SEAL/SEA LION AND WALRUS SURVEYS OF THE NAVARIN BASIN

by

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ABSTRACT

Seal, seal lion, and walrus distribution, habitat use, and density were examined in the 54,000 nm2 Navarin Basin planning unit of the northcentral Bering Sea during four seasons distributed between 1982 and 1983. Vessel and helicopter surveys were conducted along systematic tracklines distributed over the outer continental shelf, slope, and rise encompassing the Basin. The survey design was modified during winter when pack ice covered approximately half of the Basin in order to thoroughly survey the marginal ice front. During the surveys seven species of pinnipeds were observed over almost 5,500 nm of aerial and 2,600 nm of vessel surveys. Approximately 90 percent of the 1,852 animals observed were recorded during the winter survey when pinnipeds haul out on the ice. Over 75 percent of the 1,670 animals recorded during winter were walruses (52 percent) and northern sea lions (24 percent). Of the 310 seals recorded in winter, 78 percent were spotted seals, followed by ribbon and a few bearded, ringed, and fur seals in decreasing order of abundance. Walruses were primarily encountered deep in the ice front, while sea lions concentrated along the edge. Ribbon and spotted seals were intermediate in location between those two species, although distributions among species overlapped. Walruses were predominantly found in the eastern half of the ice front, sea lions and spotted seals in the western half, and ribbon seals in the center. Ice conditions utilized by these species differed, but sea lions, spotted seals, and ribbon seals generally inhabited areas of broken ice containing small floes, compared to walruses that utilized areas of thin ice surrounded by heavier pack ice. Densities of these species were estimated from the strip transect procedure and included 15.4 animals per 100 nm^2 for walrus, 6.09 for spotted seals, 2.45 for sea lions, and 0.95 for ribbon seals. Too few of the other species were sighted to analyze. None of the estimates account for submerged animals. The survey results verify that all seven of the pinniped species indigenous to the Bering Sea winter in the marginal ice front of the Navarin Basin, and at least the four most common species partition their use of the ice front, thus probably reducing interspecific competition. Density estimates of pinnipeds using the Basin were generally lower than in traditional concentration areas such as the St. Lawrence Island vicinity, Gulf of Anadyr, and Bristol Bay for each species except for ribbon seals which were higher. A similar analysis was not possible to do for pinnipeds encountered during the spring, summer, and fall seasons because of the few animals observed; however, most of the animals encountered were recorded during spring using bands of fringe ice where they bear their young. The only newborns observed during winter were walruses which occurred at a time of the year earlier than has been previously reported in the literature.

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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; and Fay 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.

Determination of these population characteristics is particularly important since the Navarin Basin planning unit [hereafter referred to as the Navarin Basin) in the northcentral Bering Sea is scheduled for oil and gas development in 1984. Because development may alter

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habitats of these animals, the Outer Continental Shelf Lands Act of 1953 as amended in 1978 requires that baseline studies be clone to assess potential impacts to the populations. In accordance to these requirements, the Minerals Management Service funded the Outer Continental Shelf Environments? Assessment Program (OCSEAP) to support studies 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. The report examines pinniped abundance and distribution in the Basin during the spring (May-June), summer (July-August), fall (October-November), and winter (February-March). Because of the difficulty in detecting and identifying pinnipeds in open water, the report concentrates on winter when pinnipeds hauled out on the ice and were most visible to survey. The other two objectives are addressed in an earlier report.

ACKNOWLEDGMENTS

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was provided by the staffs of the NOAA ship SURVEYOR and the U.S.C.G. icebreaker POLAR SEA. Without the support of these people, organizations, and personnel of both the Minerals Management Service and Outer Continental Shelf Environmental Assessment Program, the accomplishments of this study would never have been realized.

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STUDY AREA

The Navarin Basin is located in the northcentral Bering Sea, approximately 200 nautical miles (rim) off the coast of Alaska (Figure 1). It covers over 54,000 nm^2, an area approaching the size of the State of Michigan, and is bounded by the U.S.-U.S.S.R. 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 about 44 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 winter survey period (Figure 2).

The climate of the study area features harsh environmental conditions that promote the seasonal development of sea ice (Figure 3). 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 0°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.

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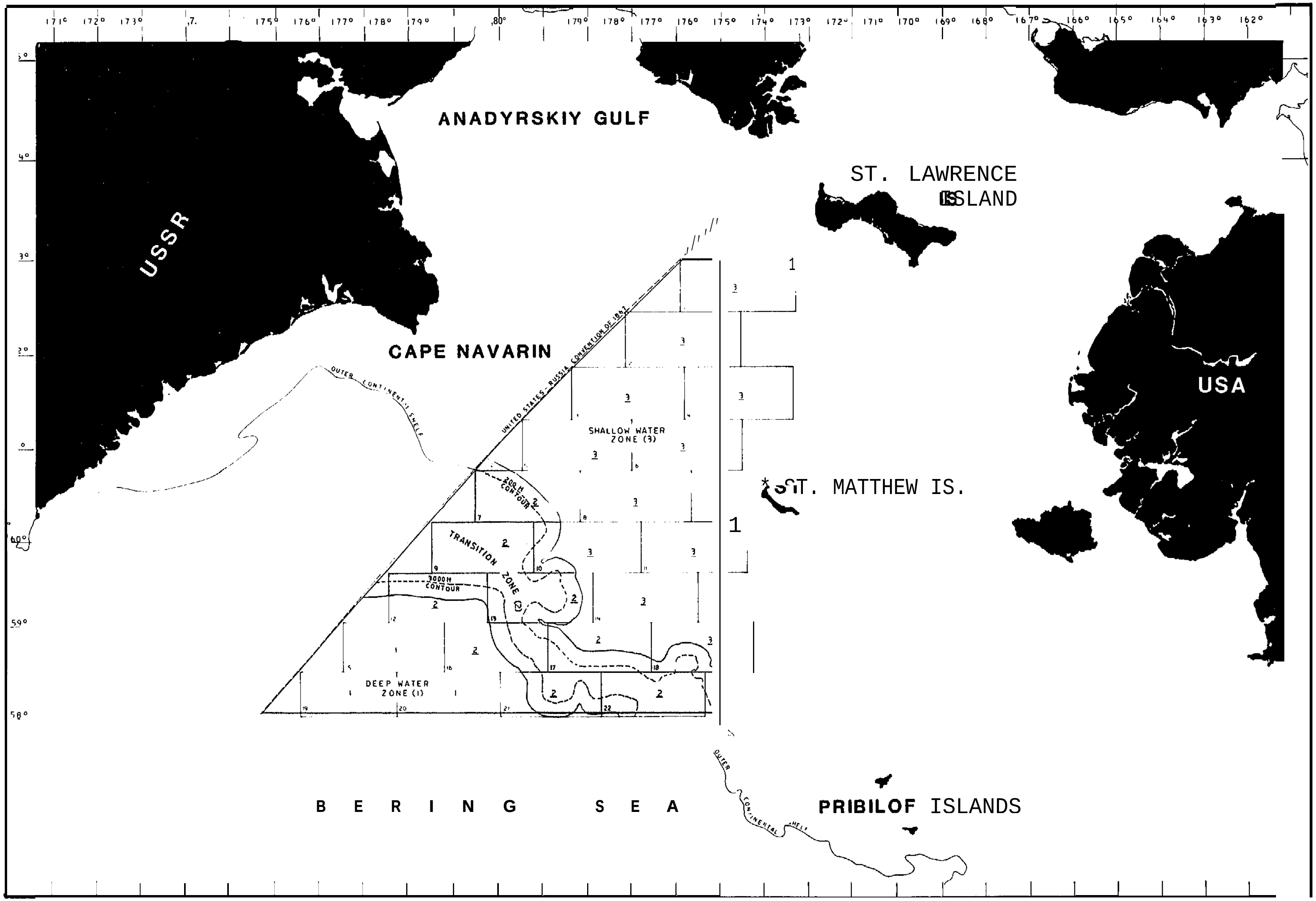

FIGURE 1 STUDY AREA AND SAMPLING DESIGN IN THE **NAVARIN** BASIN FOR SPRING THROUGH FALL SURVEY PERIOD, 1982.

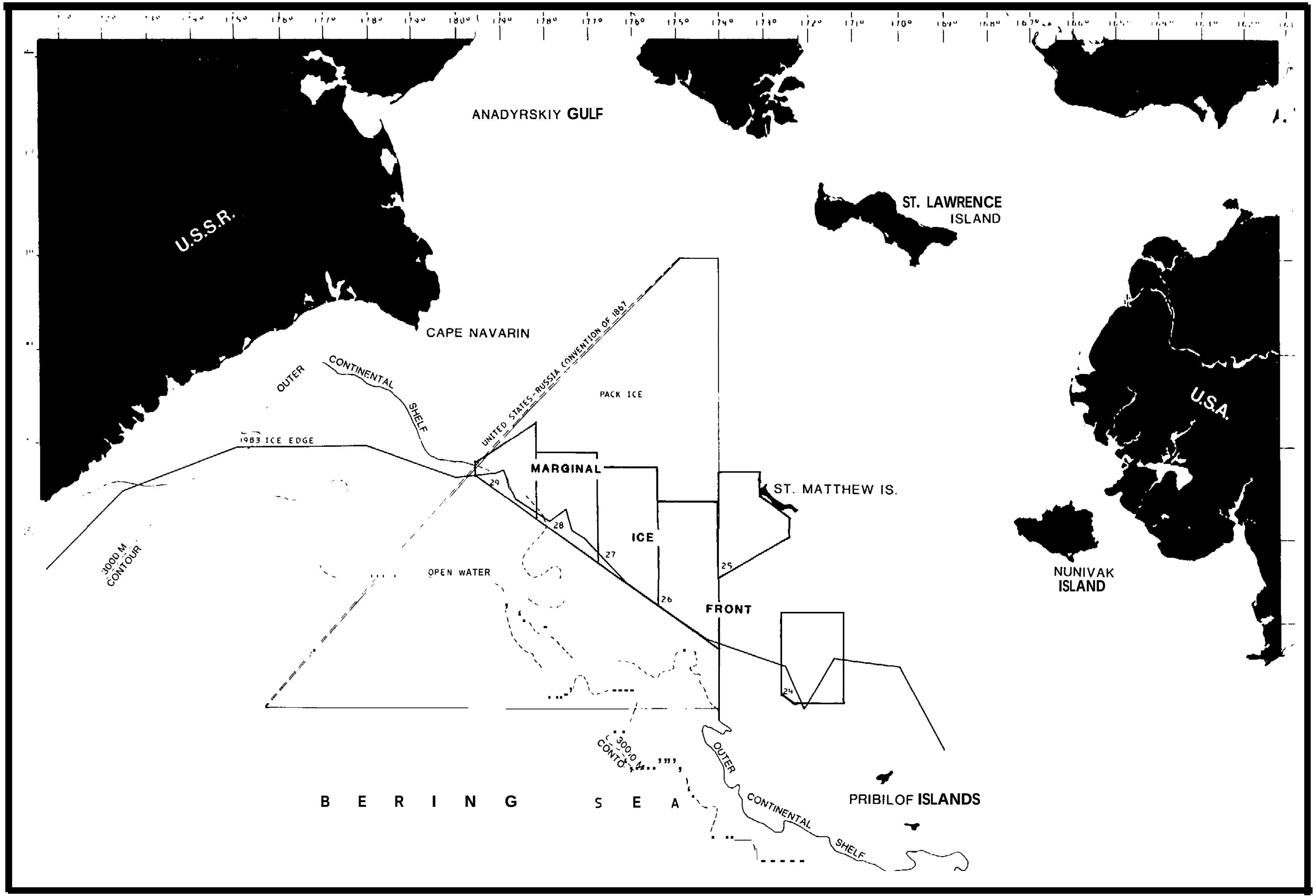

Figure 2 STUDY AREA AND SAMPLING DESIGN IN THE NAVARIN BASIN DURING WINTER SURVEY PERIOD

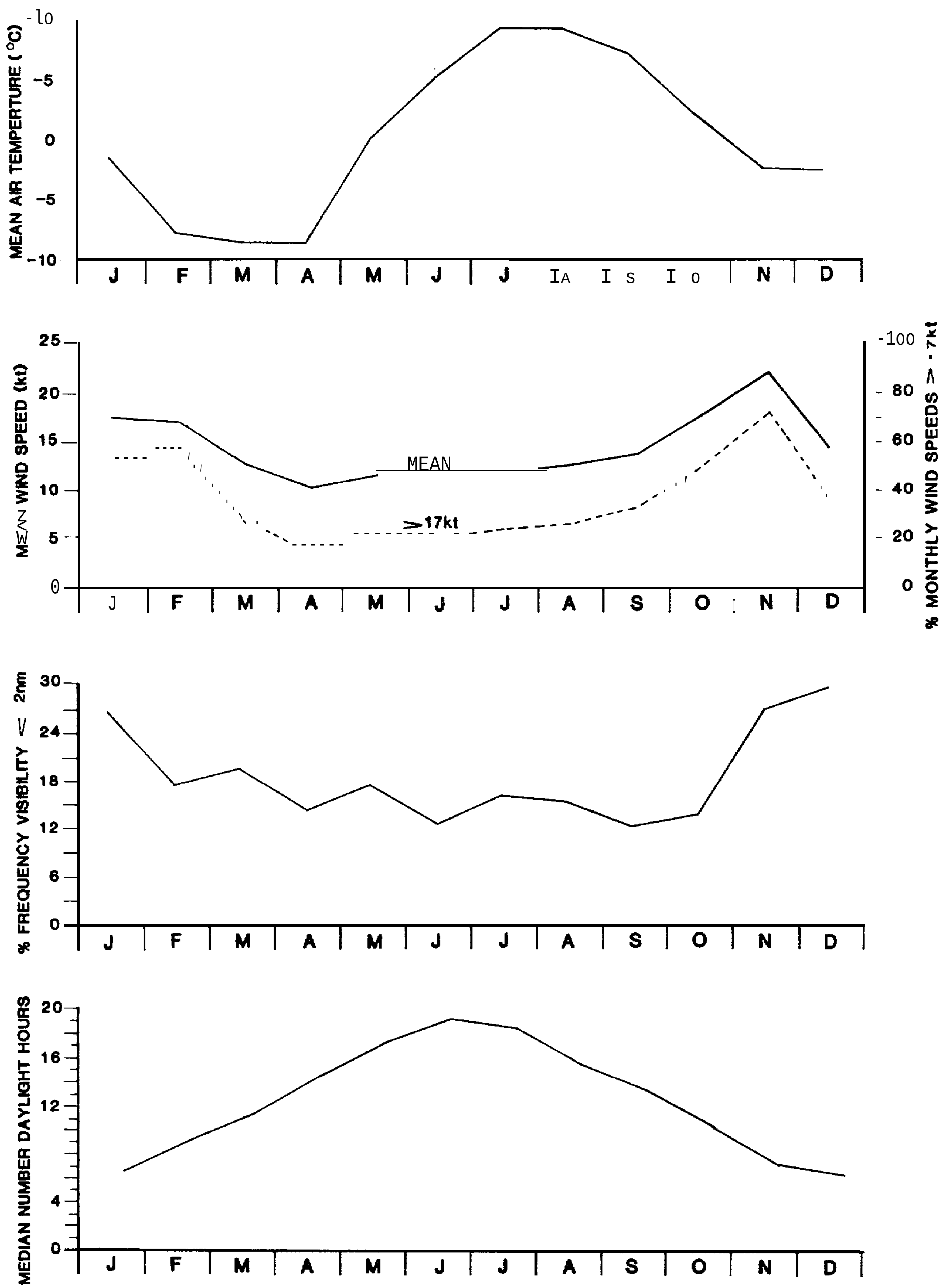

FIGURE 3 HISTORIC ENVIRONMENTAL CONDITIONS OF THE NORTH CENTRAL BERING SEA (BROWER ET AL. 1977).

METHODS

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 eight units, and the deep water zone three 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 4). This configuration provided thorough coverage of a sampling unit and prevented double surveying of adjacent lines or units.

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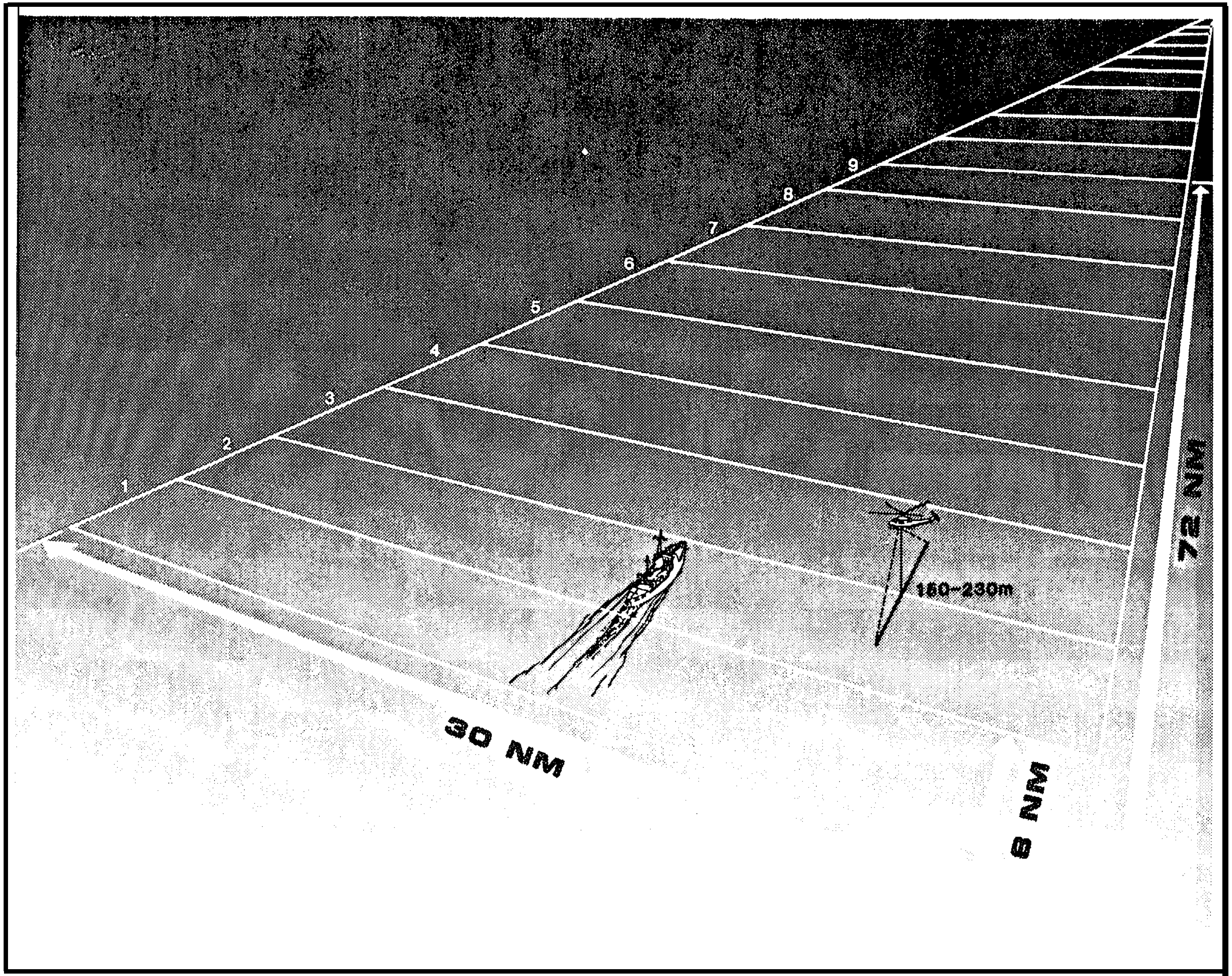

Figure 4 TRACKLINE ORIENTATION **OF** AERIAL AND VESSEL SURVEYS DURING **SPRING THROUGH** FALL PERIOD.

Aerial and vessel surveys were conducted along the transect lines of randomly selected sampling units (Figure 4). 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 co-pilot'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 Table 1), Beaufort Wind Scale (Appendix Table 2), 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

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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 4). The ship travelled 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. 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 ice-breaker 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. 1981, Brueggeman 1982).

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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 5). 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 5). 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 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 Table 3 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 travelled a predetermined course, while the helicopter flew a

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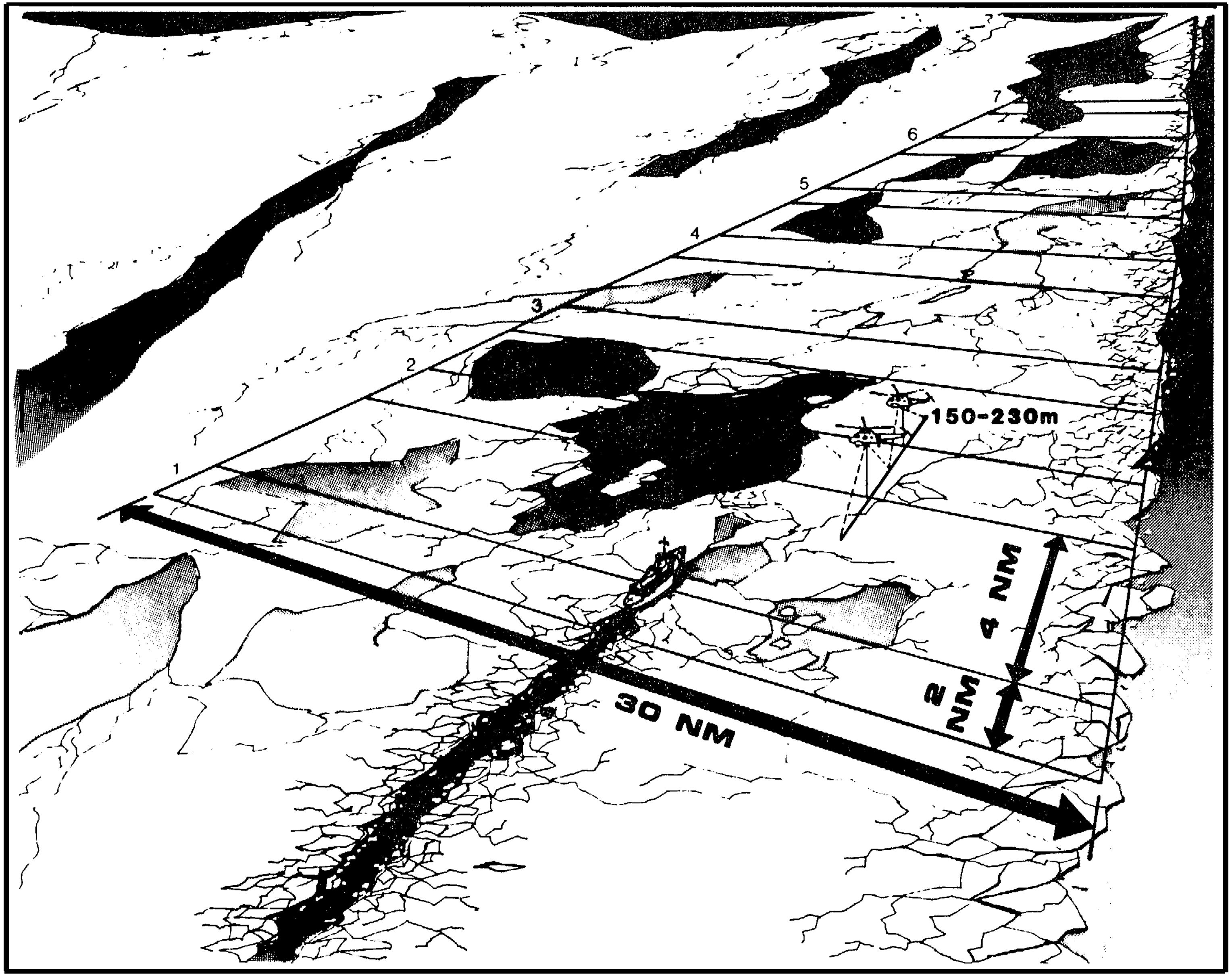

FIGURE 5 TRACKLINE ORIENTATION OF AERIAL AND VESSEL SURVEYS DURING WINTER, 1983.

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 travelled longer distances from the ship.

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 the ice free period surveys 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 when one helicopter was inoperable; data collected during these surveys were used to describe marine mammal distribution and species composition.

DATA ANALYSIS

Standard statistical procedures were used in the data analysis. 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. However, this method provided the best relative index of pinniped abundance for this study.

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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 Navarin Basin,

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
y_i = the number of pinnipeds in the i^{th} transect strip, and
x_i = the area of the i^{th} transect strip

Estimated variance of D_i is:

$$s^2_{D_i} = \Sigma\, (y_i^2 / \; i) - D\, y_i\, \Sigma / (n-1)(\Sigma\, x_i)$$

where n = number of transects

Estimated abundance for a unit is:

$$T_i = D_i\, A_i$$

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

Estimated abundance for all zones is

$$T = \Sigma\, T$$

Estimated variance of T is:

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

The 95 percent confidence interval for T is:

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

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Pinniped abundance was estimated from systematic aerial and vessel surveys. Estimates were made from animal observations occurring in a strip width of 0.5 nm (0.25 nm per side of the trackline) for the winter 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 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. This procedure tests 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 Nue et 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.

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RESULTS

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 low visibility of 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 6). During the summer and fall seasons, 17 fur seals and 4 northern sea lions were observed primarily as singles. Most of the 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

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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

	Spring				Sumner				Fall				Winter				Total			
		No. Individuals				No. Individuals				No. Individuals				No. Individuals				No. Individuals		
Species	No. Groups	**Aerial**	**Vessel**	Total	No. Groups	**Aerial**	**Vessel**	Total	No. Groups	**Aerial**	**Vessel**	Total	No. Groups	**Aerial**	**Vessel**	Total	No. Groups	**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	3	-	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.

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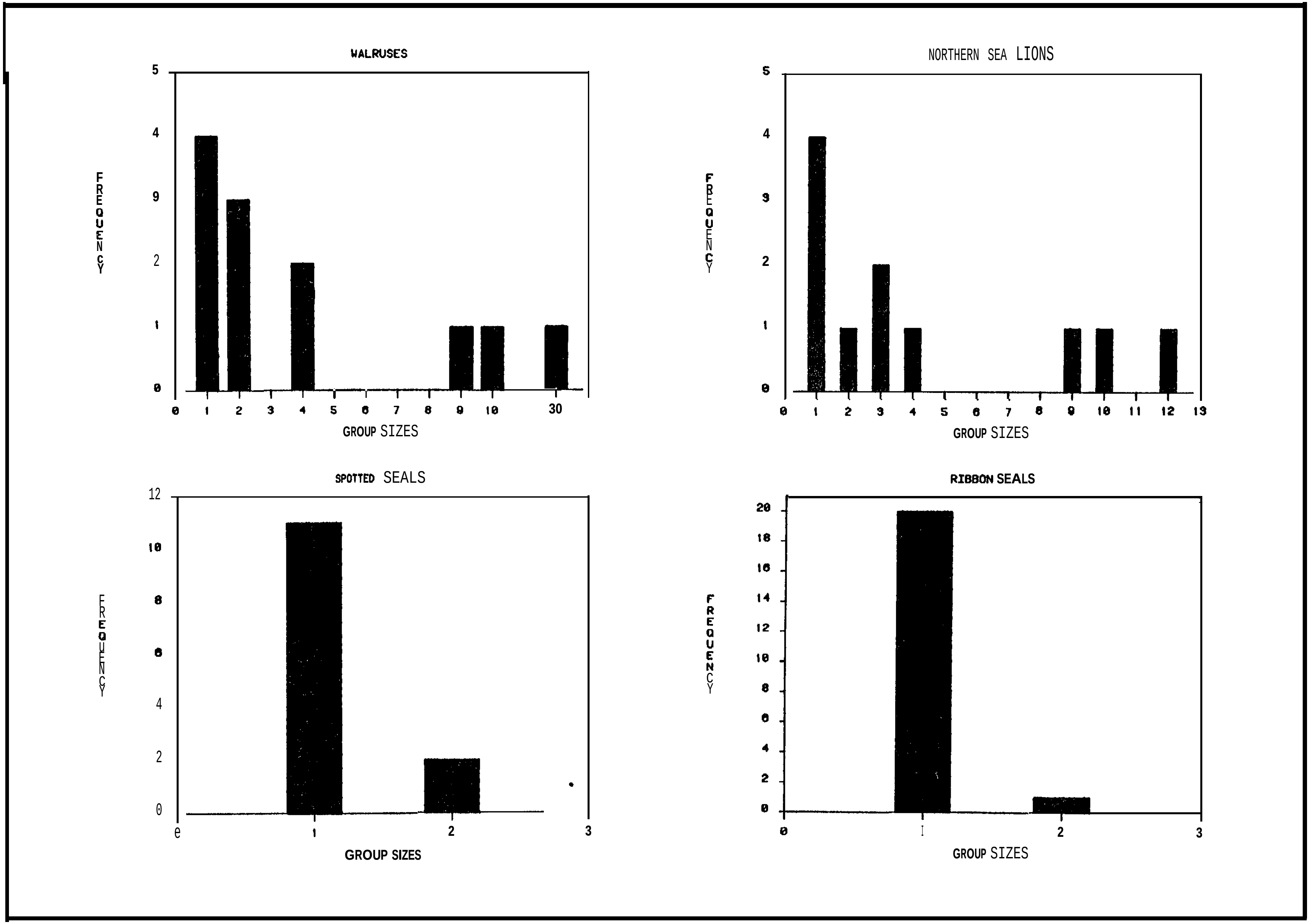

FIGURE 6 FREQUENCY DISTRIBUTION OF GROUP SIZES FOR THE FOUR MOST COMMON SPECIES OF **PINNIPEDS** OBSERVED IN THE **NAVARIN** BASIN DURING SPRING 1982.

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 7). 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. (Appendix Figures 7-11 illustrate the locations of the survey tracklines and animals.)

Group sizes of pinnipeds were quite variable (Figure 8). 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. Although the large groups of walruses typically associated with the spring (Fay 1981; Brueggeman unpubl. data) 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 were observed primarily with single adults, presumably their mothers. The newborns were recorded between 25 February and 7 March, inclusively. The earliest previously recorded birth date of walruses was 15 April (Fay 1981). No other species of newborn seals were observed because

TABLE 2

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

Sampl ing Unit	Trackl ine distance surveyed			Spotted seal		Ribbon seal		Bearded seal		Ri nged seal		N. fur seal		N. sea 1 ion		N. Pacific walrus		Unidentified pinniped		Total	
	Aeri al (%)	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	25c/	42	7	12	38	66
25	82	18	462	1b/	1	5	5							-b/	-	43c/	198	17	18	66	222
26	71	29	613	4b/	15	12c/	45	6	6	-	-	-	-	8b/	26	64c/	556	24	26	118	674
27	83	17	482	4	37	3b/	6					1	1	10	34	5b/	3	3	3 3	26	114
28	80	20	466	3b/	3	2b/	2							36	324	-b/	-	7	7	48	336
29	23	77	240	28c/	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	147	868	73	86	364	1670

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

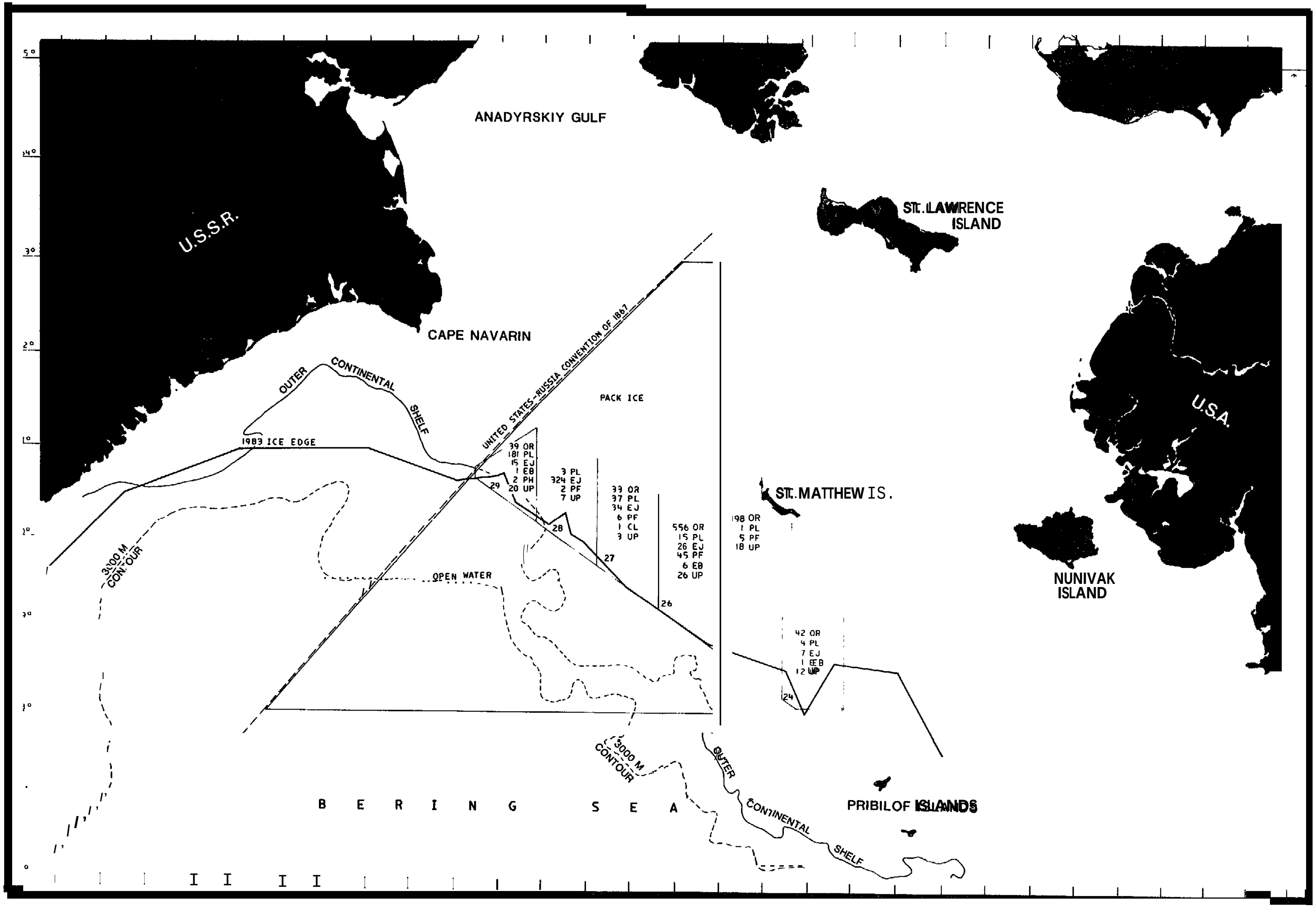

Figure 7 DISTRIBUTION OF PINNIPEDS RECORDED IN NAVARIN BASIN DURING WINTER. FEBRUARY 19-MARCH 18, 1983.
(See Figures 7 Through 11 and Table 4 in Appendices for Specific Locations of Survey Tracklines and Animals.)

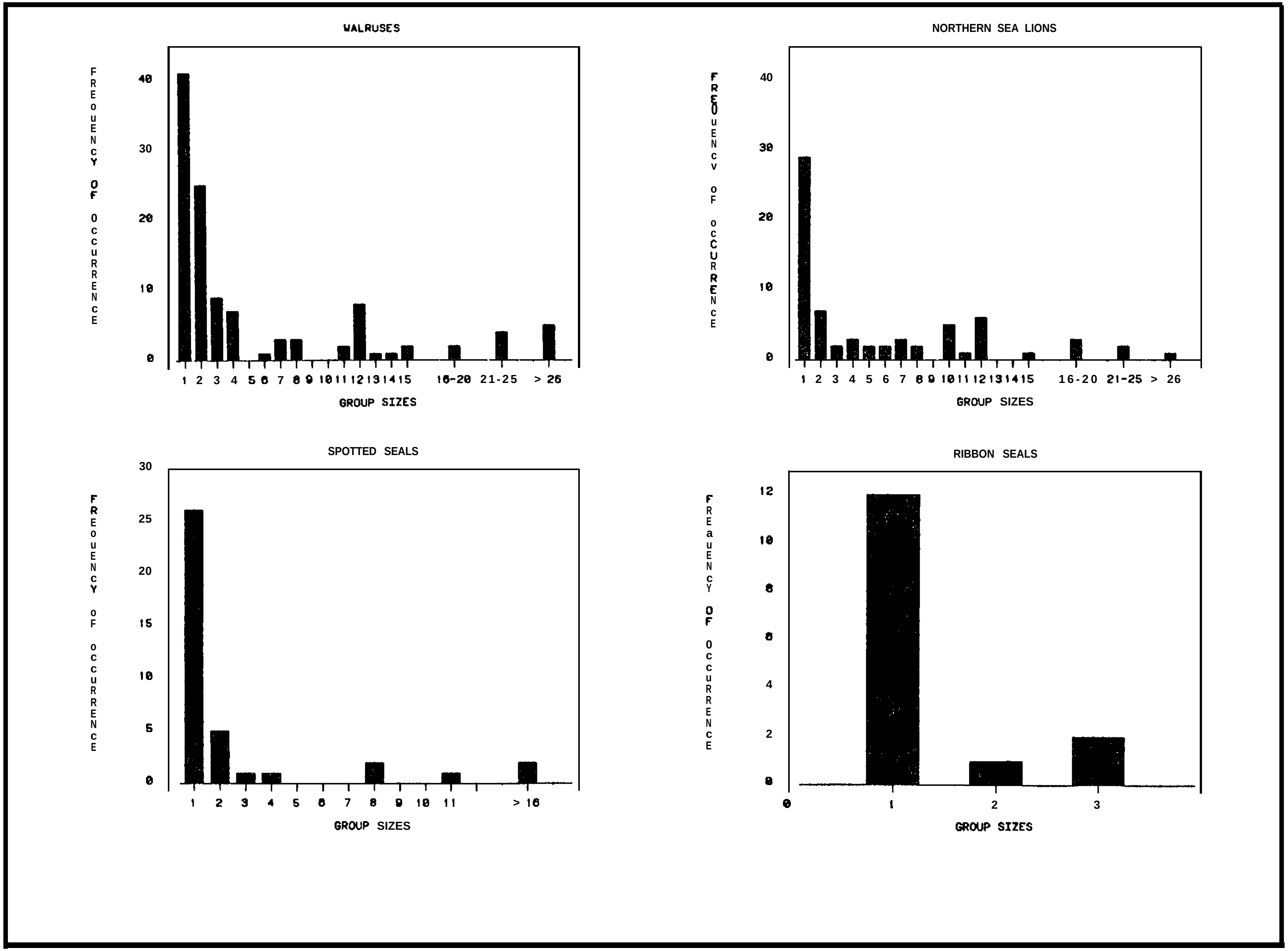

FIGURE 8 FREQUENCY DISTRIBUTION OF GROUP SIZES FOR THE FOUR MOST COMMON SPECIES OF PINNIPEDS OBSERVED IN THE MARGINAL ICE FRONT DURING WINTER, 1983.

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 from the ice edge or open water (Figure 9). 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 Table 5). 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 the 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 10). 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 closest (12.5 nm$\pm$0.8 standard error) and walruses farthest (67.4 nm$\pm$1.9) from the ice edge. Distributed between these two species were the spotted (30.5 nm$\pm$2.7) and ribbon (60.5 nm$\pm$4.2) seals, although

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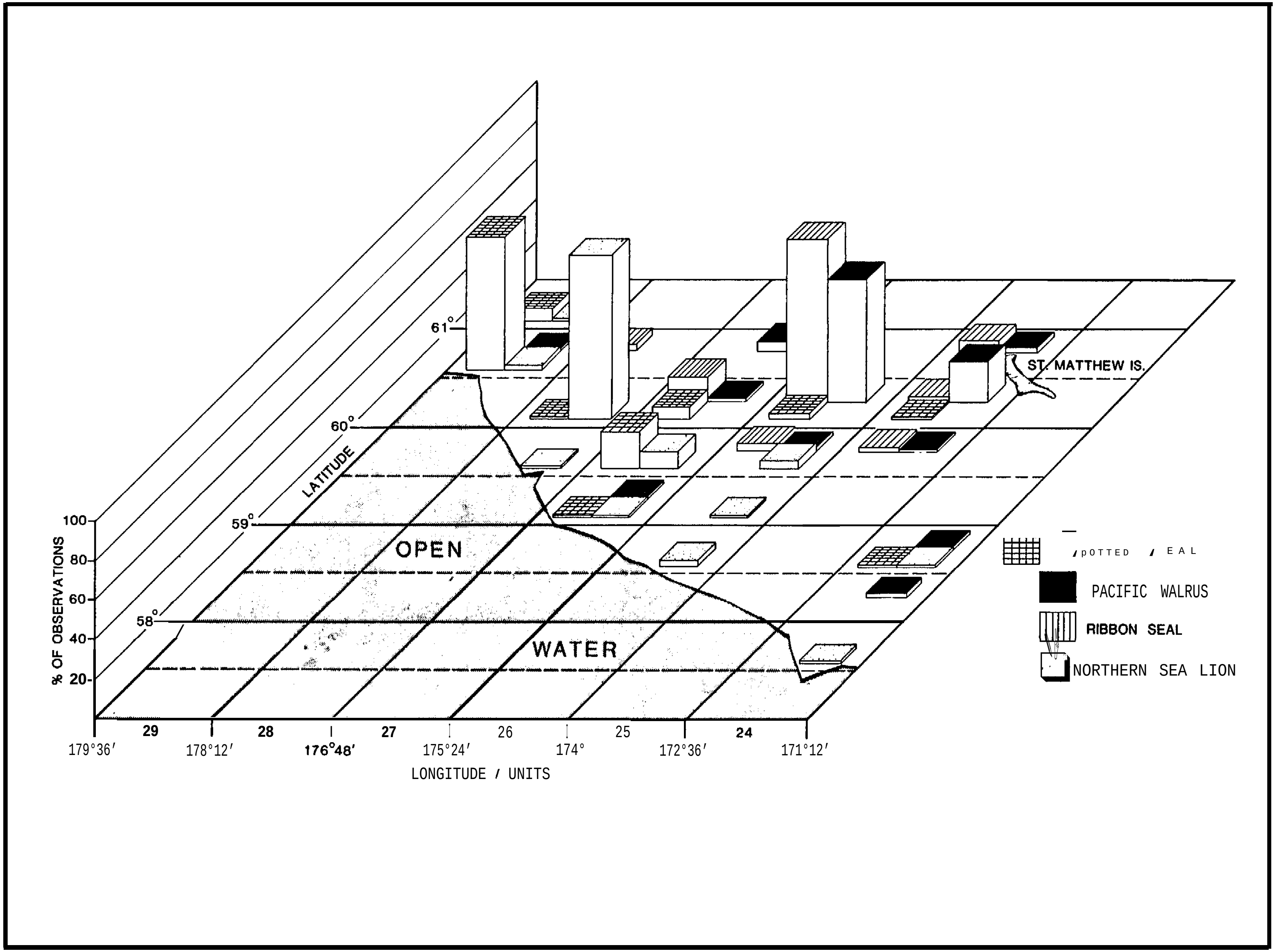

FIGURE 9 DISTRIBUTION OF THE FOUR MOST COMMON **PINNIPEDS** OBSERVED IN THE MARGINAL ICE FRONT **DURING** WINTER, 1983.

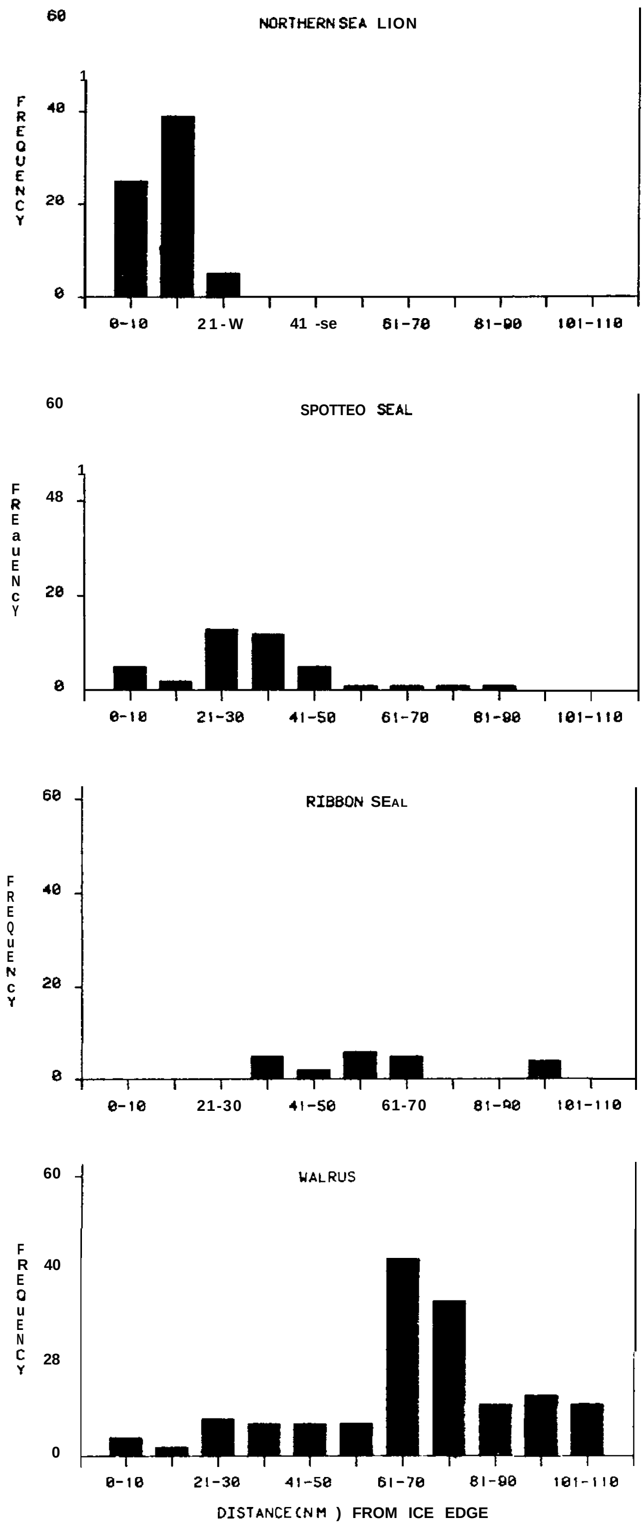

FIGURE 10 DISTANCE FREQUENCIES OF NORTHERN SEA LIONS, SPOTTED SEALS, RIBBON SEALS, AND WALRUSES INTO THE PACK ICE FROM THE EDGE OF MARGINAL ICE FRONT DURING WINTER 1983.

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 may be 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. 1981). 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 11). 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 zone of transition between the irregular southern margin of the main pack ice and the heavier consolidated pack ice (Burns et al. 1981), 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, 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 ice was thick. Conversely, ice in the eastern units was relatively

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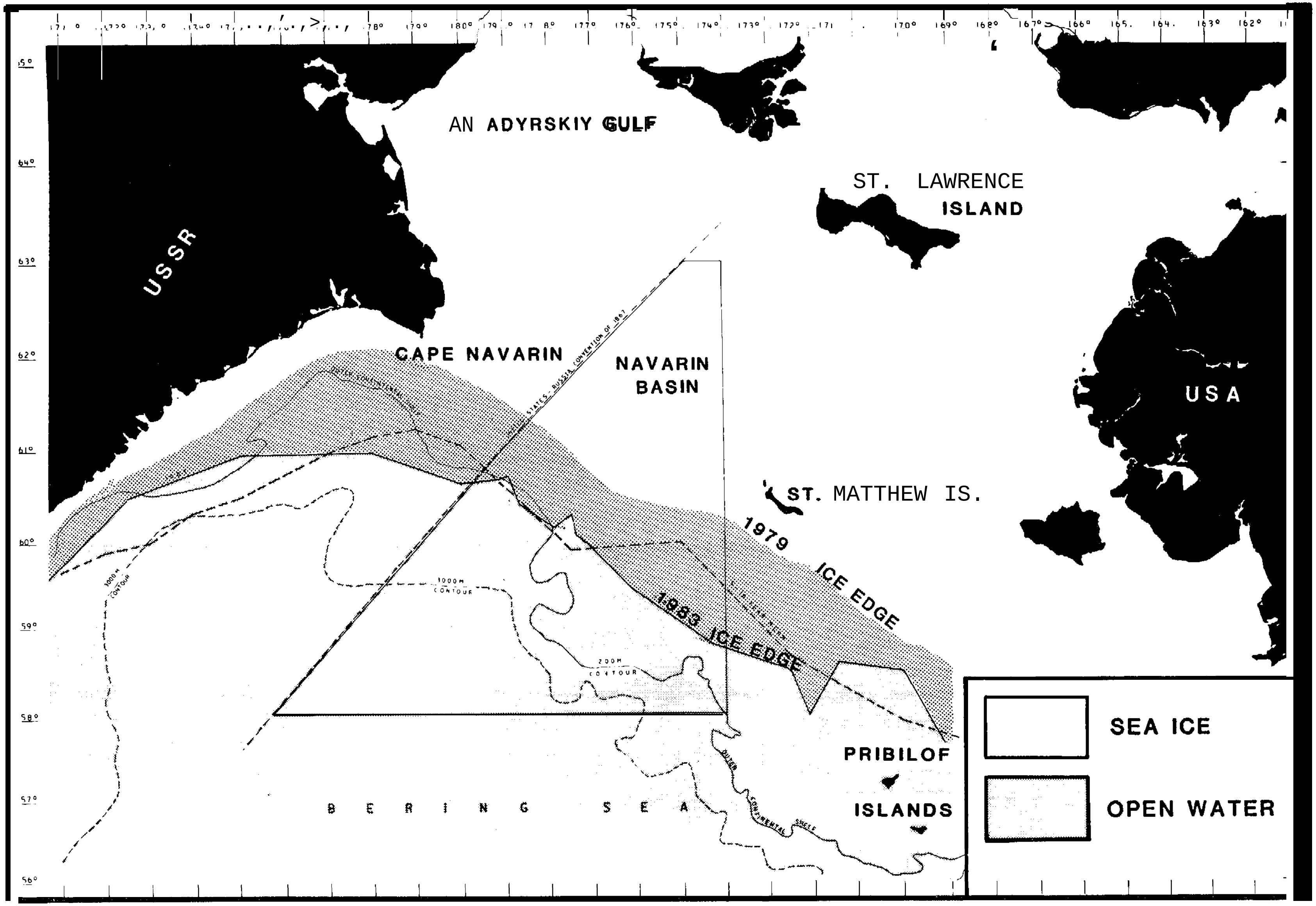

Figure 11 APPROXIMATE LOCATION OF ICE EDGE DURING 1979 AND 1983 STUDY PERIODS COMPARED TO A 5-16 YEAR MEAN (Potocsky 1975) IN THE BERING SEA.

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 of each ice size category[b/]				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 B-3.

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

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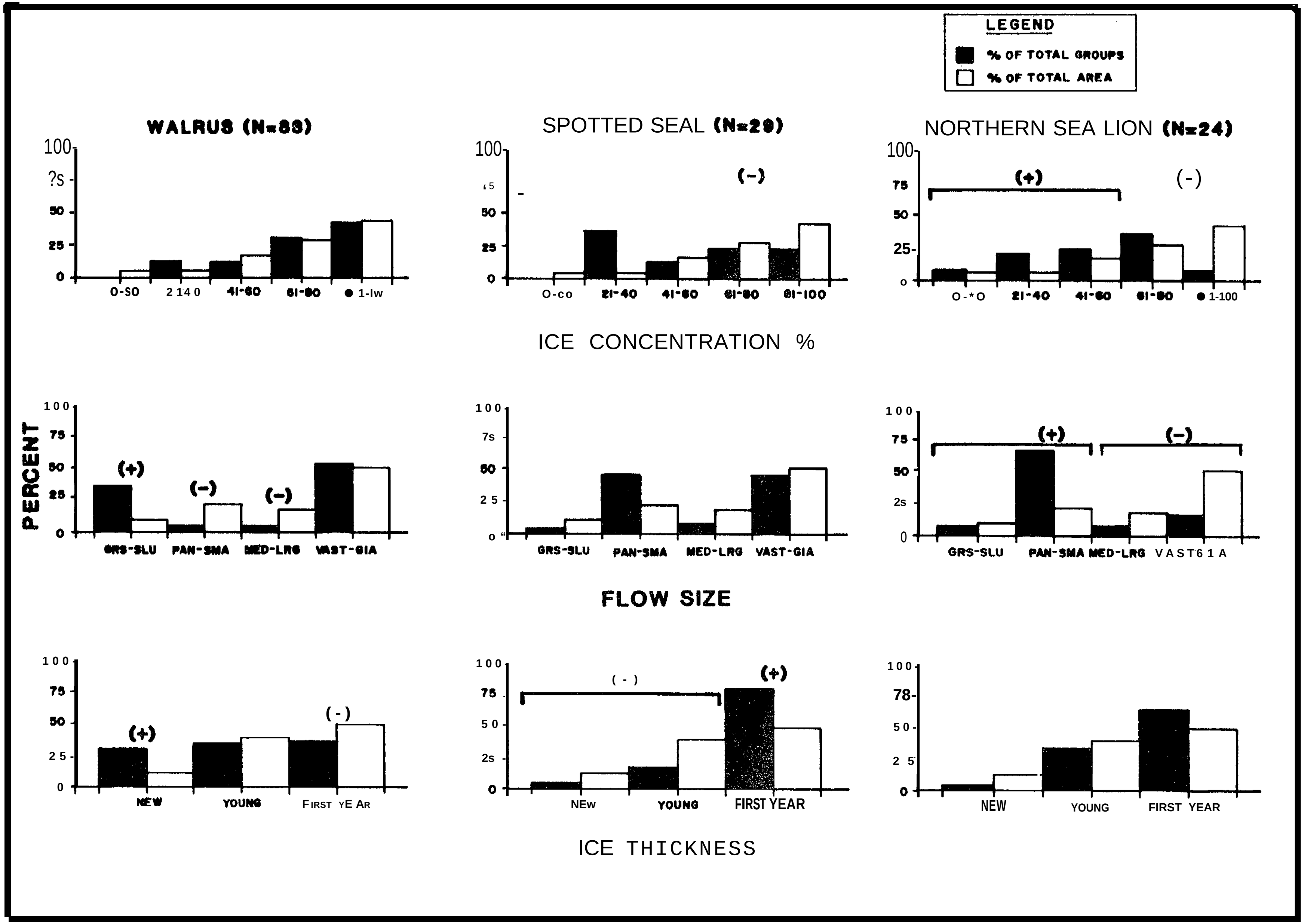

FIGURE 12 PERCENT OCCURRENCE OF **PINNIPEDS** RELATIVE **TO** PERCENT AVAILABILITY OF **ICE** TYPES IN THE **MARGINAL** ICE FRONT : PLUS **(+) SIGNIFIES** SIGNIFICANT PREFERENCE, **MINUS (-)** SIGNIFIES **SIGNIFICANT** AVOIDANCE, BRACKET (┌─┐) SIGNIFIES POOLED DATA.

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 12). Chi-square analysis (Appendix Table 6) 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 recoded 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 thickness in proportion to their availability, but they were more abundant than expected ($P<0.05$) in areas with grease to small floes (pooled) and O 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). 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 sea? 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. Although there was no significant ($P>0.05$) seal use of specific floe sizes, they 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.

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Density

Density estimates of pinnipeds may be influenced by environmental conditions at the time of survey. Withrow (1982), Everitt and Jeffries (1979), and others have shown that harbor seals and northern sea lions have definite haul out 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 haul out 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

TABLE 4

CHI-SQUARE GOODNESS-OF-FITTEST COMPARING HAUL OUT PATTERNS
OF SEALS (SPOTTED, RIBBON, BEARDED, AND RINGED SEALS),
SEA LIONS, AND WALRUSES TO TIME OF DAY AND WIND CHILL

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	67	67.0	114	114.0
			$x^2=8.01$ $p>0.10$		$x^2=39.81$ $p<0.001$		$X^2=147.68$ $p<0.001$

Wind chill interval (°C)	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
-10 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	67	67.0	114	114.0
			$x^2=42.89$ $p<0.001$		$x^2=4.17$ $p>0.10$		$x^2=6.14$ $p>0.10$

TABLE 5

ESTIMATED DENSITY (per 100 nm^2) OF SEALS, SEA LIONS, AND WALRUSES IN THE MARGINAL ICE FRONT OF THE NAVARIN BASIN DURING WINTER, FEBRUARY-MARCH 1983

Sampling unit	Total area (nm^2)	Area coverage: Aerial %a/	Aerial %b/	Vessel %a/	Vessel %b/	Total %a/	Total %b/	Spotted seal No.c/	Spotted seal Den.	Ribbon seal No.c/	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	16,382	2.32	5.02	0.93	2.35	3.25	7.37	63	6.09	8	0.95	1	0.09	15	2.35	36	2.45	184	15.40	307	27.33
Unstratified								63	11.83	8	1.50	1	0.19	15	2.81	36	2.98	184	15.24	307	34.55

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.

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TABLE 6

ESTIMATED ABUNDANCES AND 95% CONFIDENCE INTERVALS FOR
SEALS, SEA LIONS, 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 walrus	Total
24	- [b/]	-				477	477
25						618	618
26	125	62		187	146	853	1373
27	524	93		31	14	441	1103
28				111	218		329
29	349	-	14	56	24	134	577
Total	998±861	155±199	14±19	385±336	402±396	2523±2050	4477
Unstrat-ified	1938:14742462253		31 +50	460±371	488±468	2497±1827	5660

[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.

the front. Density estimates for the other species ranged between 0.09 for bearded seals and 2.45 animals per 100 nm^2 for northern sea 1 ions. Estimated densities for these species in 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 genera?, 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 seal so 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.

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DISCUSSION

Pinnipeds inhabited the Navarin Basin yearlong. 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 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 ribbon 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 non-breeding animals since these species occupy rookeries throughout the summer. Because of the low numbers of animals observed during the 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 interspecific 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) reported qualitative evidence that walrus use was greater deeper in the pack than along the front. Furthermore, Fay (1981) reported that the northcentral

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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 wal rus 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. 1981), 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 flow 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. 1981).

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 haul out periods. Walruses, however, were deeper in the ice but generally near broken ice where openings were available for them to enter the water.

Food availability is undoubtedly another important factor influencing the distribution of pinnipeds in the ice front (Burns et al. 1981; Lowry et al. 1982; Lowry and Frost 1981) but predator-prey studies were beyond the scope of our project. The Pacific walrus, a benthic feeder, preys primarily on bivalve mollusks (Musculus sp., Nucula sp., and Mya truncata sp.) which comprise over 80 percent of their diet (Fay 1982). Spotted and ribbon seals and sea lions all have overlapping prey species with the predominant species being walleye pollock (Gel'tsev 1971; Lowry et al. 1979; Frost and Lowry 1980; Burns et al. 1981; Burns 1981a; Lowry et al. 1982; Bukhtiyarovet al. in prep.;). Other major prey of these species are Arctic cod, saffron cod, capel in, rainbow smelt, sandlance, greenling, sculpins, herring, cephalopods, and shrimp (Lowry et al. 1981, 1982). Sea lions also feed on squid and octopus, species principally associated with the outer continental slope. The availability and distribution of these various prey species, while poorly known north of the slope, are widespread and within the areas occupied by the four pinnipeds (Umeda and Bakkala 1983). Walruses mainly occurred in the shallow water considerably north of the front where access to benthic invertebrates was easiest. Spotted and ribbon seal locations were difficult to interpret since their prey is quite diverse and widely distributed on the shelf. Their distribution may be more a function of the suitability of ice conditions, but this cannot be verified until better information is available on site specific distribution of prey species. A similar problem is associated with evaluating sea lion distribution; however, since sea lions' prey include several species primarily found near the slope, the narrow distribution of sea lions along the edge of the front may in part be related to access to the slope. It is obvious that food is important in the distribution of pinnipeds since it provides the fuel for maintenance and reproduction. ice, however, is also important since it provides the platform for conducting reproductive events and molting as well as being a barrier to movement. Consequently, distribution of pinnipeds in the marginal ice front is interrelated to ice conditions and prey availability.

Other factors affecting the observed distribution of pinnipeds in the ice front were unclear but the value of partitioning space has been clearly documented. Habitat partitioning reduces competition among

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consumers for limited resources. This strategy has been reviewed (Schoener 1974) and documented for birds (Cody 1968), mammals (Koplin and Hoffman 1968; Singer 1978; Dueser and Shugart 1979;) and other organisms. In our studies, walruses and sea lions utilized different habitats and distinct feeding strategies. Spotted seals and sea lions also used different habitats, although they prey on many of the same species, but food habits are not completely overlapping. The greatest overlap occurred between the spotted and ribbon seals for a food resource and between ribbon seals and walruses for space. Because ribbon seals prey on species different from walruses, these two species coexisted without competing. Competition between ribbon and spotted seals, however, was reduced through geographical separation. Although prey availability appears to be high on the shelf, the species studied still displayed a partitioning of habitats suggesting that other factors (behavior, etc.) probably play an important role in determining their distributions.

Estimated densities of pinnipeds in the marginal ice front varied from those reported by other investigators (Table 7). Density comparisons, however, must be viewed with caution for several reasons: data collection and analysis procedures differed among investigators; other surveys coincided with peak haul out periods whereas our surveys occurred before that time; there may be considerable variation in densities between years. Pups were excluded from the densities reported by Burns and Harbo (1977) to make comparisons with our data" more compatible; it was not possible to also do this with Braham et al. (unpublished) data. Despite these concerns, density comparisons describe the relative importance of the ice front in the Navarin Basin to pinnipeds. We found that walrus densities were almost triple those previously reported for the ice front in the southcentral Bering Sea or Navarin Basin, but were similar for spotted seals. Spotted seal and walrus densities were, however, five times lower in the study area than reported for known areas of highest density (walrus in Bristol Bay and northern Bering Sea, spotted seals in southeastern Bering Sea) for these two species. Bearded seal densities were also much lower than

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TABLE 7

COMPARISON OF PINNIPED DENSITIES (PER NM²) REPORTED FOR THE CURRENT STUDY TO THOSE REPORTED BY OTHER INVESTIGATORS

Location a/	Source	Pacific walrus	Northern sea lion	Spotted seal	Ribbon seal	Bearded seal
Navarin Basin	Current study	0.152	0.030	0.120	0.015	0.002
SouthCentral Bering Sea	Burns and Harbo (1977)	0.058	-	0.194		
Southeastern Bering Sea	Burns and Harbo (1977)	0.118	-	0.614		
Southeastern Bering Sea	Braham et al. (unpublished)	0.82	-	0.370	0.006	0.083
Bristol Bay	Burns and Harbo (1977)	0.740	-	0.084		
Northern Bering Sea	Braham et al. (unpublished)	2.77	-		<0.001	0.141

a/ Southeastern Bering Sea = 160° to 168°W, south of 61°N; Northern Bering Sea = St. Lawrence Island vicinity; Southeastern Bering Sea = 163°W to 169°W; Southcentral Bering Sea = 169°W to 180°W; Bristol Bay = 157°W to 163°W; Navarin Basin = 171°W to 180°W.

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reported elsewhere in the pack ice, particularly when compared to areas deeper in the pack ice of the northern Bering Sea than we surveyed, which is where this species normally occurs. Conversely, ribbon seal densities were higher in the Basin than in the southeastern or northern Bering Sea, which has been reported to hold true for the western Bering Sea in general (Braham et al. unpublished). Availability of data for additional comparisons of densities in different geographic areas of the pack ice for ribbon and bearded seals was quite limited since few surveys have been conducted in their habitats. Similarly, no comparisons of sea lion densities were possible because our studies document the first density estimates of this species in the marginal ice front. In summary, our results indicate that the marginal ice front in the Navarin Basin supports lower densities of walrus, spotted, and bearded seals than in their prime areas of use while ribbon seal densities were higher in the Basin than eastward in the front; comparisons of sea lion densities were not possible.

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APPENDIX A

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APPENDIX TABLE 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 = O, visibility greater than 5 km. Marine mammals will 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, sane 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 ft with 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 over3 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).

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APPENDIX TABLE 2

DESCRIPTION OF BEAUFORT WIND SCALE
USED DURING AERIAL AND VESSEL SURVEYS a/

Scale	Sea Condition	Wave Height (ft)	Wind Speed (kt)
0	Smooth and mirrorlike	0	0-1
1	Scale-like ripples without foam crests	1	1-3
2	Small short wavelets; crests glass appearance and not breaking	2	4-6
3	Large wavelets; some crests break, foam of glassy appearance; occasional white form crests	3	7-1o
4	Small waves become longer; fairly frequent white foam crests	4	11-16
5	Moderate waves more pronounced long form; many white foam crests; there may be some spray	6	17-21
6	Large waves form; white foam crests extensive; may be spray	10	22-27
7	Sea heaves; white foam from breaking waves brown in streaks in direction of wind; spindrift	14	28-33
8	Moderately high waves of greater lengths; edges of crests break into sprindrifts; foam blown in well-marked streaks	18	28-33

a/ Beaufort wind scale was taken from Consiglieri and Bouchet (1981).

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APPENDIX TABLE 3

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.
Slush	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 descriptions 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.

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APPENDIX TABLE 4
RECORD OF PINNIPEDS 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	Location
		SPRING SURVEY	
5/21/82	PF	1	59″ 54'N, 174″ 39'W
5/21/82	PL	1	600 7'N, 174° 34'W
5/21/82	EB	1	60° 6'N, 174° 34'W
5/21/82	PF	1	60° 6'N, 174° 34'W
5/21/82	PF	1	60° 6'N, 174° 34'W
5/21/82	PF	1	60° 6'N, 174″ 34'W
5/21/82	EB	1	600 6'N, 174° 34'W
5/21/82	PF	1	600 6'N, 174° 34'W
5/21/82	PL	1	60° 4'N, 174° 34'W
5/21/82	PL	1	600 4'N, 174″ 34'W
5/21/82	PF	1	60 ″ 4'N, 174° 34'W
5/21/82	O R	1	59° 55'N, 174° 37'W
5/21/82	OR	9	59″ 55'N, 174° 15'W
5/21/82	OR	2	59° 55'N, 174° 15'W
5/21/82	OR	2	59° 54'N, 174° 34'W
5/21/82	OR	4	59″ 55'N, 174° 18'W
5/21/82	PL	1	59° 56'N, 174° 18'W
5/21/82	PF	1	59° 58'N, 174° 18'W
5/21/82	OR	1	60° 00'N, 174″ 18'W
5/21/82	OR	30	60° 00'N, 174° 18'W
5/21/82	PF	1	60 ″ 7'N, 174° 18'W
5/21/82	EJ	2	600 7'N, 174° 18'W
5/21/82	PF	1	60 ″ 7'N, 174° 18'W
5/21/82	PL	1	60 ″ 7'N, 174° 18'W
5/21/82	PL	1	600 7'N, 174° 18'W
5/21/82	PF	1	60″ 7'N, 174° 18'W
5/21/82	PF	1	600 7'N, 174° 18'W
5/21/82	PL	1	60 ″ 8'N, 174° 18'W
5/21/82	PL	1	600 8'N, 174° 18'W
5/21/82	PL	1	60″ 10'N, 174° 18'W
5/21/82	PF	1	60° 10'N, 174° 2'W
5/21/82	PF	1	60″ 10'N, 174° 2*W
5/21/82	PF	1	600 7'N, 174″ 2'W

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

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RECORD OF PINNIPEDS 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	Location
	SPRING SURVEY (Continued)		
5/21/82	PF	1	600 7′N, 174° 2'W
5/21/82	OR	1	600 5′N, 174° 2'W
5/21/82	OR	4	59° 59'N, 173° 46′W
5/21/82	OR	10	59° 59'N, 173° 46′W
5/21/82	EJ	9	600 1'N, 173° 46′W
5/21/82	OR	1	600 1'N, 173″ 46'W
5/21/82	PL	2	60 ″ 2′N, 173° 46′W
5/21/82	PF	2	600 3′N, 173″ 46'W
5/21/82	PF	1	600 5'N, 173° 46′W
5/21/82	PL	1	60° 7'N, 173° 46'W
5/21/82	PF	1	600 7*N, 173° 46′W
5/21/82	EB	1	60° 8'N, 173° 46′W
5/21/82	EJ	1	60° 10′N, 173° 44′W
5/21/82	PF	1	600 5′N, 173° 30′W
5/21/82	PL	2	600 5'N, 173° 30′W
5/21/82	EJ	10	60 ″ 1′N, 173° 30′W
5/21/82	EJ	12	600 1'N, 173° 30′W
5/21/82	EJ	3	60 ″ 1'N, 173° 30′W
5/21/82	EJ	4	600 1*N, 173° 30′W
5/21/82	EB	1	600 1'N, 173° 30′W
5/23/82	PF	1	60° 43′N, 175° 20′W
5/23/82	PF	1	60° 43′N, 175° 20′W
5/23/82	EJ	1	60° 41'N, 175° 20′W
5/21/82	UP	1	59° 55′N , 174° 48'W
5/21/82	UP	4	59° 55'N, 174° 43′W
5/21/82	OR	2	59° 54'N, 174° 40′W
5/21/82	UP	1	59° 54'N, 174° 39'W
5/27/82	PL	1	60° 37′N, 174° 46′W
5/27/82	EJ	3	60° 41'N, 174° 46′W
5/27/82	EJ	1	60° 42′N, 174° 46′W
	SUMMER SURVEY		
7/28/82	EJ	2	60° 48'N, 178° 22′W
7/26/82	EJ	2	60° 53'N, 175° 1'W
7/29/82	CL	1	59° 46′N, 179° 8′W
8/04/82	CL	1	59° 52'N, 173° 30′W
8/07/82	CL	2	58° 26′N, 174″ 39′W
8/07/82	CL	1	58° 19'N, 174″ 39′W
8/07/82	CL	1	58° 18'N, 174° 39′W
8/07/82	CL	1	58° 16'N, 174° 39′W

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

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APPENDIX TABLE 4
RECORD OF PINNIPEDS 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	Location
	WINTER SURVEY (Continued)		
02/24/83	EJ	2	59° 33'N, 176° 12'W
02/24/83	CL	1	59° 33'N, 176° 10'W
02/24/83	EJ	4	59° 32'N, 176° 04'W
02/24/83	UP	1	59° 44'N, 175° 54'W
02/24/83	PL	1	59° 54'N, 175° 52'W
02/25/83	EJ	1	59° 29'N, 176° 04'W
02/25/83	EJ	1	59° 28'N, 176° 04'W
02/25/83	OR	2	59° 28'N, 176° 04'W
02/25/83	EJ	4	59° 29'N, 176° 03'W
02/25/83	PL	1	59° 31'N, 176° 03'W
02/25/83	PL	34	59° 31'N, 176° 03'W
02/26/83	PL	1	60° 07'N, 177° 27'W
02/26/83	EJ	1	60° 16'N, 177° 34'W
02/26/83	UP	1	60° 18'N, 177° 41'W
02/26/83	EJ	1	60° 19'N, 177° 41'W
02/26/83	UP	1	60° 27'N, 177° 42'W
02/26/83	EJ	1	60° 21'N, 177° 52'W
02/27/83	PL	1	60° 35'N, 178° 13'W
02/28/83	PL	1	60° 54'N, 178° 14'W
02/28/83	PL	1	60° 54'N, 178° 15'W
02/28/83	PL	1	60° 55'N, 178° 17'W
02/28/83	OR	4	60° 55'N, 178° 18'W
02/28/83	PL	1	60° 55'N, 178° 19'W
02/28/83	PL	1	60° 55'N, 178° 19'W
02/28/83	PL	1	60° 55'N, 178° 19'W
02/28/83	PL	1	60° 55'N, 178° 19'W
02/28/83	PL	1	60° 55'N, 178° 19'W
02/28/83	PL	1	60° 56'N, 178° 21'W
02/28/83	PL	1	60° 57'N, 178° 23'W
02/28/83	OR	2	61° 02'N, 178° 19'W
02/28/83	UP	1	61° 01'N, 178° 17'W
02/28/83	UP	1	61° 01'N, 178° 17'W
02/28/83	OR	1	61° 04'N, 178° 16'W
02/28/83	UP	1	61° 05'N, 178° 16'W
02/28/83	OR	1	61° 11'N, 178° 20'W
02/28/83	PL	2	61° 13'N, 178° 25'W
02/28/83	OR	1	61° 12'N, 178° 27'W
02/28/83	PL	1	61° 12'N, 178° 29'W
02/28/83	PH	1	61° 11'N, 178° 30'W
02/28/83	UP	1	61° 11'N, 178° 30'W
02/28/83	OR	1	61° 04'N, 178° 40'W
02/28/83	OR	1	61° 04'N, 178° 40'W

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APPENDIX TABLE 4
RECORD OF PINNIPEDS 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	Location
	WINTER SURVEY (Continued)		
02/28/83	OR	23	61° 01'N, 178° 41'W
02/28/83	PL	1	61° 01'N, 178° 41'W
02/28/83	OR	2	61° 01'N, 178° 41'W
02/28/83	PH	1	61° 01'N, 178° 35'W
03/01/83	UP	1	61° 00'N, 178° 30'W
03/01/83	PL	1	60° 59'N, 178° 28'W
03/01/83	OR	3	60° 56'N, 178° 28'W
03/01/83	EB	1	60° 39'N, 178″ 28'W
03/02/83	PL	1	60° 41'N, 178° 51'W
03/02/83	UP	1	60° 43'N, 178° 51'W
03/02/83	PL	1	60° 55'N, 178° 54'W
03/02/83	PL	2	60° 56'N, 178° 52'W
03/02/83	PL	1	60° 56'N, 178° 52'W
03/02/83	PL	2	60° 56'N, 178″ 52'W
03/02/83	PL	35	60° 58'N, 178° 53'W
03/02/83	PL	99	60″ 58'N, 178° 53'W
03/02/83	UP	4	61° 00'N, 178° 52'W
03/02/83	UP	1	61'' 00'N, 178″ 52'W
03/02/83	UP	1	61° 00'N, 178° 58'W
03/02/83	PL	4	61° 01'N, 179° 02'W
03/02/83	PL	8	61° 01'N, 179″ 02'W
03/02/83	PL	2	61° 01'N, 179° 02'W
03/02/83	PL	8	60° 59'N, 179° 04'W
03/02/83	UP	1	60° 58'N, 179° 04'W
03/02/83	PL	1	60° 55'N, 179″ 04'W
03/02/83	UP	1	60″ 55'N, 179° 04'W
03/03/83	EJ	1	60° 44'N, 179″ 04'W
03/03/83	UP	2	60° 44'N, 179″ 04'W
03/03/83	EJ	1	60° 44'N, 179″ 04'W
03/03/83	EJ	1	60° 44'N, 179° 04'W
03/03/83	EJ	1	60″ 43'N, 179° 05'W
03/03/83	EJ	1	60″ 41'N, 179′ 15'W
03/03/83	EJ	1	60° 41'N, 179° 15'W
03/03/83	EJ	2	60° 44'N, 179° 16'W
03/03/83	EJ	1	60° 49'N, 179° 16'W
03/03/83	UP	1	60″ 47'N, 179° 24'W
03/03/83	UP	2	60° 49'N, 179° 24'W
03/03/83	PL	1	60″ 49'N, 179° 15'W
03/03/83	EJ	2	60° 47'N, 179° 14'W
03/03/83	EJ	1	60° 51'N, 179° 18'W

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APPENDIX TABLE 4
RECORD OF PINNIPEDS 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	Location
	WINTER SURVEY (Continued)		
03/03/83	EJ	2	60° 47'N, 178″ 51'W
03/03/83	EJ	1	61° 00'N, 178° 38'W
03/03/83	UP	1	60″ 58'N, 178″ 36'W
03/04/83	EJ	4	60° 18'N, 177° 37'W
03/04/83	EJ	10	60° 20'N, 177″ 37'W
03/04/83	EJ	10	60° 18'N, 177° 26'W
03/04/83	EJ	35	60° 18'N, 177° 26'W
03/04/83	EJ	25	60° 18'N, 177° 24'W
03/04/83	EJ	12	60° 18'N, 177° 24'W
03/04/83	EJ	10	60° 18'N, 177° 24'W
03/04/83	EJ	25	60° 20'N, 177° 25'W
03/04/83	EJ	12	60° 20'N, 177° 25'W
03/04/83	EJ	1	60° 20'N, 177° 25'W
03/04/83	EJ	8	60° 19'N, 177° 28'W
03/04/83	EJ	8	60° 17'N, 177° 24'W
03/04/83	EJ	7	60″ 17'N, 177° 24'W
03/04/83	EJ	12	60° 17'N, 177° 24'W
03/04/83	EJ	11	60° 16'N, 177° 23'W
03/04/83	EJ	19	60° 16'N, 177″ 23'W
03/04/83	EJ	18	60° 15'N, 177° 23'W
03/04/83	EJ	10	60° 13'N, 177° 22'W
03/04/83	EJ	12	60° 13'N, 177° 22'W
03/04/83	EJ	16	60° 11'N, 177° 21'W
03/04/83	EJ	2	60° 08'N, 177° 19'W
03/04/83	EJ	2	60° 05'N, 177° 15'W
03/04/83	PL	1	60° 30'N, 177° 20'W
03/04/83	PL	1	60° 27'N, 177° 20'W
03/04/83	EJ	7	600 15'N, 177° 20'W
03/04/83	EJ	1	60° 13'N, 177° 20'W
03/04/83	EJ	1	60° 11'N, 177° 20'W
03/04/83	EJ	15	60° 09'N, 177° 16'W
03/04/83	EJ	1	60° 09'N, 177° 20'W
03/04/83	EJ	5	60° 09'N, 177° 16'W
03/04/83	EJ	7	60° 09'N, 177° 20'W
03/04/83	EJ	12	60° 09'N, 177° 20'W
03/04/83	EJ	1	60° 27'N, 177° 16'W
03/04/83	UP	1	60″ 30'N, 177° 16'W
03/04/83	EJ	1	60° 05'N, 177″ 08'W
03/04/83	EJ	1	59° 57'N, 176° 58'W
03/04/83	UP	1	60° 24'N, 176° 52'W
03/04/83	OR	15	60° 47'N, 176″ 44'W
03/04/83	OR	13	60° 47'N, 176° 44'W

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APPENDIX TABLE 4
RECORD OF PINNIPEDS 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	Location
	WINTER SURVEY (Continued)		
03/04/83	OR	1	60° 43'N, 176° 44'W
03/04/83	UP	1	60° 39'N, 176° 44'W
03/04/83	PF	1	60″ 25'N, 176° 44'W
03/04/83	PF	2	60″ 26'N, 176° 40'W
03/04/83	PF	3	60° 26'N, 176° 40'W
03/04/83	PF	1	60° 38'N, 177° 05'W
03/04/83	PF	1	60″ 37'N, 177″ 09'W
03/04/83	UP	1	60° 52'N, 177″ 16'W
03/04/83	UP	1	60° 53'N, 177° 16'W
03/04/83	UP	1	60° 56'N, 177° 08'W
03/05/83	EJ	3	59″ 37'N, 176° 08'W
03/05/83	EJ	1	59° 33'N, 175° 52'W
03/05/83	EJ	6	59″ 42'N, 175° 44'W
03/05/83	EJ	10	59° 42'N, 175° 44'W
03/05/83	EJ	2	59° 32'N, 175° 51'W
03/05/83	UP	1	59° 55'N, 175° 32'W
03/05/83	EJ	12	59° 35'N, 175° 20'W
03/05/83	OR	1	59° 45'N, 175° 20'W
03/05/83	PL	2	60° 09'N, 175″ 20'W
03/05/83	OR	1	60° 05'N, 175° 23'W
03/05/83	PL	11	60° 04'N, 175° 25'W
03/05/83	EB	1	60° 04'N, 175″ 25'W
03/06/83	PF	1	59° 56'N, 174° 53'W
03/06/83	PF	1	60″ 07'N, 174° 52'W
03/06/83	UP	1	60° 16'N, 174° 44'W
03/06/83	OR	2	60° 23'N, 174° 44'W
03/06/83	OR	1	60° 22'N, 174° 48'W
03/06/83	UP	1	60° 22'N, 174° 48'W
03/06/83	OR	1	60″ 22'N, 174° 50'W
03/06/83	UP	1	60° 22'N, 174° 51'W
03/06/83	UP	1	60° 20'N, 175° 05'W
03/06/83	OR	1	60° 19'N, 175″ 05'W
03/06/83	UP	1	60° 19'N, 175″ 05'W
03/06/83	UP	1	60° 16'N, 175″ 04'W
03/06/83	UP	1	60″ 11'N, 175° 04'W
03/06/83	UP	1	60° 11'N, 175″ 04'W
03/06/83	PL	1	60″ 10'N, 175″ 06'W
03/06/83	OR	1	60° 10'N, 175″ 06'W
03/06/83	UP	1	60° 09'N, 175″ 06'W

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

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APPENDIX TABLE 4
RECORD OF PINNIPEDS 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	Location
	WINTER SURVEY (Continued)		
03/10/83	OR	1	60° 28′N, 173″ 08′W
03/10/83	OR	3	60° 28′N, 173″ 08′W
03/10/83	OR	1	60° 27′N, 173° 08′W
03/10/83	UP	1	60° 27′N, 173° 08′W
03/10/83	UP	1	60° 23′N, 173° 09′W
03/10/83	UP	1	60° 18′N, 173° 08′W
03/10/83	UP	1	60° 17′N, 173″ 08′W
03/10/83	PF	1	60″ 15′N, 173° 07′W
03/10/83	UP	1	60″ 14′N, 173″ 06′W
03/10/83	UP	1	60° 11′N, 173° 07′W
03/10/83	UP	2	60° 08′N, 173″ 08′W
03/10/83	UP	1	60° 06′N, 173° 08′W
03/10/83	UP	1	60° 02′N, 173° 08′W
03/10/83	UP	1	60° 01′N, 172° 56′W
03/10/83	UP	1	60° 04′N, 172″ 56′W
03/10/83	PL	1	60° 06′N, 172° 56′W
03/10/83	UP	1	60° 08′N, 172° 56′W
03/11/83	UP	1	60° 19′N, 172° 52′W
03/11/83	OR	3	60° 19′N, 172° 52′W
03/11/83	OR	1	60° 14′N, 172″ 35′W
03/11/83	OR	1	60° 15′N, 172° 34′W
03/11/83	OR	1	60° 15′N, 172″ 34′W
03/11/83	OR	3	60° 16′N. 172° 33′W
03/11/83	OR	1	60° 16′N, 172° 33′W
03/11/83	OR	2	60° 16′N, 172″ 32′W
03/11/83	OR	1	60° 16′N, 172° 32′W
03/11/83	OR	3	60° 16′N, 172″ 32′W
03/11/83	OR	1	60° 09′N, 172″ 32′W
03/11/83	PL	1	60° 04′N, 172° 28′W
03/11/83	OR	3	60″ 05′N, 172″ 29′W
03/11/83	OR	1	60° 05′N, 172″ 29′W
03/12/83	OR	1	60° 34′N, 173° 37′W
03/12/83	OR	2	60″ 33′N, 173″ 42′W
03/12/83	OR	1	60″ 31′N, 173° 44′W
03/12/83	OR	1	60″ 29′N, 173° 46′W
03/12/83	OR	1	60° 25′N, 173″ 44′W
03/12/83	OR	2	60° 26′N, 173° 47′W
03/12/83	OR	6	60° 25′N, 173° 48′W
03/12/83	OR	3	60° 24′N. 173″ 48′W
03/12/83	OR	15	60° 23′N; 173″ 52′W
03/12/83	OR	1	60″ 17′N, 173° 54′W

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APPENDIX TABLE 4
RECORD OF PINNIPEDS 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	Location
	WINTER SURVEY (Continued)		
03/12/83	OR	1	60° 17'N, 173° 54'W
03/12/83	OR	1	60° 20'N, 173° 54'W
03/12/83	OR	5	60° 18'N, 173° 55'W
03/12/83	OR	1	60° 14'N, 173° 54'W
03/12/83	UP	1	60° 14'N, 173° 54'W
03/12/83	OR	5	60° 17'N, 173° 56'W
03/12/83	OR	4	60° 15'N, 173° 53'W
03/12/83	OR	3	60° 15'N, 173° 53'W
03/12/83	OR	2	60° 22'N, 173° 56'W
03/12/83	OR	1	60° 18'N, 173° 56'W
03/12/83	UP	1	60° 16'N, 173° 56'W
03/12/83	OR	12	60° 16'N, 174° 08'W
03/12/83	PF	4	60° 07'N, 174° 08'W
03/12/83	PF	24	60° 02'N, 174° 13'W
03/12/83	OR	2	60° 01'N, 174° 16'W
03/12/83	UP	1	60° 01'N, 174° 18'W
03/12/83	EB	1	60° 00'N, 174° 19'W
03/12/83	OR	1	59° 59'N, 174° 23'W
03/12/83	UP	1	59° 59'N, 174° 23'W
03/12/83	UP	1	59° 59'N, 174° 23'W
03/12/83	OR	2	60° 03'N, 174° 28'W
03/12/83	EB	1	59° 59'N, 174° 26'W
03/12/83	EB	1	59° 59'N, 174° 29'W
03/12/83	UP	1	60° 00'N, 174° 31'W
03/12/83	UP	2	60° 01'N, 174° 31'W
03/13/83	PF	4	60° 10'N, 174° 38'W
03/13/83	PF	1	60° 10'N, 174° 38'W
03/13/83	PF	3	60° 12'N, 174° 23'W
03/13/83	OR	1	60° 19'N, 174° 32'W
03/13/83	OR	2	60° 17'N, 174° 28'W
03/13/83	UP	2	60° 08'N, 174° 29'W
03/13/83	OR	1	60° 07'N, 174° 27'W
03/13/83	OR	1	60° 12'N, 174° 21'W
03/13/83	EB	1	60° 12'N, 174° 21'W
03/13/83	OR	23	60° 11'N, 174° 20'W
03/13/83	OR	37	60° 11'N, 174° 20'W
03/13/83	OR	2	60° 17'N, 174° 20'W
03/13/83	OR	16	60° 16'N, 174° 20'W
03/13/83	OR	12	60° 17'N, 174° 20'W
03/13/83	OR	2	60° 17'N, 174° 20'W
03/13/83	PF	3	60° 11'N, 174° 15'W

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APPENDIX TABLE 4
RECORD OF PINNIPEDS ENCOUNTERED IN THE
NAVARIN BASIN DURING THE FOUR SURVEY SEASONS,
MAY-JUNE, JULY-AUGUST, OCTOBER-NOVEMBER, 1982
AND FEBRUARY-MARCH 1983

Date	Species?/	Number	Location
	<u>wINTER SURVEY</u> (Continued)		
03/13/83	OR	12	60″ 13'N, 174° 09'W
03/13/83	OR	11	60″ 13'N, 174° 09'W
03/13/83	OR	4	60° 13'N, 174″ 09'W
03/13/83	OR	3	60° 13'N, 174° 09'W
03/13/83	PF	1	60° 08'N, 174″ 04'W
03/13/83	OR	42	60° 13'N, 174″ 10'W
03/13/83	OR	4	60″ 12'N, 174″ 08'W
03/13/83	OR	6	60° 21'N, 174° 07'W
03/13/83	OR	1	60° 21'N, 174″ 08'W
03/13/83	OR	35	60° 18'N, 174° 08'W
03/13/83	OR	38	60° 15'N, 174″ 03'W
03/13/83	OR	7	60° 15'N, 174° 08'W
03/13/83	OR	99	60° 15'N, 174″ 03'W
03/13/83	OR	3	60° 12'N, 174° 08'W
03/13/83	OR	23	60° 16'N, 174″ 06'W
03/13/83	OR	36	60° 16'N, 174° 06'W
03/13/83	OR	22	60° 17'N, 173° 55'W
03/13/83	OR	14	60° 17'N, 173° 55'W
03/13/83	OR	1	60° 16'N, 173° 52'W
03/13/83	OR	2	60° 17'N, 173° 45'W
03/13/83	OR	2	60″ 16'N, 174″ 01'W
03/13/83	OR	12	60° 16'N, 174° 01'W
03/13/83	OR	1	60° 16'N, 173° 58'W
03/13/83	OR	12	60° 16'N, 173° 55'W
03/13/83	OR	12	60° 17'N, 173″ 53'W
03/13/83	OR	3	60″ 17'N, 173° 53'W
03/13/83	OR	8	60° 20'N, 173° 35'W
03/13/83	OR	20	60° 19'N, 173″ 20'W
03/13/83	OR	7	60° 20'N, 173° 20'W
03/14/83	OR	1	60° 35'N, 173″ 44'W
03/14/83	OR	4	60° 35'N, 173° 44'W
03/14/83	UP	1	60° 26'N, 173° 40'W
03/14/83	OR	6	60° 40'N, 173° 41'W
03/14/83	PF	1	60° 38'N, 173° 53'W
03/14/83	PF	1	60° 38'N, 173° 53'W
03/14/83	PF	1	60″ 38'N, 173° 53'W
03/14/83	OR	1	60° 26'N, 173° 49'W
03/15/83	OR	12	60° 01'N, 173° 20'W
03/15/83	OR	1	59″ 59'N, 173° 20'W
03/15/83	OR	2	59° 53'N, 173″ 25'W
03/15/83	OR	4	59° 58'N, 173″ 32'W

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APPENDIX TABLE 4
RECORD OF PINNIPEDS 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	Location
	WINTER SURVEY (Continued)		
03/15/83	PF	1	59° 47'N, 173° 48'W
03/15/83	UP	1	59° 49'N, 174° 08'W
03/15/83	UP	1	59° 47'N, 174° 08'W
03/15/83	UP	1	59° 37'N, 174° 20'W
03/15/83	EB	1	59° 46'N, 174° 26'W
03/15/83	UP	1	59° 35'N, 174° 42'W
03/15/83	UP	1	59° 36'N, 174° 47'W
03/15/83	UP	1	59° 36'N, 174° 52'W
03/16/83	OR	1	60° 43'N, 175° 22'W
03/16/83	PL	1	60° 26'N, 176° 02'W
03/16/83	OR	2	60° 25'N, 176° 03'W

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APPENDIX TABLE 5

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	$0.088 \leq P \leq 0.252$ a/	3	4.2	0.043	$-0.021 \leq P \leq 0.107$
25	462	0.192	43	28.2	0.293	$0.194 \leq P \leq 0.392$ a/	0	13.2	0.000	b/
26	613	0.254	64	37.4	0.435	$0.327 \leq P \leq 0.543$ a/	8	17.6	0.116	$0.014 \leq P \leq 0.218$ b/
27	482	0.200	5	29.4	0.034	$-0.005 \leq P \leq 0.073$ b/	10	13.8	0.145	$0.033 \leq P < 0.257$
28	466	0.193	0	28,4	0.000	b/	36	13.3	0.522	$0.364 \leq P \leq 0.680$ a/
29	240	0.100	10	14.6	0.068	$0.013 < P < 0.123$	12	6.9	0.174	$0.054 < P < 0.294$
Total	2,410	1.000	147	147.0	1.000	$\chi^2 = 105.23$	69	69.0	1.000	$\chi^2 = 62.34$

Sampling 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 Prop. obs.	Ribbon seal 95 confidence interval
24	147	0.061	2				0	5.5	0.227	$0.027 \leq P \leq 0.427$
25	462	0.192	1	11.7	0.072	$-0.309 \leq P \leq 0.175$ b/	5			
26	613	0.254	4	10.7	0.095	$-0.022 \leq P \leq 0.212$ b/	12	5.6	0.546	$0.308 \leq P \leq 0.784$ a/
27	482	0.200	4	8.4	0.095	$-0.022 \leq P \leq 0.212$	3			
28	466	0.193	3	8.1	0.071	$-0.031 \leq P \leq 0.173$ b/	2	10.9	0.227	$0.027 \leq P \leq 0.427$ b/
29	240	0.100	28	4.1	0.667	$0.479 < P < 0.855$ a/	0			
Total	2,410	1.000	42	42.0	1.000	$\chi^2 = 155.39$	22	22.0	1.000	$\chi^2 = 10.55$

a/ Significant preference.

b/ Significant avoidance.

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APPENDIX TABLE 6

CHI-SQUARE ANALYSIS OF PACIFIC WALRUS **OCCURRENCE IN DIFFERENT** ICE CONCENTRATION, **SIZE,** ANO 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
61-80	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	1,205	1.000	83	83	1.000	χ^2 = 2.31

Ice Size Category	Area (nm^2)	Proportion of total area		Number observed	Number expected	Proportion observed	95 confidence interval
Grease-slush	91	0.100		30	8	0.361	0.230 ≤ P ≤ 0.493?/
Pan-small	192	0.210	4		18	0.048	-0.011 ≤ P ≤ 0.107b/
Ned-large	159	0.174	4	15	0.048		-0.011 ≤ P ≤ 0.107b/
Vast-giant	472	0.516	45	42	0.542	0.406 < P	< 0// 67 ,
Total	914	1.000	83	83	1.000	χ^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 ≤ 0.422a/
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 < 0.487b/
To ta 1	1205	1.000	83	83	1.000	χ^2 . 25.95

a/ Significant preference.
b/ Significant avoidance.

9750A

APPENDIX TABLE 6 (Continued)

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/
41-60	208	0.173	6	4	0.250	
61-80	357	0.294	9	7	0.375	$0.138 \leq P \leq 0.612$
81-100	525	0.437	2	11	0.083	$-0.052 \leq P \leq 0.218$ b/
Total	1,205	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
Grease-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	0.083
Vast-giant	472	0.516	4	12	0.167	$0.052 < P < 0.448$ 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	Proportion observed	95 confidence interval
New (<10 cm)	142	0.118	1	3	0.042	$0.154 \leq P \leq 0.596$
Young (10-30 cm)	468	0.388	8	9	0.333	
First year (>30 cm)	595	0.494	15	12	0.625	$0.404 < P < 0.846$
Total	1,205	1.000	24	24	1.000	$x^2 = 1.50$

a/ Significant preference.
b/ Significant avoidance.

9750A

APPENDIX TABLE 6 (Continued)

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 ≤ P ≤ 0.740 a/
41-60	208	0.173	4	5	0.138	
61-80	357	0.294	7	9	0.241	0.024 ≤ P ≤ 0.431
81-100	525	0.437	7	13	0.241	0.024 ≤ P ≤ 0.431 b/
Total	1,205	1.000	29	29	1.000	χ^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
Meal-large	159	0.174	2	5	0.069	-0.044 ≤ P ≤ 0.182
Vast-giant	472	0.516	13	15	0.448	0.227 ≤ P <0.670
Total	914	1.000	29	29	1.000	χ^2 = 4.84

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	1	4	0.035	0.038 ≤ P ≤ 0.376 b/
Young (10-30cm)	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	1,205	1.000	29	29	1.000	χ^2 = 11.19

a/ Significant preference.
b/ Significant avoidance.

9750A

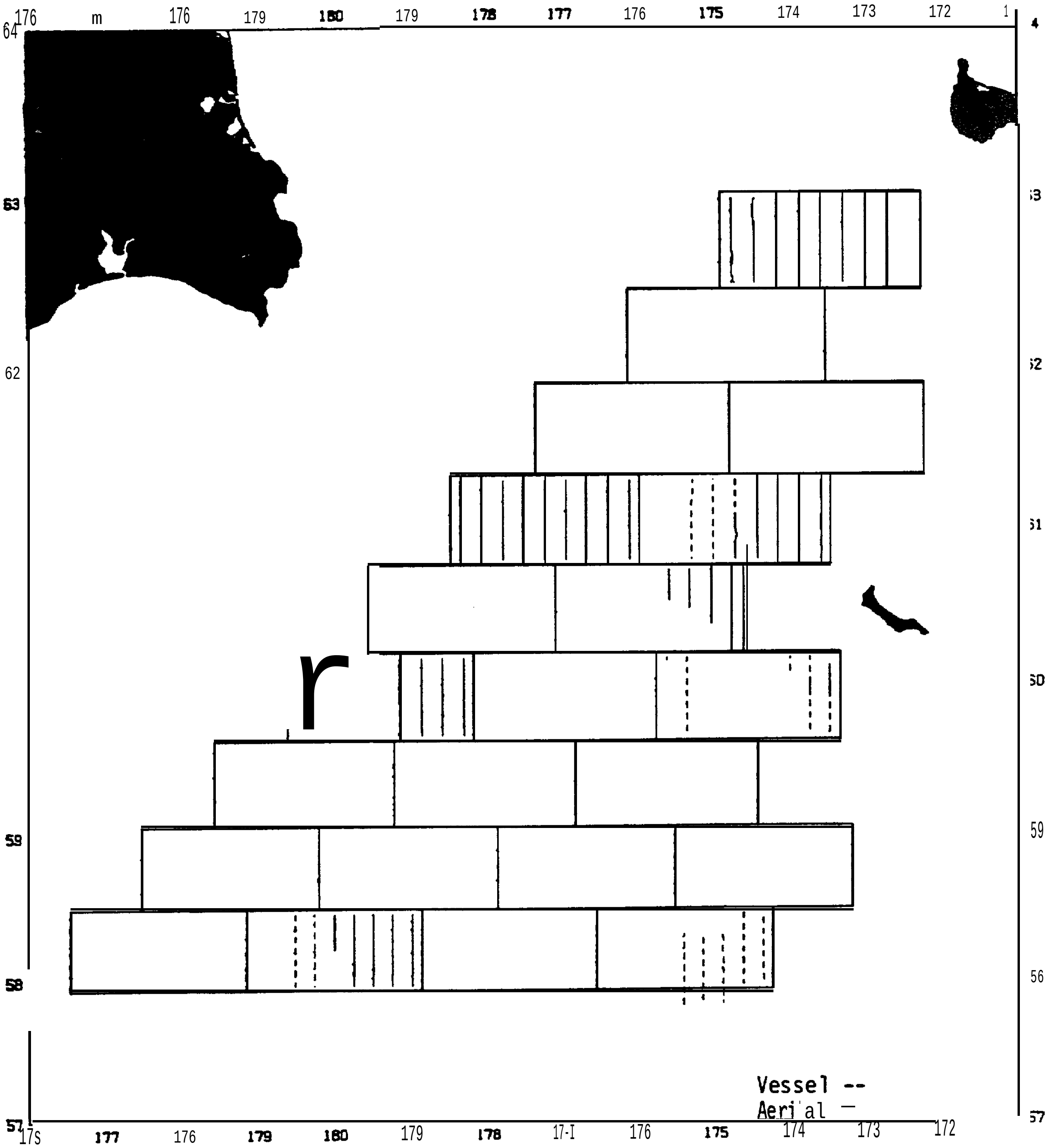

FIGURE 1 LOCATION OF AERIAL AND VESSEL TRACKLINES SURVEYED IN **THE** NAVARIN BASIN DURING SPRING, MAY - JUNE, **1982.**

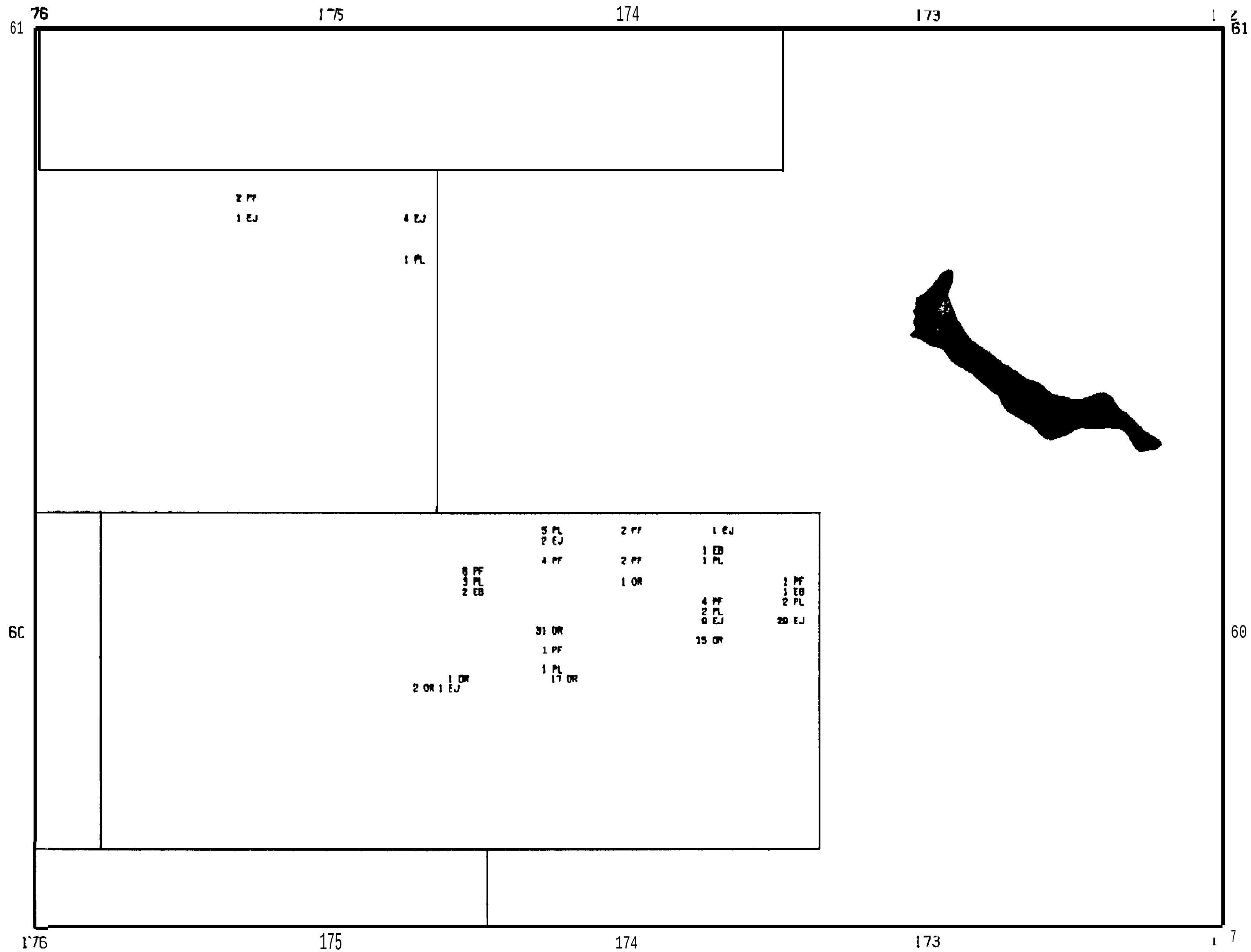

Figure 2 LOCATION OF **PINNIPEDS** OBSERVED IN THE **NAVARIN** BASIN DURING THE SPRING SURVEY, MAY-JUNE 1982. (Abbreviations are defined in Appendix Table 4).

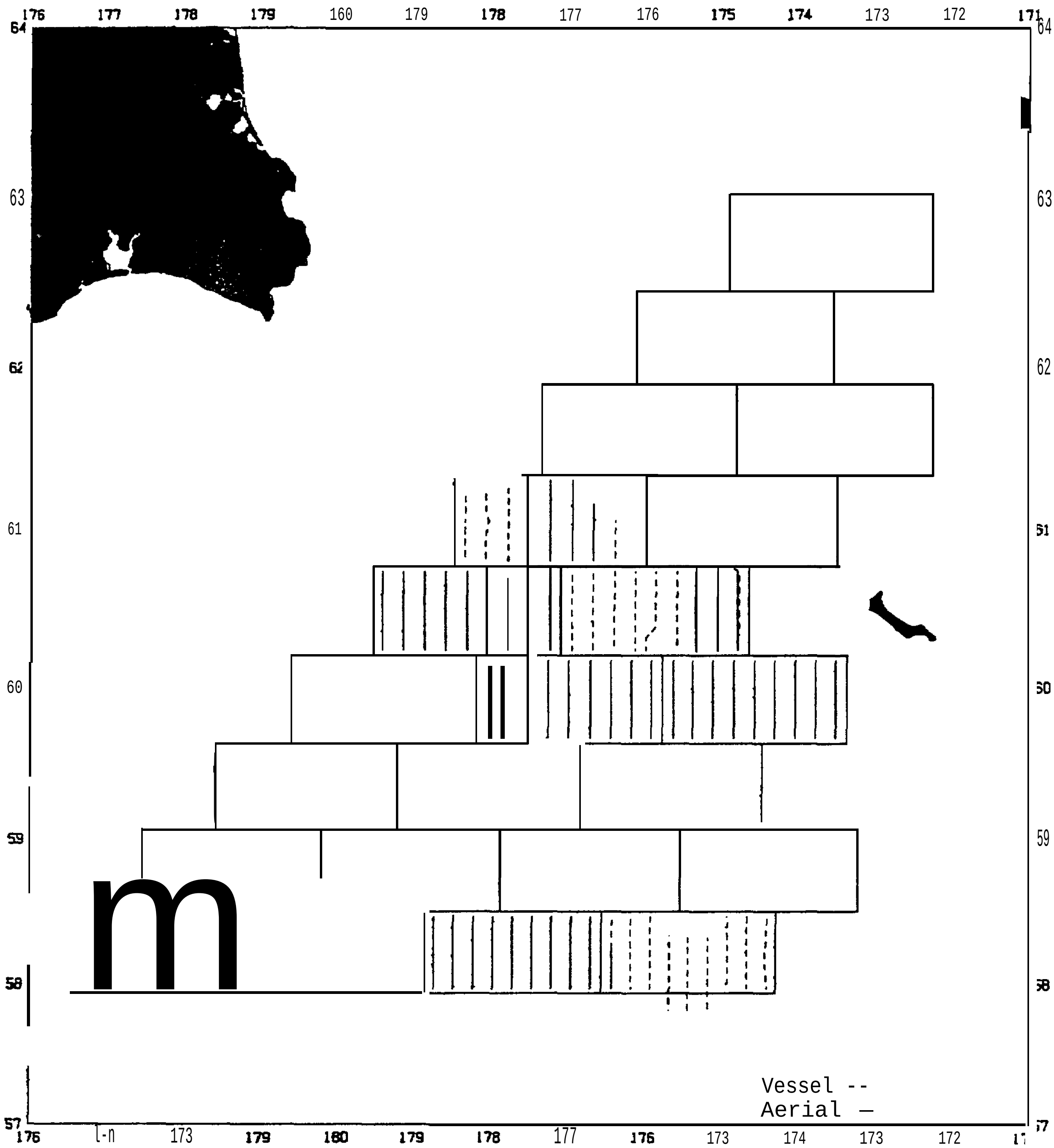

FIGURE 3 LOCATION OF AERIAL AND VESSEL TRACKLINES SURVEYED IN THE NAVARIN BASIN DURING SUMMER, JULY -AUGUST, 1982.

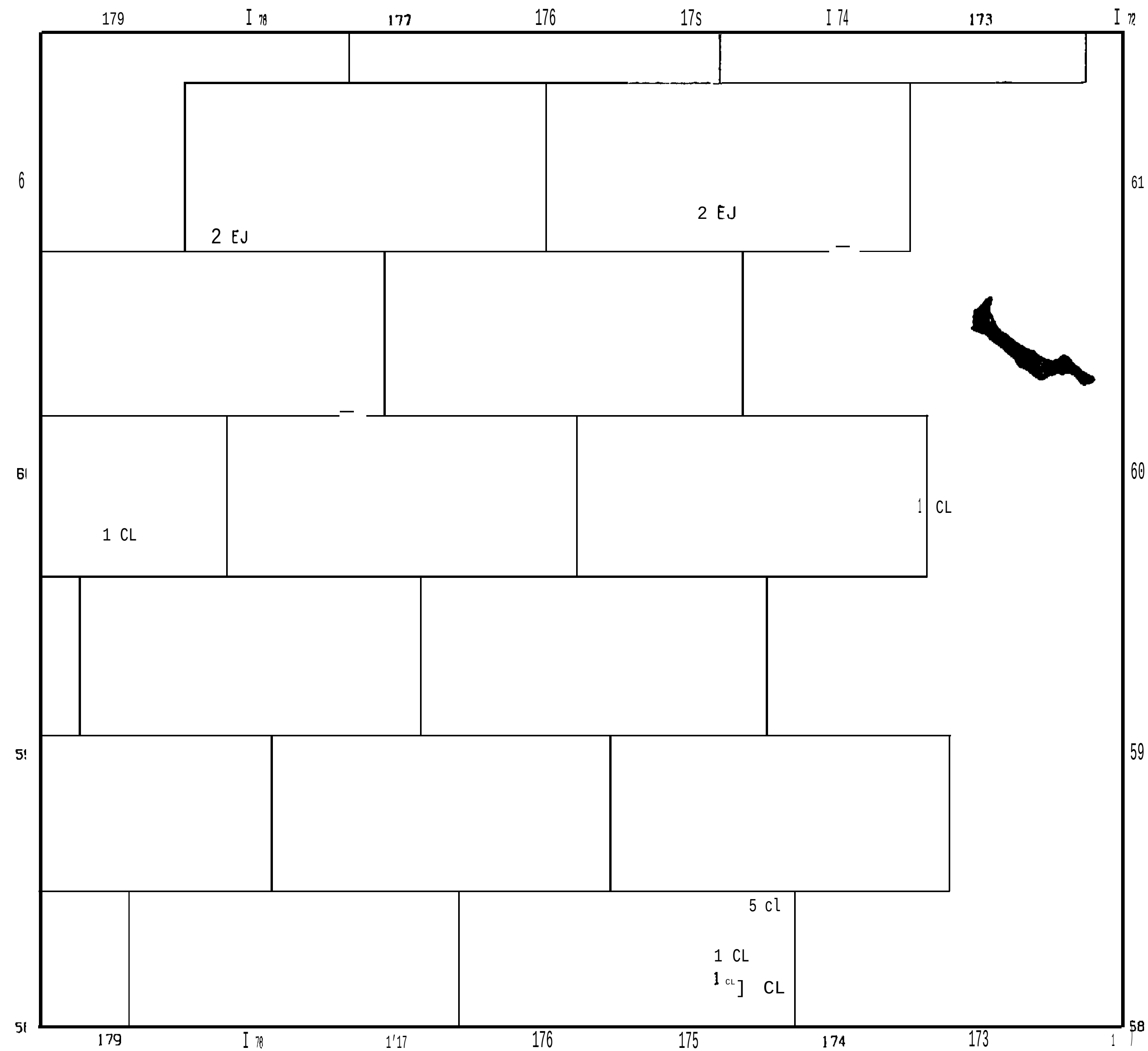

Figure 4 LOCATION OF **PINNIPEDS** OBSERVED IN THE **NAVARIN** BASIN **DURING** THE SUMMER SURVEYS, JULY-AUGUST 1982. (A **bbreviations** are defined In Appendix Table 4).

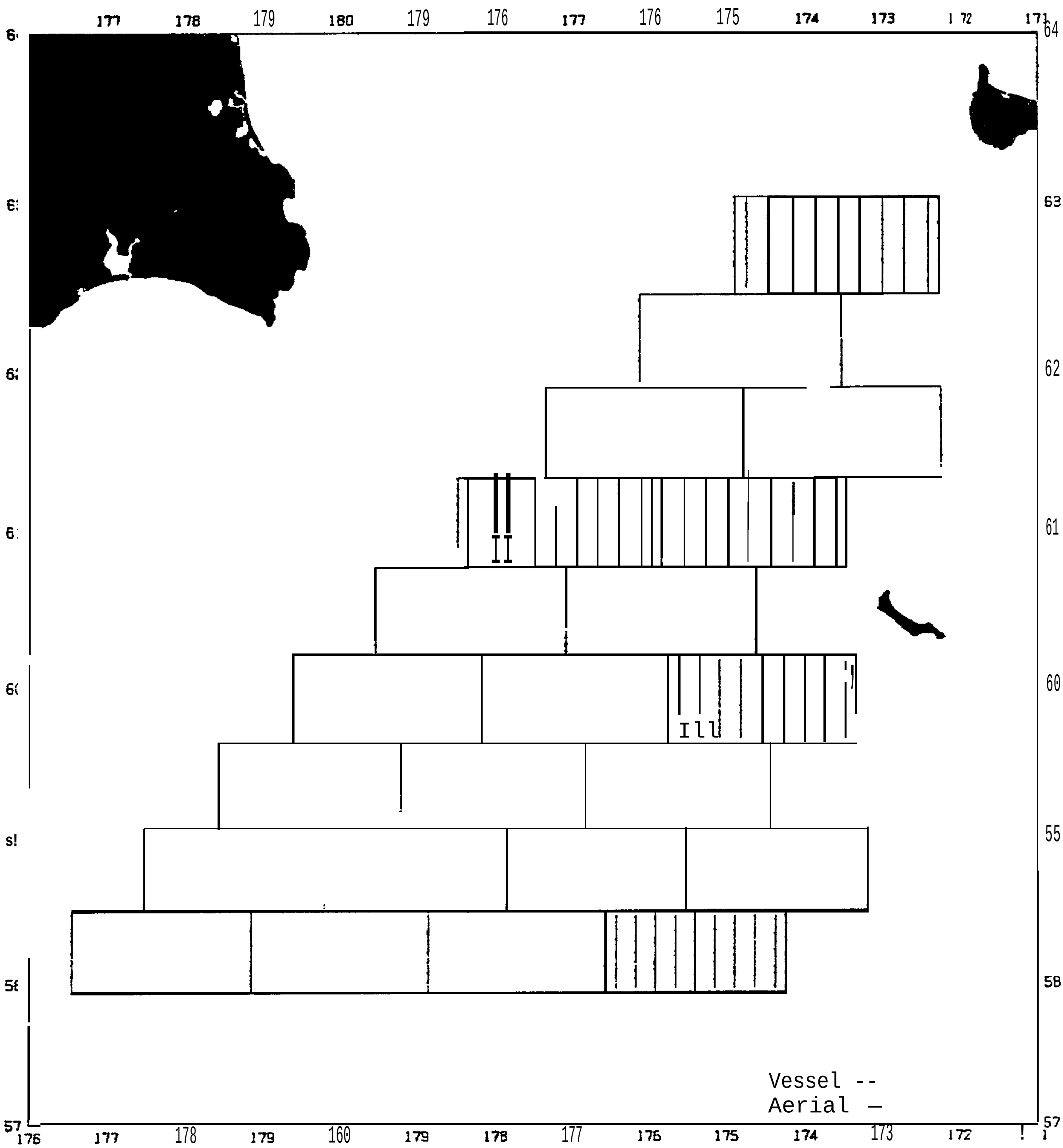

FIGURE 5 LOCATION OF AERIAL AND VESSEL TRACKLINES SURVEYED IN THE **NAVARIN** BASIN DURING FALL, OCTOBER - NOVEMBER, **1982.**

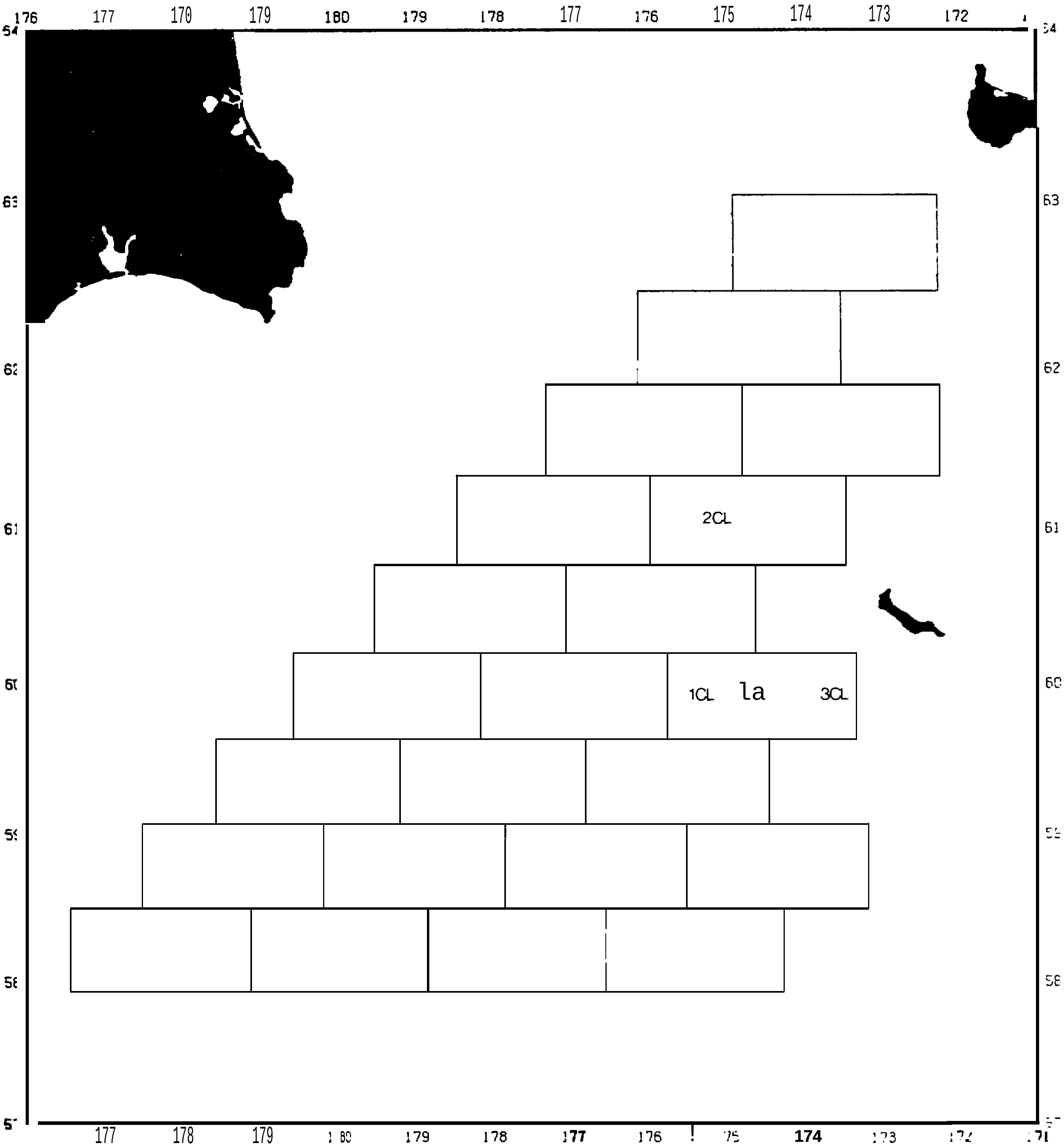

Figure 6 LOCATION OF **PINNIPEDS** OBSERVED IN THE NAVARIN BASIN **DURING** THE FALL SURVEYS, OCTOBER-NOVEMBER 1982. (Abbreviations are defined in Appendix Table 4).

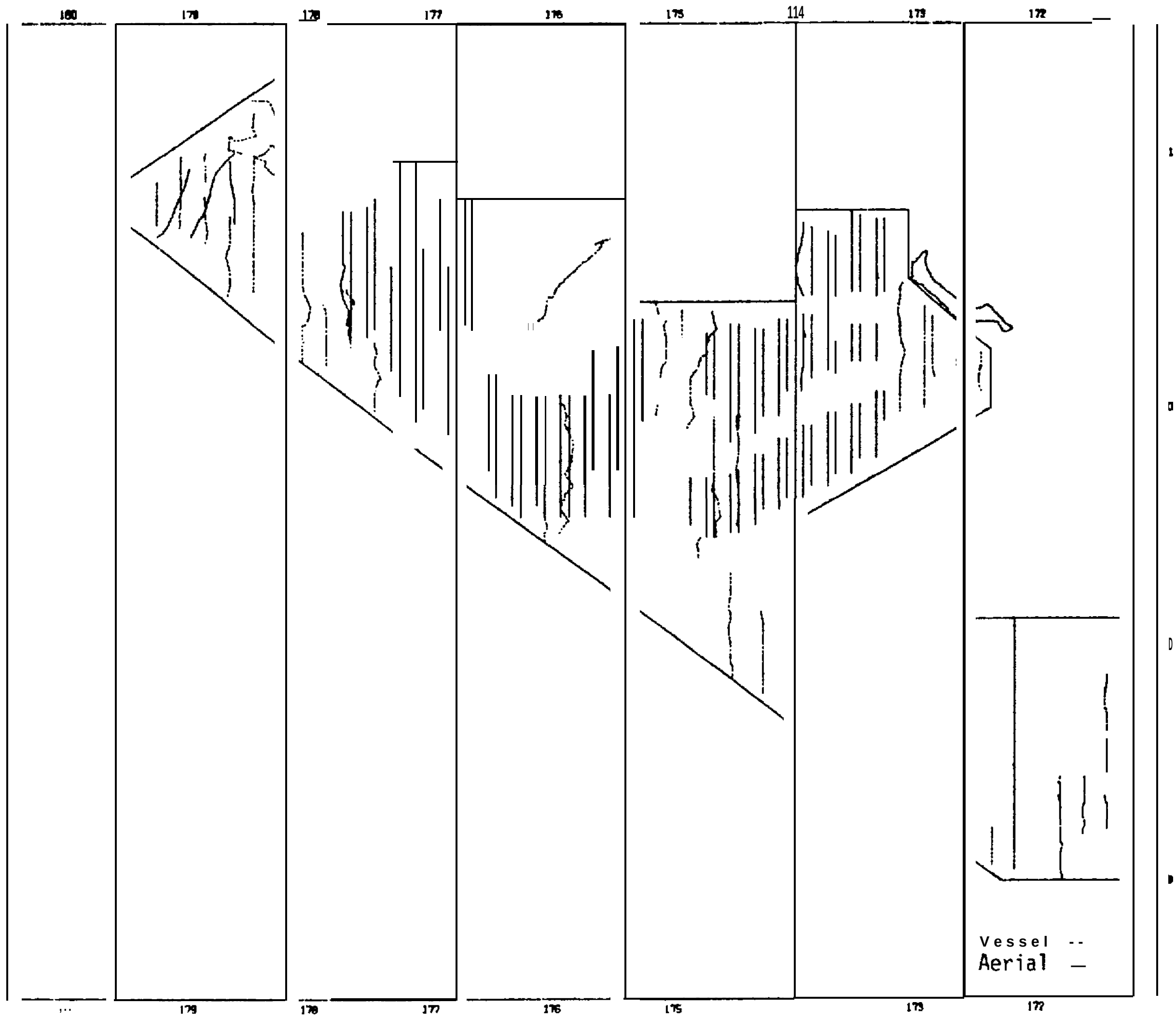

FIGURE 7 LOCATION OF AERIAL AND VESSEL TRACKLINES SURVEYED IN THE **NAVARIN** BASIN DURING WINTER, FEBRUARY - MARCH, 1983.

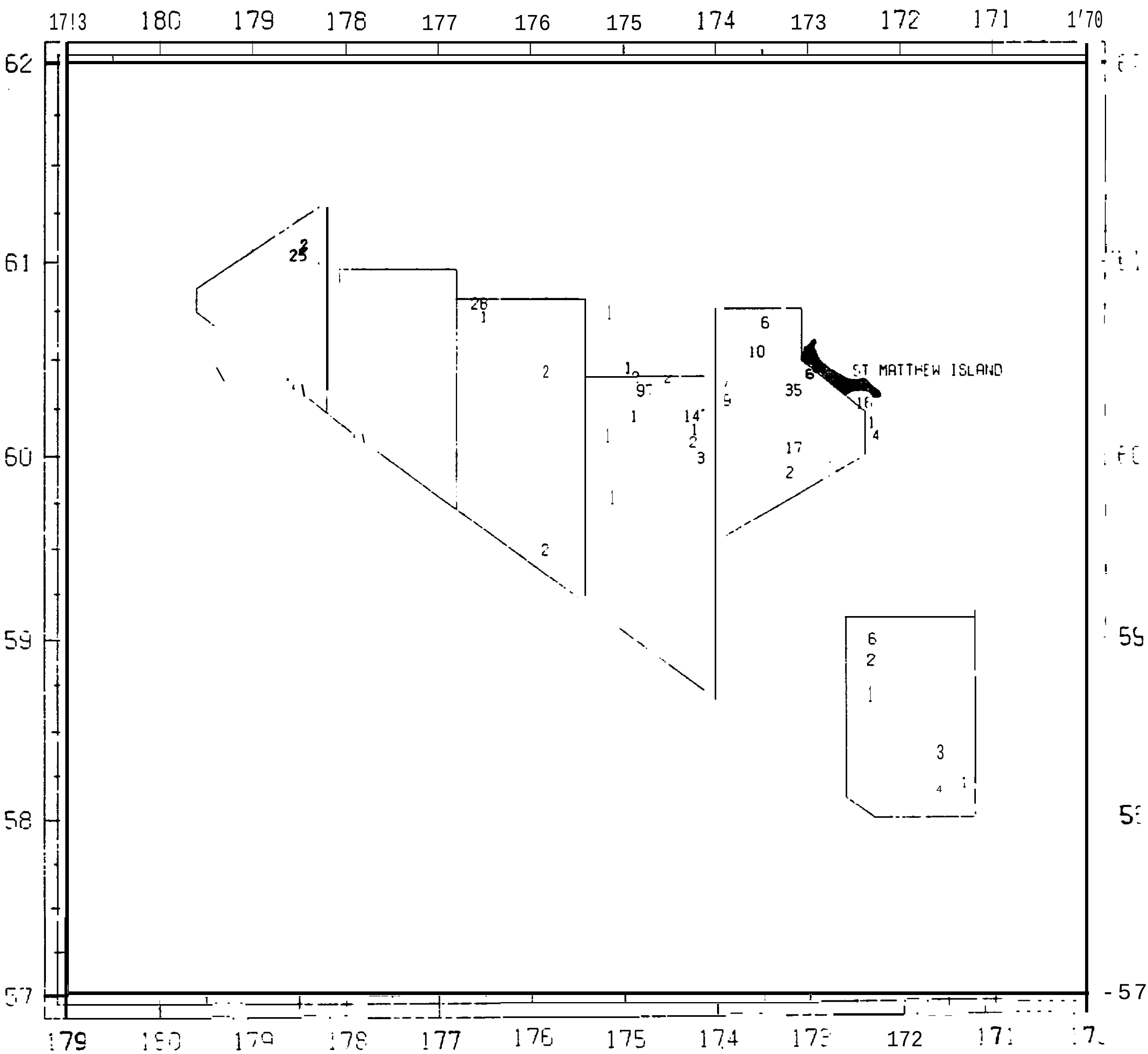

Figure 8 LOCATION OF WALRUSES OBSERVED IN THE **NAVARIN BASIN** DURING THE WINTER **SURVEYS,** FEBRUARY-MARCH 1983.

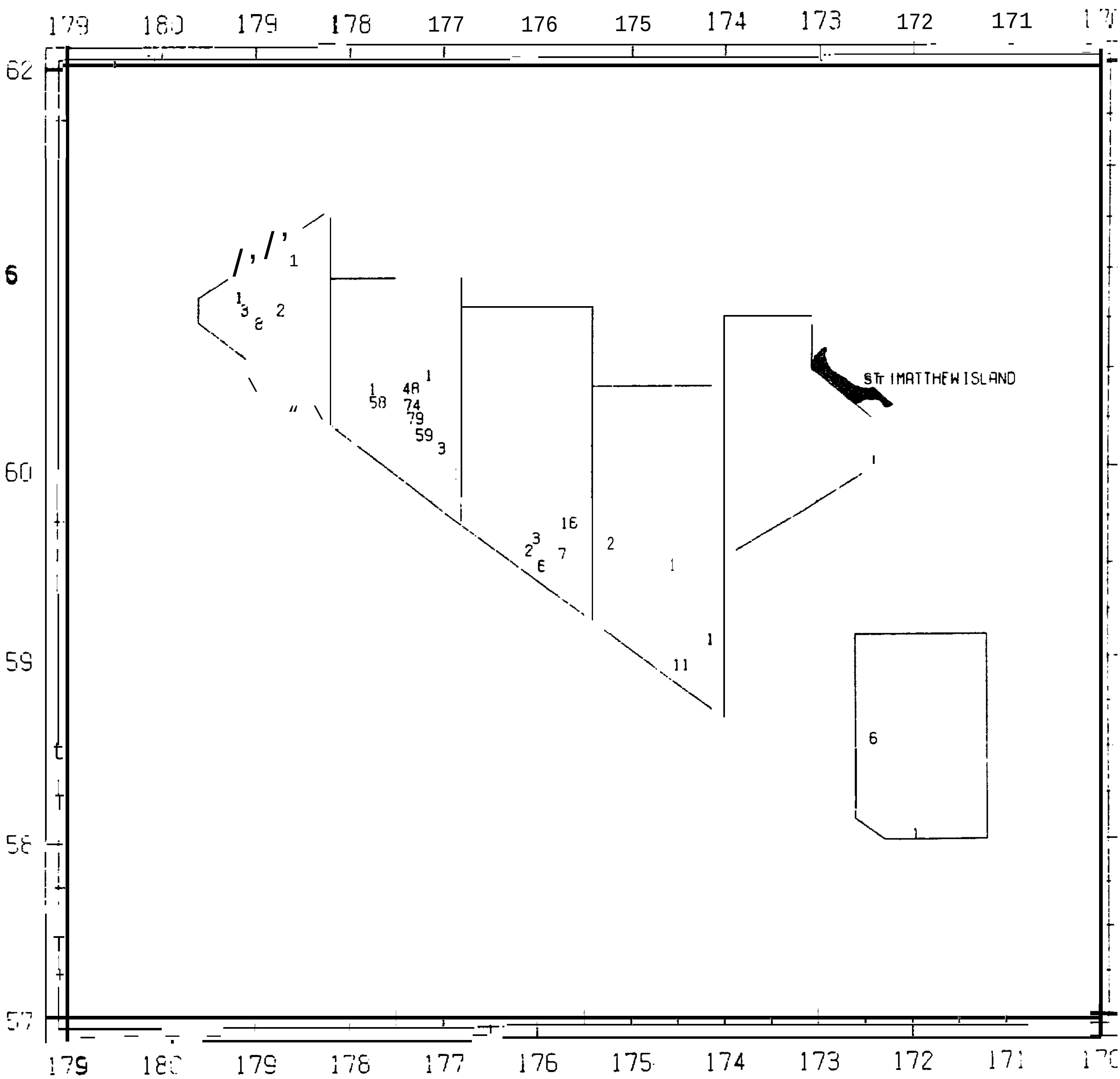

Figure 9 LOCATION OF NORTHERN SEA LIONS OBSERVED IN THE NAVARIN BASIN DURING THE WINTER SURVEYS, FEBRUARY-MARCH 1983.

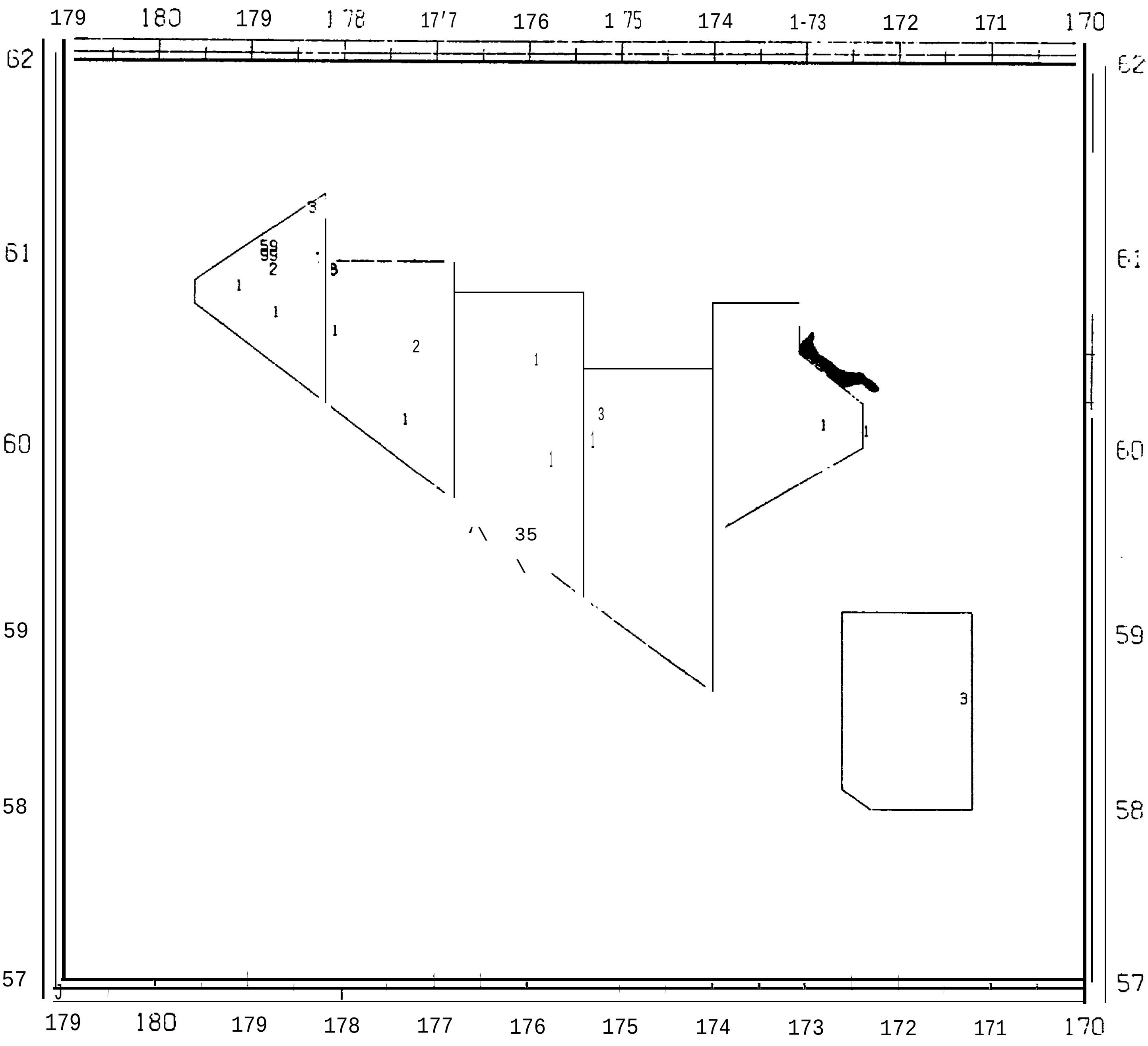

Figure 10 LOCATION OF SPOTTED SEALS OBSERVED IN THE NAVARIN **BASIN DURING** THE WINTER SURVEYS, **FEBRUARY-MARCH** 1983.

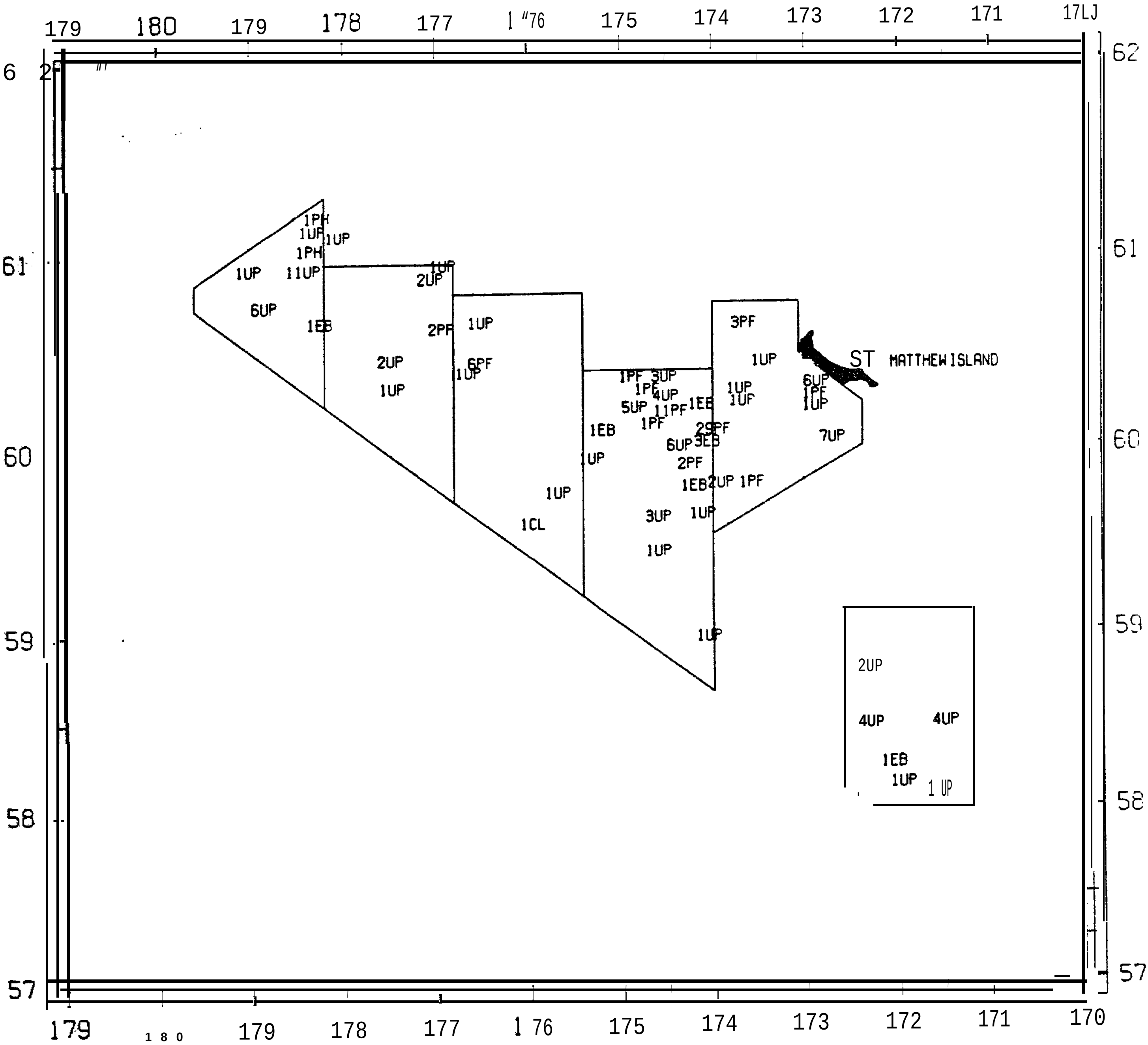

Figure 11 LOCATIONS OF **BEARDED(EB), FUR(CL),** RIBBON, AND RINGED(PH) SEALS **AND** UNIDENTIFIED **PINNIPEDS(UP)** OBSERVED IN THE NAVARIN BASIN DURING WINTER, FEBRUARY-MARCH **1983.**