SEAL, SEA LION, WALRUS AND BELUGA WHALE SURVEYS OF THE BERING SEA, 1979 AND 1982-1983

by

John J. Brueggeman
Envirosphere Company
10900 N.E. Eighth Street
Bellevue, Washington 98004

Richard Grotefendt
13504 - 432nd Avenue S.E.
North Bend, Washington 98045

Final Report
Outer Continental Shelf Environmental Assessment Program
Research Unit 669

May 1986

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF FIGURES (Continued)

LIST OF FIGURES (Continued)

LIST OF FIGURES (Continued)

LIST OF TABLES

LIST OF TABLES

TABLE OF CONTENTS (Continued)

LIST OF TABLES

ABSTRACT

Aerial and vessel surveys were conducted in the Bering Sea to determine pinniped and beluga whale density, distribution, and association with sea ice during 1979, 1982, and 1983. The 1982 surveys were conducted with a single helicopter flown over open water from a ship. The 1979 and 1983 surveys were conducted from one or two helicopters flown over the pack ice from an icebreaker. Because pinnipeds are difficult to observe in open water and most beluga whales are north of the Bering Sea during the seasons of open water, this report primarily addresses the 1979 and 1983 late winter to early spring surveys when pinnipeds haul-out on the pack ice and belugas are present. The 1979 surveys included the area from the marginal ice front north to St. Lawrence Island, while the 1983 surveys were restricted to the marginal ice front.

A total of 1,670 pinnipeds were recorded along 2,410 nm surveyed in 1983, and 2,909 pinnipeds were recorded along 4,342 nm in 1979. The Pacific walrus was the most abundant of the seven pinniped species recorded and also the most widespread. Walrus densities were particularly high in the pack ice south and west of St. Lawrence Island and in the marginal ice front between St. Matthew Island and the US-USSR Convention Line. Bearded, spotted, ribbon, and ringed seals and northern sea lions were considerably less abundant and more specific in their distribution. Bearded and ringed seal densities were highest in the central pack ice and spotted and ribbon seal densities were highest in the marginal ice front. Northern sea lion distribution was limited to the southern extreme of the marginal ice front.

The distribution of pinnipeds in the marginal ice front was variable. Spotted seals and northern sea lions primarily occurred in the western section of the front and ribbon seals in the central section of the front. Walruses occurred across the front, but were particularly high

in abundance in the central front. The distance pinnipeds were found in the front from its southern extreme was also variable. Walruses were on the average farthest from the southern extreme of the front, sea lions nearest, and ribbon and spotted seals intermediate. These results and those for the pack ice in general show that pinniped species partitioned their distribution in the project area to reduce competition for food and space.

In addition to pinnipeds, 886 and 598 beluga whales were recorded in 1979 and 1983, respectively. Belugas were widespread in the pack ice, but large numbers of belugas were observed along the western fringe of the St. Matthew Island polynya and in the central pack ice along the US-USSR Convention Line. Belugas were primarily encountered in narrow leads or areas of thin but extensive ice coverage.

Lastly, our studies provide estimated densities for beluga whales and pinnipeds in the project area. Estimates for most species were relatively consistent with those reported by other investigators for areas in or near the study area. Estimates for walrus in the marginal ice front were, however, higher than previously reported anywhere in the front. Furthermore, we report the first estimates of beluga whale and northern sea lion numbers in the Bering Sea pack ice.

INTRODUCTION

Information on pinniped use of the northcentral Bering Sea is limited. Most information is derived from studies in the eastern (Kenyon 1960; Burns 1970; Kenyon 1972; Fay 1974; Burns and Harbo 1977; andFay 1982) and to a lesser degree the western (Tikhomirov 1964; Shustov 1965; and Kosygin 1966) Bering Sea during spring when pinnipeds haul out on the pack ice. While these and other surveys (Braham et al. unpublished) have entered into the central Bering Sea, very little effort has been devoted to the northcentral Bering Sea ice front. Even less effort has been given to this area during ice-free seasons (Consiglieri and Bouchet 1981). Studies of marine mammals in the northcentral Bering Sea, particularly during winter, have been few primarily because of its remoteness, high logistical costs to access it, and harsh weather.

The results of these published studies identify that seven species of pinnipeds inhabit the northcentral Bering Sea seasonally: northern fur seal (Callorhinus ursinus); northern sea lion (Eumetopias jubatus); Pacific walrus (Odobenus rosmarus); and the spotted (Phoca largha), bearded (Erignathus barbatus), ribbon (Phoca fasciata), and ringed (Phoca hispida) seals (Burns and Harbo 1977). Pinnipeds are most abundant during winter and spring when pack ice provides a platform for resting, breeding, birthing, and molting. Most species migrate either passively on the ice as it retreats northward or actively (swimming) to the Chukchi Sea to summer, except for spotted seals, sea lions, and fur seals, which move to coastal areas of the Bering Sea. Varying sex and age components of these pinniped populations adopt a pelagic existence in the Bering Sea during the ice-free seasons. The densities and movement patterns of pinnipeds in the northcentral Bering Sea, however, are poorly known.

The purpose of this report is to document and compare the results from pinniped and beluga whale surveys conducted in the Bering Sea during 1982-1983 and 1979. This report was prepared in order to document the

results of two dedicated research projects for use by MMS in managing petroleum activities in the Navarin Basin and adjacent planning areas of the Bering Sea. The report is divided into three sections:

1. 1982-1983 survey of the Bering Sea.
2. 1979 survey of the Bering Sea.
3. Comparison between the 1982-1983 and 1979 survey results.

The purpose of the 1982-1983 survey was to determine the seasonal use of the Bering Sea by marine mammals during the spring, summer, fall, and winter. The objectives were to:

1. assess winter habitat use of the Navarin Basin by cetaceans, emphasizing the seasonal population size and distribution of bowhead whales relative to ice and other environmental parameters;

2. identify and enumerate the endangered species of whales in the Basin during the ice free period, assess habitat use, and correlate their temporal and spatial distribution with environmental parameters; and

3. document sightings of other species of marine mammals observed during the surveys, and provide estimates of their abundance and distribution within the region.

Objective 3 is addressed in this report, which examines pinniped and beluga whale abundance and distribution in the Basin during the spring (May-June), summer (July-August), fal l (October-November), or winter (February-March). Because of the difficulty in detecting and identifying pinnipeds in open water, the report concentrates on winter when pinnipeds haul out on the ice and are most visible to survey. The other two objectives are addressed in an earlier report (Brueggeman et al., 1984).

The purpose of the 1979 survey was to determine marine mammal use of the Bering Sea pack ice during early spring. The objectives were to:

1. identify the distribution and density of bowhead whales and their association to sea ice in the Bering Sea and

2. document sightings of other marine mammals observed during the survey, and provide estimates of their distribution, density, and association with sea ice.

Objective 2 is addressed in this report, which documents information collected on seals, sea lions, walruses, and beluga whales. The bowhead whale results are reported by Brueggeman (1982). For both the 1979 and 1982 through 1983 surveys, the beluga whale results are reported in Appendix C.

Acknowledgements: We thank the 1982-83 field team of Dr. A. Erickson, Dr. T. Newby, J. Joyce, J. Harley, B. Troutman, and W. Everett. L. Consiglieri, M. Dahlheim, B. Kelly, D. Rugh, J. Taggart, and D. Wencker were the 1979 field team. Dr. D. Chapman, Dr. T. Quinn, and R. Fairbanks provided advice on statistical procedures. Dr. T. Loughlin and M. Athey reviewed the report. Logistical support was provided by the staffs of the NOAA ship SURVEYOR during the 1982 seasonal surveys and by the USCG icebreaker POLAR SEA during the 1983 and 1979 surveys of the pack ice. The National Marine Mammal Laboratory of the National Marine Fisheries Service was responsible for the operation, administration, and management of the 1979 survey. Funding for both studies and the analysis we present in this report was provided by the Outer Continental Shelf Environmental Assessment Program.

STUDY AREA

The 1982-1983 study area is located in the northcentral Bering Sea, approximately 200 nautical miles (rim) off the coast of Alaska in the Navarin Basin (Figure 1). It covers over 54,000 nm^2, an area approaching the size of the State of Michigan, and is bound by the

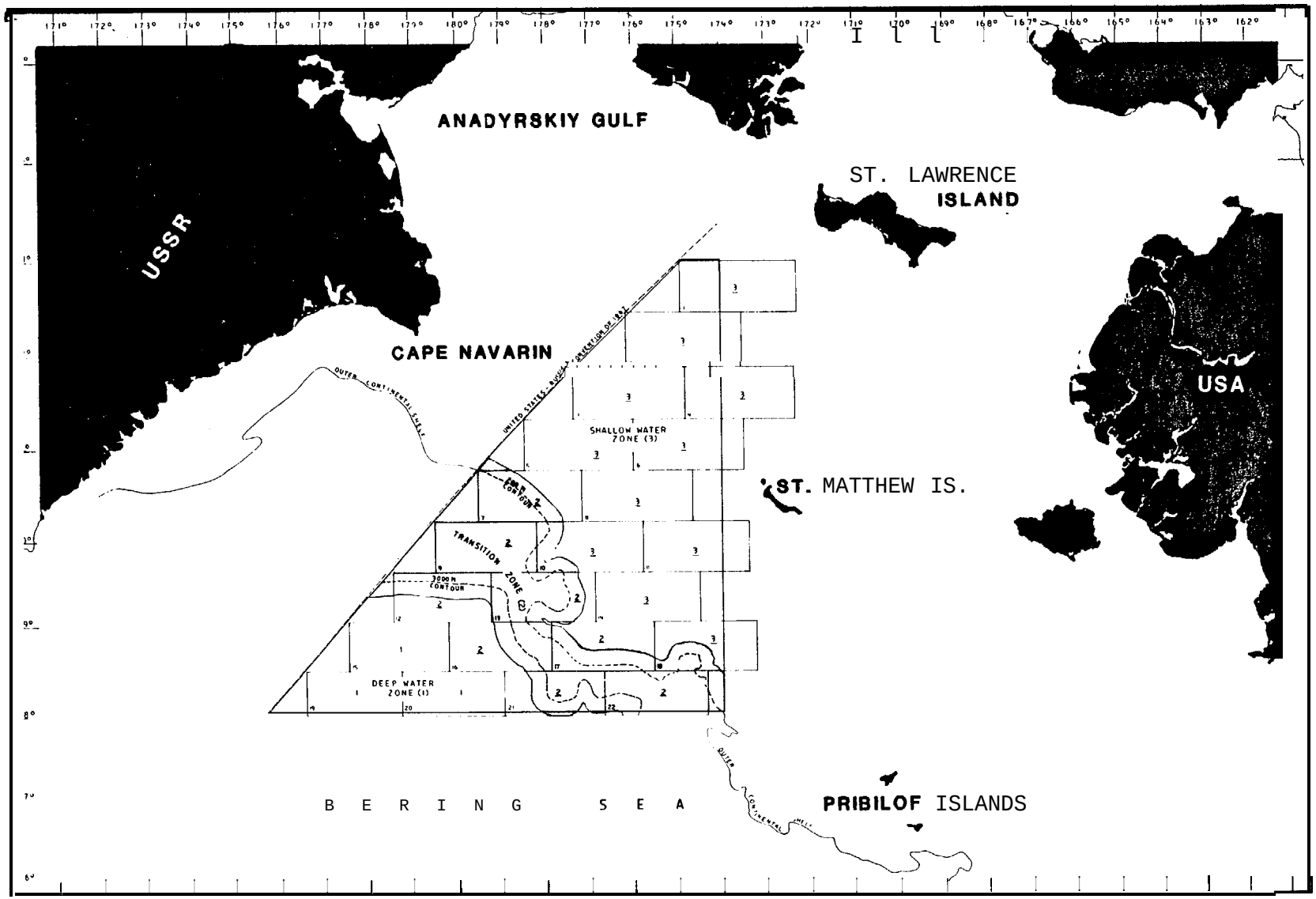


FIGURE 1 **STUDY AREA AND SAMPLING DESIGN IN THE NAVARIN BASIN FOR SPRING THROUGH FALL SURVEY PERIOD, 1982.**

US-USSR Convention Line to the west, 174°W longitude to the east, and latitudes 63°N and 58°N to the north and south. Water depth in the Basin ranges from about44 m on the outer continental shelf to over 3000 m outside the shelf. The shelf comprises approximately half of the area in the Basin, while the continental slope and rise comprise 36 percent and 14 percent, respectively. The study area was extended to 171°W longitude during the 1983 winter survey period (Figure 2).

The 1979 study area is also located in the northcentral Bering Sea (Figure 3). It covers approximately 47,380 km² and is bound by longitudes 170°W and 180°W to the east and west and latitudes 59°N and 65"N to the south and north. The study area is on the outer continental shelf, where water depths are less than 200 m. The southern boundary was the approximate edge of the pack ice where it meets the open ocean. The 1979 study area overlapped parts of the Navarin Basin, Norton Basin, and the St. Matthew-Hall planning areas. Since the 1982-83 surveys were in the Navarin Basin and also crossed into the St. Matthew-Hall planning areas, the surveys of the two study periods are comparable. In addition, the longitudinal span of the marginal ice front surveyed for both years was largely identical.

The climate of the study area features harsh environmental conditions that promote the seasonal development of sea ice (Figure 4). Environmental conditions typically consist of cold temperatures, high wind speeds, low visibility, and extreme ranges in day length (Brewer et al. 1977). Average annual air temperature and wind speed are O"C and 14 kt, and visibility <2 nm persists approximately 14 percent of the time during the year. Sea ice persists in the Navarin Basin from December through June and ice coverage is greatest from February through April (Potocsky 1975). It seldom extends south of the outer continental shelf and is typically <1 m thick. Breakup of the ice begins in mid-April, and the Basin is generally ice-free by late June.

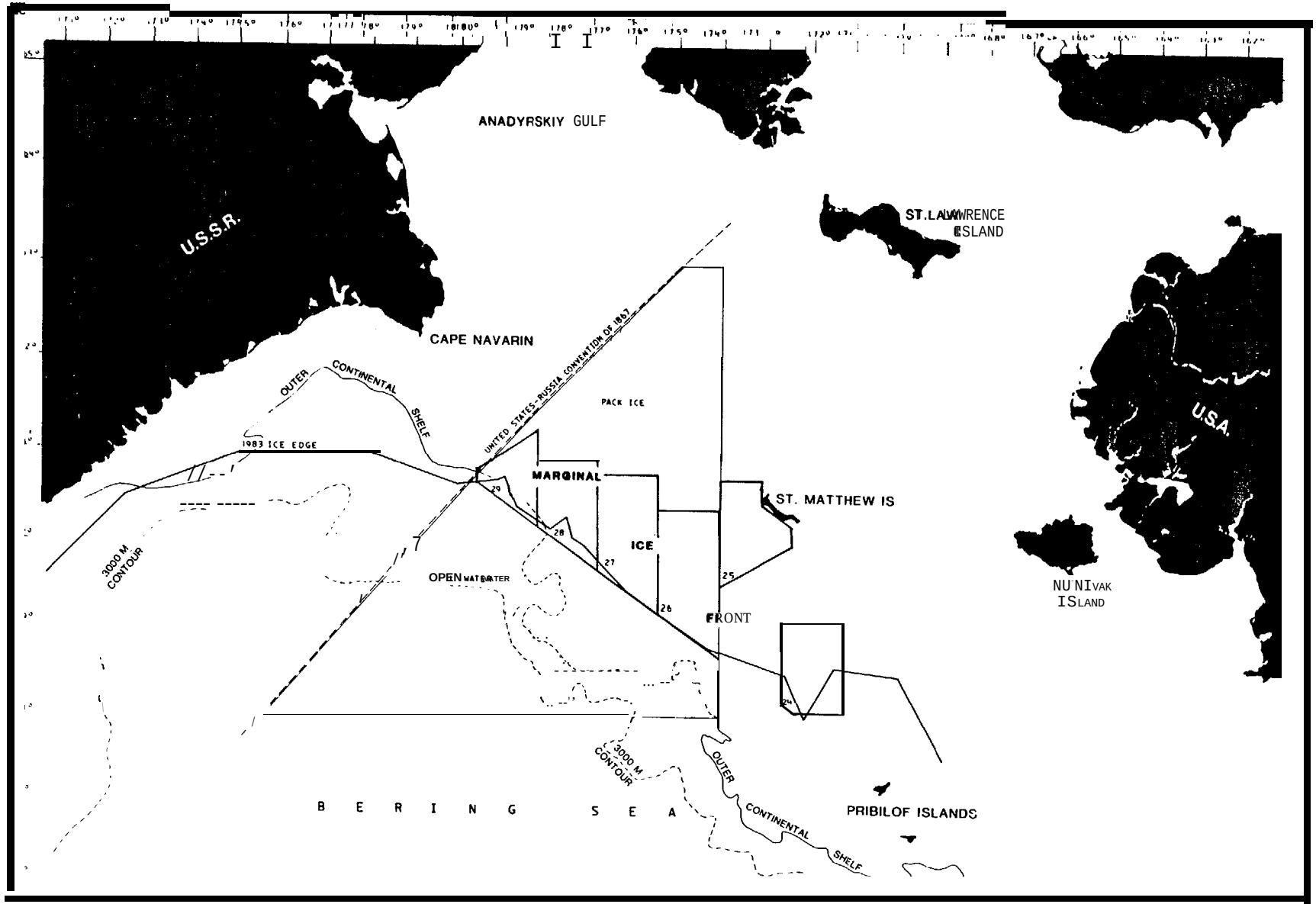


Figure 2 **STUDY AREA AND SAMPLING DESIGN IN THE NAVARIN BASIN DURING WINTER SURVEY PERIOD, 1983.**

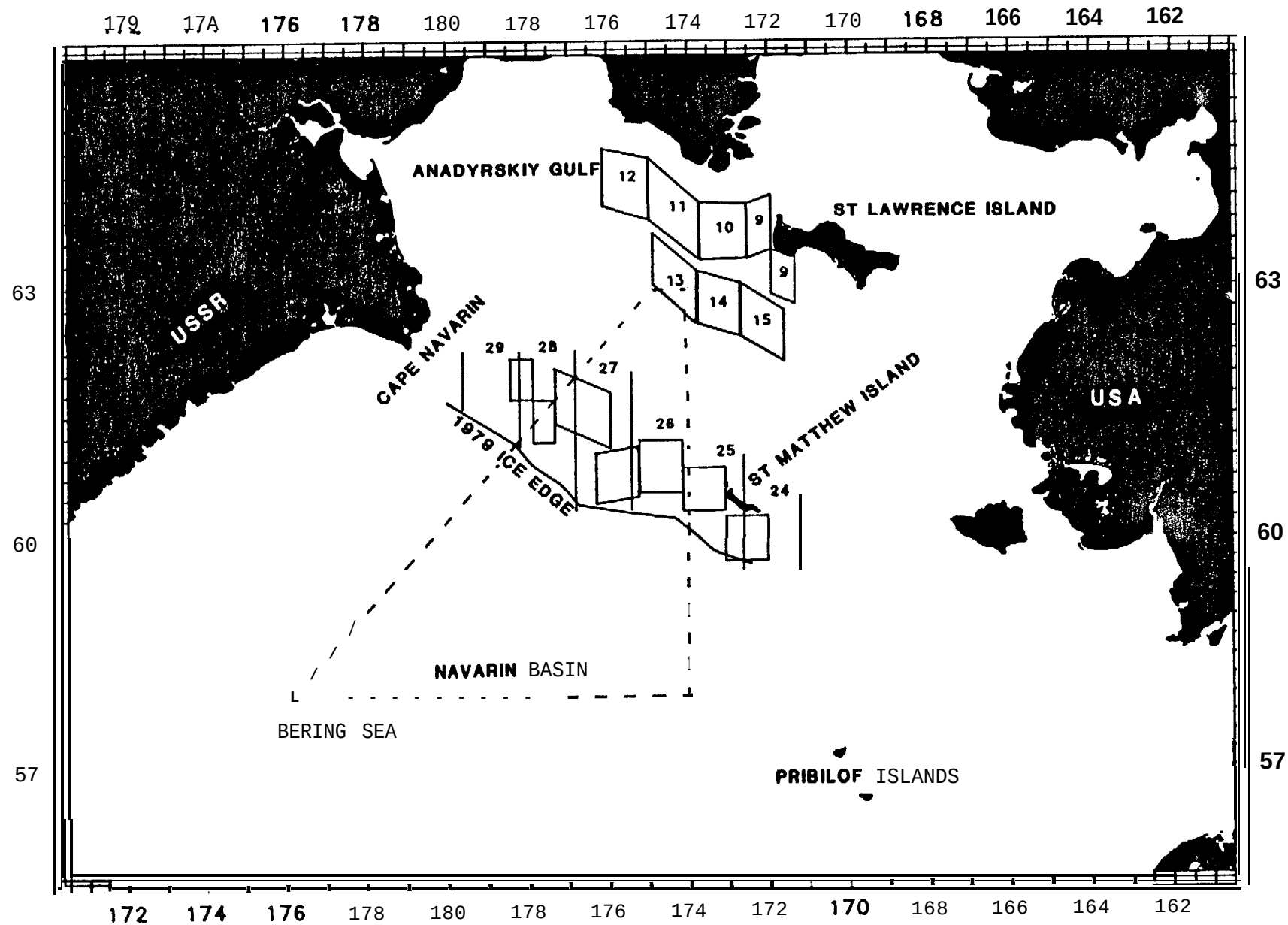


FIGURE 3 **STUDY AREA AND SAMPLING DESIGN IN THE BERING SEA FOR THE EARLY SPRING AERIAL SURVEY PERIOD, MARCH-APRIL 1979.**

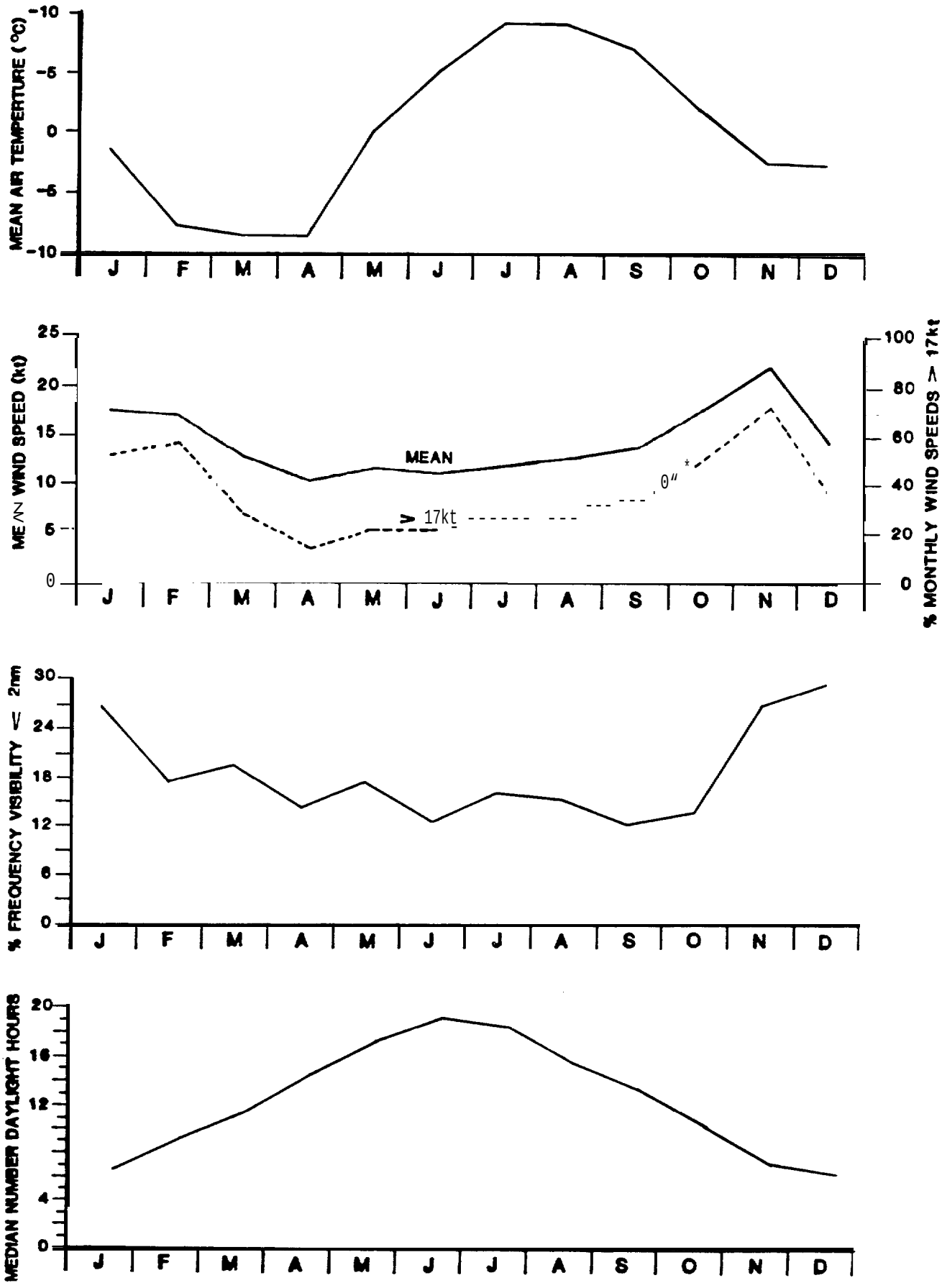


FIGURE 4 HISTORIC ENVIRONMENTAL CONDITIONS OF THE NORTH CENTRAL BERING SEA (BROWER ET AL. 1977)

METHODS

SURVEY PROCEDURES

1982-1983 Surveys

Two sampling designs were developed for aerial and vessel surveys of marine mammals in the Navarin Basin. One design was for surveys during the ice-free period from late spring to early fall. This design was modified for surveys during the late winter-to-early spring when sea ice was in the Basin.

ICE-FREE PERIOD - SPRING, SUMMER, AND FALL: The Basin was stratified into three survey zones (Figure 1). The shallow water zone coincided with the outer continental shelf, while the transition and deep water zones corresponded to the outer continental slope and rise, respectively. The former zone was the area northeast of a point 10 nm northeast of the 200 m contour line, and the latter zone was the area southwest of a point 10 nm southwest of the 3000 m contour line. The area between these points was the transition zone, which featured the greatest topographic relief. The Basin was stratified in this manner to account for distributional differences of marine mammals relative to major changes in water depth. Moreover, areas of potential petroleum development in the Basin may be closely linked to the feasibility of extracting petroleum in various water depths.

Twenty-two sampling units were distributed over the three zones (Figure 1). The shallow water zone contained 11 units, the transition zone 8 units, and the deep water zone 3 units. Each unit was approximately 34 nm by 72 nm and comprised about 2,450 nm^2. Nine transect lines, 30 nm long, were equidistantly spaced every 8 nm corresponding to the longitude lines in each sampling unit (Figure 5). This configuration provided thorough coverage of a sampling unit and prevented double surveying of adjacent lines or units.

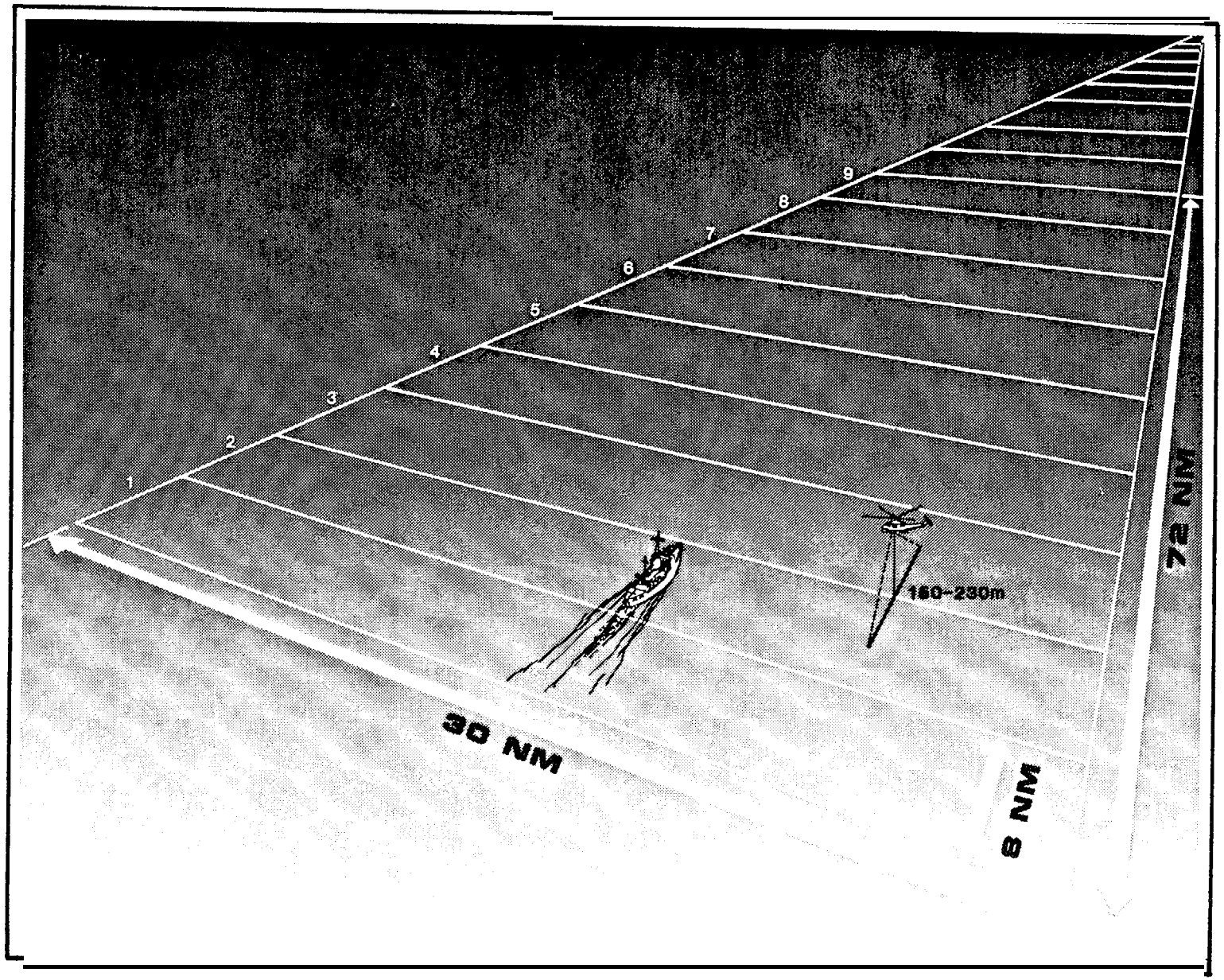


FIGURE 5 TRACK LINE ORIENTATION **OF** AERIAL AND VESSEL SURVEYS DURING SPRING **THROUGH** FALL PERIOD, **1982.**

Aerial and vessel surveys were conducted along the transect lines of randomly selected sampling units (Figure 5). Survey effort in a given zone was allocated in proportion to the relative amount of area in each zone. Consequently, we attempted to allocate 50 percent of the survey effort in the shallow water zone, 36 percent in the transition zone, and 14 percent in the deep water zone. This approach assumed that marine mammals were distributed in proportion to the amount of area available in each zone, an assumption that was the best available at the initiation of the study from the marine mammal literature for the Basin.

Aerial surveys were conducted from a UH1M helicopter based on the NOAA ship SURVEYOR. Surveys were flown at altitudes of 150-230 m and at speeds of 65-75 kt. Two observers, one positioned in the copilot's seat and one in the right-aft section of the helicopter, provided data on marine mammals and environmental conditions to a data recorder; all data were recorded on computer-ready forms. Data collected on marine mammals during a survey were number, species, vertical angle when an animal was perpendicular to the trackline, group size, time, and position. Environmental conditions including visibility (Appendix A, Table A-l), Beaufort Wind Scale, air temperature, and glare were evaluated at the start of each transect line surveyed, or whenever the conditions changed. Vertical angles were taken with clinometers and positions were recorded from a GNS-500 every 3 nm along a transect line. The pilot was responsible for providing positions of the aircraft to the data recorder, maintaining a constant altitude and airspeed, and when possible, searching for marine mammals.

When the wind speed was greater than a Beaufort 4, the visibility <2 nm, or the ceiling below 150 m, vessel surveys were conducted along the transect lines in place of aerial surveys. Surveys were performed from the flying bridge, approximately 18 m above the water, and at a vessel speed of 12 kt. Two observers, individually stationed on the port and starboard sides of the vessel, recorded marine mammal and environmental data on the same variables described for the aerial

surveys. Radial angles, instead of vertical angles, were taken with a sighting board or 10 minute surveyors transit and animal' distances from the vessel were estimated by observers who generally had substantial experience with this estimation procedure. Water depth was recorded every 3 nm. Vessel surveys were terminated when wind speed exceeded a Beaufort 6.

Vessel surveys were also conducted in conjunction with the aerial surveys (Figure 5). The ship traveled an east-west route along the mid-latitudinal points of the north-south transect lines. One observer, positioned on the flying bridge, recorded marine mammals encountered along the trackline. The use of the ship during the aerial surveys was for the purpose of collecting distributional information on marine mammals and providing safeguards to the helicopter crew.

SEASONAL ICE PERIOD - WINTER: During the seasonal ice period, the Basin was stratified into three zones identified as the open water, marginal ice front, and heavy pack ice zones (Figure 2). The former zone occurred entirely in open water, while the heavy pack ice zone was primarily in areas of 90 to 100 percent ice coverage; the marginal ice front zone was intermediate between these two strata and consisted chiefly of 10 to 90 percent ice coverage and the fringe of ice along the southern margin of the pack. The size of each zone varied according to the movement of the sea ice during the course of the study. Although this stratification procedure was developed, the open water was not surveyed because of persistent high seas, nor was the heavy pack ice surveyed since the icebreaker had difficulty penetrating the dense, and at times thick, pack ice. Consequently, the entire survey effort was devoted to the marginal ice zone, where the largest number and greatest diversity of marine mammals were expected to be found (Burns et al. 1980, Brueggeman 1982).

Six sampling units were equidistantly distributed across the marginal ice front between longitudes 171°12'W and 179°36'W (Figure 2). The survey area extended beyond the boundaries of the Basin in order to increase coverage of the front. Although each unit was 36 nm wide, the

north and south boundaries varied since they corresponded to the edge of the ice and the start of heavy pack ice; boundaries that are governed by wind and currents. The average sampling unit size was 2,730 nm^2, with a range of 1,474 to 3,731 nm^2.

Aerial and vessel surveys were conducted along seven paired transect lines established in each sampling unit (Figure 6). The paired transect lines were spaced every 4 nm and corresponded to the longitude lines. Individual transect lines comprising each pair were separated by 2 nm and extended 30 nm into the pack ice from the interface of the marginal ice front with the open water; the exact length of the transect lines varied depending on ice conditions and a combination of logistical factors influencing opportunities for surveys.

Aerial surveys were conducted from two Sikorsky H-52-A helicopters based on the U.S. Coast Guard icebreaker POLAR SEA (Figure 6). The helicopters flew transect lines parallel to each other or singly at speeds of 65-75 kt and at altitudes of 150-230 m. Observer and data collection procedures were largely the same as those reported for aerial surveys during the ice-free period. The only difference was that navigation was determined from Loran-C systems on each helicopter, and ice thickness, size, and concentration were visually evaluated every 3 nm along the transect line by the observer occupying the copilot's seat in each helicopter; ice characteristics were evaluated by the same two observers for every survey to maintain data consistency (Appendix A, Table A-2 defines ice characteristics). Single helicopter surveys were flown along the transect lines when one helicopter was inoperable. Under these circumstances, the Coast Guard restricted the helicopter range to 8 nm from the ship. To maximize the use of a single helicopter, the ship traveled a predetermined course, while the helicopter flew a transect line 8 nm both north and south of the ship. A similar vessel travel pattern was followed during the two-helicopter surveys but the aircraft traveled longer distances from the ship.

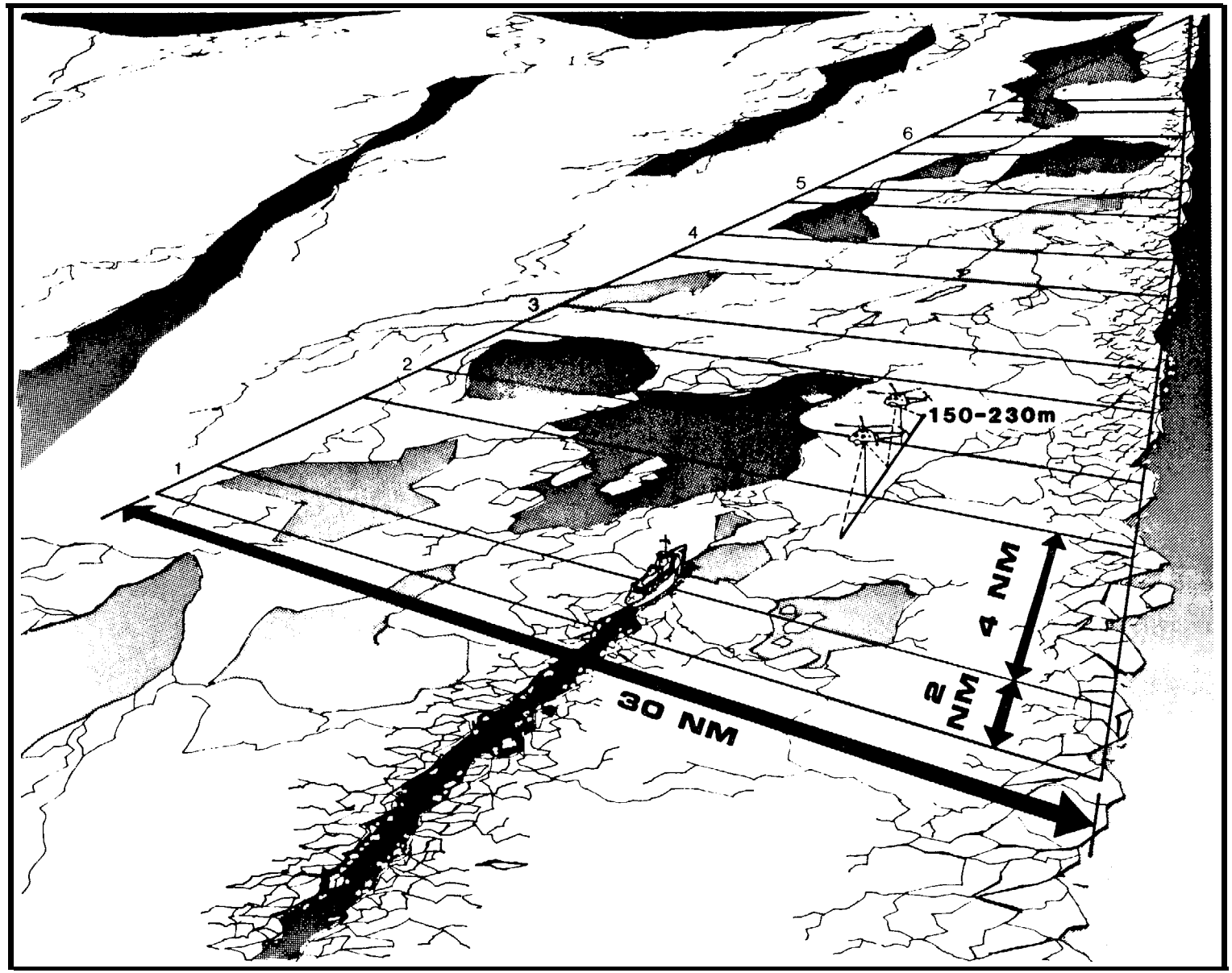


FIGURE 6 TRACKLINE ORIENTATION OF AERIAL AND VESSEL SURVEYS DURING WINTER, 1983.

When winds exceeded 25 kt, ceiling was below 91 m, visibility was <2 nm, or both helicopters were inoperable, vessel surveys were conducted along the transect lines in place of aerial surveys, Vessel surveys followed the same data collection procedures as described for surveys during the ice-free period except for the location of the observers and the angle measurement to an observed animal. Observations of marine mammals were made from the loft-conning tower, 34 m above the water. Each observer recorded all marine mammals occurring in a 90° arc on either side of the bow of the ship for the port and starboard sides. Angles to animals were taken in combination with a sighting board for the radial angle and a clinometer for the vertical angle. This approach provided an accurate way of determining animal distances from the ship. Vessel surveys were also conducted during aerial surveys if survey team members were available to observe due to one helicopter being inoperable; data collected during these surveys were used to describe marine mammal distribution and species composition.

1979 Survey

The study area was stratified into three survey zones (Figure 3). Fifteen sampling units, each approximately 55 km long by 59 km wide, were distributed systematically within these zones. The southern zone or marginal ice front contained 7 sampling units, the northern zone 5 units, and the central zone 3 units. The southern zone or marginal ice front is defined on page 12. The central and northern zones were in the heavier, consolidated pack ice north of the front. These three zones were selected because they characterize the wide range of habitats, ice conditions, and geographic areas used by pinnipeds and cetaceans in the pack ice. The ice conditions of the zones are described on page 45.

Aerial surveys were conducted from two Sikorsky H52-A helicopters based on the icebreaker, POLAR SEA. The helicopters were flown parallel at altitudes of 150 and 230 m, respectively, which was similar to the survey pattern followed in 1983 (Figure 6). Helicopters were

simultaneously flown at different altitudes so that pinnipeds could be surveyed from the lower flying helicopter while whales were surveyed from both helicopters. In each sampling unit, 8 paired-strip transects, 55 km long and 1.8 km apart, were aligned with longitudinal lines and spaced every 5.5 km. A directional radio-navigational system (TACAN) was used between helicopters and the ship to guide the aircraft along the transects. Single helicopter surveys were flown (Units 11-15) when one helicopter was inoperable. All marine mammals were counted during the single-helicopter surveys.

Two observers, one positioned in the copilot's seat and one in the right-aft section of the helicopter, provided data on marine mammals and environmental conditions to a data recorder; all data were recorded on computer-ready forms. Data collected on marine mammals included species, number, group size, sex and age composition, time, and geographic location. Environmental conditions, including visibility (Appendix A, Table A-l), and glare (percent of viewing area) were evaluated at the start of each transect line surveyed, or whenever conditions changed. Ice concentration and floe size were visually evaluated every three minutes along the transect line by the observer occupying the copilot's seat (Appendix A, Table A-2). Ice nomenclature followed that of the World Meteorological Organization (1970).

When winds exceeded approximately 25 kt, ceiling was below 91 m, visibility was <2 nm, or both helicopters were inoperable, limited vessel surveys were conducted along the transect lines. Too few data were collected, however, during these surveys for analysis.

DATA ANALYSIS PROCEDURES

Standard statistical procedures were used in the analysis of the 1982-1983 and 1979 data. Population estimates were derived from the strip-transect method (Eberhardt 1978). The strip-transect method involves calculating abundance from the density of animals in a survey

strip. Although this method assumes that all animals in the designated strip are counted, confirmation of this assumption is impossible and probably violated for marine mammals since animals below the surface of the water can be not counted. However, this method provided the best relative index of abundance of pinnipeds hauled out on the pack ice for this study.

Estimates of the density and abundance of pinnipeds and associated variances were calculated from methods described by Estes and Gilbert (1978) for strip-transect analysis. Density and abundance were calculated by summing the sampling unit estimates for the project area.

The estimator has the following form:

Estimated density is:

$$D_i = \Sigma y_i / \Sigma x_i$$

where D_i = the density of pinnipeds per nm^2 for a sampling unit
Yi = the number of pinnipeds in the i^{th} transect strip, and
xi = the area of the i^{th} transect strip

Estimated variance of D_i is:

$$S^2_{D_i} = [\Sigma(y^2_{i/} x_i) - D \Sigma y_i] / (n-1)(\Sigma x_i)$$

where n . number of transects

Estimated abundance for a unit is:

$$T_i = D_i A_i$$

where: Ti = abundance of pinnipeds in a sampling unit, and
A_i = total area of that sampling unit

Estimated abundance for all zones is:

$$T = \Sigma T_i$$

Estimated variance of T is:

$$V(T) = A (A - \Sigma Xi) S^2_{D_i}$$

The 95 percent confidence interval for T is:

$$T \pm 1.96 \sqrt{V(T)}$$

Pinniped abundances were estimated from systematic aerial (1979, 1982-1983 surveys) and vessel (1982-1983 surveys) surveys. Pinniped estimates were made from observations occurring in a strip width of 0.5 nm (0.25 nm per side of the trackline) for both surveys. This strip width best fit the observed distribution of perpendicular distances of pinnipeds from the transect line. Other investigators (Burns and Harbo 1977, Braham et al. unpublished) have found this strip width to be suitable for estimating pinniped population sizes. The number of pinniped observations recorded from the two survey platforms (1983 data) did not indicate an observation bias for either side of the aircraft or vessel, so the observations for the two sides were treated equally in estimating abundance. No density estimates were made for pinniped populations during the ice free season because of the difficulties of accurately counting pinnipeds in open water.

Other statistical procedures used in the analysis were Chi-square goodness-of-fit for testing animal abundance among units, animal use of ice types, and interaction of time of day and wind chill on haul out patterns of pinnipeds (1982-83 data only). These procedures test the hypothesis that animals are uniformly distributed in space or time. Significant animal occurrence in a particular ice type was identified by procedures developed by Nueet al. (1974). Analysis of variance was applied to data delineating species distance from the ice edge. All tests were performed at the 0.05 level of significance.

RESULTS

1982-1983 SURVEY

Four hundred and fifty groups of pinnipeds representing seven species and 1,852 individuals were observed during four seasonal surveys of the Navarin Basin (Table 1). Over 50 percent of the animals were walruses, while northern sea lions comprised approximately another 25 percent. Spotted seals were the most abundant seal species encountered, followed by ribbon, bearded, ringed, and fur seals. Approximately 90 percent of the pinnipeds were recorded during the winter survey period (February-March), when pinnipeds haul out on pack ice and are most visible. Conversely, counts made during the other three seasons were generally much lower because of the difficulty of seeing pinnipeds in open water. More animals were recorded during spring than summer or fall, however, because bands of remnant ice (Burns et al. 1980) in the northern third of the Basin provided a platform for pinnipeds to haul out on. Over 75 percent of the animals recorded for all four seasons were observed during aerial surveys, which accounted for 69 percent of the 8,057 nm censused.

ICE FREE PERIOD

Ten percent of the pinnipeds recorded in the Basin were observed during the spring through fall seasons (Table 1). The greatest number and highest diversity of species were recorded in the spring, primarily on remnant ice. Walruses and sea lions comprised over 70 percent of the 161 pinnipeds encountered during this time, while 41 ribbon, spotted, and bearded seals were recorded. Mean group sizes were largest for walruses (5.6±2.4 standard error) and smallest for bearded seals (1.0±0.0); mean sizes of northern sea lion (4.311.2), spotted seal (1.2±0.1), and ribbon seal (1.0±0.04) groups were intermediate (Figure 7). During the summer and fall seasons, 17 fur seals and 4 northern sea lions were observed primarily as singles. Most of the

TABLE 1

NUMBER OF SEALS, SEA LIONS, AND WALRUSES RECORDED DURING THE FOUR SEASONAL SURVEYS OF THE NAVARIN BASIN, 11 MAY-10 JUNE, 20 JULY-19 AUGUST, 29 OCTOBER-12 NOVEMBER 1982, AND 19 FEBRUARY-18 MARCH, 1983

Species	Spring				Sumner				Fall				Winter				Total			
	No. Groups	No. Individuals			No. Groups	No. Individuals			No. Groups	No. Individuals			No. Groups	No. Individuals			No. Groups	No. Individuals		
		Aerial	Vessel	Total		Aerial	Vessel	Total		Aerial	Vessel	Total		Aerial	Vessel	Total		Aerial	Vessel	Total
Spotted seal	13	14	1	15	--a/	--	--	--	--	--	--	--	42	225	16	241	55	239	17	256
Ribbon seal	21	22	--	22	--	--	--	--	--	--	--	--	22	46	12	58	43	68	12	80
Bearded seal	4	4	--	4	--	--	--	--	--	--	--	--	8	6	2	8	12	10	2	12
Ringed seal	--	--	--	--	--	--	--	--	--	--	--	--	2	2	--	2	2	2	--	2
Fur seal	--	--	--	--	9	--	10	10	6	--	7	7	1	1	--	1	16	1	17	18
Northern sea lion	11	42	5	47	4	2	2	4	--	--	--	--	69	361	45	406	84	405	52	457
Walrus	12	65	2	67	--	--	--	--	--	--	--	--	147	574	294	868	159	639	296	935
Unidentified pinniped	6	--	6	6	--	--	--	--	--	--	--	--	73	72	14	86	79	72	20	92
TOTAL	67	147	14	161	13	2	12	14	6	--	7	7	364	1287	383	1670	450	1436	416	1852

a/ Dash (--) signifies no animals were observed.

4486A

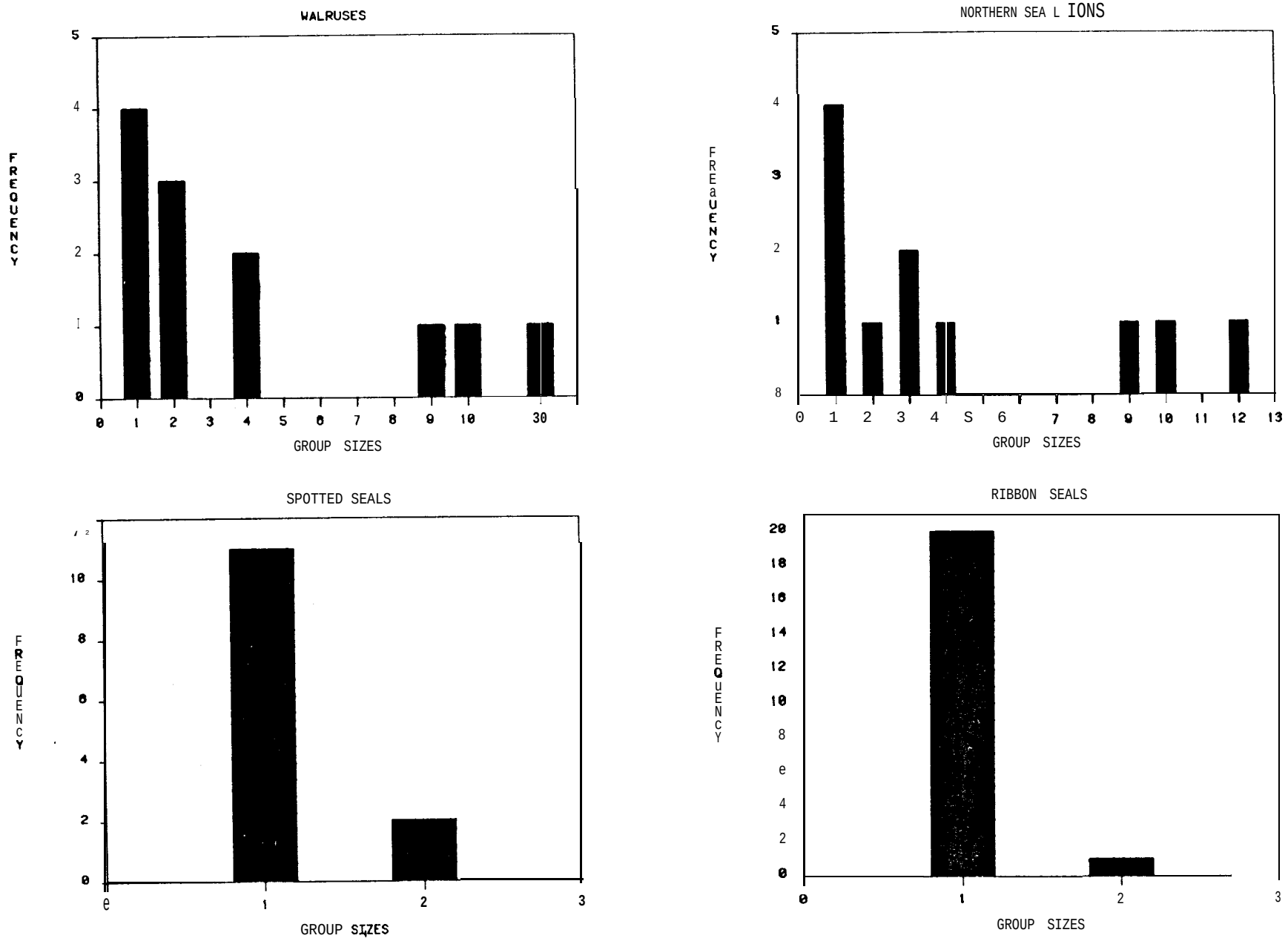


FIGURE 7 **FREQUENCY DISTRIBUTION OF GROUP SIZES FOR THE FOUR MOST COMMON SPECIES OF PINNIPEDS OBSERVED** IN THE **NAVARIN** BASIN DURING SPRING 1982.

animals were observed from the vessel in open water, compared to the spring when almost all of the animals were observed from the helicopter on ice. A total of 5,647 nm were surveyed from vessel and helicopter over these three seasons (Appendix Figures 1-6 illustrate the locations of the survey tracklines and animals).

SEASONAL ICE PERIOD

Composition and Relative Abundance

The seven species of pinnipeds found in the Bering Sea were observed in the marginal ice front of the Navarin Basin during the winter survey (Table 2, Figure 8). Over 75 percent of the 1,670 animals recorded along the 2,410 nm censused were walruses (52 percent) and northern sea lions (24 percent). Of the 310 seals encountered, 78 percent were spotted seals, followed by ribbon, bearded, ringed, and fur seals in their order of decreasing relative abundance. Eighty-six animals, primarily seals, were not identified to species because most of them were briefly seen in the water. Approximately 65 percent of the pinnipeds were recorded during aerial surveys, which represented 68 percent of the total survey effort.

Group sizes of pinnipeds were quite variable (Figure 9). Average group sizes were largest for walruses (6.9+1.4 standard error) and smallest for ribbon seals (1.3±0.2). Spotted seals and northern sea lions were recorded in groups averaging 6.3+3.6 and 5.9±0.8 animals, respectively. Spotted seal groups were the most variable, occasionally occurring in large but loose aggregations, while ribbon seal group sizes were consistently small. Spotted seal group sizes were considerably smaller (1.2 ± 0.1) in the spring during the birthing period. Although the large groups of walruses typically associated with the spring (Fay 1981) were not observed, group sizes of the other pinnipeds were similar to those reported by Burns and Harbo (1977). The sex or age composition of the groups was not determined, but eight newborn walruses, recorded between 25 February and 7 March, were observed primarily with single adults, presumably their mothers. The

TABLE 2

NUMBER OF SEALS, SEA LIONS, AND WALRUSES OBSERVED DURING THE WINTER AERIAL AND VESSEL SURVEYS OF THE NAVARIN BASIN, 19 FEBRUARY-18 MARCH, 1983

Sampling Unit	Trackline distance surveyed			Spotted seal		Ribbon seal		Bearded seal		Ringed seal		N. fur seal		N. sea lion		N. Pacific walrus		Unidentified pinniped		Total	
	Aerial (%)	Vessel (%)	Total (nm)	No. Groups	No. Indiv.	No. Groups	No. Indiv.	No. Groups	No. Indiv.	No. Groups	No. Indiv.	No. Groups	No. Indiv.	No. Groups	No. Indiv.	No. Groups	No. Indiv.	No. Groups	No. Indiv.	No. Groups	No. Indiv.
24	0	100	147	2	4	--a/	--	1	1	--	--	--	--	3	7	25 c/	42	7	12	38	66
25	82	18	462	1 b/	1	5	5	--	--	--	--	--	--	-- b/	--	43 c/	198	17	18	66	222
26	71	29	613	4 b/	15	12 c/	45	6	6	--	--	--	--	8 b/	26	64 c/	556	24	26	118	674
27	83	17	482	4	37	3 b/	6	--	--	--	--	1	1	10	34	5 b/	33	3	3	26	114
28	80	20	466	3 b/	3	2 b/	2	--	--	--	--	--	--	36	324	-- b/	--	7	7	48	336
29	23	77	240	28 c/	181	-- b/	--	1	1	2	2	--	--	12	15	10	39	15	20	68	258
TOTAL	68	32	2410	42	241	22	58	8	8	2	2	1	1	69	406	?47	868	73	86	364	1670

a/ Dash (--) signifies no animals.
b/ Significantly fewer observed than expected ($p<0.05$).
c/ Significantly more observed than expected ($p<0.05$).

4486A

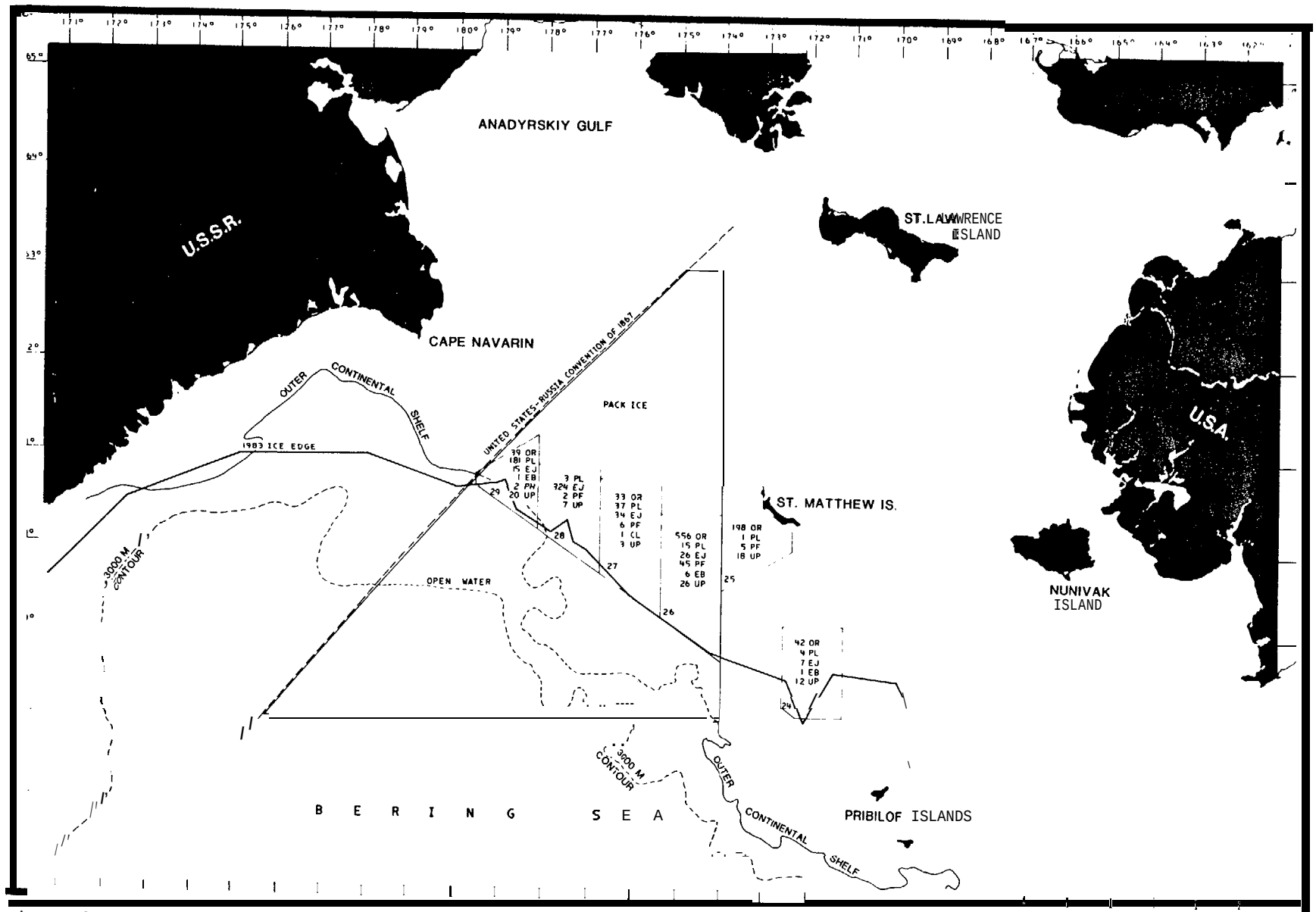


Figure 8 DISTRIBUTION OF **PINNIPEDS** RECORDED IN **NAVARIN BASIN DURING WINTER, FEBRUARY 19-MARCH 18, 1983.** (In appendices see Figures A-8 through A-ll, Figures B-7 through B-11, and Table B-1.)

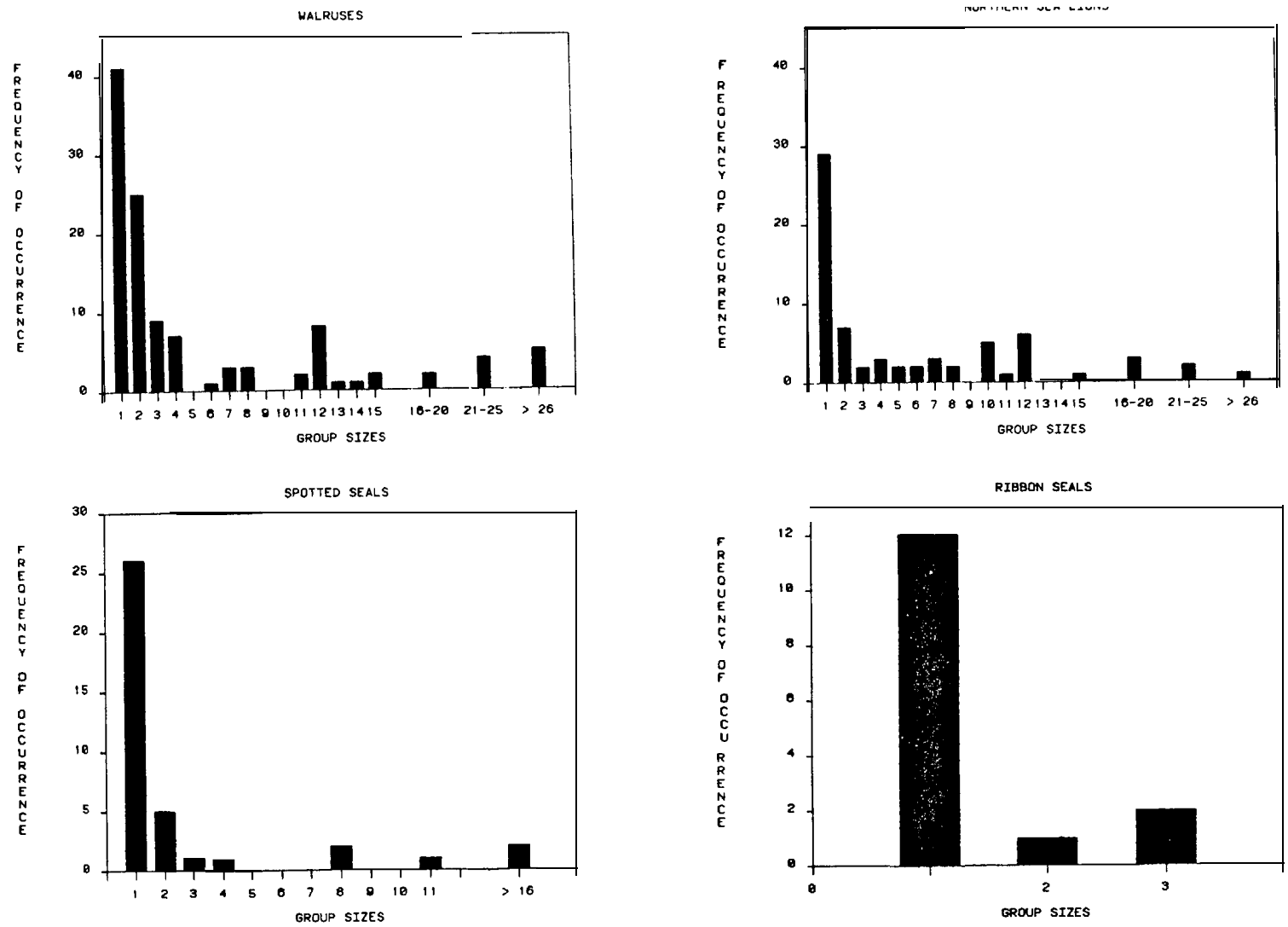


FIGURE 9 **FREQUENCY DISTRIBUTION OF GROUP SIZES FOR THE FOUR MOST COMMON SPECIES OF PINNIPEDS OBSERVED IN THE NAVARIN BASIN DURING WINTER, 1983.**

earliest previously recorded birth date of walruses was 15 April (Fay 1981) . However, the pups may have been yearlings since the two age classes are difficult to distinguish without close physical inspection. No other species of newborn seals were observed because birthing periods of ice seals occurred after completion of our surveys and sea lions or fur seals birth on land outside the Basin. Group characteristics of the other species were not examined because too few animals were recorded, and only animals observed on the ice were included for the four species analyzed.

Distribution

Pinnipeds differed in their spatial distribution across the ice front and into the pack ice from the ice edge or open water (Figure 10). Spotted seals were the most widely distributed species in the ice front. They occurred in every unit, but were especially abundant in Unit 29, where observed numbers significantly ($p<0.05$) exceeded expected numbers (Appendix A, Table A-4). Ribbon seals, the most narrowly distributed species, occurred in the four units centrally located in the ice front. They were particularly abundant in Unit 26, where the number observed was significantly ($p<0.05$) greater than expected. Although walruses and northern sea lions were encountered in 5 of the 6 units, the distribution of each species spanned the entire front. Walrus use was significantly ($p<0.05$) greater than expected in the three eastern units, as was sea lion use ($p<0.05$) in Unit 28 of the front. Although there were too few observations of the other species to assess distribution, bearded seals were sporadically observed across the entire ice front. These results identify that pinnipeds were widespread in the ice front, and furthermore, certain areas were preferentially used by each species, which generally did not overlap.

In addition to having specific distribution patterns across the ice front, pinnipeds were differentially spaced from the ice edge (Figure 11). The average distance from the ice edge was significantly different ($P<0.05$; 3,274 df; $F=149.40$) among northern sea lions, walruses, spotted seals, and ribbon seals. Northern sea lions were

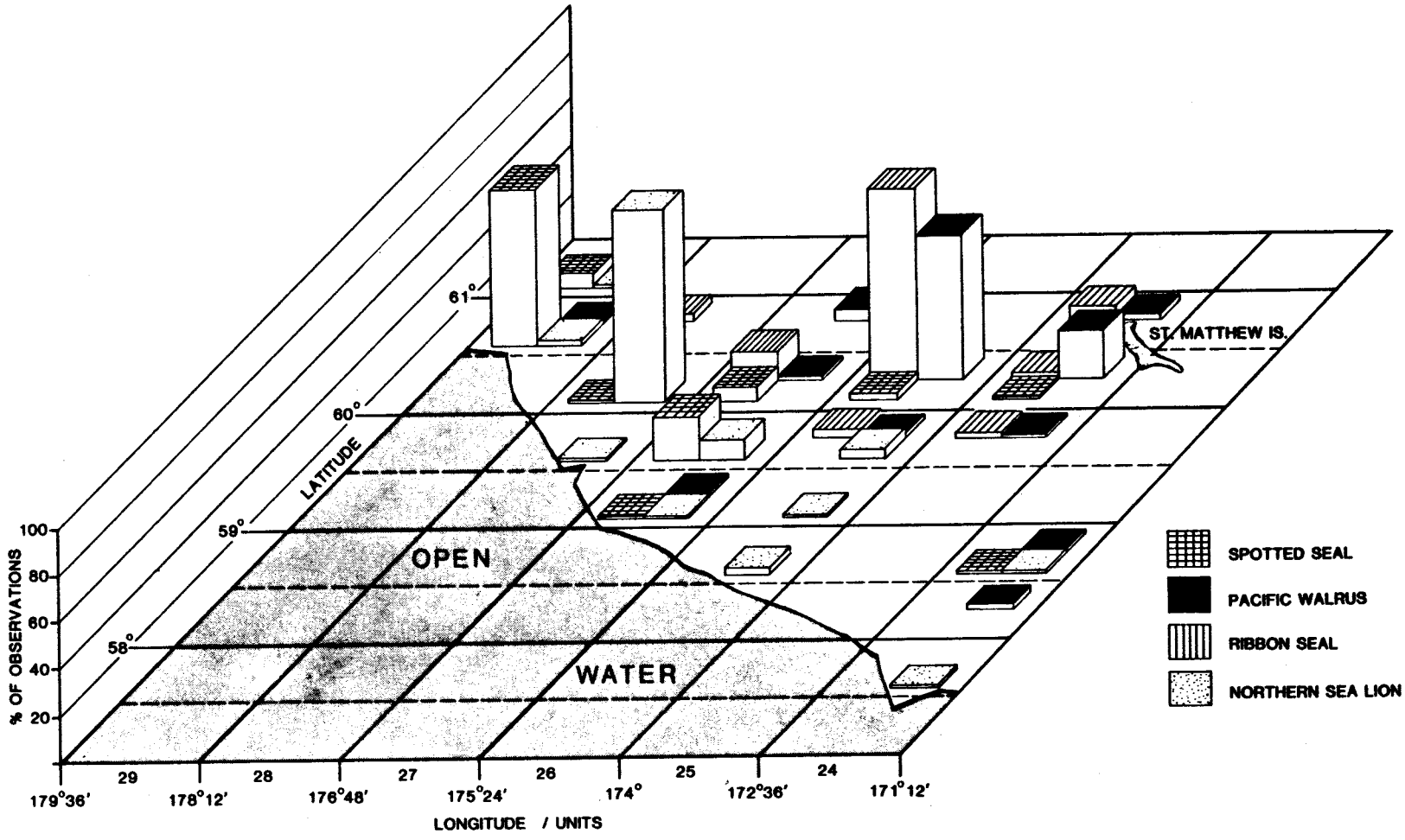


FIGURE 10 **DISTRIBUTION OF THE FOUR MOST COMMON PINNIPEDS OBSERVED IN THE MARGINAL ICE FRONT DURING WINTER, 1983.**

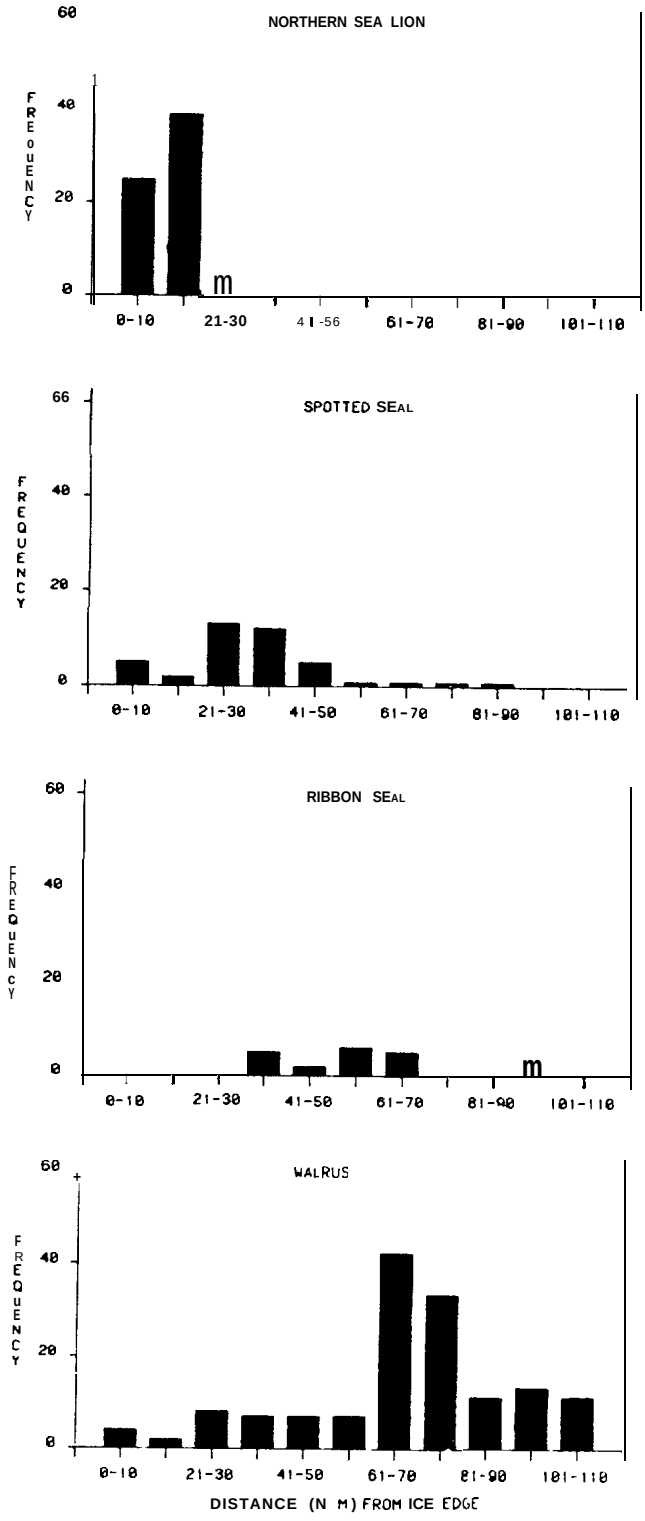


FIGURE 11 **DISTANCE** FREQUENCIES OF NORTHERN SEA LIONS, SPOTTED SEALS, **RIBBON SEALS,** AND WALRUSES INTO **THE** PACK ICE FROM THE **EDGE** OF MA **RGINAL** ICE FRONT DURING WINTER **1983.**

closest (12.5 nm±0.8 standard error) and walruses farthest (67.4 nm±1.9) from the ice edge. Distributed between these two species were the spotted (30.5 nm±2.7) and ribbon (60.5 nm±4.2) seals, although ribbon seals were considerably deeper into the pack ice. Walruses were found over the greatest range of distances and sea lions the narrowest range, suggesting that while each species concentrated at certain distances from the edge, the adaptability of sea lions to penetrate into the pack ice is more limited than for walruses or the other pinniped -species examined. Too few sightings were recorded of the other species to analyze.

Ice Characterization and Use

The spatial distribution of pinnipeds is influenced by ice. Ice provides pinnipeds a platform for birthing, breeding, and molting (Burns et al. 1980). Pinnipeds may select certain ice conditions to accomplish these biological events. In order to evaluate the role of ice in the life cycle of pinnipeds, measurements were made of ice coverage, floe size, and ice thickness. A description of these ice conditions and their use by pinnipeds is provided below.

Ice coverage in the Basin was more extensive than average (Figure 12). The approximate ice edge, which was located south of the 1954-70, 16 year mean (Potocsky 1975), followed the outer continental slope. This resulted in pack ice covering approximately half of the Navarin Basin. The marginal ice front, a transition zone between the irregular southern margin of the main pack ice and the heavier consolidated pack ice (Burns et al. 1980), ranged between 30 and 100 nm in width in the study area. Ice coverage in the marginal ice front was 76 percent during the winter survey (Table 3). Pack ice coverage increased from 68 percent in the most western Unit 29 to approximately 80 percent in the eastern Units 24 and 25. One-way ANOVA (following arcsine transformation) indicated that ice coverage among units was significantly different ($p<0.001$; 5,837 df; $F=14.78$). Ice in the western units was more broken and featured relatively large proportions of area in the lower ice concentration and floe size classes but the

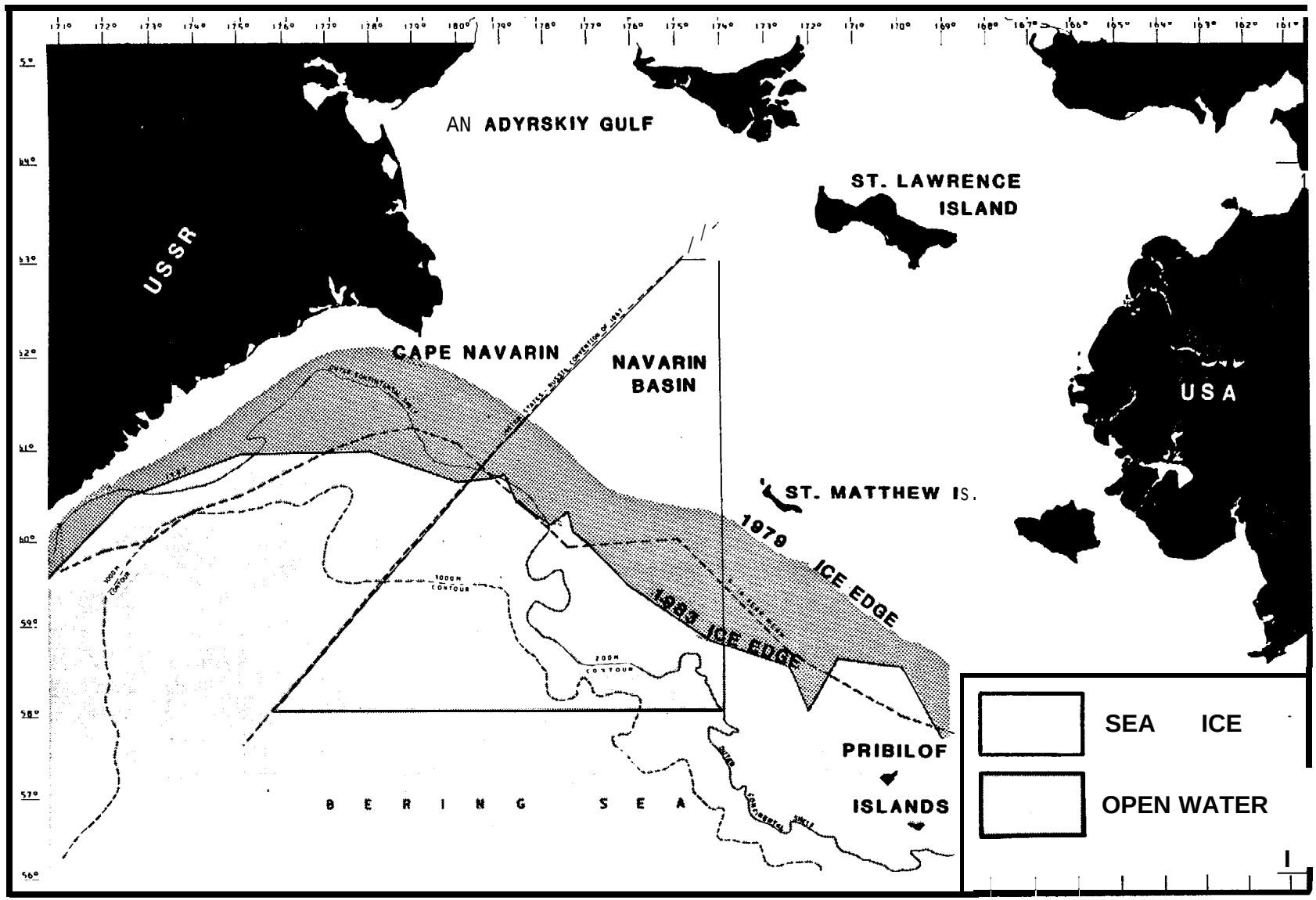


Figure 12 APPROXIMATE LOCATION OF ICE EDGE DURING 1979 AND 1983 STUDY PERIODS COMPARED TO A 5-16 YEAR MEAN (Potocsky 1975) IN THE NAVARIN BASIN.

TABLE 3

ICE CHARACTERISTICS OF STUDY AREA, 19 FEBRUARY - 18 MARCH, 1983[a/]

Sampling unit	Percent area coverage of ice	Percent area (nm^2) coverage of each ice concentration category					Percent area coverage[b/] of each ice size category				Percent area coverage of each ice thickness category			Total area surveyed (nm^2)
		0-20	21-40	41-60	61-80	81-100	Grease-slush	Pancake-small	Medium-large	Vast-giant	New	Young	First year	
24	79.0	2.0	7.1	15.1	25.3	50.5	4.8	4.5	5.6	85.1	19.1	11.7	69.2	73.4
25	80.5	0.6	4.5	12.8	35.7	46.4	17.3	0.0	8.8	73.9	28.2	45.6	26.2	231.2
26	78.5	2.0	3.8	19.4	25.9	48.9	17.1	5.2	15.7	62.0	17.9	55.6	26.5	306.4
27	71.5	9.3	3.9	21.9	23.8	41.1	2.7	59.2	20.0	18.1	1.9	30.3	67.8	240.9
28	75.7	3.0	3.5	18.1	38.4	37.0	4.1	24.0	30.8	41.1	0.6	29.5	69.9	233.0
29	68.2	11.7	13.5	12.2	24.2	38.4	3.9	40.2	15.8	40.1	1.7	35.0	63.3	119.9
TOTAL	75.9	4.4	5.1	17.3	29.6	43.6	10.0	21.0	17.4	51.6	11.8	38.8	49.4	1204.8

a/ Ice characteristics are defined in Appendix Table A-2.

b/ Ice size was calculated as a proportion of total ice coverage.

4486A

ice was thick. Conversely, ice in the eastern units was relatively thin but more concentrated, as evidenced by the presence of large amounts of areas in the higher ice concentration and floe size classes.

Pinnipeds occurred in a variety of ice conditions (Figure 13). Chi-square analysis (Appendix A, Table 5) identified that walruses preferred ($p<0.05$) areas of new ice and grease to slush floes, but indiscriminately ($p>0.05$) used areas of 20 to 100 percent ice coverage. Seventy-five percent of the animals, however, were recorded in the higher ice coverage areas (60 to 100 percent). Significantly fewer ($p<0.05$) walruses were associated with the intermediate floe sizes (pancake to large floes) and first year ice. Northern sea lions used areas of different ice thicknesses in proportion to their availability, but they were more abundant than expected ($p<0.05$) in areas with grease to small floes (pooled) and 0 to 60 percent ice coverage (pooled); use was particularly high in the areas with pancake to small floes (pooling of certain ice classes was necessary to obtain sample sizes sufficient to perform Chi-square analysis for sea lions and spotted seals, Appendix A, Table 6). Conversely, areas of high ice coverage (80-100 percent) and large floe sizes (medium to giant) received significantly ($p<0.05$) low use by sea lions. Spotted seal occurrence in ice was most similar to northern sea lions. Areas of 20 to 60 percent (pooled) ice coverage and first year ice were preferred ($p< 0.05$) by spotted seals. while they occurred in areas of new and young ice (pooled) and 81 to 100 percent ice coverage in numbers significantly ($p<0.05$) less than expected (Appendix A, Table 7). Although there was no significant ($p>0.05$) use of specific floe sizes, spotted seals were most abundant in areas with pancake to small floes. Similar comparisons for the other pinniped species were not made because sample sizes were insufficient for analysis. These results suggest that while the species examined displayed wide use of pack ice, each species generally tended to have preferences and avoidances for particular ice conditions in the areas surveyed.

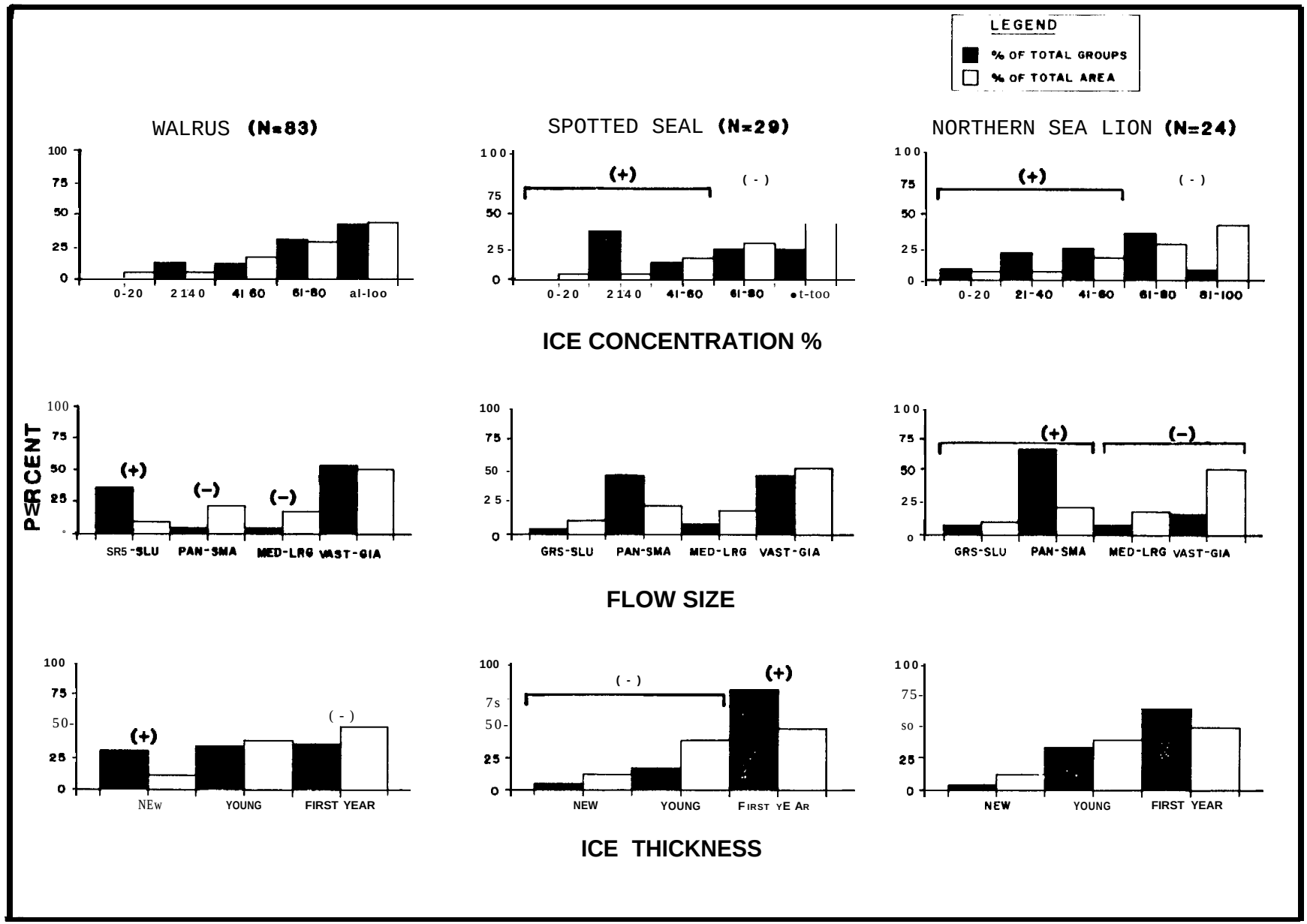


FIGURE 13 PERCENT OCCURRENCE OF PIN **NIPEDS** RELATIVE TO PERCENT AVAILABILITY OF ICE TYPES IN THE MARGINAL ICE FRONT : PLUS (+) SIGNIFIES SIGNIFICANT PREFERENCE, MINUS (-) SIGNIFIES SIGNIFICANT AVOIDANCE. **BRACKET (⌐¬)** SIGNIFIES **POOLEDDATA1983.**

Density

Density estimates of pinnipeds may be influenced by environmental conditions at the time of survey. Withrow (1982), Everett and Jeffries (1979), and others have shown that harbor seals and northern sea lions have definite haulout patterns correlated to time of day. Surveys conducted at off times produce biased estimates of density. Since ice-related pinnipeds may also show a similar pattern to time of day and be further influenced by wind chill during winter, we examined the influence of these environmental factors on our counts. Counts may also be influenced by vessel or helicopter noises; however, most of the animals we observed were counted before they reacted to the survey platforms.

The number of pinnipeds we observed on the ice was influenced by wind chill and possibly by time of day (Table 4). Seals as a group were observed on the ice in significantly ($p<0.05$) lower numbers during wind chill conditions colder than -30°C, while sea lions and walruses did not significantly ($p>0.05$) respond to wind chills reaching -50°C. Conversely, time of day did not significantly ($p>0.05$) influence number of seals seen on the ice but it was significantly ($p<0.05$) associated with sea lion and walrus counts. There was, however, no recognizable trend, suggesting sample size may have been too small or these species have no predictable haulout patterns during the winter season. Because of the effect of wind chill on seal counts, density estimates were derived for seals and areas surveyed under wind chills warmer than -30°C for all times of day, while sea lion and walrus densities were calculated without concern to wind chill or time of day.

The stratified estimated density of pinnipeds in the marginal ice front was 27.33 animals per 100 nm^2, representing an estimated 4,477 seals, sea lions, and walruses (Tables 5, 6). Walrus and spotted seal estimated densities were over 75 percent greater than for the other species. Walrus densities were highest in the eastern half of the ice front while spotted seals densities were highest in the western half of the front. Density estimates for the other species ranged between 0.09

TABLE 4

CHI-SQUARE GOODNESS-OF-FITTEST COMPARING HAULOUT PATTERNS OF SEALS (SPOTTED, RIBBON, BEARDED, AND RINGED SEALS), SEA LIONS, AND WALRUSES TO TIME OF DAY AND WINDCHILL

Time interval	Distance surveyed (rim)	Seals		Sea lions		Walruses	
		Observed number groups	Expected number groups	Observed number groups	Expected number groups	Observed number groups	Expected number groups
0800-1000	648	4	9.9	6	11.0	5	18.7
1000-1200	935	15	14.2	37	15.9	13	27.1
1200-1400	973	13	14.8	13	16.5	29	28.2
1400-1600	727	15	11.1	3	12.4	16	21.0
1600-1800	580	10	8.8	8	9.9	33	16.8
1800-1900	77	3	1.2	0	1.3	18	2,2
Total	3940	60	60.0 $x^2=8.01$ $p>0.10$	67	67.0 $x^2=39.81$ $p<0.001$	114	114.0 $x^2=147.68$ $p<0.001$

Wind chill interval (°C)	Distance surveyed (nm)	Seals		Sea lions		Walruses	
		Observed number groups	Expected number groups	Observed number groups	Expected number groups	Observed number groups	Expected number groups
-lo to -19	355	15	5.4	8	6.5	4	10,3
-20 to-29	1311	35	20.0	16	24.0	44	37.9
-30 to -39	1999	10	34.6	43	36.5	61	57.8
-40 to -49	275					5	8.0
Total	3940	60	60.0 $x^2=42.89$ $p<0.001$	67	67.0 $x^2=4.17$ $p>0.10$	114	114.0 $x^2=6.14$ $p>0.10$

TABLE 5

ESTIMATED DENSITY (per 100 nm²) OF SEALS, SEA LIONS, AND HALRUSES IN THE MARGINAL ICE FRONT OF THE NAVARIN BASIN DURING WINTER, FEBRUARY-MARCH 1983

Sampling unit	Total area (nm²)	Area coverage: Aerial % a/	Aerial % b/	Vessel % a/	Vessel % b/	Total % a/	Total % b/	Spotted seal N c/	Spotted seal Den.	Ribbon seal N	Ribbon seal Den.	Bearded seal No. c/	Bearded seal Den.	Unidentified pinniped No. c/	Unidentified pinniped Den.	Northern sea lion No. c/	Northern sea lion Den.	Pacific walrus No. c/	Pacific walrus Den.	Total No. c/	Total Den.
24	2924	0.00	0.00	0.09	2.51	0.09	2.51	--d/	--	--	--	--	--	--	--	--	--	12	16.33	12	16.33
25	2381	0.71	7.98	0.00	1.73	0.71	9.71	--	--	--	--	--	--	--	--	--	--	60	25.95	60	25.95
26	3731	2.43	5.81	0.78	2.40	3.21	8.21	4	3.34	2	1.67	--	--	6	5.02	12	3.92	70	22.85	94	36.80
27	3429	5.83	5.84	0.66	1.19	6.49	7.03	34	15.27	6	2.70	--	--	2	0.90	1	0.42	31	12.87	74	32.16
28	2443	1.86	7.69	0.84	1.94	2.70	9.63	--	--	--	--	--	--	3	4.55	21	8.93	--	--	24	13.48
29	1474	1.91	1.91	5.26	6.27	7.17	8.18	25	23.65	--	--	1	0.95	4	3.78	2	1.66	11	9.12	43	39.16
Total	16,332	2.32	5.02	0.93	2.35	3.25	7.37	63	11.83±9.15	8	1.50±1.57	1	0.19±0.31	15	2.81±2.29	36	2.98±2.97	184	15.24±11.59	307	34.55
Stratified								63	6.09	8	0.95	1	0.09	15	2.35	36	2.45	184	15.40	307	27.33

a/ Percent area surveyed for seals and unidentified pinnipeds during wind chill conditions warmer than -30°C.
b/ Percent area surveyed for sea lions and walruses.
c/ Number of animals in strip.
d/ Dash (--) signifies no animals.

4486A

TABLE 6

ESTIMATED ABUNDANCES AND 95% CONFIDENCE INTERVALS FOR SEALS, SEA L1ONS, AND WALRUSES IN THE MARGINAL ICE FRONT OF THE NAVARIN BASIN DURING MINTER, FEBRUARY-MARCH, 1983[a/]

Sampling unit	Spotted seal	Ribbon seal	Bearded seal	Unid. seal	Northern sea lion	Pacific wal rus	Total
24	- [b/]					477	477
25						618	618
26	125	62		187	146	853	1,373
27	524	93		31	14	441	7,103
28				111	218		329
29	349	___	14	56	24	134	577
Total	1,938±1474	246±253	31±50	460±371	488±468	2,497±1,827	5,660
Strat-ified	998±861	155:199	14±19	385±336	402±396	2,523±2,050	4,477

a/ Abundance was calculated for animals in the survey strip during acceptable wind chill conditions. Numbers were derived by multiplying the estimated density times the unit area (Table 5).

b/ Dash {-) signifies no animals.

4486A

for bearded seals and 2.45 animals per 100 nm^2 for northern sea lions. Estimated densities for these species within the ice front were difficult to evaluate because of small sample sizes, except for sea lions, which were most dense in the western third of the front. In general, pinniped densities were highest in the portion of the ice front corresponding to the Navarin Basin proper (Units 26-29). Indices of abundance for the pinnipeds in the marginal ice front were estimated at 2,523 walruses, 998 spotted seals, 402 northern sea lions, 155 ribbon, and 14 bearded seals. These estimates were based on a survey coverage of 7.4 percent for sea lions and walruses and 3.3 percent for seals. Since they do not account for animals in the water or missed, the estimates should be considered conservative and as an index and not an absolute value of abundance. Confidence intervals around the estimates were wide because of small sample sizes.

1979 SURVEY

Composition and Relative Abundance

Six species of pinnipeds were observed in the Bering Sea pack ice during early spring (Table 7, Figure 14). Over 91 percent of the 2,909 pinnipeds recorded along the 4,342 nm censused were walruses. Of the remaining 238 animals observed, approximately 55 percent were bearded seals followed by spotted, ringed, ribbon, and northern sea lions. Sixty-three pinnipeds were not identified to species. All of these animals were recorded during aerial surveys.

Group sizes of pinnipeds were quite variable (Figure 15). Average group size was largest for walrus (10.0 ± 27.0, standard error) and nearly identical for spotted (1.5 ± 0.7), bearded (1.2 ± 0.7), ringed (1.1 ± 0.3), and ribbon (1.0 ± 0.0). Although walrus group sizes ranged between 1 and 280 animals over 70 percent of the walrus group sizes were between 1 and 5 animals. Too few sea lions were recorded

TAME 7

NUMBER OF SEALS, SEA LIONS, AND WALRUSES OBSERVED DURING THE EARLY SPRING AERIAL SURVEYS OF THE BERING SEA, MARCH-APRIL, 1979 a/

Zone	Sampling Unit	Trackline Distance Surveyed (rim)	Spotted Seal No. Group	Spotted Seal No. Indiv.	Ribbon Seal No. Group	Ribbon Seal No. Indiv.	Bearded Seal No. Group	Bearded Seal No. Indiv.	Ringed Seal No. Group	Ringed Seal No. Indiv.	Northern Sea Lion No. Group	Northern Sea Lion No. Indiv.	N. Pacific Walrus No. Group	N. Pacific Walrus No. Indiv.	Unidentified Pinniped No. Group	Unidentified Pinniped No. Indiv.	Total No. Group	Total No. Indiv.
NORTHERN	9	278 (134)	--b/	--	--	--	9	9	--	--	--	--	12	28	1	1	22	38
	10	315 (243)	--	--	--	--	--	--	--	--	--	--	3	4	--	--	3	4
	11	414 (274)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12	382 (287)	--	--	--	--	4	4	1	1	--	--	25	92	3	3	33	100
Subtotal		1,389 (938)	--	--	--	--	13	13	1	1	--	--	40	124	4	4	58	142
CENTRAL	13	353 (256)	3	3	1	1	80	97	6	6	--	--	47	566	12	13	149	686
	14	397 (312)	1	2	--	--	--	--	--	--	--	--	5	6	--	--	6	8
	15	384 (273)	5	8	--	--	14	18	7	8	--	--	21	235	18	21	65	290
Subtotal		1,134 (841)	9	13	1	1	94	115	13	14	--	--	73	807	30	34	220	984
SOUTHERN	24	174 (98)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	25	333 (217)	--	--	--	--	--	--	--	--	--	--	11	20	1	1	12	21
	26	456 (332)	--	--	6	6	4	4	--	--	1	2	85	387	7	7	103	406
	27	479 (284)	--	--	1	1	--	--	--	--	--	--	36	1,002	6	6	43	1,009
	28	377 (256)	2	4	1	1	--	--	--	--	--	--	22	331	5	11	30	347
Subtotal		1,819 (1,187)	2	4	8	8	4	4	--	--	1	2	154	1,740	E!	25	188	1,783
TOTAL		4,342 2,966	11	17	9	9	111	132	14	15	1	2	267	2,671	53	63	4662,909	

a/ Distances and observations are for systematic and non-systematic surveys; systematic survey distances are in Parentheses.
b/ Dash (--) signifies no animals

7539A

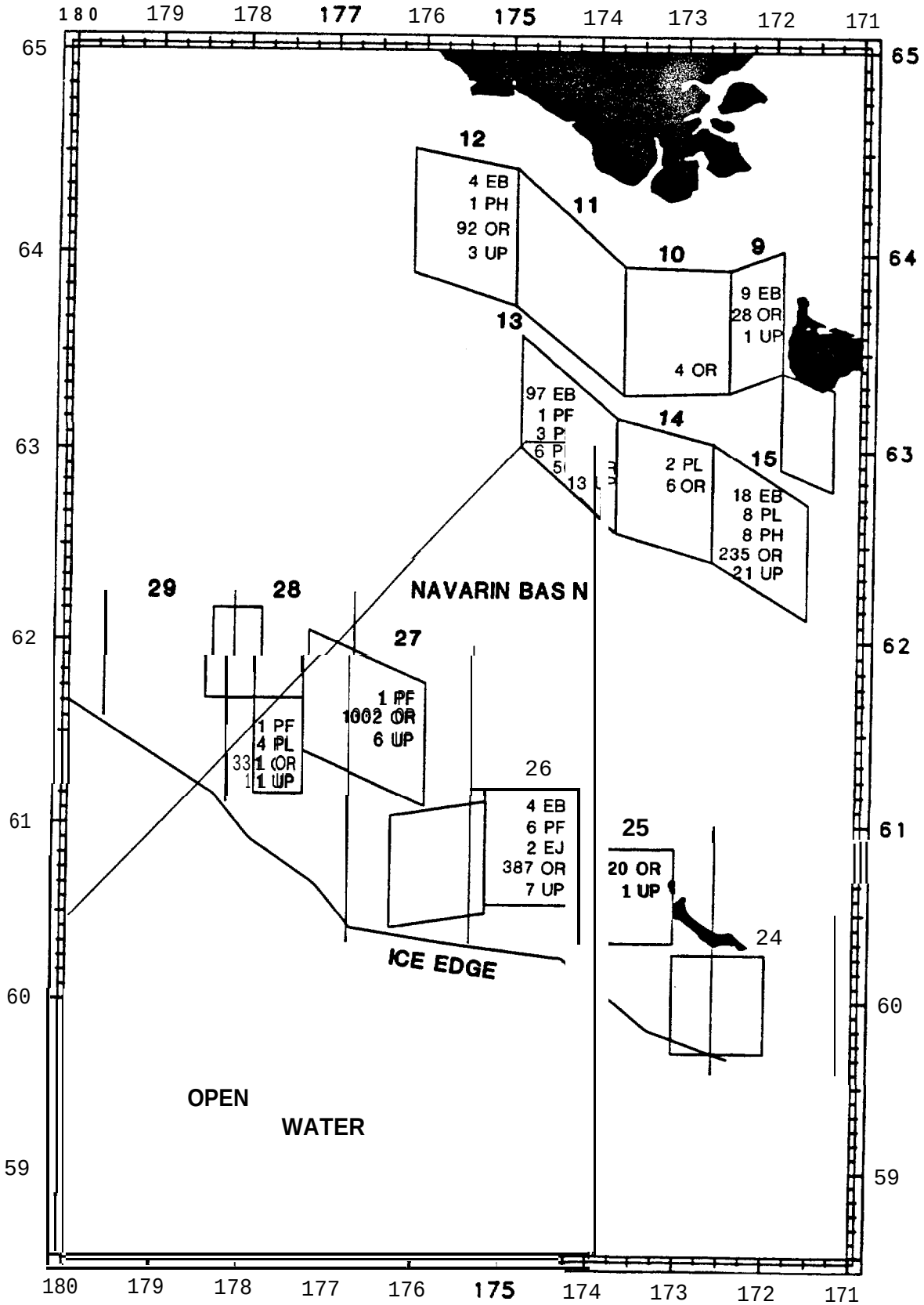


Figure 14 Distribution of pinnipeds recorded in the Bering Sea during early spring, 1979.

(SEE PAGE 93 FOR ABBREVIATION DEFINITIONS.)

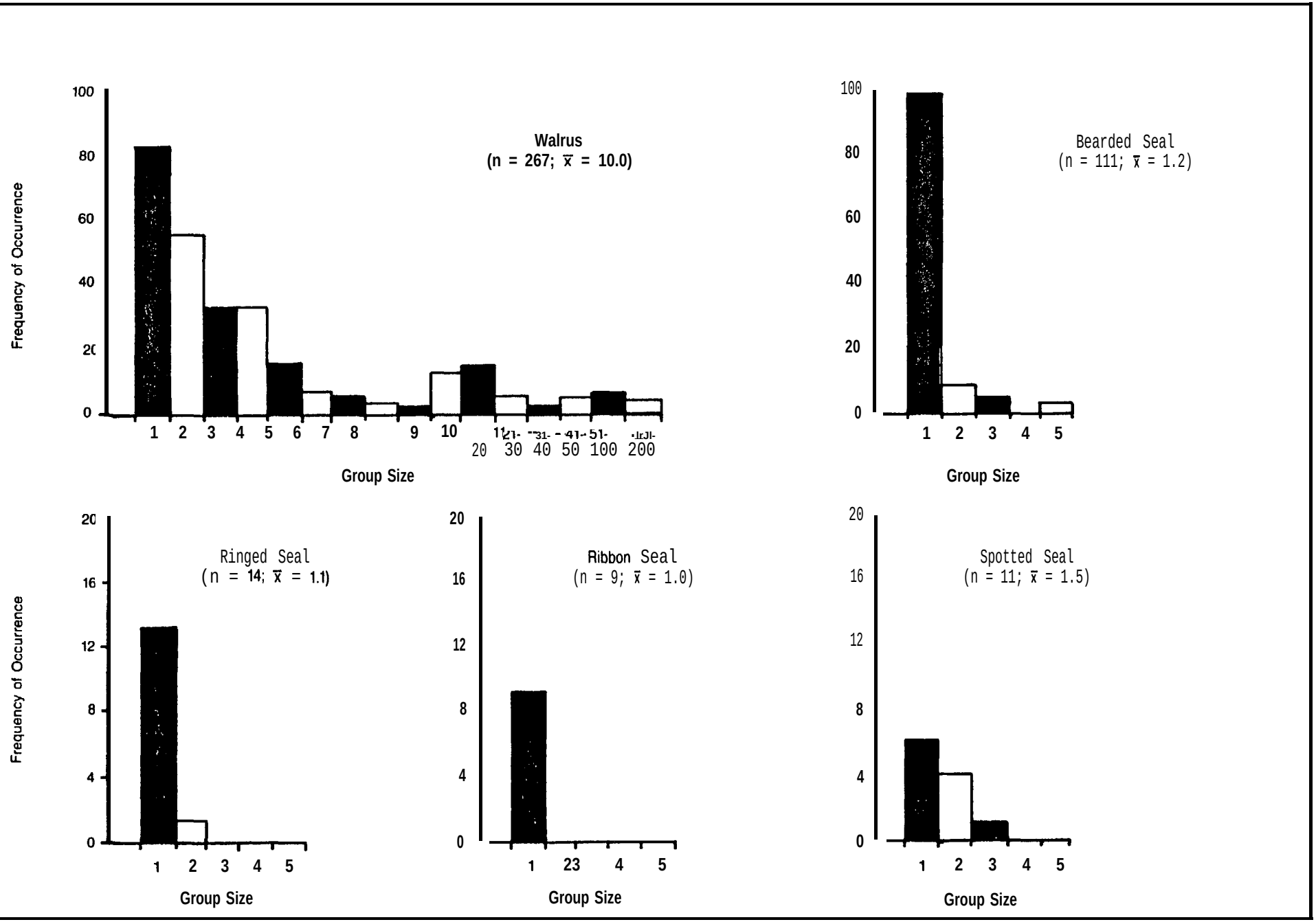


Figure 15 Frequency distribution of group sizes for the common species of pinnipeds observed in the pack ice during early spring, 1979.

to meaningfully determine the group size. Group sizes of these pinnipeds were similar to those reported by Fay (1981) and Burns and Harbo (1977). Ten newborns were recorded in these groups of which there were five walrus, three spotted, one ringed, and one bearded seal (Table 8). These newborns were observed between 15 March and 12 April which fall within the birthing period reported for these species (Burns, 1970). The walrus pups may have been yearlings since the two age classes are difficult to differentiate without physically inspecting the animals.

Distribution

The spatial distribution of pinnipeds was highly variable among zones (Figure 16). Walrus were the most widespread species. They occurred in 10 of the 12 units in the 3 zones which included: 3 of 4 units in the northern zone, the 3 units in the central zone, and 4 of 5 units in the southern zone. Walrus use was higher in the southern and central zones than in the northern zone. Walrus use of the southern zone or marginal ice front was greatest in the western Units 26, 27, 28, and particularly high in Unit 27. Use of all the other units was low except for Units 13 and 15 of the central zone where it was intermediate.

Bearded seals were the second most widespread pinniped species (Figure 16). They occurred in 5 of the 12 units in the 3 zones which included 2 of 4 units in the northern zone, 2 of 3 units in the central zone, and 1 of 5 units in the southern zone. Bearded seal use of these zones was highest in the central zone and lowest in the southern zone. Use was over five times greater in Unit 13 of the central zone than in the other units.

The distribution of the spotted, ribbon, ringed seal and northern sea lion was unclear because of the small number of observations. Spotted and ribbon seals, however, were entirely in the central and southern zones. Spotted seals were more prevalent in the central zone whereas

TABLE 8

NUMBER AND DATES OF NEWBORN PINNIPEDS OBSERVED IN THE BERING SEA PACK ICE DURING EARLY SPRING, 1979[a/]

Number	Species	Date
1	Walrus	March 15
1	Walrus	March 15
1	Walrus	March 24
2	Walrus	April 7
1	Bearded Seal	April 7
1	Spotted Seal	April 12
1	Spotted Seal	April 12
1	Spotted Seal	April 12
1	Ringed Seal	April 12

a/ Walrus pups were not physically inspected; therefore, they may have been yearlings, which are difficult to distinguish from pups during the spring.

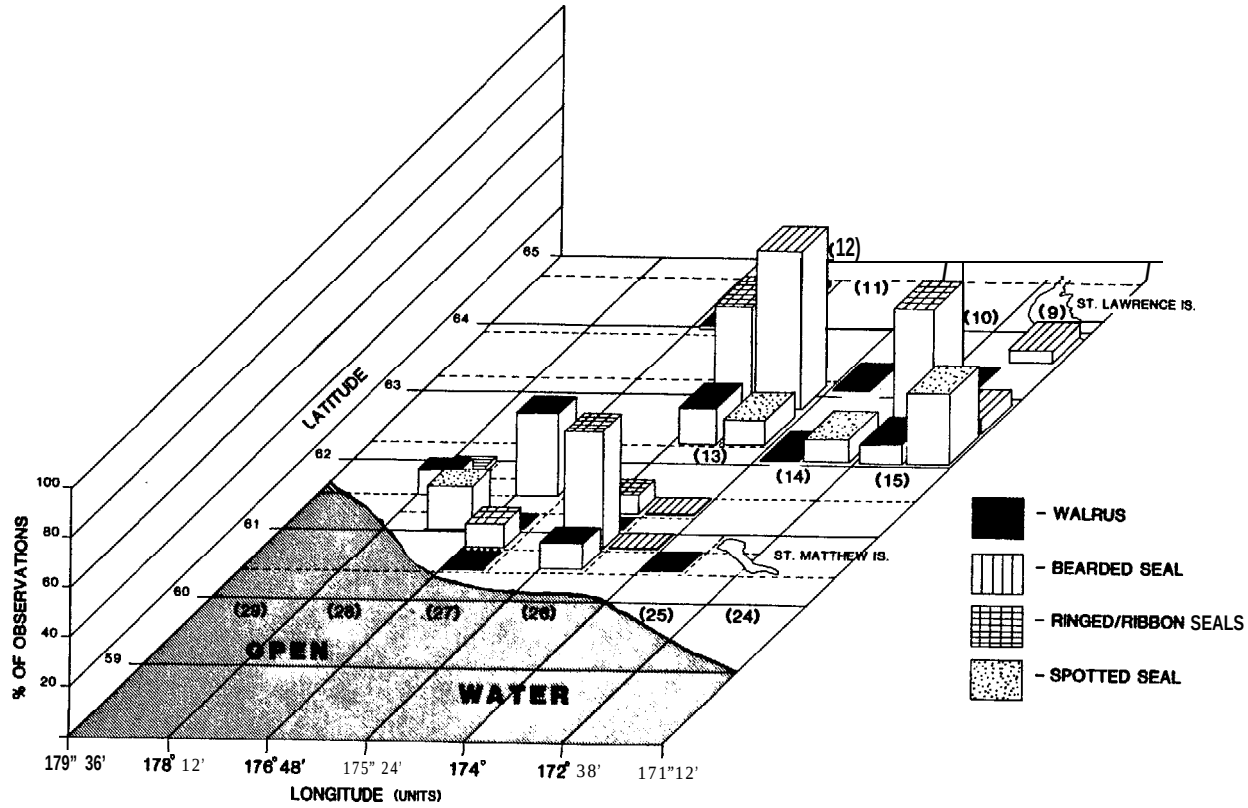


FIGURE 16 DISTRIBUTION OF PINNIPEDS MOST COMMONLY OBSERVED IN THE BERING SEA DURING EARLY SPRING, 1979.

ribbon seals were more abundant in the southern zone. Ringed seals were present in the northern and most abundant in the central zones. Two northern sea lions were observed in the southern zone.

These results identify that the central and southern zones supported the highest diversity of species. Walrus and bearded seals were the most widely distributed species. Walrus use was greatest in the southern and central zones, whereas bearded seal use was highest in the central zone. Use by the other species was less definite because of small sample sizes but in general, spotted and ringed seal use was highest in the central zone, and ribbon seal and northern sea lion use was highest in the southern zone.

Ice Characterization and Use

Ice coverage in the Bering Sea during 1979 was less extensive than average (Figure 12). The approximate ice edge, which was located north of the 1954-70, 16 year mean (Potocsky 1975), followed the outer continental slope.

Ice coverage in the three study area zones increased from approximately 64 percent in the southern zone to 75 percent and 85 percent in the northern and central zones, respectively (Table 9). Analysis of variance (following arcsine transformation) indicated that these differences were significant ($F=5.15$; 2, 9 df; $p < 0.05$). Correspondingly, ice in the southern zone was most broken, having large proportions of area in the lower ice concentration (0-25 percent, 26-50 percent) and size (grease-slush, pancake-small) categories. The northern zone contained moderately broken ice, with large proportions of area having medium to giant-sized floes in the higher ice concentration (51-75 percent) categories. In this zone ice concentration and size tended to increase from St. Lawrence Island west. The ice in the central zone was most compacted, having large amounts of area in the highest ice concentration (76-100 percent) and size (vast-giant) categories. Although pack ice during the study was farther north than usual, ice characteristics in the three zones were typical (Potocsky 1975).

TABLE 9

ICE CHARACTERISTICS OF STUDY AREA, 2 MARCH - 13 APRIL, 1979

Zone	Sampling Unit	Percent area coverage of Ice	Percent Area (nm^2) coverage of each ice concentration Coverage				Percent area coverage[a/] of each ice size Coverage.				Total area surveyed (nm^2)
			0-25	26-50	51-75	76-100	Grease-Slush	Pancake-Small	Medium-Large	Vast-Giant	
NORTHERN	9	66.3	0.0	12.0	83.1	5.0	11.0	37.9	34.5	16.6	66.9
	10	65.2	1.2	13.6	80.1	5.0	29.5	36.1	27.8	6.6	121.4
	11	80.3	0.0	0.0	53.7	46.3	0.3	12.3	33.5	53.9	137.1
	12	82.6	1.8	0.0	30.4	67.8	6.5	6.8	23.7	63.0	143.5
	Subtotal	75.1	0.9	5.2	57.6	36.3	10.3	19.0	29.1	41.6	468.9
CENTRAL	13	82.9	0.0	0.0	30.7	69.3	0.0	0.2	15.3	84.5	127.9
	14	84.8	0.0	1.6	17.0	81.4	0.0	0.2	5.8	94.0	156.1
	15	86.1	0.0	0.0	20.3	79.7	1.5	5.4	11.0	82.1	136.5
	Subtotal	84.6	0.0	0.6	22.2	77.2	0.5	1.9	10.4	87.2	420.5
SOUTHERN (Marginal Ice Front)	24	81.5	0.0	0.0	47.7	52.3	0.0	26.6	45.4	28.0	48.9
	25	57.8	9.4	39.0	27.5	24.2	22.8	19.7	35.7	21.8	108.5
	26	66.8	2.4	31.3	34.3	32.1	21.4	72.5	5.7	0.4	166.1
	27	63.3	11.0	25.6	35.3	28.0	50.6	14.3	3.5	31.6	142.1
	28	59.3	11.4	27.0	55.3	6.3	2.4	22.7	31.9	43.0	128.0
	Subtotal	63.9	7.5	27.8	38.9	25.8	22.5	35.2	19.5	22.8	593.6

a/ Ice size was calculated as a proportion of total ice coverage.

7539A

Pinnipeds occurred in a wide variety of ice conditions. Walrus were found in all ice concentration and floe size categories (Figure 17). Use was, however, higher than expected ($p<0.05$) in the intermediate ice concentration categories and lower than expected ($p<0.05$) in the other categories for the southern and central zones (Appendix B, Table 2). Walrus use of the different ice concentration categories in the northern zone was in proportion to their availability. Over 50 percent of the walrus were observed in areas of 50 to 100 percent ice coverage. The occurrence of walruses on floes of different sizes was statistically different but inconsistent among the zones (Appendix B, Table 3). Walrus numbers were, however, consistently high in the vast-giant floe size category except for in the southern zone where the highest numbers were in the pancake-small floe size category. These results show that walrus occurred in a wide variety of ice conditions but were most common in areas of higher ice concentrations and floe sizes typical of the inner pack ice. Similarly, the ice conditions primarily associated with walrus occurrences in the marginal ice front were characteristic of the interior of the front.

Bearded seals showed a preference for the intermediate ice concentration category (50-75 percent) and a slight avoidance for the 75-100 percent category (Figure 18). Almost 65 percent of the bearded seals were recorded in this latter category. There was no statistical significance associated with bearded seal use of different floe sizes, however, over 85 percent of the bearded seals were recorded in the vast-giant floe size (Appendix B, Table 4). These results substantiate the findings by other investigators that bearded seals inhabit the more concentrated pack ice where bigger floes are more prevalent. Similar comparisons for the other pinniped species were not made because sample sizes were insufficient for analysis. However, both the spotted and particularly the ringed seals were associated with areas in the higher ice concentration and floe sizes (Table 10). Ribbon seals were widespread in the different ice concentration and floe size categories but were more common in the higher ice concentrations and lower floe sizes.

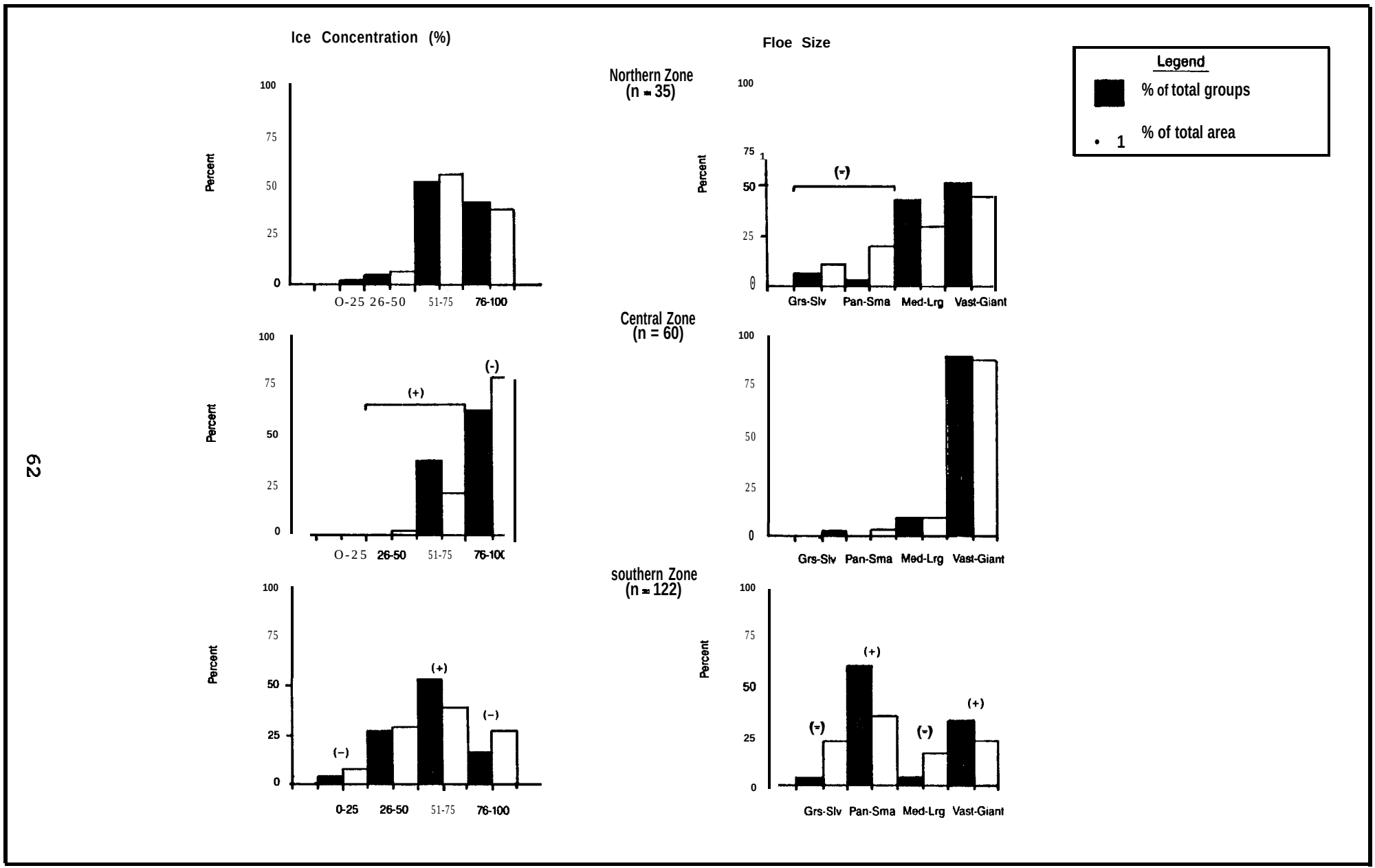
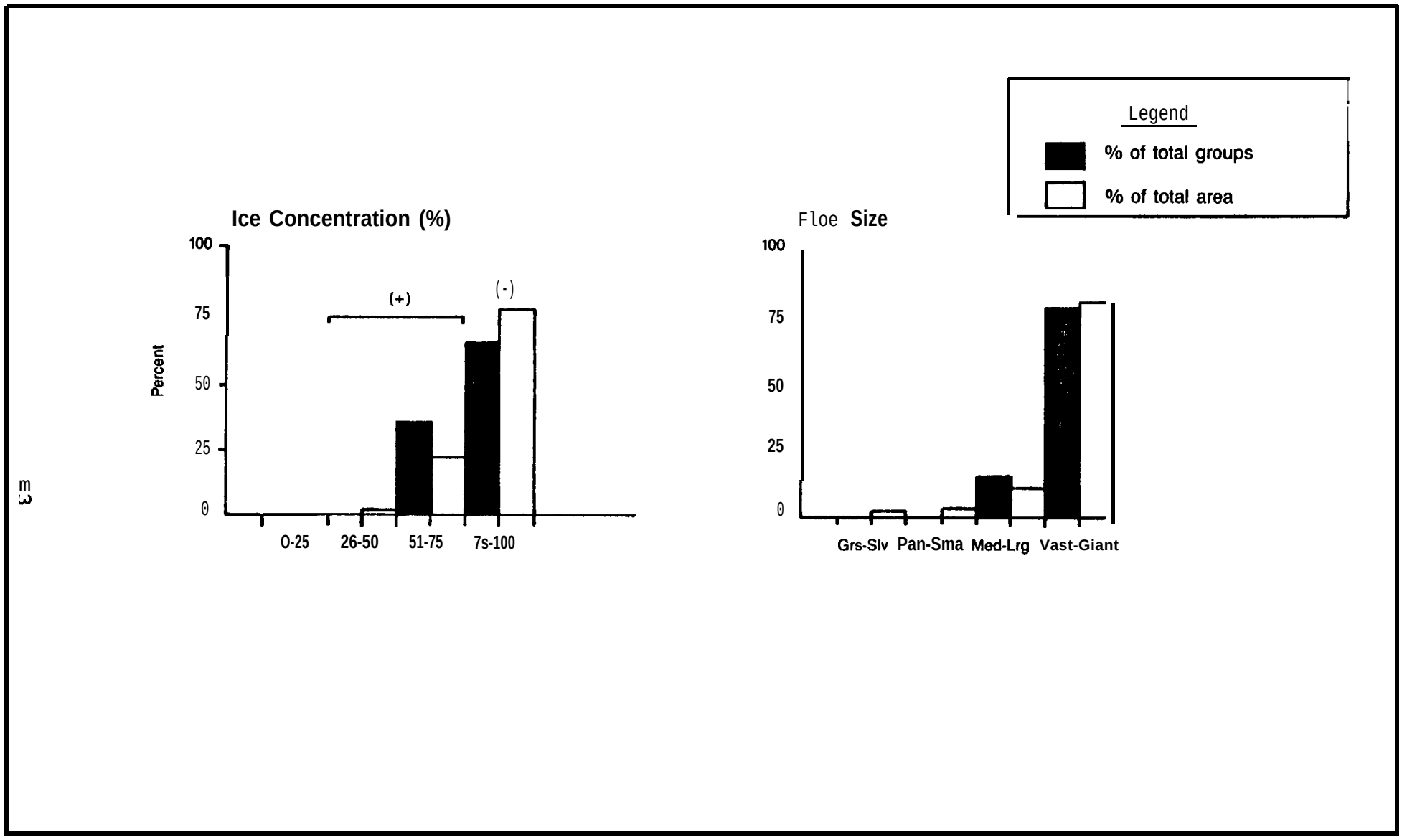


Figure 17 Percent occurrence of walrus relative to percent availability of ice types in the Bering Sea, 1979: plus (+) signifies significant preference; minus (-) signifies significant avoidance, brackets (¬) signifies pooled data.



m3

Figure 18 Percent occurrence of bearded seals relative to percent availability of ice types in the Bering Sea, 1979: plus (+) signifies significant preference; minus (-) signifies significant avoidance, bracket (⌐) signifies pooled data.

TABLE 10

NUMBER OF PINNIPED GROUPS OBSERVED IN EACH ICE CONCENTRATION AND FLOE SIZE CATEGORY OF THE PACK ICE IN THE BERING SEA DURING EARLY SPRING, 1979[a/]

Species	Ice Concentration Category				Floe Size Categories				Total
	0-25%	26-5(.)%	51-75%	/6-100%	Grease-Slush	Pancake-Smal 1	Medium-Large	Vast-Giant	
Ribbon seal	1	2	1	5	1	7	1	---	9
Ringed seal	--	--	1	8	--	--	1	8	9
Spotted seal	--	--	3	5	--	2	2	4	8

a/ Numbers are based on animal groups seen along systematic transect lines both in and out of strip.

b/ Dash (--) signifies no animal.

Density

The density of pinnipeds in the project area was estimated from 1,463 animals representing 192 groups encountered along 1,483 nm or 741 nm^2 surveyed (Table 11). Walrus densities were over 90 percent higher than any other species. They were highest in the central zone, lowest in the northern zone, and intermediate in the southern zone or marginal ice front. Walrus density was particularly high in Unit 27 of the marginal ice front and in Units 13 and 15 of the central zone. Densities for the other pinniped species were considerably lower and ranged from 0.39 ringed seals per 100 nm^2 to 4.20 bearded seals per 100 nm^2. Bearded, ringed, and spotted seals densities were highest in the central zone and ribbon seal densities were highest in the marginal ice front. Indices of abundance for the pinnipeds in the project area were estimated at 12,906 walruses, 512 bearded seals, 48 ringed seals, 40 spotted seals, and 27 ribbon seals (Table 12).

DISCUSSION

1982-83 SURVEY

Pinnipeds inhabited the Navarin Basin all year long. Use was greatest during the winter and spring when most pinnipeds are driven from more northern latitudes by the pack ice. The pack ice, particularly during the late winter and spring, provides pinnipeds a platform for resting, birthing, and molting. During the summer and fall when use of the Basin was lowest, the majority of pinnipeds had migrated northward or to coastal areas except for ribbons seals that probably summered over the shelf break (Burns 1970, 1981a). Although no ribbon seals were recorded in the Basin during these seasons, they may have been present but missed because phocid detection and identification in open water were difficult. The few sea lions and fur seals recorded were probably nonbreeding animals since these species occupy rookeries throughout the summer. Because of the low numbers of animals observed during the

TABLE 11

ESTIMATED DENSITY (PER 100nm2) OF SEALS AND WALRUSES IN THE PACK ICE OF THE BERING SEA DURING EARLY SPRING 1979 a/

Zone b/ Unit	Total Area (nm)2	Coverage	Spotted seal No.	Spotted seal Den.	Ribbon seal No.	Ribbon seal Den.	Bearded seal No.	Bearded seal Den.	Ringed Seal No.	Ringed Seal Oen.	Unidentified pinniped No.	Unidentified pinniped Den.	North Pacific walrus No.	North Pacific walrus Den.	Total No.	Total Oen.
NORTHERN																
9	960	6.97	--c/	--	--	--	--	--	--	--	--	--	--	--	--	--
10	%0	12.65	--	--	--	--	--	--	--	--	--	--	4	3.29	4	3.29
11	900	15.23	--	--	--	--	--	--	--	--	--	--	--	--	--	--
12	900	15.83	--	--	--	--	1	0. 70	--	--	2	1.39	23	16.03	26	18.25
Subtotal	3, 72D	12.60	--	--	--	--	1	0.21±0 .40	--	--	2	0.43±0.59	27	5.76*5.27	30	6.40
CENTRAL																
13	900	14.20	2	1.56	--	--	56	43.79	4	3.13	5	3.91	439	343.32	506	395.93
14	900	17.34	--	--	--	--	--	--	--	--	--	--	4	2.56	4	2.56
15	900	15.17	4	2.93	--	--	17	12.46	3	2.20	14	10.26	224	164.12	262	191.90
Subtotal	2,700	15.57	6	1.43±1.50	--	--	73	17.36*11.62	7	1.66±1.70	19	4.52±3.64	667	158.65*124.70	772	183.64
SOUTHERNb/																
24	480	10.19	--	--	--	--	--	--	--	--	--	--	--	--	--	--
25	1,320	8.22	--	--	--	--	--	--	--	--	--	--	16	14.75	16	14.75
26	1,200	13.84	--	--	1	0.60	--	--	--	--	--	--	2	1.20	3	1.81
27	1,800	7.89	--	--	1	0.70	--	--	--	--	4	2.82	613	431.42	618	435.15
28	960	13.33	--	--	1	0.78	--	--	--	--	1	0.78	22	17.19	24	18.75
	5,760	10.31	--	--	3	0.51*0.52	--	--	--	--	5	0.84±0.89	653	110.00*161.21	661	111.31
TOTAL	12,180	12.17	6	0.40*0.44	3	0.20*0.22	74	4.99*3.56	7	0.47*0.50	26	1.75*1.14	1,347	90.83*74.60	1,463	98.70
Stratified			6	0.33	3	0.22	74	4.20	7	0.39	26	1.63	1,347	105.96	1,463	112.80

a/ Density is based on number of animals in a 0.5 nm wide strip for pinnipeds.

b/ Southern zone corresponds to the marginal ice f rent.

c/ Oash (--) signifies no animals.

TABLE 12

ESTIMATED ABUNDANCE AND 95 PERCENT CONFIDENCE INTERVALS FOR SEALS AND WALRUSES IN THE PACK ICE OF THE BERING SEA DURING EARLY SPRING, 1979 [a]

Zone	Sampling Unit	Spotted Seal	Ribbon Seal	Bearded Seal	Ringed Seal	Unidentified Seal	Pacific Walrus	Total
NORTHERN	9	- [b]						
	10						32	32
	11					-	-	-
	12		—	—		13	144	163
	Subtotal			6		13	176	195
CENTRAL	13	14		394	28	35	3090	3561
	14	-			-		23	23
	15	26	—	112	20	92	1477	1727
	Subtotal	411		506	48	127	4590	5311
SOUTHERN	24						-	
	25		-				195	195
	26		7			-	14	21
	27		13			51	7766	7830
	28		7		—	7	165	179
	Subtotal	-	27	-	-	58	8,140	8,225
TOTAL		49±50	25*2 5	608±407	57*57	214*130	11,064±8,515	13,731
Stratified		40±37	27*29	512*302	48±42	198±159	12,906*12,071	

[a] Dash (-) signifies no animals were observed.

[b] Numbers were derived by multiplying the estimated density times the unit area (Table 12).

7539A

summer and fall and the limited survey effort of the fringe ice where pinnipeds almost entirely occurred in the spring, the discussion will concentrate on the winter survey results which we were able to more thoroughly analyze. Since these results do not reflect the peak period pinnipeds haul out on ice, biases may exist among interspecies comparisons, but the data represent a first detailed description of pinniped use of the central Bering Sea ice front during late winter and early spring.

During the winter survey period, walruses, sea lions, spotted seals, and ribbon seals partitioned their distributions in the pack ice. Walruses, although widespread, occurred principally deep in the pack ice in the eastern half of the ice front. They preferred areas of thin and grease-slush ice, avoided areas of thick ice and intermediate floe sizes, and displayed no association with ice concentration. Correspondingly, the eastern half of the front featured areas containing the highest proportion of grease-slush ice and new ice of the areas surveyed. Braham et al. (unpublished) also reported, but qualitatively, that walrus use was greater deeper in the pack than along the front. Furthermore, Fay (1981) reported that the northcentral concentration area (St. Lawrence Island vicinity) of walruses lies in an area of relatively thin, broken ice, surrounded by areas of heavier, more consolidated pack ice, and that walrus were conspicuously absent in areas of heavy ice. Walruses appear to select ice conditions that allow easy entry into shallow water feeding areas from haul out sites.

Sea lions, conversely, were very narrowly distributed in the ice front near the ice edge in the western third of the front (Unit 28). They preferred areas of grease to small floes (particularly pancake to small floes) and O to 60 percent ice coverage, avoided areas of high ice concentration and medium-giant floes, and exhibited no association with ice thickness. These conditions closely describe areas near the ice edge (Burns et al. 1980), and partially agree with ice conditions in

Unit 28, which featured somewhat lower proportions of area in high ice concentrations and larger floes than elsewhere in the front. Burns and Harbo (1977) also reported that sea lions haul out mainly on small floes at the extreme southern edge of the front or within a few miles of it, but are likely to be encountered at any location along the front. Consequently, sea lions appear to be poorly adapted to inhabiting the deeper pack ice.

Spotted seals, like walruses, were widespread but primarily occurred at locations from the ice edge that were intermediate to walruses and sea lions, and were predominantly in the westernmost unit of the front. They preferred areas of moderate ice coverage (20-60 percent and particularly 20-40 percent) and thick ice (first year), but avoided thin to moderately thick ice. They indiscriminately used ice floe sizes, although the highest proportion of seals was in the pancake to small floe size class. Correspondingly, the unit they occupied in greatest numbers was most similar to the ice condition they preferred. Spotted seals, according to Burns and Harbo (1977) are most abundant in the front, utilizing small floes near the southern terminus of the pack, generally within 30 miles of the open ocean, but are also encountered deeper in the pack where currents or wind keep the ice thin. Since spotted seals, like sea lions, do not maintain breathing holes in ice, they inhabit areas of pack ice where there is persistent open water.

Also intermediate in location to walruses and sea lions, but deeper than spotted seals from the ice edge, were ribbon seals. They primarily occurred in the central section, Unit 26, of the front which partially overlapped areas of high walrus use. Too few sightings were made to determine ice use, but Burns and Harbo (1977) reported that ribbon seals usually haul out on relatively thick, clear, rough, snow covered ice floes in the ice front, most often located between 20 and 50 miles north of the ice edge. The ribbon seals we observed were in somewhat similar ice conditions to these, but on the average they were

deeper in the pack ice. Too few bearded and ringed seals were observed to evaluate their distribution patterns; these species primarily occur deep in the pack ice largely beyond the areas we surveyed (Burns and Frost 1979; Burns et al. 1980).

Consequently, the distribution of pinnipeds was influenced by sea ice. While ringed seals, and to a lesser degree bearded seals, maintain breathing holes in ice, the other species of pinnipeds do not. This precludes sea lions, spotted seals, and ribbon seals from occupying areas deep in the pack ice. Walruses, however, because of their much larger size, can inhabit areas of heavier pack ice than these species but not to the degree of ringed seals. Consequently, sea lions, spotted, and ribbon seals occurred chiefly in areas of broken ice toward the edge of the ice front where smaller floes were prevalent because of the influence of wave action from the open water. In addition, smaller floes provided the greatest amount of edge for these animals to use during haulout periods. Walruses, however, were deeper in the ice but generally near broken ice where openings were available for them to enter the water.

1979 SURVEY

Walrus were widely distributed in the pack ice in 1979. Walrus density was highest in the central zone and lowest in the northern zone. Although group size averaged 10.0 animals, almost 75 percent of the groups consisted of five or less animals. Most of the animals occurred deep in the pack ice away from the ice edge even in the zone comprising the marginal ice front. Walruses were primarily found in areas associated with the higher ice concentration and floe size categories except in the marginal ice front where they occurred in the more intermediate categories. Areas of high walrus use within the three zones tended to have more broken ice than other units, although the trend was not consistent among units. Braham et al. (unpublished) reported that surveys by Kenyon (1960, 1972) identified that the highest walrus concentrations in the northcentral Bering Sea were also

southwest of St. Lawrence Island and in Anadyr Strait. In contrast to our findings, Braham et al. (unpublished) further reported that walruses were conspicuously absent in the central Bering Sea from 59°N to 63°N. Walrus densities in each zone of the project area were lower than reported by Braham et al. (unpublished) for areas near St. Lawrence Island (2.77 animals per nm^2) but higher in the central and southern zones than they reported for Bristol Bay (0.82 animals per nm^2).

Bearded seals, although widespread in the project area, were most abundant in the central zone and least abundant in the southern zone. Group sizes averaged 1.2 animals but almost 90 percent of the groups were of single animals. Bearded seals were most prevalent in the higher ice concentration and floe size categories. These conditions were most common in the central zone and least common in the southern zone. Braham et al. (unpublished) reported that bearded seal densities were 1.7 times higher in the northern than the southern section of the Bering Sea pack ice. Surveys by Burns and Frost (1979) showed high densities of bearded seals southwest of St. Lawrence Island in an area close to our central zone.

Ringed seals were almost entirely (14 of 15 animals) observed in the central zone. They were associated with areas of high ice concentrations and floe sizes which characterized the central zone pack ice. Thirteen of the 14 groups recorded consisted of solitary animals. One group of two animals, consisting of an adult with a pup, was recorded on April 12. Other investigators (Lowry et al. 1982) have reported that ringed seals occur throughout the Bering Sea pack ice but densities are highest in the shorefast ice. In areas where detailed ringed seal studies have been conducted, such as in the Chukchi Sea, seal densities were as much as 31 times greater in the shorefast ice than in the pack ice (Burns and Harbo 1977, Stirling et al. 1977, Burns and Eley 1978). Braham et al. (unpublished) reported that ringed seals were not numerous in the offshore pack ice of the Bering Sea except

west of St. Lawrence Island, which generally corresponds to our results. Consequently, our results which are supported by those of other investigators, identify that ringed seal densities are highest southwest of St. Lawrence Island but are in general much lower in the Bering Sea pack ice than in the nearshore fast ice.

Ribbon seals were primarily encountered deep in the marginal ice front, although one was recorded in the central zone southwest of St. Lawrence Island. The seals were entirely observed west of 174°W where they were associated with a variety of ice concentrations and small floes characteristic of the front. Lowry et al. (1982) also reported that ribbon seals were most numerous in the ice front, particularly west of 173°W (Braham et al., unpublished). They further reported that isolated areas of abundance in the inner pack ice were west of St. Matthew Island and southwest of St. Lawrence Island. Ribbon seals according to Fay (1974) seem to be mainly solitary, which agrees with our findings where all eight ribbon seals we encountered were singles.

Spotted seals were most common in the central zone and there were none in the northern zone. Few were encountered in the ice front, which is reported to have the highest densities. Braham et al. (unpublished) found that densities decreased northward into the pack ice from the ice front. Densities were highest between 175°W and 180°W in the ice front (Braham et al. unpublished) and in Bristol Bay between 162°W and 165° 30'W (Burns and Harbo, 1977). This difference between results may be an artifact of our small sample size, but it is unclear why we saw so few spotted seals in the front. The three pups we observed on April 12 in Unit 15 agree with the late March and April pupping period reported by Fay (1974).

The 1979 results identify that pinniped distributions were influenced by ice conditions. Bearded and ringed seals were primarily associated with the areas of extensive ice coverage in the inner pack ice. These species are capable of maintaining breathing holes in the ice which provides a mechanism for them to inhabit heavy ice conditions.

Conversely, ribbon seals, which do not maintain breathing holes, were primarily encountered in the broken ice of the front. Walruses were widespread throughout the pack ice. Their wide distribution was partly the result of their capacity to break ice up to 22cm thick with their relatively large bodies (Fay 1974). Spotted seal association with the heavy ice of the inner pack is contrary to findings by other investigators. The reason for this association is unclear, but probably due to the small sample size. While the information for walrus and bearded seals was developed from relatively large numbers of observations, too few observations were obtained for ribbon, ringed, and spotted seals to draw firm conclusions.

Other factors beyond ice conditions undoubtedly influenced the distribution of pinnipeds. These probably include availability and accessibility of food, inter- or intra-specific competition or separation of sex and age groups. These factors or a combination of factors are probably responsible for explaining the site-specific distribution of the various species. Unfortunately, collection of these data was beyond the scope of this study.

COMPARISON BETWEEN THE 1982-1983 AND 1979 SURVEYS

The results of the 1983 and 1979 surveys are comparable because the study areas and methodologies were similar. The two study areas partially overlapped, particularly in the marginal ice front between St. Matthew Island and the U.S.-U.S.S.R. Convention Line (Appendix B Figure 8). While the 1983 study area was limited to the marginal ice front, the 1979 study area included areas of the deeper pack ice south and west of St. Lawrence Island. Consequently, marine mammal use of the marginal ice front is comparable between the two years and with other areas of the pack ice.

The methods used for the 1983 and 1979 surveys of the pack ice were also similar. Both surveys were flown at similar altitudes with identical helicopters along transect lines oriented in a north-south

direction. Marine mammal data for the two periods were collected according to the strip transect procedure. Lastly, the study periods were similar, 19 February - 18 March, 1982, and 2 March - 13 April, 1979. Because of the similarity in methods and locations, the results of the 1983 and 1979 surveys are largely comparable.

The composition and relative abundance of pinnipeds in the marginal ice front differed between 1983 and 1979 (Table 13). Seven species of pinnipeds were recorded during the two survey periods. Only the fur seal was not encountered both years, but this species is an uncommon winter visitor in the pack ice. The most common species in the front both years was the North Pacific walrus. Walruses were almost twice as abundant in 1979 as in 1983, even though the effort was not double. Northern sea lions, spotted seals, and ribbon seals were, however, substantially more commonly recorded in 1983 than in 1979. Small numbers of ringed and bearded seals occurred in the front during both years. These species, however, are typically associated with the deeper pack ice as evidenced by the high numbers of bearded seals and to a lesser degree, ringed seals recorded south and west of St. Lawrence Island during 1979. While the reasons for the observed differences in abundances of the various species were unclear, the results show that the marginal ice front is important to walruses, northern sea lions, and ribbon and spotted seals, whereas bearded and ringed seals primarily inhabit the deeper pack ice.

The average group sizes of the six prominent pinniped species in the marginal ice front was generally consistent between the survey periods. Group sizes averaged approximately one for bearded, ribbon, ringed, and spotted (except in 1983) seals, while it was over four times higher for walruses and northern sea lions. Variation of group sizes between survey periods was greatest for walruses and spotted seals. Walrus group sizes were particularly high during the early spring 1979 survey in the marginal ice front (and the central zone of the pack ice). Spotted seal group sizes were substantially higher

TABLE 13

COMPARISON OF THE 1979 AND 1983 PINNIPED DISTRIBUTIONS IN THE MARGINAL ICE FRONT OF THE BERING SEA [a/]

Sampling Unit	Distance Surveyed 1979	Distance Surveyed 1983	Number Per Nautical Mile: Spotted Seal 1979	Spotted Seal 1983	Ribbon Seal 1979	Ribbon Seal 1983	Bearded Seal 1979	Bearded Seal 1983	N. Sea Lion 1979	N. Sea Lion 1983	N. Pacific Walrus 1979	N. Pacific Walrus 1983
24	174	147	0	2.72	0	0	0	0.68	0	4.76	0	28.57
25	333	462	0	0.22	0	1.08	0	0	0	0	6.01	42.86
26	456	613	0	2.45	1.32	7.34	0.88	0.98	0.44	4.24	84.87	90.70
27	479	482	0	7.68	0.21	1.24	0	0	0	7.05	209.19	6.85
28	377	466	0	0.64	0.27	0.43	0	0	0	69.53	87.80	0
29	0	240	-	75.42	-	0	-	0.42	-	6.25	-	16.25
Total	1819	2410	0	10.00	0.44	2.41	0.22	0.33	0.11	16.85	95.66	36.02

[a/] Too few ringed and fur seals were observed in the marginal ice front during both 1979 and 1983 to compare distributions.

during the 1983 winter survey, when they were occasionally observed in large but loose aggregations. The variation of group size for these species was probably associated with one or a combination of factors, including the social structure of spatially separated groups comprised of different sex and age compositions, availability of food, and character of sea ice (B. Fay and L. Lowry, personal communication).

The specific distribution of pinnipeds in the marginal ice front is difficult to compare between years because of the small numbers of animals encountered in 1979 except for the walrus. During both years, walruses were widely distributed. Use of the front was greatest in the western half during 1979 and in the eastern half during 1983. Highest concentrations of walruses were, however, near the center of the front. Walruses were also more common deeper in the ice front than along the edge during both years. Comparisons are less meaningful for the other species; however, observations from one or both years show that ribbon, spotted, and northern sea lions, and a few bearded seals, were widely distributed across the front in varying numbers. Moreover, sea lions primarily occurred along the southern boundary of the front while the other species were intermediate to sea lions and walruses in the front.

The distribution of marine mammals in the marginal ice front was influenced by the characteristics of the sea ice during 1979 and 1983. The ice front was considerably further north and the percent ice cover was lower in 1979 than in 1983 (Figure 12). The percent of area covered by ice in the front averaged 64 percent (58-82 percent) in 1979 and 76 percent (68-80 percent) in 1983 ($P<0.05$). Correspondingly, greater proportions of area were represented by the higher ice concentration and floe size categorizes in 1983 than in 1979. Lastly, the distribution of ice across the front tended to become more broken and less concentrated when going from the eastern to the western units during 1983, while there was no obvious trend in 1979. Consequently, pinniped distribution probably varies with the location and character of the sea ice each year.

Pinniped association with sea ice between 1979 and 1983 was only comparable in the marginal ice front for the walrus, since there were too few observations of the other species. Walruses occurred in virtually every type of ice condition during the two survey periods (Figure 19). Walrus association with the different ice concentration categories did not differ significantly ($P<0.05$) in 1983 but it did ($P< 0.05$) in 1979. Walrus occurrence was higher than expected in the intermediate concentration category, and lower than expected in the other categories, except for the 26-50 percent category where it did not differ significantly. Walruses were, however, most abundant in the higher ice concentration, typical of areas deeper in the ice front. Burns (1970) also reported that walruses were widespread in the sea ice but that distribution was primarily influenced by prey availability while ice provided a platform for resting and birthing.

Estimated density of pinnipeds was variable between 1979 and 1983 in the marginal ice front (Table 14). Walrus densities were over 7 times higher in 1979 than in 1983. These values for the marginal ice front were, however, lower than in the central zone where walrus density was highest. Braham et al. (unpublished) reported that walrus densities were also much higher in the northern than in the southern Bering Sea or Bristol Bay. Walrus densities in the central Bering Sea were 1.7 times lower than Braham et al. (unpublished) reported for the northern Bering Sea. Densities which they and Burns and Harbo (1977) reported for the marginal ice front and Bristol Bay were, however, lower than we found in the front. This suggests that the marginal ice front and the areas southwest of St. Lawrence Island, associated with the central zone, are important to walrus.

Bearded seal densities were low in the marginal ice front during both 1979 and 1983 and were highest in the central zone. Braham et al. (unpublished) also found that bearded seal densities were considerably higher in the northern than in the southern Bering Sea pack ice. The

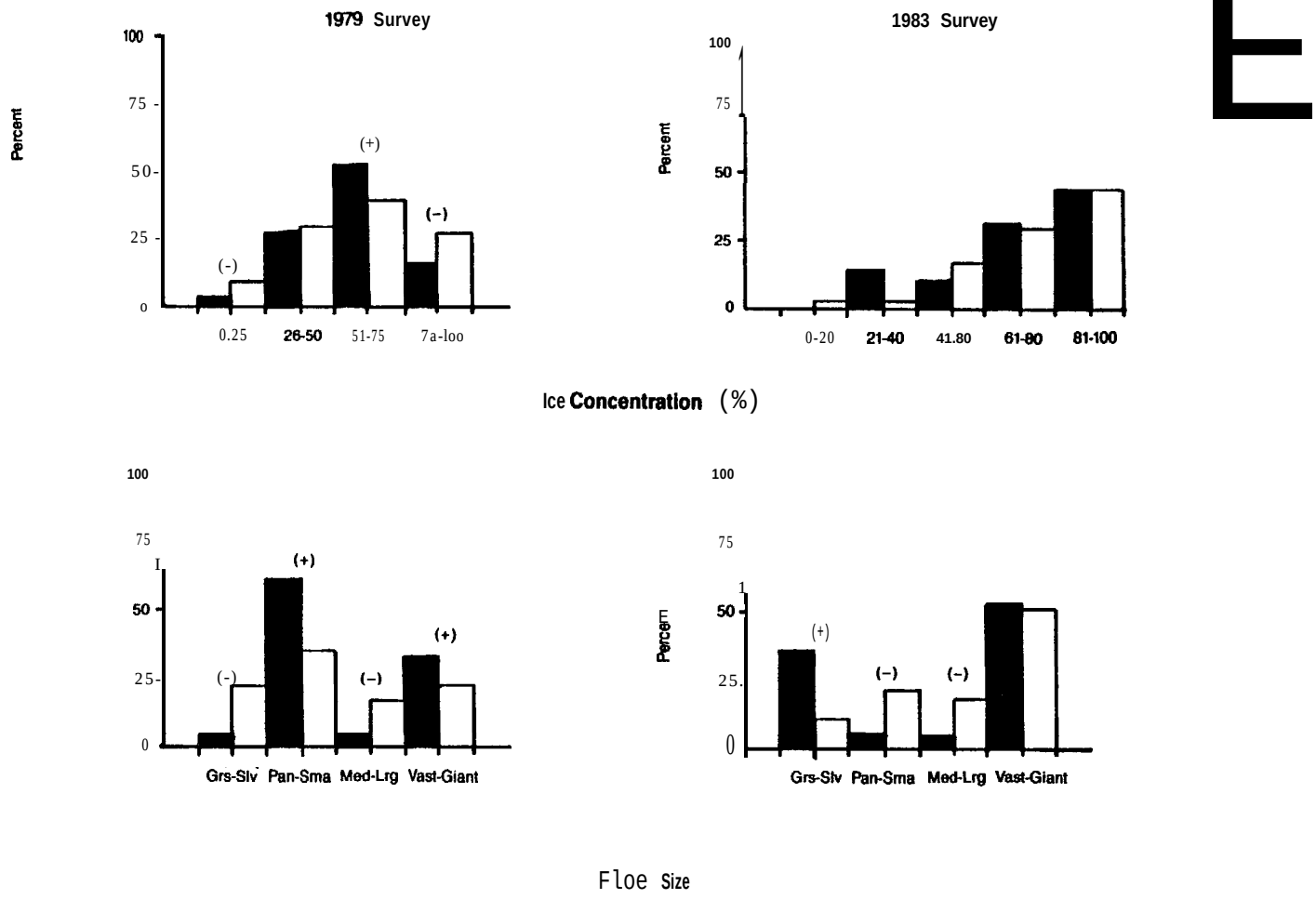


Figure 19 Percent occurrence of walrus in 1979 and 1983 relative to percent availability of ice types in the marginal ice front: plus (+) signifies significant preference; minus (-) signifies significant avoidance.

TABLE 14

COMPARISON OF PINNIPED DENSITIES (PER nm^2) REPORTED FOR THE CURRENT STUDY (1979, 1983) TO THOSE REPORTED BY OTHER INVESTIGATORS

Location[a]	Source	Pacific Walrus	Northern Sea Lion	Spotted Seal	Ribbon Seal	Bearded Seal	Ringed Seal
Marginal Ice Front							
SouthCentral	1979 Study	1.100	0.000	0.000	0.005	0.000	0.000
Southcentral	1983 Study	0.152	0.030	0.120	0.015	0.002	0.000
SouthCentral	Burns and Harbo (1977)	0.058	--	0.194	--	--	--
Southeastern	Burns and Harbo (1977)	0.118	--	0.614	--	--	--
Southeastern	Braham et al. (unpubl.)	0.820	--	0.370	0.006	0.083	0.017
Bristol Bay	Burns and Harbo (1977)	0.740	--	0.084	--	--	--
Central and Northern Bering Sea							
Central[b]	1979 study	1.586	0.000	0.014	0.000	0.174	0.017
Northern[c]	1979 Study	0.057	0.000	0.000	0.000	0.002	0.000
Northern	Brahamet al. (unpubl.)	2.770	--	--	0.000	0.141	0.059

a/ Southcentral Bering Sea = 169°W to 180°W; Southeastern Bering Sea = 163°W to 169°W; Bristol Bay = 157°W to 163°W; Northern Bering Sea = St. Lawrence Island vicinity.

b/ SouthCentral in 1979 and 1983 studies corresponds to southern zone or marginal ice front.

c/ Central and northern in 1979 and 1983 studies corresponds to central and northern zone.

7539A

densities we recorded in the central zone were 1.2 times higher than those reported by Braham et al. (unpublished). This suggests that the central zone, which is southwest of St. Lawrence Island, is an important area for bearded seals.

Ribbon seal densities were higher in the marginal ice front in 1979 and 1983 than in the areas surveyed deeper in the pack ice. Densities were not available for comparison in the area we reported but our results were similar to those reported by Braham et al. (unpublished) for the eastern section of the front. Furthermore, other investigators reported lower ribbon seal densities deeper in the pack ice than in the front.

Spotted seal densities were inconsistent between areas sampled for 1979 and 1983, but were highest in the marginal ice front. The densities we reported were however 5 times lower than these reported in the marginal ice front for the southeastern Bering Sea, where spotted seal densities are highest. These results suggest that the marginal ice front in the project area is of moderate importance to spotted seals.

Only two ringed seals were observed in the marginal ice front during both study periods. Densities were considerably higher in the deeper pack ice of the central zone, but lower than reported by Braham et al. (unpublished). Since ringed seals primarily inhabit the shorefast ice (Burns, 1970), densities were expected to be low in the pack ice.

Northern sea lion densities were extremely variable between 1979 and 1983. Densities for 1983, however, represent the first estimates for this species in the marginal ice front. Moreover, the absence of sighting deep in the pack in 1979 shows that northern sea lions only utilized the marginal ice front.

In summary, our results show that northern sea lion and spotted and ribbon seal densities were highest in the marginal ice front while walrus and ringed and bearded seal densities were highest in the central zone, an area of heavy pack ice southwest of St. Lawrence Island. These findings are consistent with those reported by other investigators (Burns and Harbo, 1977; Burns, 1970; Braham et al. unpublished), except for the density of walrus in the marginal ice front, which we found to be considerably higher than has been reported for the southcentral section of the front.

LITERATURE CITED

Alaska Dep. FishGame. 1975. Unpubl.manuscr. Alaska Dep. Fish Game, Juneau. 8 pp.

Bailey, A.M., and R.W. Hendee. 1926. Notes on the mammals of northwestern Alaska. J. Mammal. 7(1):9-28.

Braham, H.W., J.J. Burns, G.A. Fedoseev, and B.D. Krogman. Unpublished report. Habitat partitioning by ice-associated pinnipeds: distribution and density of seals and walruses in the Bering Sea, April 1976. National Marine Mammal Laboratory, National Oceanic and Atmospheric Administration. 50 pp.

Braham, H.W., R.D. Everett, B.D. Krogman, D.J. Rugh, and D.E. Withrow. 1977. Marine mammals of the Bering Sea: a preliminary report on distribution and abundance, 1975-1976. NWAFC, NMFS, NOAA. 90 pp.

Braham, H.W., and B.D. Krogman. 1977. Population biology of the bowhead (Balaena mysticetus) and beluga (Delphinapterus leucas) whale in the Bering, Chukchi and Beaufort Seas. Processed Rep., U.S. Dep. Commer., Natl. Oceanic Atmos. Admin., Natl. Mar. Fish. Serv., Northwest Alaska Fish. Cent., Mar. Mammal Div., Seattle, Wash. 28 pp.

Brooks, J.W. 1954. A preliminary report on beluga investigations in Bristol Bay, Alaska. Unpubl. manuscr. Alaska Dep. Fish. 38 pp.

Brooks, J.W. 1963. The management and status of marine mammals in Alaska. Trans. North Amer. Wildl. Natur. Resour. Conf. 28-314-325.

Brewer, W.A., Jr., H.F. Diaz, and A.S. Prechtel. 1977. Climatic atlas of the Outer Continental Shelf waters and coastal regions of Alaska, Vol. II Bering Sea. Arctic Environmental Information and Data Center, Univ. Alaska, 707 A Street, Anchorage, Alaska. 443 pp.

Brueggeman, J. J., R.A. Grotefendt, and R.L. Fairbanks. 1984. Seal, sea lion, and walrus surveys of the Navarin Basin, Alaska. Minerals Management Service, Outer Continental Environmental Assessment Program. 75 pp.

Brueggeman, J.J., R.A. Grotefendt, and A.W. Erickson. 1983. Endangered Whale Surveys of the NavarinBasin, Alaska. Minerals Management Service, Outer Continental Shelf Environmental Assessment Program. 124 pp.

Brueggeman, J.J. 1982. Early spring distribution of bowhead whales in the Bering Sea. J. Wild. Manage. 46:1036-1044.

Bukhtiyarov, Y.A., K.J. Frost, and L.F. Lowry. In prep. New information on foods of the largha seal (Phoca largha) in the Bering Sea in spring.

Burns, J.J. 1970. Remarks on the distribution and natural history of pagophilic pinnipeds in the Bering and Chukchi seas. J. Mammal. 51:445-454.

Burns, J.J. 1981a. Ribbon seal (Phoca fasciata). Pages 89-110. In: S.H. Ridgeway and R.J. Harrison (eds.). Handbook of marine mammals, vol. 2. Academic Press, London and New York.

Burns, J.J. 1981b. Bearded seal (Erignathus barbatus). Pages 145-170. In: S.H. Ridgeway and R.J. Harrison (eds.). Handbook of marine mammals, vol. 2. Academic Press, London and New York.

Burns, J.J. and T.J. Eley. 1978. The natural history and ecology of the bearded seal (Erignathus barbatus) and the ringed seal (Phoca hispida). In Environmental Assessment of the Alaskan Continental Shelf, Annual Reports of the Principal Investigators for the year ending March 1978, Vol. I. Outer Continental Shelf Environmental Assessment Program, Boulder, Colo.

Burns, J.J. and K.J. Frost. 1979, The natural history and ecology of the bearded seal. Final report Outer Continental Shelf Environmental Assessment Program, Contract 03-5-022-53. 77 pp.

Burns, J.J. and S.J. Harbo. 1972. An aerial census of ringed seals, northern coast of Alaska. Arctic 25:279-290.

Burns, J.J. and S.J. Harbo, Jr. 1977. An aerial census of spotted seal (Phoca vitulina largha) and walruses (Odobenus rosmarus) in the ice front of Bering Sea. Pages 58-132. In: Environmental assessment of the Alaskan continental shelf, quarterly reports, April-June, vol. 1. Outer Continental Shelf Environmental Assessment Program. Boulder, Colorado.

Burns, J.J., L.H. Shapiro, and F.H. Fay. 1980. Relationship of marine mammal distribution, densities, and activities to sea ice conditions. Pages 489-670. In: Environmental assessment of the Alaskan continental shelf, final reports of principal investigators, vol. 11. Outer Continental Shelf Environmental Assessment Program. Boulder, Colorado.

Consiglieri, L. and C. Bouchet. 1981. Marine mammal data documentation for Platforms of Opportunity Project and Outer Continental Shelf Environmental Assessment Program. NWAF processed rpt., U.S. Dept. Commerce, NOAA, NMFS, NWAFS. 96 pp.

Eberhardt, L.L. 1978. Transect methods for population studies. J. Wild. Manage. 42:1-31.

Estes, J.A. and J.R. Gilbert. 1978. Evaluation of an aerial survey of Pacific walruses (Odobenus rosmarus divergent). J. Fish. Res. board. Can. 35:1130-1140.

Everett, R.D. and S.J. Jeffries. 1979. Marine mammal investigations in Washington 1975-1979. Paper presented at the Third Conference on the Biology of Marine Mammals, 7-11 October. Seattle, Washington.

Fay, F.H. 1974. The role of ice in the ecology of marine mammals of the Bering Sea. Pages 383-399. In: D.W. Hood and E.J. Kelly (eds.). Oceanography of the Bering Sea. Occs. Publ. No. 2, Inst. Mar. Sci., Univ. Alaska, Fairbanks.

Fay, F.H. 1981. Modern populations, migrations, demography, trophies, and historical status of the Pacific walrus. Pages 191-233. In: Environmental assessment of the Alaskan continental shelf, annual reports of principal investigators, vol. I. Outer Continental Shelf Environmental Assessment Program. Boulder, Colorado.

Fay, F.H. 1982. Ecology and biology of the Pacific walrus (Odobenus rosmarus divergens Illiger). U.S. Fish. Wild. Serv. N. Am. Fauna No. 74. 279 pp.

Gol'tsev, V.N. 1971. Feeding of the common seal. Ekologiya 2(2):62-70.

Johnson, M.L., C.H. Fiscus, B.T. Ostenson, and M.L. Barbour. 1966. Marine mammals. In N.J. Wilimovsky (cd.), Environment of the Cape Thompson region, Alaska, p. 877-923. U.S. Atomic Energy Comm. Avail. Nat. Tech. Inf. Serv., Springfield, Virginia.

Kenyon, K.W. 1960. Aerial surveys of marine mammals in the Bering Sea, 23 February - 2 March and 25-28 April 1960. Bur. Sport. Fish. Wild., U.S. Fish. Wild. Serv., Seattle. 39 pp.

Kenyon, K.W. 1972. Aerial surveys of marine mammals in the Bering Sea, 6-16 April 1972. Unpubl. Rpt. Bur. Sport. Fish. Wild., U.S. Fish Wild. Serv., Seattle. 79 pp.

Kleinenberg, S. E., A.V. Yablokov, V.M. Bel'kovich, and M.N. Tarasevich. 1964. Belukha. Opyt monograficheskogo issledovaniya viola (Beluga, Delphinapterus leucas: Investigation of the species). Izd. "Nauka," Moscow. In Russian. (Transl. by Israel Program Sci. Transl., 1969, 376 p. Avail. Natl. Tech. Inf. Serv., Springfield, Virginia.)

Klinkhart, E. 1966. The beluga whale in Alaska. Project Rep., Fed. Aid Wildl. Restoration, Vol. VII, Alaska Dep. Fish Game, 11 pp.

Kosygin, G.M. 1966. Distribution and some features of the biology of pinnipeds of the Bering Sea (spring-summer period, 1963). Izv. TINRO 58:117-124.

Lowry, L.F. and K.J. Frost. 1981. Feeding and trophic relationships of phocid seals and walruses in the western Bering Sea. Pages 813-824. In: D.W. Hood and J.A. Calder (eds.). The eastern Bering Sea shelf: oceanography and resources, vol. 2. Off. Marine Pollution Assessment, NOAA. Distrib. by Univ. Washington Press, Seattle.

Lowry, L.F., K.J. Frost, and J.J. Burns. 1979. Potential resource competition in the southeastern Bering Sea: fisheries and phocid seals. Pages 287-296. In: B.R. Melteff (cd.). Proc. 29th Alaska Sci. Conf., Fairbanks, Alaska, 15-17 August 1978. Univ. Alaska Sea Grant Rep. No. 79-6.

Lowry, L.F., K.J. Frost, and J.J. Burns. 1981. Trophic relationships among ice-inhabiting phocid seals and functionally related marine mammals in the Bering Sea. Pages 97-173. In: Environmental assessment of the Alaskan continental shelf, final reports of principal investigators, vol. 11. Outer Continental Shelf Environmental Assessment Program. Boulder, Colorado.

Lowry, L. F., K.J. Frost, D.G. Calkins, G.L. Swartzman, and S. Hills. 1982. Feeding habits, food requirements, and status of Bering Sea marine mammals. Final rep. to North Pacific Fishery Management Council. Anchorage, Alaska. 676 pp.

Nue, C., C. Byers, andJ. Peek. 1974. A technique for analysis of utilization-availability data. J. Wild. Manage. 38:541-547.

Potocsky, G.J. 1975. Alaska area 15- and 30-day ice forecasting guide. U.S. Dept.Defense, Naval Oceanographic Off. Spec. Publ. 263. 190 pp.

Scheffer, V.B. 1972. Marine mammals of the Gulf of Alaska. In D.H. Rosenberg (cd.), A review of the oceanography and renewable resources of the northern Gulf of Alaska, p. 175-207. Inst. Mar. Sci., Univ. Alaska, Fairbanks.

Sergeant, D.E., and W. Hock. 1974. Seasonal distribution of bowhead and white whales in the eastern Beaufort Sea. In J.C. Reed and J.E. Sater (eds.), The coast and shelf of the Beaufort Sea - symposium on Beaufort Sea, p. 705-719. Arctic Inst. North Amer., Arlington, Virginia.

Sergeant, D.E., and P.F. Brodie. 1975. Identity, abundance, and present status of populations of white whales, Delphinapterus leucas, in North America. J. Fish. Res. Bd. Cn. 32:1047-1054.

Shustov, A.P. 1965. Distribution of the ribbon seal (Histriophoca fasciata)in the Bering Sea. Pages 118-121. In: E.H. Pavlovski, B.A. Zenkovich, S.E.Kleinenburg, and K.K. Chapski (eds.). Akacl. Nauk SSSR, Ikhtiol. Comm., Moscow, USSR.

Stirling, I., W.R. Archibald, and D. DeMaster. 1977. Distribution and abundance of seals in the eastern Beaufort Sea. J.Fish.Res. Board Can. 34:976-988 pp.

Tikhomirov, E.A. 1964. (Distribution and hunting of the sea lion in the Bering Sea and adjacent parts of the Pacific.) Tr. VNIRO 53 and Izu. TINRO 52. In Russian. (Transl. by Israel Program Sci. Transl., 1968. Pages 281-285. In: P.A. Moiseev (cd.). Soviet fisheries investigations in the northeast Pacific, part 3. NTIS No. TT 67-51205.)

Townsend, C.H. 1935. The distribution of certain whales as shown by log book records of American whaleships. Zoologica 19:3-50.

Umeda, Y. and R. Bakkala. 1983. Data report: 1980 demersal trawl survey of the eastern Bering Sea continental shelf. U.S. Dept. Commerce, NOAA Technical Memorandum NMFSF/NWC-49. 175 p p .

Withrow, D. 1982. Using aerial surveys, ground truth methodology, and haul out behavior to census Steller sea lions. Thesis. University of Washington, Seattle. 102 pp.

World Meteorological Organization. 1970. Sea-ice nomenclature. World Meteorol. Organ., Geneva, Switzerland, WMO/OMM/BMO 259. TP. 145. 147pp.

APPENDIX A

1982-1983 SUPPLEMENTAL TABLES AND FIGURES

APPENDIX TABLE A-1
DEFINITION OF SURFACE VISIBILITY CATEGORIES
USED DURING AERIAL AND VESSEL SURVEYS[a/]

Category	Definition
Excellent	Surface of water calm, a high overcast solid enough to prevent sun glare. Beaufort = 0, visibility greater than 5km. Marine mammal swill appear black against a uniform gray background.
Very good	May be a light surface ripple on the surface or slightly uneven lighting, but still relatively easy to distinguish animals at a distance. Beaufort = 1 or 2, visibility greater than 5 km.
Good	May be a light chop, some sun glare or dark shadows in part of survey track. Beaufort less than or equal to 3, visibility less than or equal to 5 km. Animals up close (300 m or less) can still be detected and fairly readily identified.
Fair	Choppy waves with some slight whitecapping, sun glare or dark shadows in 50 percent or less of the survey track. Beaufort less than or equal to 4, visibility less than or equal to 1 km.
Poor	Wind in excess of 15 kt, waves over 2 ftwith whitecaps, sun glare may occur in over 50 percent of the survey track. Beaufort less than or equal to 5, visibility less than or equal to 500 m. Animals may be missed unless within 100 m of the survey trackline, identification difficult except for larger species.
Unacceptable	Wind in excess of 25 kt; waves over 3 ft high with pronounced whitecapping. Sun glare may or may not be present. Beaufort greater than or equal to 6 or visibility less than or equal to 300 m. Detection of any marine mammal unlikely unless observer is looking directly at the place where it surfaces. Identification very difficult due to improbability of seeing animal more than once.

a/ Surface visibility classification was taken from the National Marine Fisheries Service's Platform of Opportunities Program (Consiglieri and Bouchet 1981).

APPENDIX TABLE A-2

SEA ICE CLASSIFICATION USED DURING AERIAL AND VESSEL SURVEYS[a/]

Category	Description
Ice thickness	
New ice	less than or equal to 10 cm
Young ice	10-30 cm
1st year ice	greater than or equal to 30 cm
Ice type	
Grease ice	A later stage of freezing than frazile ice (fine spicules or plates of ice suspended in water) when the crystals have coagulated to form a soupy layer on the surface. Grease ice reflects little light, giving the sea a matt appearance.
S1 ush	Snow which is saturated and mixed with water on ice surfaces, or as a viscous floating mass in water after a heavy snowfall.
Pancake ice	Predominately circular pieces of ice from 30 cm-3 m in diameter, and up to about 10 cm in thickness, with raised rims due to the pieces striking against one another.
Floes	Any relatively flat piece of ice 10 m or more across.
Small floe	less than 10 m across
Medium floe	10-30 m across
Large floe	30-100 m across
Vast floe	100-200 m across
Giant floe	greater than 200 m across
Ice Concentration	The ratio of tenths of the sea surface actually covered by ice to the total area of sea surface, both ice-covered and ice-free, at a specific location or over a defined area.

a/ Ice description were taken from the World Meteorological Organization (1970). Ice floe sizes were modified from the World Meteorological Organization according to definitions of National Oceanic and Atmospheric Administration.

APPENDIX TABLE A-3
RECORD OF PINNIPEDS AND BELUGA WHALES ENCOUNTERED IN THE NAVARIN BASIN DURING THE FOUR SURVEY SEASONS, MAY-JUNE, JULY-AUGUST, OCTOBER-NOVEMBER, 1982 AND FEBRUARY-MARCH 1983

Date	Species[a/]	Number[b/]	Location
		SPRING SURVEY	
5/21/82	PF	1	59° 54′, 174° 39′W
5/21/82	PL	1	60° 7′, 174° 34′W
5/21/82	EB	1	60° 6′, 174° 34′W
5/21 /82	PF	1	60° 6′, 174° 34′W
5/21/82	PF	1	60° 6′, 174° 34′W
5/21/82	PF	1	60° 6′, 174° 34′W
5/21 /82	EB	1	60° 6′, 174° 34′W
5/21/82	PF	1	60° 6′, 174° 34′W
5/21/82	PL	1	60″ 4′, 174″ 34′W
5/21/82	PL	1	60° 4′, 174° 34′W
5/21/82	PF	1	60° 4′, 174° 34'W
5/21 /82	OR	1	59° 55′, 174° 37′W
5/21 /82	OR	9	59° 55′, 174° 15'W
5/21/82	OR	2	59° 55′, 174° 15'W
5/21/82	OR	2	59° 54′, 174° 34'W
5/21 /82	OR	4	59° 55′, 174° 18'W
5/21 /82	PL	1	59° 56′, 174° 18'W
5/21/82	PF	1	59° 58′, 174″ 18'W
5/21/82	OR	1	60° 00′, 174° 18'W
5/21/82	OR	30	60° 00′, 174″ 18'W
5/21/82	PF	1	60° 7′, 174° 18'W
5/21/82	EJ	2	60° 7′, 174° 18'W
5/21/82	PF	1	60° 7′, 174° 18'W
5/21/82	PL	1	60° 7′, 174° 18'W
5/21/82	PL	1	60° 7′, 174° 18'W
5/21 /82	PF	1	60° 7′, 174° 18'W
5/21 /82	PF	1	60° 7′, 174° 18′W
5/21/82	PL	1	60° 8′, 174° 18'W
5/21/82	PL	1	60° 8′, 174° 18'W
5/21 /82	PL	1	60° 10′, 174° 18'W .
5/21/82	PF	1	60° 10′, 174° 2'W
5/21/82	PF	1	60° 10′, 174° 2'W
5/21/82	PF	1	60° 7′, 174° 2'W

a/ EJ = northern sea lion, CL = northern fur seal, PL = spotted seal, EB = bearded seal, PF = ribbon seal, PH = ringed seal, OR = Pacific walrus, DL = beluga whale

b/ Duplicate counts of beluga whales may have occurred during the 12 and 13 March surveys

APPENDIX TABLE A-3 CONT.
RECORD OF PINNIPEDS AND BELUGA WHALES ENCOUNTERED IN THE NAVARIN BASIN DURING THE FOUR SURVEY SEASONS, MAY-JUNE, JULY-AUGUST, OCTOBER-NOVEMBER, 1982 AND FEBRUARY-MARCH 1983

Date	Species[a/]	Number[b/]	Location
	SPRING SURVEY (Continued)		
5/21 /82	PF	1	60° 7′, 174′ 2′W
5/21 /82	OR	1	60° 5′, 174″ 2′W
5/21 /82	OR	4	59″ 59′, 173″ 46'W
5/21 /82	OR	10	59° 59′, 173° 46′W
5/21 /82	EJ	9	60° 1′, 173″ 46'W
5/21 /82	OR	1	60° 1', 173″ 46'W
5/21 /82	PL	2	60″ 2', 173° 46'W
5/21 /82	PF	2	60° 3′, 173° 46′W
5/21/82	PF	1	60° 5′, 173° 46′W
5/21 /82	PL	1	60° 7′, 173° 46′W
5/21/82	PF	1	60° 7′, 173″ 46'W
5/21 /82	EB	1	60″ 8′, 173° 46'W
5/21 /82	EJ	1	60° 10′, 173° 44′W
5/21 /82	PF	1	60° 5′, 173° 30'W
5/21/82	PL	2	60° 5′, 173° 30′W
5/21 /82	EJ	10	60° 1′, 173″ 30′W
5/21/82	EJ	12	60° 1′, 173° 30'W
5/21 /82	EJ	3	60° 1′, 173″ 30'W
5/21/82	EJ	4	60″ 1′, 173° 30′W
5/21 /82	EB	1	60° 1′, 173° 30′W
5/23/82	PF	1	60° 43′, 175° 20′W
5/23/82	PF	1	60° 43′, 175° 20′W
5/23/82	EJ	1	60° 41′, 175° 20′W
5/21 /82	UP	1	59″55′, 174″ 48'W
5/21 /82	UP	4	59″ 55′, 174″ 43′W
5/21 /82	OR	2	59° 54′, 174° 40′W
5/21 /82	UP	1	59*54′, 174″ 39'W
5/27/82	PL	1	60° 37′, 174° 46′W
5/27/82	EJ	3	60° 41′, 174″ 46'W
5/27/82	EJ	1	60″ 42′, 174° 46′W
	SUMMER SURVEY		
7/28/82	EJ	2	60° 48′, 178° 22'W
7/26/82	EJ	2	60° 53′, 175° 1'W
7/29/82	CL	1	59° 46′, 179° 8'W
8/04/82	CL	1	59° 52′, 173° 30′W
8/07/82	CL	2	58° 26′, 174° 39′W
8/07/82	CL	1	58° 19′, 174″ 39'W
8/07/82	CL	1	58° 18′, 174° 39′W
8/07/82	CL	1	58° 16', 174° 39′w

APPENDIX TABLE A-3 CONT.
RECORD OF PINNIPEDS AND BELUGA WHALES ENCOUNTERED IN THE NAVARIN BASIN DURING THE FOUR SURVEY SEASONS, MAY-JUNE, JULY-AUGUST, OCTOBER-NOVEMBER, 1982 AND FEBRUARY-MARCH 1983

Date	Species[a/]	Number[b/]	Location
	SUMMER SURVEY (Continued)		
8/07/82	CL	1	58° 8′, 174″ 39′W
8/08/82	CL	1	58° 10′, 174° 54′W
8/08/82	CL	1	58″ 15′, 174° 54'W
	FALL SURVEY		
11 /6/82	CL	1	61003′, 175″ 33'W
11 /6/82	CL	1	61° 03′, 175° 24′W
11/10/82	CL	1	59° 55′, 173° 38′W
11/10/82	CL	2	59° 55′, 173° 53′W
11/10/82	CL	1	59′ 55′, 174″ 47′W
11/10/82	CL	1	59° 55′, 175° 28'W
	WINTER SURVEY		
02/21/83	PL	3	58° 36′, 171″ 25′W
02/21/83	OR	1	58° 10′, 171° 32′W
02/21/83	UP	1	58° 27′, 171″ 43′W
02/21/83	UP	3	58″25′, 171″ 48'W
02/21/83	OR	4	58″ 22′, 171″ 48'W
02/21/83	OR	3	58° 22′, 171° 48′W
02/21/83	OR	1	58″ 20′, 171″ 48′W
02/21/83	OR	1	58° 19′, 171° 48'W
02/22/83	OR	2	58° 10′, 171″ 48'W
02/22/83	OR	2	58° 08′, 171 ° 48'W
02/22/83	UP	1	58° 03′, 171″ 48′W
02/22/83	EJ	1	57° 59′, 172″ 05′W
02/22/83	UP	1	58° 07′, 172″ 11'W
02/22/83	EB	1	58″ 14′, 172° 17'W
02/23/83	UP	4	58″ 27′, 172″ 32'W
02/23/83	EJ	1	58″ 31', 172° 32′W
02/23/83	EJ	5	58° 31′, 172° 32'W
02/23/83	OR	1	58″ 39′, 172° 33′W
02/23/83	UP	1	58° 45', 172″ 32′W
02/23/83	UP	1	58′ 48′, 172° 32′W
02/23/83	OR	1	58° 51′, 172° 33'W
02/23/83	OR	1	58″ 53′, 172″ 32'W
02/23/83	OR	2	58° 58′, 172″ 32′W
02/23/83	OR	2	58° 58′, 172″ 32′W
02/23/83	OR	2	58″ 58′, 172″ 32'W

4486A

APPENDIX TABLE A-3 CONT.
RECORD OF PINNIPEDS AND BELUGA WHALES ENCOUNTERED IN THE NAVARIN BASIN DURING THE FOUR SURVEY SEASONS, MAY-JUNE, JULY-AUGUST, OCTOBER-NOVEMBER, 1982 AND FEBRUARY-MARCH 1983

Date	Species[a/]	Number[b/]	Location
		WINTER SURVEY (Continued)	
02/24/83	EJ	2	59″ 33′, 176° 12'W
02/24/83	CL	1	59° 33′, 176° 10'W
02/24/83	EJ	4	59″ 32′, 176° 04′W
02/24/83	UP	1	59° 44′, 175″ 54′W
02/24/83	PL	1	59° 54′, 175° 52′W
02/25/83	EJ	1	59° 29′, 176″ 04′W
02/25/83	EJ	1	59° 28′, 176° 04'W
02/25/83	OR	2	59° 28′, 176° 04'W
02/25/83	EJ	4	59° 29′, 176° 03'W
02/25/83	PL	1	59° 31′, 176″ 03'W
02/25/83	PL	34	59° 31′, 176° 03′W
02/26/83	PL	1	60° 07′, 177° 27′W
02/26/83	EJ	1	60″ 16′, 177″ 34′W
02/26/83	UP	1	60″ 18′, 177° 41'W
02/26/83	EJ	1	60″ 19′, 177° 41'W
02/26/83	UP	1	60° 27′, 177° 42'W
02/26/83	EJ	1	60° 21′, 177″ 52'W
02/27/83	PL	1	60″ 35′, 178″ 13'W
02/28/83	PL	1	60° 54′, 178° 14′W
02/28/83	PL	1	60″ 54′, 178° 15'W
02/28/83	PL	1	60″ 55′, 178° 17'W
02/28/83	OR	4	60° 55′, 178″ 18'W
02/28/83	PL	1	60° 55′, 178° 19'W
02/28/83	PL	1	60° 55′, 178° 19'W
02/28/83	PL	1	60″ 55′, 178″ 19'W
02/28/83	PL	1	60″ 55′, 178″ 19'W
02/28/83	PL	1	60° 55′, 178° 19'W
02/28/83	PL	1	60° 56′, 178° 21'W
02/28/83	PL	1	60″ 57′, 178° 23'W
02/28/83	OR	2	61° 02′, 178° 19'W
02/28/83	UP	1	61001′, 178° 17'W
02/28/83	UP	1	61001′, 178″ 17'W
02/28/83	OR	1	61° 04′, 178° 16'W
02/28/83	UP	1	61° 05′, 178″ 16'W
02/28/83	OR	1	61″ 11′, 178″ 20′W
02/28/83	PL	2	61° 13′, 178° 25′W
02/28/83	OR	1	61° 12′, 178° 27′W
02/28/83	PL	1	61° 12′, 178° 29'W
02/28/83	PH	1	61° 11′, 178° 30'W
02/28/83	UP	1	61° 11′, 178° 30′W
02/28/83	OR	1	61004′, 178° 40′W
02/28/83	OR	1	61° 04′, 178° 40′W

APPENDIX TABLE A-3 CONT.
RECORD OF PINNIPEDS AND BELUGA WHALES ENCOUNTERED IN THE NAVARIN BASIN DURING THE FOUR SURVEY SEASONS, MAY-JUNE, JULY-AUGUST, OCTOBER-NOVEMBER, 1982 AND FEBRUARY-MARCH 1983

Date	Species[a/]	Number[b/]	Location
	WINTER SURVEY (Continued)		
02/28/83	OR	23	61001′, 178° 41'W
02/28/83	PL	1	61° 01′, 178° 41'W
02/28/83	OR	2	61″01′. 178° 41'W
02/28/83	PH	1	61″ 01', 178′ 35′W
03/01/83	UP	1	61° 00′. 178″ 30′W
03/01/83	PL	1	60° 59′; 178″ 28'W
03/01/83	OR	3	60″ 56′, 178″ 28′W
03/01/83	EB	1	60° 39′, 178° 28'W
03/02/83	PL	1	60″ 41', 178° 51'W
03/02/83	UP	1	60° 43′, 178° 51'W
03/02/83	PL	1	60° 55′, 178″ 54′W
03/02/83	PL	2	60° 56′, 178″ 52′W
03/02/83	PL	1	60° 56′, 178″ 52′W
03/02/83	PL	2	60″ 56′, 178° 52′W
03/02/83	PL	35	60° 58′, 178° 53'W
03/02/83	PL	99	60° 58′, 178″ 53′W
03/02/83	UP	4	61° 00', 178° 52'W
03/02/83	UP	1	61° 00′, 178° 52′W
03/02/83	UP	1	61° 00′, 178° 58'W
03/02/83	PL	4	61° 01′, 179° 02'W
03/02/83	PL	8	61° 01′, 179″ 02′W
03/02/83	PL	2	61001′, 179° 02'W
03/02/83	PL	8	60″ 59′, 179° 04′W
03/02/83	UP	1	60° 58′, 179° 04′W
03/02/83	PL	1	60° 55′, 179″ 04'W
03/02/83	UP	1	60° 55′, 179° 04'W
03/03/83	EJ	1	60° 44′, 179° 04'W
03/03/83	UP	2	60° 44′, 179° 04′W
03/03/83	EJ	1	60° 44′, 179° 04'W
03/03/83	EJ	1	60° 44′, 179° 04′W
03/03/83	EJ	1	60043′, 179° 05'W
03/03/83	EJ	1	60″ 41′, 179″ 15'W
03/03/83	EJ	1	60° 41′, 179° 15'W
03/03/83	EJ	2	60° 44′, 179° 16'W
03/03/83	EJ	1	60° 49′, 179° 16'W
03/03/83	UP	1	60° 47′, 179° 24′W
03/03/83	UP	2	60° 49', 179° 24′W
03/03/83	PL	1	60° 49′, 179° 15'W
03/03/83	EJ	2	60″ 47′, 179° 14'W
03/03/83	EJ	1	60° 51′, 179° 18'W

APPENDIX TABLE A-3 CONT.
RECORD OF PINNIPEDS AND BELUGA WHALES ENCOUNTERED IN THE NAVARIN BASIN DURING THE FOUR SURVEY SEASONS, MAY-JUNE, JULY-AUGUST, OCTOBER-NOVEMBER, 1982 AND FEBRUARY-MARCH 1983

Date	Species[a/]	Number[b/]	Location
	WINTER SURVEY (Continued)		
03/03/83	EJ	2	60″ 47′, 178° 51'W
03/03/83	EJ	1	61° 00′, 178′ 38′W
03/03/83	UP	1	60° 58′, 178″ 36′W
03/04/83	EJ	4	60° 18′, 177° 37′W
03/04/83	EJ	10	60° 20', 177° 37′W
03/04/83	EJ	10	60° 18′, 177″ 26′W
03/04/83	EJ	35	60° 18′, 177″ 26′W
03/04/83	EJ	25	60° 18', 177° 24'W
03/04/83	EJ	12	60° 18′, 177″ 24′W
03/04/83	EJ	10	60° 18', 177″ 24′W
03/04/83	EJ	25	60″ 20′, 177° 25'W
03/04/83	EJ	12	60″ 20′, 177° 25'W
03/04/83	EJ	1	60° 20′, 177″ 25′W
03/04/83	EJ	8	60° 19', 177° 28′W
03/04/83	EJ	8	60°17′,1770 24′W
03/04/83	EJ	7	60″ 17′, 177° 24′W
03/04/83	EJ	12	60° 17′, 177″ 24'W
03/04/83	EJ	11	60° 16′, 177° 23'W
03/04/83	EJ	19	60″ 16′, 177° 23′W
03/04/83	EJ	18	60° 15′, 177° 23'W
03/04/83	EJ	10	60° 13′, 177° 22′W
03/04/83	EJ	12	60° 13′, 177° 22′W
03/04/83	EJ	16	60° 11′, 177° 21'W
03/04/83	EJ	2	60° 08′, 177″ 19'W
03/04/83	EJ	2	60° 05′, 177° 15'W
03/04/83	PL	1	60° 30′, 177° 20′w
03/04/83	PL	1	60″ 27′, 177° 20'W
03/04/83	EJ	7	60″ 15′, 177° 20′w
03/04/83	EJ	1	60″ 13′, 177″ 20'W
03/04/83	EJ	1	60° 11′, 177° 20′W
03/04/83	EJ	15	60″ 09′, 177° 16'W
03/04/83	EJ	1	60° 09′, 177° 20′w
03/04/83	EJ	5	60° 09′, 177″ 16'W
03/04/83	EJ	7	60° 09′, 177″ 20'W
03/04/83	EJ	12	60″ 09′, 177° 20'W
03/04/83	EJ	1	60° 27′, 177° 16'W
03/04/83	UP	1	60° 30′, 177″ 16'W
03/04/83	EJ	1	60″ 05′, 177° 08'W
03/04/83	EJ	1	59″ 57′, 176″ 58'W
03/04/83	UP	1	60″ 24′, 176° 52′W
03/04/83	OR	15	60″ 47′, 176° 44′W
03/04/83	OR	13	60″ 47′, 176° 44′W

APPENDIX TABLE A-3 CONT.
RECORD OF PINNIPEDS AND BELUGA WHALES ENCOUNTERED IN THE NAVARIN BASIN DURING THE FOUR SURVEY SEASONS, MAY-JUNE, JULY-AUGUST, OCTOBER-NOVEMBER, 1982 AND FEBRUARY-MARCH 1983

Date	Species[a/]	Number[b/]	Location
	WINTER SURVEY (Continued)		
03/04/83	OR	1	60° 43′, 176* 44′W
03/04/83	UP	1	60° 39′, 176″ 44′W
03/04/83	PF	1	60° 25′, 176° 44′W
03/04/83	PF	2	60° 26′, 176° 40'W
03/04/83	PF	3	60° 26′, 176° 40'W
03/04/83	PF	1	60° 38′, 177° 05'W
03/04/83	PF	1	60″ 37′, 177° 09′W
03/04/83	UP	1	60° 52′, 177″ 16′W
03/04/83	UP	1	60° 53′, 177″ 16'W
03/04/83	UP	1	60° 56′, 177* 08'W
03/05/83	EJ	3	59° 37′, 176° 08'W
03/05/83	EJ	1	59033′, 175° 52′W
03/05/83	EJ	6	59° 42′, 175″ 44′W
03/05/83	EJ	10	59° 42′, 175° 44′W
03/05/83	EJ	2	59032′, 175° 51'W
03/05/83	UP	1	59° 55′, 175° 32′W
03/05/83	EJ	12	59″ 35′, 175″ 20'W
03/05/83	OR	1	59" 45', 175″ 20′W
03/05/83	PL	2	60″ 09′, 175° 20'W
03/05/83	OR	1	60° 05′, 175″ 23′W
03/05/83	PL	11	60° 04′, 175″ 25′W
03/05/83	EB	1	60″ 04′, 175° 25'W
03/06/83	PF	1	59″ 56′, 174° 53′W
03/06/83	PF	1	60007′, 174° 52'W
03/06/83	UP	1	60° 16′, 174° 44′W
03/06/83	OR	2	60° 23′, 174″ 44'W
03/06/83	OR	1	60° 22′, 174° 48′W
03/06/83	UP	1	60° 22′, 174° 48'W
03/06/83	OR	1	60° 22′, 174° 50'W
03/06/83	UP	1	60° 22′, 174° 51'W
03/06/83	UP	1	60° 20′, 175″ 05′W
03/06/83	OR	1	60° 19′, 175° 05′W
03/06/83	UP	1	60° 19′, 175° 05'W
03/06/83	UP	1	60° 16′, 175″ 04′W
03/06/83	UP	1	60° 11′, 175° 04'W
03/06/83	UP	1	60° 11′, 175° 04′W
03/06/83	PL	1	60° 10′, 175″ 06'W
03/06/83	OR	1	60° 10′, 175″ 06′W
03/06/83	UP	1	60″ 09′, 175° 06'W

APPENDIX TABLE A-3 CONT.

RECORD OF PINNIPEDS AND BELUGA WHALES ENCOUNTERED IN THE NAVARIN BASIN DURING THE FOUR SURVEY SEASONS, MAY-JUNE, JULY-AUGUST, OCTOBER-NOVEMBER, 1982 AND FEBRUARY-MARCH 1983

Date	Species[a]	Number[b]	Location
	WINTER SURVEY (Continued)		
03/07/83	PL	1	60° 23′, 175° 08′W
03/07/83	OR	1	60° 26′, 175° 10′W
03/07/83	UP	1	60′ 26′, 175° 08′W
03/07/83	PF	1	60° 23′, 175° 06′W
03/07/83	OR	1	60″ 23′, 175° 05′W
03/07/83	OR	1	60° 23′, 175° 00′W
03/07/83	OR	1	60° 23′, 174° 58′W
03/07/83	OR	3	60° 22′, 174″ 56′W
03/07/83	OR	2	60° 21′, 174° 56′W
03/07/83	OR	1	60° 21′, 174″ 56′W
03/07/83	OR	1	60° 21′, 174″ 56′W
03/07/83	OR	3	60″ 21′, 174″ 56′W
03/07/83	OR	2	60° 21′, 174° 56′W
03/07/83	OR	1	60° 20′, 174″ 56′W
03/07/83	OR	15	60° 20′, 174° 56′W
03/07/83	OR	8	60° 20′, 174° 56′W
03/07/83	OR	3	60° 20′, 174° 56′W
03/07/83	OR	1	60° 20′, 174° 56′W
03/07/83	OR	8	60° 19′, 174° 56′W
03/07/83	OR	1	60″ 19′, 174″ 56′W
03/07/83	OR	2	60° 19′, 174° 56′W
03/07/83	OR	7	60° 19′, 174″ 56′W
03/07/83	OR	2	60° 19′, 174° 56′W
03/07/83	OR	2	60″ 19′, 174° 56′W
03/07/83	OR	4	60° 19′, 174″ 56′W
03/07/83	OR	11	60° 19′, 174° 56′W
03/07/83	OR	12	60° 19′, 174° 56′W
03/07/83	OR	2	60″ 19′, 174° 56′W
03/07/83	PF	1	60° 17′, 174° 56′W
03/08/83	PF	1	59″ 53′, 174° 28′W
03/08/83	EJ	1	59° 27′, 174° 40′W
03/08/83	UP	1	59° 26′, 174° 49′W
03/09/83	EJ	1	58° 59′, 174° 32′W
03/09/83	EJ	3	58° 57′, 174° 32′W
03/09/83	EJ	6	58″ 56′, 174° 32′W
03/09/83	EJ	1	58° 53′, 174″ 31′W
03/09/83	UP	1	58° 57′, 174° 16′W
03/09/83	EJ	1	59″ 04′, 174° 16′W
03/09/83	EJ	1	59° 09′, 174° 14′W
03/10/83	UP	1	60° 16′, 173° 06′W
03/10/83	OR	1	60° 28′, 173° 08′W

APPENDIX TABLE A-3 CONT.
RECORD OF PINNIPEDS AND BELUGA WHALES ENCOUNTERED IN THE NAVARIN BASIN DURING THE FOUR SURVEY SEASONS, MAY-JUNE, JULY-AUGUST, OCTOBER-NOVEMBER, 1982 AND FEBRUARY-MARCH 1983

Date	Species[a/]	Number[b/]	Location
	WINTER SURVEY (Continued)		
03/10/83	OR	1	60° 28′, 173° 08′W
03/10/83	OR	3	60° 28′, 173″ 08′W
03/10/83	OR	1	60° 27′, 173° 08′W
03/10/83	UP	1	60″ 27′, 173° 08'W
03/10/83	UP	1	60″ 23′, 173° 09′W
03/10/83	UP	1	60° 18′, 173′ 08'W
03/10/83	UP	1	60″ 17′, 173″ 08′W
03/10/83	PF	1	60° 15′, 173″ 07'W
03/10/83	UP	1	60° 14′, 173° 06′W
03/10/83	UP	1	60° 11′, 173° 07′W
03/10/83	UP	2	60° 08′, 173° 08′W
03/10/83	UP	1	60″ 06′, 173° 08'W
03/10/83	UP	1	60° 02′, 173″ 08′W
03/10/83	UP	1	60° 01', 172° 56'W
03/10/83	UP	1	60° 04′, 172° 56'W
03/10/83	PL	1	6(I″ 06′, 172° 56′W
03/10/83	UP	1	60″ 08′, 172° 56'W
03/11/83	UP	1	60° 19′, 172″ 52'W
03/11/83	OR	3	60″ 19′, 172° 52′W
03/11/83	OR	1	60° 14′, 172″ 35′W
03/11/83	OR	1	60″ 15', 172° 34′W
03/11/83	OR	1	60″ 15′, 172° 34′W
03/11/83	OR	3	60° 16′, 172° 33'W
03/11/83	OR	1	60° 16′, 172° 33′W
03/11/83	OR	2	60° 16′, 172″ 32'W
03/11/83	OR	1	60° 16′, 172″ 32′W
03/11/83	OR	3	60° 16′, 172° 32′W
03/11/83	OR	1	60″ 09′, 172° 32′W
03/11/83	PL	1	60″ 04′, 172° 28′W
03/11/83	OR	3	60° 05′, 172° 29′W
03/11/83	OR	1	60° 05′, 172° 29'W
03/12/83	OR	1	60° 34′, 173° 37′W
03/12/83	OR	2	60° 33′, 173° 42'W
03/1 2/83	OR	1	60° 31', 173″ 44′W
03/12/83	OR	1	60″ 29′, 173° 46'W
03/12/83	OR	1	60″ 25′, 173″ 44′W
03/12/83	OR	2	60″ 26′, 173° 47′W
03/12/83	OR	6	60″ 25′, 173″ 48′W
03/12/83	OR	3	60″ 24′, 173″ 48'W
03/12/83	OR	15	60° 23′, 173° 52′W
03/12/83	OR	1	60° 17', 173° 54′W
03/12/83	OR	1	60° 17′, 173″ 54′W

APPENDIX TABLE A-3 CONT.
RECORD OF PINNIPEDS AND BELUGA WHALES ENCOUNTERED IN THE NAVARIN BASIN DURING THE FOUR SURVEY SEASONS, MAY-JUNE, JULY-AUGUST, OCTOBER-NOVEMBER, 1982 AND FEBRUARY-MARCH 1983

Date	Species[a/]	Number[b/]	Location
	WINTER SURVEY (Continued)		
03/12/83	OR	1	60° 20′, 173″ 54′W
03/12/83	OR	5	60018′, 173° 55'W
03/12/83	OR	1	60° 14′, 173″ 54'W
03/12/83	UP	1	60° 14′, 173″ 54'W
03/12/83	OR	5	60″ 17′, 173° 56′W
03/12/83	OR	4	60° 15′, 173″ 53′W
03/12/83	OR	3	60° 15′, 173″ 53′W
03/12/83	OR	2	60° 22′, 173″ 56′W
03/12/83	OR	1	60″ 18′, 173° 56'W
03/1 2/83	UP	1	60° 16′, 173° 56′W
03/12/83	OR	12	60° 16′, 174° 08'W
03/12/83	PF	4	60″07′, 174″ 08'W
03/12/83	PF	24	60° 02′, 174″ 13'W
03/12/83	OR	2	60° 01', 174° 16'W
03/12/83	UP	1	60° 01′, 174° 18'W
03/12/83	EB	1	60° 00′, 174° 19'W
03/12/83	OR	1	59″ 59′, 174″ 23′W
03/12/83	UP	1	59″ 59′, 174° 23'W
03/12/83	UP	1	59° 59′, 174″ 23′W
03/12/83	OR	2	60° 03′, 174° 28′W
03/12/83	EB	1	59° 59′, 174″ 26′W
03/12/83	EB	1	59° 59′, 174° 29′W
03/1 2/83	UP	1	60° 00′, 174° 31′W
03/12/83	UP	2	60° 01′, 174° 31'W
03/12/83	DL	11	59° 58′, 174° 11'W
03/12/83	DL	4	59″ 57′, 174° 13'W
03/12/83	DL	5	59″ 58′, 174° 16'W
03/12/83	DL	2	59° 58′, 174° 16'W
03/12/83	DL	25	60° 04′, 174″ 20′w
03/12/83	DL	2	60° 04′, 174° 20′w
03/12/83	DL	2	60° 04′, 174″ 20′W
03/12/83	DL	6	59° 54′, 174° 20′W
03/12/83	DL	2	59° 54′, 174° 20′W
03/12/83	DL	8	59° 56′, 174″ 20′w
03/12/83	DL	4	59° 55′, 174″ 28′W
03/12/83	DL	1	59° 55′, 174″ 28'W
03/12/83	DL	2	60″ 00′, 174″ 28′W
03/12/83	DL	12	59″ 57′, 174″ 28′W
03/12/83	DL	6	59″ 55′, 174° 32′W
03/12/83	DL	7	59″ 55′, 174° 32′w

APPENDIX TABLE A-3 CONT.
RECORD OF PINNIPEDS AND BELUGA WHALES ENCOUNTERED IN THE NAVARIN BASIN DURING THE FOUR SURVEY SEASONS, MAY-JUNE, JULY-AUGUST, OCTOBER-NOVEMBER, 1982 AND FEBRUARY-MARCH 1983

Date	Species[a/]	Number[b/]	Location
	WINTER SURVEY (Continued)		
03/12/83	DL	6	59° 54′, 174° 32′W
03/12/83	DL	6	59″ 56′, 174° 33′W
03/12/83	DL	2	59° 56′, 174″ 33′W
03/12/83	DL	3	59° 56′, 174° 33′W
03/12/83	DL	1	59° 57′, 174° 33′W
03/12/83	DL	3	59° 58′, 174° 32′W
03/12/83	DL	3	59° 58′, 174° 32′W
03/12/83	DL	6	59° 55′, 174″ 32′W
03/13/83	PF	4	60° 10′, 174″ 38′W
03/13/83	PF	1	60° 10′, 174° 38′W
03/13/83	PF	3	60° 12′, 174° 23′W
03/13/83	OR	1	60° 19′, 174° 32′W
03/13/83	OR	2	60° 17′, 174° 28′W
03/13/83	UP	2	60° 08′, 174° 29′W
03/13/83	OR	1	60″ 07′, 174° 27′W
03/13/83	OR	1	60012′, 174° 21′W
03/13/83	EB	1	60° 12′, 174″ 21′W
03/13/83	OR	23	60° 11′, 174° 20′W
03/13/83	OR	37	60° 11′, 174″ 20′W
03/13/83	OR	2	60° 17′, 174° 20′W
03/13/83	OR	16	60° 16′, 174° 20′W
03/13/83	OR	12	60° 17′, 174″ 20′W
03/13/83	OR	2	60″ 17′, 174° 20′W
03/13/83	PF	3	60° 11′, 174° 15′W
03/13/83	OR	12	60″ 13′, 174° 09′W
03/13/83	OR	11	60″ 13′, 174° 09′W
03/13/83	OR	4	60° 13′, 174° 09′W
03/1 3/83	OR	3	60″ 13′, 174″ 09′W
03/13/83	PF	1	60° 08′, 174° 04′W
03/13/83	OR	42	60° 13′, 174° 10′W
03/13/83	OR	4	60° 12′, 174° 08′W
03/1 3/83	OR	6	60° 21′, 174″ 07′W
03/13/83	OR	1	60° 21′, 174″ 08′W
03/13/83	OR	35	60° 18′, 174° 08′W
03/1 3/83	OR	38	60° 15′, 174° 03′W
03/13/83	OR	7	60° 15′, 174″ 08′W
03/1 3/83	OR	99	60° 15′, 174° 03′W
03/13/83	OR	3	60° 12′, 174″ 08′W
03/13/83	OR	23	60° 16′, 174° 06′W
03/13/83	OR	36	60″ 16′, 174* 06′W
03/13/83	OR	22	60″ 17′, 173° 55′W

APPENDIX TABLE A-3 CONT.
RECORD OF PINNIPEDS AND BELUGA WHALES ENCOUNTERED IN THE NAVARIN BASIN DURING THE FOUR SURVEY SEASONS,
MAY-JUNE, JULY-AUGUST, OCTOBER-NOVEMBER, 1982
AND FEBRUARY-MARCH 1983

Date	Species[a/]	Number[b/]	Location
	WINTER SURVEY (Continued)		
03/13/83	OR	14	60° 17′, 173″ 55′W
03/13/83	OR	1	60° 16′, 173° 52'W
03/13/83	OR	2	60017′, 173° 45′W
03/13/83	OR	2	60° 16′, 174° 01'W
03/13/83	OR	12	60″ 16′, 174° 01'W
03/13/83	OR	1	60° 16′, 173° 58'W
03/13/83	OR	12	60″ 16′, 173° 55′W
03/13/83	OR	12	60″ 17′, 173° 53'W
03/1 3/83	OR	3	60″17′, 173″ 53'W
03/1 3/83	OR	8	60° 20′, 173″ 35'W
03/13/83	OR	20	60° 19′, 173° 20'W
03/13/83	OR	7	60020′, 173″ 20'W
03/13/83	DL	433	60″ 19′, 174° 22'W
03/14/83	OR	1	60° 35′, 173° 44′W
03/14/83	OR	4	60° 35′, 173* 44′W
03/14/83	UP	1	60° 26′, 173″ 40′W
03/14/83	OR	6	60° 40′, 173° 41'W
03/14/83	PF	1	60″ 38′, 173° 53'W
03/14/83	PF	1	60″ 38′, 173″ 53′W
03/14/83	PF	1	60° 38′, 173″ 53′W
03/14/83	OR	1	60° 26′, 173* 49'W
03/14/83	DL	13	60° 44′, 173° 50′W
03/14/83	DL	3	60″ 44′, 173″ 50'W
03/14/83	DL	18	60″44′, 173″ 50′W
03/14/83	DL	2	60° 44′, 173° 50'W
03/15/83	OR	12	60001′, 173° 20′W
03/15/83	OR	1	59″ 59′, 173″ 20'W
03/15/83	OR	2	59° 53′, 173* 25′W
03/15/83	OR	4	59° 58′, 173″ 32'W
03/15/83	PF	1	59″ 47′, 173″ 48′W
03/15/83	UP	1	59° 49′, 174° 08'W
03/15/83	UP	1	59° 47′, 174° 08′W
03/15/83	UP	1	59° 37′, 174* 20′W
03/15/83	EB	1	59° 46′, 174° 26'W
03/15/83	UP	1	59° 35′, 174″ 42′W
03/15/83	UP	1	59″ 36′, 174° 47'W
03/15/83	UP	1	59″36′, 174″ 52'W
03/16/83	OR	1	60″43′, 175″ 22′W
03/16/83	PL	1	60° 26′, 176° 02'W
03/16/83	OR	2	60″25′, 176″ 03′W

APPENDIX TABLE A-4

CHI-SQUARE ANALYSES OF PINNIPED OCCURRENCE
IN SAMPLING UNITS OF THE MARGINAL ICE FRONT

Sampling unit	Distance surveyed (nm)	Proportion of total distance	Walrus No. obs.	Walrus No. exp.	Walrus Prop. obs.	Walrus 95 % confidence interval	Northern sea lion No. obs.	Northern sea lion No. exp.	Northern sea lion Prop. obs.	Northern sea lion 95 % confidence interval
24	147	0.061	25	9.0	0.170	0.088 ≤ p ≤ 0.252[a]	3	4.2	0.(M3	-0.021 ≤ p ≤ 0.107
25	462	0.192	43	28*2	0.293	0.194 ≤ p ≤ 0.392[a]	0	13.2	0.000	[b]
26	613	0.254	64	37.4	0.435	0.327 ≤ p ≤ 0.543[a]	8	17.6	0.116	0.014< p ≤ 0.218[b]
27	482	0.200	5	29.4	0.034	-0.005 ≤ p ≤ 0.073[b]	10	13.8	0.145	0.033 ≤ p ≤ 0.257
28	466	0.193	0	28.4	0.000	[b]	36	13.3	0.522	0.364 ≤ p ≤ 0.680[a]
29	240	0.100	10	14.6	0.068	0,013< p <0.123	12	6.9	0.174	0.054< p <0.291
Total	2410	1.000	147	147.0	1.000	X^2 = 105.23	69	69.0	1.000	X^2 = 62.34

Sapling unit	Distance surveyed (nm)	Proportion of total distance	spotted seal No. obs	spotted seal No. exp	spotted seal Prop. obs.	spotted seal 95 % confidence interval	Ribbon seal No. obs.	Ribbon seal No. exp.	Ribbon seal Prep. obs.	Ribbon seal 95 % confidence interva
24	147	0.061	2				0	5.5	0.227	0.027 ≤ p ≤ 0.427
25	462	0.192	1	11.7	0.072	-0.309 ≤ p ≤ 0.175[b]	5			
26	613	0.254	4	10.7	0.095	-0.022 ≤ p ≤ 0.212[b]	12	5.6	0.546	0.308 ≤ p ≤ 0.784[a]
27	482	0.200	4	8.4	0.095	-0.022 ≤ p ≤ 0.212	3			
28	466	0.193	3	8.1	0.071	-0.031 ≤ p ≤ 0.173[b]	2	10.9	0.227	0.027 ≤ p ≤ 0.427[b]
29	240	0.100	28	4.1	0.667	0.479< p < 0.855[a]	0			
Total	2410	1.000	42	42.0	1.000	X^2= 155.39	22	22.0	1.000	X^2 =10.55

[a] Significant preference.
[b] Significant avoidance.

APPENDIX TABLE A-5

CHI-SQUARE ANALYSIS OF PACIFIC WALRUS OCCURRENCE IN DIFFERENT ICE CONCENTRATION, SIZE, AND THICKNESS CATEGORIES

Ice Concentration category	Area (nm^2)	Proportion of total area	Number observed	Number expected	Proportion observed	95% confidence interval
0-20	53	0.045	0	4	0.000	
21-40	62	0.051	11	4	0.132	0.039< p <0.225
41-60	208	0.173	10	14	0.121	0.032 < p < 0.210
61-83	357	0.296	26	25	0.313	0.186 < p < 0.440
81-100	525	0.436	36	36	0.434	0.298 < p < 0.570
Total	1205	1.000	83	83	1.000	$x^2 = 2.31$

Ice Size Category	Area (nm^2)	Proportion of total area		Number observed	Number expected	Proportion observed	95% confidence interval
&ease-slush	91	0.100		30	8	0.361	0.233< p < 0.493[a]
Pan-smal 1	192	0.210		4	18	0.048	-0.0117 p < 0.107[b]
Med-large	159	0.174	4	15	0.048		-0.011 < p < 0.107[b]
Vast-giant	472	0.516	45	42	0.542	0.406 < p	
Total	914	1.000	83	83	1.000	$x^2 = 79.67$	

Ice Thickness Category	Area (nm^2)	Proportion of total area	Number observed	Number expected	Proportion observed	95% confidence interval
New (<10 cm)	142	0.118	25	10	0.301	0.180 < p < 0.422[a]
Young (10-30cm)	468	0.388	28	32	0.338	0.214 < p < 0.462
First year (>30 cm)	595	0.494	30	41	0.361	0.235< p < 0.487[b]
Total	1205	1.000	83	83	1.000	$x^2 \cdot 25.95$

a/ Significant preference.
b/ Significant avoidance.

APPENDIX TABLE A-6

CHI-SQUARE ANALYSIS OF NORTHERN SEA LION OCCURRENCE IN DIFFERENT ICE CONCENTRATION, SIZE, AND THICKNESS CATEGORIES

Ice Concentration category	Area (nm^2)	Proportion of total area	Number observed	Number expected	Proportion observed	95% confidence interval
0-20	53	0.045	2	1	0.083	
21-40	62	0.051	5	1	0.208	$0.298 \leq p \leq 0.785$ [a]
41-Q	208	0.173	6	4	0.283	
61-80	357	0.294	9	7	0.375	$0.138 \leq p \leq 0.612$
81-1(XI	525	0.437	2	11	0.083	$-0.052 \leq p \leq 0.218$ [b]
Total	1205	1.000	24	24	1.000	$x^2 = 16.10$

Ice Size Category	Area (nm^2)	Proportion of total area	Number observed	Number expected	Proportion observed	95% confidence interval
-Se-Slush	91	0.100	2	3	0.083	
Pan-small	192	0.210	16	5	0.667	$0.552 \leq p \leq 0.948$ [a]
Meal-large	159	0.174	2	4	0.083	
Vast-giant	472	0.516	4	12	0.167	$0.052 \leq p \leq 0.448$ [b]
Total	914	1.000	24	24	1.000	$x^2 = 18.75$

Ice Thickness Category	Area (nm^2)	Proportion of total area	Number observed	Number expected	PmPortion observed	95% confidence interval
New (do an)	142	0.118	1	3	0.042	
Young (loam)	468	0.388	8	9	0.333	$0.154 \leq p \leq 0.596$
First year (>30 cm)	595	0.494,	15	12	0.625	$0.404 < p < 0.846$
Total	1205	1.000	24	24	1.000	$x^2 \cdot 1.50$

[a] Significant preference.
[b] Significant avoidance.

APPENDIX TABLE A-7

CHI-SQUARE ANALYSIS OF SPOTTED SEAL Occurrence IN DIFFERENT ICE CONCENTRATION, SIZE, AND THICKNESS CATEGORIES

Ice Concentration Category	Area (nm^2)	Proportion of total area	Number observed	Number expected	Proportion observed	95% confidence interval
0-20	53	0.045	0	1	0.000	
21-40	62	0.051	11	1	0.380 -	$0.296 \leq p \leq 0.740$ [a]
41-60	208	0.173	4	5	0.138 [1]	
61-83	357	0.294	7	9	0.241	$0.024 \leq p \leq 0.431$
81-100	525	0.437	7	13	0.241	$0.024 \leq p \leq 0.431$ [b]
Total	1205	1.000	29	29	1.000	$x^2 = 12.36$

Ice Size Category	Area (nm^2)	Proportion of total area	Number observed	Number expected	Proportion observed	95% confidence interval
Grease-slush	91	0.100	1	3	0.034	
Pan-small	192	0.210	13	6	0.448	$0.260 < p < 0.705$
Med-large	159	0.174	2	5	0.069	$-0.044 \leq p \leq 0.182$
Vast-giant	472	0.516	13	15	0.448	$0.227 < p < 0.670$
Total	914	1.000	29	29	1.000	$x^2 = 4.84$

Ice Thickness Category	Area (nm^2)	Proportion of total area	Number observed	Number expected	Proportion observed	95% confidence interval
New (do an)	142	0.118	1	4	0.035	$0.038 \leq p \leq 0.376$ [b]
Young (lo-mm)	468	0.388	5	11	0.172	
First year (>30 cm)	595	0.494	23	14	0.793	$0.624 < p < 0.962$ [a]
Total	1205	1.000	29	29	1.000	$x^2 = 11.19$

[a] Significant preference.
[b] Significant avoidance.

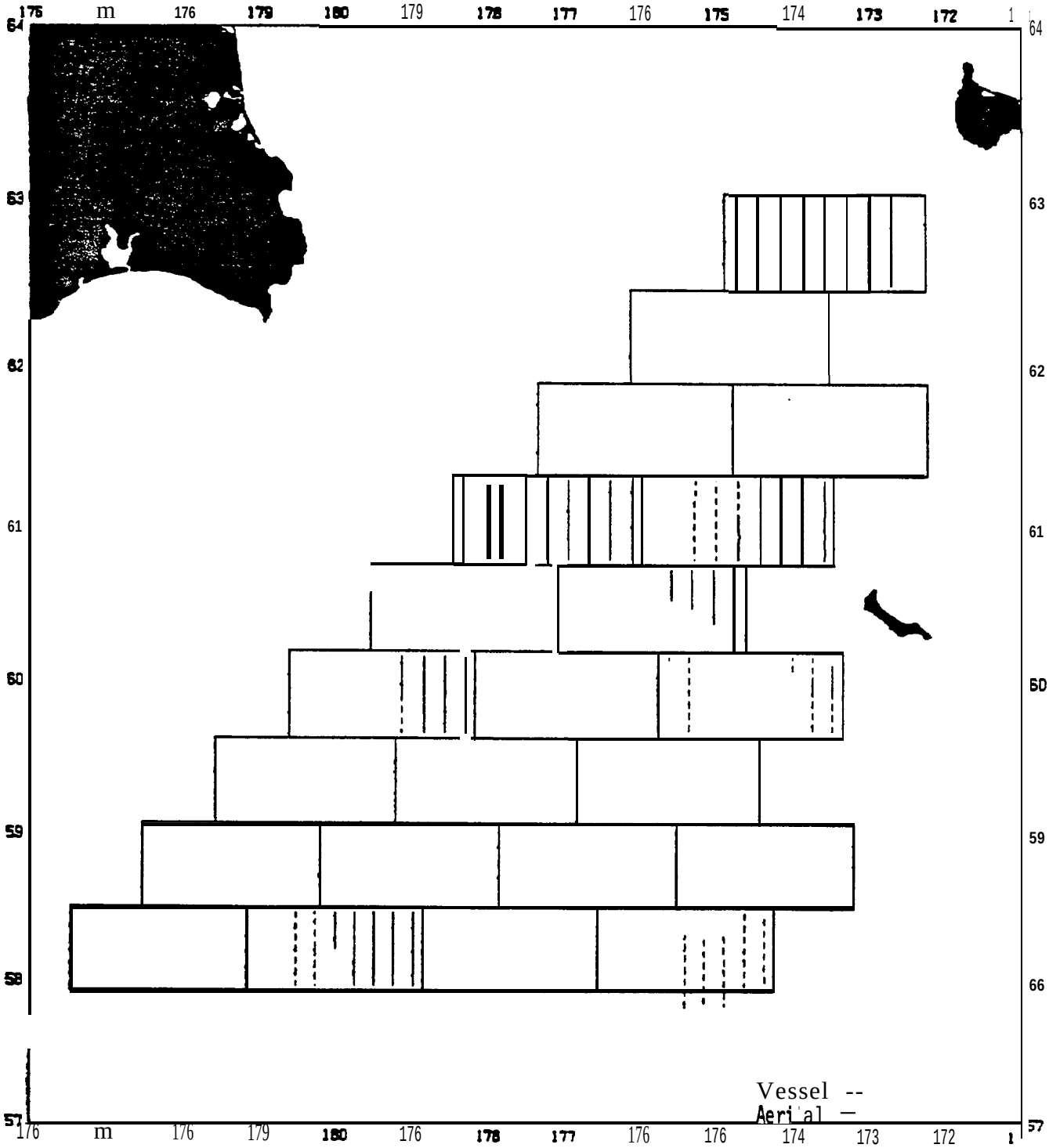


FIGURE A-1 **LOCATION OF AERIAL AND VESSEL TRACK LINES SURVEYED IN THE NAVARIN BASIN DURING SPRING, MAY - JUNE, 1982.**

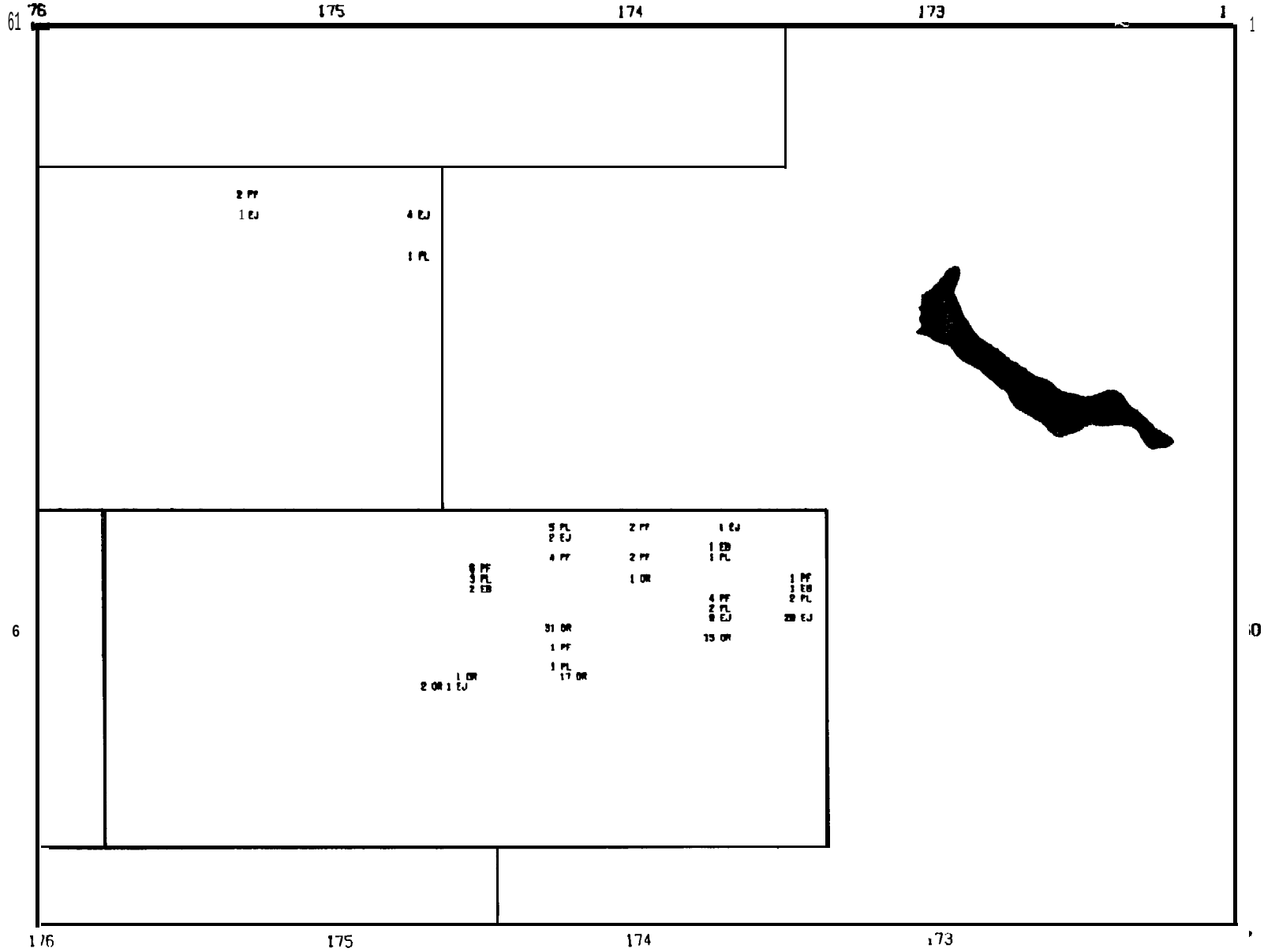


FIGURE A-2 **LOCATION OF PINNIPEDS OBSERVED IN THE NAVARIN BASIN DURING THE SPRING SURVEY, MAY-JUNE 1982. (Abbreviations are defined in Appendix Table).**

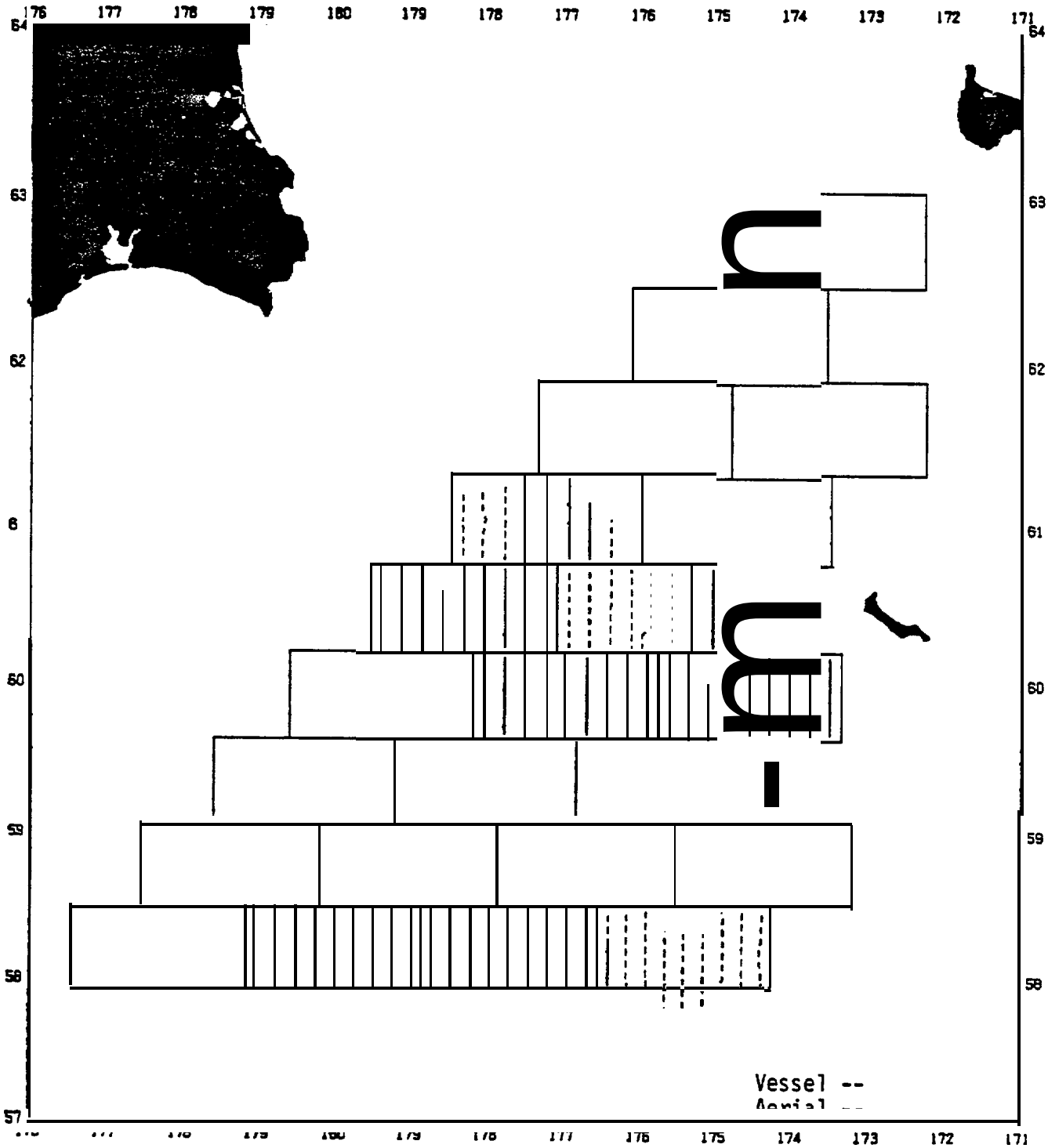


FIGURE A-3 LOCATION OF AERIAL AND VESSEL TRACKLINES SURVEYED IN THE NAVARIN BASIN DURING SUMMER, JULY - AUGUST, 1982.

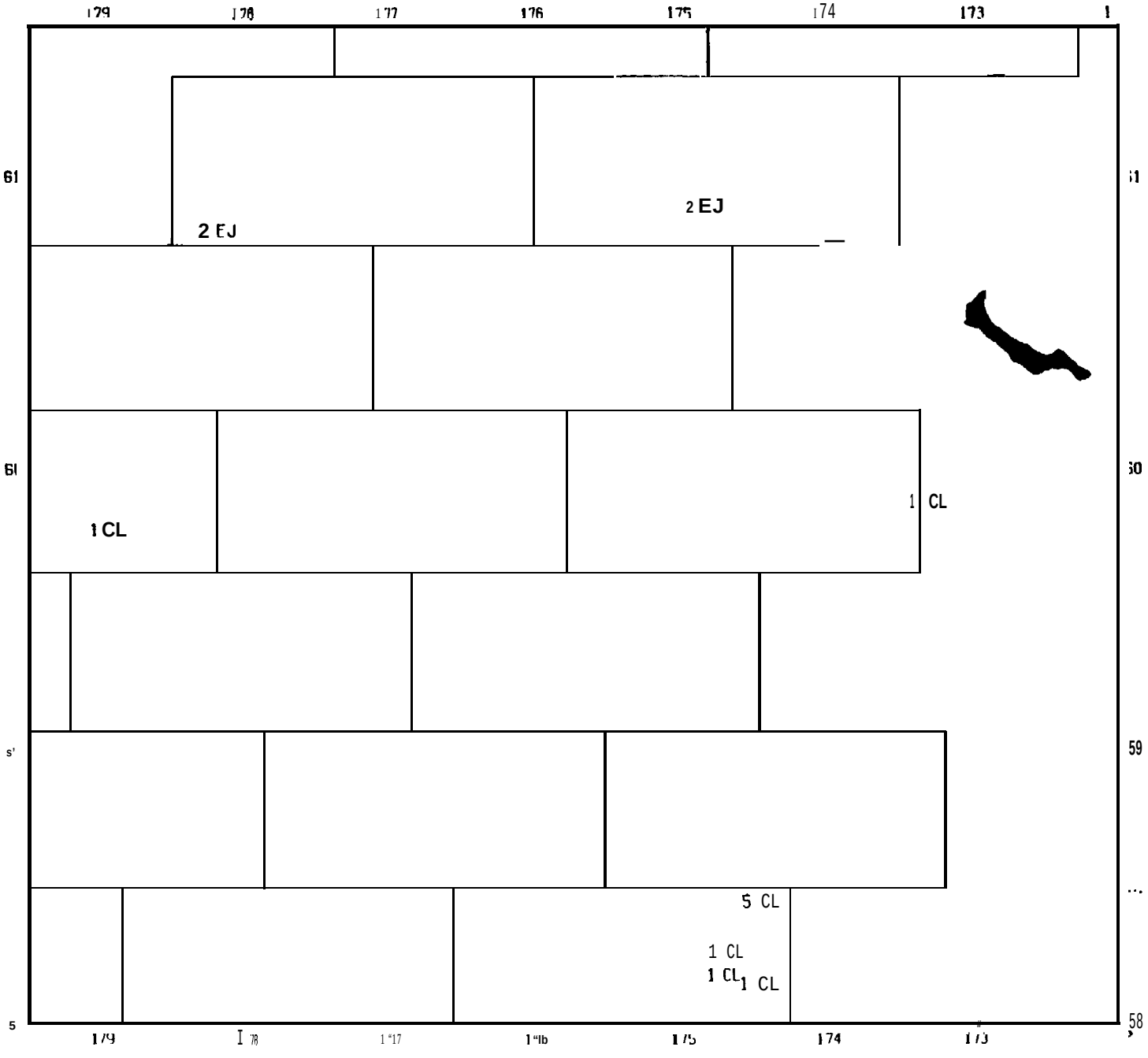


FIGURE A-4 LOCATION OF PINNIPEDS OBSERVED IN THE NAVARIN BASIN DURING THE SUMMER SURVEYS, JULY-AUGUST 1982. (Abbreviations are

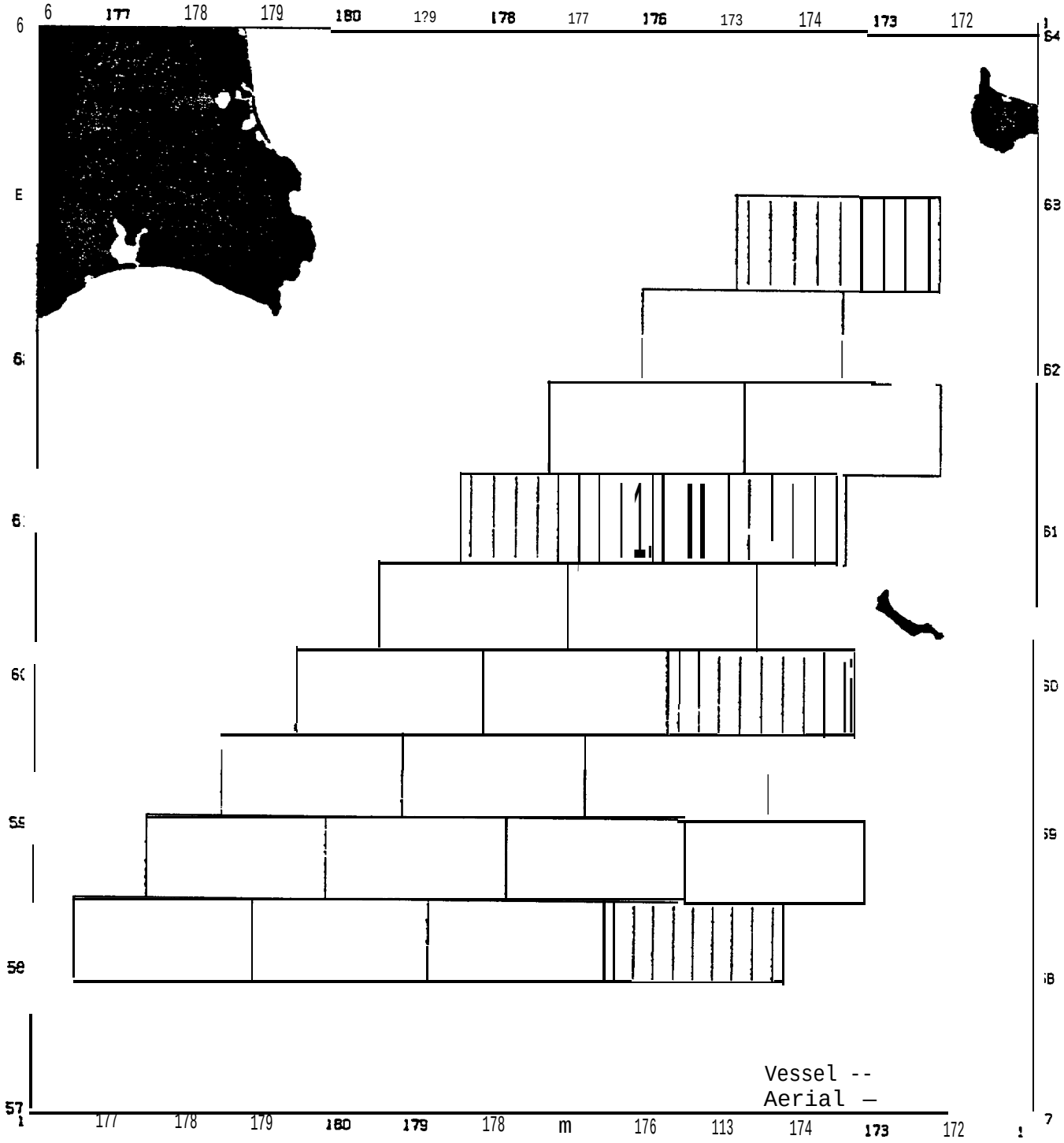


FIGURE A-5 **LOCATION OF AERIAL AND VESSEL TRACKLINES SURVEYED IN THE NAVARIN BASIN DURING FALL, OCTOBER - NOVEMBER, 1982.**

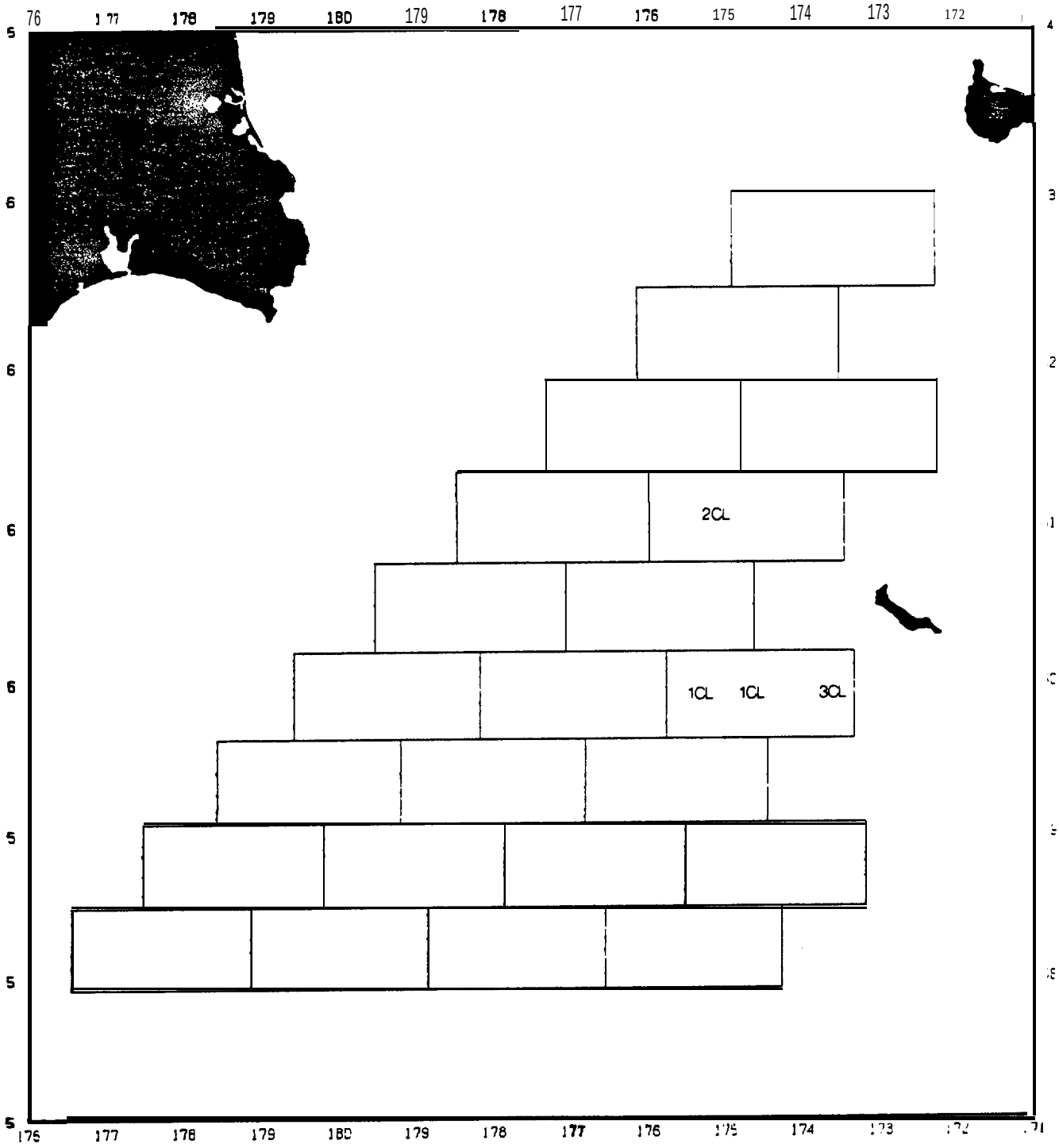


FIGURE A-6 **LOCATION OF PINNIPEDS OBSERVED IN THE NAVARIN BASIN DURING THE FALL SURVEYS, OCTOBER-NOVEMBER 1982. (Abbreviations are defined in Appendix Table).**

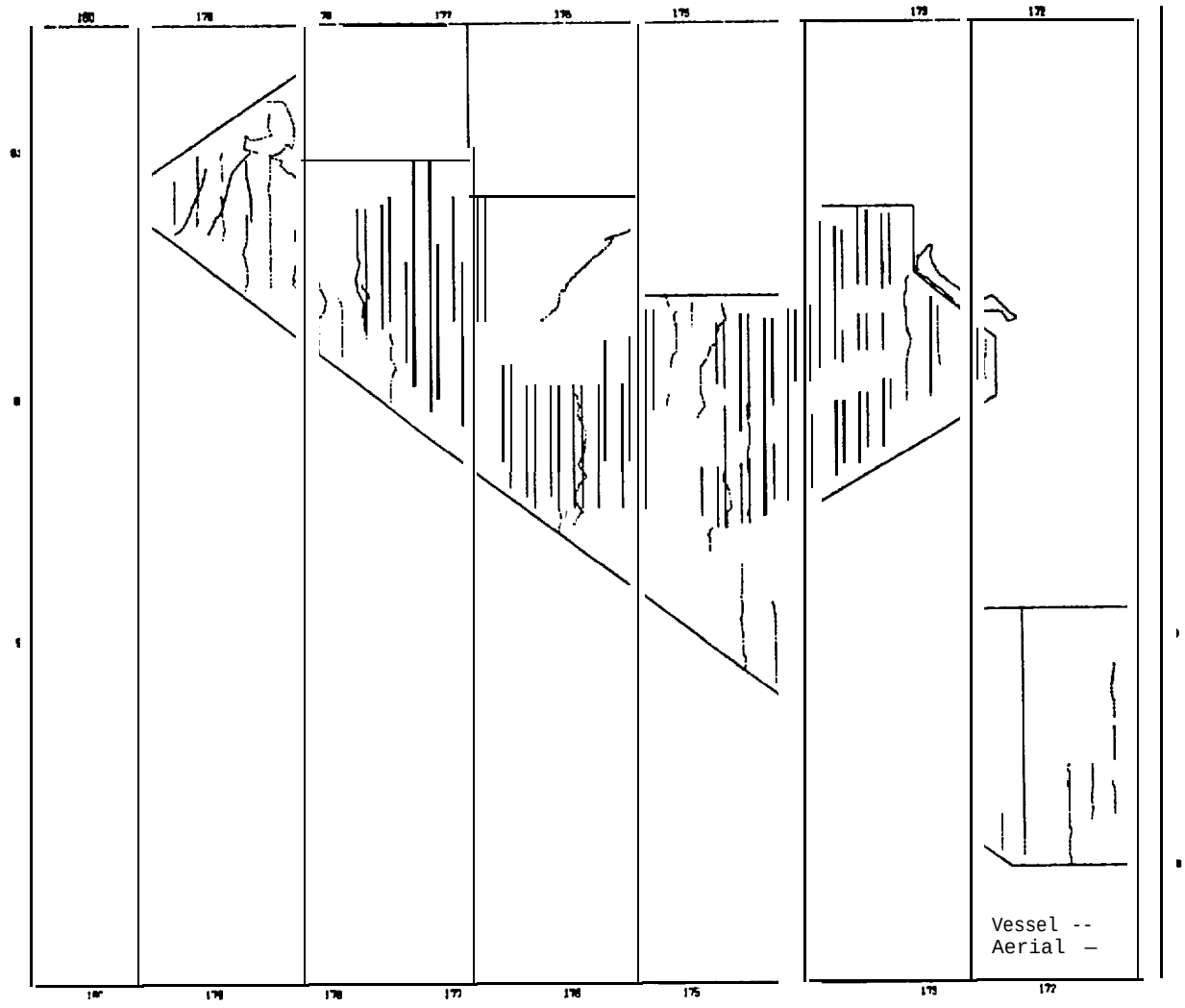


FIGURE A-7 LOCATION OF AERIAL AND VESSEL TRACKLINES SURVEYED IN THE **NAVARIN BASIN DURING WINTER, FEBRUARY - MARCH, 1983.**

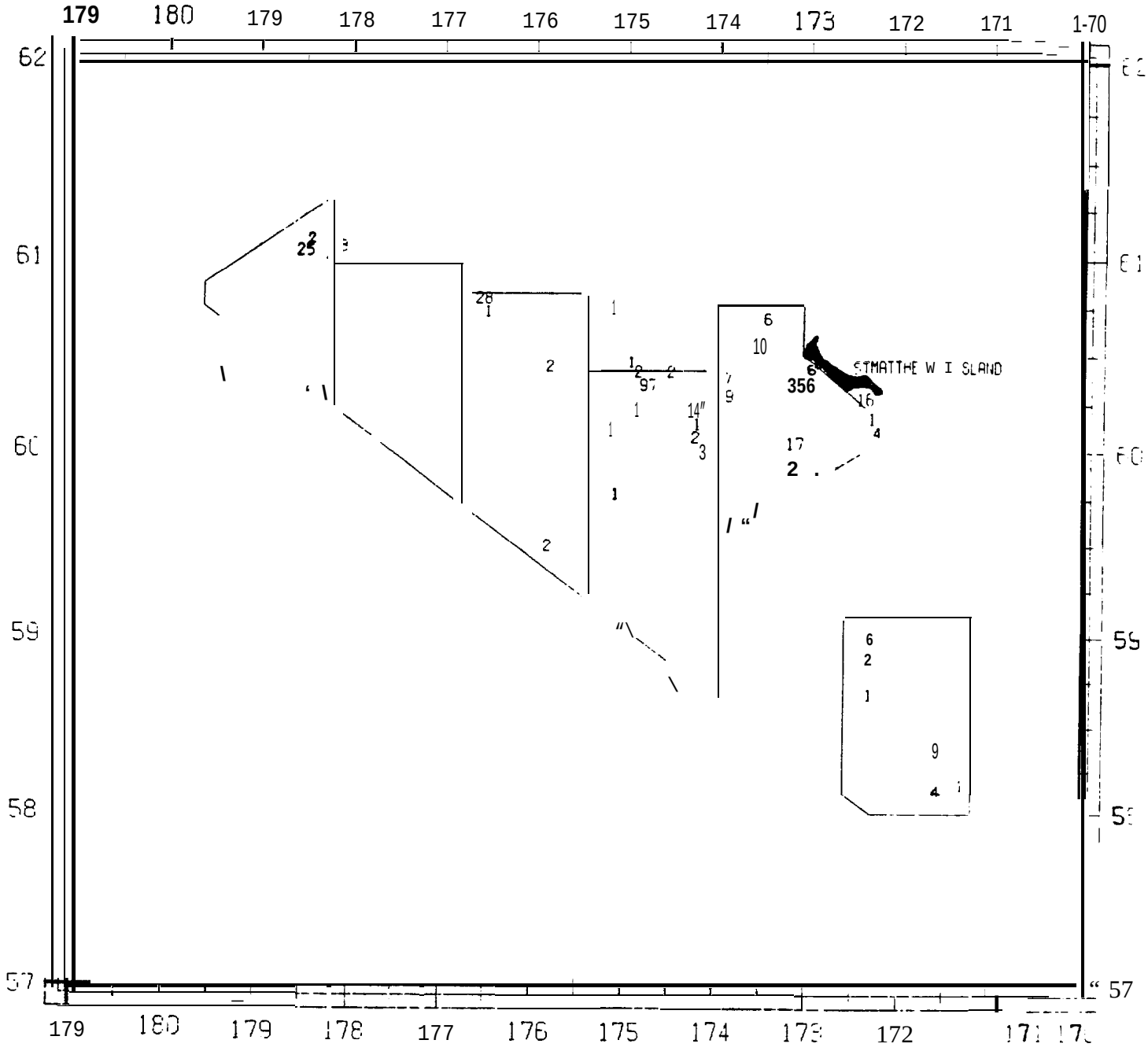


FIGURE A-8 **LOCATION OF WALRUSES OBSERVED IN THE NAVARIN BASIN DURING THE WINTER SURVEYS, FEBRUARY-MARCH 1983**

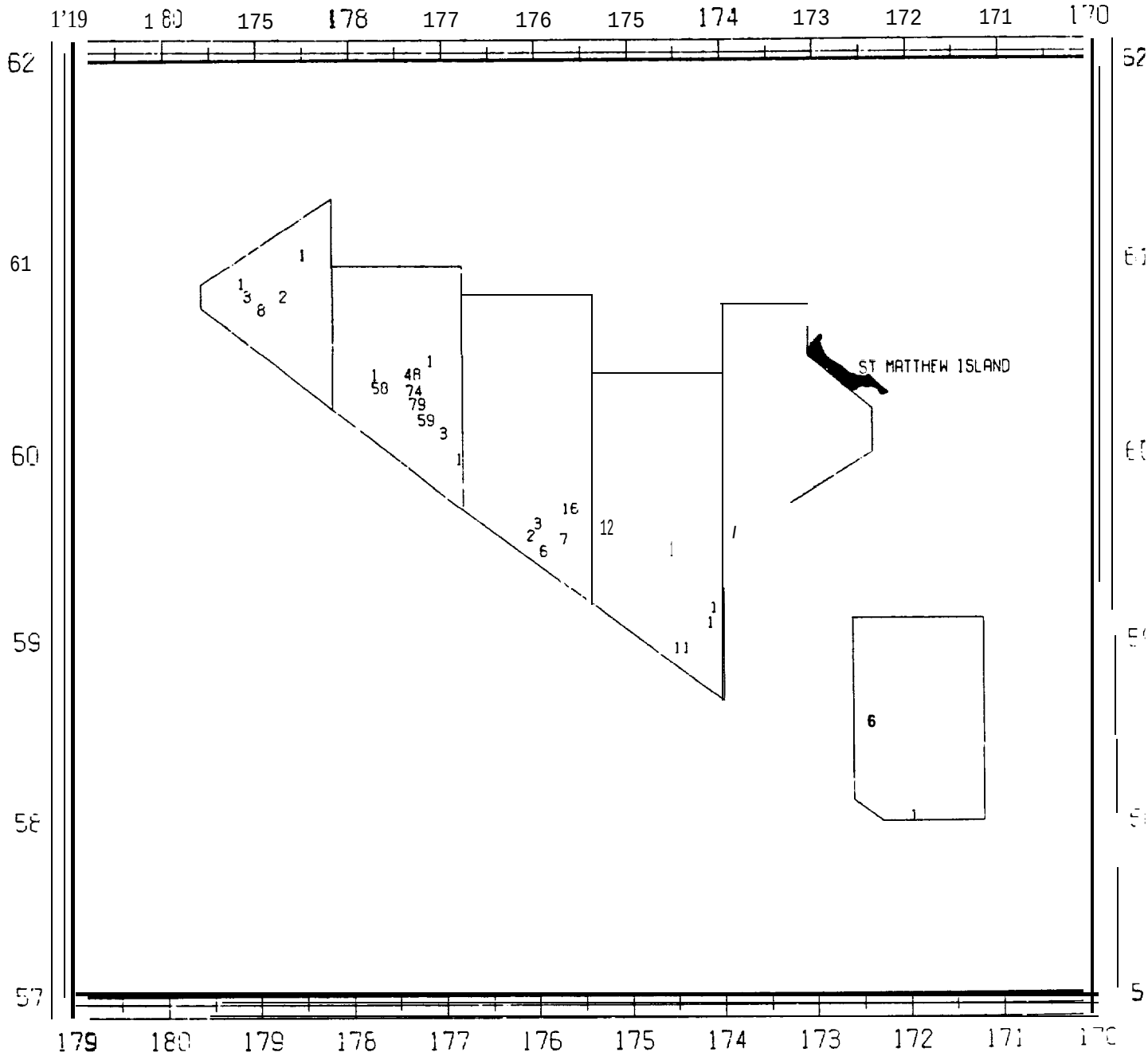


FIGURE A-9 LOCATION OF NORTHERN SEA **LIONS OBSERVED IN THE NAVARIN BASIN DURING THE WINTER SURVEYS, FEBRUARY-MARCH 1983**

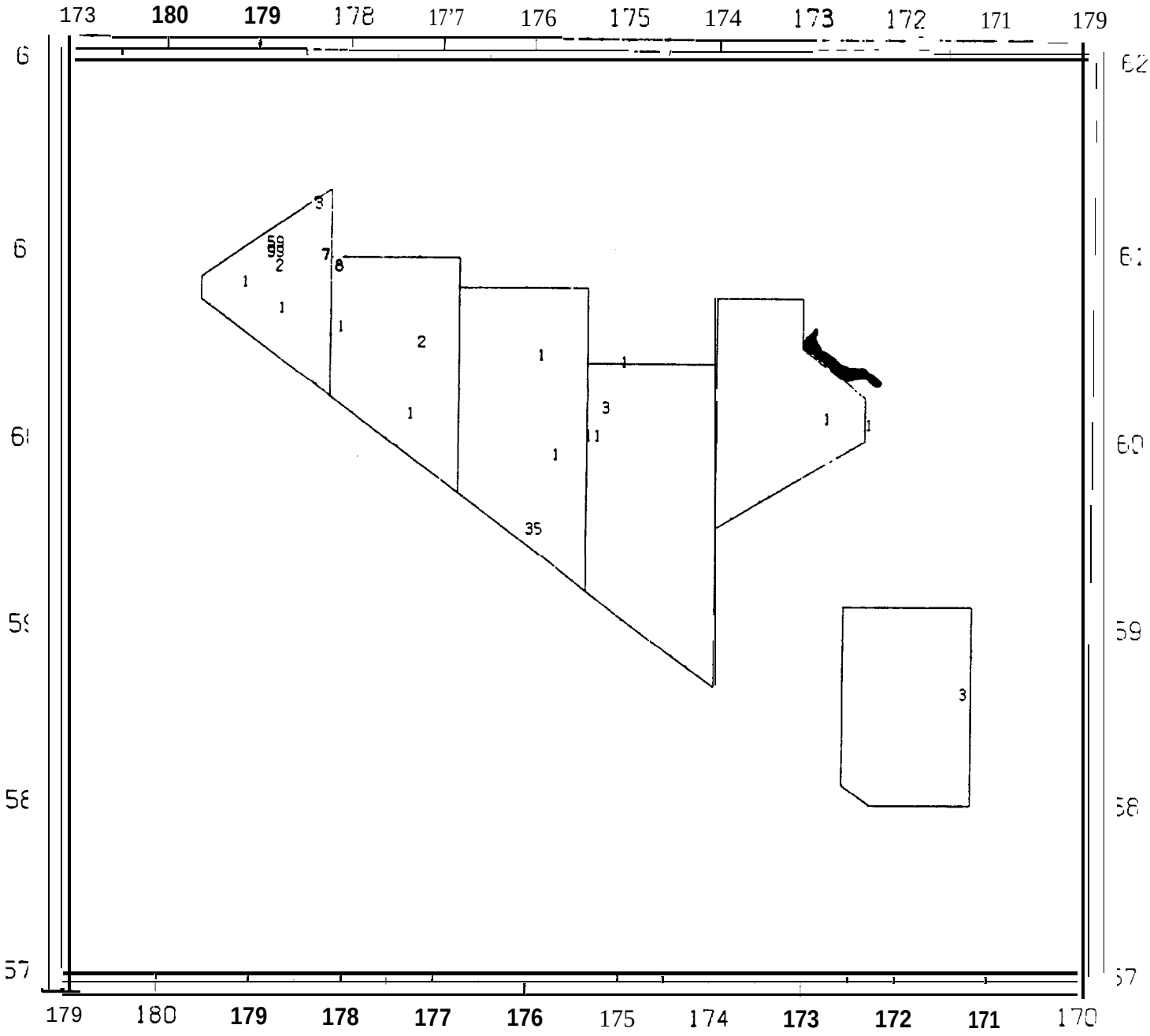


FIGURE A-10 **LOCATION OF SPOTTED SEALS OBSERVED IN** THE **NAVARIN** BASIN DURING THE WINTER SURVEYS, FEBRUARY-MARCH 1083.

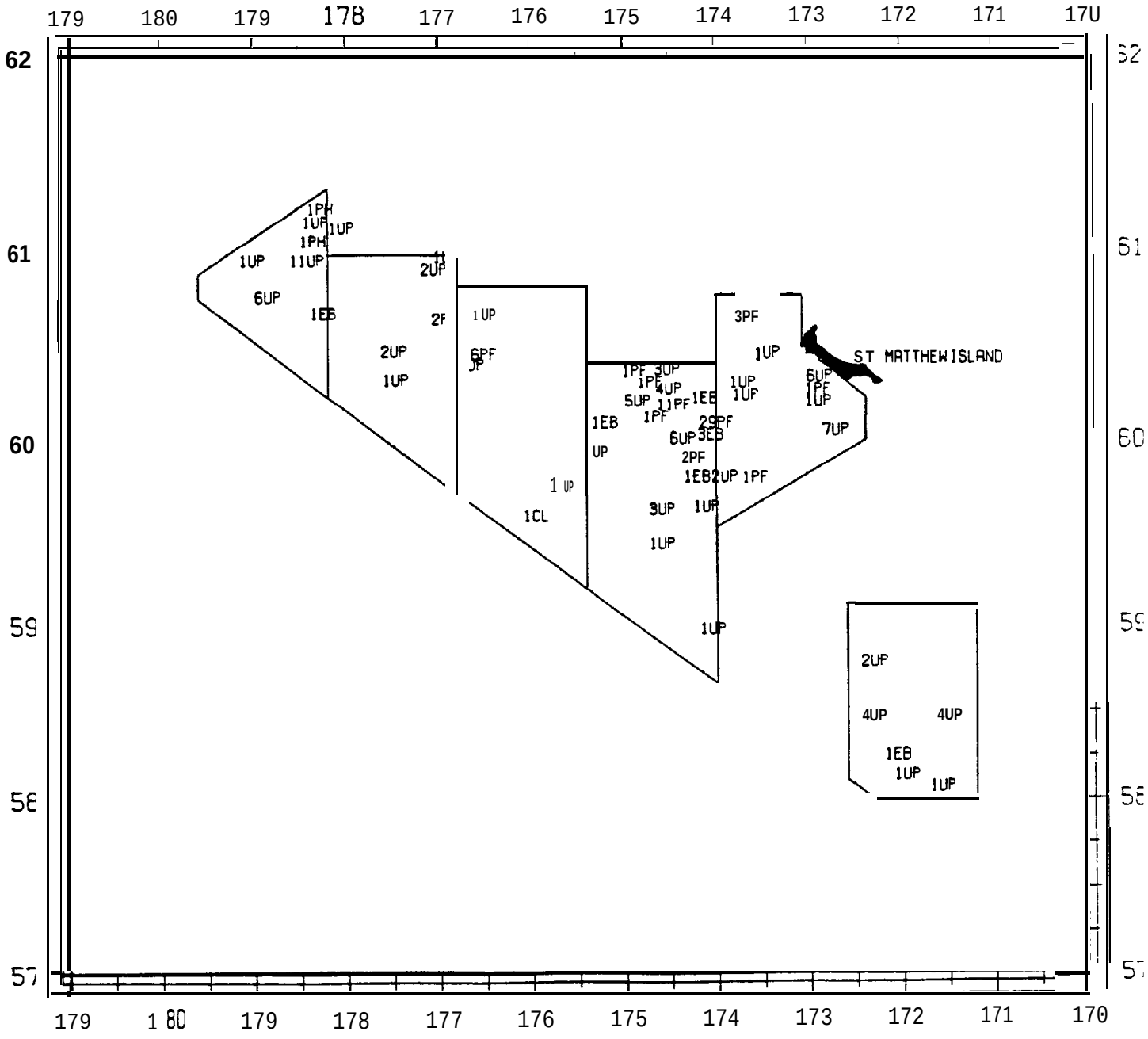


FIGURE A-n LOCATIONS OF BEARDED(EB), **FUR(CL),** RIBBON, **AND** RINGED(PH) SEALS **AND UNIDENTIFIED PINNIPEDS(UP) OBSERVED IN THE NAVARIN BASIN DURING WINTER, FEBRUARY-MARCH 1983**

APPENDIX B

1979 SUPPLEMENTAL TABLES AND FIGURES

APPENDIX B

APPENDIX TABLE B-1
RECORD OF PINNIPEDS AND BELUGA WHALES ENCOUNTERED IN THE PACK ICE OF THE BERING SEA DURING EARLY SPRING, MARCH-APRIL 1979.

Date	Species	Number	Location
3/5/79	DL	15	62025′, 176°30'W
3/5/79	DL	23	62023′, 176°35'W
3/5/79	DL	50	62023′, 176°35'W
3/5/79	DL	4	62023′, 176°35'W
3/5/79	DL	5	62023′, 176°35'W
3/5/79	DL	15	62023′, 176°35'W
3/5/79	DL	120	62023′, 176°35'W
3/5/79	DL	10	62023′, 176°35'W
3/5/79	DL	5	62023′, 176°35'W
3/5/79	DL	25	62023′, 176°36'W
3/5/79	DL	6	62022′, 176°36'W
3/5/79	DL	1	62022′, 176°36'W
3/5/79	DL	46	62022′, 176°36'W
3/5/79	DL	123	62022′. 176°36'W
3/5/79	DL	28	62021′, 176°34'W
3/5/79	DL	14	62021′, 176°34'W
3/5/79	DL	120	62020′, 176°31'W
3/5/79	DL	11	62019′, 176°27'W
3/5/79	DL	15	62021′, 176°39'W
3/5/79	DL	2	62018′, 176°43'W
3/5/79	DL	3	62018′, 176°45'W
3/5/79	DL	7	62018′, 176°45'W
3/5/79	DL	1	62018′, 176°37'W
3/5/79	DL	1	62019′, 176°37'W
3/5/79	DL	49	62021′. 176°34'W
3/5/79	DL	42	62021′: 176°34'W
3/5/79	DL	20	62021′, 176°36'W
3/5/79	DL	6	62°21', 176°36'W
3/5/79	DL	10	62021′, 176°36'W
3/5/79	DL	30	62021′. 176°36'W
3/5/79	DL	1	62022′; 176°31'W
3/5/79	DL	35	62022′, 176°30'W
3/5/79	DL	25	62022′, 176°30'W

APPENDIX TABLE B-1 CONT.
RECORD OF PINNIPEDS AND BELUGA
WHALES ENCOUNTERED IN THE PACK ICE OF
THE BERING SEA DURING EARLY SPRING,
MARCH-APRIL 1979.

Date	Species	Number	Location
3/ 7/79	UP	1	61038', 176°50'W
3/ 7/79	OR	55	61°46' 176°45'W
3/ 7/79	OR	3	610481: 176°45'W
3/ 7/79	OR	2	61048', 176°45'W
3/ 7/79	OR	2	61°49', 176°44'W
3/ 7/79	OR	1	61°47', 176°40'W
3/ 7/79	OR	30	61°41', 176°42'W
3/ 7/79	OR	50	61°41', 176°42'W
3/ 7/79	OR	3	61°30', 176°41'W
3/ 7/79	OR	7	61°22' 176°41'W
3/ 7/79	OR	10	61044': 176°18'W
3/ 7/79	OR	10	61°37', 176°24'W
3/ 7/79	OR	1	61037', 176°24'W
3/ 7/79	OR	1	61037', 176°24'W
3/ 7/79	OR	1	61037', 176°32'W
3/ 7/79	OR	99	61039', 176°32'W
3/ 7/79	OR	51	61°39', 176°32'W
3/ 7/79	OR	99	61°42', 176°33'W
3/ 7/79	OR	99	61042', 176°33'W
3/ 7/79	OR	82	61°42', 176°33'W
3/ 7/79	OR	1	61045', 176°34'W
3/ 7/79	UP	1	61°48' 176°34'W
3/ 7/79	OR	1	61048': 176°34'W
3/ 7/79	OR	1	61047', 176°31'W
3/ 7/79	OR	4	61047', 176°31'W
3/ 7/79	OR	3	61047', 176°29'W
3/ 7/79	OR	1	61047', 176°26'W
3/ 7/79	OR	1	61047', 176°26'W
3/ 7/79	OR	3	61°45', 176°26'W
3/ 7/79	OR	6	61°45', 176°26'W
3/ 7/79	OR	1	61°30', 176°18'W
3/ 7/79	OR	2	61036', 176°17'W
3/ 7/79	OR	15	61040', 176°16'W
3/ 7/79	OR	99	61°39', 176° 8'W
3/ 7/79	OR	51	61039', 176° 8'W
3/ 7/79	UP	1	61037', 176° 8'W
3/ 7/79	OR	1	61037', 176° 8'W
3/ 7/79	OR	99	61035', 176° 8'W
3/ 7/79	OR	1	61035', 176° 8'W
3/ 7/79	OR	99	61°33', 176° 8'W
3/ 7/79	OR	26	61°33', 176° 8'W
3/ 7/79	OR	30	61032', 176° 8'W

APPENDIX TABLE B-1 CONT.
RECORD OF PINNIPEDS AND BELUGA
WHALES ENCOUNTERED IN THE PACK ICE OF
THE BERING SEA DURING EARLY SPRING,
MARCH-APRIL 1979.

Date	Species	Number	Location
3/ 7/79	OR	1	61°28', 176° 8'W
3/ 7/79	UP	1	61023', 176° 9'W
3/ 7/79	UP	1	61°22', 176° 9'W
3/ 7/79	OR	4	61°20', 176° 9'W
3/ 7/79	OR	3	61°18', 17601o'w
3/ 7/79	OR	1	61017', 176° 2'W
3/ 7/79	OR	2	61017', 176o 2'W
3/ 7/79	OR	1	61°16' 175056'w
3/12/79	PF	1	61049'; 178° 6'w
3/12/79	UP	1	61053', 177°50'W
3/13/79	OR	3	61°41' 177°45'W
3/13/79	OR	2	61041': 177°29'W
3/13/79	OR	20	61°41', 177°27'W
3/13/79	OR	99	61°41', 177°24'W
3/13/79	OR	1	61°41' 177°24'W
3/13/79	OR	10	61041'; 177°24'W
3/13/79	OR	3	61038', 177°22'W
3/13/79	UP	3	61°18', 177°23'W
3/13/79	PL	3	61016', 177°23'W
3/13/79	PL	1	61°16', 177°23'W
3/13/79	UP	3	61°16', 177°23'W
3/13/79	UP	3	61°14' 177°22'W
3/13/79	OR	10	61034'; 177°31'W
3/13/79	OR	5	61035', 177°38'W
3/13/79	OR	2	61035', 177°38'W
3/13/79	OR	15	61035', 177°38'W
3/13/79	OR	5	61035', 177°38'W
3/13/79	OR	10	61035', 177°38'W
3/13/79	OR	5	61035', 177°38'W
3/13/79	OR	10	61034', 177°39'W
3/13/79	OR	4	61"34', 177°39'W
3/13/79	OR	45	61036', 177°49'W
3/13/79	OR	5	61036', 177°49'W
3/13/79	OR	15	61°40', 177°55'W
3/14/79	UP	1	60050', 175°46'W
3/14/79	PF	1	60°50' 175°46'W
3/14/79	OR	1	60052': 175°46'W
3/14/79	UP	1	60055', 175°48'W
3/14/79	PF	1	60056', 175°24'W
3/14/79	OR	1	60054', 175°12'W
3/15/79	UP	1	60°42', 174°47'W
3/15/79	OR	2	600491, 174°48'W
3/15/79	OR	4	60039', 174°49'W
3/15/79	UP	1	60037', 175° 81W

APPENDIX TABLE B-1 CONT.
RECORD OF PINNIPEDS AND BELUGA
WHALES ENCOUNTERED IN THE PACK ICE OF
THE BERING SEA DURING EARLY SPRING,
MARCH-APRIL 1979.

Date	Species	Number	Location
3/15/79	OR	5	60'42', 175' 7'W
3/15/79	OR	15	60043', 1750 7'W
3/15/79	OR	2	60°44', 175° 7'W
3/15/79	OR	2	600461, 175' 7'W
3/15/79	OR	2	60°46', 175° 7'W
3/15/79	OR	3	690461, 175' 7'W
3/15/79	OR	3	60°48', 175° 7'W
3/15/79	OR	3	60049', 1750 7'W
3/15/79	OR	1	60°49', 175' 7'W
3/15/79	UP	1	69049', 175" 7'W
3/15/79	CR	1	60052', 175o 8'W
3/15/79	OR	1	61° 4', 175°10'W
3/15/79	EB	1	61° 6', 175"10'W
3/15/79	PF	1	61° 0', 174°59'W
3/15/79	OR	25	61° 0', 174°59'W
3/15/79	PF	1	61° 0', 174°59'W
3/15/79	OR	15	60051', 175° 0'W
3/15/79	OR	1	60049', 174°59'W
3/15/79	OR	2	60048', 174°58'W
3/15/79	OR	1	60°46', 174°58'W
3/15/79	OR	15	60°46', 174°58'W
3/15/79	OR	2	60°46', 174°58'W
3/15/79	OR	1	60°44', 174°57'W
3/15/79	OR	20	60°42', 174°57'W
3/15/79	OR	10	60°40', 174°57'W
3/15/79	OR	5	60°40', 174°57'W
3/15/79	OR	6	60°40', 174°52'W
3/15/79	OR	2	60045', 174°52'W
3/15/79	OR	6	60050', 174°52'W
3/15/79	OR	1	60050', 174°52'W
3/15/79	OR	2	60"50', 174°52'W
3/15/79	OR	1	60°50', 174°52'W
3/15/79	OR	8	60051', 174°52'W
3/15/79	OR	2	60053', 174°53'W
3/15/79	OR	3	60055', 174°53'W
3/15/79	OR	3	60°55', 174°53'W
3/15/79	OR	2	60'57', 174°53'W
3/15/79	OR	2	60057', 174°53'W
3/15/79	OR	1	60057', 174°53'W
3/15/79	OR	7	60°58' 174°53'W
3/15/79	OR	1	60"59'; 174°53'W
3/15/79	OR	1	60"59', 174°53'W
3/15/79	PF	1	61° 0', 174°53'W
3/15/79	UP	1	61o 4', 174°54'W

APPENDIX TABLE B-1 CONT.
RECORD OF PINNIPEDS AND BELUGA
WHALES ENCOUNTERED IN THE PACK ICE OF
THE BERING SEA DURING EARLY SPRING,
MARCH-APRIL 1979.

Date	Species	Number	Location
3/15/79	EJ	2	61°10', 174°47'W
3/15/79	UP	1	61°10', 174°42'W
3/15/79	OR	2	60°58', 174°42'W
3/15/79	OR	2	60054', 174°43'W
3/15/79	OR	2	60054', 174°43'W
3115179	OR	4	60051', 174°45'W
3115/79	OR	3	60048', 174°43'W
3/15/79	EB	1	60046', 174°42'W
3/15/79	EB	1	60°49', 174°40'W
3115/79	OR	1	60°45', 174°43'W
3/15/79	OR	3	60045', 174°43'W
3/15/79	OR	2	60°41', 174°44'W
3/15/79	OR	6	60041', 174°44'W
3/15/79	OR	3	60°41', 174°44'W
3/15/79	OR	8	60°41', 174°44'W
3/15/79	OR	7	60°41', 174°44'W
3/15/79	OR	5	60°40', 174°43'W
3/15/79	OR	5	60°40', 174°43'W
3/15/79	OR	5	60°40', 174°43'W
3/15/79	OR	10	60040," 174°43'W
3/15/79	OR	2	60°40', 174°43'W
3/15/79	OR	10	60040," 174°43'W
3/15/79	OR	3	60038', 174°42'W
3/15/79	OR	2	60038', 174°42'W
3/15/79	OR	3	60038', 174°42'W
3/15/79	OR	5	60°34', 174°40'W
3/15/79	OR	5	60034', 174°40'W
3/15/79	OR	5	60034', 174°40'W
3/15/79	OR	10	60034', 174°40'W
3/15/79	OR	2	60034', 174°40'W
3/15/79	OR	2	60037', 174°36'W
3/15/79	OR	50	60040', 174°35'W
3/15/79	OR	1	60040', 174°35'W
3/15/79	OR	2	60040', 174°35'W
3/15/79	OR	1	60°40', 174°35'W
3/15/79	OR	1	60042', 174°35'W
3/15/79	OR	2	60°5.2', 174°34'W
3/15/79	OR	2	60052', 174°34'W
3/15/79	EB	1	61° 7', 174°26'W
3/15/79	PF	1	61° 4', 174°25'W
3/15/79	UP	1	60°58' 174°27'W
3/15/79	OR	2	60053': 174°26'W
3/15/79	OR	1	60052', 174°26'W

APPENDIX TABLE B-1 CONT.
RECORD OF PINNIPEDS AND BELUGA
WHALES ENCOUNTERED IN THE PACK ICE OF
THE BERING SEA DURING EARLY SPRING,
MARCH-APRIL 1979.

Date	Species	Number	Location
3/15/79	OR	1	60°41' 174°26'W
3/15/79	OR	1	60041': 174°26'W
3/15/79	OR	1	60°41', 174°26'W
3/15/79	OR	1	60°41', 174°26'W
3/15/79	OR	6	60039', 174°22'W
3/15/79	OR	1	60°39', 174°22'W
3/15/79	OR	1	60040,", 174°19'W
3/15/79	OR	1	60°45', 174°18'W
3/15/79	OR	3	60°46', 174°18'W
3/15/79	PF	1	61° 0', 174°19'W
3/15/79	UP	1	60046' 174°10'W
3/15/79	OR	1	60040': 174" 9'W
3/18/79	OR	2	69°38' ; 173°13'W
3/18/79	OR	1	60"38', 173°11'W
3/18/79	OR	1	60046', I7301O'W
3/18/79	OR	8	60."51', 173"1O'W
3/18/79	OR	2	60051', 17301O'W
3/18/79	OR	1	60°52', 173°19'W
3/18/79	OR	1	60°49', 173°20'W
3/18/79	OR	1	60°46', 173°19'W
3/18/79	OR	1	62°49', 173°25'W
3/18/79	OR	1	60°50' 173°25'W
3/18/79	UP	1	60°49': 173°53'W
3/18/79	OR	1	60°49', 173°53'W
3/18/79	OR	1	60"32' ; 174° 8'W
3/24/79	DL	4	63°23', 172°11'W
3/24/79	OR	1	63°28', 172° 8'W
3/24/79	OR	7	63031', 172° 9'W
3/24/79	OR	3	63°33' ; 172° 9'W
3/24/79	OR	2	63°33', 172° 9'W
3/24/79	OR	1	63°36', 172° 4'W
3/24/79	DL	4	63°34', 172" 4'W
3/24/79	EB	1	63°24', 172° 5'W
3/24/79	UP	1	63°52', 171053'W
3/24179	EB	1	63°50', 171°51'W
3/24/79	EB	1	63024', 171°51'W
3/24/79	EB	1	63°24', 171051'W
3/24/79	OR	3	63023', 171°50'W
3/24/79	EB	1	63019', 171°50'W
3/24/79	EB	1	63019', 17105O'W
3/24/79	EB	1	63019', 17105O'W
3/24/79	OR	1	63"18', 171°52'W
3/24/79	EB	1	63018', 171°52'W
3/24/79	OR	2	63017', 171049'W

APPENDIX TABLE B-1 CONT.
RECORD OF PINNIPEDS AND BELUGA
WHALES ENCOUNTERED IN THE PACK ICE OF
THE BERING SEA DURING EARLY SPRING,
MARCH-APRIL 1979.

Date	Species	Number	Location
3/24/79	OR	1	63014', 171°50'W
3/24/79	OR	2	63012', 171°50'W
3/24/79	OR	3	63010', 171°51'W
3/24/79	EB	1	63o 6', 171°52'W
3/2.4/79	OR	1	63015', 171056'w
3/24/79	OR	1	63015', 171056'w
4/ 4/79	OR	2	63°48', 173°28'W
4/ 4/79	OR	1	63°35', 173°40'W
4/ 4/79	OR	1	63035', 173°40'W
4/ 5/79	DL	1	63"53' ; 174° 1'W
4/ 6/79	PH	1	64° 5', 175°26'W
4/ 6/79	UP	1	640 1', 175" 4'W
4/ 6/79	OR	1	64° 1', 175°25'W
4/ 6/79	EB	1	64o 7', 175°32'W
4/ 6/79	DL	6	640221, 175°33'W
4/ 6/79	DL	3	64°22', 175°33'W
4/ 6/79	OR	1	64° 4', 175°38'W
4/ 6/79	OR	5	64° 1', 175°38'W
4/ 6/79	OR	1	64o 0', 175°46'W
4/ 6/79	OR	10	64° 2', 175°46'W
4/ 6/79	OR	1	64o 6' 175°47'W
4/ 6/79	UP	1	64"10': 175°47'W
4/ 6/79	OR	1	64°16' 175°46'W
4/ 6/79	OR	1	64"18': 175°46'W
4/ 6/79	EB	1	64°18' 175°52'W
4/ 6/79	OR	4	64017': 175°53'W
4/ 6/79	OR	6	64"14' 175°53'W
4/ 6/79	OR	3	64"14': 175°53'W
4/ 6/79	OR	3	64"12' 175°53'W
4/ 6/79	OR	6	64° 8': 175°52'W
4/ 6/79	OR	1	64o 3', 175°59'W
4/ 6/79	OR	3	64o 8', 175°59'W
4/ 6/79	OR	2	640 8', 175°59'W
4/ 6/79	OR	20	640 8', 175°59'W
4/ 6/79	OR	2	64o 9', 175°59'W
4/ 6/79	OR	2	64011' 175°59'W
4/ 6/79	OR	1	64013': 175°59'W
4/ 6/79	EB	1	64"17', 175°59'W
4/ 6/79	EB	1	64020', 175°59'W
4/ 6/79	OR	4	64"21', 175°59'W
4/ 6/79	UP	1	64°14', 176° 7'W
4/ 6/79	OR	1	64°14' 176° 7'w
4/ 6/79	OR	9	64014': 176° 7'W
4/ 6/79	OR	3	64°12', 176° 7'W

APPENDIX TABLE B-1 CONT.
RECORD OF PINNIPEDS AND BELUGA WHALES ENCOUNTERED IN THE PACK ICE OF THE BERING SEA DURING EARLY SPRING, MARCH-APRIL 1979.

Date	Species	Number	Location
4/ 6/79	OR	1	640 1', 175°52'W
4/ 7/79	PH	1	63o 4', 174°47'W
4/ 7/79	OR	15	63021', 174°47'W
4/ 7/79	OR	30	63°2?9, 174°47'W
4/ 7/79	OR	99	63029', 174°48'W
4/ 7/79	OR	1	63029', 174°48'W
4/ 7/79	OR	2	63029', 174°48'W
4/ 7/79	OR	50	63029', 174°48'W
4/ 7/79	OR	5	63029', 174°48'W
4/ 7/79	OR	1	63030', 174°47'W
4/ 7/79	OR	1	63030', 174°47'W
4/ 7/79	OR	3	63030', 174°45'W
4/ 7/79	OR	1	63°30', 174°45'W
4/ 7/79	OR	15	63030', 174°45'W
4/ 7/79	OR	2	63029', 174°43'W
4/ 7/79	OR	75	63°27', 174°42'W
4/ 7/79	OR	2	63026', 174°42'W
4/ 7/79	OR	25	63026', 174°42'W
4/ 7179	OR	3	63026', 174°42'W
4/ 7/79	OR	2	63024', 174°41'W
4/ 7/79	OR	4	63021', 174°40'W
4/ 7/79	EB	1	63015', 174°40'W
4/ 7/79	OR	1	62059', 174°33'W
4/ 7/79	EB	1	63o 1', 174°34'W
4/ 7/79	EB	1	63o 6', 174°36'W
4/ 7/79	EB	1	63° 7', 174°36'W
4/ 7/79	EB	1	63o 8', 174°35'W
4/ 7/79	EB	1	63o 8', 174°35'W
4/ 7/79	EB	1	63014', 174°34'W
4/ 7/79	EB	1	63015', 174°34'W
4/ 7/79	PH	1	63015', 174°34'W
4/ 7/79	EB	1	63015', 174°34'W
4/ 7/79	EB	1	63015', 174°34'W
4/ 7/79	PH	1	63017', 174°34'W
4/ 7/79	OR	1	63018', 174°34'W
4/ 7/79	EB	1	63020', 174°34'W
4/ 7/79	PH	1	63023', 174°34'W
4/ 7/79	EB	1	63025', 174°35'W
4/ 7/79	EB	1	63026', 174°33'W
4/ 7/79	EB	1	63026', 174°30'W
4/ 7/79	EB	1	63026', 174°30'W

APPENDIX TABLE B-1 CONT.
RECORD OF PINNIPEDS AND BELUGA
WHALES ENCOUNTERED IN THE PACK ICE OF
THE BERING SEA DURING EARLY SPRING,
MARCH-APRIL 1979.

Date	Species	Number	Location
4/ 7/79	EB	1	63°26', 174°30'W
4/ 7179	EB	1	63°24', 174°28'W
4/ 7/79	EB	1	63024', 174°28'W
4/ 7/79	EB	1	63°24', 174°28'W
4/ 7/79	EB	1	63024', 174°28'W
4/ 7/79	EB	1	63019', 174°29'W
4/ 7/79	EB	1	63019', 174°29'W
4/ 7/79	OR	1	63019', 174°29'W
4/ 7/79	EB	1	63017', 174°29'W
4/ 7/79	EB	1	63014', 174°28'W
4/ 7/79	UP	2	63014', 174°28'W
4/ 7/79	EB	1	63010', 174°28'W
4/ 7/79	EB	1	63° 9', 174°28'W
4/ 7/79	UP	1	63° 7', 174°28'W
4/ 7/79	OR	1	63o 6', 174°28'W
4/ 7/79	EB	1	63o 4', 174°28'W
4/ 7/79	EB	1	63o 4', 174°28'W
4/ 7/79	EB	1	63o 4', 174°28'W
4/ 7/79	EB	1	63o 4', 174°28'W
4/ 7/79	EB	1	63° 4', 174°28'W
4/ 7/79	EB	1	63o 1', 174°29'W
4/ 7/79	EB	1	63o 1', 174°29'W
4/ 7/79	EB	1	63° 1', 174°29'W
4/ 7/79	EB	1	62059', 174°29'W
4/ 7/79	OR	2	62056', 174°28'W
4/ 7/79	EB	1	62055', 174°26'W
4/ 7/79	EB	1	62055', 174°26'W
4/ 7/79	EB	1	62054', 174°24'W
4/ 7/79	EB	1	62054', 174°22'W
4/ 7/79	EB	1	62057', 174°22'W
4/ 7/79	OR	4	62°571, 174°22'W
4/ 7/79	EB	1	62057', 174°22'W
4/ 7/79	EB	1	62057', 174°22'W
4/ 7/79	EB	1	62059', 174°22'W
4/ 7/79	EB	1	63o 0', 174°21'W
4/ 7/79	EB	1	63o 1', 174°21'W
4/ 7/79	EB	3	63o 6', 174°20'W
4/ 7/79	EB	1	63o 6', 174°20'W
4/ 7/79	EB	1	63011', 174°20'W
4/ 7/79	EB	1	63013', 174°20'W
4/ 7/79	EB	1	63013', 174°20'W

APPENDIX TABLE B-1 CONT.
RECORD OF PINNIPEDS AND BELUGA
WHALES ENCOUNTERED IN THE PACK ICE OF
THE BERING SEA DURING EARLY SPRING,
MARCH-APRIL 1979.

Date	Species	Number	Location
4/ 7/79	EB	1	63010', 174°20'W
4/ 7/79	EB	3	63o 7', 174°21'W
4/ 7/79	EB	1	63" 7', 174°21'W
4/ 7/79	EB	5	63° 3', 174°22'W
4/ 7/79	EB	3	63°10', 174°22'W
4/ 7/79	UP	1	6301.2', 174°22'W
4/ 7/79	OR	6	63014', 174°23'W
4/ 7/79	EB	2	63°15', 174°23'W
4/ 7/79	OR	7	63°18', 174°22'W
4/ 7/79	EB	1	63016', 174°14'W
4/ 7/79	EB	1	63"16', 174°14'W
4/ 7/79	EB	1	63015', 174°14'W
4/ 7/79	OR	15	63013', 174°14'W
4/ 7/79	UP	1	63013', 174°14'W
4/ 7/79	EB	1	63012', 174°14'W
4/ 7/79	EB	1	63010', 174°15'W
4/ 7/79	EB	1	63010', 174°15'W
4/ 7/79	UP	1	63o 1', 174°15'W
4/ 7/79	PF	1	62057', 174°16'W
4/ 7/79	EB	5	62057', 174°16'W
4/ 7/79	EB	1	62057', 174°16'W
4/ 7/79	OR	4	62055', 174°16'W
4/ 7/79	PL	1	62052', 174°16'W
4/ 7/79	UP	1	62°52', 174°16'W
4/ 7/79	EB	1	620521, 174°16'W
4/ 7/79	EB	1	62052', 174°16'W
4/ 7/79	OR	2	62052', 174°16'W
4/ 7/79	PH	1	62°50', 174°16'W
4/ 7/79	UP	1	62050', 174°16'W
4/ 7/79	EB	1	62°50', 174°16'W
4/ 7/79	PH	1	62°50', 174° 8'W
4/ 7/79	PL	1	62051', 174° 7'W
4/ 7/79	EB	1	62°52', 174° 7'W
4/ 7/79	E%	1	62°55', 174° 8'W
4/ 7/79	EB	1	62057', 174°8'W
4/ 7/79	UP	1	63o 0', 174° 9'W
4/ 7/79	EB	1	63o 3', 174° 9'w
4/ 7/79	OR	25	63o 6', 174" 9'W
4/ 7/79	OR	3	63o 6', 174o 9'w
4/ 7/79	OR	4	63o 6', 174° 9'W
4/ 7/79	OR	2	63o 6', 174°9'W
4/ 7/79	OR	12	63o 6', 174° 9'w
4/ 7/79	OR	10	63o 6', 174°9'W

APPENDIX TABLE B-1 CONT.
RECORD OF PINNIPEDS AND BELUGA WHALES ENCOUNTERED IN THE PACK ICE OF THE BERING SEA DURING EARLY SPRING, MARCH-APRIL 1979.

Date	Species	Number	Location
4/ 7/79	OR	2	63o 8', 174" 9*W
4/ 7/79	PL	1	63° 8', 174° 9'W
4/ 7179	OR	4	63° 9', 174° 9'W
4/ 7/79	OR	1	630121, 174o 9'W
4/ 7/79	EB	1	63012', 174° 9'W
4/ 7/79	EB	1	63013', 174° 9'W
4/ 7/79	EB	1	63016', 174° 7'W
4/ 7/79	OR	2	63o 9', 174° 2'W
4/ 7/79	OR	2	63° 9', 174° 2'W
4/ 7/79	OR	1	63° 8', 174° 2'W
4/ 7/79	UP	1	63° 8', 174° 2'w
4/ 7/79	UP	1	63° 6', 174° 2'W
4/ 7/79	OR	4	63o 4', 173°55'W
4/ 7/79	OR	35	63o 5', 173°56'W
4/ 7/79	EB	1	63o 8', 173055'W
4/ 7/79	EB	1	63011', 173°54'W
4/ 7/79	OR	60	63011', 173°54'W
4/ 7/79	EB	1	63o 8', 173°48'W
4/ 7/79	EB	1	63° 6', 173°49'W
4/ 7/79	OR	2	63o 6', 173°49'W
4/ 7/79	OR	8	63o 6',173°49'W
4/ 7/79	OR	4	63° 6', 173°49'W
4/ 7/79	OR	5	63° 6', 173°49'W
4/ 7/79	UP	1	63° 3', 173°49'W
4/ 7/79	EB	1	62051', 173°55'W
4/ 7/79	EB	1	62°56' 174°10'W
4/ 7/79	UP	1	62059': 174°16'W
4/ 7/79	EB	2	63o 1', 174°21'W
4/ 9/79	OR	2	62032', 173" 5'W
4/ 9/79	OR	1	62032', 173" 5'W
4/ 9/79	OR	1	62°46' 173" 3'W
4/ 9/79	OR	1	63o 1': 173° 4'W
4/ 9/79	OR	1	62°45' 172°56'W
4/ 9/79	PL	1	62031': 172°48'W
4/ 9/79	PL	1	62031', 172°48'W
4/12/79	OR	1	62"43', 172°39'W
4/12/79	OR	1	62035', 172°40'W
4/12/79	PH	1	62036', 172°32'W
4/12/79	OR	1	62039', 172°34'W
4/12/79	EB	1	62°58', 172°31'W
4/12/79	EB	1	62°54', 172°32'W
4/12/79	OR	1	62°46', 172°32'W
4/12/79	OR	1	62°28', 172°30'W

APPENDIX TABLE B-1 CONT.
RECORD OF PINNIPEDS AND BELUGA WHALES ENCOUNTERED IN THE PACK ICE OF THE BERING SEA DURING EARLY SPRING, MARCH-APRIL 1979.

Date	Species	Number	Location
4/12/79	PH	1	62°25', 172°26'W
4/12/79	EB	1	62032'; 172°16'W
4/12/79	PH	1	62°49', 172°14'W
4/12/79	OR	2	62049', 172°10'W
4/12/79	UP	1	62°45', 172° 8'W
4/12/79	EB	1	62°42', 172° 9'W
4/12/79	UP	1	62°42', 172" 9'W
4/12/79	OR	2	62°20', 172°12'W
4/12/79	PH	1	6.2°25', 172°12'W
4/12/79	UP	2	62°25', 172" 7'W
4/12/79	PL	1	620241, 172° 7'W
4/12/79	PL	1	620241, 172° 7'W
4/12/79	UP	1	62019', 172° 4'W
4/12/79	UP	1	62019', 172° 4'W
4/12/79	PH	1	62019', 172° 4'W
4112/79	PH	1	62019', 172° 4'W
4/12/79	OR	1	62°24', 172° 2'W
4/12/79	EB	1	62°29', 172° 2'W
4/12/79	OR	3	62°29', 172° 2'W
4/12/79	OR	2	62039', 172° 3'W
4/12/79	EB	2	62°41', 172° 3'W
4/12/79	EB	2	62°41' 172° 3'W
4/12/79	OR	1	62041'; 172° 3'W
4/12/79	OR	55	62°48', 172° 3'W
4/12/79	UP	1	62°44', I71057'W
4/12/79	UP	1	62°43', 171057'W
4/12/79	OR	40	62°43', 171°57'W
4/12/79	OR	1	62°41', 171°57'W
4/12/79	OR	99	62°38', 171058'w
4/12/79	OR	11	62038', 171058'w
4/12/79	UP	1	62°36', 171°58'W
4/12/79	UP	1	62°26', 171°57'W
4/12/79	OR	2	62°25', 171056'w
4/12/79	PH	1	62°22', 171°56'W
4/12/79	EB	1	62°20', 171°56'W
4/12/79	UP	1	62019', 171°56'W
4/12/79	UP	1	62019', 171°56'W
4/12/79	UP	1	62019', 171056'w
4/12/79	UP	1	62°31', 171°48'W
4/12/79	EB	1	62°37', 171051'W
4/12/79	OR	3	62°41', 171°51'W
4/12/79	PL	1	62041', 171°51'W
4/12/79	PL	1	62041', 171051'W

APPENDIX TABLE B-1 CONT.
RECORD OF PINNIPEDS AND BELUGA WHALES ENCOUNTERED IN THE PACK ICE OF THE BERING SEA DURING EARLY SPRING, MARCH-APRIL 1979.

Date	Species	Number	Location
4/12/79	EB	2	62°44' I7105O'W
4/12/79	UP	1	62043': 171°48'W
4112179	EB	2	62039', 171°45'W
4/12/79	EB	1	62038', 171044'w
4/12/79	OR	3	62038', 171°44'W
4/12/79	EB	1	62033', 171°45'W
4112179	UP	1	62028', 171044'W
4/12/79	UP	1	62°11', 17104O'W
4/12/79	UP	1	62"18' 171°37'W
4/12/79	PH	1	62"18': 171°37'W
4/1.2/79	UP	1	62°24', 171037'W
4/12/79	UP	1	62027', 171°37'W
4/12/79	FL	1	62030', 171 °36'W
4/12/79	PL	1	62033', I71036'W
4/12/79	EB	1	62034', 171°37'W
4/12/79	OR	3	62°41', 171°45'W
4/12/79	OR	1	62041', 171°45'W
4/12/79	PL	1	62°41', 171048'w
4/12/79	PL	1	62041', 171048'W
4/12/79	OR	1	62"40', 171°55'W
4/12/79	UP	1	62036', 172° 3'W

APPENDIX TABLE B-2

CHI-SQUARE ANALYSIS OF NORTH PACIFIC WALRUS OCCURRENCES IN DIFFERENT ICE CONCENTRATION CATEGORIES, 1979

Ice Concentration Category	Area (nm^2)	Proportion of Total Area	Number Observed	Number Expected	Proportion Observed	95 Percent Confidence Interval
NORTHERN ZONE						
0-25	4	0.009	0	<1	0.000	
26-50	24	0.052	1	2	0.029	
51-75	271	0.576	19	20	0.543	
76-100	170	0.363	15	13	0.428	
Total	469	1.000	35	35	1.000	$\chi^2 = 0.28$ a/
CENTRAL ZONE						
0-25	0	0.000	0	0	0.000	
26-50	3	0.006	0	<1	0.000	- 0.5064 ≤ p ≤ 0.2276 b/
51-75	93	0.222	22	13	0.3671	
76-100	324	0.772	38	46	0.633	0.7724 ≤ p ≤ 0.4936 b/
Total	420	1.000	60	60	1.000	$\chi^2 = 5.24$ b/
SOUTHERN ZONE						
0-25	45	0.075	3	9	0.025	0.0603 ≤ p ≤ -0.0103 b/
26-50	165	0.278	32	34	0.262	0.3615 ≤ p ≤ 0.1625 a/
51-75	231	0.389	68	47	0.557	0.6694 ≤ p ≤ 0.4446 b/
76-100	153	0.258	19	32	0.156	0.2381 ≤ p ≤ 0.0739 b/
Total	594	1.000	122	122	1.000	$\chi^2 = 18.78$ b/

a/ Significant avoidance.
b/ Significant preference.

1191a

APPENDIX TABLE B-3

CHI-SQUARE ANALYSIS OF NORTH PACIFIC WALRUS OCCURRENCES IN DIFFERENT ICE SIZE CATEGORIES, 1979

Ice Size Category	Area (nm^2)	Proportion of Total Area	Number Observed	Number Expected	Proportion Observed	95 Percent Confidence Interval
NORTHERN ZONE [b]						
Grease-Slush	36	0.103	2	4	0.057	
Pan-Small	67	0.190	1	7	0.029	$0.1993 \leq p \leq -0.0273$ [a]
Meal-Large	102	0.291	14	10	0.400	$0.5979 \leq p \leq 0.2021$ [b]
Vast-Giant	147	0.416	18	14	0.514	$0.7159 \leq p \leq 0.3121$ [b]
Total	352	1.000	35	35	1.000	$X^2 = 8.56$ [a]
CENTRAL ZONE [a]						
Grease-Slush	2	0.005	0	<1	0.000	
Pan-Small	7	0.019	0	1	0.000	
Meal-Large	37	0.104	6	6	0.100	
Vast-Giant	309	0.872	54	52	0.900	
Total	355	1.000	60	60	1.000	$X^2 = 0.32$ [b]
SOUTHERN ZONE [b]						
Grease-Slush	85	0.225	5	27	0.041	$0.0812 \leq p \leq -0.0010$ [a]
Pan-Small	134	0.352	73	43	0.598	$0.6974 \leq p \leq 0.4986$ [a]
Meal-Large	74	0.195	4	24	0.033	$0.0692 \leq p \leq -0.0032$ [a]
Vast-Giant	87	0.228	40	28	0.328	$0.4232 \leq p \leq 0.2328$ [a]
Total	380	1.000	122	122	1.000	$X^2 = 60.67$ [a]

[a] Significant preference.
[b] Significant avoidance.

1191a

APPENDIX TABLE B-4

CHI-SQUARE ANALYSIS OF BEARDED SEALOCCURRENCES IN DIFFERENT ICE CONCENTRATION AND SIZE CATEGORIES, 1979 a/

Ice Concentration Category	fires (nm^2)	Proportion of Total Area	Number Observed	Number Expected	Proportion Observed	95 Percent Confidence Interval
O-25	0	0.000	0	0	0.000	
26-50	3	0.006	0	1	0.000	- 0.4815 ≤ p ≤ 0.2305 a/
51-75	93	0.222	26	16	0.356 1	
76-100	324	0.772	47	56	0.644	0.7695 ≤ p ≤ 0.5185 a/
Total	420	1.000	73	73	1.000	χ^2 = 5.54 a/

Ice Size Category	Area (nm^2)	Proportion of Total Area	Number Observed	Number Expected	Proportion Observed	95 Percent Confidence Interval
Grease-Slush	2	0.005	0	0	0.000	
Pan-Small	7	0.019	0	1	0.000	
Meal-Large	37	0.104	11	8	0.151	
Vast-Giant	310	0.872	62	64	0.849	
Total	356	1.000	73	73	1.000	χ^2 = 0.51 b/

a/ Analysis was performed only on central zone of study area, since 87 percent of total sightings were in this zone. Ice categories were combined to increase sample sizes.
b/ Significant preference.
c/ Significant avoidance.

1191a

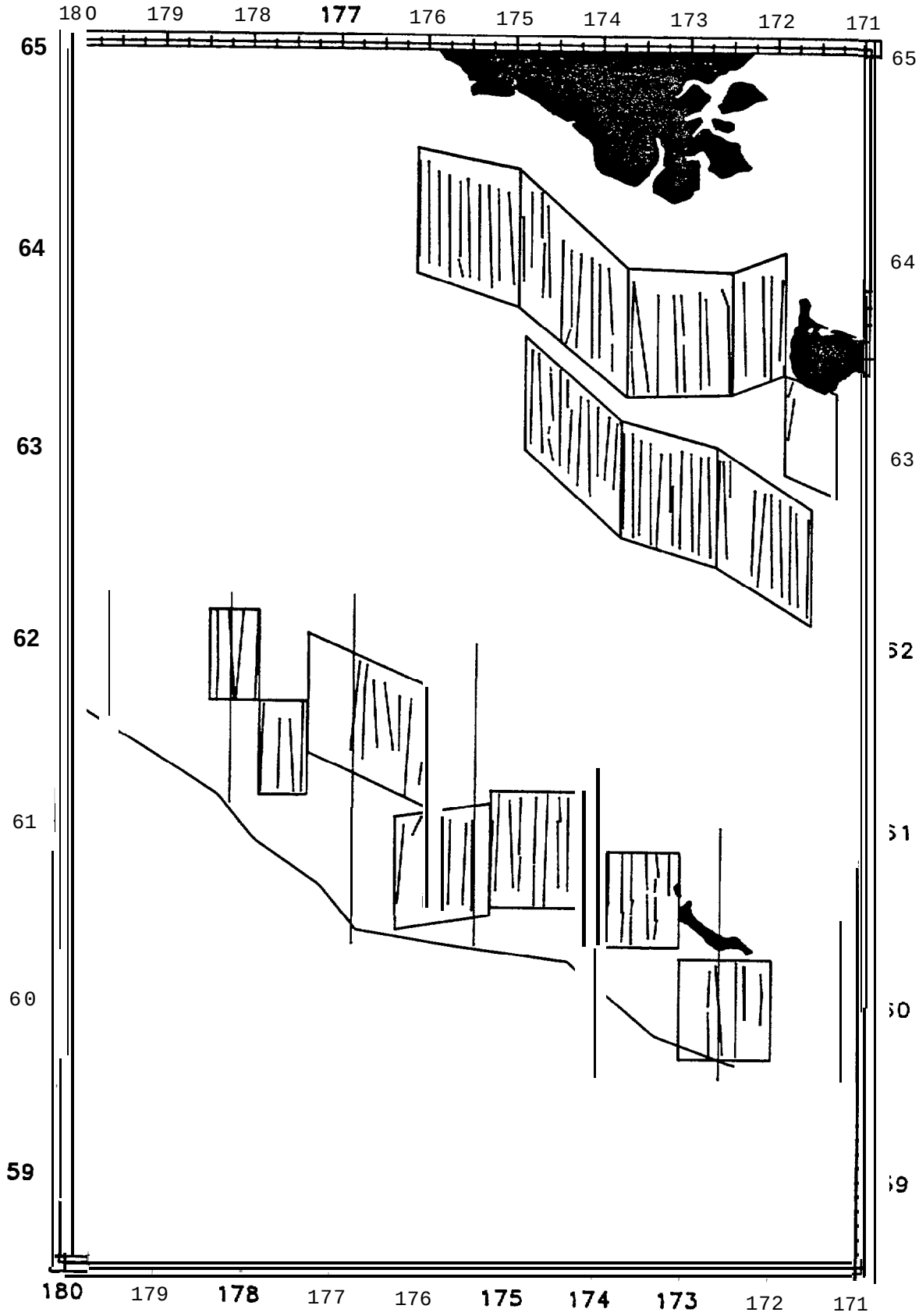


Figure B-1 Location of aerial tracklines surveyed in the pack ice of the Bering Sea during early spring, March - April 1979.

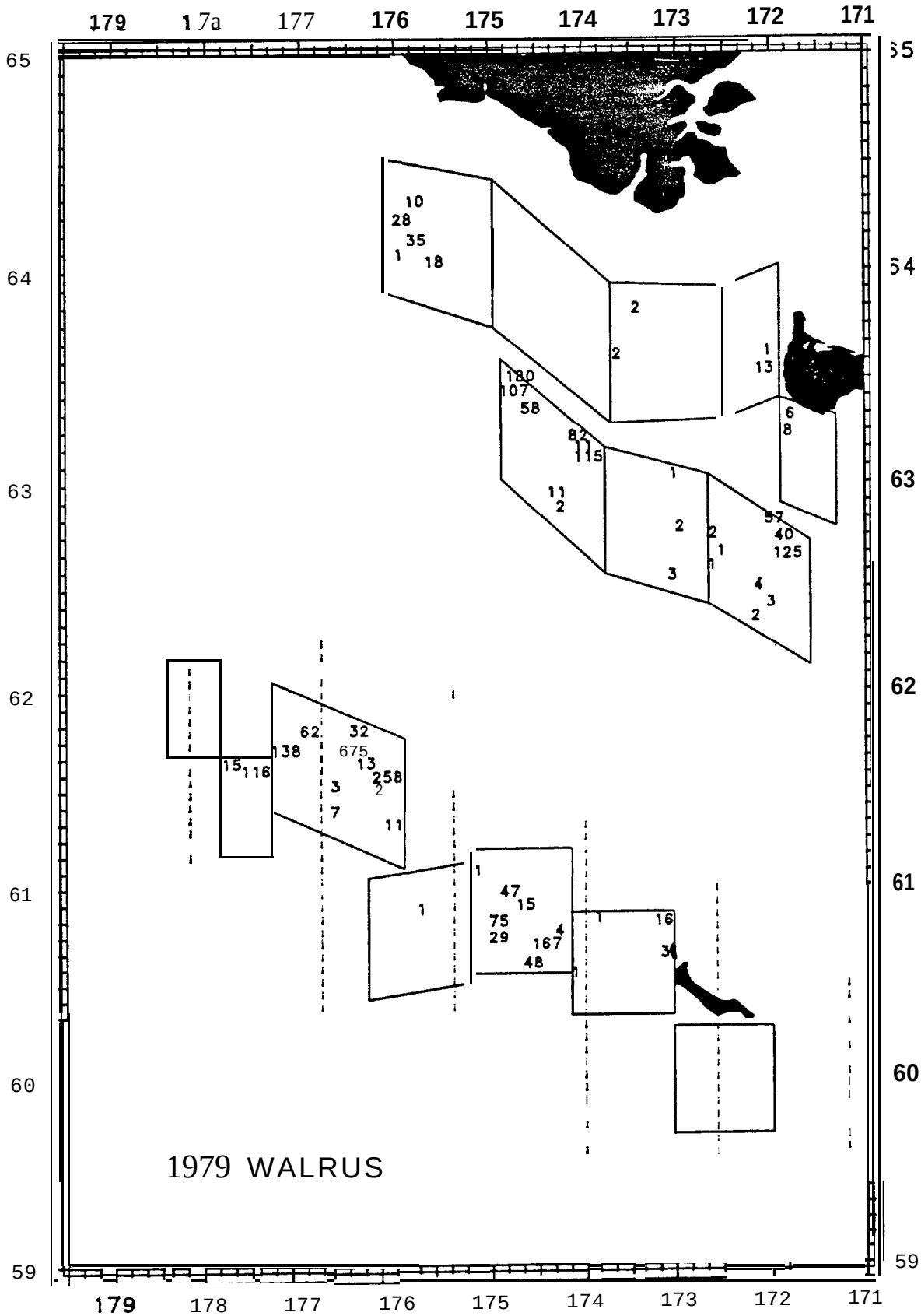


Figure B-2 Location of walruses observed in the pack ice of the Bering Sea during early spring, March - April 1979.

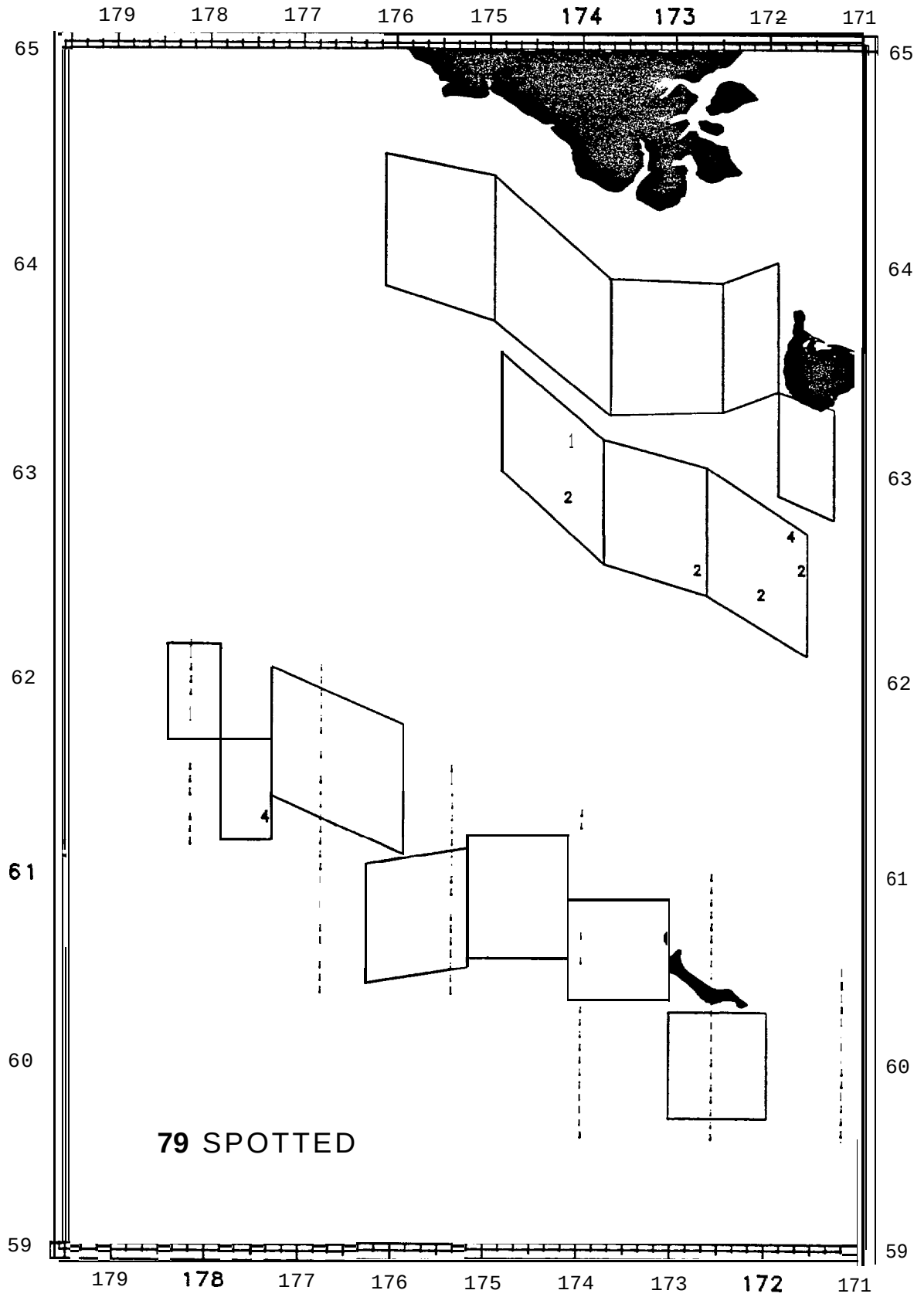


Figure B-3 Location of spotted seals observed in the pack ice of the Bering Sea during early spring, March-April 1979.

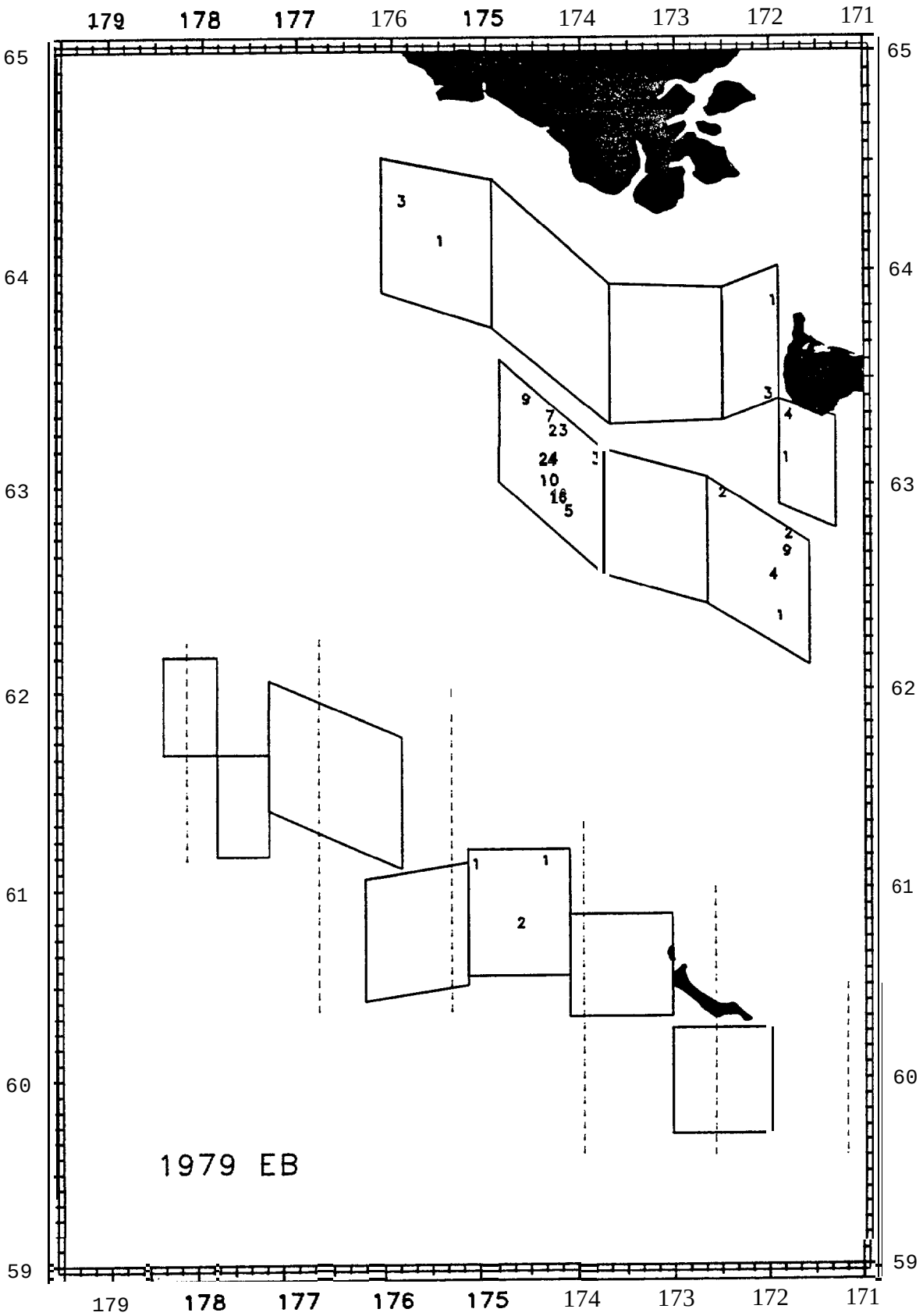


Figure B-4 **Location of bearded seals observed** in the pack ice of the Bering Sea during early spring, March - April 1979.

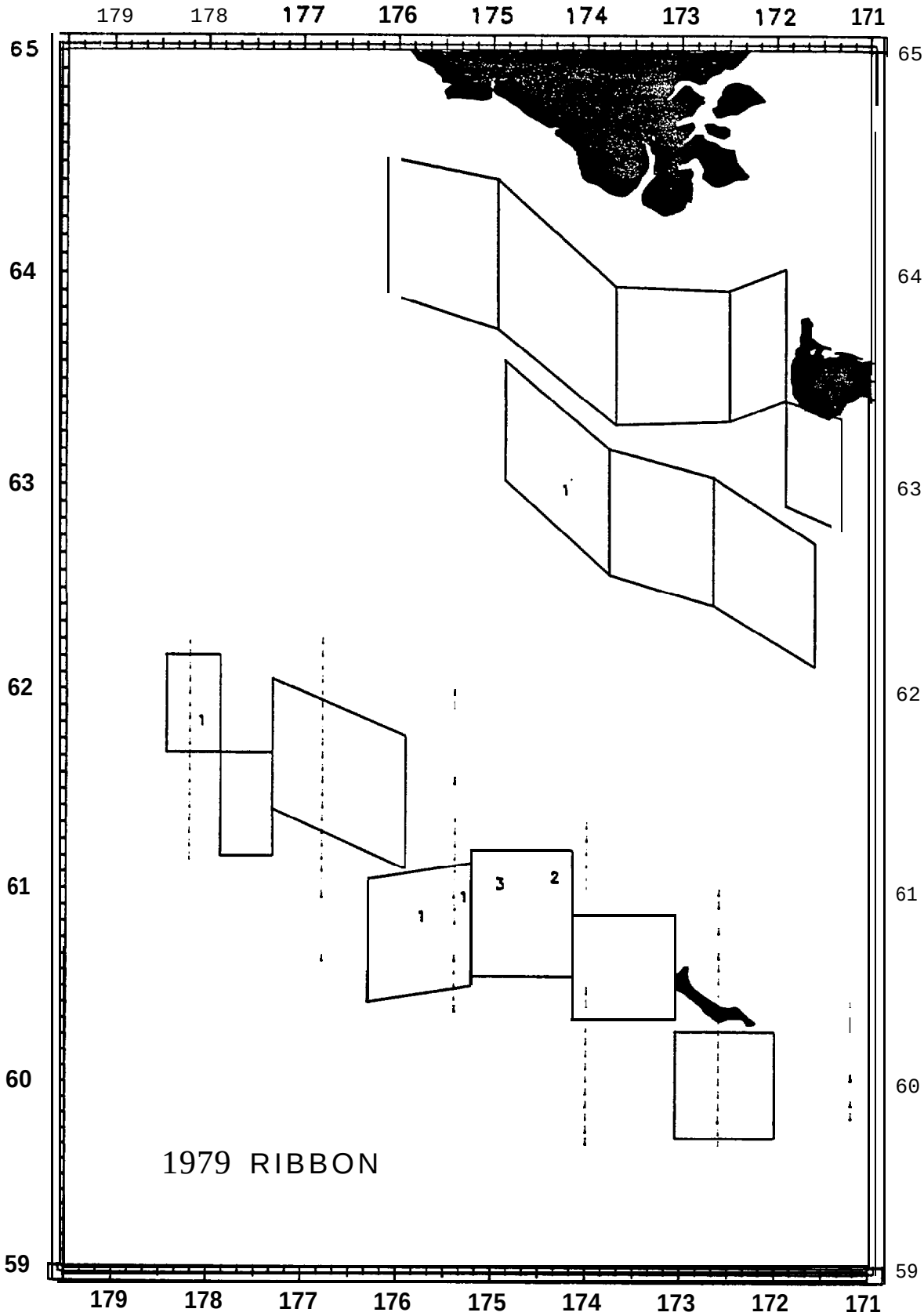


Figure B-5 Location of ribbon seals observedin the pack ice of the Bering Sea during early spring, March-April 1979.

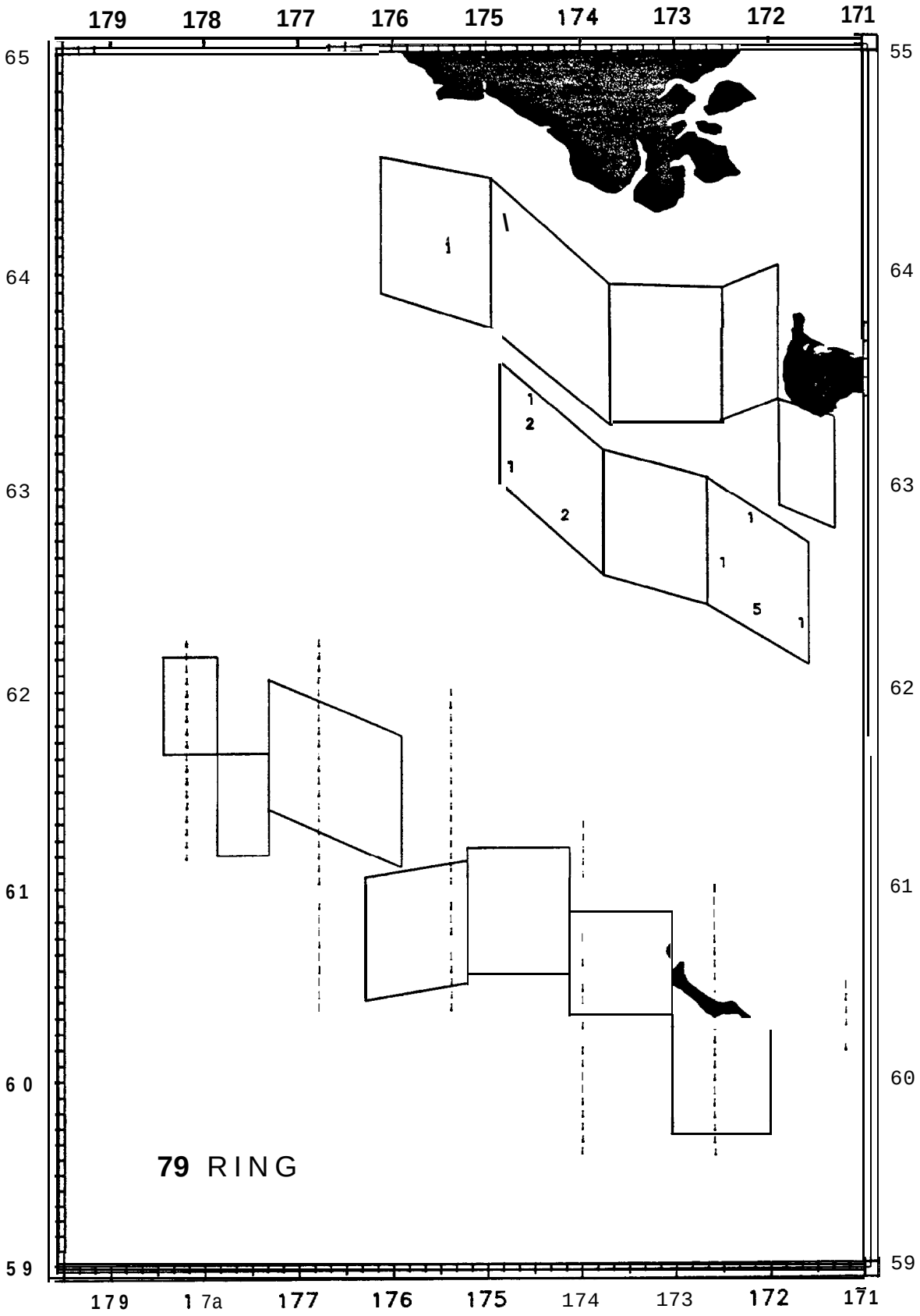


Figure B-6 Location of ringed seals observed in the pack ice of the Bering Sea during early spring, March - April 1979.

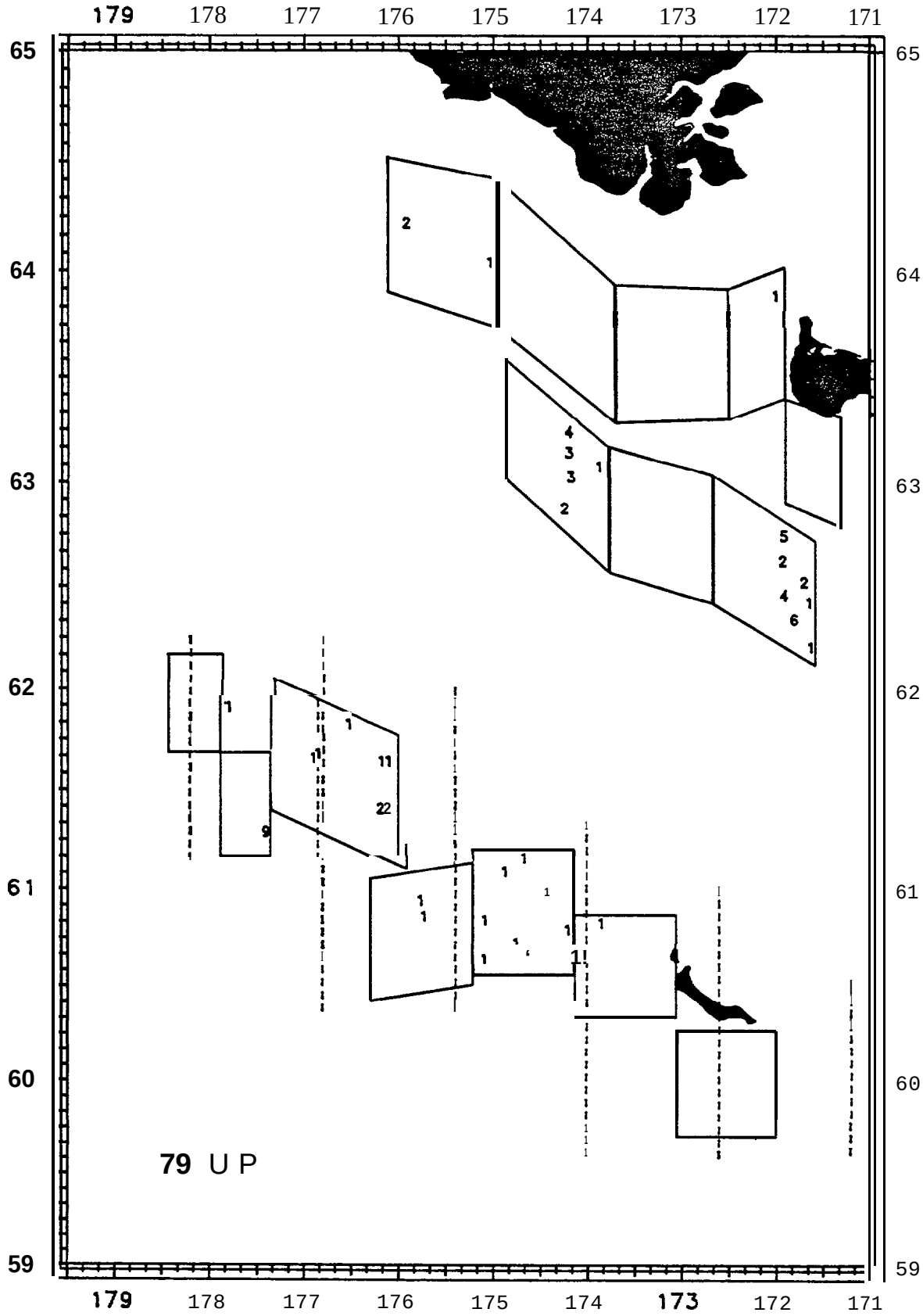


Figure B-7 Location of unidentified pinnipeds observed in the pack ice of the Bering Sea during early spring, March - April 1979.

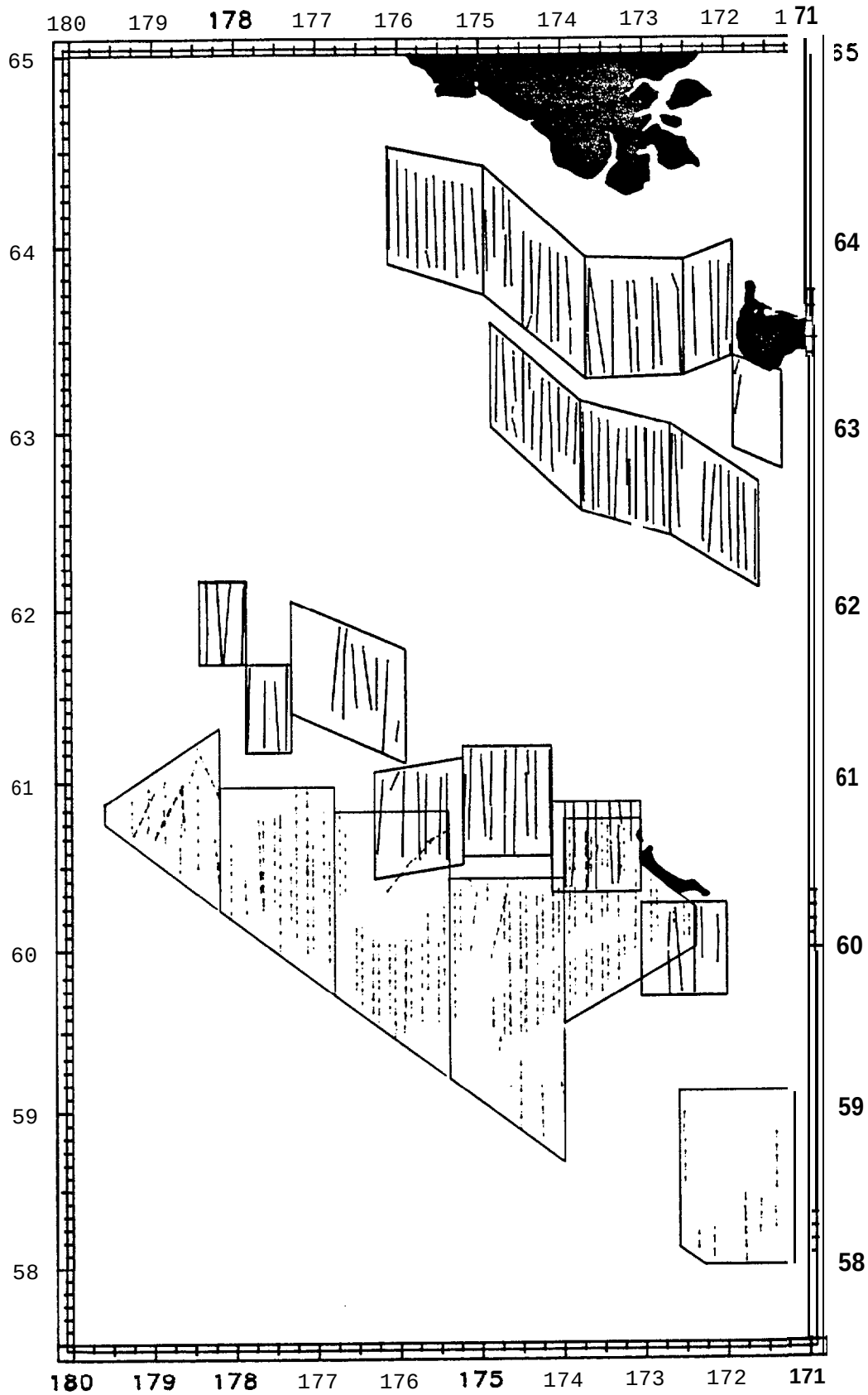


Figure B-8 Location of February - March 1983 (~) and March - April 1979 (|) tracklines surveyed in the pack ice of the Bering Sea.

APPENDIX C

BELUGA WHALE STUDY REPORT

Beluga (Delphi napterus leucas) whales of the eastern North Pacific Ocean occur from the Gulf of Alaska westward to the Bering Sea, northward through the Chukchi Sea, and eastward into the Beaufort Sea (Brooks, 1963; Klinkhart, 1966; Scheffer, 1972). A minimum of 15,000 belugas are estimated to occupy these waters (Alaska Dep. Fish Game, 1975).

The Gulf of Alaska beluga population is largely located in Cook Inlet (Scheffer, 1972). The herd, estimated at 300 to 500 animals, appears to remain in the inlet the year-round (Klinkhart, 1966; Alaska Dep. Fish Game, 1975). The Alaska peninsula is evidently a barrier to the northward movement of these animals into the Bering Sea.

Beluga whales occurring in the Bering Sea consist of resident and migratory stocks. An estimated 1,000 to 1,500 (Klinkhart, 1966; Sergeant and Brodie, 1975; Alaska Dep. Fish Game, 1975) and possibly as many as 8,000 (DEIS in Braham and Krogman, 1977) animals remain in Bristol Bay throughout the year. An additional but unknown number of belugas are thought to winter in the Bering Sea and migrate to their summering grounds in eastern Siberian and Canadian waters (Brooks, 1954; Kleinenberg et al., 1964; Sergeant and Hock, 1974; Alaska Dep. Fish Game, 1975). Part of this migratory stock summers in Norton Sound, Yukon Delta, and the Kuskokwim River, while the other animals continue north through the Bering Strait (Scheffer, 1972; Fay, 1974). Sergeant and Brodie (1969) suggest further that belugas in the Yukon Delta and Kuskokwim River may be resident.

The purpose of this section of the report is to document the number and distribution of beluga whales recorded in the pack ice of the Bering

Sea during our 1979 and 1983 surveys. The study area location and data collection procedures are largely identical to those described for pinnipeds. The main exception is that beluga whale surveys in 1979 were conducted from two helicopters compared to the one helicopter used to survey pinnipeds. Consequently, over 25 percent more trackline distance was surveyed for beluga whales than pinnipeds in 1979.

A total of 886 beluga whales were recorded in 1979 compared to 598 in 1983 (Table C-l). Group size averaged 26.8 (range = 1 to 123) animals in 1979 and 20.6 (range = 1 to 433) animals in 1983. The group sizes ranged widely because beluga whales were generally encountered as clusters of animals in large congregations. Kleinenberg et al. (1964) also reported that beluga whales congregate in large groups of variable size in the Canadian Arctic during early spring.

Beluga whales were widespread in the pack ice during 1979 and 1983 (Table C-1, Figure C-l). They occurred in the southern, central, and northern sections of the study area. Particularly large numbers of belugas were observed near the US-USSR Convention Line in 1979 and along the western fringe of the polynya, south and west of St. Matthew Island in 1983. In both areas, belugas were in areas occupied by concentrations of bowhead whales.

The span of time we observed belugas in the pack ice was from 5 March to 6 April. This identifies that belugas occur in the Bering Sea at least until early April. Other investigators (Braham and Krogman, 1977; Johnson et al., 1966; Kleinenberg et al., 1964; Bailey and Hendee, 1926) have postulated that belugas move north from the Bering Sea in March and April and return between November and January, and on occasion as early as September and October (D. Harry, Gambell, AK, Personal Communication).

Beluga whales we observed were primarily in thin but extensive ice coverage in 1983 and in leads in 1979. Almost 90 percent of the beluga

APPENDIX TABLE C-1

NUMBER AND DISTRIBUTION OF BELUGA WHALES
RECORDED IN THE PACK ICE OF THE BERING SEA
DURING LATE WINTER TO EARLY SPRING, 1979 AND 1983

Location	Distance	Surveyed	1979 No. Group	1979 No. Indiv.	1983 No. Group	1983 No. Indiv.
Northern	1,749	--	5	18	--	--
Central	1,134	--	28	868	--	--
Southern	3,006	2,410	--	--	29	598
TOTAL	5,889	2,410	33	886	29	598

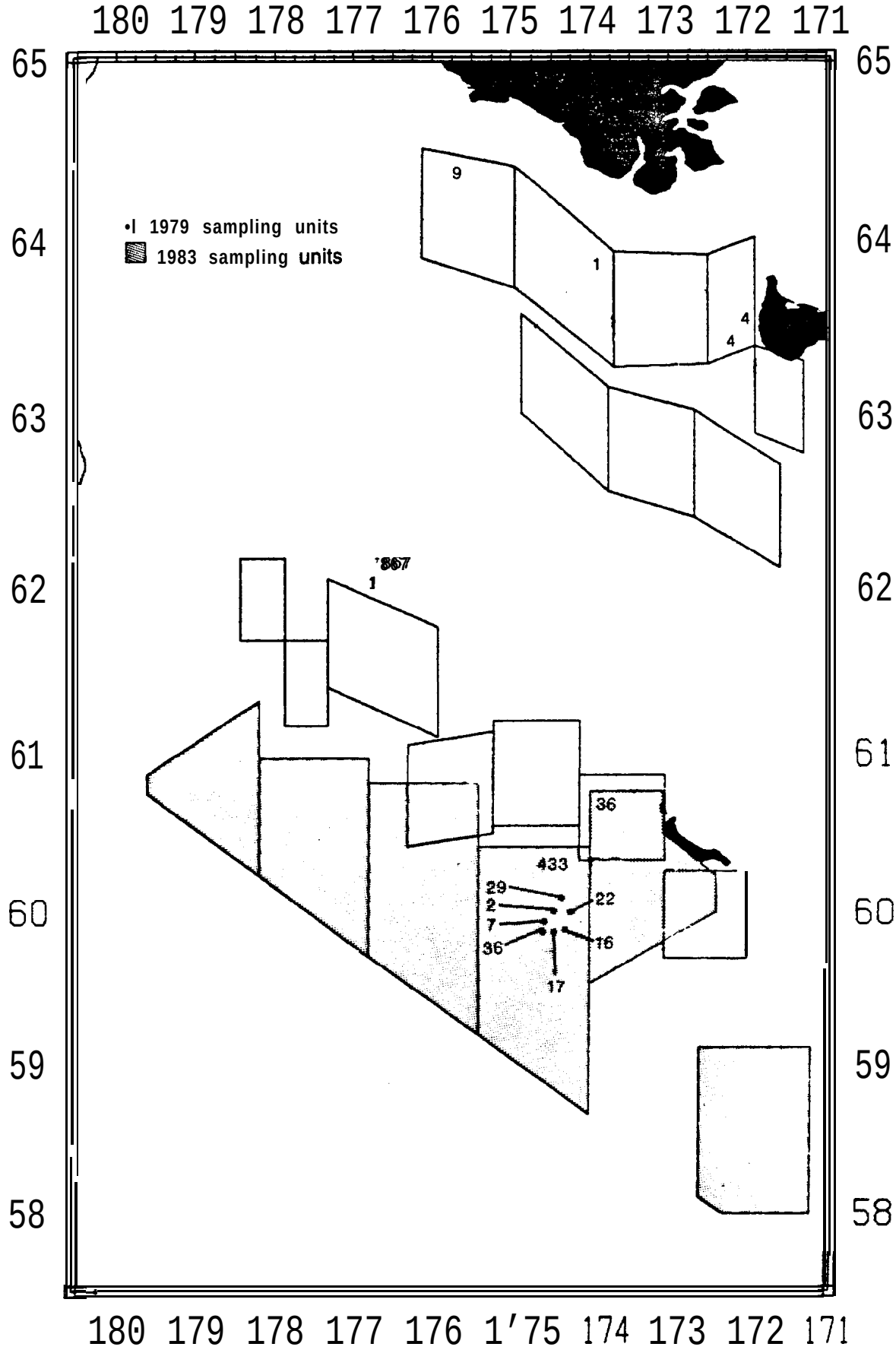


Figure C-1 Locations of beluga whales observed in the Bering Sea pack ice during March - April 1979 and February - March 1983.

observations in 1983 were in areas of 80-100 percent ice concentration predominated by new and young ice (Figure c-2). Few whales were observed in the lower ice concentrations, particularly the 0-40 percent categories, and there were no whales encountered in areas of first-year ice. In 1979, almost all of the belugas were observed in long narrow leads north of the marginal ice front. Floe size did not appear to influence beluga whale distribution.

Beluga whale densities were estimated for 1983 but not 1979 because too few animals were observed during systematic surveys. An estimated 0.028 belugas per nm^2 representing 462 + 578 animals occurred in the marginal ice front in 1983 (Brueggeman et al., 1983). This estimate is based on 6.7 percent coverage of 16,382 nm^2 involving observations of 37 belugas. Since the estimated abundance is below the actual number observed, the actual observed value of 886 animals is the best estimate of abundance. This estimate is above the 598 animals observed in 1979 and it represents a minimum estimate since it does not account for animals below the surface that *were* missed.

The results of the 1979 and 1983 surveys showed that an estimated 886 beluga whales occurred throughout the pack ice from winter to early spring. Most of the whales occurred in areas of higher ice concentrations and in leads. Particularly high occurrences of belugas were in an area along the US-USSR Convention Line and along the fringe of the St. Matthew Island polynya.

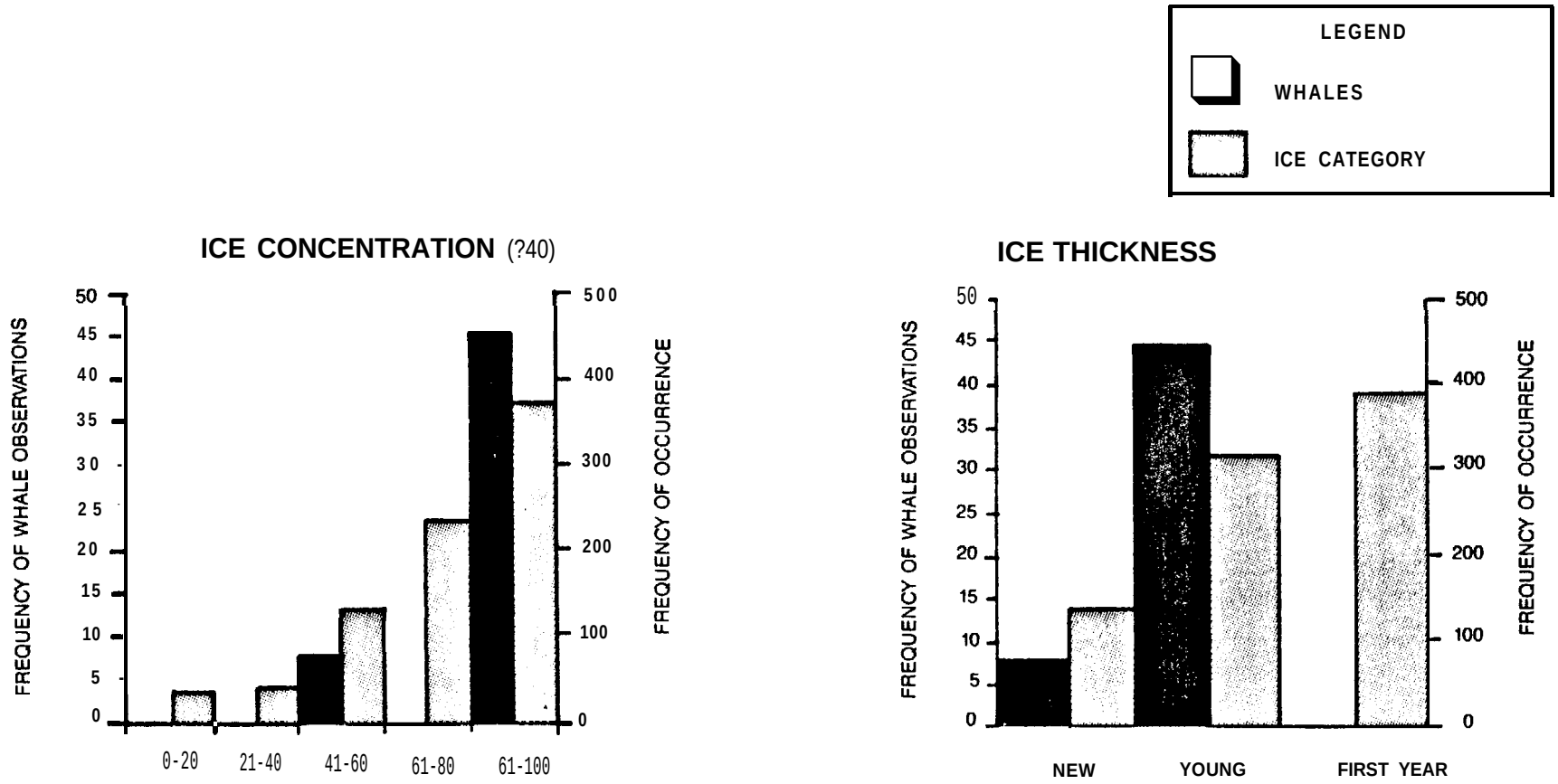


Figure C-2 **Frequency of beluga whale observations relative to frequency of ice concentration and thickness.**