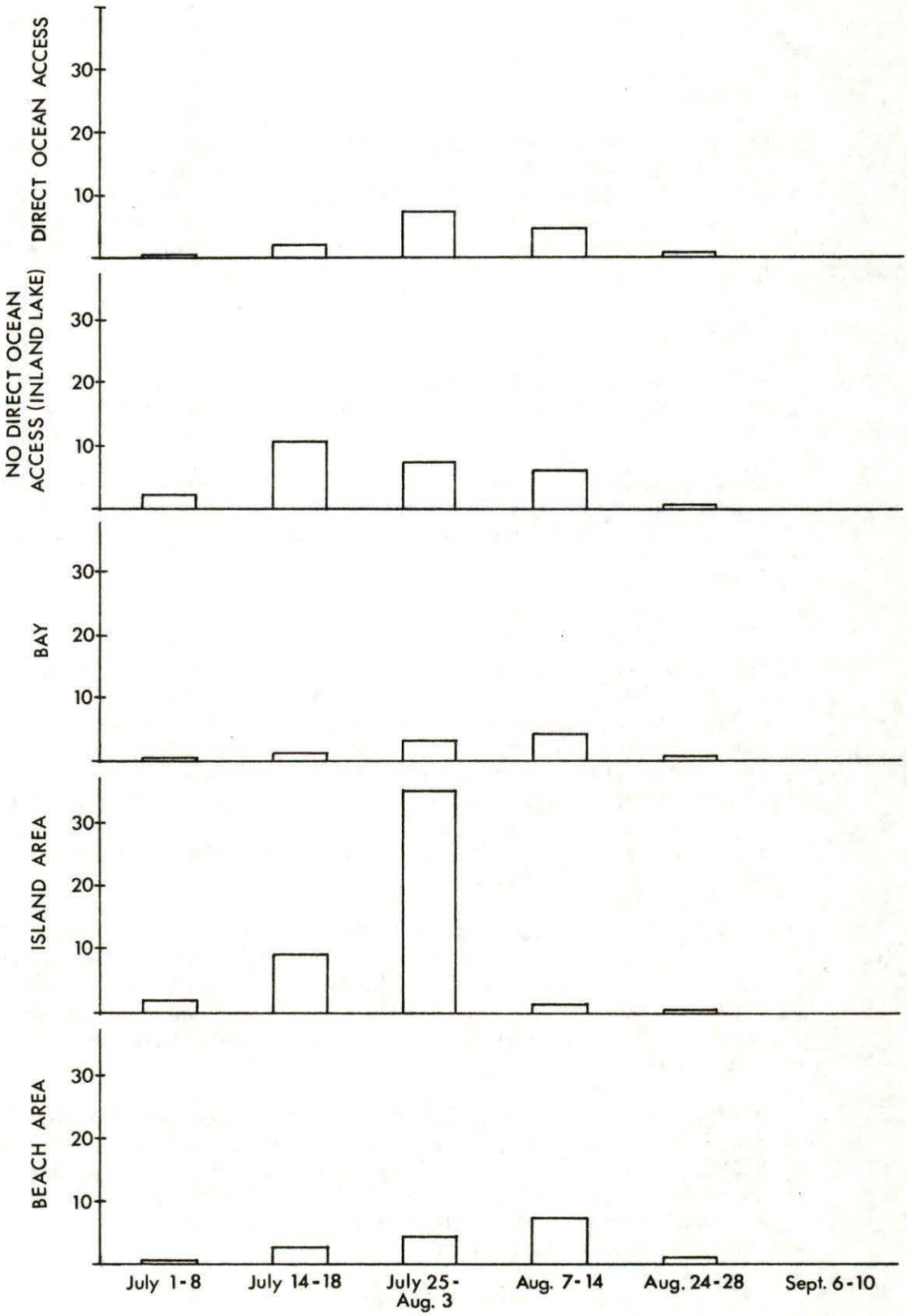


FIGURE 90. Average Number of Arctic Tern per Waterbody by Waterbody Type, 1 July to 10 September 1974.

Cepphus grylle: Black Guillemot

Black Guillemots are among the very few avian species that overwinter in the Beaufort Sea. This species is known to breed in a small colony on Herschel Island; Black Guillemots are not common elsewhere in the study area. Between 10 July and 16 August 1972 eight sightings of single birds were recorded at Nunaluk Spit (for dates see Gollop and Davis 1974a).

Owls

During this study, two species of owls were seen in the Beaufort Sea area: the Snowy Owl and Short-eared Owl. The latter species occurred uncommonly during both years of the study (see Figure 91).

Some Snowy Owls may remain in the Arctic year-long and during some years, large numbers of this species may subsist in the Beaufort Sea area throughout the winter by preying primarily on lemmings and other sources of food such as ptarmigan.

Nyctea scandiaca: Snowy Owl

This vagarious species is present and breeds in large numbers in the Beaufort Sea area during years of high lemming populations and is normally present in smaller numbers and does not breed when lemmings are scarce (Pitelka *et al.* 1955). Although the Snowy Owl may reside in the Arctic the year round (Platt in prep.), it commonly migrates, though erratically, from its breeding range. Although Snowy Owls were not observed in this study until 31 May in 1972 and 29 May in 1974, the first migrants normally arrive in the Beaufort Sea area as early as mid to late April (Slaney 1974).

Snowy Owls were observed in moderate numbers during both 1972 and 1974. All Snowy Owls (42) seen in 1972 were observed during spring at Cape Dalhousie. During 1974, 35 sightings representing at least 40 individuals were noted. The locations where these birds were sighted ranged from Liverpool Bay near Bathurst Peninsula, N.W.T., to the sea-ice off Komakuk, Y.T.

During some years, a number of migrant Snowy Owls do not leave the Beaufort Sea area until December. During 1974, however, the last Snowy Owl was sighted on 10 September but it is very likely that many Snowy Owls remained beyond this date. During 1975, C.E. Tull and W. Koski (pers. comm.) sighted a Snowy Owl on Rapid Creek, Y.T., during an aerial survey on 23 Ocotber.

Asio flammeus: Short-eared Owl

The Short-eared Owl breeds on the mainland coast of the eastern portion of the Beaufort Sea and perhaps on Banks Island (Godfrey 1966). Only two sightings of Short-eared Owls were made during 1972: a single Short-eared Owl was observed at Moose Channel on 30 July 1972 and an-

OWLS

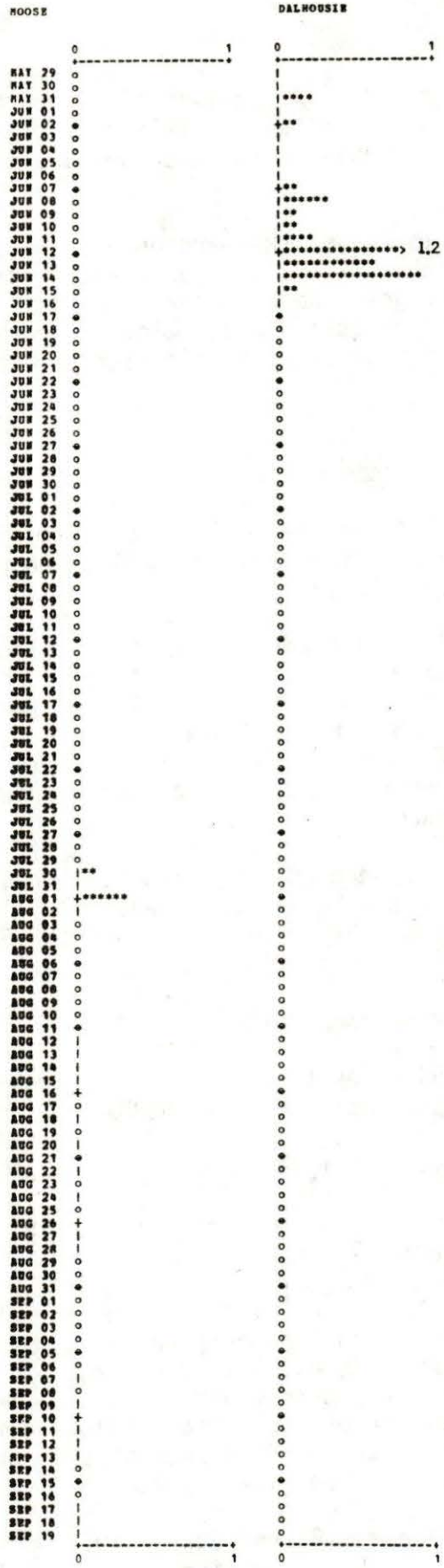


FIGURE 91. Number of Birds per Hour Observed Passing Coastal Migration Watch Stations in the Yukon and Northwest Territories in 1972. Only Locations Where Birds were Observed are Presented.

other on 1 August 1972. A single Short-eared Owl was sighted on 14 May 1974 flying west off Baillie Island at the tip of Bathurst Peninsula. This was the only Short-eared Owl identified during this study in 1974.

Johnson *et al.* (In Press), Richardson *et al.* (1976) and W. Koski (pers. comm.) reported that Short-eared Owls are considerably more common than the above data suggest; Koski reported a nest record from Old Camp Farewell on Richards Island and a winter record on 21 October 1975 from upper Cache Creek near the Yukon Territory--Northwest Territories border.

Others

Colaptes auratus: Common Flicker

Although Common Flickers breed only as far north as the northern limit of trees, they are a wide-ranging species and prefer moderately open habitats (Godfrey 1966).

One Common Flicker was reported from Cape Dalhousie migration watch station on 9 June 1972.

Fremophila alpestris: Horned Lark

Horned Larks breed on dry tundra habitats throughout the Beaufort Sea area (Godfrey 1966).

One Horned Lark was seen at Cape Dalhousie on 5 June 1972. At Toker Point, however, Horned Larks were frequently sighted in the fall between 22 August and 9 September. As many as 15 individuals were recorded on a single day at this site.

Petrochelidon phrrhonota: Cliff Swallow

Godfrey (1966) indicates that the breeding range of this species in the Canadian Arctic includes only the Mackenzie Delta.

A single Cliff Swallow sighting was recorded on 13 June 1972 at Cape Dalhousie.

Corvus corax: Common Raven

Common Ravens are not abundant in the Beaufort Sea region, but are regularly present in small numbers and some winter in the Arctic (White and Cade 1971; Temple 1974; Platt in prep.; F. Smith pers. comm.). Common Ravens were seen throughout the season from 9 June to 17 September 1972, from Cape Dalhousie to Nunaluk Spit. No large concentrations were noted; the maximum seen at any one time was 13 in the Eskimo Lakes area on 8 September 1974.

Most sightings of Common Ravens during 1972 were made from mid-August to mid-September; however, sampling effort was less intense during July. Sightings during 1974 were more evenly distributed over the season.

Largest numbers of Common Ravens appeared to occur in the Tuktoyaktuk-Kugmallit Bay area. This is probably due to the presence of the settlement of Tuktoyaktuk and the resultant food supply that is found there.

Anthus spinoletta: Water Pipit

Water Pipits are among the earliest migrants to the Arctic; this species nests on rocky ledges throughout the eastern Beaufort Sea coastal area (Godfrey 1966).

Two Water Pipits were seen at Toker Point during 1972. A single bird was observed on 22 August and two more were seen two days later.

Acanthis hornemanni: Hoary Redpoll

Hoary Redpolls breed locally on the mainland coast of the Beaufort Sea east of the Mackenzie Delta (Godfrey 1966).

Both species of redpoll were reportedly identified at Moose Channel during 1972. The first Hoary Redpoll sighting was on 30 July when 10 birds were observed and the last sighting was of one Hoary Redpoll on 22 August 1972.

Acanthis flammea: Common Redpoll

Common Redpolls occur as local breeders along the entire mainland coast of the eastern portion of the Beaufort Sea (Godfrey 1966).

Common Redpolls were sighted at Moose Channel in small numbers from 14 to 22 August 1972. The largest number seen on any one day was 16.

Passerculus sandwichensis: Savannah Sparrow

The Savannah Sparrow is perhaps among the most common of the passerines in the Arctic. These birds were sighted as early as 13 June (at Cape Dalhousie--one bird) and as late as 17 September (at Nunaluk Spit--25 birds) during 1972. Most sightings came from Moose Channel in the Mackenzie Delta where from 100 to 200 individuals were recorded nearly daily from 14 to 28 August. On 24 August 1975 one bird and six birds were seen at Hansen Harbour and Toker Point, respectively. During 1972 this species was last seen on 10 September.

Pooecetes gramineus: Vesper Sparrow

According to the A.O.U. (1957), Vesper Sparrows range north only to the southern portion of the District of Mackenzie, N.W.T. On 16 August 1972, one Vesper Sparrow was sighted at Moose Channel.

Spizella arborea: Tree Sparrow

Tree Sparrows breed along the southeastern protion of the coast of the Beaufort Sea and perhaps on Banks Island (Godfrey 1966).

During 1972, Tree Sparrows were occasionally seen at two sites: one Tree Sparrow was reported from Cape Dalhousie on 14 June, two Tree Sparrows were observed at Moose Channel on 15 August, and one bird of this species was seen at Moose Channel on 24 and 26 August.

Zonotrichia leucophrys: White-crowned Sparrow

According to Godfrey (1966), this species breeds in the eastern Beaufort Sea area from the Mackenzie Delta east along the southern shore of Liverpool Bay to Bathurst Inlet.

During 1972, White-crowned Sparrows were seen near the Beaufort Sea both in spring and fall. Small numbers of birds of this species were noted at Cape Dalhousie from 2 to 7 June 1972. Only two autumn sightings were recorded: one White-crowned Sparrow was seen on 25 August 1972 at Moose Channel and 51 White-crowned Sparrows were seen on 28 August 1972 on Pelly Island.

Calcarius lapponicus: Lapland Longspur

Lapland Longspurs, by far the most abundant birds on the Yukon-Alaska North Slope, were frequently observed at all sites except Liverpool Bay, During 1972, Lapland Longspurs were sighted at Cape Dalhousie as early as 31 May; a few birds of this species were observed passing Cape Dalhousie in migration until the end of observations on 16 June. At Nunaluk Spit, one bird was recorded on 12 June 1972; all other records were from mid-August to mid-September. The peak of the 1972 autumn migration was apparently well synchronized across the coast and was observed to occur on 24 August at Hansen Harbour, Toker Point, and Moose Channel. Nearly 15 birds/hr were seen moving past the latter two sites on this date and over 250 birds were counted at each site. Moderate numbers were observed migrating for as much as two weeks before and after the date of peak migration. At Nunaluk Spit and Pelly Island the observed migration peaked on 28 August but never reached the magnitude recorded at Toker Point and Moose Channel. In addition, the duration of the migration was less prolonged with a more abrupt peak both at Nunaluk and Pelly Island.

Calcarius pictus: Smith's Longspur

Smith's Longspurs breed along the north coast of the Yukon Territory and District of Mackenzie, N.W.T. (Godfrey 1966).

During 1972, two Smith's Longspurs were sighted: one sighting was of four Smith's Longspurs on 31 July at Moose Channel, the other sighting was of a single bird on 27 August at Toker Point. Smith's Longspurs are often found in mixed flocks with Snow Buntings and occasionally with Lapland Longspurs.

Plectrophenax nivalis: Snow Bunting

Snow Buntings are among the earliest of the migrant birds to arrive in the North and one of the latest to depart. Often Snow Buntings appear

well before the snow cover has begun to thaw and flocks can be seen on the tundra feeding on seeds of the previous year's plants that protrude above the snow-line.

The earliest record of a Snow Bunting in 1972 was of a single bird on 31 May at Cape Dalhousie. Thirty birds of this species were seen there on the next day and a small but nearly constant number of birds was seen then until 13 June. Similarly, small numbers were seen at Nunaluk Spit on 11 and 12 June.

Few Snow Buntings were seen from the air during 1974*. Only three birds were sighted: one on Pelly Island on 6 July and the other two on 24 and 26 August, respectively, at lakes near Tuktoyaktuk.

The largest numbers of Snow Buntings were seen during the fall of 1972. Large numbers migrated eastward past Nunaluk during mid-September; a peak of 394 birds/hr was observed on 15 September: 560 birds were counted on that date. Snow Buntings were also recorded in substantial numbers at Pelly Island and Toker Point and at Moose Channel where the latest sighting of this species was recorded on 19 September. That 81 birds were sighted during the third week in September indicates that additional movement probably took place after this date. Migration is inland (Salter 1974b).

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* It has been shown that only a very small percentages of the passerines that are present in arctic habitats are detected during surveys from either fixed-wing aircraft or helicopter (Bartels 1973; Davis *et al.* 1975).

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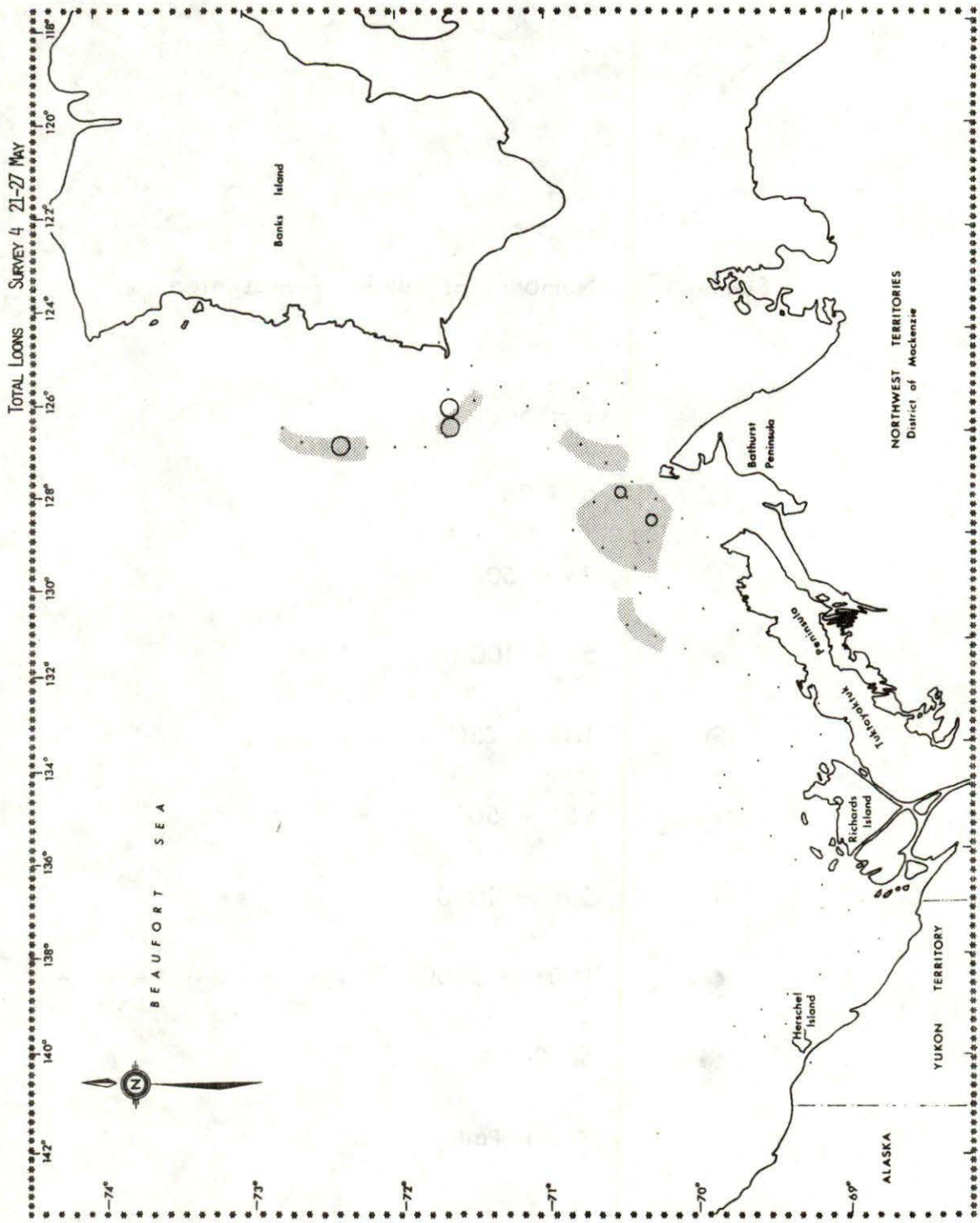
APPENDIX 1. Maps of the Distribution and Abundance of Birds Offshore in the Beaufort Sea During 1974.

This appendix gives data on the distribution and abundance of the three species that were most frequently observed during the 1974 aerial surveys of the southeastern Beaufort Sea. One map has been compiled for each of these species and for each survey during which these species were observed.

In order to represent the distributions of birds in relation to the areas surveyed, the approximate route followed during each survey has been shown on each map as a series of dotted lines. Abundance has been depicted through use of symbols of varying sizes and densities; nine separate categories were distinguished (see below).

Areas of at least partly open water along the transect route are represented by the stippled areas. Hence, stippled areas are regions of less than 100% ice cover. A more detailed presentation of ice cover conditions encountered during each survey can be found in Appendix 2.

Symbol	Number of Birds Represented
∘	1 - 5
○	6 - 25
◯	26 - 50
⊙	51 - 100
◎	101 - 250
⊙	251 - 500
•	501 - 1000
●	1001 - 5000
●	5000 +
. . . . .	Flight Path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Richards Island
Herschel Island
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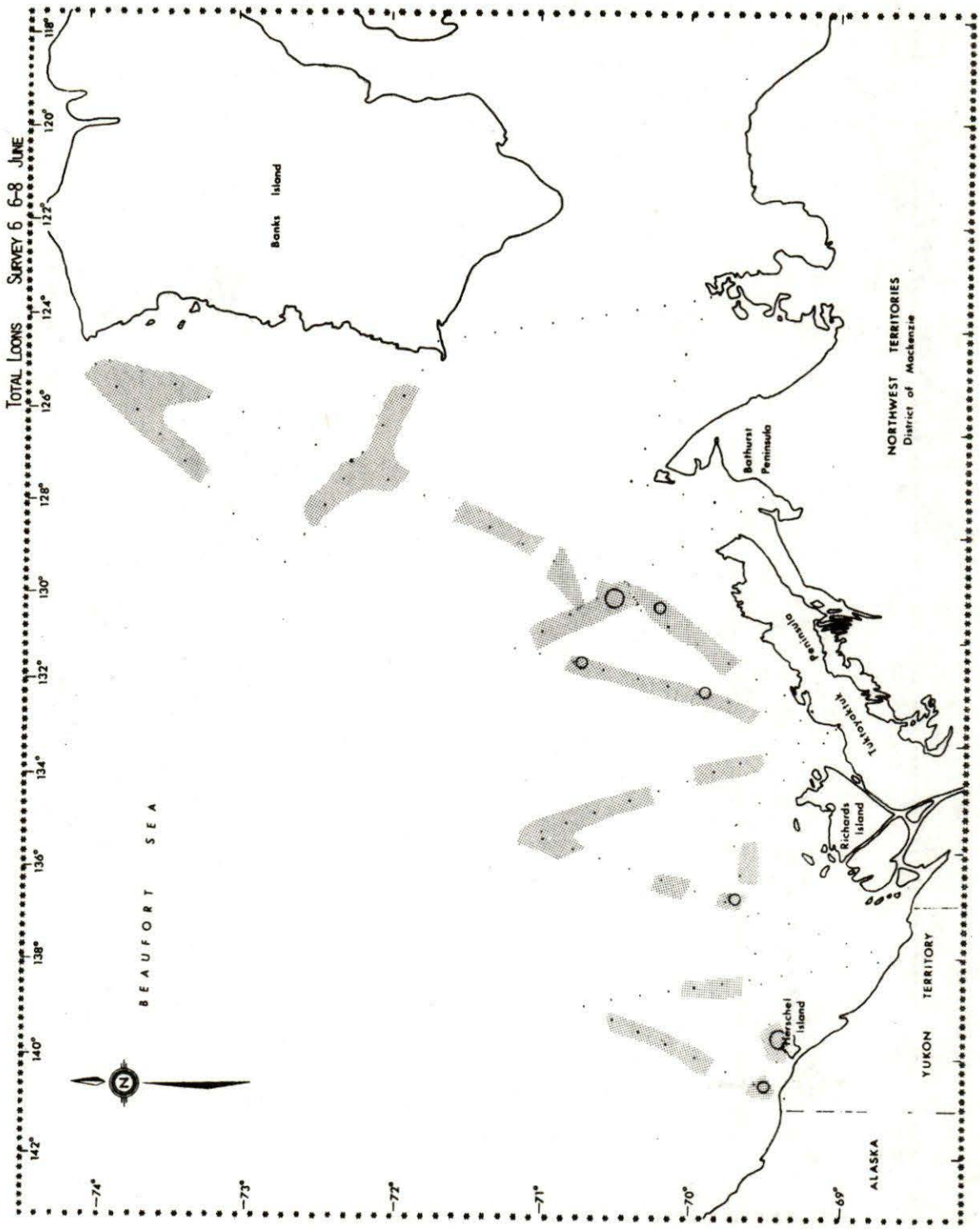
TOTAL LOONS SURVEY 6 6-8 JUNE
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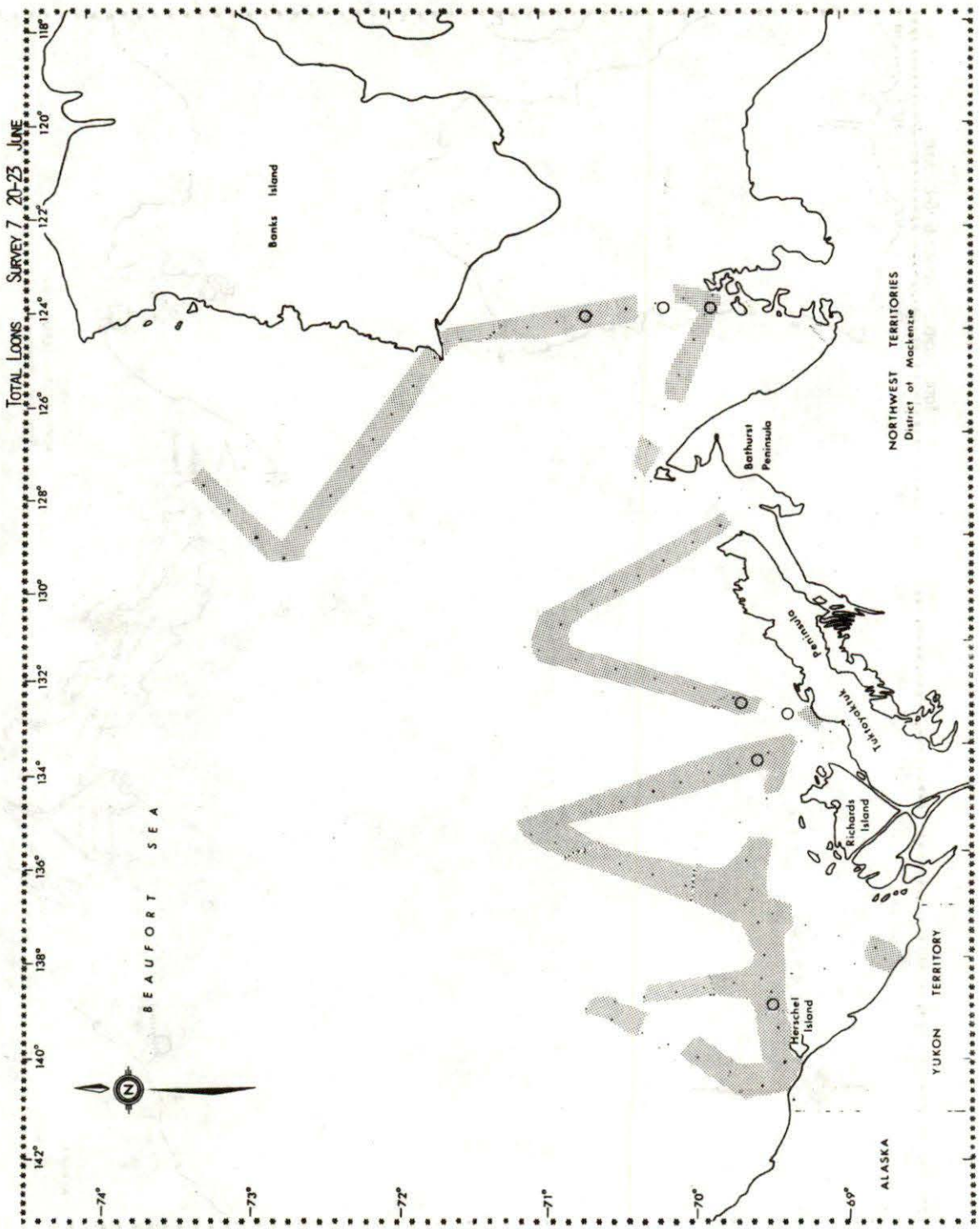
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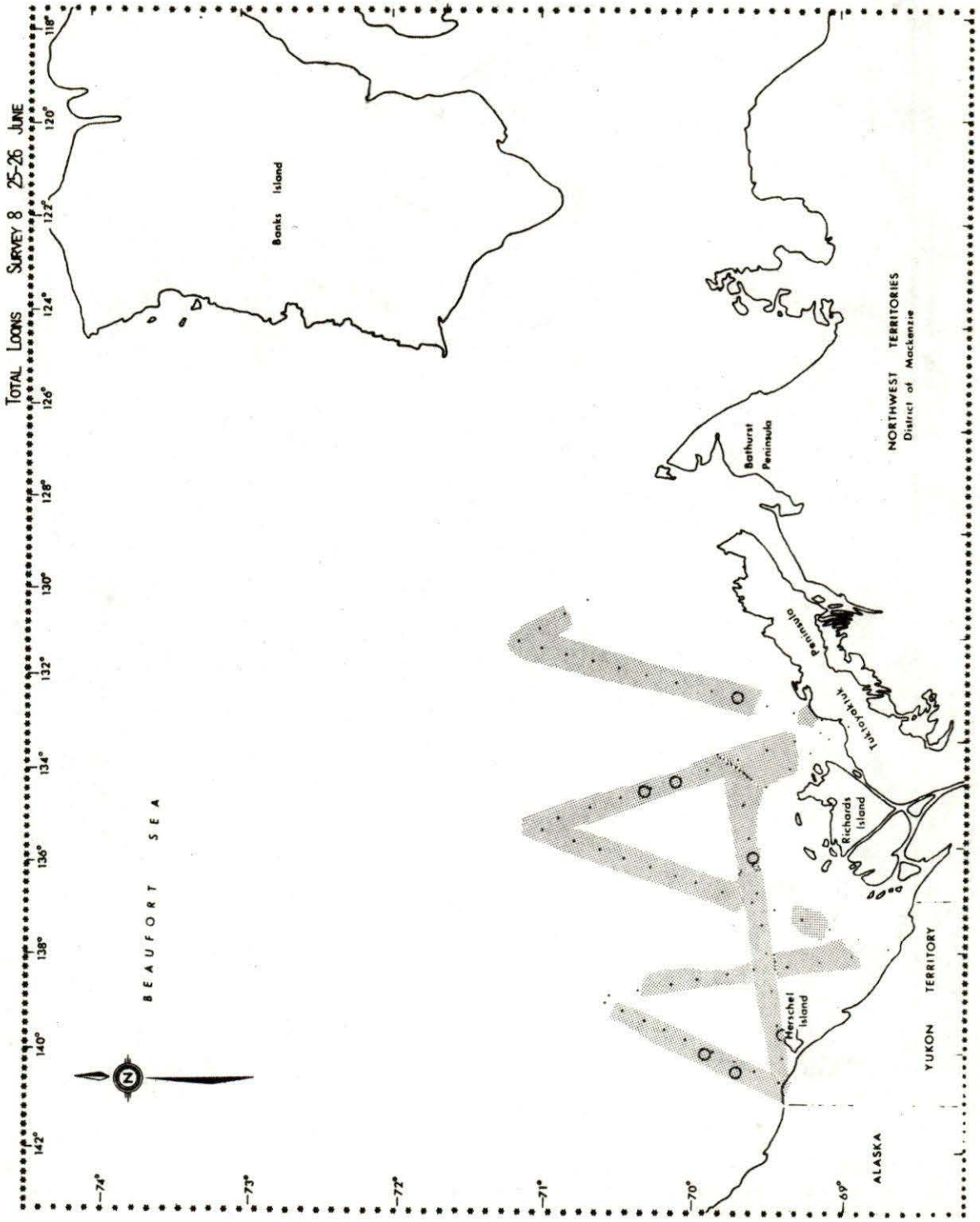
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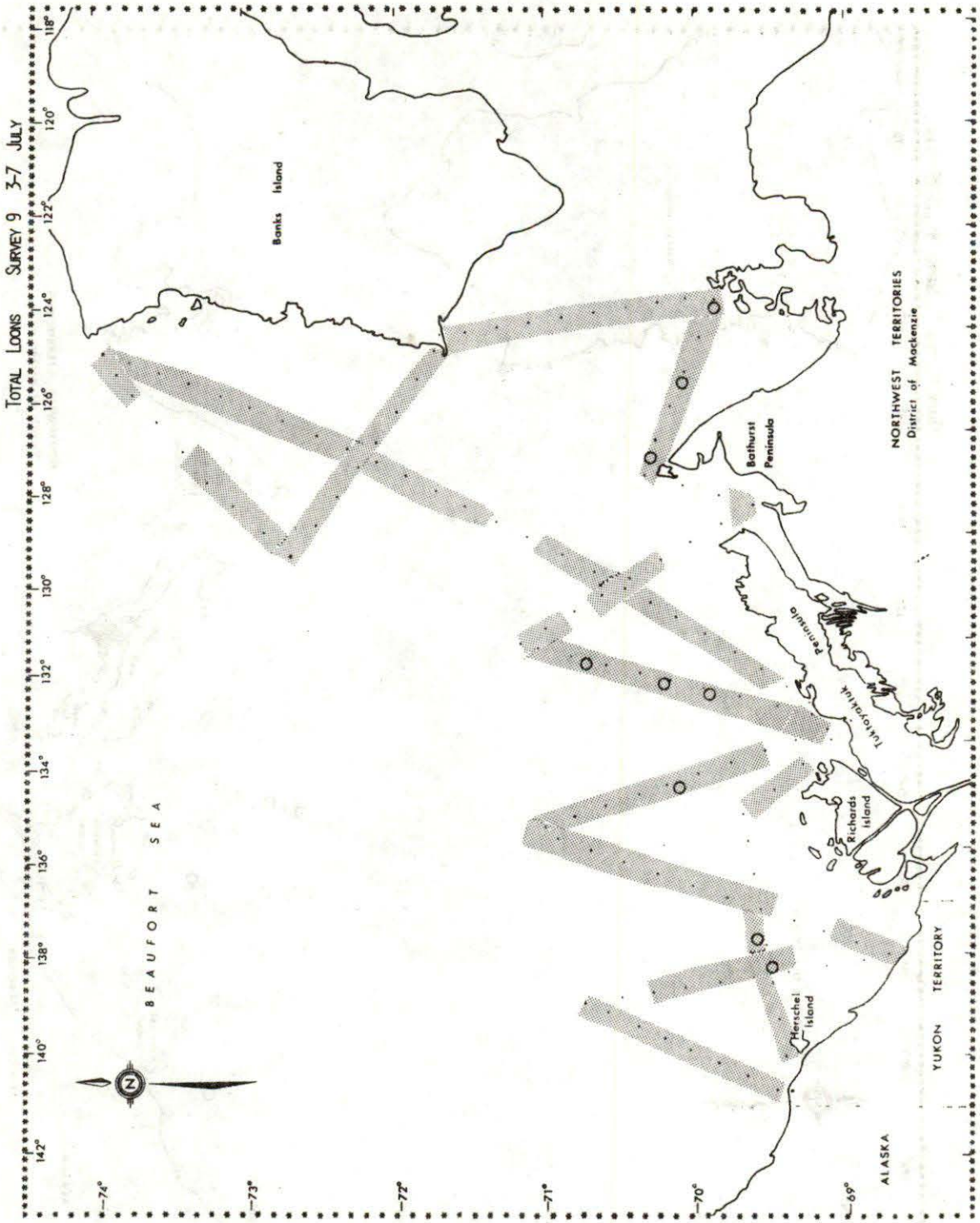
TOTAL LOONS SURVEY 9 3-7 JULY
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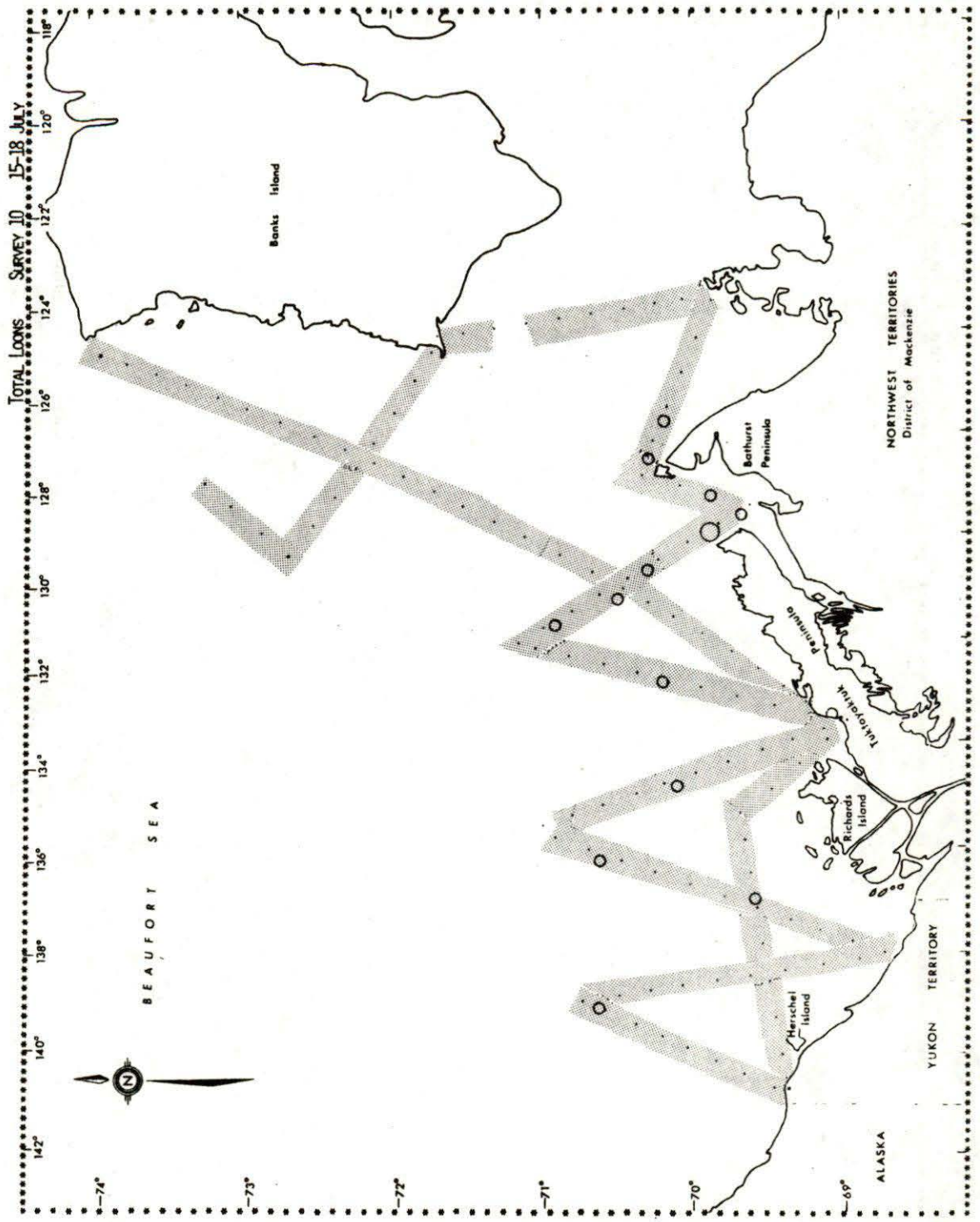
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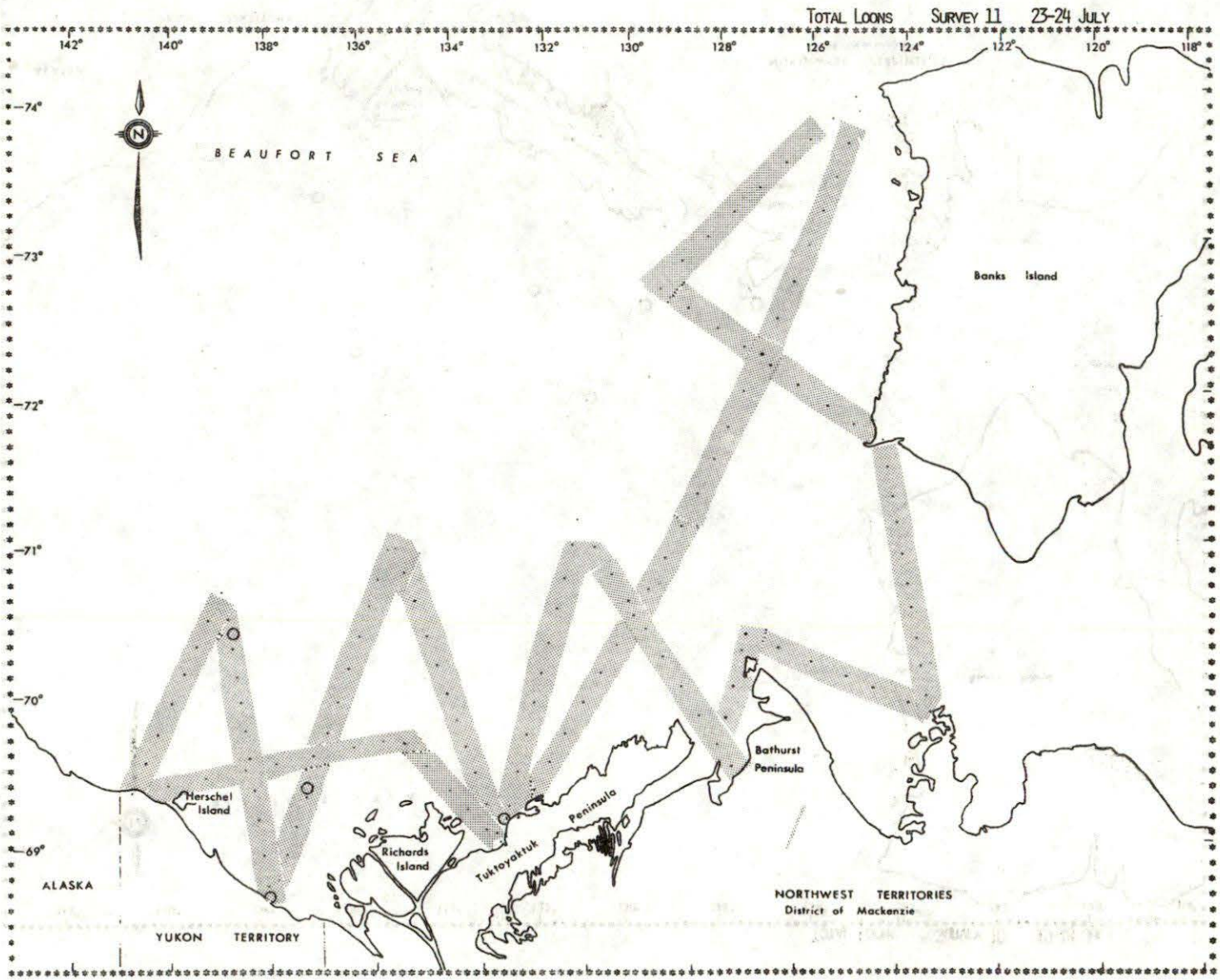
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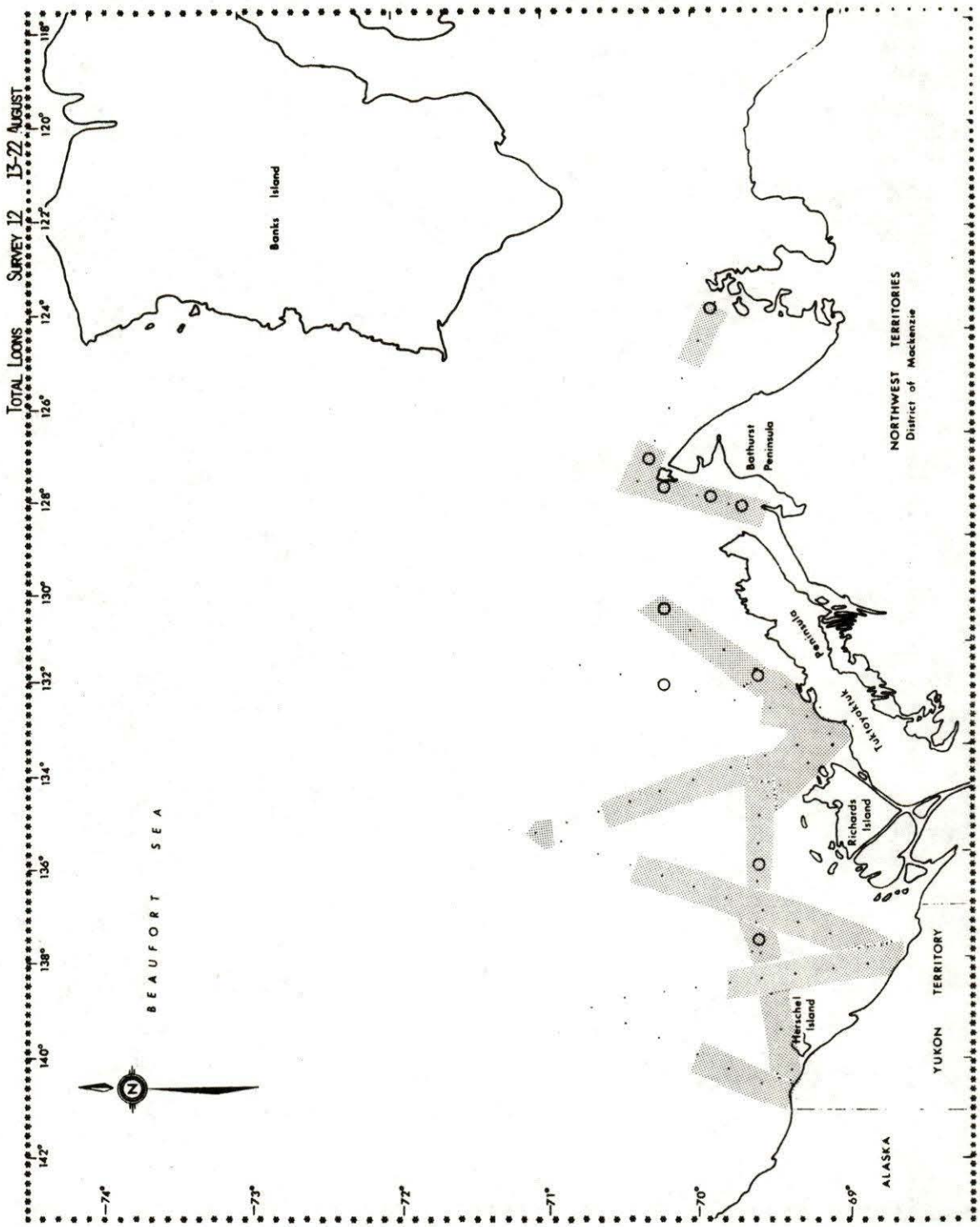
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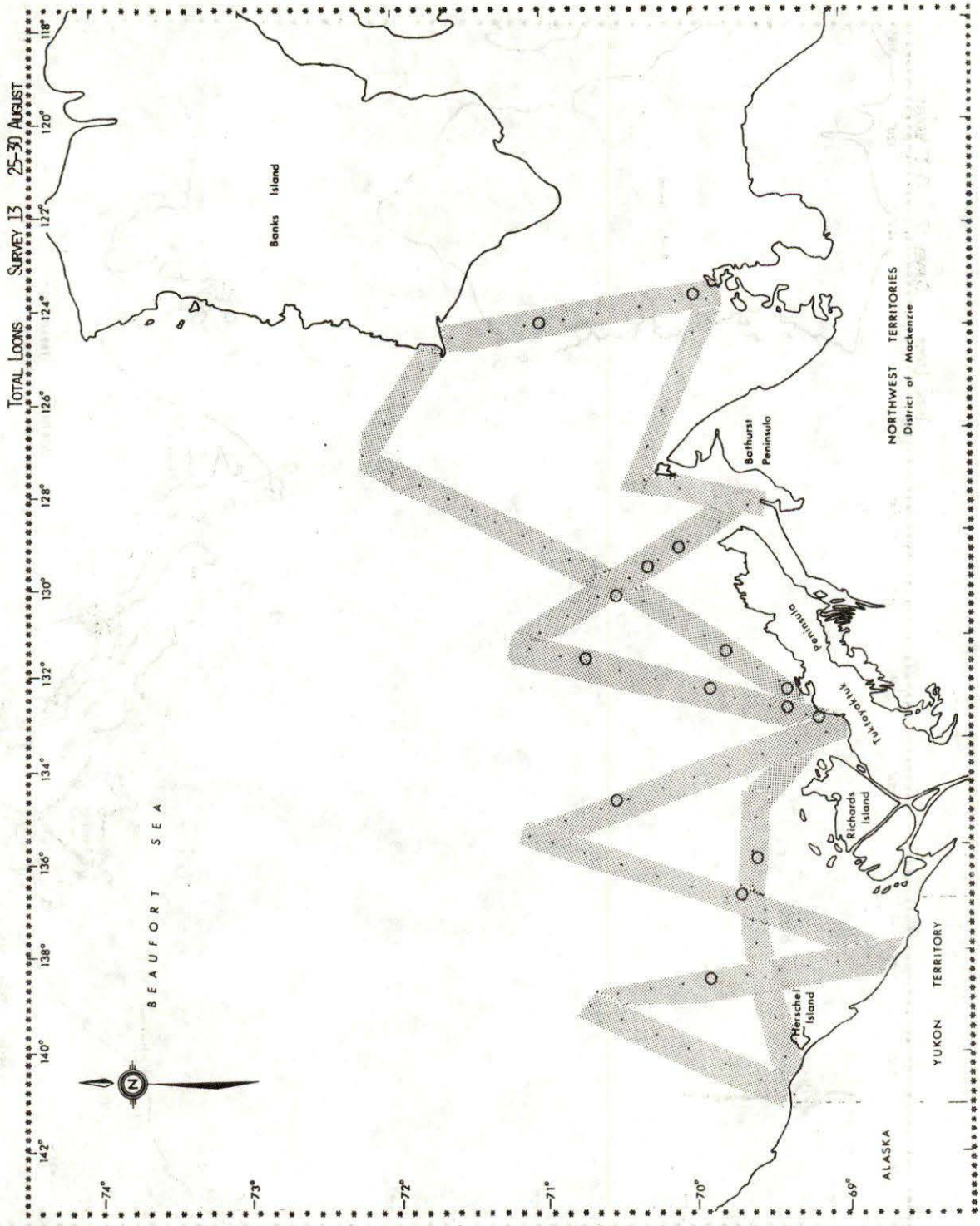
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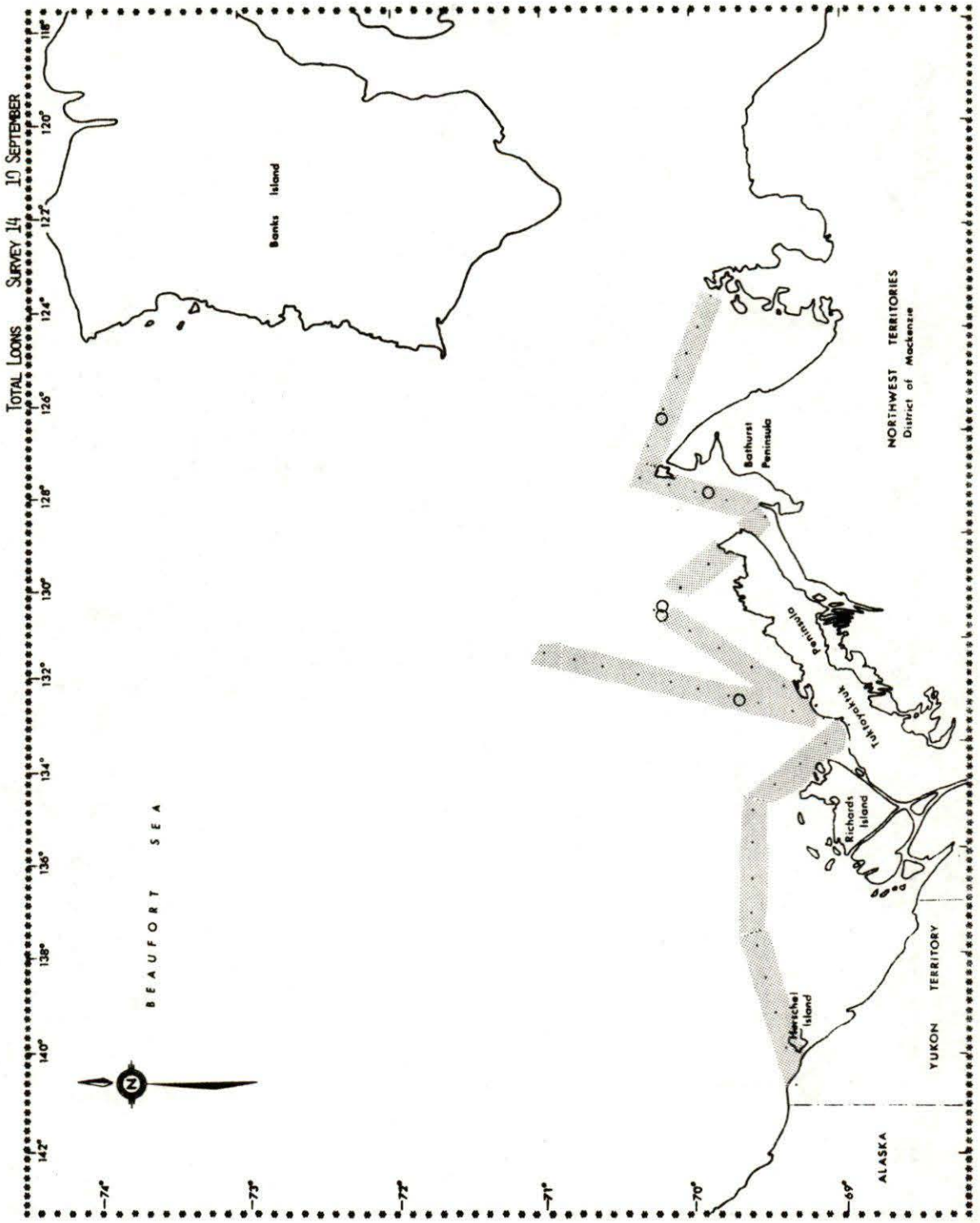
TOTAL LOONS SURVEY 14 10 SEPTEMBER
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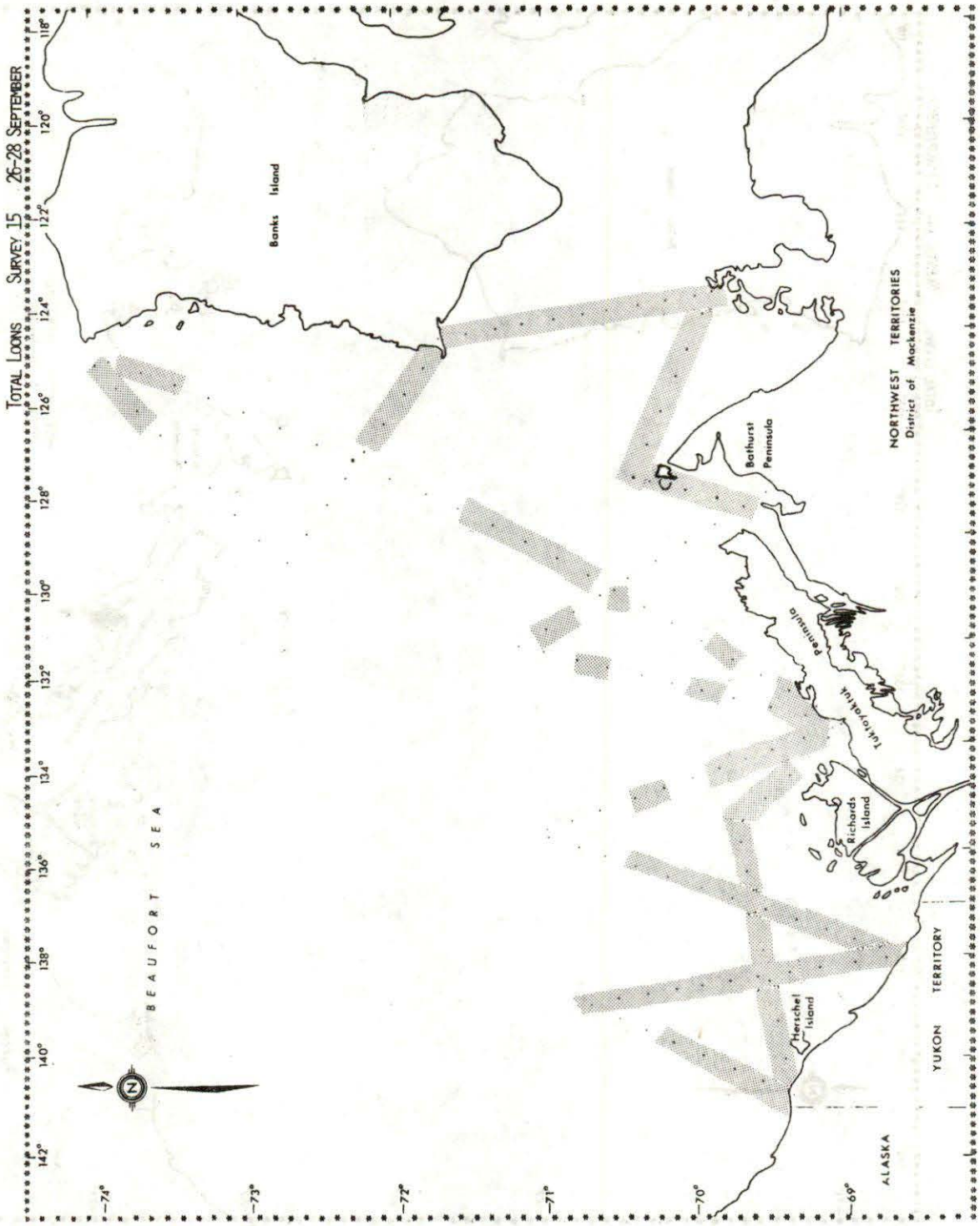
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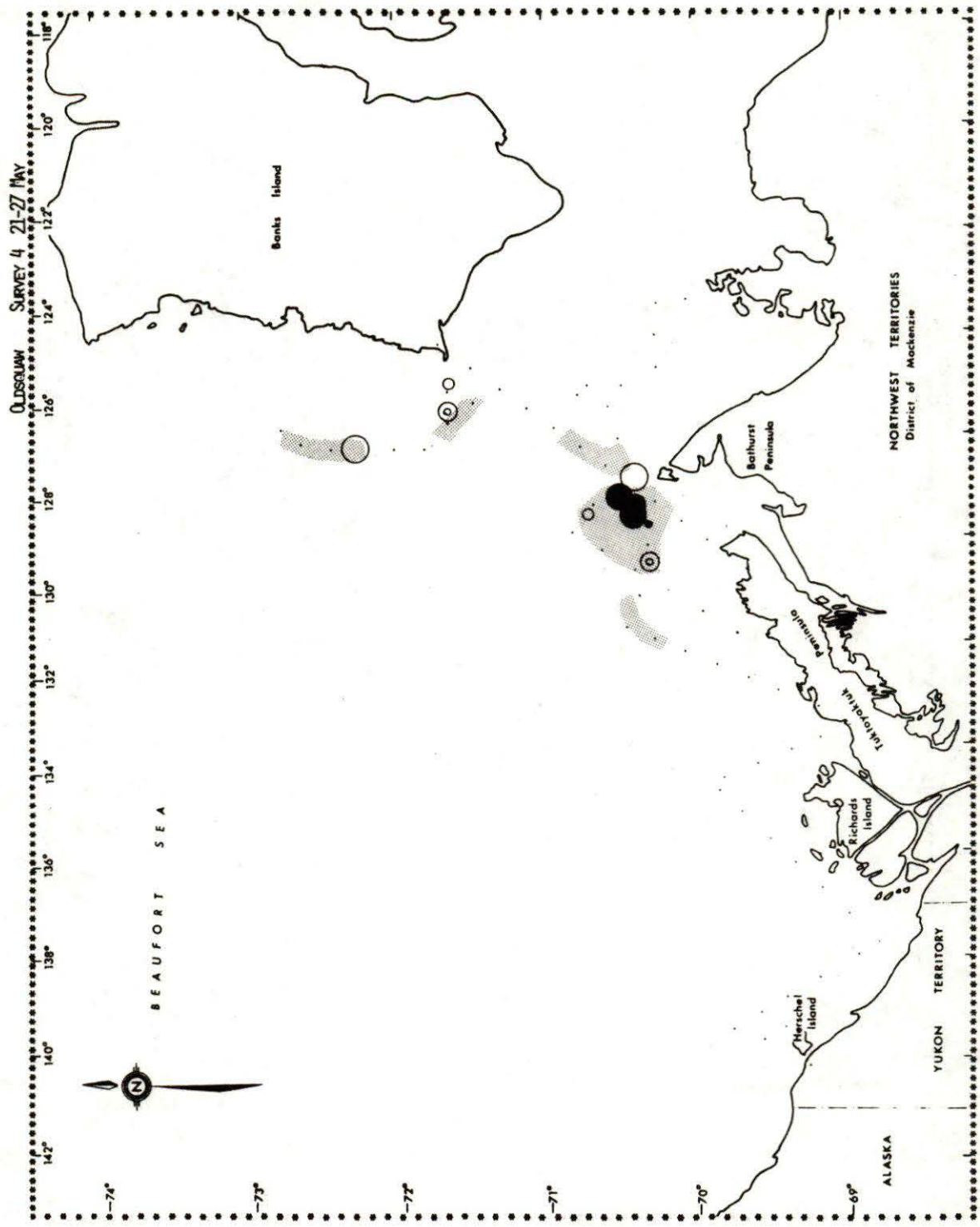
OLDSQUAW SURVEY 4 21-27 MAY
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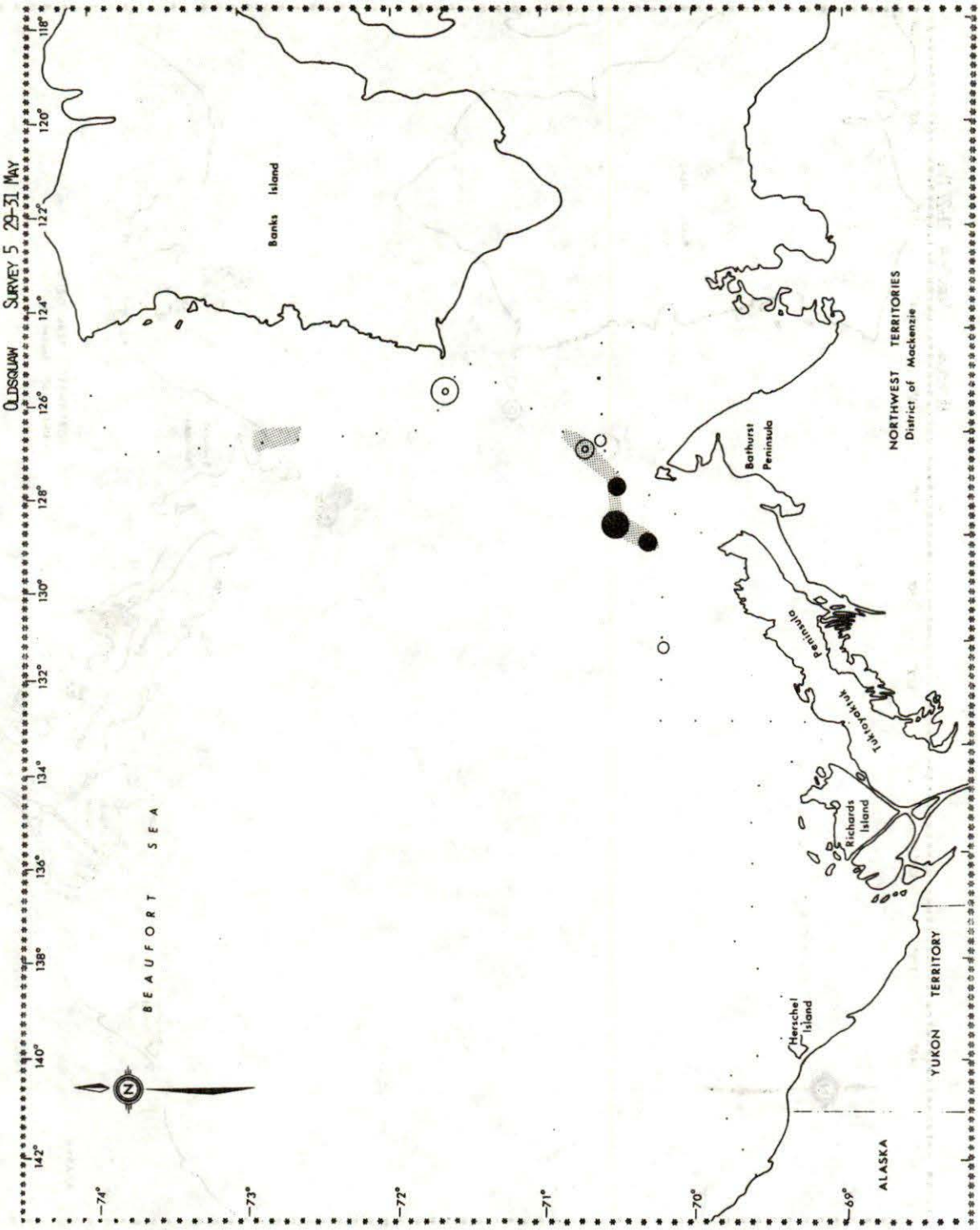
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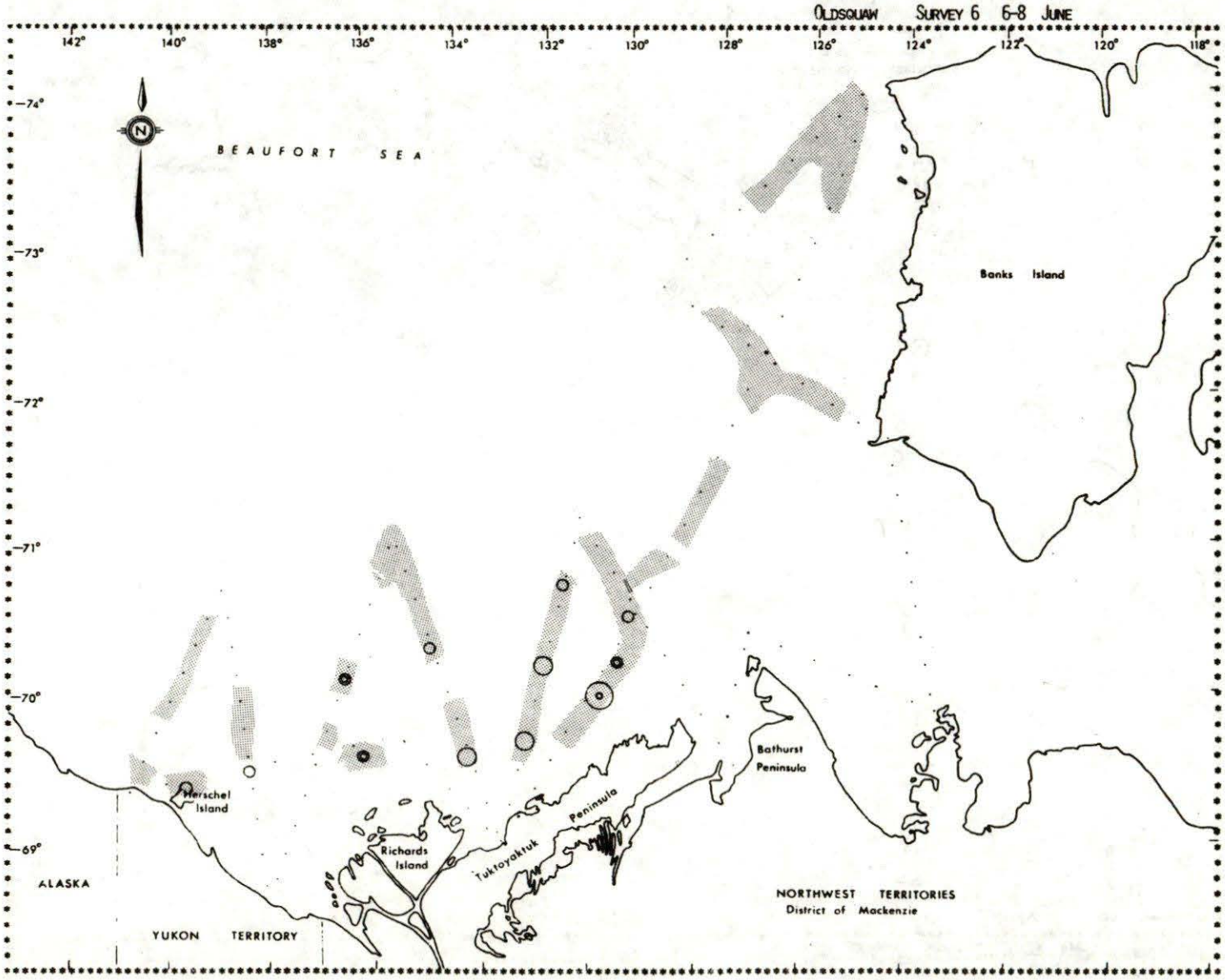
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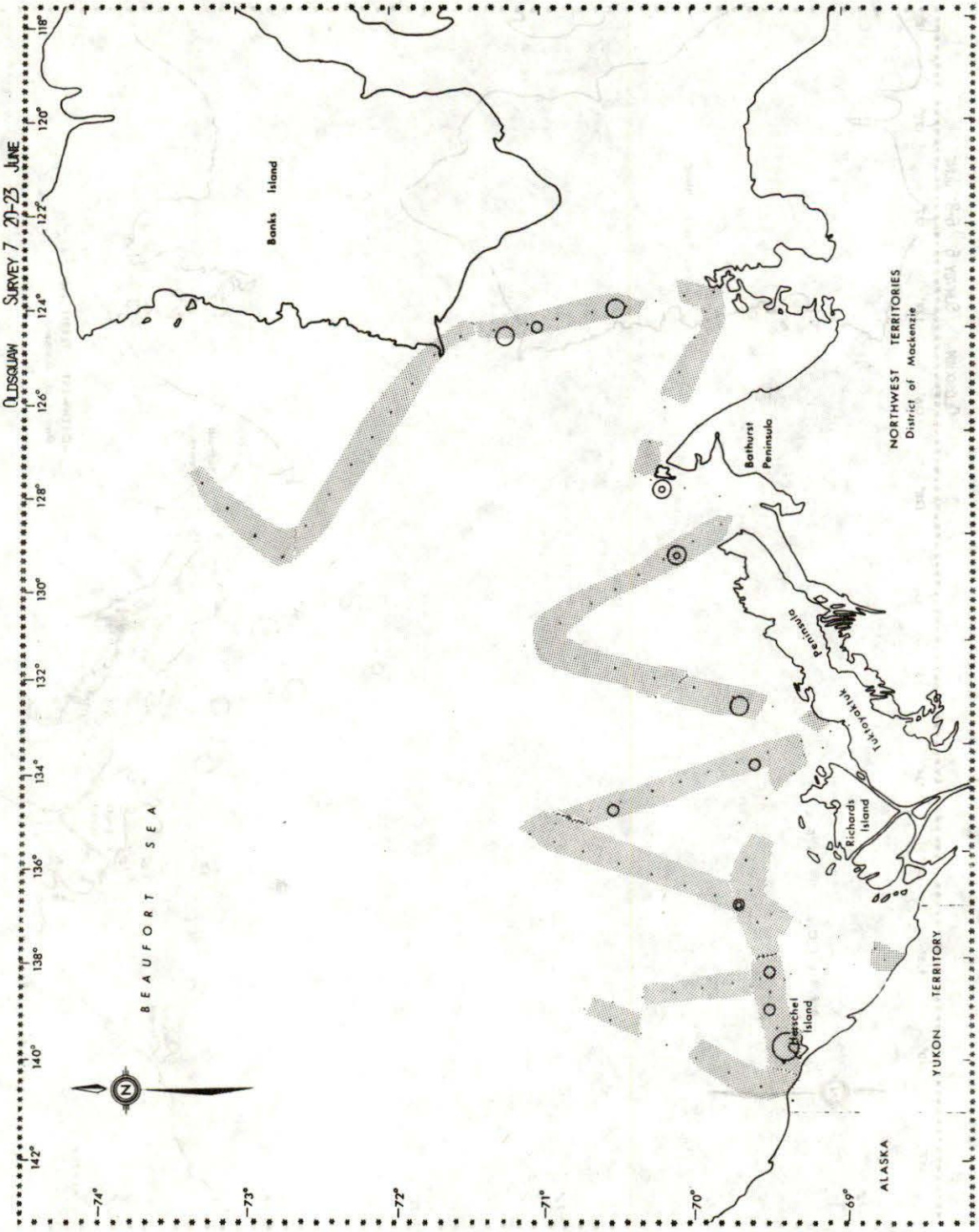
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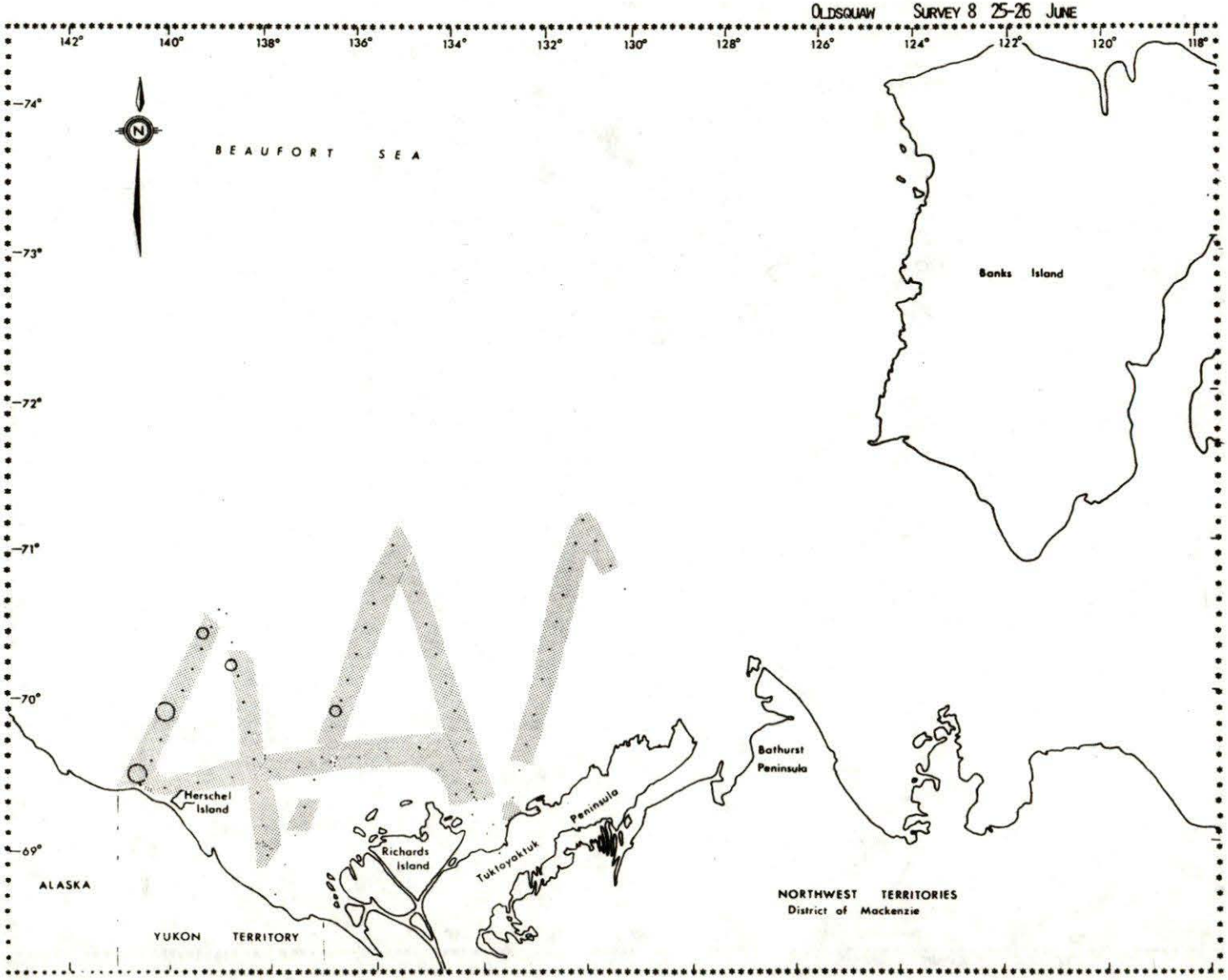
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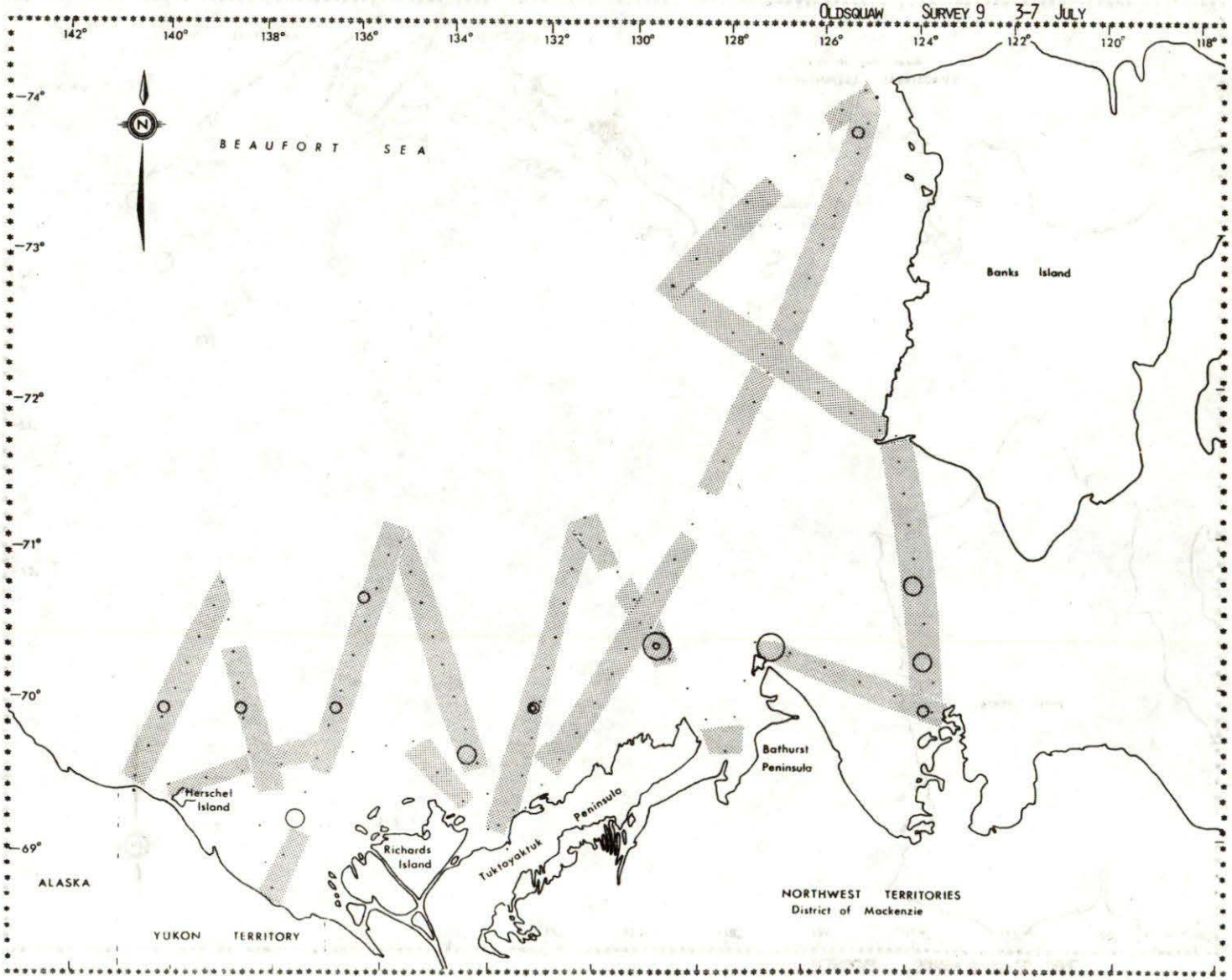
District of Mackenzie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BEAUFORT SEA
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Bathurst Peninsula
Herschel Island
Richards Island
Tuktoyaktuk Peninsula
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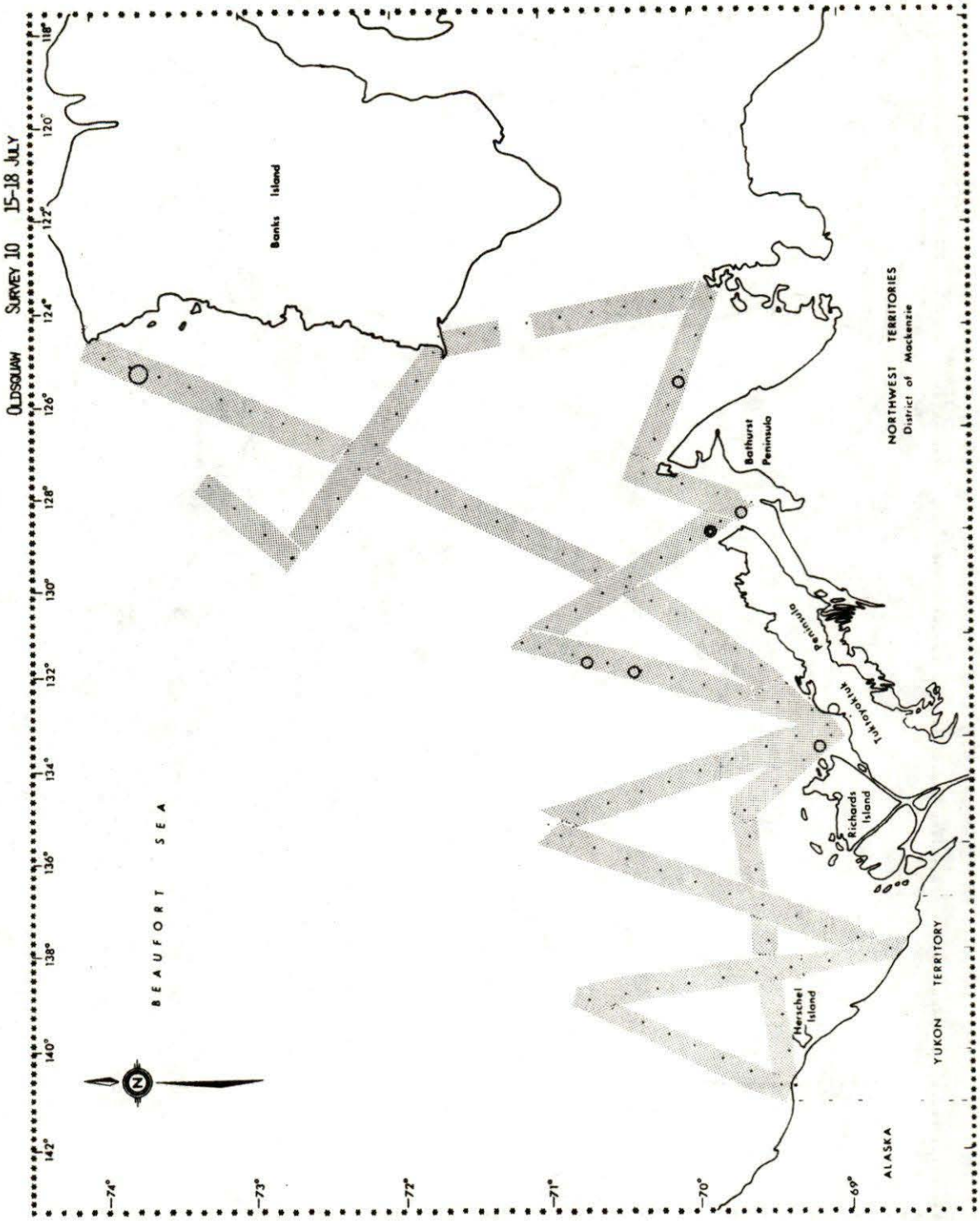
NORTHWEST TERRITORIES
District of Mackenzie


OLDSQUAW SURVEY 10 15-18 JULY
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District of Mackenzie
Tuktoyaktuk Peninsula
Richards Island
Herschel Island
BEAUFORT SEA
YUKON TERRITORY
ALASKA
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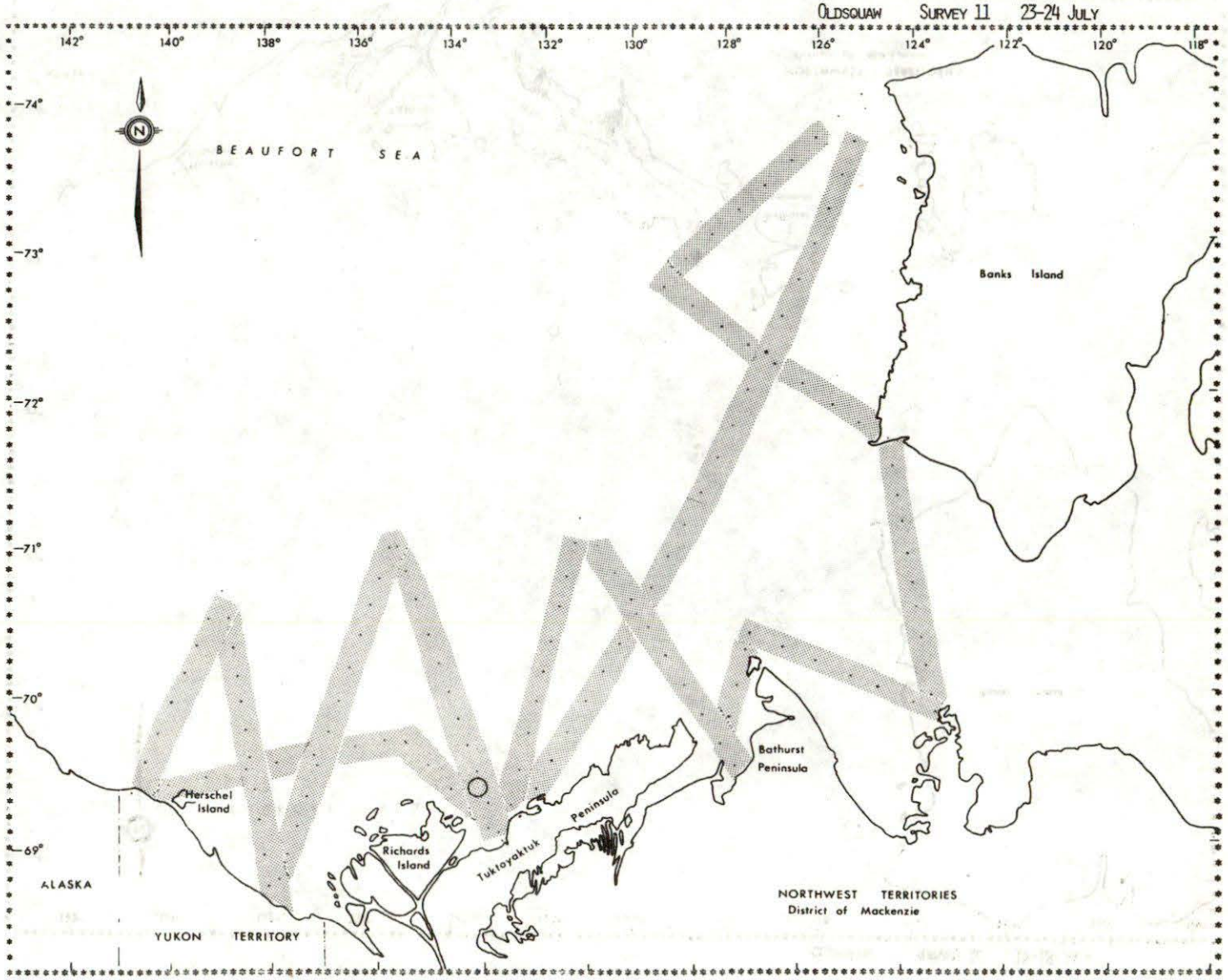
OLDSQUAW SURVEY 11 23-24 JULY
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BEAUFORT SEA
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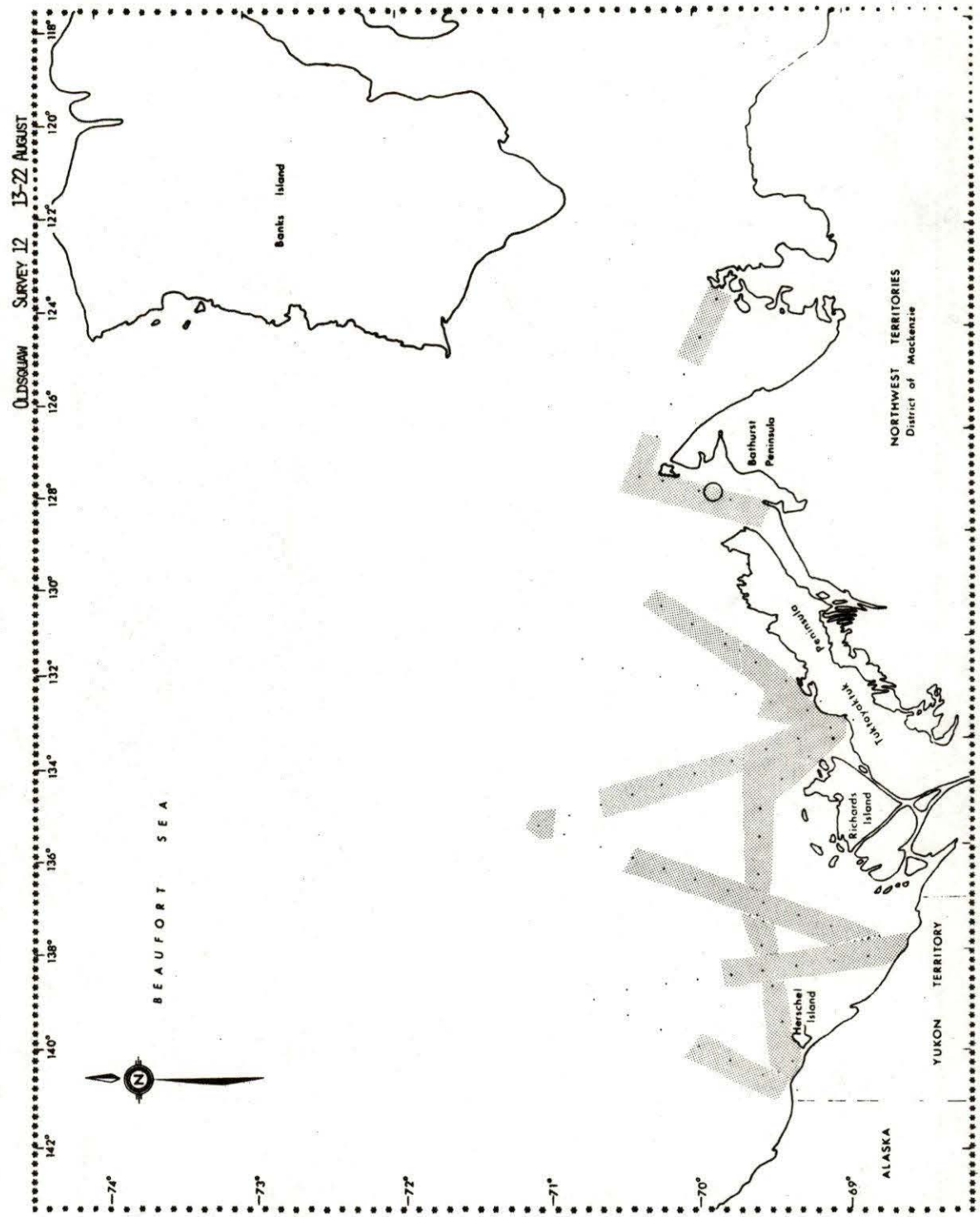
Richards Island
Tuktoyaktuk Peninsula
ALASKA
YUKON TERRITORY
NORTHWEST TERRITORIES
District of Mackenzie


OLDSQUAW SURVEY 12 13-22 AUGUST
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Bathurst Peninsula
NORTHWEST TERRITORIES
District of Mackenzie
Tuktoyaktuk Peninsula
Richards Island
Herschel Island
YUKON TERRITORY
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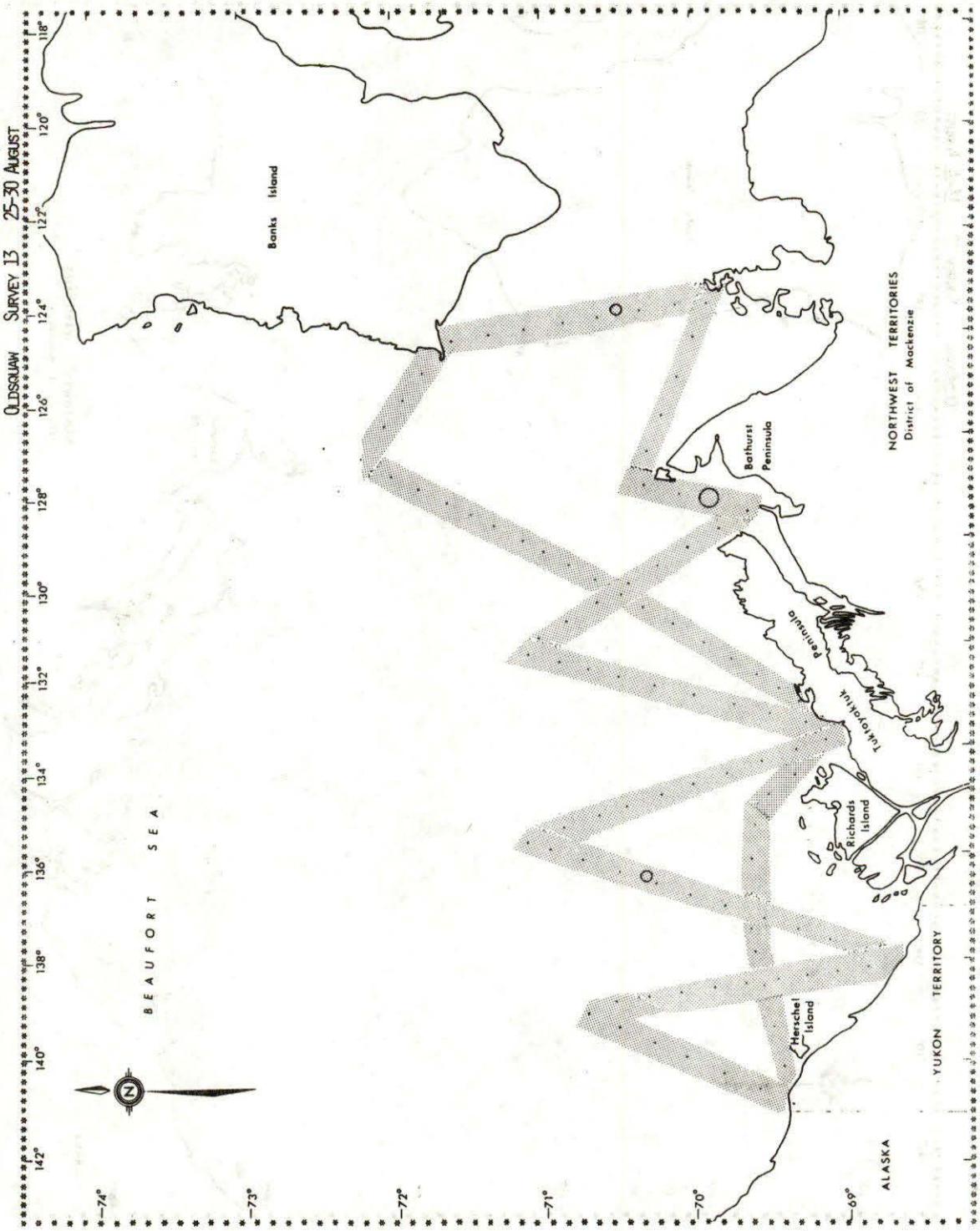
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Banks Island
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District of Mackenzie
Tuktoyaktuk Peninsula
Richards Island
Herschel Island
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YUKON TERRITORY
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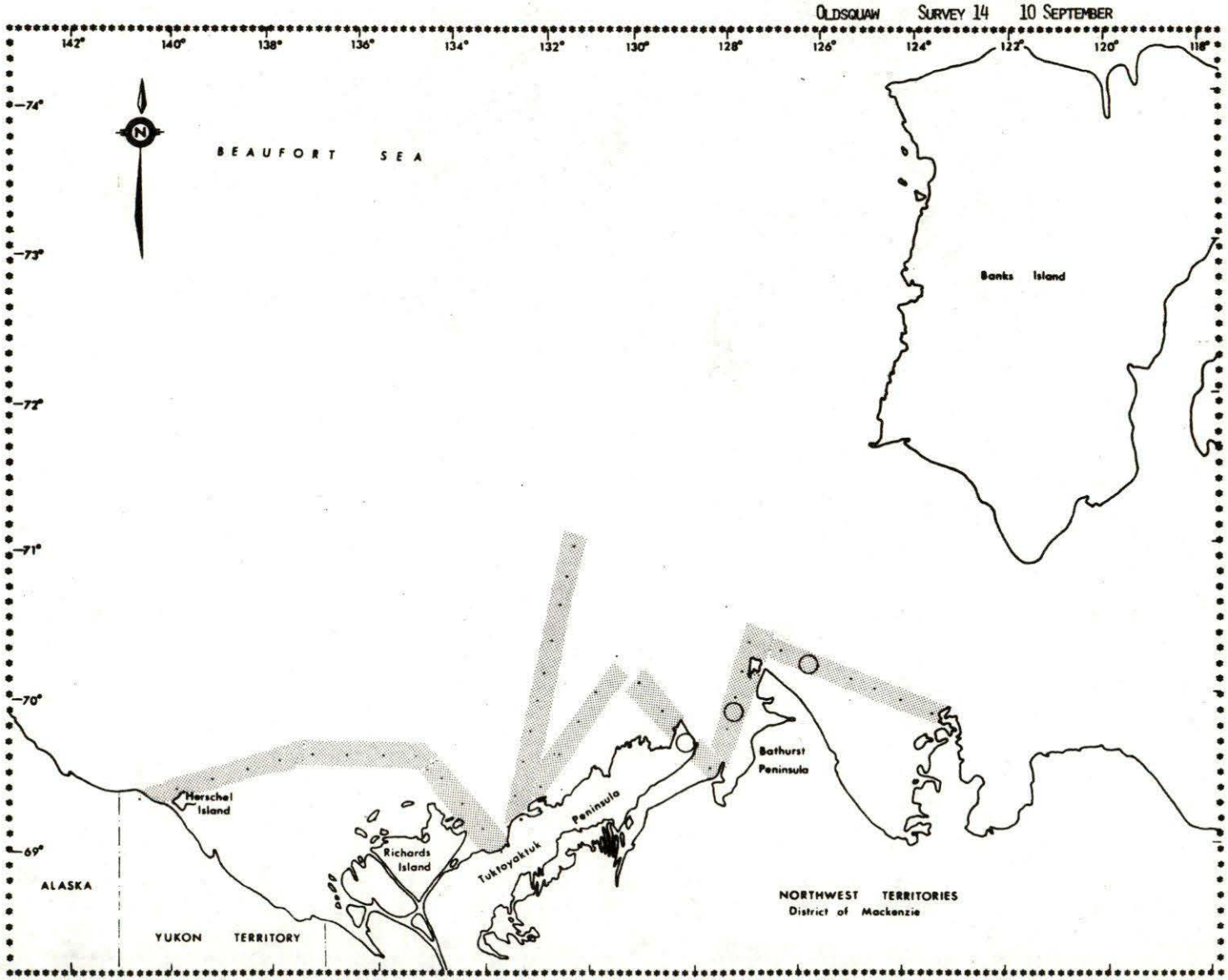
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BEAUFORT SEA
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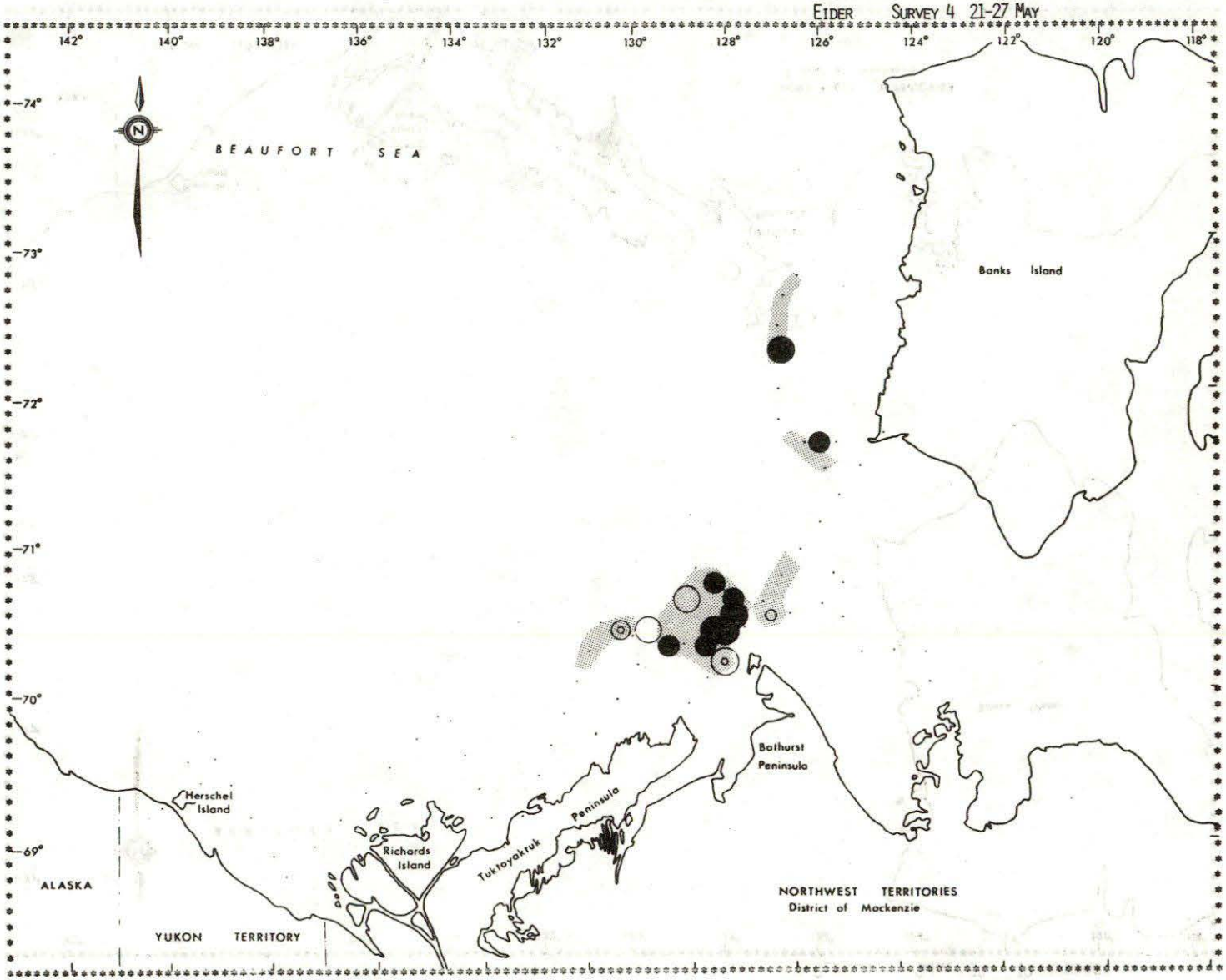
Herschel Island
Richards Island
Tuktoyaktuk Peninsula
ALASKA
YUKON TERRITORY
NORTHWEST TERRITORIES
District of Mackenzie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BEAUFORT SEA
Banks Island
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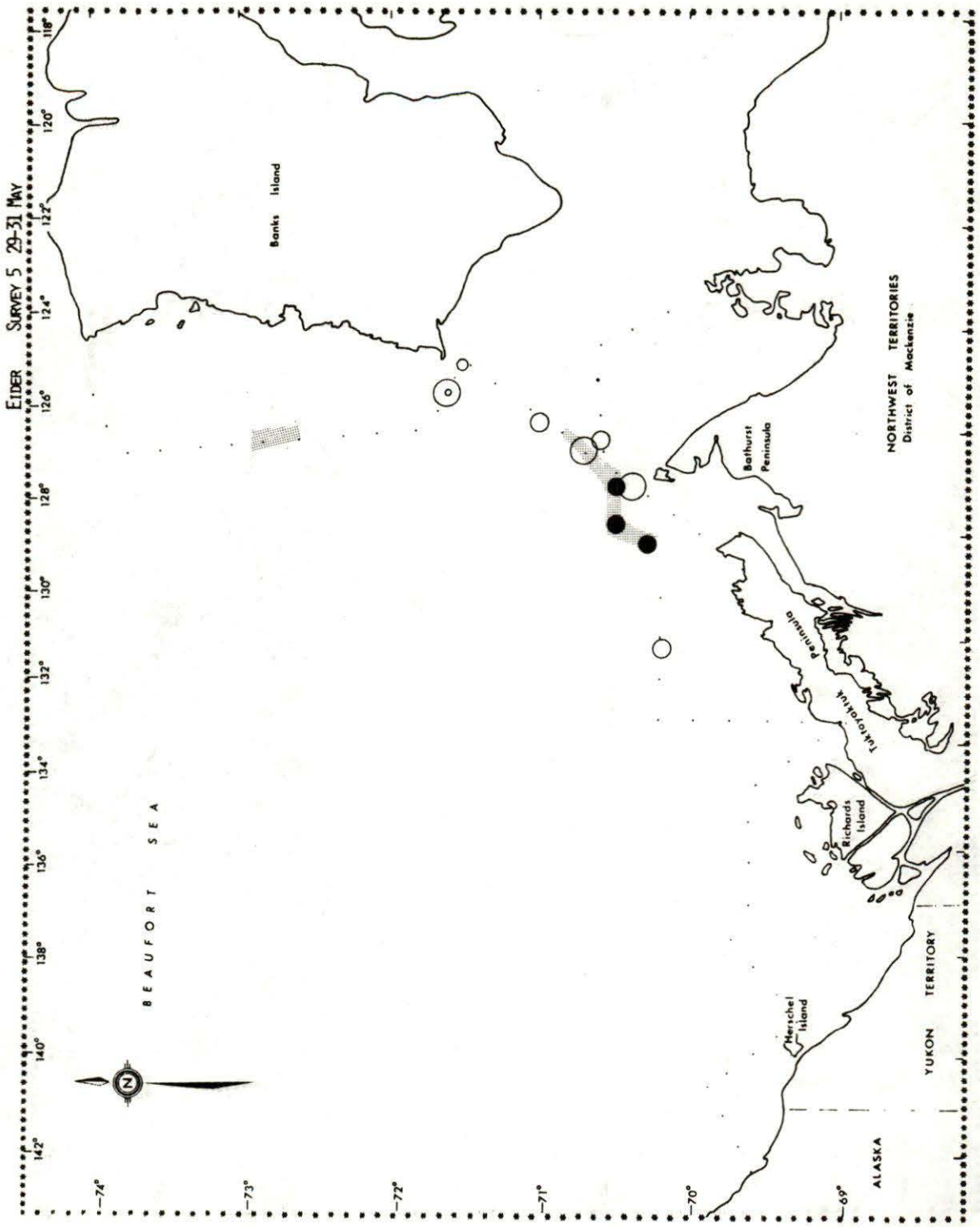
Herschel Island
Richards Island
Tuktoyaktuk Peninsula
ALASKA
YUKON TERRITORY
NORTHWEST TERRITORIES
District of Mackenzie


EIDER SURVEY 5 29-31 MAY
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NORTHWEST TERRITORIES
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Bathurst Peninsula
Tuktoyaktuk Peninsula
Richards Island
Herschel Island
YUKON TERRITORY
ALASKA
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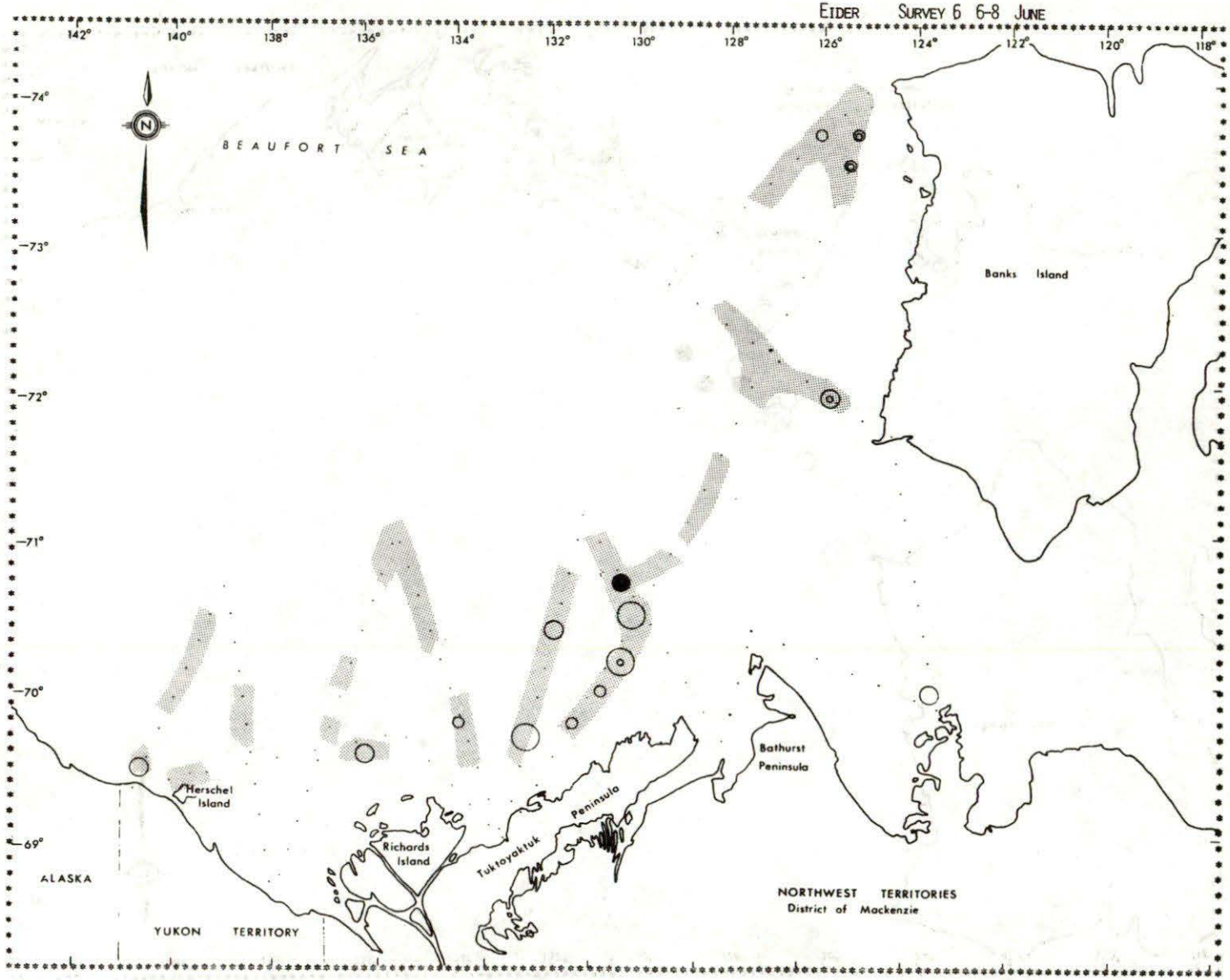
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BEAUFORT SEA
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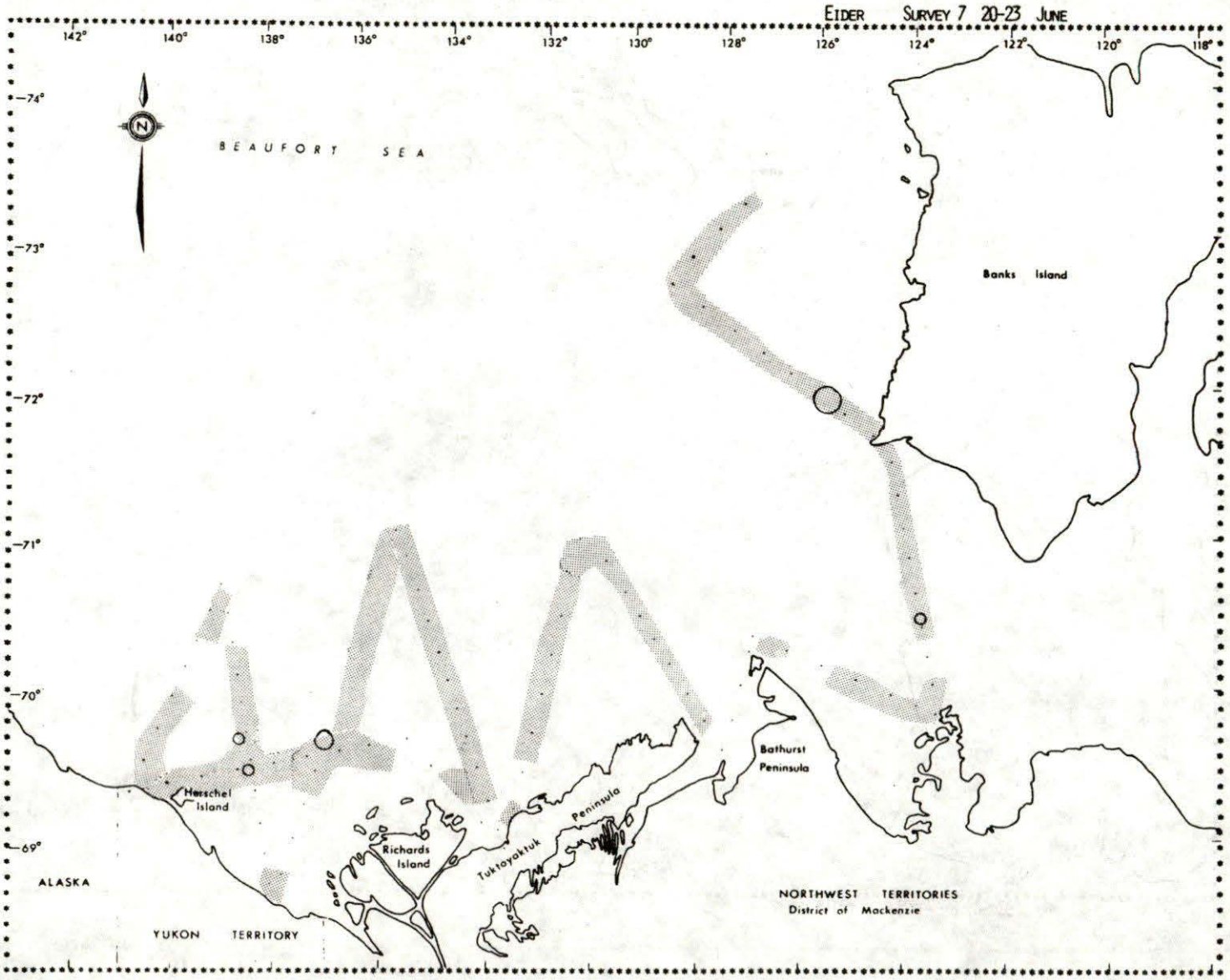
Tuktoyaktuk Peninsula
Bathurst Peninsula
ALASKA
YUKON TERRITORY
NORTHWEST TERRITORIES
District of Mackenzie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BEAUFORT SEA
Banks Island
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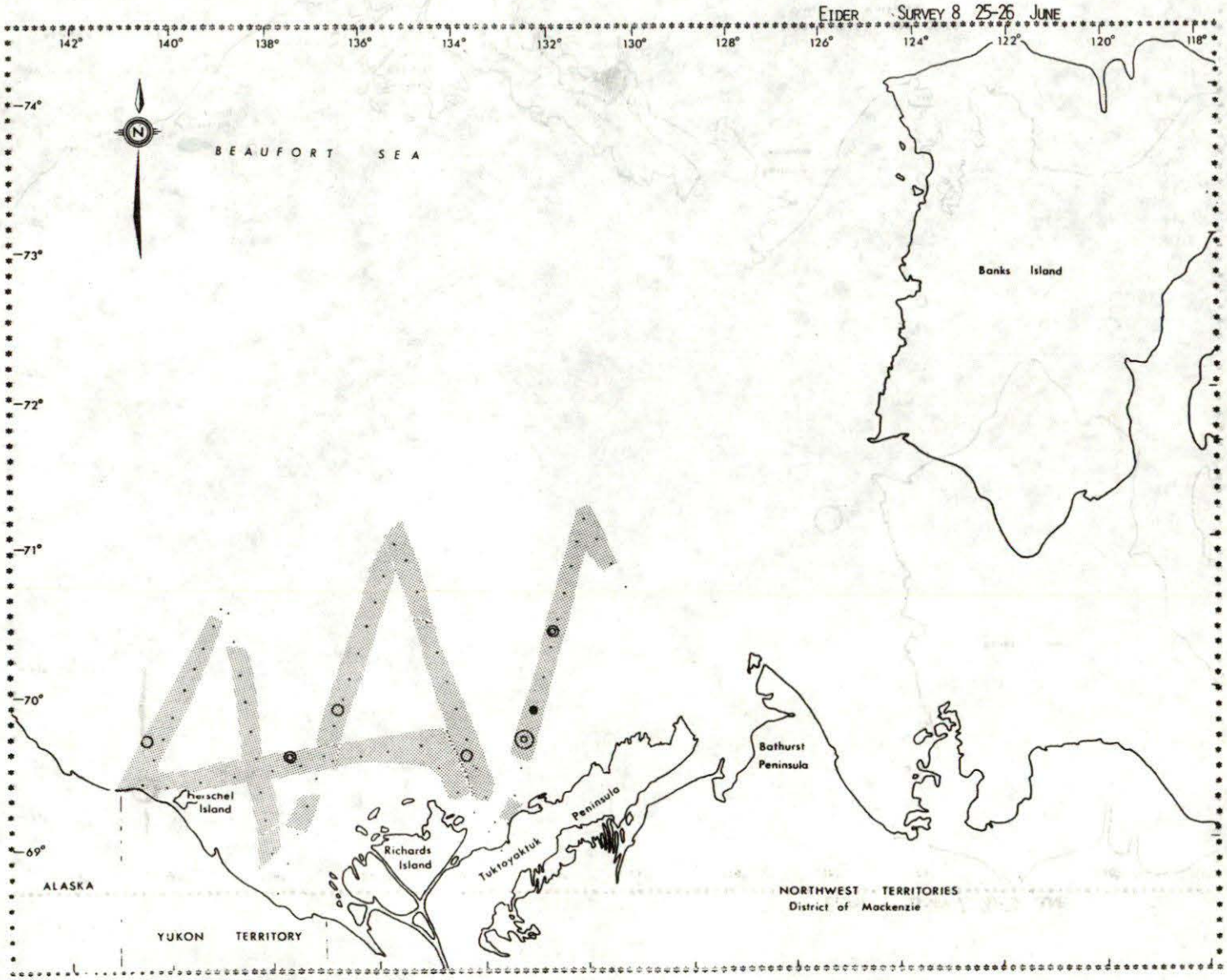
Tuktoyaktuk Peninsula
Richards Island
Herschel Island
ALASKA
YUKON TERRITORY
NORTHWEST TERRITORIES
District of Mackenzie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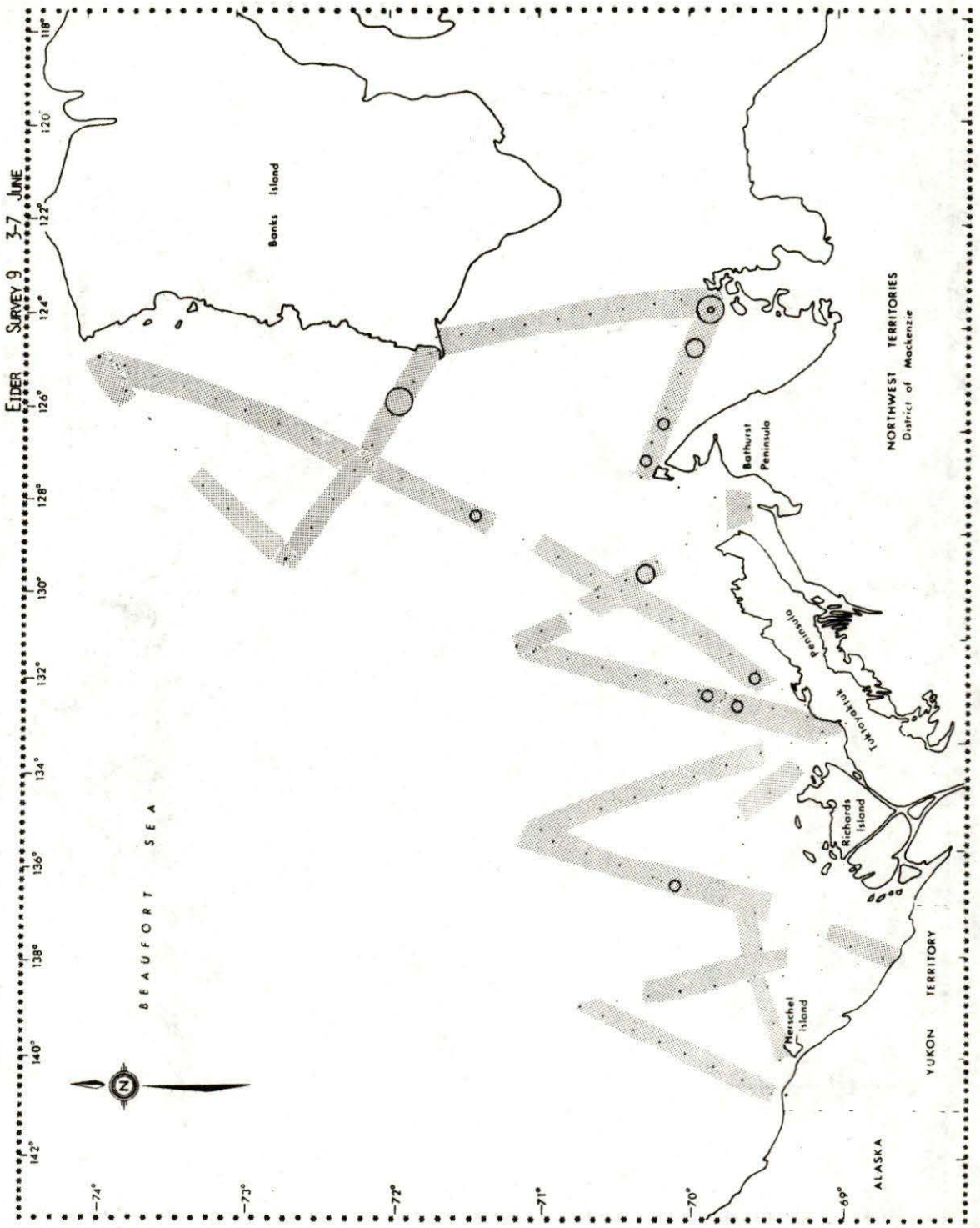
BEAUFORT SEA
Banks Island
Herschel Island
Richards Island
Tuktoyaktuk Peninsula
Bathurst Peninsula
ALASKA
YUKON TERRITORY
NORTHWEST TERRITORIES
District of Mackenzie


EIDER SURVEY 9 3-7 JUNE
Banks Island
Bathurst Peninsula
Tuktoyaktuk Peninsula
Richards Island
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NORTHWEST TERRITORIES
District of Mackenzie
YUKON TERRITORY
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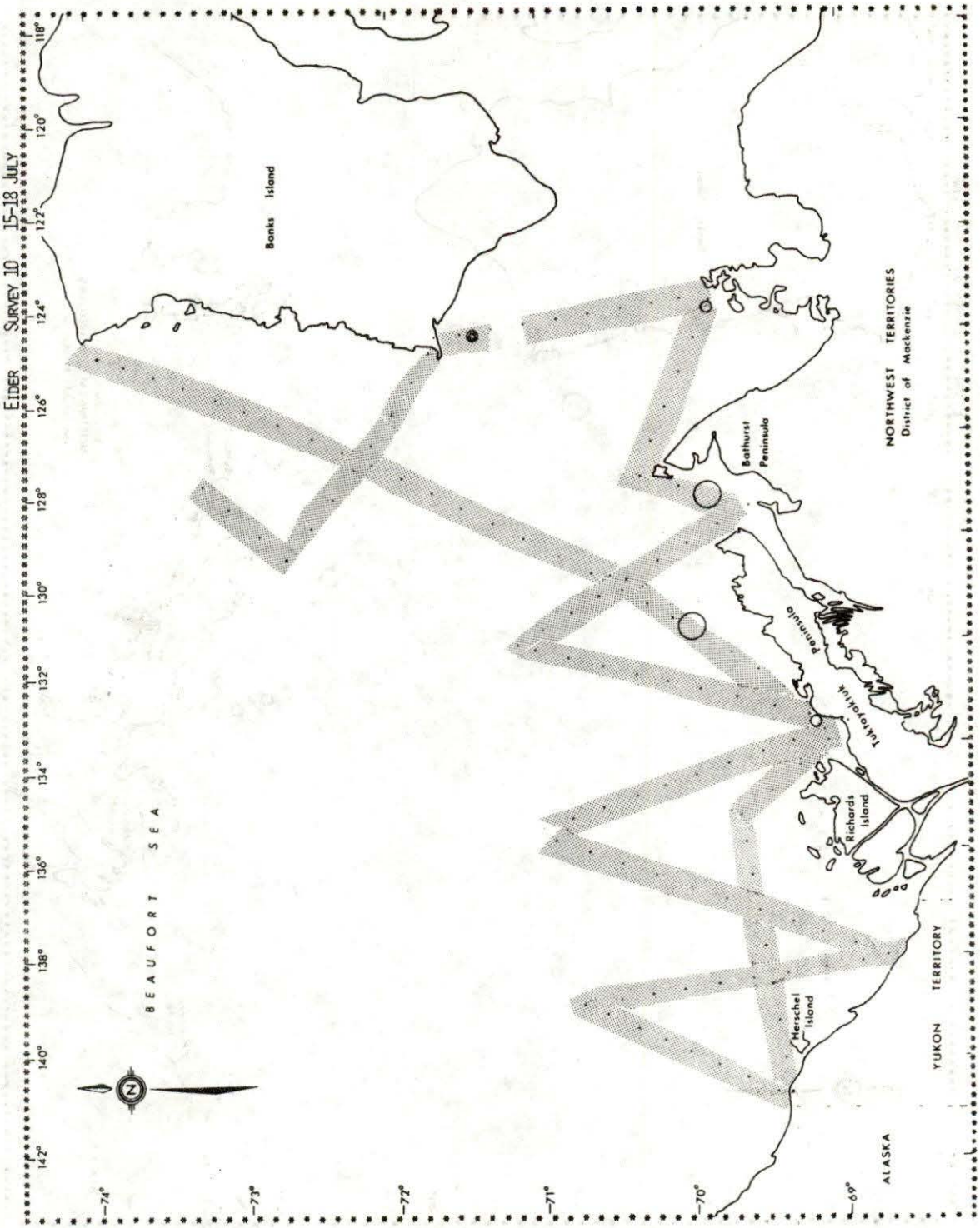
EIDER SURVEY 10 15-18 JULY
Banks Island
Bathurst Peninsula
NORTHWEST TERRITORIES
District of Mackenzie
Tuktoyaktuk Peninsula
Richards Island
Herschel Island
YUKON TERRITORY
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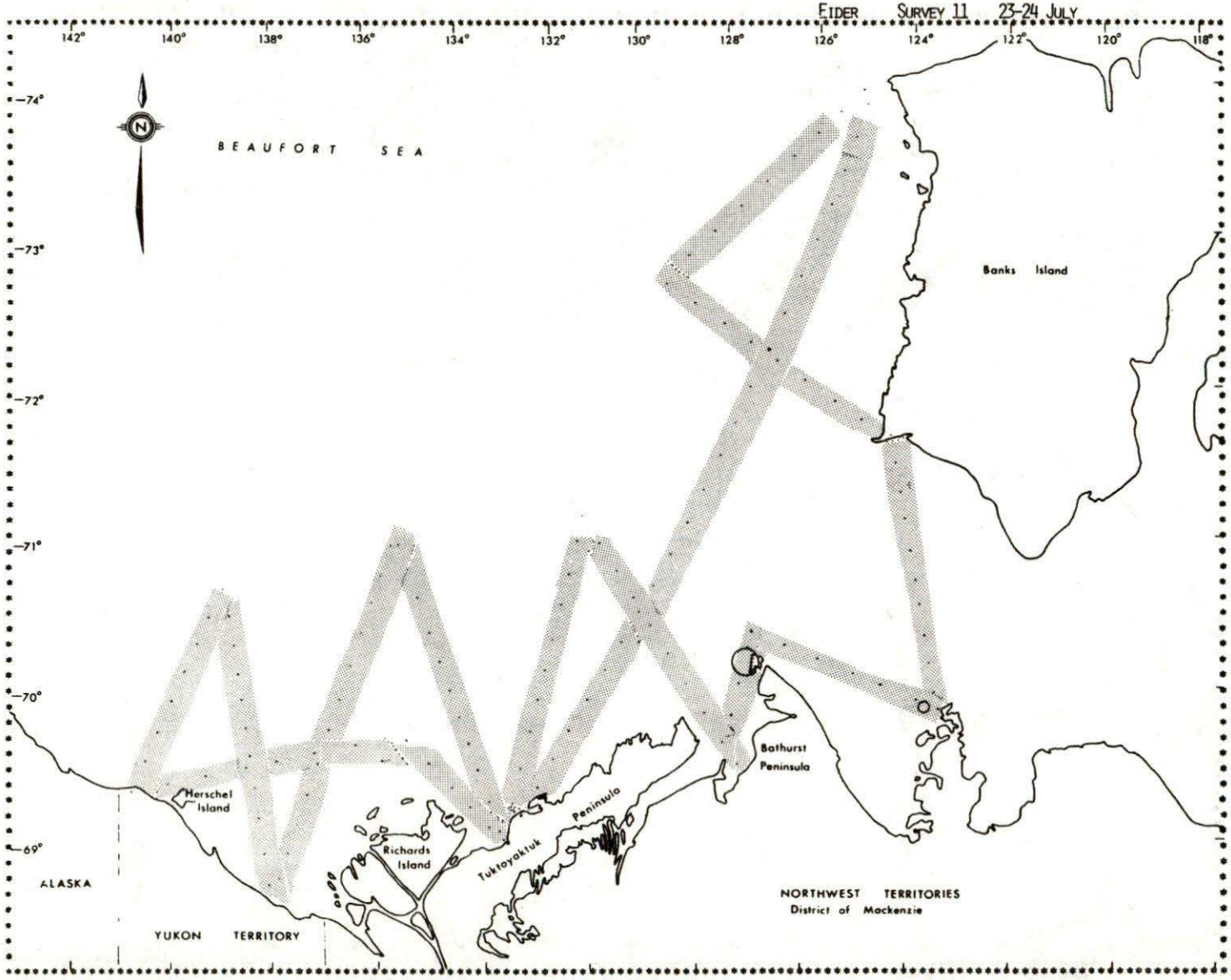
EIDER SURVEY 11 23-24 JULY
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BEAUFORT SEA
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Richards Island
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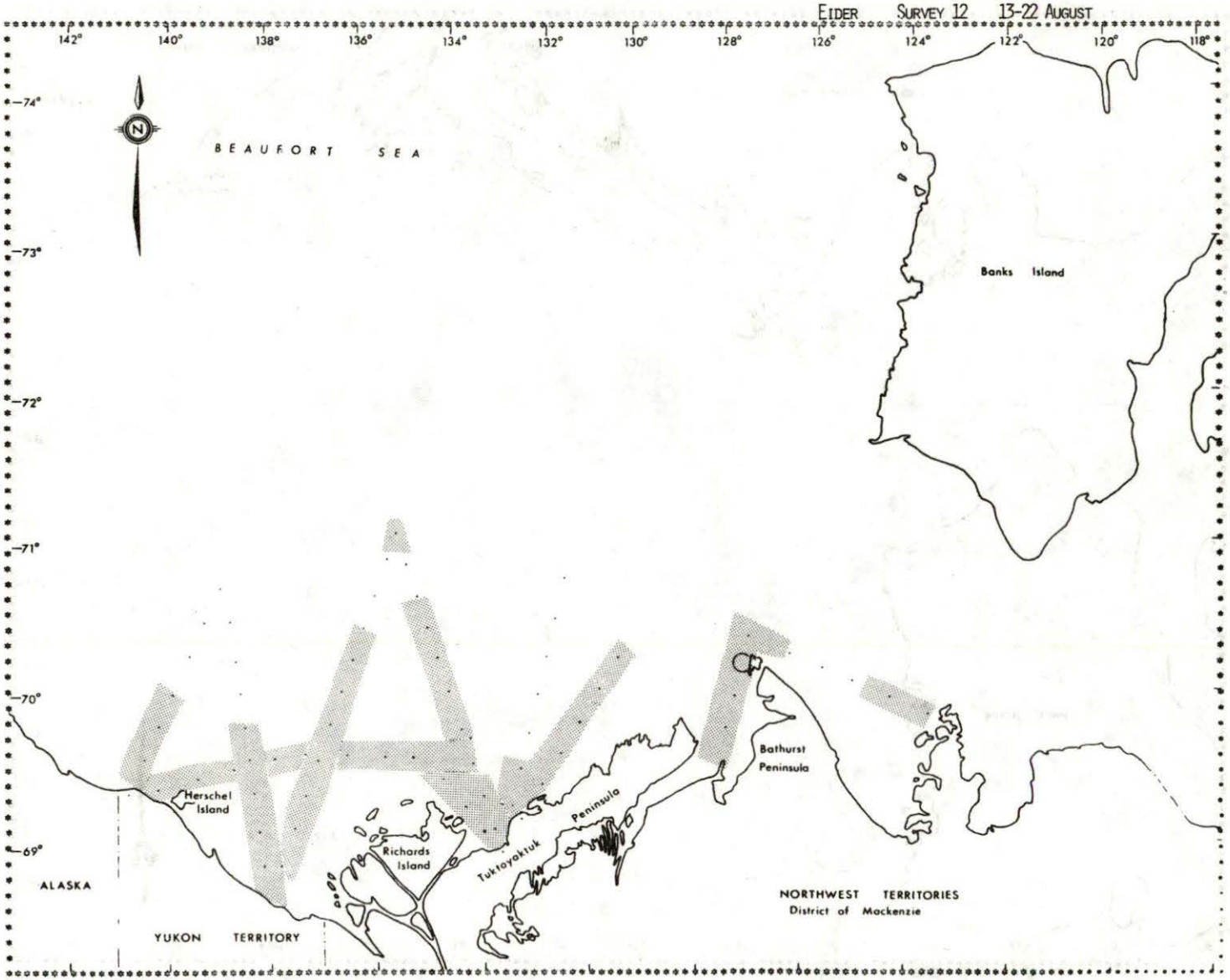
YUKON TERRITORY
NORTHWEST TERRITORIES
District of Mackenzie


EIDER SURVEY 12 13-22 AUGUST
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BEAUFORT SEA
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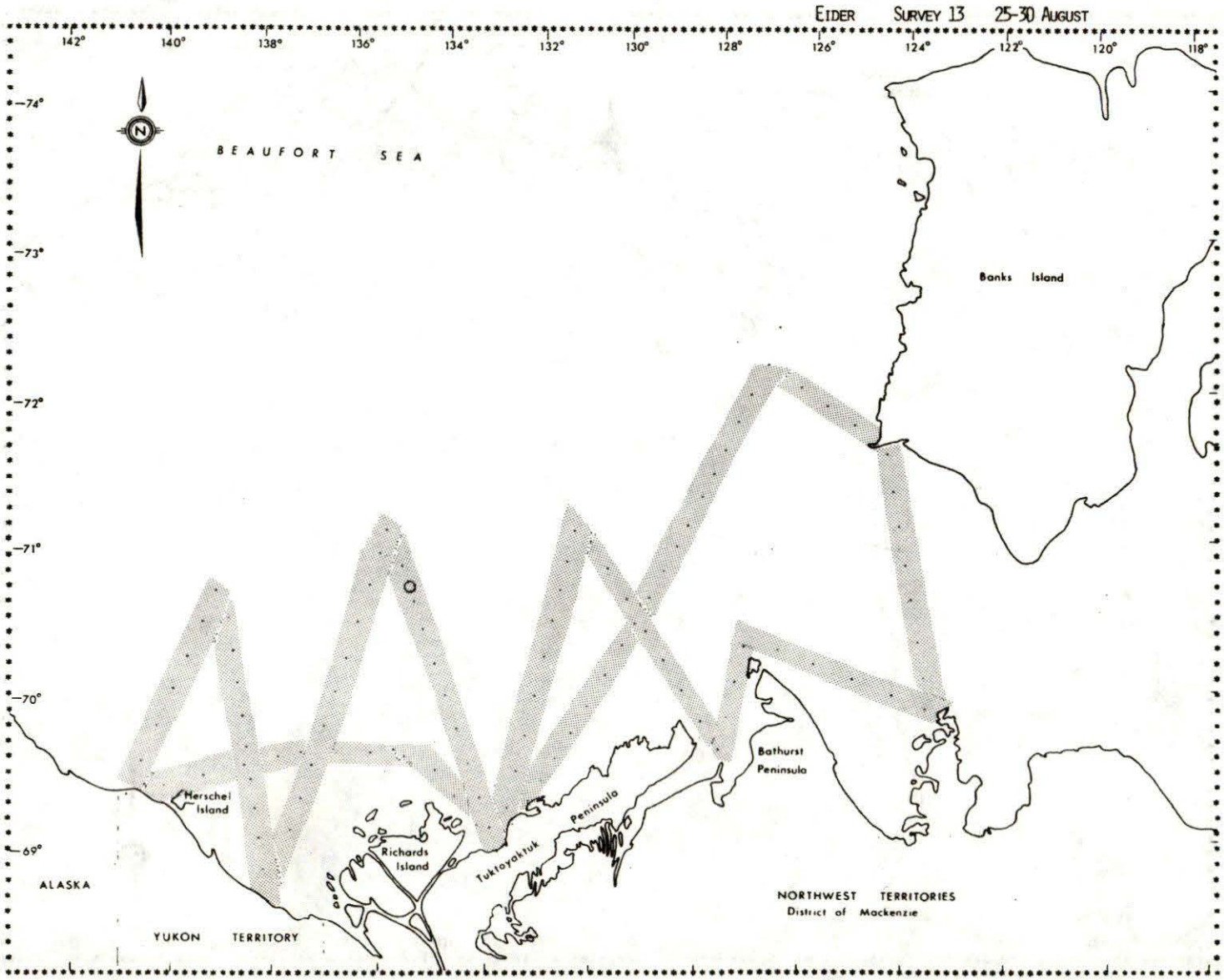
Richards Island
Tuktoyaktuk Peninsula
Bathurst Peninsula
ALASKA
YUKON TERRITORY
NORTHWEST TERRITORIES
District of Mackenzie


EIDER SURVEY 13 25-30 AUGUST
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BEAUFORT SEA
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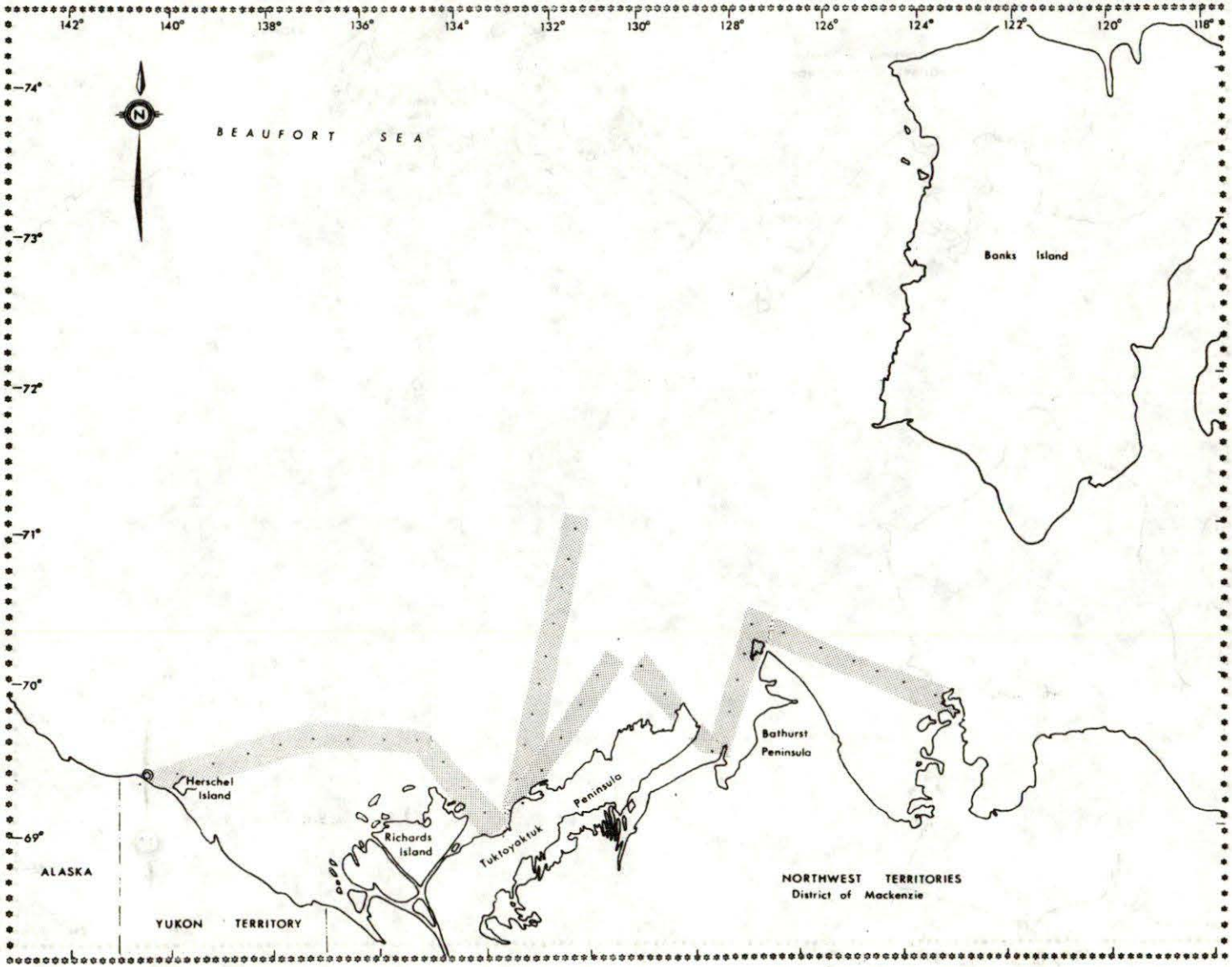
ALASKA
YUKON TERRITORY
NORTHWEST TERRITORIES
District of Mackenzie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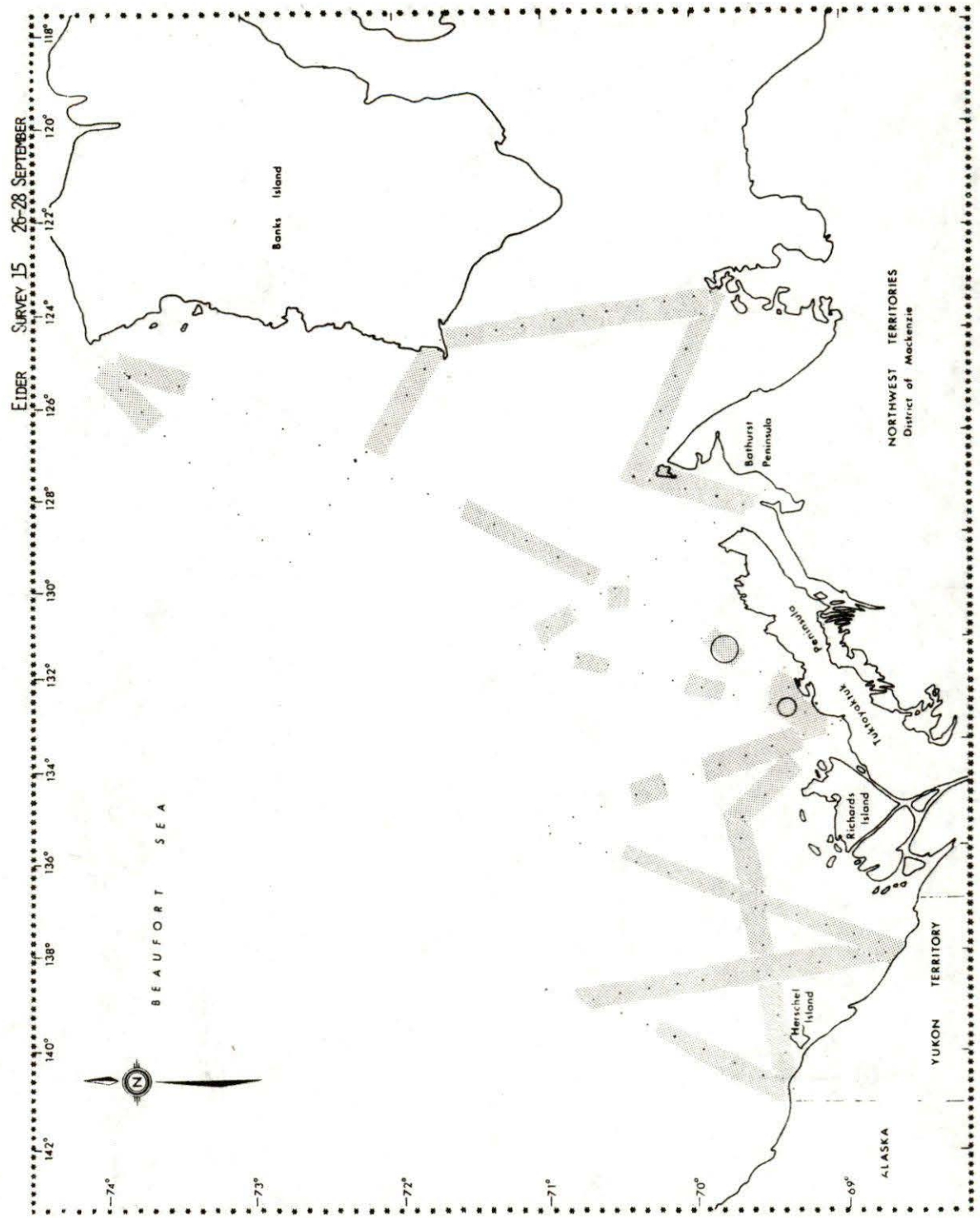
YUKON TERRITORY
NORTHWEST TERRITORIES
District of Mackenzie


EIDER SURVEY 15 26-28 SEPTEMBER
Banks Island
Bathurst Peninsula
NORTHWEST TERRITORIES
District of Mackenzie
Tuktoyaktuk Peninsula
Richards Island
Herschel Island
YUKON TERRITORY
ALASKA
BEAUFORT SEA
118°
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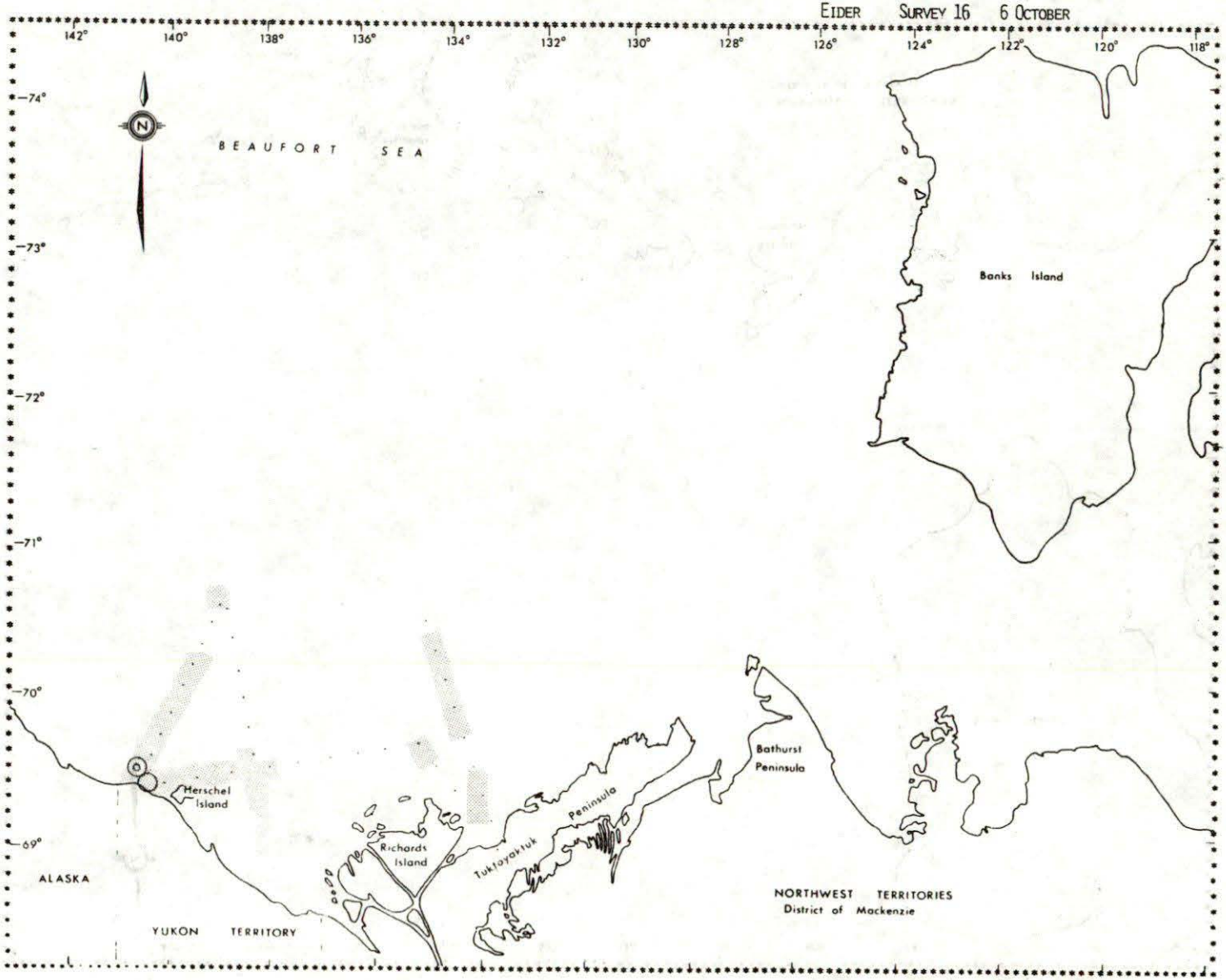
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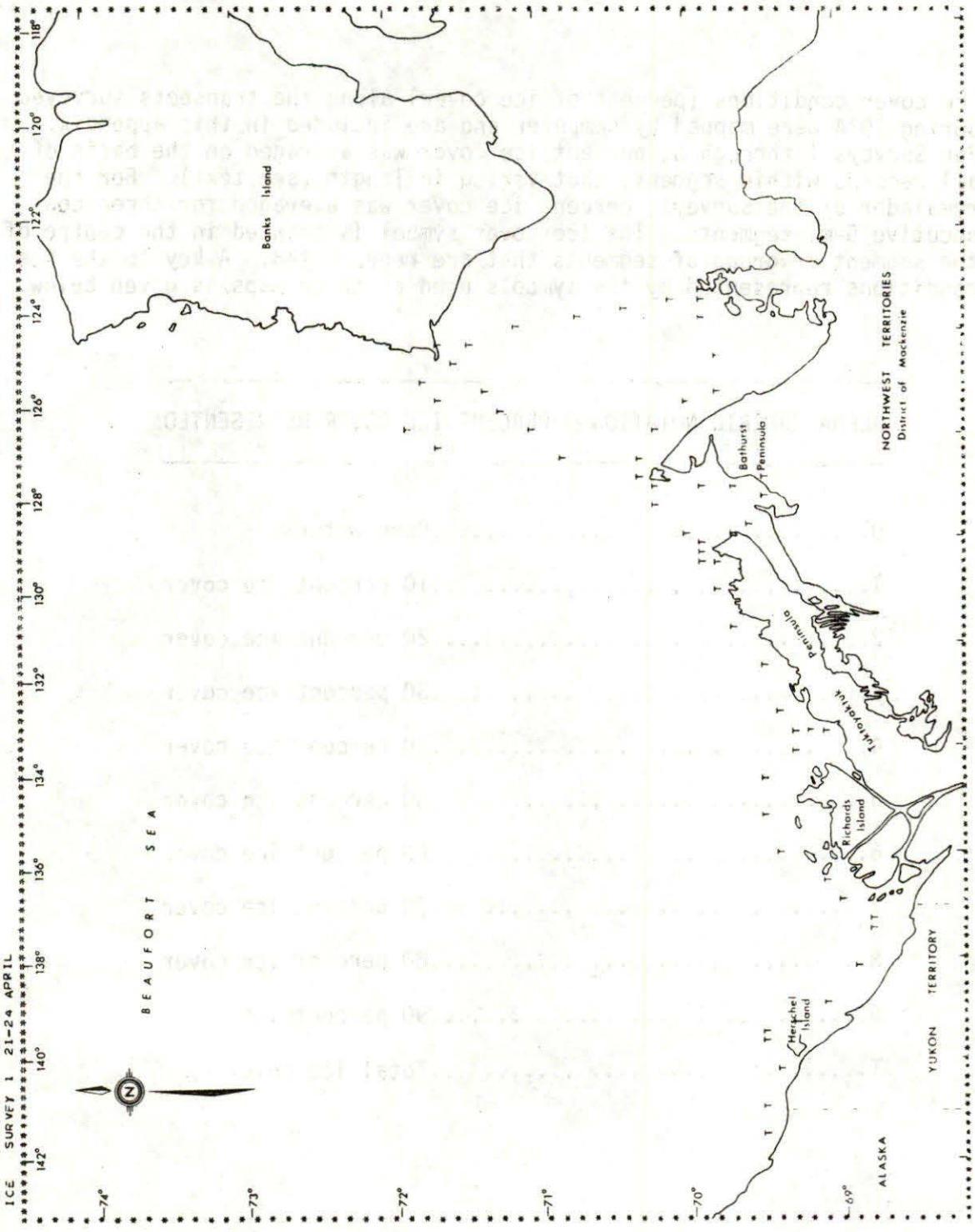
Banks Island
Bathurst Peninsula
Peninsula
Tuktoyaktuk
Richards Island
Herschel Island
ALASKA
YUKON TERRITORY
NORTHWEST TERRITORIES
District of Mackenzie

APPENDIX 2. 1974 Ice Cover Conditions Along the Aerial Transects.

Ice cover conditions (percent of ice cover) along the transects surveyed during 1974 were mapped by computer and are included in this appendix. For Surveys 1 through 5, percent ice cover was averaged on the basis of all records within segments that varied in length (see text). For the remainder of the surveys, percent ice cover was averaged for three consecutive 5-mi segments. The ice cover symbol is printed in the centre of the segment or group of segments that are represented. A key to the ice conditions represented by the symbols used on these maps is given below.

ALPHA-NUMERIC NOTATION	PERCENT ICE COVER REPRESENTED
0	Open water
1	10 percent ice cover
2	20 percent ice cover
3	30 percent ice cover
4	40 percent ice cover
5	50 percent ice cover
6	60 percent ice cover
7	70 percent ice cover
8	80 percent ice cover
9	90 percent ice cover
T	Total ice cover


ICE SURVEY 1 21-24 APRIL
BEAUFORT SEA
Banks Island
Bathurst Peninsula
NORTHWEST TERRITORIES
District of Mackenzie
Tuktoyaktuk Peninsula
Richards Island
Herschel Island
YUKON TERRITORY
ALASKA
118°
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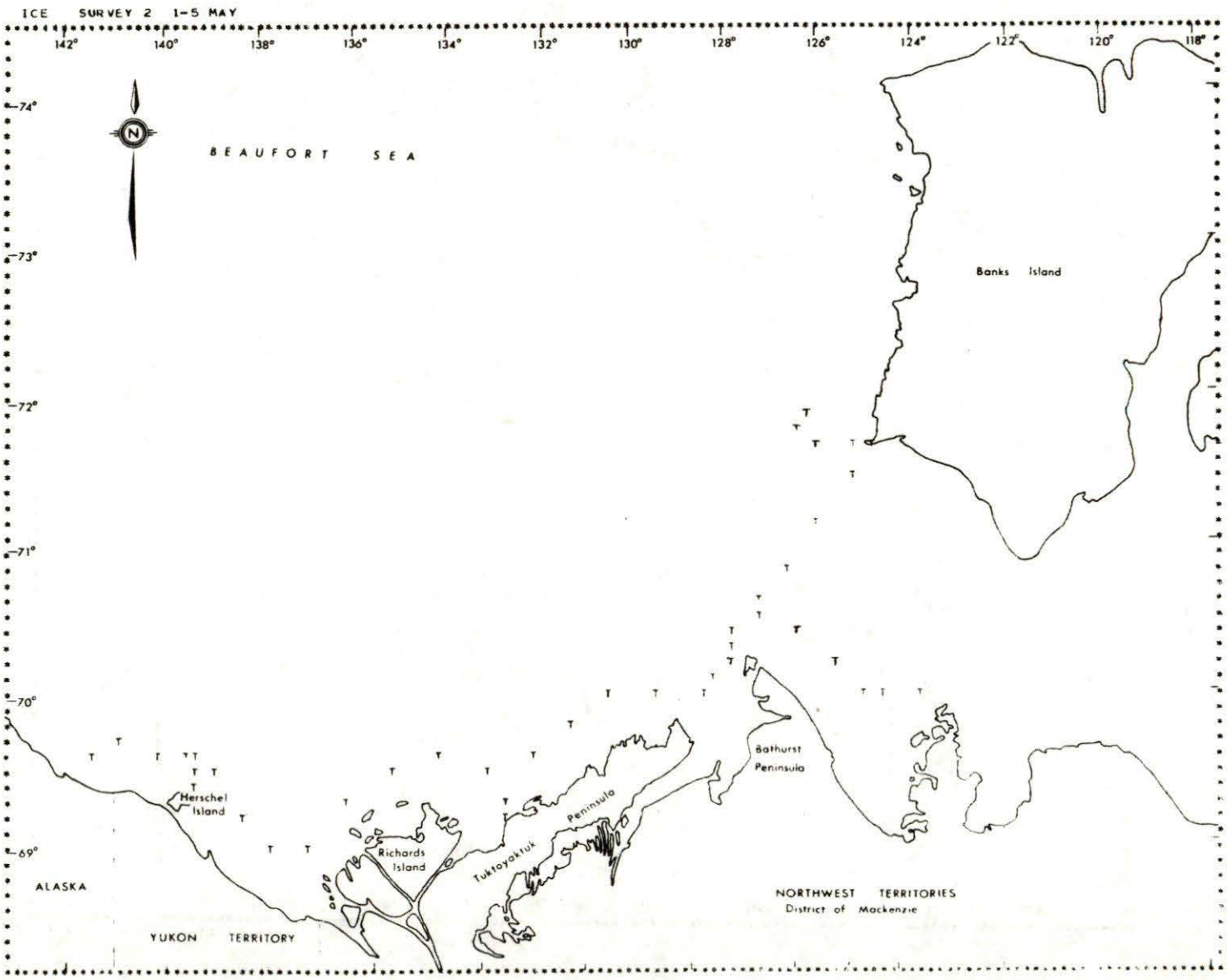
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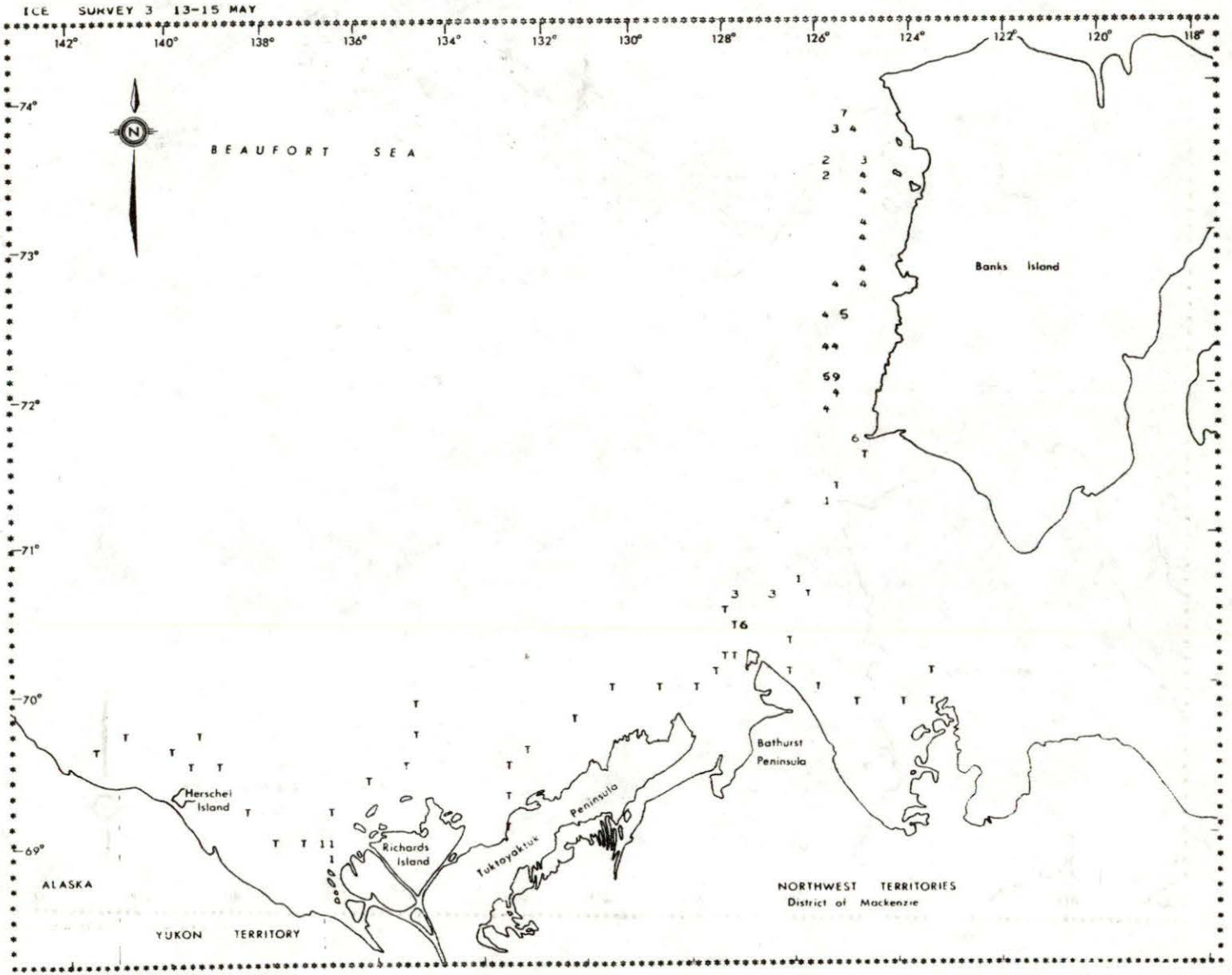
BEAUFORT SEA
Banks Island
Herschel Island
Richards Island
Tuktoyaktuk Peninsula
Bathurst Peninsula
ALASKA
YUKON TERRITORY
NORTHWEST TERRITORIES
District of Mackenzie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BEAUFORT SEA
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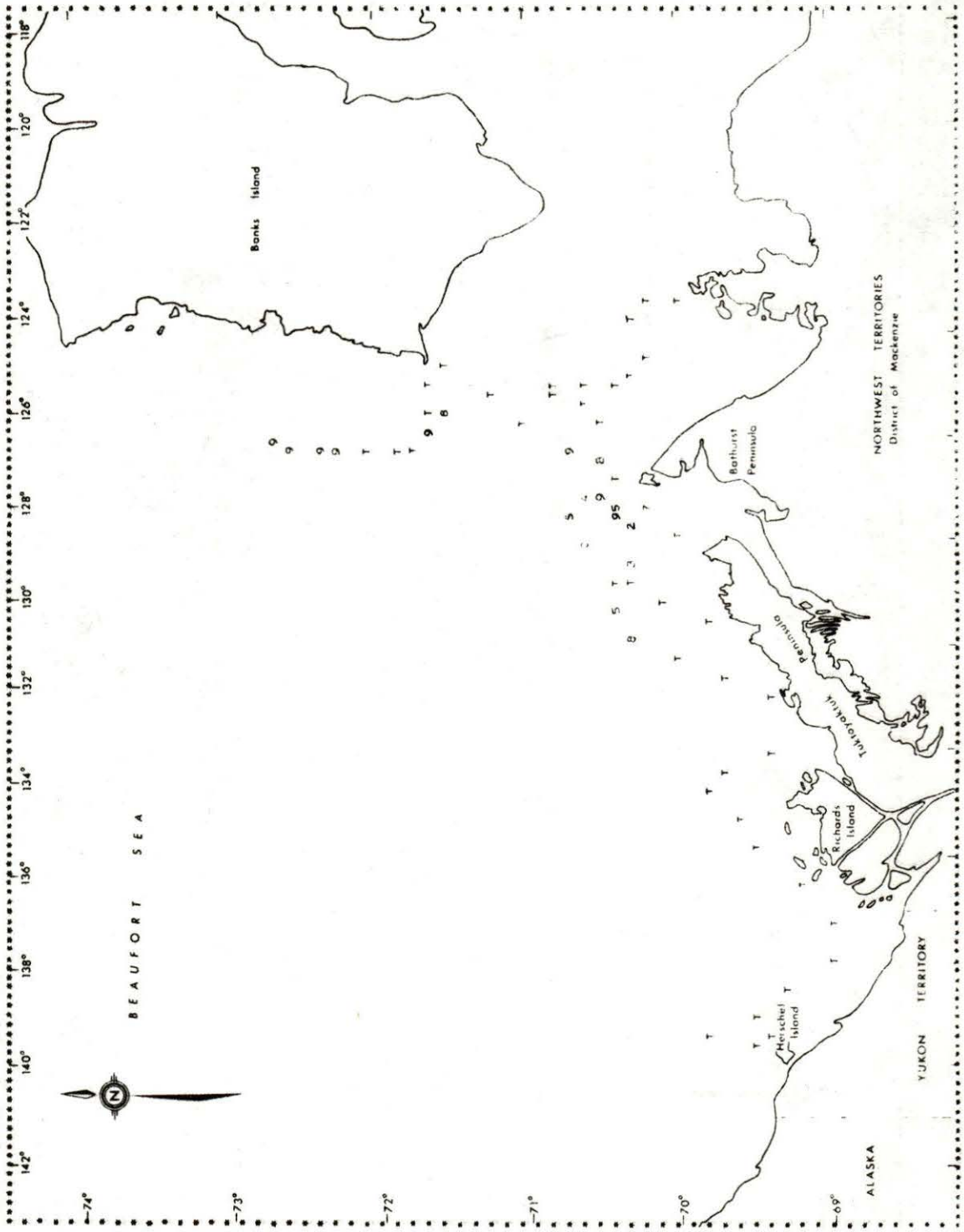
ALASKA
YUKON TERRITORY
NORTHWEST TERRITORIES
District of Mackenzie


ICE SURVEY 4 21-27 MAY
BEAUFORT SEA
Banks Island
Bathurst Peninsula
Tuktoyaktuk Peninsula
Richards Island
Herschel Island
NORTHWEST TERRITORIES
District of Mackenzie
YUKON TERRITORY
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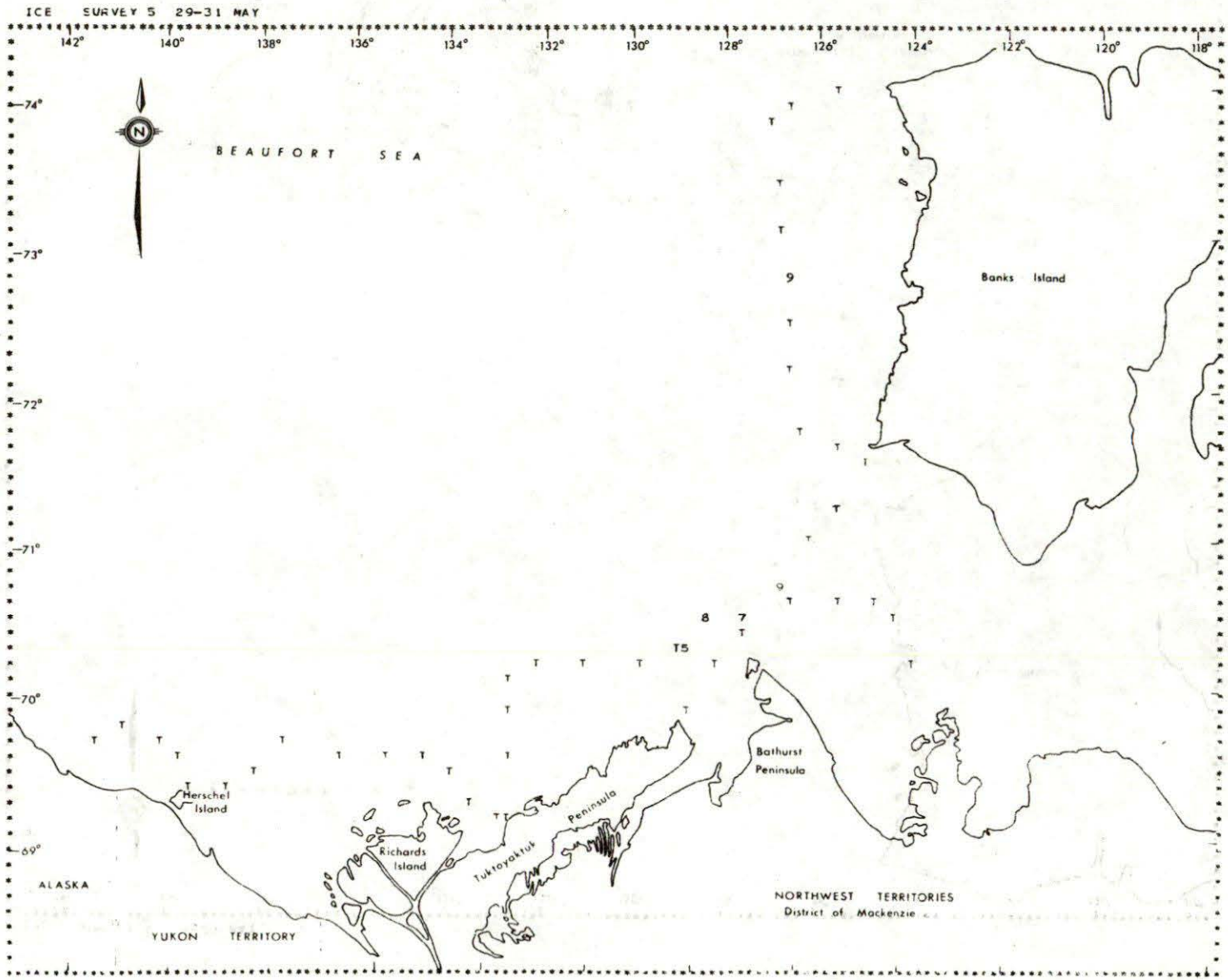
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BEAUFORT SEA
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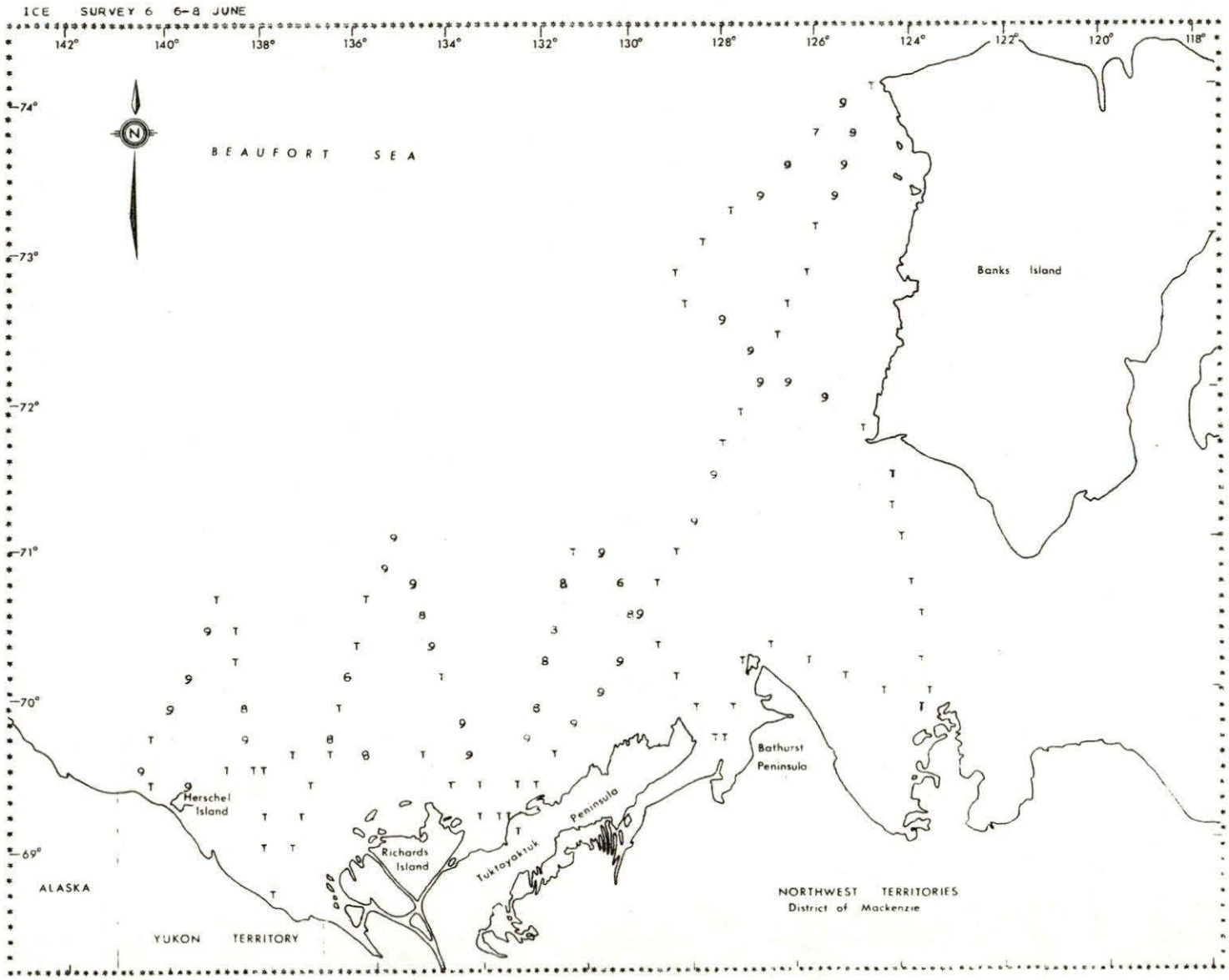
Richards Island
Tuktoyaktuk Peninsula
ALASKA
YUKON TERRITORY
NORTHWEST TERRITORIES
District of Mackenzie


ICE SURVEY 6 6-8 JUNE
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Bathurst Peninsula
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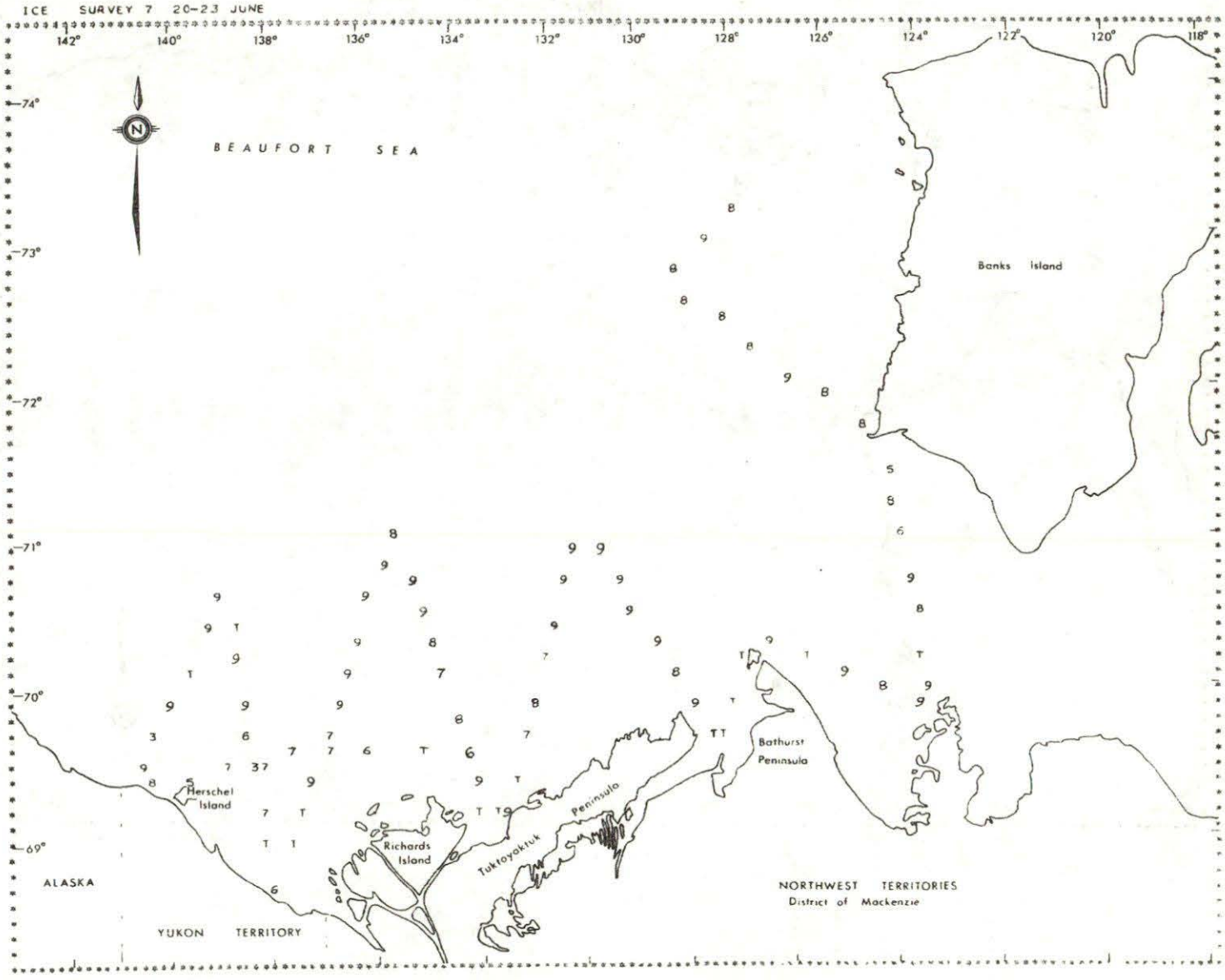
Richards Island
Tuktoyaktuk Peninsula
ALASKA
YUKON TERRITORY
NORTHWEST TERRITORIES
District of Mackenzie


ICE SURVEY 7 20-23 JUNE
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BEAUFORT SEA
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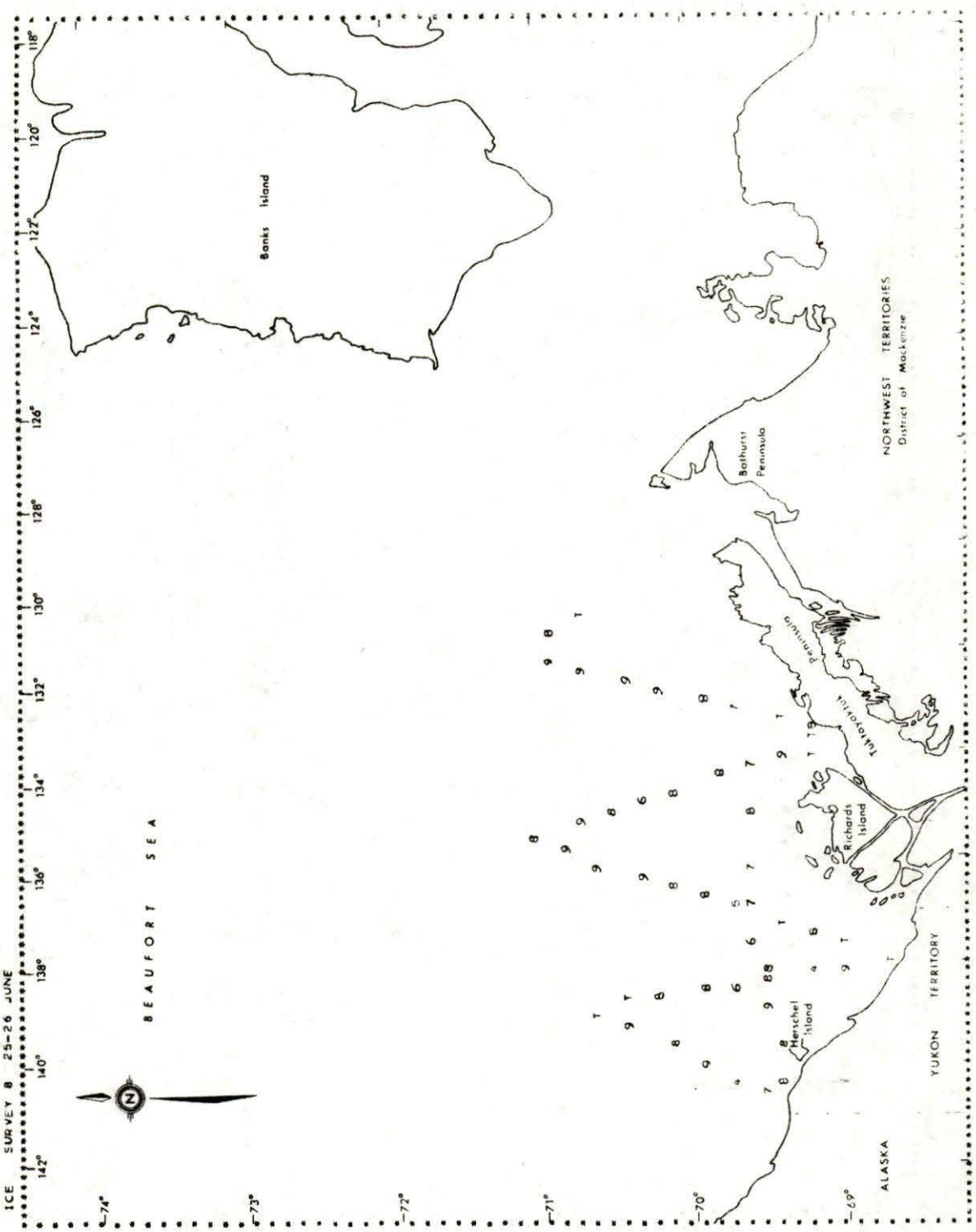
ALASKA
YUKON TERRITORY
NORTHWEST TERRITORIES
District of Mackenzie


ICE SURVEY 8 25-26 JUNE
BEAUFORT SEA
Banks Island
Bathurst Peninsula
NORTHWEST TERRITORIES
District of Mackenzie
Richards Island
Herschel Island
ALASKA
YUKON TERRITORY
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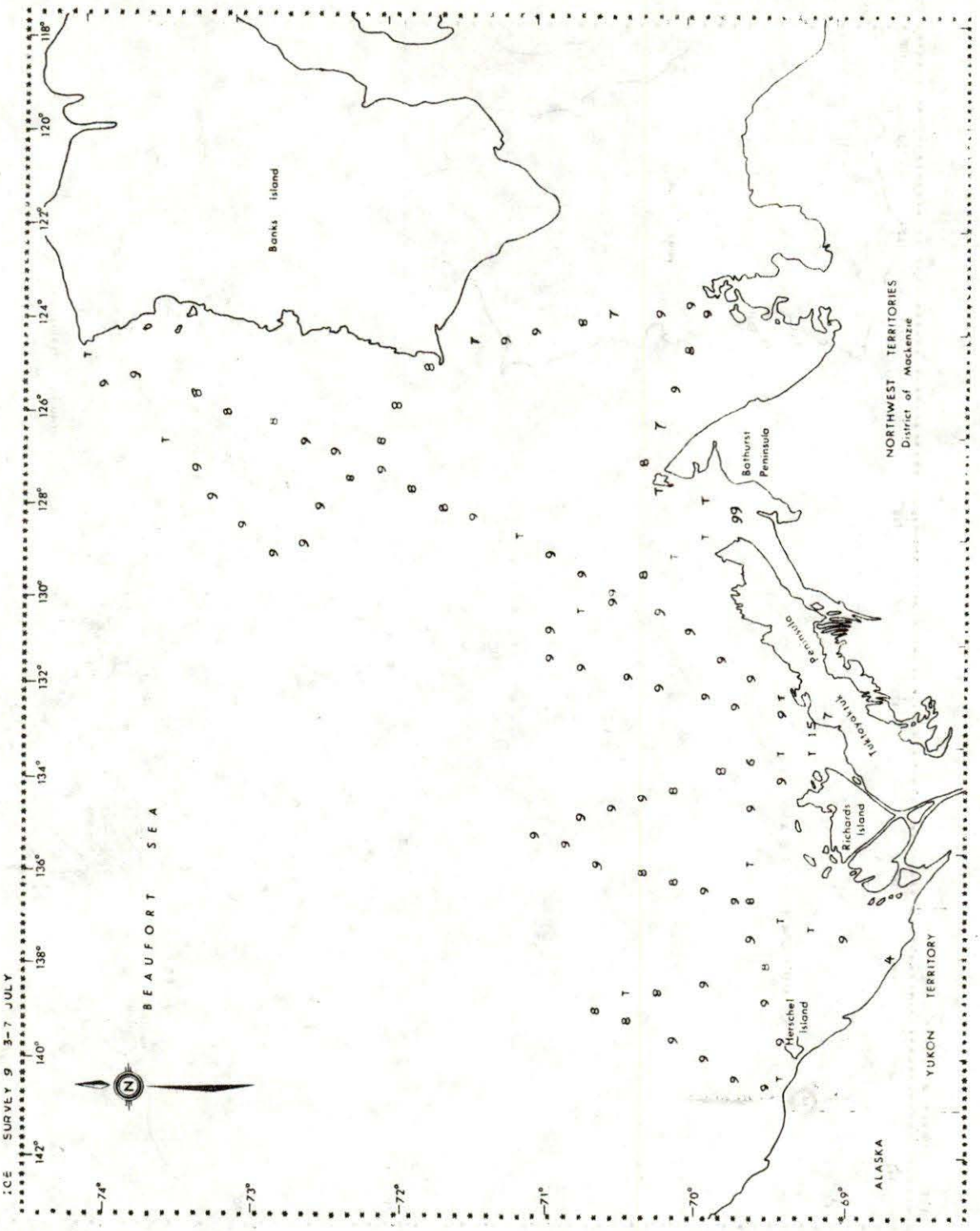
ICE SURVEY 9 3-7 JULY
BEAUFORT SEA
Banks Island
Bathurst Peninsula
NORTHWEST TERRITORIES
District of Mackenzie
Richards Island
Herschel Island
YUKON TERRITORY
ALASKA
N
118°
120°
122°
124°
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128°
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142°
74°
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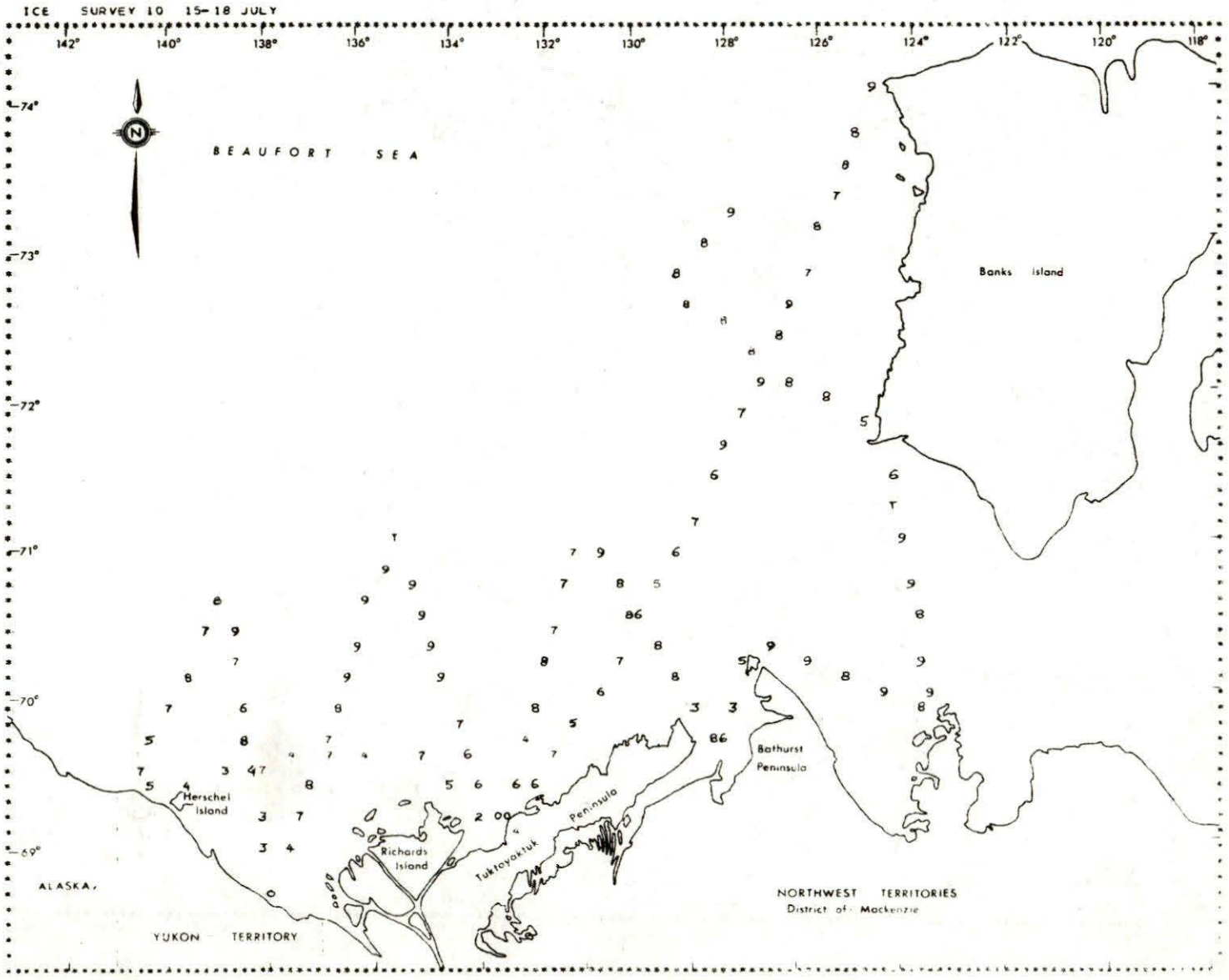
ICE SURVEY 10 15-18 JULY
142°
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134°
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130°
128°
126°
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122°
120°
118°
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72°
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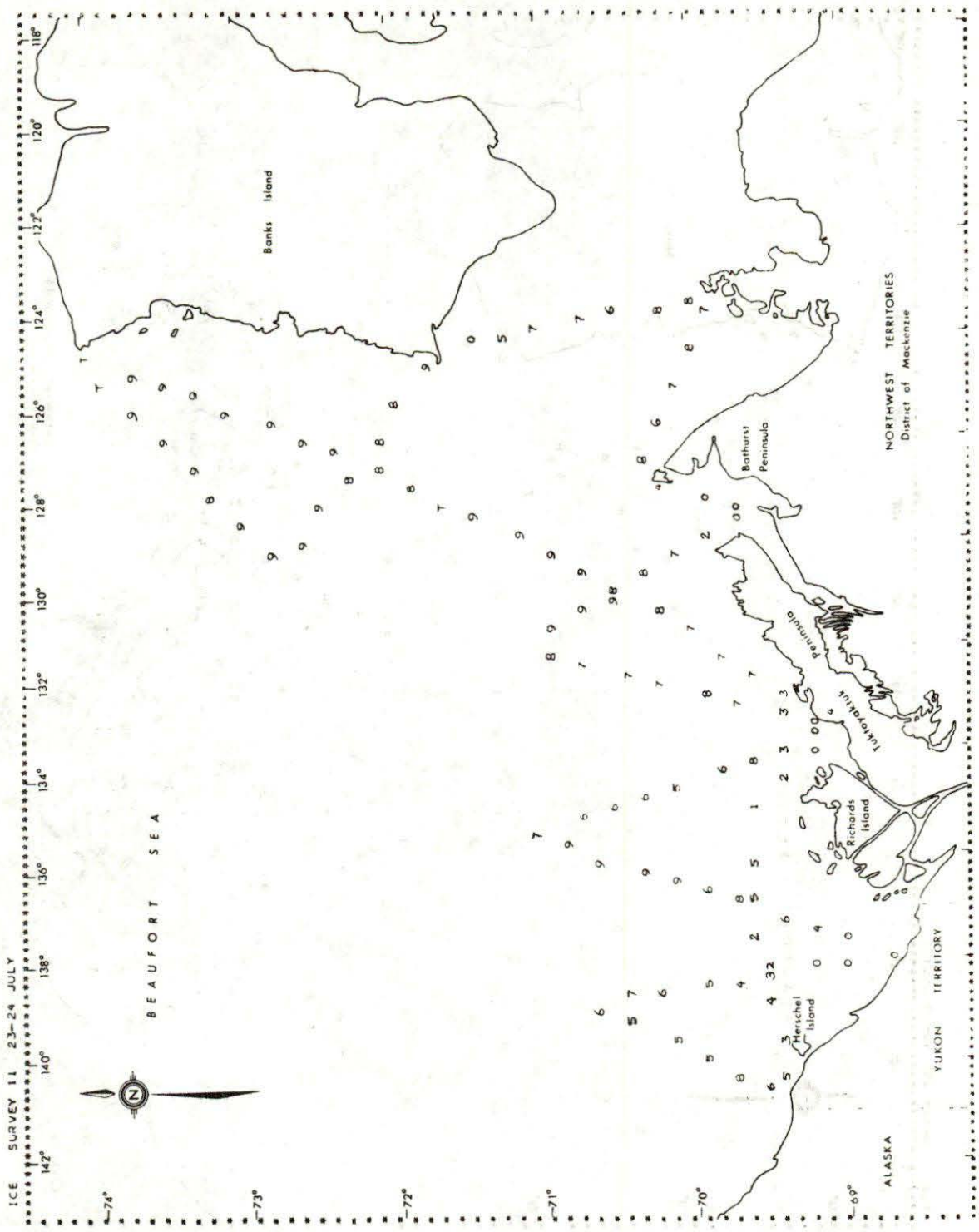
70°
69°
N
BEAUFORT SEA
Banks Island
Herschel Island
Richards Island
Tuktoyaktuk Peninsula
Bathurst Peninsula
ALASKA
YUKON TERRITORY
NORTHWEST TERRITORIES
District of Mackenzie


ICE SURVEY 11 23-24 JULY
BEAUFORT SEA
Banks Island
Bathurst Peninsula
Richards Island
Herschel Island
NORTHWEST TERRITORIES
District of Mackenzie
YUKON TERRITORY
ALASKA
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118°
120°
122°
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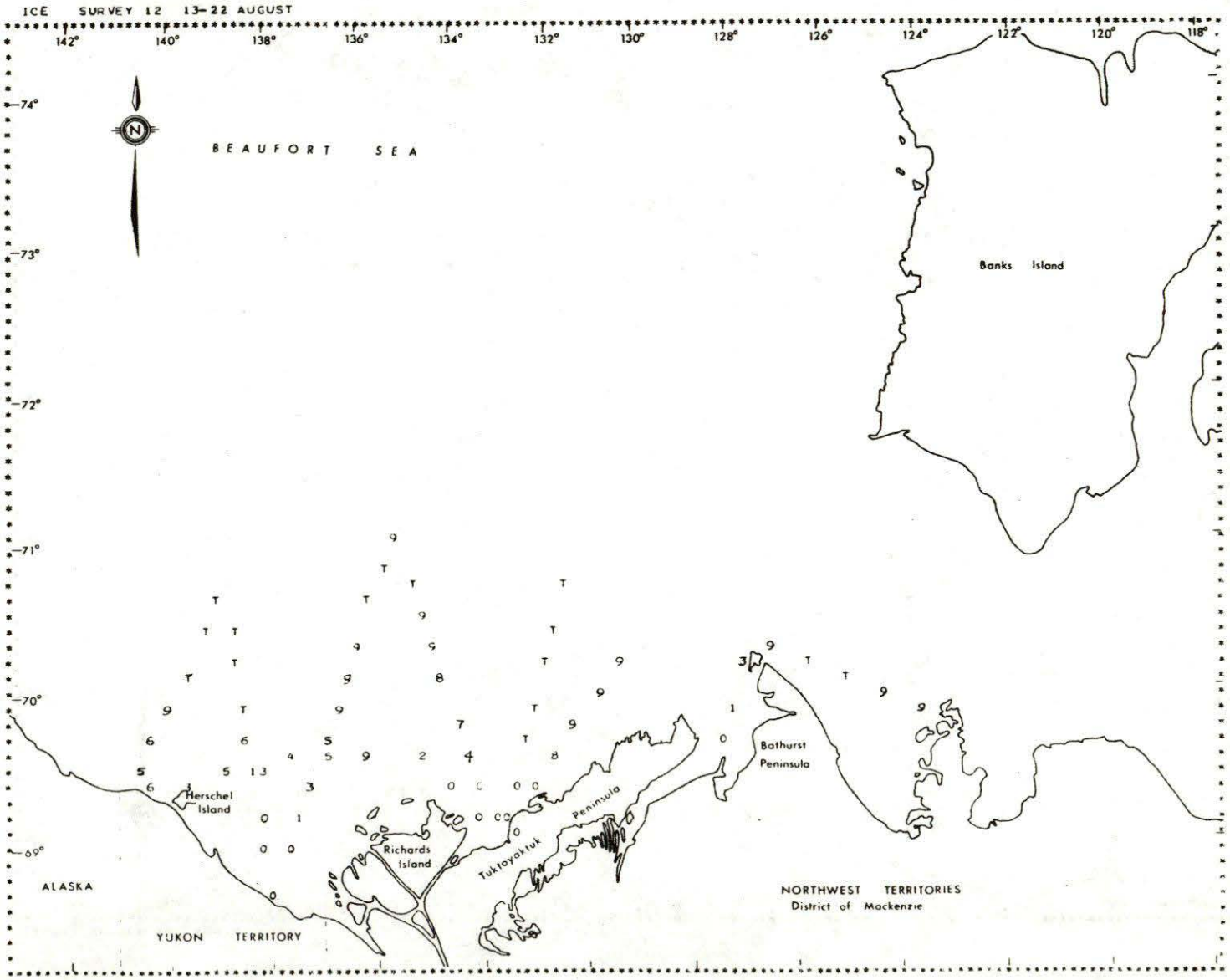
ICE SURVEY 12 13–22 AUGUST
142°
140°
138°
136°
134°
132°
130°
128°
126°
124°
122°
120°
118°
74°
73°
72°
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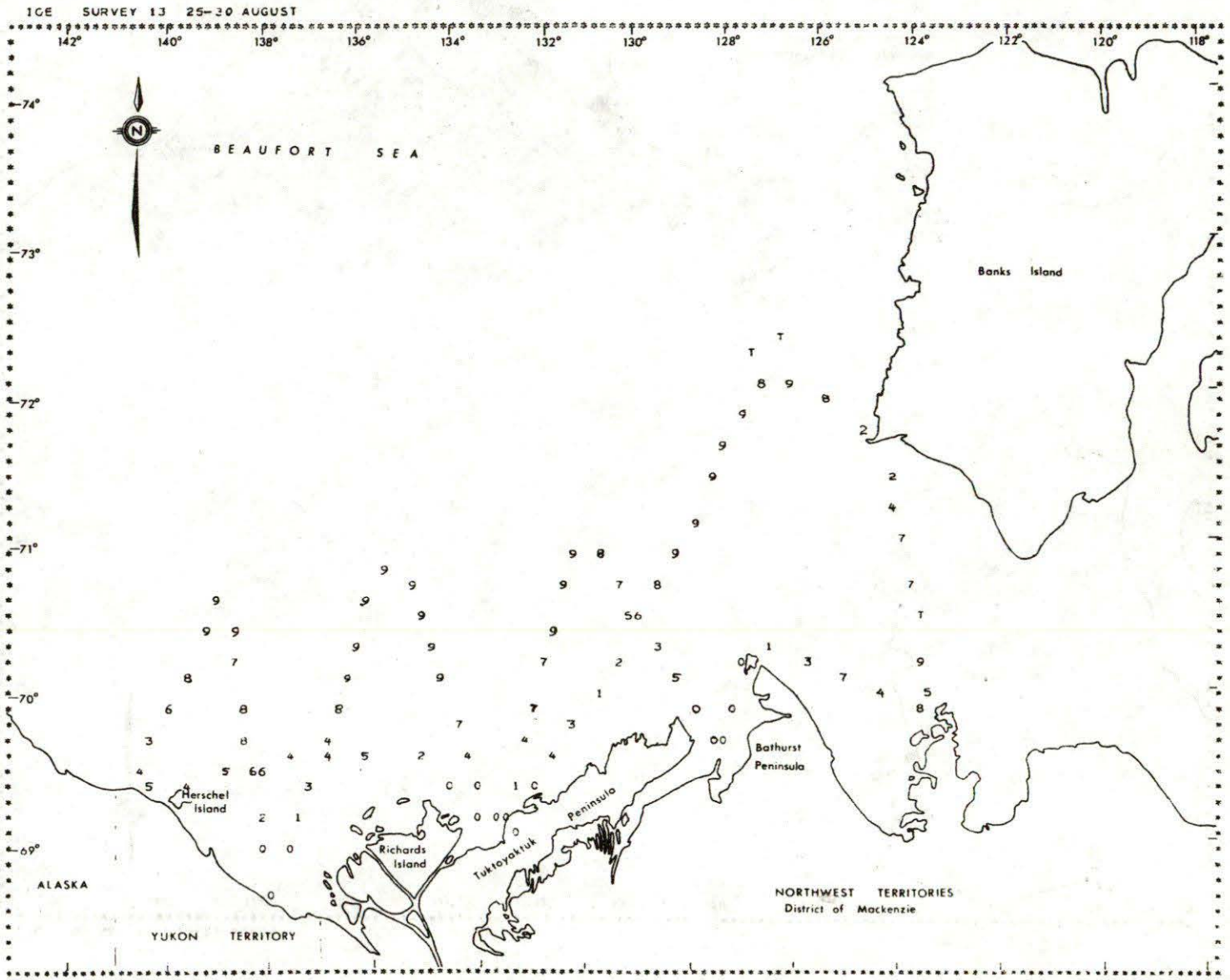
70°
69°
N
BEAUFORT SEA
Banks Island
Herschel Island
Richards Island
Tuktoyaktuk Peninsula
Bathurst Peninsula
ALASKA
YUKON TERRITORY
NORTHWEST TERRITORIES
District of Mackenzie


ICE SURVEY 13 25-30 AUGUST
142°
140°
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136°
134°
132°
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126°
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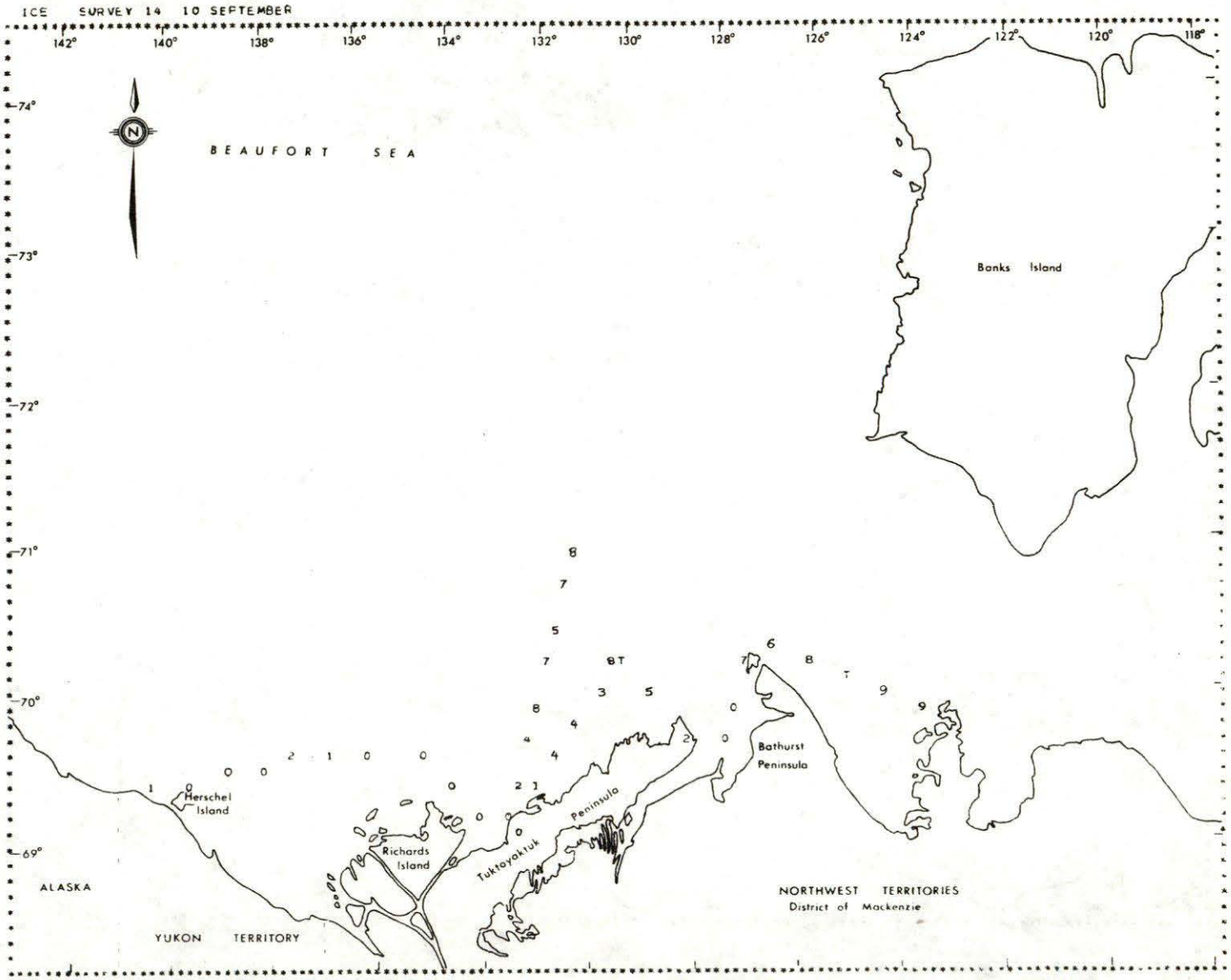
122°
120°
118°
74°
73°
72°
71°
70°
69°
BEAUFORT SEA
Banks Island
Herschel Island
Richards Island
Tuktoyaktuk Peninsula
Bathurst Peninsula
ALASKA
YUKON TERRITORY
NORTHWEST TERRITORIES
District of Mackenzie


ICE SURVEY 14 10 SEPTEMBER
142°
140°
138°
136°
134°
132°
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126°
124°
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120°
118°
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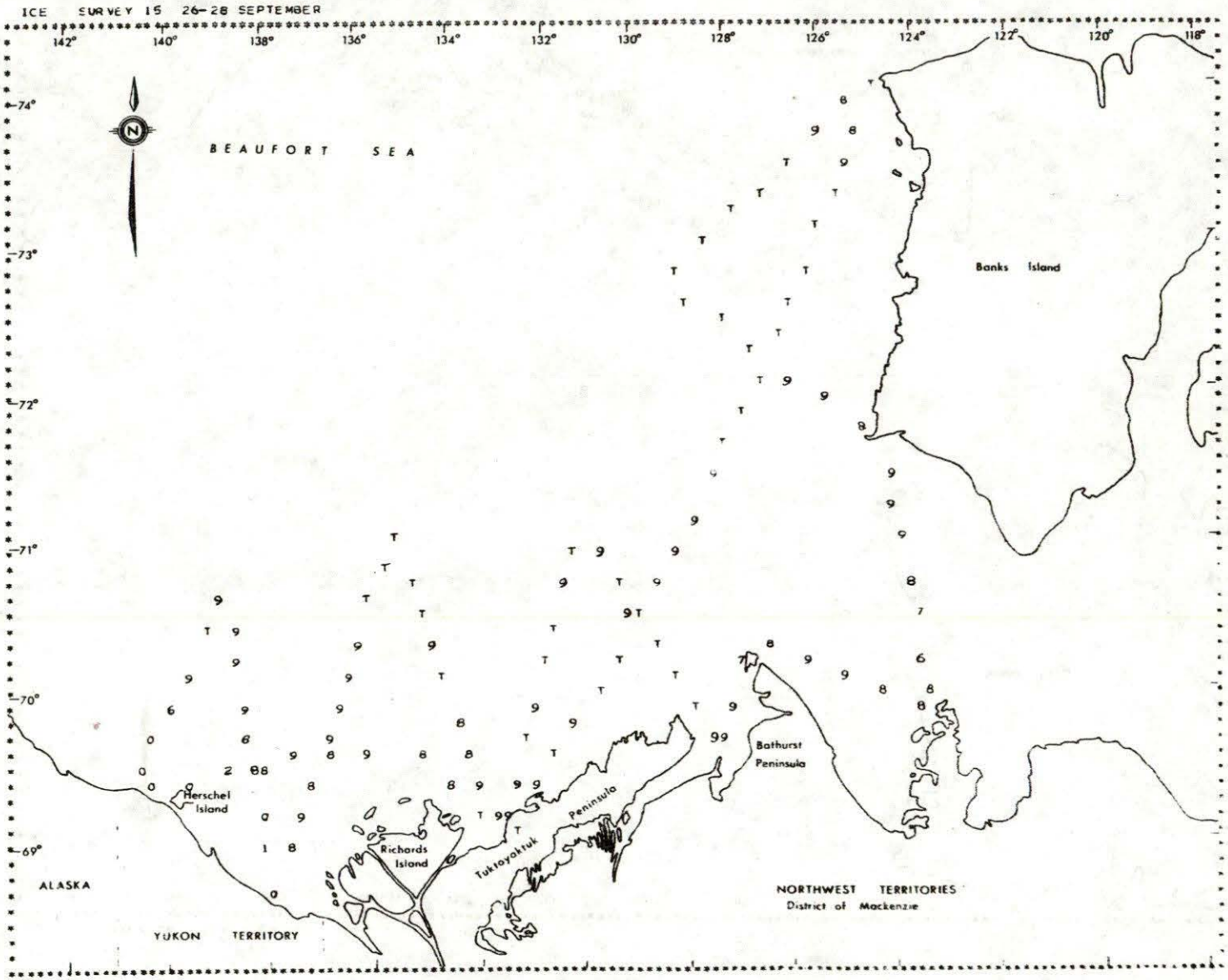
73°
72°
71°
70°
69°
BEAUFORT SEA
Banks Island
Herschel Island
Richards Island
Tuktoyaktuk Peninsula
Bathurst Peninsula
ALASKA
YUKON TERRITORY
NORTHWEST TERRITORIES
District of Mackenzie


ICE SURVEY 15 26-28 SEPTEMBER
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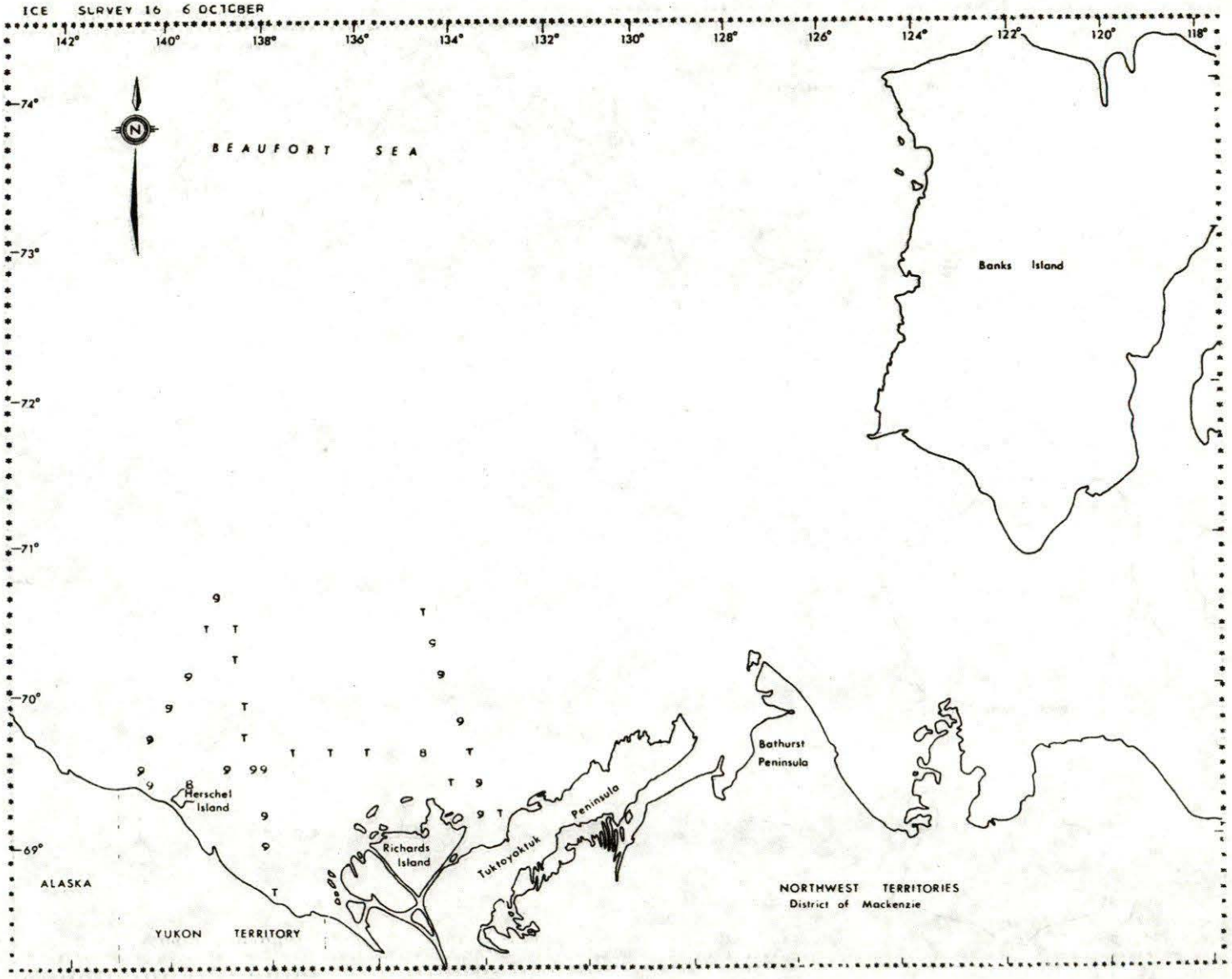
70°
69°
BEAUFORT SEA
Banks Island
Herschel Island
Richards Island
Tuktoyaktuk Peninsula
Bathurst Peninsula
ALASKA
YUKON TERRITORY
NORTHWEST TERRITORIES
District of Mackenzie


ICE SURVEY 16 6 OCTOBER
142°
140°
138°
136°
134°
132°
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128°
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124°
122°
120°
118°
74°
73°
72°
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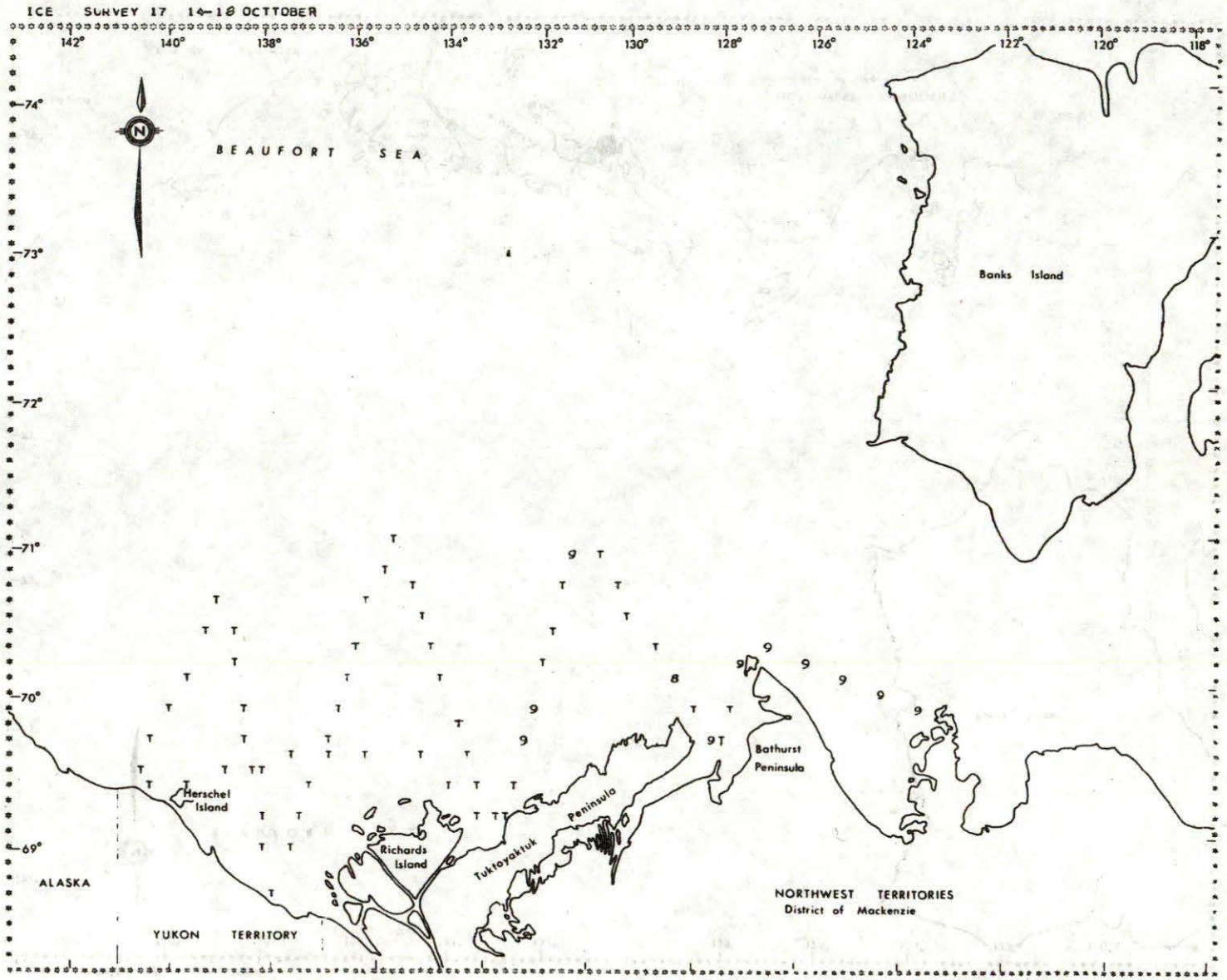
70°
69°
N
BEAUFORT SEA
Banks Island
Herschel Island
Richards Island
Tuktoyaktuk Peninsula
Bathurst Peninsula
ALASKA
YUKON TERRITORY
NORTHWEST TERRITORIES
District of Mackenzie


ICE SURVEY 17 14–18 OCTTOBER
142°
140°
138°
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130°
128°
126°
124°
122°
120°
118°
74°
73°
72°
71°
70°
69°
N
BEAUFORT SEA
Banks Island
Herschel Island
Richards Island
Tuktoyaktuk Peninsula
Bathurst Peninsula
ALASKA
YUKON TERRITORY
NORTHWEST TERRITORIES
District of Mackenzie

APPENDIX 3

Translation of location numbers from those used in 1974 Beaufort Sea Coast Survey.

NEW NUMBER	OLD NUMBER	TYPE	NEW NUMBER	OLD NUMBER	TYPE	NEW NUMBER	OLD NUMBER	TYPE
1	52	Beach	31	11	Bay	61	35	Lake
2	50	Beach	32	28	Bay	62	36	Lake
3	51	Beach	33	12	Bay	63	37	Lake
4	49	Bay	34	13	Bay	64	38	Lake
5	47	Bay	35	27	Beach	65	39	Lake
6	45	Bay	36	14	Bay	66	40	Lake
7	44	Bay	37	15	Bay	67	61	Lake
8	43	Bay	38	26	Beach	68	62	Lake
9	42	Bay	39	25	Beach	69	63	Lake
10	41	Island	40	16	Bay	70	64	Lake
11	53	Island	41	24	Beach	71	65	Lake
12	54	Island	42	17	Bay	72	66	Lake
13	55	Island	43	23	Beach	73	67	Lake
14	56	Island	44	22	Beach	74	68	Lake
15	1	Bay	45	18	Bay	75	69	Lake
16	2	Bay	46	19	Bay	76	70	Lake
17	3	Bay	47	21	Bay	77	71	Lake
18	5	Bay	48	20	Bay	78	72	Lake
19	4	Bay	49	90	Lake	79	73	Lake
20	6	Bay	50	48	Lake	80	74	Lake
21	7	Bay	51	91	Lake	81	75	Lake
22	34	Bay	52	46	Lake	82	76	Lake
23	33	Bay	53	92	Lake	83	77	Lake
24	32	Beach	54	93	Lake	84	78	Lake
25	8	Bay	55	94	Lake	85	79	Lake
26	31	Beach	56	95	Lake	86	80	Lake
27	9	Beach	57	96	Lake	87	81	Lake
28	30	Beach	58	97	Lake	88	82	Lake
29	10	Beach	59	98	Lake	89	83	Lake
30	29	Beach	60	99	Lake	90	84	Lake