Environmental Assessment of the Alaskan Continental Shelf

Final Reports of Principal Investigators

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ENVIRONMENTAL ASSESSMENT
OF THE
ALASKAN CONTINENTAL SHELF

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CONTENTS

SUMMER DISTRIBUTION AND NUMBERS OF FIN, HUMPBACK, AND GRAY WHALES IN THE GULF OF ALASKA

by

Dale W. Rice and Allen A. Wolman

National Marine Fisheries Service
Northwest and Alaska Fisheries Center
National Marine Mammal Laboratory
7600 Sand Point Way NE
Seattle, Washington 98115

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INTRODUCTION

The Gulf of Alaska is inhabited by 7 of the world's 10 species of baleen whales (Fiscus et al. 1978). Six of these species--the minke Balaenoptera acutorostrata, sei B. borealis, fin B. physalus, blue B. musculus, humpback Megaptera novaeangliae, and right Balaena glacialis whales--utilize the gulf as one of their major feeding grounds from spring to autumn. Although all six species are virtually cosmopolitan in distribution, all except the small minke whale are classified as endangered species throughout their ranges (U.S. Dept. Comm. 1979). The seventh species--the gray whale Eschrichtius robustus--is endemic to the North Pacific, and virtually the entire world population migrates along the shore of the gulf twice each year, in spring and fall; the gray whale is also classified as an endangered species.

The Marine Mammal Protection Act of 1972 and the Endangered Species Act of 1973 stipulate that studies be made to determine whether proposed habitat alterations will have any adverse effects on populations of endangered species of marine mammals, and to determine what measures might be used to alleviate any such effects. In the summer of 1980 we conducted a preliminary survey to determine whether petroleum exploration and development lease sites on the outer continental shelf around Kodiak Island (Sale No. 48) and in the northeastern Gulf of Alaska (Sale No. 55) are important habitats for the endangered whale populations that inhabit the gulf, especially fin, humpback and gray whales.

Most species of baleen whales spend the winter in lower latitudes where they mate and, a year later, bear their calves (Mackintosh 1965). They largely fast during this period. They migrate long distances to their summer feeding grounds in productive high-latitude waters. During the summer they must accumulate sufficient fat reserves to sustain them through their winter fast. Pregnant females must support a rapidly-growing fetus, and lactating females must nurture an even more rapidly-growing calf to independence before the fall migration and winter fast. Being filter feeders, baleen whales require dense concentrations of their prey species to ingest adequate nourishment. For this reason, they tend to be nomadic during the summer, aggregating in local areas with temporarily high food densities. Patterns of distribution and movement may vary considerably from month to month and year to year.

In the Gulf of Alaska, aboriginal whaling was practiced only from Kodiak Island westward (Heizer 1973; Mitchell 1979). It ceased many decades ago. However, the gray whales that migrate through the Gulf and into the Bering Sea (Rugh and Braham 1979) are the object of an important subsistence fishery around the Chukotski Peninsula, USSR, and a few of these whales are sometimes taken by Eskimos in arctic Alaska.

Populations of all species of great whales that inhabit the Gulf of Alaska have been greatly reduced by commercial whaling (Table 1). During the 19th century, right whales were heavily exploited on the "Northwest Coast Grounds" by the American high-seas whale fishery (Townsend 1935). During the same period, gray whales were also heavily exploited while migrating past California and while in their Mexican calving lagoons (Rice and Wolman 1971). Between 1910 and 1940, rorquals--blue, fin, sei, and humpback whales--were exploited by shore whaling stations in Alaska, British Columbia, Washington and California, and by floating factory ships off Mexico. From 1946 to 1976, large numbers of rorquals were killed throughout the North Pacific by Japanese and Soviet pelagic whaling fleets.

Two species of whales that inhabit the Gulf of Alaska--the humpback and the gray whale--now support a lucrative tourist industry on their respective winter grounds in Hawaii and in southern California and Baja California, Mexico.

There are many data on the past distribution and numbers of whales in the Gulf of Alaska. These data derive mainly from commercial whale catches (Nishiwaki 1966; Townsend 1935), and from sightings by scouting vessels attached to whaling expeditions (Berzin and Rovnin 1966; Wada 1979). Since the cessation of commercial whaling, little information has become available on the distribution and numbers of the surviving populations of these species. The NMML has censused humpback populations in southeastern Alaska and Prince William Sound, and annually monitors the gray whale population as it migrates along the California coast. A considerable amount of sighting data has been collected in the last 5 years under NMFS's continuing Platforms of Opportunity Program (Fiscus et al. 1976). Sightings from NOAA research vessels with trained marine mammal personnel aboard have indicated some areas of particular abundance in the gulf for humpbacks and fin whales. Sightings by casual observers, although often unreliable for certain species (particularly blue, fin, and sei whales) have also been of some value in determining distribution patterns.

From 17 June to 28 August 1980, we conducted a cruise to investigate the distribution and movements of fin whales, humpback whales, gray whales and other marine mammals in the Gulf of Alaska. We surveyed the waters over the continental shelf and slope, and immediate offshore waters, from Cape Fairweather (138°W) west to Chirikof Island (156°W). The primary objectives were:

(a) To determine the spatial and temporal distribution of humpback and fin whales in the Gulf of Alaska (from Fairweather Grounds to Shumagin Islands), including Prince William Sound and adjacent waters.

(b) To define patterns of summer (June-August) movements and important areas of habitat use for the gray, fin and humpback whale.

(c) To improve present abundance estimates for the total number of humpback and fin whales occupying the Gulf of Alaska during summer months.

Secondary objectives were:

(d) To use radio receivers aboard the survey vessel for detection of gray whales radio-tagged in Mexico as part of the BLM/NMFS radio tagging project.

(e) To conduct exploratory acoustic monitoring involving deployment of a hydrophone at station intervals along the cruise track to detect the presence of whales which might not be visually sighted.

STUDY AREA

Our systematic census area included the waters over the continental shelf, continental slope, and immediate offshore waters of the Gulf of Alaska from 138°W to 156°W.

For statistical purposes, we divided this area into 24 quadrats of 1° latitude (60 nautical miles) by 2° longitude (58-69 miles). The water area defined by these quadrats (Fig. 1) totals 76,117 square miles (221,915 km^2) (Table 2).

In addition to this primary study area, we also explored (1) the coastal waters from Seattle, Washington to Cape Fairweather, Alaska; (2) Icy Straits and Cross Sound in southeastern Alaska; (3) Yakutat Bay; (4) Icy Bay; (5) Prince William Sound; (6) Shelikof Straits; and (7) the coastal waters from Chirikof Island west to Dutch Harbor in the Aleutian Islands.

METHODS

The cruise was conducted with the chartered fishing vessel U.S. Dominator. This vessel, designed for the Bering Sea king crab fishery, is 37.8 m long and its gross tonnage is 199. Its cruising speed is 10 knots (18.5 km/hr). The bridge affords excellent visibility in all directions. The observer's eye level is 7.7 m above the waterline.

Research methods included (1) line-transect censuses of marine mammals; (2) photography of humpback whales for individual identification; (3) radio-monitoring for previously radio-tagged gray whales; and (4) acoustic recording.

Line-transect census

A series of north-south transects were established at regular intervals across the study area. During the first half of the cruise (17 June to 20 July), 15 transects were run (Fig. 2 and Table 3); these were spaced at intervals of 1° longitude through the sectors that include lease sites, and at intervals of 2° longitude through the remaining sectors. These transects totaled 1,927 nautical miles.

During the second half of the cruise (24 July to 28 August), 9 transects were run (Fig. 3 and Table 4); all were spaced at intervals of 1° of longitude. These transects totaled 1,179 miles.

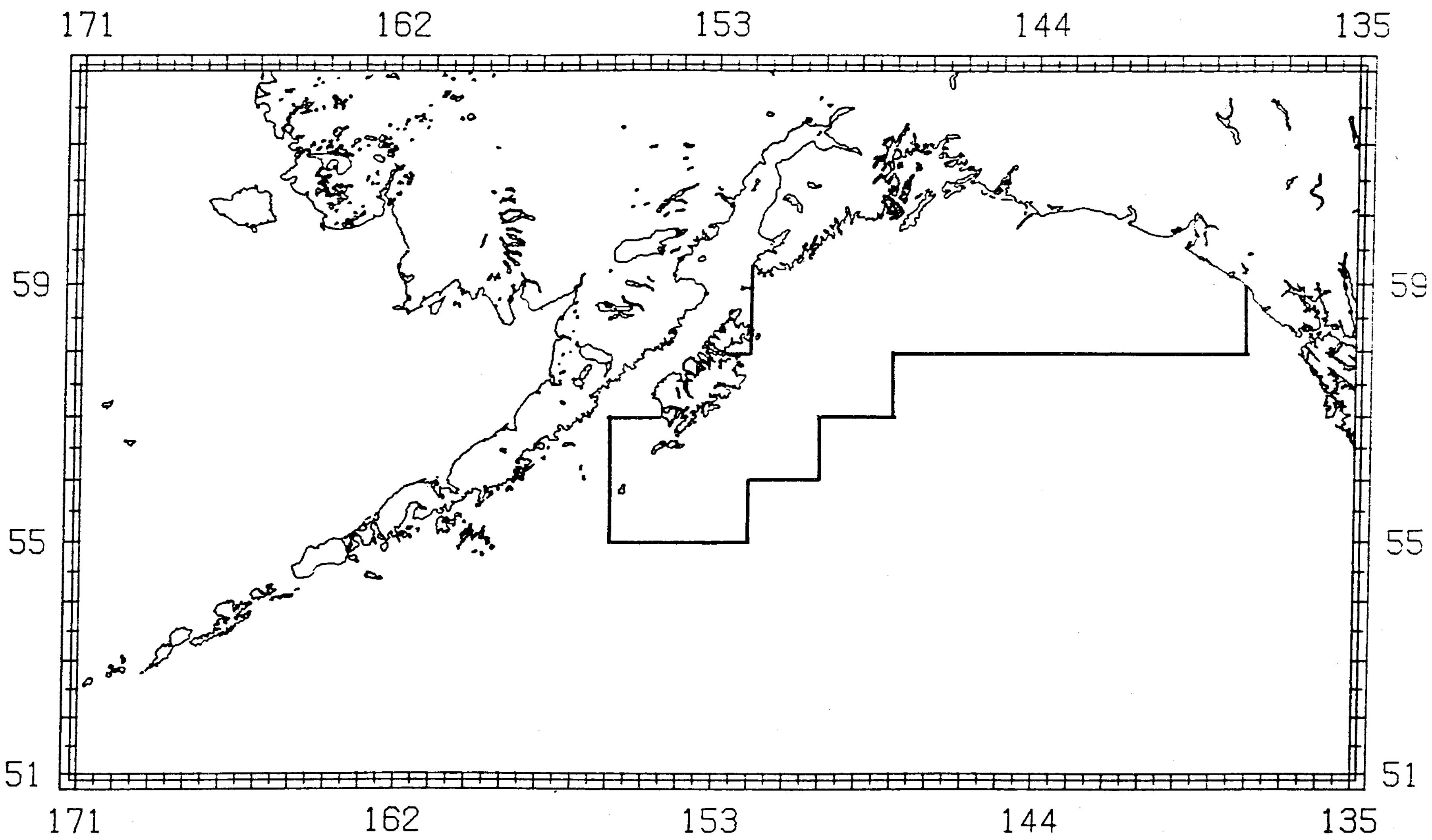

Figure 1.--Chart showing boundaries of census area.

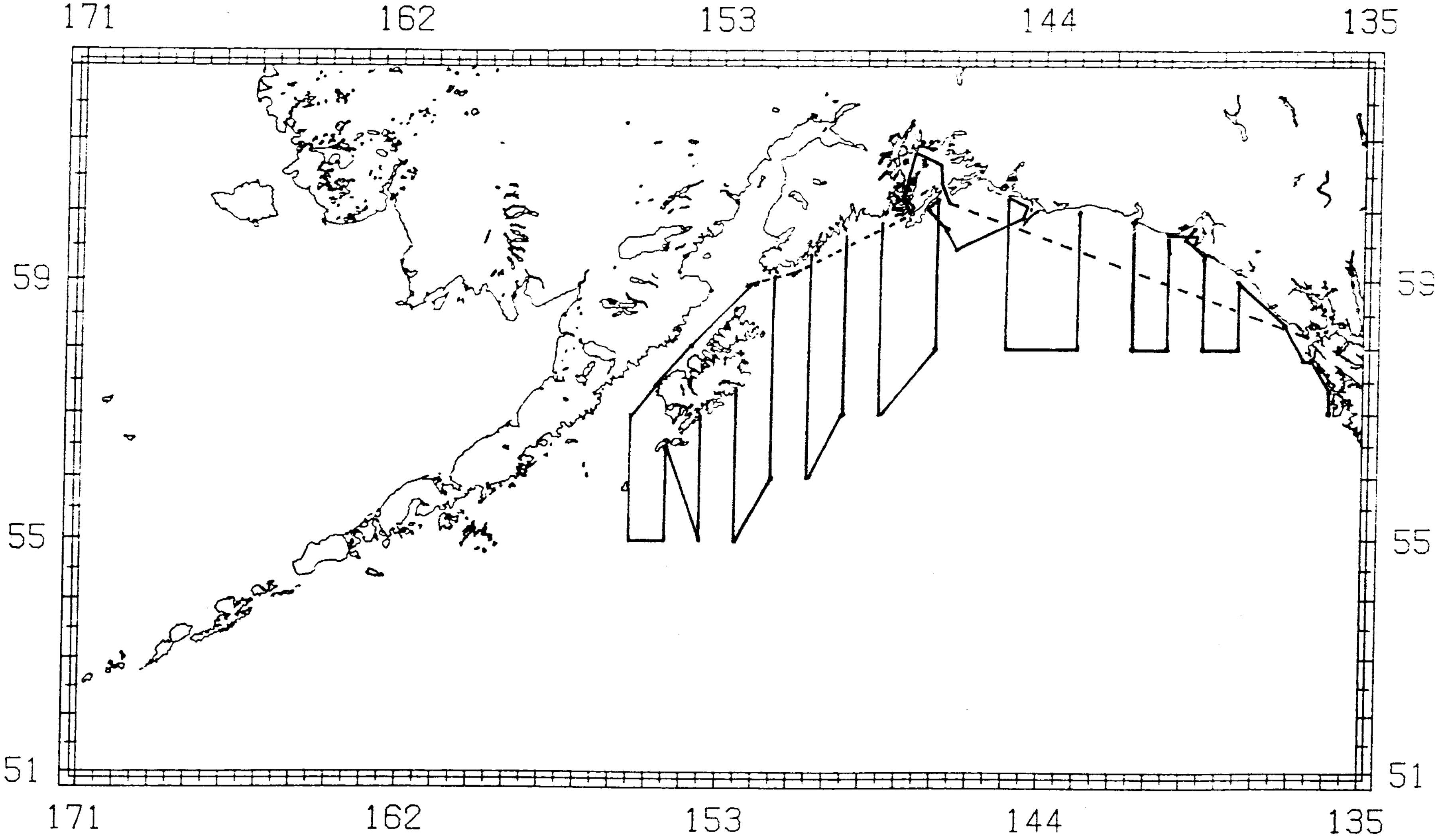

Figure 2.--Chart of cruise track, 17 June to 20 July.

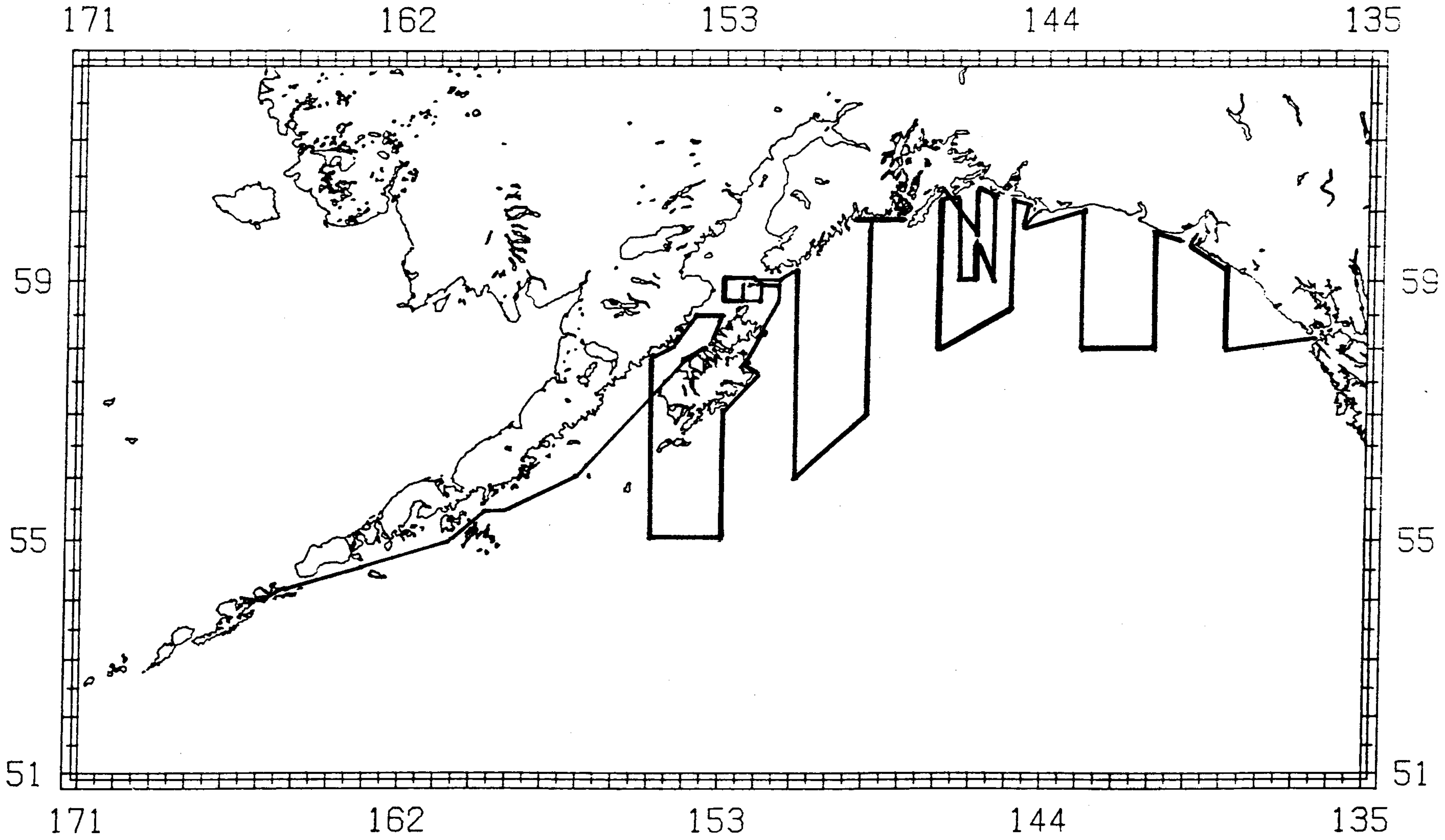

Figure 3.--Chart of cruise track, 24 July to 28 August.

In addition, 3 shorter transects, space at intervals of 30 minutes of longitude, were run in the vicinity of Middleton Island (Fig. 3 and Table 5); these totaled 222 miles. Four short transects, spaced at intervals of 30 minutes of longitude, were also run in the vicinity of the Barren Islands (Fig. 3 and Table 5); these totaled 75 miles.

The systematic census tracks for the entire cruise totaled 3,303 nautical miles.

While running the transect lines the vessel maintained a steady speed. When whales were sighted more than 0.5 km from the trackline, the vessel immediately altered course and closed with the animals. After confirmation of the identity and number of the whales (and photography in the case of humpbacks), the vessel headed due east or west until it was back on the trackline, and then continued along the preestablished course.

Three observers (in addition to the helmsman) were continuously on watch on the bridge. We attempted to keep the entire 360° arc under surveillance.

TABLE 1.--Original and current population sizes of large baleen whales in the North Pacific Ocean, and year that each species was afforded complete protection from commercial whaling (Sources: Gambell 1976; Reilly et al. 1980; Rice 1978; Tillman 1977; Wada 1979).

Species	Year protected	Population	
		Original	Current
Gray whales (Eschrichtiidae):			
Gray whale *Eschrichtius robustus*	1947	15,000[a]	15,000
Rorquals (Balaenopteridae):			
Sei whale *Balaenoptera borealis*	1976	42,000	9,000
Fin whale *B. physalus*	1976	44,000	17,000
Blue whale *B. musculus*	1967	5,000	1,700
Humpback whale *Megaptera novaeangliae*	1967	15,000	1,200
Right whales (Balaenidae):			
Black right whale *Balaena glacialis*	1937	n.d.	220

[a] The gray whale population was reduced to about 4,000 by the year 1900, and has since recovered.

TABLE 2.--Water area (square nautical miles) of quadrats (each 1° lat by 2° long) in study area.

	W. longitude									
N. latitude	156°	154°	152°	150°	148°	146°	144°	142°	140°	138°
61°										
					638	798				
60°										
			1020	3125	3398	3654	3654	3290	950	
59°										
			3750	3762	3762	3762	3762	3762	3739	
58°										
		1740	3869	3869						
57°										
	3790	3893	3974							
56°										
	4078	4078								
55°										

TABLE 3.--Main census transects and whale sightings during first half of cruise.

Date	Longitude	Latitude		Miles	Whale sightings*		
		N. end	S. end		Humpback	Fin	Sperm
22 June	138°30'W	59°02'N	58°00'N	62			
23 June	139°30'W	59°22'N	58°00'N	82	2(4)		
25 June	140°30'W	59°40'N	58°00'N	100		1(2)	1(2)
26 June	141°30'W	59°51'N	58°00'N	111			
27-28 June	143°00'W	60°03'N	58°00'N	123	2(3)		
29 June	145°00'W	60°07'N	58°00'N	127	1(2)		
1 July	147°00'W	60°12'N	58°00'N	132		5(10)	
2-3 July	148°30'W	59°55'N	57°00'N	175	1(1)		1(2)
4-5 July	149°30'W	59°39'N	57°00'N	159			
6-7 July	150°30'W	59°24'N	56°00'N	204	1(2)		
8-9 July	151°30'W	59°05'N	56°00'N	185			
10 July	152°30'W	57°20'N	55°00'N	140			
13 July	153°30'W	57°00'N	55°00'N	120			
14 July	154°30'W	56°27'N	55°00'N	87	1(2)	1(1)	
15 July	155°30'W	57°00'N	55°00'N	120	1(2)		
Total				1,927	9(16)	7(13)	2(4)

*Number of sightings, with number of individuals in parentheses.

TABLE 4.--Main census transects and whale sightings during second half of cruise.

Date	Longitude	Latitude		Miles	Whale sightings*		
		N. end	S. end		Humpback	Fin	Sperm
25 July	139°00'W	59°13'N	58°00'N	73			
27 July	141°00'W	59°42'N	58°00'N	102	1(1)		3(32)
28 July	143°00'W	60°03'N	58°00'N	123	1(3)		
29 July	145°00'W	60°10'N	58°00'N	91	1(1)		
30 July	147°00'W	60°13'N	58°00'N	133	1(2)		
8-9 Aug	149°00'W	59°55'N	57°00'N	175			
10-11 Aug	151°00'W	59°10'N	55°00'N	190			1(1)
19 Aug	153°00'W	57°03'N	55°00'N	123			
20-21 Aug	155°00'W	57°49'N	55°00'N	169	1(2)		
Total				1,179	5(9)		4(33)

* Number of sightings, with number of individuals in parentheses.

TABLE 5.--Supplementary census transects and whale sightings during second half of cruise.

Date	Longitude	Latitude		Miles	Whale sightings*		
		N. end	S. end		Humpback	Fin	Sperm
Middleton Island:							
1 Aug	145°30'W	60°12'N	59°00'N	72			
31 July-1 Aug	146°00'W	60°16'N	59°00'N	76	2(8)	1(1)	
31 July	146°30'W	60°14'N	59°00'N	74			
Total				222	2(8)	1(1)	
Barren Islands:							
13 Aug	151°30'W	59°05'N	58°45'N	20	1(2)		
13 Aug	152°00'W	59°05'N	58°45'N	20	2(4)		
12 Aug	152°30'W	59°05'N	58°45'N	20	1(10)		
12 Aug	153°00'W	59°00'N	58°45'N	15			
Total				75	4(16)		

* Number of sightings, with number of individuals in parentheses.

Each time that marine mammals were sighted, we recorded the sighting angle relative to the vessel's heading, and the distance of the animals from the vessel at the time of sighting. Distances were estimated by three methods:

1) Visual estimates were made at the time of sighting.
2) Dead-reckoning estimates were made by noting the time it took at known speed to close with the animals.
3) Loran-C positions were recorded at the moment of sighting, and again when we closed with the animals. These positions are accurate to within 0.01 second of latitude and longitude (9 to 18 meters).

Photo-identification

Photographs were taken of the flukes of as many humpback whales as possible. The color pattern of the underside of the flukes provides a reliable means of identifying individual animals. The photographs were entered into the National Marine Mammal Laboratory's computerized Photographic Identification Storage and Retrieval (PISAR) system for comparison with the extensive file of photographs already in the system.

Radio-tracking

During the second half of the cruise (24 July to 28 August) a radio-receiver was mounted on the bridge. It was monitored continuously while the vessel was underway, to detect any radio-tagged gray whales that might be within range. These whales had been tagged the previous winter in Laguna San Ignacio, Baja California Sur, Mexico, by Bruce R. Mate of Oregon State University.

Acoustic recording

During the second half of the cruise (24 July to 28 August), underwater phonations of cetaceans were recorded on an opportunistic basis.

Data Management

Data aquisition and archival, and quality control, followed the procedures outlined by Mercer, Krogman, and Sonntag (1978) for the Platforms of Opportunity Project and Outer Continental Shelf Environmental Assessment Program.

RESULTS

A total of 1,231 sightings, totaling 6,968 individuals, of 13 species of marine mammals were recorded during the cruise (Table 6). Distribution of all sightings of each species are plotted on the accompanying charts (Appendix figs. 1-25).

Humpback whale Megaptera novaeangliae

Humpbacks were sighted on 90 occasions, totaling 190 individuals. They were thinly scattered over the entire area, and small aggregations were found during both halves of the cruise in four areas: (1) Yakutat Bay; (2) Cape Saint Elias to Middleton Island; (3) the Barren Islands, and (4) Prince William Sound.

Only 14 of the sightings, totaling 25 individuals, were made during the main systematic census transects (Tables 3-4). A sample size of at least 40 sightings is necessary to enable valid statistical inferences to be drawn (Burnham, Anderson, and Laake 1980). An approximation of population size may be made, however, by assuming that the "effective transect width" was 1.0 mile (1.85 km) on either side of the vessel's track, as we found during four seasons' censusing of humpbacks around the Hawaiian Islands. On this basis, the 25 whales sighted along 3,106 miles of main census transect may be extrapolated over the entire 76,117 square mile study area to provide an estimate of 306 humpback whales.

Our maximum counts of humpback whales in each of the four aggregation areas (Table 7), which were not counted during the systematic offshore line transects, were as follows: Yakutat Bay - 13; Cape Saint Elias to Middleton Island - 13; Prince William Sound - 12; Barren Islands - 20. These counts are minimum estimates of the number of humpback whales using these areas.

Movements of humpback whales were revealed by photographic documentation of individually recognizeable whales. During the cruise we obtained photographs of 36 such whales (19% of the total seen). Repeat observations of four of these animals at intervals of 2 to 27 days were all very close to the positions where they were first found (Table 8); two of them had been observed in the same area in 1977 (and one in 1978) by Hall (1979). Humpback whales that inhabit inshore waters during the

TABLE 6.--Summary of marine mammals sighted during Gulf of Alaska cruise.

Species	First half		Second half		Total	
	No. sightings	No. individuals	No. sightings	No. individuals	No. Sightings	No. Individuals
Eumetopias jubatus	59	303	45	2,558	104	2,861
Callorhinus ursinus	105	144	31	32	136	176
Enhydra lutris	16	41	53	110	69	151
Phoca vitulina	16	167	29	48	45	215
Balaenoptera acutorostrata	21	21	16	16	37	37
B. physalus	13	19	4	14	17	33
Megaptera novaeangliae	43	82	46	109	89	191
Lagenorhynchus obliquidens	11	874	2	32	13	906
Orcinus orca	6	41	13	92	19	133
Phocoena phocoena	15	25	37	43	52	68
Phocoenoides dalli	372	1,301	269	852	641	2,153
Physeter macrocephalus	3	4	4	33	7	37
Ziphius cavirostris	2	7	-	-	2	7
Total	682	3,029	549	3,939	1,231	6,968

TABLE 7.--Counts of humpback whales in aggregation areas.

Area	First count		Second count	
	Date	Number	Date	Number
Yakutat Bay	24 June	13	26 July	4
Middleton Island	30 June	13	31 July-1 Aug	8
Prince William Sound	17-18 July	5	2-6 Aug	12
Barren Islands	16 July	15	12-14 Aug	20

TABLE 8.--Repeat sightings of individually-recognizeable photo-documented humpback whales.

PISAR Whale Number	Date	Location
000331	24 June 1980	Yakutat Bay
	26 July 1980	Yakutat Bay
000337	June 1977[1]	Prince William Sound
	June 1978[1]	Prince William Sound
	Aug 1978[1]	Prince William Sound
	4 Aug 1980	Prince William Sound: Icy Bay
	5 Aug 1980	Prince William Sound: Icy Bay
	31 Aug 1980[2]	Prince William Sound: Whale Bay
000342	June 1977[1]	Prince William Sound
	4 Aug 1980	Prince William Sound: Icy Bay
	5 Aug 1980	Prince William Sound: Whale Bay
	30 Aug 1980[2]	Prince William Sound: Chenega Island
000365	5 Aug 1980	Prince William Sound: Whale Bay
	27 Aug 1980[2]	Prince William Sound: Bainbridge Passage

[1] Photographed by Hall (1979)

[2] Photographed by Craig Matkin

summer thus appear to have strong site-fidelity, with little if any dispersal between aggregation areas.

Fin whale *Balaenoptera physalus*

Finbacks were sighted on only 13 occasions, totaling 19 individuals. The only minor aggregation that we encountered was 10 animals west of Middleton Island on 1 July. The remaining sightings were thinly scattered over the entire area.

Only 7 of the sightings, totaling 13 individuals, were made during the main systematic census transects (Tables 3-4). A crude approximation of total numbers may be made by assuming an "effective transect width" of 1.0 mile, as for the humpback whale, and extrapolating over the entire 76,117 square mile study area. This gives an estimate of 159 fin whales.

Gray whale *Eschrichtius robustus*

No gray whales were seen during the cruise, even though most of their preferred close-inshore habitat was searched. No radio signals were received from tagged gray whales.

Other endangered species

Sperm whales *Physeter macrocephalus* were sighted over deep water beyond the continental shelf on 6 occasions, totaling at least 36 individuals.

No blue whales *Balaenoptera musculus*, sei whales *B. borealis*, or right whales *Balaena glacialis* were sighted. At least until the early 1960's, the immediate offshore waters were a major summer ground for blue whales (Berzin and Rovnin 1966; Nemoto and Kasuya 1965). Sei whales tend to range farther offshore (Nemoto and Kasuya 1965) so our census may have missed most of the Gulf of Alaska population. Right whales are on the verge of extinction in the North Pacific (Rice 1974); most of the recent sightings have been made in the area immediately south of Kodiak Island (Omura et al. 1969).

SUMMARY AND CONCLUSIONS

Our preliminary survey indicated that the populations of all species of great whales in the Gulf of Alaska have been severely depleted.

Humpback whales were sparsely distributed throughout the area from 138° to 156°W longitude, where the total population is calculated to be 306; we made too few sightings to calculate confidence limits. In addition, minor aggregations of humpbacks were found in Yakutat Bay (≯13), around Middleton Island (≯13), in Prince William Sound (≯12), and around the Barren Islands (≯20). Humpback whales in inshore waters show strong site-fidelity and rarely move between aggregation areas.

Fin whales are sparsely distributed throughout the area, where a rough estimate of the total population is only 159 animals.

No gray whales, blue whales, sei whales or right whales were sighted. Sperm whales were seen far offshore on 6 occasions, totaling 36 individuals.

Baleen whales in offshore waters tend to be nomadic during the summer, when they aggregate temporarily in areas of denser food supplies. Therefore one season's observations are inadequate to reveal distribution patterns and numbers in a limited area.

ACKNOWLEDGEMENTS

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APPENDIX

Distribution Charts

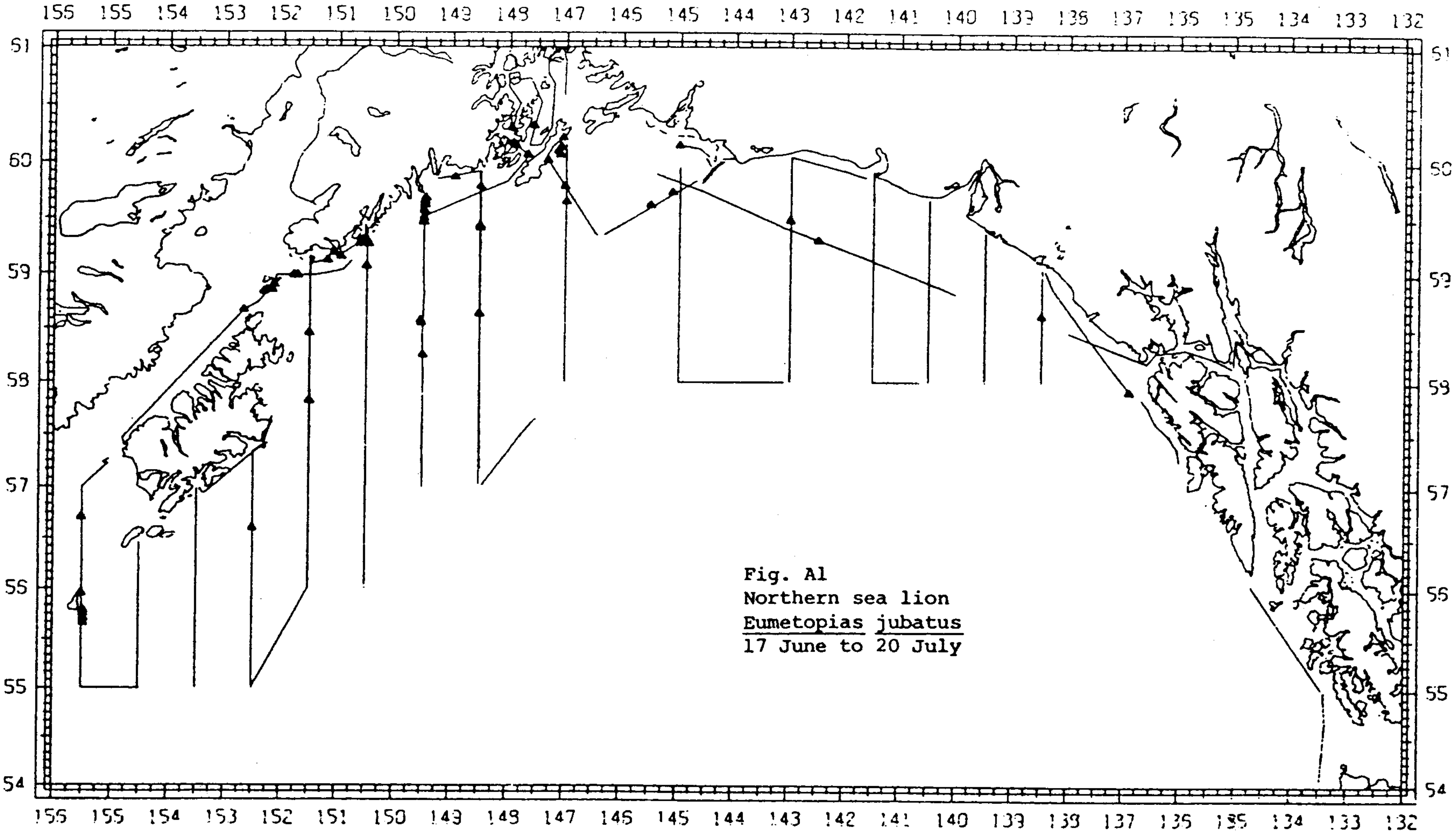


Fig. A1
Northern sea lion
Eumetopias jubatus
17 June to 20 July

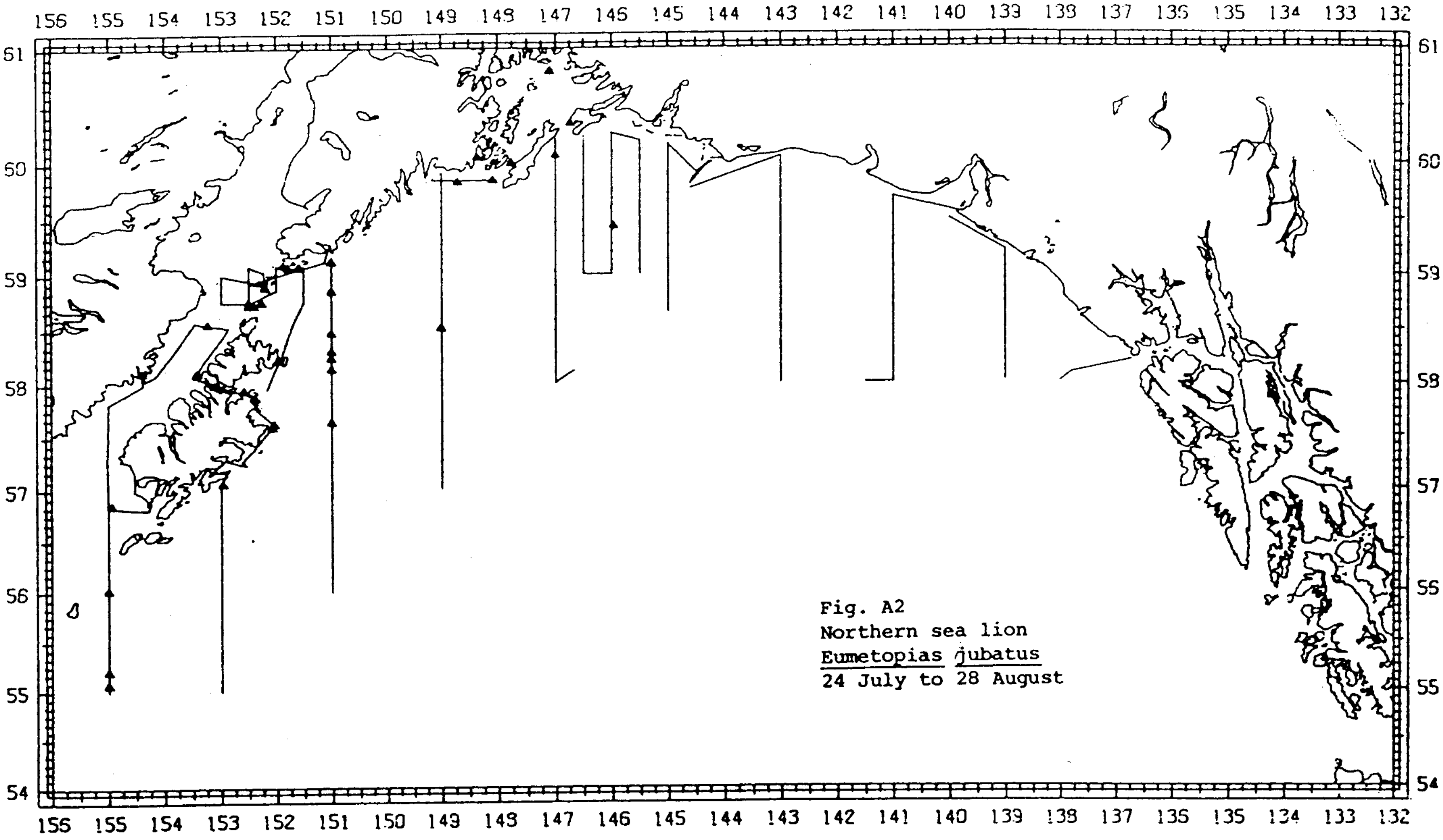


Fig. A2
Northern sea lion
Eumetopias jubatus
24 July to 28 August

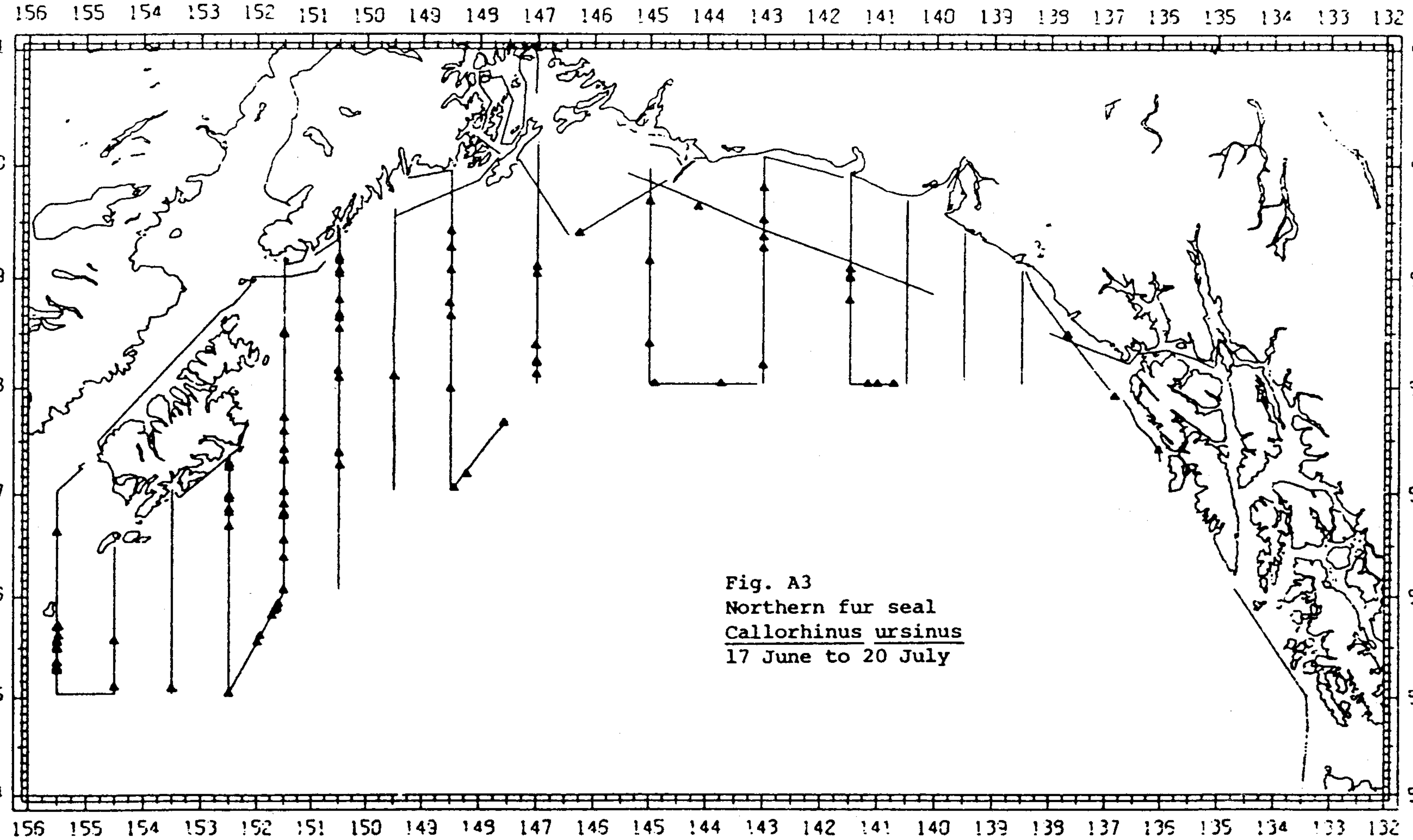


Fig. A3
Northern fur seal
Callorhinus ursinus
17 June to 20 July

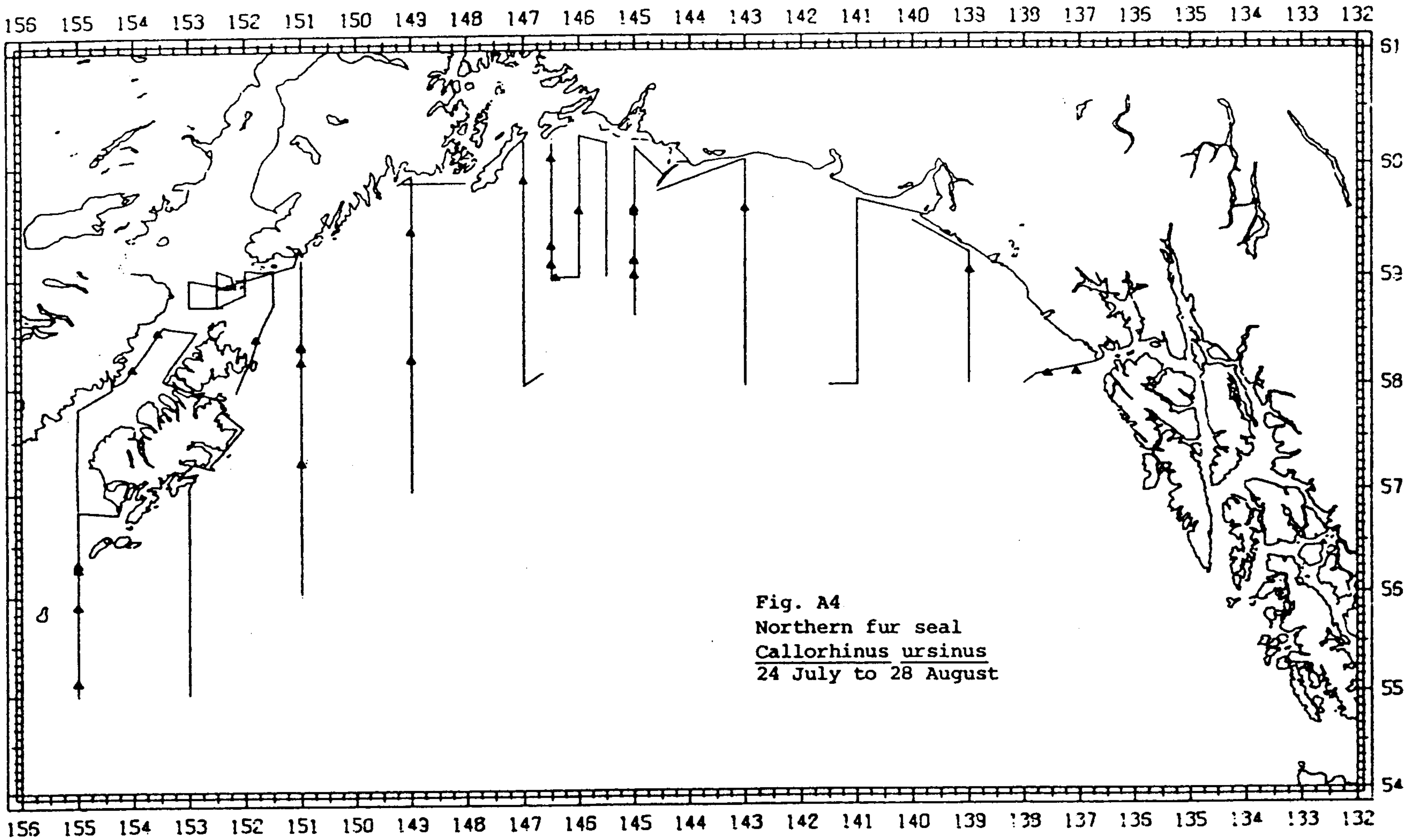


Fig. A4
Northern fur seal
Callorhinus ursinus
24 July to 28 August

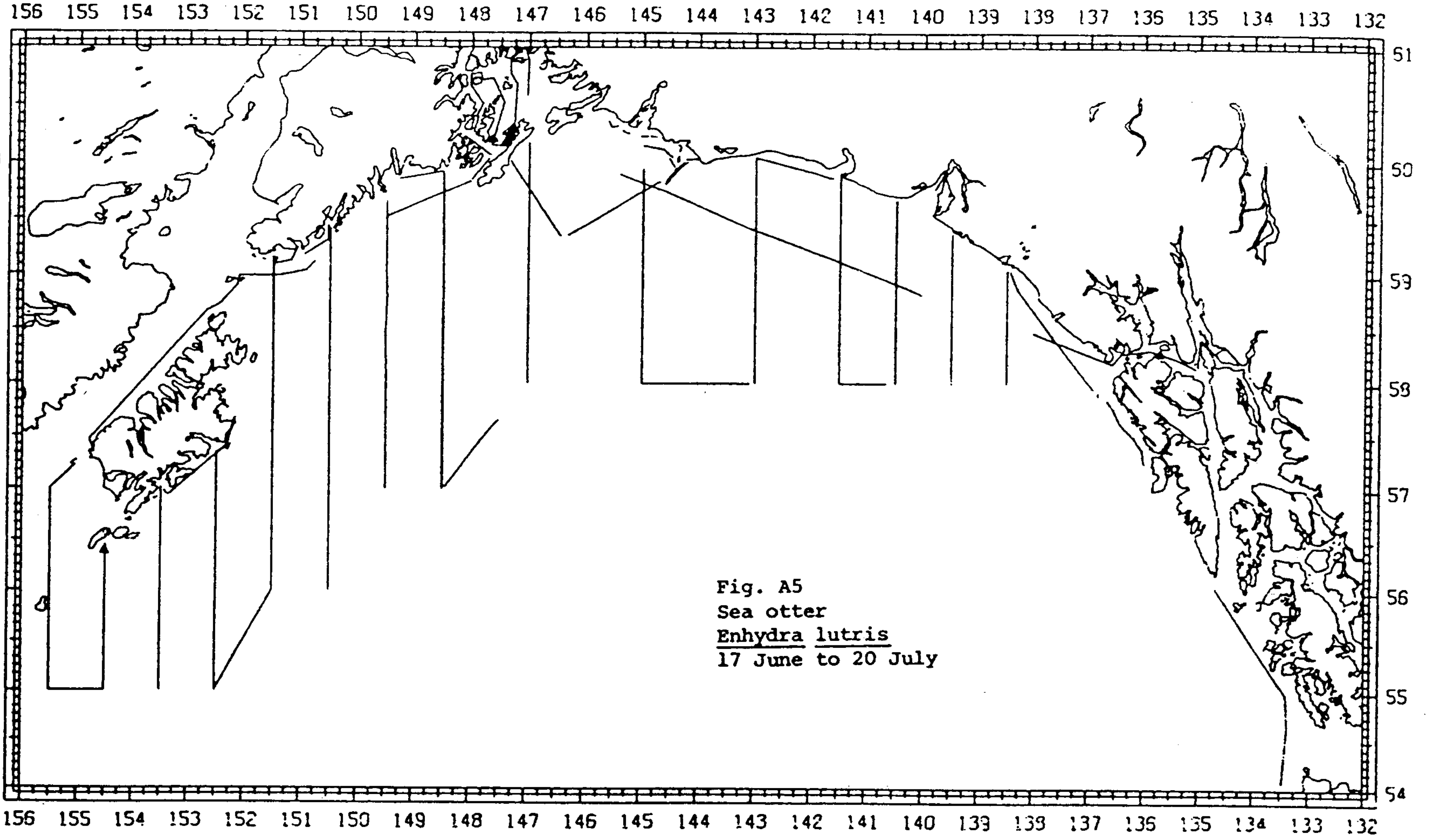


Fig. A5
Sea otter
Enhydra lutris
17 June to 20 July

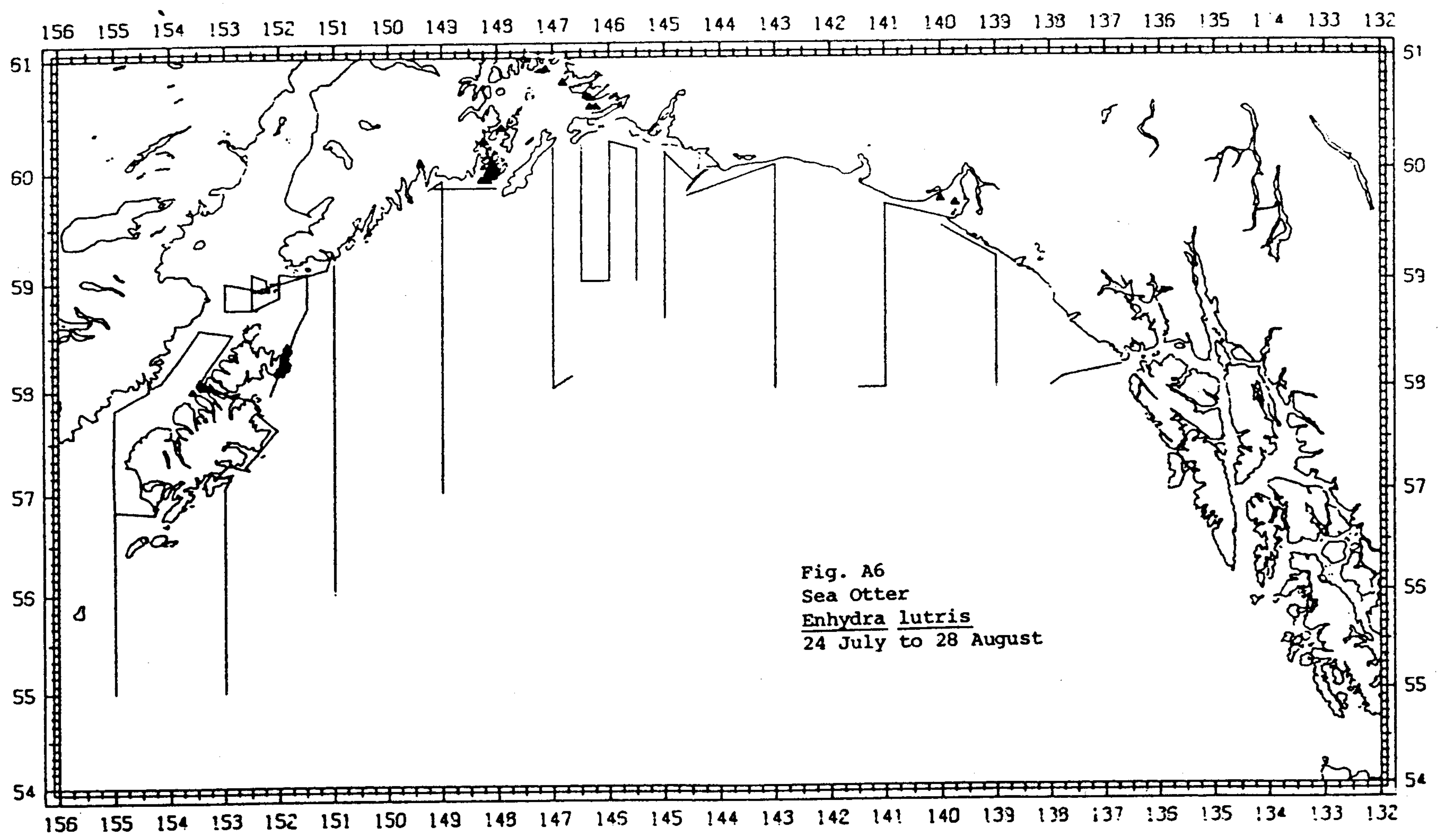


Fig. A6
Sea Otter
Enhydra lutris
24 July to 28 August

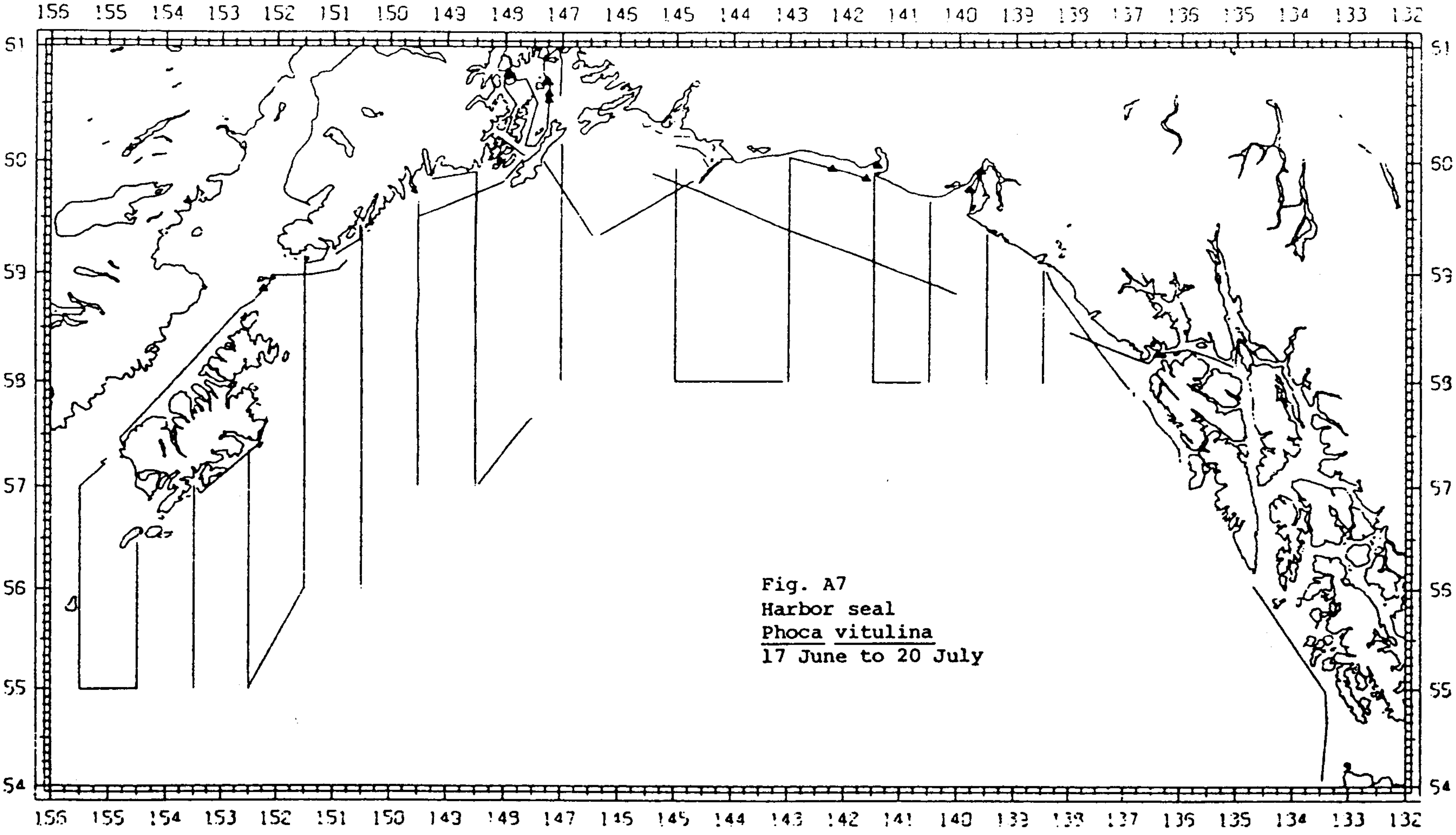


Fig. A7
Harbor seal
Phoca vitulina
17 June to 20 July

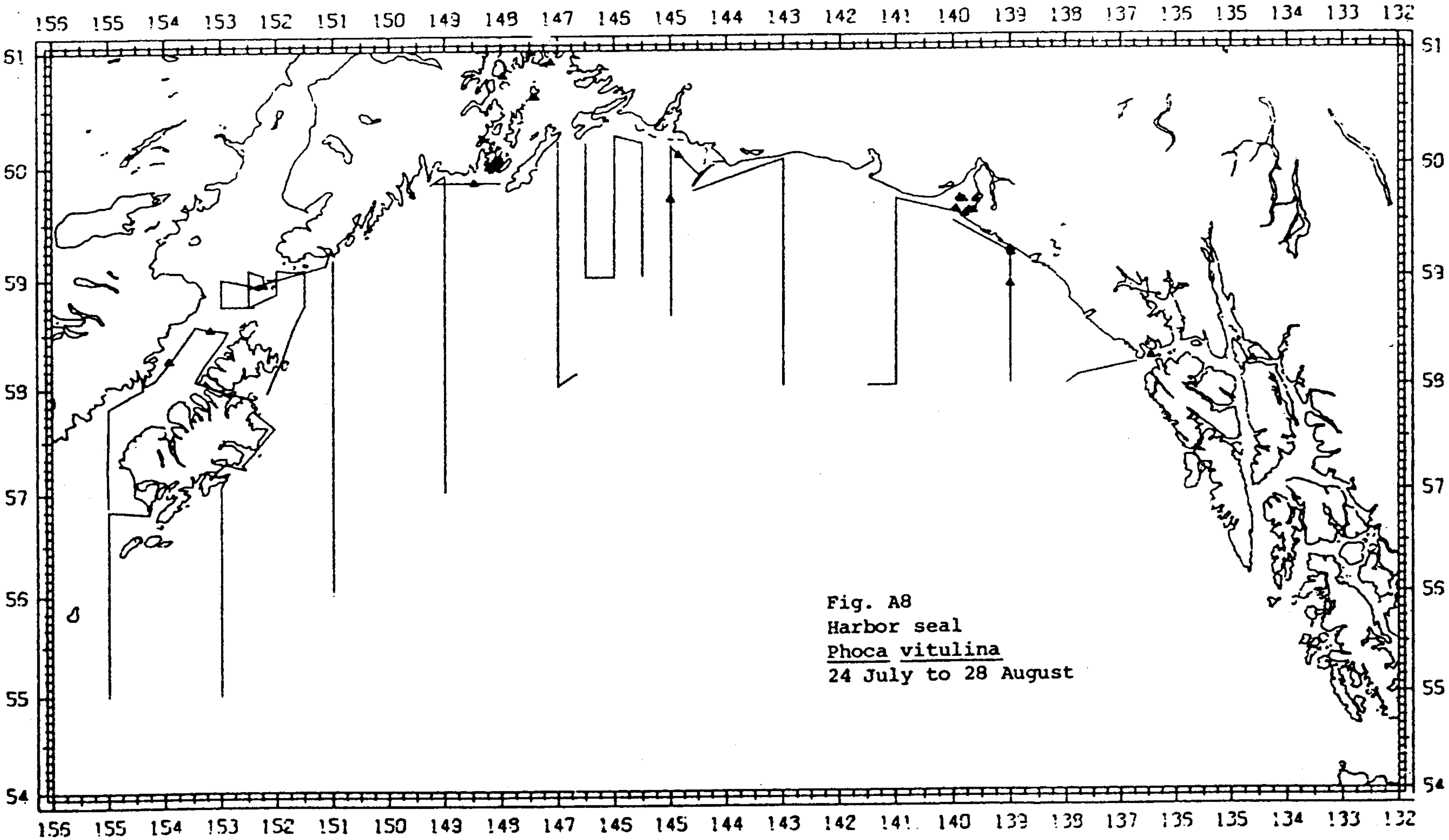


Fig. A8
Harbor seal
Phoca vitulina
24 July to 28 August

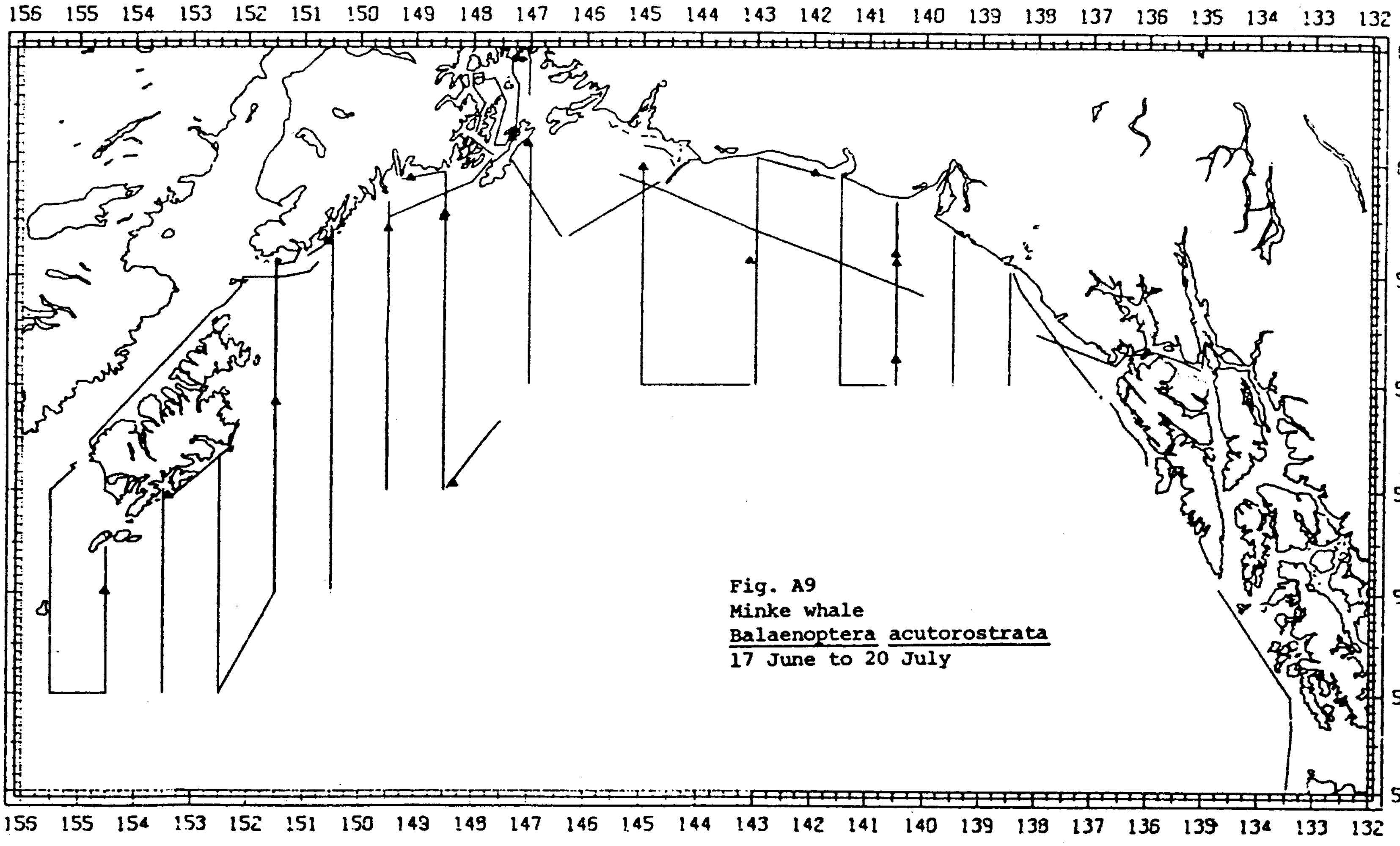


Fig. A9
Minke whale
Balaenoptera acutorostrata
17 June to 20 July

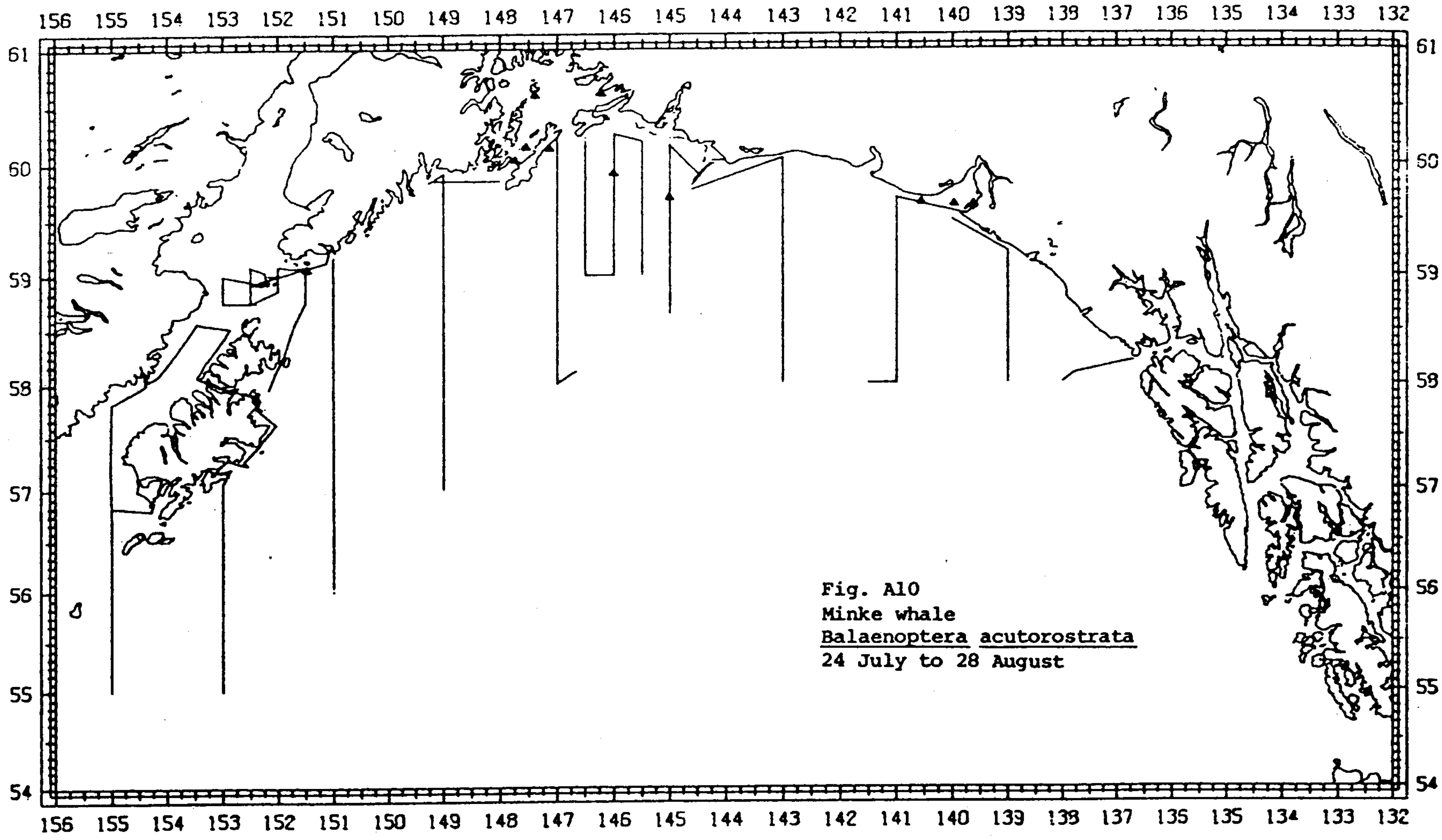


Fig. A10
Minke whale
Balaenoptera acutorostrata
24 July to 28 August

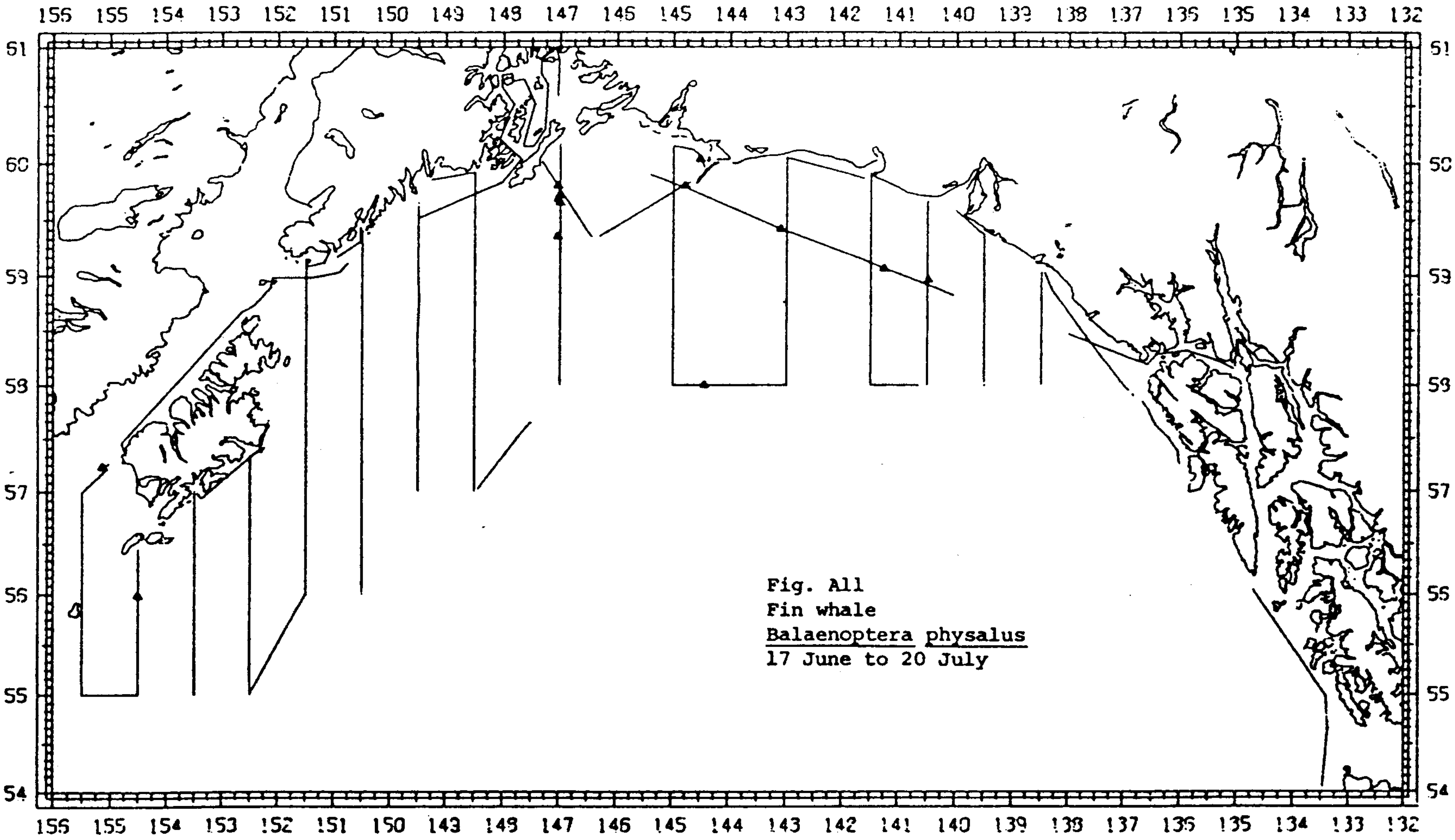


Fig. All
Fin whale
<u>Balaenoptera physalus</u>
17 June to 20 July

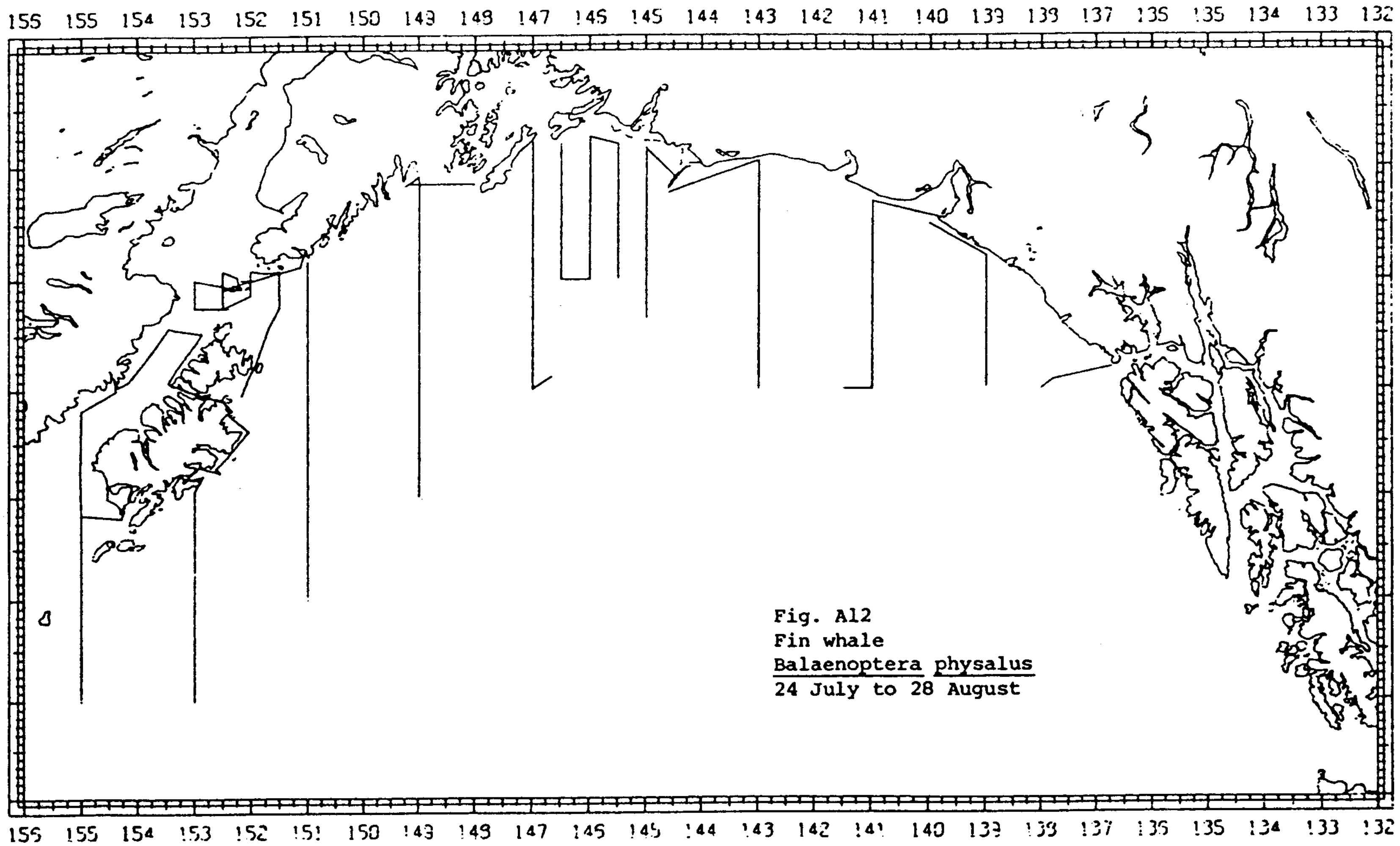


Fig. A12
Fin whale
Balaenoptera _physalus_
24 July to 28 August

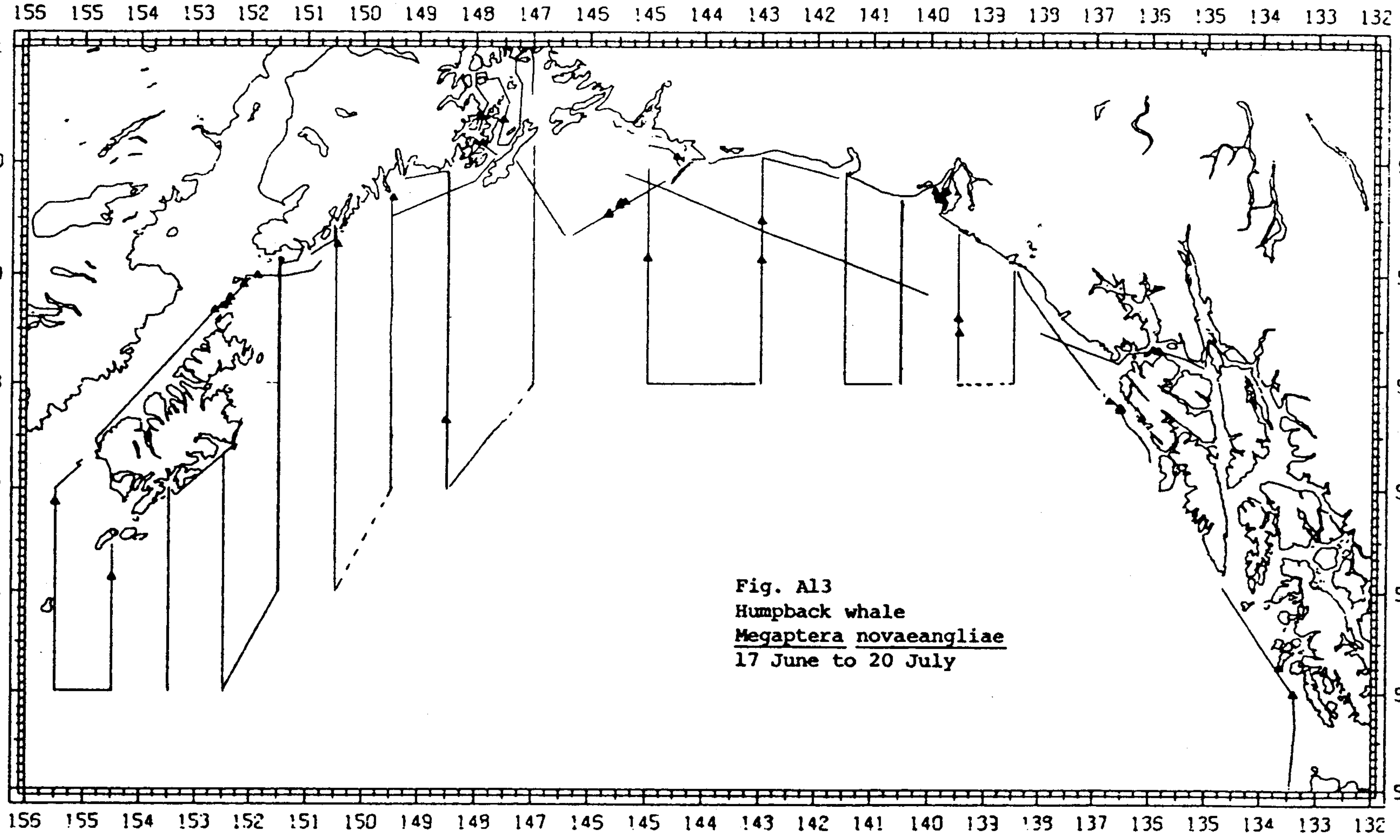


Fig. A13
Humpback whale
Megaptera novaeangliae
17 June to 20 July

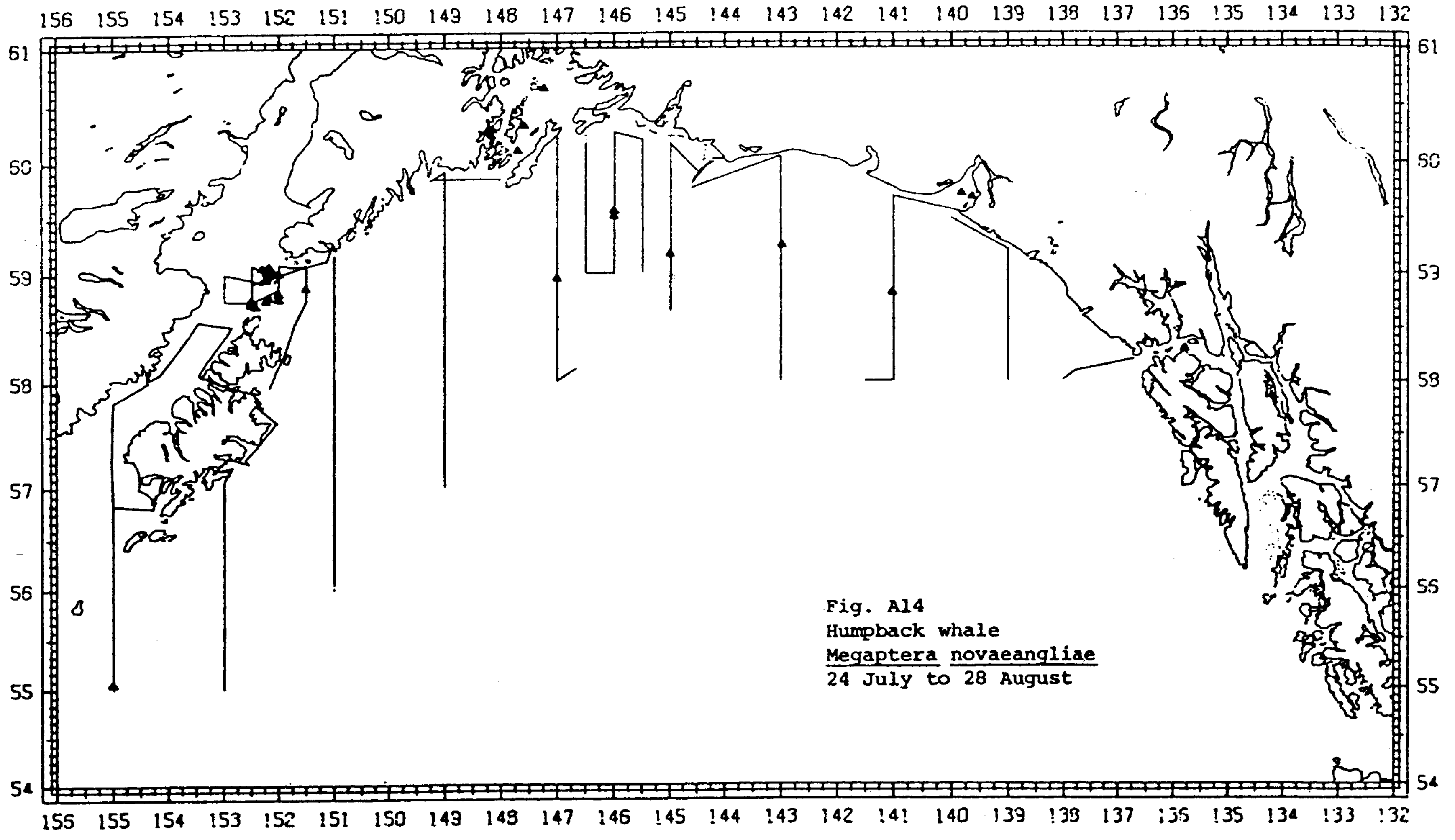


Fig. A14
Humpback whale
Megaptera novaeangliae
24 July to 28 August

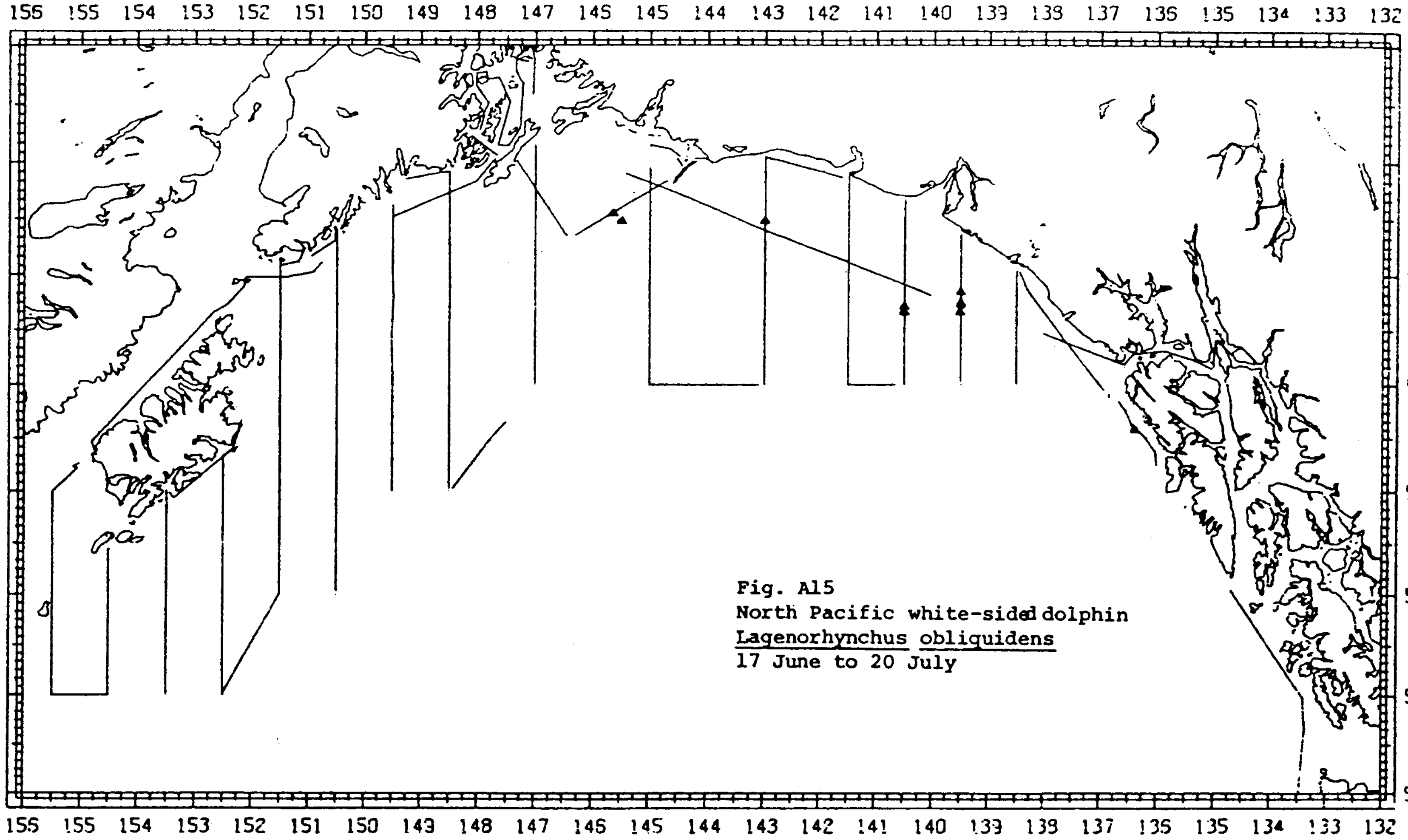


Fig. A15
North Pacific white-sided dolphin
Lagenorhynchus obliquidens
17 June to 20 July

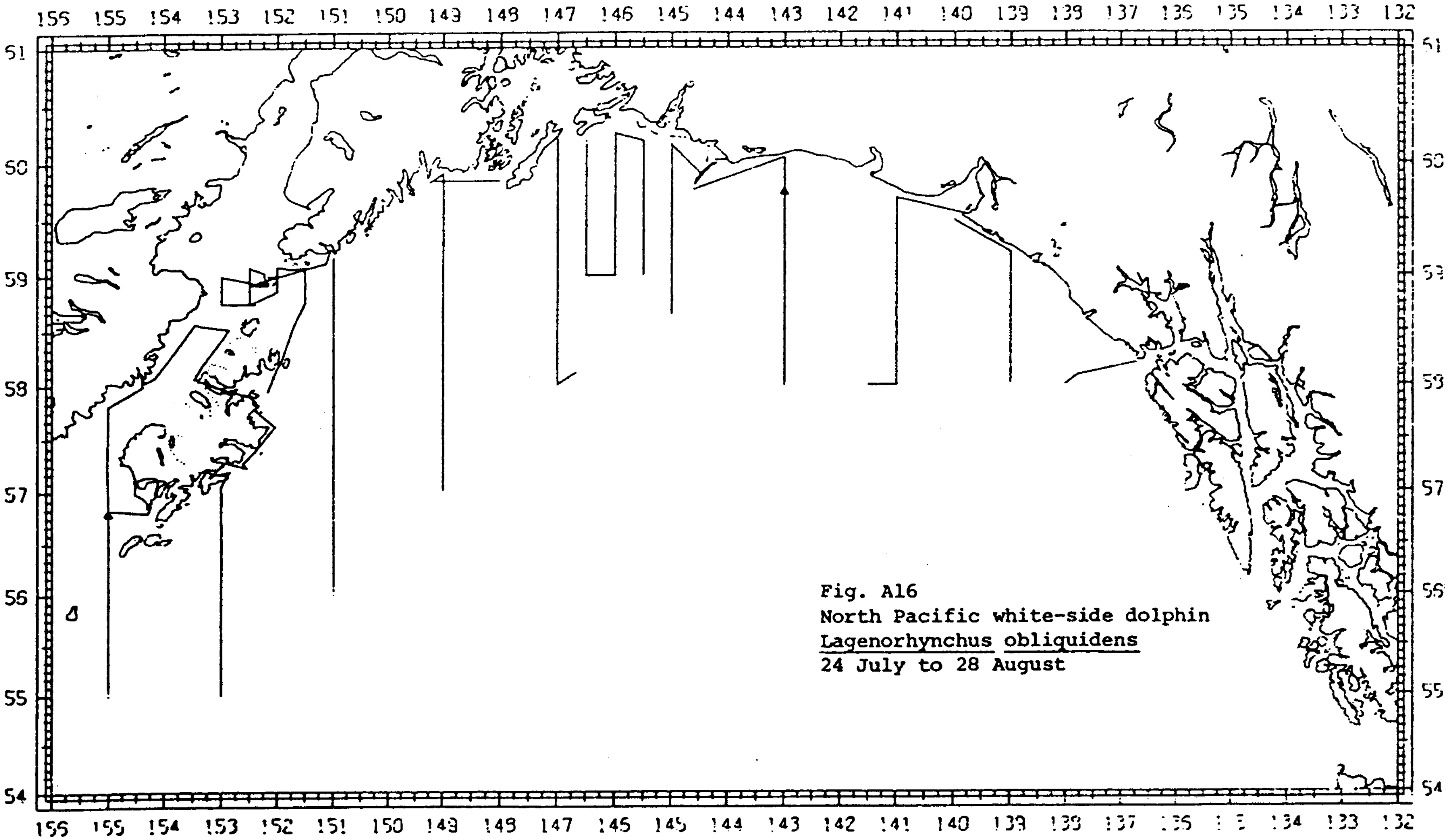


Fig. A16
North Pacific white-side dolphin
Lagenorhynchus obliquidens
24 July to 28 August

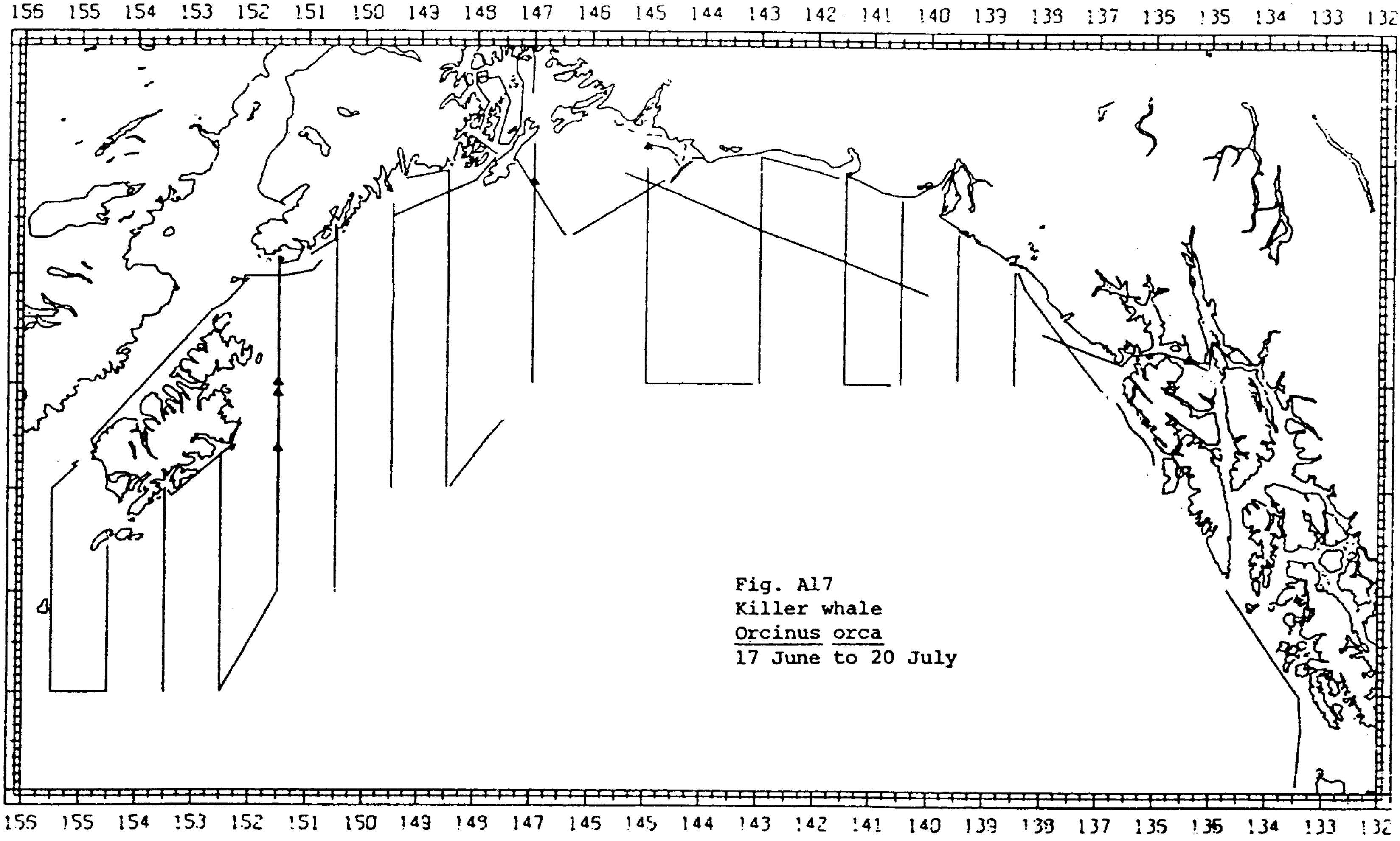


Fig. A17
Killer whale
<u>Orcinus</u> <u>orca</u>
17 June to 20 July

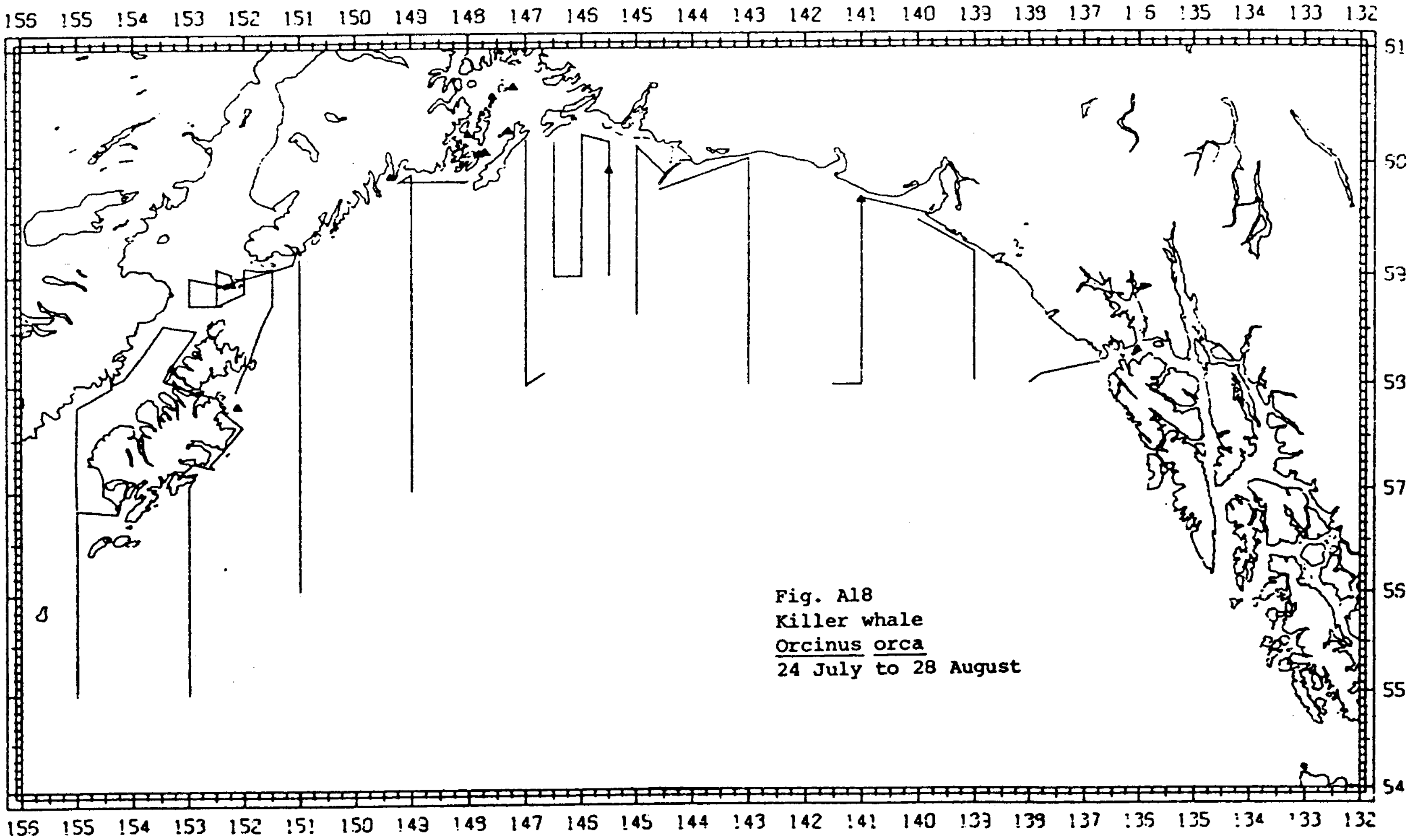


Fig. A18
Killer whale
Orcinus orca
24 July to 28 August

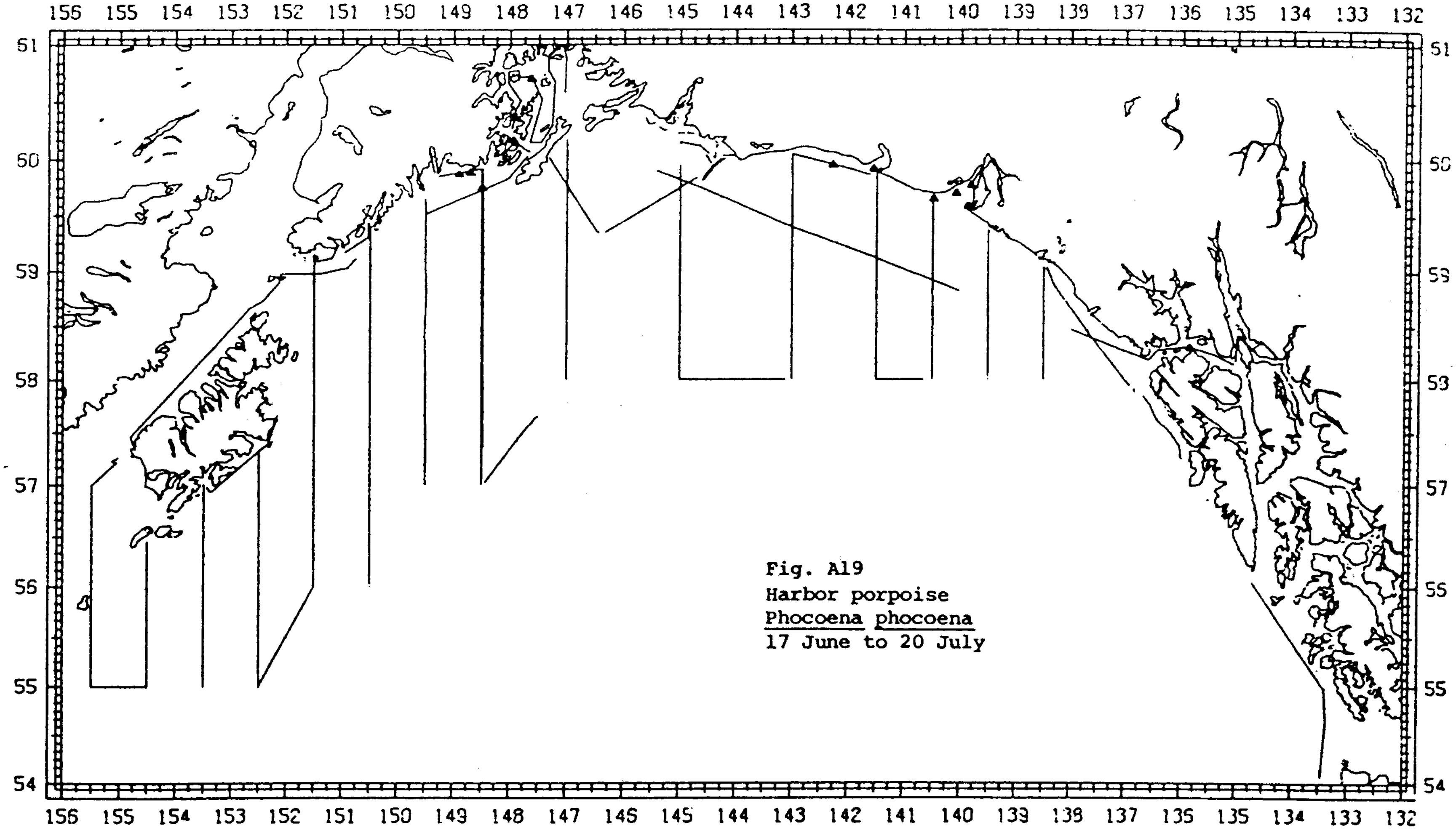


Fig. A19
Harbor porpoise
Phocoena phocoena
17 June to 20 July

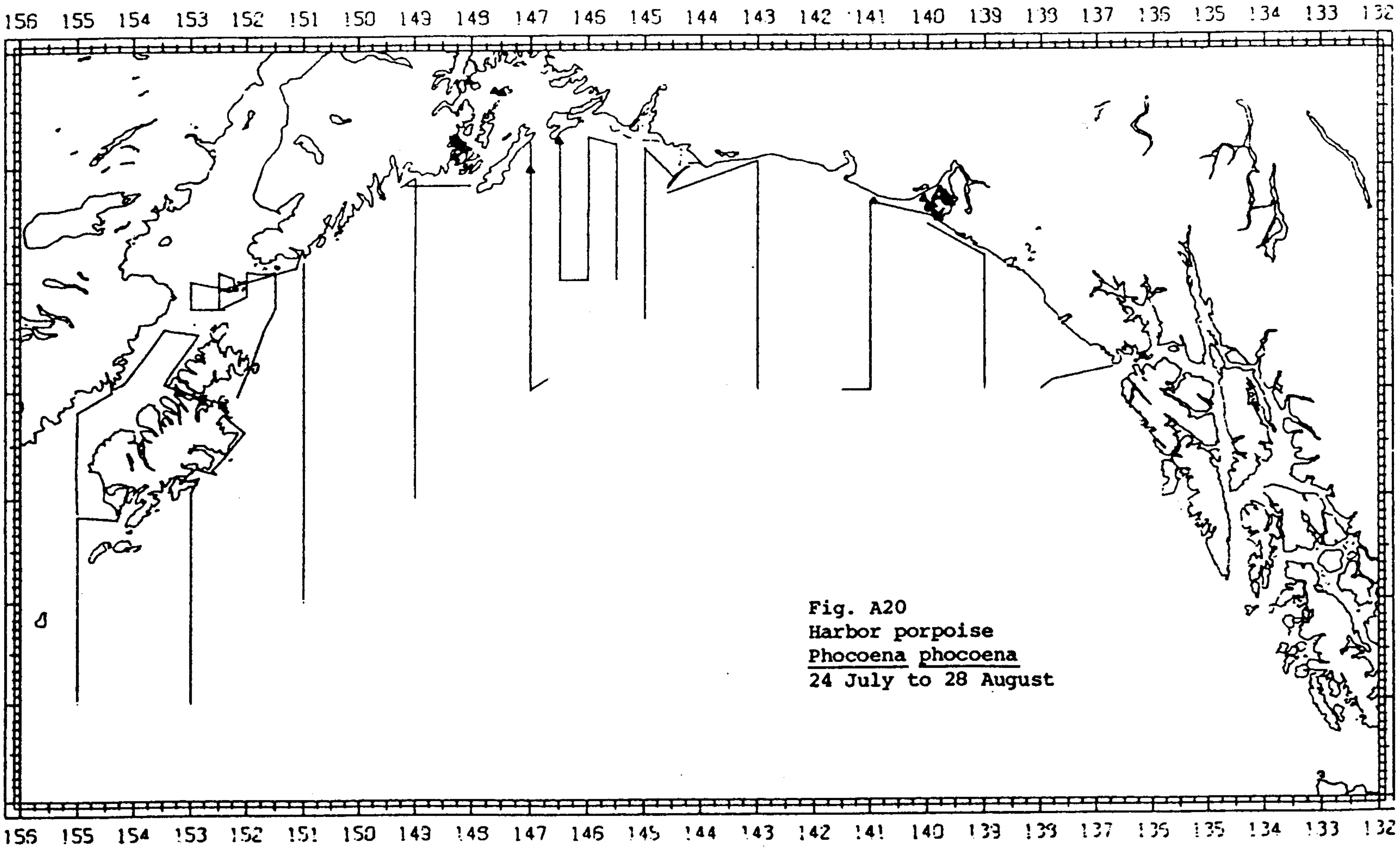


Fig. A20
Harbor porpoise
Phocoena phocoena
24 July to 28 August

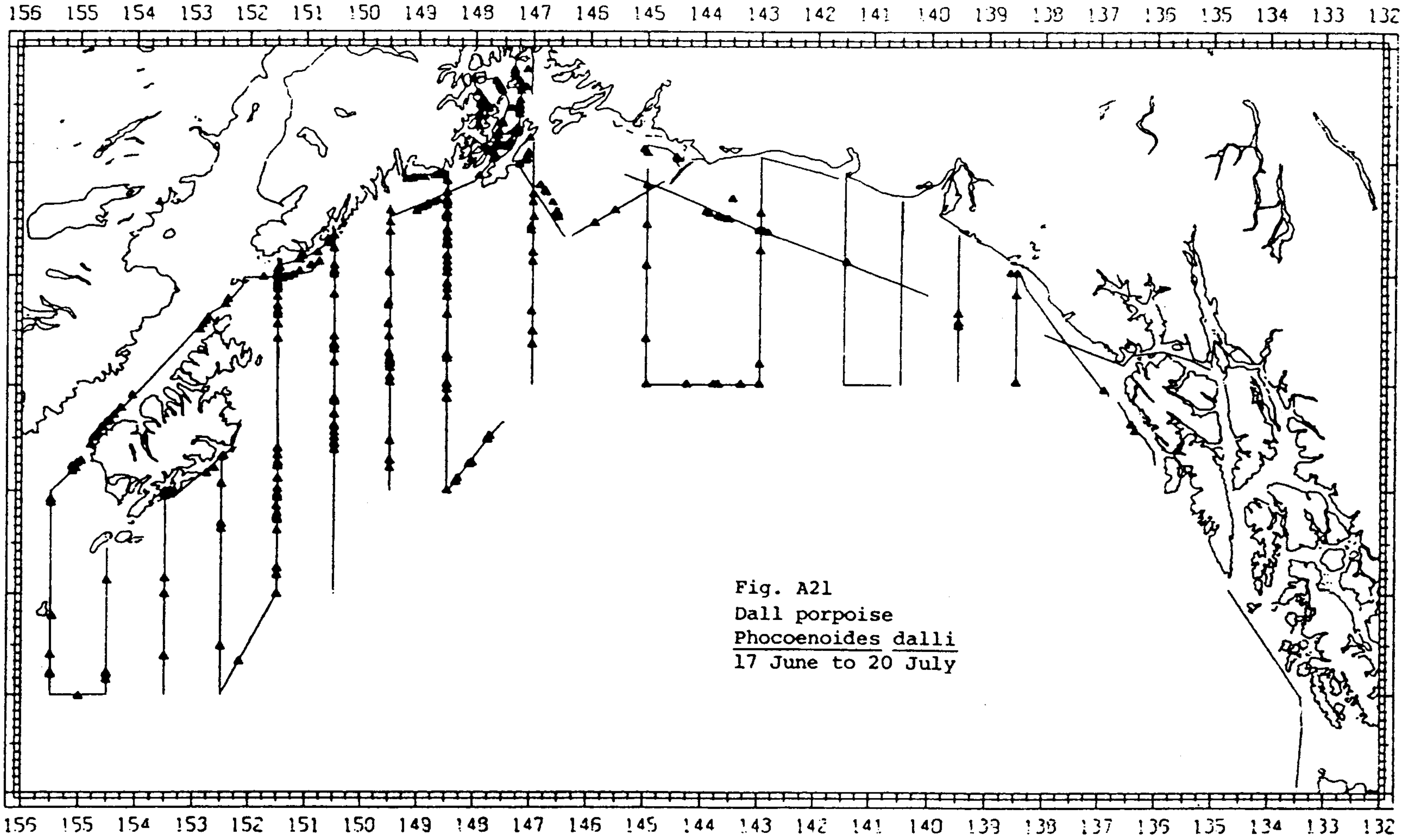


Fig. A21
Dall porpoise
Phocoenoides dalli
17 June to 20 July

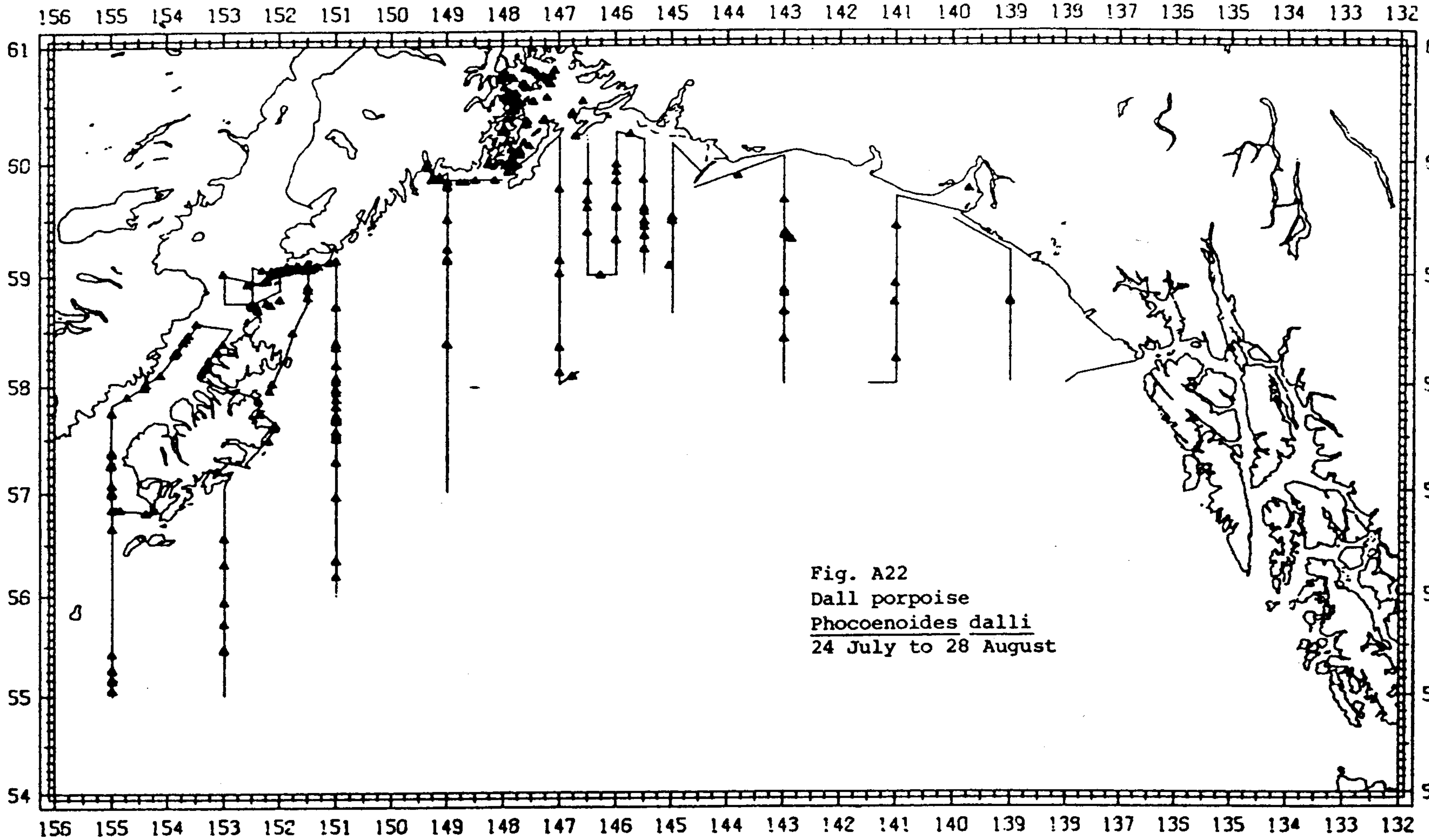


Fig. A22
Dall porpoise
Phocoenoides dalli
24 July to 28 August

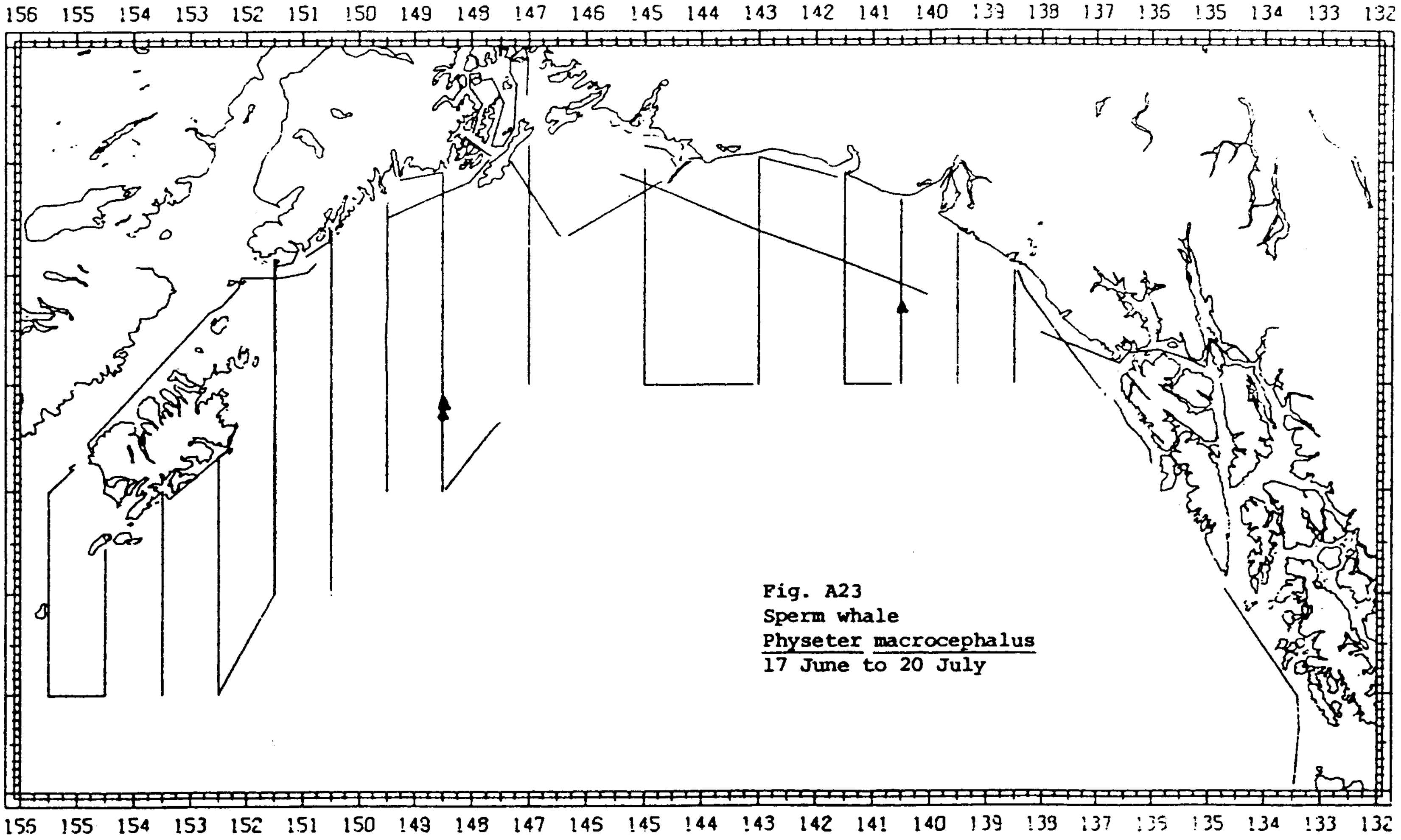


Fig. A23
Sperm whale
Physeter macrocephalus
17 June to 20 July

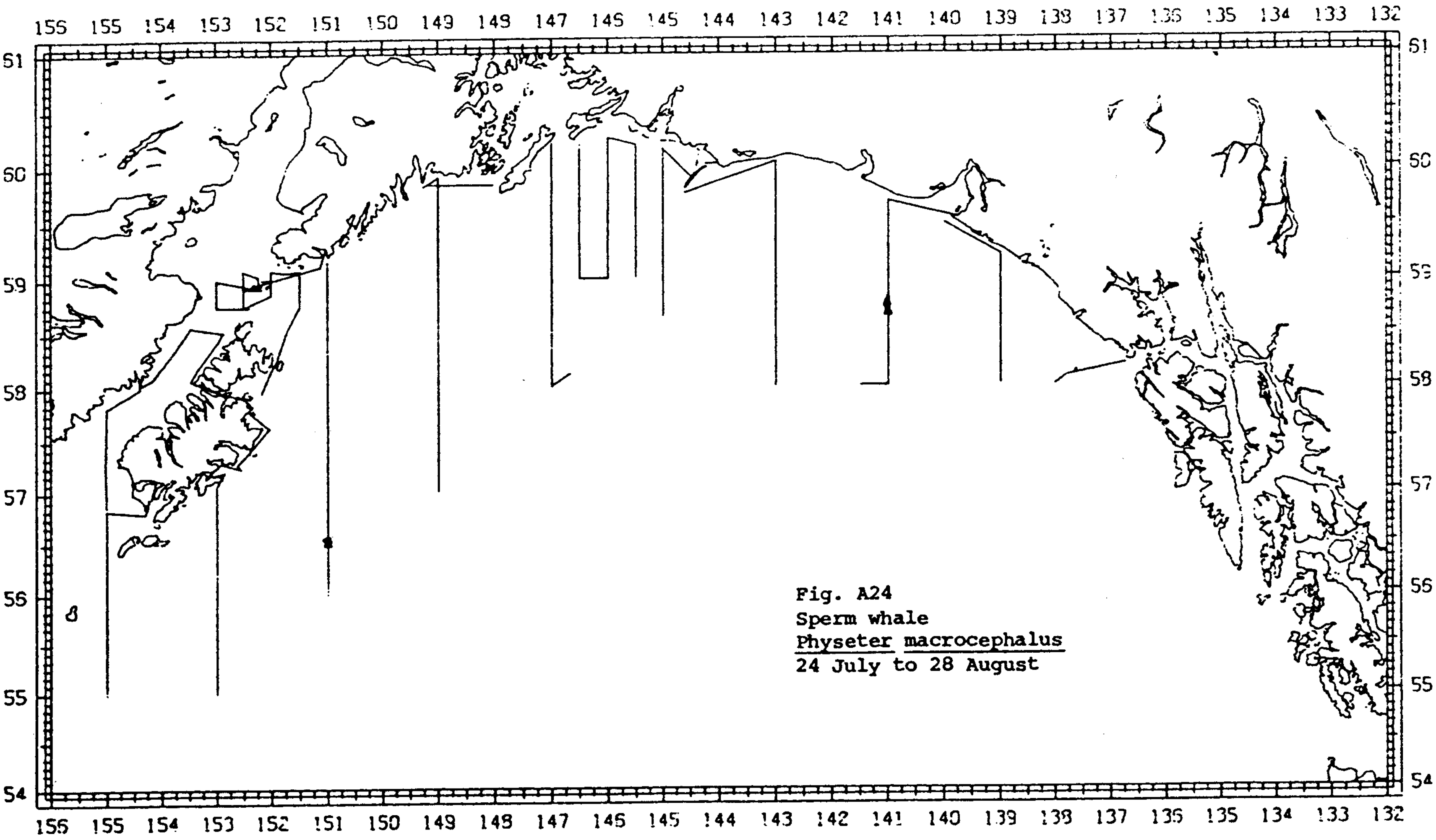


Fig. A24
Sperm whale
Physeter macrocephalus
24 July to 28 August

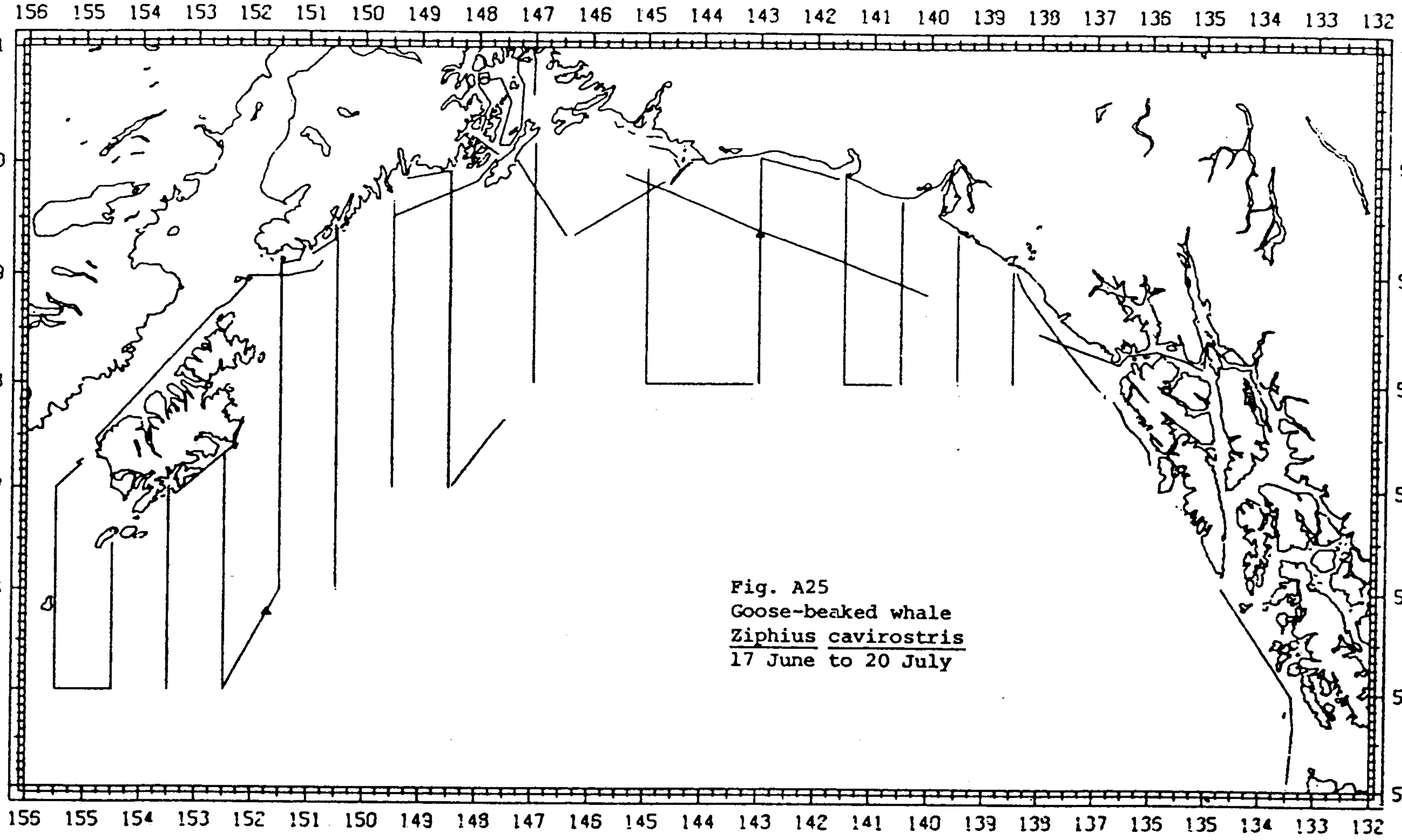


Fig. A25
Goose-beaked whale
Ziphius cavirostris
17 June to 20 July

GRAY WHALE (<u>ESCHRICHTIUS</u> <u>ROBUSTUS</u>) MIGRATION INTO THE BERING SEA OBSERVED FROM CAPE SARICHEF, UNIMAK ISLAND, ALASKA

SPRING, 1981

by

Pauline Hessing

P.O. Box 81237
College, Alaska 99708

Final Report
Outer Continental Shelf Environmental Assessment Program
Contract Number NA 81RGA 00080

June 1981

GRAY WHALE (ESCHRICHTIUS ROBUSTUS) MIGRATION INTO THE BERING SEA OBSERVED FROM CAPE SARICHEF, UNIMAK ISLAND, ALASKA SPRING, 1981

by Pauline Hessing

INTRODUCTION

With petroleum exploration and exploitation in the Bering Sea planned for the immediate future, it is imperative that physical and biological parameters of the area be accurately assessed prior to any development. Gray whales (*Eschrichtius robustus*) migrate into and out of the Bering Sea annually as they swim from breeding lagoons in Baja, Mexico, to feeding grounds in the Bering and Chukchi seas. Their observed use of a coastal migratory route, as well as their benthic feeding habits, make them an important species to be monitored. The gray whale passes near two of the three lease areas in the southern Bering Sea, i.e., St. George Basin and the North Aleutian Shelf, making the study of current productivity of the population critical. Also, little quantitative data have been collected to date on the migratory timing and offshore distribution in Unimak Pass during the spring.

It was formerly hypothesized that gray whales passed from the Pacific Ocean into the Bering Sea in the western Aleutians (Gilmore 1960). This theory was superceded by direct evidence collected by Braham (1977), Hall et al. (1977), and Rugh and Braham (1979) showing that Unimak Pass, on the western side of Unimak Island, is the route used. A shore-based census was taken at Cape Sarichef, Unimak Island, Alaska from 23 March to 17 June 1981, in order to augment the existing information about the spring migration of gray whale censuses (Rugh, in prep.), and one spring census (Hall et al. 1977). In all of the studies except for the 1979 fall census, the early and late portions of the migration were unobserved. Because cows and calves are the last to leave the breeding lagoons for the north (Rice and Wolman 1971), it was hoped that by extending the census season beyond what it was in 1977, a better estimate of recruitment to the population might be obtained. Emphasis was also given to recording the offshore distribution of whales. There are no reliable records of any California gray whales sighted west of Unimak Pass. Several aerial surveys were flown in this area as well as along the Alaska Peninsula coast during the migration to compare distribution of whales both near and offshore.

STUDY AREA

The physical location of Cape Sarichef is such that it might be considered the northeastern gatepost of Unimak Pass. It has been previously described by Rugh and Braham (1979). For the past four censuses, Cape Sarichef was used not only because of the excellent vantage point it offered for viewing whales, but also because the U.S. Coast Guard formerly maintained an active LORAN station there and could offer logistical support. Responsibility for the facility passed to the U.S. Fish and Wildlife Service in 1979, and it was subsequently closed in 1980. Except for shelter, the station offers no amenities at the present time.

The Aleutian Islands are well known for their mercurial weather. Censusing was done in conditions which ranged from hail and sleet to calm, sunny days. A box was constructed which afforded some shelter from the elements in inclement weather. The low temperature recorded during the census was -2° C on 2 May. The high temperature was 18° C on 8 June. Wind speeds reached 60 km/h on several occasions. Higher winds than this occurred during the course of the study, but not while a watch was underway. A total of 12.9 cm of precipitation fell as rain, sleet, hail, and snow from 5 April to 17 June.

METHODS

From 23 March to 17 June 1981, single-person watches were maintained west of the Coast Guard station, on a bluff-edge 50 m above sea level. The presence of a second observer from 15 April until 13 May made two-person watches possible for part of the time, as well as increasing the amount of daily census time. In an attempt to census all daylight hours during the census period, watches were scheduled when weather, light, and observer fatigue allowed, beginning as early as 0500 and lasting as late as 2300, Alaska Daylight Time. Environmental conditions were noted at the beginning and end of each watch, as well as during the watch when changes occurred. Visibility was ranked in five categories ranging from excellent to poor. Watches were cancelled during the latter.

Census methods were similar to those described by Rugh (in prep.). Whales were counted as they passed an imaginary line perpendicular to the observer. The angle from the observer to the whale was measured with a hand-held inclinometer for later translation into distance offshore. In optimal viewing conditions, visibility extended to nearly 4 km offshore. However, had whales been sighted at this distance, it is questionable whether they would have been identifiable as to species. Other data collected included time, pod size, direction of travel, and unusual or non-migratory behavior. Whales were subjectively sized when possible as large, medium, small, or calf. Dive profiles were taken opportunistically. Other marine mammals were recorded as time allowed, with special attention given to their interactions with gray whales. To avoid overcounting whales, binoculars were used to identify individuals by noting unusual scarring, arrangements of barnacles, and unique skin colorations. Binoculars were rarely used otherwise, except for the clarification of behavioral observations.

Walks were taken on beaches within a 8-km radius of Cape Sarichef in order to search for beached marine mammals. Bird and mammal observations were made when expedient and archived on sighting cards for the U.S. Fish and Wildlife Service office in Cold Bay, Alaska. The card file in the office was searched for sighting records of gray whales.

Four aerial surveys were flown during the study, approximately one month apart. Information recorded during aerial surveys included altitude and air speed of aircraft, and visibility, species, direction headed, and behavior observed of whales sighted. When flying conditions allowed, distance offshore was measured using a hand-held inclinometer. Flights ranged in altitude from 225 m to 366 m. Coastal surveys followed the shoreline out to approximately 1 km. Offshore surveys included transects up to 25 km from shore. Both pilot and observer searched for whales. The observer also acted as recorder. A Grumman Goose was used for offshore transects, while coastal surveys were flown in the Goose or a Piper Cherokee.

RESULTS AND DISCUSSION

Census

Migrating gray whales were censused for a total of 87 days, from 2 to 10 hours a day. The mean time censused for the entire period was 6.2 hours per day, for a total of 533.6 hours censused. Observations were made by one person except for 10.9 hours of two-person watches. Visibility was categorized as excellent 19% of the time, very good for 34%, good for 37%, and fair for 10%.

At the end of each census day, the number of whales observed crossing the azimuth and swimming from north to south was subtracted from the northbound whales to correct for course deviations. The observer assumed that all whales seen went north ultimately, and that the course deviations at this time were of a temporary nature. The average hourly rate of passage during a day was calculated and then multiplied by 24 in order to obtain a daily estimation of gray whale migration, as shown in Figure 1. No allowances were made for the potential effects of tidal fluctuations or currents on the timing and rate of whales swimming past Cape Sarichef.

A total of 3,851 northbound gray whales was counted, with 477 more conditional sightings. Conditional status was assigned to whales in instances where the observer was uncertain as to the exact number of whales passing the azimuth at a given time. Subtracting 217 to 234 southbound whales from these numbers gives a low count of 3,617 and a high count of 4,111 gray whales swimming north past Cape Sarichef. Interpolating for uncounted periods, the cumulative count for calculated northbound gray whales was 14,346 by the end of the census. This seems to be a reasonable comparison with prior population estimates of about 15,000 (Rugh and Braham 1979) leaving the Bering Sea in 1977, and 16,511 counted from California in the winter of 1978-79 (Reilly et al. 1980). A more refined estimate of 17,000 gray whales in the population (Rugh, in prep.) compares less favorably, but differences may be ascribed in part to the difficulties of single-person watches for an extended period of time, as well as to the analytical methods used.

The highest number of whales estimated for a 24-hour period was on 27 April, when 478 were calculated to have passed. Although this was considered the peak day, high rates were recorded from 21 April to 2 May. The migration peak recorded by the study in 1977 (Taber 1977) was 3 days later, on 30 April. These data also show a "high week" during a similar span of time.

Course Deviations

During the course of the census, a total of 217 whales were counted swimming south, with an additional 17 conditional sightings. In contrast with the 1977 spring census, the majority of the southbound whales were seen during the first week of the census, rather than near the peak of the migration, as observed by Taber (1977). The 1977 study began at a later date so no direct comparison is possible. It would be interesting to know whether these early deviations are a yearly occurrence or whether they are related to weather.

Throughout the census, but particularly during the first 3 weeks, loitering whales were seen off Sea Lion Rocks, 1.5 km south of Cape Sarichef, where they were frequently breaching, tail-lobbing, and milling. During aerial surveys, whales were sometimes seen loitering

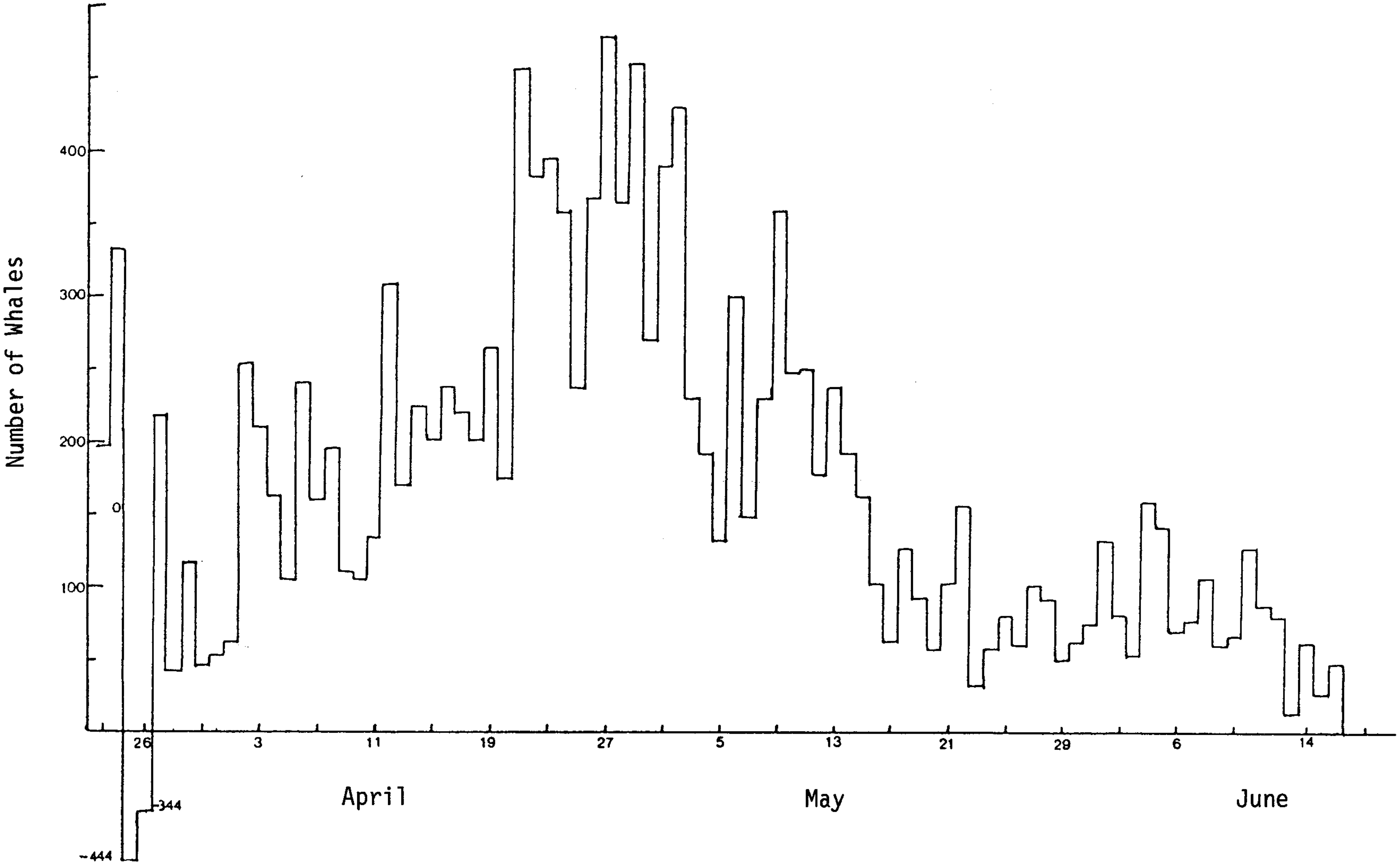


Figure 1.--Mean daily whale passage, Cape Sarichef, Alaska during the spring of 1981.

Table 1.--Daily whale passage past Cape Sarichef, Unimak Island, Alaska during the spring of 1981. Conditional sightings not included.

Date	Hours observed	Northbound whales	Southbound whales	$\bar{X}$ Northbound whales/ 24 hours
March 23	2.0	27	10	198.0
24	5.0	90	21	333.6
25	2.0	19	53	-444.0
26	3.0	21	63	-344.0
27	5.0	77	34	218.4
28	5.0	19	11	40.8
29	5.0	24	0	117.6
30	5.5	12	1	45.8
31	3.0	6	0	52.0
April 1	5.5	14	0	63.3
2	6.0	62	0	254.0
3	6.0	51	0	210.0
4	6.0	43	3	164.0
5	6.0	26	0	106.0
6	6.0	58	0	240.0
7	6.0	41	2	160.0
8	9.0	75	2	196.0
9	6.0	30	2	110.0
10	5.0	28	6	105.6
11	6.0	33	1	134.0
12	6.0	73	0	308.0
13	6.0	40	1	172.0
14	3.0	26	0	228.0
15	6.0	51	3	202.0
16	8.0	76	2	237.0
17	6.0	54	0	222.0
18	8.0	63	0	202.5
19	6.0	61	0	266.4
20	8.0	54	0	175.5
21	6.0	105	0	454.0
22	8.0	123	0	384.0
23	6.0	93	0	394.0
24	8.0	112	0	357.0
25	5.0	45	0	237.6
26	6.0	80	0	368.0
27	6.0	111	0	478.0
28	6.0	82	0	364.0
29	5.75	101	0	461.2
30	3.0	30	0	272.0
May 1	6.0	88	0	390.0
2	6.0	101	0	430.0
3	5.33	47	0	231.8
4	6.5	51	0	193.8
5	9.0	47	0	133.3
6	9.5	113	0	300.6

Table 1.--(continued)

Date	Hours observed	Northbound whales	Southbound whales	$\bar{X}$ Northbound whales/ 24 hours
May 7	9.0	52	0	149.3
8	9.0	80	0	230.7
9	7.0	99	1	358.3
10	10.0	95	0	247.2
11	5.5	54	0	250.9
12	8.5	58	0	177.9
13	8.0	73	0	237.0
14	6.0	46	0	194.0
15	6.0	38	0	164.0
16	6.0	24	0	102.0
17	6.0	14	0	64.0
18	6.5	32	0	129.2
19	7.0	24	0	92.6
20	6.5	14	0	59.1
21	6.0	24	0	104.0
22	4.0	24	0	156.0
23	7.0	10	0	34.3
24	6.5	15	0	59.1
25	6.0	20	0	80.0
26	7.0	17	0	61.7
27	7.0	28	0	101.1
28	6.0	22	0	92.0
29	6.0	12	0	50.0
30	7.0	18	0	63.4
31	8.0	24	0	76.5
June 1	6.0	32	0	134.0
2	3.0	10	0	80.0
3	7.0	15	0	54.9
4	8.0	50	0	159.0
5	7.0	39	0	140.6
6	6.0	17	0	72.0
7	7.0	23	0	78.9
8	7.0	31	0	109.7
9	6.0	14	1	60.0
10	6.0	16	0	66.0
11	6.0	31	0	128.0
12	7.0	22	0	77.1
13	9.0	29	0	80.0
14	4.0	2	0	12.0
15	5.0	12	0	62.4
16	4.0	4	0	27.0
17	2.0	4	0	48.0

off other significant coastal points. Perhaps these and Sea Lion Rocks are rendezvous areas where the migrating whales regroup before continuing north (G. Oliver, pers. commun.). This behavior might be an artifact of the navigational efforts. That is, perhaps the route must be re-explored each season by northbound whales. Breaching and spyhopping may be aids to navigation (Taber 1977), as well as serving to communicate.

Distribution

Distribution of whales offshore was calculated by changing the degrees below the horizon shown by the inclinometer into meters. A constant of 174 m was subtracted from all values to correct for a rock jetty. The mean tidal range at Cape Sarichef, slightly over 1 m (U.S. Department of Commerce 1980), did not affect the calculated distance offshore significantly. During periods of high surf (surf from 2 to 6 m), no distribution analysis was done, because it was felt that the size of the waves was interfering with the observer's typical search pattern.

Figure 2 shows the distribution offshore of whales passing Cape Sarichef during the census in periods when the surf was less than 2 m. The most dramatic difference occurred between the first 2 and last 3 weeks of the census. Early in the season, northbound whales passed Cape Sarichef further offshore than did later arrivals, 46% of the whales being sighted further than 500 m from shore. These early whales also loitered frequently off Sea Lion Rocks.

During the last 3 weeks of the census, less than 1% of the whales were seen at that distance, whereas 90% of them were within 100 m of the

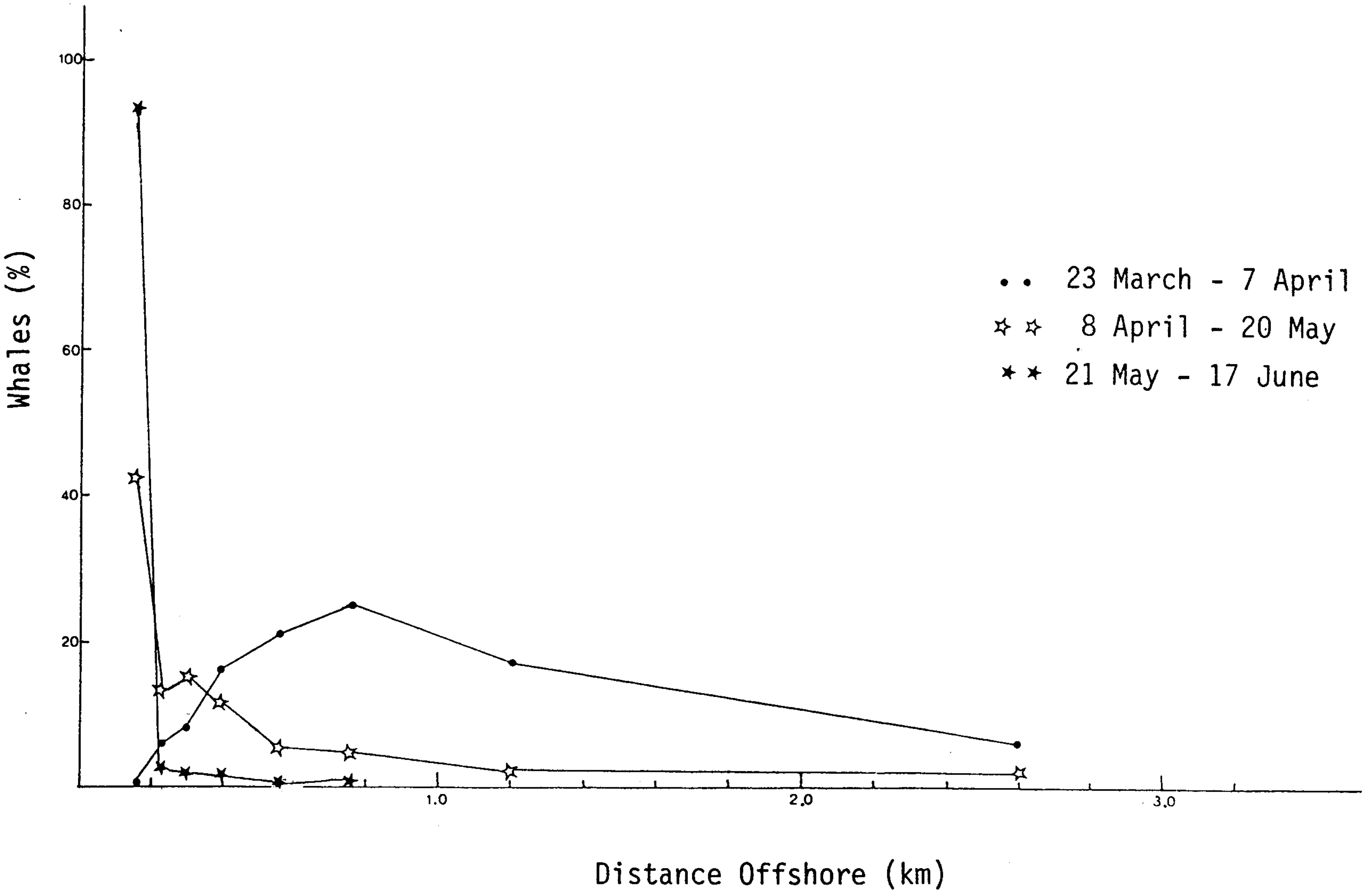


Figure 2.--Offshore distribution of northbound gray whales, Cape Sarichef, Alaska during spring 1981.

offshore rocks. After 21 May, no whales were seen further offshore than 800 m. Whales passing during the period between these two extremes (8 April - 20 May) stayed within 500 m of shore for the most part (95%), although they did not parallel the coastline as closely as the later whales.

This marked difference in distance traveled offshore may be due more to population composition than any other factor. Cow/calf pairs swam within 25 m of shore in the small cove to the south of the census azimuth. It was evident from frequent observations that the pairs either entered this small cove and followed the shore, or swam point to point across the outer edges of the cove. In either case, they were not seen further offshore than 150 m.

Sizing

Both observers found it difficult to consistently size whales, particularly in inclement weather and when whales were passing singly, precluding comparison for size with other whales. Table 2 summarizes the size data collected, but does not necessarily reflect the observed trends which are described below.

During the first 2 weeks of the census, from 23 March to 7 April, nearly all whales seen were large. These whales were traveling further offshore than those seen later in the census. As the rate of migration increased, a greater range in size was evident, although it was not quantified.

A second wave of large whales was noticed between 9 and 13 May, especially on the latter day. These whales were several hundred meters further offshore than were others passing during the same period of

Table 2.--Size of whales passing Cape Sarichef, Unimak Island, Alaska during spring 1981.

Census period	Large		Medium		Small		Calf		Total sized	Census total
	%	#	%	#	%	#	%	#		
23 March - 7 April	50	9	39	7	11	2	0	0	18	590
8 April - 22 April	19	3	44	7	37	6	0	0	16	892
23 April - 7 May	37	9	42	10	21	5	0	0	24	1153
8 May - 22 May	51	157	29	91	11	35	9	28	311	699
23 May - 7 June	47	147	15	47	12	38	26	83	315	352
8 June - 17 June	45	56	8	10	2	2	45	56	124	165
Total	47	381	21	172	11	88	21	167	808	3851

time, and were swimming noticeably faster. The timing and size of this wave would make it possible that they were the anestrous females reported by Rice and Wolman (1971), or they may have been whales which lost their calves (Rice, pers. commun.).

Small whales, assumed to be yearlings, were seen throughout the census period, but were more numerous during the latter half of the census. They were frequently seen with at least one large adult.

Calf Count and Calf Behavior

A total of 167 northbound calves was counted after the first one was sighted on 9 May. Calves passing Cape Sarichef prior to 9 May might have been missed due to the difficulty of identifying calves. Taber (1977) stated that observing suckling behavior was his primary means of calf identification. However, perhaps because of the minimal amount of time spent using binoculars, this behavior was not seen during the 1981 census. Calves were usually close to the cows when swimming and generally rose lower when breathing than did the adults. Frequently the water was calm enough to allow the observer to see whales passing the azimuth underwater. When calves swam next to the adults, the most common position was close to the body of the adult behind the flippers. This probably serves to lessen the water resistance for the calf, but it certainly makes distinguishing calves more difficult.

The birth rate previously has been calculated by Rice and Wolman (1971) at 13% of the population per year. The 1977 census (Taber 1977) showed calves well below the expected number. More calves were seen in 1981, presumably because of the extended census period, but the estimated birth rate of 4.6% is still well below Rice and Wolman's figure.

Calculating productivity based on the ratio of censused calves to adults in a direct function of calf visibility and may be misleading. Also, calves were still being sighted when the fieldwork ended, suggesting that calves continue to enter the Bering Sea during the summer. Hatler and Darling (1974) reported seeing calves during the summer near Vancouver Island. There may be other sites between Cape Sarichef and Baja where cows and calves are found in the summer. Without more data concerning the summer distribution of calves, the 167 calves seen passing Cape Sarichef represent an unknown percentage of the recruitment to the population.

Of the 124 single calves seen passing Cape Sarichef, 65% were with a single adult. Pods of two, three, or four adults, and pods of two calves composed 29% of the remainder, with the final 6% being calves who were observed alone. This demonstrates that the majority of calves were observed traveling in close company with a single adult.

On two occasions a pod with a calf entered the small cove south of the bluff, following which the calf was seen "bubbling," a behavior in which large quantities of air are released underwater. Swartz and Cummings (1978) mention that the production of high frequency sounds is related to bubbling in Tursiops truncatus. Possibly the calf was calling to the adult. This behavior was also seen in groups of adults, usually in conjunction with rolling or high fluking.

Feeding

There have been observations of feeding during the southern part of the migration (Sund 1975; Balcom, in Ray and Schevill 1974), but few published observations of feeding during the migration through the southern part of the Bering Sea. Behavior suggesting feeding while migrating was seen on 9 different days during the census. Generally, whales thought to be feeding rose in a characteristically "head high" position. Their mouths were open, and clear water was usually seen streaming through the baleen. Because the sea floor off Cape Sarichef is primarily rocky, any feeding probably occurred near the surface of the water. On one occasion, gulls were seen dipping and diving in the wake of a rising whale.

Two calves were seen diving into, and rising with, kelp in their mouths or draped on their rostrums. They may have been playing, but it was an interesting observation in view of Wellington and Anderson's (1978) observations of a young whale feeding on kelp.

Other Cetacean Sightings

Killer whales (Orcinus orca) were the second most frequently sighted whale during the census. At least 22 were seen, and possibly as many as 26, on a total of 7 census days. The smallest pod was two whales and the largest was five.

On 9 April, one humpback whale (Megaptera novaeangliae) was seen as it swam north. This whale rose two times 300 m from shore and it was not seen again.

Beach Walks

On 22 May, part of the skeleton of a large baleen whale was found at Raven Point, approximately 8 km north of Cape Sarichef. Three vertebrae, the upper jaws, and part of the headplate were lying at the high tide mark. The bones were in good condition and most likely were from the previous fall. Gnaw marks, presumably from fox and bear, were seen on all the bones.

Aerial Surveys

Aerial surveys were flown for a total of 6.3 hours. Funding not only limited the number of aerial surveys flown, but also made it necessary that surveys were flown with only one observer/recorder. In addition, sudden turbulence and rapidly changing weather detracted from the efficacy of the surveys. The findings should be considered a representation of offshore distribution.

Results from coastal surveys are shown in Table 3. Gross representation of timing trends evident in the census data may be seen here. The high number of whales during the first week of the census is reflected in the number seen on a coastal survey en route to Cape Sarichef. Similarly, the peak of the migration occurred shortly after the second aerial survey was flown. Both of the subsequent surveys reflect the lower numbers of migrating whales.

Figure 3 depicts the route followed during the two offshore transects. No whales were sighted further than 1.5 km offshore. During offshore transects no whales were sighted at all, although gray whales were seen along the coastal legs of the same survey. This indicates that gray whales migrate through the eastern part of Unimak Pass.

The final aerial survey of the season was flown from Cape Sarichef to Cold Bay on 18 June. The pilot, Buster Points, stated that while flying to Cape Sarichef he saw at least two white whales (*Delphinaptera leucas*) in False Pass, swimming to the west. Although we flew two

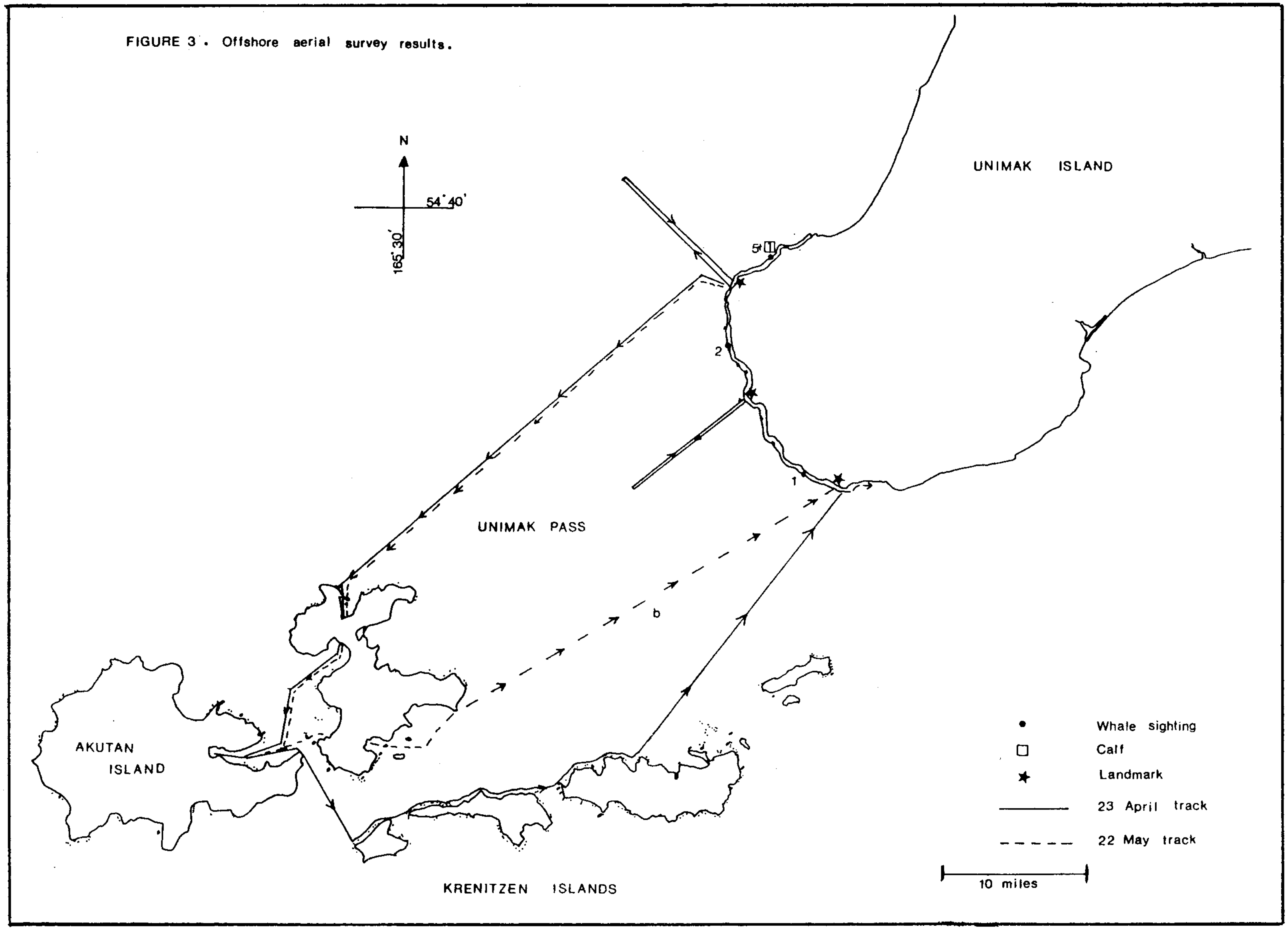
Table 3.--Coastal aerial survey results for gray whales during the spring of 1981. ( ) denotes southbound whale; PC, Piper Cherokee; GG, Grumman Goose; ☐, calf.

Date	Distance flown	Whales sighted	Landmarks
22 March	From Cold Bay south to Cape Sarichef, west side of Unimak Island.		
PC	15	1	Norma Bay - Cape Krenitzen
	10	3	Cape Krenitzen - Swanson Lagoon
	10	3	Swanson Lagoon - Big River
	10	3 + (1)	Big River - Cape Lapin
	10	4 + (1)	Cape Lapin - Urilia Bay
	10	3	Urilia Bay - Oksenof Pt.
	10	3	Oksenof Pt. - Cave Pt.
	10	11	Cave Pt. - Cataract Cove
	10	8	Cataract Cove - Lava Flats
Total	95	39 + (2)	
23 April	From Cape Sarichef west to Akutan, north to Cold Bay along east side of Unimak Island.		
GG	5	2	Cape Sarichef - Lava Flats
	10	4	Scotch Cap - E. Seal Cape
	10	3	Seal Cape - Cape Lutke
	10	2	Cape Lutke - Lava Flow
	10	4	Unimak Bight - Big Delta
	10	3	Unimak Bight (north end)
	10	11	Brown Pk. - Cape Lazaref
	10	2	Cape Lazaref - Otter Cove
	10	0	Otter Cove - Ikatan Bay
	10	0	Ikatan Bay - Bechevin Bay
	10	0	Bechevin Bay - Big Lagoon
Total	110	31	

Table 3.-- (continued)

Date	Distance flown	Whales sighted	Landmarks
22 May	From Cape Sarichef to Akutan to Scotch Cap to Cape Sarichef, along east shore of Unimak Pass.		
GG	5	4	Raven Pt. - Lava Flats
	20	0	Rootok Island - Tigalda Bay
	10	1	Scotch Cap - Sennett Pt.
	10	2	Sennett Point - Cape Sarichef
	10	5 + $\boxed{1}$	Cape Sarichef - Cataract Cove
Total	55	12 + $\boxed{1}$	
18 June	From Cape Sarichef to Cold Bay along Unimak Island, west side.		
PC	10	0	Lava Flats - Cataract Cove
	10	0	Cataract Cove - Cave Pt.
	10	0	Cave Pt. - Oksenof Pt.
	10	1	Oksenof Pt. - Urilia Bay
	10	6 + $\boxed{1}$	Urilia Bay - Cape Lapin
	10	0	Cape Lapin - Big River
	10	1	Big River - Swanson Lagoon
	10	6 + $\boxed{2}$	Swanson Lagoon - Cape Krenitzen
	35	0	False Pass (two transects)
Total	115	14 + $\boxed{3}$	

FIGURE 3. Offshore aerial survey results.



transects over False Pass en route to Cold Bay, we saw no whales in the pass.

CONCLUSION

The mean number of whales observed entering the Bering Sea in the spring of 1981 was calculated at 14,346 from 533.6 hours of observation over a period of 87 days at Cape Sarichef, Alaska. No extrapolations were made for the early and late portions of the census missed, and no variance has been calculated for this figure. The number seems reasonable when compared to other estimates (Reilly et al 1980; Rugh and Braham 1979). The main peak of the migration occurred on 27 April. Slightly less than half of the northbound whales counted had passed by this data. By the end of the census, the rate of passage had slowed to 1-2 whales per hour.

All whales sighted both during land-based and aerial surveys, were within 3.0 km of shore. Early in the census, larger whales were seen further offshore than later. This may be due to navigatory behavior, to population composition, or to sea state.

A total of 167 calves was counted. The low number indicates that the calf migration started late and continued into the summer after this study terminated. Difficulties involved in calf identification also suggest that this number is a minimum figure of recruitment into the population.

Several instances of probable feeding by adults were observed. No prey items were collected or identified. Gulls were seen feeding on what were likely the same items.

Although there are little data concerning the direct effects of oil spills on cetaceans, petroleum-related development may affect gray whales in several ways. Increasing noise may alter their migratory habits (Nishiwaki and Sasao 1977). Human harassment of California gray whales is significant off California and Mexico. With the current public interest in whales, this no doubt well-intentioned harassment may not abate in the near future. Geraci and St. Aubin (1980) have suggested that impaired metabolism may result from direct contact with oil by cetaceans. In addition to the direct effects of petroleum development on whales, there are also the indirect effects. These human-related disturbances are capable of changing the food supply quantitatively or qualitatively. Given the current state of knowledge, the results of such changes are unpredictable.

Despite the obvious restraints posed by a limited budget and a small-scale project, this study served to support prior work done on gray whale numbers and offshore distribution during migration into and out of the Bering Sea. As is inevitable, further research needs are evident. Several suggestions follow.

RECOMMENDATIONS

(1) Of high priority is a systematic, extensive survey of Unimak Pass for marine mammals and cetaceans. This pass is the major gateway into the Bering Sea for a variety of whales (Berzin and Rovnin 1966), yet little is known about the timing and numbers for most of the species involved. Extensive shipboard and aerial surveys during the spring would help to pinpoint critical migration dates. In the coming years, Unimak Pass will probably see increasingly heavy tanker and other

commercial traffic. It is important to have a solid data base and a systematic plan of study implemented in order to assess all phases of development accurately.

(2) Use of Nelson Lagoon and False Pass by gray and other whales has been reported by fishermen and residents of the area. Petroleum-related development may affect these areas directly or may impact them indirectly through deterioration of food resources due to oil spills or other human-related activities. A survey of use of coastal lagoons and coves by cetaceans and marine mammals is important for delineation of the vulnerability of local, seasonal, and permanent populations.

(3) At least one complete migratory cycle should be observed from Cape Sarichef. A study from one spring to spring of the following year would cover present gaps in knowledge. No gray whale surveys have been made during January and February in this area (R. Rugh, pers. commun.), and early dates of migration past Cape Sarichef in the spring are inexact. Conceivably, censusing could be done during the recorded census times. A minimum land-based effort could continue through the year at Cape Sarichef, with coastal surveys for gray whales, stranding searches, and observations of other marine mammals done at planned intervals.

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BOWHEAD WHALE (BALAENA MYSTICETUS) MIGRATION, DISTRIBUTION, AND ABUNDANCE IN THE BERING, CHUKCHI, AND BEAUFORT SEAS, 1975-1978, WITH NOTES ON THE DISTRIBUTION AND LIFE HISTORY OF WHITE WHALES (DELPHINAPTERUS LEUCAS)

by

Howard W. Braham, Bruce D. Krogman, and Geoffrey Carroll

National Marine Fisheries Service
Northwest and Alaska Fisheries Center
National Marine Mammal Laboratory
7600 Sand Point Way NE
Seattle, Washington 98115

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PREFACE

This final report for OCSEAP Research Unit 69/70 is for the period September 1975 to March 1978. Because a great deal of additional research has been conducted since 1978, as part of an expanded National Marine Fisheries program, we felt it important to update our original final report submitted to OCSEAP in September 1979 in order to reflect some new data, clarify past statements, and in general provide more timely information for managers.

This report is not comprehensive because our OCSEAP research was general in scope and was funded at too low a level to provide complete coverage over the entire study area. Most of the new information added to this report came from other programs supported by the NMFS from 1978-1981 (c.f. Braham et al. 1980e).

Some of the recommended research we propose in this report, dating back to 1978, have been undertaken through the U.S. Bureau of Land Management. Again, we do not claim to have covered the breadth and depth of this topic, and recognize that much more systematic work is needed on both species.

ABSTRACT

From September 1975 to September 1977 we conducted field research on bowhead (Balaena mysticetus) and white (Delphinapterus leucas) whales in the U.S. Bering, Chukchi and Beaufort Seas. The objectives were to determine the general distribution and migration of these whales in spring and autumn and to estimate abundance. We also surveyed the literature beginning in June 1975 through March 1978 to augment our empirical results.

Bowhead and white whales spend the winter months among the pack ice and open water of the central and western Bering Sea. They migrate into the eastern Chukchi Sea and across the southern and central Beaufort Sea from April through June. Their route takes them up the west side of the northern Bering Sea through the Bering Strait, along the northwest coast of Alaska between Point Hope to Point Barrow, generally within 50 km of shore (closer to Point Barrow than off Point Hope and Cape Lisburne), and offshore in the Beaufort Sea generally to 60 km of the coast. Exceptions exist, and these are pointed out in the text.

It appears that the entire bowhead migration follows this migration pattern; however, white whales may be divided into groups (or stocks) of varying size, some occurring in Bristol Bay, Norton Sound, Kotzebue Sound, and along the northwest coast of Alaska during summer. The largest component of the white whale population migrates into the Canadian Beaufort Sea in spring at roughly the same time as the bowheads. Autumn migration results were not obtained, generally, for either species.

The 1978 best estimate of the size of the bowhead population was 1,800 to 2,900 individuals, and for the white whales occurring in Alaskan waters between 8,000 and 16,000 individuals.

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INTRODUCTION

In 1975 the Outer Continental Shelf Environmental Assessment Program (OCSEAP) Office awarded a contract to the Marine Mammal Division (now the National Marine Mammal Laboratory) of the Northwest and Alaska Fisheries Center, NMFS, to study the bowhead whale (Balaena mysticetus) and white whale (Delphinapterus leucas) in the Bering, Chukchi, and Beaufort Seas. The objectives were to summarize the current state of knowledge on each population, define migration routes and timing, and make an estimate of population size from original field research and a review of the literature. Field research was funded from September 1975 to September 1977.

This report is the final of two reports written under OCSEAP contract number R7120807, research unit 69/70. Braham and Krogman (1977)1/ covered our first full year's research, 1976. All significant research findings, including those already reported on in our other OCSEAP reports, are incorporated into this report. This document is an update of the final report submitted to OCSEAP in September 1979.

During the course of our field research information was acquired regarding spring movements of whales from St. Lawrence Island to Point Barrow. Research on bowhead and white whale distribution south of St. Lawrence Island was not extensive, nor was much information found in the literature. Also, our understanding of distribution in the Beaufort Sea was fragmentary, coming from scant data from our research, from Eskimo informants, and from early commercial whaling accounts. At the time this contract was active, site-specific oil lease areas were not known. Therefore, our research was directed only at a general understanding of these species.

In 1978, the National Marine Fisheries Service expanded its research on bowhead whales, with the principal objectives of determining population size and obtaining information on life history parameters. Data acquired during the 1978 and 1979 field season are reported in Braham et al. (1979, 1980a, 1980b). Further analyses, and reports, are continuing. Where applicable, information from these papers is presented here.

The bowhead whale is the most depleted marine mammal occurring exclusively in Arctic and sub-Arctic waters of the Northern Hemisphere. It is also the only depleted endangered species annually harvested. Under the Endangered Species Act of 1973, no human activities of any kind can take place which are likely to jeopardize the continuing existence of a species or population. Proposed OCS development for oil and gas in the Beaufort, Chukchi, and Bering Sea include habitat essential for the survival of this population.

1/ Braham, H. W., and B. D. Krogman. 1977. Population biology of the bowhead (Balaena mysticetus) and beluga (Delphinapterus leucas) whales in the Bering, Chukchi and Beaufort Seas. Processed rep., 29 p. Natl. Mar. Mammal Lab., Northwest and Alaska Fish. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, Wash. 98115.

Results presented in this report represent the first research funded by a U.S. Federal agency to provide baseline information on the endangered bowhead whale in relation to proposed OCS development.

STUDY AREA AND DATA SOURCES

STUDY AREA

The study area included the eastern Bering Sea, the Chukchi Sea east of the USA-USSR 1867 Convention line, and the Beaufort Sea to the U.S.-Canadian border at long 141°W.

Sea ice covering the Chukchi Sea begins to advance south in early October from its most northerly limit near lat 72°-74°N and extends well into the Bering Sea through June during average ice years (Shapiro and Burns 1975). Sea ice is present winter and spring over most of the intercontinental shelf of the northern and eastern Bering Sea and occurs infrequently in the southwestern Bering Sea. With the progression of winter, landfast ice develops most extensively in bays and inlets that are protected from the shearing forces of mobile drift (sea) ice. Landfast ice increases outward from shore to the 12-30 m depth contour. Along the northwest coast of Alaska from Point Hope to Point Barrow in spring, a persistent flaw or transition zone occurs between the landfast ice and pack ice where open water often is found. These open water pathways are called leads when they are long and thin; when the openings are persistent and lake-like, they are called polynyas. The importance of polynyas has recently been summarized by Stirling (1980). It is this transition zone which is used by migrating bowhead and white whales. The transition zone may exceed 50 km in width near Cape Lisburne and Point Hope during some years (Pers. obs.; Burns et al. 1977)2/; east of Point Barrow into the Beaufort Sea the zone occurs farther offshore (Marko 1975).

Shelf waters of the Beaufort Sea are typically ice-free from late July to September or early October, but northerly winds may keep or blow the pack ice near or against the coastline at any time (Blood 1977)3/.

2/ Burns, J. J., L. H. Shapiro, and F. H. Fay. 1977. In Environmental assessment of the Alaskan continental shelf, annual reports of principal investigators for the year ending March 1977, Vol. 1, Receptors - mammals, Unpubl. rep., p. 503-554. U.S. Dep. Commer., Natl. Oceanic Atmos. Admin., Environ. Res. Lab., Boulder, Colo.

3/ Blood, D. A. 1977. Birds and marine mammals: the Beaufort Sea and the search for oil. Unpubl. rep., 12 p. Beaufort Sea Project, Dep. Fish. Environ., Can.

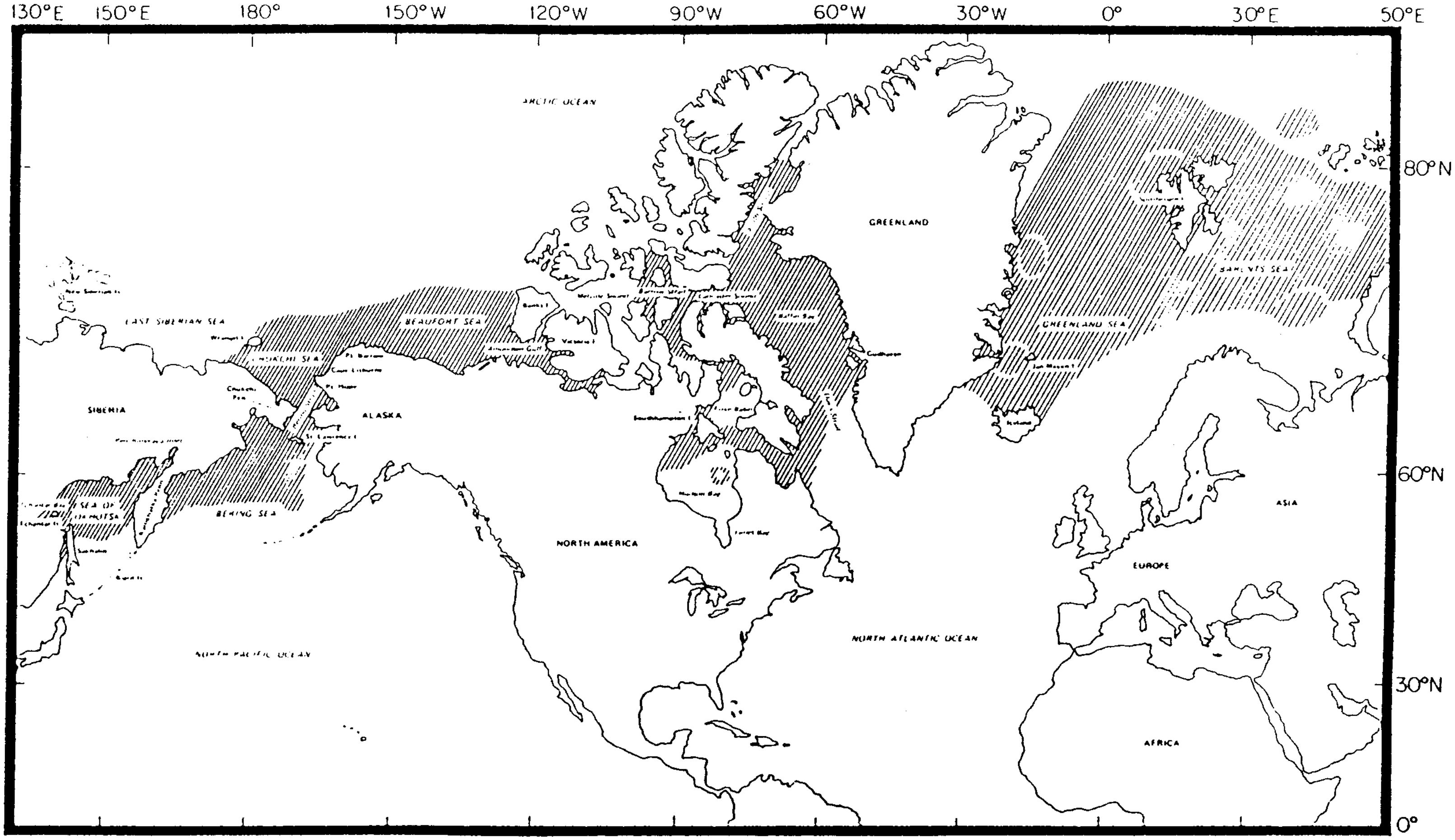

Figure 1.--Approximate world distribution of bowhead whales prior to commercial exploitation.

DATA SOURCES

Aerial surveys were used to study the spatial distribution of bowhead and white whales throughout the Bering, Chukchi, and Beaufort Seas. Data collected during these surveys have been digitized, stored in the National Marine Mammal Laboratory computer file library (Appendix I), and submitted to the Environmental Data Service (EDS), NOAA.

Spring migration and temporal distribution of bowhead and white whales along the northwest coast of Alaska was studied from ice and land stations near Point Barrow, Cape Lisburne, and Point Hope. As data collected at these field sites during 1976 and 1977 were analyzed by hand (not digitized for computer analysis), they were not submitted to EDS.

METHODS AND MATERIALS

ICE AND LAND CAMPS

During the spring migration, counts of bowhead and white whales were maintained on a 24-hour basis as conditions allowed at the following localities: fast ice edge near Point Barrow (25 April-2 June 1976 and 19 April-3 June 1977); cliffs at Cape Lisburne (6-15 May 1977); and fast-ice edge off Point Hope (18 April-28 May 1977). One or two observers stood 4-hr watches.

As whales moved past observers, the following information was scored: number of animals; direction of travel; general behavior; weather conditions; time of day; and, when possible, length of time animals(s) spent at the surface and duration of dive.

In 1978, an upgraded counting effort was conducted at Point Barrow, Alaska, utilizing two counting stations (Braham et al. 1979). The camps, called South Camp and North Camp, worked in conjunction with each other, 15 April-5 June. South Camp observers made the primary counts and, through radio communication to North Camp, North Camp observers evaluated South Camp's results. The watch schedule during 1978 was two observers per shift rotating each 3 hr. Complete documentation of current ice camp counting methodology and theory is reported in Krogman et al. (1979a);4/ Krogman (1980). In addition to the Barrow counts, counting was conducted at Cape Lisburne 2 April-7 June 1978.

4/ Krogman, B. D., R. M. Sonntag, H. W. Braham, S. Savage, and G. W. Priebe. 1979a. Arctic Whale Task ice camp survey format 1979 version. Unpubl. manuscr., 60 p. Natl. Mar. Mammal Lab., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, Wash. 98115.

AERIAL SURVEY

Aerial survey procedures were designed to delineate nearshore and offshore distribution of whales frequently over pack ice conditions. We flew the aircraft over open water--the leads or polynya--at elevations of 70-300m depending upon cloud cover. Data collected on bowheads and white whales during OCSEAP studies RU 14 (Krogman et al. 1979b)[5/] and RU 67 (Braham et al. 1977[6/]; Braham et al. In prep.[7/]) are included in this report. Aerial survey methodology for RUs 14 and 67 differed in the placement of flight tracks in that for those studies (walruses and seals) tracks were flown as straight lines irrespective of sea ice coverage. Because this report presents aerial survey results by showing only tracklines and geographic positions of sightings, the two methodologies of aerial survey (systematic flying over open water versus straight tracklines) are analytically equivalent although no estimate of abundance is generated from either method. Aerial surveys were not flown to make estimates of bowhead abundance. This method was determined to be impractical (experimentally) and too costly.

Four aircraft types were used during the surveys for whale distribution: a single engine Cessna[8/] from Cape Smythe Air Service, Barrow, Alaska; a twin-engine Grumman Otter chartered from the Naval Arctic Research Laboratory, Barrow, or Cape Smythe Air Service; a twin-engine Grumman Goose (N780) and a Lockheed P-2V (N48347) both chartered from the Office of Aircraft Services, U.S. Fish and Wildlife Service, Anchorage, Alaska. Depending on the aircraft used, one to five observers were used; the usual crew of two observers, one recorder, and one person resting aft rotated hourly to reduce observer fatigue. For the study period 1976-1978, the Grumman Goose was by far the more frequently used aircraft.

[5/] Krogman, B. D., H. W. Braham, R. M. Sonntag, and R. G. Punsly. 1979b. Early spring distribution, density and abundance of the Pacific walrus (Odobenus rosmarus) in 1976. Unpubl. rep. 47 p. Natl. Mar. Mammal Lab., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, Wash. 98115.

[6/] Braham, H. W., R. D. Everitt, B. D. Krogman, D. J. Rugh, and D. E. Withrow. 1977. Marine mammals of the Bering Sea: A preliminary report on distribution and abundance, 1975-76. Processed Rep., 90 p. Natl. Mar. Mammal Lab., Northwest and Alaska Fish. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, Wash. 98115.

[7/] Braham, H., and D. Rugh. In prep. Distribution and relative abundance of marine mammals in the eastern Bering and Chukchi Seas. Unpubl. rep. Natl. Mar. Mammal Lab., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, Wash. 98115.

[8/] Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

Information recorded included species identification; number of adults and/or calves; local time of sightings; geographic position to 1 square nmi obtained from an onboard Global Navigation System-500; perpendicular angular distance from aircraft to animal(s) taken with an optical reading clinometer (Model PM-5/360 PC, by Suunto Oy of Finland); animal activity; and environmental data on weather, visibility, and ice. Complete documentation of aerial survey methodology used for this research is reported in Krogman et al. (1979c)[9/].

LABORATORY ACTIVITIES

Ice and land camp results are presented by locality by year. Length of season, total number of hours watched, percent of total hours watched, total number of whales counted, and indices to total number of whales passing by the counting camps are presented. Bowhead abundance indices for spring seasons 1976 and 1977 were computed as the sum of the products of rates per day for each day times 24 hr. Histograms showing the daily index are used to illustrate temporal distribution that occurred during each field study. Indices are presented for bowheads only. The temporal distribution of white whales were too clumped to calculate a meaningful index.

Aerial survey results are presented in computer plots showing effort and sighting data. Numerical results accompanying the figures include the total number of adults and immatures observed, average group size, and standard deviation (SD) of average group size. A plot of all tracklines flown in 1976 and 1977 is displayed in Appendix II.

REVIEW OF BOWHEAD STOCKS

Rice (1977) recognized four bowhead whale populations or stocks worldwide: 1) from Spitsbergen west to east Greenland, called the Spitsbergen stock by Tomilin (1957) or Spitsbergen-Barents Sea stock by Jonsgard (University of Oslo, Oslo, Norway, Pers. commun., 7 February 1979); 2) in Hudson Bay, Davis Strait, Baffin Bay, and James Bay, called the West Greenland stock by Tomilin (1957) or Davis Strait stock by the International Whaling Commission (IWC) Committee of Scientific Advisors (IWC 1978); 3) Bering, Chukchi, and Beaufort Seas, called the Bering-Chukchi stock by Tomilin (1957), Bering Sea stock by the IWC (IWC 1978), or the western Arctic population by Durham (1972)[10/] and Bockstoce (1977);

[9/] Krogman, B. D., R. M. Sonntag, and H. W. Braham. 1979c. Arctic Whale Task aerial survey format 1979 version. Unpubl. manuscr., 30 p. Natl. Mar. Mammal Lab., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, Wash. 98115.

[10/] Durham, F. E. 1972. Biology of the bowhead whale (Balaena mysticetus L.) in the western Arctic. Unpubl. manuscr., 93 p. Univ. Southern Calif., Dep. Biol., Los Angeles, Calif. 90500.

and 4) in the Sea of Okhotsk. Mitchell (1975) recognized five stocks, treating the Hudson Bay population as isolated from the West Greenland stock. Figure 1 is an overview of the species distribution prior to commercial exploitation.

Commercial whaling severaly reduced the Spitsbergen stock during the 17th century, the West Greenland stock during the 18th century, and the western Arctic-Bering Sea and Okhotsk Sea stocks during the 19th century (Tomilin 1957; Braham and Krogman[1/]; Bockstoce 1978[11/]).

SPITSBERGEN-BARENTS SEA STOCK

Bowheads from this stock apparently wintered south of the area bounded by the eastern coast of Greenland, Iceland, and Jan Mayen I., to Spitsbergen (Tomilin 1957). Their northeasterly spring movement was associated with the recession of the ice front, with some whales arriving at Spitsbergen in April (Clark 1943). By early summer, most of the population was found between Greenland, Spitsbergen, and the Barents Sea, with some animals occurring south along the coast of Greenland when sea coverage was extensive (Vibe 1967). A southerly migration was made during autumn along the Greenland coast and open winter areas of the coast. From an initial population estimated at 25,000 (IWC 1978), the Spitsbergen-Barents Sea stock underwent a gross reduction in size as a result of intensive commercial exploitation (Vibe 1967). This stock is now considered to be extinct or nearly so (A. Jonsgard, Pers. commun., 7 February 1979; Jonsgard 1981). Reeves (1980) recently completed a review of the stock.

WEST GREENLAND OR DAVIS STRAIT STOCK

Recent information on the seasonal distribution of bowheads in this stock is lacking. However they apparently winter in southern Davis Strait from Godhaven southwest to approximately lat 60°00'N. Migration to summering grounds is closely associated with the northerly retreat of the ice front. The summering area and migration routes include northeast Baffin Bay as far north as Smith Sound (Clark 1943), the waters between the islands of the Canadian Arctic Islands and as far west as Barrow Strait (Gilmore 1951), Lancaster Sound, and Prince Regent Inlet (Lubbock 1937). Animals apparently winter in Hudson Strait and southcentral and western Hudson Bay. In summer, animals move to the northwestern part of Hudson Bay and Foxe Basin (Gilmore 1951; Ross 1974). Sex and age segreation within the population was reported by Southwell (1898) to be that older males occurred more often in open water than females and young who were associated with the

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[11/] Bockstoce, J. R. 1978. A preliminary estimate of the reduction of the western Arctic bowhead whale (Balaena mysticetus) population by the pelagic whaling instury: 1848-1915. Unpubl. rep., 33 p. U.S. Mar. Mammal Comm., 1625 I St., N.W., Wash., D.C. 20006.

pack ice front. The initial stock size was estimated at 6,000 and the current level is believed to be 10% of that (IWC 1978). However, since so few animals have been seen this century it seems likely that the present population size is smaller than the 10% estimated (R. Davis, LGL Ltd., Toronto, Can., Pers. commun., 30 June 1979). Mansfield (1971) believed the stock was recovering; recent studies have not confirmed this (Davis et al. 1978).

WESTERN ARCTIC-BERING SEA STOCK

The distribution of bowheads in western Arctic-Bering Sea stock prior to commercial exploitation (1848) can be inferred from Townsend's (1935) charts which locates by month bowhead whales taken by Yankee whalers (Figure 2). The whaling grounds were within lat 53° to 73°N and long 120°W to 175°E. Whaling occurred in the Bering Sea from April to July and, in the Chukchi and Beaufort Seas, generally from August to October. The lack of harvest records north of the Bering Strait during April and May is explained by the avoidance of heavy ice by whalers. Very few whales were taken in the eastern Bering Sea, suggesting that the species was formerly distributed off the continental shelf in the southwest Bering Sea and over the shelf in the west central and northern Bering Sea during the winter, spring, and early summer months.

Initial stock size estimates range from 9,000 to 40,000 (IWC 1978; Bockstoce and Botkin 1980[12/]), with a best estimate of about 18-20,000 (IWC 1978; Breiwick et al. 1980; Bockstoce[11/]). The stock was exploited commercially from 1848 to approximately 1921. An estimate of the population size in the early 1900's is 600-2,000 (Eberhardt and Breiwick 1980). For further details of commercial exploitation and whaling activities refer to Marquette (1976, 1977)[13/], Bockstoce[11/], and Marquette and Bockstoce (1980).

OKHOTSK SEA STOCK

Bowheads were generally found in northern and western Okhotsk Sea, spring and summer. They once occurred as far north as Penzhinskaya Inlet and as far west as Tchantar Bay (Townsend 1935). During spring, they were also taken as far south as Korea and Japan (Townsend 1935; Nishiwaki and Kasuya 1970). Today, their seasonal movements are unknown. During the

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[12/] Bockstoce, J. R., and D. B. Botkin. 1980. The historical status and reduction of the western arctic bowhead whale (Balaena mysticetus) population by the pelagic whaling industry, 1848-1914. Unpubl. rep., 120 p. Natl. Mar. Mammal Lab., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, Wash. 98115.

[13/] Marquette, W. 1977. The 1976 catch of bowhead whales (Balaena mysticetus by Alaskan Eskimos, with a review of the fishery, 1973-1976, and a biological summary of the species. Processed Rep., 79 p. Natl. Mar. Mammal Lab., Northwest and Alaska Fish. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, Wash. 98115.

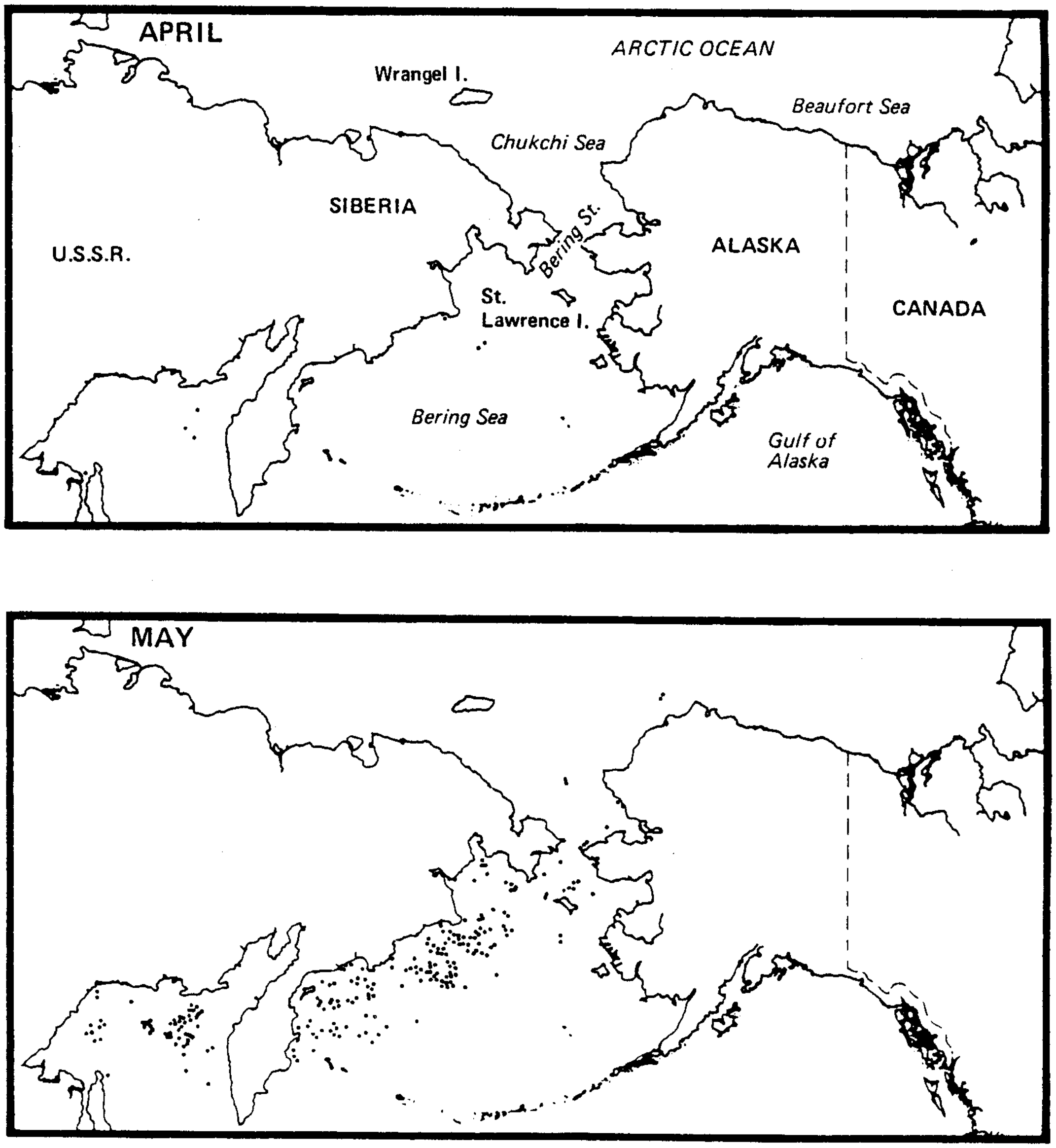

Figure 2a.--Locations where bowheads were taken by Yankee Whalers in April and May 1848-1919. Each black dot represents a single harvested whale. Data redrafted by month from Townsend (1935). plot by Townsend (1935) of all months.

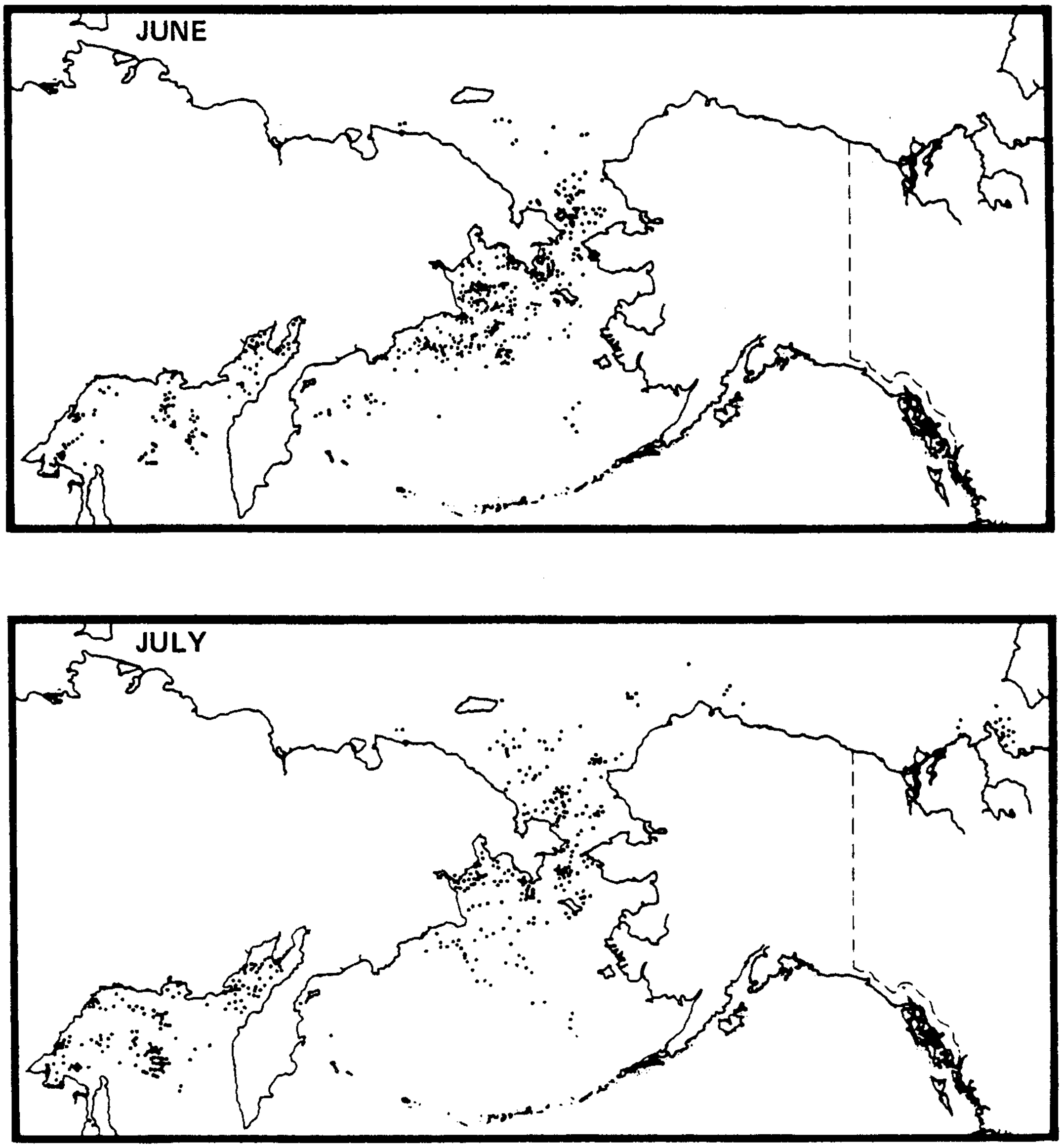

Figure 2b.--Locations where bowheads were harvested by Yankee Whalers in June and July 1848-1919 (adapted from Townsend, 1935).

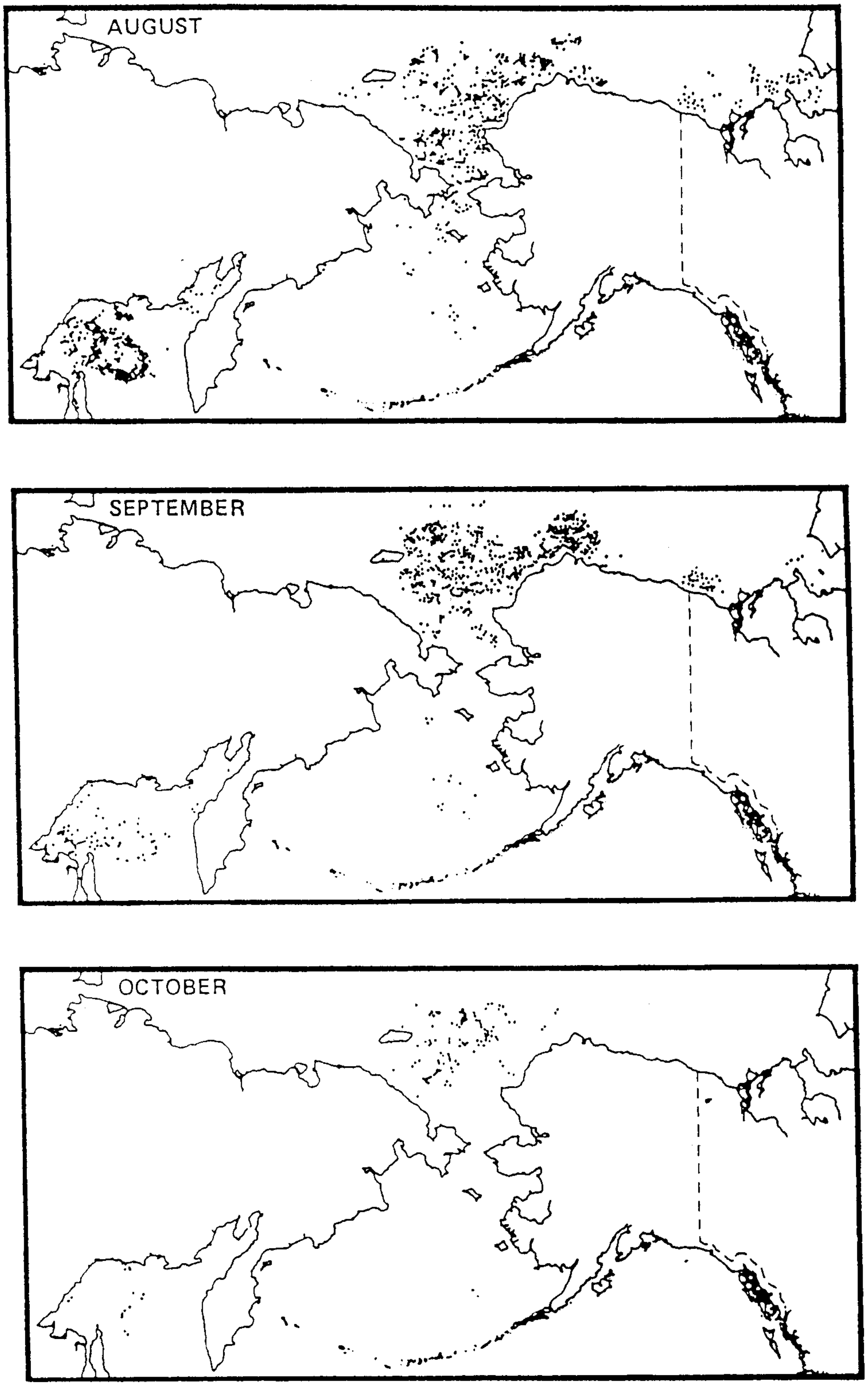

Figure 2c.--Locations where bowheads were harvested by Yankee Whalers in August, September, and October 1978, 1979 (adapted from Townsend, 1935).

late 1850's, as it became more difficult to find bowheads in the Bering Sea, whalers turned their attention to the Okhotsk Sea, and soon depleted this stock. Initial stock size has been estimated at 6,500 (IWC 1978). Although inconclusive, recent results of Bockstoce and Botkin[12/] leads us to conclude that intermixing between the Okhotsk Sea and the Bering Sea stocks may have taken place in the past, but probably not since the late 19th century. Sighting records supplied by A. A. Berzin (Pacific Scientific Research Institute of Fisheries Oceanography (TINRO), 20 Lenin St., Vladivostok, USSR Pers. commun., 7 January 1976) indicate that bowheads still occur in the Okhotsk Sea: 16 bowheads were sighted during surveys in 1973-74. Fifty-five (55) bowheads were seen in south-southwest Okhotsk Sea during an August aerial survey in 1979 (Berzin and Doroshenko 1981).

FIELD RESEARCH RESULTS

SPRING COUNTS OF MIGRATING BOWHEAD WHALES: ICE AND LAND CAMPS

Barrow

Counts of bowhead whales were made 25 April-2 June 1976, 19 April-3 June 1977, and 15 April-5 June 1978 at the nearshore lead northwest of Point Barrow. These periods coincided with the annual northeasterly spring migration of bowhead whales from their winter grounds in the Bering Sea to summer feeding grounds in the Arctic Ocean. Summary data for these three census years are presented in Table 1. The estimate ("Index") of the number of whales passing the camps during the census periods was not, for 1976 and 1977, considered to be a total population estimate. A more detailed comparison of indices among years for the period 15 April-30 May is reported in Braham et al. (1979, 1980a) and Krogman (1980).

The 1978 index of 2,276 was higher than indices of 762 achieved in 1976 (revised from 796, originally quoted in Braham and Krogman 1977[1/]), and 715 in 1977 (Figure 3). The increase in counts is attributable to several factors: 1) increase in survey effort (period of watch); 2) better survey location; 3) environmental conditions; and 4) increase in observer effort.

Figure 4 partially illustrates the increase in survey efort by comparing the number of hours watched per day during the same time frame among years. These histograms illustrate the variation in watch effort among years. For all years the strategy was to maintain an unbroken 24-hr watch schedule. In 1976 and 1977, the period of OCSEAP funding, this watch-effort strategy was undermined by fog, closed leads, unstable ice conditions and a limited number of observers. This was not so during 1978, the first year of the NOAA, NMFS expanded bowhead research program.

In addition to the outstanding environmental conditions in 1978, another factor contributing to the increase in the index was a change in location of the ice camps. During 1976 and 1977 the primary location for counting was 10-20 km to the southwest of Point Barrow, where our observers

TABLE 1.--Summary of spring counts of bowhead whales during their annual spring migration through the flaw zone near Barrow, Alaska. See methods section for how indices were calculated.

Year	Counting period	Total hr in period	Total hr watched	Percent period watched	Bowheads counted	Index
1976	25 April-2 June	936	392:25	42	330	762
1977	19 April-3 June	1,104	395:12	36	327	715
1978	15 April-5 June	1,248	1,108:44	89	1,389	2,276[a]

[a] In Braham et al. (1979) an estimate of 2,264 was given for the period from 15 April-30 May. The value of 2,276 has a range of uncertainty of approximately (-481 to +601) around the value, and will be further adjusted as results of bias analysis dictate.

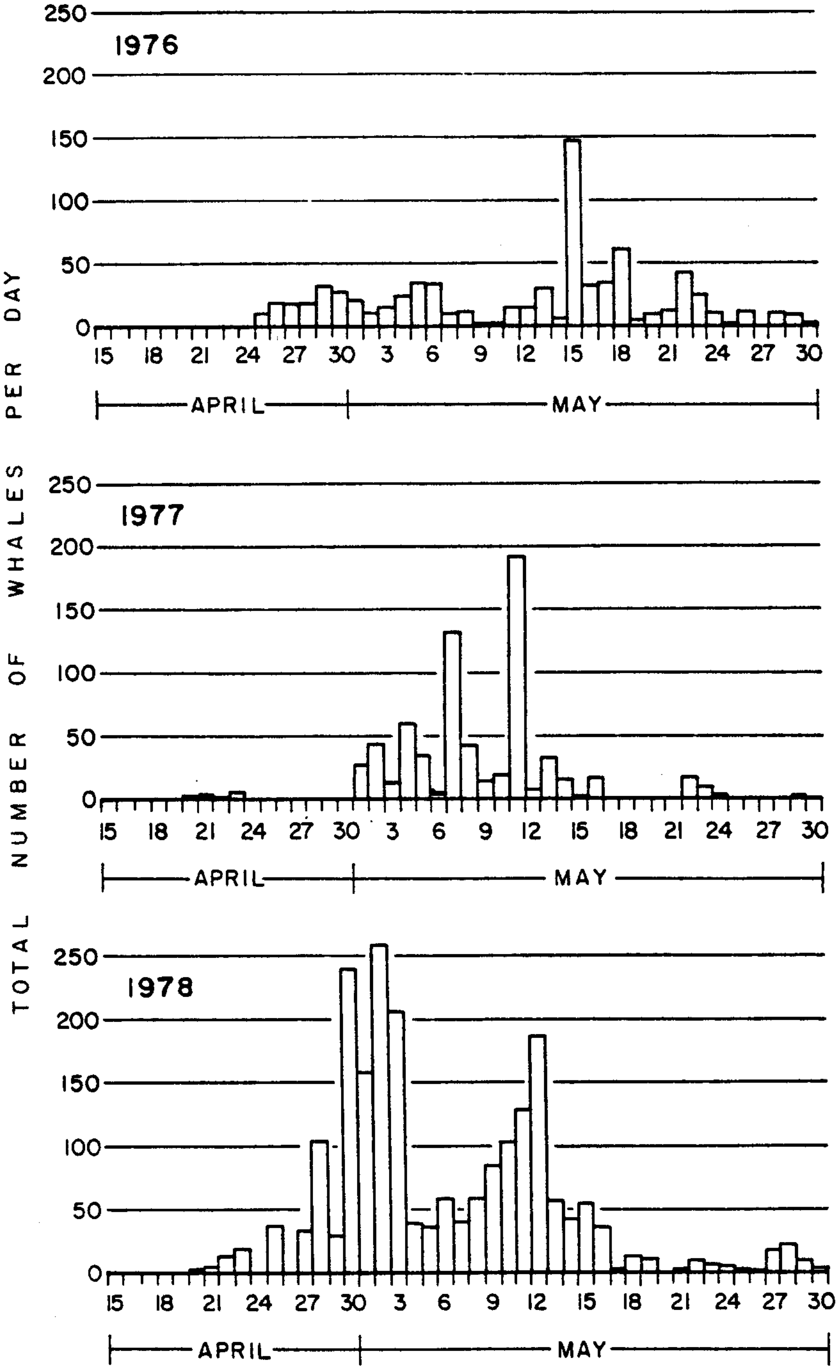

Figure 3. Comparison among years (1976-1978) of estimated total number of bowhead whales migrating northwardly past Pt. Barrow, Alaska, from 15 April-30 May. For purposes of comparison, totals are based on hourly rates per day times (x) 24 hours.

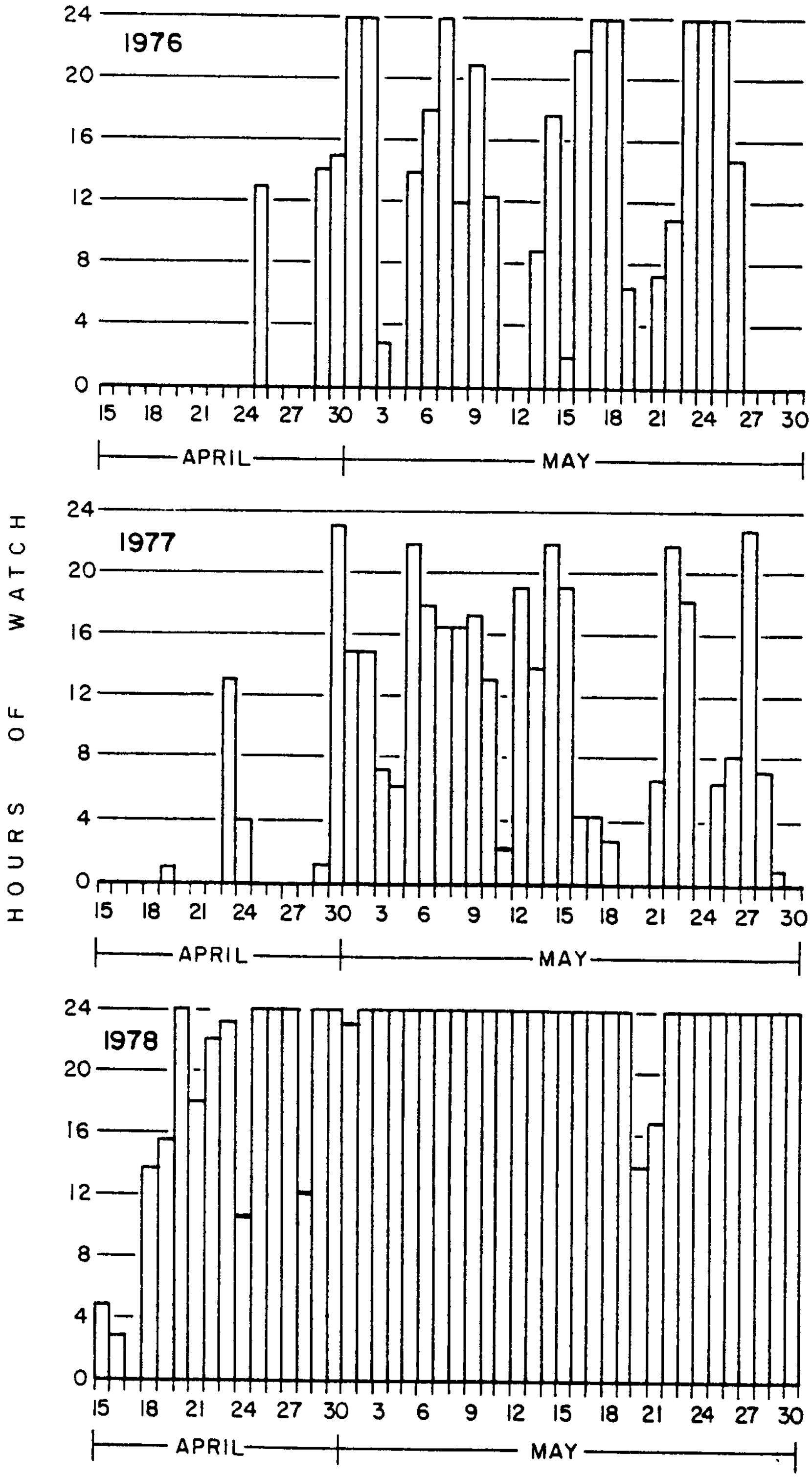

Figure 4. Comparison among years (1976-1978) of observer effort (total hours of watch/hour) expended from 15 April-30 May. The schedule for 1976 and 1977 called for rotating single observers every four hours, whereas the 1978 schedule called for two teams of two observers each (four total) to rotate every three hours. Percent of total survey hours watched were: 1976= 37.0%; 1977= 35.8%; 1978= 86.7%.

stationed themselves near Eskimo whalers. In that vicinity, the lead is generally 11-32 km in width, whereas immediately northwest of Point Barrow, where the 1978 camps were located, the lead width is generally 1-11 km wide. During 1978 the lead was open wider than 0.5 km approximately 94% of the time providing us with an unusually long time period to watch for whales. The median as well as mean (of means) lead width, 23 April to 1 June 1978, at Barrow as 3.70 km (SD = 2.94, n = 38) as calculated from data in Brueggeman (1980). A lead width of 5 km or less is considered ideal for viewing bowheads.

Another important factor contributing to a higher count during 1978 was the increase in observer effort. The 1978 observer schedule called for two observers per 3-hr rotating watch; in previous years single observers rotated every every 4-hr.

Observers at South Camp conducted all watches from an unusually high perch (ice ridge) in 1978. Height of the eye at South Camp was approximately 11.8 m above sea level yielding a view to the horizon of 10 km. Observers in 1976 and 1977 were located on young ice with eye height of 2-4 m, yielding a view to the horizon of 4-6 km.

Cape Lisburne - Point Hope

Counts of bowhead whales were made 6-16 May 1977 at Cape Lisburne, Alaska. This was a feasibility study which resulted in 54 bowhead whales counted during 72 hours of watch. Based upon results of the 1977 study, a full scale counting study was conducted 2 April-7 June 1978 (Rugh and Cubbage 1980). Results of that study indicated that: 1) spring migration of bowhead whales past Cape Lisburne commenced during the latter half of April; 2) bowheads generally pass Cape Lisburne on a northeasterly course; 3) bowheads usually require 3-5 days to traverse the corridor from Cape Lisburne to Point Barrow; 4) our counting camps at Point Barrow were established before whales passed Cape Lisburne; and 5) few if any whales moved past Point Barrow beyond 1 June. These results, and those from aerial surveys, indicated that the 1978 counts made at Point Barrow probably can be used to estimate total abundance.

Counts of bowhead whales were made at Point Hope from 18 April to 28 May 1977. A total of 185 bowhead whales was observed during 546 hr of watch. Two waves of movement apparently occurred that year, the first during late April and early May and the second during the latter half of May.

AERIAL SURVEYS FOR BOWHEAD AND WHITE WHALES

Approximately 75,000 km of tracklines were flown during 96 flights over the 1975-77 study period. For ease of analysis and reporting, these surveys have been chronologically and geographically ordered into 16 sets (Appendix I). Survey results are reported by month; no surveys were flown November-February.

Statistics presented in figure captions associated with aerial surveys are total number of whales counted, mean group size, and standard deviation of group size. Whale counts from the air were used as a relative indicator of how many whales were present in any given area. Group size described the number of whales observed in "close association" which were counted at any one moment. When more whales surfaced, they were tallied as new sightings. Thus, mean group size is downward biased since only a subset of the total group was visible near the surface at any given time.

March and April

1976

From 15 to 21 March 1976, four surveys were flown in the vicinity of St. Lawrence Island. South of St. Lawrence Island thin ice coverage was extensive. North of the island there was nearly 90% ice coverage and pack ice was thick. No bowhead whales were observed. White whales were most common just northwest of St. Lawrence Island (Figure 5).

During the 6-23 April 1976 survey pack ice was thick between lat 64°N and 65°N in the vicinity of St. Lawrence Island. South of lat 64° N pack ice was medium thickness. Ice coverage at this time of year was still extensive: 70-100%; 80% coverage was most common. Large expanses of 100% coverage occurred northwest of St. Matthew Island. Southeast of St. Matthew Island, and in Bristol Bay, sea ice was extensive to the southern limit indicated by aerial survey tracklines (Fig. 6).

No bowheads were seen during the 6-23 April 1976 survey in Bristol Bay (Figure 6)[14/]. Three bowheads were observed in the northern Bering Sea, one on 19 April about 20 km south of Little Diomede Island (Bering Strait), migrating northeasterly in a lead.

White whales were observed most often in the region from northwest of St. Lawerence Island to the Bering Strait during the 6-23 April 1976 surveys (Figure 7). Twenty-five white whales, 18 adults with seven presumed immatures (grey skin) were seen on 9 April in Bristol Bay (Figure 7).

1977

In the region near St. Lawrence Island, aerial surveys were flown 31 March-3 April 1977 (Figure 8). No bowheads were observed in Norton Sound, but a pair was observed southwest of St. Lawrence Island and another, or one of a pair, observed later in the same area. Two more were observed in the lead just southeast of the Bering Strait.

[14/] One bowhead was observed on 9 April 1976 west of the Pribilof Islands by Patrick McGuire, National Marine Mammal Laboratory, from the NOAA ship Surveyor.

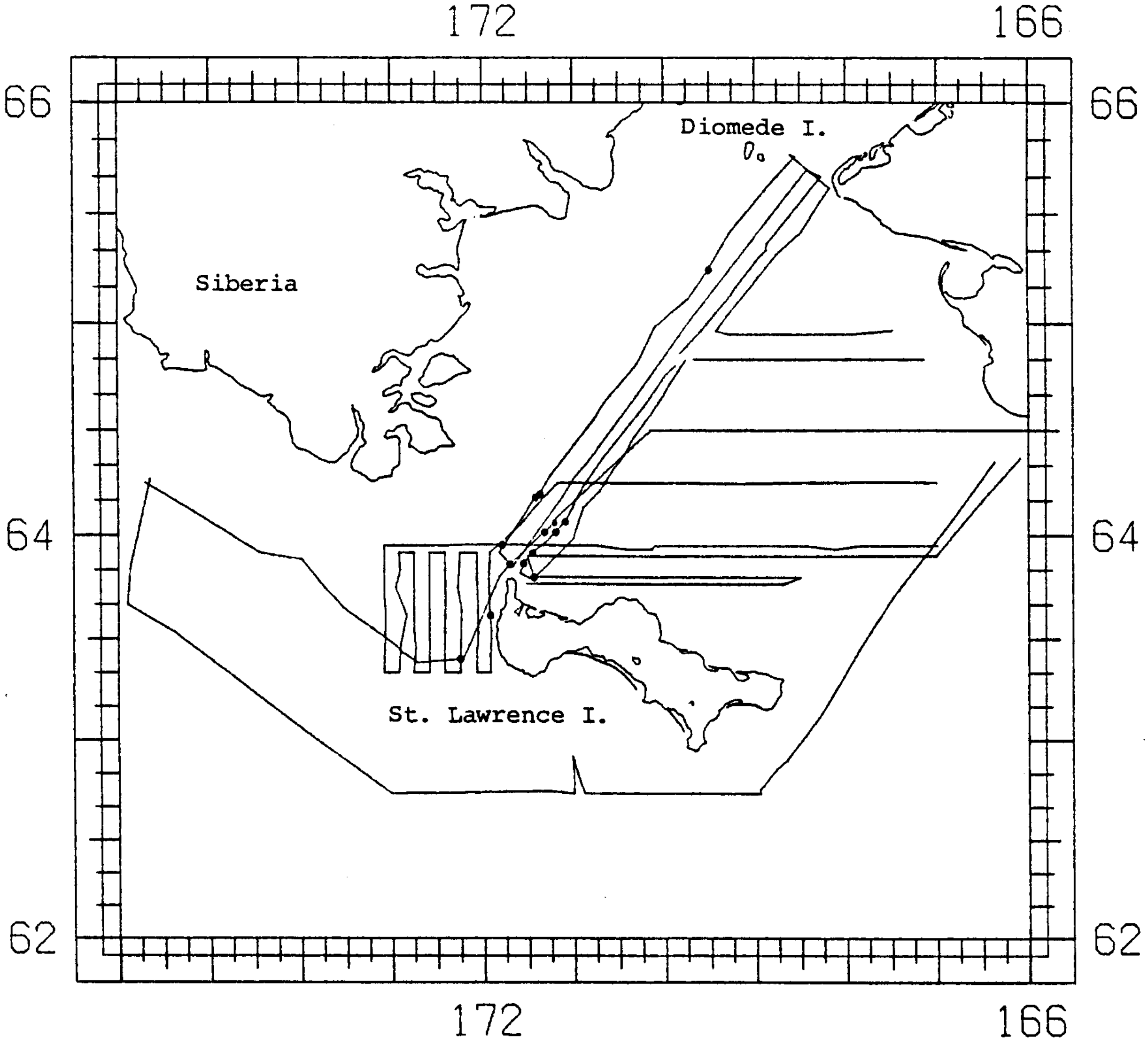

Figure 5.--Aerial survey tracklines flown in the northern Bering Sea on 15, 18, 19 and 21 March 1976. No bowheads were observed. Dots depict the presence of white whales: a total of 39 were counted with a mean group size of 2.8 with a standard deviation (S.D.) of 2.3.

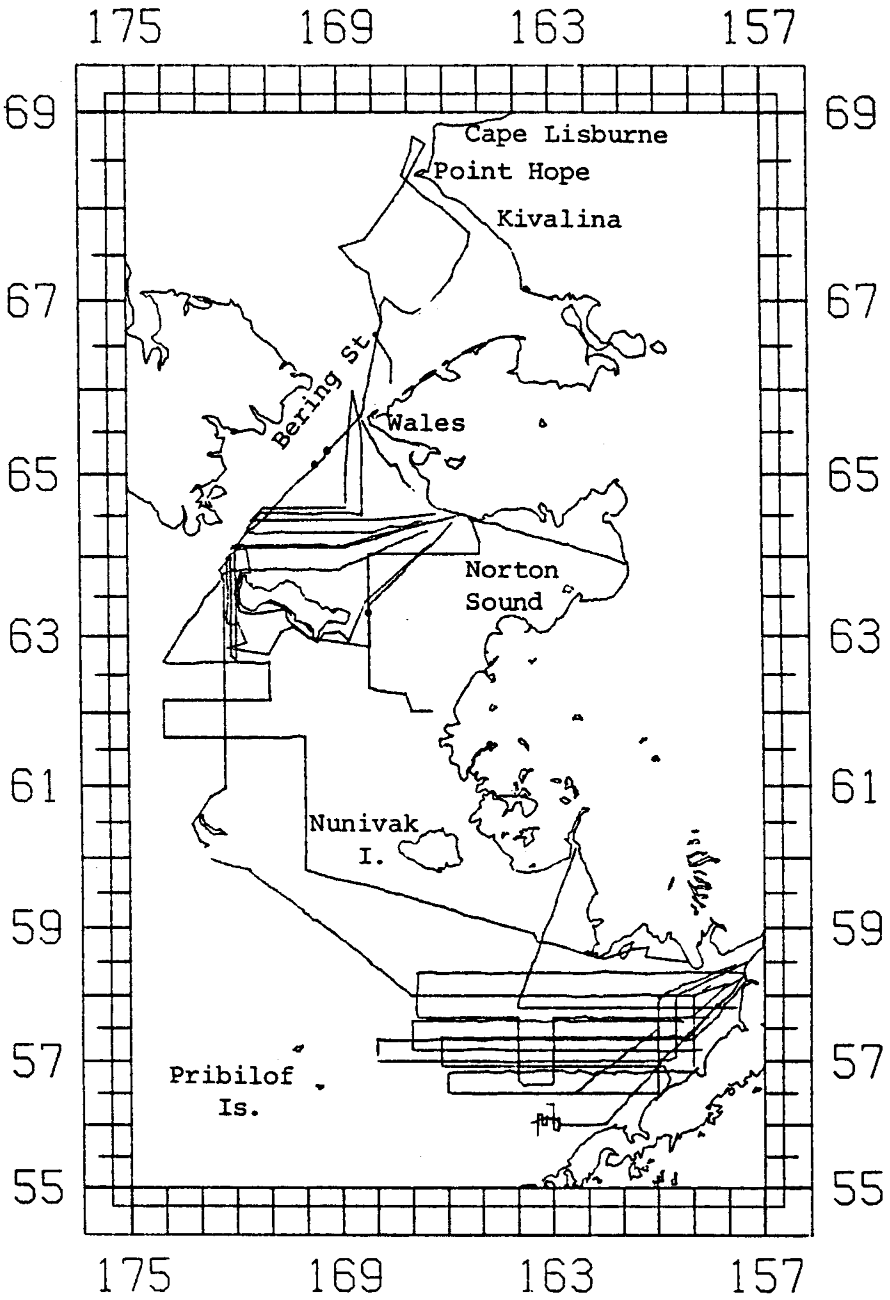

Figure 6.--Aerial survey tracklines flown on 6, 8, 9, 12, 13, 15, 17, 18, 19, 20, 21, 22 and 23 April 1976. Each of the three dots represent a sighting of a bowhead whale. No bowheads were observed below 63° north latitude.

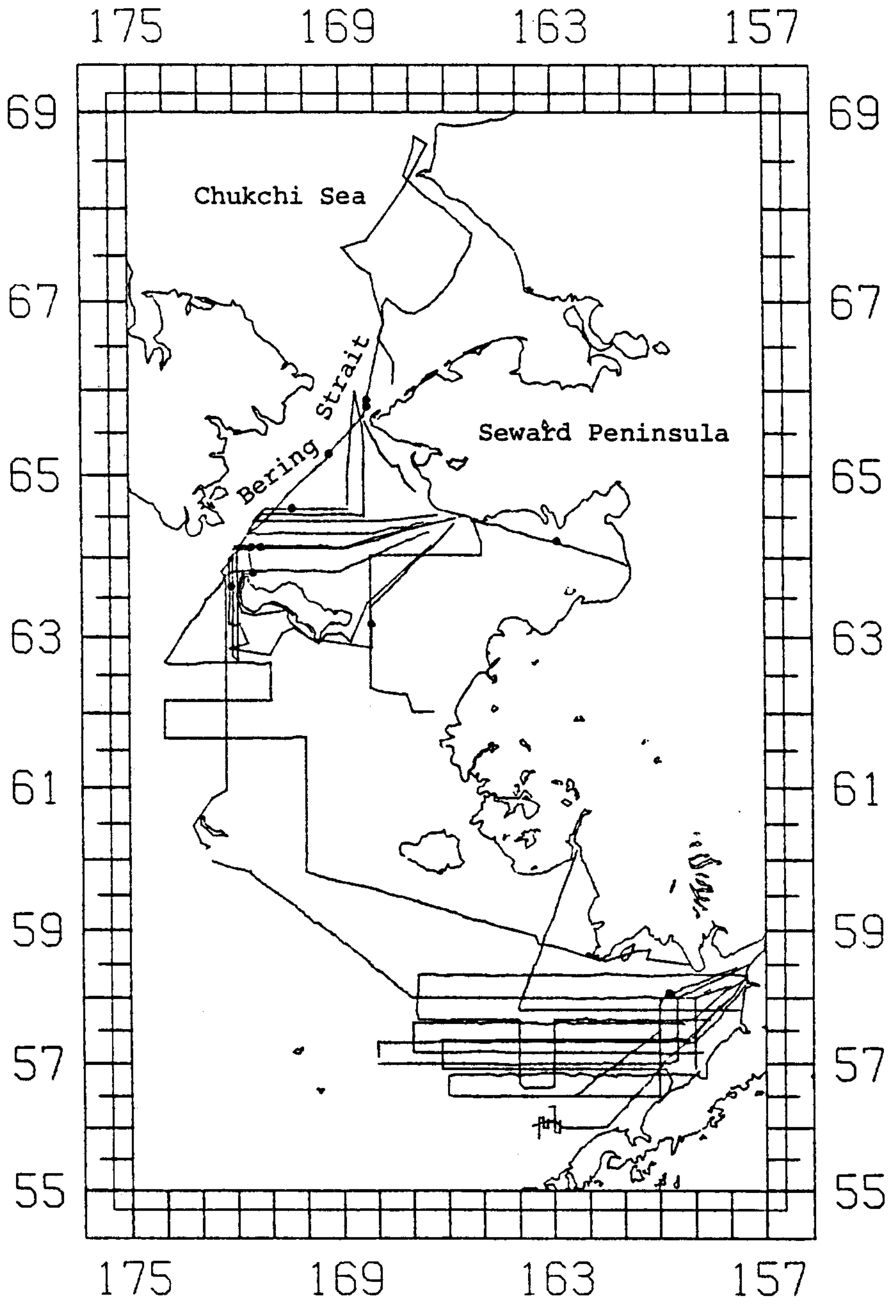

Figure 7.--Aerial survey tracklines flown in the Bering Sea on 6, 8, 9, 12, 13, 15, 17, 18, 19, 20, 21, 22 and 23 April 1976. Dots depict presence of white whales: a total of 135 were counted with a mean group size of 5.4 (S.D. 6.2).

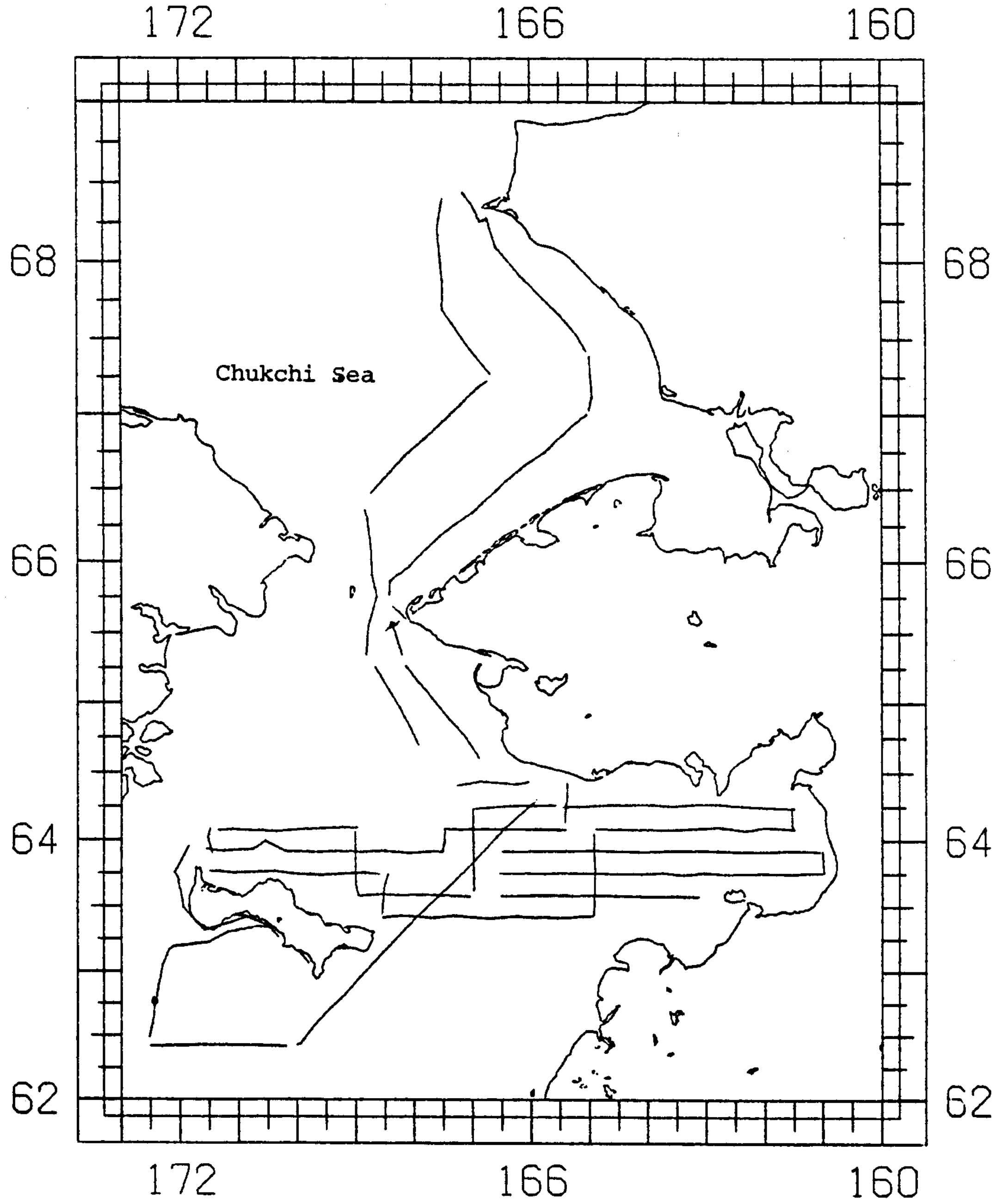

Figure 8. Aerial survey tracklines in the northern Bering and southern Chukchi Seas 31 March 1977 and 1-3 April 1977. The two dots represent presence of bowhead whales: a total of 5 whales were sighted with a mean group size of 1.7 (S.D. 0.6).

During the 31 March-3 April 1977 surveys white whales were most common north and west of the west end of St. Lawrence Island, and in a large polynya off the coast of the Seward Peninsula (Figure 9).

1976

Results from the 30 April to 14 May 1976 (Figure 10) and the 15 to 31 May 1976 (Figure 11) aerial surveys indicate that the northeast migration of bowhead whales along the northwest coast of Alaska (Chukchi Sea) occurred in the nearshore lead. No bowheads were seen nearshore in the Beaufort Sea.

From Figures 12 and 13 it is apparent that white whales were more widely distributed in the Chukchi Sea than bowheads. They were observed to the northerly limits of most aerial surveys offshore to approximately 60 km, indicating that they penetrate the pack ice even farther north than bowheads. White whales were also common in the nearshore lead.

1977

Aerial surveys flown from 11 to 14 May 1977 (Figure 14) in the southeastern Chukchi and eastern Bering Seas revealed no bowhead whales. It was not expected that bowheads would be observed in the area surveyed from Norton Sound south.

A herd of white whales was encountered on the 11-14 May survey in Kotzebue Sound (Figure 14). Six adult white whales were observed in Norton Sound; eight, including one immature, were observed south of Norton Sound. The trackline leading south from Norton Sound followed near the fast ice edge to Nunivak Island. No white whales were observed in the open water south of Nunivak Island.

The hypothesis we proposed that spring migrating white whales use leads offshore in the Beaufort Sea (Braham and Krogman 1977)[1/] is further substantiated by the fact that white whales were observed as far as 150 km north of Point Barrow but not nearshore along the north coast of Alaska in the Beaufort Sea (example, Fig. 15). The fact that no bowheads were seen is probably a reflection of fewer animals present nearing the end of their spring migration (c.f. Fig. 3).

June

1976

In early June 1976 the bowhead whale migration along the northwest coast of Alaska (Chukchi Sea) was still confined to the nearshore lead. From Figure 16, however, it is evident that few bowheads were present in the study area. During the 8-14 June (Figure 17) aerial surveys in the southern Chukchi and northern Bering Seas, two bowheads were observed just south of the southern limit of the pack ice edge. They may have been waiting for a lead to open, as the pack ice appeared solid north of their location.

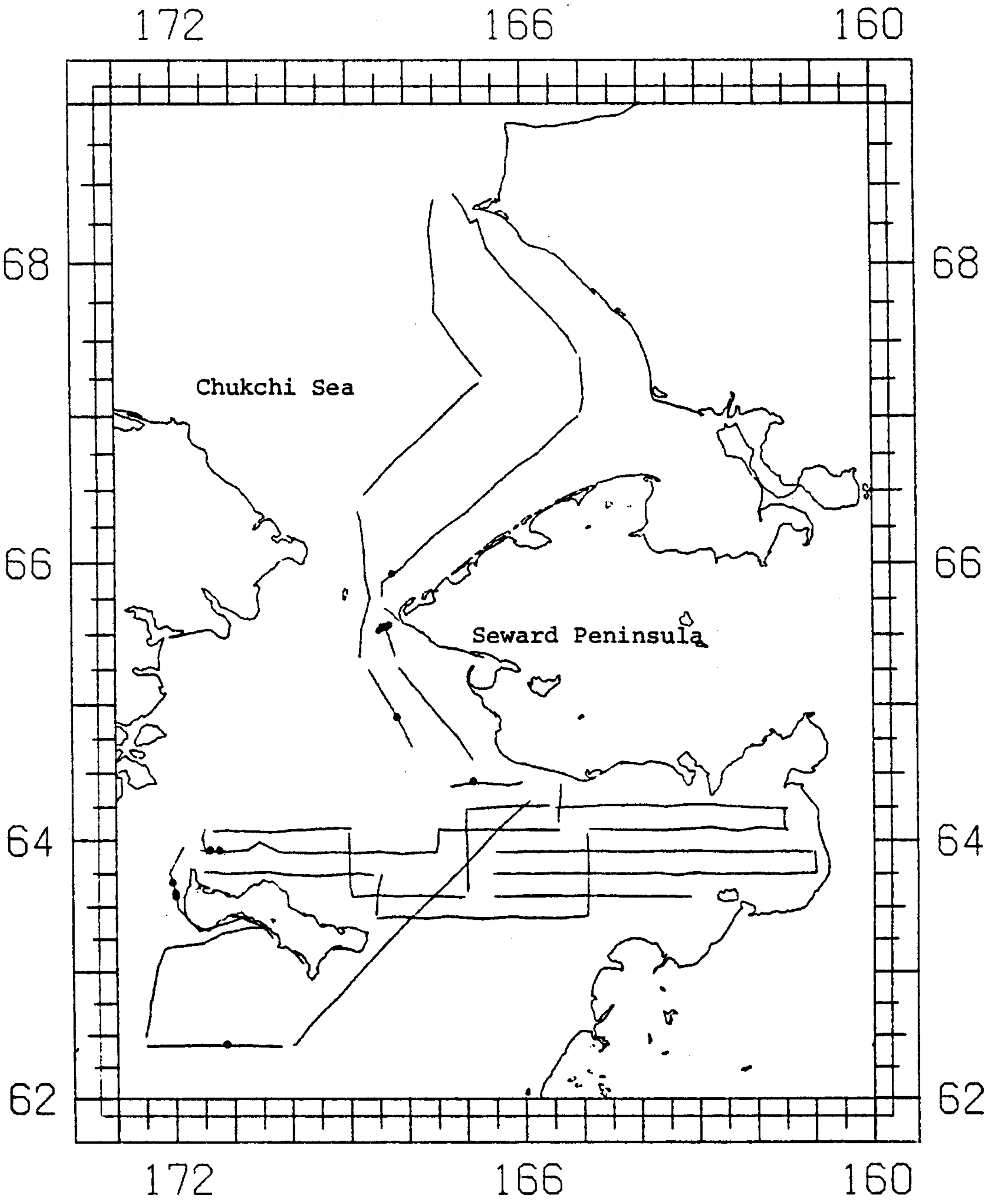

Figure 9.--Aerial survey tracklines flown in the northern Bering and southern Chukchi Seas 31 March and 1-3 April 1977. Dots represent presence of white whales: a total of 370 whales were counted with a mean group size of 4.6 (S.D. 4.5).

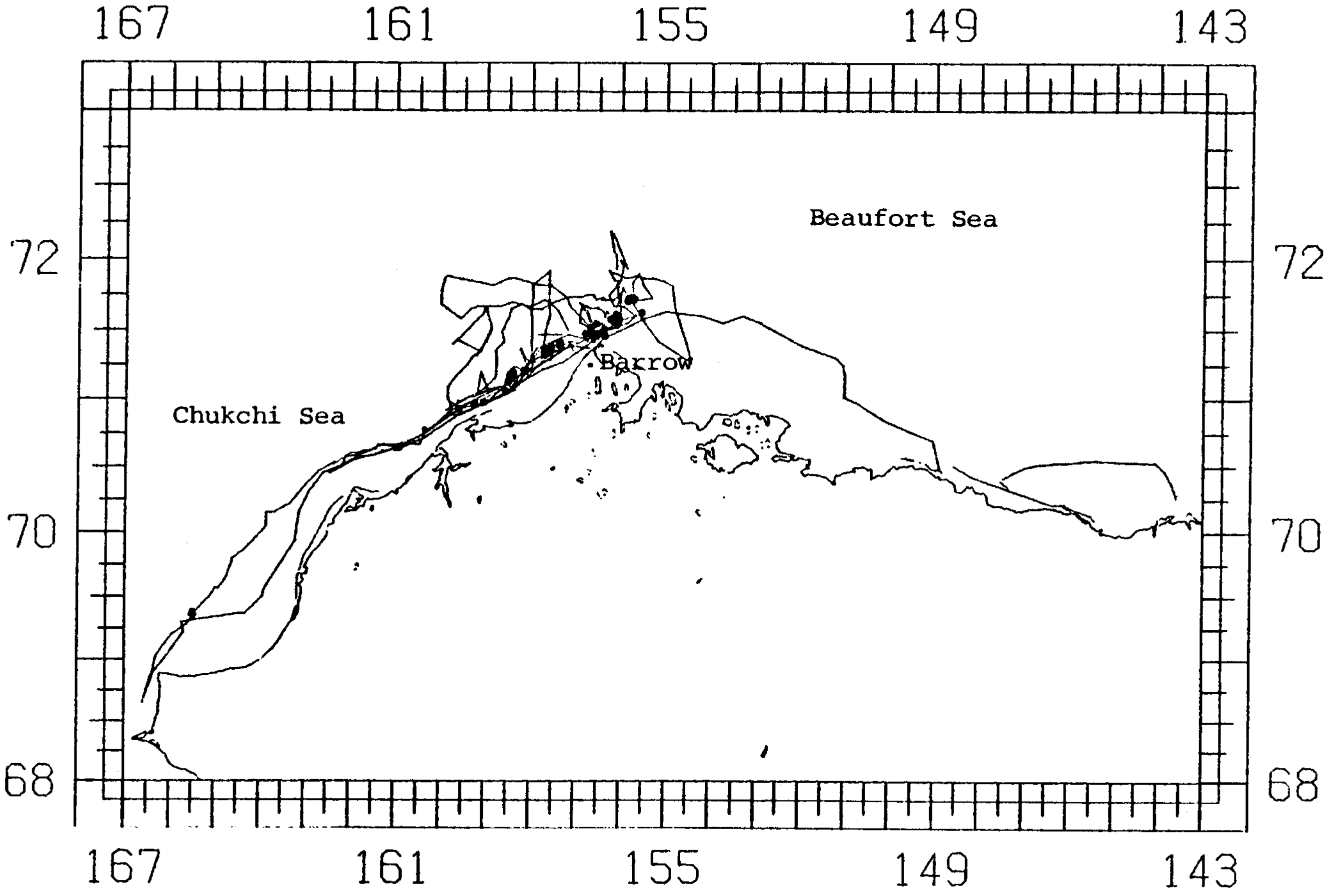

Figure 10.--Aerial survey tracklines flown in the eastern Chukchi and southern Beaufort Seas on 30 April and 1,3, 8, 9, 12 and 14 May 1976. Dots represent presence of bowhead whales: a total of 68 whales were counted with a mean group size of 1.3 (S.D. 0.86). Whales were observed in the nearshore lead only in the Chukchi Sea.

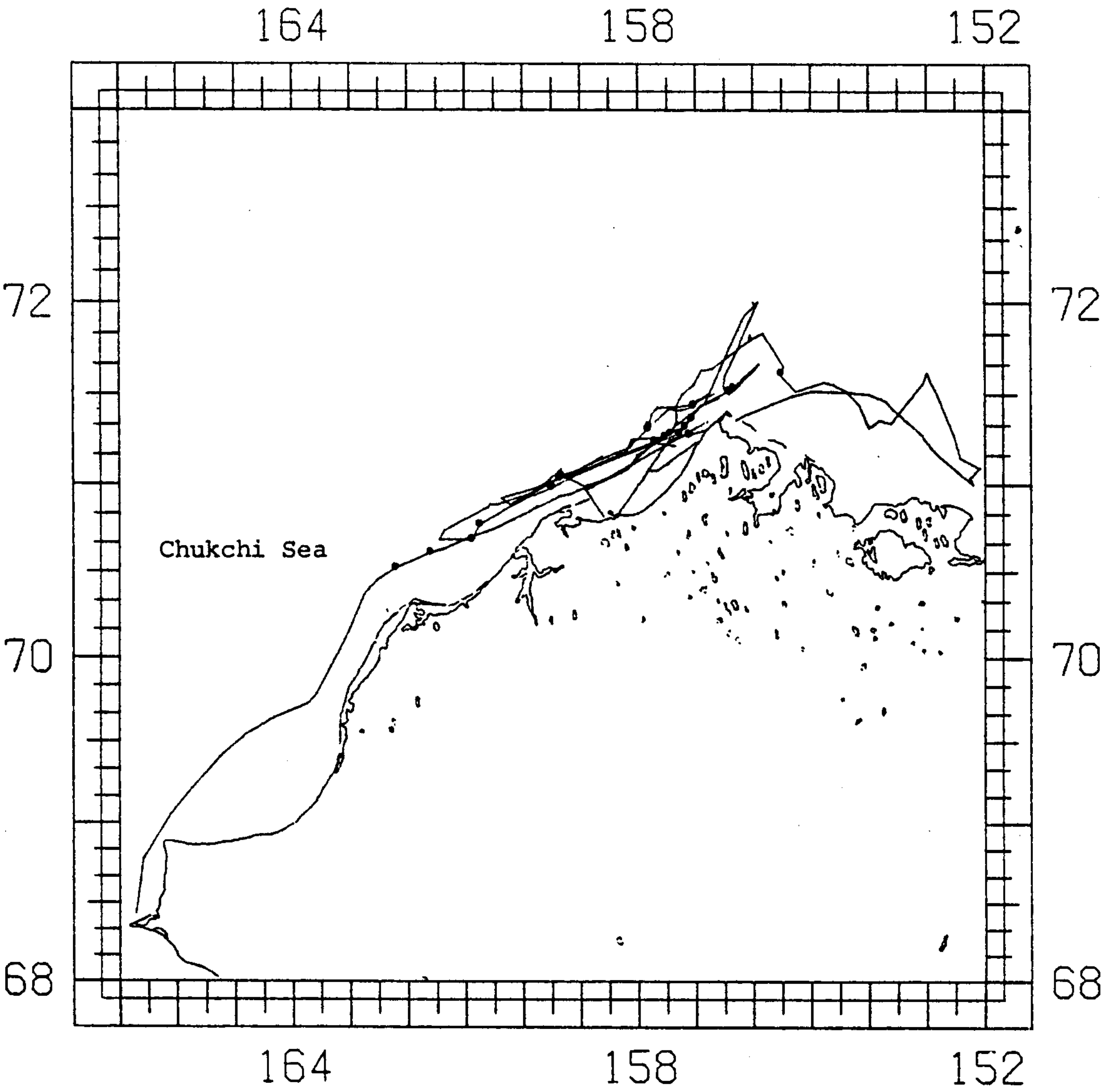

Figure 11. Aerial survey tracklines flown on 15, 19, 20, 22 24, 28, and 31 May 1976. Dots represent presence of bowhead whales: a total of 30 whales were counted with a mean group size equal 1.2 (S.D. 0.82). Whales were observed in the nearshore lead only.in the Chukchi Sea.

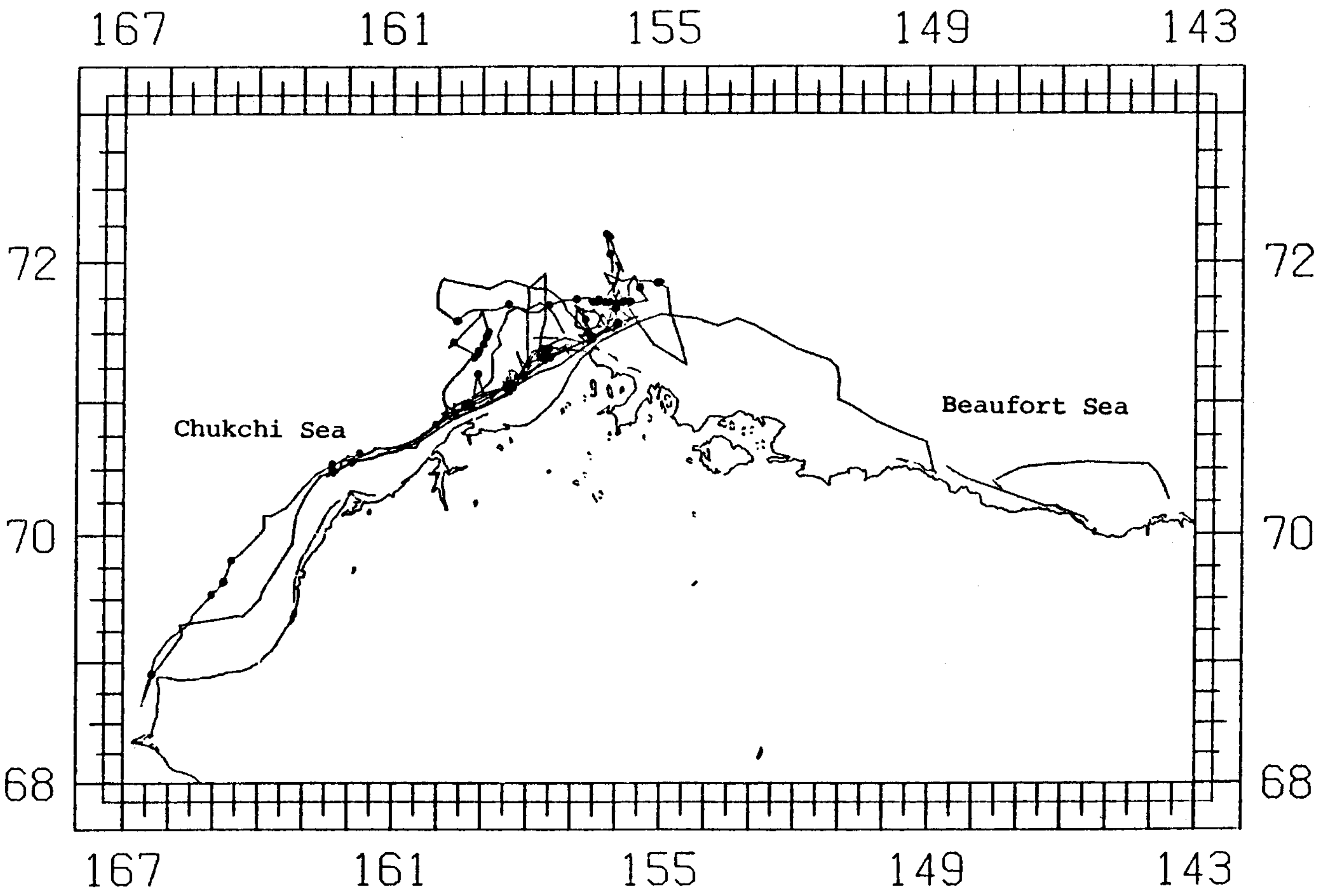

Figure 12.--Aerial survey tracklines flown in the eastern Chukchi and Beaufort Seas on 30 April and 1, 3, 8, 9, 12 and 14 May 1976. Dots represent presence of white whales: a total of 485 whales were counted with a mean group size of 3.9 (S.D. 5.5).

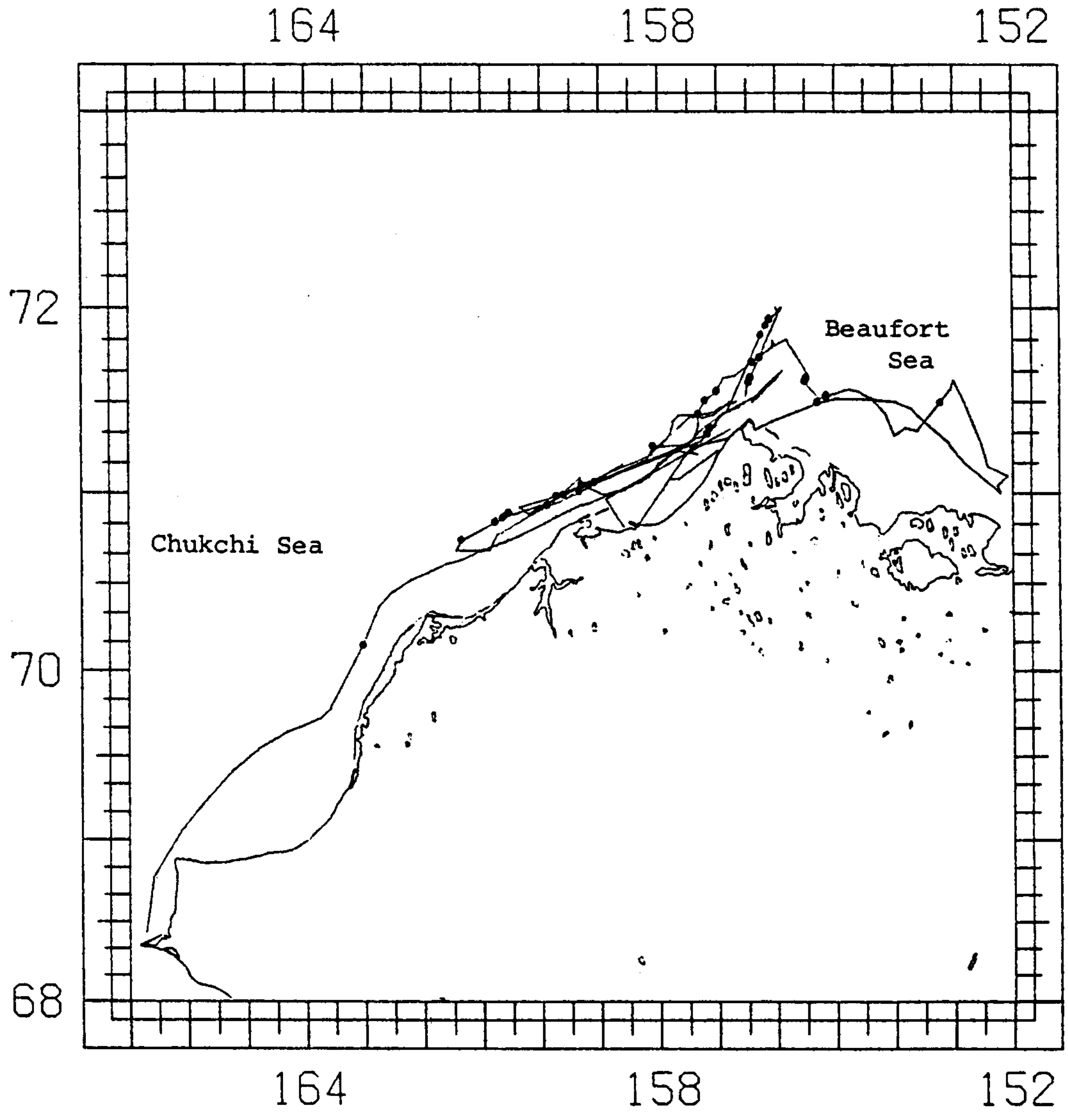

Figure 13.--Aerial survey tracklines flown in the eastern Chukchi and western Beaufort Sea 15, 19, 20, 22, 24, 28 and 31 May 1976. Dots represent presence of white whales: a total of 289 whales were counted with a mean group size of 6.0 (S.D. 7.4).

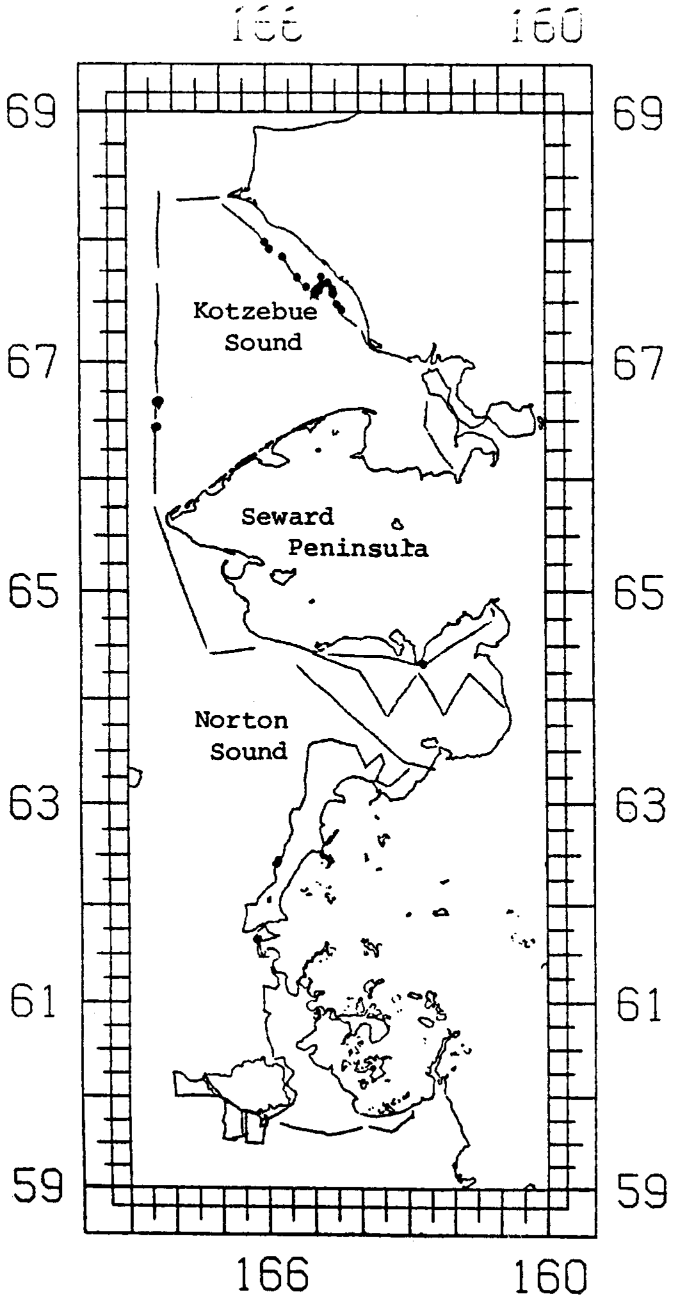

Figure 14.-- Aerial survey tracklines flown in the eastern Bering and southeastern Chukchi Seas on 11, 12, and 14 May 1977. No bowhead whales were seen. Dots represent presence of white whales: a total of 272 were counted with a mean group size of 4.5 (S.D. 7.6).

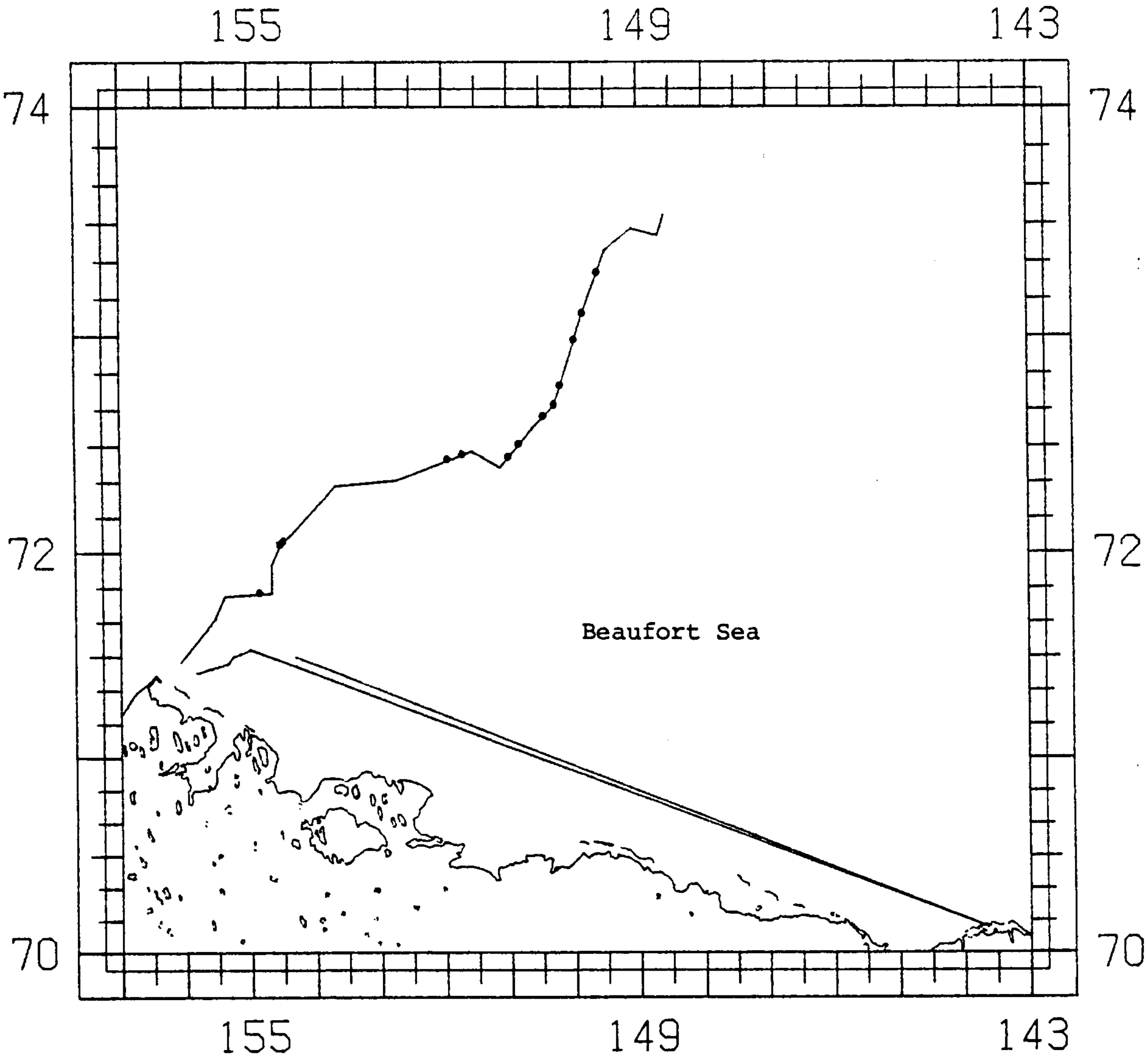

Figure 15. Aerial survey tracklines flown in the western Beaufort Sea on 21 and 30 May 1977. No bowhead whales were seen. Dots represent presence of white whales: a total of 26 whales were counted with a mean group size of 1.5 (S.D. 2.5).

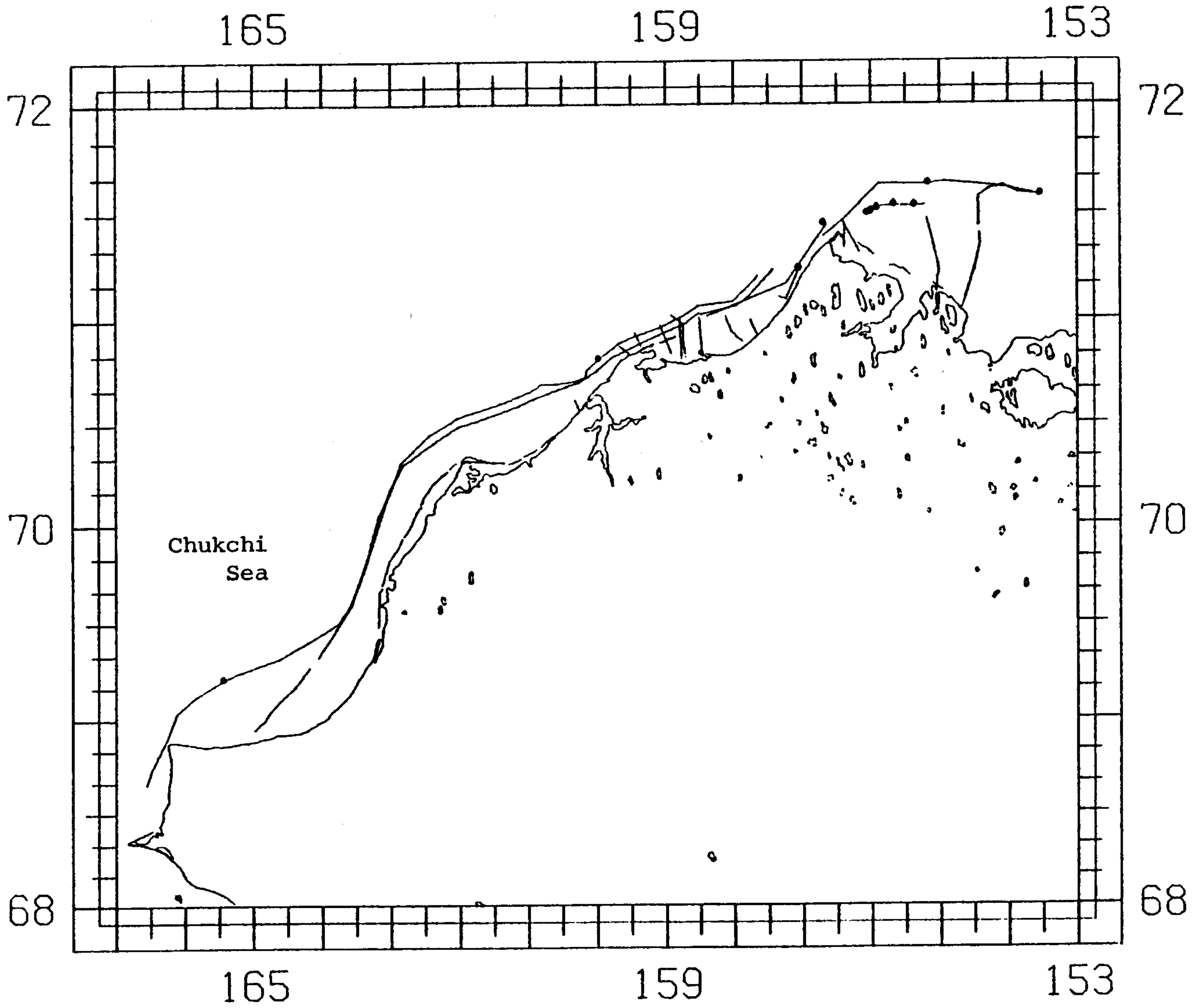

Figure 16.--Aerial survey tracklines flown in the eastern Chukchi and western Beaufort Seas on 1, 4, 5 June 1976. Dots represent presence of bowhead whales: a total of 20 whales were counted with a mean group size of 1.8 (S.D. 1.1).

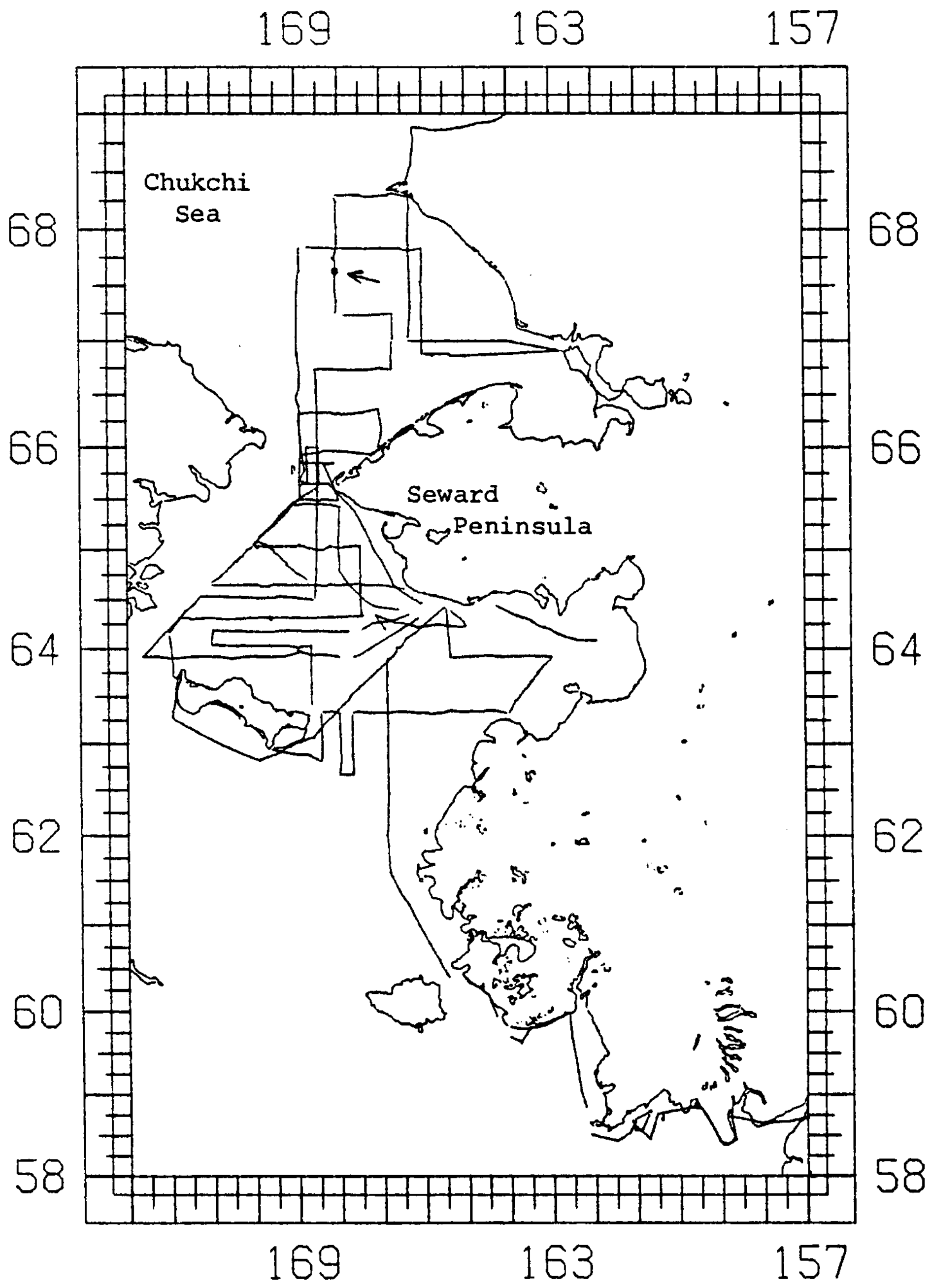

Figure 17.--Aerial survey tracklines in the northern Bering and southern Chukchi Seas flown on 8, 9, 10 11, 12, 13 and 14 June 1976. The dot (highlighted by an arrow) represents two bowheads seen just south of the ice front. One whale, a large adult, remained stationary at the surface for the 5-10 min. period we surveyed the area.

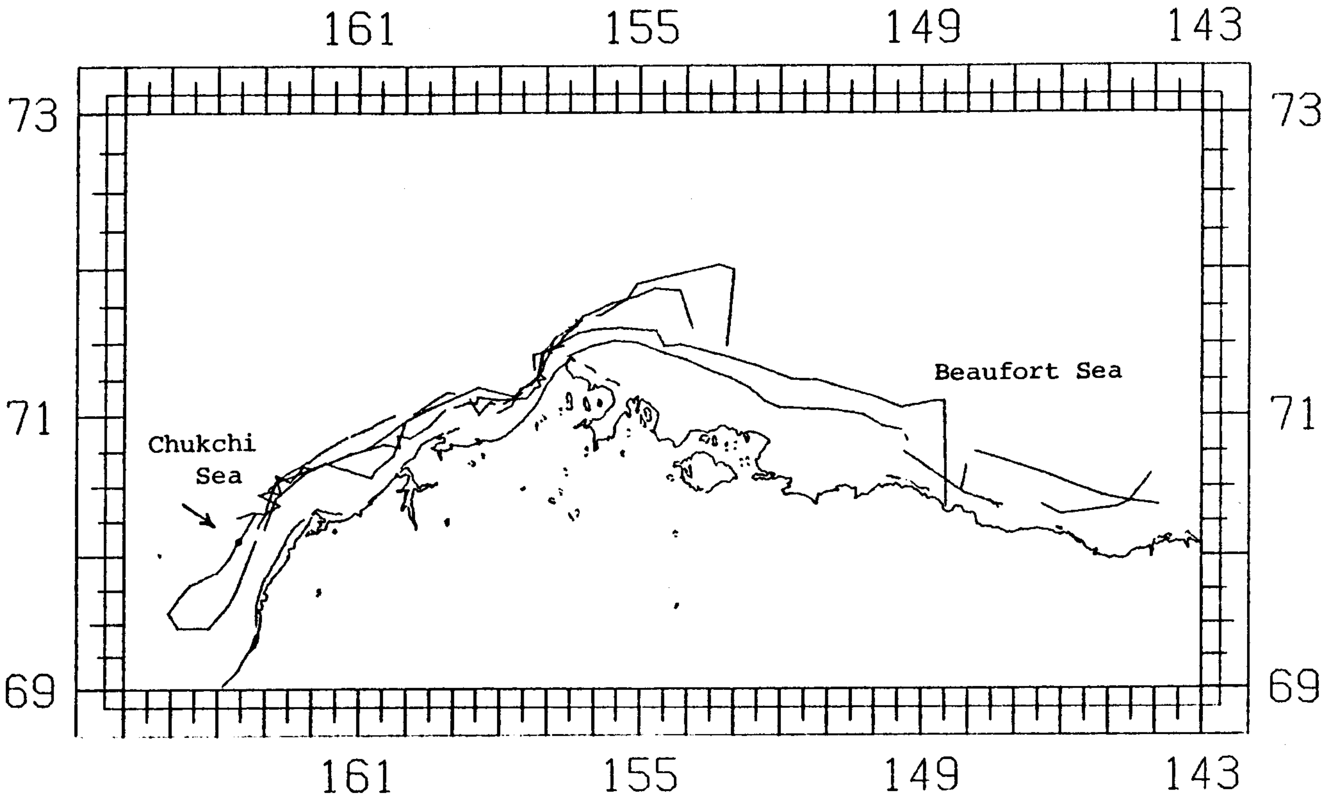

Figure 18.--Aerial survey tracklines flown in the eastern Chukchi and western Beaufort Seas 18-20 June 1976. The dot (highlighted by an arrow) represents one bowhead whale seen.

By 18-20 June 1976 the bowhead migration along the northwest coast of Alaska was essentially over; during extensive surveys flown in the nearshore leads only one animal was observed (Figure 18).

The 1-5 June 1976 survey along the northwest coast of Alaska verified that white whales were still present in the Chukchi Sea (Figure 19). On 1 June, 153 white whales were observed at lat 70°59'N, long 158°41'W. All other sightings were of 12 or fewer whales.

Eighteen adult white whales were sighted near the mouth of the Yukon River on 14 June 1976 (Figure 20). White whales were not encountered elsewhere during the survey, which suggests that most had left the north Bering Sea by June and that the Yukon Delta sightings were of a group which summers in Norton Sound.

The Chukchi and Beaufort Sea were again surveyed 18-20 June 1976 (Figure 21). Only two sightings of white whales were made: 12 adults were observed at lat 70°39'N, long 161°47'W on 19 June, and 49 adults with 12 immatures were observed at lat 69°28'N, long 164°10'W on 20 June.

July

No aerial surveys were flown in July 1976, 1977, or 1978.

August

Aerial surveys were flown from 17-26 August 1976 over open water (Figure 22). Four bowhead whales were observed together on 19 August east of Point Barrow.

Sighting records of bowhead whales from other OCSEAP contractors have been sent to us. In August 1975 Carleton Ray (Johns Hopkins University, Baltimore, Md, Pers. commun. 21 January 1978) sighted 74 bowheads northeast of Icy Cape (about lat 70°34'N, long 161°00'W). Ray's data and ours from 1975 suggest that at least some bowheads may not have been able to complete their migration into the Beaufort Sea that year because of the heavy pack ice that year. Ice did not restrict their migration however in 1976-1978.

Seven white whales were observed during the 17-26 August 1976 survey (Figure 23). Five were observed in Norton Sound, none were seen in the Chukchi Sea, and two were seen in the north central Beaufort Sea.

September and October

During the 20-26 September 1976 survey an aggregation of bowhead whales was observed nearshore from Smith Bay to Point Barrow (Figure 24). The highest count was 47 on 21 September. Several animals were observed to be stationary at the surface with their mouths open; they appeared to be feeding. The area between Smith Bay and Point Barrow may be a staging area for migrating whales and/or an important feeding location during years of high

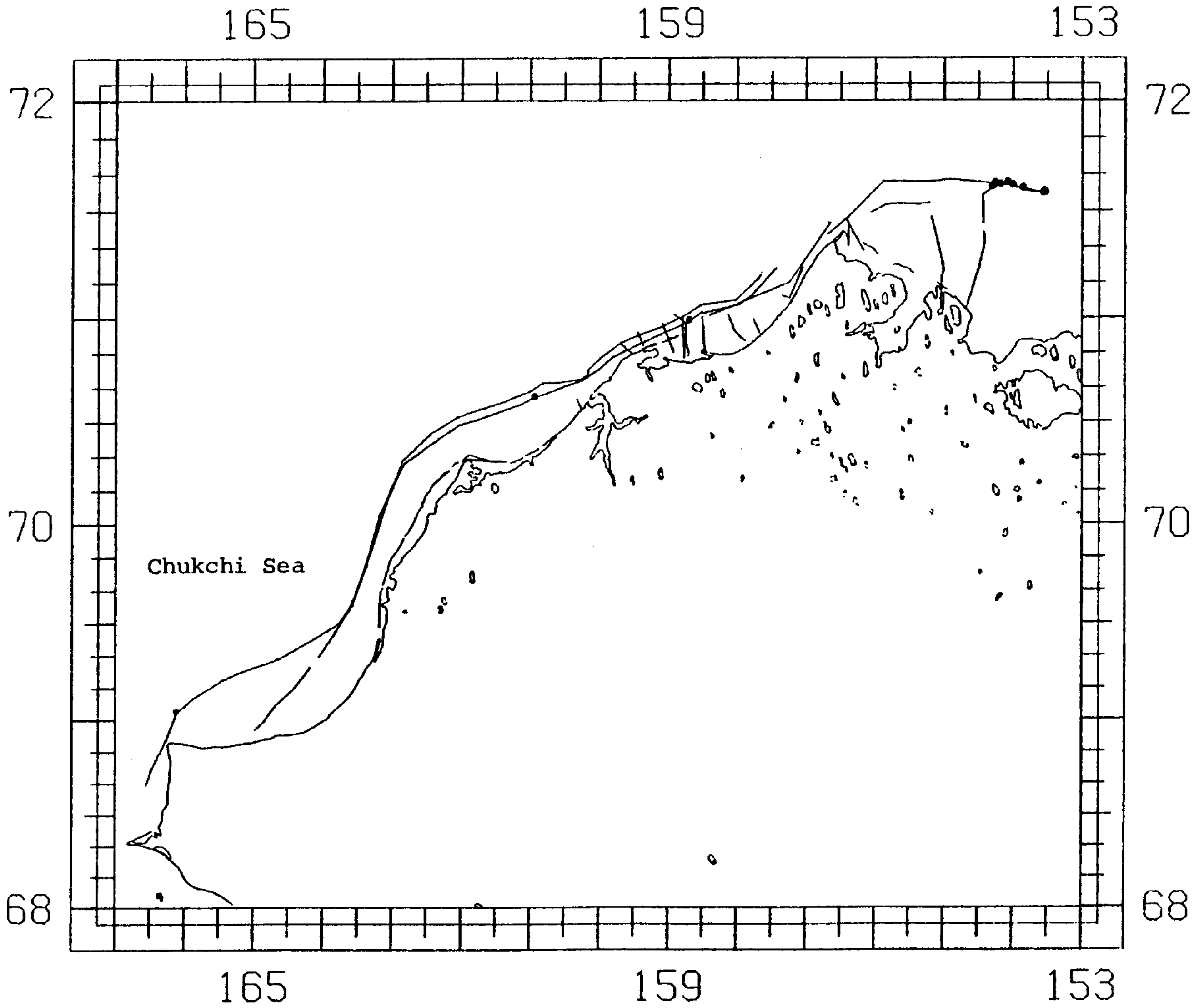

Figure 19.--Aerial survey tracklines flown in the eastern Chukchi and western Beaufort Seas on 1, 4, and 5 June 1976. Dots represent presence of white whales: a total of 177 were counted with a mean group size of 11.1 (S.D. 32.0).

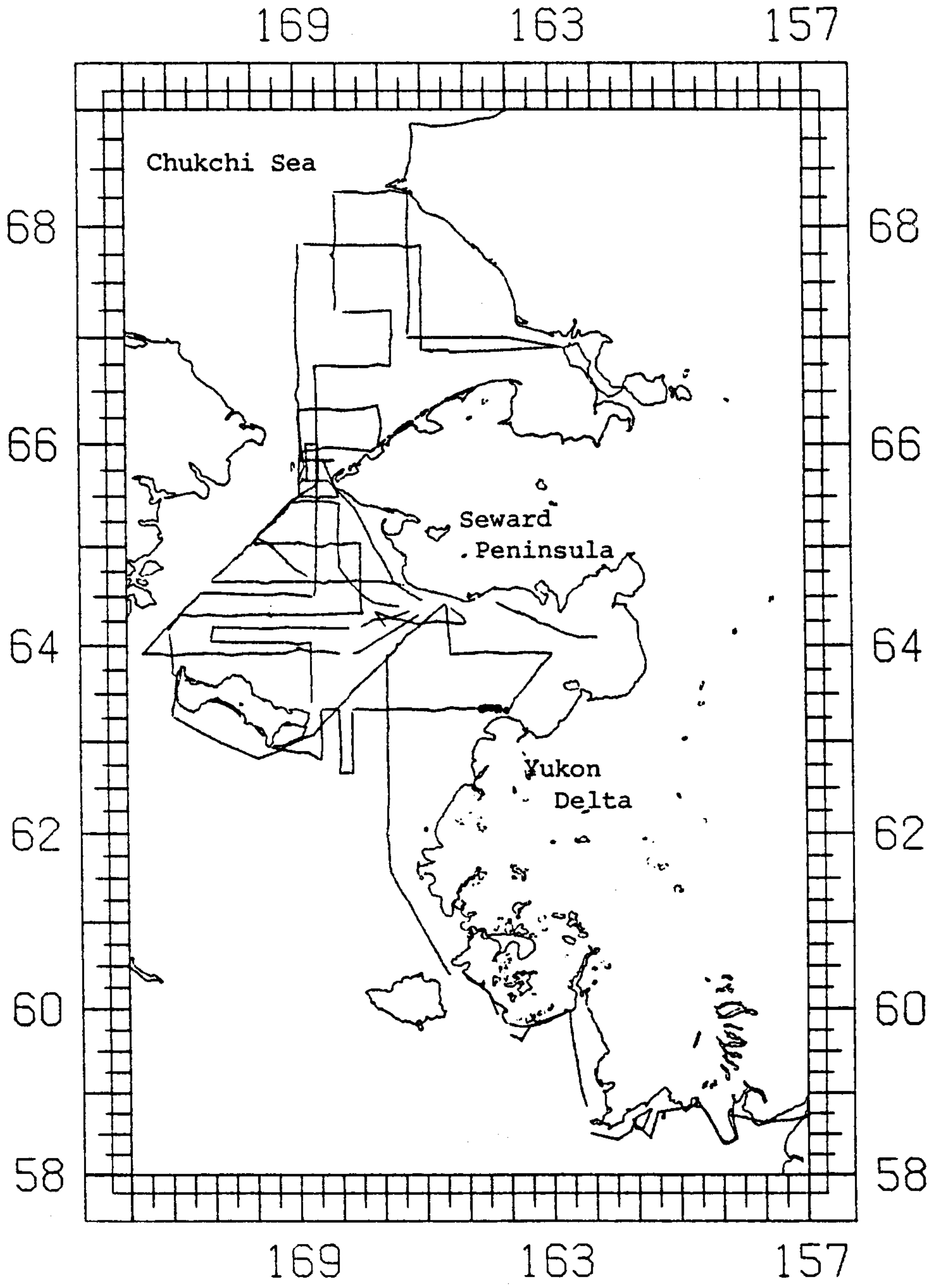

Figure 20.--Aerial survey tracklines flown in the northern Bering and southern Chukchi Seas 8, 9, 10, 11, 12, 13 and 14 June 1976. Dots represent presence of white whales: a total of 18 whales were counted with a mean group size of 1.6 (S.D. 1.4).

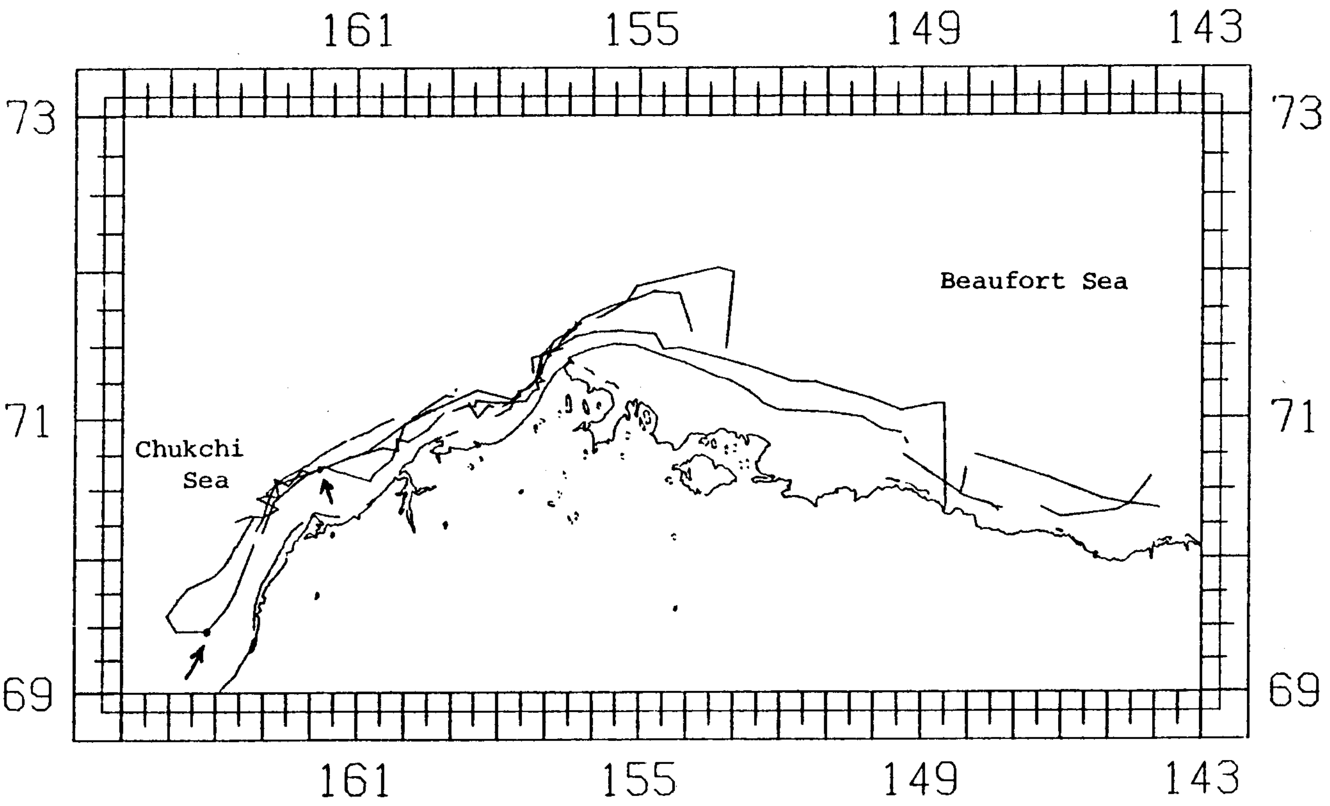

Figure 21. Aerial survey tracklines flown in the eastern Chukchi and western Beaufort Seas on 18, 19, and 20 June 1976. Dots (highlighted by arrows) represent presence of white whales: a total of 73 whales were counted with a mean group size of 36.5 (S.D. 34.6).

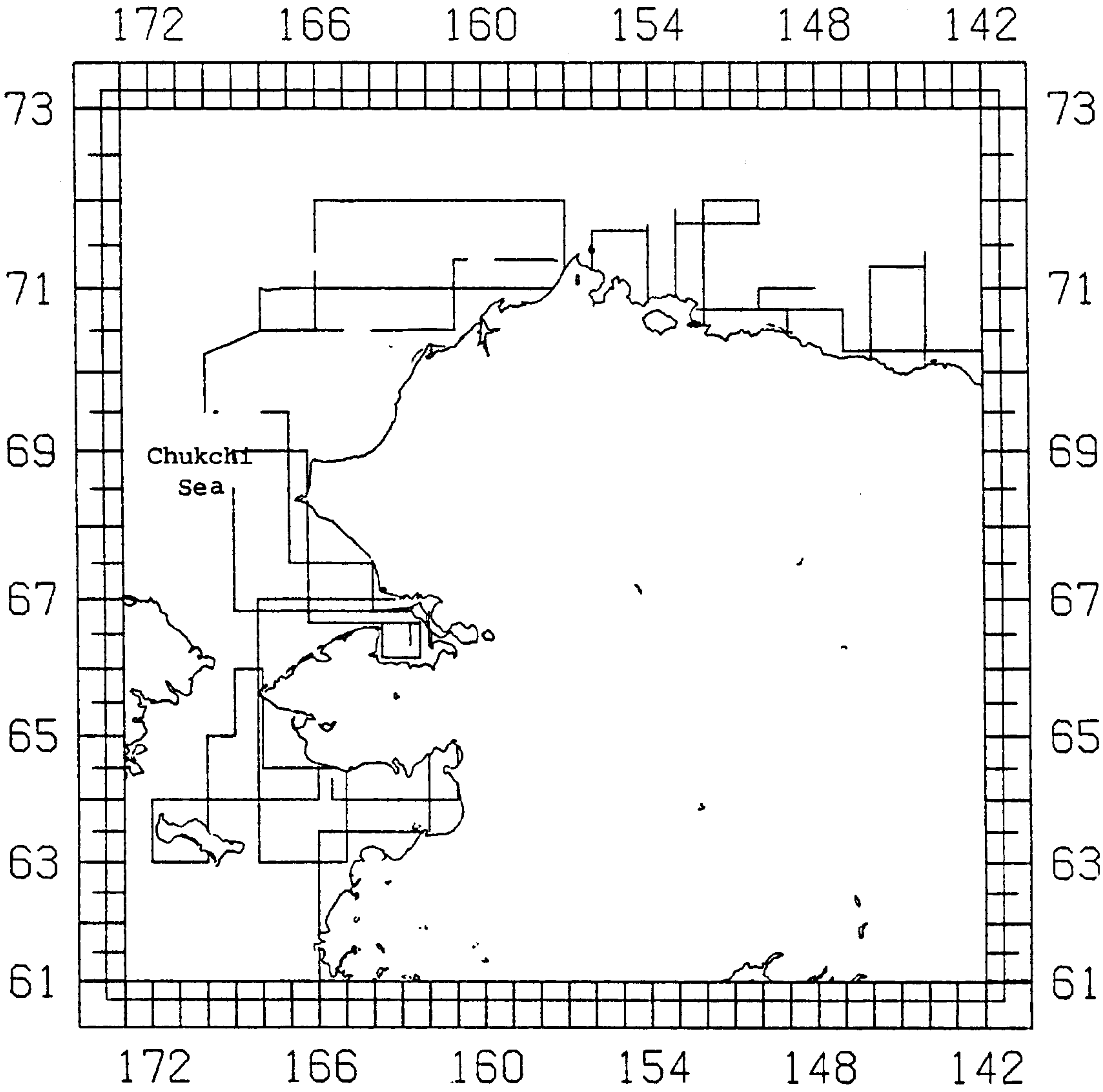

Figure 22.--Aerial survey tracklines flown in the northern Bering, eastern Chukchi and western Beaufort Seas 17, 18, 19, 20, 21, 22, 23, 24, 25 and 26 August 1976 during bird surveys conducted by the U.S. Fish and Wildlife Service. The dot represents 4 bowhead whales seen just east of Pt. Barrow in open water.

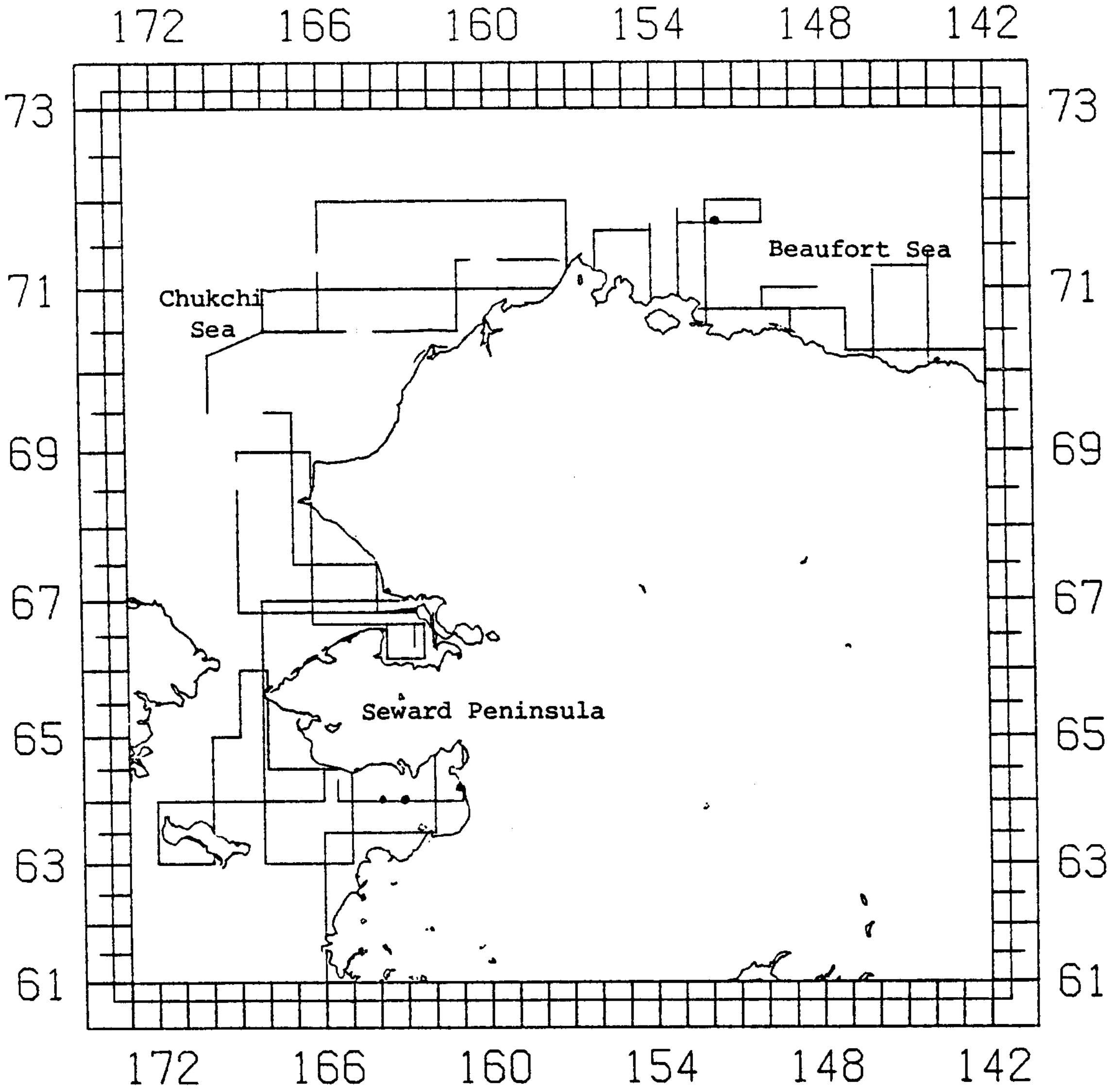

Figure 23.--Aerial survey tracklines flown in the northern Bering, Chukchi and western Beaufort Seas during bird surveys conducted by the U.S. Fish and Wildlife Service on 17, 18, 19, 20, 21, 22, 23, 24, 25 and 26 August 1976. Dots represent presence of white whales: a total of 7 whales were counted with a mean group size of 1.2 (S.D. 0.4).

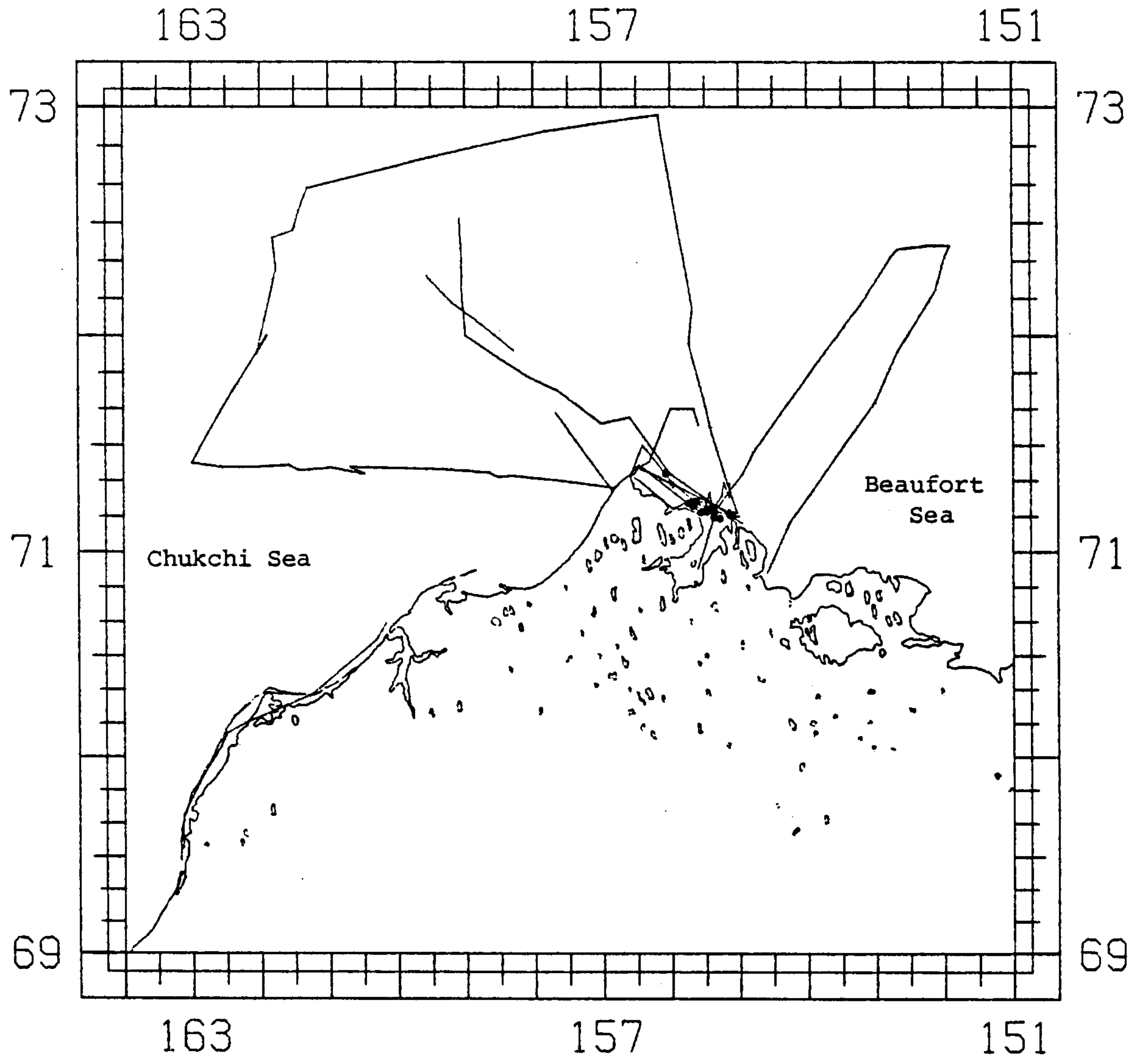

Figure 24.--Aerial survey tracklines flown in the eastern Chukchi and western Beaufort Seas on 20, 21, 22, 24 and 26 September 1976. Dots represent presence of bowhead whales: a total of 102 bowheads were counted with a mean group size of 2.7 (S.D. 3.5).

invertebrate production. It is likely these animals, and perhaps more, summered in this region in 1976. A few Eskimo whalers from Barrow have told us that this is not an uncommon occurrence. Tracklines were flown offshore during this period in 1976 but no bowheads were observed.

Results were inconclusive as to whether or not bowheads congregate every year nearshore east of Point Barrow. During a 12-22 September 1974 aerial survey by Fiscus and Marquette[15] many bowhead were observed near Cape Simpson; the highest count, 57, was made on 18 September 1974. During the 26 August-13 October 1977 survey, however, only seven bowheads were observed in the area (Figure 25). Of significance, though, was that most of the 1977 sightings were made offshore, probably of whales on their return migration from the Beaufort into the Chukchi Seas.

Although the data are sparse, they indicate that bowheads move west and south in September. We have, as does C. Ray, sightings that place bowheads at three locations during September: 1) east along the northern coast of Alaska to within 100 km of Point Barrow; 2) south of Barrow along the coast to Peard Bay lat 70°50'N, long 158°30'W; and 3) west of Point Barrow some 100 km into the Chukchi Sea.

One white whale was observed during the 20-26 September 1976 survey (Figure 26). Eighty-nine white whales were observed on the 26 August-13 October 1977 survey (Figure 27). The westward migration of white whales past Point Barrow appears to be predominantly offshore.

No bowheads were seen on the 9-14 October 1975 survey conducted over the southern Chukchi and northern Bering Seas (Figure 28). A. Berzin (TINRO, Magada, USSR, Pers. commun., 14 February 1979) reported seeing bowhead whales near the Soviet coast of the Chukotka Peninsula during surveys conducted in October 1974 and 1975 (Figure 29). His sighting (in Figure 29), commercial whaling records (Figure 2), and our results reported in Johnson et al. (1981) indicate that at least some, and perhaps most bowheads migrate to the northern coast of Siberia in the autumn before moving south through the Bering Strait and into the Bering Sea to their wintering grounds.

Twenty large, apparently adult bowheads were observed north of Point Barrow at lat 71°N between long 156° and 157°W on 22 October 1978 (Savage 1978)[16]. The animals were following a large slow moving ice floe and appeared to be feeding. As ice appeared to cover the Beaufort Sea east of

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[15] Fiscus, C. H., and W. M. Marquette. 1975. National Marine Fisheries Service field studies relating to the bowhead whale harvest in Alaska, 1974. Processed rep., 23 p. Natl. Mar. Mammal Lab., Northwest and Alaska Fish. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, Wash. 98115.

[16] Savage, S. 1978. Distribution of B. mysticetus and D. leucas in the Beaufort Sea, October 1978. Unpubl. manuscr., 11 p. Natl. Mar. Mammal Lab., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, Wash. 98115.

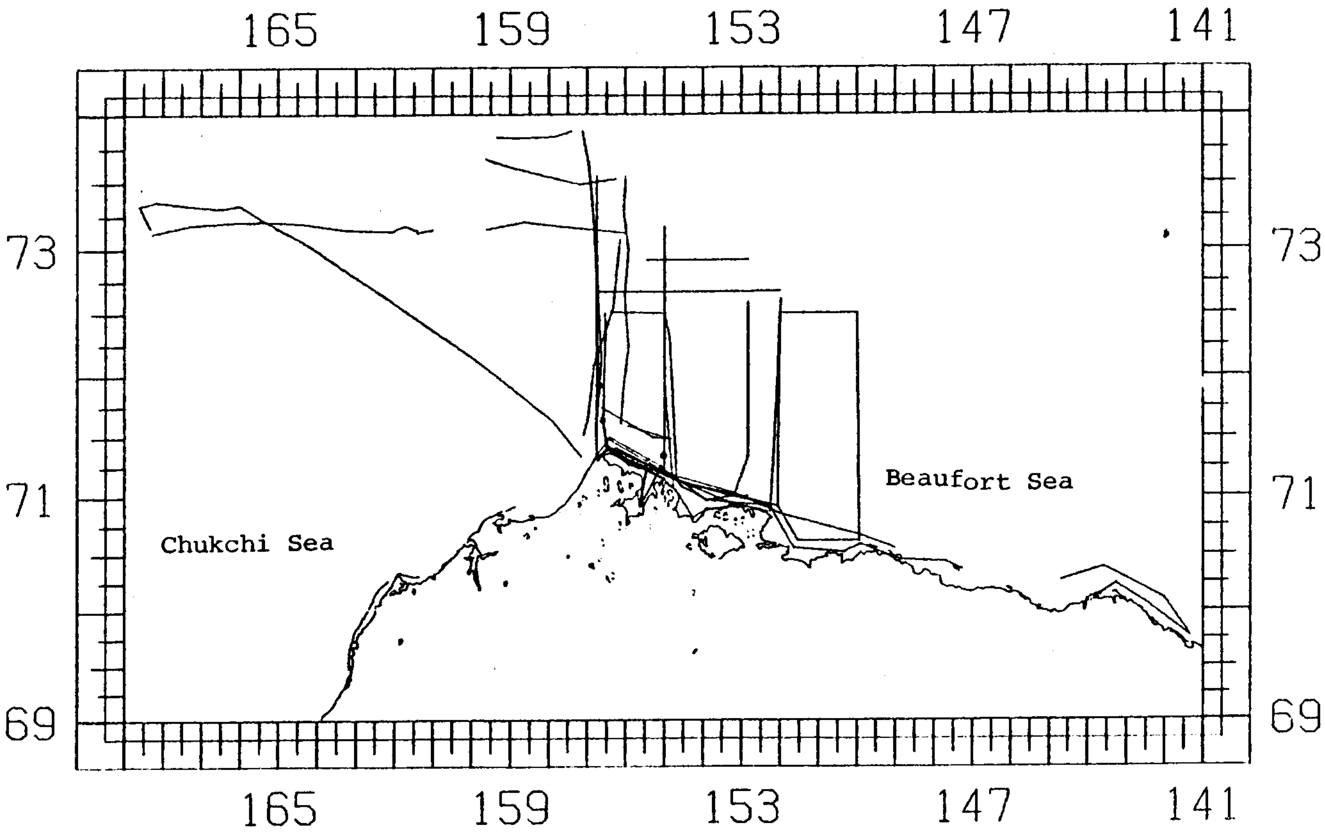

Figure 25. Aerial survey tracklines flown in the eastern Chukchi and western Beaufort Seas on 26 and 29 August 1977, 1, 5, 8, 10 and 14 September 1977, and 3, 6 and 13 October 1977. Dots represent presence of bowhead whales: a total of 7 bowheads were counted in September and October with a mean group size of 1.2 (S.D. 0.4). No whales were observed in August 1977.

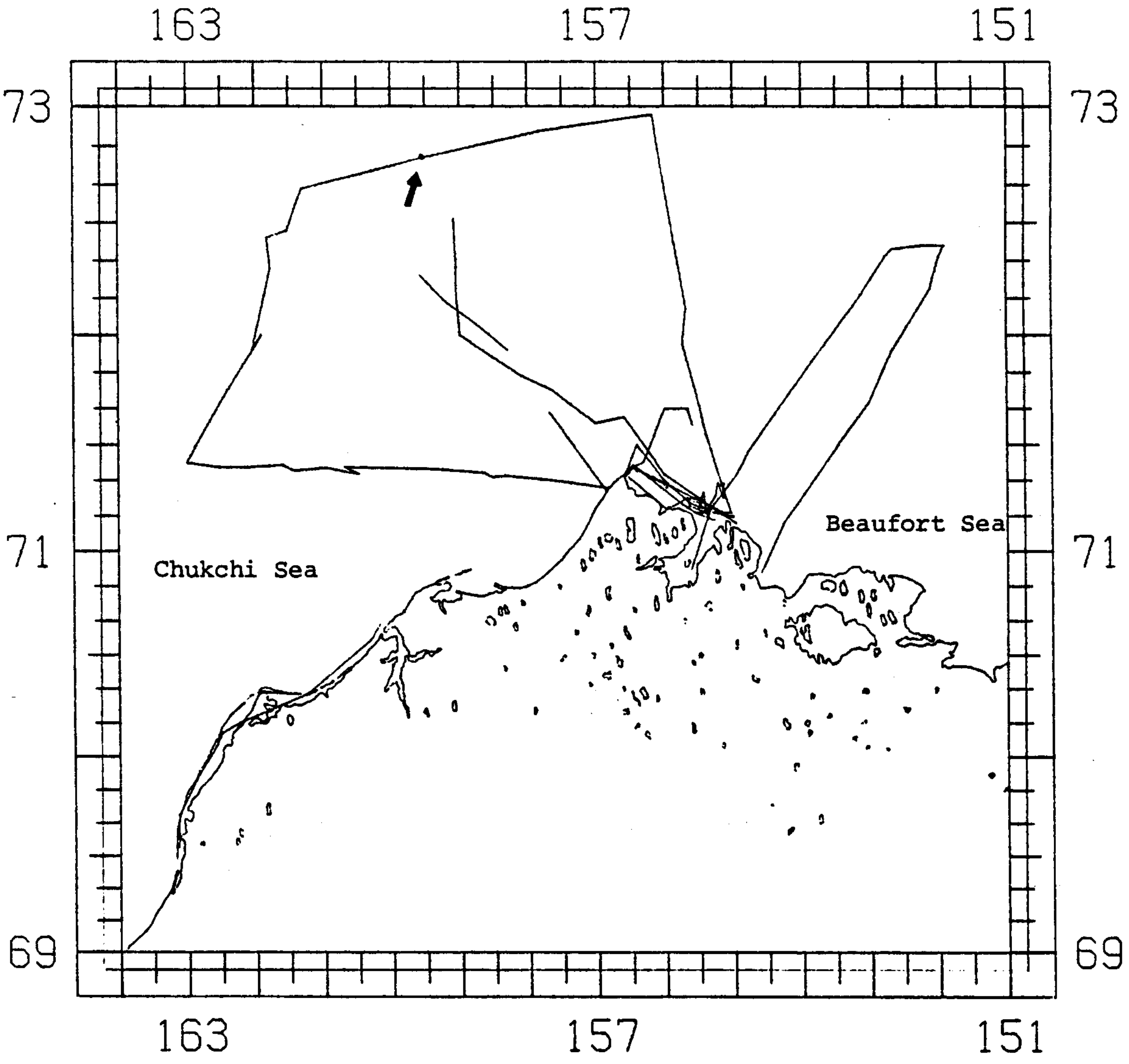

Figure 26.--Aerial survey tracklines flown in the eastern Chukchi and western Beaufort Seas 20, 21, 22, 24 and 26 September 1976. The dot (highlighted by an arrow) represents one white whale seen.

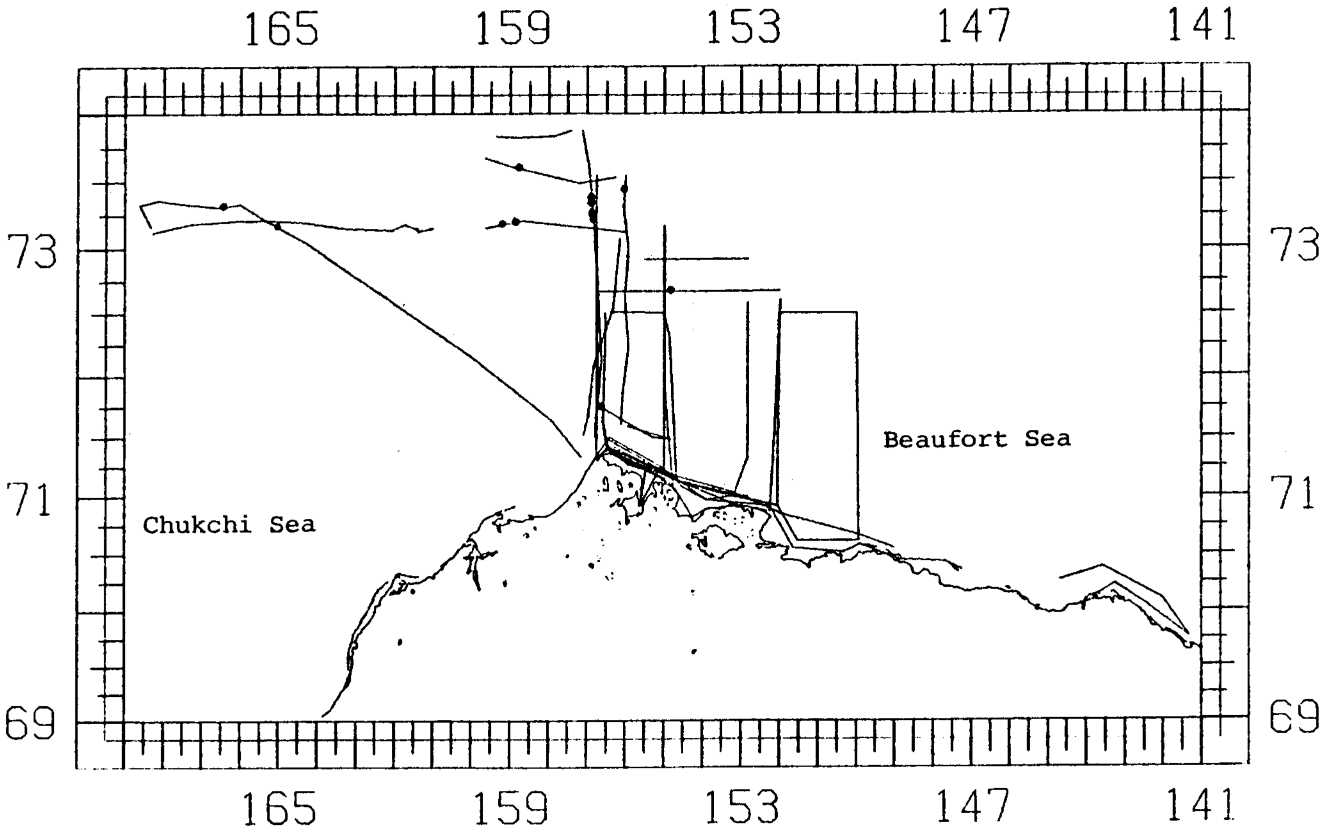

Figure 27. Aerial survey tracklines flown in the eastern Chukchi and western Beaufort Seas on 26 and 29 August 1977, 1, 5, 8, 10 and 14 September 1977, and 3, 6 and 13 October 1977. Dots represent presence of white whales: a total of 89 were counted with mean group size of 4.0 (S.D. 3.5). All but three of the 89 were observed on 10 and 14 September.

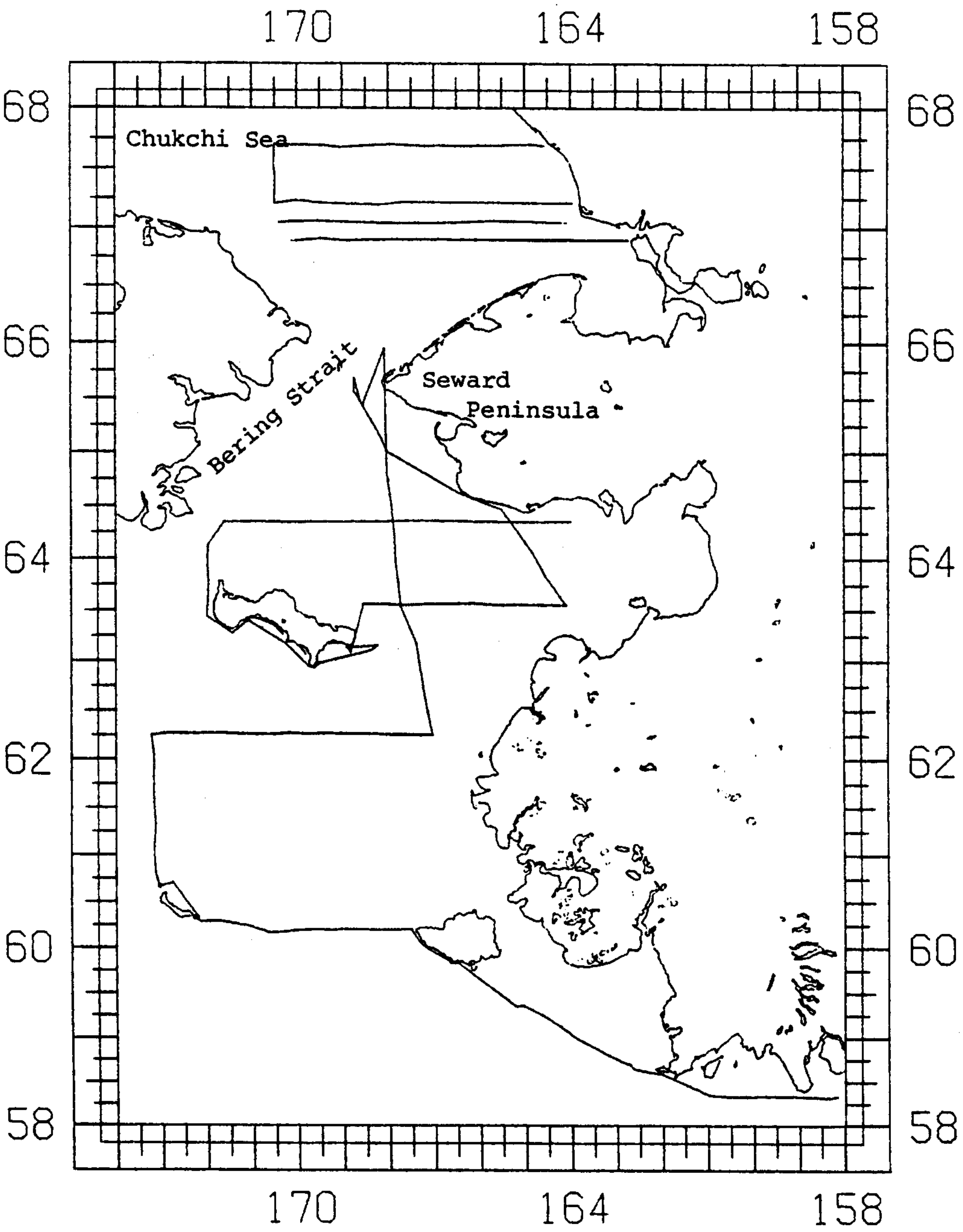

Figure 28.--Aerial survey tracklines flown in the northern Bering and southern Chukchi Seas on 9, 12 and 14 October 1975. No bowhead or white whales were observed.

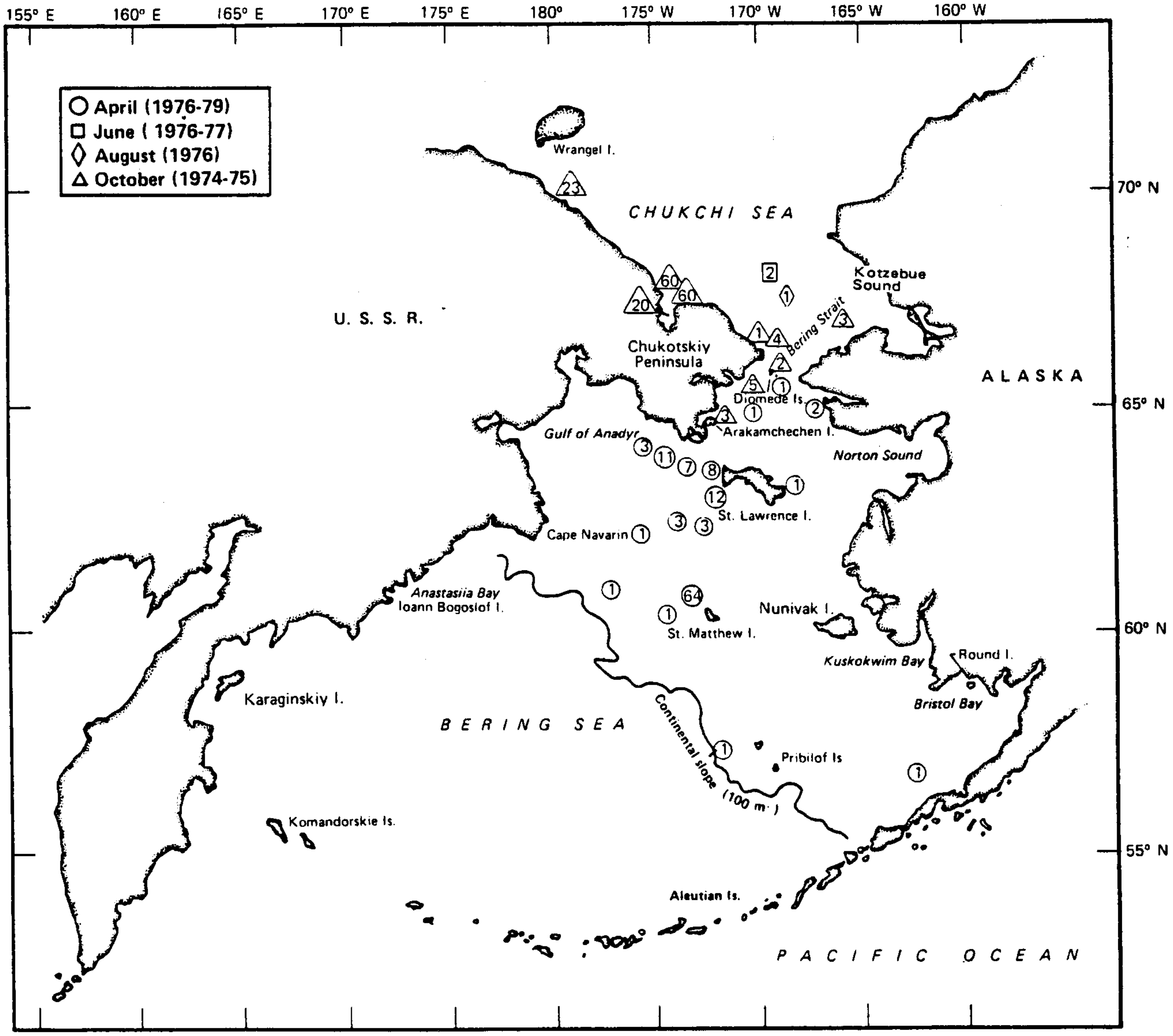

Figure 29.--Bowhead whale sightings in the Bering and southern Chukchi Seas, 1974-1979, from aerial and vessel surveys. October sightings (Δ) were provided by A. Berzin, Pers. commun. For greater detail see Braham et al.(1980c).

long 152°W on this date, Savage felt that these sightings were made near the end of the autumn westward migration. Details of the few other sightings made in October 1978 and the unsuccessful aerial survey effort of the area around Prudhoe Bay in September 1978 are reported in Braham et al. (1980b).

DISCUSSION AND REVIEW

WESTERN ARCTIC-BERING SEA POPULATION OF BOWHEAD WHALES

Distribution and Migration

Bowhead whales of the western Arctic-Bering Sea stocks occur seasonally from the west central Bering Sea northward along the coast of Siberia and around St. Lawrence I. in the northern Bering Sea, throughout the Chukchi Sea and in fewer numbers in eastern East Siberian Sea, and eastward throughout the U.S. Beaufort Sea to Banks Island and Amundsen Gulf, Northwest Territories, Canada (Figure 1).

The exact location of the wintering area for bowheads is not known, but the western and central Bering Sea appear to be the most probable location (Sleptsov 1961; Durham 1972[10/]; Braham and Krogman[1/]; Braham et al. 1980c). Results from our icebreaker survey in March and April 1979 indicated that bowheads winter in the west central Bering Sea pack ice (Braham et al. 1980b). Comments made to Braham by A. Berzin, (TINRO, Vladivostok, USSR, Pers. commun., 14 February 1979) indicate that in some years a few bowheads may winter in open water in the Gulf of Amadyr. The waters around St. Lawrence Island are occupied intermittently by bowheads, dependent upon open water, from approximately December to April (Braham et al. 1980a, b). Past whaling records and reported observations by Alaskan Eskimos support the hypothesis that bowhead winter distribution is south and west of St. Lawrence Island to the pack ice front and perhaps further south into open water. Townsend's (1935) records of bowhead whale catches and recent data from Bockstoce and Botkin[12/] show that large numbers of whales were taken from Cape Olyutorskiy north to the Gulf of Anadyr, USSR, and adjoining waters during early spring and summer during commercial whaling when bowheads were more abundant than now. Few whales were taken or have been observed in the eastern Bering Sea, despite extensive aerial and shipboard surveys. Of those sightings in the eastern Bering Sea over the Continental Shelf, most were in the vicinity of the Pribilof Islands (Townsend 1935) and St. Matthew Island (Hanna 1920; Braham et al. 1980a). In April 1976, at least two bowheads were seen in outer and southern Bristol Bay representing the most southeastwardly sighting of the species (Figure 29).

The northward spring migration of the bowhead whale from the Bering Sea is timed with the breakup of the pack ice (Bailey and Hendee 1926; Foote 1964;[17/] Nishiwaki 1967; Durham[10/]). This generally occurs in April (Sleptšov 1961) or earlier in a mild ice year (as in 1979). At that time,

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[17/] Foote, D. C. 1964. Observations of the bowhead whale at Pt. Hope, Alaska. Unpubl. manuscr., 73 p. Available on loan at the Natl. Mar. Mammal Lab., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, Wash. 98115.

most whales travel north through the Strait of Anadyr, between St. Lawrence Island and Chukchi Peninsula, continuing north by northeast through the Bering Strait probably on the Soviet side, west of Big Diomede Island (Braham et al. 1979). During an "average" ice year, apparently few animals migrate through the eastern half of the northern Bering Sea--heavier ice usually occurs there than to the west. Even so, Eskimo whales at Wales periodically take bowheads along the Alaska coast near the Bering Strait (Marquette[13]; Johnson et al. 1981). Most of the migrating animals have passed through this corridor between St. Lawrence Island and the coast of the Chukotka Peninsula by mid-May (Bailey and Hendee 1926; Foote 1964[17]; Durham[10]; Burgess 1973[18]; Braham and Krogman[1]; Braham et al. 1979, 1980a).

Upon entering the Chukchi Sea the migration is northeasterly across outer Kotzebue Sound in leads occurring in the flaw zone. A few whales move into a polynya that characteristically forms between Kivalina and Point Hope, but most whales move past Point Hope some offshore to 45-90 km (Braham et al. 1980c). A few whales might migrate into the western Chukchi Sea in spring; however, this is unlikely as pack ice is extensive with few leads north of the Chukotka Pensinsula (Braham et al. 1979; G. Fedoseev, Pacific Scientific Research Institute of Fisheries, Oceanography, Magadan, Nagaevskaya, 51, 685013, USSR, Pers. commun., 28 February 1977). Apparently, Siberian Eskimos living along the north side of the Chukotka Peninsula did not hunt bowheads in the spring as did their counterparts along the east side of the Peninsula (A. Berzin, Pers. commun., 14 February 1979).

Proceeding northerly on a heading of 10-20° magnetic (Braham et al. 1980b) bowheads follow open leads north past Cape Thompson and Point Hope and then northeasterly to Cape Lisburne and Point Barrow. The migration past Cape Lisburne seems to follow two or more corridors, depending on the number of leads, 2-10 km offshore; sightings have been made to 15 km offshore (Rugh and Cubbage 1980). No bowheads have been observed in offshore leads between Point Lay and Point Barrow during 4 years of aerial surveys, even though aerial survey time has been split equally between offshore (to 100 km) and nearshore coverage (Braham and Krogman[1]; Braham et al. 1979, 1980a, b). The majority of bowheads have usually passed Point Hope by mid-May (Foote[17]; Johnson et al. 1966) and occur in peak numbers at this time at Point Barrow (Maher and Wilimovsky 1963; Fiscus and Marquette 1975[15]; Braham and Krogman[1]; Braham et al. 1979, 1980a). The migration along the northwest coast (Bering Strait to Point Barrow) essentially covers the period mid-April to early June, with a few whales migrating by thereafter.

Previous authors and numerous Eskimo whalers describe the bowhead migration as occurring in three waves or pulses of whales that pass by the northwest coast each spring (Foote[17]; Marquette[13]). Examination of Figure 3 confirms that at least two pulses of whales migrated past Point Barrow in 1976, 1977, and 1978. These pulses appeared to occur in late April-early May and again near mid-May. A third pulse may occur in late May or early June; but our data either do not support this or are incomplete.

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[18] Burgess, S. 1973. Marine mammal phenology in western St. Lawrence Island waters. (Abstract.) In Proc. p. 49. 23rd Alaska Sci. Conf., August 15-17, Fairbanks, Alaska Div., Amer. Assoc. Advancement Sci.

The significance of this bimodal, or trimodal, distribution is not clear, but Eskimo whalers associate it with age, sex and/or segregation of cow-calf pairs from other adults in the population. This cannot be confirmed from sightings and harvest data collected between 1975 and 1980.

From Point Barrow the whales travel northeasterly into the Beaufort Sea to Banks Island and Amundsen Gulf, Canada, some by early May (Braham and Krogman[1/]; Fraker et al. 1978; Braham et al. 1979). Leads do occur closer to shore, but no whales were seen in them (Figures 10, 15 and 18), nor are the nearshore leads extensive. Further evidence in support of the hypothesis that bowhead and white whales migrate offshore in the Beaufort Sea in the spring independently proposed by Braham and Krogman (1977)[1/] and Fraker (1977)[19/] is reported in Braham et al. (1979, 1980b). The portion of the population which enters Canadian waters compared to the number passing Point Barrow is unknown. In the Canadian Beaufort Sea bowheads remain from May until late August or September (Cook 1926; Townsend 1935; Foote[17/]; Sergeant and Hoek 1974; Fraker et al. 1978) before beginning the return autumn migration west. From June to September bowheads are reported to frequent Amundsen Gulf, Franklin Bay, Coronation Gulf, the east side of the Mackenzie Delta, and various areas south of Banks Island (Cook 1926; Townsend 1935; Anderson 1946; Porslid 1950; Hohn 1958; Sergeant and Hoek 1974; Allen 1978; and Fraker et al. 1978).

In August and September bowheads begin to leave the eastern Beaufort Sea on their autumn migration back to the Bering Sea (Cook 1926). The whales travel west in the southern Beaufort Sea, where they are hunted during September and October by Alaskan Eskimos from Kaktovik, Nuiqsut, and Barrow (Brower 1942; Maher and Wilimovsky 1963; Marquette[13/]). Whales traveling this route have been sighted or harvested near Herschel Island (Cook 1926; Townsend 1935); Barter Island (Marquette[13/]), Cross Island (T. Brower, Barrow, Alaska, Pers. commun., 4 October 1977); Colville River and Harrison Bay (Brower 1942); and Cape Simpson and Plover Islands (Braham and Krogman[1/]; A. Brower, Barrow, Alaska, Pers. commun., 19 May 1978). Their spatial distribution from the shore to the pack ice during the autumn migration is not known, but it is likely to be dependent on ice conditions, food availability, and water depths. Sightings made in the Beaufort Sea since 1974 (Figure 30) indicate that bowheads are distributed from shallow coastal waters to the pack ice. The numerous sightings in shallow water from Point Barrow to Smith Bay (Figure 30) seem to confirm the importance of the nearshore areas to this species in the western Beaufort Sea.

From Point Barrow the animals appear to move westerly to Herald Shoal and Herald and Wrangel Islands (Cook 1926); Townsend 1935; Bockstoce 1977), then south through the Chukchi Sea into the Bering Sea. There is speculation by Soviet scientists that bowheads pass to the Bering Sea by traveling the

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[19/] Fraker, M. A. 1977. The 1976 white whale monitoring program, Mackenzie Estuary, N.W.T. Imperial Oil Ltd. Unpubl. rep., 73 p. F. F. Slancy & Co., Ltd., Vancouver, B. C., Can.

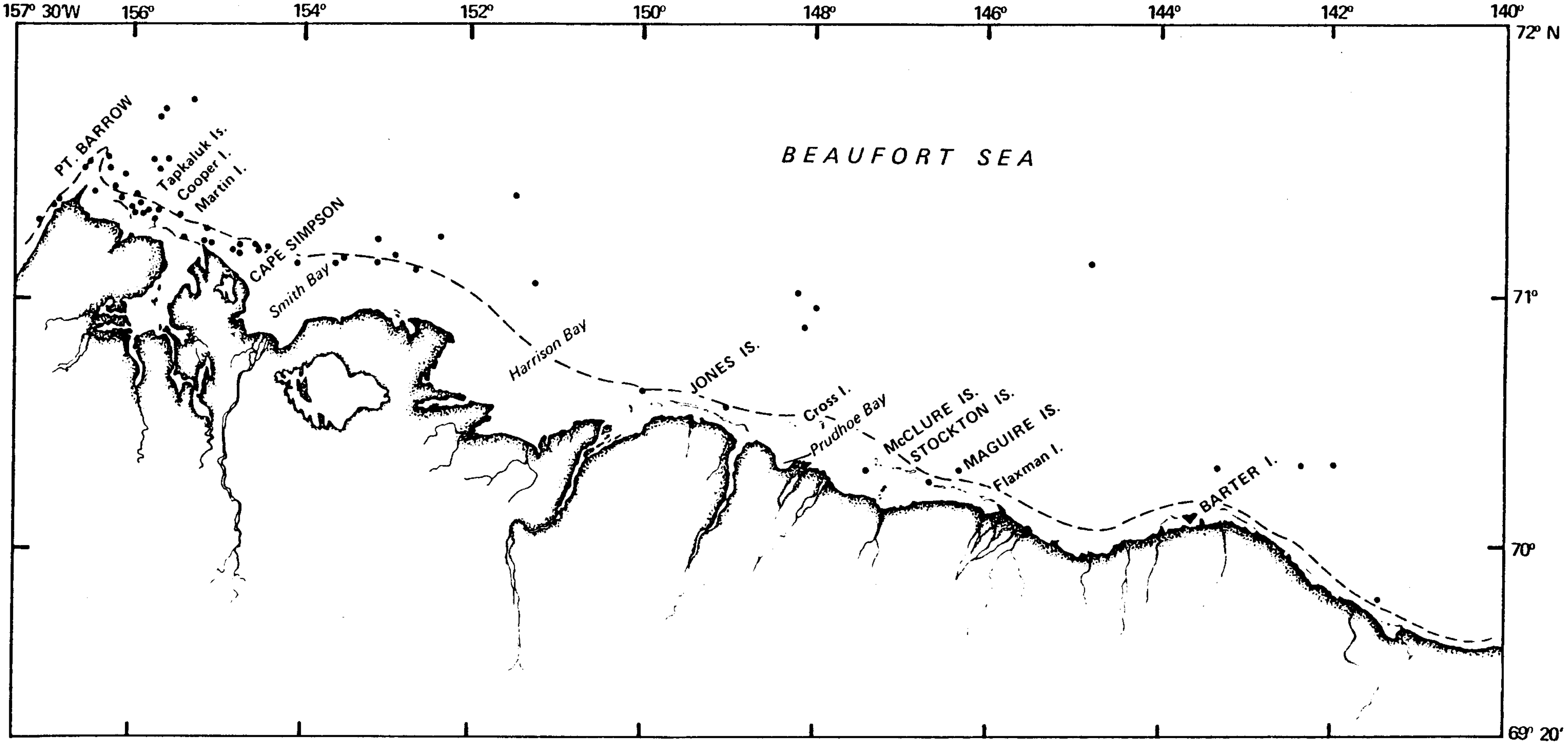

Figure 30.--Bowhead whale sightings (.) in the Beaufort Sea, August through November, 1974-1978. Only sightings with a verified position were used. Most sightings occurred in the last half of September. The dashed line represents the 12 m depth contour.

the western Chukchi Sea. Some animals appear to move southwest along the northwest coast of Alaska past Point Barrow to the Bering Strait, but this probably varies with weather and ice conditions. Most in the population migrates to the north side of the Chukotka Peninsula before entering the Bering Sea (Figure 2; Townsend 1935; Johnson et al. 1981). Johnson et al. (1966) and F. Durham (University of California, Los Angeles, Pers. commun., 21 September 1978) believed that the fall migration through the Chukchi Sea followed an offshore passage, since bowheads were not seen at Wainwright, Cape Thompson, Point Hope, or Kivalina in the autumn during their studies. Bowheads generally enter the northern Bering Sea in November and December, although sometimes they are seen in late September, arriving in central Bering Sea wintering areas in December-February (D. Harry and C. Oozeva, Gambell, Alaska, Pers. commun., 25 July 1978 and 25 February 1979, respectively).

Life History and Associated Information

Reproduction

Facts about the reproductive biology of the bowhead whale are scant, though information gathered on animals harvested by Alaskan Eskimos has provided opportunities to study this species' reproductive cycle. A summary of some estimated reproductive life history data are reported in Table 2.

Sexual maturity is reached when animals attain lengths exceeding 1100 cm. Durham[10/] (1979) reported that males attain sexual maturity at 1,158 cm (38 ft) and females at 1,220 cm (40 ft) at 4 years of age. Marquette[13/] noted that two female whales taken at Barrow, one accompanied by a newborn calf and the other containing a fetus, measured 1,525 cm (50 ft) and 1,730 cm (56 ft 6 in) long, respectively. From the presence of corpora albicantia in ovaries of 12 whales harvested in 1978 and 1979, sexual maturity in females may be reached at about 1,200 cm (preliminary findings); and adult females are larger than males (Johnson et al. 1981). Age, and length at first pregnancy, however, is unknown.

The mating period of the bowhead whale is not well known. Durham[10/] maintained that mating occurs in early April before the whales reach Point Hope. Foote[17/], however, observed what appeared to be copulatory behavior in May, as whales passed Point Hope. Copulatory behavior was also reported by Krogman (1979) and Everitt and Krogman (1979) in May north of Point Barrow. Mating behavior of Atlantic bowheads was reported in late summer (Scoresby 1820). Possible copulation was witnessed on 16 March 1979 west of St. Matthew Island (Braham et al. 1980a). Mating may therefore occur from late winter to summer, with spring (April-June) being the more probable peak period.

Gestation is estimated to last 1 year. Scoresby (1820) believed that bowheads have a 9-10 month gestation period, while Eschricht and Reinhardt (1866) believed it to be 13-14 months. Durham (1980)[10/] reported from observations of harvested bowheads taken at Point Hope and Barrow that the gestation period is 12 months. The actual length, however, is still unknown.

TABLE 2.--Summary of some estimated reproductive life history data for bowhead whales.

Life history parameter	Parameter value	Area data collected	Reference
Sexual maturity			
Males	11 m	Chukchi Sea	Durham[10](1979)
Females	12 m	Chukchi Sea	Durham[10](1979); Johnson et al. (1981)
Calving and mating period	March-May	No. Atlantic	Eschricht and Reinhardt (1866)
	March-June	Bering to Beaufort Seas	Braham and Krogman[1]; Braham et al. (1979, 1980a); Everitt and Krogman (1979)
	April	Chukchi Sea	Durham[10]
	April-June	Chukchi Sea	Maher and Wilimovsky (1963); Marquette (1976)
	April-August	Western and eastern Arctic	Summarized in Marquette[13]
	May	Chukchi Sea	Foote[17]
	May-July	No. Atlantic	Gray (1886)
Gestation	9-10 mo.	No. Atlantic	Scoresby (1820)
	12 mo.	Chukchi Sea	Durham (1980)
	13-14 mo.	No. Atlantic	Eschricht and Reinhardt (1866)
Lacation	5-6 mo.	Beaufort Sea	Marquette[13]
	12 mo.	No. Atlantic	Slijper (1962)
	711-851 cm (calf length)	-	Tomilin (1957)

The calving period is reported to correspond with the time of mating--early spring to early summer. Cows with calves pass Point Hope and Point Barrow from mid-April to early-June (Maher and Wilimovsky 1963; Marquette 1976; Braham et al. 1979). Whalers in the eastern Arctic reported seeing apparent cows with calves from early May to July (Gray 1886). Durham[10/] believed that bowhead whales in the western Arctic calve in early April. Eschricht and Reinhardt (1866) in the eastern Arctic Canada reported calving occurred from late March to early May. Most researchers agree that a single calf is born.

Although recognizing that parturition has never been observed, our scant sightings of calves indicates that bowheads probably give birth in spring, perhaps a few before (February-March) but most during migration (April-June). Marquette[13/], summarizing the known data on calving, provides information that bowheads may calve from April through August. Observations of calves in the spring (Braham et al. 1979, 1980c) and apparent copulatory behavior in the late winter (Braham et al. 1980a) and spring (Everitt and Krogman 1979) with no sightings reported for the autumn, also indicate that the peak period of mating and calving is March-June, with few calves being born in summer or autumn if any.

The length of newborn calves has been measured at 305-460 cm (10-15 ft) (Scoresby 1820; Durham 1980). Bodfish (1936) estimated the length of newborns at 305-366 cm (10-12 ft); Eschricht and Reinhardt (1866) reported lengths of 366 to 396 cm (13-14 ft). An apparent newborn calf taken at Barrow 20 May 1954 was measured by Eskimos at 300-350 cm (10-12 ft) (Marquette[13/]). According to these findings the average length of a newborn bowhed whale is about 360 cm (12 ft). One bowhead calf with attached umbilicus taken at Barrow in 1971 or 1972, was estimated (no measurements made) by resident Eskimo whalers to be about "20 ft" long, or 615 cm (O. Leavitt and J. Adams, Alaska Eskimo Whaling Commission, Barrow, Alaska, Pers. commun., 15 May 1978). This is unusually large for a newborn, if the estimate was accurate.

Information on the duration of the lactation period in bowheads is scant and variable. Slijper (1962) reported the lactation period to be 12 months. Marquette[13/] stated that since lactating females have not been recorded in the autumn take near Barrow, lactation may last only 5 or 6 months. Tomilin (1957) reported that lactation ends and calves are weaned at a length of 711-851 cm (23-28 ft). Although inconclusive, it appears that bowheads have a 6-12 month lactation period. Since yearlings are not seen in very close association with adults in spring, it seems unlikely that lactation lasts one year. Lactation in gray whales last approximately 4 months (Rice and Wolman 1971).

Based on the estimated lactation and gestation periods, the calculated calving interval for female bowhead whales is at least 2 years and may indeed be longer. Large, long-lived mammals are characterized in having calving intervals of more than 2 years (Fowler and Smith 1973; Goodman 1978).

Food Habits

Nemoto (1976) classified the bowhead whale as a bottom skimmer, and although individuals have been observed feeding in shallow waters, bowhead probably feed throughout the water column. A comprehensive study of bowhead feeding has not been conducted; however, the small data base from the available literature indicated that pelagic arthropods (euphausiids, mysids, pteropods, copepods, and amphipods) are the prey species mostly taken, and, to a lesser extent, annalids, molluscs, and echinoderms (Mitchell 1975; Marquette13/; Lowry et al. 1978). Johnson et al. (1966) examined the stomach contents of three bowhead whales taken by Point Hope Eskimos in the spring. The stomachs were empty and the third contained fragmentary remains of polychaetes, reptantia, gastropods, crustaceans, echinoides, and sand and gravel. Lowry et al. (1978) analyzed the stomach contents of two bowhead whales taken at Point Barrow in the fall of 1977 and found that together they contained (by volume) 90.3% euphausiids (*Thysanoessa raschii*), 6.9% gammarid amphipods (*Gammarus zaddachi*, *Acanthostepheia behringiensis*, *Monculoides zernovi*, and *Rozinante fragilis*) and 2.7% hyperiid amphipods (*Parathemisto libellula*). Five bowheads taken by Kaktovik whalers off Barter Island autumn 1979 had primarily euphausiids and copepods (*Calanus spp.*) in their stomachs (Lowry and Burns 1980). A one year study of bowhead feeding contracted by us to the Alaska Department of Fish and Game, Fairbanks, determined that competition for food with arctic cod may be important in some years if food is limiting (Frost and Lowry 1981)20/. Of the 17 bowhead whale stomachs and intestinal tracks examined to date from whales landed at Barrow and Kaktovik with discernable prey items present, the following proportions in the bowhead diet were: euphausiids - 65%; copepods - 30%; hyperid amphipods 1%; and all others, primarily including amphipods - 4% (see Marquette et al. 1981 for a summary of Frost and Lowry20/).

Behavior

Essentially all bowheads progress steadily through the nearshore lead during the spring migration along the northwest coast of Alaska, following a fairly straight course towards the northeast (20-30° magnetic north). Since the NMFS ice camp studies were initiated in 1976 less than 1% of all bowheads seen were going southwest in the spring (Carroll and Smithhisler 1980). The rare exceptions occurred when the lead was obstructed by ice, or when the whales were resting, feeding (presumably), courting, mating, or breaching. Most whales progressed past the ice camp at a rate of 1.9-7.5 km/hr (1.0-4.0 nmi/hr) depending on the direction of the current; this rate of travel was confirmed by studies at Cape Lisburne (Rugh and Cubbage 1980).

Bowheads do not travel in close association with one another. Of 2,406 bowhead observations recorded between 1976 and 1978, 1,815 (75.4%) were singles, 470 (19.5%) were in pairs, 105 (4.4%) were in groups of three, and

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20/ Frost, K. and L. Lowry. 1981. Feeding and trophic relationships of bowhead whales and other vertebrate consumers in the Beaufort Sea. Final report to Natl. Mar. Mammal Lab., Contract No. 80-ABC-00160., Northwest and Alaska Fisheries Center, NMFS, NOAA. 106 p. Unpubl. manusc. Alaska Rep. Fish Game, 1300 College Rd, Fairbanks, Alaska 99701.

16 (0.7%) were in groups of 4. There were noticeable peaks during the course of the migration, sometimes related to ice conditions, but also at times when the whales had free movement in the lead.

When bowheads come to the surface to breathe, they usually break the water surface from 1 to 14 times, with each surfacing (roll) interrupted by a short shallow dive. Exhalation is not always observed during each roll. A completed series of rolls is termed a rise (= total number of rolls visible during a passage of one whale in front of an observer). The mean number of rolls per rise recorded from 1975 to 1977 was 6.57 (SD = 3.08; n = 63), while the mean in 1978 was 6.53 (SD = 2.84; n = 41)(Carroll and Smithhisler 1980).

Each time a bowhead rolled it was on the surface for a mean of 4.7 sec (SD = 2.0). The average time below the surface between blows (= rolls) was 10.8 sec (SD = 5.2). From this we calculated that the average amount of time a bowhead was above the surface per rise was about 31 sec. The average duration of a rise between the first roll and the sounding dive was 1.5 min.

The duration of sounding dives varied from 3.0 to 26.7 min. The mean dive time recorded during the 1975-1977 spring seasons was 15.2 min (SD = 4.4). Of 51 dives timed in 1978 the mean was 15.6 min (SD = 5.2). Combining these with the 1.5 min mean rise time, a time of 17.1 min was calculated for the complete cycle. On the basis of these data, we estimate that during their migration near Barrow, bowhead whales were visible above the water surface 3.1% of the time within the field of view of our ice camp observer(s). Using the same basic calculations, bowheads were visible to aircraft observers for approximately 8.4% of the time they were under observation.

The surfacing pattern of a cow and calf pair seems to be related to the calf's activity. Of three cow and calf pairs timed, mean dive time was 6.6 min (range 5.9-7.0 min). Calves often blew two times during each roll. Very small calves were seen during the migration, usually traveling very close to the accompanying adult. We judged these calves to be recently born.

Bowheads move steadily through partially closed leads by adjusting their diving and surfacing sequences to the size and location of open water in the pack ice. They take fewer breaths per rise and make shorter dives. A whale coming to a small polynya will roll as many times as it has time, while traveling at a normal speed, then dive when it comes to the distant edge.

Occasionally, the ice cover was so complete that the whales' progress was hindered and they were seen milling in polynyas. It appears that the whales dive, search and, if they do not find another polynya close enough, return to the original hole. Sea ice is more flexible than fresh water ice and both bowheads and white whales push up on the ice to breathe, forming hummocks. Bowheads have been heard exhaling under the ice when no apparent open water is available (Eskimo whalers, Pers. commun., 1976-1979).

Apparently bowheads are not always successful in finding open water nor in being able to lift pack ice to breathe. Tomilin (1957) and Southwell (1898) both cited instances of bowheads perishing in the ice, and Sleptsov (1961) stated that there was a mass mortality of several dozen bowheads in Karaginsky Bay in 1932. Cook (1926) also reported bowheads perishing under ice during the autumn in the Beaufort Sea. Unfortunately, the details of these events were not reported.

Bowheads do not seem habituated to small boats. An outboard will cause a bowhead to vacate an area. The normal reaction to being pursued is docile escape. If a bowhead is injured, it will often dive under the ice. Reaction to airplanes flying overhead seems mixed. Few whales have reacted vigorously to our presence when we fly between 130-300 m. On a few occasions we have flown above whales at 65 m without obvious disturbance (c.f. photos in Everitt and Krogman 1979 where altitudes were down to 65 m). In 160 encounters using a Coast Guard helicopter and flying at elevations below 300 m only 17 (11%) bowheads appeared to react noticeably to the aircraft noise. The same results occurred at altitudes down to 130 m (Braham et al. 1980a). It appears then that fright reaction to noise varies greatly, depending upon the source, time of year, environmental conditions, and activity of the animals. Surface noises in water appear to cause more frequent fright reactions by bowheads than noises originating above them in the air.

Occasionally bowheads show considerable exuberance. We have observed them breaching, tail lobbing, flipper slapping, swimming on their back and sides, and demonstrating other behavior. Along with numerous tail lobs and flipper slaps, a whale seen off Point Hope in 1977 breached 57 times in 96 min. We do not know the significance of these kinds of activities, but they may indicate a communicatory function (Rugh and Cubbage 1980).

During the autumn migration bowheads may travel in larger groups than in spring. Groups of 2-30 animals have been recorded in the Canadian Beaufort Sea (Sergeant and Hoek 1974), and several groups up to 20 animals each were seen in September of 1974 and 1976 east of Point Barrow. Unfortunately, the composition of these groups or their specific activities during the fall migration are not known.

WHITE WHALES IN ALASKA

Abundance and Distribution

White whales of the northeastern 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 (Klinkhart 1966; Scheffer 1972) and west into the East Siberian Sea (Kleinenberg et al. 1964).

The Gulf of Alaska population or stock[21], an estimated 300-500 animals, appears to remain in or near Cook Inlet year-round (Brooks 1963; Klinkhart 1966; Scheffer 1972; Alaska Department of Fish and Game 1975[22], Harrison and Hall 1978).

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[21] "Stock", as defined here, is a geographic sub-unit of a larger interbreeding population.

[22] Alaska Department of Fish and Game. 1975. [Untitled.] Unpubl. manuscr., 8 p. Alaska Dep. Fish. Game, Juneau.

Murray and Fay (1979)[23] found few animals present during the winter months.

White whale sightings have been made, however, in the Gulf of Alaska beyond the boundaries of Cook Inlet. Harrison and Hall (1978) document the sighting of a single animal in Prince William Sound in March, and near Kodiak Island in March and July. Calkins and Pitcher (1977)[24] report a late May sighting of 21 white whales in Yakutat Bay. They have been sighted as far south as Washington state (Scheffer and Slipp 1948), although this is certainly beyond their normal range. The population in Cook Inlet and Gulf of Alaska is believed to be local and separate from Bristol Bay and Bering Sea population(s). Even though the Alaska Peninsula is evidently a barrier to the movement of these animals from the Gulf of Alaska into the Bering Sea, it seems plausible that interbreeding occurred in the recent past.

White whales occurring in the Bering Sea compose resident (or at least local to a defined area) and migratory groups. A minimum of 1,000-1,500 has been estimated to occur in the Bristol Bay-Kuskokwim Bay area throughout the year (Alaska Department of Fish and Game 1957, 1975[22]; Klinkhart 1966). An additional, but unknown, number are thought to winter in the Bering Sea north of Bristol Bay. These animals apparently migrate into eastern Siberian and western Canadian waters in late spring and summer (Alaska Department of Fish and Game 1955; Kleinenberg et al. 1964; Sergeant and Hoek 1974; Braham and Krogman[1]; Fraker[19]). An unknown portion of these migratory animals summer in the Norton Sound-Yukon Delta area (Figures 20 and 31), while others continue north through the Bering Strait (Scheffer 1972; Fay 1974).

White whales in the Chukchi Sea seem to be largely transient. Most migrate between the Bering and Chukchi Seas. An unknown number summer in Kotzebue Sound, particularly in Eschscholtz and Spafarief Bays, and others along the northwest coast. White whales have been reported in the southern Chukchi Sea in February (C. Ray, Pers. commun., 20 April 1976), which may mean that some overwinter in the Chukchi Sea as well as the Bering Sea.

The Beaufort Sea probably serves mainly as a summer feeding area for white whales migrating from the Bering and Chukchi Seas. Over-wintering in the Beaufort and Chukchi Seas, should it occur (Bailey and Hendee 1926) would most likely be associated with the occurrence of some open water during mild ice years.

The Bering Sea population of white whales in 1976 exceeded 8,000. Some 6,000 migrants from U.S. waters were estimated in the Canadian Beaufort Sea (Fraker[19]; Fraker et al. 1978) at the same time that over 2,000 animals

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[23] Murray, N. K., and F. H. Fay. 1979. The white whales or belukhas, Delphinapterus leucas, of Cook Inlet, Alaska. Unpubl. manuscr., 6 p. Coll. Environ. Sci., Univ. Alaska, Fairbanks, Alaska 99701.

[24] Calkins, D., and K. Pitcher. 1977. Unusual sightings of marine mammals in the Gulf of Alaska. (Abstract.) In Proc. Second Conf. Biol. Mar. Mammals, San Diego, Calif., 12-15 Dec., 1977, p. 53.

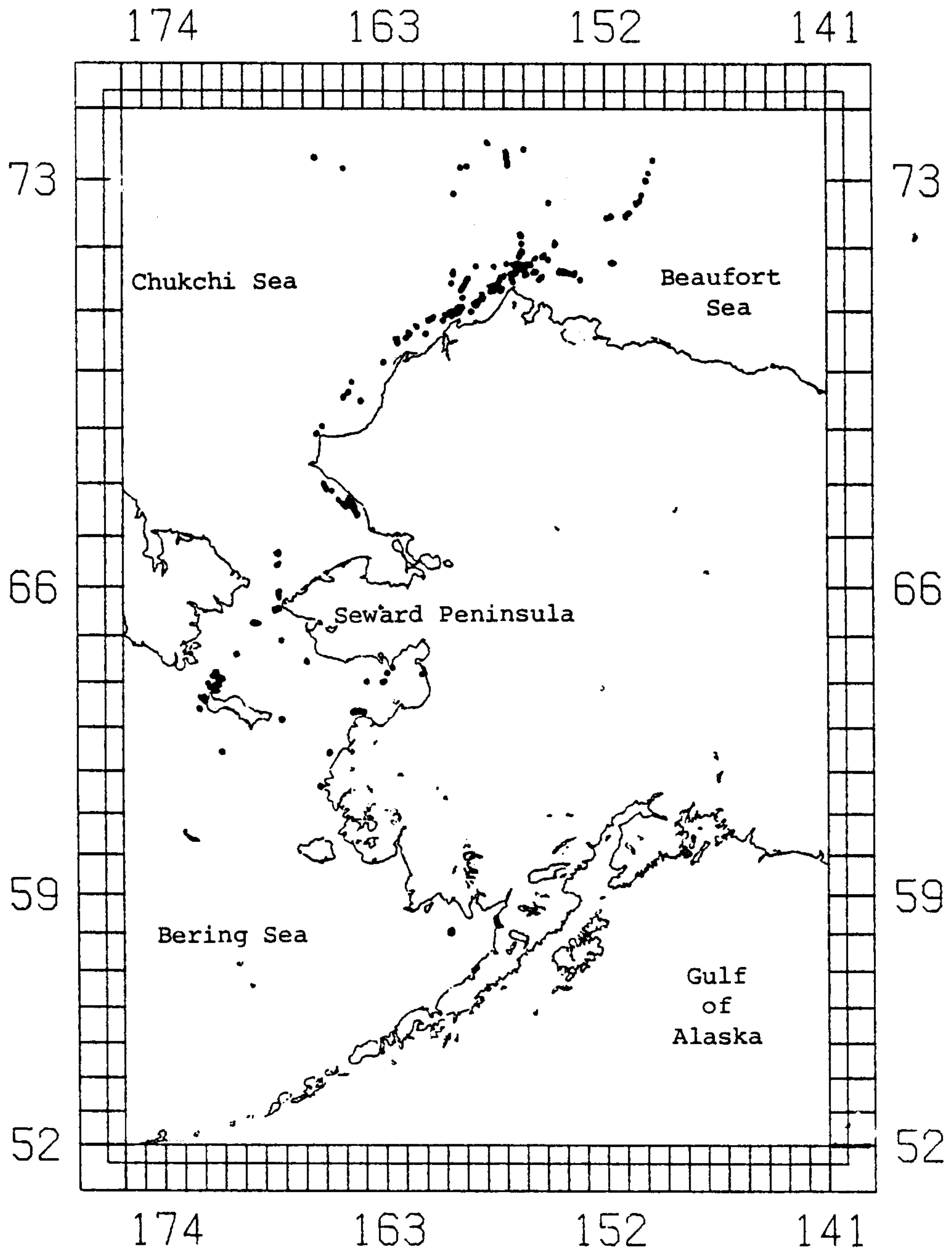

Figure 31.--Sightings of white whales during aerial surveys conducted between the months of March and September, 1975-1977. Over 400 sightings were made of approximately 2,000 white whales.

were estimated in U.S. waters along the northwest coast of Alaska (Point Lay to Wainwright), Kotzebue Sound, Norton Sound, and Bristol Bay (J. Burns, ADF&G, Fairbanks, Pers. commun., 7 November 1977). J. Burns (Pers. commun.) estimates the Alaska population size of white whales to be near 16,000 individuals.

Migration

The spring and summer migration route of white whales in the eastern North Pacific follows inshore and offshore leads in the pack ice along the west and north coasts of Alaska, through the Bering and Chukchi Seas and corresponds closely to the bowhead migration (Braham and Krogman[1/]). Kleinenberg et al. (1964) suggested that as the migrating animals move through the Bering Strait, some continue along the north coast of the Chukotka Peninsula. The bulk of the population follows open leads east to Banks Island in Canada's Northwest Territories (Braham and Krogman[1/]; Fraker[19/]; Fraker et al. 1978). What percentage of the Alaskan population(s) is represented in the western Chukchi and Beaufort Seas is uknown, as is our knowledge of how many white whales from the Soviet Union join those in U.S. waters to migrate into Canada each spring.

Spring migration occurs from March to early July, when white whales follow leads along the flaw zone throughout the pack ice, using offshore and nearshore lead(s). Moving north, white whales leave the Bering Sea in March and April (Bailey and Hendee 1926; Kleinenberg et al. 1964; Johnson et al. 1966; Braham and Krogman[1/]). Those summering in Canadian Arctic waters pass through the Chukchi Sea in middle to late April (Fiscus and Marquette[15/]; Braham and Krogman[1/]) and cross the Beaufort Sea from May to June (Sergeant and Hoek 1974; Fraker[19/]). Braham and Krogman[1/]; Fraker et al. (1978), and Braham et al. (1979) proposed that the eastbound migrants follow the 30-100 km offshore (varying annually) open lead system northeast to Banks Island, Northwest Territories, Canada. The animals then move south along the west side of Banks Island to Amundsen Gulf and on to the Mackenzie Delta (Fraker)[19/]. Whether they migrate directly to Banks Island or to Amundsen Gulf consistently each year probably depends on ice conditions. The earliest recorded sightings of white whales near Banks Island were made in mid-May (Stefansson 1943; Fraker et al. 1978; Braham et al. 1979); however, two bowheads were sighted on 8 May 1978, near the northwest tip of Banks Island (Braham et al. 1979), suggesting that white whales may reach Banks Island even before May. R. Goose (Holman Island, Northwest Territory, Canada, Pers. commun., 23 May 1979) saw 10 white whales off Holman Island in late April 1979, earlier than in most years (1979 was an unusual ice year because breakup was 1 week-1 month earlier than expected). Our preliminary results indicate that some white whales precede bowheads in their northward migration by perhaps 1-2 weeks, but again, this may vary among years.

The timing of the autumn migration west from Canada to U.S. and Soviet waters is not well documented. Departure from the Canadian Beaufort Sea commences in August and September (Sergeant and Hoek 1974; Fraker et al. 1978) with passage into the Bering Sea in Decemmber (Burgess[18/]) or during the time of advancing ice. White whales begin to appear regularly near St. Lawrence Island in the Bering Sea from November to January and, on occasion, as early as September and October as do some bowheads (D. Harry, Gambell, Alaska, Pers. commun., 25 July 1978). Though scant information is available on the autumn migration, Fraker et al. (1978) believed that those white whales summering in Canadian waters return to the Bering Sea, and that few, if any, move east into eastern Canadian high Arctic.

Identity of Stocks

From aerial surveys of the Bering Sea and western Arctic Ocean since 1976, a composite of white whale sightings was made (Figure 31). In March and April white whales were seen moving from the west central Bering Sea along the east coast of Siberia and north along the northwest coast of Alaska. The movements of the whales was directional--north. It is not until May and June, when the pack ice breaks up along the coast, that we began seeing white whales in areas where they appear to summer: the northwest coast from Point Lay to Point Barrow, Kotzebue Sound, and Norton Sound. Sightings of white whales in Bristol Bay in April, May, and June indicate that these animals may be resident, or return to Bristol Bay after having moved south with the advancing ice in the winter.

Animals observed in Bristol Bay, Norton Sound, or Kotzebue Sound during the summer may be either 1) late migrants of a single Bering Sea population that remain in the shallow waters or 2) stocks of an Alaskan and or Soviet population. It seems improbable that any major isolation would take place, because there are no isolating barriers except, perhaps, the pack ice; however, this is only seasonal. Except in 1977 and 1978, very few white whales have been seen along the northwest coast of Alaska offshore during the summer; some isolation between components of the Bering Sea population thus occurs from May to November. Little work has been conducted during the summer in the U.S. Arctic Ocean. If those whales observed in the southern and east central areas of the Bering Sea were to intermix with the main body of the population to the north, then they could do so for four months, January through April. Without knowing the rate of exchange or the frequency of intermixing among years, it is impossible to evaluate whether we are dealing with one, two, or perhaps as many as four breeding stocks of white whales in the Bering and Chukchi Seas. White whales which are harvested by Alaska Eskimos in summer, as in Kotzebue Sound and adjacent bays, as well as those along the northwest coast should probably be considered separate stocks because of the timing of harvest occurring simultaneously with reproduction.

Life History and Associated Information

Reproduction

The average age at sexual maturity for female white whales in eastern Canadian arctic waters has been reported to be 5 years, at 270 cm long, or 85% full adult length (Doan and Douglas 1953; Brodie 1971; Sergeant 1973). Males, on the average, were reported by Brodie (1971) and Sergeant (1973) to be sexually mature at 8 years of age. Kleinenberg et al. (1964) found that female white whales in the eastern Siberian Arctic attained sexual maturity at an average age of 3, at 247-470 cm in length, compared to 2-3 years and 380-450 cm for males (Dorofeev and Klumov 1936). Disagreement in calculated age at sexual maturity between the Soviet and Canadian data may be due to the poor state of knowledge concerning ageing methodology at the time of the earlier studies.

Calving and mating apparently occur simultaneously from May through August in eastern Siberian and Canadian waters (Vladykov 1944; Laws 1959; Sergeant 1962, 1973; Kleinenberg et al. 1964; Brodie 1971; Nishiwaki 1972). Similarly, Bel'kovich (1960) found that in the Soviet Arctic (White to Kara Seas) calving occurred from mid-June to mid-July, later to the east. Calving in Alaska is believed to commence in May or June (Klinkhart 1966); however, young calves are commonly seen by coastal Eskimo residents as early as March. Young of the year and neonatal calves have been seen in April and May each of the 4 years we have been studying bowheads along the northwest coast of Alaska (Braham et al. 1979, 1980a). Small young of the year calves were observed by the senior author 100 km north of Barrow on 28 September 1979. Calving may therefore occur into late summer or early autumn. Mating locations in the eastern Bering Sea are southeast Kotzebue Sound, Bristol Bay, Yukon Delta-Norton Sound, and along the northwest coast of Alaska, particularly near Peard Bay.

White whales are reported to give birth nearshore to single calves averaging 150 cm in length (Doan and Douglas 1953; Sergeant 1962; Kleinenberg et al. 1964). Newborn calves have been observed in river estuaries of the eastern Canadian Arctic (Brodie 1969; Sergeant 1973) and western Canadian Arctic, specifically, the Mackenzie River estuary (Sergeant and Hoek 1974).

Cows are believed to nurse calves for approximately 24 mo. Brodie (1971) and Sergeant (1973) estimated lactation periods of 24 and 21 months, respectively, for white whales in eastern Canadian Arctic waters. Kleinenberg et al. (1964) estimated the lactation period in Siberian Arctic waters to be 5-6 months.

Given a gestation period of approximately 12-15 mo. (Vladykov 1944; Bel'kovich 1960; Kleinenberg et al. 1964; Brodie 1971; Nishiwaki 1972; Sergeant 1973) and no more than a 2-year lactation, and assuming a cow nurses one calf at a time, the reproductive cycle for white whales could last up to 3 years. Female white whales have been reported to mate on the average once every 2-3 years (Degerboel and Freuchen 1935; Brodie 1971; Sergeant 1973).

Food Habits

White whales feed on fish, mainly, and invertebrates in estuaries, small streams, and rivers and in bays near the mouths of rivers and on occasion, considerable distances up rivers. In these areas they feed midwater to the bottom on organisms seldom found deeper than 50 fathoms (Doan and Douglas 1953; Sergeant 1962, 1968; Kleinenberg et al. 1964).

Prey consumed in the eastern Canadian Arctic (Vladykov 1946; Doan and Douglas 1953; Sergeant 1973) and Siberian Arctic (Kleinenberg et al. 1964) are more thoroughly doucmented than in the western Canadian and Alaskan Arctic. For Hudson Bay-Churchill region Sergeant (1968) reported that the most common species of fish consumed by white whales was capelin, a species which spawns in shallow water close to river mouths, July-August. River fish, ciscos and pike, marine worms, and squid are also taken. In Hudson Bay's Whale Cove area, where capelin do not occur, white whales forage primarily on decapod shrimp (bottom dwellers), Arctic char, Greenland cod, and polar cod.

Sergeant and Hoek (1974) reported that prey taken by white whales in offshore area of the Beaufort Sea in decreasing order of importance were squid, fish, and crustacea. The fish included lake herring, and possibly Pacific herring. Fraker et al. (1978) report polar cod and squid to be common offshore species consumed by white whales in the Beaufort Sea and Amundsen Gulf. Prey species taken in the U.S. Beaufort Sea are unknown, but arctic cod is an abundant species in the western Arctic. White whales resident to Bristol Bay and Cook Inlet feed on five species of salmon, smelt, flounder, sole, sculpin, blenny, lamprey, two types of shrimp, and mussels, May to August (Alaskan Department of Fisheries 1955, 1956; Alaska Department of Fish & Game 1957). Prey taken by white whales in the coastal waters of the Chukchi Sea vary greatly: saffron cod, sculpins, capelin, rainbow smelt, arctic cod, herring, whitefish, char, salmon, suckers; and cragonid shrimp, isopods, snails, octopus, gonatid squid and polychaetes (Lowry et al. 1980).[25]

Group Composition

Group size varies seasonally. Large pods congreate in the early spring until the breakup of the pack ice (Kleinenberg et al. 1964). Once this occurs they form smaller groups of two to four individuals which spread out over several kilometers until the summering areas are reached (Kleinenberg et al. 1964; Fraker[19]). However, larger groups have been observed in April and May during our aerial studies and at Point Barrow and Point Hope. On the summering areas the whales assemble into large congregations for feeding and/or reproductive activities (Sergeant and Hoek 1974). Later on, due to the gradual dispersal of food (primary fish), Klumov (1939) reported the whales divide into smaller groups and eventually move toward the wintering grounds.

From a sample size of 2,002 white whales observed during surveys since 1976, we calculated that mean group size was 4.8 (SD 0.43, n = 419). The preponderance of sightings occurred in April and May. The mean group size estimated is believed to be biased downwards because of a tendency to split larger "groups" when counting from an airplane. Group size estimates made from our ice camps at Point Barrow varied from 4.8 to 12.4 (no variance estimate) depending on lead width (extent of water). As open water increased, group size decreased.

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[25] Lowry, L., K. Frost, and J. Burns. 1980. Trophic relationships among ice-inhabiting phocid seals and functionally related marine mammals in the Chukchi Sea. Unpubl. final OCSEAP report, RU232., 58 p. Alaska Dep. Fish and Game, 1300 College Rd., Fairbanks, Alaska 99701.

Kleinenberg et al. (1964) further detailed the composition of groups with size variation (i.e., 10's or 100's of individuals). In groups of 10, the animals were normally traveling by twos and threes, some 10-30 m apart. Within these groups of 10 they found that 1) adults always kept apart; 2) adults often formed the majority of the herd; and 3) the few young that were present remained in the middle of the larger group structure. In groups of 100's, large adult males, forming 51.2% of the herd, were followed by females with calves (Dorofeev and Klumov 1936; Arsen'ev 1939). Kleinenberg et al. (1964) report that females were often accompanied by one to three "young" (presumably gray-colored subadults).

White whales are dark brown to gray in color up to about 6 years old. Sexual maturity occurs at approximately 5 years for females and 8 years for males (Sergeant 1973). Color change can thus be used to estimate the minimum size of the subadult population. In 1977, we scored 1,699 white whales (including 7 newborn calves) as to color phase during their annual spring migration past Point Hope, Alaska. It was possible to make a classified count of 515 animals: 316 (76.7%) were white; 166 (18.4%) were gray; and 25 (4.9%) were transitional between gray and white. This resulted in an estimated adult to subadult ratio of 3.2:1. From aerial surveys in 1976 and 1977, a ratio of 14:1 (white:gray phase) was estimated. We believe the aerial results to be an overestimate because of the short amount of time to count and confirm the color of an animal from air (for these data years only).

OCCURRENCE OF BOWHEADS IN OUTERCONTINENTAL SHELF LEASE AREAS

Outer Bristol Bay-St. George Basin

Bowhead whales probably occur in southeastern Bering Sea only during the late winter and early spring months when the seasonal pack ice front extends south of lat 60°N, and then in low numbers. Only three sightings have been made in this area between 1976 and 1980, with one of those in 1976 undoubtedly being a duplicate west of St. Paul Island (Figure 29). During the height of commercial whaling very few bowheads were taken in the southeastern Bering Sea even at a time when the population was at its apparent maximum size (Figure 2, Bockstoce and Botkin)[12/]. It seems unlikely that animals would have been missed during commercial whaling operations as many ships traveled there enroute to Alaskan and Siberian ports to the north. The St. George Basin-Outer Bristol Bay area is beyond the central range of the bowhead.

Given our present state of knowledge, the Outer Bristol Bay-St. George Basin OCS areas east of long 170°W and south of lat 59°N does not include important or traditional habitat for the bowhead whale. If during those years when ice extends to its maximum southern limit (similar to 1976) and if unusual ice or storm conditions force the whales to move farther southeast than normal, then some whales are likely to occur here.

Navarin Basin

Townsend's (1935) review of bowheads taken in the Bering Sea clearly indicated that they formerly frequented the Navarin Basin (St. Matthew Island to Cape Navarin along the continental shelf break) from April to July (Figure 2). Under NOAA's Platforms of Opportunity Project we have received a few observations of bowheads throughout the Bering Sea and, although some effort has been expended near the Navarin Basin, we have received no bowhead sightings from the area. Several U.S. and Soviet aerial surveys have been conducted during the spring in or near the area but no bowheads were reported (Fedoseev 1966; Kenyon 1972[26]; G. Fedoseev and V. Golt'sev, TINRO, Magaden, USSR, Pers. commun., 12 September 1977).

A recent icebreaker survey of bowhead winter distribution (Braham et al. 1980a), indicated that bowheads spend the late winter and early spring months in and adjacent to the Navarin Basin. We made a systematic survey of the ice front in March 1979 from approximately 50 km east of Cape Navarin to south of St. Matthew Island. Bowheads were observed in highest densities on the west side of St. Matthew, as well as farther north of St. Matthew I., and west, and southwest of St. Lawrence Island (Figure 29). Weather prohibited extensive coverage of the Navarin Basin.

No bowheads were seen between St. Lawrence and St. Matthew Islands in 1976 and 1977 but 109 animals were seen in 1979. During years of more extensive ice coverage bowheads presumably occur farther south. Under these circumstances they are likely to occur in and adjacent to the Navarin Basin in greater numbers than we have seen. (Note: The Navarin Basin was not surveyed in 1976 and 1977.) The frequency of occurrence and time spent by bowheads near Navarin, then, is probably related to ice conditions.

Norton Sound-Northern Bering Sea

The Norton Sound-northern Bering Sea (NBS) OCS lease area, as it is presently designated to include St. Lawrence Island and the eastern half of the northern Bering Sea from the USA-USSR 1867 Convention Line to the Bering Strait at Cape Prince of Wales, includes both important habitat for bowheads and areas where they do not normally occur. Bowheads have not, prior to spring 1980, been reported east of long 166°W into Norton Sound. West of long 166°W bowheads occur seasonally (Table 3).

The best available data indicate that the bowhead population is found in the NBS during the spring, from late March through May, and in the fall from November through January. They might be present in low numbers near the Bering Strait from July to October, especially in September and October; however, Eskimo informants at Little Diomede and St. Lawrence Islands have told us (Braham et al. 1980b) that bowheads are essentially absent in the

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[25] Kenyon, K. 1972. Aerial surveys of marine mammals in the Bering Sea, 6-16 April 1972. Unpubl. rep., 79 p. Natl. Mar. Mammal Lab., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, Wash. 98115.

TABLE 3.--Area use and timetable for the majority of the bowhead whale population in or adjacent to proposed Outer Continental Shelf (OCS) lease areas of the Bering, Chukchi and Beaufort Seas. Some exceptions exist, of course.

OCS lease areas	Temporal Use		Spatial Use	
	Present	Absent	Present	Absent
St. George Basin-outer Bristol Bay	Essentially absent, a few may occur irregularly in the spring in the western side.		west-central[a/] St. George Basin	remaining?
Navarin Basin	Feb-Apr	May-Jan	unknown	unknown
Norton Sound-No. Bering Sea	Mar-June, Oct-Jan	Feb, July-Sep	western half	Norton Sound[b/]
Hope Basin (Chukchi Sea)	Apr-June, Sep-Dec	Jan-Mar, July-Aug	west of long 164°W	Kotzebue Sound[c/]
Beaufort Sea	Apr-June Aug-Nov	Dec-Mar July?	nearshore west of long 152° east of 152° unknown	unknown

[a/] if and when present
[b/] during most years
[c/] east of long 164°W

NBS during the summer (late June-October). An adult with calf was seen in July several years ago, and two adult bowheads were reported near the Punuk Island (southeast of Northeast Point, St. Lawrence Island) in June or July 1978, however this is an unusual occurrence (R. Silook, Gambell, Alaska, Pers. commun. from another, unidentified Eskimo from Savoonga, 16 August 1979.

The bowhead whale spring migration around St. Lawrence Island may be more complex than reported by us earlier1/. Bowheads apparently converge on the island from the south exhibiting three general patterns: two routes around the west end of the island and one around the east end. Many Eskimos at Gambell and Savoonga report that whales that reach the island near Southeast Cape move west along the south coast and then north past the west end of the island near Gambell. Whales that arrive at the island at Southwest Cape are said to migrate west away from the island across the Anadyr Strait to the Siberian coast at Cape Chukotskii (lat 64°15'N, long 173°W) and the village of Siriniki before continuing north on migration. This suggests that there are two migration routes around the west end of St. Lawrence Island. Data collected since 1976 on the occurrence and movements of bowheads adjacent to St. Lawrence Island did not confirm this hypothesis, primarily because few sightings were made. In 1979 bowheads were seen all across the Strait of Anadyr (Braham et al. 1980a); however, mild ice conditions may have altered the migration pattern as described above.

The migration route along the west side of St. Lawrence Island then takes the whales through the western portion of the NBS OCS lease area west of an imaginary line from Savoonga to Cape Prince of Wales. Whales in spring are on occasion seen in open water east of Gambell to west of Savoonga (closer to Gambell). Open water increases from east to west towards the Chukotka Peninsula. We conclude that most bowheads migrate through the western half of the NBS OCS lease area in the spring, during average ice years. Eskimos also report that some bowheads migrate around the east end of St. Lawrence Island in the spring. We have only two sightings at the east end of the island since 1976. We do not believe that the east end of the island is an important migration corridor. A more detailed description of the spring migration is covered in Braham et al. (1980c).

No records were found nor sightings made by us prior to 1980 of bowheads in the eastern portion (east of long 166°W) of the NBS OCS lease area (i.e. Norton Sound). More than 10 bowheads were observed in Norton Sound in May 1980; at least five were seen near Norton Bay. These animals occurred here as a result of an ice blockage in the Bering Strait which halted their spring migration. Although a complete account of the number and location of bowheads in Norton Sound during the spring of 1980 was not available for this revised report, Johnson et al. (1981) summarizes the causes for the delayed migration. The important point here is that, given the proper conditions, bowheads can be found throughout the NBS OCS lease area but in low numbers in Norton Sound.

The autumn migration pattern in the NBS is less clear than for the spring, but apparently bowheads can be seen across the north side of St. Lawrence Island, suggesting that the migration path in autumn may be more diffuse than in spring. Several Eskimos at St. Lawrence Island have told us that bowheads do not migrate around the east end of the island in the autumn but rather move by the west end.

The waters adjacent to St. Lawrence Island are important to the survival of this population. The Bering Strait is also important because the entire bowhead population passes through it twice annually. The autumn period in the Bering Strait may be more important than the spring because if bowheads were limited or restricted from entering the Chukchi and Beaufort Seas in the spring, they would still be able to feed throughout the summer in the ice-free waters of the northern Bering Sea. Townsend (1935) clearly showed that bowheads once occurred in the NBS in the summer, a period thought to be a traditional feeding time for the species. However, if restricted from moving into the Bering Sea in autumn, some, if not many bowheads might be trapped by winter freezeup.

In conclusion the following points can be made from our investigations:

1) In spring, bowheads are more likely to migrate through the western portion of the NBS OCS lease area than to the east.

2) The autumn-winter migration in the NBS probably occurs throughout most of the western NBS, but no information exists to help us predict how far east into outer Norton Sound they occur.

3) Inner Norton Sound (east of long 166°W) is seldom used by bowhead whales, and does not include important habitat.

4) Waters adjacent to St. Lawrence Island and the Bering Strait may be critical habitat areas for the stability and survival of this population.

Hope Basin and Northeastern Chukchi Sea

Very little is known of the specific movements of bowheads in the Hope Basin (south of lat 69°N, east of long 169°W) and northeastern Chukchi Sea (north of lat 69°N, east of long 169°W). From April to June, bowheads migrate north in leads through the pack ice flaw zone from the Bering Strait to an area stretching from Kivalina to on some occasions out to 90 km offshore Point Hope. For additional, specific details see Braham et al. (1980c) and Johnson et al. (1981).

The autumn migration through the northern Chukchi Sea and Hope Basin to the Bering Sea appears to be farther offshore than during the spring. Bowheads are not known to frequent Kotzebue Sound (east of long 164°W) with any regularity. Townsend's (1935) plots of harvested whales (Figure 2) idicated that the western portion of the Hope Basin was more heavily exploited, presumably a reflection of bowhead distribution. We believe that bowheads are generally found west of this lease area during autumn (September-November) (Braham et al. 1980a; Dahlheim et al. 1980; Johnson et al. 1981).

In conclusion, bowheads frequent the Hope Basin and northeastern Chukchi Sea during the spring and autumn migration but do not appear to spend a significant portion of time there for purposes of reproduction, growth, or feeding. The entire population migrates through the lease area from April-June and are found primarily west of the lease area from September-December.

The northeastern Chukchi Sea is important for both spring and autumn migration, nearshore in the spring, and less so during autumn. Bowheads probably feed in the northeastern Chukchi Sea during autumn, most likely from September to December. If some bowheads do not migrate into the Beaufort Sea during the spring, then it seems likely that some whales occur west and perhaps southwest of Point Barrow from late summer on, especially during years of heavy ice.

Beaufort Sea

For an assessment of the occurrence of bowheads in or adjacent to existing or anticipated OCS lease areas in the Beaufort Sea, we consider the Beaufort Sea east of long 150°W first, then west to approximately Point Barrow. This was done because 1) of the high probability that the western Beaufort Sea will soon be considered for OCS leasing, and 2) we have more sight specific information on bowheads west of long 150°W than east.

East of Longitude 150°W

The fact that few sightings (5) were made of bowheads within or adjacent to the existing OCS lease area (approximately betwen Colville River and Flaxman Island) between 1974 and 1978 makes it extremely difficult to determine what effects oil and gas development may have on the population (Table 4). Since 1974 we have made, or obtained, 53 fall sightings totaling approximately 323 animals for the entire Beaufort Sea (Figure 30). Only about 23% (a total of 15 animals) were made east of long 150°W. The paucity of sightings is directly proportional to effort: we were not able to conduct extensive surveys east of long 150°W because of poor flying weather.

Results nevertheless indicate that bowheads do visit the OCS lease area, as 38% of our sightings east of long 150°W were within or adjacent to the barrier islands between long 145° and 150°W (Figure 30). Other evidence exists for the occurrence of bowheads in the OCS lease area. In autumn 1921 Sara Kunaknana's (Kaktovik, Barter Island, Alaska) family took a whale on Cross Island; and in 1935 they took another whale in the "Prudhoe Bay area" (G. Jarrell, NMFS, Pers. commun., 15 October 1978). A whale was also taken near the east fork of the Canning River (east edge of OCS lease area) in the fall of 1973.

Commercial whalers frequently followed bowheads during the late summer and autumn months from the western Canadian Beaufort Sea to the Chukchi Sea, yet few whales were taken near the OCS lease area (Figure 2). This may have been because 1) few whales were present; 2) whales occurred in areas where the whalers could not go (e.g., in shallow waters); or 3) the whales moved swiftly through the area and thus were difficult for the whalers to catch. The net result is that we simply do not know how important the Beaufort Sea OCS lease area is to the bowhead whale. However, if they are present in any significant numbers, then they probably occur from late August to mid-October. Unfortunately, we have very little data to verify the precise timing and magnitude of their movements. We do know a few bowheads have been sighted or taken by Eskimos in the OCS area in the past 50 years.

TABLE 4.--Sightings of bowhead whales within and adjaccent to the existing Beaufort Sea Outer Continental Shelf lese area between long 150°W and long 145°W within the 12 m depth contour. Data compiled from aerial surveys conducted between 1974 and 1978. Positions are approximate.

Date	Time	No. of animals	Latitude (N)	Longitude (W)	Information source
Sept 21, 1974	1528	1(t)[a]	70°13'	146°39'	NMFS
Sept 12, 1975	1130	1	70°16'	147°21'	NMFS
Aug 2, 1977	2300	1(t)[a]	70°35'	150°00'	S.R. Johnson[b]
Sept 21, 1977	1243	1	70°30'	149°00'	NMFS
Sept 21, 1977	1442	1	70°20'	146°20'	NMFS

[a] (t) - tentative

[b] LGL, Edmonton, Alberta, Canada, Pers. commun., 20 September 1977.

Eskimo whalers at Kaktovik, Barter Island, hunt bowheads as the whales head west on their autumn migration. They inform us that the autumn migration is segregated roughly into age classes. Smaller whales pass by early in the autumn and larger whales, including cow-calf pairs, pass by later. Whales are often first seen by late August, and later are seen near the pack ice as the ice moves closer to shore in September and October. The earliest whale taken in memory by Kaktovik Eskimos was 21 August 1972. Bowheads are still going by Barter Island as late as the whalers can get out in their boats and are seen even when the sea is covered with slush ice as late as mid-October.

West of Longitude 150°W

Bowheads apparently frequent the inshore waters of the Beaufort Sea between Point Barrow and Smith Bay on an annual basis (Figures 24, 25, and 30). Though we have spent more time flying offshore (out to 225 km) than nearshore west of long 150°W, most animals were sighted within only a few kilometers of the coast. Most were seen in September (over 90%), but sightings made in August (Figure 22; A. Brower, Sr., Barrow, Alaska, Pers. commun., 20 December 1977), and one in November (J. Burns, ADF&G, Fairbanks, Alaska, Pers. commun., 20 December 1977) point out that the time of occurrence here, as well as east of long 150°W, covers a longer period than we previously thought (Table 2). Again, the timing of migration and occurrence undoubtedly varies somewhat among years.

We observed bowheads feeding east of Point Barrow to Smith Bay during September 1976. The whales were observed in shallow water, adjacent to the Plover Islands (Figure 24). The same occurrence and behavior was observed in 1974 (C. Fiscus, Natl. Mar. Mammal Lab., Seattle, Pers. commun., 28 September 1976), 1975 (Ray in Braham and Krogman[1/]), and 1978 (Braham et al. 1980b) (Figure 30). On 21 September 1976 R. Everitt (NMML, Seattle) photographed three whales laying at the surface with their mouths wide open at right angles to the wind and tide. If they were feeding, and we believe they were as this incident coincided with a large bloom and onshore movement of euphausiids, then this is the first known case of a whale passively feeding.

Eskimo whalers hunt for whales west of long 150°W. Four whales were taken in the channel between Tapkaluk and Cooper Islands (lat 71°51'N, long 155°40'W) 29 September-8 October 1974. Whether the nearshore waters west of long 150°W are more important to this population than east of long 150°W has not been determined, but we believe that it is.

Bowheads have been seen in the autumn in shallow water of 3-12 m deep in the U.S. Beaufort Sea (c.f. Fig. 30, and Fraker and Bockstoce 1980). Bodfish (1936) found bowheads consistently at water depths less than 40 m, but not deeper. Between August and November, 1974-1978, we have scored 234 sightings of bowheads in the Beaufort and eastern Chukchi sea near Point Barrow: 172 were in water less than 12 m deep, and 62 in water greater than

12 m (Figure 30). The 12 m contour east of Point Barrow averages less than 5 km offshore and 2 km off the Plover Islands. More of our aerial survey effort was conducted offshore near the 12 m contour rather than nearer to shore. The nearshore waters here appear to be more important for feeding whales than further offshore.

A QUESTION OF SPECIES IDENTITY: BOWHEAD, INGUTUK, RIGHT WHALE?

In 1977, little concern was voiced about the real possibility that endangered cetaceans occurring in OCS lease areas might represent a factor capable of inhibiting or limiting OCS development. Since then, much interest, coupled with some misunderstanding, has led to statements which were not founded on scientific evidence. For example, during spring 1978 some individuals contended that at least two species of right whales (of the genus *Baleana* = *Eubalaena*) were present during the bowhead whale migration along the northwest coast of Alaska. Discussion at that time centered around the belief that a small, early spring "Arctic ice whale," called *ingutuk*, was the Pacific right whale (*Balaena glacialis*) rather than the bowhead whale (*Balaena mysticetus*). This led to the further concern that two endangered right whales, as well as the California stock of gray whales (*Escharichtius robustus*), seasonally frequent the Beaufort Sea OCS lease area. The following evidence may resolve the issue. It is condensed from Braham et al. (1980d).

HISTORICAL EVIDENCE

Nomenclature

The question of taxonomic placement of the *ingutuk* is not new: Hadley (1915), Brower (1942), and Jim Allen in Bailey and Hendee (1926) thought *ingutuks* were not the same species as bowheads. The term *ingutuk*, an Eskimo word thought to refer specifically to young, fat, perhaps female, bowheads, is one of several terms commonly used to describe differing age and/or size categories of *agvik*--the bowhead whale. The term *ingutuvuk* ("one who carries a calf") describes a large female; *usingwachaek* is a full-sized bowhead; *kairalik*, *kiyralivuk*, and *kiyralivoak* refer to different sizes of male bowheads[27] (Durham[10]; Rice 1977; A. Brower, Sr., Barrow, Alaska 99723, Pers. commun., 19 May 1978). The profusion of terms describing these whales appears to be based upon historic and cultural usage.

Geographic Isolation

Bowheads now in the western Arctic-Bering Sea stock may be isolated from the Atlantic and/or Okhotsk stocks, and morphologically differences among stocks may explain the existence of the *ingutuk*. Townsend's (1935)

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[27] "Eskimo whaling at Barrow", an anonymously authored manuscript dated 12 December 1972, "compiled by the Naval Arctic Research Laboratory, Barrow, Alaska, for use by Dr. Floyd Durham".

and Bockstoce and Botkin's[12] harvest records indicate that while the Okhotsk and western Arctic-Bering Sea stocks are now isolated, this may not have been so less than 100 years ago. This would not seem enough time for genetic-morphological changes to occur. No diagnostic differences have been described between Atlantic and Pacific stocks (Scoresby 1820; Eschricht and Reinhart 1866; Scammon 1874), and although detailed recent morphological data are not available for comparison among stocks, geographic isolation leading to new morphological types reentering the population does not seem plausible.

BIOLOGICAL EVIDENCE

Morphological Features

Some 22 morphological and behavioral features have been used to describe the differences between bowheads and ingutuks. After evaluating these characters with results of our research since 1973, and using information compiled by Durham[10] and Foote[17] we found that 14 (61%) of the characters were not unique to ingutuks, and that 4 (18%) of the characters could not be classified to either. Only 4 (18%) seemed to be positive ingutuk characteristics. These data do not exclude the possibility that the ingutuk represents one extreme of normal variation. An occasional whale with features usually attributed only to ingutuk, usingwachaek, or kyralik have been reported (Durham[10]), suggesting that a range of features may occur within individuals as well as within the (bowhead) population.

Sex and Size Categorization

There is belief by some Alaskan Eskimos that ingutks are young female bowheads. Prior to 1978 only one of many ingutuks taken since 1962 was reported to be a male; all others were females. Since 1978, three males have been reported. Since 1973 we have identified 14 ingutuks out of 112 bowheads taken at Point Hope and Barrow. Ten of the ingutuks were female, 3 were males, and 1 was not satisfactorily sexed. The sex ratio of non-ingutuk bowheads from 1973 to 1978 was 46 females to 53 males. Significantly fewer male than female ingutuks have been taken, suggesting that "ingutuk" may be a female sex-related trait or term. Ingutuks have been reported to be smaller than bowheads; however, we found no significant difference. This test included all size classes of usingwachaek (= kiyralik), ingutuk, and ingutuvuk (= large ingutuk?).

Genetic-Biochemical Studies

We conducted biochemical and genetic studies on bowheads taken from 1977 to 1979 to help clariffy stock discreteness. Electrophoretic analyses of liver tissues (nine whales) and blood proteins (three whales), including one ingutuk in each analysis, showed that much variability occurs within the population and within at least one individual analyzed. The biochemically variant animal, however, did not possess morphological characteristics attributed to ingutuk. Conversely, the ingutuk samples were not distinguishable from the other bowheads.

CONCLUSION

It is apparent that some bowhead whales look different from others, even though it often takes an experienced observer to make the distinction. The most apparent differences seem to occur with the variant called ingutuk. The preponderance of direct and circumstantial evidence suggests, however, that a clear distinction between ingutuk and bowhead cannot always be made when considering all morphological features over a range of whale sizes.

Although detailed morphometric and genetic-biochemical analyses of bowhead whales are far from complete, our research to date leads us to conclude that the ingutuk is not a species separate from the bowhead. This conclusion is supported by the most experienced Eskimo whaling captains we have interviewed.

RECOMMENDATIONS

ACTIONS BASED ON EXISTING KNOWLEDGE

Based on our present state of knowledge of the distribution and biology of the bowhead whale in the Bering, Chukchi, and Beaufort Seas, we recommend that serious consideration be given to removing or drastically limiting oil and gas development in four important (perhaps critical) habitat areas:

1) The northern Bering Sea around St. Lawrence Island.
2) The Bering Strait.
3) Northwest coast of Alaska, Cape Lisburne to Point Barrow.
4) The western U.S. Beaufort Sea from long 150°W to Point Barrow.

Designation of these areas as of primary importance to the species is partly based on the fact that we have better information for these areas than for others. Unfortunately, we have less good information for areas which might prove to be of particular importance, e.g. the eastern Beaufort Sea (including the present OCS lease site), Hope Basin, and the Navarin Basin. However, the eastern Beaufort Sea and th Hope Basin appear to be transition zones for the whales during their annual migration rather than vital places where they would be most vulnerable. Additional research, particularly in the Beaufort Sea, is needed to verify this point.

Without precedents regarding effects to whales of oil-related development activities, it is difficult to assess joepardy to this population, as required by Section 7 of the U.S. Endangered Species Act of 1972. However, we can predict the times and locations where the population, or at least individuals, would be vulnerable to an oil spill or other possible disturbing activities. The times are outlined by OCS lease area in Table 3. Specifically the above described areas are of greatest significance because we believe bowheads engage in two critical life history phases there--reproduction and feeding. They also migrate directly through these areas twice annually.

Our conclusions are based on two years of OCSEAP research, and two additional years of NMFS studies where, in both cases, we were limited by weather, time, and budget to completely cover all areas visited by bowheads. It is, of course, difficult to draw conclusions on the importance of areas and times within their range where few data exist.

We are less certain about the times and areas where white whales might be vulnerable. Certainly inner Kotzebue Sound appears to be an important summering area for reproduction and feeding. The northwest coastal waters from Point Lay to Point Barrow appear also be an important area for white whales, althougfh this may vary among years. But again, because we do not know how many stocks of white whales we are dealing with, site specific vulnerability is particularly difficult to assess.

White whales appear to occur farther offshore in the U.S. Arctic Ocean than bowheads: perhaps they are less vulnerable to nearshore development. Some do, however, occur very near shore in the eastern Bering and Chukchi Sea during the spring and summer. Because some Eskimo subsistence depends upon both species, we urge that site specific studies related to interaction between whale, subsistence activities (hunting requirements), and oil development activities be undertaken. We further urge that ecological studies be conducted placing greater value on both species habitat requirements and environmental (physical and biological) interaction than previously suggested or conducted.

PROPOSED RESEARCH NEEDS

Future bowhead whale research needs include consideration of direct and indirect effects of oil pollution and developmental activities with potential first-order effects: 1) intestinal compositions from oil ingestion; 2) irritation and deterioration of skin and eye tissues; 3) impairment of thermal regulation; 4) fouling of baleen plates; 5) inhalation of oil and congestion of the lungs; 6) noise interference with intraspecific communications; and 7) threat to traditional migration routes, calving areas, and/or feeding grounds. The most critical second order effects would be destruction of food supplies through contamination or alteration of the marine habitat, should it occur.

The objectives of any research in and near OCS lease areas should be to determine 1) the frequency of occurrence in and adjacent to specific lease sites; 2) the magnitude of, or component of the population (including sex and/or age class segregation) frequenting the lease areas; 3) the reasons why whales occur in certain areas (e.g. apparent annual feeding nearshore east of Point Barrow in September); and 4) the studies (direct and indirect) that could best address potential noise, oil, and traffic interference problems. Because destruction of preferred wildlife habitat is a common result of man's activities, general studies of the marine environment as it now exists in Alaska would be of primary importance. Presumably these kinds of studies will continue on a lease site basis as lease sale scheduling proceeds from site to site.

The following is a list of proposed research topics with regard to bowheads and white whales. Results from these studies should provide at least the minimum information needed to make management decisions, especially where related to the requirements of the Endangered Species Act. These studies admittedly relate primarily to occurrence and direct effects because, we believe, these are the most obvious studies for which answers might be readily obtained. Most have previously been recommended in various meetings and documents since June 1978. Some studies (e.g. bowhead spring migration across the Beaufort Sea and baleen fouling study) were previously discussed in the earlier draft of this paper and are presently being conducted by the Bureau of Land Management.

Bering Sea

1) Study whale movements and habits of whales associated with the movement of ice during breakup in spring and formation in autumn around St. Lawrence Island.

2) Study calving and feeding near St. Lawrence Island in the spring and feeding in the autumn, especially north of the island.

3) Study habitat use patterns in the Navarin Basin during late winter.

Chukchi Sea

1) Determine if bowhead and white whales migrate directly into the western Chuckhi Sea during the late spring or summer from the NBS, and if they migrate from the Beaufort Sea into the Chukchi Sea between June and September. This information is necessry to determine if the entire population enters the Beaufort Sea and, thus, might be vulnerable to oil· development related activities along the North Slope.

2) Ascertain whether the Hope Basin area supports bowheads for feeding in late autumn.

3) Study presence of white whales in Kotzebue Sound and adjacent bays (e.g. Escholtz Bay) and the northwest coast to relate habitat use and seasonal dependency. Population segregation or stock identification might be studied using electrophoretic analyses. Life history information is essential.

4) Determine which areas of the northeast Chukchi Sea that bowhead whales are most likely to feed in and migrate through in the autumn.

Beaufort Sea

1) Determine the frequency distribution of whales from the shore to the pack ice in the summer and autumn. It is essential that we know what component of the migrating population will be in or near the OCS area. For example, do all whales move offshore (i.e. near the ice edge), or near shore through the lease area? A knowledge of the spatial distribution is necessary to determine how many individuals in the population might be vulnerable. Changes in ice conditions and relative movement of whales to ice is an important corollary study.

2) Conduct aircraft and/or vessel surveys in the western Canadian Beaufort Sea during the summer, principally in Amundsen Gulf, to further determine if the relative magnitude of the bowhead population here is similar to that estimated at Point Barrow in the spring. Again, this is important in order to assess what portion of the population might be vulnerable. Related behavior and feeding studies are also recommended.

3) Define the importance of the U.S. Beaufort Sea for bowhead feeding. Food habit studies and sample collecting of zooplankton should be done over a wide area of the Beaufort Sea. General trophic interaction studies are important too. This is important baseline information becuase we have no idea how, or if, animals respond to changing resource (prey density) patterns between the shore and pack ice, or even east to west in the Beaufort Sea. General biological oceanographic information is paramount to understand the Beaufort Sea ecosystem; such information is presently lacking.

Non-site specific studies

1) A noise effects study might be useful. Additional detailed studies on behavior and response vocalizations might also help determine their sensitivity to man's activities.

2) Gather detailed historical information from Eskimos and Soviets and do further analysis of early whaling records to establish specific use patterns in and adjacent to the lease areas.

3) If the euphasiid *Thysanoessa rashii* (or other species such as *Calanus* spp.) is the preferred prey item for bowheads as it now appears then a detailed study of the life cycle and quantitative occurrence of *T. rashii* and *Calarus* spp. should be made in the Arctic, especially in the Beaufort Sea nearshore from Barter Island to Point Barrow, Amundsen Gulf, and eastern Chukchi Sea. Naturally, the life histories and quantititative determination of other prey species and competing predators should be made as other important bowhead food items are discovered. Oil effects studies, after life cycle studies, should follow.

The aforementioned proposed studies are only generally discussed here. Specific studies should be thoroughly reviewed for scientific relevance and management alternative considerations. Results from these, or similar studies, will provide a preliminary basis for making timely decisions concerning further research and possible implications of OCS development.

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APPENDIX I

Aerial surveys flown during 1975-77 as part of OCSEAP Research Unit 69. File identifiers are those used on both Environmental Data Service OCSEAP 027 format and National Marine Mammal Laboratory format. Mileage (approximate) is in kilometers. Wnt-Wainwright; RE-return.

File identifier	Survey date	Description (survey origin/area surveyed)
1. Sep 6-Sep 29,'75 Total miles surveyed: 10,945. Total hours flown: 47:10.		
175249	6 Sep	Barrow, Wnt., RE / C. Simpson / coast
175252	9 Sep	Barrow, RE / C. Simpson / coast
175255	12 Sep	Barrow, Deadhorse, RE / coast
175257	14 Sep	Barrow, Barter I., Deadhorse, RE / coast
175258	15 Sep	Barrow, Prudoe Bay, Lonely / coast
175259	16 Sep	Lonely, Barrow / coast
175263	20 Sep	Barrow, Barter I., RE / coast
175266	23 Sep	Barrow, Pt. Lay., Icy Cape, RE / coast
175267	24 Sep	Barrow, RE / C. Simpson
175269	26 Sep	Barrow, Pt. Lay, RE / coast
175270	27 Sep	Barrow, RE / coast
175272	29 Sep	Barrow, Barter I., Barter I., RE / Herschel I.
2. Oct 9-Oct 14,'75 Total miles surveyed: 4,695. Total hours flown: 18:25.		
175282	9 Oct	Nome, RE / S. Chukchi Sea
175285	12 Oct	Nome, RE / N. Bering Sea, St. Lawrence I.
175287	14 Oct	Nome, Anch. / St. Lawrence I., St. Matthew I., Nunivak I.
3. Mar 15-Mar 21,'76 Total miles surveyed: 4,380. Total hours flown: 19:52.		
176075	15 Mar	Nome, RE / St. Lawrence I., Gulf of Anadyr
176078	17 Mar	Nome, RE / St. Lawrence I., Bering St.
176079	19 Mar	Nome, RE / N. St. Lawrence I., SW. St. Lawrence I.
176081	21 Mar	Nome, RE / N. St. Lawrence I.
4. Apr 6-Apr 23,'76 Approx. total miles surveyed: 17,140. Total hours flown: 72:07.		
176097	6 Apr	King S., RE / Bristol Bay, ice front, Cold Bay
176099	8 Apr	King S., RE / Central Bristol Bay
176100	9 Apr	King S., RE / Bristol Bay
176103	12 Apr	King S., RE / Central Bristol Bay
176104	13 Apr	King S., Nome/Bristol Bay, St. Lawrence I.
176106	15 Apr	Nome, King S. / St. Lawrence I., St. Matthew I. Bristol Bay
176108	17 Apr	King S., RE / Central Bristol Bay
176109	18 Apr	King S., RE / Central Bristol Bay
176110	19 Apr	King S., Bethel, Nome / Bristol Bay, St. Lawrence I.

File identifier	Survey date	Description (survey origin / area surveyed)
176111	20 Apr	Nome, RE / St. Lawrence Island, Bering St.
176112	21 Apr	Nome, RE / St. Lawrence I., Bering St., Pt.Hope
176113	22 Apr	Nome, RE / St. Lawrence I.
176114	23 Apr	Nome, Anch / Norton Sound

5. Apr 30-May 14,'76 Total miles surveyed: 4,600. Total hours flown: 25:17.

176121	30 Apr	Barrow, RE / coast, Pt. Hope
176122	1 May	Barrow, RE / Wainwright, offshore
176124	3 May	Barrow, RE / Icy Cape
176129	8 May	Barrow, RE / Shorelead
176130	9 May	Barrow, RE / N.E. offshore
176133	12 May	Barrow, Barter I., Deadhorse, RE / Leads, fast
176135	14 May	Barrow, RE / N.E. offshore

6. May 15-May 31,'76 Total miles surveyed: 2,605. Total hours flown: 14:43.

176136	15 May	Barrow, RE / Shorelead W.
176140	19 May	Barrow, Pt. Hope, RE / coast
176141	20 May	Barrow, RE / N.E. lead system
176143	22 May	Barrow, RE / lead W., N.E. pack ice
176145	24 May	Barrow, RE / shorelead W.
176149	28 May	Barrow, Peard Bay, RE/shorelead, fast ice
176152	31 May	Barrow, RE / shorelead W.

7. Jun 1-Jun 5,'76 Total miles surveyed: 1,575. Total hours flown: 7:21.

176153	1 Jun	Barrow, Pt. Hope, RE / coast
176156	4 Jun	Barrow, RE / C. Simpson and N.E.
176157	5 Jun	Barrow, RE / coast W.

8. Jun 8-Jun 14,'76 Total miles surveyed: 8,025. Total hours flown: 34:30.

176160	8 Jun	Anch., Nome/Norton Sd.
176161	9 Jun	Nome, RE / St. Lawrence I., Bering St.
176162	10 Jun	Nome, RE / N. Bering Sea, S. Chukchi Sea
176163	11 Jun	Nome, Kotz. / N. Bering Sea, S. Chukchi Sea
176164	12 Jun	Kotz., Nome / Bering St., N. St. Lawrence I.
176165	13 Jun	Nome, RE / Norton Sd., St. Lawrence I.
176166	14 Jun	Nome, King S. / Bering St., E. Bering Sea

9. Jun 18-Jun 20,'76 Total miles surveyed: 2,930. Total hours flown: 15:26.

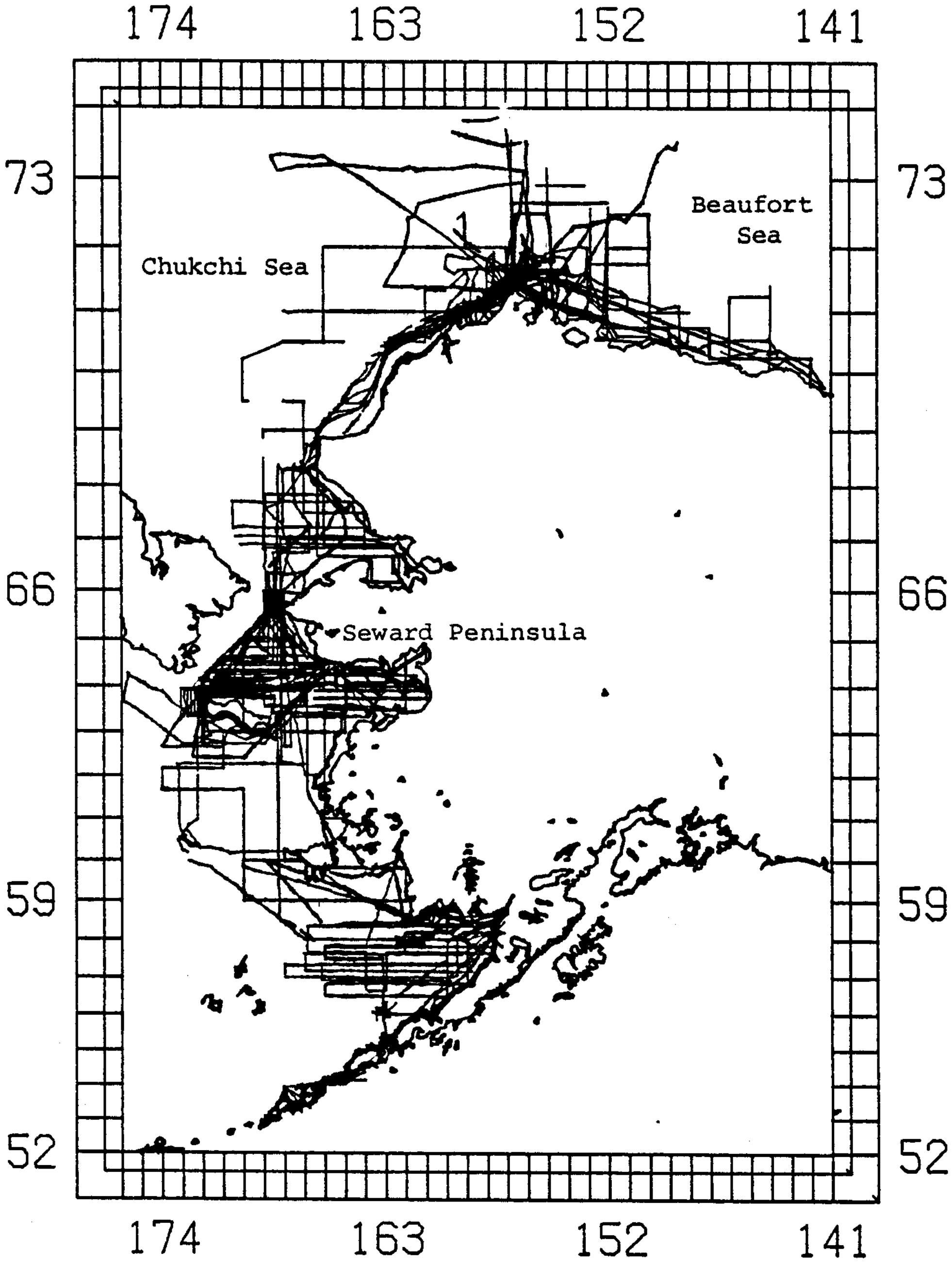
176170	18 Jun	Barrow, RE / offshore
176171	19 Jun	Barrow, RE / nearshore leads
276172	20 Jun	Barrow, Barter I. Prudoe Bay, RE / offshore, fast ice

File identifier	Survey date	Description (survey origin / area surveyed)
10. Aug 17-Aug 26,'76 Total miles surveyed: 8,830. Total hours flown: 39:22.		
176230	17 Aug	Deadhorse, RE / S. Beaufort Sea
176231	18 Aug	Deadhorse, RE / S. Beaufort Sea
176232	19 Aug	Deadhorse, Barrow / S. Beaufort Sea
276233	20 Aug	Barrow, RE / S. Chukchi Sea
276234	21 Aug	Barrow, Kotz. / S. Chukchi Sea
176235	22 Aug	Kotz., RE / Kotz. Sd.
176236	23 Aug	Kotz., RE / Kotz. Sd.
176237	24 Aug	Kotz., Nome / Bering Sea
176238	25 Aug	Nome, RE / St. Lawrence I.
176239	26 Aug	Nome, Bethel / Norton Sd.
11. Sep 20-Sep 26,'76 Total miles surveyed: 2,183. Total hours flown: 9:49.		
176264	20 Sep	Barrow, C. Lis., RE / coast, bird survey
176265	21 Sep	Barrow, RE / C. Simpson, N. pack ice
176266	22 Sep	Barrow, RE / C. Simpson, N.W. pack ice
176268	24 Sep	Barrow, RE / C. Simpson, N.E. pack ice
176270	26 Sep	Barrow, RE / C. Simpson
12. March 31-Apr 3,'77 Total miles surveyed: 4,540. Total hours flown: 18:18.		
177090	31 Mar	Anch., Nome / S. Norton Sd.
177091	1 Apr	Nome, RE / Pt. Hope, Kotz. Sd.
177092	2 Apr	Nome, RE / St. Lawrence I.
177093	3 Apr	Nome, RE / N. Norton Sd., N. St. Lawrence I.
13. Apr 19-Apr 26,'77 Total miles surveyed: 325. Total hours flown: 1:17.		
177109	19 Apr	Barrow, RE / Pt. Hope
177113	23 Apr	Barrow, Pt. Hope / coast, fast ice
177116	26 Apr	C. Lis., Barrow / coast
14. May 11-May 14,'77 Total miles surveyed: 3,875. Total hours flown: 12:14.		
177131	11 May	Anch., Nome / N. Norton Sd.
177132	12 May	Nome, RE / Pt. Hope, Kotz. Sd.
177134	14 May	Nome, Bethel / Norton Sd., Nunivak I.
15. May 21-May 30,'77 Total miles surveyed: 1,317. Total hours flown: 5:45.		
177141	21 May	Barrow, RE / Barter I.
177150	30 May	Barrow, RE / Northeast leads

File identifier	Survey date	Description (survey origin / area surveyed)
16.	Aug 26-Oct 13,'77	Total miles surveyed: 6,500. Total hours flown: 27:17.
177238	26 Aug	Barrow, C. Simpson, RE / coast, Oarlock Isl.
177241	29 Aug	Barrow, RE / coastal to Lonely, Mid-Oarlock I.
177244	1 Sep	Barrow, C. Simpson, RE / coast, Oarlock I.
177248	5 Sep	Barrow, RE / N. to ice, E. to Lonely, coastal
177251	8 Sep	Barrow, Barter Isl., RE / offshore E. to Bord
177253	10 Sep	Barrow, RE / N.W. Chukchi Sea
177257	14 Sep	Barrow, RE / N.W. Chukchi Sea
177276	3 Oct	Barrow, RE / N. to ice, E., coastal
177279	6 Oct	Barrow, RE / N.E. and coastal
177286	13 Oct	Barrow, C. Simpson, RE / coast.

APPENDIX II

Aerial survey tracklines flown September 1975-October 1977.



MARINE MAMMALS OF LOWER COOK INLET AND THE POTENTIAL FOR IMPACT FROM OUTER CONTINENTAL SHELF OIL AND GAS EXPLORATION, DEVELOPMENT, AND TRANSPORT

by

Donald G. Calkins

Alaska Department of Fish and Game
333 Raspberry Road
Anchorage, Alaska 99502

Final Report
Outer Continental Shelf Environmental Assessment Program
Research Unit 243

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INTRODUCTION

Petroleum exploration, production and transportation in marine waters have the potential for extensive environmental impacts. Major oil and gas development has taken place in upper Cook Inlet as a result of lease sales held by the State of Alaska between 1959 and 1974. There are five oil and three gas fields with 14 offshore platforms and a submarine pipeline network which carries the majority of the oil to the Drift River Terminal on the west side of the Inlet. Approximately 0.2 million hectares of lower Cook Inlet were leased by the Federal government in 1977. It is expected that 32 exploratory wells and 71 production wells will be drilled and three platforms required for production. Up to 442 kilometers of onshore and submarine pipeline will be needed depending on the location of the oil terminals and treatment facilities. Warren (1978) provides a complete scenario of development for the area. Future lease sales may include Shelikof Strait.

Studies of the biological, physical and chemical properties of the area are being conducted by the National Oceanic and Atmospheric Administration Outer Continental Shelf Environmental Assessment Program to provide the data necessary for managing petroleum development with a minimum of environmental degredation. The biological research should include studies of all trophic levels in order to identify sensitive organisms and to determine the effects of oil development on the ecosystem.

Marine mammals are high trophic level consumers and may be directly and severely affected by external contamination or ingestion of oil or through disturbance associated with petroleum development. Indirect effects include mortality or decreased vitality due to ingestion of compounds passed along the food chain and a decrease in the food supply due to oil caused mortality of prey items, and destruction of habitat in the form of oiling beaches making them unsuitable as hauling areas.

The economic importance, highly visible nature and aesthetic appeal of marine mammals are additional reasons for consideration.

Objectives

The objectives of this report are:

1. review: (a) all available data on marine mammals in Cook Inlet;

   (b) all pertinent information on the physical, chemical and biological properties of Cook Inlet and

   (c) the known oil operations, probable development scenarios and the fate of oil in the marine environment.

2. synthesize the data into a comprehensive discussion on marine mammal use of Lower Cook Inlet.

3. determine the potential for impact by oil and gas exploration, production and transportation on marine mammals.

Area of Consideration

The study area is located in southcentral Alaska and includes the waters and adjacent shores of Cook Inlet from the Forelands to Kennedy Entrance (Fig. 1). Shelikof Strait, which receives most of the waters leaving Cook Inlet, will also be included for consideration.

The area includes Cook Inlet, a tidal estuary, which flows into the Gulf of Alaska, is approximately 200 kilometers long and ranges in width of 16 kilometers at the Forelands in the northeast to 120 kilometers at the mouth in the southwest.

The climate of Cook Inlet is a transition zone between the Alaskan interior with its cold winters, warm summers, low precipitation and moderate winds and the maritime zone with cool summers, mild winters, high precipitation and frequent storms. Mean precipitation over the entire Cook Inlet is 53 cm per year (Evans et al. 1972). Northeast winds prevail in the winter while summer winds tend to be from the southwest. An extensive climatic description of Cook Inlet can be found in Evans et al. (1972) and Selkregg (1974).

The circulation of water in Cook Inlet is influenced by the seasonally variable fresh water runoff, the large tidal range of up to 6 meters (Trasky et al. 1977) and wind patterns. In general, water from the Gulf of Alaska enters Cook Inlet through Kennedy Entrance. This intruding water is diverted past Kachemak Bay and moves northward along the eastern

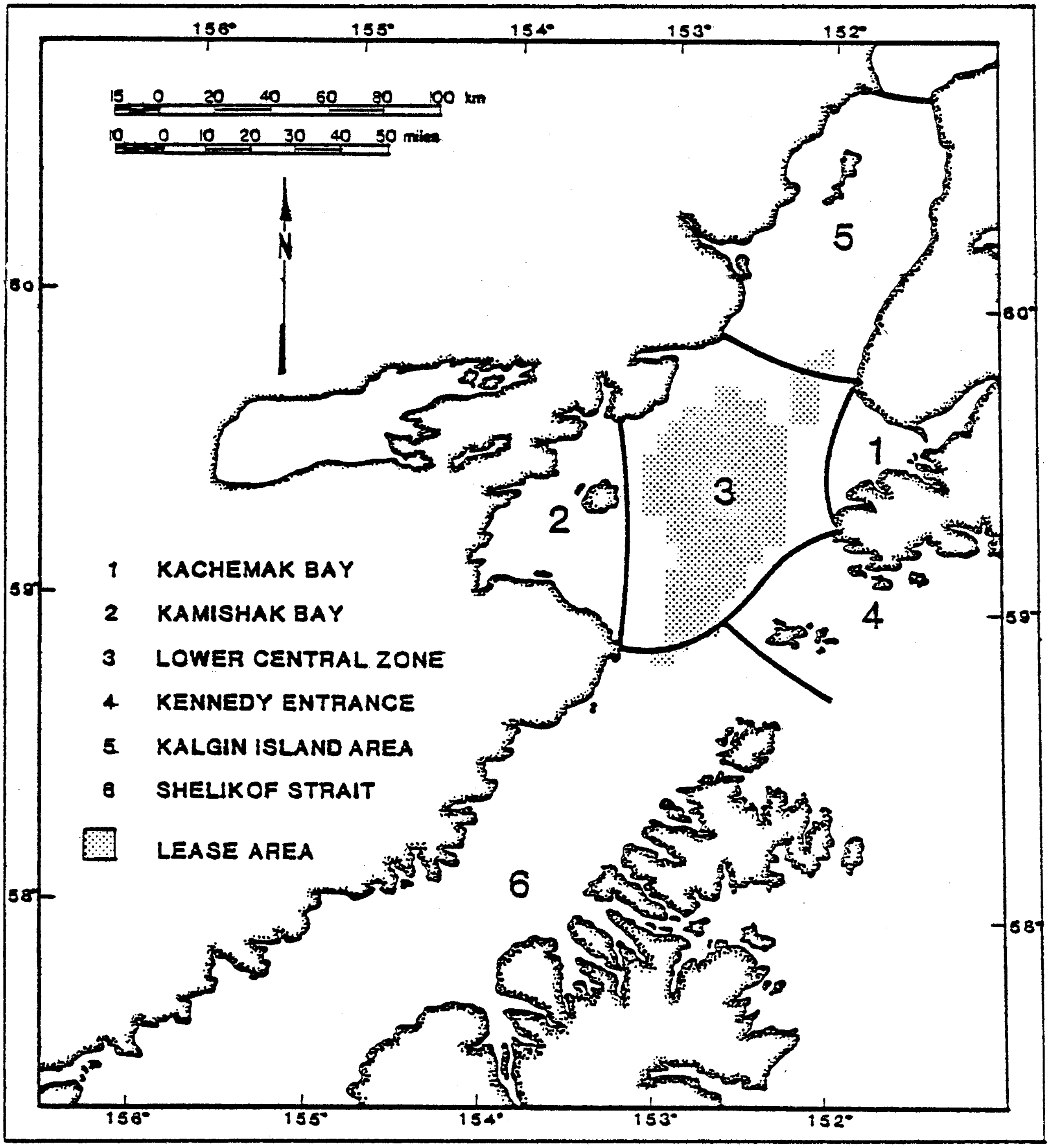

FIGURE 1. AREA OF CONSIDERATION FOR LOWER COOK INLET AND SHELIKOF STRAIT.

shore of Cook Inlet where a portion diverges sharply to the west at Anchor Point while the remaining northward flow extends past the Forelands. The water flowing westward from Anchor Point meets a southward flow of turbid, low salinity water from the upper inlet. This water flows south past Kalgin Island, through Kamishak Bay and into Shelikof Strait. The complexity of the circulation patterns is dealt with in detail by Burbank (1977) and ADF&G (1978a).

The study area can be broken down into six general zones: Kachemak Bay, Kamishak Bay, Lower Central Zone, Kennedy Entrance, the Kalgin Island area and Shelikof Strait (Fig. 1). An extensive background description of the area can be found in Sears and Zimmerman (1977), Science Applications (1977), Trasky et al. (1977) and ADF&G (1978a). The following is a short summary of each zone:

Kachemak Bay is located on the east side of Lower Cook Inlet and is characterized by depths to 165 meters and a diverse and highly productive fauna. The bay has an inner and outer region partially divided by Homer Spit, the outer region being relatively ice free in winter, whereas ice is commonly found at the head of the bay. The north coastline is smooth, with gradual slopes and beaches consisting largely of mud flats. The southern shore is irregular, with gradual slopes and beaches composed of intermittent stretches of gravel, sand and bedrock.

Kamishak Bay, located on the western side of Cook Inlet is relatively shallow, with depths to 56 meters. There appears to be less diversity in the fauna as compared to Kachemak Bay, although the region is still highly productive. The circulation pattern tends to carry sediments into the bay, thus increasing turbidity. Winter ice, which is formed in upper Cook Inlet, also tends to drift down the western side of the Inlet and accumulate in the bay. The coastline is indented with numerous small bays and coves which usually contain extensive mud flats. The remaining coastline is a mixture of gradually sloping sand, gravel and bedrock beaches. Augustine Island, found within Kamishak Bay, is a volcano with sand and gravel beaches.

The Lower Central Zone is located between Kamishak and Kachemak Bays. It is relatively deep, with vigorous tidal circulation, although the middle portion of this zone tends to be sluggish. Again, this region is highly productive.

Kennedy Entrance is located between the Chugach Islands, off the southern tip of the Kenai Peninsula and the Barren Islands. It is the main pathway for tidal exchange between Cook Inlet and the Gulf of Alaska. The entrance is narrow and deep (up to 128 meters), with extremely swift currents. The Chugach and Barren Islands are characterized by steeply sloping shorelines with narrow bedrock beaches.

The Kalgin Island area extends south from the Forelands to the Lower Central Zone and is a region of high turbidity due to mixing with the sediment laden waters from upper Cook Inlet. Winter ice from upper Cook Inlet is carried by currents and wind into this area. Although primary productivity tends to be low due to the turbidity and ice, the area is still an important fishing ground for salmon (ADF&G 1978a). This region, including Kalgin Island, has a relatively smooth coastline with gently sloping mud, sand and gravel beaches. The shoreline of Tuxedni Bay, the only major indentation, consists of an almost entirely uninterupted mud beach.

Shelikof Strait, an area characterized by high winds and heavy seas is located between Kodiak Island and the Alaska Peninsula. Most of the water from Cook Inlet tends to flow through Shelikof Striat along the Alaska Peninsula shore. The coastline is very irregular, with small bays, coves and lagoons found throughout the area. Considerable variation exists in the slope and composition of the beaches.

MARINE MAMMALS OF COOK INLET AND SHELIKOF STRAIT

The following discussion summarizes the life histories of the more important marine mammal species in the study area; these include sea otters (*Enhydra lutris*), Steller sea lions (*Eumetopias jubatus*), harbor seals (*Phoca vitulina*) and belukha whales (*Delphinapterus leucas*). The limited data available on humpback (*Megaptera novaeangliae*), gray (*Eschrichtius robustus*), Minke (*Balaenoptera acutorostrata*) and killer (*Orcinus orca*) whales and Dall (*Phocoenoides dalli*) and harbor (*Phocoena phocoena*) porpoises are also discussed. A list of all marine mammals likely to occur in lower Cook Inlet and Shelikof Strait appears in Table 1.

Table 1. Marine mammals species likely to occur in lower Cook Inlet and Shelikof Strait (from Calkins et al. 1975).

SPECIES	SIGHTINGS	USUALLY SIGHTED WITH 50fm CURVE	USUALLY SIGHTED OUTSIDE 50fm CURVE
Sea otter (*Enhydra lutris*)	C	X	
Steller sea lion (*Eumetopias jubatus*)	C	X	X
Northern fur seal (*Callorhinus ursinus*)	F	X	X
Harbor seal (*Phoca vitulina*)	C	X	
Black right whale (*Balaena glacialis*)*	F		X
Gray whale (*Eschrichtius robustus*)*	C	X	X
Minke whale (*Balaenoptera acutorostrata*)	C	X	X
Sei whale (*Balaenoptera borealis*)*	F	X	X
Fin whale (*Balaenoptera physalus*)*	F	X	X
Blue whale (*Balaenoptera musculus*)*	F		X
Humpback whale (*Megaptera novaeangliae*)*	C	X	X
North Pacific white-sided dolphin (*Lagenorhynchus obliquidens*)	F		X
Killer whale (*Orcinus orca*)	C	X	X
Harbor porpoise (*Phocoena phocoena*)	C	X	
Dall porpoise (*Phocoenoides dalli*)	C	X	X
Sperm whale (*Physeter catodon*)*	F		X
Bering Sea beaked whale (*Mesoplodon stejnegeri*)	F		X
Goose beaked whale (*Ziphius cavirostris*)	F		X
Northern right whale dolphin (*Lissodelphis borealis*)	F		X
Belukha (*Delphinapterus leucas*)	C	X	
Pacific giant bottlenose whale (*Berardius bairdi*)	F		X

* Endangered species (USDI 1979) C = commonly sighted F = few sightings

Sea lion

Steller sea lions (*Eumetopias jubatus*) can be found throughout the Lower Cook Inlet, Shelikof Strait area at all times of the year. They utilize seventeen different hauling areas and breeding rookeries on a regular, predictable basis (Table 2 and Fig. 2). Eight other locations are used as stop over areas where sea lions have been sighted irregularly (Table 3). Table 2 summarizes counts at all locations within Lower Cook Inlet and Shelikof Strait. These counts include only those made during the most recent photo surveys. It is important to remember that when considering sea lion numbers, only those sea lions which are hauled out or are in the water near a hauling area are counted. Many more animals are likely within the study area, but not associated with a specific hauling area at the time of the survey and therefore are not counted. The total numbers of sea lions within the study area fluctuates daily and the counts can only be used as a fractional indicator of this.

Steller sea lion populations within the lower Cook Inlet/Shelikof Striat OCS lease area are contiguous with and an integral part of the overall population of the north Gulf of Alaska. All of our evidence indicates no areas within the Gulf of Alaska have separate, distinct sea lion populations. Biochemical studies have shown that sea lions in the Gulf have extremely low genetic variation (Lidicker et al. 1979). Movements studies indicate they are highly mobile, capable of moving great distances and utilizing a variety of areas as haulouts. Sea lions marked within the study area have been sighted throughout the year both within the LCI/Shelikof area as well as throughout the rest of the Gulf of Alaska.

Table 2. Steller sea lion haulouts and rookeries located in Lower Cook Inlet and Shelikof Strait, with counts made 1957 through 1976. 1957 counts made by Mathisen and Lopp (1959).

Location	March 1957	June 1957	March 1976	June 1976	March 1977
Puale Bay 57°40'55"N 155°24'05"W			1,704	3,166	15,000+
Cape Iklolik 57°21'40"N 154°46'50"W			1,913	0	
Cape Ugat 57°52'20"N 153°50'45"W			222	0	
Takli Island 58°03'40"N 154°27'35"W			1,014	1,727	
Cape Gull 58°12'40"N 154°08'45"W			0	207	
Latax Rocks 58°41'25"N 152°29'00"W		3,334	322	1,164	
Rocks SW Sud Island 58°52'50"N 152°18'43"W			87	670	
Sud Island 58°53'00"N 153°15'00"W					
Ushagat Island SW 58°57'31"N 152°20'42"W	0	834	819	902	
Ushagat Island NW 58°57'31"N 152°20'42"W			0	106	
Sugarloaf Island 58°53'29"N 152°12'49"W	585	11,963	301	5,226	
Amatuli Island 58°55'20"N 152°02'30"W		1,576		57	
Nagahut Rocks 59°05'58"N 151°39'31"W			68	344	
Perl Island 59°05'58"N 151°39'31"W	12		8	33	
Cape Elizabeth 59°05'58"N 151°39'31"W	0				
E. Chugach Island 59°08'20"N 152°39'30"W	0	20	68	124	
Gore Point 59°10'47"N 150°57'50"W	0	200	200	535	

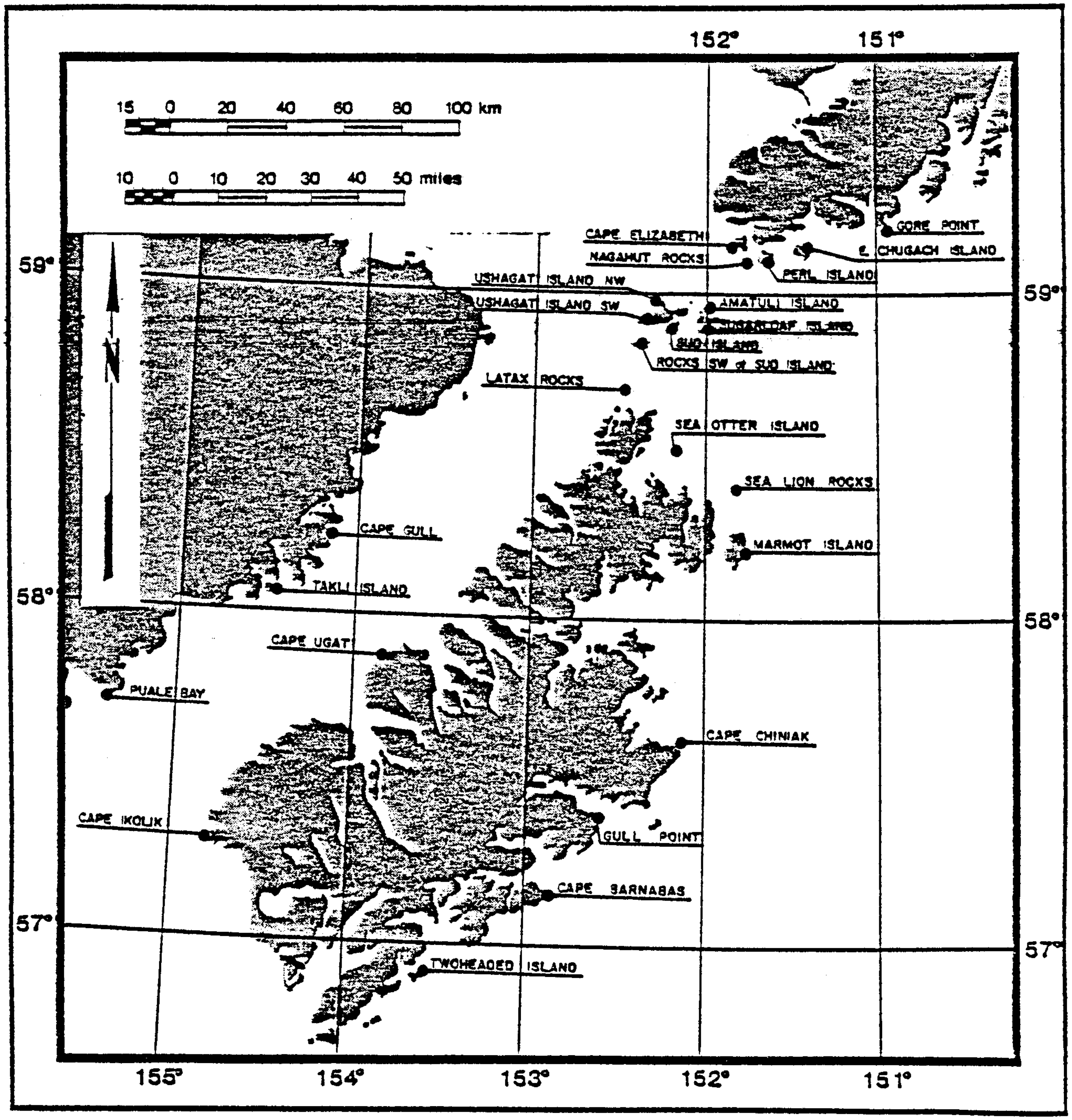

FIGURE 2. STELLER SEA LION HAULING AREAS IN THE LOWER COOK INLET / SHELIKOF STRAIT AREA.

Table 3. Location in Lower Cook Inlet and Shelikof Strait where Steller sea lions have been sighted, but which are not considered true hauling areas (Calkins and Pitcher 1977).

Name	Location	
	Latitude	Longitude
Sturgeon Head	57° 30' 30"N	154° 37' 50"W
Noisy Islands	57° 55' 30"N	153° 33' 00"W
Malina Point	58° 02' 30"N	153° 22' 00"W
Steep Cape	58° 12' 00"N	153° 12' 30"W
Cape Paramanof	58° 18' 15"N	153° 02' 45"W
Augustine Rocks	59° 13' 30"N	153° 22' 00"W
Cape Nukshak	58° 23' 30"N	153° 52' 50"W
Cape Ugyak	58° 16' 35"N	154° 06' 10"W

Sea lions often use some hauling areas on a seasonal basis only. Some areas are used primarily in winter, while others are used only during the summer breeding and pupping season. In the lower Cook Inlet/Shelikof Strait area, the most pronounced shift in seasonal distribution is found at Sugarloaf Island and at Puale Bay. These two areas are of key importance.

Sugarloaf Island is the only breeding rookery within the study areas and is the second largest breeding rookery in the northern Gulf of Alaska. Greater than 5,000 sea lion pups are produced here annually. This is approximately 20 percent of the total number of sea lion pups produced within the Gulf of Alaska each year.

Sea lion use of Sugarloaf Island is insignificant during the winter. Fewer than 500 sea lions remain on the island between December and March. By approximately mid April sea lions of both sexes and all ages begin hauling out on Sugarloaf Island. Near the end of April and the beginning of May large males begin to arrive at Sugarloaf and establish territories. Throughout May, pregnant females arrive in increasing numbers. Pupping begins approximately in mid May and continues through mid July. Pupping appears to peak between June 15 to June 25. By the end of June sea lions can be found all around Sugarloaf Island although the majority of pupping takes place on the north side of the Island.

During the middle of July, the large males' territorial structure begins to break down and they begin shifting about on the island and leaving. During this period the cows with older pups begin shifting along the shore as the pups lose their reluctance to enter the water. By the end of July nearly all pups readily enter the water. Adult females appear to remain on Sugarloaf with their pups until at least the end of October. Probably with the onset of winter storms in November they begin leaving the island. We know that sea lions move in all directions away from Sugarloaf Island in the winter. Sea lions born at Sugarloaf have been sighted at Cape Chiniak off Kodiak, Marmot Island off Afognak, Latax Rocks off Shuyak, Chirikof Island, the Semidi Islands, the Chiswell Islands on the Kenai Peninsula, Seal Rocks in the entrance to Prince William Sound and Cape St. Elias. Few of these animals return to Sugarloaf Island in the spring as subadults 2 and 3 years old. We do not yet know if pups born at Sugarloaf Island will return as adults to breed.

Puale Bay on the Alaska Peninsula in Shelikof Strait (Fig. 2) is probably one of the most important "hauling" areas in the northern Gulf of Alaska. This area is used by sea lions at all times, but as can be seen from Table 2 is most important during the winter. The sea lions use a group of rocks and small islands on the north side of the entrance to Puale Bay to haulout on. The largest group of sea lions seen here were sighted in March 1977. All traditional haulout areas were in use by sea lions. Several thousand other sea lions were resting nearby in the water. The reasons for this concentration of sea lions in the winter is not fully understood. We do know that sea lions born at Sugarloaf and Marmot Islands come here. In September 1978 this area was visited and a maximum of 2,000 sea lions, most of which were subadults were counted. At other times when visiting the Puale Bay haulout, the composition appeared to be all ages and both sexes.

Breeding in sea lions takes place shortly after pupping. Generally most of the pups are born at specific pupping rookeries although a few pups are born at other locations. Sugarloaf Island is the single major pupping rookery within the Cook Inlet/Shelikof Striat area with a few pups born at Puale Bay and possibly Takli Island. Breeding can take place at any location as cows of breeding age which are not pregnant do not necessarily return to these rookeries, but probably come into estrus even though they do not have a pup, and breed at whatever location they happen to be at the time.

Female sea lions are capable of breeding and becoming pregnant at 3 years of age. Age specific pregnancy rates for sea lions in the Gulf of

Alaska are approximately 21% for 3 years of age, 53% for 4 years, 57% for 5 years and 88% for ages 6 through 30. The oldest estimated age of a Steller sea lion taken in the Gulf of Alaska is 30 years. Although the sex ratio at birth is nearly equal, there appears to be a shift in the adult sex ratio with fewer males surviving to become members of the reproductive population.

Steller sea lions prey on a wide variety of fishes and cephalopods (Calkins and Pitcher 1978). Major prey items eaten by sea lions within and adjacent to lower Cook Inlet and Shelikof Strait study areas were capelin (*Mallotus villosus*), pollock (*Thergra chalcogramma*) and Pacific cod (*Gadus macrocephallus*). Octopus (*Octopus* sp.) was a major item by frequency of occurrence analysis, but was relatively unimportant by volume. Herring are undoubtedly important in the spring in Kamishak Bay during spawning, as large concentrations of sea lions have been sighted here when the herring are present.

Harbor Seal

Information on distribution and abundance of harbor seals is incomplete for the Cook Inlet-Shelikof Straits area. Studies specifically designed to collect these data have not been conducted. Information which is available is largely the result of incidental observations conducted during related studies in the area. Distributional data are particularly weak in upper Cook Inlet and the Alaska Peninsula coast of Shelikof Strait.

Figure 3 and Table 4 show locations and provide details of observations of major harbor seal concentrations in the area. Only sighting of 25 or more seals are included. This listing is incomplete and could undoubtedly be expanded with additional coverage. Particularly large hauling areas were found on Elizabeth Island, Yukon Island, Gull Island, Augustine Island and Shaw Island. There appear to be some seasonal changes in distribution of seals in the area. From May through September harbor seals are found in the upper Inlet even entering some river systems. They are absent during the winter months, probably moving to the lower Inlet. Seal movements coincide with movements of anadromous fishes including eulachon (*Thaleicthys pacificus*) and salmon (*Oncorynchus* spp.) into the upper Inlet. Also during some winters, heavy sea ice forms in Cook Inlet which may influence distribution. Harbor seals generally tend to use the ice edge for hauling out and are not found within areas with extensive ice cover.

Cook Inlet harbor seals may form a fairly discrete population as adult body size is significantly smaller than in nearby areas. Some interchange probably occurs from the Outer Kenai coast and the Alaska Peninsula coast of Shelikof Strait as distribution is continuous.

No data are available on population dynamics of Cook Inlet harbor seals. Information will be presented for seals from the Gulf of Alaska in the final report for RU 229 due for completion in October 1979. Timing of key life history events for harbor seals in Cook Inlet probably do not differ greatly from the Gulf of Alaska and are as follows: pupping--25 May to 25 June, nursing--25 May to 15 July, breeding--15 June to

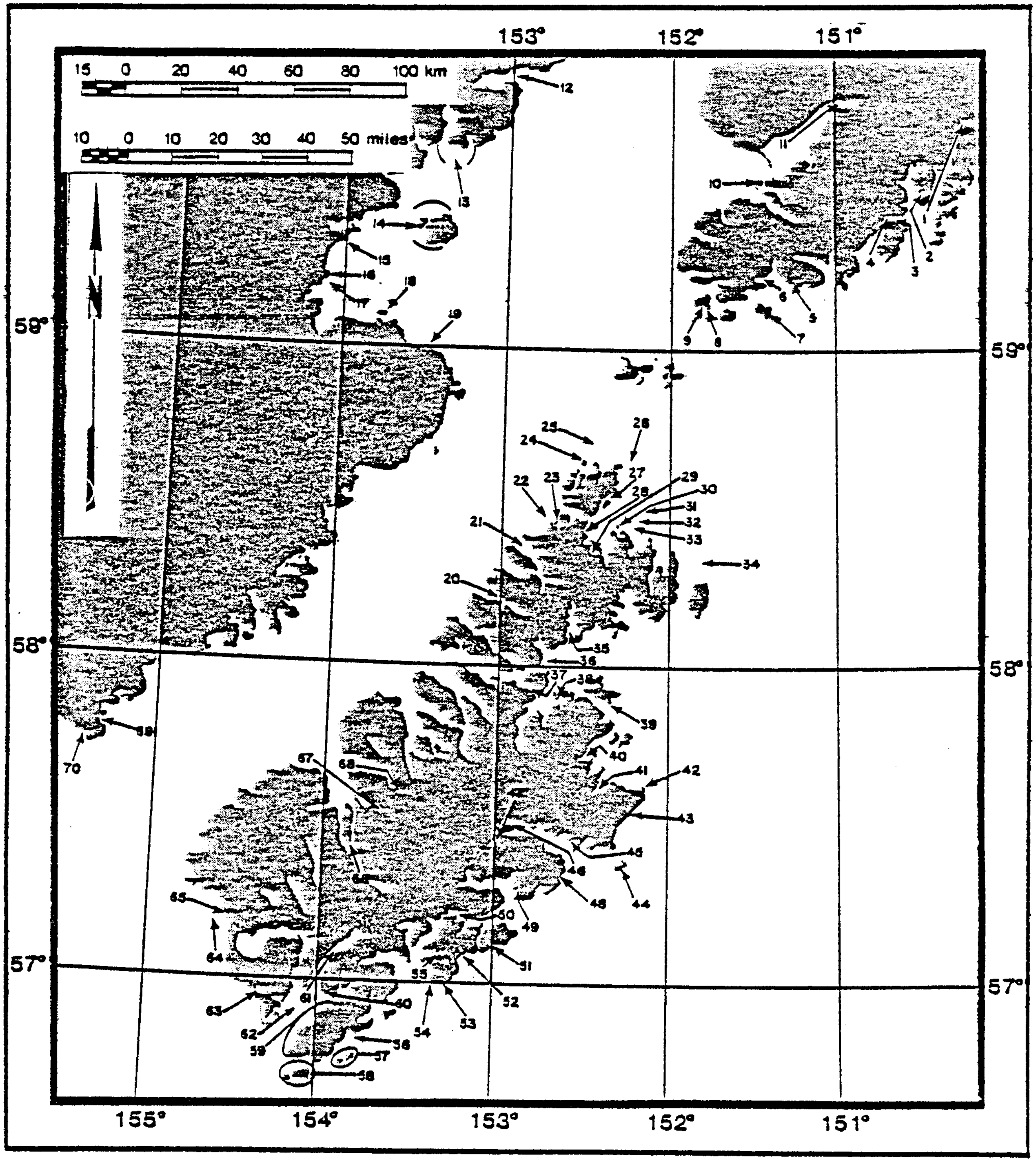

FIGURE 3. OBSERVATION LOCATIONS OF HARBOR SEALS IN THE LOWER COOK INLET/SHELIKOF STRAIT AREA. (SEE TABLE 4 FOR NUMBERS OF SEALS SIGHTED AT EACH LOCATION.)

Table 4. Partial listing of major harbor seal concentrations in Lower Cook Inlet and Shelikof Strait.

Location	(Map No.)	Maximum number of seals observed	Date	Remarks
McCarty Arm 59 43 06 N 150 13 25 W	(1)	100	12 Nov. 1970	Hauled on glacial ice floes, ADF&G aerial survey
Suprise Cove 59 31 40 N 150 28 32 W	(2)	25	21 March 1977	ADF&G small boat survey
Division Island 59 25 23 N 150 41 50 W	(3)	50	6 June 1978	Hauled on intertidal rocks, ADF&G aerial survey
Nuka Island, NW 59 23 24 N 150 42 00 W	(4)	37	31 Aug. 1976	Hauled on intertidal rocks, Arneson (RU 003)
No Name Bay 59 14 07 N 151 17 25 W	(5)	176	24 June 1976	Arneson (RU 003)
Windy Bay 59 13 42 N 151 26 50 W	(6)	26	24 June 1976	Arneson (RU 003)
East Chugach Island 59 06 55 N 151 25 47 W	(7)	40	1 Oct. 1976	Hauled on sand beach, Arneson (RU 003)
Elizabeth Island 59 08 15 N 151 47 37 W 59 08 37 N 151 50 25 W	(8,9)	41-619	21 Aug. to 10 Sept. 1978	Hauled on gravel-cobble beach and intertidal rocks, ADF&G field camp daily counts
Yukon Island 59 31 37 N 151 30 20 W	(10)	250	30 Sept. 1976	Hauled on gravel beach, Arneson (RU 003)
Bradley-Fox River Flats 59 46 45 N 151 00 43 W	(11)	140	-	Arneson (RU 003)

Table 4. (cont.)

Location	(Map No.)	Maximum number of seals observed	Date	Remarks
Gull Island 59 50 29 N 152 59 15 W	(12)	400	1 Oct. 1976	Arneson (RU 003)
Mouth Oil Bay to Mouth Iniskin Bay 59 37 32 N 153 24 15 W	(13)	200	Summer	Arneson (RU 003)
Augustine Island 59 20 08 N 153 32 55 W	(14)	850-1,500	30 Sept. 1976	Hauled out many locations along shore, Arneson (RU 003)
No Name Reef (Kamishak Bay) 59 17 30 N 153 53 07 W	(15)	200	8 April 1978	ADF&G small boat survey
Nordyke Island 59 10 57 N 154 05 22 W	(16)	109	15 July 1978	Arneson (RU 003)
Juma Reef 59 11 45 N 154 04 02 W	(17)	150	8 April 1978	ADF&G small boat survey
Douglas River Reefs 59 05 09 N 153 44 03 W	(18)	200		Sears and Zimmerman (1977)
Shaw Island 59 00 35 N 153 22 18 W	(19)	500-1,000	23 June 1978	ADF&G small boat survey
Malina Bay 58 11 35N 152 59 35 W	(20)	50	30 July 1978	ADF&G small boat survey
Foul Bay 58 21 45 N 152 52 00 W	(21)	40	30 July 1978	ADF&G small boat survey
Alligator Island 58 92 40 N 152 46 33 W	(22)	30	26 July 1978	ADF&G aerial survey
Blue Fox Bay 58 26 03 N 152 40 44 W	(23)	25	22 April 1976	ADF&G small boat survey

Table 4. (cont.)

Location	(Map No.)	Maximum number of seals observed	Date	Remarks
Dark Island 58 39 00 N 152 31 50 W	(24)	45	12 June 1978	ADF&G aerial survey
Latax Rocks 58 40 15 N 152 30 45 W	(25)	175	26 July 1978	Hauled on rocky beach, ADF&G aerial survey
NE Shuyak Island, offshore rocks 58 35 31 N 152 16 43 W	(26)	25	12 June 1978	ADF&G aerial survey
Andreon Bay 58 30 36 N 152 23 33 W	(27)	25	April 1976	ADF&G small boat survey
Big Waterfall Bay 58 25 46 N 152 28 15 W	(28)	50	21 May 1977	ADF&G small boat survey
Phoenix Bay 58 22 07 N 152 28 20 W	(29)	25	22 May 1977	ADF&G small boat survey
Posliedni Pt. offshore rocks 58 26 48 N 152 18 08 W	(30)	60	14 June 1978	ADF&G aerial survey
Sea Otter Island area 58 30 33 N 152 10 25 W 58 29 48 N 152 16 28 W	(31)	30	12 June 1978	ADF&G aerial survey - nearby tidal rocks
Seal Bay-offshore rocks 58 24 13 N 152 12 04 W 58 23 35 N 152 10 14 W	(32)	35	22 May 1977	ADF&G aerial survey

Table 4. (cont.)

Location	(Map No.)	Maximum number of seals observed	Date	Remarks
Seal Island 58 26 19 N 152 16 07 W	(33)	40	12 June 1978	ADF&G aerial survey
Sea Lion Rocks 58 21 00 N 151 47 45 W	(34)	34	6 Oct. 1975	ADF&G aerial survey
Kazakof Bay-offshore rocks 58 04 48 N 152 34 30 W	(35)	45	12 June 1978	ADF&G aerial survey
Hog Island group 58 00 15 N 152 41 01 W	(36)	160	12 June 1978	ADF&G aerial survey
Whale Passage 57 55 58 N 152 50 04 W	(37)	35	20 May 1977	ADF&G small boat survey
Anton Larsen Bay 57 53 15 N 152 39 27 W	(38)	25	20 May 1977	ADF&G small boat survey
Spruce Island-rocks off southeast tip 57 53 22 N 152 20 20 W	(39)	25	12 June 1978	ADF&G aerial survey
Womens Bay 57 42 40 N 152 31 42 W	(40)	31	1 March 1978	Arneson (RU 003)
Kalsin Bay 57 38 35 N 152 21 02 W	(41)	200	-	Sears and Zimmerman (1977)
Cape Chiniak 57 37 50 N 152 08 10 W	(42)	100	10 June 1978	ADF&G aerial survey, hauled on tidal rocks
Sacremento River-mainland beach 1 mile north 57 32 17 N 152 14 35 W	(43)	140	11 June 1978	ADF&G aerial survey hauled on gravel beach

Table 4. (cont.)

Location	(Map No.)	Maximum number of seals observed	Date	Remarks
Ugak Island 57 22 18 N 152 16 15 W	(44)	1,600	29 July 1978	ADF&G aerial survey hauled on gravel beach
NE Ugak Bay-offshore ~~rocks~~ 57 25 50 N 152 33 50 W	(45)	410	24 July 1978	ADF&G aerial survey
Hidden Basin-entrance 57 30 12 N 152 54 40 W	(46)	107	1 March 1976	Arneson (RU 003)
Ugak Bay-head 57 26 43 N 153 01 04 W	(47)	200+	10 Nov. 1976	ADF&G small boat survey
Ugak Lagoon 57 20 06 N 152 38 15 W	(48)	50	6 Sept. 1978	ADF&G aerial survey, hauled on sand bar
NE Kiluda Bay 57 18 48 N 152 54 17 W	(49)	160	24 July 1978	ADF&G aerial survey
Sitkalidak Straits 57 12 07 N 153 10 37 W	(50)	35	2 May 1977	ADF&G small boat survey, hauled on tidal rocks
NE Sitkalidak-mouth lagoon 57 07 32 N 153 00 43 W	(51)	125	27 Aug. 1978	ADF&G aerial survey, hauled on sand bar
Ocean Beach 57 05 30 N 153 07 18 W	(52)	40	-	Sears and Zimmerman (1977)
Sitkalidak Island, Ocean Beach to Black Point 57 00 00 N 153 15 54 W	(53)	48	-	Sears and Zimmerman (1977)

Table 4 (cont.)

Location	(Map No.)	Maximum number of seals observed	Date	Remarks
Puffin Island 57 00 25 N 153 21 11 W	(54)	90	27 Aug. 1978	ADF&G aerial survey
Natalia Bay 57 05 48 N 153 17 47 W	(55)	30	-	Sears and Zimmerman (1977)
Flat Island 56 49 53 N 153 44 20 W	(56)	100	27 July 1978	ADF&G aerial survey
Geese Islands 56 43 42 N 153 54 03 W	(57)	670	27 July 1978	ADF&G aerial survey
Aiaktalik-Sundstrom Islands 56 41 53 N 154 07 45 W	(58)	635	27 July 1978	ADF&G aerial survey
Aliulik Peninsula-west side 56 51 35 N 154 01 05 W	(59)	200	10 June 1978	ADF&G aerial survey, hauled on tidal rocks, many locations
Cape Hepburn 56 52 25 N 154 05 08 W	(60)	50	2 May 1977	ADF&G small boat survey, hauled on tidal rocks
Deadman Bay 57 04 18 N 154 56 38 W	(61)	100	-	Sears and Zimmerman (1977)
Middle Reef 56 54 36 N 154 02 28 W	(62)	150	2 May 1977	ADF&G small boat survey, hauled on tidal rocks
Sukhoi Lagoon 56 56 52 N 154 20 43 W	(63)	350	28 Aug. 1978	ADF&G aerial survey, hauled on sand bar
Ayakulik Island 57 13 03 N 154 35 00 W	(64)	75	-	Sears and Zimmerman (1977)

Table 4. (cont.)

Location	(Map No.)	Maximum number of seals observed	Date	Remarks
Ayakulik River 57 12 17 N 154 32 30 W	(65)	100	9 Oct. 1976	Hauled on mainland gravel beach, ADF&G aerial survey
Alf Island-Uyak Bay 57 24 45 N 153 49 50 W	(66)	250	1 Sept. 1978	Hauled on gravel spit, ADF&G aerial survey
Zachar Bay-Head 57 32 31 N 153 42 18 W	(67)	30	5 Nov. 1976	ADF&G small boat survey
Spiridon Bay-Head 57 36 50 N 153 35 41 W	(68)	50	5 Nov. 1976	ADF&G small boat survey
Alinchak Bay 57 45 50 N 155 15 00 W	(69)	200	16 June 1976	ADF&G aerial survey
Puale Bay 57 41 40 N	(70)	150	24 June 1978	Hauled on tidal rocks, ADF&G small boat survey

20 July, molting—late June to early October and implantation of the blastocyst—20 September to 1 November.

Sampling for food habit information in lower Cook Inlet was limited to two time periods 7-11 April and 22-23 June. Octopus (*Octopus* sp.) was the major item followed by shrimps, eulachon and capelin (*Mallotus villosus*) (Table 5). The most striking difference in prey utilization between lower Cook Inlet and the rest of the Gulf of Alaska was the dominance of invertebrates which formed 61% of the occurrences compared to only 26% for the Gulf of Alaska. Walleye pollock (*Theragra chalcogramma*), the dominant prey in the Gulf, was not encountered in our lower Cook Inlet sample.

Table 5. Prey of harbor seals collected from lower Cook Inlet. Total stomachs with contents = 17, total occurrences = 23, total volumes = 5,412 cc.

Prey	Percent of Occurrences with 95% C.L.	Percent of Volume
Octopus	39.1 ± 28.3	43.4
Shrimp	17.4 ± 18.6	30.6
Eulachon	21.7 ± 20.0	23.1
Capelin	8.7 ± 14.4	1.9

An index count area was established at the major hauling area on Elizabeth Island to provide a baseline to monitor trends in abundance of harbor seals in the area. Daily counts (Table 6) were made at low tide when maximum numbers of seals are usually hauled out.

Table 6. Elizabeth Island harbor seal count data, 21 August-10 September 1977.

Number of Seals	Number of Seals	Number of Seals
282	99	262
88	110	472
220	114	264
184	539	279
250	619	59
123	336	294
241	41	291
237	269	615

$\bar{x}$ with 95% confidence limit = 262.0 ± 69.8
Range = 41 - 619
Standard Deviation = 161.7

Sea Otter

Sea otters were eliminated from most of their original range in Cook Inlet by fur hunters during the 18th and 19th centuries. Remnant colonies probably remained in Prince William Sound and near Shuyak Island, Augustine Island and Sutwick Island. These colonies have grown and expanded their ranges into lower Cook Inlet during the past 15 years. Substantial areas of former sea otter habitat remain vacant or sparsely populated but all established groups of sea otters are continuing to grow. Habitat degredation has been limited to relatively small areas and sea otter densities should reach aboriginal levels during the next 10 to 20 years.

Sea otters currently inhabiting lower Cook Inlet and Shelikof Strait can be divided into four subpopulations. While these groups are relatively discrete, interchange between them is believed to occur and should increase as the subpopulations grow.

The following descriptions are based on data from Schneider (1976) and recent sightings:

1. Kenai Peninsula

Sea otters probably were eliminated from the Kenai Peninsula by the early 1900's. Small numbers were occasionally reported between the Chugach Islands and Cape Puget in the 1950's and early 1960's but Kenyon (1969) concluded that no significant population occurred in the area. Reports increased steadily through the mid-1960's and in

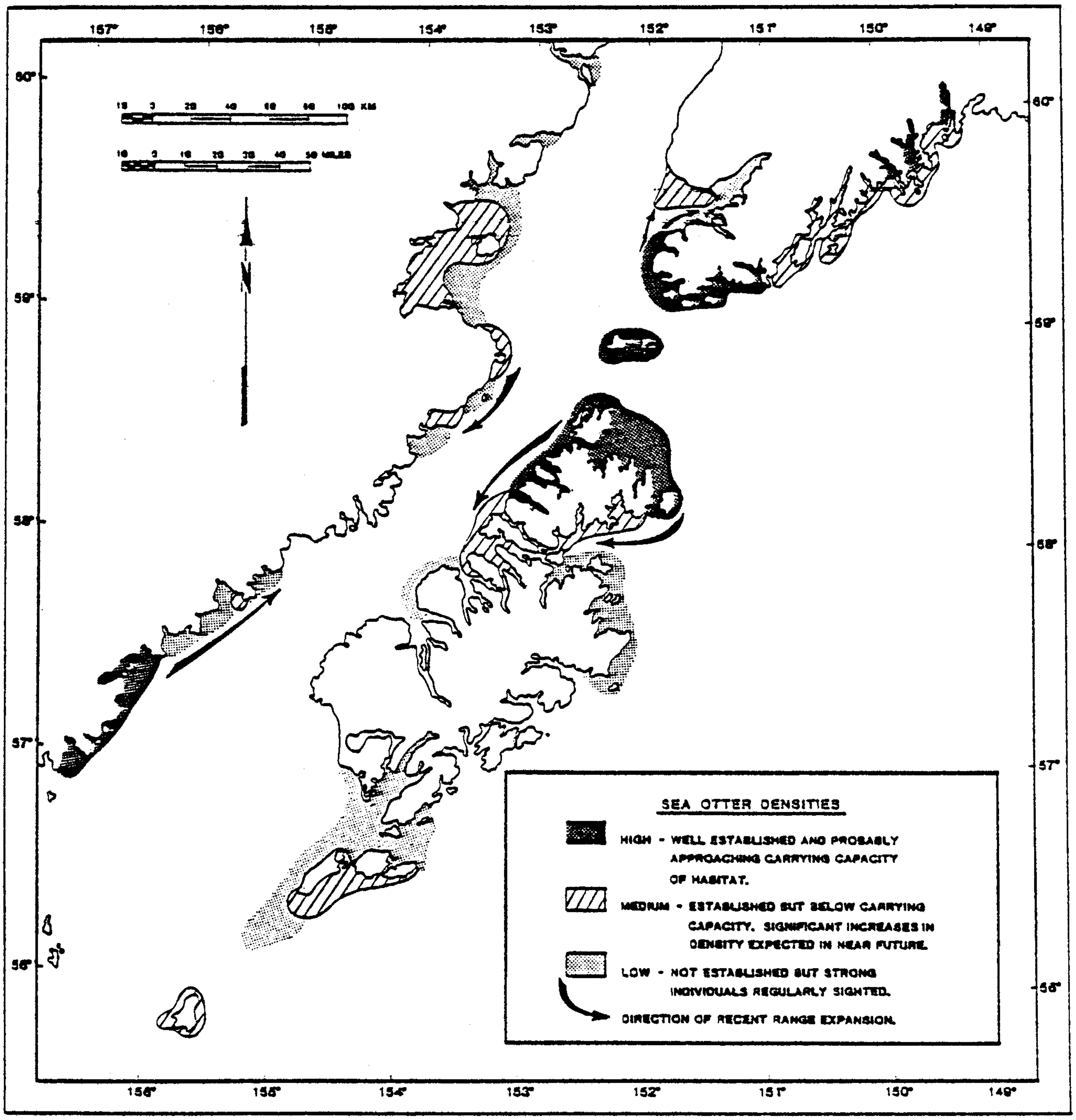

FIGURE 4. SEA OTTER DISTRIBUTION IN THE LOWER COOK INLET/SHELIKOF STRAIT LEASE AREA.

1967 several hundred and perhaps over 1,000 abruptly appeared in the vicinity of Port Graham and Chugach Bay. This concentration diminished over the next few years, perhaps as the result of dispersal to the east.

By 1970 sea otters were distributed in small numbers along the entire Peninsula from Cape Puget to Port Graham. Rare sightings occurred in Kachemak Bay. It appeared that repopulation was the result of range expansion by the Prince William Sound population and large scale immigration from another area, perhaps the Barren Islands.

At present the outer coast of the Peninsula from Gore Point to Port Graham appears fully repopulated. This subpopulation is expanding its range northward into Kachemak Bay and lower Cook Inlet. Stray animals occur throughout Kachemak Bay and several hundred inhabit a shallow offshore area west of Homer and south of Anchor Point. Occasional individuals have been sighted as far north as Clam Gulch. We can expect continued movement of animals from the outer Kenai Peninsula into Kachemak Bay and northward up Cook Inlet.

Kachemak Bay particularly the south side, should eventually support relatively high sea otter densities. Opportunities for the general public to view sea otters in Alaska are extremely limited. Kachemak Bay will probably eventually be one of the most accessible sea otter viewing areas in Alaska. Therefore, the importance of the bay and the sea otter population that will repopulate it is increased.

The potential for range expansion north of Kachemak Bay is less certain. Sea otters are capable of feeding in waters 80 m deep and in rare cases more than 100 m deep although most normally remain in water 60 m deep or less. Therefore, potential sea otter habitat extends across Cook Inlet and this population may become contiguous with that in Kamishak Bay. Food availability and perhaps the occurrence of sea ice will probably determine the eventual northern limit of this population. At this time it is difficult to predict what the northern limit will be. A recent sighting near Kalgin Island suggests that at least stray individuals may eventually occur throughout lower Cook Inlet.

2. Kamishak Bay

The history of sea otters in Kamishak Bay is vague. It appears that a small remnant population of sea otters remained there in the early 1900's. This population, centered around Augustine Island, probably grew throughout the 1940's and 1950's although no growth is evident in the counts. By 1965 some range expansion to the south had occurred. Counts made between 1969 and 1971 indicated that there may have been an increase in numbers around Augustine Island and the waters immediately to the north and west and that there had been a substantial movement around Cape Douglas to the vicinity of Shakun Rocks. The relatively high numbers seen by Prasil (1971) southwest of Cape Douglas suggest that the population within Kamishak Bay proper had reached a much higher level in the early 1960's than indicated by the counts.

Most likely, densities in the bay increased steadily through the 1960's then stabilized or declined slightly as animals emigrated to the southwest and possibly to the east across Cook Inlet. There is also a possibility that periodic oil spills influenced numbers although no direct evidence of oil related mortality is available from that area.

The available information indicates that the range of the population extends from northern Kamishak Bay to Cape Nukshak. Otters may occur throughout the shallow waters of Kamishak Bay and often range far from shore. The sea otters appear to be relatively mobile in this area and major shifts may occur periodically. Concentrations usually occur around Augustine Island, praticularly the north side; in the waters west of Augustine Island; around Shaw Island and Cape Douglas; at Douglas Reef; and at Shakun Rocks. Observed numbers in each of these areas have fluctuated widely, however. Sea otters inhabiting the Alaska Peninsula coast between Cape Douglas and Cape Chiniak should be considered part of the Kamishak population.

The population should continue to expand its range to the southwest. Eventually some range expansion to the north should occur.

3. Kodiak Archipelago

Three separate sea otter population centers exist in the Kodiak Archipelago. These are: (1) The Barren Islands (2) Shuyak-

Afognak and (3) Trinity Islands-Chirikof Island. The first two border on the lower Cook Inlet OCS lease area.

The Barren Islands were fully repopulated at least by 1957 when first surveyed. It is suspected that hundreds of sea otters migrated from the Barren Islands and Shuyak Island to the Kenai Peninsula during the mid 1960's.

At the present time this population can be considered at or near the carrying capacity of the habitat. Densities are highest in the shallow waters south of Ushagat Island including those around Carl Island and Sud Island. Low densities are usually found throughout the remainder of the island group. Little change is expected in the status of sea otters in the Barren Islands. Numbers may fluctuate but the distribution should remain similar to that observed in recent years.

A remnant population survived in the vicinity of Latax Rocks and Sea Otter Island near Shuyak Island. By the 1950's this population was well established and appeared to be growing rapidly, expanding its range to Afognak Island in the vicinity of Seal Bay.

Little change was evident in the 1960's. The range of the population remained the same although stray individuals were seen around Kodiak Island. No increase in numbers was evident. This apparent lack of increase may have resulted from emigration to the Kenai Peninsula, mortality from oil spills or been an artifact of survey techniques.

By 1970 the population was growing and rapid range expansion had occurred. In 1976 the primary range of the population extended from Shuyak Island south to Raspberry Island on the west side of the archipelago and to Marmot Island on the east side. The area between Ban Island and Marmot Island supported sea otter densities comparable to those anywhere in the world. High proportions of females with pups were observed throughout this area. Several hundred moved into Marmot Bay during 1977 and 1978.

Range expansion southward along both sides of the archipelago should continue at a rapid rate over the next few years. This will be most noticeable in Marmot and Chiniak Bays which appear to contain large areas of suitable sea otter habitat. The timing of this expansion is difficult to predict but it seems reasonable to expect moderate to high densities to build up in those areas in the next 5 to 10 years.

Eventually the population should become continuous with the Trinity Island population. Potential sea otter habitat on the northwest side of Kodiak Island north of Cape Ikolik appears limited and should require less time to become fully repopulated than the remainder of the island. We can expect a relatively sparse distribution of sea otters with a few small concentrations in areas such as the Noisy Islands, Chief Point and Harvester Island.

The southeast side of Kodiak Island has a number of broad shallow areas that will probably support large numbers of sea otters. The number of stray individuals and small groups in the area should grow over the next few years. Eventually increasing numbers of sea otters should move into the area, primarily from the north but also from the Trinity Islands. It may take many years for sea otters to reach carrying capacity throughout the entire area.

4. Alaska Peninsula

A large colony of sea otters has existed around Sutwick Island and Kujulik Bay for many years. During the 1960's this population extended its range northeastward to the vicinity of Wide Bay and a small group became established at Puale Bay.

No sea otter surveys have been made in the range of this subpopulation since 1970 however, incidental sightings indicate that the pattern of range expansion has continued. In June 1978 a minimum of 64 sea otters was seen at Puale Bay.

While this subpopulation resides outside of the lower Cook Inlet lease area it is evident that it will extend its range into Shelikof Strait and merge with the Kamishak Bay colony.

Available data are not adequate for reliable sea otter population estimates. However, the Alaska Department of Fish and Game has periodically projected rough estimates to indicate the approximate magnitude of sea otter numbers and the relative abundance among areas. The most recent estimates for the three subpopulations which could be directly impacted by leasing of lower Cook Inlet are: Kenai Peninsula—2,000 to 2,500, Kamishak Bay-Shelikof Strait—1,000 to 2,000, and Kodiak Archipelago—4,000 to 6,000.

The estimated sea otter population of Alaska is 105,000 to 140,000. Smaller natural populations exist in California and the USSR and transplanted groups remain in British Columbia, Washington and Oregon.

Sea otters tend to favor nearshore areas of shallow, rocky-bottomed habitat. Areas exposed to the open ocean but broken by reefs, islets and kelp beds are preferred. In such areas sea otters tend to range offshore to feed and move into kelp beds or the lee of rocks and islands to rest. In portions of their range they may haul out on beaches or intertidal rocks to rest. However, this picture of "classical" sea otter haibtat which has been described in most publications dealing with sea otter—community relationships can be misleading.

Sea otters apparently do not require nearshore areas, rocky bottoms, kelp beds or protected areas although they will use these when available. In some areas large numbers lead an almost pelagic existence ranging over 30 miles from shore where there are no exposed rocks or kelp beds.

Lower Cook Inlet contains both types of habitat and a wide variety of intermediate types. Often a heterogeneous mix of habitat types occurs within a small area. Since virtually all sea otter community studies have been conducted in areas that fall at one end of the spectrum, rocky habitat, and no studies have been conducted in lower Cook Inlet, only gross conclusions about the habitat requirements of sea otters in the lease area can be made.

The only obvious universal characteristic of all areas supporting moderate to high densities of sea otters is an abundant supply of accessible food. The available evidence indicates that sea otter populations at carrying capacity are generally food limited. Adult sea otters consume 3.5 to 6.5 kg of digestable food each day. Areas supporting high densities of sea otters must have prey populations capable of sustaining a yield of up to 30,000 kg/km^2/year. Sea otters are capable of using a wide variety of prey species. In some areas the high level of predation by sea otters has altered community structure. This in turn has forced sea otters to shift their food habits. Therefore the relationship between sea otters and food can be complex. It is clear that sea otter habitat must be highly productive of suitable food items, but at this time it can not be stated that any particular species of prey is critical in a particular area.

Water depth is a major factor limiting the availability of food and hence the distribution of sea otters. Almost all sea otter prey live in, on or near the bottom. There are records of individual sea otters diving to depths of 100 m but it is rare to see feeding sea otters in water deeper than 80 m. The highest concentrations of sea otters usually occur in waters less than 60 m deep.

Another important habitat characteristic is water quality. A major problem encountered in holding captive sea otters is providing clean water. When water becomes contaminated with food scraps, feces or oil the otters fur becomes soiled, looses its water repellency and the animal dies from hypothermia. While the need for clean water is well documented, no quantitative data are available to suggest how clean it must be.

In summary, while sea otters may have a number of specific habitat requirements they appear to be able to adapt to a wide variety of habitats provided large amounts of food are available, water depths are less than 80 m and preferably less than 60 m and the water is relatively clean. When the available food is reduced and water quality deteriorates a reduction in the capacity of the habitat to support sea otters will occur. At present there is no quantitative basis for assessing the quality of habitat in lower Cook Inlet. The patterns of sea otter distribution and range expansion suggest that the quality of habitat is highly variable from area to area.

Sea otters are not migratory and each individual tends to conduct major activities such as feeding, resting, breeding and pupping within the same general area. Therefore all of these critical activities occur throughout most of the habitat occupied by sea otters. However, there are areas where adult females tend to congregate and other sex and age classes are excluded to varying degrees. These "female areas" are probably the most critical sea otter habitat since they support almost all of the reproductively active animals. However, female areas tend to be extensive and include most of the habitat which supports medium to high sea otter densities. Therefore it is difficult to select a few small areas of "critical" sea otter habitat which merit special protection. Critical processes occur in virtually all areas that contain established sea otter populations. Unless extensive areas are protected the population will suffer.

Most information on sea otter reproduction was obtained from Aleutian populations that were near carrying capacity. There is some evidence of differences in timing of pupping and perhaps frequency of pregnancy in other areas. In the Aleutian populations studied, most female sea otters became sexually mature when 3 years old and produced their first pup when approximately 4 years old. Most females produced one pup every 2 years. It is possible that annual breeding occurs where populations are below carrying capacity but this has not been confirmed. Pup survival is high prior to weaning which may occur up to a year after birth. Survival remains good until old age in populations where food is not limiting but large numbers of recently weaned subadults die where food is limiting. This juvenile mortality appears to be a major population regulating mechanism.

Sea otters may live for more than 20 years but mortality rates of females over 15 years and males over 10 years appear high.

The sex ratio of the populations studied has been skewed in favor of females. This can result from a higher number of females being born, higher mortality among juvenile males, longer lifespan of females reaching adulthood and a greater tendency of males to disperse to sparsely populated habitat.

Therefore the sea otter's reproductive strategy is one of low productivity but high survival rates and long life. The behavior of the species seems adapted to providing adult females with the best opportunity to survive. This strategy is highly successful where sea otters are coping with most natural events that are likely to occur within their range. However, it is a poor strategy for resisting catastrophic events which kill both sexes all and age classes.

Belukha Whale

The Cook Inlet belukha population has been estimated by Klinkhart (1966) at 300 to 400. Recent survey conducted in the Inlet to determine distribution and abundance have not changed this estimate. Most surveys have involved shoreline observations and have not been intensive surveys of the open water areas of the Inlet. Accurate counting methods need to be developed so that a better population estimate will become available.

Fay (pers. comm.) feels the Cook Inlet belukha population could be a separate stock. A preliminary investigation of comparative crainial morphology indicated that the Cook Inlet belukhas may be taxonomically distinct from all other populations, perhaps as a consequence of long-term isolation in this area.

The Cook Inlet belukha population is thought to be resident in the Inlet year-round (Fay 1971; Klinkhart 1966; Scheffer 1973). Sighting data from 1976-1979 (Fig. 5) confirm that belukhas are present in all seasons in the Inlet.

Belukhas are seasonally distributed in the different regions of the Inlet. They have been sighted in the Upper Inlet primarily in late spring and summer. Belukhas are seen throughout the year in the central and lower Inlet, with heaviest use occurring in the central area.

Within the Inlet, numbers fluctuate seasonally, with the greatest number seen in mid to late summer and the fewest in winter. Ice conditions may have a strong correlation with winter abundance. In a winter of warm temperatures (1978) with little ice cover, belukhas were found in the central and lower Inlet. Whereas, in a winter of normally colder temperatures and extensive ice conditions (1979), few belukhas were observed. The location to which the belukhas go when and if they leave the Inlet in winter has not been determined. An aerial survey in March, 1979 turned up no belukhas in the neritic waters from Chignik Bay on the Alaska Peninsula to the mouth of Cook Inlet to the eastern extremity of Prince William Sound.

There is a paucity of information on breeding, calving and feeding concentrations of belukhas in Cook Inlet. Breeding whales have not been observed in the Inlet. Calving areas are not known; however, on aerial surveys in 1978 calves were observed at the Beluga River and in Trading and Redoubt Bays in mid-July. No calves were seen on the mid-June survey. Consequently, it appears that calving begins between mid-June and mid-July and may occur at the large river estuaries in the western upper Inlet. Calves were also observed in mid-August in the central Inlet between Kalgin Island and the Kasilof River and in mid-October in Tuxedni Bay.

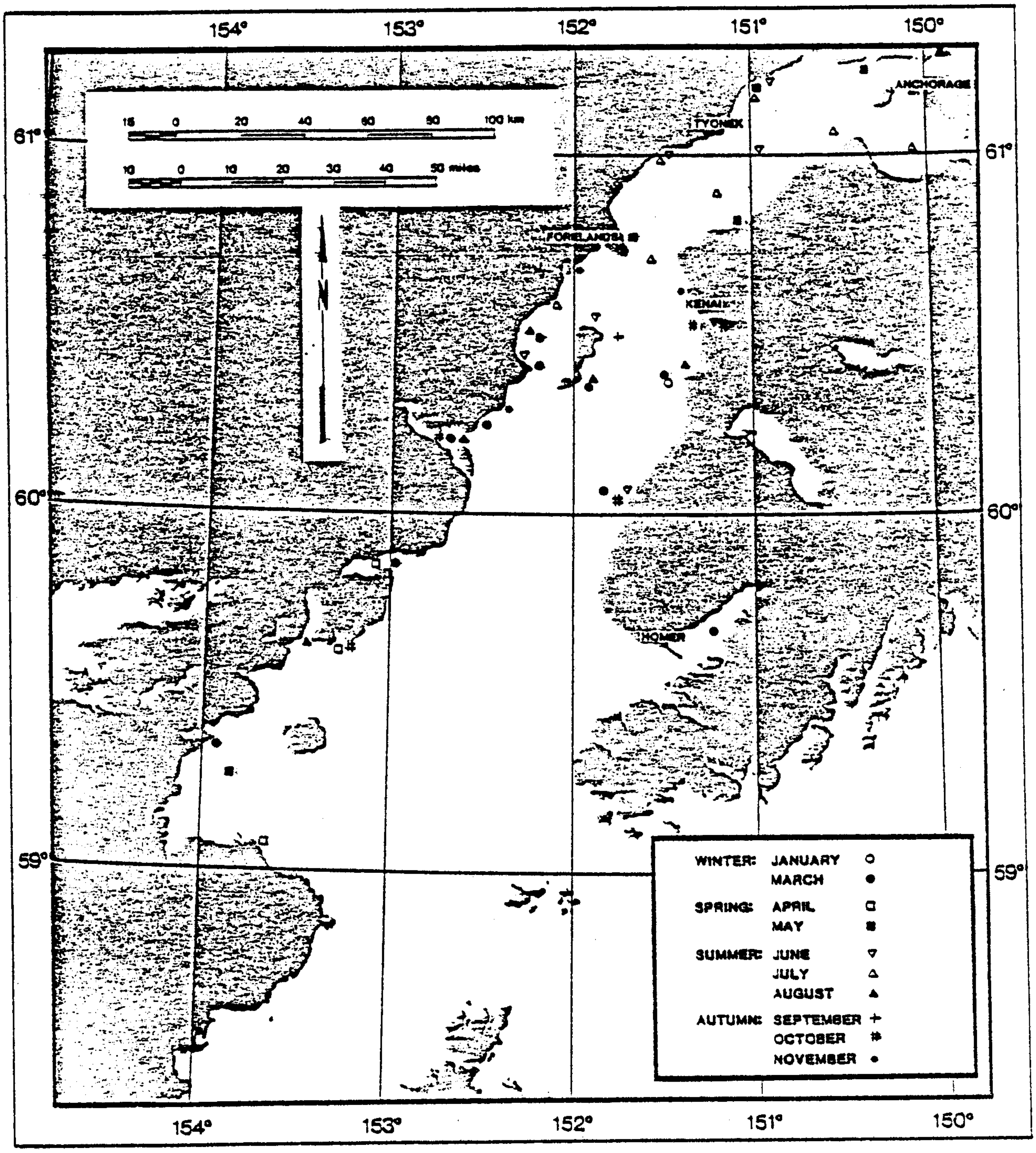

FIGURE 5. SEASONAL SIGHTINGS OF BELUKHA WHALES IN COOK INLET, 1976, 1977 AND 1978.

Concentrations were observed in mid-July at the mouth of the Beluga River and along the shoreline in Trading Bay, apparently feeding. The belukhas appeared to be eating fish caught close in to shore. These belukhas were in groups ranging from two to 25 animals. In mid-August a group of at least 150 whales was observed on three different days in the waters between Kalgin Island and the Kasilof River. The whales remained in this general area over at least a 4 day period. The whales were all aligned on the same directional heading with lead animals observed to break off from the front of the group. This behavior did not result in the remainder of the group changing its heading. Consequently, this type of large group formation most likely represents a feeding aggregation, although no feeding behavior (such as darting after a fish, etc.) or food source was directly observed.

Studies have been conducted on various aspects of the biology of belukha whales in several major arctic and subarctic concentration areas, but no study directly addressing the problem of habitat requirements has been undertaken.

The habitat types used by belukhas appear to fall into four categories: 1) migration routes, 2) feeding grounds, 3) breeding grounds, and 4) calving/nursery grounds. Food resources may be the critical element determining the interrelationship of habitat requirements. The habitat requirements vary seasonally and with the age and sex of the whale. The seasonal variations are dynamic and introduce difficulties in determining simple habitat requirements.

Migrations, whether extensive or localized, can be influenced by abiotic and biotic factors. Some authors consider ice dynamics to be of primary importance, while others contend that availability of food resources dominates. Kleinenberg et al. (1964) held that these factors act in combination. Ice conditions have a definite impact on the direction and timing of movements. Both the pattern of distribution and the abundance of whales are dominated by ice (Fay 1974; Fraker 1977). Although migratory patterns along the Alaska coast are poorly known, the presence of belukhas appears to be related to the movements of smelt, salmon smolts, and Arctic cod (Fiscus et al. 1976). Major surface current patterns in Cook Inlet would suggest that the most energetically efficient route to the upper Inlet would be along the eastern coast, while the route from the upper Inlet to the lower would be on the western coast. Seasonal distribution in the Inlet suggest that localized movements, most likely related to food resources and possibly calving ground areas, are critical to sustaining this population.

Feeding areas are determined and influenced by both biotic and abiotic factors. Concentration of food organisms is probably of major importance in determining where belukhas will feed. The biology and behavior of the food organisms plays a key role in their accessibility to the belukha. Ice dynamics affect the presence of food organisms in certain areas as well as influence the movements of belukhas. Other abiotic factors, including temperature, salinity, depth, sediment characteristics, and tides and currents not only affect the distribution of the belukha but the distribution of the belukhas' food resources as well.

The belukhas' characteristic summer movement inshore to river estuaries appears to be associated with concentrations of fish in these areas (Klinkhart 1966; Sergeant 1962; Tarasevich 1960). These whales also leave the estuarine areas to feed on pelagic fishes and invertebrates in the open sea and among the broken ice (Hay and McClung 1976). Belukhas also feed along the migration routes on patchy plankton and fish concentrations (Kleinenberg et al. 1964), indicating an overlap between migration route and feeding ground categories. Large herd formation is associated with heavy concentrations of food organisms in small feeding areas (Bel'kovich 1960). Fluctuations in food organism numbers, periodicity of occurrence, and seasonal inaccessibility cause irregularity of food resources for the belukha. This variability has likely resulted in selection for the broad feeding spectrum exhibited by these whales.

There is a lack of information on the belukha's breeding biology. Breeding grounds are unknown in Cook Inlet. Due to the timing of reproductive events, it is assumed here that breeding may occur along the migration route (overlap between categories) as the whales are approaching their summer feeding and calving grounds. It is also not known whether these whales feed while engaged in breeding activities.

While river estuaries are thought to be calving grounds, no births have been witnessed in these or any other areas. Recent evidence indicates that calves may be born outside the estuaries (Fraker 1977) and then move into these areas with their mothers (Hay and McClung 1976). Therefore, these areas might be considered more appropriately as nursery grounds.

Estuarine areas maybe important to newborn calves due to the higher temperatures which "may lessen the shock of birth and reduce heat loss in the first few days until the young animal has acquired some subcutaneous fat" (Sergeant 1973). Fraker (1977) also emphasized water temperature as the key factor in selection of these areas. He found that at the time of their use by large numbers of whales, these river estuaries had high temperatures, high turbidities, low salinities and shallow depths. All age classes congregate in the estuaries during the calving period. Fraker (1977) hypothesized that all age classes benefit from the thermal advantages, but that newborn calves would benefit the most from this advantage due to their small surface-to-volume ratio and limited fat deposits. Food resources have not been investigated in these areas, so it is possible that juvenile and adult whales may be feeding while in the calving/nursery grounds.

There is little information available at present on the seasonal use of specific habitat categories for the Cook Inlet population. Localized migrations occur throughout the Inlet during the year and may extend outside the Inlet into Shelikof Strait or possibly as far away as Yakutat Bay in the winter. Since food resources are likely the primary influence on localized migrations, the Cook Inlet belukhas are probably feeding in most areas where they are found. There are likely to be shifts in food items correlated with season and location. If Cook Inlet belukhas are breeding in May and or June, this activity is most likely occurring in the Upper Inlet. Calving/nursery grounds would be occupied in early to mid summer. The large river estuaries in the northwest Inlet (from Susitna River to Trading Bay) are probably the primary location for these activities. In summary, the Cook Inlet belukhas range widely throughout the Inlet making seasonal use of specific habitat areas and food resources.

Mating behavior has not been observed in belukhas. Sexual maturity is reached in the female at an age of five years and in the male at about eight years (Brodie 1971). Strong pair bonding between any one male and female is unlikely, since trios of two adults and a calf are not observed (Fraker 1977). This also appears to be the case for the Cook Inlet belukhas. Although Vladykov (1946) states that breeding occurs from April to June and Doan and Douglas (1953) state that breeding can occur later in the summer, the general concensus is that a breeding peak occurs in May (Brodie 1971; Doan and Douglas 1953; Vladykov 1946). Klinkhart (1966) states that all adult males taken from the Bristol Bay population from May to September were in reproductive condition. However, a short peak of calving for this population suggested that breeding was confined to a relatively short period in May or June. This timing may also be found for the Cook Inlet population.

Belukhas have a three year reproductive cycle (Brodie 1971). The gestation period is about 14 months (Sergeant 1962 and 1973). The breeding period occurs approximately 2 months prior to the calving period. Assuming that breeding occurs in May, Brodie (1971) found that females gave birth approximately 14 months later, in late July and early August. Lactation lasted for the next 21 months, indicating an almost 2 year period of nursing.

Reproductive rates have not been calculated for any population. However, assuming an average life span of 32 years (Kleinenberg et al. 1964) with the onset of maturity in the female at 5 years and a 3 year period between calving, a female would have an average of nine calves over her life span.

The sex and age structure has not been determined for the Cook Inlet population. Males cannot be easily differentiated from females. However, color differentiation can be made between juveniles and adults, since attainment of white coloration corresponds to sexual maturity. In the large concentration observed in August 1978, approximately one of seven whales was a juvenile.

Mortality factors include predation, parasites, diseases, and hunting. The only natural predator of the belukha known to occur in Cook Inlet is the killer whale, *Orcinus orca*. Killer whales are seen only in the lower Inlet in summer. Since the belukhas are generally in the central and upper Inlet areas during this time, there is probably little loss of belukhas to killer whale predation.

Endoparasites found in the belukha include acanthocephalans, trematodes, cestodes and nematodes (Kleinenberg et al. 1964; Klinkhart 1966). Their effects on the belukha are unknown. The occurrence of these parasites in Cook Inlet belukhas has not been studied. Other diseases are unknown in belukha populations.

Hunting of the Cook Inlet belukhas has not taken place since the 1960's. However, belukhas found near fishing nets and vessels are occasionally shot and killed. There are not figures on the frequency of occurrence of whales killed in this manner.

Food Habits

The belukha has the broadest feeding spectrum of any whale. Their food resources include a variety of fishes and various kinds of octopus, squid, crab, shrimp, clams, snails, and sand worms (Fay 1971). The maximum size of food organisms is limited by the capacity of the esophagus, since food items are swallowed whole (Fay 1971; Fraker 1977). Kleinenberg et al. (1964) state that belukhas do not feed on deep water organisms.

The preferred food organisms of the belukha in Cook Inlet in the summer appear to be the osmerids and salmonids. Belukhas caught in Bristol Bay and Cook Inlet during the summer were found to contain salmon, smelt, flounder, sole, sculpin, and shrimp. Data for the upper Inlet are not available. Possible foods for the belukha in the Kachemak Bay area are shrimp, crab, halibut, sole and herring. There appears to be a circulation gyre around Kalgin Island; this area, although uncharacterized for the most part, may be rich in food resources. Crustaceans are known to occur in the southern Kalgin Island region.

The food of the belukha can be expected to vary seasonally and with location. During the spring and summer, the Cook Inlet belukhas probably feed on salmon smolts migrating from river estuaries and herring moving to and from spawning grounds as well as heavy concentrations of adult salmon schooling off the river mouths. Throughout the summer, belukhas may switch from one salmon species to the next. King salmon run earliest in the Inlet with reds, pinks, chum and silvers following in that order. In the fall-winter season belukhas may eat smelt, bottom fishes and invertebrates. In the spring belukhas are found near concentrations of smelt.

Sergeant and Brodie (1969) suggest that productivity of the winter environment is critical in determining the adult size of belukhas in different regions. They suggest that "Selection has reduced the biomass of an individual white whale to that enabling it to maintain its metabolic activity on the available food." Further, "there appears to be no gross difference in numbers of white whales between trophically suboptimal and more suitable environments; the difference is expressed in individual biomass."

The food of the belukha also varies with age and sex. Lactation lasts about 2 years in belukha (Brodie 1971; Sergeant 1973). Young of the year feed only on milk, while yearlings supplement the milk by feeding on capelin, sand lance, shrimp, and small bottom dwelling crustacea (Brodie 1971; Kleinenberg et al. 1964; Sergeant 1962). The food of subadults is similar to the diet of adult animals. Adult males feed primarily on large fish while females prefer food items such as sand lance, octopus and particularly *Nereis* (Kleinbert et al. 1964). Fluctuations in food organism numbers, periodicity of occurrence, and seasonal inaccessibility cause irregularity of food resources for the belukha. This may have caused the belukha not only to widen its feeding spectrum but to differentiate food habits by age and sex. This differentiation enables the belukha to successfully utilize the available food (Kleinenberg et al. 1964).

Behavior

Possible feeding behavior of belukhas has only been observed on two occassions during aerial surveys in Cook Inlet. Near shore feeding groups appear to consists of small aggregations of belukhas randomly aligned with respect to one another. Whales were seen lying at the surface facing the shore; individuals pitched forward in the water such that only the flukes were visible at the sruface and then pitched back to the original position. The whales appeared to be operating individually in their efforts to catch food.

Groups of migrating belukhas vary in number and composition of whales. Most groups contain a predominance of adults with a few juveniles. Generally the animals are closely spaced, although a widely scattered group on which all individuals had the same directional heading was observed in March 1979. In groups of 10 to 30 animals, all whales do not surface simultaneously. Instead, there is usually a wave of three groups: the first group surfaces; as it is beginning to submerge, the second group surfaces; as this group is beginning to submerge, the third group surfaces; this is closely followed by the first group surfacing while the third is still at the surface. Calves closely follow their mother's movements and on all occassions were seen to the left rear side of the adult.

Humpback Whale

Humpback whales are the most common of the large, dorsal finned whales found in the Gulf of Alaska (Calkins et al. 1975), with a minimum of 60 individuals found in the Gulf of Alaska adjacent to Cook Inlet (Fiscus et al. 1976). Humpbacks are migratory, spending April through December in the Gulf. The area south of Kodiak Island may be relatively important since whales are frequently sighted there (Fiscus et al. 1976). Relatively large concentrations of humpbacks have been sighted in September in the area just northwest of Shuyak Island and south of the Barren Islands. Humpback whales are commonly sighted in the Barren Islands and the southern tip of the Kenai Peninsula.

Humpbacks are surface feeders, feeding mostly on euphausiids, although they will occassionally eat fish such as herring (*Clupea harengus*), cod (*Gadus* spp.) and salmon (*Onchorhynchus* spp.) (Wolman 1978).

Gray Whale

The gray whale population probably numbers greater than 11,000 animals (Rice and Wolman 1971). Nearly all of these are known to migrate through the Gulf of Alaska from May through November to feed in the waters of the Bering and Chukchi seas (Calkins et al. 1975). Gray whales generally travel near the coast (Rice and Wolman 1971). When migrating through the study area the whales apparently follow the east coast of the Kenai Peninsula and then turn southwest at the Barren Islands and move along the east coast of Afognak and Kodiak Islands (Cunningham ms).

Although gray whales appear to abstain from feeding on their migration along the California coast there is no quantitative data available to verify this behavior for whales in the Gulf of Alaska. There is some indication that whales may feed in the Gulf since Cunningham (1979) observed what appeared to be feeding behavior near Kayak Island. Similar behavior has been observed in the Barren Islands.

Minke Whale

The minke whale is migratory and found in the study area during the summer months where it frequents the near-shore habitat. Numerous sightings have been recorded in Kachemak Bay during August (Fiscus et al. 1976).

Minke feed on small schooling fish such as sandlance (*Ammodytes hexapterus*) and herring, euphausiids and other invertebrates (Mitchell 1978) and are known to concentrate in areas where food is abundant.

Killer Whale

Killer whales are found throughout the Gulf of Alaska during the summer months and may shift south in the winter (Leatherwood et al. 1972). They tend to prefer shallow water and generally stay within 200 miles of shore (Fiscus et al. 1976).

Killer whales feed on pinnipeds, porpoises, whales, cephalapods and fish (Fiscus et al. 1976, Rice 1968) with adult males feeding predominantly on marine mammals (Rice 1968). This species generally hunts in groups, especially when feeding on marine mammals (Fiscus et al. 1976). Groups of up to 10 individuals are common, with groups of up to 500 reported in the Gulf of Alaska (Calkins et al. 1975). Killer whales have been observed in Cook Inlet near the Kenai Peninsula and in deep water.

Dall Porpoise

The Dall porpoise is probably the most common cetacean in the Gulf of Alaska and is found both near shore and offshore (Calkins et al. 1975). This species appears to prefer channels between islands and wide straits where ocean currents meet (Fiscus et al. 1976). Dall porpoise can be encountered anywhere within Lower Cook Inlet.

Feeding is known to occur at considerable depths where prey such as hake (*Urophycis* spp.), lantern fish (*Myctophidae*) and squid are taken (Leatherwood and Reeves 1978).

Harbor Porpoise

Harbor porpoises are the smallest cetacean in the Gulf of Alaska (Calkins et al. 1975). They are common in bays, estuaries, tidal channels and harbors (Calkins et al. 1975, Fiscus et al. 1976) and usually confine their activities to waters of less than 18 meters (Leatherwood and Reeves 1978). This species is wary and easily disturbed by boat traffic.

Its food habits include small fish and cephalapods such as herring and squid (Leatherwood and Reeves 1978). Harbor porpoise use nearly all shallow waters of Lower Cook Inlet.

Terrestrial Mammals

Although this report deals mainly with marine mammals, this section highlights aspects of certain terrestrial mammals which utilize the marine environment to a significant degree. These species include river otter (*Lutra canadensis*), mink (*Mustela vison*), brown bear (*Ursus arctos*), Sitka black-tailed deer (*Odocoileus hemionus*) and red fox (*Vulpes fulva*).

River otters are distributed throughout the lower Cook Inlet region and along both shores of Shelikof Strait. Mink distributions are similar, except for their absence from Kodiak Island. Little information is available on densities, although it appears that otter densities are low along the eastern shore of the Kenai Peninsula and high along the south shore of Kachemak Bay and throughout Kodiak Island. There is no data for otters in other areas nor is there data anywhere in the area for mink (ADF&G 1978b).

River otters commonly utilize shallow coastal waters for hunting and travel. The effects of oil on river otters is unknown, but may be similar to sea otters since they also rely on their pelage for insulation (Kooyman et al. 1977). Although there is little information on food habits in the study area, it appears likely that the majority of prey will consist of small fish and crustaceans (Toweill 1974) which would be susceptable to oil pollution. There is no data available on the ability of otters to detect and avoid oil slicks or contaminated prey.

Mink similarly use the coastal region. There is no information on the effects of oil on mink. They are known to use the narrow strip of snow free beach during winter months in southeast Alaska (Harbo 1958), where they feed on mussels (*Mytilus edulis*), clams (*Siliqua* spp.), sea urchins (*Strongylocentrotus* spp.) and Dungeness crabs (*Cancer magister*). Snow conditions are similar in the study area and one would expect concentrated activity along the beaches in the winter. Oil spills in the winter could contaminate much of the available habitat as well as eliminate what could be potentially crucial winter food sources.

Brown bears inhabit Kodiak Island and all of the mainland within the study area except the region south of Kachemak Bay (USDI 1976). A minimum estimate of 500-600 bears inhabit the western side of Cook Inlet (J. Faro pers. comm.) and 1000-1500 bears inhabit the western drainages of Kodiak Island (R. Smith pers. comm.).

Bears use the coastal beaches from April through November, but are most frequently found during spring, with June probably the most important month (L. Glenn pers. comm.). Bears travel the beaches searching for newly emergent grasses, sedge and herbaceous plants, carrion and invertebrates. Coastal sedge meadows are also important feeding areas. Later in the summer and fall bears feed inland on either salmon or berries and are less likely to be exposed to oil spills.

Bears could be impacted by oil spills in several ways. Acute spills in the spring could inundate marshes and beaches, which would either force bears to avoid feeding areas, causing increased competition for the limited food resource during that season or expose them to oil ingestion from contaminated food. Bears may not avoid oil (Hanna 1963) and thus be susceptable to contamination of their pelage. Bears oiled prior to denning may be impacted by a reduction in the insulating quality of the fur during hibernation. Contamination of newborn cubs could also result.

Sitka black-tailed deer are found on Kodiak, Afognak and Raspberry Islands. There may be 5,000 to 10,000 deer in the western drainages of Kodiak (R. Smith pers. comm.). Deer tend to concentrate on the outer capes during winter where they feed on kelp. During severe winters the beach may provide the bulk of available forage to deer (R. Smith pers. comm.).

Spills during severe winters could contaminate the majority of available forage, causing increased competition for the remaining food items, ingestion of oil and possible starvation. Should deer become oiled then the reduction in the insulating quality of the fur would lead to increased energy consumption. The increased energy demands may become critical during winter months.

Red fox are found throughout the study area and are known to hunt along the beaches for amphipods, clams, crabs, stranded fish and carrion (USDI 1976). It appears that foxes utilize the beaches on islands more than the mainland (USDI 1976), and increase their use during winter (R. Smith pers. comm.). Fox are known to eat oiled birds and mammals (Hanna 1963) and were numerous on the beaches after a spill in Cook Inlet in 1969 (USDI 1976). The consequences of an oil spill on red fox are largely unknown.

POTENTIAL FOR IMPACT FROM OCS OIL AND GAS EXPLORATION, DEVELOPMENT AND PRODUCTION

ACUTE OIL SPILLS

Oil Spill Source

Leaks at drilling platforms, oil well blowouts, major pipeline breaks, tanker spills and spills at tanker terminals are all potential sources of acute oil spills in Cook Inlet. These spills will fall into two major categories: underwater spills from pipelines and oil well blowouts and surface spills from drilling platforms and tankers.

Oil Spill Transport

The major factors which contribute to the transport of oil after an acute spill are wind, net circulation, tidal currents, surface spreading, mixing and winter ice accumulations (ADF&G 1978a).

Wind induced transport is frequently the most influential factor (ADF&G 1978a) usually moving a slick at about 3 percent of the wind velocity (Dames and Moore 1976). Drogue studies have indicated that wind speeds greater than 5 m/sec will become the dominant influencing factor (Burbank 1977). Higher and persistant winds can also alter the net circulation itself, thus increasing the magnitude of the surface transport of oil (ADF&G 1978a).

The net circulation and tidal currents are important dispersing mechanisms for oil, especially under calm conditions and when the oil is incorporated into the water column. Of the two, the net circulation is more sluggish and is superimposed on the oscillatory tidal movements; thus the net trajectory of oil introduced into the water at a particular location is dependent on the stage of the tide at that time (ADF&G 1978a).

The spreading of oil across the water's surface will enlarge the size of the oil slick, and in areas of minimal circulation, such as a gyre in a bay, may be an important factor in determining the affected area (ADF&G 1978a). Spreading speeds up the weathering process by increasing the surface area exposed to the air and seawater (McAuliffe 1977).

The transport of oil may differ depending on the degree of mixing. Oil layered on the water's surface can be affected by wind and currents while oil incorporated into the water column by wave action or underwater spills will be transported primarily by currents.

Winter ice will act as a temporary barrier to slicks. Eventually oil will become incorporated with the ice (Milne 1977) and be transported along with it.

Crude Oil Composition

The behavior of crude oil once it is spilled is largely determined by the complex nature of its composition. The bulk of crude oil is composed of hydrocarbons, which can be placed in three classes of compounds: parafinic, naphthenic and aromatic (Evans and Rice 1974). A brief summary of their characteristics will aid in understanding the ultimate fate of crude oil:

Parafinic compounds are straight chained hydrocarbons of high molecular weight and relatively low toxicity (Evans and Rice 1974). They tend to make up the more persistant portion of crude oil due to their insolubility and high viscosity. The commonly observed tar balls are composed mainly of parafinic compounds.

Napthenic compounds contain at least one saturated ring structure. They can combine with other compounds to form complex molecules.

Aromatic compounds contain unsatuarated ring structures. They are of a relatively low molecular weight, are highly volatile, relatively water soluable and are highly toxic (Evans and Rice 1974). Since toxicity increases with molecular weight and solubility decreases, the compounds likely to cause the greatest harm probably have weights somewhere in the middle (Rice et al. 1975). Some aromatic compounds are also known cancer causing agents (Blumer et al. 1970).

Fate of Crude Oil

The fate of crude oil after a spill is governed by various physical, chemical and biological processes. These processes include evaporation, dissolution, emulsification, biodegredation, adsorption, mixing, sinking and human induced chemical dispersion.

One of the first major changes in an oil spill is the loss of the highly volatile aromatics through evaporation and dissolution. The evaporation rate would depend on the water and air temperature, the amount of radiant energy impinging on the slick and the wind speed. High winds would aid evaporation on one hand, but also increase the amount of dissolved aromatics through increased water turbulance. Cook Inlet crude has a high content of volatile aromatic hydrocarbons and visible evidence of a slick may be gone within several days (Kinney et al. 1969).

Should an oil spill occur due to an underwater pipeline break or an oil well blowout one would expect an increase in the amount of aromatics in solution as compared to a surface spill (McAuliffe 1977). Indeed, in a blowout situation the turbulance of the oil being expulsed would tend to emulsify the oil particles (Milne 1977) and probably increase the amount of aromatics in solution. Thus, an underwater oilwell blowout could be an increased source of dissolved aromatics which would be available for uptake by organisms.

Spills during periods of strong winds would tend to be emulsified. The composition of the oil droplets suspended in the water would be affected by the type of mixing. Violent mixing would tend to encorporate dispersed droplets similar to the parent oil while slower mixing would only incorporate the more soluable portions (Rice et al. 1975). Once oil is dispersed and no longer observable as a surface slick it will principally remain near the surface (McAuliffe 1977).

Emulsified oil provides greater surface area for biodegradation to occur (Kinney et al. 1969), although most microbial action is on the less toxic parafinic compounds (Evans and Rice 1974, Gibson 1977). Emulsion also allows for increased adsorption to suspended particles which aids in biodegredation and transport to the sea floor (McAuliffe 1977). Although Cook Inlet has a heavy sediment load in some regions, Kinney et al. (1969) found that it had no apparent effect on Cook Inlet crude oil.

The viscosity of the oil also effects the amount of oil entering the water phase (Rice et al. 1975) since more energy is needed to mix more viscous oil. Cook Inlet crude is relatively thin, having twice the water soluable fraction as Prudhoe Bay crude (Rice et al. 1976).

Oil that reaches shore will become incorporated into beach sediments to varying depths depending on the substrate (Evans and Rice 1974). This oil may persist indefinitely due to the absence of oxygen needed for its degredation (Boesch 1973).

Some oil fractions have densities approaching that of water and will sink directly to the bottom (Evans and Rice 1974). Photo oxidation changes some compounds into polar hydrocarbons which are water soluable and thus add to the concentration in the water column (Winters et al. 1976). Salinity and pH will also affect the amount of oil which will dissolve in the water (Rice et al. 1975).

The use of chemical dispersants to form oil-in-water emulsions can markedly alter the fate and effects of an oil spill. The emulsifying agent or surfactant is a compound which is soluble in water at one end and soluble in oil at the other (McAuliffe 1977). When mixed with an oil it forms a stable oil-in-water emulsion which, due to the surfactant's chemical properties, will not coalesce and decreases the adhering properties on rocks, sand and marine organisms (McAuliffee 1977).

Dispersants have been shown to be quite toxic in some instances (Dorrler 1977, Lonning and Hagstrom 1976). A major portion of the dispersant is a solvent, which, depending on the particular brand, may be a highly toxic aromatic hydrocarbon (Dorrler 1977). Dispersants have been shown to increase the toxicity of oil by making it more readily available for uptake (Canevari and Lindblom 1975, Tarzwell 1970), and by enhancing the movement across the gill structure in fish (McKeown and March 1978). Since dispersants can emulsify a wide range of molecular weights of hydrocarbons (McAuliffe 1977) it appears that if a fresh oil spill was dispersed it would incorporate toxic aromatic compounds into the water column which may otherwise have evaporated.

THE EFFECTS OF ACUTE OIL SPILLS ON MARINE MAMMALS - A REVIEW

The effects of oil on marine mammals is still only partially understood. The potential impacts are related to the biological characteristics of the species. The impact of oil on sea otters, fur seals, phocid seals and sea lions and cetaceans are reviewed separately.

Sea Otter

The behavior, physiology and morphology of the sea otter combine to make it the marine mammal most vulnerable to direct oil pollution (Schneider 1976).

Sea otters rely on air trapped within their dense fur for insulation (Barabash-Nikiforov et al. 1947, Kenyon 1972a). The fur is kept clean and water repellent by grooming, an activity which normally may take up to 10 percent of an otter's time (Calkins 1972). After being contaminated with oil, otters have been observed spending up to 75 percent of their time grooming (Williams 1978). Grooming is accomplished primarily by rubbing the fur with the palms of the forepaws; water is pressed from the fur and removed with the tongue (Kenyon 1969). This behavior would allow for the ingestion of oil. It is interesting to note that an otter's pelage cleaned of oil using detergents may take as long as 8 days to recover its water repellency (Kooyman and Costa 1978).

Conflicting reports exist concerning the ability of sea otters to detect and escape from an oil spill. Williams (1978) observed that the two otters he was studying did not avoid oil while Barabash-Nikiforov et al. (1947) reported that Japanese poachers used petroleum to repel otters from shore rocks into the sea.

The behavior of sea otters contaminated with oil appears to vary depending on the availability of a haul out area. Williams (1978) observed that otters spent 75 percent of their time grooming underwater when oil was on the surface. There was no available haulout. This may exemplify the case of sea otters oiled far offshore. In another study oiled otters began vocalizing and hauled out (Kenyon 1972a). Vocalizing and hauling are the reactions to stress from cold temperatures (Stullken and Kirkpatrick 1955).

It appears that even small amounts of oil are sufficient to degrade the insulating quality of the fur. Kenyon (1972a) described how a thin iridescent film of oil was sufficient to cause death by exposure. The major causes of death from oiling appear to be hypothermia or pneumonia, depending on the amount of fur that is contaminated (Kooyman and Costa 1978).

If the area of a spill is adjacent to unaffected areas with high densities of sea otters, the lost animals could be quickly replaced through immigration. However, expanding colonies such as exist in lower Cook Inlet may not have such reservoirs of surviving animals. For example the Kamishak Bay population is surrounded by sparsely populated or vacant habitat. Immigrants would have to come from the Kenai Peninsula or the south side of the Alaska Peninsula but since vacant habitat remains in these areas the rate of immigration to Kamishak Bay would be slow.

As sea otters continue to repopulate their former habitat their ability to recover from oil spills will improve. At the present time a single major oil spill has the potential for setting back the process of repopulation of former habitat for 10 or 20 years.

Food is believed to be the primary factor determining carrying capacity of sea otter habitat. A reduction in densities of sea otter food items could reduce sea otter numbers in areas.

The importance of food in determining the carrying capacity of many species is not clear, however the available evidence indicates that it is the primary factor determining the capacity of habitat to support sea otters. Therefore, a reduction in densities of sea otter food species in an area where sea otters are near maximum levels is likely to reduce the number of sea otters in that area. Most sea otter prey are relatively sedentary. A localized reduction in food is likely to result in a localized reduction in sea otter densities. Reductions in prey in areas where sea otter densities are well below maximum could significantly alter the rates and patterns of repopulation of former sea otter habitat.

The time between oil contamination and death has been recorded to be only several hours (Kenyon 1972a) in one case and less than 24 hours in another (Williams 1978). Death due to malnutrition and the stress of confinement have varied from a few hours to 11 days (Stullken and Kirkpatrick 1955). The health of the otter and environmental condition at the time of stress appear to be important variables. The short time that can take place between the inducement of stress and death could reduce the chances of a successful program for rehabilitating oiled otters.

Sea otters need to eat approximately 25 percent of their body weight per day and cannot undergo long periods of fasting (Stullken and Kirkpatrick 1955). Insufficient food combined with other stresses has been shown to be sufficient to cause gastro-enteritis and possibly death (Stullken and Kirkpatrick 1955). Should an oil spill occur and otters are able to escape direct oiling, the possible disruption of their feeding habits, cold stress due to even a slight oiling, and the stress due to exposure during periods of inclement weather all could provide an accumulated stress which may prove fatal. This would be magnified during times of prolonged foul weather when otters are already experiencing sublethal environmental stress (Stullken and Kirkpatrick 1955).

An acute oil spill entering sea otter habitat may quickly kill most sea otters in the immediate area. If this occurs in a female area a high proportion of those killed will be reproductively active females. The reproductive strategy of the sea otter is not well adapted to cope with catastrophic events which eliminate adult females. Recovery will be slower than in a species with a high rate of productivity.

In summary sea otters are highly vulnerable to both direct oiling and indirect effects of oil through the food chain. Both mechanisms are likely to produce very site-specific impacts. The significance an oil spill to the sea otter population as a whole will vary according to the specific area affected. Because sea otter populations in lower Cook Inlet are still expanding into vacant habitat they are more vulnerable to oil spills than if all former habitat was fully repopulated. As the existing populations grow the importance of specific areas of habitat will change.

Fur Seals (*Callorhinus ursinus*)

Fur seals are similar to sea otters since their dense underfur acts as an insulator; in addition fur seals also have a subcutaneous fat layer (Kenyon 1972a).

Tests by Kooyman et al. (1976) have shown that oiling of 30 percent of the pelt surface area resulted in a 1.5 fold increase in the metabolic rate, an effect that lasted for at least two weeks. Seals were also reluctant to enter the water after being oiled, a result probably due to the increased heat loss through the fur. If oiled seals hauled out for longer periods of time, then feeding could be disrupted which would add to the metabolic drain which was already occuring from the loss of insulation.

Kenyon (1972a) reported that fur seals entering busy shipping lanes may be contanimated with oil. He concluded that oiled seals do not return to their breeding grounds in the Pribilof Islands since no contaminated seals were observed there among the hundreds of thousands harvested.

Phocid Seals and Sea Lions

External oil contamination has very little effect on phocid seals and sea lions since they rely on a subcutaneous fat layer for insulation (Kooyman et al. 1976).

The ingestion of crude oil has been shown to cause kidney damage in ringed seals (*Phoca hispida*) (Smith and Geraci 1975). It was hypothesized that the route of entry included accidental swallowing and absorption through the skin and mucous membranes. Respiratory absorption may be an important pathway, especially with fresh crude oil, which still contains the more volatile fractions. Eye damage, including lacrimation, conjunctivitis and corneal erosion also occurred, with the severity of damage related to exposure time (Smith and Geraci 1975).

It has been hypothesized (Smith and Geraci 1975) that oiling of nursing pups may prove to be detrimental due to ingestion or absorption of oil. There is little data on this subject. LeBoeuf (1971) found no effects of oiling on elephant seal (*Mirouinga angustirostris*) pups, but these young had already been weaned. Brownell and LeBoeuf (1971) also concluded that oiling did not contribute to California sea lion (*Zalophus californianus*) pup mortality. It is interesting to note that the oil in question was weathered before contacting the pups and probably had lost the more toxic, aromatic fractions. Certainly, large amounts of oil on steller sea lion rookeries during the period when pups are unable to swim would cause high mortality.

Davis and Anderson (1976) studied the effects of oil on grey seal (*Halichoerus grypus*) pups. They found that oiled pups had significantly lower weights than unoiled pups, but attributed this to either interference of mother-pup relationship due to masking of the identifying smell or due to the greater human disturbance of oiled pups from veterinary inspections, cleaning operations and visiting observers.

There is little data on the ability of seals and sea lions to avoid oil slicks. Smith and Geraci (1975) found that ringed seals did not try to avoid oil under experimental conditions, but cite an obscure reference to seals avoiding oil in the wild (Mansfield 1970 in Smith and Geraci 1975).

Sea lions are known to frequently pick up foreign objects in their mouths, a behavior which makes them susceptable to ingesting tar balls. Sea lions have been observed with tar balls lodged in their throats and others with petroleum-like substances around the lips, jaw or neck. Petroleum-like substances have also been found in their feces.

The behavior of individuals exposed to crude oil include squinting, arching the back out of the water and submerging for long durations (Smith and Geraci 1975). Other reports of aberrant behavior include Pearce (1970 in Nelson-Smith 1973) who stated "after the Arrow Spill in Nova Scotia, young grey seals were found blundering about in the woods 1/2 mile from shore unable to find their way because of oil around eyes and nostrils."

Steller sea lions are probably most vulnerable to acute oil spills during mid-May through mid-July, the period of time they are on the pupping and breeding rookeries. The only major rookery in the lower Cook Inlet area is Sugarloaf Island in the Barren Islands. The coastline of Sugarloaf Island is dominated by large boulders, rock outcrops and cliffs intersperced with pocket beaches of coarse sand or gravel. If a major oil spill occurred here during the pupping period, the potential would exist for substantial pup mortality to occur even though Hayes et al. (1976) would probably place this area in a low risk classification.

Cetaceans

There is little or no data on the direct effects of oil on cetaceans (Fraker et al. 1978). Orr (1969) found no evidence that oil from the Santa Barbara spill was a mortality factor in the death of beached whales in the vicinity of the spill.

The potential exists for oil to be absorped into the respiratory tract by whales surfacing into an oil spill. There are relatively small amounts of hydrocarbons present under a spill on a calm surface (McAuliffe 1977) so it is possible that whales would not detect a spill until they surfaced.

THE EFFECTS OF CHRONIC OIL POLLUTION - A REVIEW

Chronic oil pollution is the release of petroleum hydrocarbons at a low but persistant rate. Many researchers believe that chronic pollution may ultimately prove to be the most damaging form of oil pollution (Evans and Rice 1974, Michael 1976, Boesch 1973, St. Amant 1971).

Sources of chronic oil pollution include formation waters, deck drains, fuel leaks, leaky pipeline valves, ship's bilges and small spills at tanker terminals (ADF&G 1978a).

Direct Ingestion of Oil

There is little data on marine mammals ingesting crude oil. The noxious odor and taste would probably be an adequate deterrent during acute oil spills. Direct accumulation of hydrocarbons could occurr if marine mammals ignore or are unable to detect low levels of pollution.

The behavior of some species could increase the amount of oil ingested. Sea otters are constantly grooming their fur and would be susceptable to sublethal doses of oil. Williams (1978) found that sea otters spent considerable time grooming after being oiled and one could hypothesize that otters inhabiting contaminated waters would increase their grooming activities in order to maintain the insulating quality of the fur and in turn ingest more oil.

Baleen whales could pick up oil particles or tar balls while feeding. Gray whales have been observed exhibiting feeding type behavior in an area where tar balls were coming ashore daily. The current patterns appeared to concentrate food items in the area and in turn could accumulate floating debris such as tar balls which would increase the chance of whales ingesting them.

Mortality of Prey Species

Acute and chronic pollution could lead to direct mortality of important prey species such as crabs (*Chionoecetes* sp.) (Karinen and Rice 1974), shrimp (*Pandalus* spp.), (Rice et al. 1976), sea urchins (Allen 1971), and several species of fishes (Rice 1973, Morrow 1974, Rice et al. 1976, Struhsaker 1977). Plankton are the only major category of prey in which there is a lack of evidence for major impacts (Michael 1977).

Oil Uptake through the Food Web

Studies have been inconclusive concerning the degree which hydorcarbons accumulate in the food chain (National Academy of Science 1975, Boesch 1973). Apparently most species tend to depurate most of the hydrocarbons they accumulate when placed in clean water (Fossato and Cazonier 1976, Lee 1977), although the more toxic aromatic hydrocarbons have been known to be retained in shellfish for several months (Blumer et al. 1970). Studies have shown that low concentrations can disrupt physiological and sensory mechanisms in crustacea, molluscs and fish (Karinen and Rice 1974), which could cause a significant reduction in their population levels. A comprehensive summary of the various sublethal effects of oil pollution on invertebrates and fish can be found in ADF&G (1978a).

The aberrant behavior and unnatural movements of contaminated prey can make them more vulnerable to predation (Hess 1978); marine mammals feeding in contaminated water could become selective feeders on oil laden prey due to their ease of capture and thus be exposed to greater amounts of hydrocarbons.

Another result of chronic and acute oil pollution would be the "tainting" of prey species (Krishnaswami and Kupchanko 1969, Nelson-Smith 1971, Knieper and Culley 1975, Lee 1977). There is the possibility that "tainted" prey species may be less desirable food items which could result in a change in diet to other untainted species or a reduction in feeding. This phenomena may not always occur since only a small fraction of petroleum has a pronounced odor or taste (National Academy of Sciences 1975).

THE EFFECTS OF DISTURBANCES ON MARINE MAMMALS - A REVIEW

Disturbance can be defined as the physiological and behavioral stress animals experience as a result of human-related physical intrusion into their environment (Trasky et al. 1977). The activities associated with oil and gas exploration and development have the potential for causing disturbances. The primary sources are helicopters, fixed-winged aircraft, boats, human presence, onshore and offshore support facilities and seisimic exploration.

Aircraft

Aircraft flights during oil exploration have been projected to include between 150 and 225 helicopter trips and at least 45 fixed-wing trips per month from offshore rigs to Homer or Kenai. Air traffic is expected to further increase during the development phase.

Different types of aircraft appear to have substantially different effects on marine mammals. Helicopters have a more sever effect than fixed-wing aircraft. Larger helicopters such as the Bell 205 have a more pronounced effect than smaller helicopters such as the Bell 206.

The only intensive study of aircraft disturbance on marine mammals was done by Johnson (1977), who observed harbor seals on Tugidak Island. He found that aircraft flying at altitudes of less than 123 meters and particularly less than 30 meters resulted in most seals in a herd entering the water. Flights at higher altitudes had varying reactions depending on the weather and past disturbances in the area. Both calm days and frequent disturbances tended to increase the seal's wariness. Helicopters tended to be the most disturbing type of aircraft.

Due to the aircraft's mobility the entire island's population was frequently disturbed and chased into the water. Aircraft have the capability of being the most intensive and extensive of all disturbing factors.

A severe disturbance usually resulted in all seals entering the water and not reusing the haulout site for at least 2 hours; seals appeared to cruise along the beach in search of other areas where seals were hauled out (Johnson 1977). Aircraft flights over seal herds in conjunction with an oil spill could be detrimental by forcing the animals into the water and increasing their contact with oil.

Aircraft disturbance also resulted in permanent separation of mother and pup in many instances, especially pups born within two hours before or one half hour after a major disturbance. Aircraft disturbance alone accounted for more than 10 percent mortality of pups born on Tugidak Island (Johnson 1977).

Sea lion reaction to aircraft is varied and depends upon multiple factors. On haulout areas when sea lions are not breeding and pupping, approaching aircraft will most generally cause some disturbance, frightening at least some animals into the water. On some occasions on haulouts, approaching aircraft can cause complete panic and stampede all sea lions to the water. The variability in reaction on haulouts appears to depend on environmental conditions (weather, tide, etc.) as well as the type, speed and altitude of the approaching aircraft. When sea lions are on breeding rookeries during the breeding and pupping season their reaction to aircraft is altered and appears to depend more upon the sex, age and reproductive status of the individual. Immatures and pregnant females may enter the water when aircraft approach, while territorial males and females with small pups generally remain hauled out and vocalize.

Fraker et al. (1978) cites two observations of belukha whale reactions to aircraft. On one occasion whales appeared to look skyward at a single engine aircraft flying at an altitude of 300 meters and in another instance a group of whales retreated into deep water after a twin engine aircraft flew over at 300 meters. The water was clear and it was hypothesized that whales in clear water may be more easily disturbed by aircraft.

Although no quantifiable data are available, other whales such as humpbacks, grays and fins appear to alter the behavior to avoid approaching aircraft. Often when repeatedly approached by low flying aircraft all of these species appear to dive and remain submerged for longer periods.

Boats

Boats can also be a cause of disturbance. Loughlin (1974) believed that the absence of seals in two bays in California was due to extensive commercial and sport boat traffic. A sport boat launching ramp in another area was believed to be restricting the formation of a large permanent population or pupping colony in that area (Loughlin 1974).

Boats have been observed to disturb belukha whales. Fraker (1978) observed whales swimming rapidly away from a barge under tow; whales reacted within 2,400 meters of the barge. The scattering effect was still observable for 3 hours afterward although the distribution returned to near normal after 30 hours. Heavy barge traffic could block or, at least, impede whale movement (Fraker et al. 1978).

Studies in Glacier Bay have shown that humpback whales, killer whales and Dall porpoises are disturbed by boats. It appears that the sounds generated by boats can cause these animals to abandon an area when feeding, resting or traveling (Jurasz pers. comm. in MCHM 1979). The apparent echo location abilities of sea lions (Poulter 1963) may also make them more sensitive to boat traffic.

Human

Disturbance due to the presence of humans will most likely have the greatest impact on those marine mammals using the terrestrial environment. These would include seals and sea lions, and to a lesser degree sea otters.

It has been observed that human harassment was an important factor in the abandonment of hauling areas for California sea lions, Guadalupe fur seals (USDI 1976) and Steller sea lions (Kenyon 1962). Construction appeared to cause harbor seals (Calambokidis et al. 1978) and Steller sea lions (Pike and Maxwell 1958) to abandon favored hauling grounds. California sea lions (USDI 1976) and Hawaiian Monk seals (*Monachus schauinslandi*) (Kenyon 1972b) have been observed utilizing areas whose main characteristic was its inaccessibility to humans.

Johnson (1977) considered disturbances by hikers and all-terrain vehicles as detrimental as aircraft to harbor seals and therefore an important potential mortality factor. Kenyon (1972b) believed human disturbance increased juvenile mortality of the Hawaiian Monk seal. There is some evidence from fur seal studies that human disturbance causes weight loss and higher mortality among pups (USDI 1976).

Seismic activities during exploration may also be a disturbing factor. Porpoises and possibly belukha whales are attracted to side scan sonar used in seismic work (Ken Holden pers. comm. in Hamilton 1979). Belukha were observed to give artificial islands a wide berth due to the sound generated on them (Fraker et al. 1978).

Studies on California sea lions (Poulter 1966) showed the real possibility of an active sonar mechanism in this species. The sensitivity of marine mammals to underwater sounds could be an area of concern.

It should be noted that man-made structures were used for haulout areas by harbor seals in Washington (Calombokidis et al. 1978). Log booms and oyster rafts were used, although oyster rafts were preferred, probably due to the less frequent human visits to these structures. Seals also tended to haulout nocturnally on man made structures, thus lessening human encounters and disturbances.

Sea otters are relatively tolerant of human disturbance as exhibited by groups of sea otters living near dense human populations in California. There is evidence that some sea otters, particularly females with pups, will avoid areas of regular disturbance, but again no quantitative data are available.

DRILL CUTTING AND DRILLING MUDS

Drilling muds are a complex mixture of organic and inorganic materials whose main function is to remove cuttings from the bore hole, cool and lubricate the drill bit and hold back formation pressures (Trasky et al. 1977). Approximately 100 cubic meters of drilling mud and up to 450 cubic meters of drill cuttings will be discharged into the marine environment for every well completed (Trasky et al. 1977). Drill cuttings from one well could cover up to 23,000 square meters of bottom (Trasky et al. 1977), although the strong currents in Cook Inlet will probably prevent accumulation of a visible cutting pile (Dames and Moore 1978). It has been estimated that 32 exploratory wells will be drilled in the study area between 1978 and 1985 (Warren 1978). Although the bulk of the drilling mud is composed of nontoxic substances such as bentonitic clay, additives such as oil, surfactants, caustic soda and bactericides are used to improve the properties of the mud (Robichaux 1975).

Drill cuttings and muds will have little direct impact on marine mammals due to their localized nature and relative nontoxicity. The possibility exists for contamination of prey species from the mud addatives although the relative significance of this pollutant source is unknown.

FORMATION WATERS

Formation waters are waters associated with oil and gas deposits. The water is produced along with oil and gas and may exceed the volume of petroleum produced (Brooks et al. 1977). The water is characterized by higher salinity and temperature and lower oxygen content than seawater (Levorsen 1967). Formation waters, when discharged, can contain up to 50 ppm of hydrocarbons and varying amounts of heavy metals and hydrogen sulfide (Trasky et al. 1977).

The impact of formation waters appears to be confined to the area near the drilling platform, especially at drill sites in deep water (Mackin 1973), such as lower Cook Inlet. The effect of formation waters on marine mammals in lower Cook Inlet is unknown at present.

ENTRAINMENT

The cooling system of drilling platforms and vessels use up to 13,600,000 liters of seawater each day (EPA 1977). The water is heated from 17° to 22°C above ambient water temperature before being returned to the sea (Trasky et al. 1977). The cooling systems have the potential for the entrainment of crab, shrimp and fish larvae and plankton, resulting in 100 percent mortality due to the increased temperature (Trasky et al. 1977). Potentially the most significant impact associated with entrainment would be the loss of prey.

PIPELINE LAYING OPERATIONS

It has been estimated that up to 241 kilometers of pipe will be buried under the sea floor which would result in temporary resuspension of 0.34 to 0.92 million cubic meters of sediment (USDI 1976). The resettling of the sediments could cause smothering of benthic organisms. Pipe laying operations could be a disturbing factor and temporary abandonment of the waters in the vicinity of the operation is possible.

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MARINE MAMMAL DATA DOCUMENTATION FOR THE PLATFORMS OF OPPORTUNITY PROGRAM AND OUTER CONTINENTAL SHELF ENVIRONMENTAL ASSESSMENT PROGRAM

by

Lewis D. Consiglieri and Christopher Bouchet

National Marine Fisheries Service
Northwest and Alaska Fisheries Center
National Marine Mammal Laboratory
7600 Sand Point Way NE
Seattle, Washington 98115

Submitted as part of the Final Report
Outer Continental Shelf Environmental Assessment Program
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ABSTRACT

Research Unit 68 of the Outer Continental Shelf Environmental Assessment Program is based upon the Platforms of Opportunity Program (POP) which was officially instituted by Marine Mammal Division, Northwest and Alaska Fisheries Center in 1971. The Platforms of Opportunity Program solicits marine mammal sighting data from various sources through a volunteer logbook program. Sighting information is hand and computer processed for computer analysis and magnetic tape storage. Errors can be introduced to the data base by (A) the observers themselves, (B) during transcription of logbook entries onto keypunching abstracts, and (C) during keypunching. Several levels of manual and computerized quality control steps have been instituted to assure that phases B and C above are done accurately and that possible errors made by the observer during phase A are at least double-checked during data processing. After all quality control steps have been made, the data is plotted and tabulated by species, month and geographical area; and, translated to the Outer Continental Shelf Environmental Assessment Program's 027 format for submission to the Environmental Data Service, NOAA.

This document updates and replaces the April 1978 document entitled "Marine Mammal Data Documentation For the Platforms of Opportunity Program and Outer Continental Shelf Environmental Assessment Program" by R. Mercer, B. Krogman, and R. Sonntag.

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Definition of Terms:

Algorithm - An equation or series of equations used in a computer program to derive a value for a variable.

Card Image - An 80 column or character computer format.

GMT - Greenwich Mean Time

QCPI - Version one of the Marine Mammal Division quality control program described in this paper.

Record - Refers to a series of 80 column card images which serve to document a batch of data such as often exists in a Platforms of Opportunity Program logbook. A record can be a cruise for any given vessel or a season's data from an individual observer or contributing organization.

Record ID - A six digit number applied to all cards within each POP record that uniquely identifies that record from all others within the file.

INTRODUCTION

The Marine Mammal Platforms of Opportunity Program (POP) provides a medium for collection of marine mammal sighting information from volunteer observers with a wide range of experience. The POP is administered by the National Marine Mammal Laboratory, Northwest and Alaska Fisheries Center, National Marine Fisheries Service, NOAA, Seattle, Washington; consequently, most contacts with scientists and naturalists have been made on the West Coast and in Alaska. Figure 1 demarcates the area where most marine mammal sighting reports originate.

In June 1975, the Marine Mammal Division (now the National Marine Mammal Laboratory) began an environmental assessment program of the waters adjacent to Alaska with the primary objective of determining seasonal distribution and abundance of marine mammals (C. F. Fiscus, et al. 1976). Funded by the Department of Interior, Bureau of Land Management (BLM), the program is part of the U. S. Outer Continental Shelf Environmental Assessment Program (OCSEAP), administered through the National Oceanic and Atmospheric Administration (NOAA), Environmental Research Laboratory, Boulder, Colorado, and Juneau, Alaska.

The POP was supported indirectly under OCSEAP Research Unit 68, (RU-68): Seasonal Distribution and Relative Abundance of Marine Mammals in the Gulf of Alaska. Increased research activities on the continental shelf of Alaska attributable to OCSEAP have resulted in a dramatic increase of data received by POP (Figure 2).

The purpose of this report is to provide detailed documentation of data management for the National Marine Mammal Laboratory's POP. This documentation serves three purposes: 1) insures that quality control within the project will be maintained; 2) allows the project to continue with minimal perturbation due to the inevitable changes in personnel that occur during any ongoing project; and 3) provides users of data transmitted to the Environmental Data Service, NOAA with a complete description of where, when, and how the data were compiled and its strengths and weaknesses.

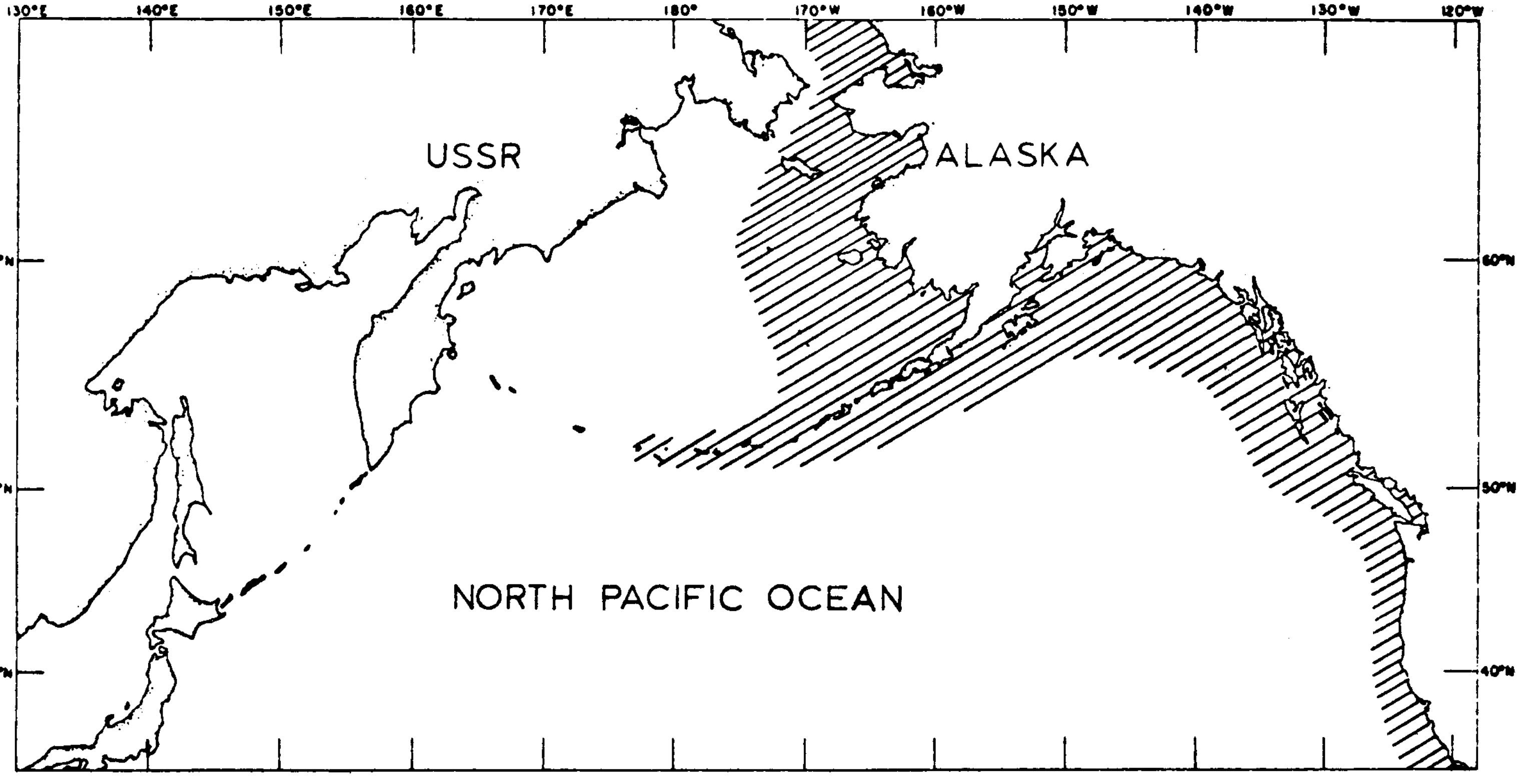


FIGURE 1.--Study area map with shaded portion depicting area where most Platforms of Opportunity marine mammal sightings are made.

DATA ACQUISITION AND ARCHIVAL

Data Sources

Platforms of Opportunity Program data sources, consistent with the nature of the project, ranged from NOAA and U. S. Coast Guard vessels recording effort and sighting data by official directive, to the weekend boating enthusiast reporting an occasional marine mammal sighting. Organizations which have contributed data to the Program are described below:

National Oceanic & Atmospheric Administration

Pacific Fleet:

The fleet of the National Ocean Survey, NOAA, based out of the Pacific Marine Center, Seattle, first began reporting marine mammal sightings for the project in 1972. Vessels of this fleet, used as platforms for carrying out marine research and surveys over much of the North Pacific Ocean, are now participating in the program on a routine basis. A large proportion of the data received by the program is obtained through this source. The OCSEAP has required reactivation of three additional NOAA vessels; these vessels have been active along the continental shelf and slope underlying the Gulf of Alaska and the Bering Sea from 1975 to 1981. Each of these vessels has an officer who, in addition to his regular duties, is responsible for collecting data and providing identification material to the bridge watch. Two types of reports were submitted by the NOAA fleet from 1975-1980: the non-OCSEAP contracted vessels prepared summary reports to accompany the Marine Mammal Logbook and the OCSEAP contracted vessels (DISCOVERER, SURVEYOR, and MILLER FREEMAN) recorded data in the OCSEAP Marine Operations and Station Abstract (MOSA) a copy of which was routed to National Marine Mammal Laboratory from the Juneau OCSEAP office. Since 1980, keypunchable field forms have been submitted by all NOAA vessels.

U. S. Coast Guard:

Since 1972, the U. S. Coast Guard has been cooperating in developing a program for reporting marine mammal sightings. Marine Observation Reports were originally used for recording marine mammal watch effort and sightings. In 1980, Coast Guard vessels began reporting sightings on the same keypunchable field forms used by NOAA vessels. Approximately 3,000 sighting reports have been received from this source. These sightings are from vessels operating along the U. S. Continental and Alaskan coasts.

Foreign Vessel Observer Program:

Since 1977, the Northwest and Alaska Fisheries Center's Foreign Vessel Observer Program has been contributing incidental sightings of marine mammals. U. S. observers monitoring foreign sterntrawlers and longliners in Alaskan and West Coast waters for fish hauls also record marine mammals observed.

Alaska Trollers' Association:

The Alaska Trollers' Association Logbook Program commenced in 1976 with some 50 fishing vessels participating. Data recorded in the logbooks developed especially for the program include marine mammal observations. This is a cooperative program involving the Alaska Trollers' Association, the Alaska Department of Fish and Game, The National Marine Fisheries Service (NMFS), Alaska Sea Grant Program, and the University of Alaska.

National Marine Fisheries Service, Enforcement:

Agents of the Alaska and Seattle Regional Law Enforcement and Marine Mammal Protection Branch, NMFS, have been reporting marine mammal sightings incidental to surveillance activities since 1972. Surveillance was conducted from U. S. Coast Guard vessels and aircraft operating within the U. S. contiguous zone until 1976 and thereafter out to the 200 mile fisheries management boundary.

International Pacific Halibut Commission:

Scientists and personnel of vessels chartered by the Commission for halibut research recorded incidental marine mammal sightings from 1972 to 1978. Most of the observations contributed by the Commission have come from the western Gulf of Alaska and southeastern Bering Sea.

U. S. Forest Service:

Naturalists of the U. S. Forest Service have contributed sighting data from southeastern Alaska and Prince William Sound each year since 1971. In the Whale Watch Program, naturalists show interested ferry passengers how to identify marine mammals common to local waters; the passengers then watch for and report sightings while travelling between ports.

Other contributors:

In addition to larger organizations, many smaller groups and independent observers have been contributing to POP by reporting sightings of marine mammals.

Field Formats and Data Receipt

Field formats vary with data source, but certain types of information are necessary for a valid observation to exist. Information must be provided on: species identification; number of animals seen; date (at least year and month); and location of sighting. Animal behavior and environmental data are desirable but optional. As a means of documenting observation effort, observers are requested to record the time and position on the chart at the beginning and end of each watch period.

From 1975 to 1980, the POP received most of its data by mail in five basic styles or formats:

Source and format	Percentage
POP Logbook	45%
OCSEAP Marine Observation and Station Abstract	20%
U. S. Coast Guard Marine Observation Report	10%
U. S. Forest Service Abstract	10%
Alaska Trollers' Magnetic Tape	10%
Miscellaneous	5%

The appendix provides descriptions and examples of the first four of these data sources and formats with accompanying examples of how they are coded into the POP format. In 1980, all NOAA, Coast Guard, and miscellaneous vessels were sent directly keypunchable sighting forms. These forms, with a section devoted entirely to description and behavior, relieve the data screener of having to evaluate reliability of a questionable source. If the description accompanying a given species is judged inadequate for verification, the sighting may be changed to "unidentified whale/pinniped" or discarded altogether. These forms also have corresponding sighting effort forms, for use by NMML personnel trained in marine mammal identification. Examples of both sighting and effort forms are found in the appendix.

Data from the Alaska Trollers' Association were coded by the Alaska Department of Fish and Game in 1976 and by the University of Alaska in 1977. Two difference computer formats were used, but the codes for information of interest to POP were not significantly different. Data from Alaska Trollers' tapes were transformed into the POP format by computer program and, consequently, were not subject to human recording errors during transformation.

Computer Formatting:

The Marine Mammal POP uses volunteer observers of varying abilities and motivations aboard many different types of vessels and aircraft. As a consequence, the data received vary considerably in quality and quantity from observer to observer. These data are screened as they are coded to insure that only valid sightings are entered into the POP raw data computer file.

Basic information extracted from the logbooks includes where, when, and what marine mammal was seen and how many there were. Species identification should always be accompanied by explanatory notes on features used for identification unless the source of data is known to be reliable. In some cases, data are screened by contributing organizations and have been assumed to be reliable (see Appendix).

Format and File Logic

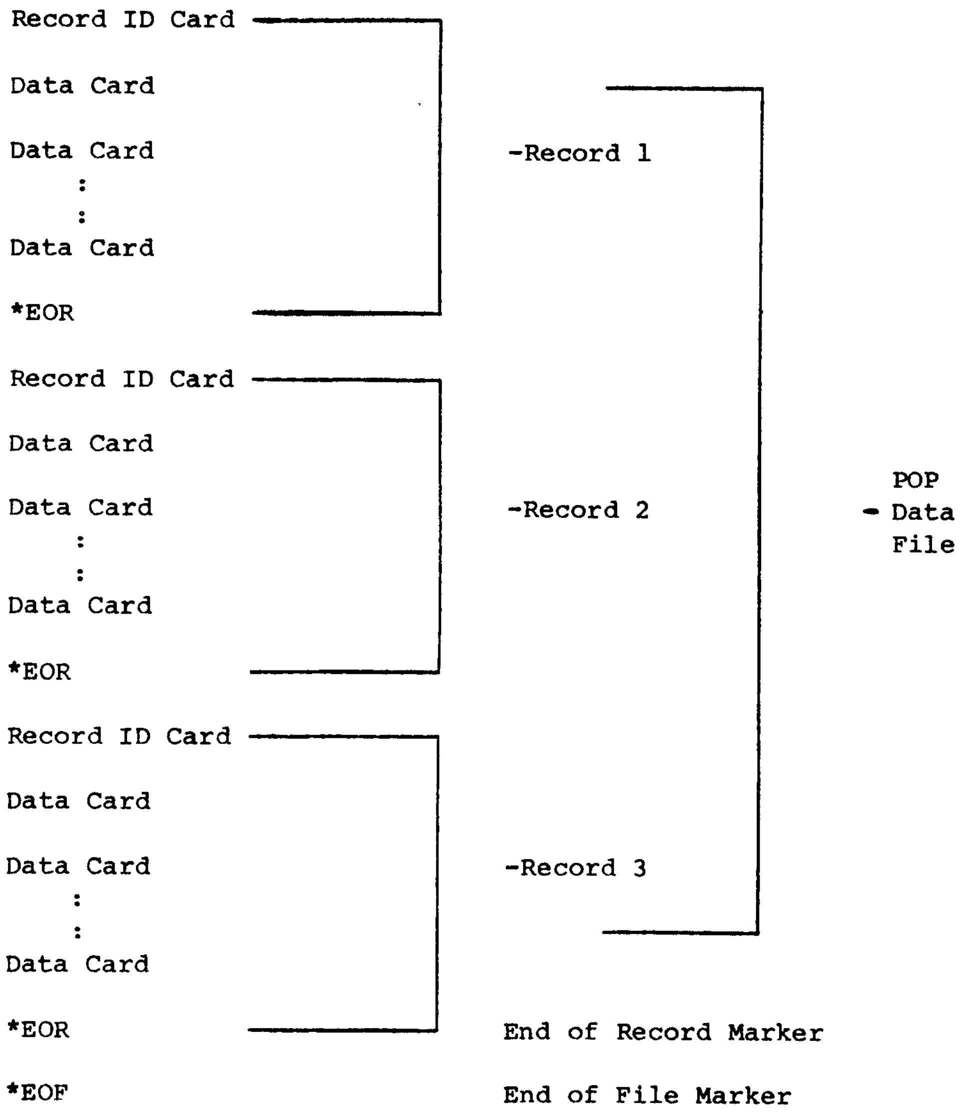
The POP format is hierarchical in structure. The fundamental unit of information is the variable. Variables are arranged on 80-column cards, and are referred to as card images (occasionally referred to as CI's). Two types of card image formats are employed in the POP system: data cards (see Appendix) contain all data within a record; and a Record ID card is used at the beginning of each record to briefly describe that record (Figure 3 and Appendix). A number of card images which contain information attributable to the same source constitute a record. A number of records constitute a POP data computer file. An end-of-record marker (CDC CYBER 170-750 NOS Operating System)1/ separates records within a POP file. At the end of the file is placed and end-of-marker followed by an end-of-file marker. Table 1 depicts the POP file logic. At the present time (4/81) there are eleven files in the POP data base.2/

Each record contains information acquired fromm a single source. These sources are usually identified as a single ship cruise with one or more observers. Occasionally, it is impossible to classify the data as coming from the same ship cruise. When this situation occurs, the data must be categorized as coming from some source which might be the person who collected the data or the organization which transmitted the data to POP. In general, each file has all of the data collected during a given year.

1/ Reference to trade names is required to uniquely identify equipment used and should not be interpreted as an endorsement by the authors of any particular product or manufacturer.

2/ Currently the data base is being converted from the University of Washington's CDC CYBER 170-750 to the Northwest and Alaska Fisheries Center's Burroughs 7800. This will alter the file structure to the extent that the Burroughs has no equivalent to the CDC end-of-record; thus records will only be separated by a Record ID card.

TABLE 1.--POP data file logic. Each computer card is defined as a card image (CI). A record is a set of card images having the same source code. The first card image of each record contains summary information describing the contents of the record. Each record is separated by an end-of-record (EOR) marker. At the end of each file is placed an end-of-file marker (EOF). (See Footnote 2, p. 280.)



The source is described by the variables, Platform Type and Source ID. Each CI within a record must have the same Source ID. Since it is possible to receive data having the same Source ID but coming from different cruises, each record is assigned a unique Record Identifier (RID) code. Each card image within a record must have the same RID in columns 1-6 (for further explanation refer to Appendix).

Sighting data are arranged in chronological order within each record. Records are added to the end of the POP computer data base after all quality control stages are complete; consequently, records exist on the computer file in random order. Raw field logs for each computer record are filed alphabetically (by vessel or source name) and by year class in the POP raw field log files. Record ID's are included on the file folder as a cross indexing system with the computer files.

Occasionally, times and positions of transmitting ships are provided to such detail, during periods when observers are expending some watch effort for marine mammals, that POP personnel can categorize these data as transits. A transit is any pair of data cards which, through the use of variable called Flag, define a ship's trackline.

Certain information must be present (exist) for each card image. All variables must be present on Record ID cards (Appendix). For data card images, variables which must exist are: RID, Year, Month, Platform Type, Platform ID and Time Zone (see Appendix). Additional information must exist on data card images according to the following conditions:

1) If the card image marks the beginning or ending of a transit, variables describing time and position must be filled out to whole minutes and the variable Flag must exist.

2) If the card image contains information collected during a transit, then variables describing either time and/or position must be filled out to whole minutes. Additionally information must be provided describing species and number sighted and/or environmental conditions via codes and/or comments.

3) If the card image contains information collected while not on transit, then positions must be filled out at least to the whole degree of latitude and longitude, the date must include year and month, and information must be provided describing species and number sighted and/or environmental conditions via codes or comments.

Tables 6 and 7, in the quality control section, provide explicit descriptions of variable relationships and logical dependence in and between card images.

QUALITY CONTROL

Success of the POP depends on the development of a large data base system which is free of errors. Not only can results of data analysis be compounded by errors in data, but data processing itself may be impeded.

Since it is nearly impossible to locate and correct all errors in a large data base, it is important that an accurate amount be made of those tests for errors which have been performed. By doing so, users of the data will better know strengths and weaknesses of data upon which they conduct their analyses. Most importantly, the user will be better able to discriminate between legitimate outliers and outliers which result from real errors.

Data transcription and manual checking

Prior to the use of directly keypunchable sighting forms, data were transcribed from raw data sheets to keypunch abstracts according to POP formatting directions (see Appendix). The keypunch abstracts are then 100% manually checked against raw data sheets to assure accurate transcription. The checking process is independent of the transcription phase and is usually carried out by two people. As discrepancies between raw data sheets and keypunch abstracts are encountered, abstracts are corrected. Upon completion of the 100% check, abstract(s)/raw data are submitted to a keypunch facility for punching and verification.

A raw listing is made from the returned punched cards and the listing is compared with the abstract(s)/raw data. A 10% check is performed at this stage, and if more than 10% of the rechecked card images are found to be in error, a more thorough check of the keypunched data is made to determine whether it would be more expeditious to edit the data, or resubmit the abstract(s)/raw data for keypunching. This procedure allows only punched decks containing fewer than approximately 1% keypuncching mistakes to pass on to the next phase of quality control. Our experience has shown that accuracy of keypunching is either very good or very poor. We suspect this situation results from a keypunch machine occasionally being switched to an improper mode of operation during the verification process. The 10% check has in all cases detected these few "bad" data decks.

Computer Program Checks

The final stage of quality control relies on a comprehensive series of checks made on the raw data file by a computer quality control program (QCPI). There are two basic categories of checks: those which test conformity of data to formal specifications and those which test relationships among variables for logical consistency and validity. Methodology for identification of tests is modeled after Naus (1973). When a test is made and fails, QCPI lists the card image with diagnostics indicating which test hass filed. This process of flagging errors allows POP personnel to reevaluate the information and determine the validity of data.

Tests for conformity of data to POP format codes and logic are categorized by QCPI as:

I. Class (Blanks) - ensures that fields designated as blank are in fact blank.

II. Class (Integer) - ensures that integer fields contain integers.

III. Interval (Integer) - range checks are performed on all integer variables.

IV. Codes (Alphanumeric) - alphanumeric variables are checked for validity of codes.

V. Existence - POP format logic requires some variables to always have a value, whereas other variables may remain blank. When a variable contains a value, we say it "exists". All variables which must exist are tested and, if found blank, are flagged. A more sophisticated testing procedure also checks for the existence of dependent variables. Dependent variables must exist only when certain other independent variables exist. For instance, the variable "species" may or may not exist, but when it does exist, the number of animals seen must also exist.

VI. Relational - multivariate checks are made among variables, within and between card images. This test procedure is the most complicated to construct in that variable relationships which can be checked are often difficult to identify and not easily categorized. See "Tests Performed" for more detailed discussion (see page 286).

Error Diagnostics

The QCPI reference variables by field number for test categories I, II, III, IV, and V. Table 3 provides field numbers associated with each variable on a data card image with brief variable descriptions. Table 2 provides examples of two card images and error diagnostics as

TABLE 2.--Sample diagnostic listing from Quality Control Program run on dummy data demonstrating error messages for all classes of checks. Deck is equivalent to the POP Record and card number is the number of the POP card image within a record that failed a test. Level is the class of check that failed; check classes I through V are followed by the field numbers that failed (Table 3) and checks of class VI are followed by the relational check number (Table 7) that failed.

```
DECK NUMBER  1       CARD NUMBER 7

[LKJADFLKJKJKFUIOIUEUJKL545654654565456545654654                               ]

--------------------------------------------------------------------------------
*   *    *    *    *    *    *    *    *    *    *    *    *    *    *    *    *
1        10        20        30        40        50        60        70        80
---------LEVEL---------   ------------VARIABLES OR TESTS WHICH FAILED-----------


I    CLASS (BLANKS)       7,16

II   CLASS (INTEGER)      1,2,3,4,5,6,8,9,10,12

III  INTERVAL (INTEGER)   23

IV   CODES (ALPHANUMERIC) 11,15,17,18,22,24

V    EXISTENCE            (29,29), (30,30), (31,31)


DECK NUMBER 2          CARD NUMBER 2

[]76274760931          50000N122000W                       1003  0             ]

--------------------------------------------------------------------------------
*   *    *    *    *    *    *    *    *    *    *    *    *    *    *    *    *
1        10        20        30        40        50        60        70        80

---------LEVEL--------   ------------VARIABLES OR TESTS WHICH FAILED-----------

VI   Relational          [1]
```

as listed by QCPI. Since relational tests (Category VI below) utilize combinations of more than two variables from sometimes more than one card image, tests are numbered sequentially rather than naming each test by all variables associated with it.

Tests Performed

Category I - Class (Blanks) Fields 7 and 16 (see Table 3) are checked for nonblanks. Test failure occurs when characters occur in these fields.

Category II - Class (Integer) - Fields 1-6, 8-10, 12-14, 19-21, 23, and 25-32 are checked. Test failure occurs when noninteger characters are encountered, or when integer values contain imbedded blanks or when integer values are not right justified.

Category III - Interval (Integer) - the 24 fields listed under Category II are checked for minimum and maximum allowable integer values (Table 4). For integer fields such as behavior code where several intervals exist between the minimum and maximum values, a search technique called a binary string search is used to search for unacceptable values. Test failure occurs when range boundaries are exceeded.

Category IV - Codes (Alphanumeric) - Fields 11, 15, 17, 18, 22, and 24 are tested for the legality of characters. Test failure occurs when undefined codes are encountered (Table 5).

Category V - Existence - 24 tests involving two or more fields are made on 28 variables. Table 6 summarizes these tests. Test failure occurs when conditions of test as described in Table 6 are violated.

Category VI - Relational - 20 relational checks are made among variables. Table 7 lists these checks along with a brief description of the variables involved. Listed below are more complete descriptions for each test number:

1) Number of days in month incorrect.

A test is made to insure that the variable "DAY" has a value less than or equal to the number of days in that month listed on the same card image. See also test 8.

2) Number of animals sighted for species too large.

Based on our knowledge of natural history and stock sizes of some marine mammals, we can estimate the maximum number of animals one might expect to see for any given species. For example, a sighting of 500 sea lions is not unusual, but a sighting of 500 blue whales would clearly be questionable. Test failure occurs when number of animals exceed specified values (Table 8).

TABLE 3.--List of variable names on data card images with descriptions as used in POP[1] format.

Variable Name	Field Number	Starting Column	Field Length	Variable Description
RID	1	(1)	6	Record identifier - integer
YR	2	(7)	2	Year - integer
MO	3	(9)	2	Month - integer
DAY	4	(11)	2	Day - integer
HR	5	(13)	2	Hour - integer
MIN	6	(15)	2	Minute - integer
	7	(17)	1	blank - treated as "variable" in quality control
LH	8	(18)	2	Latitude in degrees - integer
LM	9	(20)	2	Latitude in minutes - integer
LS	10	(22)	1	Latitude in tenths of minutes-integer
NS	11	(23)	1	Latitude hemisphere - alphanumeric
LLH	12	(24)	3	Longitude in degrees - integer
LLM	13	(27)	2	Longitude in minutes - integer
LLS	14	(29)	1	Longitude in tenths of minutes - integer
EW	15	(30)	1	Longitude hemisphere - alphanumeric
	16	(31)	1	blank
SPE	17	(32)	3	Species - alphanumeric
REL	18	(35)	1	Reliability of species identification - alphanumeric
CONF	19	(36)	1	Confidence interval - integer
NUM	20	(37)	4	Number of animals sighted - integer

TABLE 3.--List of variable names on data card images with descriptions as used in POP[1] format--continued.

Variable Name	Field Number	Starting Column	Field Length	Variable Description
GROUP	21	(41)	2	Group size - integer
IDIR	22	(43)	2	Direction animals swimming - alphanumeric
BEHAVE	23	(45)	2	Behavior of animal - integer
ANGLE	24	(47)	2	Relative angle (360 degree circle with bow at 000°) that animal was initially sighted at (to nearest ten degrees) - integer
IDIST	26	(49)	3	Initial sighting distance to animals in ten of meters - integer
VISI	27	(52)	1	Visibility - integer
WATER	28	(53)	3	Surface water temperature (°C) - integer
PTYPE	29	(56)	1	Platform type - integer
SID	30	(57)	3	Source identification - integer
TZ	31	(60)	3	Time zone - integer
FLAG	32	(63)	1	Flag designating beginning or ending of leg - integer
TEXT	33	(64)	17	Text or comments - alphanumeric
DEPTH	34	(77)	4	Water depth in meters

---

[1] Platforms of Opportunity Program.

TABLE 4.--Integer variables checked by the quality control program with acceptable range of values for each.

Variable Name	Field Number	Minimum Possible Value	Maximum Possible Value	Notes
RID	1	1		
YR	2	58	77	To present
MO	3	1	12	
DAY	4	1	31	Varies by month
HR	5	0	24	Military time (24 hour clock)
MIN	6	0	59	
LH	8	32	75	Where most POP vessels sail
LM	9	0	59	
LS	10	0	9	
LLH	12	110	180	Where most POP vessels sail
LLM	13	0	59	
LLS	14	0	9	
CONF	19	0	9	
NUM	20	0	9999	
GROUP	21	0	99	
BEHAVE	23	0	98	Not all inclusive values are possible. See Appendix Table 22.
ANGLE	24	00	35	
IDIST	26	0	999	
VISI	27	1	6	
WATER	28	-4	26	
PTYPE	29	1	4	
SID	30	1	9999	Not all inclusive values are possible. See Appendix Table 26.
TZ	31	-12	12	
FLAG	32	0	2	

TABLE 5.--Alphanumeric variables and associated possible codes.

Variable Name	Field #	Code
NS	11	N, S
EW	15	E, W
SPE	17	See POP[1] format code list for Species (SPE) (Appendix Table 21)
REL	18	T
IDIR	22	[2] N , A , E, W, NE, NW, SE, SW

[1] Platforms of Opportunity Program.

[2] = blank

TABLE 6.--Relational existence checks performed on each sighting record are listed in vector form: (a, b,...c) where a the field number is treated as the independent variable and b,...c are treated as dependent variables. This vector is read: Given a exists, b,...c must also exist. Vector (a,a) indicates a variable a cannot be blank. Checks are applied to each data card.

Test	Description
(1,1)	Record Identifier (RID) must exist.
(2,2)	Year (YR) must exist.
(3,3)	Month (MO) must exist.
(5,4)	Given Hour (HR), Day (DAY) must exist.
(6,4,5)	Given Minute (MIN), Hour (HR) and Day (DAY) must exist.
(8,8)	Latitude in Degrees (LH) must exist.
(10,9)	Given Latitude in tenths of a minute (LS), Latitude in Minutes (LM) must exist.

TABLE 6.--Relational existence checks performed on each sighting record are listed in vector form: (a, b,...c) where a the field number is treated as the independent variable and b,...c are treated as dependent variables. This vector is read: Given a exists, b,...c must also exist. Vector (a,a) indicates a variable a cannot be blank. Check are applied to each data card--continued.

Test	Description
(11,11)	Latitude Hemisphere (NS) must exist.
(12,12)	Longitude in Degrees (LLH) must exist.
(14,13)	Given Longitude in tenths of a minute (LLM), Longitude in Minutes (LM) must exist.
(15,15)	Longitude Hemisphere (EW) must exist.
(17,20)	Given Species (SPE), Number (NUM) must exist.
(18,17)	Given Reliability (REL), Species (SPE) must exist.
(19,17)	Given Confidence Interval (CONF), Species (SPE) must exist.
(21,17)	Given Group Size (GROUP), Species (SPE) must exist.
(22,17)	Given Direction Headed (IDIR), Species (SPE) must exist.
(23,17)	Given Animal Behavior (BEHAVE), Species (SPE) must exist.
(24,17)	Given Angle of Initial Sighting (ANGLE), Species (SPE) must exist.
(26,17)	Given Initial Sighting Distance (IDIST), Species (SPE) must exist.
(29,29)	Platform Type (PTYPE) must exist.
(30,30)	Source Identification (SID) must exist.
(31,31)	Time Zone (TZ) must exist.
(32,4,5,6, 8,9,12,13)	Given Flag (FLAG), Day (DAY), Hour (HR), Minute (MIN), Latitude Degrees (LH), Latitude Minutes (LM), Longitude Degrees (LLH), and Longitude Minutes (LLM) must exist.

TABLE 7.--Relational checks performed by the quality control program. Check numbers in brackets refer to QCP1 output diagnostic.

Check number	Field numbers involved	Description
[1]	2,3	Number of days in month incorrect.
[2]	17,20	Number of animals sighted for species is too high.
[3]	17,21	Group size too large.
[4]	17,23	Behavior code incompatible with species.
[5]	19,20	Confidence interval indicates a range larger than half the total animals seen.
[6]	20,21	Group size exceeded total animals seen.
[7]	23,26	Initial sighting distance incompatible with behavior code.
[8]	2,3,4	Number of days in Fbruary on a leap year incorrect.
[9]	8,12,17	Area in which species was sighted not normal for that species or sighting occurred outside the normal bounds of the study area.
[10]	2,3,4,5,6	Time out of sequence.
[11]	8,9,10,11,12,13,14,15	Distance of transit exceeded 300 nautical miles.
[12]	2,3,4,5,6,8,9,10,11,12,13,14,15	Vessel speed during a transit exceeded 20 knots.
[13]	2,3,4,5,6,8,9,11,12,13,15	Number of continuous observation hours exceeded 15.
[14]	2,3,4,5,6,8,11,12,15	Transit occurred during darkness.
[15]	17	Species is rare.
[16]	32	Transit beginning and ending flags not in proper order.
[17]	1,2,3,4	Record Identifier on data cards incorrect or inconsistent with starting date of record.

TABLE 7.--Relational checks performed by the quality control program. Check numbers in brackets refer to QCP1 output diagnostic.--continued.

Check number	Field numbers involved	Description
[18]	31	Time Zone changed by more than two on adjacent data cards.
[19]	8,12,28	Water temperature has exceeded value allowed for this latitude.
[20]	2,3,4,5,6,8,9,10,12,13,14,15,32	Beginning and ending times of transit are the same, or the positions are the same.

3) Group size too large.

Based upon our knowledge of natural history of some marine mammals, we can predict goup sizes, i.e., a number of animals in close association with each other. Table 8 lists the maximum allowable values before test failure occurs.

4) Behavior code incompatible with species.

As each species is encountered by QCP1, a check is made to determine whether or not the indicated behavior is possible. For example, gray whales do not haul out on ice. If such a combination of species and behavior code were detected, test failure would result. Table 9 lists incompatible behavior codes for each species.

5) Confidence interval indicates a range larger than half the total animals seen.

By our definitions, the lower range boundary of the confidence interval cannot be less than zero, and the upper range boundary cannot exceed half the total. Test failure occurs when range boundaries are exceeded.

6) Group size exceeded total animals seen.

Test failure occurs when the variable group size exceeds the variable number.

TABLE 8.--Range of allowable value states of number (NUM), group size (GROUP), latitude (LH) and longitude (LLH) for each species. Values exceeding range boundaries are flagged by the quality control program (QCP1) for verification by researcher.

Species code	Number of animals		Group size		1/ Latitude		2/ Longitude	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
BE	1	15	1	15	32	60	110	140E
DL	1	300	1	50	58	75	110	140E
MS	1	3	1	3	42	65	110	140E
MM	1	20	1	20	65	75	110	140E
OO	1	25	1	25	32	75	110	140E
SL	1	2000	1	2000	32	25	110	140E
TT	1	500	1	500	32	30	110	140E
SG	1	2000	1	2000	32	30	110	140E
SA	1	2000	1	2000	32	30	110	140E
SC	1	2000	1	2000	32	30	110	140E
PP	1	20	1	20	32	65	110	140E
PD,PT,PX	1	50	1	20	32	65	115	140E
LO	1	1000	1	1000	32	62	110	140E
LH	1	2000	1	2000	32	30	110	140E
ZX	1	25	1	25	32	65	110	140E
LB	1	2000	1	2000	32	60	115	140E
PM	1	100	1	100	32	60	110	140E
GG	1	1000	1	25	32	61	110	140E
PC	1	100	1	100	32	50	110	140E
DD	1	2000	1	2000	32	50	110	140E
GM	1	500	1	500	32	50	110	140E
BM	1	6	1	6	55	75	110	140E
BL	1	10	1	4	32	60	110	140E
BP	1	50	1	15	32	61	110	140E
BB	1	50	1	20	32	61	110	140E
BX	1	50	1	20	32	50	110	140E
BA	1	10	1	4	32	65	110	140E
MN	1	100	1	25	32	61	110	140E
ER	1	200	1	200	32	75	110	140E
EG	1	10	1	10	32	65	110	140E
UZ	1	200	1	200	32	75	110	140E
UX	1	2000	1	2000	32	75	110	140E
UD	1	2000	1	2000	32	75	110	140E
UW	1	2000	1	2000	32	75	110	140E
UM	1	30	1	5	60	75	110	140E
EL	1	300	1	150	32	61	115	140E
CU	1	8000	1	1000	32	62	110	140E
EB	1	25	1	25	50	75	110	140E
EJ	1	8000	1	1000	32	65	115	140E
OR	1	2000	1	2000	55	75	135	140E
PF	1	100	1	10	50	75	110	140E
PH	1	25	1	25	55	75	110	140E
PV	1	1500	1	1500	30	75	115	140E

TABLE 8. Range of allowable value states of number (NUM), group size (GROUP), latitude (LH) and longitude (LLH) for each species. Values exceeding range boundaries are flagged by the quality control program (QCP1) for verification by researcher.--continued.

Species code	Number of animals		Group size		Latitude		Longitude	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
PL	1	100	1	100	32	60	110	140E
ZC	1	1000	1	1000	32	51	110	140E
MA	1	100	1	100	32	60	110	140E
UP	1	2000	1	2000	32	75	110	140E
US	1	1500	1	1500	32	75	110	140E
UO	1	8000	1	1000	32	65	115	140E
SB	1	2000	1	2000	0	30	100	140E
FA	1	10	1	10	0	30	100	100E

1/ Latitudes are all northern hemisphere.

2/ Longitudes are western hemisphere unless otherwise specified.

7) initial sighting distance incompatible with behavior code.

This relational check compares behavior codes with initial sighting distance (i.e., distance from observer to animal when the animal was first seen). For example, behavior code 2 represents an animal which was sleeping, perhaps a sea lion sleeping on rocks, and the initial sighting distance for behavior code 2 exceeds 500 meters, the test would fail and the case would be rechecked with raw data sheets for verificaiton or rejection of the data. See Table 10 for range boundaries of initial sighting distances as it relates to behavior code.

8) Number of days in February on a leap year incorrect.

This test is made separately from test 1, for two reasons: program efficiency and the test involves 3 variables whereas test 1 involves two variables. Test failure occurs when day exceeds 29 during February on leap years.

TABLE 9.--List of behavior codes (BEH) by species (SPE) which are flagged by the quality control program for re-inspection. Codes listed below are based on current knowledge of natural history and known behaviors.

Species code	Improbable or impossible behavior codes[1]
BE	08-11, 24, 25, 31-39, >41
DL	08-11, 24, 25, 31-39, >41
MS	08-11, 24, 25, 31-39, >41
MM	08-11, 24, 25, 31-39, >41
OO	08-09, 31-39, >41
SL	28-39, >41
TT	28-39, >41
SG	28-39, >41
SA	28-39, >41
SC	28-39, >41
PP	10, 11, 24, 25, 28, 30-39, >41
PD,PT,PX	28-39, 41-90
LO	28-39, >41
LH	28-39, >41
ZX	08-11, 24, 25, 28-39, >41
LB	10, 11, 24, 25, 28-39, >41
PM	08-11, 24, 25, 31-39, >41
GG	08, 10, 11, 24, 25, 28-39, >41
PC	08, 10, 24, 25, 28-39, >41
DD	11, 28-39, >41
GM	08, 11, 31-39, >41
BM	08-11, 31-39, >41
BL	08-11, 31-39, >41
BP	08-11, 31-39, >41
BB	08-11, 31-39, >41
BX	08-11, 31-39, >41
BA	08-11, 31-39, >41
MN	08-11, 31-39, >41
ER	08-11, 31-39, >41
BG	08-11, 31-39, >41
UZ	08-11, 31-39, >41
UX	31-39, >41
UD	31-39, 41-90
UW	31-39, >41
UM	02, 03, 08-12, 15, 19-26, 28-30, 78
EL	08, 09, 28-30, >41
CU	08, 28-30, 63
EB	08, 09, 10, 11, 28-30
EJ	08, 09, 28-30
OR	08-11, 28-30
PF	08-11, 28-39
PH	08-11, 28-39
PV	08-11, 24-26, 28-39
PL	08-11, 24-26, 28-39

TABLE 9.--List of behavior codes (BEH) by species (SPE) which are flagged by the quality control program for re-inspection. Codes listed below are based on current knowledge of natural history and known behaviors.--continued.

Species code	Improbable or impossible behavior codes[1/]
ZC	08, 09, 28-30
MA	08, 09, 28-30
UP	08, 09, 28-30
US	08, 09, 28-30
UO	08, 09, 28-30
SB	11, 28-39, >41
FA	10, 11, 24, 25, 28-39, >41

[1/] See Appendix for behavior code definitions.

9) Area in which species was sighted not normal for that species or sighting occurred outside normal bounds of study area.

Based on knowledge of gross geographic distribution of each species, and on knowledge of where most ships sail that contribute data to POP, minimum and maximum latitudes and longitudes have been defined where species are likely to be sighted. If these boundaries which vary by species are exceeded, test failure occurs. As an example, if beluga whales which live in Alaskan waters were sighted off the coast of Washington, QCP1 would flag the sighting (see Table 8).

10) Time out of sequence.

Time must be in chronological order throughout each record. If time is not in chronological order, test failure occurs.

11) Distance of transit exceeded 300 nautical miles.

Occasionally, data is received which documents ship time and position at intervals during which some watch effort is expended. This information can be treated as transit data, whereby watch effort can be evaluated with ship position to obtain some index to animal density. We have arbitrarily allowed transit lengths to be less than or equal to 300 nautical miles in length (equivalent to 20 knots for 15 hours) before test failure occurs.

12) Speed of ship exceeded 20 knots.

Ship speed is calculated, based upon the beginning and ending of transits. When ship speed exceeds 20 knots, the end of transit card image is flagged.

TABLE 10.--Minimum and maximum initial sighting distances (in meters) that can be associated with observed behaviors.

	Initial sighting distances			Initial sighting distances	
Behavior code[1]	Minimum allowable	Maximum allowable	Behavior code	Minimum allowable	Maximum allowable
01	0	9999	35	0	200
02	0	500	36	0	200
03	0	500	37	0	100
04	0	500	38	0	150
05	0	500	39	0	300
06	0	500	40	0	300
07	0	500	61	0	300
08	0	500	62	0	80
09	0	1500	63	0	200
10	0	500	64	0	100
11	0	500	65	0	100
12	0	500	66	0	200
13	0	500	67	0	150
14	0	500	68	0	300
15	0	500	69	0	50
16	0	500	71	50	300
17	0	500	72	50	300
18	0	500	73	50	300
19	0	500	74	40	300
20	0	500	75	30	300
21	0	500	76	0	500
22	0	500	77	0	500
23	0	500	78	0	500
24	0	500	79	0	300
25	0	500	80	0	300
26	0	500	81	50	500
27	0	500	90	0	500
28	0	1500	91	0	500
29	0	500	92	0	500
30	50	500	93	0	500
31	0	500	94	0	500
32	0	80	95	0	500
33	0	200	96	0	500
34	0	100			

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[1] See Appendix for behavior code definitions.

13) Number of continuous hours of observation exceeded 15.

Any transit that encompasses a time period exceeding 15 hours in duration is flagged.

14) Transit occurred during darkness.

The beginning and ending time of each transit is checked against computed sunrise and sunset times to verify that transits occurred during daylight hours. Sightings at night while on transits indicate possible errors in data. Note that some nighttime sightings have been received from commercial fishermen who have observed sea lions within range of flood lights during fishing operations. These sightings, however, were made during nontransit-type operations.

The time (Greenwich Mean Time) of sunrise and sunset is computed according to the following[1]:

Sunrise is computed from

$$S = [\ _o - \cos^{-1} (-\tan\ _s \tan\ _o)]/15 - E + 12,$$

where

= observer's longitude
= observer's latitude
= subsolar latitude (declination of sun)
E = equation of time

$_s$ and E are approxiamted by

= 23.5 cos (t + 10)
E = 0.123 cos (t + 87) - 1/6 sin (2t + 20)
t = 0.988 (D - 1 + 30.3 (m - 1)),

where D and m are day and month, respectively.

Sunset is computed from

$$S = [\ _o + \cos^{-1} (-\tan\ _s \tan\ _o)]/15 - E + 12,$$

where

= observer's longitude
= observer's latitude
= subsolar latitude (declination of sun)
E = equation of time

---

[1] Hewlett Packard HP-97 Users Library, Avigation.

$_s$ and E are approximated by

$$
\begin{aligned}
&= -23.5 \cos (t + 10) \\
E &= 0.123 \cos \ (t + 87) - 1/6 \sin (2t + 20) \\
t &= 0.988 \ (D - 1 + 30.3 \ (m - 1)),
\end{aligned}
$$

where D and m are day and month, respectively.

15) Species sighted is rare.

Strictly speaking, this is not a relational test because only one variable, species, is tested. The test, however, does not fit well into any other categories and, therefore, is listed here as a relational check. Test failure occurs when any species which is rarely seen (Table 11) occurs on a sighting card.

16) Transit beginning and ending flags not in proper order.

The variable, Flag, can receive the values of "1" for the beginning of a transit, or "2" for the end of a transit. The value of "1" must always be followed at some later time by a value of "2". A "1" cannot be followed by a "1" and a "2" cannot be followed by a "2". Test failure occurs whenever the above logic is violated.

17) Record I.D. (RID) on a data card incorrect or inconsistent with starting date of record.

The variable, RID, defined in POP format instructions (Appendix, page 320) is calculatable from the date provided on the first data card of the Record. This value not only should agree with the starting date of the cruise, but also should be the same on every card image of the record.

18) Time zone value changed by more than "2" on adjacent data cards.

Vessels very rarely change clock settings by more than two time zones in any given day. If such a change occurs, then it is flagged by QCP1 for inspection.

19) Water temperature has exceeded allowable value for latitude of card image.

Surface water temperature varies roughly by latitude. Upper limit expected temperatures for several ranges of latitudes have been assigned for this test. If the temperature on a data card exceeds that allowed for the latitude, the card image is flagged.

TABLE 11.--List of Species (SPE) which are rarely seen on marine mammal surveys. These values are flagged by the quality control program for verification by researcher.

Species Code	Species	
	Scientific name	Common name
BE	Berardius bairdii	North Pacific giant bottlenose whale
MS	Mesoplodon stejnegeri	Sabertooth whale, Bering Sea beaked whale
MM	Monodon monoceros	Narwhal
ZX	Ziphius cavirostris	Goosebeak whale
BL	Balaenoptera musculus	Blue whale
BG	Balaena glacialis	Right whale
FA	Feresa attenuata	Pygmy killer whale

20) Beginning and ending times of transit are the same or the positions are the same.

A transit must span a period of time or length of trackline. If it does not, the second card (Flag = 2) of the transit pair is flagged.

Mapping and Quality Control

A computer drawn map is made of positions after all data have been completely processed by QCP1, and edited by POP personnel. A visual scan is made for any points occurring on land. Points occurring on land are checked against raw data and values are either corrected to match the raw data, or rejected completely if no discrepancy occurs. Note that each card image containing bad positions is removed from the data set.

Transmission of Data to OCSEAP

Data from the Gulf of Alaska and Bering Sea are transmitted through the Juneau OCSEAP Office to the Environmental Data and Information Services (EDIS) in partial fulfillment of RU-68 contractual obligations. Data are processed and analyzed at the National Marine Mammal Laboratory in the POP format (see Appendix); translation of data to the OCSEAP 027 format is the final step in preparing it for submission to the EDS.

A POP card image or "CI" (see Page 6) consists of essentially one 80 column format that documents a single sighting or event at one time and position. Transit data can be documented using a pair of data card images marked with first a "1" in the Flag field (column 63) and then a "2" to indicate the beginning and end, respectively, of a transit. All POP card images are ordered chronologically to reflect as accurately as possible recorded events in the order that they actually occurred. A POP transit consists of a period of time during which a vessel travelled a straight line course at a steady speed with an observer (may be part of bridge watch) watching for and recording sightings of marine mammals.

Translation of information from the POP format to the OCSEAP 027 format is facilitated, in part, by using codes identical to those of the OCSEAP 027 format (Tables 13-19). When codes are not identical, some translation must be done to convert the POP data to 027 formats. In some cases, 027 variables are derived from the POP file by using more than one POP variable or, sometimes, more than one card image (e.g., the 027 variable "Platform Direction" is obtained by using the beginning and end position from a pair of POP transit "Flagged" card images and is computed in degrees true from the beginning to the ending position.)

The following tables have been prepared to demonstrate more precisely how information is translated from the POP format to the OCSEAP 027 format. Table 12 lists all variables in the POP format and indicates which 027 Record Types contain the same or derived information. Note a difference in terminology: the 027 format "record" refers to a single card image, whereas Pop "record" refers to a set of card images attributable to the same data source. Variables in the 027 format which have no POP equivalent are left blank during translation and do not appear in the following tables. Tables 13 through 19 list only the variables of each 027 Record Type that are derived from the POP format and include an explanation of the derivation of each.

TABLE 12.--List of Platforms of Opportunity Program Variables and their location by Record Type in the 027 Format.

POP Format		027 Format						
		[1]Record Type						
Columns	Variable	1	2	3	4	5	6	7
1- 6	Record ID	x	x	x	x	x	x	x
7-12	Year, Month, Day	x	x	x	x			
13-16	Time	x	x	x	x			
18-30	Latitude and Longitude	x	x	x	x			
32-34	Species					x		
35	Species ID Reliability						x	
36	Number Confidence Interval					x		
37-40	Number of Animals					x		
41-42	Group Size				x			
43-44	Direction Headed				x			
45-46	Behavior Code					x		
47-48	Angle				no 027 equivalent			
49-51	Initial Distance				x			
52	Visibility Code			x				
53-55	Water Surface Temp. °C			x				
56	Platform Type		x					
57-59	Source ID		x					
60-62	Time Zone	converted to Greenwich Mean Time (GMT)						
63	[2]Transit Flags	x	x		x			
64-80	[3]Text							x

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[1] No equivalent information exists in the POP format for 027 record type 8, consequently, this Record Type is not used.

[2] This information is computed from beginning and end of transit (FLAG = 1, FLAG = 2) cards.

[3] Water depth (columns 77-80) is not converted to 027 format. It remains part of the text.

TABLE 13.--OCSEAP[1] 027 Record Type 1 (Location) format and derivation from POP format. The OCSEAP 027 Record Type 1 (location card) format contains transit information. Derivation of this 027 Record Type requires information from a pair of POP[2] transit flagged (1 and 2 in column 63) card images. If no transit information exists in the POP format, then this card will not be produced during translation from POP to 027.

027 Record Type 1		
Name of field	Columns	Derivation from POP format
File Type	1-3	Always 027
File Identifier	4-9	Identical to POP Record ID
Record Type	10	Always 1
Flight/Station Number	11-20	Numbered 1 thru N for each POP transit or for each series of sightings reported while not on transits. If no transit cards exist in the POP File (Flag 1 or 2 in Column 63) then entire file is treated as a single station. Refer to transit "FLAG" explanation in the Appendix.
Sequence Number	21-24	1 thru N for N card images within a single POP record.
Starting Date-Time	25-34	This information is taken from the beginning transit card (FLAG = 1) in a POP transit series.
Year	25-26)	This information is taken from the equivalent fields in the POP format but is converted to Greenwich Mean Time using POP Time zone information from columns 60-62.
Month	27-28)	
Day	29-30)	
Hour	31-32)	
Minute	33-34)	
Starting Position	35-49	This position copied from POP (FLAG = 1) card.
Latitude		
Degrees	35-36	Copied from POP LH field.
Minutes	37-38	Copied from POP LM field.
Seconds	39-40	POP LS field (tenths of minutes) converted to seconds (LS x 6). Left blank if blank on POP card.
Hemisphere	41	Copied from POP NS field.

TABLE 13.--OCSEAP[1] 027 Record Type 1 (Location) format and derivation from POP format. The OCSEAP 027 Record Type 1 (location card) format contains transit information. Derivation of thiss 027 Record Type requires information from a pair of POP[2] transit flagged (1 and 2 in column 63) card images. If no transit information exists in the POP format, then this card will not be produced during translation from POP to 027--continued.

027 Record Type 1 Name of field	Columns	Derivation from POP format
Longitude		
Degrees	42-44	Copied from POP LLH field.
Minutes	45-46	Copied from POP LLM field.
Seconds	47-48	POP LLS field (tenths of minutes) converted to seconds (LLS x 6).
Hemisphere	49	Copied from POP EW field.
Elapsed Time	50-53	The HR, MIN field from the POP (FLAG = 1) card is subtracted from the equivalent field on the following POP (FLAG = 2) card.
Distance Along Track	54-58	The rhumb line distance D in nautical miles between the POP (FLAG = 1) and (FLAG = 2) card positions is computed and placed in this field.
Ending Position	60-75	This is the position information from the POP (FLAG = 2) card that is associated with the (FLAG = 1) card used for beginning position.
Latitude		
Degrees	60-61	Copied from POP LH field.
Minutes	62-63	Copied from POP LM field.
Seconds	64-65	POP LS field (tenths of minutes) converted to seconds (LS x 6).
Hemisphere	66	Copied from POP NS field.
Ending Longitude		
Degrees	67-69	Copied from POP (FLAG = 2) LLH field.
Minutes	70-71	Copied from POP (FLAG = 2) LLM field.
Seconds	72-73	POP LLS (tenths of minutes) field converted to seconds (LLS x 6).
Hemisphere	74	Copied from POP (FLAG = 2) EW field.

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[1] Outer Continental Shelf Environmental Assessment Program.

[2] Platforms of Opportunity Program.

TABLE 14.--OCSEAP[1] "027" Record Type 2 (Environmental 1) format and derivation from the POP[2] format. This Record type is used to provide Platform Type and Source Identification codes. When transit information exists within POP records, a Record Type 2 occurs for each transit, with Platform Direction (course made good) and speed made good indicated.

027 Record Type 2		
Name of field	Columns	Derivation from POP format
File Type	1-3	Always 027
File Identifier	4-9	Identical to POP Record Identifier
Record Type	10	Always 2
Flight/Station Number	11-20	Same derivation as for Record Type 1
Sequence Number	21-24	Same derivation as for Record Type 1
Sighting Date & Time	25-34	This information is taken from the equivalent POP fields and converted to GMT. Day and time fields will be left blank if found blank in corresponding POP fields.
Sighting Latitude and Longitude	35-49	Same derivations as for Record Type 1.
Platform Type Code	50	Translated to 027 equivalent from POP. See Appendix Table 25. POP 027 1 2 2 5 3 G 4 F
Platform ID Code	51-53	Copied from POP (Appendix Table 26) Source ID Code.
Platform Direction	54-56	Computed from POP Transit Data if available.
Air Speed	61-63	Computed from POP Transit Data if available.

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[1] Outer Continental Shelf Environmental Assessment Program.

[2] Platforms of Opportunity Program.

TABLE 15.--OCSEAP[1] 027 Record Type 3 (Environmental 2) format and derivation from POP[2] format. Record Type 3 receives Water Surface Temperature (°C) and Surface Visibility (Appendix) from the POP format. Whenever one of these variables change value, a new Environmental 2 record will be produced with the Time, Date, Latitude and Longitude of the change taken from the appropriate POP card image.

027 Record Type 3		
Name of field	Columns	Derivation from POP format
File Type	1-3	Always 027
File Identifier	4-9	Copied from POP Record ID
Record Type	10	Always 3
Flight/Station Number	11-20	Same derivation as for Record Type 1.
Sequence Number	21-24	Same derivation as for Record Type 1.
Date, Time	25-34	Copied from same POP card image accompanying environmental data but converted to GMT.
Latitude and Longitude	35-49	Same derivation as for Record Type 1.
Water Surface Temperature (C°)	64-67	Taken from POP water temperature which is only accurate to whole degrees Celsius and does not include tenth of a degree, consequently, the 027 tenths column is set to zero in all cases.
Surface Visibility	70	Copied from POP VISI Field.

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[1] Outer Continental Shelf Environmental Assessment Program.
[2] Platforms of Opportunity Program.

TABLE 16.--OCSEAP[1] 027 Record Type 4 (Sighting 1) format and derivation from POP[2] format. Record Type 4 receives information pertaining to an actual marine mammal sighting. Distance Surveyed (Columns 50-55) is computed from POP transit flagged cards when available.

027 Record Type 4		
Name of field	Columns	Derivation from POP format
File Type	1-3	Always 027.
File Identifier	4-9	Copied from POP Record ID (Columns 1-6)
Record Type	10	Always 4
Flight/Station Number	11-20	Same derivation as for Record Type 1.
Sequence Number	21-24	Same derivation as for Record Type 1.
Date, Time	25-34	Taken from same POP card image as accompanying sighting data but converted to GMT.
Latitude & Longitude	35-49	Same deriation as for Record Type 1.
Distance Surveyed	50-55	Distance in kilometers to hundredths computed between POP FLAG = 1 and FLAG = 2 cards.
Group Size	65-67	Copied directly from POP equivalent (Columns 41-42).
Animal Movement Direction	68-70	Taken from POP equivalent field (Columns 43-44) and converted to whole degrees True (e.g.NE "045").
Unit Code for Sighting Distance	71	The initial sighting distance field (IDIST) in POP format is always in tens of meters (up to 9999). Since 027 format allows only values up to 999; distances exceeding 999 meters in POP format are converted to miles and tenths. 027 unit code "1" indicates distance has been copied in meters, and unit code "0" indicates distance has been translated to miles and tenths.

TABLE 16.--OCSEAP[1] 027 Record Type 4 (Sighting 1) format and derivation from POP[2] format. Record Type 4 receives information pertaining to an actual marine mammal sighting. Distance surveyed (Columns 50-55) is computed from POP transit flagged cards--continued.

027 Record Type 4		
Name of field	Columns	Derivation from POP format
Distance from Platform	72-74	Converted directly from IDIST (Columns 49-51) or converted to nautical miles and tenths if greater than 9990 meters.
Bearing to Animals	75-77	Calculated from POP angle when sightings occur along transects. Heading of ship is azimuth in degrees true from the beginning to ending transit positions.
Platform Heading	78-80	Same as that received by 027 Record Type 2.

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[1] Outer Continental Shelf Environmental Assessment Program.
[2] Platforms of Opportunity Program.

TABLE 17.--OCSEAP[1] 027 Record Type 5 (Sighting 2) format and derivation from POP[2] format. Record Type 5 contains sighting data contained in the POP format. The POP format contains only one "Number of Animals" field which becomes "Number of Individuals" in the 027 format. No information regarding number of adults or immatures is recorded on the POP format. POP codes UD & UW translate to 8912019901 and 8999999901 respectively. POP codes for unidentified small whales 'UX' and unidentified large whales 'UZ' have no 027 code equivalents and, consequently, are not translated to the 027 format for submission to EDS.

027 Record Type 5		
Name of field	Columns	Derivation from POP format
File Type	1-3	Always 027
File Identifier	4-9	Copied from POP Record ID
Record Type	10	Always 5
Flight/Station Number	11-20	Same derivation as for 027 Record Type 1.
Sequence Number	21-24	Same derivation as for 027 Record Type 1.
Taxonomic Code	25-34	POP Species Code (Columns 32-34) translated to 027 Code for species of same scientific name (see Appendix)
Subspecies Code	35-36	No POP equivalent
Behavior Code	37-38	Copied directly from POP equivalent (Columns 45-46)
Confidence Code	39	Applies to Number of Animals reported. Copied directly from POP equivalent (Column 36)
Number of Individuals	40-44	Copied directly from POP Number of animals field (Columns 37-40)

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[1] Outer Continental Shelf Environmental Assessment Program.
[2] Platforms of Opportunity Program.

TABLE 18.--OCSEAP[1] 027 Record Type 6 (Sighting 3) format and derivation from POP[2] format. Record Type 6 contains one type of information from the POP sighting record which is the species identification Reliability Code.

027 Record Type 6		
Name of field	Columns	Derivation from POP format
File Type	1-3	Always 027.
File Identifier	4-9	Copied from POP Record ID (Columns 1-6)
Record Type	10	Always 6
Flight/Station Number	11-20	Same derivation as for 027 Record Type 1.
Sequence Number	21-24	Same derivation as for 027 Record Type 1.
Identification Reliability	35	Translated from POP Reliability Code (column 35) POP 027 T = 0 Blank = 2 No equivalent = 1

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[1] Outer Continental Shelf Environmental Assessment Program.
[2] Platforms of Opportunity Program.

TABLE 19.--OCSEAP[1] 027 Record Type 7 (Text) format and derivation from POP[2] format. Record Type 7 contains text from the POP Text field (Columns 64-80) and is kept in proper sequence by the Sequence Number field.

027 Record Type 7		
Name of field	Columns	Derivation from POP format
File Type	1-3	Always 027
File Identifier	4-9	Copied from POP Record ID (Columns 1-6)
Record Type	10	Always 7
Flight/Station Number	11-20	Same derivation as for 027 Record Type 1
Sequence Number	21-24	Same derivation as for 027 Record Type 1
Text	25-80	Copied directly from POP Text Field (Columns 64-80)

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[1] Outer Continental Shelf Environmental Assessment Program.
[2] Platforms of Opportunity Program.

DISCUSSION

The Platforms of Opportunity Program solicits marine mammal sighting reports from a wide variety of observers. Some observers contribute data because of a personal interest in marine mammals, and others do so because of official directives from their parent organization. Although all reasonable efforts have been made to carefully screen the data before it is coded for computer archival, some invalid card images may exist within the POP computer file.

All checks made on the data are outlined in this paper, and any card images containing data that fell outside of stated acceptability ranges were at least double checked with the raw field logs and have been deemed to be valid. Very few sighting reports, however, can be absolutely confirmed as valid by either clear accompanying photographs or through the testimony of expert marine mammal biologists present when sightings were made. Reports of species outside of their normal range, when accompanied by descriptive notes, have been included in the computer file so that similar reports by other observers in the same area might be detected. Similar reports by independent observers might lend credence to such reports. The minimum requirement for positioning accuracy is whole degrees latitude and longitude which translates roughly to plus or minus 30 nautical miles. Most positions, however, are probably accurate to within plus or minus five nautical miles. Optional information such as behavior, surface water temperature, etc., is valid where entered.

It is the opinion of the authors that the majority of POP data that has been passed for computer archival and transmitted to the National Oceanographic Data Center (NODC) are valid to the extent of providing supporting evidence for determination of range, temporal distribution, and certain behavioral characteristics of marine mammals that occur in the North Pacific Ocean. Also, the quality of information received from observers improves over time as each observer gains experience in identifying marine mammals. As a result, the overall quality of POP data has improved since the project's inception, and data from 1978-80 are considered more reliable than those collected earlier.

The primary value of this data base is for determination of general distribution and seasonality of marine mammals. Copies of raw field data for unique reports such as rare animals or those outside of their normal range can be obtained from the POP office, National Marine Mammal Laboratory, Northwest and Alaska Fisheries Center, 7600 Sand Point Way NE, Bldg. 32, NOAA, Seattle, Washington 98115.

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APPENDIX CONTENTS

Data Coding

General guidelines and symbols for following instructions:

(1) All values entered into variable fields must be right justified, unless specified otherwise.

(2) Use all capitals for coding.

(3) = blank space; do not write anything.

(4) " " = print exactly what is written between quotation marks.

(5) zeros (0) placed to the left of values in variable fields are not required (e.g., for time: 0945 = 945).

(6) If information regarding some variable is not given, leave the field blank.

(7) Use standard abbreviations in comments as listed in Table 1.

(8) Time must occur in chronological sequence.

(9) If you are new, and are going to log data for the first time, there are three information sources which you must study before you begin logging. First, browse through these instructions; second, look at the examples of how raw data sheets are coded; and third, read the sections on File Logic and Quality Control. After having overviewed these sources, reread these coding instructions and then you may start logging data. Please refer to these sources whenever you have a question. If you can't find the answer, make a note of your question and ask the POP officer your question.

PLEASE BE EXTREMELY CAREFUL WHEN LOGGING DATA. THE FASTEST WAY TO GET OUR WORK DONE IS TO DO IT CORRECTLY THE FIRST TIME.

APPENDIX TABLE 20.--List of standard abbreviations used in Platforms of Opportunity Program (POP) format, comments field (columns 64-80).

Abbreviation	Description
AERIAL	Describes data collected from aerial survey
AK	Alaska
ALEUTIANS	Data collected near Aleutian Islands
BERING	Bering Sea
CANADA	Indicates waters near western Canadian coastline
CHARTERS	Charter boats, sport fishing and otherwise
CHUKCHI	Chukchi Sea
E	East
EQ	Equatorial
FVOP	Foreign Vessel Observer Program. Identifies data collected by U. S. observers aboard foreign fishing vessels.
GOA	Gulf of Alaska, typically away from the coast or northern Gulf of Alaska
GOJ	Government of Japan
LCI	Lower Cook Inlet
MISCELLANEOUS DATA	Enter in lieu of source and platform on file header to indicate that data as received cannot be ascribed to source or platform. This data will be held in the raw data files under "miscellaneous," sufficient information should be supplied in the comments field when this designation is used to permit positive assessment of the raw data record.
MMD	Marine Mammal Division
MR.	Mister. Used when identifying contributor of data as a male person rather than as an organization.
MS.	Same as above, only for females.

APPENDIX TABLE 20.--List of standard abbreviations used in Platforms of Opportunity Program (POP) format, comments field (columns 64-80)--continued.

Abbreviation	Description
N; NE; NW	North; northeast; northwest
NMML	National Marine Mammal Laboratory. Used to identify cruises on which an NMML observer was aboard.
NOAA	National Oceanic and Atmospheric Administration
PWS	Prince William Sound
SS	Shelikof Strait
S; SE; SW	South; southeast; southwest
UNID	Typically used on Record ID card to describe unidentified persons or vessels which are a member of some identifiable group (e.g. Unid Troller = source of data was a member of the Alaska Trollers' Association which, as an organization, contributes data to POP). Records thus categorized should not contain any transit information to preclude the possibility of pairing the beginning and the end transit cases for different vessels.
UNK	Typically used on File Header to describe platforms (vessels) or species that cannot be identified.
USCG	United States Coast Guard
W	West
W COAST	Pacific Ocean waters off of Washington, Oregon and California

There are two types of card images in the POP file, the Record ID card or ID card and the data or sighting card.

Instructions for filling out the Record ID Card

The Record ID Card is used once and only once at the beginning of each Record.

Columns	Variable Name	Definition and Remarks
1-4	-	"RU68" - OCSEAP Research Unit number
5		
6-11	RID	Record Identifier is a unique descriptor for each record (cruise or data set), and has been arbitrarily defined as follows: Column 6 is used to sequence records which may have otherwise identical record ID's (e.g. 175168 equates to the First "1" cruise received by POP which provided marine mammal sighting data as early as the "168"th Julian Day in year 1975 "75". Up to nine unique RID's can be assigned for a single Julian Day).
12		
13	EN	"E" if data is earmarked for sending to EDS - Environmental Data Service. These data include all OCSEAP funded work. "N" if data will not be transmitted to EDS.
14-16		
17-19	BEGMO	Three digit alphanumeric abbreviation for beginning month of data set, i.e., the alphanumeric equivalent of month as specified numerically on the first sighting card image of the Record. Use the following abbreviations for BEGMO: JAN,FEB,MAR,APR,MAY,JUN,JUL,AUG,SEP, OCT,NOV,DEC.
20		

Columns	Variable Name	Definitions and Remarks
21-22	BEGDAY	Beginning day of beginning month of Record, i.e. DAY as specified on first sighting card image of Record.
23-24		
25-27	ENDMO	Three digit alphanumeric abbreviation for ending month of Record, i.e. the alphanumeric equivalent of month as specified numerically on the last sighting card image of the Record. See BEGMO for abbreviations.
28		
29-30	ENDDAY	Ending day of ending month of Record, i.e. DAY as specified on last sighting card image of Record.
31-33		
34-37	YEAR	Beginning year of Record. Note that Records seldom contain information collected over a period exceeding a few months, but occasionally cruises may extend for example, from December of one year to February of the next. In this case year should refer to beginning year.
38		
39-80		Alphanumeric text which describes source of data and area from which data was collected. Use standard POP abbreviations (Appendix Table 20) and left justify the text. Enter the organization source (e.g. NOAA, USFS) and then the platform name from which the data was collected (e.g. SURVEYOR, FERRIES, UNK CHARTERS). Separate without a space the platform and area from which data was collected with a slash (/). Enter the general area from which data was collected (e.g. Bering, GOA). Example: USFS WICKERSHAM/SE AK translates as data collected aboard the vessel WICKERSHAM by the U.S. Forest Service in waters off the coast of southeastern Alaska. Note that in some instances, the above guidelines cannot always be followed. When this situation occurs use your own judgment as to how best to describe data source and collection location.

Instructions for filling out Data Cards

Columns	Variable Names as used by QCP1[1]	Definitions and Remarks
1-6	RID	Record Identifier as found in columns 6-11 of Record ID Card.
7-8	YR	Last two digits of year when sighting was made (e.g., 1975 = 75).
9-10	MO	Number corresponding to month of year.
11-12	DAY	Day of month.
13-16	HR, MIN	Time of observation by the 24 hour clock (e.g. 3:01 PM translates to 1501). Be very careful to record the proper time zone in columns 60-62. Conversion from one time zone to another, such as Pacific Standard Time (+8) to Greenwich Mean Time (0), by the person logging data should be kept to an absolute minimum. Such conversions, when necessary, are best done by the computer.
17		
18-22	LH,LM,LS	Latitude in degrees (LH), minutes (LM) and tenths of a minute (LS). Degrees must be specified in columns 18-19. Minuts (columns 20-21) and tenths of minutes (22) may or may not be entered, depending on the resolution of data and whether or not the ship is on transit. If the ship is on transit, positions must be filled out at least to whole minutes of resolution. Leave LM and LS fields blank if minutes or tenths of minutes cannot be determined within + 5 miles.
23	NS	"N" for north latitude "S" for south latitude
24-29	LLH,LLM,LLS	Longitude in degrees, minutes and tenths of minutes. Same logic applies as for latitude.
30	EW	"E" for east longitude "W" for west longitude
31	-	

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[1] Quality Control Program number 1 for shipboard data.

Columns	Variable Names	Definitions and Remarks
32-33	SPE	Species code (Appendix Table 21). Remember to right justify.
35	REL	Reliability of species identification. Enter a "T" if there is any doubt regarding the validity of the species identification made by the observer. If the identification appears valid (i.e., description of animals or known observer reliability), leave this column blank.
36	CONF	"Confidence interval" which sometimes can be ascribed to a sighting. Occasionally an observer will indicate that he/she saw 10 animals ± 2. So as not to lose this information, enter the following codes which best characterize the "confidence interval" of the sighting: Code Description 0 No error 1 plus or minus one animal 2 " " " two " 3 " " " five " 4 " " " 10 " 5 " " " 25 " 6 " " " 50 " 7 " " " 100 " 8 " " " 1000 " 9 represents a minimal estimate of number of animals seen (e.g. at least 10 animals)
37-40	NUM	Number of animals reported.
41-42	GROUP	Group size. If number of animals is reported as being in discrete groups (e.g. 10 seals in pairs), then record the size of the groups. In this example, a group size of pairs = 2.

Columns	Variable Names	Definitions and Remarks
43-44	IDIR	Direction animals are swimming, if given. Indicate approximate direction using N=Due North, NW=northwest, SE=southwest, etc. Usage of this field does not follow conventional right justification. Always enter N or S in column 43 and always enter E or W in column 44.
45-46	BEHAVE	Behavior if noted. See Appendix Table 22 for applicable behavior codes.
47-48	ANGLE	If given, indicate relative angle from the bow of the ship that animal(s) was first sighted to nearest 10° (Dead ahead = 0, 30° to Starboard = 3, 40° to Port = 32).
49-51	IDIST	If given, indicate the initial sighting distance to animal in tens of meters (e.g. 100 meters = "10").
52	VISI	Surface Visibility Code-A subjective code that takes all factors that may affect visibility of marine mammals into account (Appendix Table 24).
53-55	WATER	Water surface temperature in degrees celsius. If temperature is minus, enter a "-" sign in the column immediately adjacent (left) of temperature; if positive, leave blank. Use Appendix Table 23 if temperature conversion for Fahrenheit to Centigrade is necessary.
56	PTYPE	Platform Type. Enter code which most aptly describes where observation was made from: Code Description 1 Surface vessel 2 Aircraft 3 Ice station 4 Shore station
57-59	SOURCE ID	Source Identifier (see Appendix Table 26).

Columns	Variable Names	Definitions and Remarks
60-62	TZ	Time Zone in which observation was recorded. This should be expressed as plus or minus so many hours as determined from Appendix Figure 3. This field and the time field are very important, especially when a record contains transit data. Time Zone boundaries for Alaska and the U.S. Pacific Coast are outlined in Appendix Figure 4. These boundaries are determined more from social rather than astronomical considerations. Note that each area will keep time in a different zone according to the time of year (e.g., for Seattle from 25 October through 24 April the time used is Pacific Standard Time which equals time zone plus eight [+8]; from 25 April through 24 October the time used is Pacific Daylight Saving Time which equals time zone plus seven [+7]. Generally, standard time is kept from 25 October to 24 April and daylight savings time is kept from 25 April to 24 October. In the western hemisphere, subtract one from the standard time zone (e.g. PDT = +8 goes to PDST = 8-1 = +7). Observers will usually note which time zone they have used for their records, if not, then the logger must assume that time was kept in the appropriate zone for the area and time of year.
63	FLAG	Transit Flag: A "1" is used to indicate the beginning of a transit and a "2" is used to mark the end of a transit. A transit is defined as any straight line travelled by a ship or an aircraft where observation effort is made, and beginning and ending times and positions of transit are provided. Any string of sighting cards that have a "1" placed in column 63 on the first card of that string, and a "2" placed in column 63 on the last card of that string will be treated as a transit during data analysis. For every "1" that is indicated, a "2" must also exist at some later time.
64-80	TEXT	Comments may be made by the logger to help describe or add to information existing as coded data on each card. Use standard POP abbreviations when possible (Appendix Table 20).

APPENDIX TABLE 21.--Common and scientific names and corresponding codes for marine mammals reported by Platforms of Opportunity Program observers; names are ordered and spelled as found in Rice, 1977[1]. NE indicates no equivalent.

Code	Common name	Scientific name
UM	Polar bear	*Ursus maritimus*
OR	Walrus	*Odobenus rosmarus*
ZC	California sea lion	*Zalophus californianus californianus* (sp)
EJ	Northern sea lion	*Eumetopias jubatus*
CU	Northern fur seal	*Callorhinus ursinus*
EL	Sea otter	*Enhydra lutris*
PV	Harbor seal	*Phoca vitulina*
PL	Spotted seal; larga seal	*Phoca largha*
PH	Ringed seal	*Phoca hispida*
PF	Ribbon seal	*Phoca fasciata*
EB	Bearded seal	*Erignathus barbatus*
MA	Northern elephant seal	*Mirounga angustirostris*
UO	Unidentified otariid	NE
US	Unidentified phocid	NE
UP	Unidentified pinniped	NE
ER	Gray whale	*Eschrichtius robustus*
BA	Minke whale	*Balaenoptera acutorostrata*
BX	Bryde whale	*Balaenoptera edeni*
BB	Sei whale	*Balaenoptera borealis*
BP	Fin whale	*Balaenoptera physalus*
BL	Blue whale	*Balaenoptera musculus*
MN	Humpback whale	*Megaptera novaeangliae*
BG	Black right whale	*Balaena glacialis*
BM	Bowhead whale	*Balaena mysticetus*
SB	Rough toothed dolphin	*Steno bredanensis*
TT	Bottlenose dolphin	*Tursiops truncatus*
SL	Spinner dolphin	*Stenella longirostris*
SA	Spotted dolphin (Central Pacific)	*Stenella attenuata*
SG	Spotted dolphin (Eastern Pacific)	*Stenella a. graffmani*
SC	Striped dolphin	*Stenella coeruleoalba*
DD	Saddleback dolphin	*Delphinus delphis*
LH	Shortsnouted whitebelly dolphin	*Lagenodelphis hosei*
LO	Pacific whiteside dolphin	*Lagenorhynchus obliquidens*
LB	Northern right whale dolphin	*Lissodelphis borealis*
GG	Whiteheaded grampus; gray grampus	*Grampus griseus*
FA	Pygmy killer whale	*Feresa attenuata*
PC	False killer whale	*Pseudorca crassidens*
GM	Shortfin pilot whale	*Globicephala macrorhynchus*
OO	Killer whale	*Orcinus orca*
PP	Harbor porpoise	*Phocoena phocoena*

APPENDIX TABLE 21.--Common and scientific names and corresponding codes for marine mammals reported by Platforms of Opportunity Program observers; names are ordered and spelled as found in Rice, 1977[1]. NE indicates no equivalent--continued.

Code	Common name	Scientific name
PD	Dall's porpoise	*Phocoenoides* *dalli*: dalli type
PT	Dall's porpoise	*Phocoenoides* *dalli*: truei type
PX	Dall's porpoise	*Phocoenoides* *dalli*: type unknown
DL	Belukha; beluga	Delphinapterus leucas
MM	Narwhal	Monodon monoceros
PM	Sperm whale	Physeter macrocephalus
BE	North Pacific giant bottlenose whale	Berardius bairdii
ZX	Goosebeak whale	Ziphius cavirostris
MS	Bering Sea baked whale	Mesoplodon stejnegeri
UD	Unidentified dolphin/porpoise	NE
UZ	Unidentified large whale	NE
UX	Unidentified small whale	NE
UW	Unidentified whale	NE

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[1] Rice, Dale W. 1977. A list of the marine mammals of the world. U. S. Dep. Commer., NOAA Tech. Rep. NMFS SSRF-711, 13 p.

APPENDIX TABLE 22.--Types of behavior and corresponding Codes utilized in the Platforms of Opportunity Program format. Behavior is broken down into four categories: in the water, hauled on land, hauled on ice, and miscellaneous.

---

0 - 30 -- In Water

01 - No specific behavior other than in the water
02 - Sleeping
03 - Courtship or breeding behavior
04 - Feeding
05 - Mother with young
06 - Aggressive
07 - Nonspecific contact/play
08 - Bow riding
09 - Porpoising
10 - Following vessel (e.g. Sea Lions following a fishing vessel)
11 - Attracted by fish nets
12 - Associated with cetacea
13 - Associated with pinniped
14 - Associated with birds
15 - Associated with cetacea and birds
16 - Associated with pinnipeds and birds
17 - Associated with pinnipeds and cetaceans
18 - Associated with pinnipeds, cetaceans, and birds
19 - Associated with kelp
20 - Associated with shrimp, euphausids, etc. Krill
21 - Associated with school of baitfish (length under 18 inches)
22 - Associated with larger fish (length over 18 inches)
23 - Associated with concentrations of squid
24 - Associated with vessel and cetacean
25 - Associated with vessel and pinniped
26 - Synchronous diving
27 - Dead animal
28 - Breaching
29 - Avoidance
30 - Lob-tailing

---

31 - 60 -- On Land

31 - No specific
32 - Sleeping
33 - Breeding and pupping (Rookery)
34 - Feeding
35 - Mother with young
36 - Mother with young nursing
37 - Aggressive
38 - Nonspecific contact/play
39 - Thermoregulatory
40 - Dead animal
41-60 - Unassigned

APPENDIX TABLE 22.--Types of behavior and corresponding Codes utilized in the Platforms of Opportunity format. Behavior is broken down into four categories: in the water, hauled on land, hauled on ice, and miscellaneous--continued.

---

61 - 80 -- On Ice

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61 - No specific behavior noted
62 - Sleeping
63 - Breeding and pupping rookery
64 - Feeding
65 - Mother with young nursing
66 - Mother with young
67 - Aggressive
68 - Nonspecific contact/play
69 - Dead animal
70 - Unassigned
81 - Hauled on floating debris other than ice

---

90 - Spyhopping

---

91 - 96 -- Developed for Dall's porpoise

---

91 - Roostertailing
92 - Slow-rolling
93 - Riding stern wake
94 - Milling
95 - Approach vessel > veer away
96 - Slow roll > roostertail > slow roll

Additional notes on behavior can be made in the comments field.

APPENDIX TABLE 23.--Temperature Conversion Table.

Fahrenheit	Celsius
90	32.2
88	31.1
86	30.0
84	28.0
82	27.8
80	26.7
78	25.6
76	24.4
74	23.3
72	22.2
70	21.1
68	20.0
66	18.9
64	17.8
62	16.7
60	15.6
58	14.4
56	13.3
54	12.2
52	11.1
50	10.0
48	8.9
46	7.8
44	6.7
42	5.6
40	4.4
38	
36	
34	
32	0.0
30	-1.1
28	-2.2
26	-3.3

APPENDIX TABLE 24.--Explanation of surface visibility codes used in the Platforms of Opportunity Program computer format.

Code	Explanation
1	Excellent - Surface of water calm, a high overcast solid enough to prevent sun glare. Marine mammals will appear black against a uniform gray background. Beaufort 0. Visibility >5 km.
2	Very Good - May be a light ripple on the surface or slightly uneven lighting but still relatively easy to distinguish animals at a distance. Beaufort 1 or 2. Visibility >5 km.
3	Good - May be light chop, some sun glare or dark shadows in part of the survey track. Animals up close (400 meters or less) can still be detected and fairly readily identified. Beaufort 2 or 3. Visibility $\leq$ 5 km.
4	Fair - Choppy waves with some slight whitecapping, sun glare or dark shadows in 50% or less of the survey track. Animals much further away than 400 meters are likely to be missed. Beaufort 3. Visibility $\leq$ 1 km.
5	Poor - Wind in excess of 15 knots, waves over two feet with whitecaps, sun glare may occur in over 50% of the survey track. Animals may be missed unless within 100 meters of the survey trackline, identification difficult except with the larger species. Beaufort 4 or 5. Visibility $\leq$ 500 m.
6	Unacceptable - Wind in excess of 25 knots, waves over three feet high with pronounced whitecapping. Sun glare may or may not be present. Detection of any marine mammal unlikely unless the observer is looking directly at the place where it surfaces. Identification very difficult due to improbability of seeing animal more than once. Beaufort $\geq$ 6. Visibility $\leq$ 300 m.

APPENDIX TABLE 25.--Codes used in the Platforms of Opportunity format to designate the type of platform from which observations were made.

Code	Platform Type
1	Surface vessel
2	Aircraft
3	Ice station
4	Shore station

APPENDIX TABLE 26.--Source codes used in the Platforms of Opportunity format to designate specific aircraft, vessels or organizations that contribute sighting data.

Codes 001 thru 049 are reserved for NOAA vessels.

Code	Vessel name
001-	Oceanographer
002-	Discoverer
003-	Surveyor
004-	Fairweather
005-	Rainier
006-	Miller Freeman
007-	MacArthur
008-	Davidson
009-	David Starr Jordan
010-	Oregon
011-	Cobb
012-	Kelez
013-	Pribilof
014-	Townsend Cromwell

Codes 050 thru 069 are reserved for U. S. Forest Service data from Alaska State Ferries.

Code	Vessel name
051-	MV EL Bartlett
052-	MV Tustemena
053-	MV Wickersham
054-	MV Matanuska
055-	MV Taku
056-	MV Malaspina
057-	MV Columbia

APPENDIX TABLE 26.--Source codes used in the Platforms of Opportunity format to designate specific aircraft vessels or organizations that contribute sighting data--continued.

Codes 070 thru 299 are reserved for miscellaneous surface vessels.

Code	Vessel name
071-	RV Alpha Helix
072-	RV Resolution
073-	RV Acona
074-	RV Thomas G. Thompson
075-	RV Tordenskjold
076-	RV Moana Wave
077-	Tonquin
078-	Montegue
079-	Professor Siedlicki
080-	S. P. Lee
081-	Commander
082-	Sea Hawk
083-	Western Viking
084-	U. S. Dominator
085-	Imperial Adgo
086-	Ungaluk
087-	Half Moon Bay
088-	Pacific Queen
089-	Pressure Ridge
201-	New St. Joseph
202-	Mark I
203-	Discovery (Sam Guill)
204-	Trinity
205-	Tacoma
206-	Harmony
207-	Morningstar
208-	Lynn Ann
209-	GB Reed
210-	Nordic Prince
211-	Aleutian Tern
212-	Surfbird
213-	Lindblad Explorer
214-	Glacier Queen
215-	Bartlett
216-	Shelby D
217-	Yankee Clipper
218-	Aikane
219-	Orient
220-	Carter
221-	Diakan
222-	Lindy
223-	St. Michael
224-	Yaquina
225-	Windward
226-	Pat San Marie
227-	China Bear
228-	Anna Marie
229-	Susetta
230-	Flying Cloud

APPENDIX TABLE 26.--Source codes used in the Platforms of Opportunity format to designate specific aircraft vessels or organizations that contribute sighting data--continued.

Codes 300 thru 399 are reserved for U. S. Coast Guard Vessels.

Code	Vessel name	Code	Vessel name
301-	USCG Polar Star	313-	USCGC Modoc
302-	USCG Confidence	314-	USCGC Mellon
303-	USCG Boutwell	315-	USCGC Resolute
304-	USCGC Storis	316-	USCGC Campbell
305-	USCGC Glacier	317-	USCGC Yocona
306-	USCGC Winona	318-	USCGC Jarvis
307-	USCGC Iris	319-	USCGC Burton Island (Decommissioned)
308-	USCGC Minnetonka		
309-	Not assigned	320-	USCGC Mongenthan
310-	USCGC Ironwood	321-	USCGC Sherman
311-	USCGC Midgett	322-	USCGC Comanche
312-	USCGC Rush	323-	USCGC Acushnet
		324-	USCGC Munro

Codes 400 thru 499 are reserved for fishing vessels of various fishing organizations.

Code	Vessel name
401-	Maranatha
402-	Ole B.
403-	Jolene
499-	Unid. Troller

Codes 500 thru 550 are reserved for Japanese vessels.

Code	Vessel name	Code	Vessel name
500-	Misc. motherships	508-	Hokushin Maru
501-	Oshoru Maru	509-	Iwaki Maru
502-	Hokusei Maru	510-	Kumamoto Maru
503-	Hokuko Maru	511-	Not assigned
504-	Hoyo Maru #67	512-	Not assigned
505-	Hokko Maru	513-	Hoyo Maru #81
506-	Shotoku Maru #35	514-	Misc. catcherboats
507-	Riasu Maru #2		

Codes 551 - 949 are presently unreserved.

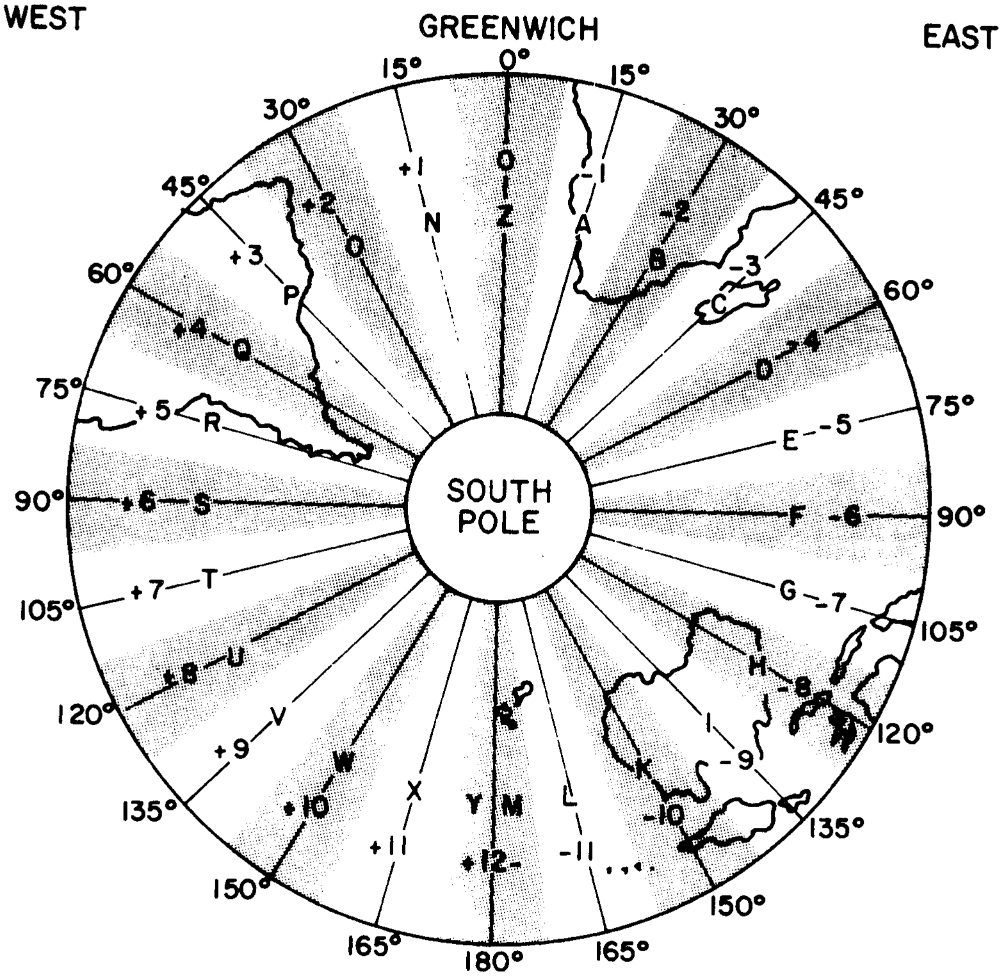
APPENDIX TABLE 26.--Source codes used in the Platforms of Opportunity format to designate specific aircraft vessels or organizations that contribute sighting data--continued.

Codes 950 thru 998 have been reserved for data submitted by various persons or organizations where the vessel is unidentified.

Code	Organization
950-	Mr. Rodney Judy (Aerial)
987-	Alaska Dept. of Fish & Game
988-	Washington Dept. of Fish & Game
989-	Mr. Bill Lawton
990-	U. S. Forest Service
991-	NOAA, NMFS Enforcement Division
992-	Coast Guard
993-	Mr. Terry Wahl
994-	Foreign Vessel Prgm., NMFS
995-	International Pacific Halibut Commission
996-	National Marine Mammal Laboratory, observer unidentified
997-	Fish & Wildlife Service
998-	National Marine Mammal Laboratory, pelagic sealing

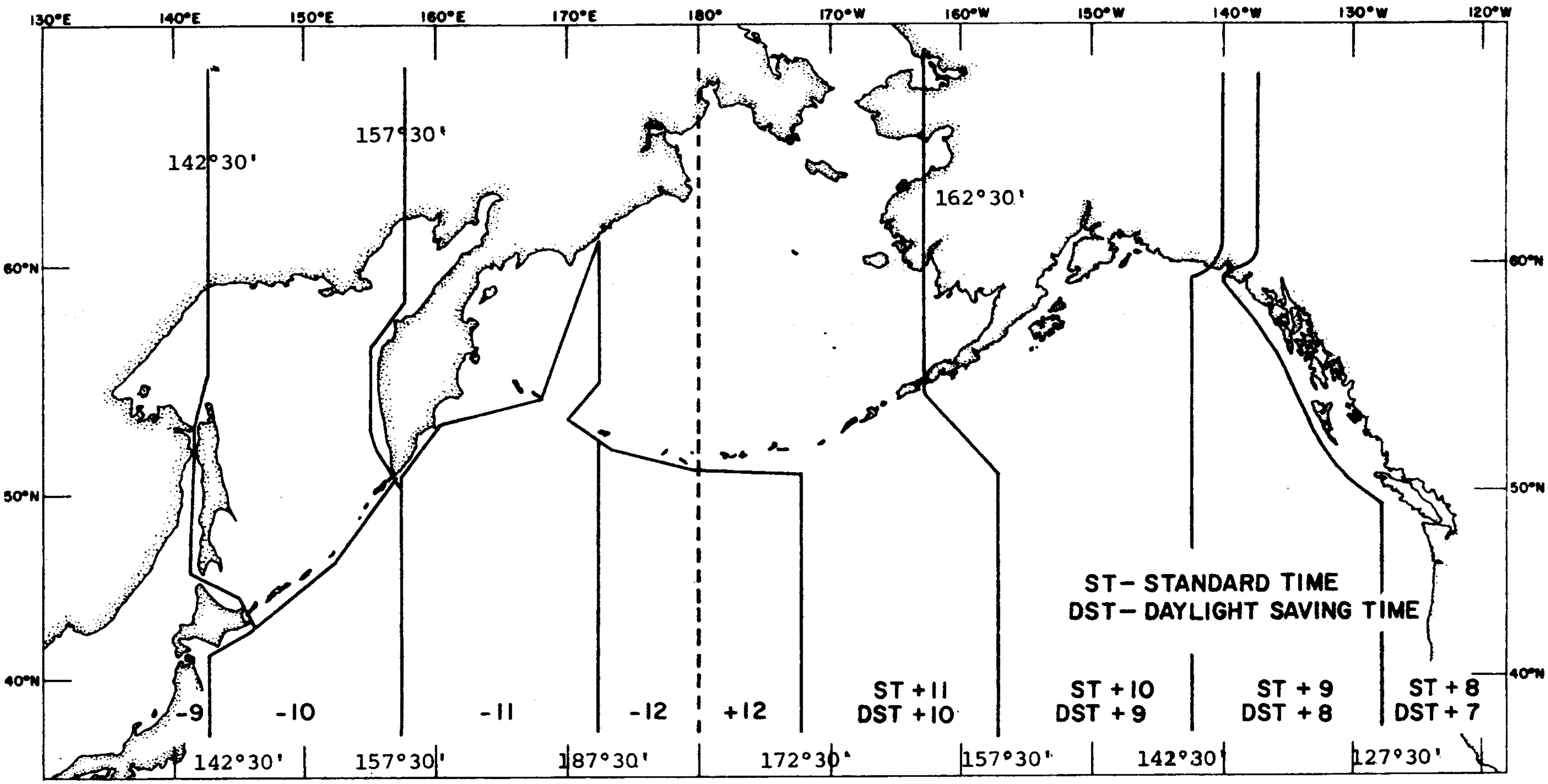
The names of individuals within the above organizations who made observations will be included in the comments field where possible.

Code 999 is used to identify data that is received from miscellaneous sources on a one-time only basis. Cases with this source ID are more fully documented in the raw data files under miscellaneous.



1/ Appendix Figure 2 --Diagram of earth's time zones with numeric and alphameric designators. Subtract one hour from numeric designator for daylight savings time (e.g. +8 is Pacific Standard Time, PST, which becomes +7 or Pacific Daylight Savings Time, PDST, from April 25th to October 24th).

1/ Adapted from Dutton's Navigation and Piloting, 1957.



Appendix Figure 3 --Map of North Pacific Legal Time Zone boundaries as taken from the Rand McNally Cosmopolitan World Atlas. Daylight savings time is normally used from April 25th through October 24th each year with standard time being used the remainder of the year.

Appendix-Field Format Example 1.

This is a copy of the Marine Observation and Station Abstract (MOSA) which is used by Outer Continental Shelf Environmental Assessment Program contract vessels to record information which includes marine mammal transit and sighting data. The PROVISIONAL OCSEAP NAVIGATION SUBINSTRUCTION (1976) FIELD SEASON for filling out the Marine Operations Abstract (MOA) was used by observers to transcribe information onto the MOSA. Water surface temperature and Surface Visibility are taken directly from or deduced from the accompanying Deck Log-Weather Observation Sheet (NOAA Form 77-13J). Please note that the MOA and MOSA are kept in Greenwich Mean Time and that the Weather Observation Sheet is kept in local mean time (+9 in this case). Care must be taken when transcribing data from these sources to the Platforms of Opportunity Program format not to confuse time zones. Entries that have been selected for transcription to the example POP format have been circled on the MOSA.

MARINE OBSERVATION AND STATION ABSTRACT

SHIP Discoverer
LOCALITY G.O.A. Kodiak
O.S. SHEET NO. ch 16580
SHEET NO. 3
PLOTT

PROJECT NAME OCSEAP
PROJECT NO. RP-4-DI-77
CRUISE A
LEG VI
INVESTIGATORS

POSITION RESOLUTION CODE
THIS IS AN INDICATION OF THE RESOLUTION AND STRENGTH OF THE POSITIONING SYSTEM(S) USED
A ±0-.25 MILE
B ±.25-.5 MILE
C ±.5-1.0 MILE
D ±1.-2. MILES
E ±2.-4. MILES
F >±4. MILES

MODE
1. STEAMING AT CONST. COURSE AND SPEED
2. MANEUVERING
3. HOLDING STATION
4. OTHER (REMARKS)

DATES COVERED 21 MAY 77
DATE PREPARED 21 MAY 77

TIME OF OPERATION				SMOOTHED POSITION			MADE GOOD						
JULIAN DATE	BEGINNING TIME (GMT)	ENDING TIME (GMT)	TIME ZONE	LATITUDE	LONGITUDE	POS RES CODE	COURSE	SPEED	MODE	DEPTH (METERS)	EVENT CODE	OPERATIONS AND REMARKS	STA NO.
141	0531		+9	56 15.0	153 57.6	C	223	13.9	1	–	74	4 Dall's Porpoise (c) Dead ahead ✓	
	1330			55 23.3	156 40.6	C	271	14.0	1	–	74	2 (c) MINKE WHALE ✓	
	1445			55 23.8	157 13.7	C	↓	↓	1	91	71	Begin Bird Transect	
		1500		55 23.8	157 19.7	C	271	14.0	1	88	71	END BIRD TRANSECT	
	1500			55 23.8	157 19.7	C	273	14.0	1	88	71	BEGIN BIRD TRANSECT	
		1515		55 24.1	157 25.9	C			1	88	71	End Bird Transect	
	1545			55 24.5	157 37.8	C			1	90	71	Begin Bird Transect	
		1600		55 24.7	157 41.0	C			1	88	71	End Bird Transect	
	1600			55 24.7	157 41.0	C	↓	↓	1	88	71	Begin Bird Transect	
		1615		55 24.9	157 50.0	C	273	14.0	1	82	71	End Bird Transect	
	1630			55 24.9	157 56.5	C	273	14.0	1	–	74	2 (c) DALLS PORPOISE ✓	
	1700			55 25.2	158 08.9	C	273	13.8	1		74	Begin NMFS Mammal Transit ✓	
	1700			↓	↓	C			1	127	71	Begin Bird TRANSIT	
		1715		55 25.5	158 15.0	C			1	135	71	END BIRD MR 34	
	1715			↓	↓	C			1	↓	71	BEGIN BIRD	
		1730		55 25.7	158 21.4	C	↓	↓	1	143	74	END MAMMAL MR 6.9 ✓	

SB WORKSHEET 002

MARINE OBSERVATION AND STATION ABSTRACT

SHIP: Discoverer
LOCALITY: LW GOA
O.S. SHEET NO.: CAGE 16013
SHEET NO.: 5
PLOT
PROJECT NAME: OCSEAP
PROJECT NO.: RP-4-DI-77
CRUISE: A
LEG: 1
INVESTIGATORS:

POSITION RESOLUTION CODE
THIS IS AN INDICATION OF THE RESOLUTION AND STRENGTH OF THE POSITIONING SYSTEM(S) USED

A ±0-.25 MILE
B ±.25-.5 MILE
C ±.5-1.0 MILE
D ±1.-2. MILES
E ±2.-4. MILES
F >±4. MILES

MODE
1. STEAMING AT CONST. COURSE AND SPEED
2. MANEUVERING
3. HOLDING STATION
4. OTHER (REMARKS)

DATES COVERED: 21-22-M
DATE PREPARED: 21 May

TIME OF OPERATION				SMOOTHED POSITION			MADE GOOD						
JULIAN DATE	BEGINNING TIME (GMT)	ENDING TIME (GMT)	TIME ZONE	LATITUDE	LONGITUDE	POS RES CODE	COURSE	SPEED	MODE	DEPTH (METERS)	EVENT CODE	OPERATIONS AND REMARKS	ST. NO
141	2330		+9	55° 23.8'	160° 52.1'	A	280	15.0	1		74	BEGIN NMFS Mammal ✓	
142		0000		55° 20.6'	161° 03.6'	A	↓	↓	1		74	End NMFS Mammal ✓	
	0450			54° 54.1'	162° 32.6'	A	216	14.5	1		74	1 Sea Otter 25 m on Stbd beam Watching ship. ✓	
	1311			54° 25.2'	165° 16.0'	A	310	3.5	1	160	42	BEGIN BONGO OBLIQUE TO 70 M	00
		1328		54° 25.8'	165° 17.1'	A	310	3.5	1	160	42	END BONGO TOW	001
	1445			54° 34.7'	165° 38.0'	B	304	14.2	1	320	71	BEGIN BIRD TRANSECT	—
		1500		54° 36.7'	165° 42.9'	B	304	14.2	1	363	71	END BIRD TRANSECT	—
	1500			54° 36.7'	165° 42.9'	B	299	14.2	1	363	71	BEGIN BIRD TRANSECT	—
		1515		54° 38.1'	165° 48.1'	B			1	276	71	END BIRD TRANSECT	—
	1515			54° 38.1'	165° 48.1'	B			1	276	71	BEGIN BIRD TRANSECT	—
		1530		54° 39.8'	165° 53.2'	B			1	354	71	END BIRD TRANSECT	—
	1530			↓	↓	B			1	354	74	1 (C) KILLER WHALE ✓	—
	1530			54° 39.8'	165° 53.2'	B	↓	↓	1	354	71	BEGIN BIRD TRANSECT	—
	1540			54° 40.9'	165° 56.7'	B	299	14.2	1		74	10-12 (E) DALLS PORPOISE ✓	—
		1545		54° 41.5'	165° 58.3'	B	299	14.2	1	307	71	END BIRD TRANSECT	—
	1549			54° 41.7'	165° 58.9'	B	302	14.1	3	307	42	BEGIN BONGO OBLIQUE	002

29 WORKSHEET 002

MARINE OBSERVATION AND STATION ABSTRACT

SHIP Discoverer

LOCALITY WGOA

O.S. SHEET NO. 16013

SHEET NO. 4

PLOT

PROJECT NAME OCSEAP

PROJECT NO. RP-4-DE-77

CRUISE A

LEG VI

INVESTIGATORS

POSITION RESOLUTION CODE

THIS IS AN INDICATION OF THE RESOLUTION AND STRENGTH OF THE POSITIONING SYSTEM(S) USED

A ±0-.25 MILE
B ±.25-.5 MILE
C ±.5-1.0 MILE
D ±1.-2. MILES
E ±2.-4. MILES
F >±4. MILES

MODE

1. STEAMING AT CONST. COURSE AND SPEED
2. MANEUVERING
3. HOLDING STATION
4. OTHER (REMARKS)

DATES COVERED 21 MAY 77

DATE PREPARED 21 MAY 77

TIME OF OPERATION				SMOOTHED POSITION			MADE GOOD						
JULIAN DATE	BEGINNING TIME (GMT)	ENDING TIME (GMT)	TIME ZONE	LATITUDE	LONGITUDE	POS RES CODE	COURSE	SPEED	MODE	DEPTH (METERS)	EVENT CODE	OPERATIONS AND REMARKS	ST NO
141	[illegible]	1730	+9	55 25.7	158 21.4	C	273	12.8	1	143	71	END BIRD MR 3.4	
	1730			↓	↓	C			1	143	71	BEGIN BIRD	
		1745		55 25.8	158 27.5	C			1	144	71	END BIRD MR 3.4	
	1745			↓	↓	C			1		74	BEGIN Mammal ✓	
		1815		55 26.1	158 40.1	C	↓	↓	1		74	END Mammal MR 6.9 ✓	
	1830			55 26.4	158 46.4	C	274	14.2	1		74	Begin Mammal ✓	
		1900		55 26.2	158 59.4	C	274	14.2	1		74	END Mammal MR 7.1 ✓	
	1915			55 26.2	159 04.4	C	262	16.2	1		74	Begin Mammal ✓	–
		1945		55 25.2	159 18.2	C			1		74	END Mammal MR 8.1 ✓	
	2000			55 24.7	159 25.4	C			1		74	Begin Mammal – ✓	
	2015			55 24.2	159 32.1	C			1	23	71	Begin Bird	
		2030		55 23.3	159 39.2	C			1	125	71	END Bird 4.0 N.M. Run	
	2030			55 23.3	159 39.2	C			1	125	71	Begin Bird	
		2045		55 22.9	159 46.4	B			1	87.8	71	END Bird 4.0 MR	
		2045		↓	↓	B	↓	↓	1		74	END Mammal	
	2157			55 22.1	160 15.1	A	280	15.0	1		74	1 DAlls Porpoise off 100 yards ✓	

XCS WORKSHEET 002

NOAA FORM 77-13d
(3-76)

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

DECK LOG – WEATHER OBSERVATION SHEET

SHIP	DAY	DATE	TIME ZONE
DISCOVERER R-102	FRIDAY	20 MAY 77	+9 (V)

MOORED KODIAK, ALASKA : WOMENS BAY, GULF OF ALASKA

TIME	POSITION (Lat. and Long.)	PRESENT WEATHER	VISIBILITY (N.M.)	WIND		SEA WAVE HEIGHT (Ft.)	SWELL WAVES		SEA WATER TEMP. °C	SEA LEVEL PRESSURE (mb)	TEMPERATURE °C	
				DIR. (True)	SPEED (Kts.)		DIR. (True)	HEIGHT (Ft.)			DRY BULB	WET BULB
01												
02												
03												
04	57.7N 152.5W	PC	11	—	CALM					1012.1	1.9	1.6
05												
06												
07												
08	57.7N 152.5W	PC	12		CALM					1013.6	3.8	3.7
09	57.7N 152.5W	PC	12		CALM					1013.5	5.1	3.9
10	57.7N 152.3W	PC	12		CALM					1013.5	5.0	4.0
11	58.7N 152.2W	PC	12	105	8	1	120	2	5.6	1013.5	5.0	4.1
12	57.7N 152.0W	PC	12	105	7	—	120	2	5.9	1013.9	5.2	4.3
13	57.6N 152W	PC	12	130	10	–	120	3	5.8	1014.0	5.9	5.1
14	57.3N 152W	PC	12	150	9	–	120	2	5.9	1014.0	5.8	5.0
15	57.2N 152.1W	PC	12	125	5	–	120	3	5.9	1014.0	5.3	5.0
16	57.0N 152.7W	PC	12	215	5	1	190	4	6.5	1014.0	4.8	2.7
17	56.8N 152.9W	PC	12	220	4	1	190	34	6.0	1013.8	5.2	2.9
18	56.7N 153.2W	PC	12	220	4	1	200	4	6.2	1013.5	4.9	2.7
19	56.5N 153.5W	PC	12	070	6	1	195	4	6.1	1013.2	3.2	2.5
20	56.3N 153.8W	PC	12	170	5	0	210	3	6.3	1013.0	4.9	2.8
21	56.3N 153.9W	PC	12	180	5	1	200	3	6.5	1012.9	4.4	2.7
22	56.1N 154.3W	PC/C	12	190	8	—	190	3	6.2	1012.9	4.1	3.9
23	55.9N 154.7W	PC	10	150	6	–	190	2	6.1	1012.5	3.0	2.1
24	55.7N 154.9W	PC	10	120	5	–	190	2	6.0	1012.0	2.6	1.8

REMARKS

0437 - SUNRISE 0550 - SNOW SHOWER 1800 - SQUALLS ON HORIZON. 1900 - WIND SHIFT FROM PASSING SQUAL 2133 SUNSET

NOAA FORM 77-13d
(3-76)

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

DECK LOG - WEATHER OBSERVATION SHEET

SHIP	DAY	DATE	TIME ZONE
DISCOVERER	SAT.	21 MAY 77	+9

ENROUTE BERING SEA

TIME	POSITION (Lat. and Long.)	PRESENT WEATHER	VISIBILITY (N.M.)	WIND		SEA WAVE HEIGHT (Ft.)	SWELL WAVES		SEA WATER TEMP. °C	SEA LEVEL PRESSURE (mb)	TEMPERATURE °C	
				DIR. (True)	SPEED (Kts.)		DIR. (True)	HEIGHT (Ft.)			DRY BULB	WET BULB
01	55.5N 155.3W	PC	12	175	8	—	200	3	6.1	1011.8	2.7	2.0
02	55.4N 155.7W	PC	12	185	6	—	200	3	6.1	1011.3	3.5	2.8
03	55.3N 156.1W	PC	12	180	5	—	200	3	6.1	1011.0	3.5	3.0
04	55.4N 156.5W	PC	12	180	13	—	200	3	6.3	1010.5	3.7	2.5
05	55.5N 156.9W	PC	12	—	CALM	—	210	3	5.5	1010.1	2.8	2.2
06	55.4N 157.3W	PC	12	270	5	—	200	3	5.3	1010.0	3.0	2.5
07	55.4N 157.7W	PC	12	—	CALM	—	220	3	5.8	1010.0	2.9	1.8
08	55.4N 158.1W	PC	12	115	4	—	205	3	5.9	1010.0	4.0	2.8
09	55.4N 158.5W	PC	12	—	CALM	—	185	2	5.9	1010.0	3.8	2.8
10	55.4N 158.8W	PC	12	210	5	—	180	2	5.6	1010.0	4.3	2.8
11	55.5N 159.3W	PC	12	200	2	—	200	1	5.7	1010.1	4.1	3.0
12	55.4N 159.8W	PC	12	200	C-3	—	200	1	5.9	1010.1	5.0	3.1
13	55.4N 160.1W	PC	8	170	2/3	—	CALM		5.2	1010.1	5.0	3.8
14	55.4N 160.7W	C/L/S	5	110	1/2	—	CALM		5.8	1010.1	3.0	3.0
15	55.4N 161.1W	PC	12	175	9	1	CALM		5.1	1010.1	4.5	4.0
16	55.4N 161.5W	PC	12	200	12	1	—	—	5.2	1010.0	4.6	4.0
17	55.3N 161.9W	PC	12	175	18	2	—	—	5.1	1009.8	4.8	3.9
18	55.1N 162.1W	PC	12	175	19	2	—	—	~~5.1~~ 4.8	1009.5	4.2	3.9
19	55.0N 162.4W	PC	10	220	11	1	—	—	4.8	1009.5	4.9	3.8
20	54.9N 162.5W	CL	12	245	13	1	—	—	5.0	1009.5	4.4	3.2
21	54.7N 162.8W	CL	12	205	12	2	—	—	5.1	1009.5	4.8	3.7
22	54.6N 163.1W	CL	12	210	14	2	215	3	5.1	1009.7	5.0	3.3
23	54.5N 163.5W	PC	12	250	10	1	230	3	5.8	1009.8	4.0	3.0
24	54.4N 163.9W	PC	12	180	11	1	225	3	5.1	1009.8	3.4	2.8

REMARKS

0330 - RAIN/HAIL SHOWER, SQUALS ABOUT THE HORIZON. 0505 - SUNRISE
0900 - SQUALS STILL ABOUT THE HORIZON. 1200 GORMAN STRAIT 1300 KOROVIN
STRAIT 1345 UNGA STRAIT 1900 DEER PASSAGE 2110 - RAIN SHOWER
20 - SQUALS ON HORIZON 2157 - SUNSET.

Marine Mammal Platforms of Opportunity

Page 1 of 1

Date Submitted for keypunching________

Example 1

Logged by P. McGuire, Date________

Checked by________________, Date________

year	mo.	day	hour min.	Deg.	Min.	N/S	Deg.	Min.	E/W	Species	Reliability	Confidence Interval	Number Animals	Group Size	N/S Direction E/W Headed	Behavior Code	Port P/Stbd S Points 1pt=90°	Initial Distance in tens of meters eg. 1=10 meters	Visibility Code	Water Surface Temperature +/- C°	Platform Type	Platform ID	Time Zone GMT +/-?	Flag Column	TEXT
77	05	20	2031	56	150	N	153	576	W	PD		0	4			01	0		3	6	1	002	9		
		21	0430	55	233		156	426		BA		0	2			01			3	6					
			0730	55	249		157	565		PD		0	2			01			3	6					
			0800	55	252		158	089											3	6				1	
			0830	55	257		158	214											3	6				2	
			0845	55	258		158	275											2	6				1	
			0915	55	261		158	401											2	6				2	
			0930	55	264		158	464											1	6				1	
			1000	55	267		158	594											2	6				2	
			1015	55	262		159	044											1	6				1	
			1045	55	252		159	183											2	6				2	
			1100	55	247		159	254											2	6				1	
			1145	55	229		159	464											2	6				2	
			1257	55	221		160	151		PD		0	1			01	P	1	2	5					
			1430	55	238		160	521											2	5				1	
			1500	55	206		161	036											2	5				2	
		21	1950	54	541		162	326		EL		0	1			01	S8	3	2	5					
		22	0630	54	398		165	532		OO		0	1			01									
77	05	22	0640	54	409	N	165	567	W	PD		2	11			01					1	002	9		

Appendix-Field Format Example 2.

This is a copy of an older version of the standard Platforms of Opportunity Program (POP) Marine Mammal Observation Log filled out by the NOAA Ship DAVIDSON. This field format was used by all NOAA Pacific Fleet Vessels during 1974 and 1975, NOAA vessels doing OCSEAP work began using the Marine Observation and Station Abstract in 1976. The latest POP Log is presented in Field Format Example 4.

The Observation Effort Section is checked for transit information and, if it appears to be valid straight line course data, is transcribed into the POP format as transit information (FLAG = 1 and 2 cards). In this example, transit information would not be coded because of the necessity of the vessel to change course and speed while transiting narrow inland passages. If the Deck Log - Weather Observation Sheets (see example 1) had been sent in by the ship for this period, water temperature and surface visibility would also have been coded into the POP format.

MARINE MAMMAL OBSERVATION LOG

Page 4 of

VESSEL NOAA SHIP DAVIDSON DATE 11 MAY 74

Observation Effort (even if nothing seen):

Weather Scattered Showers

Time: From 0800 Zone 7 To 1906

Sea State FLAT

Position: From Petersburg Alaska To N58 10', 135° 09.5

Water Temp. 44°F

Average Speed 13 [✓ Knots] or mph (circle one)

Time (hours)	Location Lat. Long.	Kind (species)	No.	Notes*
0857 ZONE 7	57°00N 133-10W	PHOCENOIDES DALLI	10	DALL'S PORPOISE, WEST-BOUND
1058	57 06N 133 55W	Balaenoptera borealis T	3	Appeared to be Sei whales surfacing often (1-2 min. apart). Remained near surface. Occasionally dorsal fin was visible when whale blew. Behavior matched well with description of Sei whale.
1345 +7 from GMT	57 08.2N 134 41.2W	~~Blue or~~ ~~Finback~~ T ~~Whale~~ Balaenoptera borealis	1	Whale hedded south in the center of Chatham Straight in S.E. Alaska /(J.L.)
1653	N57°48' 134°50.3'W	Phocoenoides dalli	6	Scattered - several hundred yards apart except for two travelling close together
1822	N58°05.5 135°00W	Phocoenoides dalli	10-20	Scattered - moving in a NW direction. Rolling gently on surface.
1902	N58°10.0' 135° 09.5'W	Phocoenoides dalli	~~15~~ 8	Scattered - followed along for 10-15 min.

* Include the following when possible, sketch; photograph; size; direction of travel; behavior; associated animals (birds, fish) FEATURES USED FOR IDENTIFICATION, course changes of vessel.

Name:

Address:

Tel No.:

GPO 988-035

Marine Mammal Platforms of Opportunity

Page 1 of 1

Date Submitted for keypunching__________

Logged by P McGuire, Date________

Checked by________________, Date________

year	mo.	day	hour min.	Deg.	Min.	N/S	Deg.	Min.	E/W	Species	Reliability	Confidence Interval	Number Animals	Group Size	N/S Direction E/W Headed	Behavior Code	Port P/Stbd S Points 1pt=90°	Initial Distance in tens of meters eg. 1=10 meters	Visibility Code	Water Surface Temperature +/- C°	Platform Type	Platform ID	Time Zone GMT +/-?	Flag Column	TEXT
74	05	11	0857	57	00	N	133	10	W	PD		2	10		W	01					7	1008	7		
↑	↑	↑	1058	57	06	↕	133	55	↕	BB	T	0	3			01					7	↕	7		
			1345	57	082		134	412		BB	T	0	1		S	01					7		7		
			1653	57	48		134	503		PD		2	6			01					7		7		
			1822	58	055		135	00		PD		3	15		NW	01					7		7		
			1902	58	100	N	135	095	W	PD		2	8			08					7	1008	7		

Appendix-Field Format Example 3.

This is a standard Platforms for Opportunity Marine Mammal Log taken from a cruise with an Observer from Marine Mammal Division aboard. The sheet contains transit, sighting and environmental data. Data on the computer format sheet prior to 1105 are from another Field log sheet which is not included here. Marine Mammal Logs of this format were in use from 1976-1978.

May 13, 1977

MARINE MAMMAL LOG

VESSEL Discoverer /OBSERVER McGuire

TIME ZONE GMT - 10 HEADING (if constant)_____° TRUE or MAGNETIC?

NAUTICAL MILES TRAVELLED______ SPEED MADE GOOD (KNOTS)______

BEGIN WATCH: Date (Yr/Mo/Day) ___/___/___ Time ______

Position ___°/___'/___"([✓ N]/S) ___°/___'/___"(E/[✓ W])

END WATCH : Date (Yr/Mo/Day) ___/___/___ Time ______

Position ___°/___'/___"(N/S) ___°/___'/___"(E/W)

TIME	LOCATION	SPECIES	NO.	RELATIVE BEARING & DISTANCE	NOTES: BEHAVIOR, SKETCHES, WEATHER, WATER TEMP., PHOTOS, ASSOC. SPECIES.
1105	57°12.4 166°46.6	unid. delphin	1	20m	stbd side, brief glimpse only Water Temp. 2°C
1115	57°11.9 166°43.8	E jubatus	1	80m	stbd bow, had fish in its mouth, birds (10 or so) flocked around to get in on the goodies
1130	57°10.3 166°37.3				change course (End Transect)
1130 to	"				Begin Transect water = 1.9°c visib: very good
1140	57°09.3 166°33.7				change course (End transect)
1140	"				Begin Transect water = 2.6°c, visib = very good
1150	57°08.4 166°30.2	O. orca	2 maybe 3	200m	stbd bow, just saw tall black dorsal fins briefly
1155	57°07.8 166°28.1				end Transect
1158 - 1235				on	CTD Station No. 75
1245 to	57°05.8 166°31.1				start transect water = 2.9°c visib = very good
1315	57°02.1 166°41.9				end transect

Marine Mammal Platforms of Opportunity

Page 1 of 1

Date Submitted for keypunching__________

Logged by P McGuire, Date________

Checked by________________, Date________

NA NA NA

year	mo.	day	hour min.	Deg.	Min.	N/S	Deg.	Min.	E/W	Species	Reliability	Confidence Interval	Number Animals	Group Size	N/S Direction E/W Headed	Behavior Code	Port P/Stbd S Points 1pt=9°	Initial Distance in tens of meters eg. 1=10 meters	Visibility Code	Water Surface Temperature +/- C°	Platform Type	Platform ID	Time Zone GMT +/-?	Flag Column	TEXT
77	05	13	0906	57	181	N	167	181	W										2	2	1	002	10	1	
			0918	57	171		167	143		PPT		1	2			01		19	2	2					
			0920	57	168		167	132											2	2				2	
			0920	57	168		167	132											2	2				1	
			0935	57	162		167	071		U		0	1			01		3	2	2					
			1005	57	151		166	553											2	2				2	
			1055	57	133		166	507											2	2				1	
			1105	57	124		166	466		U0		0	1			01	S8	2	2	2					
			1115	57	119		166	438		EJ		0	1			04	S4	8	2	2					ASSOC W/BIRDS
			1130	57	103		166	373											2	2				2	
			1130	57	103		166	373											2	2				1	
			1140	57	093		166	337											2	2				2	
			1140	57	093		166	337											2	3				1	
			1150	57	084		166	302		00		1	2			01	S4	20	2	3					
			1155	57	078		166	281											2	3				2	
			1245	57	058		166	311											2	3				1	
77	05	13	1315	57	021	N	166	419	W										2	3	1	002	10	2	

Appendix-Field Format Example 4.

This is the most recent Platforms of Opportunity Marine Mammal Log. It consists of two parts: a sighting form, and an effort form. Both forms are directly keypunchable. NOAA and Coast Guard vessels do not utilize effort forms unless a National Marine Mammal Laboratory observer is aboard. All vessels with NMML observers aboard utilize both forms.

MARINE MAMMAL SIGHTING FORM

* DO NOT FILL IN BOXES PRECEDED BY AN ASTERISK

1. NAME MARK TOWNER RECORD ID * 1 8 0 0 7 2 (1 2 3 4 5 6)

VESSEL NOAA SHIP MILLER FREEMAN

2. DATE (Yr./Mo./Day) & TIME (local) OF SIGHTING 8 0 0 3 1 4 (7 8 9 10 11 12) 1 0 4 0 (13 14 15 16)

3. LATITUDE (degrees/minutes/10ths)–N/S 5 7 5 4 . 4 (18 19 20 21 22) N (23)

4. LONGITUDE (degrees/minutes/10ths)–E/W 1 5 4 1 4 . 1 (24 25 26 27 28 29) W (30)

5. SPECIES Fin Whale (Common name) Balaenoptera physalus (Scientific name) * B P (33 34) TENTATIVE * ☐ (35)

6. NUMBER SIGHTED 3 ± 0 C.I. * ☐ (36) 3 (37 38 39 40)

7. GROUP SIZE ☐☐ (41 42) 8. DIRECTION HEADED S E (43 44) * 0 1 (45 46)

9. ANGLE FROM BOW (10's of degrees) 2 7 (47 48) 10. INITIAL SIGHTING DISTANCE 1000 yrds

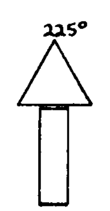
10's of meters 9 0 (49 50 51)

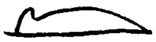
11. VISIBILITY 15 Nm 12. SEA STATE (Beaufort) 1ft VIS CODE * 4 (52)

13. WEATHER Clear, Wind 220 at 11 14. SEA SURFACE TEMP (° C) ± ☐ (53) 4 (54 55)

PLATFORM CODE * 1 0 0 6 (56 57 58 59) 15. TIME ZONE ± + (60) 1 0 (61 62)

16. How did you identify animal(s)? Sketch and describe animal; associated organisms; behavior (include closest approach); comments.





Assoc Pictures MT 3 # 1-10

Whales moved from Right to Left.

☆ FISHING

* ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐ (64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80)

MARINE MAMMAL SIGHTING EFFORT FORM

1	2	3	4	5	6
1	8	0	0	7	2

* Record I.D.

7	8	9	10	11	12
8	0	0	3	2	1

Year Month Day

Name MARK TOWNER

Vessel NOAA SHIP MILLER FREEMAN

	TIME		LATITUDE	N/S	LONGITUDE	E/W	SEA STATE	WEATHER	VISIBILITY	* Vis. code	±	Sea surface Temp. (° C)	*	Platform code	±	Time zone	Transit flag
	13 14 15 16	17	18 19 20 21 22	23	24 25 26 27 28 29	30				52	53	54 55	56	57 58 59	60	61 62	63
	0639		5654.7	N	15550.8	W	2ftChop 6ftSwell	PartlyCloudy, Wind 218° at 23	10 NM	5	+	4	1	006	+	10	1
	0715		5651.5	N	15557.3	W	2ftChop 7ftSwell	PartlyCloudy, Wind 238° at 18	10 NM	5	+	4	1	006	+	10	2
	1030		5646.6	N	15605.9	W	2ftChop 5ftSwell	PartlyCloudy, Wind 207° at 17	15 NM	5	+	4	1	006	+	10	1
	1215		5641.5	N	15531.7	W	1ft 5ftSwell	PartlyCloudy, Wind 205° at 9	15 NM	5	+	4	1	006	+	10	2
XBT	1509		5643.0	N	15528.5	W	1ft 3ftSwell	PartlyCloudy, Wind 216° at 21	10 NM	5	+	4	1	006	+	10	1
	1545		5643.6	N	15539.6	W	2ftChop 5ftSwell	PartlyCloudy, Wind 216° at 17	10 NM	5	+	4	1	006	+	10	2

SECURED FOR DAY

1:14

GPO 989-609

Appendix-Field Format Example 5.

Example 5 is an abstract of marine mammal sightings made from the NOAA Ship Townsend Cromwell on Cruise 68 during 1976. Data was compiled by the National Marine Fisheries Service Southwest Fisheries Center. No environmental or transit data are provided with this abstract.

1976

Table 1. Marine Mammal Sightings, Townsend Cromwell - Cruise 68

Date	Position	Mammal*	Number
9 Jan.	11°35'N; 146°33'W	Unidentified Large Whale	2±1
9 Jan.	11°35'N; 146°33'W	*Stenella longirostris*	500±200
10 Jan.	09°50'N; 144°15'W	Unid. Large Whale	1
10 Jan.	09°46'N; 143°51'W	*Balaenoptera physalus*	2±1
13 Jan.	05°00'N; 138°24'W	Unid. Medium Whale	1
13 Jan.	04°48'N; 138°15'W	Unid. Small Whale	1
14 Jan.	01°25'N; 137°42'W	*Orcinus orca*	2
19 Jan.	00°00' ; 125°12'W	*Pseudorca crassidens*	20±10
19 Jan.	00°00' ; 125°12'W	Unid. Large Baleen Whale	1
20 Jan.	00°17'N; 122°45'W	Unid. Large Whale	2±1
20 Jan.	00°22'N; 122°13'W	Unid. Small Whale	2
20 Jan.	00°27'N; 120°55'W	*Balaenoptera borealis*	2
21 Jan.	00°00'N; 118°41'W	Unid. Large Whale	1
22 Jan.	02°25'S; 116°09'W	*Globicephala macrorhyncus*	15±5
22 Jan.	03°20'S; 115°29'W	*Physeter catodon*	3±1
23 Jan.	04°03'S; 113°15'W	*Stenella longirostris*	500±200
23 Jan.	03°47'S; 112°40'W	*Stenella longirostris* + *Stenella attenuata*	2000±500
25 Jan.	00°49'N; 107°30'W	*Stenella coeruleoalba*	75±25
25 Jan.	00°40'N; 106°55'W	*Stenella coeruleoalba*	75±25
25 Jan.	00°38'N; 106°45'W	*Delphinus delphis*	125±25
25 Jan.	00°37'N; 106°44'W	*Balaenoptera physalus/borealis*	2

Marine Mammal Platforms of Opportunity Page 1 of 1 Date Submitted for keypunching__________

Logged by P. McGuire, Date________

Checked by__________________, Date________

year	mo.	day	hour min.	Deg.	Min.	N/S	Deg.	Min.	E/W	Species	Reliability	Confidence Interval	Number Animals	Group Size	N/S Direction E/W Headed	Behavior Code	Port P/Stbd S Points 1pt=90°	Initial Distance in tens of meters eg. 1=10 meters	Visibility Code	Water Surface Temperature +/- C°	Platform Type	Platform ID	Time Zone GMT +/-?	Flag Column	TEXT
76	01	09		11	35	N	146	33	W	UZ		1	2			01					1	014	10		
		09		11	35		146	33		SL		7	500										10		
		10		09	50		144	15		UZ		0	1										10		
		10		09	46		143	51		BP		1	2										10		
		13		05	00		138	24		UW		0	1										9		
		13		04	48		138	15		UX		0	1										9		
		14		01	25	N	137	42		OO		0	2										9		
		19		00	00		125	12		PC		4	20										8		
		19		00	00		125	12		UZ		0	1										8		BALEEN WHALE
		20		00	17	N	122	45		UZ		1	2										8		
		20		00	22	N	122	13		UX		0	2										8		
		20		00	27	N	120	55		BB		0	2										8		
		21		00	00		118	41		UZ		0	1										8		
		22		02	25	S	116	09		GM		3	15										8		
		22		03	20	S	115	29		PM		1	3										8		
		23		04	03	S	113	15		SL		7	500			01							8		
		23		03	47	S	112	40		SL		7	1000			12							8		
		23		03	47	S	112	40		SA		7	1000			12							8		
		25		00	49	N	107	30		SC		5	75			01							7		
		25		00	40	N	106	55		SC		5	75			01							7		
		25		00	38	N	106	45		DD		5	125			01							7		
76	01	25		00	37	N	106	44	W	UZ		0	2			01					1	014	7		BP OR BB

Appendix-Field Format Example 6.

These are marine mammal sightings compiled by U. S. Forest Service naturalists aboard Alaska State Ferries. Sightings of less common species that do not have additional notes are either marked as tentative identifications or discarded. These forms have been abstracted from the Forest Service before transmission to Marine Mammal Division and are not raw field data.

USDA Forest Service MARINE HIGHWAY MARINE MAMMAL SURVEY

VESSEL ________________ TRIP DATES ____________ NATURALIST ______________

Date	Time	Location	Identification			Numbers		Conditions: Weather, unusual behavior, activity	Observer
		Lat. Long.	Species	Pos.	Np.	Pos.	Np.	(resting, playing, feeding, family group,...)	
07-21-76	1930	58°22' N 134°26 W	Humpback Whale	✓		2		announced by bridge saw one breach in wake of ship-1 leaped twice ½ body exposed slight	Dougherty
								roll to show left pectoral fin second animal diver	
	1940	58°20' N 134°25' W	Humpback Whale	✓		2		announced by bridge moving south	
07-27-76	0600	57°33' N 133°40' W	Humpback Whale	✓			2-3	low clouds and fog w/ light rain spout and flukes clearly visible	Loken
	0623	57°35' N 133°43' W	Humpback Whale	✓		1		breached several time pectoral fins clearly white	
	0630	57°39' N 133°43' W	Humpback Whale	✓		2		very close to ship generally moving south	
	1245	58°17' N 134°43' W	Harbor Seal		✓		1	low overcast w/rain round face only once	
	1343	58°33' N 134°55' W	Dall porpoise	✓		2		overcast sighted characteristic "rooster tail"	
	1505	57°00' N 135°12' W	Dall porpoise	✓			8-12	medium overcast moving south	
07-28-76	0800 -0900	57°25 N 133°35 W	Humpback Whale		✓		8/12	reported by passengers and crew	Blau
	0800 -0900	57°25' N 133°35' W	Killer Whale		✓		2-5	reported by passengers and crew	
	1405	58°58' N 135°08' W	Dall porpoise	✓		3		clear and sunny	Searby
	1930	56°16' N 132°37' W	Killer Whale	✓		2			Thrasher
07-29-76	0900	57°18' N 133°31' W	Humpback Whale	✓		3		Sunny Breaching and spouting	Searby
	0925	57°15' N 133°37' W	Humpback Whale	✓		2			
07-30-76	0915	57°20' N 133°43' W	Humpback Whale	✓		3		saw only spouts	Daugherty

Marine Mammal Platforms of Opportunity   Page 1 of 1   Date Submitted for keypunching 15 Sept. 1976

Logged by R. Mercer , Date 10 Sept. 1976

Checked by ____________ , Date ________

year	mo.	day	hour min.	Deg.	Min.	N/S	Deg.	Min.	E/W	Species	Reliability	Confidence Interval	Number Animals	Group Size	N/S Direction E/W Headed	Behavior Code	Port P/Stbd S Points 1pt=90°	Initial Distance in tens of meters eg. 1=10 meters	Visibility Code	Water Surface Temperature +/- C°	Platform Type	Platform ID	Time Zone GMT +/-7	Flag Column	TEXT
76	07	26	1930	58	23	N	134	26	W	MN		0	2			28					1	990	7		1 BREACHED
		26	1940	58	20		134	25		MN		0	2		S	01									
		27	0600	57	33		133	40		MN		1	3			01									
			0623	57	35		133	43		MN		0	1			28									WHITE PECTORALS.
			0630	57	39		133	43		MN		0	2		S	01									
			1245	58	17		134	43		PV	T	0	1			01									
			1343	58	33		134	55		PD		0	2			01									
		27	1505	59	00		135	12		PD		2	10		S	01									
		28	0830	57	25		133	35		MN	1	2	10			01									
			0830	57	25		133	35		OO	T	2	3			01									
			1405	58	58		135	08		PD		0	3			01									
		28	1930	56	16		132	37		OO		0	2			01									
		29	0900	57	18		133	31		MN		0	3			28									
		29	0925	57	15		133	37		MN		0	2			01									
		30	0915	57	20		133	43		MN	T	0	3			01									

Appendix-Field Format Example 7.

Marine Observation Reports were filled out by participating U. S. Coast Guard vessels and routed through:

Commander
U. S. Coast Guard
630 Sansome Street
San Francisco, California 94126

to the Marine Mammal Platforms of Opportunity Program (POP) Officer. Sightings are recorded in local time with no fix or position given. The latitude and longitude of each sighting are interpolated from the beginning and end of watch (four hour watches) positions provided. Since the instructions were not specific, it cannot be assumed that the vessel travelled a straight, constant speed course during each watch; consequently, all U. S. Coast Guard marine mammal sighting positions should be considered approximate within a 20 mile radius. Due to the condensed format, identification of animals cannot be accompanied with notes or illustations and sightings of rare or uncommon species are not considered reliable.

The Coast Guard has not adopted the POP Marine Mammal Logbook and recent data is better documented.

Entries taken from the Marine Observation Report (MOR) for transcription into the POP format have been circled on the MOR.

U.S. NAVAL OCEANOGRAPHIC OFFICE
WASHINGTON, D.C. 20373

MARINE OBSERVATION REPORT

UNITED STATES COAST GUARD/UNITED STATES NAVAL OCEANOGRAPHIC OFFICE

(For legibility please print)

SHIP (Name) USCGC Boutwell (WHEC 719)

CAPTAIN Capt. J.C. Guthrie

ADDRESS FPO Seattle WA 98799

VOYAGE FROM Kodiak AK DATE 14 APR 75 TO Adak Alaska DATE 23 APR 75

OBSERVER 12-4 WATCH (NAME AND RANK) Ens. M.E. Saylor

OBSERVER 4-8 WATCH (NAME AND RANK) Ltjg. D.L. Thompson

OBSERVER 8-12 WATCH (NAME AND RANK) CWO S.L. Harvie

The U.S. Naval Oceanographic Office is investigating the distribution of whales and other marine animals which are responsible for sonar classification problems. Marine life data are being recorded by personnel aboard U.S. ships and aircraft. The sustained data collection effort by your ship is an invaluable input to this program. Each watch should complete this form over to the column marked "No sighting." The columns to the right of this need be filled in only when marine life has been observed. (Note, a separate line should be used for each observation.) Use the Remarks Column to describe characteristics, such as: color, shape of tail or fins, form of blow, swimming or diving behavior, or any features or conditions observed which seem significant. Enter approximate position at time of observation, if possible. Also under remarks, report algae, bioluminescence, plankton blooms (discolored water), and oil spills, giving the area covered (approximate area in yards) and color. Watch should be maintained while on ocean stations, however, identical position data need not be repeated.

	POSITION AND EFFORT DATA																			OBSERVATION									
	DAY	MONTH	WATCH (✓)						FROM POSITION				TO POSITION				DISTANCE SAILED (NM)	AVERAGE VISIBILITY (miles)	NO SIGHTING (✓)	TIME (LOCAL)	WHALE	PORPOISE	FISH SCHOOL	FISH (10 or less)	SHARK-RAY	NUMBER	SIZE (feet)	DISTANCE FROM SHIP (n.m. tenths)	DIRECTION SWIMMING (degrees)	REMARKS 1. Key remarks to numbers at left to indicate day and watch. 2. Use as much space as necessary.
			0000-0400	0400-0800	0800-1200	1200-1600	1600-2000	2000-2400	LAT. [✓ N] S (Circle one)		LONG. E [✓ W] (Circle one)		LAT. [✓ N] S (Circle one)		LONG. E [✓ W] (Circle one)															
									Deg	Min	Deg	Min	Deg	Min	Deg	Min														
1	14	4				X			57	45	152	50	57	41	152	07														
2							X		57 57	41 26	152 ~~151~~	07 26	57	25	151	24.5	35	3.0	✓											
3								X	57	25	151	24.5	56	13.5	151	46.0	39	0.5	✓											
4	15	4	X						56	14	151	46	56	25	152	41	37	5	✓											
5				X					56	25	152	41	56	10	153	33	40	5	✓											
6					X				56	10	153	33	55	49	153	00	40	5	~~✓~~	0845	X	X				6	8	~~0.2~~	~~[illegible]~~	6) School of 3 KILLER WHALES AND RESIDENT 3-4 PORPOISES 6 SEALS
7						X			55	49	155	00	55	47	155	56	40	0.5	✓									~~0.2~~		5-3 [illegible]
8							X		55	17	155	56	—	—	—	—	—	0.5		1725						5		0.2		5 SEALS
9							X		—	—	—	—	55	29	156	21	30	0.5		1920						1		0.1	310	SEAL
10								X	55	27	156	32	55	00	157	20	35	2.0		2005		✓				3	5	0.3	240	
11	16	4	X						55	00	157	20	54	47	156	14	40	3	—											
12				X					54	47	157	14	54	12	160	53	39	UNR	✓											
13					X				54	24	159	15	54	25 12	159 160	50 [illegible]	40	UNR	✓											

Marine Mammal Platforms of Opportunity Page 1 of 1 Date Submitted for keypunching__________

Logged by P McGuire, Date__________

Checked by__________________, Date__________

year	mo.	day	hour min.	Deg.	Min.	N/S	Deg.	Min.	E/W	Species	Reliability	Confidence Interval	Number Animals	Group Size	N/S Direction E/W Headed	Behavior Code	Port P/Stbd S Points 1pts90°	Initial Distance in tens of meters eg. 1=10 meters	Visibility Code	Water Surface Temperature +/- C°	Platform Type	Platform ID	Time Zone GMT +/-?	Flag Column	TEXT
75	04	15	0845	56	06	N	153	50	W	00		0	3			01					1	303	10		
			0845	56	06		153	50		UD		1	3			01									
			0845	56	06		153	50		UP		0	6			01									
			1725	55	39		156	095		UP		0	5			01									
			1920	55	30		156	26		UP		0	1		NW	01									
75	04	15	2005	55	26	N	156	33	W	UD		0	3		SW	01					1	303	10		

Appendix-Field Format Example 8.

This is a copy of the field form used by U. S. observers aboard foreign fishing vessels to record marine mammal sightings. Observers are requested to specifically look for marine mammals at least three times a day, in five minute intervals. No effort is transcribed, only sightings.

Ryuko Maru #37

FORM 11 MARINE MAMMAL OBSERVATION LOG Year 1979 Page ~~1~~ of 11

Cruise No. 355 Vessel Code JSAX Time ~~Kept by Ship~~ : +/- GMT

DATE Mo/Day	GMT TIME	LOCATION	SPECIES	NO.	NOTES: Behavior, sketches, photos, features used for identification, size, associated species
07/20	0340	57° 14'N. 173°53'W.	Killer Whales (Orcinus orca)	5	mammal observations begin aboard Ryuko Maru #37 1 male and 4 females showed up when we started the winches to bring in the nets. They stayed and fed on processing scrap until 0435 then disappeared Seas moderate. Complete high cloud cover. (code 4 seas)
07/20	1957	57°40'N. 174°09'W.	Killer whales (Orcinus orca)	3	as nets were being brought aboard they showed up 1 female, 1 male, 1 calf. Estimate lengths at (♀) 13 feet, ♂ (25 feet) and calf at 6 feet. Were not inclined to stay with us for very long; they left when the captain opened up the throttles (11.4 knots) to move farther north. Seas rough. (code 5). observed for 25 minutes.
07/21	0500	58° 15'N 175° 12'W			no sightings. 15 minutes of effort. Seas code 5 (rough). 360° sweep.
07/21	1235	58°21'N 175°32'W.			no sightings. 15 minute effort sea code 5 (rough). 360° sweep.
07/21	2357	58°32'N. 176°35'W.			no sightings. 15 minute effort. sea code 2 (smooth wavelet). 360° sweep. 26 feet above water, eyelevel.
07/22	0310	58°31'N. 176° 15'W.			no sightings. 15 minute effort. sea code 4 (moderate). 360° sweep. 26 feet above water - eyelevel.
07/22	0550	58°33'N. 177°10'W.			no sightings. 15 minute effort sea code 2 (smooth wavelet) 360° sweep. 26 feet above water. - eyelevel.

DISTRIBUTION OF MARINE MAMMALS IN THE COASTAL ZONE OF THE BERING SEA DURING SUMMER AND AUTUMN

by

Kathryn J. Frost, Lloyd F. Lowry, and John J. Burns

Alaska Department of Fish and Game
1300 College Road
Fairbanks, Alaska 99701

Assisted by

Susan Hills and Kathleen Pearse

Final Report
Outer Continental Shelf Environmental Assessment Program
Research Unit 613, Contract Number NA 81 RAC 000 50

1 September 1982

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I. Summary

A study was conducted with the objectives of compiling all available sightings of marine mammals in the coastal zone of the eastern Bering Sea during summer and autumn and evaluating the importance of coastal areas to the various species. Specific attention was given to identification of terrestrial hauling areas used by pinnipeds, and bays, lagoons, and estuaries utilized by cetaceans. The study area included the mainland coast, as well as major offshore islands, but did not include the Aleutian Islands.

Based on available sightings, it was possible to identify in general terms the areas of greatest importance to marine mammals, as well as to examine some aspects of seasonal distribution and abundance in specific areas. Although marine mammals inhabit the entire coastal zone of the eastern Bering Sea during summer and autumn, their distribution is far from uniform. Sea otters occur principally along the southwestern portion of the Alaska Peninsula, with a few animals on the Pribilof Islands. Steller sea lions haul out on most offshore islands and along rocky portions of the mainland coast in northwestern Bristol Bay. The only presently active breeding rookeries are at Sea Lion Rocks near Amak Island and Walrus Island in the Pribilof Islands. Major haulouts for walruses are at Cape Seniavin and Round Island in Bristol Bay, and at the Punuk Islands, St. Lawrence Island, King Island, and Big Diomede Island in the northern Bering Sea. Most Bering Sea harbor seals haul out at several locations along the north side of the Alaska Peninsula. Harbor seals and spotted seals mix in northern Bristol Bay and portions of the Kuskokwim Delta. Major haulouts in those regions occur at Nanvak Bay and in Kuskokwim Bay. Spotted seal hauling areas occur on St. Matthew Island, Hall Island, St. Lawrence Island, Golovnin Bay, and Port Clarence. Gray whales migrate through the entire coastal zone of Bristol Bay, pass along the south and west sides of Nunivak Island, and occur commonly near St. Lawrence Island. Major concentration areas for belukhas occur in Kvichak, Nushagak, Golovnin, and Norton bays and off the mouths of the Yukon River. Harbor porpoises are occasionally seen along the entire mainland coast, with several recent records from Norton Sound. Minke whale sightings have occurred primarily off the Alaska Peninsula, Nunivak Island, and Golovnin Bay. We located only one sighting of a killer whale in the coastal zone.

Available data indicate substantial fluctuations in numbers of animals at particular locations but are not adequate to measure those fluctuations or explain their causes. We suggest that OCSEAP initiate studies on representative species and areas in order that the effects of OCS activities on marine mammals in the coastal zone can be rigorously evaluated.

II. Introduction

Approximately 26 species of marine mammals are known to occur with some regularity in the Bering Sea. Included are eight species of pinnipeds, eight mysticete cetaceans, eight odontocete cetaceans, and two carnivores (Fay 1974, Lowry et al. 1982b). While a number of species such as several of the ice-associated pinnipeds and the oceanic cetaceans are seldom if ever seen near shore, several others regularly utilize coastal habitats. During summer and autumn when the coastal zone is ice free, 10 species may be common components of the nearshore fauna. They are:

Steller sea lion, *Eumetopias jubatus*
Harbor seal, *Phoca vitulina richardsi*
Spotted seal, *Phoca largha*
Walrus, *Odobenus rosmarus divergens*
Belukha whale, *Delphinapterus leucas*
Harbor porpoise, *Phocoena phocoena*
Killer whale, *Orcinus orca*
Minke whale, *Balaenoptera acutorostrata*
Gray whale, *Eschrichtius robustus*
Sea otter, *Enhydra lutris*

Fur seals (*Callorhinus ursinus*), which haul out almost exclusively on the Pribilof Islands, were not included in this study.

While in the coastal zone, all of the above species forage on the abundant food resources available in nearshore waters. In addition, seals, sea lions, walruses, and sometimes sea otters commonly haul out at specific coastal locations. For walruses, coastal haulouts appear to be important principally as a place to rest between feeding forays, while harbor seals and sea lions give birth, care for, and nurture their young, and molt on land.

While major features of the distribution and biology of these species are well known (e.g., Lowry et al. 1982b), specific published information on their utilization of coastal waters of the Bering Sea is generally not available. Proposed OCS leases will offer for sale much of the area adjacent to important coastal marine habitats in the Bering Sea. Potential effects of OCS exploration, development, and production activities on marine mammals include not only chronic and catastrophic discharge of hydrocarbons into the environment, but also disturbance factors associated with both onshore and offshore activities. Information on the distribution of marine mammals in the coastal zone must be of adequate resolution to provide input for tract selections, selection of onshore facilities sites, designation of transportation corridors, and design of stipulations relating to the nature and timing of activities. In addition, such information is required in order to evaluate "normal" changes in the distribution and numbers of marine mammals in coastal areas, as well as to monitor the future impacts of OCS activities.

This project has included two major components. The first involved field work, designed to increase the data available on distribution and food habits of marine mammals along the western coast of Alaska. Included were shipboard and aerial surveys and collections of animals conducted during May to October 1981. Results of the field studies have been compiled and reported (Lowry et al. 1982a). The second component consisted of a compilation of all available data on distribution and abundance of marine mammals in the coastal zone of western Alaska during summer and autumn. The compilation of distributional information is being prepared in two parts: this report, which covers the Bering Sea, and a second report covering the Chukchi Sea coast, which is in preparation and will be completed by the end of 1982.

III. Current State of Knowledge

A. Steller Sea Lion

Steller sea lions are gregarious, highly mobile pinnipeds and are the largest and most widely distributed otariids in the North Pacific Ocean. Their breeding range in Alaska includes the Pribilof, Walrus, and Aleutian Islands (including Amak Island and Sea Lion Rocks) and various locations throughout the Gulf of Alaska south to the Canadian border (Scheffer 1958, Mathisen 1959, King 1964). Seasonal movements of sea lions in the Bering Sea have not been well documented. There appears to be a late summer movement of adult and subadult males toward Bering Strait, although no breeding areas are found that far north (Kenyon and Rice 1961). Some animals from the Pribilof and perhaps Aleutian Islands move to the ice edge in the central Bering Sea during winter.

Sea lions are polygynous and gather annually at traditional rookeries to pup and breed (Pitcher and Calkins 1981). The largest, fittest males hold territories and defend harems of females. Females give birth to a single pup in mid-May to mid-July and breed shortly thereafter, in late May to mid- or late July (Pitcher and Calkins 1981). Steller sea lions begin concentrating at rookeries in mid-May, and numbers continue to increase until mid- to late June (Calkins and Pitcher 1982). The animals remain on the rookeries until autumn. Some other areas are used as haulouts on a regular and predictable basis during the remainder of the year. In this report, "rookery" will refer to an area where sea lions haul out to give birth and breed. Other areas used for resting or molting are referred to as haulouts.

The distribution of sea lions along the Bering Sea coast of Alaska is better documented than for most species, largely because of their tendency to haul out on land in large conspicuous groups. Their general distribution in the North Pacific and Alaska has been described by Scheffer (1958), King (1964), and Schusterman (1981). King noted a single breeding colony in the Pribilofs on Walrus Island and stated that the center of abundance for the species was the Aleutian Islands. Murie (1959) summarized the distribution of Steller sea lions in Alaska and mentioned Amak Island as a major haulout. Mathisen (1959) and Mathisen and Lopp (1963) presented the results of aerial surveys flown in 1956, 1957, and 1958. Only two hauling areas, Cape Newenham (250 sea lions present in June 1956) and Twin Island (300 sea lions), were reported in northern Bristol Bay. Counts at Amak Island ranged from 253 (July-August 1956) to 3,016 (June 1957) and at Sea Lion Rock from 2,775 (December 1958) to 5,118 (August-October 1958).

Kenyon and Rice (1961) conducted an extensive survey of sea lions in the eastern Bering Sea from Bering Strait to and including the Aleutian Islands. They noted a northward movement of males during summer, with animals appearing and hauling out at St. Matthew and Hall islands (several hundred after mid-July); St. Lawrence Island (regular visitors in variable numbers, mostly at Southwest Cape and the Punuk Islands, from late June to November); Nunivak Island (spring and especially summer on the west side); and the Diomede Islands (few, irregular visitors in late summer and early autumn). On surveys in February and March 1960, they saw no sea lions at those areas. Kenyon and Rice counted 1,000 sea lions at Otter Island in the Pribilofs in April 1955 and 75-160 adult and subadult males there in summer. Residents of the Pribilofs told them that "large numbers" are present on Otter Island during winter. They also summarized the observations of others as follows: St. Paul Island and Sea Lion Rock, 300 (Kenyon 1960, field notes); Otter Island, 160 (Kenyon 1960, field notes); Walrus Island, 4,000-5,000 (Kenyon 1960, field notes); and St. George Island, 1,200 (L. Riley 1960, field notes). They also reported sea lions hauled out at the Twins in northern Bristol Bay (400 in late April, 66 in late June). The largest number of animals was seen on Unimak Island (4,200) and Amak Island/Sea Lion Rock (2,350). Kenyon and Rice (1961) estimated the entire Steller sea lion population from California to Alaska, including the Kuril Islands, Kamchatka, the Sea of Okhotsk, and Sakhalin, at 240,000-300,000.

Kenyon (1962a) reviewed the past and present distribution of sea lions in the Pribilof Islands and estimated that the population in 1960 was 5,700-6,700 (excluding pups) or approximately half of what it was in 1867. In the 1700's and 1800's, there were at least four breeding rookeries in the Pribilofs, including two on St. George, one on St. Paul, and one on Walrus Island. Although those sites continue to be used as haulout sites, Kenyon reported that only Walrus Island is still a breeding ground, with 4,000-5,000 adults and approximately 3,000 pups in 1960. He reported Otter Island as a regular winter hauling ground and Sea Lion Rock as a summer haulout for 200-500 nonbreeding animals.

Kenyon and King (1965), as an appendix to their report on aerial surveys for sea otters in April-May 1965, reported the numbers of sea lions observed in the Aleutians and along the Alaska Peninsula. They counted 810 sea lions on Unimak Island and 4,100 on Amak and Sea Lion Rock.

Braham et al. (1977a) presented the results of over 4.300 km of aerial survey conducted in 1975-76 from Cape Newenham to Unimak Island and in the eastern Aleutians. They found that 80% of the observed sea lions were in the eastern Aleutians, with most of the remaining 20% on Amak Island/Sea Lion Rock. Numbers on Amak ranged from 905 (October 1976) to 2,316 (August 1975), on Sea Lion Rock from 1,836 (October 1976) to 2,331 (August 1976), and on the unnamed rock between the two from 108 (June 1975) to 355 (August 1976). A few sea lions were seen in northern Bristol Bay: 30-50 on the Twins and 250-325 on Round Island in summer 1975. They counted only 60-70% as many animals hauled out in October as in June and August.

Braham et al. (1977b, 1980) compared population estimates from the eastern Aleutians and Amak/Sea Lion Rock in the mid-1970's to estimates from the late 1950's, using the same data presented in Braham et al. (1977a) plus additional survey counts from June 1977. They estimated a population decline of approximately 50%, from about 45,000 in 1957 to less than 25,000 in 1975-77.

B. Harbor Seal

The Pacific harbor seal is found in coastal waters of Alaska north to approximately 60°N in the Bering Sea, along the Aleutian Island chain, and on the Pribilof Islands (Scheffer 1958; Shaughnessy and Fay 1977; Burns and Gol'tsev, in press). In the eastern Bering Sea they are found along the Alaska Peninsula, in Bristol Bay and Kuskokwim Bay, and around Nunivak Island (Burns 1970, Shaughnessy and Fay 1977). Harbor seals are normally considered relatively sedentary and non-migratory (Bigg 1981), although studies by Pitcher and McAllister (1981) have shown movements of up to 194 km across 74 km of open ocean in the Gulf of Alaska. Seasonal occurrence in northern areas such as Bristol Bay and Nunivak Island also indicates substantial seasonal movement. Harbor seals haul out on rocks, sandbars, or reefs, sometimes in very large numbers, where they rest, molt, and care for their young. Local movements are made in conjunction with feeding and breeding (Bigg 1981).

There is little specific information on the distribution or abundance of harbor seals in the Bering Sea. Mathisen and Lopp (1963) presented minimum counts of harbor seals at Port Heiden and Port Moller for July-August 1956 and December 1957. Kenyon (1960a) surveyed the eastern Aleutians in March 1960 and counted 550 harbor seals on Unimak Island and 13 on Amak Island. Kenyon and King (1965) attempted to count harbor seals as well as sea otters on their April-May 1965 surveys of the Aleutians and Alaska Peninsula. On 21 April and 8 May they estimated that they saw 1,500 harbor seals on a sandbar at the mouth of Bechevin Bay, and on 19 April and 8 May they saw approximately 350 seals on sandbars near the mouth of Izembek Lagoon. They cited C. P. McRoy (pers. commun.) as estimating the seal population of Izembek Lagoon to number about 600 to 700 animals. Braham et al. (1977a) and

Everitt and Braham (1980) reported aerial survey counts for June 1975-77 and August 1975-76 for harbor seals along the northern Bristol Bay coast, the north side of the Alaska Peninsula (including Unimak Island), and the eastern Aleutian Islands. They found no consistently used hauling-out areas in northern Bristol Bay, although 20-200 seals were seen at Hagemeister Island in July and August 1975. Along the Alaska Peninsula they reported eight major hauling grounds: Egegik Bay, Ugashik Bay, Cinder River, Port Heiden, Seal Islands, Port Moller, Izembek Lagoon, and the Isanotski Islands in Bechevin Bay. In addition, a few seals were seen at Cape Seniavin, Cape Leiskof, Amak Island, and Unimak Island. Aerial counts ranged from about 6,000 (August 1975) to 25,000 (June 1976), and Everitt and Braham considered 25,000 as a minimum estimate of the number of harbor seals on the north side of the Peninsula.

The harbor seal population in Bristol Bay (including the Alaska Peninsula) has been estimated at 30,000 (Interagency Task Group 1978, NOAA 1979).

C. Spotted Seal

Published information on the distribution of spotted seals is limited to general descriptive accounts of their overall distribution (Scheffer 1958, King 1964, Shaughnessy and Fay 1977, Bigg 1981) or of their distribution in the Bering Sea ice front in spring (Burns 1970; Fay 1974; Burns and Harbo 1977; Burns et al. 1980; Braham et al., in press a). In late winter and spring, the entire Bering-Chukchi population is concentrated in or near the ice front (Burns and Harbo 1977, Burns 1978), with major pupping and breeding concentrations in the Bristol Bay-Pribilof Islands region, Karaginski Bay, and the Gulf of Anadyr (Shaughnessy and Fay 1977). As the sea ice disintegrates and recedes in spring, spotted seals move generally northward and toward the coast. During summer, they are common along the eastern Bering and Chukchi sea coasts, where they haul out on land. A few animals move eastward into the Beaufort Sea (Burns 1978). In autumn and early winter, as shorefast ice begins to form, spotted seals move offshore to the edge of the pack ice (Fay 1974).

The population of spotted seals in the Bering-Chukchi region has been estimated at 280,000-300,000, of which 80,000 occur in Karaginski Bay (Burns 1978).

D. Pacific Walrus

Pacific walruses inhabit the broad continental shelf of the Bering and Chukchi seas. They migrate seasonally from wintering areas in the Bering Sea to summering grounds on the coast of the Bering and Chukchi seas and the Chukchi Sea ice edge. Based on observations conducted from 1960 to 1976, there are two areas of concentration in late winter and early spring, one south and west of St. Lawrence Island and the other in Bristol Bay (Fay 1982). The actual location of these concentrations is somewhat dependent on the extent of ice in the Bering Sea, which the animals use as a resting platform when not engaged in other activities such as feeding and breeding. Mating occurs in February-March, and females give birth in April-May while moving north with the receding ice edge. Much of the population migrates northward through Bering Strait in April and May. Subadults and females with young follow the retreating ice edge northward and summer primarily in the northern Chukchi Sea (Estes and Gilbert 1978). Adult males form large herds on hauling grounds in Bristol Bay, Bering Strait, and along the Chukchi Peninsula.

Most aerial surveys of walruses have been conducted over the pack ice in Bering Sea in spring or over the Chukchi Sea ice edge and coastal rookeries along the Chukchi Peninsula in late summer-early autumn. Thus, although there are numerous accounts of winter-spring distribution in the offshore Bering Sea (e.g., Kenyon 1960b, Kenyon 1972, Burns and Harbo 1977, Krogman et al. 1979) or summer-autumn distribution in the Chukchi Sea (e.g., Fedoseev 1962, Gol'tsev 1972), there are few systematic published reports of distribution along the Bering Sea coast of western Alaska in summer and autumn. Most information is in the form of scattered sightings reported in field notes or appendices to aerial surveys for other species. The best synoptic overview of walrus distribution in Alaska is provided by Fay (1982), in which he maps and discusses distribution by month.

Brooks (1954a) reported sightings of walruses hauled out on the Walrus Islands (Round, High, and Big Twin islands). Fay (1957) summarized the historical and present status of walruses and noted that at the time of writing no walruses had been recently seen on the north coast of the Alaska Peninsula. He stated that there were no regularly frequented hauling grounds in Alaska except for the Walrus Islands, which were used at that time by about 1,000 walruses. Occasional strays had been reported from the Pribilof Islands in winter.

Kenyon (1958) estimated that 1,500-2,000 adult and subadult male walruses were using Round Island in June 1958. No walruses were seen on the Twins, Black Rock, or Crooked Island.

Murie (1959) summarized historical accounts of walruses in the Aleutian Islands and Bristol Bay. He reported that walruses were historically present on "Walrus Island" in Izembek Lagoon, as well as on several other small islands near the mouth of that lagoon, on Amak Island, and on the north side of Unimak Island. King (1964) noted that walruses were present on the Pribilofs around the turn of the century. Kenyon and King (1965) reported sightings of 100 adult males on the east shore of Amak Island in April 1962 and of five males on the southwest shore in May 1965. They saw 75 males approximately 1 km off Cape Glazenap (near the mouth of Izembek Lagoon) in May 1965.

Burns (1965) listed the following islands as historical hauling areas for walruses: Amak, Walrus, the Pribilofs, Hall, St. Matthew, St. Lawrence, the Punuks, Besboro, and the Diomedes. He described reports of hauled-out walruses in the early 1960's from Cape Constantine (one bull, July 1963), Besboro Island (200 adult and subadult males, August 1961), the Punuk Islands (1,000 in October 1962, 20-25 in October and early November 1963), Southeast Cape on St. Lawrence Island (November 1963), and Cape Prince of Wales (one subadult male, July 1963) and noted haulout areas were usually on rocky gravel beaches near high promontories of islands or at the base of headlands projecting into the sea.

Fay and Kelly (1980) reported on the high natural mortality of walruses on St. Lawrence Island in autumn 1978. They reported that unusually large numbers of walruses had hauled out on the Punuks and St. Lawrence Island in October and November of that year. In addition to the traditionally used haulouts on the Punuks and on the northwest end of St. Lawrence Island near Gambell, four other areas were used for the first time in 40-50 years. Estimated numbers hauled out were 19,000 at Salghat, 35,000 at Maknik, 37,000 at Kialegak (all on St. Lawrence Island), and 50-60,000 on the three Punuk Islands. Fay and Kelly also commented that since the late 1960's thousands of walruses have been hauling out on the Diomedes, King Island, and Arakamchechen Island.

Fay and Lowry (1981) conducted monthly aerial surveys from April 1980 to May 1981 to determine the seasonal distribution of walruses in Bristol Bay. They noted that, although walruses occasionally haul out at Amak Island, Deer Island (in Port Moller), Cape Seniavin, Cape Constantine, and Cape Newenham, Round Island is the only haulout used throughout the entire summer. In recent years, 12,000-15,000 bulls have hauled out there, resting for 1-6 days, then leaving the island for 2-18 days, presumably to feed. During their 1980-81 surveys, Fay and Lowry counted from 40 (February 1981) to 9,700 (August 1980) walruses on Round Island. They summarized other recent reports of walrus hauling areas along the Alaska Peninsula. Those included the Ugashik Bay-Cinder River area, Port Heiden, Port Moller, and Cape Seniavin.

E. Belukha Whale

Belukha whales are widely though not uniformly distributed throughout seasonally ice-covered waters of Alaska. They spend the winter in offshore waters associated with drifting ice. In spring, as soon as the ice begins to break up and move offshore, they move toward the coast, some making extensive northward migrations in excess of 2,000 km, while others move relatively short distances. Most belukhas appear to spend the summer in coastal waters, concentrating in shallow bays or estuaries of large rivers, although an unknown proportion may remain associated with offshore pack ice. In late summer to late autumn, they move generally south and away from the coast, ahead of or with the advancing pack ice (Kleinenberg et al. 1964, Fay 1974, Gurevich

1980, Seaman and Burns 1981). Major summer concentrations in the Bering Sea occur in Bristol Bay, particularly in the Nushagak and Kvichak River systems (Brooks 1954b, Klinkhart 1966), in Norton Sound, and off the mouths of the Yukon River (Fay 1974, Seaman and Burns 1981).

General accounts of the distribution of belukhas in Alaskan waters have been presented by Nelson (1887), Gurevich (1980), and Seaman and Burns (1981). Nelson found belukhas to be common summer residents from Bristol Bay north to Point Barrow. He considered them to be migratory over most of their range, moving north in spring as the ice melted and receded and south in autumn as the pack ice advanced. Seaman and Burns summarized the distribution of belukhas by 2-month intervals and also concluded that most belukhas winter in the drifting ice of the Bering Sea, move northward and toward the coast in spring and summer, and leave the coastal zone in late summer to late autumn.

Brooks (1954b, 1955, 1956) conducted studies on the distribution, movements, and feeding of belukhas in inner Bristol Bay. Based on surface observations, aerial observations, and interviews with fishermen, he estimated the numbers of belukhas in Kvichak and Nushagak bays during May through August. In 1954 he estimated a total of 1,000 belukhas in both bays combined and in 1955 a total of 525. Lensink (1961) summarized Brooks' work and added information for areas north of Bristol Bay. He reported the average breakup and freeze-up dates for Kuskokwim Bay, Hooper Bay, Norton Sound, Kotzebue Sound, and Bering Strait and suggested that belukhas were probably present in those areas during the ice-free period. Daily movements of 36-55 km up the Kvichak River were described, as well as movements between Kvichak and Nushagak bays. Fish and Vania (1971) described similar movements in the Kvichak River.

Braham et al. (1977c, in press b) plotted more than 400 sightings of a total of almost 2,000 belukhas. Many sightings were made in conjunction with spring bowhead whale surveys from Point Hope to just east of Point Barrow. In addition, they reported April sightings from eastern and southern Bristol Bay and around St. Lawrence Island, St. Matthew Island, and northeastern Norton Sound. June and August sightings were made in southwestern and western Norton Sound.

Harrison and Hall (1978) presented results from 80,000 km of aerial survey tracklines, 28,000 km of which were in the Bering Sea. They observed belukhas in summer and autumn in Norton Sound near the mouths of the Yukon River, in Bristol Bay, and offshore in the vicinity of the Pribilof Islands. Winter sightings were numerous in the northern part of Bristol Bay.

Ljungblad et al. (1981, 1982) reported the results of aerial surveys for endangered whales in the northern Bering, Chukchi, and Beaufort seas. In spring 1980 they made 284 sightings of 3,404 belukhas, 1,362 of which were seen from Norton Sound to Bering Strait area. Belukhas were sighted on five of eight flights (1,279 whales) in the Chirikof

Basin and two of four flights (83 whales) in Norton Sound. In 1981, belukhas were sighted in outer Norton Sound and throughout the Chirikof Basin in April, in western Norton Sound in May, and in southwestern Norton Sound in June and July.

F. Harbor Porpoise

Little information is available on the distribution of harbor porpoises in the Bering Sea. They have been recorded from the Pribilof Islands and the Aleutians (Murie 1959). Braham et al. (1977a) reported sightings from west of St. Paul Island, central Bristol Bay, and the eastern Aleutians. Harbor porpoises are found near the coast and generally in waters less than 20 m deep (Tomilin 1957, Leatherwood and Reeves 1978).

G. Killer Whale

There is very little published information on the distribution of killer whales in Alaska. Most records are of opportunistic sightings in conjunction with other marine mammal surveys. Dahlheim (1981) summarized the worldwide distribution of killer whales. She reported that they are apparently abundant off the Pribilof Islands and the Aleutian Islands chain. Murie (1959) noted that killer whales were common along the Alaska Peninsula and throughout the Aleutians, generally in small groups or alone, but occasionally as many as 25 in a group. The whales were often seen along the borders of kelp beds. Braham et al. (1977a) recorded killer whale sightings in Bristol Bay, on the north side of Unimak Island and in Unimak Pass, around the Pribilofs, and north of St. Lawrence Island. Killer whales are also seen near the Diomedes and King Island (Ivashin and Votrogov 1981a).

H. Minke Whale

Pacific minke whales are distributed widely in inshore waters, often within 160 km of the coast, as well as in the southern edge of seasonal pack ice (Omura and Sakiura 1956, Tomilin 1957). They are most abundant in the Aleutian Islands and off the Alaska coast from May to July. Some probably migrate south to winter off Washington and California, and some may remain year-round in the Bering Sea (Tomilin 1957, Ivashin and Votrogov 1981b). There is little specific information on the distribution of minke whales in the coastal waters of western Alaska. Kawamura (1975) stated that in June-July 1974 minkes were most often seen between Unalaska Island and the Pribilofs, in 100 m or less of water. Braham et al. (1977a) reported sightings of minkes south of St. George Island, in southwestern and western Bristol Bay, off the tip of the Alaska Peninsula, and in Unimak Pass. According to them, minkes are one of the four most commonly observed cetaceans in the Bering Sea.

1. Gray Whale

The eastern Pacific stock of gray whales winters in the warm coastal waters of Baja California and the southern Gulf of California. From late February to May, the whales begin a northward migration, following the coast closely and occasionally stopping to rest or feed (Pike 1962). They enter the Bering Sea through passes in the eastern Aleutian Islands, particularly Unimak Pass, in April and May and continue moving along the coast of Bristol Bay and southern Nunivak Island, then toward St. Lawrence Island where they arrive in May or June (Pike 1962, Braham et al. 1977a). A few gray whales have been sighted near the Pribilofs in June (Braham et al. 1977a). Upon reaching St. Lawrence Island, the whales disperse to spend the summer feeding in the shallow waters (usually less than 50-60 m deep) of the northern and western Bering Sea and the Chukchi Sea (Rice and Wolman 1971). In the central Bering Sea, gray whales are especially abundant around St. Lawrence Island and in the central Chirikof Basin (referred to as the "large kitchengarden" by the Soviets) (Nerini et al. 1980, Votrogov and Bogoslovskaya 1980, Zimushko and Ivashin 1980). Gray whales begin their southward migration in mid-October (Kuz'min and Berzin 1975). They pass through Unimak Pass between late October and early January, with peak movements from mid-November to mid-December, and arrive in Baja California mainly in December and January (Pike 1962, Rugh and Braham 1979, Rugh 1981).

The eastern Pacific gray whale population was once severely depleted by commercial whaling but has since recovered to near pre-exploitation levels (Scheffer 1976, Blokhin 1979, Rugh and Braham 1979). Ohsumi (1975) estimated an original population of about 15,000 and suggested that it declined to a low of 4,400 in 1875. By the early 1970's, the population had risen to an estimated 11,000 (Rice and Wolman 1971, Mitchell 1973). Recent aerial surveys and ground counts during the migration give estimates of 16,500 ± 2,900 (Reilly et al. 1980) to 18,500 (Herzing and Mate 1981).

The distribution and migration of gray whales has been described most completely by Pike (1962) and later by Rice and Wolman (1971). Pike noted that gray whales moved northward through Unimak Pass in late May and early June and were abundant around St. Lawrence Island during summer months. He knew of only one report in July 1958 of gray whales sighted from the Pribilofs and stated that otherwise during summer there were no records of these whales from the Alaska Peninsula to St. Lawrence Island, nor were any whales taken at the whaling station on Unimak Island. Citing F. H. Fay (pers. commun.), he noted that gray whales arrived off Gambell from the 11th to the 21st of May in 1950-1961 and were seen traveling and feeding close to the west shore of St. Lawrence Island in May-July 1952-54. Sightings of whales were made in the Chirikof Basin in July and August 1958 and off the east coast of St. Lawrence Island in July and August 1958 and 1959. Rice and Wolman (1971) summarized northward and southward migrations, noting that females generally migrated earlier than males and adults preceded subadults. They reported that gray whales were abundant in the shallow waters of the northern and western Bering Sea from May to October but were very scarce in the eastern Bering Sea, probably because of the low biomass of benthos found there. In addition to the sighting from the Pribilofs reported by Pike, Rice and Wolman noted several sightings around St. George Island in the summers of 1965-68 and a sighting of four in Sarichef Strait between St. Matthew and Hall Islands in August 1960.

Ichihara (1958) reported that Japanese whalers working from June to September west of a line between Unimak Pass and St. Lawrence Island in water deeper than 50 m saw no gray whales. However, in August 1955 and July 1957 gray whales were seen west of St. Lawrence Island.

Hall (1979) monitored the gray whale migration through Unimak Pass in April-May 1977. He estimated that about 9,000 whales entered the Bering Sea through that pass. Few cow-calf pairs were observed.

Braham et al. (1977a) listed gray whale sightings from their 1976 surveys of the Bering Sea. Gray whales were observed in southern Bristol Bay and along the Alaska Peninsula in April, May, June, and August; near the Pribilofs in April-June; off the southeast and west end of St. Lawrence Island in June; and throughout the Chirikof Basin in June and August. Based on their sightings, Braham et al. proposed that gray whales move through Unimak Pass, remain close to shore along the Alaska Peninsula and the north coast of Bristol Bay, then head north and west toward St. Lawrence Island.

Harrison (1979) reported on the association of birds with feeding gray whales in June-October 1976. Feeding gray whales were present northeast of St. Lawrence Island, north of Gambell, and west of King Island.

Rugh and Braham (1979) and Rugh (1981) reported on the migration of gray whales through Unimak Pass in November-December 1977. They estimated that 15,000 whales left the Bering Sea through this pass, with peak numbers on 22 and 23 November. The eastern shore was found to be the primary migratory corridor, with 71% of the whales passing within 815 m of shore.

Nerini et al. (1980) discussed the feeding areas of gray whales in the northern Bering Sea and summarized aerial and vessel sightings from 1975 to 1980. Gray whales were seen in May-October off the east and west ends of St. Lawrence Island, near Southeast Cape, north of Gambell, and throughout the Chirikof Basin. Sightings were uncommon in Norton Sound, although whales were observed in the inner sound in July, and one was seen south of Golovnin Bay in August.

Ljungblad et al. (1981, 1982) reported on surveys of endangered whales in the northern Bering Sea in spring through autumn 1980 and 1981. In May 1980, six gray whales were seen within 1 km of the beach southeast of Nome. In autumn 1980, 254 gray whales were seen on six survey flights in the area between St. Lawrence Island, Nome, and Bering Strait. In May-August 1981, numerous gray whales were seen in the Chirikof Basin (381 on 14 flights) and a few south and southeast of St. Lawrence Island (13 on 2 flights). Whales were also seen in May near Cape Constantine, west of Cape Newenham in outer Kuskokwim Bay, and along the south side of Nunivak Island.

J. Sea Otter

Sea otters inhabit the nearshore North Pacific from California to the Aleutian Islands and southern Bristol Bay. They are seldom seen in waters deeper than 60 m. In the Bering Sea, sea otter habitat varies from rocky intertidal areas with dense macroalgal flora, such as much of the Aleutian Islands, to extensive shallow, offshore areas, such as are found off Unimak Island and in southern Bristol Bay (Kenyon 1969). Formation of sea ice in southern Bristol Bay can drastically affect distribution of sea otters in that area (Schneider and Faro 1975). Sea otters were heavily harvested until 1911, when they were protected by international treaty. The sea otter population in 1911 probably did not exceed a few thousand animals (Kenyon 1969). Since then the remnant population nuclei have grown and expanded, repopulating much of their former range in Alaska. Schneider (pers. commun. and unpubl. ms.) estimates 55,000 to 73,700 in the Aleutian Islands, 11,700 to 17,200 on the north side of the Alaska Peninsula, and 10 on the Pribilof Islands.

Lensink (1960) summarized the distribution and status of sea otters in Alaska based on boat and aerial surveys. He reported a group of 786 otters located 4-7 km from shore on the north side of Unimak Island between Cape Mordvinof and Bechevin Bay. No otters were observed near shore. Scattered small groups were seen off the west end of Unimak Island and near Cape Mordvinof in September 1957 and March 1958, but observers failed to resight the large offshore group. In September 1957, 40 sea otters were seen in the vicinity of Amak Island. Lensink estimated that 1,100-1,500 sea otters were present in the Fox Island area, including Unimak and Amak islands. He noted that 16 otters were transplanted to the Pribilofs in 1955, but none had apparently survived. An additional seven were released in 1959.

Kenyon (1960a) surveyed marine mammals in the eastern Aleutians in early March 1960. Only 90 otters were counted in the Unimak-Amak area, 82 of which were in the area east of Amak. Kenyon considered Lensink's (1960) estimate of 1,100-1,500 sea otters in that area to be reliable.

Kenyon and Spencer (1960) presented the results of their 1959 aerial, small-boat, and shore surveys for sea otters in the western Aleutian Islands. They also summarized and evaluated Lensink's 1957 surveys in other areas of Alaska and estimated the total Alaskan population of otters at 20,000 to 30,000, of which 1,100 to 1,500 were in the Fox Islands (including Unimak Island). Attempts to transplant sea otters to the Pribilof Islands from Amchitka were summarized, and at the time of writing the 1959 transplant of seven animals was thought to be successful.

Kenyon (1962b) tabularized the best available data on sea otter populations and distribution in Alaska, mapped observations of otters, and summarized observations obtained on aerial surveys in March and April 1962. Based on 811 observed animals, he estimated the Unimak-Amak area population at 1,081-1,622 otters. He sighted otters 7-15 km north of Unimak Island near the 38-m depth curve and near Amak Island.

Lensink (1962) summarized the recovery of sea otters in Alaska. He reported otters from four locations east of Unimak Pass: Sennett Point, Cape Mordvinof, Otter Point, and near Amak Island. He estimated that 1,050-1,300 otters were present in the offshore areas of Unimak Island and 150-200 in the shoreline areas.

A very complete summary of the distribution of sea otters, their reduction through exploitation, and subsequent recovery is provided by Kenyon (1969). He noted that, in general, the prosperous sea otter colonies are located south of areas where sea ice forms regularly and remains for long periods of time. Kenyon reported otters observed and estimated total otters for the Unimak-Amak area as 811 and 1,081 in 1962, and 2,892 and 3,856 in 1965. In 1962 most otters were seen offshore near the 38-m depth curve. In 1965, most sightings (2,678) were within 6 km of the coast in the area between Amak Island and Bechevin Bay. No sea otters were seen east of Port Moller. In spring 1961, one or two sea otters were sighted in the Pribilof Islands and were presumably survivors of the 1959 transplant.

Schneider and Faro (1975) discussed the effects of sea ice on sea otters. They estimated that 8,000 to 10,000 sea otters inhabit the shallow waters north of Unimak Pass and the Alaska Peninsula, ranging at least 42 km offshore in up to 80-m water depth. They reported that since Kenyon's 1965 surveys the population had extended north as far as Port Heiden, with occasional sightings at least as far as Ugashik Bay. In 1971 and 1972, sea ice extended unusually far south and caused substantial mortality and displacement of sea otters. In 1971 there was a reduction in numbers but no change in the range of the population, whereas in 1972 there was little apparent mortality but a major, although probably temporary, change in distribution. Schneider and Faro attributed mortality to causes either directly or indirectly related to malnutrition. They suggested that the northeastward expansion of the population into Bristol Bay is probably being restricted by sea ice and that very few otters could survive an average winter northeast of Port Heiden.

Schneider (1976, 1981) conducted aerial surveys north of Unimak Island and the Alaska Peninsula in June and August 1975 and June and July 1976. He found the main range (which he considered critical habitat) of sea otters there to lie from the shore to 60-m water depth between Cape Mordvinof and Cape Leiskof, including Bechevin Bay; smaller numbers were present in Izembek Lagoon, Moffet Lagoon, to the west of Cape Mordvinof, and to the northeast near Port Moller, sometimes as far as Ugashik and Egegik bays. In August 1975, 2,585 of the 2,605 sea otters counted were between Moffet Point and Otter Point. Some otters were found over 40 km from shore and in greater than 60 m of water, although the greatest densities on the dates he surveyed were in water depths of 0-20 m (3.1/km^2) and 20-40 m (5.8/km^2). Schneider identified two high-density areas (6.5/km^2) between Cape Mordvinof and Cape Leiskof which were located mostly within the 40-m contour and separated by a line from Amak Island to Cold Bay. Medium-density (0.3/km^2) areas were mostly between 40-m and 60-m water depth, and low-density (0.06/km^2) in water deeper than 60 m. Schneider believes that water depth, rather than shoreline configuration, influences sea otter distribution in the Unimak-Amak area. Otters in this region apparently move more than those along rocky coastal habitats and disperse widely in offshore areas. Most animals sighted in deep water were adult males, whereas females with pups and young animals preferred shallower water. Schneider's total population estimate for the Unimak-Amak population, based on the 1975 and 1976 surveys, was a minimum of 17,000 otters. He considered that number was probably below the 1970 level as a result of the cumulative effect of heavy ice years in 1971, 1972, and 1974. The heavy ice years also restricted the range of sea otters along the Alaska Peninsula to the area west of Cape Leontovich, whereas before 1970 they were common to Port Heiden, with occasional sightings east to Ugashik and Egegik bays.

Schneider (1981) also summarized the status of sea otters in the Pribilof Islands. He reported that of 55 animals transplanted to St. George Island in 1968 only six, none of which had pups, had been sighted in 1976. Scattered sightings of one or two otters were made at St. Paul and Otter islands in 1972-74. Schneider also reported occasional sightings from Nunivak Island, St. Lawrence Island, and Norton Sound but considered them as extralimital occurrences.

IV. Study Area

The principal emphasis of this study has been to document marine mammal utilization of coastal areas of western Alaska. This report covers information obtained for the eastern Bering Sea, which includes the Alaskan coast from Unimak Pass to Bering Strait. Several major islands in the Bering Sea are also important marine mammal habitats, and those, with the exception of the Aleutian Islands, were included as part of the study area.

The study area was divided into four major sub-areas which correspond to the U.S. Department of Interior Outer Continental Shelf planning areas (Fig. 1). For purposes of cataloging information and for presentation of results, each planning area was divided into geographical regions, which are described in Table 1. Geographical coordinates of specific locations referred to are given in Appendix I.

Our intention in this report has been to include all sightings of relevance to marine mammal distribution in the coastal zone. While it is obvious that sightings of animals hauled out on land or in lagoons and estuaries are significant, the evaluation of sightings made at sea is less straightforward. We did not attempt to review and compile all of the available pelagic sighting data, but we did evaluate and include offshore sightings of particular significance. Generally speaking, all sightings made within 5 km of the coast have been included.

V. Methods

We have attempted to make a complete review of all available sightings of marine mammals in the coastal zone of the Bering Sea during summer and autumn. Our intention in restricting the study to the summer-autumn period was to eliminate the seasons when the coastal zone is covered by shorefast ice, which excludes most species of marine mammals. By so doing, we have eliminated from our study polar bears (Ursus maritimus), ringed seals (Phoca hispida), bearded seals (Erignathus barbatus), and ribbon seals (Phoca fasciata), which, in Alaska, only very rarely utilize terrestrial haulouts. We have included in this report any sightings of the 10 species listed in section II which occurred during the open-water season. In areas such as southern Bristol Bay, this includes virtually the entire calendar year.

As discussed in section IV, the study area has been limited to the coastal zone of the Bering Sea, including the major offshore islands but not including the Aleutian Islands. Emphasis was given to identification of terrestrial hauling areas of pinnipeds, and lagoons, bays, and estuaries regularly utilized by cetaceans and pinnipeds. Sea otters, although they may occur more than 60 km offshore, are a coastal species in the sense that their distribution is limited by water depth. Therefore, we have included all sightings of sea otters regardless of their proximity to the coast. We have not reviewed all available pelagic sightings of cetaceans and generally have included only sightings made within 5 km of the shore. We have dealt primarily with sightings made since 1950 and have not attempted a complete review of earlier historical information, since what is available is usually presented in general terms and is of anecdotal value. Reports and sightings of beached, dead animals have not usually been included.

The idea of cataloging sightings and information on distribution of Bering Sea mammals is not new. In fact, a number of investigators have maintained files of sightings, and we have benefited greatly from their efforts. Although some relevant information is contained in

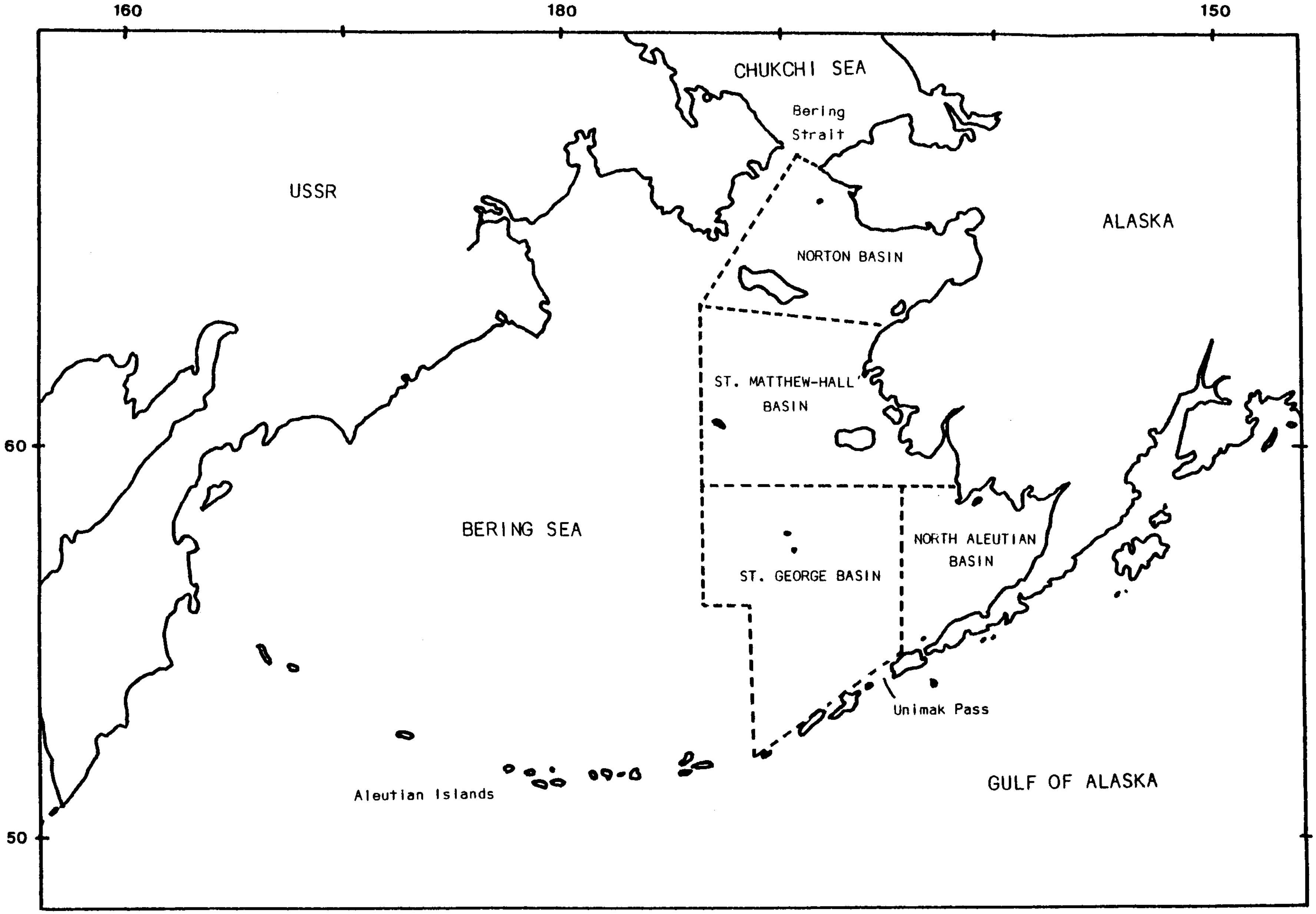

Figure 1. Map of the study area showing Outer Continental Shelf planning areas.

Table 1. Geographical subdivisions of the Bering Sea study area.

North Aleutian Basin

NAB 1 - north coast of the Alaska Peninsula from Unimak Pass to east of Cape Seniavin
NAB 2 - north coast of the Alaska Peninsula from east of Cape Seniavin to Cape Chichagof
NAB 3 - northeastern Bristol Bay from Cape Chichagof to west of the Nushagak Peninsula
NAB 4 - northwestern Bristol Bay from west of the Nushagak Peninsula to north of Cape Newenham

Saint George Basin

SGB 1 - the Pribilof Islands, including St. Paul, St. George, Otter, and Walrus islands

Saint Matthew - Hall Basin

SMH 1 - Kuskokwim Bay
SMH 2 - Nunivak Island
SMH 3 - mainland coast from east of Kipnuk to Pastol Bay
SMH 4 - Saint Matthew and Hall islands

Norton Basin

NB 1 - inner Norton Sound from Pastol Bay to east of Cape Darby, including Stuart, Egg, and Besboro islands
NB 2 - southern coast of the Seward Peninsula from east of Cape Darby to Cape Rodney, including Sledge Island
NB 3 - southwestern coast of the Seward Peninsula from Cape Rodney to Cape Prince of Wales
NB 4 - Saint Lawrence Island and the Punuk Islands
NB 5 - King Island
NB 6 - Diomede Islands and Fairway Rock

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published literature (e.g., see section III), much of the specific information on sightings is usually lost in the process of data reduction. We have therefore, to the maximum extent possible, derived sighting information from original sources, which are usually the files of individual investigators or agencies and notes and observations of field biologists. Sources which we have used, in addition to published literature (section X), are given in Table 2. The observations and files of personnel associated with the U.S. Fish and Wildlife Service wildlife refuge system and with the Alaska Department of Fish and Game have been particularly useful. Dr. F. H. Fay (University of Alaska, Institute of Marine Science) contributed much from the wealth of data he has collected during many years of observing Alaskan marine mammals. We did not intensively review data collected on the Pribilof Islands by the National Marine Fisheries Service.

Data were recorded on formatted sighting cards, which were cataloged by species and area. Geographical subunits of the study area are shown and described in section IV. Depending on the specificity of the data source, we recorded for each sighting the species, number of animals, date, time, location, and any other significant observations such as sex/age classes, apparent behavior, etc.

We have presented our results principally in a series of tables in which sightings are ordered by species, location, and time of year. The location given to each sighting is generally the nearest recognized geographical locale. For example, sightings of both seals hauled out at and whales swimming by Cape Newenham are recorded as at Cape Newenham. Place names and associated geographical coordinates are from Orth (1971) and are listed in Appendix I. Some place names not in Orth (1971) are included in tables, maps, and Appendix I; latitudes and longitudes of those places were determined from 1:250,000 USGS maps. Acronyms for sources given in data tables are explained in Appendix II. We have indicated the source from which we obtained the data, which may not in all cases be the original observer. Sightings for a particular species and area are arranged by time of year to elucidate seasonal patterns in abundance.

Although the data-compilation phase of this project terminated at the end of calendar year 1981, new information has been regularly received during the course of preparation of the report. We have incorporated as much of this new information as possible; however, we do not consider the data included for the summer of 1982 to be complete.

Table 2. Information sources consulted in addition to published literature.

ADF&G (Alaska Department of Fish and Game) Annual Project Segment Reports - Federal Aid in Wildlife Restoration Projects, 1960-1981.

ADF&G Files - Anchorage, Bethel, Fairbanks, King Salmon, and Nome

ADF&G Herring Surveys - April-August 1967-1981, Bristol Bay to Cape Prince of Wales, aerial and boat surveys

ADF&G Marine Mammal Field Reports - cruise and aerial survey

ADF&G Marine Mammal Harvest Data

ADF&G Subsistence Division Reports

Alaska Maritime NWR (National Wildlife Refuge) - Annual Report 1981 and letter to refuge manager requesting any additional data from files

Alaska Peninsula NWR - Annual Report 1981 and letter to refuge manager requesting any additional data from files

Aleutian Islands NWR - Annual Reports 1955-1981

Arvey, W. - ADF&G, field notes

Barton, L. - ADF&G, field notes, herring surveys

Baxter, R. - ADF&G, field notes, herring surveys

Burns, J. - ADF&G, field notes 1962-1982

Calkins, D. - ADF&G, field notes 1975-1982

Cape Newenham NWR - Reports January 1966, April 1971; Annual Reports 1969-1971

Clarence Rhodes NWR - Annual Reports 1952, 1963-1971, 1976-78.

Divoky, G. - seabird biologist, sent letter of inquiry

Drury, W. - seabird biologist, sent letter of inquiry

Table 2., continued

Fay, F. - Institute Marine Science, Univ. Alaska, Fairbanks; terrestrial haulouts 1930's - 1980

Frost, K. - ADF&G, field notes 1975-1982

Izembek NWR - Annual Reports 1950-1981 and letter to refuge manager requesting any additional data from files

Johnson, B. and P. - ADF&G, field reports Nanvak Bay and Otter Island

Jonrowe, D. - ADF&G, field notes

Kelly, B. - Institute of Marine Science, Univ. Alaska, Fairbanks, and ADF&G; field notes 1977-1982

Lensink, C. - USFWS, pers. commun.

Lowry, L. - ADF&G, field notes 1975-1982

Lust, G. - ADF&G, field notes

Marks, S. - ADF&G, field notes

Nelson, R. - ADF&G, field notes, field reports

Nunivak Is. NWR - Annual Reports 1951, 1953, 1965-1971, 1978

Pitcher, K. - ADF&G, field notes, field reports

Seaman, G. - ADF&G, field notes, field reports

Stoker, S. - Univ. Alaska, Fairbanks; field notes, field reports

Table 2., continued

Taggart, J. and C. Zabel - ADF&G, field notes, field reports

Togiak NWR - Annual Report 1981 and letter to refuge manager requesting any additional data from files

USFWS (U.S. Fish and Wildlife Service) Aerial Surveys for Waterfowl -

- south side of Yukon-Kuskokwim Delta to Unimak; 23-27 April 1981; emperor goose survey; R. King
- Bethel to Bechevin Bay; 1-4 October 1979; waterfowl; R. Gill
- Bethel to Bechevin Bay; 4-8 October 1980; waterfowl; R. Gill and R. King
- Point Barrow to Dillingham; 15-22 September 1977; waterfowl; R. King

USFWS Seabird Colony Status Reports - files of all sightings/censuses/ visits of established seabird colonies along entire Alaskan coast, usually only visited during breeding season

USFWS Shorebird Surveys - July-October 1977-1981, R. Gill and C. Handel, 11 flights, Baird Inlet to Hooper Bay

USFWS Walrus Harvest Reports - 1980 and 1981 from Diomede, Wales, Nome, Gambell, and Savoonga

USFWS Walrus Survey - joint project with ADF&G and Soviet Union, 10-23 September 1980, Barrow to Bristol Bay

Yukon Delta NWR - Annual Report 1981 and letter to refuge manager requesting any additional data from files

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VI. Results

A. North Aleutian Basin (Figures. 2-6; Tables 3-6)

Steller Sea Lion

Sea lions utilize three principal hauling areas on Unimak Island: Sea Lion Point/Cape Sarichef, Okseanof Point, and Cape Mordvinof. Sightings have occurred during March-August. In excess of 4,000 animals occurred there in March 1960. Surveys conducted in 1975-77 recorded less than 100 animals hauled out on the island.

Amak Island (including Sea Lion Rocks and the unnamed nearby rocks) is presently the largest sea lion haulout in Bristol Bay. Animals haul out there from at least early March until mid-October, with largest numbers probably in April to August. Reasonably complete counts of sea lions in the Amak/Sea Lion Rocks area have been made on 13 occasions from 1960 to 1981. Based on four counts conducted in June and three in October, the number of animals declined from a mean of 3,496 to 2,034 during that period. Two counts made in August indicate that peak numbers (mean 4,471) may occur during that month.

There are few other records of sea lion haulouts along the Alaska Peninsula. The northeasternmost recorded haulout occurs at Cape Seniavin.

Sea lions are common throughout northwestern Bristol Bay. Although they have been regularly sighted feeding near the coast between Estus Point and Kulukak Bay, we located no records of haulouts in that area. A similar situation exists in Security Cove. A significant haulout occurs in the Cape Peirce/Cape Newenham area. Several hundred animals occur there each year from at least May through September, with a probable peak in numbers in May. Sea lions also haul out on Hagemeister, High, Crooked, and Round islands and on the Twins. Animals have been seen on Round Island from at least April through November. Largest numbers appear to occur on South Twin Island (up to 300) and Round Island (400-500).

Harbor Seal

The principal reported harbor seal haulout on Unimak Island appears to be in the vicinity of Cape Lapin, where as many as 200 animals were reported in June 1967. Animals are more abundant to the east in the False Pass region (Cape Krenitzin and Isanotski Islands), where 1,500 were seen in April and May 1965 and July 1967. Major hauling areas along the southwestern portion of the Alaska Peninsula occur in the vicinity of Izembek Lagoon/Moffet Lagoon and Nelson Lagoon/Port Moller. Maximum counts at those two areas were 5,000 in late June 1975 at Izembek/Moffet and 7,968 in June 1976 at Port Moller. Small numbers of harbor seals haul out at Amak Island and at several locations along

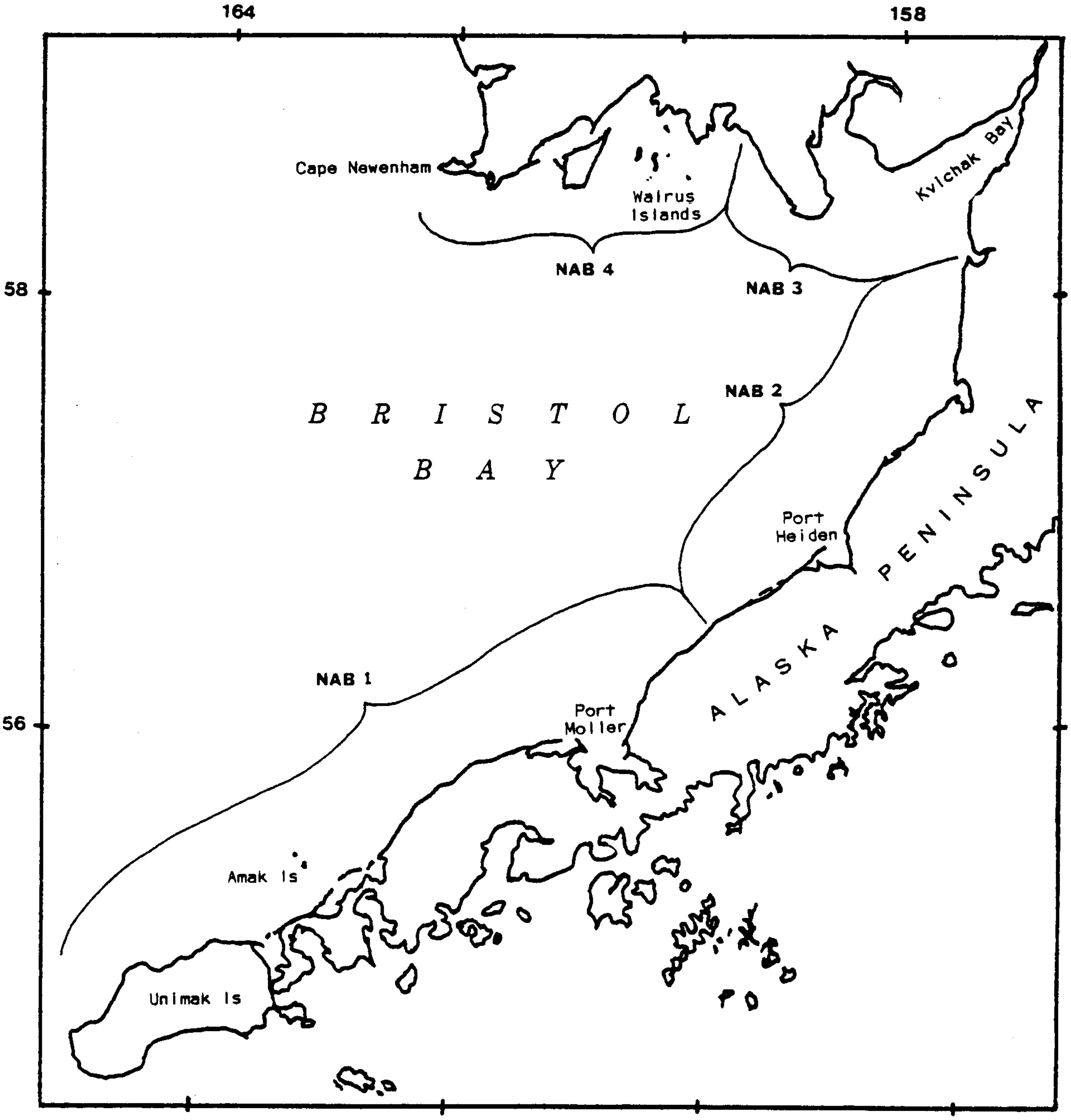

Figure 2. Map of the North Aleutian Basin planning area showing subdivisions used in data compilation.

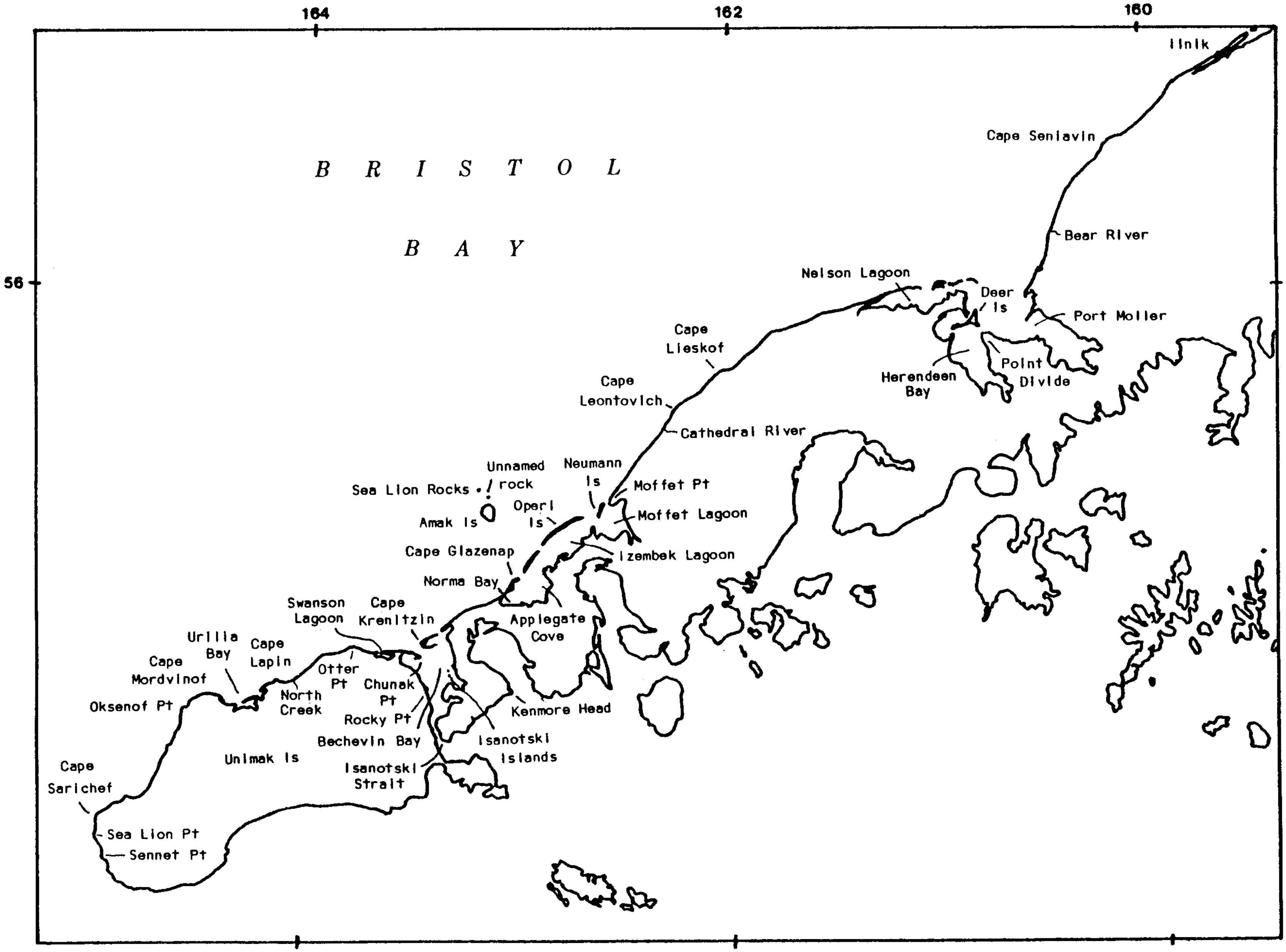

Figure 3. Map of the North Aleutian Basin, region NAB 1.

Table 3. Sightings of coastal marine mammals in the North Aleutian Basin, region NAB 1.

Location	Date	Number	Comments	Source
STELLER SEA LION				
Unimak Is., Sea Lion Pt. (S of Cape Sarichef)	general	present		USFWS/BB Manage. Plan Maps
	May 76	present	on rocks just offshore	USFWS/SBCS Rep.
	13 May 77	present	in water below cliffs	"
Unimak Is., Cape Sarichef	general	200	rookery, ADF&G #167	FEIS 1978
	3-4 Mar 60	200	hauled out; aerial survey	Kenyon and Rice 1961
Unimak Is., Oksenof Pt.	general	4,000	rookery, ADF&G #168	FEIS 1978
	general	present	hauled out	USFWS/BB Manage. Plan Maps
	3-4 Mar 60	4,000	hauled out; aerial survey	Kenyon and Rice 1961
Unimak Is., Cape Mordvinof	Mar 58	500	seen during otter surveys	Aleutian Is. NWR Rep., Jan-May 1958
Unimak Is. area	1960's	4,200		Kenyon and Rice 1961
Unimak Is.	8 Apr 62	630	aerial survey	Kenyon 1962b
	Apr-May 65	810	aerial survey for sea otters	Kenyon and King 1965
	Jun 75	63	hauled out; aerial survey; groups >20 counted from photos	Braham et al. 1980
	Jun 76	38	"	"
	Jun 77	11	"	"
	Aug 75	0	"	"
	Aug 76	39	"	"
Amak Is.	general	350	rookery, ADF&G #201	FEIS 1978
	general	present	hauled out	USFWS/BB Manage. Plan Maps
	3-4 Mar 60	350	hauled out; aerial survey	Kenyon and Rice 1961
	9 Mar 81	475		Izembek NWR files
Amak Is. (N side)	15 Mar 67	400-600		"
	8 Apr 62	2,000	aerial survey	Kenyon 1962b
Amak Is.	7 May 80	1,350		Izembek NWR files

Table 3., continued

Location	Date	Number	Comments	Source
STELLER SEA LION, cont.				
Amak Is., cont	28-30 Jun 57	3,016	aerial photo survey, no pups	Mathisen and Lopp 1963
	Jun 75	927	hauled out; aerial survey; groups >20 counted from photos	Braham et al. 1980
	Jun 76	1,777	"	"
	Jun 77	1,315	"	"
	6 Jun 80	2,400		Izembek NWR files
	2 Jul 80	1,045		"
	4-5 Jul 73	418		USFWS/SBCS Rep., V. Byrd/G. Divoky
	13 Jul 82	620-770	N side; aerial survey, estimate	K. Frost
	19 Jul 75	15	9 hauled out, 6 in water	USFWS/SBCS Rep.
	28 Jul - 9 Aug 56	253	aerial photo survey; 1 pup	Mathisen and Lopp 1963
	Aug 75	2,316	aerial survey; groups >20 counted from photos	Braham et al. 1980
	Aug 76	1,381	"	"
	6-14 Aug 57	570	aerial photo survey, 1 pup	Mathisen and Lopp 1963
	28 Aug - 2 Oct 57	683	aerial photo survey; 113 pups	"
	Oct 76	905	"	"
Amak Is. (NW end)	11 Oct 81	300	hauled out, subadult males; boat survey	J. Burns
Amak Is.	16 Oct 81	300	hauled out on large rocks at base of cliff; boat survey	K. Frost
	4 Dec 57	1,401	aerial photo survey; count includes pups	Mathisen and Lopp 1963
Amak Is. and Sea Lion Rocks area	early 1960's	2,350		Kenyon and Rice 1961
	Apr-May 65	4,100	aerial survey for sea otters	Kenyon and King 1965
Sea Lion Rocks	general	2,000	rookery, ADF&G #200	FEIS 1978
	general	present	hauled out	USFWS/BB Manage. Plan Maps

Table 3., continued

Location	Date	Number	Comments	Source
STELLER SEA LION, cont.				
Sea Lion Rocks, cont.	3-4 Mar 60	2,000	hauled out; aerial survey	Kenyon and Rice 1961
	9 Mar 81	575	plus several individuals and small groups in remainder of area	Izembek NWR files
	8 Apr 62	3,500	hauled out; aerial survey	J. Burns
	28-29 May 57	2,866	hauled out; aerial photocensus, 11 pups	Mathisen and Lopp 1963
	Jun 75	2,006	hauled out; aerial survey; groups >20 counted from photos	Braham et al. 1980
	Jun 76	1,944	"	"
	Jun 77	2,130	"	"
	6 Jun 80	900		Izembek NWR files
	28-30 Jun 57	3,100	aerial photocensus, 229 pups	Mathisen and Lopp 1963
	2 Jul 80	1,300		Izembek NWR files
	6 Jul 76	710		USFWS/SBCS Rep.
	13 Jul 82	1,150-1,350	aerial survey; visual estimate	K. Frost
	28 Jul - 9 Aug 56	4,815	aerial photocensus; 1,035 pups	Mathisen and Lopp 1963
	Aug 75	2,126	hauled out; aerial survey; groups >20 counted from photos	Braham et al. 1980
	Aug 76	2,331	"	"
	6-14 Aug 57	3,056	aerial photocensus; 169 pups	Mathisen and Lopp 1963
	Aug-Oct 57	5,118	aerial photocensus; 424 pups	"
	Oct 76	1,836	hauled out; aerial survey; groups >20 counted from photos	Braham et al. 1980
	11 Oct 81	1,500-1,600	all sizes and age classes present, including pups; boat survey	J. Burns
	16 Oct 81	1,100	all age groups present, including pups; boat survey	K. Frost
	4 Dec 57	2,775	aerial photocensus; count includes pups	Mathisen and Lopp 1963

Table 3., continued

Location	Date	Number	Comments	Source
STELLER SEA LION, cont.				
Amak Is., unnamed rock near Sea Lion Rocks	Jun 75	108	hauled out; aerial survey; groups >20 counted from photos	Braham et al. 1980
	Jun 76	132	"	"
	Jun 77	97	"	"
Amak Is., other small rocks	6 Jun 80	250		Izembek NWR files
	2 Jul 80	15		"
	13 Jul 82	200-250	hauled out; aerial survey	K. Frost
Amak Is., unnamed rock near Sea Lion Rocks	Aug 75	234	hauled out; aerial survey; groups >20 counted from photos	Braham et al. 1980
	Aug 76	355	"	"
	Oct 76	110	"	"
Izembek Lagoon, Neumann Is.	11 Jun 81	5		Izembek NWR files
Moffet Pt. to Nelson Lagoon	3 May 82	15		"
Cape Seniavin	12 Apr 81	6	hauled out on rock by beach	F. Fay, RESOLUTION cruise
HARBOR SEAL				
Unimak Is., Sea Lion Pt. (S of Cape Sarichef)	13 May 77	present	in water below cliffs	USFWS/SBCS Rep.
Unimak Is., Cape Lapin	26 May 76	40	hauled out on rocks; aerial survey	M. Dick
	23 Jun 67	200		Izembek NWR files
Unimak Is., North Creek (E of Cape Lapin)	26 Jul 67	70		"
Unimak Is.	3-4 Mar 60	550	aerial survey	Kenyon 1960a
	Jun 75	125	aerial survey for sea lions; large groups counted from photos	Everitt and Braham 1980
	Jun 76	5	"	"
	Jun 77	0	"	"
	Aug 75, 76	0	"	"
Bechvin Bay, mouth	21 Apr 65	1,500	hauled out on sandbar; aerial survey for sea otters	Kenyon and King 1965
Either Chunak Pt. or Cape Krenitzin	3 May 67	500-1,000	pilot report	Izembek NWR files

Table 3., continued

Location	Date	Number	Comments	Source
HARBOR SEAL, cont.				
Bechevin Bay, mouth	8 May 65	1,500	hauled out on sandbar; aerial survey for sea otters	Kenyon and King 1965
Cape Krenitzin	19 Jul 67	1,500		Izembek NWR files
	17 Aug 67	500		"
Isanotski Islands	Jun 75	368	highest count recorded for month; aerial survey for sea lions; large groups counted from photos; offshore rocks and volcanic beaches	Everitt and Braham 1980
	Jun 76	99	"	"
	Jun 77	422	"	"
	Aug 75	414	"	"
	Aug 76	511	"	"
Cape Krenitzin to Moffet Pt.	24 Apr 81	150	aerial survey for emperor geese	R. King
Izembek Lagoon	general	600–700	estimated total population	Kenyon and King 1965
Izembek Lagoon, mouth	19 Apr 65	350	hauled out on sandbars; aerial survey for sea otters	"
Izembek Lagoon	27 Apr 81	150		Izembek NWR files
	May 57	620	aerial photo survey	Mathisen and Lopp 1963
	8 May 65	350	hauled out on sandbars; aerial survey for sea otters	Kenyon and King 1965
Izembek Lagoon (incl. Moffet Pt.)	Jun 75	2,034	highest count recorded for month; aerial survey for sea lions; large groups counted from photos	Everitt and Braham 1980
	Jun 76	559	"	"
	Jun 77	874	"	"
Izembek Lagoon	11 Jun 82	groups of 150–200		Izembek NWR files
Izembek Lagoon, Norma Bay	23 Jun 67	20		"
Izembek Lagoon	24 Jun 51	200	"I wouldn't put much emphasis on the annual distribution of sightings. Seals are common in the lagoon and especially	C. Dau, Izembek NWR

Table 3., continued

Location	Date	Number	Comments	Source
HARBOR SEAL, cont.				
Izembek Lagoon, cont.			obvious at low tides when they can haul out on exposed sand. Bars near the main channels (outlets) appear to be most preferred."	C. Dau, Izembek NWR
	27 Jun 75	5,000	aerial survey; hauled out on sandbars; 1,842 counted on one bar	J. Sarvis
Izembek Lagoon, Norma Bay	9 Jul 67	85		Izembek NWR files
Izembek Lagoon, Applegate Cove	13 Jul 68	100	hauled out on sandbar	"
Izembek Lagoon, Moffet Pt.	13 Jul 82	+ 400	hauled out; visual estimate from aerial survey	K. Frost
Izembek Lagoon, Norma Bay	26 Jul 67	200		Izembek NWR files
Izembek Lagoon	mid-Jul 75	4,500	aerial survey	J. Sarvis
	Aug 57	1,142	aerial photo survey	Mathisen and Lopp 1963
	Aug 75	208	aerial survey; highest count for month	Everitt and Braham 1980
	Aug 76	1,204	"	"
	11 Oct 81	3	boat survey - W entrance	J. Burns
Izembek Lagoon, Moffet Pt.	18 Oct 67	800-1,000		Izembek NWR files
	21 Oct 66	250		"
Amak Is.	3-4 Mar 60	13	aerial survey	Kenyon 1960a
	Jun 75	14	highest count recorded for month; aerial survey for sea lions; large groups counted from photos; offshore rocks and volcanic beaches	Everitt and Braham 1980
	Jun 76	46	"	"
	Jun 77	12	"	"
	Aug 75	61	"	"
	Aug 76	14	"	"
	16 Oct 81	3	2 hauled out, 1 in water; all on SE side; boat survey	K. Frost
Cathedral River (Cape Leontovich)	4 Jul 65	20		Izembek NWR files

Table 3., continued

Location	Date	Number	Comments	Source
HARBOR SEAL, cont.				
Cape Lieskof	Jun 75	125	highest count recorded for month; aerial survey for sea lions; large groups counted from photos	Everitt and Braham 1980
	Jun 76	199	"	"
	Jun 77	1	"	"
	Aug 75	89	"	"
	Aug 76	1	"	"
	29 Oct 65	100		Izembek NWR files
Cape Seniavin	Jun 75	10	highest count recorded for month; aerial survey for sea lions; large groups counted from photos	Everitt and Braham 1960
	Jun 76	71	"	"
	Jun 77	2	"	"
	11 Jul 73	40	hauled out on bar at river mouth; aerial survey	K. Pitcher
	Aug 75	0	aerial survey for sea lions	Everitt and Braham 1980
	Aug 76	0	"	"
Port Moller (including Nelson Lagoon)	Jun 75	6,078	highest count recorded for month; aerial survey for sea lions; large groups counted from photos	Everitt and Braham 1980
	Jun 76	7,968	"	"
	Jun 77	4,335	"	"
Port Moller area	11 Jul 73	1,675 - 26 groups	hauled out, largest group ± 300; aerial survey	K. Pitcher
Port Moller/Deer Is. area	18 Jul 65	1,400		Izembek NWR files
Port Moller (including Nelson Lagoon)	Aug 75	1,740	highest count recorded for month; aerial survey for sea lions; largest group counted from photos	Everitt and Braham 1980
	Aug 76	1,701	"	"
Port Moller, Nelson Lagoon	9 Oct 65	1,500		Izembek NWR files
Port Moller (W side of entrance)	10 Oct 81	500-600	hauled out; boat survey	K. Frost/J. Burns

Table 3., continued

Location	Date	Number	Comments	Source
HARBOR SEAL, cont.				
Port Moller	Dec 57	431	aerial photo survey	Mathisen and Lopp 1963
Bear River	18 Jul 65	6		Izembek NWR files
WALRUS				
Unimak Is., Cape Sarichef	27 Mar 80	1 male		Izembek NWR files
Unimak Is., Otter Pt.	11 May 67	present		"
Amak Is.	general	present		USFWS/BB Manage. Plan Maps
	9 Mar 81	none		Izembek NWR files
	7 Apr 81	none		F. Fay, RESOLUTION cruise
	8 Apr 62	± 100	hauled out, adult males; aerial photo survey	Kenyon 1962b
	15 Apr 69	100	E side, 1/2 mi N of prominent southern point	K. Schneider
	7 May 80	0		J. Sarvis
	8 May 65	5	in water; aerial survey	K. Kenyon
	early Jun 79		rumors of walrus	Izembek NWR files
	6 Jun 80	0		J. Sarvis
	23 Jun 80	0		"
	28 Jun 79	500 males	on SW side (the Head)	"
	2 Jul 80	0		"
	13 Jul 82	0		K. Frost
	15 Jul 79	400 males	hauled out and in water on SW side (the Head)	J. Sarvis
	28 Jul 79	50 males	on SW side (the Head)	"
	26 Aug 79	0	checked SW side only	"
	29 Aug 79	20 males	along reef at SE corner and on rocks along E side	"
	1 Sep 79	4-5	along E side	"
	6 Sep 79	9 males	on rocks, SW side	"
	11 Oct 81	0		K. Frost

Table 3., continued

Location	Date	Number	Comments	Source
WALRUS, cont.				
Amak Is., cont.	16 Oct 81	0		K. Frost
	fall until 1 Nov 79	many	hauled out	R. Tremaine
Cape Glazenap	8 May 65	± 75	in water, aerial survey	K. Kenyon
Port Moller, W side	Jan-Feb 69	± 200		J. Hemming
Port Moller, Herendeen Bay	20 Apr 68	500-1,000	hauled out, all males	J. Burns
Port Moller, Pt. Divide	21 Apr 82	4		Izembek NWR files
Port Moller bars and beaches	late Apr-early May 79	2-4,000	hauled out; reports from air taxi operators and residents	C. Smith
Port Moller, Pt. Divide	27 Apr 82	0		Izembek NWR files
Port Moller	3 May 82	0		"
Port Moller - spit	6 May 80	750-1,000	hauled out; aerial survey	T. Schmitt
Port Moller	mid-May 79	400		C. Smith
	27 May 80	± 800		Izembek NWR files
	summer 76	"thousands" offshore		R. Tremaine, from fishermen
Port Moller, N of, mouth of Bear River	17 Apr 79	100	reports from residents--2-4,000 hauling out on bars and beaches of Port Moller over next 4 weeks	L. Steele/ W. Fleek
Cape Seniavin	general	present	haulout	USFWS/BB Manage. Plan Maps
	late Mar 80	many	hauled out	C. Smith
	5 Apr 80	600	hauled out; counted from ground	J. Sarvis
	7 Apr 80	500-600	hauled out	S. Reynolds
	7 Apr 81	1,500-2,000	aerial survey for walrus	L. Lowry
	8 Apr 81	± 1,000	hauled out on beach; chased off beach later that day; by 1745 hrs none left on beach	F. Fay, RESOLUTION cruise
	9 Apr 81	60-100		"
	10 Apr 80	50	hauled out; aerial survey	S. Reynolds
	10 Apr 81	100		F. Fay, RESOLUTION cruise
	11 Apr 81	40	30 on beach, 10 in water	"

Table 3., continued

Location	Date	Number	Comments	Source
WALRUS, cont.				
Cape Seniavin, cont.	12 Apr 81	34	25 on beach, 9 in water	*F. Fay, RESOLUTION cruise
	13 Apr 80	0		J. Sarvis
	14 Apr 80	0		L. Lowry
	16 Apr 80	1,000-1,500		F. Fay/C. Smith
	17 Apr 80	1,000	hauled out, very few at sea	C. Smith
	18 Apr 80	383		L. Lowry
	21 Apr 82	0		Izembek NWR files
	23 Apr 78	140 males		J. Sarvis
	23 Apr 81	0	no live walrus	R. Sellers
	27 Apr 82	0		Izembek NWR files
	Apr-May 79	several hundred	hauled out	J. Sarvis
	Apr-May 80	± 1,000	hauled out; by late May moved 30 mi SW to Port Moller area due to harassment and shooting; regular spring occurrence	Izembek NWR 1980 Rep.
	15 May 80	200	all in north cove	C. Smith
	20 May 80	1		L. Hood
	21 May 80	2		"
	22 May 80	100		"
	23 May 80	130	harassed by aircraft, abandoned beach in p.m.	"
	25 May 80		walrus left	Izembek NWR files
	14 Jun 80	0		"
KILLER WHALE				
Cape Sarichef	unknown	present		Braham et al. 1977a
Cape Mordvinof	unknown	present		"
BELUKHA WHALE				
Unimak to Port Heiden		0	never observed; natives never mention	M. Bricker

Table 3., continued

Location	Date	Number	Comments	Source
BELUKHA WHALE, cont.				
Port Moller	Jul 79	1	from local fishermen	J. Burns
Port Moller, NW of	13 Apr 76	> 300	C. Ray observed	Braham and Krogman 1977
HARBOR PORPOISE				
Port Moller, entrance	14 Jun 80	2		J. Burns, RESOLUTION cruise
Port Moller	14 Jun 80	3		"
Cape Seniavin	9 Apr 81	4		F. Fay, RESOLUTION cruise
	14 Jun 80	4		J. Burns, RESOLUTION cruise
Cape Seniavin to Port Moller	18 Apr 81	9		F. Fay, RESOLUTION cruise
MINKE WHALE				
Unimak Is., Urilia Bay	23 Apr 76	1	aerial survey	R. Gill
Cape Seniavin	9 Apr 81	1		F. Fay, RESOLUTION cruise
	14 Jun 80	1		J. Burns, RESOLUTION cruise
GRAY WHALE				
Unimak Pass	Apr-Jun 77	+ 2,100 counted; ± 10,000 estimated	northward migration	Hall 1979
	late Oct-early Jan	present	southward migration	Rugh 1981
	20 Nov - 9 Dec 77	2,055 counted; 11,179 ± 878 estimated	82.5 hrs of systematic, shore-based observations	Rugh and Braham 1979
Unimak Is., Sea Lion Pt. (S of Cape Sarichef)	13 May 77	present	in water below cliffs	USFWS/SBCS Rep.
Unimak Is., Cape Sarichef	23 Apr 76	present	aerial survey	R. Gill

Table 3., continued

Location	Date	Number	Comments	Source
GRAY WHALE, cont.				
Port Moller, Nelson Lagoon	18 Apr - 15 Oct 77	present	up to 30 whales at any one time	R. Gill
	23 Apr 76	present	aerial survey	"
Moffet Pt. to Nelson Lagoon	27 Apr 81	10	aerial survey	"
Port Moller, Nelson Lagoon	27 Apr 81	2		"
	18 May - 2 Sep 76	present	up to 30 whales at any one time	"
	20 Jun - 5 Oct 79	present	fewer than 30 whales at any one time	"
	13 Sep - 10 Oct 76	present	up to 30 whales at any one time	"
	25 Sep - 16 Oct 78	present	fewer than 30 whales at any one time	"
	2 Oct 79	1	feeding in upper lagoon; aerial survey for birds	R. King
	15-23 Nov 76	present	up to 30 whales at any one time	R. Gill
Port Moller	12 Jun 80	abundant		J. Burns
	10 Oct 81	6	milling--stayed in area at least 1 hr; boat survey	K. Frost/J. Burns
Cape Seniavin	8 Apr 81	"numerous"	off coast	F. Fay, RESOLUTION cruise
	10 Apr 80	6	moving N, 1/4 mi offshore	S. Reynolds
	11 Apr 81	3		F. Fay, RESOLUTION cruise
	13 Apr 81	5		"
Cape Seniavin area	14 Jun 80	6		J. Burns, RESOLUTION cruise
Port Moller, Nelson Lagoon to Ilnik	11 Jun 80	12		"
SEA OTTER				
Unimak Is., Sennet Pt.	Mar 58	75		Lensink 1960
Unimak Is., Cape Mordvinof	Mar 58	20		"
Unimak Is. area	8 Apr 62	486	aerial photo survey; most near 20-fathom curve and 4-8 mi offshore	Kenyon 1962b

Table 3., continued

Location	Date	Number	Comments	Source
SEA OTTER, cont.				
Unimak Is. to Amak Is.	8 Apr 62	1,081	estimated total; 811 counted	Kenyon 1969
Unimak Is., Rocky Pt. to Isanotski Strait	24 Apr 81	77	aerial survey for emperor geese	R. King
Unimak Is., Cape Sarichef to Cape Mordvinof	8 May 65	10		Kenyon 1969
Unimak Is., Cape Mordvinof to Isanotski Strait	8 May 65	143		"
Unimak Is. to Amak Is.	8 May 65	3,856	estimated total; 2,892 counted	"
Unimak Is., N side	summer 49	3-5		Lensink 1960
	Jul 57	786		"
Unimak Is., Cape Lapin to Swanson Lagoon	Jul 76	700-800	2-3 mi offshore	Izembek NWR files
Unimak Is., Urilia Bay	4 Jul 73	15 +		USFWS/SBCS Rep.
Unimak Is., Cape Mordvinof to Cape Lieskof	Aug 75	2,605	counted on aerial coast transects	Schneider 1976
		17,173	total estimate of population	
			critical habitat for population; few otters seen N of Cape Lieskof	
Unimak Is., W end	Sep 57	3		Lensink 1960
Isanotski Pt. to Moffet Pt.	8 May 65	2,678	aerial survey	Kenyon 1969
Cape Krenitzin to Moffet Pt.	24 Apr 81	3	aerial survey for emperor geese	R. King
Bechevin Bay - Isanotski Strait to Kenmore Head	27 Apr 81	350		Izembek NWR files
Bechevin Bay - remainder of bay	27 Apr 81	77		"
Cape Glazenap, offshore of base	14 Jun 82	1,250	loose pod in 1-mi area; largest group - 600, others in pods of 50-150	"
Cape Glazenap	2 Jul 80	700		"
Bechevin Bay	30 Jul 75	186	aerial survey	Schneider 1976
	8 Oct 75	75		Izembek NWR files
Izembek Lagoon	Jan-Dec 65	"large numbers"	before 1965 were few/none; now reestablished in lagoon	Aleutian Is. NWR Rep., Jan-Dec 1976
	21 Apr 82	13		Izembek NWR files

Table 3., continued

Location	Date	Number	Comments	Source
SEA OTTER, cont.				
Izembek Lagoon, cont.	27 Apr 81	3		Izembek NWR files
Izembek Lagoon, Neumann Is.	Jun or Jul 78	± 1,500-2,000	in large group	"
Izembek Lagoon, Moffet Pt.	14 Jun 82	800	in 2-mi area offshore; largest group - 75	"
Izembek Lagoon, Operl Is.	13 Jul 78	several hundred	four large groups	"
Izembek Lagoon, Neumann Is.	2 Oct 70	130		"
Izembek Lagoon, Moffet Lagoon	11 Oct 81	20	most in water; 1 on island, 1 female with pup; boat survey	J. Burns
Izembek Lagoon	13 Oct 60	1		Izembek NWR 1960 Annu. Rep.
	17-19 Dec 63	several		Kenyon 1969
	winter 73-74	0	Bering Sea froze 3rd time in 4 years; wiped out last of otters	Aleutian Is. NWR Rep., FY 74
Moffet Pt. to Port Moller	8 May 65	59	aerial survey	Kenyon 1969
Moffet Pt. to Cape Leontovich	13 Jul 82	+ 500	aerial survey; pods of 10-100	K. Frost
Amak Is.	9 Mar 81	60		Izembek NWR files
	8 Apr 62	5	aerial photo survey	Kenyon 1962b
Amak Is., SW of	8 Apr 62	325	"	"
Amak Is.	8 May 65	11	aerial survey	Kenyon 1969
	Sep 57	40		Lensink 1960
Amak Is. (S, W, & NW sides only)	11 Oct 81	4	including 1 very large male; boat survey	K. Frost/J. Burns
Amak Is. (S side only)	16 Oct 81	36	boat survey	K. Frost
Port Moller	10 Oct 81	"several"	boat survey	K. Frost/J. Burns
Port Moller to Ilnik	21 Apr 82	4		Izembek NWR files

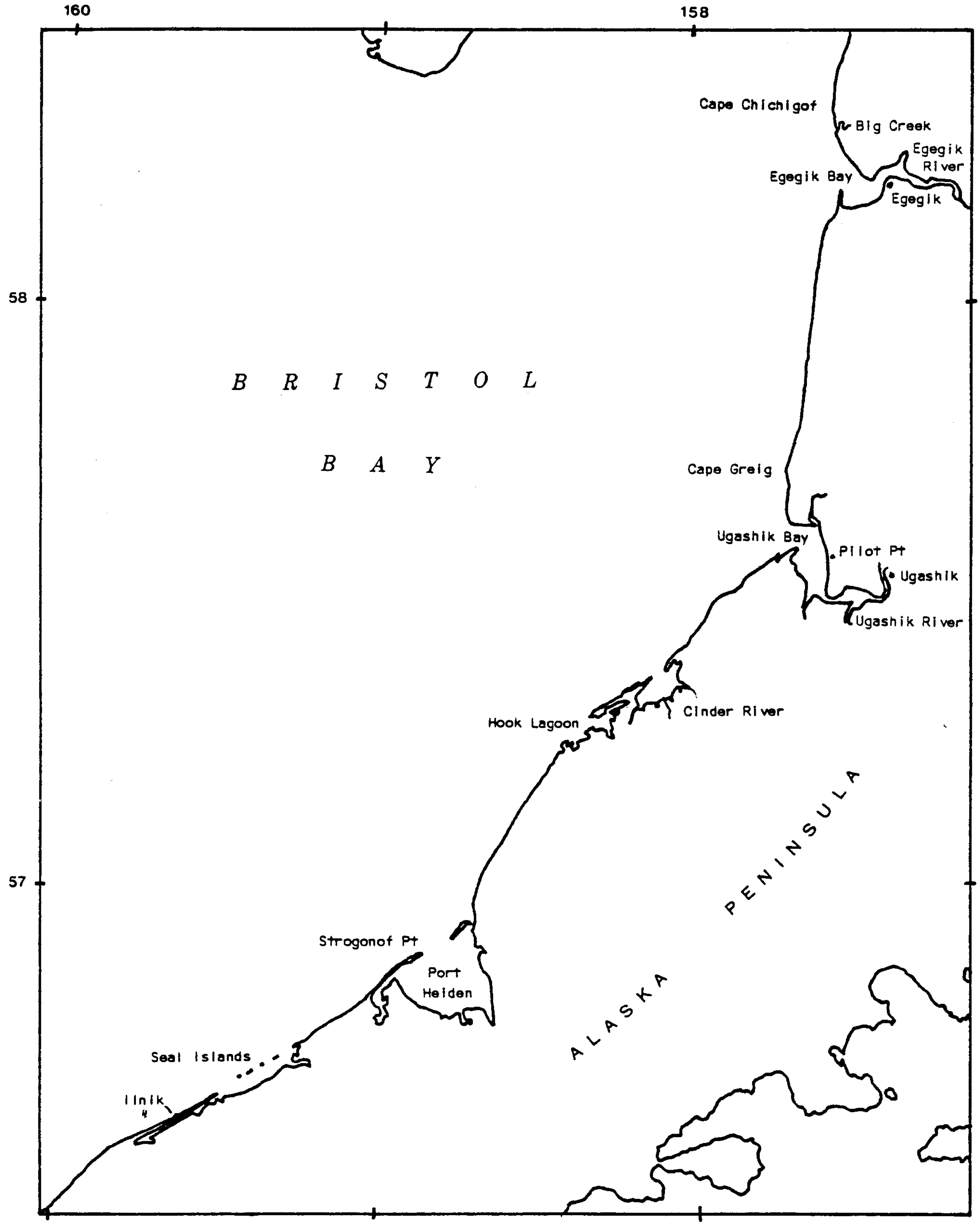

Figure 4. Map of the North Aleutian Basin, region NAB 2.

Table 4. Sightings of coastal marine mammals in the North Aleutian Basin, region NAB 2.

Location	Date	Number	Comments	Source
HARBOR SEAL				
Ilnik	5 Jun 71	3,200	aerial survey	K. Pitcher
	18 Jun 71	1,000	"	"
	6 Jul 71	860	"	"
	14 Jul 71	1,550	"	"
	2 Aug 71	1,350	"	"
Seal Islands	5 May 67	200	"	"
	Jun 75	1,137	highest count recorded for month; aerial survey for sea lions; large groups counted from photos	Everitt and Braham 1980
	Jun 76	786	"	"
	Jun 77	497	"	"
	1 Jun 67	300	aerial survey	K. Pitcher
	5 Jun 71	400	"	"
	7 Jun 66	1,000	"	"
	13 Jun 66	1,000	"	"
	20 Jun 70	1,000	"	"
	21 Jun 70	1,000	"	"
	24 Jun 66	500	"	"
	30 Jun 66	1,100	"	"
	30 Jun 69	900	"	"
	2 Jul 68	300	"	"
	4 Jul 66	400	"	"
	6 Jul 66	700	"	"
	10 Jul 68	3,500	"	"
	11 Jul 73	375	"	"
	17 Jul 68	300	"	"
	17 Jul 69	1,000	"	"
	18 Jul 67	500	"	"
	22 Jul 66	150	"	"
	23 Jul 68	400	"	"

Table 4., continued

Location	Date	Number	Comments	Source
HARBOR SEAL, cont.				
Seal Islands, cont.	25 Jul 70	1,600	aerial survey	K. Pitcher
	31 Jul 68	400	"	"
	Aug 75	75	highest count recorded for month; aerial survey for sea lions; large groups counted from photos	Everitt and Braham 1980
	Aug 76	241	"	"
	2 Aug 66	250	aerial survey	K. Pitcher
	4 Aug 68	450	"	"
Port Heiden, Strogonof Pt.	Jul-Aug 56	100	aerial survey; visual estimate	Mathisen and Lopp 1963
	Dec 57	1,295	aerial photo survey	"
Port Heiden	18 Apr 77	500	no pups; in drifting ice; boat survey	J. Burns
	5 May 67	800	aerial survey	K. Pitcher
	19 May 65	2,500-3,000	"	"
	24 May 76	650	aerial survey for herring	M. Dick
	31 May 66	850	aerial survey	K. Pitcher
	Jun 75	5,273	highest count recorded for month; aerial survey for sea lions; large groups counted from photos	Everitt and Braham 1980
	Jun 76	10,548	"	"
	Jun 77	6,222	"	"
	1 Jun 67	350	aerial survey	K. Pitcher
	5 Jun 71	1,000	"	"
	7 Jun 66	800	"	"
	18 Jun 71	5,900	"	"
	20 Jun 70	4,000	"	"
	21 Jun 70	3,100	"	"
	24 Jun 66	1,500	"	"
	27 Jun 69	1,400	"	"
	27 Jun 70	2,400	"	"

Table 4., continued

Location	Date	Number	Comments	Source
HARBOR SEAL, cont.				
Port Heiden, cont.	29 Jun 69	2,100	aerial survey	K. Pitcher
	30 Jun 66	2,500	"	"
	30 Jun 69	1,900	"	"
	1 Jul 65	8,000-10,000	"	"
	2 Jul 68	1,200	"	"
	2 Jul 70	6,500	"	"
	4 Jul 66	1,600	"	"
	4 Jul 69	2,100	"	"
	6 Jul 66	2,500	"	"
	6 Jul 71	2,000	"	"
	8 Jul 69	1,300	"	"
	10 Jul 68	2,500	"	"
	11 Jul 73	4,298	aerial survey, counted from photos	"
	14 Jul 69	1,500	aerial survey	"
	14 Jul 71	1,600	"	"
	17 Jul 66	1,200	"	"
	17 Jul 68	3,000	"	"
	17 Jul 69	2,050	"	"
	18 Jul 67	2,300	"	"
	18 Jul 70	2,100	"	"
	22 Jul 66	650	"	"
	23 Jul 68	3,000	"	"
	23 Jul 69	1,000	"	"
	25 Jul 69	1,300	"	"
	25 Jul 70	2,600	"	"
	29 Jul 69	1,400	"	"
	31 Jul 68	1,000	"	"
	Aug 75	3,453	highest count recorded for month; aerial survey for sea lions; large groups counted from photos	Everitt and Braham 1980

Table 4., continued

Location	Date	Number	Comments	Source
HARBOR SEAL, cont.				
Port Heiden, cont.	Aug 76	4,782	aerial survey	K. Pitcher
	1 Aug 65	2,500-3,000	"	"
	2 Aug 66	750	"	"
	2 Aug 71	1,700	"	"
	4 Aug 68	800	"	"
	9 Oct 81	1,100	hauled out at low tide; mixed sex and age classes; many swimming by; boat survey	J. Burns/K. Frost
Port Heiden, N of	Jun 75	0	highest count recorded for month; aerial survey for sea lions; large groups counted from photos	Everitt and Braham 1980
	Jun 76	48	"	"
	Jun 77	4	"	"
	Aug 75	0	"	"
	Aug 76	0	"	"
Cinder River	19 May 65	1,000	aerial survey	K. Pitcher
	Jun 75	2,867	highest count recorded for month; aerial survey for sea lions; large groups counted from photos	Everitt and Braham 1980
	Jun 76	4,503	"	"
	Jun 77	1,530	"	"
	5 Jun 71	1,500	aerial survey	K. Pitcher
	13 Jun 66	1,500	"	"
	24 Jun 66	1,000	"	"
	27 Jun 69	500	"	"
	2 Jul 68	600	"	"
	2 Jul 70	3,400	"	"
	6 Jul 66	950	"	"
	10 Jul 68	800	"	"
	11 Jul 73	875	"	"
	14 Jul 71	350	"	"

Table 4., continued

Location	Date	Number	Comments	Source
HARBOR SEAL, cont.				
Cinder River, cont.	17 Jul 68	700	aerial survey	K. Pitcher
	18 Jul 67	3,000	"	"
	23 Jul 68	800	"	"
	31 Jul 68	200	"	"
	Aug 75	113	highest count recorded for month; aerial survey for sea lions; large groups counted from photos	Everitt and Braham 1980
	Aug 76	1,008	"	"
	2 Aug 66	2,000	aerial survey	K. Pitcher
	4 Aug 68	250	"	"
	5 Aug 66	2,000	"	"
	8 Oct 81	350	many juveniles in water; boat survey	K. Frost/J. Burns
Ugashik Bay	Jun 75	196	highest count recorded for month; aerial survey for sea lions; large groups counted from photos	Everitt and Braham 1980
	Jun 76	163	"	"
	Jun 77	215	"	"
	Aug 75	2	"	"
	Aug 76	438	"	"
Ugashik River, mouth	11 Jul 73	40	hauled out on bar; aerial survey	K. Pitcher
Cape Greig	Jun 75	0	highest count recorded for month; aerial survey for sea lions; large groups counted from photos	Everitt and Braham 1980
	Jun 76	1	"	"
	Jun 77	2	"	"
	Aug 75	0	"	"
	Aug 76	0	"	"
Egegik Bay	Jun 75	50	"	"
	Jun 76	70	"	"
	Aug 75	0	"	"

Table 4., continued

Location	Date	Number	Comments	Source
HARBOR SEAL, cont.				
Egegik Bay, cont.	Aug 76	0	highest count recorded for month; aerial survey for sea lions; large groups counted from photos	Everitt and Braham 1980
Egegik, flats below Big Cr.	11 Jul 73	300	hauled out; aerial survey	K. Pitcher
WALRUS				
Port Heiden, Strogonof Pt.	30 Jun 79	40 males	hauled out	J. Sarvis
Port Heiden	Jun-Jul 79	present		Fay and Lowry 1981
	16 Jul 79	40-50	on sandbar at mouth of port	J. Sarvis
	2 Oct 79	1 male	on land	"
Cinder River, mouth	late May 73	1 male	hauled out	J. Faro
Cinder River, 10 mi W, Hook Lagoon	early Oct 71	1 male	"	"
Cinder River to Ugashik Bay	May 62, 63	present		Fay and Lowry 1981
Ugashik Bay, SW of Pilot Pt.	May 62	"a few"		O. Seybert
BELUKHA WHALE				
Seal Islands	11 Jun 80	"numerous"	traveling parallel to shore, close in	J. Burns, RESOLUTION cruise
near Ugashik Bay	15 Oct 76	1		Harrison and Hall 1978
Ugashik Bay	early Nov 70	present	high concentration	O. Seybert/W. Fleek
Egegik Bay, approx. 20 mi W	22 Jan 81	1		L. Lowry
Egegik Bay, S of	21 Mar 77	3	3 km from shore	Harrison and Hall 1978
MINKE WHALE				
Seal Islands	18 Apr 81	2		F. Fay, RESOLUTION cruise
GRAY WHALE				
Ilnik	15 Jun 80	1	near shore	J. Burns, RESOLUTION cruise

Table 4., continued

Location	Date	Number	Comments	Source
GRAY WHALE, cont.				
Ilnik to Port Heiden	11 Jun 80	31		J. Burns, RESOLUTION cruise
Port Heiden, SW of	18 Apr 77	20+	about 1 mi off beach	L. Lowry
Seal Islands to Port Heiden	24 Apr 81	19	feeding	R. Gill
	27 Apr 81	12		"
Port Heiden	15 Apr 80	6	swimming N; aerial sighting	A. Tibbitts
	18 Apr 81	7		F. Fay, RESOLUTION cruise
Port Heiden, NE of	18 Apr 81	3		"
Port Heiden to Cinder River	24 Apr 81	13	all <800 m from shore	R. Gill
	27 Apr 81	31		"
Port Heiden to Ugashik	11 Jun 80	34	along shore	J. Burns, RESOLUTION cruise
Cinder River to Ugashik Bay	24 Apr 81	9	all within 1 km from shore	R. Gill
	27 Apr 81	42	19 at mouth of Ugashik Bay; most feeding as they moved NE; aerial survey	"
Ugashik, N of	11 Apr 80	4-6	swimming N; aerial survey	C. Smith
Ugashik Bay to Egegik	24 Apr 81	23	aerial survey	R. Gill
	27 Apr 82	18	"	"
Ugashik Bay	Jun 82	several thousand	swimming by; several hundred came into bay to feed; vessel observations	J. Hall
Egegik, 1/2 mi offshore	2 May 80	± 30	swimming N; aerial sighting	A. Tibbetts
Egegik Bay	15 Jun 80	2		J. Burns, RESOLUTION cruise
SEA OTTER				
Seal Islands	21 Apr 82	33		Izembek NWR files
Port Heiden	21 Apr 82	9		"
	9 Oct 81	present	boat survey	K. Frost/J. Burns

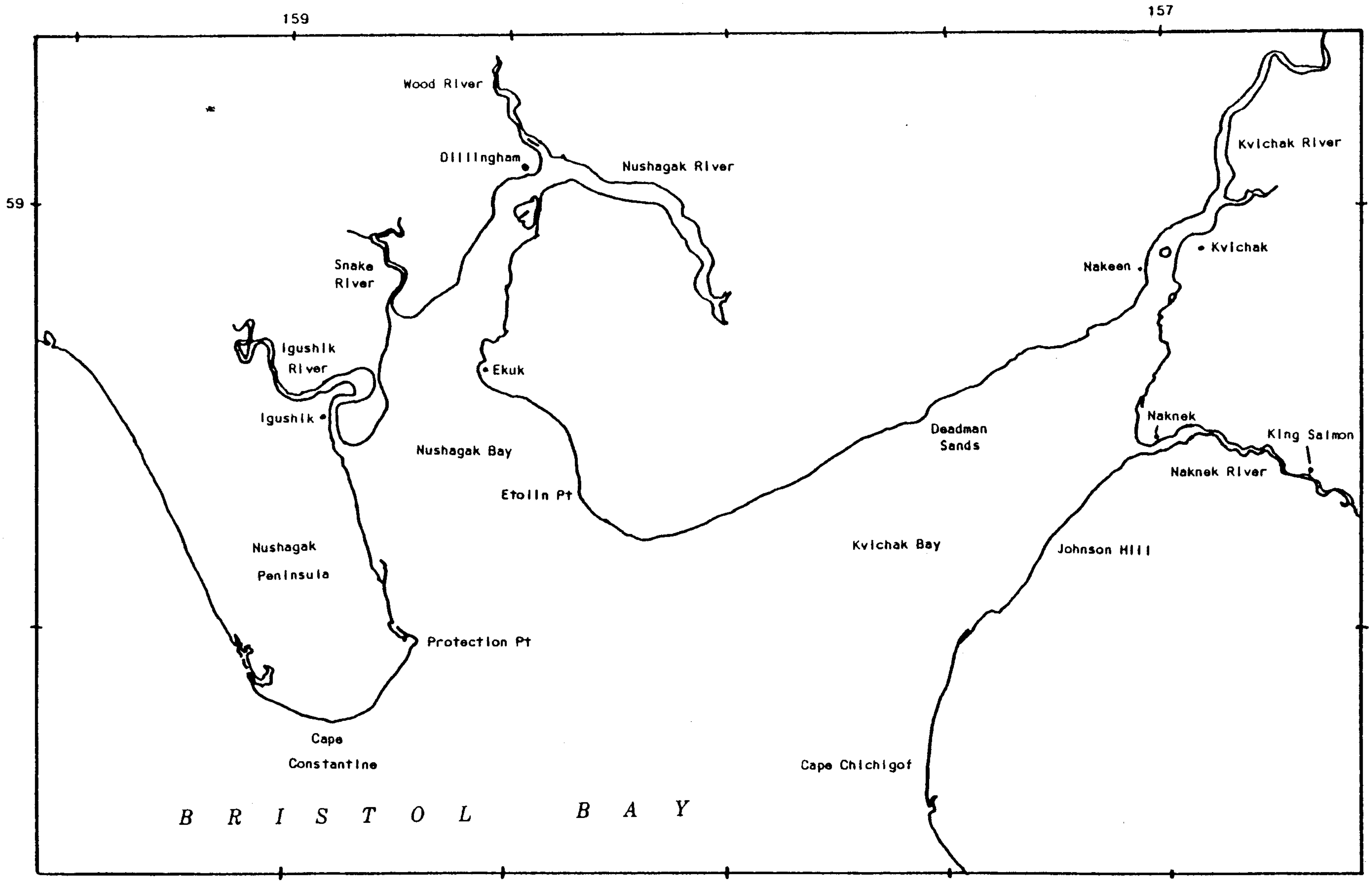

Figure 5. Map of the North Aleutian Basin, region NAB 3.

Table 5. Sightings of coastal marine mammals in the North Aleutian Basin, region NAB 3.

Location	Date	Number	Comments	Source
HARBOR SEAL				
Deadman Sands	11 Jul 73	150	hauled out on sandbar; aerial survey	K. Pitcher
Etolin Point, E of	8 May 81	1	swimming; aerial survey	L. Lowry
Kvichak Bay, N shore	8 May 81	1	"	"
Protection Pt., S of	8 May 81	14	"	"
Protection Pt.	20 May 77	12+	in water; aerial survey for herring	L. Barton
Nushagak Peninsula, E side	30 May - 15 Jun 75	present	"medium" haulout; aerial survey for herring	R. Baxter
	7-14 Jun 75	present	boat survey for herring	"
	Aug 74	present	"medium" haulout; aerial survey for herring	"
Cape Constantine	26 Jun 81	5	in water; aerial survey	D. Calkins
	29 Jul 81	75-100	hauled out; aerial survey	"
Nushagak Peninsula, W side	8 May 81	2	in water 30-60 m offshore; aerial survey	L. Lowry
	8 May 81	1	in water near shore; aerial survey	"
Nushagak Peninsula to Cape Newenham	1979-1982	present	scattered along coast; no major concentrations or haulouts in area except Nanvak Bay	L. Hotchkiss
WALRUS				
Cape Constantine	Jul 63	1	bull; hauled out	Burns 1965
KILLER WHALE				
Etolin Pt.	24-30 Jun 81	1	feeding; many salmon in area	fishermen
BELUKHA WHALE				
Johnson Hill	3 Jun 76	3	aerial survey	ADF&G herring survey
Naknek River	spring	many	ascend rivers on rising tides	N. Steen
Naknek, 5 mi W	7 Apr 81	2	aerial survey for walrus	L. Lowry

Table 5., continued

Location	Date	Number	Comments	Source
BELUKHA WHALE, cont.				
Naknek, approx. 10 mi W	7 Apr 81	13	aerial survey for walrus	L. Lowry
Naknek River, mouth	7 Apr 81	15 +	"	"
Naknek	8 Apr 80	± 20	seen from shore	J. Winjum
Naknek River, mouth	10 Apr 80	present	aerial sighting	J. Drew
Naknek River, 15 mi up, past King Salmon	prior to mid-May	100-200+	feed on smelt, ascend on rising tides	D. Bill/N. Steen
Naknek River	28 May 76	3	aerial survey	ADF&G herring survey
Kvichak River	spring	many	ascend on rising tides	N. Steen
Kvichak River, mouth	May & Jun	50-500 daily	move up and down river 20-30 km daily, feeding	Fish and Vania 1971
Kvichak River	20 May-11 Jun 66	present	feeding on red salmon fingerlings and smelt	ADF&G Annu. Rep. 1969
	26 May-17 Jun 54	present	feeding on smelt and salmon fry	"
	5 Aug-18 Aug 54	present	feeding on salmon	"
Kvichak River, Nakeen	26 Jun 81	> 30	aerial survey	D. Calkins
	26 Jun 81	1	"	"
Kvichak Bay, W side	28 Jun 79	250+	several hundred more probably present	R. Randall
Kvichak area	Apr-early May 79	hundreds		N. Steen
Kvichak Bay	late Apr-May 79	many	ascend rivers	R. Randall
	May 54	250		Brooks 1955
	May 79	200-300+		N. Steen
Kvichak Bay	late May-Jul 79	many		R. Randall
	May 55	100		Brooks 1955
	Jun 54	250-400		"
	Jun 55	150-250		"
	Jun-Jul 79	many	often common around mouth	N. Steen
	Aug 54	600		Brooks 1955
	Aug 55	50-100		"

Table 5., continued

Location	Date	Number	Comments	Source
BELUKHA WHALE, cont.				
Kvichak Bay, central	18 Sep 80	2		L. Lowry
Kvichak Bay, outer	25 Apr 77	2	1 km offshore	Harrison and Hall 1978
	25 Apr 77	3	4 km offshore	"
	25 Apr 77	4	8 km offshore	"
Nushagak Bay, E of Etolin Pt.	26 Jun 81	35	aerial survey	D. Calkins
Nushagak Bay, Ekuk to Etolin Pt.	1 Oct 79	25-50	100 yards offshore, feeding	N. Steen
Nushagak River	Spring	many	ascend on rising tides as far as Portage Creek	"
	Apr, early May 79	100's		"
	23 Jun-28 Jul	present	feeding on salmon	ADF&G Annu. Rep. 1969
Nushagak Bay, Dillingham	26 Jun 81	7	aerial survey	D. Calkins
	29 Jul 81	4	"	"
Wood River mouth	11 Jun 79	6	feeding; aerial survey	Fried et al. 1979
	14 Jun 79	11	appeared to be feeding; aerial survey	"
	25 Jun 79	11	aerial survey	"
Snake River mouth	28 Jun 79	80-120	apparently feeding; immatures present; aerial survey	"
	10 Jul 82	+ 600	calving occurring; aerial survey estimate	K. Frost
	29 Jul 81	5	aerial survey	D. Calkins
Nushagak Peninsula, E of	29 Jul 81	2	"	"
	29 Jul 81	1	"	"
Igushik River, NE of	26 Jun 81	2	offshore; aerial survey	"
Nushagak Bay	27 May 76	4	aerial survey	ADF&G herring survey
	late May-Jul 79	many		R. Randall
	Jun 54	250-400		Brooks 1955
	Jun 55	250		"

Table 5., continued

Location	Date	Number	Comments	Source
BELUKHA WHALE, cont.				
Nushagak Bay, cont.	Jun-Jul 79	many	often common at river mouth	N. Steen
	Jul 54	400		Brooks 1955
	Jul 55	250-450		"
	Aug 54	400		"
	Aug 55	450		"
	late Aug 79	3		N. Steen
	30 Aug 79	present	swimming E to W	R. Naveen
Nushagak Bay estuaries	26 May 79	1	aerial survey	Fried et al. 1979
	4 Jun 79	20	"	"
	11 Jun 79	16	"	"
	20 Jun 79	31	"	"
	22 Jun 79	3	"	"
	25 Jun 79	20	"	"
	27 Jun 79	37	"	"
Nushagak Bay, outer	26 Apr 77	1	8 km offshore	Harrison and Hall 1978
HARBOR PORPOISE				
N Bristol Bay, inshore	Jun & Aug (72?)	common - small numbers		R. Baxter
GRAY WHALE				
Egegik to Johnson Hill	24 Apr 81	69		R. Gill
Cape Chichigof	27 Apr 81	1	moving N	"
Cape Constantine, W side	8 May 81	4-5	apparently feeding, 100-300 m offshore; aerial survey for walrus	L. Lowry
Cape Constantine, W of	20 May 77	1	moving NW along coast; aerial survey for herring	L. Barton
	24 May 81	several	along W side of Nushagak Peninsula	Ljungblad et al. 1982

Table 5., continued

Location	Date	Number	Comments	Source
GRAY WHALE, cont.				
Cape Constantine	27 May 76	3	aerial survey	ADF&G herring survey
Nushagak Peninsula, W side	26 Jun 81	1	"	D. Calkins

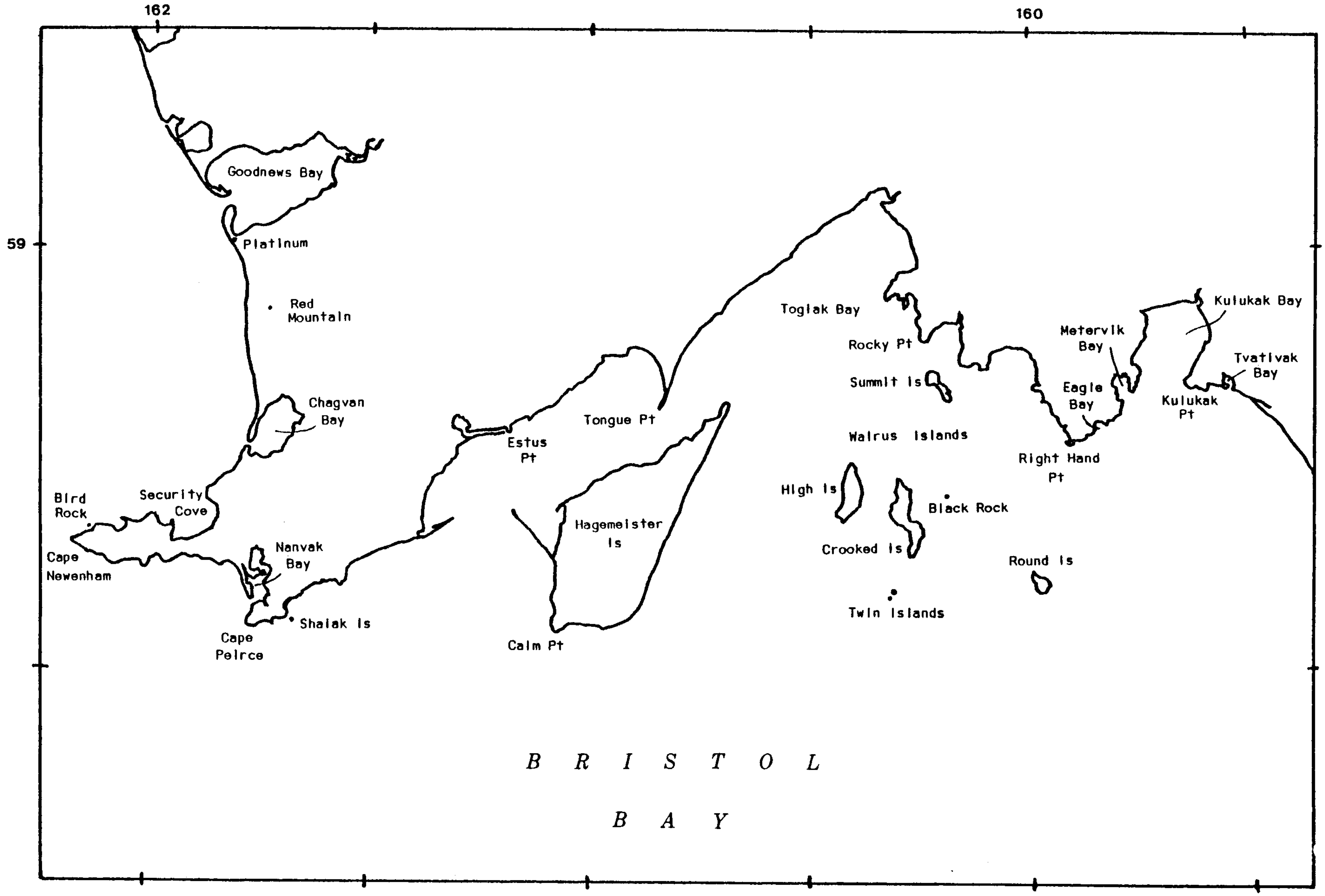

Figure 6. Map of the North Aleutian Basin, region NAB 4.

Table 6. Sightings of coastal marine mammals in the North Aleutian Basin, region NAB 4.

Location	Date	Number	Comments	Source
STELLER SEA LION				
Tongue Pt. to Kulukak Pt.	30 May 75	"lots" present	all along coast; aerial survey for herring	R. Baxter
Kulukak Bay	19 May 67	present	feeding (?) on herring; aerial survey for herring	L. Barton
Right Hand Pt., E of	8 May 81	40-50	feeding; herring spawn visible; aerial survey	L. Lowry
	26 May 72	2	in water; aerial survey for herring	L. Barton
Right Hand Pt.	28 May 68	"hundreds"	in water; lots of herring schools close by; aerial survey for herring	"
Togiak Bay, SE of	8 May 81	2	in water; aerial survey	L. Lowry
	8 May 81	5	in water, feeding; visible schools of fish, probably herring; aerial survey	"
Estus Pt., W of	8 May 81	2	feeding; aerial survey	"
Hagemeister Is., Calm Pt.	general	present	haulout	USFWS/BB Manage. Plan Maps
	summer	150	ADF&G Ref. #295	FEIS 1978
Walrus Islands	Feb-Mar 60	none	aerial survey	Kenyon and Rice 1961
High Is. (S end)	summer	50	ADF&G Ref. #296	FEIS 1978
Crooked Is. (S end)	summer	50	ADF&G Ref. #297	"
The Twins	27 Apr 60	400		Kenyon and Rice 1961
	late Jun 58	66	mostly subadults and a few adult males	"
	summer	100	ADF&G Ref. #298	FEIS 1978
	summer 75	30-50	aerial survey	Braham et al. 1977a
S. Twin Is.	general	present	haulout	USFWS/BB Manage. Plan Maps
	30 May - 15 Jun 75	present	minor haulout; aerial survey for herring	R. Baxter
	7-14 Jun 75	1	hauled out; boat survey for herring	"
	20 Jun 58	45	hauled out on flat areas; 4 adult males, rest females or immature males; no pups	Kenyon 1958

Table 6., continued

Location	Date	Number	Comments	Source
STELLER SEA LION, cont.				
S. Twin Is., cont.	26 Jun 77	9	some hauled out, some in water	USFWS/SBCS Rep., P. Arneson/ D. McDonald
	12 Jul 73	200-300	aerial survey	K. Pitcher
	26 Jul - 4 Aug 56	300	adults only; aerial photo survey	Mathisen and Lopp 1963
	10 Sep 57	147	"	"
N. Twin Is.	12 Jul 73	100-150	adults only; aerial survey	K. Pitcher
Round Is., SE side	14 Apr 81	± 200	hauled out on rocks	F. Fay, RESOLUTION cruise
Round Is.	30 May - 15 Jun 75	moderate	hauled out; aerial survey for herring	R. Baxter
	Jun 75	325	aerial survey; count from photos	Braham et al. 1977a
	Jun 76	296	"	"
	summer 80	400-500	hauled out regularly	K. Taylor
	summer 81	200-250	hauled out regularly; sharp drop from summer 1980	"
Round Is., S end	summer	100	ADF&G Ref. #305	FEIS 1978
	7-14 Jun 75	1	hauled out; boat survey for herring	R. Baxter
Round Is., S end only	29 Jun 77	19	hauled out	USFWS/SBCS Rep., P. Arneson/ D. McDonald
Round Is., SE corner	12 Jul 73	400-500	adults only; aerial survey	K. Pitcher
Round Is.	Aug 74	moderate	hauled out; aerial survey for herring	R. Baxter
	Aug 75	244	aerial survey; count from photos	Braham et al. 1977a
Round Is., SW corner	7 Oct 81	200-300	70% subadult males, no pups or large bulls	K. Frost/J. Burns
Round Is., SW tip	11 Nov 70	50		J. Faro
Black Rock *	18 Jun 77	6	in water	USFWS/SBCS Rep., P. Arneson/ D. McDonald
Cape Peirce, NE of	26 Jun 81	450	25 in water, rest hauled out; aerial survey	D. Calkins

Table 6., continued

Location	Date	Number	Comments	Source
STELLER SEA LION, cont.				
Cape Peirce, E of	26 Jun 81	1	in water; aerial survey	D. Calkins
Cape Peirce	general	present	haulout	USFWS/BB Manage. Plan Maps
Cape Newenham	general	present	"	"
	general	always present		Cape Newenham NWR Rep., Jan 66
	8 May 81	150	hauled out on rocks; aerial survey	L. Lowry
Cape Newenham, N side	8 May 81	1	in water; aerial survey	"
Cape Newenham, E of	8 May 81	1	hauled out on rocks; aerial survey	"
	8 May 81	1	in water; aerial survey	"
Cape Newenham	8 May 79	600	aerial survey for herring	L. Barton
	17 May 78	800	hauled out; aerial survey for herring	D. Jonrowe
	20 May 77	80	aerial survey for herring	L. Barton
Cape Newenham, S of	20 May 78	± 500	hauled out; aerial survey for herring	D. Jonrowe
Cape Newenham	27 May 77	100+	aerial survey for herring	L. Barton
Cape Newenham, N of	30 May 75	75	hauled out; aerial survey for herring	R. Baxter
Cape Newenham	summer every year	± 130	"Sea lions utilize this area throughout the summer months, then depart prior to Bering Sea ice-pack formation."	Togiak NWR 1981 Annu. Rep.
	30 May - 15 Jun 75	present	major haulout; aerial survey for herring	R. Baxter
Cape Newenham, S of	7-14 Jun 75	1	in water; aerial survey for herring	"
Cape Newenham	7-14 Jun 75	present	aerial survey for herring	"
	26 Jul - 4 Aug 56	250	adults only; aerial survey	Mathisen and Lopp 1963
	Aug 74	present	major haulout; aerial survey for herring	R. Baxter
	4 Aug 82	135	hauled out	L. Hotchkiss
	summer 80-82	100 - 1,500	hauled out each year on tip of cape	"

Table 6., continued

Location	Date	Number	Comments	Source
STELLER SEA LION. cont.				
Cape Newenham, cont.	10 Sep 57	30	adults only; aerial survey	Mathisen and Lopp 1963
	24-28 Sep 71	200-300	hauled out on rocks	Cape Newenham NWR 1971 Annu. Rep.
Security Cove	8 May 81	2	in water near gillnets and fish schools; aerial survey	L. Lowry
	8 May 81	1	"	"
	17 May 82	2	feeding	B. Dinneford
	18 May 82	1		"
	19 May 82	5	feeding, swimming	"
Security Cove, SW corner	23 May 82	1	feeding	"
Security Cove	29-31 May 82	± 40	swimming, feeding; groups of ± 10 along shore	"
Chagvan Bay, S end	8 May 81	1	in water; aerial survey	L. Lowry
HARBOR SEAL				
Tvativak Bay, W of	8 May 81	77	hauled out on rocks; 2 groups 60 + 15 on nearshore rocks; also 2 in water; aerial survey	L. Lowry
Kulukak Bay	16 May 79	present	aerial survey for herring	M. Nelson
SE Kulukak Pt.	21 May 79	present	in water; aerial survey for herring	"
Kulukak Pt., E of	29 May 75	present	"working" herring ball; flooding tide; aerial survey for herring	L. Barton
Kulukak Bay	2 May 79	present	in water, some near herring spawning areas; mostly in outer portion of the bay; aerial survey for herring	"
	21 May 73	"some present"	probably feeding on herring; aerial survey for herring	"
Metervik Bay	3 May 79	± 20	in water near herring spawn; aerial survey for herring	"
	16 May 77	"many"	in water: fresh herring spawn in area; aerial survey for herring	"

Table 6., continued

Location	Date	Number	Comments	Source
HARBOR SEAL, cont.				
Eagle Bay (E Right Hand Pt.)	3 May 79	"much activity"	in water; aerial survey for herring	L. Barton
Right Hand Pt., E of	8 May 81	1	feeding, herring spawn visible; aerial survey	L. Lowry
Right Hand Pt., W of	26 Jun 81	1	in water; aerial survey	D. Calkins
Togiak Bay, E side	16 May 77	present	aerial survey for herring	L. Barton
	24 May 71	3	"	M. Nelson
	15 Jun 75	present	"	R. Baxter
Summit Is., N end, NW side	11 Jul 77	5	hauled out	USFWS/SBCS Rep., P. Arneson/ D. McDonald
Summit Is.	23 Sep 80	30	hauled out; aerial survey	USFWS Walrus Survey maps
Hagemeister Is., S tip	30 May 75	± 150	aerial survey for herring	R. Baxter
Hagemeister Is., SW end	30 May - 15 Jun 75	present	minor haulout; aerial survey for herring	"
	7-14 Jun 75	present	boat survey for herring	"
Hagemeister Is., W side	15 Jun 75	present	aerial survey for herring	"
Hagemeister Is., S tip	15 Jun 75	present	"	"
Hagemeister Is., S & SW ends only	9-10 Jul 77	± 70	hauled out, some with pups	USFWS/SBCS Rep., P. Arneson/ D. McDonald
Hagemeister Is.	Jul-Aug 75	20-200	aerial survey	Everitt and Braham 1980
Hagemeister Is., SW end	Aug 74	present	minor haulout; aerial survey for herring	R. Baxter
Hagemeister Is., pt. just N of Calm Pt.	23 Sep 80	100	hauled out; aerial survey	USFWS Walrus Survey maps
High Island, E side	5 & 10 Jul	12+ pups	hauled out	USFWS SBCS Rep., P. Arneson/ D. McDonald
High Island, W side	5 & 10 Jul	26+ pups	"	"
High Is., N end	12 Jul 73	20	aerial survey	K. Pitcher
High Is., S end	12 Jul 73	2	"	"
Crooked Is.	16 Jun - 14 Jul 77	"tens of harbor seals" with some pups	hauled out on rocks at several locations	USFWS/SBCS Rep., P. Arneson/ D. McDonald

Table 6., continued

Location	Date	Number	Comments	Source
HARBOR SEAL, cont.				
Crooked Is., N end	12 Jul 73	1	aerial survey	K. Pitcher
Crooked Is., SW side	12 Jul 73	30	"	"
Round Is.	7 Oct 81	2	boat survey	J. Burns
Black Rock	12 Jul 73	20-30	aerial survey	K. Pitcher
	7 Oct 81	300	hauled out; most less than 4 yrs old; most light phase, only 3 dark phase; boat survey	K. Frost/J. Burns
Tongue Pt., W of	30 May 75	present	aerial survey for herring	R. Baxter
Cape Peirce, NE of	15 Jun 75	present	"	"
Cape Peirce, E of	6 Oct 81	present	present in most rocky coves E of Cape Peirce; no estimate of numbers; boat survey	K. Frost/J. Burns
Nanvak Bay, mouth	"always present"	1-2,000		Cape Newenham NWR Rep., Jan. 66
Nanvak Bay	late Apr & early May	200	haul out on sandbars inside bay	Togiak NWR 1981 Rep.
	5 May 80	200	hauled out	Clarence Rhodes NWR 1981 Rep.
	14 May 79	"couple hundred"	aerial survey for herring	L. Barton
	23 May 73	"many"	white-coated pups present	W. Arvey
	late May 81	50		Clarence Rhodes NWR 1981 Rep.
Nanvak Bay, W of	30 May 75	3	aerial survey for herring	R. Baxter
Nanvak Bay	Jun 75	50-450 (range for month)	hauled out, some pupping;	B. and P. Johnson
	7-14 Jun	present	boat survey for herring	R. Baxter
	mid-Jun 73	250-300	harbor seal breeding colony; pups present on sandbars	W. Arvey
	mid-Jun 73	few	spotted seals; white-coated pups present late May	"
	15 Jun 75	present	aerial survey for herring	R. Baxter
	Jul 75	300-750 (range for month)	90% harbor and 10% spotted seals	B. and P. Johnson
Nanvak Bay, mouth	25 Jul 70	1,000	700 counted in 2 main herds, estimated 1000 in area	M. Dick

Table 6., continued

Location	Date	Number	Comments	Source
HARBOR SEAL, cont.				
Nanvak Bay	Aug 75	600-2,400 (range for month)	90% harbor seals and 10% spotted seals, molting	E. and P. Johnson
Nanvak Bay, entrance bars	4 Aug 82	± 150	hauled out; sandbar most heavily used for last 3 years mostly washed away this year, now used only at low tide; no new bars formed; aerial survey	L. Hotchkiss
Nanvak Bay	31 Aug 81	3,100	numbers decline in September; 10% spotted seal, 90% harbor seal; northernmost known pupping colony for harbor seals	Clarence Rhodes NWR 1981 Rep.
	3-8 Sep 75	2,400-3,000	molting; numbers probably decreased late in September	B. and P. Johnson
	13-25 Sep 79	2000	in 2 separate groups; hauled out on sandbars	Clarence Rhodes NWR 1979 Rep.
Nanvak Bay, mouth	24 Sep 71	458	hauled out on sandbars; spotted seals (harbor?) approx. 2/3 of of total, ringed (spotted?) approx. 1/3 of total	Cape Newenham NWR 1971 Annu. Rep.
	28 Sep 71	± 900	hauled out on sandbars following storm	"
	by end of Sep 81	± 3,000		Togiak NWR 1981 Rep.
Nanvak Bay	6 Oct 80	500	aerial survey for waterfowl	R. King
Cape Newenham, E of	8 May 81	24 +	hauled out on rocks; aerial survey	L. Lowry
	8 May 81	14	in water; aerial survey	"
Cape Newenham, S of	30 May - 15 Jun 75	present	3 minor haulouts; aerial survey for herring	R. Baxter
	30 May 75	50	"	"
	Aug 74	present	"	"
Security Cove	19 May 78	2	feeding, swimming	B. Dinneford
	20 May 82	19	"	D. Jonrowe/R. Baxter
Security Cove, SW corner	23 May 82	2	"	"
Security Cove	4 Aug 82	6	hauled out--usually no large concentrations, just individuals; aerial survey	L. Hotchkiss

Table 6., continued

Location	Date	Number	Comments	Source
HARBOR SEAL, cont.				
Chagvan Bay	30 May - 15 Jun 75	moderate numbers	haulout; aerial survey for herring	R. Baxter
	17 Jun 77	150	"	D. Jonrowe
	Aug 74	moderate numbers	haulout	R. Baxter
	4 Aug 82	4	hauled out; usually no large concentrations, just individuals; aerial survey	L. Hotchkiss
WALRUS				
Walrus Islands	general	present	haulouts; High, Crooked, Summit, Black Rock, the Twins, Round Is.	USFWS/BB Manage. Plan Maps
	summer	± 1,000	hauled out throughout summer	Fay 1957
	12 Jul 73	3	aerial survey	K. Pitcher
	24 Jul 66	200		J. Vania
Hagemeister Is.	Jun 35	8		D. Gray
Hagemeister Is., S tip	30 May- 15 Jun 75	present	minor haulout; aerial survey for herring	R. Baxter
	Aug 74	present	"	"
Round and Hagemeister Is.	22 Jul 53	0		J. Brooks
High and Hagemeister Is.	12 May 58	0		J. Buckley
	29 May 58	0		R. Mahеffey
High Is.	22 Jul 53	± 250		J. Brooks
Big (North) Twin Is.	12 May 58	300		J. Buckley
	29 May 53	± 600		R. Mahaffey
	30 May - 15 Jun 75	present	"moderate" haulout; aerial survey for herring	R. Baxter
	Jun 57	800-1,000		V. Crosby
	12 Jun 76	1,000+	hauled out; aerial survey	ADF&G herring survey
	25 Jun 58	2		C. Fiscus
	22 Jul 53	± 850		J. Brooks
	Aug 59	10		F. Goro

Table 6., continued

Location	Date	Number	Comments	Source
WALRUS, cont.				
Big (North) Twin Is., cont.	Aug 74	present	"moderate" haulout; aerial survey for herring	R. Baxter
Crooked Is.	Jun 57	< 20		F. Fay
Round Is.	10 Feb 81	40		L. Lowry
	10 Mar 81	0		"
	week of 30 Mar 80	1,500	hauled out	K. Taylor
	2 Apr 77	0	aerial survey	H. Braham
	7 Apr 81	2-3,000	aerial survey for walrus	L. Lowry
	14 Apr 81	2,000 2-3,000	west side east side	F. Fay, RESOLUTION cruise
	16 Apr 80	3,000		L. Lowry
	23 Apr 68	1,000		J. Burns
	27 Apr 59	7		V. Crosby
	May 54	± 500		J. Dittmer
	May 55	"some"	+ female with calf near Cape Constantine	S. McCutcheon
	May 58	2,500		"
	6 May 59	7		V. Crosby
	7 May 77	1,660	hauled out	J. Faro
	7 May 81	5,000		L. Lowry
	8 & 14 May 58	± 50-55		V. Crosby
	12 May 58	1,300		J. Buckley
	27 May 58	2,500-3,000		V. Crosby
	27 May 80	7-8,000		L. Lowry
	29 May 53	± 400		R. Mahaffey
	Jun 57	3-400		V. Crosby
	Jun 58	350-1,500		F. Fay
	1 Jun 58	2,500		V. Crosby
	7-14 Jun 75	± 22	in water	R. Baxter

Table 6., continued

Location	Date	Number	Comments	Source
WALRUS, cont.				
Round Is., cont.	11 Jun 77	6,089	hauled out	J. Faro
Round Is., N, E, & W sides	12 Jun 76	many	hauled out; aerial survey	ADF&G herring survey
Round Is.	13 Jun 77	5,773	hauled out	J. Faro
	17 Jun 59	3,076		V. Crosby
	19-29 Jun 58	1,500 - 2,000	adult and subadult males; on cobble beaches on NW side; aerial survey and ground photographs	Kenyon 1958
	24 Jun 77	238	hauled out	J. Faro
	27 Jun 80	11,600	maximum count for season	J. Taggart/C. Zabel, summer 1980 unpubl. rep.
Round Is., 4-5 mi S	26 Jun 58	± 50		C. Fiscus
Round Is.	29 Jun - 4 Jul 77	± 5-8,000	hauled out	USFWS/SBCS Rep. P. Arneson/ D. McDonald
	14 Jul 77	± 5-8,000	"	"
	Jul 74	± 3,000		G. Ray/F. Fay
between Round Is. and Big (North) Twin	6 Jul 57	2	in water	V. Crosby
Round Is.	9 Jul 77	1,372	hauled out	J. Faro
	12 Jul 73	1,000	aerial survey	K. Pitcher
	Aug 57	500		W. Sholes
	Aug 59	± 2,000		F. Goro
Round Is., S of	4 Aug 73	25	in water	R. MacIntosh
Round Is.	5 Aug 80	11,600	maximum count for season	J. Taggart/C. Zabel, summer 1980 unpubl. rep.
	19 Aug 57	± 500		W. Sholes
	19-21 Aug 60	1,500-2,000		Burns 1965
	22 Aug 80	9,700		F. Fay
	Sep 72 or 73	"many"		F. Williamson

Table 6., continued

Location	Date	Number	Comments	Source
WALRUS, cont.				
Round Is., cont.	22 Sep 76	5,210	maximum count for August-September	J. Taggart/C. Zabel, summer 1980 unpubl. rep.
Round Is. (base of spit and NW end)	7 Oct 81	900	hauled out; all males, many 10-15 yr +; boat survey	K. Frost/J. Burns
Round Is.	17 Oct 80	4-500		F. Fay
	11 Nov 70	± 525		J. Faro
	15 Nov 80	7-8,000		L. Lowry
Cape Peirce	summer 70	1	in water	M. Dick
Cape Peirce, E of	26 Jun 81	1	hauled out on rocks; aerial survey	D. Calkins
	late Nov 81	2,800	hauled out on beach	Togiak NWR 1981 Rep.
Cape Newenham, N, off Red Mountain	24 Apr 81	1	aerial survey	ADF&G herring survey
Cape Newenham, 1.5 mi NE	27 Apr 81	3	"	"
Cape Newenham, N side near Bird Rock	Apr-Jul 79, Apr & May 80, Apr 81	up to 400	hauled out until first week of July in 1979, discovered by hunters from Goodnews Bay in 1980, and regularly hunted since then--utilization decreasing	R. Baxter
Cape Newenham	8 May 79	25	hauled out; aerial survey	ADF&G herring survey
Cape Newenham, NE	17 May 78	400 +	hauled out; aerial survey for herring	D. Jonrowe
	20 May 78	± 250	some in water, some hauled out; aerial survey for herring	"
Cape Newenham	summer 81	< 200	hauling out regularly	K. Taylor
Cape Newenham, E of	Jun 78	450-500	hauled out on beach; aerial survey for herring	D. Jonrowe
	Jul 78	0	aerial survey for herring	"
Security Cove	May 78	25-30	hauled out on entrance bars	R. Tremaine
Platinum to Chagvan Bay	1 Oct 79	1	hauled out on beach; aerial survey for waterfowl	R. King

Table 6., continued

Location	Date	Number	Comments	Source
BELUKHA WHALE				
Round Is., approx. 30 mi S	7 May 81	2		L. Lowry
Hagemeister Is., E side	15 Jun 75	1	feeding on capelin; aerial survey for herring	R. Baxter
NE Cape Newenham	20 May 78	2	cow and calf; aerial survey for herring	D. Jonrowe/R. Baxter
MINKE WHALE				
S Kulukak Bay	7-14 Jun 75	1	swimming W; boat survey for herring	R. Baxter
Hagemeister Is., S end	7-14 Jun 75	1	"	"
GRAY WHALE				
Kulukak Bay, E of	30 May 75	1	swimming NW along coast; aerial survey for herring	R. Baxter
	30 May 75	2	swimming W; aerial survey for herring	"
	30 May 75	10	swimming S; aerial survey for herring	"
	30 May 75	6	swimming W; aerial survey for herring	"
	30 May 75	1	"	"
	30 May 75	13	aerial survey for herring	"
Kulukak Bay, SW of	29 May 76	1	"	"
Kulukak Bay, E side	7 Jun 76	1	swimming W; aerial survey for herring	"
Kulukak Bay to Round Is.	late May 82	300 +	feeding during herring season	L. Hotchkiss
Right Hand Pt., W of	15 Apr 80	15-20		J. Strode
Right Hand Pt.	28 May 71	1	aerial survey	ADF&G herring survey
	29 May 68	1	"	"
Right Hand Pt., S of	30 May 75	2	swimming W; aerial survey for herring	R. Baxter
Right Hand Pt.	30 May 75	1	"	"
	30 May 75	4	"	"

Table 6., continued

Location	Date	Number	Comments	Source
GRAY WHALE, cont.				
Right Hand Pt., cont.	5 Jun 72	2	swimming W; aerial survey for herring	R. Baxter
Summit Is.	30 May 75	1	swimming NW; aerial survey for herring	"
Togiak Bay, W side	18 May 73	1	aerial survey for herring	ADF&G herring survey
	30 May 75	4	swimming SW along coast; aerial survey for herring	R. Baxter
	30 May 75	3	"	"
	30 May 75	10	aerial survey for herring	"
Hagemeister Is., E side	30 May 75	3	swimming SW along coast; aerial survey for herring	"
	30 May 75	1	swimming NE; aerial survey for herring	"
Hagemeister Is., N side	30 May 75	1	swimming SW; aerial survey for herring	"
Hagemeister Is., SE end	7-14 Jun 76	1	swimming SW; boat survey for herring	"
Hagemeister Is., SW of	7-14 Jun 75	1	swimming W; boat survey for herring	"
	7-14 Jun 75	1	swimming NNW; boat survey for herring	"
Tongue Pt. to Security Cove	summers 79-81	present	feeding, stay in area; usually 12-20 whales per pod	L. Hotchkiss
Black Rock to Round Is.	15 Apr 81	"many"		F. Fay, RESOLUTION cruise
Round Is.	14 Apr 81	"numerous"		"
Shaiak Is., 2 km NNE	23 Apr 81	1	approx. 200 m offshore	R. Gill
Cape Peirce, 2 mi SE	5 May 80	12		Clarence Rhodes NWR 1980 Rep.
Cape Peirce	8 May 81	4	swimming W, 500 m offshore; aerial survey	L. Lowry
Cape Peirce to Cape Newenham	20 May 77	8	moving W and N along coast; aerial survey for herring	L. Barton
Cape Peirce area	28 May 70	13	all moving W	M. Dick
	31 May	2		"
	6 Jun	2		"

Table 6., continued

Location	Date	Number	Comments	Source
GRAY WHALE, cont.				
Cape Peirce area, cont.	12 Jun	2	all moving W	M. Dick
	23 Jun	2		"
	26 Jun	1		"
	30 Jun	1		"
	1 Jul	5		"
	10 Jul	1		"
Cape Peirce, E of	30 May 75	4	swimming SW along coast; aerial survey for herring	R. Baxter
Cape Peirce, NW of	30 May 75	14	aerial survey for herring	"
	30 May 75	2	"	"
Cape Peirce, NE of	7-14 Jun 75	6	swimming SW along coast; aerial survey for herring	"
Cape Peirce, W of	7-14 Jun 75	1	swimming SSW; aerial survey for herring	"
Cape Peirce, E of	26 Jun 81	1	aerial survey	D. Calkins
	26 Jun 81	2	"	"
Cape Peirce, N of	27 Jun 73	2		W. Arvey
Cape Newenham	7 May 81	1	aerial survey	ADF&G herring survey
Cape Newenham, E of	8 May 81	1	"	L. Lowry
Cape Newenham	8 May 81	1	"	"
	9 May 81	1	"	ADF&G herring survey
Cape Newenham, 2-4 mi SE	9 May 81	2	"	"
Cape Newenham	30 May 75	3	swimming NW; aerial survey for herring	R. Baxter
	30 May 75	4	"	"
Cape Newenham, W & S sides	31 May 75	23	aerial survey	ADF&G herring survey
Cape Newenham, S of	7-14 Jun 75	3	swimming NW; aerial survey for herring	R. Baxter
	7-14 Jun 75	3	swimming W; aerial survey for herring	"
Cape Newenham	21 Jun 73	3	swimming N	W. Arvey
Chagvan Bay, about 15 mi W	24 May 81	present	aerial survey	Ljungblad et al. 1982

the Peninsula, including Cape Leontovich, Cape Leiskof, Bear River, and Cape Seniavin. In June 1975, 11,720 harbor seals were counted in this region; 94.5% (11,078) were at Izembek/Moffet and Port Moller.

The principal harbor seal hauling areas along the northeastern Alaska Peninsula occur at Ilnik, Seal Islands, Port Heiden, Cinder River, and Ugashik Bay. Most reported sightings are from May to August, with peak numbers in June and July. The largest number of seals counted in this area during a single survey (June 1976) was 16,119; of those, 65% (10,548) were in the vicinity of Port Heiden. Maximum counts at each area were: Ilnik - 3,200 (June 1971); Seal Islands - 3,500 (July 1968); Port Heiden - 10,548 (June 1976); Cinder River - 4,503 (June 1976); and Ugashik Bay - 438 (August 1976). The total of these maximum counts is 22,189. Very small numbers of harbor seals have been seen hauled out north of Ugashik Bay at Cape Greig and Egegik Bay.

There are no major harbor seal haulouts in northeastern Bristol Bay. A group was seen hauled out on a sandbar in Kvichak Bay in July 1973, and seals haul out fairly regularly on the southern Nushagak Peninsula at Protection Point and Cape Constantine. Individuals and small groups are occasionally seen in the water in Kvichak Bay and along the Nushagak Peninsula.

Harbor seals haul out at many locations in northwestern Bristol Bay, including Tvativak Bay; Hagemeister, Summit, High, and Crooked Islands; Black Rock; Nanvak Bay; Cape Newenham; Security Cove; and Chagvan Bay. The most important areas appear to be Hagemeister Island, Black Rock, and Nanvak Bay. In Nanvak Bay, by far the major hauling area, the ratio of harbor to spotted seals has been estimated at 9 to 1. Seal numbers there are low in April and May when ice may be present (generally less than 200), increase during June and July, and reach a peak in late August and September. From 2,000 to 3,000 seals have been reported in Nanvak Bay in August 1975 and 1981, and September 1975, 1979, and 1981.

Walrus

Although walruses have been occasionally reported from Unimak Island (Cape Sarichef and Otter Point) and Izembek Lagoon (Cape Glazenap), the areas regularly used along the southwestern Alaska Peninsula are Amak Island, Port Moller, and Cape Seniavin. Based on available reports, all animals seen in this region are males.

The presence of walruses on Amak Island was first reported in April 1962. The best documentation of their occurrence on Amak Island was in 1979 when they were seen on six occasions between 28 June and 6 September and were reported to be on the island until 1 November. The maximum estimated number was 500 on 28 June. Haulouts occurred on the east, southeast, and southwest sides of the island. No walruses were seen on the island during 1980 (May to July), 1981 (March, April, and October observations), or 1982 (13 July observation).

Walruses were first reported hauled out near Port Moller in April 1968 and were reported there again in January-February 1969. Approximately 2-4,000 were in that area in April-May 1979, and several hundred were seen there on 6 and 27 May 1980. We have no reports of walruses near Port Moller in 1981; in 1982, four animals were seen on 21 April and none on 27 April or 3 May.

The first recent record of walruses at Cape Seniavin is from 23 April 1978. They were seen there in April-May 1979 and regularly from late March to 23 May 1980 and from 7-12 April 1981. Maximum estimated numbers were 1,000-5,000 in 1980 and 1,500-2,000 in 1981. No walruses were seen there on 21 and 27 April 1982.

Walruses are very infrequently seen along the northeastern Alaska Peninsula. Small numbers have been seen near Port Heiden, Cinder River, and Ugashik Bay. Sightings have occurred during May to October.

The principal hauling areas for walruses in northern Bristol Bay are in the Walrus Islands. We have located records of walruses hauled out on Hagemeister, High, Crooked, Big Twin, and Round islands. General information suggests that Summit Island and Black Rock are also used; however, we have found no records of sightings on those two islands. Big Twin Island and Round Island appear to be the only areas used regularly by substantial numbers of animals. Sightings of up to 1,000 animals have been made on Big Twin Island during summer months since 1953. The spit and beaches on the north end of Round Island are by far the most important hauling grounds for walruses in Bristol Bay. Maximum annual counts of animals have increased markedly from 4-500 in 1953-54 to 11,600 in 1980. The Round Island hauling area is used from March to November, with greatest numbers present in June to September.

Every year since 1978 walruses have been reported hauled out in the region between Cape Peirce and Security Cove. Most sightings have been on the north side of Cape Newenham. Most haulout activity seems to occur in April to June and usually involves from a few up to 500 animals. An unusually large sighting of 2,500 hauled out at Cape Peirce was reported in November 1981.

Belukha Whale

We have only two reports of belukha whales in the southwestern Alaska Peninsula region. On 13 April 1976, over 300 belukhas were seen in the pack ice northwest of Port Moller. A single animal was seen near Port Moller in July 1979. Local observers consider belukhas to be very uncommon along this part of the Alaska Peninsula.

Belukha whales have been seen on five occasions along the northeastern Alaska Peninsula during January to November. Two of the sightings were in the vicinity of Ugashik Bay in October and November.

Belukha whales are common in northeastern Bristol Bay. They are seen in the Naknek River from the river mouth to at least 27 km upstream. Whales are present in that area in April and May; most sightings have occurred in early April. Although the majority of sightings are of 2-20 animals, one record indicates over 200 animals in the Naknek River. Belukhas occur in the Kvichak River and Kvichak Bay from April to September. Sightings of hundreds of animals have been made in May, June, and August. In Nushagak Bay, belukhas have been reported to occur during April to August. They ascend the Nushagak River as far as Portage Creek and have frequently been seen at the mouths of the Wood, Snake, and Igushik rivers, particularly during June and July. During June to August 1954 and 1955, an estimated 250-450 belukhas were in the Nushagak Bay area.

We located only three sightings of belukha whales in northwestern Bristol Bay, all of of which occurred in the months of May and June.

Harbor Porpoise

Harbor porpoises were sighted on five occasions in the Port Moller-Cape Seniavin region during 1980 and 1981. Nine animals were seen on 18 April 1981. Sightings have occurred from 9 April through 14 June.

Harbor porpoises are reported as occurring commonly in low numbers in northern Bristol Bay during summer.

Minke Whale

We have located four sightings of minke whales along the Alaska Peninsula. Sightings have occurred during April and June.

Two sightings of minke whales in northwestern Bristol Bay were reported in June 1975.

Gray Whale

Gray whales are regularly seen moving along the coast of the southwestern Alaska Peninsula. They appear to occur every year in small numbers in and near the Nelson Lagoon/Port Moller area. They have been observed there between 18 April and 23 November. In the vicinity of Cape Seniavin, gray whales were seen moving northeastward along the coast in April 1980 and 1981 and were also seen on 14 June 1980.

Sightings of gray whales along the northeastern Alaska Peninsula have occurred between 11 April and 15 June. Most sightings have been very near the coast and near Port Heiden and Ugashik Bay. Reports indicate both feeding and northward movement.

Most sightings of gray whales in northeastern Bristol Bay have occurred near Cape Constantine in May.

Gray whales are commonly seen in northwestern Bristol Bay, particularly from mid-April until the end of June. They are seen both along the mainland coast and near offshore islands. The distribution of sightings indicates that migrating animals pass both along the east and south sides of Hagemeister Island and between the island and the mainland. Whales appear to pass particularly close to shore from Cape Peirce to Cape Newenham. Most sightings are of one or two animals, although groups of up to 20 have been reported. One observer estimated at least 300 gray whales in the area in late May 1982. There are no specific sightings of animals in the North Aleutian Basin area north of Cape Newenham.

Sea Otter

Sea otters have been reported along the entire southwestern portion of the Alaska Peninsula from Unimak Island to Port Moller. From 1949 through 1962 the vast majority of sightings were made in the Unimak Island/Bechevin Bay area and near Amak Island. One otter was seen near Izembek Lagoon on 13 October 1960. Otters appeared in Izembek in large numbers in 1965 but were temporarily reduced by heavy ice conditions in the early 1970's; none were seen there during the winter of 1973-74. Since 1978, regular sightings of several hundred to over 1,000 have been made in the Izembek/Moffet Lagoon area. Particularly large aggregations have been reported there from mid-June to mid-July. The area from Cape Mordvinof to Cape Leiskof constitutes the core of the sea otter range along the Alaska Peninsula. The total population is estimated at 17,173.

In 1981 and 1982, sea otters were reported from the Seal Islands and Port Heiden.

B. Saint George Basin (Figure 7; Table 7)

Steller Sea Lion

Sea lions haul out on St. George, St. Paul, Otter, and Walrus islands. The largest haulout is on Walrus Island, which in summer 1960 had 4-5,000 adults and about 3,000 pups. At that time (and since then to our knowledge), Walrus Island was the only Pribilof haulout which was used as a breeding rookery. On 13 April 1979, about 3,000 sea lions were seen hauled out there. On St. George Island, sea lions haul out during summer at Dalnoi Point, Red Bluff, and Tolstoi Point. Dalnoi Point is by far the largest of the three haulouts, with 2,500-3,000 animals reported. Red Bluff is used by about 500 sea lions and Tolstoi Point by about 100. Aleuts from the island say that some pups are present at Dalnoi Point. However, this report is unconfirmed. St. Paul Island has two haulouts: Sea Lion Rock, with about 200-500 nonbreeding males, and Northeast Cape, with about 50-70. The northeast side of Otter Island is used as a haulout in both winter and summer. The largest number reported to be hauled out there was 1,000 males on 9 April 1955. The most recent count we know of was on 13 April 1979 when 400 were present. In early May 1978, 500-800 were seen there. The total estimate for the Pribilofs, based on surveys from 1960 and earlier, is about 9,000.

Harbor Seals

Harbor seals are present around all of the Pribilof Islands, although little information is available for locations other than Otter Island. The only major haulout is on Otter Island. The seals there were counted in April 1979 and early May 1978, when 250-300 were present; in June-August 1974, when the maximum number was about 1,300; and in July 1978, when about 700 were hauled out. Pupping takes place there in June and July on all haulout areas; about 250 pups were born on the island in 1974. Harbor seals are present in small numbers on St. Paul and St. George islands. In summer 1982, 40-50 were hauled out on the rocks about 4 km east of Dalnoi Point on St. George Island.

Walrus

We know of two recent reports of walruses in the Pribilofs, both in April 1979. One apparently healthy adult male was hauled out on Walrus Island, and another moribund male was hauled out on Otter Island. In the 19th century, walruses were more numerous on these haulouts, particularly on Walrus Island.

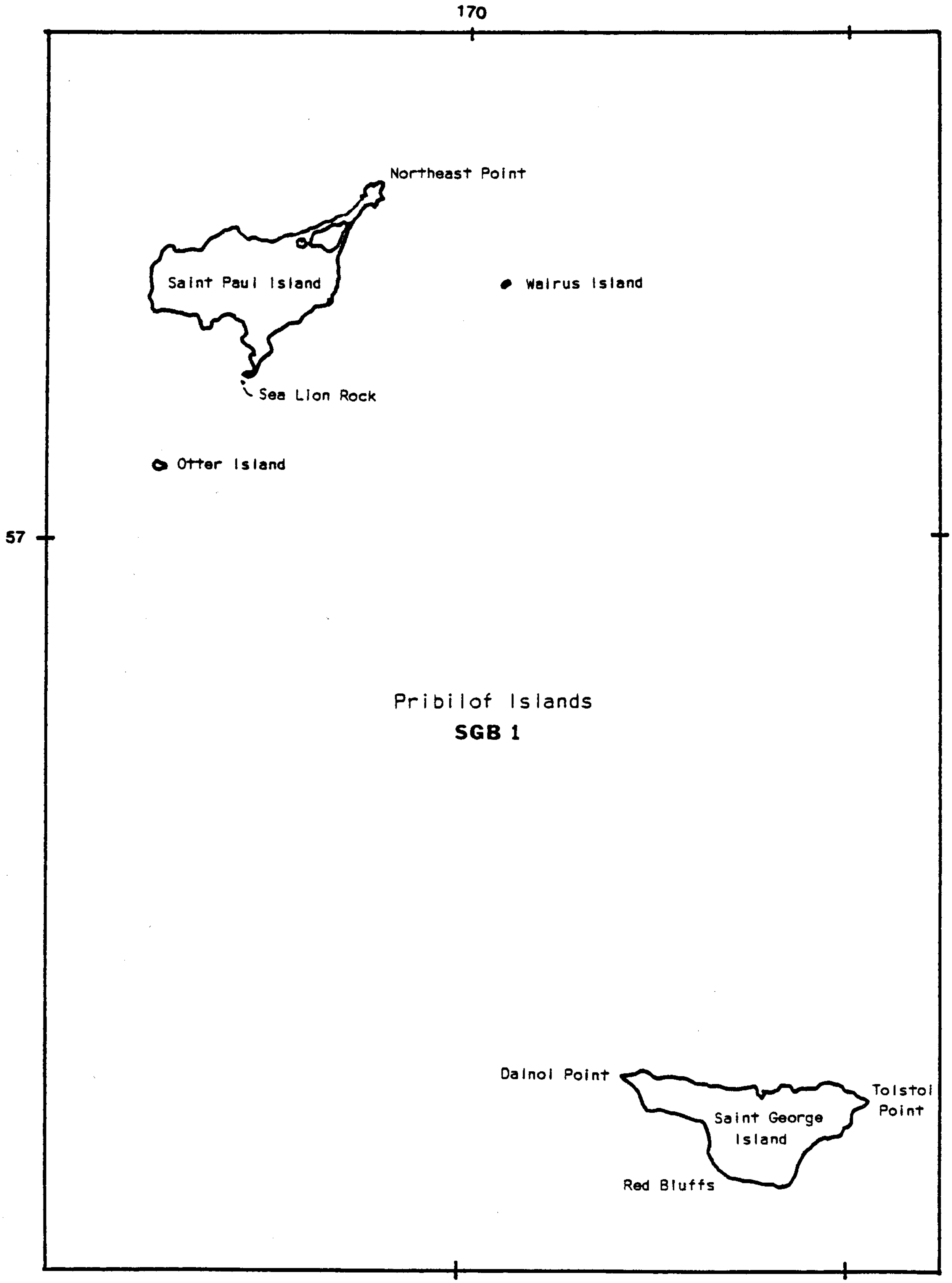

Figure 7. Map of the Saint George Basin, region SGB 1.

Table 7. Sightings of coastal marine mammals in the Pribilof Islands, Saint George Basin, region SGB 1.

Location	Date	Number	Comments	Source
STELLER SEA LION				
St. George Is., Dalnoi Pt.	summer	2,500-3.000	ADF&G Ref. #285	FEIS 1978
St. George Is., S shore Dalnoi Pt.	summer 82	present	local residents say there are pups here	K. Brink
St. George Is., Red Bluff	summer	500	ADF&G Ref. #286	FEIS 1978
St. George Is., Red Bluff (south rookery)	summer 82	many		K. Brink
St. George Is., Tolstoi Pt.	summer	100	ADF&G Ref. #287	FEIS 1978
	summer 82	present	hauled out	K. Brink
St. George Is.	summer 60	1,200	"	Kenyon and Rice 1961
St. Paul Is., NE Cape	summer	50	ADF&G Ref. #290	FEIS 1978
	summer	71	all males; no pups known to be born here since 1957	Kenyon 1962a
St. Paul Is., Sea Lion Rock	summer	30	ADF&G Ref. #290	FEIS 1978
	summer	200-500	hauled out here for many years	Kenyon 1962a
	summer 60	300	nonbreeding males	Kenyon and Rice 1961
Otter Is.	9 Apr 55	1,000	hauled out, N side of island, all identified were males	"
	13 Apr 79	400	hauled out	L. Lowry
Otter Is., NE side	22 Apr 77	200	70-80 hauled out; all adult males	J. Burns
Otter Is.	2 May 78	500	hauled out in "usual places;" aerial survey	"
	2 May 78	800	hauled out on N side; aerial survey	B. Kelly
	26 Jun 81	29	1 large bull	Pribilof Islands Program, Annu. Rep. 1981
	summer	100	ADF&G Ref. #288	FEIS 1978
	summers	75-160	hauled out; adult and subadult males	Kenyon and Rice 1961
	summer 60	160	aerial survey	"
	Jun-Aug 74	40-60	hauled out on N beach; bachelor males; about 200 there in early June	B. Johnson
	Jul 78	6-34	hauled out on NE side; males and a few subadult females	B. Kelly

Table 7., continued

Location	Date	Number	Comments	Source
STELLER SEA LION, cont.				
Otter Is., NE side	12 Aug 73	common	hauled out	J. Burns
	winters	large numbers	regular winter haulout; from residents	Kenyon and Rice 1961
Walrus Is.	13 Apr 79	3,000	hauled out	K. Frost
	22 Apr 77	1,500-2,000	all ages and both sexes	J. Burns
	summer	5,000	ADF&G Ref. #291	FEIS 1978
	summer 54	6-7,000	includes 2,797 pups; aerial photo survey	Kenyon 1962a
	summer 60	7-8,000	includes 2,866 pups; aerial photo survey	"
	4 Aug 81	1,172	30 adult males, 850 females and subadult males, 292 pups; land census	Pribilof Islands Program, Annu. Rep. 1981
HARBOR SEAL				
Pribilof Islands	mid-May - mid-Jul	present	main pupping season	Scheffer 1977
St. George and St. Paul islands	general	present	small numbers	B. Johnson
St. George Is.	30 May	present	peak of pupping season	Scheffer 1977
St. George Is., about 2 mi E of Dalnoi Pt.	summer 82	40-50	hauled out	K. Brink
St. Paul Is.	15 Jun 44	1	adult female with fetus; collected	Scheffer 1977
	23 Jul 50	1	male pup	"
Otter Is.	13 Apr 79	± 250	hauled out on N side	K. Frost
	2 May 78	300	"	J. Burns
	10 Jun 47	2	male pups; taken alive on pupping beach	Scheffer 1977
	11 Jun - 26 Aug 74	± 1,300	hauled out on reefs along N shore and at base of cliffs on S shore; pupping June and July, about 250 pups born	B. Johnson
	26 Jun 81	119	15 mother/pup pairs; high tide	Pribilof Islands Program, Annu. Rep. 1981

Table 7., continued

Location	Date	Number	Comments	Source
HARBOR SEAL, cont.				
Otter Is., cont.	8-30 Jul 78	707 max.	hauled out, most on NE side (593 max.); few on S shore (114 max.) and W end; pupping on all haulout areas	B. Kelly
	14 Jul 53	present	saw 25-lb. pup nursing	Scheffer 1977
	12 Aug 73	500 +	in water and hauled out on rocks on N side	J. Burns
	16 Aug 75	200 +	several colonies; at least 200 seals visible at any one time	USFWS/SBCS Rep., J. E. Benson
WALRUS				
Otter Is.	13 Apr 79	1	moribund, hauled out	K. Frost
Walrus Is.	13 Apr 79	1	adult male, hauled out	L. Lowry
HARBOR PORPOISE				
St. George Is.	Feb 1917	1	dead	Prescott and Fiorelli 1980
St. Paul Is., W of	11 May 76	5	vessel survey	Braham et al. 1977a
St. Paul Is.	3 Jun 1890	present		Murie 1959
	19 Jul 1916	1	dead	Prescott and Fiorelli 1980
GRAY WHALE				
Pribilof Islands	summer mid-70's	several	seen on aerial surveys	Braham et al. 1977a
St. George Is. area	summer 65	several		Rice and Wolman 1971
	summer 68	several		"
SEA OTTER				
St. George Is.	1968	55	transplanted	Schneider 1981
	1976	6	no pups seen	"
St. George Is., Dalnoi Pt.	summer 82	3	2 with pups	K. Brink

Table 7., continued

Location	Date	Number	Comments	Source
SEA OTTER, cont.				
St. Paul and Otter islands	1972-74	few sightings 1-2 otters		Schneider 1981
Otter Is.	summer 74	1		B. Johnson
	July 78	none		B. Kelly
St. Paul Is., NE Pt. and Marunich	summer 81	3	3 sightings of individual otters	Pribilof Islands Program, Annu. Rep. 1981

Gray Whale

Gray whales were sighted and reported in the St. George Island area and around the Pribilofs during summer 1965, 1968, and the mid-1970's.

Sea Otter

Fifty-five sea otters were transplanted to St. George Island in 1968, but only six were sighted in 1976. There were no pups present. In 1972-74, a few sightings were made of one to two otters near St. Paul and Otter islands. In summer 1982, three otters were regularly seen near Dalnoi Point. Two of those had pups with them.

C. Saint Matthew-Hall Basin (Figures 8-10; Tables 8-11)

Steller Sea Lion

There are no known sea lion haulouts on the mainland coast of the Saint Matthew-Hall Basin.

All reported sea lion haulouts on Nunivak Island are on the south side between Cape Mohican and Cape Mendenhall. Sightings have been made from May to October. The two main haulouts are at the mouth of Binajoaksmiut Bay, where up to 50 have been seen, and Nabangoyak Rock, where a maximum of 35 has been counted. In July 1978 a few sea lions were hauled out at Datheekook Point and Cape Mohican.

Sea lions are known to haul out on St. Matthew, Hall, and Pinnacle islands in spring through autumn. The largest reported sightings were of over 100 at Cape Upright on St. Matthew in August 1960, of 350 (no pups) south of Elephant Rock on Hall Island in August 1957, and of 100 and 150-200 on Pinnacle Island in March 1979 and September 1980. Systematic observations made in 1982 indicate that sea lions are present near St. Matthew Island from late May until at least early August. Peak numbers were observed during July.

Spotted/Harbor Seals

The principal haulouts of spotted/harbor seals in Kuskokwim Bay are on the sandbars off Quinhagak and in the mouth of the Kuskokwim River. Reported sightings have been in May-July. Maximum counts off Quinhagak were made in mid-May 1978, when about 2,200 were seen on Pilot Bar, 3,000 on Middle Bar, and 2,500 on North Bar. Approximately 2,000 harbor seals, many with pups, were seen at the mouth of the Kuskokwim in early July 1972. Other areas where smaller numbers of seals haul out in May-August include Chagvan Bay, Goodnews Bay, and Kongiganak.

Seals are present year-round on Nunivak Island and are most common in two regions: the northwest end near Cape Mohican and the southeast coast near Cape Mendenhall. On the northwest end, sightings of up to 20-70 seals have been made at Kigoumiut Bay, Mikisagimiut, the bays east of Ikook Point, and Ikookstakswak Cove. Approximately 80 seals were present in small rocky coves near Cape Mendenhall in October 1980. Spotted seals are present and hunted near Mekoryuk in April-June. It is unknown whether seals seen at the northwestern end were harbor seals or spotted seals. Four animals collected near Cape Mendenhall in October 1981 were all harbor seals.

Spotted seals are present along the mainland coast from Kipnuk to the mouths of the Yukon River. Sightings have been reported from Kipnuk, Etolin Strait, Hooper Bay, Tanunak, Scammon Bay, and the middle

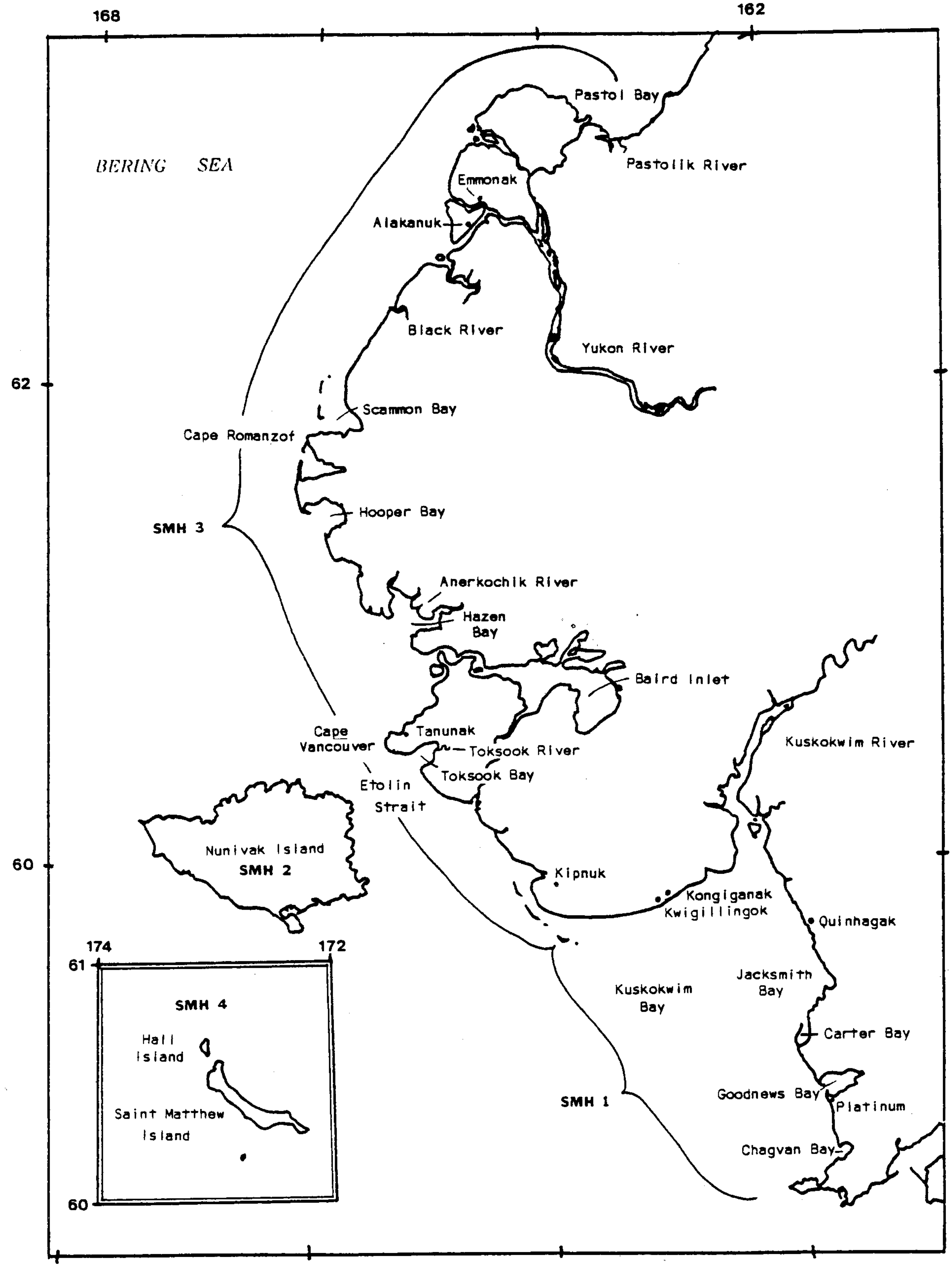

Figure 8. Map of the Saint Matthew-Hall Basin planning area showing subdivisions used in data compilation.

Table 8. Sightings of coastal marine mammals in the Saint Matthew-Hall Basin, region SMH 1.

Location	Date	Number	Comments	Source
SPOTTED SEAL/HARBOR SEAL				
Goodnews Bay	May 73	present	spotted seals; pups present; large numbers not present around here	W. Arvey
	17 May 78	± 15	aerial survey for herring	D. Jonrowe/R. Baxter
	17 Jun 77	25	hauled out; aerial survey for herring	D. Jonrowe
Quinhagak	14-16 May 73	present	spotted seals with white-coated pups	W. Arvey
Quinhagak, outer Jacksmith Bay	17 Jun 77	2,000 +	aerial survey for herring	D. Jonrowe
Quinhagak, SW of	10-13 Jul 73	present	on sandbars; most or all harbor seals; pups present	W. Arvey
Quinhagak, SW, Pilot Bar	17 May 78	± 2,200	aerial survey for herring	D. Jonrowe/R. Baxter
	20 May 78	± 2,000	no pups; aerial survey for herring	"
Quinhagak, W, Middle Bar	17 May 78	± 3,000	aerial survey for herring	"
	20 May 78	± 1,500	"	"
Quinhagak, W, North Bar	17 May 78	± 400	"	"
	20 May 78	± 2,500	"	"
Kongiganak, bar S of	17 May 78	50	hauled out; aerial survey for herring	"
Kuskokwim River mouth	Jun-Jul	present	harbor seals pup on bars in river mouth	R. Baxter
	4 Jul 72	± 2,000	on sandbars; harbor seals, many with pups; some up Kuskokwim to Akiachak; aerial survey for herring; this area was used heavily during salmon season	"
WALRUS				
Carter Bay, N end	24 Apr 81	1	aerial survey	ADF&G herring survey
Goodnews Bay	17 May 78	1 male	aerial survey for herring	D. Jonrowe/R. Baxter
Goodnews Bay, mouth of	Nov 78	200-250	hauled out for approximately 2 weeks on beach	D. Jonrowe
Kwigillingok, SW of	Jun 68	± 500	hauled out; aerial survey for herring	R. Baxter

Table 8., continued

Location	Date	Number	Comments	Source
BELUKHA WHALE				
Quinhagak	1 May - 15 Nov	present		Lensink 1961
	circa 1955, summer	"many"	with calves	R. Tremaine, from residents
	summer 77	1	harvest	R. Nelson
	summer 78	few adults	2-5 harvested, one with 24" fetus	R. Tremaine, from residents
Kuskokwim River, off mouth	Jan 1879	present		Nelson 1887
HARBOR PORPOISE				
Quinhagak	4 Jul 72	many	aerial survey for herring	R. Baxter
GRAY WHALE				
Goodnews Bay, N of	17 May 78	1	chasing ball of herring; aerial survey for herring	D. Jonrowe/R. Baxter
Quinhagak	4 Jul 72	1	aerial survey for herring	R. Baxter
Kwigillingok, 20 mi SW	30 May 81	5	aerial survey; headed N-NW; mud trail visible	Ljungblad et al. 1982

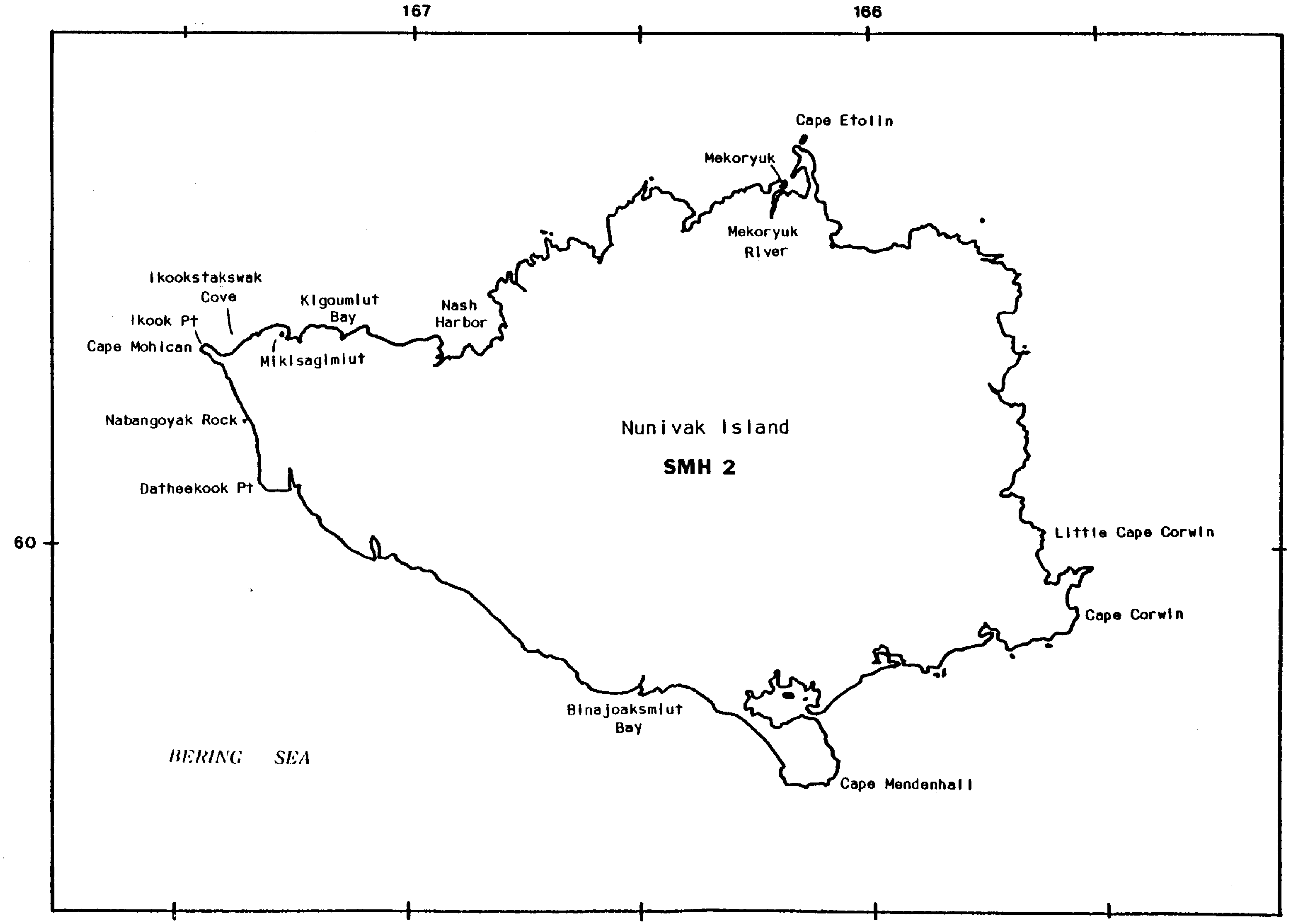

Figure 9. Map of the Saint Matthew-Hall Basin, region SMH 2.

Table 9. Sightings of coastal marine mammals around Nunivak Island in the Saint Matthew-Hall Basin, region SMH 2.

Location	Date	Number	Comments	Source
STELLER SEA LION				
Nunivak Is.	Feb-Mar 60	none	aerial survey	Kenyon and Rice 1961
Nunivak Is., S side	30 May 81	15-20	hauled out on rocks; aerial survey	K. Frost
Nunivak Is., W side	spring and especially summer	present		Kenyon and Rice 1961
Binajoaksmiut Bay, mouth of	5 Jun 79	49	on rocks and in surrounding water; one of two main sea lion haulouts on island	Clarence Rhodes NWR 1979 Annu. Rep.
Nabangoyak Rock	Jun 78 - Aug 79	32 max.	haulout area--only two main ones on island	"
	4 Jul 78	10		Ritchie 1978
	11 Jul 78	35		"
Datheekook Pt.	11 Jul 78	7		"
Cape Mohican	11 Jul 78	1		"
Cape Mendenhall, 20 mi W	4-5 Oct 81	50	hauled out; only sea lions seen during 2 days spent in area; boat survey	K. Frost/J. Burns
SPOTTED SEAL/HARBOR SEAL				
Mekoryuk	Apr-Jun 75	present	hunted; spotted seals	ADF&G harvest records
Nunivak Is., S side	30 May 81	1	in water; aerial survey	K. Frost
	30 May 81	3	"	"
Nash Harbor	30 May 81	1	"	"
Cape Mohican	spring-summer	present		C. Lensink
Nunivak Is., islets off SE coast	Jun-Sep 79	stable number	usually present all year unless heavy ice	Clarence Rhodes NWR 1979 Annu. Rep.
Kigoumiut Bay	Jun-Sep 79	stable number	"	"
Mikisagimiut	Jun-Sep 79	some		"
	3 Jul 78	present	"observed frequently after this date"	Ritchie 1978

Table 9., continued

Location	Date	Number	Comments	Source
SPOTTED SEAL/HARBOR SEAL. cont.				
Ikookstakswak Cove	Jun-Sep 79	stable number	usually present all year unless heavy ice	Clarence Rhodes NWR 1979 Annu. Rep.
	2 Jul 78	45 +	hauled out on rocks	Ritchie 1978
	6-9 Jul 78	20 +	hauled out	"
Ikook Pt., all three bays E of	22-23 Sep 80	70	aerial survey	USFWS Walrus Survey maps
Cape Mendenhall	4 Oct 81	80	harbor seals; in coves near cape; boat survey	J. Burns
	5 Oct 81	20	"	"
WALRUS				
Etolin Strait	spring	many	major migration route	Clarence Rhodes NWR 1979 Annu. Rep.
Nunivak Is., N side	Oct 78	"hundreds"	hauled out	R. Tremaine
	Nov 78	"hundreds"	"	T. Smith
Cape Etolin and Mekoryuk	3 weeks in Nov & Dec 78	groups of 200 +, sightings common	hauled out on rocks; unusually large number for that time of year	Nunivak NWR 1978 Annu. Rep.
	fall 78	some	hauled out for 3-4 weeks on beach	D. Jonrowe
BELUKHA WHALE				
Nunivak Is.	autumn, before 1930	present	occasionally caught in seal nets	Curtis 1930
HARBOR PORPOISE				
Little Cape Corwin	4-6 Jun 79	16	feeding on abundant capelin; with minke whales; boat survey	Clarence Rhodes NWR 1979 Annu. Rep.
Nunivak Is., S side	July (72?)	"few"		R. Baxter
MINKE WHALE				
Little Cape Corwin	4-6 Jun 79	4	feeding on abundant capelin; with harbor porpoise; boat survey	Clarence Rhodes NWR 1979 Annu. Rep.

Table 9., continued

Location	Date	Number	Comments	Source
MINKE WHALE, cont.				
Cape Mendenhall, E of	4 Oct 81	1	within 1/4-1/2 mi of shore; boat survey	K. Frost
	5 Oct 81	6	"	"
GRAY WHALE				
Cape Mendenhall	7 May 81	5	swimming NW; aerial survey for herring	R. Baxter
Cape Mendenhall, NW of	7 May 81	2	"	"
Cape Mendenhall, 6 mi W	11 May 81	7	aerial survey	ADF&G herring survey
Cape Mendenhall	30 May 81	1	"	Ljungblad et al. 1982
	30 Jun 72	2	aerial survey for herring	R. Baxter
Nunivak Is., S side	7 May 81	2	swimming NW; aerial survey for herring	"
	7 May 81	3	"	"
	7 May 81	7	"	"
	1-5 Jun 79	12	feeding (?) near rocky shore; boat survey	Clarence Rhodes NWR 1979 Rep.
	11 Jun 76	3	swimming W; aerial survey	ADF&G herring survey
	Jul 72	2	aerial survey for herring	R. Baxter
Nunivak Is., SW end	7 May 81	1	swimming NW along coast; aerial survey for herring	"
	7 May 81	7	"	"
	7 May 81	4	"	"
Nunivak Is., W side	11 Jun 76	1	swimming N; aerial survey	ADF&G herring survey
Cape Mohican	7 May 81	1	swimming NW along coast; aerial survey for herring	R. Baxter
Cape Mohican, 7 mi S	11 May 81	2	aerial survey	ADF&G herring survey
Nunivak Is., N side	11 Jun 76	1	swimming NW; aerial survey	"
Mekoryuk River, mouth	25 Jun 78	1	20+ ft long	Ritchie 1978
Nunivak Is., E side	11 Jun 76	1	swimming N; aerial survey	ADF&G herring survey

Table 10. Sightings of coastal marine mammals in the Saint Matthew-Hall Basin, region SMH 3.

Location	Date	Number	Comments	Source
STELLER SEA LION				
Scammon Bay	20 May 81	1		J. Burns, Jr.
SPOTTED SEAL				
Kipnuk	Jul 73	few	scarce in summer until August, when they come down from N	W. Arvey
	spring - summer	present	haul out on offshore sandbars	C. Lensink
	spring-summer	many	"	J. Burns
Etolin Strait	late May 73	"many" present	spotted seals	W. Arvey
Baird Inlet to Hooper Bay	7 Jul 77	none	aerial survey for shorebirds	R. Gill/C. Handel
	12 Jul 79	none	"	"
	16 Jul 78	none	"	"
	2 Aug 79	none	"	"
	27 Aug 79	none	"	"
	6 Sep 78	none	"	"
	7 Sep 80	none	"	"
	20 Sep 79	none	"	"
	30 Sep 79	none	"	"
	3 Oct 81	none	"	"
	4 Oct 80	none	"	"
Tanunak	late May 73	present	spotted seals, pups present; peak hunting is in early May; seals move N in late May and early June	W. Arvey
	summer	present	present during herring runs, also through summer	"
Hooper Bay	Jan 77	present	harvested by residents	ADF&G harvest data
	Jan-Dec 75	present	"	"
	28 Jan 78	1 killed	female, tag return; tagged 12 Apr 71--57°48'N, 121°21'W	ADF&G files, Nome
	open-water months	present	haul out on extensive mud bars in this area	J. Burns

Table 10., continued

Location	Date	Number	Comments	Source
SPOTTED SEAL, cont.				
Hooper Bay, cont.	Mar-Nov 73	present	harvested by residents	ADF&G harvest data
	Mar-Nov 76	present	"	"
	Apr-Nov 74	present	"	"
	May-Dec 77	present	"	"
Dall Pt.	ice-free months	present	haul out on numerous rocks in this area	J. Burns
Scammon Bay, sandbars	Jun-Jul 78	± 1,000	hauled out	R. Pegau, from residents
Scammon Bay, offshore islands and sandbars	Jun	present	follow herring runs	W. Arvey
Yukon River, middle mouth	summers	some	hauled out on island	J. Burns, from resident
Yukon River	late summer, autumn	present	hunted in river	Wolfe 1981
Yukon R. to Kuskokwim R. mouth	general	--	no regular haulouts or rookeries	M. Smith
Black R., S of, to Pastol Bay	late summer, autumn	present	hunted by villagers from Sheldon Pt., Alakanuk, Emmonak, Kotlik	Wolfe 1981
WALRUS				
Kipnuk to Toksook Bay	14 Jun 77	40		L. Henslee
Cape Vancouver (Toksook R.)	Oct 78	present	hauled out	R. Tremaine
Anerkochik River - 1 mi up from mouth	1st week Jun 79	3		M. Smith
BELUKHA WHALE				
Kuskokwim River to St. Michael	midsummer-autumn	present	especially just offshore of mouths of Yukon	Nelson 1887
Kipnuk	spring	present	adults with young along coast; used to be large numbers (50 years ago)	R. Tremaine, from residents (1979)
Toksook Bay	fall 78	12 taken in fall hunt	"first time belukhas taken in 15 years"	R. Tremaine, from residents
Tanunak area	28 May 73	3		W. Arvey

Table 10., continued

Location	Date	Number	Comments	Source
BELUKHA WHALE, cont.				
Tanunak	Aug 79	present	in bay north and east of Tanunak during summer	R. Tremaine, from pilot in area
	autumn 78	present	12 harvested	ADF&G harvest data
Hazen Bay	spring	many	many at spring breakup	R. Tremaine, from residents of Tanunak
Hooper Bay	spring	present	no large pods this area since WW II	R. Tremaine, from residents
	spring - early summer	present	appear with king and chum salmon runs	T. Ponaganuk, resident Hooper Bay
	26 May - 12 Nov	present		Lensink 1961
	summer 77	present	30 reported taken by local residents	Seaman and Burns 1981
	summer 79	present	23 reported taken by local residents	"
Cape Romanzof	20 May 78	6 +	aerial survey for herring	D. Jonrowe/R. Baxter
Cape Romanzof area	20 May 78	79	"	"
Cape Romanzof, NE of	20 May 78	6 +	"	"
Black R. to Pastol Bay	late summer, autumn	present	hunted by villagers from Sheldon Pt., Alakanuk, Emmonak, and Kotlik	Wolfe 1981
Emmonak	May-Jun 80	present	3-4 taken in commercial fishery	J. Burns, Jr.
Yukon River, N, middle, and S mouths	May & Jun	large numbers	concentrated during salmon runs	C. Hunt
Yukon River, off mouth	13 Jul 81	100 +	feeding; aerial survey	D. Ljungblad
Yukon R. to Norton Sound	13 Jul 81	8-10	"	"
Yukon Delta, shallow waters of	last half Sep, early Oct	large numbers	feeding on tomcod	C. Hunt
Yukon estuary	8-14 Jun 76	18	mean group size of 1.6; aerial survey	Braham et al. 1980
Pastol Bay, W end	20 Jun 75	1		Harrison and Hall 1978
Pastol Bay, outer	12 Jul 81	present	aerial survey	Ljungblad et al. 1982
Pastol Bay	spring/ autumn	present	important hunting area	Ray 1964, 1975

Table 10., continued

Location	Date	Number	Comments	Source
HARBOR PORPOISE				
Hooper Bay	no date	1	"Probably also in Toksook and Kokechik bays and around Nunivak Island"	C. Hunt *
Alakanuk	28 May 81	1	caught in salmon net	B. Dinneford
GRAY WHALE				
Cape Vancouver	17 May 81	1	aerial survey	ADF&G herring survey

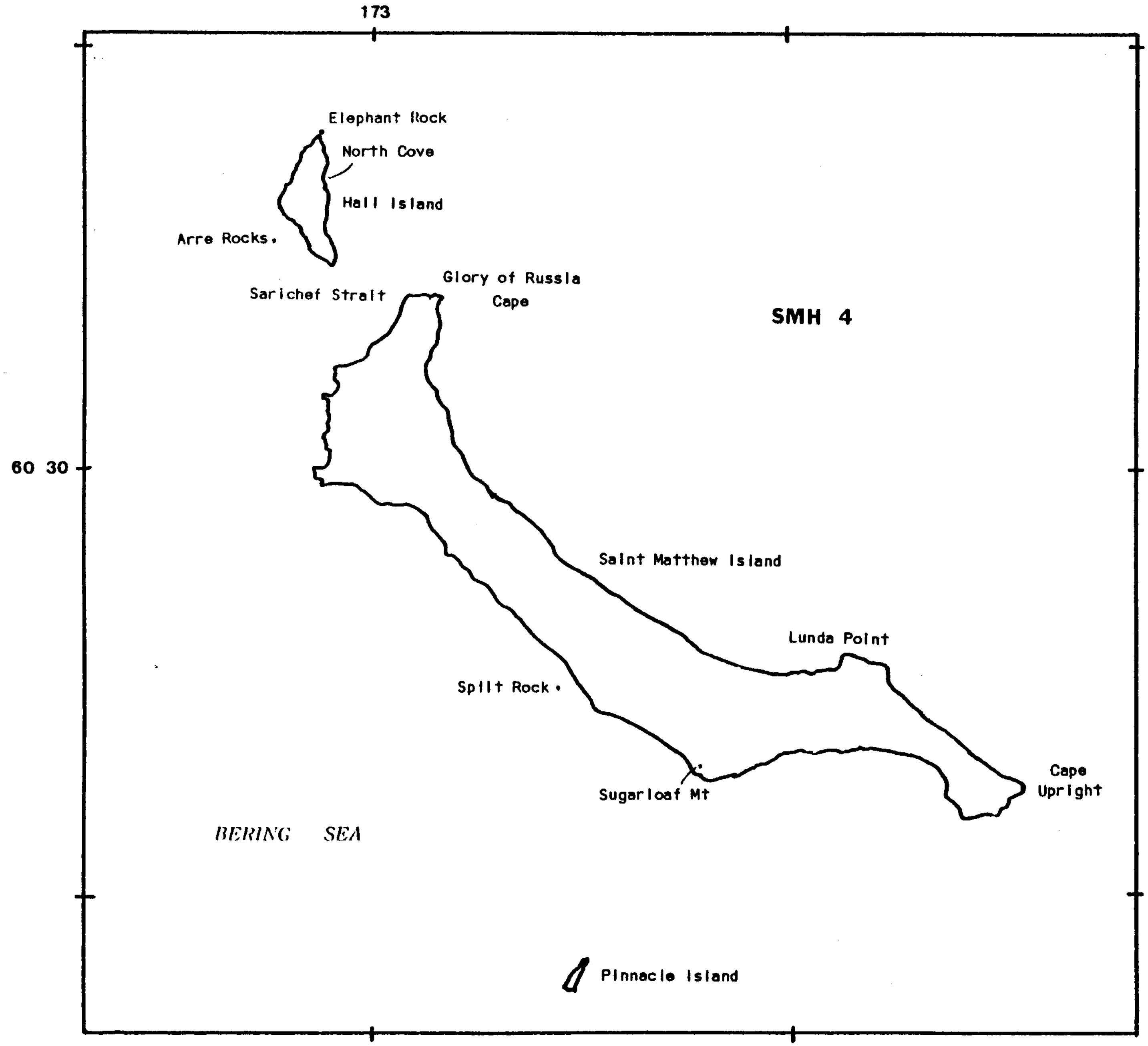

Figure 10. Map of the Saint Matthew-Hall Basin, region SMH 4.

Table 11. Sightings of coastal marine mammals on St. Matthew, Hall, and Pinnacle islands in the Saint Matthew-Hall Basin, region SMH 4.

Location	Date	Number	Comments	Source
Pinnacle Is.	26 Jul 76	no marine mammals		USFWS/SBCS Rep., C. Handel
STELLER SEA LION				
St. Matthew and Hall islands	8-14 Jul 1916	none		Hanna 1920
	Feb-Mar 60	none	aerial survey	Kenyon and Rice 1961
	summer	"several hundred"	arrive after mid-July	"
	summer 82	400-500		USFWS 1982 Field Party, A. Sowls
St. Matthew Is., S of Sugarloaf Mountain	22 May 82	50	in water	USFWS Field Party
St. Matthew Is., E of offshore rock near Lunda Pt.	5 Jun 82	1		"
St. Matthew Is., rock offshore of Cape Upright	8 Jun 82	90	maximum number seen; site used regularly	"
St. Matthew Is., N of Lunda Pt. on offshore rock	23 Jul 82	52	"	"
St. Matthew Is., Split Rock	28 Jul 82	20		"
St. Matthew Is., SE of westernmost point	28 Jul 82	13	on small offshore rock	"
St. Matthew Is., Cape Upright	2 Aug 60	100 +	hauled out	Kenyon and Rice 1961
Hall Is., Three Rivers	9 Jul 77	4	2 males on rocks, 1 female on beach, 1 male in water	USFWS/SBCS Rep., A. Degange/A. Sowls
Hall Is., Arre Rocks	16 Jul 82	150		USFWS Field Party
Hall Is., North Cove	2 Aug 82	75	on offshore rocks	"
Hall Is., 2 mi S Elephant Rock	9 Aug 57	350	hauled out; no pups; all adults or subadults	Kenyon and Rice 1961
Pinnacle Is.	16 Mar 79	100	hauled out on rocky beach; aerial survey	B. Kelly
	22-23 Sep 80	150-200	aerial survey	USFWS Walrus Survey maps
SPOTTED SEAL				
St. Matthew Is.	summer 82	400-500		USFWS Field Party

Table 11., continued

Location	Date	Number	Comments	Source
SPOTTED SEAL, cont.				
St. Matthew Is., E of Sugarloaf Mountain	2 Jul 82	300	maximum number seen; site used regularly; at river mouth	USFWS Field Party
St. Matthew Is.	18 Jul 77	± 17	hauling area	USFWS/SBCS Rep., A. Degange/A. Sowls
St. Matthew Is., E of Sugarloaf Mountain	18 Jul 82	100	maximum number seen; site used regularly; offshore rock	USFWS Field Party
St. Matthew Is., S end Lunda Pt.	20 Jul 77	present	hauling area	USFWS/SBCS Rep., A. Degange/A. Sowls
St. Matthew Is., Walrus Cove	28 Jul 82	4	maximum number seen; regularly saw seals < 100 m from shore	USFWS Field Party
St. Matthew Is., westernmost point	28 Jul 82	6	in water	"
St. Matthew Is., point SE of Lunda Pt.	30 Jul 82	18	on offshore rock	"
St. Matthew Is., E of Lunda Pt.	30 Jul 82	28	on intertidal reef	"
St. Matthew Is., Cape Upright	13 Aug 73	22	hauled out and in water; one collected was a spotted seal	J. Burns
St. Matthew Is., cape W of Cape Upright	22-23 Sep 80	200	hauled out; aerial survey	USFWS Walrus Survey maps
Hall Is., SW side	9 Jul 77	100 +		USFWS/SBCS Rep., A. Degange/A. Sowls
WALRUS				
St. Matthew Is.	27 May 78	2	males; halfway up N side; aerial survey	F. Fay
St. Matthew Is. near Cape Upright	autumn 81	110	on beach; hauled out	Alaska Maritime NWR 1981 Rep.
St. Matthew Is., Walrus Cove (W of Cape Upright)	summer 82	160	maximum count; hauled out; observed feeding nearby	D. Irons
St. Matthew Is., S of Glory of Russia Cape	22-23 Sep 80	80	in water; aerial survey	USFWS Walrus Survey maps
St. Matthew Is., Lunda Bay	summer 82	180	hauled out; maximum count; observed feeding nearby	D. Irons
Hall Is.	22-23 Sep 80	60 in water 550 hauled out	aerial survey	USFWS Walrus Survey maps

Table 11., continued

Location	Date	Number	Comments	Source
WALRUS, cont.				
Hall Is., North Cove	Jul-Aug 82	80	maximum count, 5 censuses	D. Irons
GRAY WHALE				
St. Matthew Is. area	27 Jun - 25 Jul 77	8 sightings of 12 individuals	most traveling N or NW; 1 (16 Jul) traveling S	USFWS/SBCS Rep. A. Degange/A. Sowls
Sarichef Strait (between St. Matthew and Hall islands)	3 Aug 60	4		Rice and Wolman 1971
St. Matthew/Hall Is. area	summer 82	present	"observed frequently in late May and early June, often feeding < 1 km from shore"	D. Irons

mouth of the Yukon. The largest reported sighting was of about 1,000 seals hauled out on the sandbars near Scammon Bay in June-July 1978. At Tanunak and Scammon Bay, spotted seals arrive during the herring runs and remain through the summer. At Hooper Bay, spotted seals are hunted by local residents in all months of the year but are taken in greatest abundance in July through October.

Both St. Matthew and Hall Islands have been reported as hauling areas for spotted seals during summer and autumn. About 100 seals were hauled out on the southwest side of Hall Island in July 1977. The largest number reported from St. Matthew was 250-300 hauled out on the rocks and islands to the east of Sugarloaf in summer 1982. About 200 were seen west of Cape Upright in September 1980.

No confirmed sightings or collections of harbor seals have been made at St. Matthew Island. However, it is probable that they are occasionally present in late summer and autumn.

Walrus

Walruses occasionally haul out in Kuskokwim Bay. In November 1978 several hundred hauled out for about 2 weeks on the beach at the mouth of Goodnews Bay. About 500 were reported at Kwigillingok in June 1968. A single animal was seen at Carter Bay in April 1981. North of Kuskokwim Bay, walruses were sighted three times from 1977 through 1979, twice in June and once in October. The largest sighting was of 40 animals along the coast from Kipnuk to Toksook Bay in June. Other sightings were at Cape Vancouver and about 2 km up the Anerkochik River.

Walruses haul out in summer and autumn on both St. Matthew and Hall islands. In September 1980, over 500 were hauled out on Hall Island. On St. Matthew, groups of about 100 have been reported near Glory of Russia Cape, Cape Upright, and Lunda Bay. In summer 1982, haulouts at Walrus Cove and Lunda Bay were used continuously by up to 160-180 walruses on each.

Belukha Whale

In Kuskokwim Bay in recent years, belukhas have only occasionally been sighted near Quinhagak. A few were seen and hunted there in summer 1977 and 1978. In the early to mid-1900's they were reportedly common near Quinhagak, Goodnews Bay, and Jacksmith Bay.

*Belukhas are present around Nunivak Island during the ice-free months, but the degree of use at different times of the year is unclear. They may be more common around the island during autumn when there is a tendency for the whales to use offshore waters. Historically, belukhas were occasionally caught during autumn in nets designed to catch seals.

Belukhas are present along the coast from northern Kuskokwim Bay to the mouths of the Yukon in spring through autumn. The earliest reported sighting was on 20 May 1978 near Cape Romanzof and the latest at about freeze-up time in early to mid-November at Hooper Bay. Belukhas are often sighted and occasionally hunted by residents of Kipnuk, Toksook Bay, Tanunak, and Hooper Bay, where they are apparently more common in spring and autumn than in midsummer. They concentrate off the mouths of the Yukon River from May or June until about early October, feeding on salmon (*Oncorhynchus* spp.), herring (*Clupea harengus*), and saffron cod (*Eleginus gracilis*). The largest sighting was of over 100 animals feeding off the river mouth in July 1981.

Harbor Porpoise

A single sighting of "many" harbor porpoises was made off Quinhagak in July 1972.

Harbor porpoises have been reported off the south and east sides of Nunivak Island. Sixteen were seen feeding on capelin (*Mallotus villosus*) near Little Cape Corwin in June 1979. A few were present on the south side in July 1982.

We located only two confirmed sightings of harbor porpoises along the coast north of Kuskokwim Bay. One was on an unknown date at Hooper Bay, and the other was an animal caught in a salmon net in late May at Alakanuk. Harbor porpoises are probably present along most of this coastline.

Minke Whale

Minke whales were reported near Little Cape Corwin in June 1979, when they were observed feeding on capelin, and near Cape Mendenhall in October 1981.

Gray Whale

We located only three sightings of gray whales in Kuskokwim Bay. A single whale was seen chasing a school of herring north of Goodnews Bay in May 1978. Another gray whale was seen in July 1972 off Quinhagak. Five were seen swimming west about 36 km southwest of Kwigillingok in late May 1981.

Gray whales are commonly seen swimming in a northwesterly direction along the southern coast of Nunivak Island from Cape Mendenhall to Cape Mohican in May and June. Occasional sightings have been made on the north and east sides in June. These animals were also swimming north or northwest.

A single gray whale was sighted at Cape Vancouver on 17 May 1981. We have no other records of sightings along the mainland coast between Kuskokwim Bay and Norton Sound.

Gray whales have been seen and reported in June-August near St. Matthew Island.

D. Norton Basin (Figures 11-15; Tables 12-17)

Steller Sea Lion

Sea lions are uncommon in the Norton Sound region, where rocky headlands and islands (typical sea lion haulouts) are scarce. A single sea lion was reported from Cape Denbigh on 14 June 1981. Two subadult males were sighted in northern Norton Sound in early June 1981, one at Topkok Head and one east of Chiukak. Both were hauled out on the rocks.

Sea lions, probably males only, are present around St. Lawrence Island and the Punuk Islands in summer and autumn. About 200 were reported from the Punuks in late September 1953. In 1981, residents reported that sea lions still hauled out on the Punuks in autumn. However, none hauled out there from 28 September to 4 December 1981. On St. Lawrence Island, sea lions haul out during open-water months near Southwest Cape, Southeast Cape, and along the north-central coast east of Savoonga. There are no recent counts from any of these areas. In late September 1953, about 1,000 were hauled out at Southwest Cape.

Sea lions are irregular visitors to the Diomede Islands and Fairway Rock in late summer and early autumn.

Spotted Seal

Spotted seals are present along the inner Norton Sound coast from the time the ice breaks up in spring until freeze-up. They have been reported in association with herring schools near Stebbins (Stuart Island), St. Michael Island, St. Michael Bay, and Shaktoolik in May and June. The largest sighting was of about 500 seals hauled out on the ice near St. Michael Island during the herring run in early May 1981. Spotted seals are hunted in the autumn by residents of Stebbins. The seals were quite numerous in southern Norton Bay at freeze-up in early October 1981.

Spotted seals are present in the Golovnin Bay area from breakup in June until freeze-up in November but are most numerous and visible in late summer and autumn. They haul out near Cape Darby, Carolyn Island, and Rocky Point. The largest sightings were in late September 1981, when 100-150 seals were present near Rocky Point and about 200 were hauled out and in the water near Carolyn Island. From Rocky Point to the Sinuk River west of Nome, spotted seals are abundant during their spring and autumn migrations but are less common or at least less visible during summer. Most sightings are from mid-May to mid-June and mid-November to mid-December, when the seals are hunted by local residents.

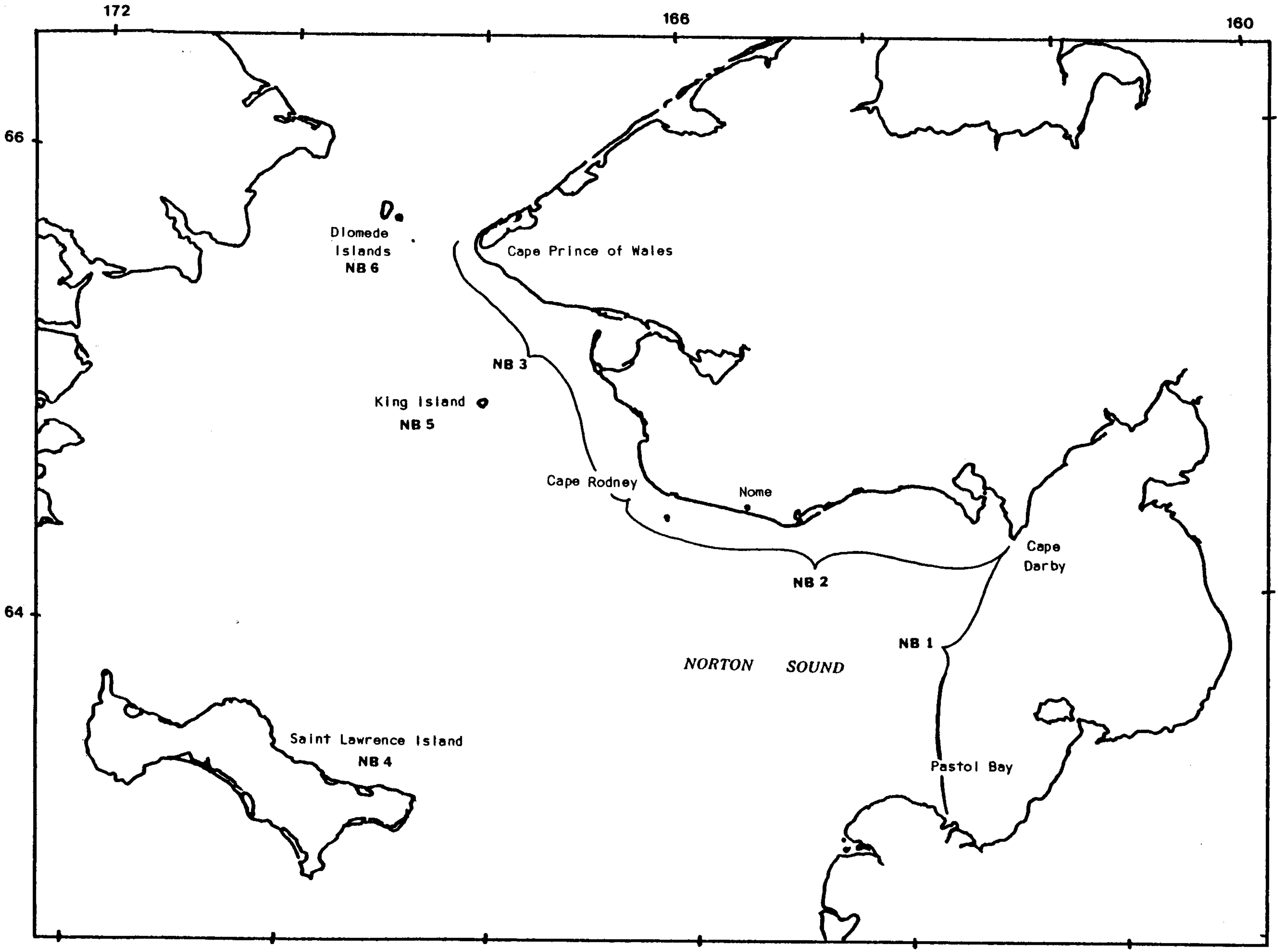

Figure 11. Map of the Norton Basin planning area showing subdivisions used in data compilation.

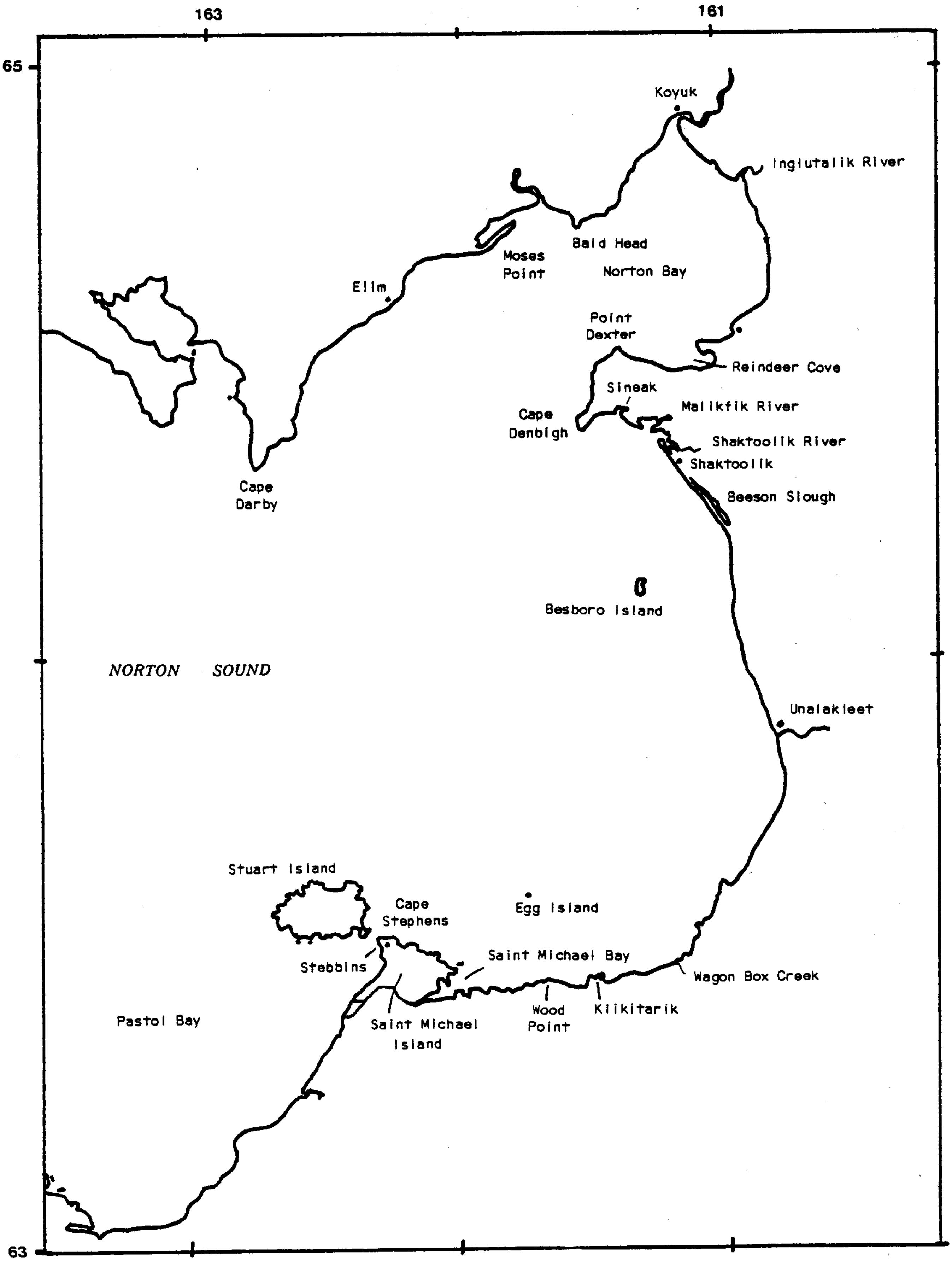

Figure 12. Map of the Norton Basin, region NB 1.

Table 12. Sightings of coastal marine mammals in the Norton Basin, region NB 1.

Location	Date	Number	Comments	Source
STELLER SEA LION				
Cape Denbigh	14 Jun 81	1	"reliable observer," aerial survey	ADF&G herring survey
SPOTTED SEAL				
Pastolik R. mouth to Egg Is.	late summer, autumn	present	hunted by villagers from Stebbins	Wolfe 1981
Stebbins/Stuart Is.	June	many	present during herring run	K. Frost, from residents
Stebbins	autumn	present	hunting occurs	"
St. Michael Is., Rock Pt. area	8 May 81	± 500	hauled out; also on ice and near herring; aerial survey for herring	L. Schwarz
St. Michael Bay	9 Jun 78	2	in water; aerial survey for herring	L. Barton
Besboro Is., N end	ice-free months	present	haul out on sand beach	Thomas 1982
Beeson Slough	autumn	present	hunted	"
Shaktoolik R. to Sineak R.	autumn	present	feeding on saffron cod	"
Shaktoolik	30 May 79	3	in water; aerial survey for herring	L. Barton
Point Dexter, E of	2 Oct 81	30 +	hauled out on ice; boat survey	K. Frost
Reindeer Cove	autumn	present	feeding on herring	Thomas 1982
Moses Point to Bald Head	summer, autumn	present	haul out on beaches when they vacate Besboro Is. due to arrival of walruses	"
WALRUS				
Egg Is.	Jun 71	200-300	hauled out	J. Burns
Besboro Is.	Jun-Jul 63	200-400	hauled out; hunted	"
	Jun-Jul 71	small number	hauled out	"
	7 Jul 64	none	aerial survey	ADF&G files, Nome
	Aug 61	200	hauled out, adult and subadult males	Burns 1965
	summers 80 and 81	100 +	hauled out	Thomas 1982

Table 12., continued

Location	Date	Number	Comments	Source
WALRUS, cont.				
St. Michael to Shaktoolik	2 Aug 62	20-25		J. Burns
Cape Denbigh	13 Jun 81	1	aerial survey	ADF&G herring survey
Norton Bay	spring 79	"large numbers, 1000 +"	not present every year	Thomas 1982
	spring 80	some		"
BELUKHA WHALE				
Norton Sound, western	17 May 81	34	aerial survey	Ljungblad et al. 1982
Norton Sound, central area	26 Jun 76	4	"	Harrison and Hall 1978
Pastolik R. mouth to Egg Is.	late summer, autumn	present	hunted by villagers from Stebbins	Wolfe 1981
Cape Stephens	17 May 81	5	near herring schools; aerial survey for herring	L. Schwarz
Stuart Is., W of	22 Jun 81	12	aerial survey	Ljungblad et al. 1982
Stuart Is., 20 mi N	23 Jun 81	40		R. Nelson
Stebbins	mid-Jun 79	present	7-8 taken	R. Tremaine
	summer 76	present	caught 1 in salmon net	K. Frost, from residents
	spring 79	present	hunted	J. Burns
	mid-Oct 80	present	2 taken	R. Nelson
	mid-Nov 79	some	hunted	"
	mid-Nov 79	present	several taken (2-10)	J. Burns
St. Michael, E of	30 May 79	2	aerial survey for herring	L. Barton
St. Michael	30 May 81	1	taken in fish net	G. Seaman
	spring-autumn	present	appear with earliest king salmon runs	J. Burns
	5-10 Jun	present	first of the year appear after ice goes out of inner bays; arrival coincides with herring spawning	Nelson 1887
	7 Jun 81	present	11 taken by hunters mid-April through the summer	G. Seaman

Table 12., continued

Location	Date	Number	Comments	Source
BELUKHA WHALE, cont.				
St. Michael, cont.	9 Jun - 10 Nov	present		Lensink 1961
	midsummer-autumn	present	feeding on saffron cod	Nelson 1887
Wood Pt. (10 mi E St. Michael Bay)	30 May 79	1	aerial survey	ADF&G herring survey
Klikitarik (E St. Michael)	late Apr	present	eating herring	L. Schwarz, from residents
Wagon Box Creek (24 mi E St. Michael)	30 May 79	1	aerial survey	ADF&G herring survey
Unalakleet	21 Jun 81	5 or 6	offshore	R. Nelson
	spring-autumn	present	few in Jul, Aug	G. Seaman
Besboro Is. to Shaktoolik	Apr-Jun Sep-Oct	present	including Beeson Slough	Thomas 1982
Besboro Is.	10 Jun 79	6-8	feeding on herring	R. Nelson
	mid-Jun	present	"	local pilots
Shaktoolik	early Apr	present	appear as ice breaks up	G. Seaman
	late May - early Jun 82	present	hunted	J. Burns
	Sep-Oct	present	"	"
	ice-free months	present	hunted only in spring and autumn; may remain until November	Thomas 1982
Shaktoolik to Cape Denbigh	ice-free months	present	hunted by Shaktoolik villagers	"
Cape Denbigh to Pt. Dexter, Reindeer Cove	ice-free months	present	hunted spring and autumn	"
Cape Denbigh	Apr	present	appear as ice breaks up	G. Seaman, from residents
	2 Jun 81	12-18	aerial survey	ADF&G herring survey
Cape Denbigh, N of	21 Jul 77	2	"	"
Pt. Dexter, SW of	28 May 81	94 counted	eating herring; aerial survey for herring	L. Schwarz
	21 Jul 77	2	aerial survey for herring	L. Barton

Table 12., continued

Location	Date	Number	Comments	Source
BELUKHA WHALE, cont.				
Norton Bay	Apr-Jun Sep-Oct	present	hunted by Shaktoolik residents who say more whales are here than near Cape Denbigh	Thomas 1982
Norton Bay between Bald Head and Pt. Dexter	2 summers in 1970's	50-75	nearshore	W. Drury
Norton Bay	approx. 10 Jul 79	some	hunted; at least 3 taken	R. Nelson, from Koyuk resident
Inglutalik River mouth	spring-autumn	present	important belukha hunting area	Ray 1964, 1975
Koyuk	May-Sep	present		G. Seaman, from residents
	Jun-early Oct	present	traditionally important hunting area; hunted Jun-Jul and Sep-Oct	J. Burns, from residents
	approx. 10 Aug 79	present	2 taken in Norton Bay	J. Burns
Elim	early Jun 77	present	3 taken	K. Frost
	Jun-Oct	present	traditionally important hunting area; hunted Jun-Jul and Sep-Oct	J. Burns, from residents
HARBOR PORPOISE				
Unalakleet	17 Jun 81	1	caught in salmon net, female	R. Nelson

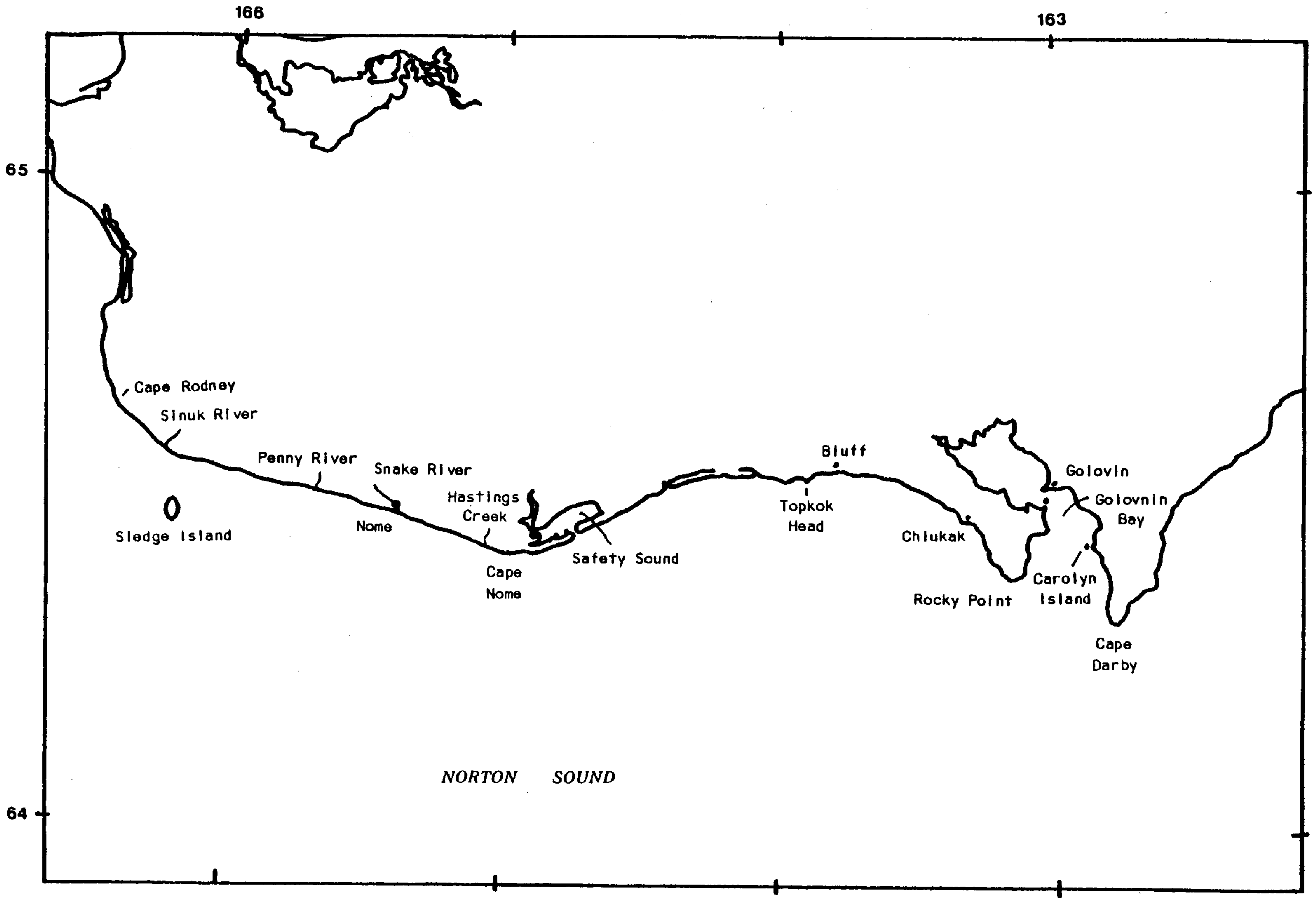

Figure 13. Map of the Norton Basin, region NB 2.

Table 13. Sightings of coastal marine mammals in the Norton Basin, region NB 2.

Location	Date	Number	Comments	Location
STELLER SEA LION				
Chiukak, E of	3 Jun 81	1	male, 1-2 years old, hauled out on rock	L. Lowry
	6 Jun 81	1	same animal as 3 Jun, hauled out on rock	"
Topkok Head	3 Jun 81	1	male about 2 years old, hauled out on rock	"
Sledge Is.	Jul-Sep	present	Nome residents report irregular sightings	J. Burns
SPOTTED SEAL				
Golovnin area, Cape Darby	6 Jul 81	2	aerial survey	Ljungblad et al. 1982
Golovnin area, Rocky Pt., SW of	13 Jun 78	1	in water; aerial survey for herring	L. Barton
Golovnin area, Rocky Pt.	12 Jul 81	100 +	hauled out; also along coast from W of Rocky Pt. to E of Cape Darby and in Golovnin Bay	R. Nelson
Golovnin area, Rocky Pt., W of	14-18 Aug 81	± 20		L. Lowry
Golovnin area, Carolyn Is.	14-18 Aug 81	15-20		"
Golovnin area, Rocky Pt.	24-25 Sep 81	100-150	most in water near and NE of point; few hauled out on rocks at point and W	"
	30 Sep 81	100 +	most in water feeding on saffron cod; boat survey	J. Burns/K. Frost
Golovnin area, Carolyn Is.	1 Oct 81	200 +	hauled out and in water; boat survey	"
Golovnin Bay, central	30 Sep - 1 Oct 81	100 +	in water; boat survey	"
	1, 2 Oct 66	9	hauled out; small, young animals	R. Baxter
Golovnin area, Rocky Pt., NW side	3 Oct 76	20-30	hauled out and in water; no seals east of point or by Cape Darby; boat survey	K. Frost
	5 Oct 76	± 15	in water; boat survey	"
Golovin	11 Oct - 2 Nov 72	present	hunted	J. Burns

Table 13., continued

Location	Date	Number	Comments	Source
SPOTTED SEAL. cont.				
Golovnin area, Rocky Pt.	29 Oct 81	18	hauled out on rocks at point and NE; aerial observations	R. Nelson
	1 Nov 66	present	hunted	J. Burns
	16 Nov 81	2	diving	R. Nelson
Topkok Head	occasional	present	not used on regular basis	J. Burns
Safety Sound	27 May 78	5	in water; aerial survey for herring	L. Barton
	summer-autumn	present	used sound before road was open; use now especially when road closed; most use in autumn	J. Burns
Cape Nome	30 May 78	2	in water	"
Cape Nome and Hastings	29 Nov 65	"numerous"	not evenly distributed; pass through about same time each year	"
Nome	mid-May - mid-Jun 67	present	hunted	"
	Nov, Dec 1963-1974	present	"	"
Sledge Island	summer-autumn	present max. 25-35 in early Nov	intermittent over many years; haul out here when not disturbed by hunters; on spit at N end (low, flat sand point)	"
	Jun 68	present	hunted	"
Sinuk River	summer-autumn	present	present during pink salmon runs; no observations of haulout; they frequent river mouth and small estuary inside the bar	"
WALRUS				
Golovnin area, Cape Darby	2 Jun 81	50	hauled out on rocks, hunted	D. Amatoolik
	4 Jun 81	1	hauled out	L. Lowry
Golovnin area, Cape Darby, E side	5 Jun 81	1	swimming; young male	"

Table 13., continued

Location	Date	Number	Comments	Source
WALRUS, cont.				
Golovnin area, Cape Darby	22 Jun 79	7	hauled out	R. Nelson
Chiukak, E of	6 Jun 81	1	adult male; hauled out, then shot	L. Lowry
Cape Nome	13 Jun 78	1	in water; aerial survey for herring	L. Barton
Nome	14 Oct 75	1 adult male	in water outside jetty	J. Burns
Sledge Is., N side	16 Jul 71	950 - 1,050	hauled out; all males	"
	summer 76	some	hauled out	USFWS/SBCS Rep., W. Drury
	Jun-Aug 80, 81	2-3	hauled out all summer; bulls	R. Nelson
BELUKHA WHALE				
Golovnin area, Cape Darby	29 Apr 79	present		Ljungblad et al. 1981
Golovnin area, Carolyn Is., near	30 May 78	4	aerial survey	ADF&G herring survey
Golovnin area, Rocky Pt.	30 May 78	5	"	"
Golovnin area, Rocky Pt., NW of	30 May 78	9	aerial survey for herring	L. Barton
Golovnin area, Rocky Pt., S of	17 Jun 77	1	aerial survey	ADF&G herring survey
Golovnin area, Rocky Pt.	30 Sep 81	70	feeding on saffron cod; boat survey	K. Frost
Golovnin area, Rocky Pt., 3 mi off	1 Oct 81	25-55	all sizes present from small gray to large white; boat survey	"
Cape Darby, N, mouth of Golovnin Bay	3 Oct 76	25-30	calves with group; boat survey	"
Golovnin Bay	spring-autumn	present	important hunting area	Ray 1964, 1975
	spring-autumn	present	historically common	Golovin residents
	late May-Jun	present	following herring schools	Giddings 1964, 1977
Bluff, S of	17 Jun 77	1	aerial survey	ADF&G herring survey
Topkok Head to Bluff	5 Sep 81	± 150	approx. 1/2 mi offshore, feeding; pods of 4-9 animals	R. Nelson

Table 13., continued

Location	Date	Number	Comments	Source
BELUKHA WHALE, cont.				
Cape Nome	ice-free period	present	most common early summer, autumn	Ray 1964
Cape Nome, W of	21 Apr 81	present	aerial survey	Ljungblad et al. 1982
Cape Nome, SE of	Jun 76	5		W. Drury
Cape Nome	9 Jul 62	2	caught in fish nets	J. Burns
	Nov 77	150-200	moving by	ADF&G files
	19 Nov 80	10	active feeding	R. Nelson
	19 Nov 80	75	feeding	"
	29 Nov 79	± 250	2 pods, came from W, milled near cape, then headed S	H. Wilkalkia
Nome	5-6 May 79	present	seen in ice	R. Tremaine
	6 May 79	present	between Nome and Sledge Is.	J. Burns
	11 May 81	1	killed by hunter	R. Nelson
	approx. 14 May 79	present	1 taken	R. Tremaine
	10 Jun 79	4	no gray animals	R. Nelson
Nome, W of Snake R. mouth	7 Jun 82	30	feeding, then moved eastward; approx. 50% younger animals	"
Nome, W of	21 Jul 77	1 adult, 1 juvenile	moving W, aerial survey for herring	L. Barton
HARBOR PORPOISE				
Nome, 26 mi E of	8 Jun 81	1 female	caught in salmon net	R. Nelson
Nome, E of Fort Davis	22 Jul 71	1	"	J. Burns
Nome	26 Sep 81	3	swimming; ship observation	L. Lowry
Penny River	23 Aug 82	1	caught in salmon gillnet; male	R. Nelson

Table 13., continued

Location	Date	Number	Comments	Source
MINKE WHALE				
Golovnin Bay, mouth of	5 Jun 81	2	feeding; capelin visible in water	L. Lowry
Golovnin area, Cape Darby	6 Jun 81	1		"
Golovnin Bay, mouth of	6 Jun 81	1		"
	6 Jun 81	1		"
Golovnin area, Rocky Pt.	1 Oct 81	1	swimming out of Golovnin Bay; boat survey	J. Burns
GRAY WHALE				
Nome, SE of	May 80	6	within 1 km of beach	Ljungblad et al. 1981
Nome area	18 May 80	15	offshore for several hours	USFWS Walrus Harvest rep.
	19-20 Jun 78	± 12	nearshore	H. Melchior
Cape Nome	4 Jul 62	1	caught in fish net	J. Burns
	9 Jul 81	1	swimming W	R. Nelson
Nome	14 Oct 75	1 ("huge")	remained in area for approx. 1 hour, 20 yards offshore	J. Burns
Nome, W, midway to Sledge Is.	24 Jun 81	4		R. Nelson

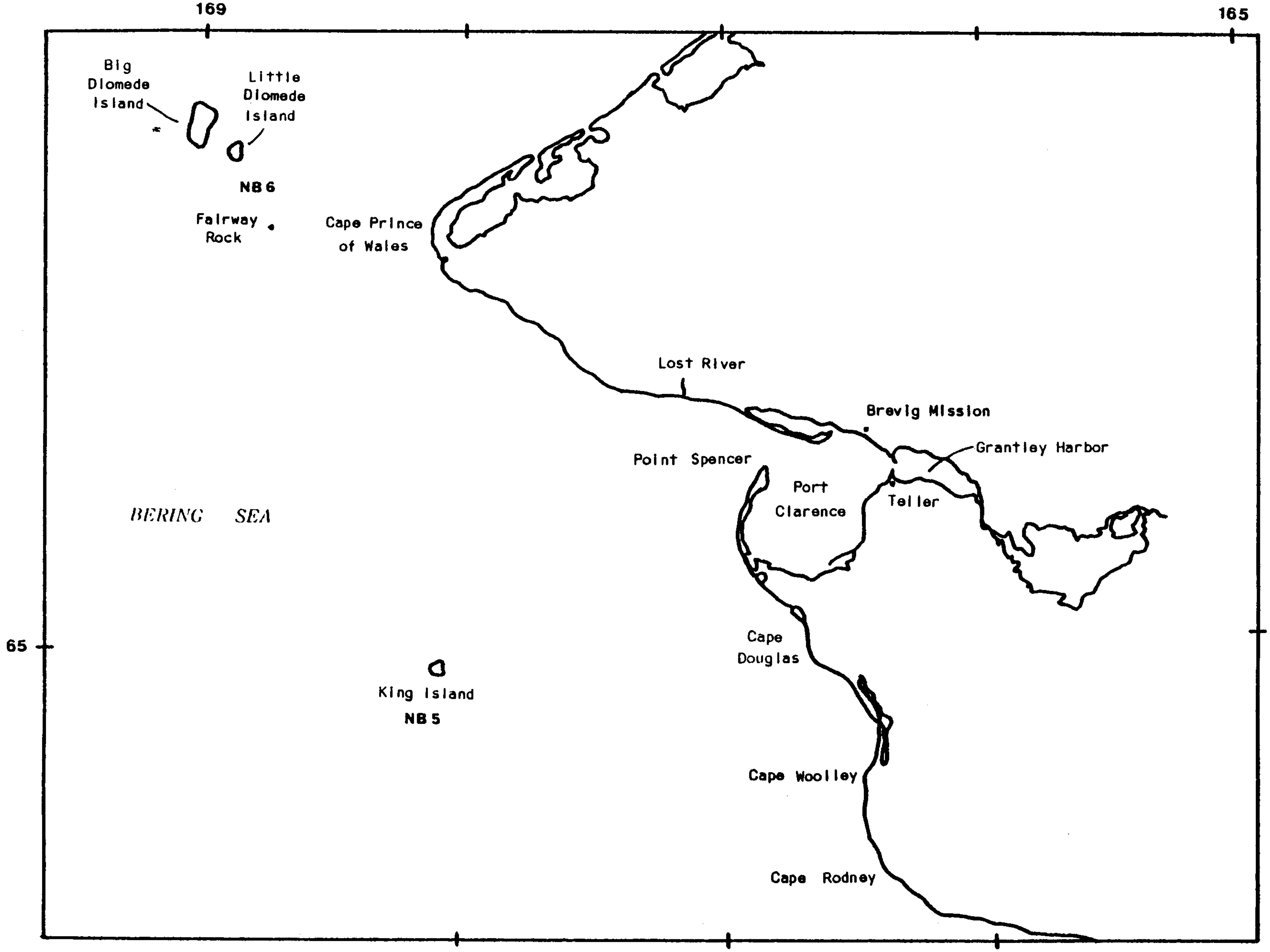

Figure 14. Map of the Norton Basin, regions NB 3, 5, and 6.

Table 14. Sightings of coastal marine mammals in the Norton Basin, region NB 3.

Location	Date	Number	Comments	Source
SPOTTED SEAL				
Cape Rodney	early Nov 66	present	hunted	J. Burns
Cape Woolley area	8-9 Jun 63	7 killed		ADF&G files, Nome
	14 Aug 72	present	hunted	J. Burns
	autumn	numerous	numerous every autumn, mainly on ocean side	"
Cape Woolley, west entrance	16, 17 Sep 67	90	W side of inlet, many subadults; hunted	"
Cape Woolley, east entrance	16-18 Sep 67	up to 150	hauled out inside entrance; probably ± 200 more in water within 1/2 mi of beach on ocean side	"
Cape Woolley area	20 Sep 71	present	hunted	"
	5 Oct 66	numerous	at mouth of Feather R.	"
	5 Nov 68	present	hunted	"
	mid-Nov 69	present	at mouth of Feather R. and at cape; hunted	"
Cape Woolley	18, 19 Nov 70	present	hunted	"
Cape Douglas	20 Jun (no year)	large concentration		ADF&G files, Nome
Port Clarence	all summer; autumn until freeze-up	present	sometimes penetrate into Imuruk Basin; most obvious in largest numbers at breakup in May-Jun (on rotten ice) and hauled out on mud flats, mainly S side from Sep to freeze-up; taken by hunters of Teller and Brevig Mission	J. Burns
	23 Aug 69	present	first of summer	W. Foster
	29 Aug - 25 Sep 69	present	hunted	J. Burns
Pt. Spencer to Teller	22 Sep 81	4	only seals seen	L. Lowry
	19 Oct 66	many	all sizes	J. Burns
Teller	Sep-Nov 1966-1972	present	hunted	"
Brevig Mission	Oct-Dec 72	present	"	"
Grantley Harbor	31 Aug 69	present	"	"

Table 14., continued

Location	Date	Number	Comments	Source
BELUKHA WHALE				
Lost River, S of	21 Jul 76	1	aerial survey	ADF&G herring survey
Port Clarence	Jun-Jul	present	appeared with schools of spawning herring	Ray 1964, 1975
	Jun-Jul	small numbers	occasional	G. Seaman, from residents
Grantley Harbor	Jun-Jul	historically common	appeared with schools of spawning herring and salmon runs	Ray 1964, 1975
	Jun-Jul	small numbers	occasional	G. Seaman, from residents
HARBOR PORPOISE				
Cape Woolley	Aug-Oct	present	reported as occasional late summer-autumn visitors	E. Muktoyuk
	6 Oct 66	2		J. Burns
	14 Oct 76	3	perhaps feeding; swimming slowly S	L. Lowry
GRAY WHALE				
Cape Douglas	15 Jun 81	3	2 more than 50 ft long; aerial survey	ADF&G herring survey
Cape Prince of Wales, 5 mi S of	15 Jun 81	2	aerial survey	"
Cape Prince of Wales	1 Jul 77	30-50	appeared to be feeding	K. Frost

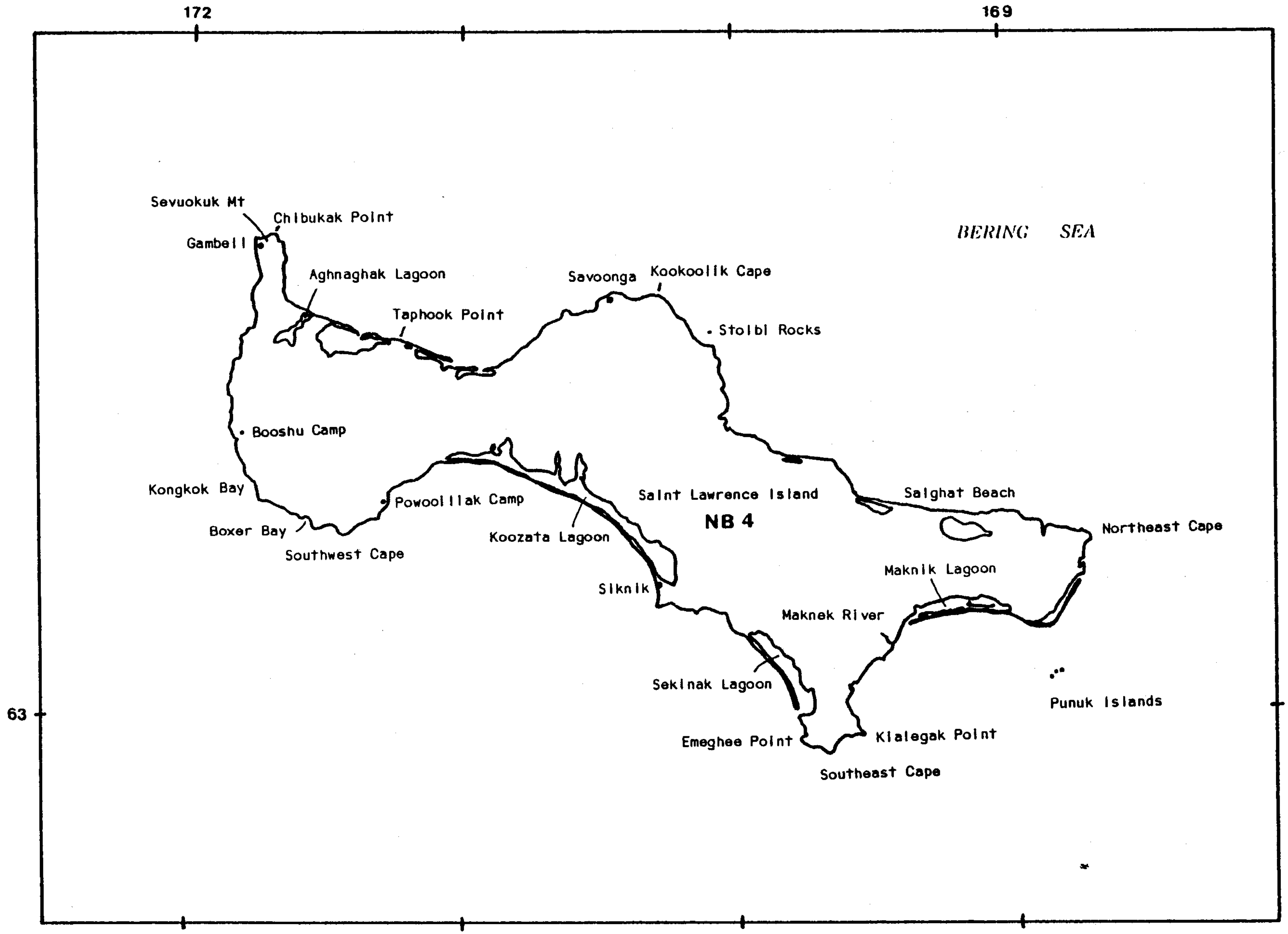

Figure 15. Map of the Norton Basin, region NB 4.

Table 15. Sightings of coastal marine mammals around St. Lawrence Island and the Punuk Islands in the Norton Basin, region NB 4.

Location	Date	Number	Comments	Source
STELLER SEA LION				
Punuk Islands	29 Jun 79	2	immatures, hauled out on rocky SE shore of South Island; shore observation	B. Kelly
	autumn	present	haulout	R. Stephenson, from residents
Punuk Islands, southernmost island	28-29 Sep 53	200	hauled out, molting; presumed to be all males	Kenyon and Rice 1961
Punuk Islands	28 Sep - 4 Dec 81	none		B. Kelly
	1 Nov 64	1	hauled out; usually leave by late August	J. Burns
St. Lawrence Is.	Feb-Mar 60	none	aerial survey	Kenyon and Rice 1961
St. Lawrence Is., E and W of Southwest Cape	open-water months	present	haulout	R. Stephenson, from residents
St. Lawrence Is., Southwest Cape	summer	present	haulout	B. Kelly, from residents
St. Lawrence Is., Stolbi Rocks	summer	present	haulout	R. Stephenson, from residents
St. Lawrence Is., Southwest Cape, rocks offshore and south Punuk	late Jun - Nov 53-59	variable numbers	regular visitors; individuals and groups of 5 or 6; greatest number arrive in Sep, depart in Nov when ice comes	Kenyon and Rice 1961
St. Lawerence Is., Kookoolik Cape	July	present	haulout	R. Stephenson, from residents
St. Lawrence Is., Southwest Cape	25 Sep 53	± 1,000	hauled out on offshore rocks and beach; molting; presumed to be all males	Kenyon and Rice 1961
SPOTTED SEAL				
St. Lawrence Is., Gambell	Feb - Jun; Oct - Nov	numerous	hunted in water or on ice; migrating	J. Burns
St. Lawrence Is., Savoonga	Apr - Jun; Oct - Nov	present	"	"
St. Lawrence Is., Northeast Cape	ice-free months	present		R. Stephenson, from residents
St. Lawrence Is., Boxer Bay	ice-free months	present	occasionally abundant	J. Burns

Table 15., continued

Location	Date	Number	Comments	Source
SPOTTED SEAL, cont.				
St. Lawrence Is., Koozata Lagoon	ice-free months	present	occasionally abundant	J. Burns
St. Lawrence Is., S side	ice-free months	present	haul out on rocks and bars along entire S side	"
St. Lawrence Is., Siknik Cape, S of point on tiny island	ice-free months	"100's"	1 of 3 major haulouts	F. Fay
St. Lawrence Is., Southeast Cape to Kialegak Pt.	ice-free months	"100's"	on rocks; 1 of 3 major haulouts	"
St. Lawrence Is., Southeast Cape to N of Kialegak Pt. (also W to Emeghee Pt.)	summer	present		R. Stephenson, from residents
St. Lawrence Is., Sekinak Lagoon, rocks and shoals S of	ice-free months	"100's"	1 of 3 major haulouts	F. Fay
St. Lawrence Is., Sevuokuk Mt. to about Aghnaghak Lagoon	autumn	present	few in summer	R. Stephenson, from residents
St. Lawrence Is., Southwest Cape E to Powooiliak Camp, W to Booshu Camp	ice-free months	present		"
WALRUS				
Punuk Islands	1930's		"some, all summer; but not every year	L. Kulukhon
	30 Mar 79	0	no live marine mammals; surrounded by ice; shore observation	B. Kelly
	24-26 Jun 79	0	walrus carcasses only; shore observation	"
	27 Jun 79	7	adult males; hauled out on NW spit; shore observation	"
	28-30 Jun 79	0	no live marine mammals; shore observation	"
	11 Jul 82	0	"	"
	29 Sep 81	0	"	"
	30 Sep 81	10-49	males	"
	Oct 62	1,500		Burns 1965

Table 15., continued

Location	Date	Number	Comments	Source
WALRUS, cont.				
Punuk Islands, cont.	24 Oct 65	60 on beach 100 in water	already on islands by late September	ADF&G files, Nome
	Oct-Nov 59	"hundreds"		V. Slwooko
	Oct-Nov 63	20-25		Burns 1965
	Oct-Nov 78	"thousands"		G. Pelowook
	Oct-Nov 78	50-60,000	32,000 North Is.; 14,000 Middle Is; 11,000 South Is.	Fay and Kelly 1980
	Nov 60	"hundreds"		V. Slwooko
Punuk Islands, E tip of large island	4 Nov 63	1 male 1 female	hauled out; circumnavigated islands, only walrus seen	J. Burns
Punuk Islands	16 Nov 81	± 15,000	both males and females; shore observation	B. Kelly
	29 Nov - 4 Dec 81	0	no live walruses; shore observation	"
	6 Dec 66	many		G. Toolie
St. Lawrence Is.	autumn 1979-1981	present	only the Chibukak Pt. haulout used	F. Fay
St. Lawrence Is., Chibukak Pt.	autumn	present	occurred irregularly for past 17 yrs	Fay and Kelly 1980
	Oct 56	5		V. Slwooko
St. Lawrence Is., Kialegak Pt.	Oct 78	"thousands"		T. Gologergan, Jr.
St. Lawrence Is., Northeast Cape	25 Oct 74	present	2 males taken; first walrus of season taken	ADF&G files, Nome
St. Lawrence Is., Salghat	Oct-Nov 78	± 19,000	hauled out	Fay and Kelly 1980
St. Lawrence Is., Maknik	Oct-Nov 78	± 35,000	"	"
St. Lawrence Is., Kialegak Pt.	Oct-Nov 78	± 37,000	"	"
St. Lawrence Is., Chibukak Pt.	Nov 62	"hundreds"	stayed 2-3 weeks first year, annually thereafter	V. Slwooko
St. Lawrence Is., Southeast Cape	4 Nov 63	3		J. Burns
St. Lawrence Is., Chibukak Pt.	Nov-Dec 78	"hundreds"		T. Antoghame

Table 15., continued

Location	Date	Number	Comments	Source
WALRUS, cont.				
St. Lawrence Is., Chibukak Pt., cont.	Dec 70	"many"		V. Slwooko
St. Lawrence Is., Kialegak Pt.	Dec 70	"some"	"for first time"	"
BELUKHA WHALE				
St. Lawrence Is., N of Gambell	2 Jan 58	many	swimming along N beach, herd about 1 mi long	F. Fay
St. Lawrence Is., beach N of Gambell	24 Jan 56	present		F. Fay, from residents
St. Lawrence Is., ± 20 mi N of Savoonga	9 Apr 53	10-12		F. Fay
St. Lawrence Is., 5-25 mi N of Gambell	9 Apr 80	30 +		R. Nelson
St. Lawrence Is., Gambell	late Apr 60	many		F. Fay, from resident
St. Lawrence Is., near Taphook Pt.	30 Jun 56	1	calf, close inshore	F. Fay
St. Lawrence Is., Siknik	24 Aug 56	1	lone calf	V. Slwooko
St. Lawrence Is., near Savoonga	Nov	present	occasionally seen	J. Burns, from residents
St. Lawrence Is., off of Gambell and N coast	late Nov, early Dec 57	at least 1,000		Lensink 1961
St. Lawrence Is., S side	winter	present	usually stay around S side all winter (reported in 1954)	V. Slwooko
HARBOR PORPOISE				
St. Lawrence Is., Stolbi Rocks	unknown, 50's or 60's	2		F. Fay
St. Lawrence Is., Koozata Lagoon	unknown	1	stranded	"
MINKE WHALE				
St. Lawrence Is.	summer	"some"		R. Stephenson, from residents

Table 15., continued

Location	Date	Number	Comments	Source
MINKE WHALE, cont.				
St. Lawrence Is., Gambell	17 Aug 78	1		J. Burns
GRAY WHALE				
St. Lawrence Is., W of	May-Jul 52-54	present	traveling and feeding close to shore	Pike 1962
St. Lawrence Is., E and W ends, Southeast Cape, N of Gambell	May-Oct 75-80	present	aerial and vessel surveys	Nerini et al. 1980
St. Lawrence Is., N of	May-Aug 81	present	aerial survey	Ljungblad et al. 1982
St. Lawrence Is., S and SE of	May-Aug 81	few	"	"
St. Lawrence Is., Gambell	11-21 May 50-61	present	"first" dates of arrival	Pike 1962
St. Lawrence Is., SW of	12 May 70	5		J. Burns
St. Lawrence Is., Gambell	14 May 80	1	aerial survey	USFWS Walrus Harvest Rep.
St. Lawrence Is., Kongkok Bay	19 May - 3 Sep 76	present	"in bay all summer"	USFWS/SBCS Rep., G. Searing
St. Lawrence Is.	summer	present	all around island	R. Stephenson, from residents
St. Lawrence Is., SE and W ends	Jun 76	present	aerial survey	Braham et al. 1977a
St. Lawrence Is., N of Gambell	Jun-Oct 76	present	"	Harrison 1979
St. Lawrence Is., W of	Jul 57, Aug 55	present		Ichihara 1958
St. Lawrence Is., E of	Jul-Aug 58, 59	present		Pike 1962
St. Lawrence Is., N of Gambell	17 Aug 78	40-50		J. Burns
St. Lawrence Is., N of	autumn 80	present	aerial survey	Ljungblad et al. 1981
St. Lawrence Is., NE of, 1/2 way between island and mainland	1 Oct 76	65-100	apparently feeding	K. Frost

Table 16. Sightings of coastal marine mammals on King Island in the Norton Basin, region NB 5.

Location	Date	Number	Comments	Source
WALRUS				
King Island	Jun-Sep 80	± 5,000	hauled out; mostly bulls	E. Muktoyuk/ R. Nelson
	Jun-Sep 81	± 1,000	hauled out; apparently all bulls	R. Nelson
	5 Jun 81	± 1,000	hauled out on rocks on SE portion of island; reported by U.S. Coast Guard personnel from Kodiak	L. Lowry
	Jul 82	± 800	hauled out; mostly bulls	J. Koozuna
	19 Jul 79	± 1,000	hauled out on rocks at NW side of island; walrus hunting at King Is. since 1 July	R. Nelson

Table 17. Sightings of coastal marine mammals around the Diomede Islands in the Norton Basin, region NB 6.

Location	Date	Number	Comments	Source
STELLER SEA LION				
Diomede Islands	Feb-Mar 60	none	aerial survey	Kenyon and Rice 1961
Little Diomede Is., S end	late summer-early autumn	few	irregular visitors, leave as soon as ice comes	"
Fairway Rock	late summer-early autumn	few	"	"
WALRUS				
Big Diomede Is.	Oct 34	"hundreds"		T. Anayah
	Nov 39	3-500		N. Whitaker
	Nov-Dec 68	2-3,000		J. Burns
	Sep 71	"many"		"
	Oct 71	"hundreds"		"
	Nov 71	± 4,000		"
	late 70's - early 80's	5-10,000	haul out regularly from Jun to Dec	"
Little Diomede Is.	summer 74	large numbers	hauled out on rocks of island	"
	summer 80	large numbers	moving between Big and Little Diomedes; repeated efforts to haul out on Little Diomede	"
BELUKHA WHALE				
Diomede Islands, S of	Mar 61	several hundreds	in leads	Lensink 1961
Diomede Islands, N of	early Apr	present		"
Bering Strait	11 Apr 81	present	aerial survey	Ljungblad et al. 1982
Little Diomede Is.	20 Apr 81	1 taken, 2 struck and lost	"	USFWS Walrus Harvest Reps.
between Big and Little Diomede islands	13 May 79	5-10		D. Strickland

Table 17., continued

Location	Date	Number	Comments	Source
GRAY WHALE				
Diomede	3 Jun 72	2	first of season	J. Burns*
Little Diomede, N of	11 Jun 81	1	aerial survey	Ljungblad et al. 1982

Spotted seals are present along the coast north of Nome from May/June until December but are most concentrated and appear to be most abundant in September through November. Largest concentrations occur near Cape Woolley and Woolley Lagoon, and in Port Clarence and Grantley Harbor, where they are hunted by Eskimos from Nome/King Island, Teller, and Brevig Mission. They are also seen near Cape Rodney and Cape Douglas.

Spotted seals are regularly present around St. Lawrence Island from late spring to early winter. In years of light ice conditions, when the southern margin of pack ice is quite far north, spotted seals occur around St. Lawrence Island at least through February. They haul out on the island during ice-free months. They are particularly abundant in and near the lagoons on the south side of the island. There are at least three major haulouts where "hundreds" of seals may be present: a small island south of Siknik Cape, from Southeast Cape to Kialegak Point, and on the rocks and shoals south of Sekinak Lagoon. Spotted seals are also found along the coast east and south of Gambell and around the southwestern end of the island. Spotted seals are not known to haul out on the Punuk Islands. They are occasionally present around Little Diomede Island and Fairway Rock in late summer and early autumn and leave when the ice arrives.

Walrus

Walruses do not commonly haul out in inner Norton Sound, although they were occasionally seen there in summer 1961-1971. The largest recorded sightings were of 200 adult and subadult males on Besboro Island in August 1971 and 200-300 on Egg Island in June 1971. A small number was also seen on Besboro in June-July 1971 and during the summers of 1980 and 1981. Other sightings have occurred between St. Michael and Shaktoolik in August and at Cape Denbigh in June.

We know of four reports of walruses at Cape Darby: three sightings in early June and one in late June. Use of the Golovnin Bay area by walruses during the open-water season is probably only occasional. Walruses are abundant in the Nome area in spring before the ice leaves but are uncommon there during the open-water season. Single animals have been sighted hauled out east of Chiukak in June and in the water outside the Nome jetty in October.

The walrus population has been increasing greatly during the last 30 years, and with it the number of animals hauling out on St. Lawrence Island and the Punuks. Most use of coastal haulouts is from October to December. In the late 1950's and and early 1960's, "hundreds" were reported to haul out on the Punuks in October-November. In October-November 1978, that number had risen to 50-60,000, with the most animals present on the north Punuk island. On St. Lawrence Island, Chibukak Point east of Gambell was the only major haulout area in the 1960's and was used by "hundreds" of walruses. In autumn 1978, four other haulout areas were used in addition to Chibukak: Kialegak Point, Maknik, Salghat, and an area southwest of Savoonga. Over 90.000 may have been hauled out at Salghat, Maknik, and Kialegak combined. Since 1978, only the haulouts at Chibukak and the Punuks have been used.

Since about 1979, walruses have hauled out on King Island in fairly large numbers. In each of the last three summers, walruses have used the island from June or July until early September. In July-August 1980, an estimated 5,000 to 6,000 walruses, including some females and calves, utilized the rocky beaches of this small island.

An estimated 5,000 to 10,000 walruses regularly haul out during the ice-free months on Big Diomede Island, where they are not disturbed by hunters. Walruses hauling out on Little Diomede Island are usually disturbed by the local residents and do not remain long. However, walruses continuously attempted to haul out on Little Diomede during June-September 1980.

Belukha Whale

Belukhas are common in this region from spring through autumn. They are first seen nearshore in May and early June and in some years as early as April. Their arrival coincides with the breakup of ice and the arrival of spawning herring and salmon. Although belukhas are present in inner Norton Sound throughout the summer, they are most commonly seen and hunted in June and September/October. They have been sighted near Stebbins, St. Michael, Klikitarik, Unalakleet, Besboro Island, Shaktoolik, Cape Denbigh, Point Dexter, throughout Norton Bay, Koyuk, and Elim. The largest reported single sighting was of about 100 whales feeding on herring southwest of Point Dexter in late May 1981.

Belukha whales are common in Golovnin Bay from spring through autumn. Historically, this was one of the important belukha hunting areas in Norton Sound. The whales first arrive in late May and June, following schools of herring, and are present until at least October. The largest documented sighting was of 70 animals feeding on saffron cod near Rocky Point on 30 September 1981. Both adults and gray subadults were present. Belukhas are seen all along the coast from Rocky Point to the Sinuk River from April through November but are most common in early summer and autumn.

Belukhas are occasionally sighted along the coast from the Sinuk River to Cape Prince of Wales. One was seen south of the Lost River in July. Historically, they were common in Port Clarence and Grantley Harbor, where their appearance coincided with the arrival of herring. Residents report they are now seen only occasionally and in small numbers.

Belukhas are rarely seen around St. Lawrence Island in summer. Occasional whales are seen in October, but most move down from the north in November and December. Local residents report that they are seen more often in autumn at Gambell than at Savoonga. Belukhas are common around St. Lawrence Island in winter and spring.

Belukhas move by the Diomedes on their northward migration in spring and again when they move south in autumn. They are not present around the islands during summer.

Harbor Porpoise

One harbor porpoise was caught in a salmon net near Unalakleet in June 1981. Four sightings of harbor porpoises have been reported in the northern Norton Sound region, all four from near Nome. Three were caught in salmon nets in June-August. The fourth sighting was of three porpoises seen just offshore from Nome in late September 1981.

Harbor porpoises have been reported twice off Cape Woolley in October 1966 and 1976.

Minke Whale

Based on observations in 1981, minke whales may occur regularly near Golovnin Bay. They were observed on 5 and 6 June and on 10 October near the mouth of the Bay.

Minke whales have been reported from around St. Lawrence Island in summer. We know nothing further about their distribution and abundance in that region.

Gray Whale

Gray whales have been reported in the Nome area from May until October. On at least two occasions they remained in a local area for 1 to several hours. On 4 July 1962, one was caught in a fish net at Cape Nome.

Gray whales have been sighted off Cape Douglas and Cape Prince of Wales in June and July. On 1 July 1977, 30-50 were apparently feeding off Cape Prince of Wales.

Gray whales are present around St. Lawrence Island from at least May until October. They are particularly abundant to the north and northeast of the island, where they feed throughout the summer. Their major summer feeding grounds, the Chirikof Basin, are just north of St. Lawrence Island .

Gray whales are seen around the Diomedes during the summer months.

VII. Discussion

A. Steller Sea Lion

Sea lions occur in large numbers in the North Aleutian and Saint George basins. They are present there year-round and gather annually at traditional rookeries to pup and breed. Pups are born in mid-May to mid-July and do not leave the rookeries to accompany their mothers on feeding forays until they are 4-5 weeks of age (Sandegrin 1970).

Sea Lion Rocks is the only large rookery along the northern Alaska Peninsula. Since 1975, about 2,000 sea lions have hauled out there in June through August. By October that number decreases somewhat to 1,100 to 1,800. Nearby Amak Island is used as a haulout but according to Braham et al. (1977a) is not a rookery. The only other only confirmed active rookery in the eastern Bering Sea (excluding the Aleutian Islands) is Walrus Island in the Pribilofs. In the summers of 1954 and 1960, 6-8,000 sea lions were present there, about 3,000 of which were pups. Prior to the breeding season in April 1977 and 1979, 1,500-3,000 sea lions of all ages and both sexes were hauled out there. The most recent count in August 1981 indicated that about 1,200 males, females, and pups were hauled out on Walrus Island. Although other areas in the Pribilofs were used as rookeries in the 1700's and 1800's, Kenyon (1962a) reported that no pups had been reported as being born there in recent years. However, in summer 1982, there was an unconfirmed report by Aleut residents that pups were present at Dalnoi Point on St. George Island.

Sea lions haul out throughout the year at many locations that may or may not be used as rookeries during the summer (Fig. 16). Animals using those haulouts during summer are usually all males and subadults since breeding adult females are restricted to the breeding rookeries. Major nonbreeding haulouts used annually by 1,000 or more animals occur on Amak Island, St. George Island (principally Dalnoi Point), and Cape Newenham. Smaller groups regularly haul out on St. Paul Island, Otter Island, Round Island, South Twin Island, Nunivak Island, St. Matthew Island, Hall Island, Pinnacle Island, and St. Lawrence Island. Sea lions are irregular visitors to Sledge Island, the Diomede Islands, and Fairway Rock. There are no major hauling areas on the mainland coast north of Cape Newenham. In most of the region, sightings have occurred from April through November. In the northern Bering Sea, sea lions generally move southward with the formation of seasonal sea ice.

Although it is difficult to compare counts from year to year, sightings over the last 4 decades suggest that sea lions are less abundant along the Alaska Peninsula and in the Pribilofs (Table 18) and more abundant in northern Bristol Bay (Table 19) in the early 1980's than they were in the 1950's and 1960's. Braham et al. (1980) presented evidence for at least a 50% decline in numbers of sea lions in the eastern Aleutians between the late 1950's or early 1960's and 1975-77.

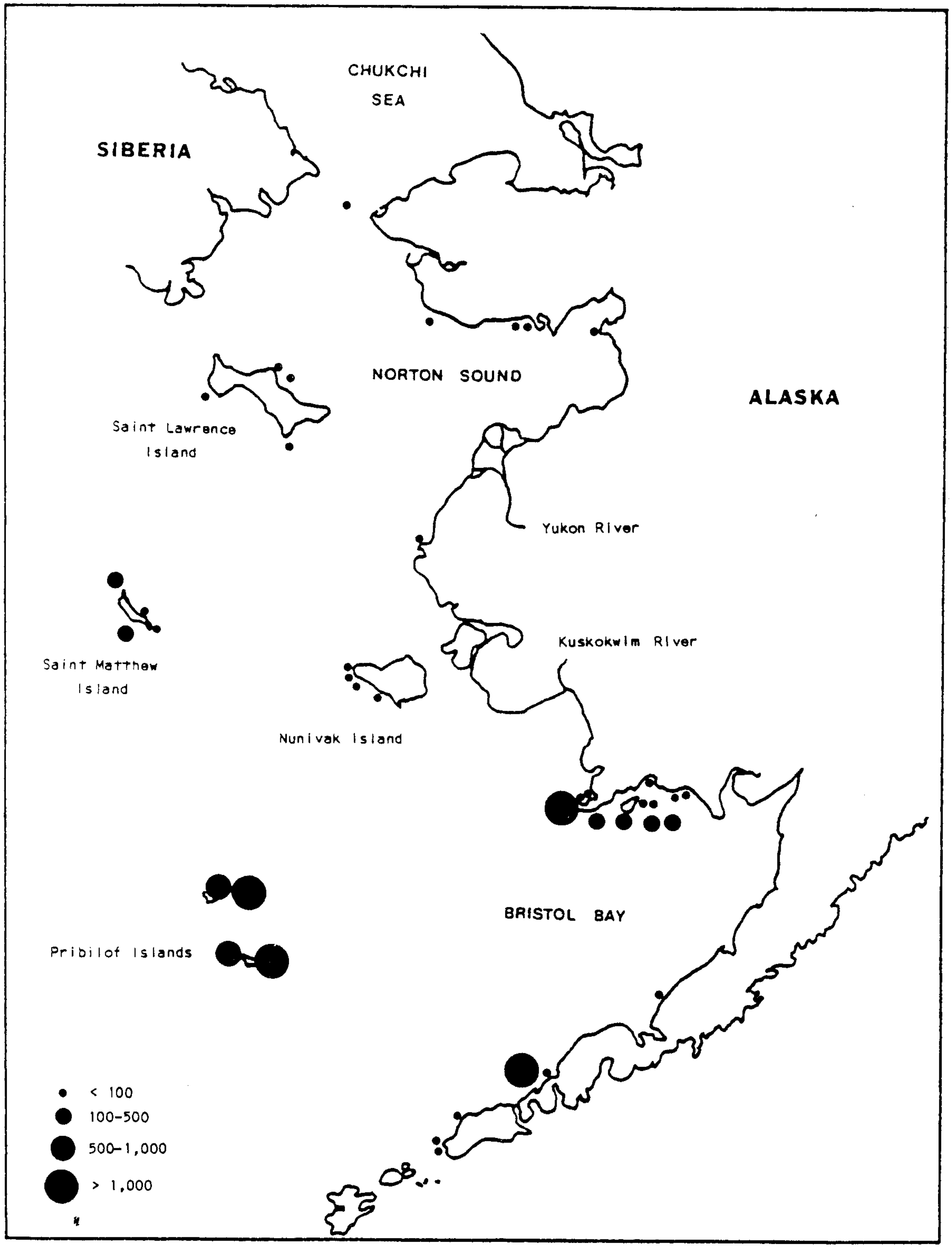

Figure 16. Map of the eastern Bering Sea showing locations where Steller sea lion haulouts have been recorded.

Table 18. Maximum recorded numbers of sea lions hauling out on Unimak and Amak islands, Sea Lion Rocks, and the Pribilof Islands from 1959 through 1982. Summer counts do not include pups since they are difficult to accurately enumerate.

	1950's	1960's	1970's	1980's
Unimak Island	--	4,200	60	--
Amak Island	3,000	2,000	2,300	2,400
Sea Lion Rocks	4,700	3,500	2,900	1,600
Pribilof Islands Walrus Island	3-4,000	4-5,000	3,000	900
Approximate Totals	12,000	14-15,000	9,000	5,000

Table 19. Maximum recorded numbers of sea lions hauling out in northern Bristol Bay from 1957 through 1982.

	1950's	1960's	1970's	1980's
Northern Bristol Bay coastline	present	hundreds	many	50-60
Hagemeister Island	--	--	150 (summer)	--
High Island	--	--	50 (summer)	--
Crooked Island	--	--	50 (summer)	--
Twin Islands	--	400 (Apr)	--	--
South Twin Is.	300 (Aug)	--	200-300 (Jul)	--
North Twin Island	21 (Jun)	--	100-150 (Jul)	--
Round Island	--	--	400-500 (Jul)	400-500 (summer)
Black Rock	--	--	6 (Jun)	--
Cape Peirce	--	--	--	450 (Jun)
Cape Newenham	250 (Jul-Aug)	--	800 (May)	1,500 (summer)
Approximate Totals	6-700	6-700	2,000	2,400-2,500

Sightings since then on Amak Island and Sea Lion Rocks suggest that sea lion numbers have remained lower and possibly declined even further. A similar trend is evident on the Pribilofs, where the number of breeding adults on Walrus Island has decreased from 3-5,000 in the 1950's and 1960's to 900 in summer 1981. On Otter Island, primarily a winter haulout, numbers appear to have remained fairly constant. In contrast, more sea lions are apparently hauling out in northern Bristol Bay in summer. About 600 were counted on the coast and islands in the late 1950's, whereas over 2,000 were there in the late 1970's and early 1980's. The causes for these apparent changes in numbers are unknown. However, Braham et al. (1980) suggested that the decline in the eastern Aleutians might correspond to a concurrent increase in commercial groundfish fisheries in that area. It is possible that, because of reduced fish stocks in more southern areas, increasing numbers of sea lions are moving to northern Bristol Bay to feed on the large herring and capelin spawning concentrations in that area.

B. Harbor Seal

Harbor seals are resident in coastal waters of the southeastern Bering Sea throughout the year. They do not migrate long distances like their ice-associated relatives, the spotted seals. In many parts of their range, harbor seals are widely dispersed along rocky coastlines and do not form major concentration areas or rookeries. Along the north coast of the Alaska Peninsula, this is not the case. Everitt and Braham (1980) listed 14 locations where a combined minimum of about 25,000 harbor seals hauls out. In aerial surveys conducted in June and August 1975-77, 75-92% of the seals counted were at three of those locations: Port Moller, Port Heiden, and Cinder River. The addition of three other locations (Seal Islands, Izembek Lagoon including Moffet Point, and Isanotski Islands) raises that to 94-99% of the total. All of these areas are rookeries where pups are born, as well as haulouts where seals rest and molt. The seals haul out on sandspits and bars exposed by the tides, with more seals hauled out at low tides than at high tides. Peak use occurs in June and July and apparently tapers off in September and October, when seals spend a greater proportion of their time in the water.

The only major haulout area for harbor seals in northern Bristol Bay is in Nanvak Bay. Both harbor seals and spotted seals are present, with harbor seals comprising about 90% of the total. Some harbor seal pups are born in Nanvak Bay in June and July, but peak numbers of animals occur during the molt in August and September, when a maximum of about 3,000 seals has been counted. Along most of the northern Bristol Bay coast, harbor seals are present in rocky coves and around rocky islands in relatively small numbers. It is not known what proportion of harbor seals in a given area those close to shore may represent. The two largest reported haulouts are at the southern end of Hagemeister Island and on Black Rock; 200-300 seals have been observed at each location. Seals in Bristol Bay are often seen in association with schools of fish. There are major herring and/or capelin spawning areas all along the northern Alaska Peninsula from Izembek Lagoon to Ugashik Bay and in northern Bristol Bay from Metervik Bay to Cape Newenham, including Hagemeister Island (Barton 1979). Spawning smelt (Osmerus mordax) and eulachon (Thaleichthys pacificus) are also present in many of those areas.

In the Saint Matthew-Hall Basin, harbor seals and spotted seals are sympatric, and in many instances it is difficult to determine which species is present. The usual northernmost limit of harbor seals is about Kuskokwim Bay and Nunivak Island, whereas the usual southernmost limit of spotted seals during summer is approximately Nanvak Bay. Thus, for at least 200-300 km of coastline, their ranges overlap. (Occasional harbor seals have been reported as far north as St. Lawrence Island and spotted seals south to the Alaska Peninsula). The largest haulout areas within harbor seal range are the offshore sandbars near Quinhagak and Jacksmith Bay and those at the mouth of the Kuskokwim River. Dark-coated pups have been observed at both of those areas in July, indicating that some or all of the seals there at that time are harbor seals. Earlier in the season, in mid-May, spotted seals with white-coated pups are present near Quinhagak. It is unknown where the harbor seals that haul out in Nanvak Bay and Kuskokwim Bay in summer go during winter when the ocean freezes. It is possible that they move to the major hauling areas along the Alaska Peninsula. If so, this would represent the longest known regular seasonal movement by harbor seals. It is over 320 km from the mouth of the Kuskokwim River to hauling areas on the Alaska Peninsula.

In spring, spotted seals are present on the ice around Nunivak Island. During the remainder of the year, relatively stable numbers of seals are found around the island, where they haul out on rocky points, islets, and coves. It is unknown whether these are harbor or spotted seals; however, four seals collected near Cape Mendenhall in October 1981 were harbor seals. It is probable that in summer there are mostly harbor seals with a few spotted seals, while in spring and autumn the reverse is true. Seals are apparently most abundant in two areas: the southeast end near Cape Mendenhall and the northwest end from Cape Mohican to Kigoumiut Bay.

Harbor seals also occur on the Pribilof Islands. They are regularly present in small numbers on St. George and St. Paul islands. Otter Island is the major haulout and rookery, where up to 1,300 seals may haul out and as many as 250 pups are born each year.

Major harbor seal and spotted seal haulouts in the Bering Sea are shown in Figure 17.

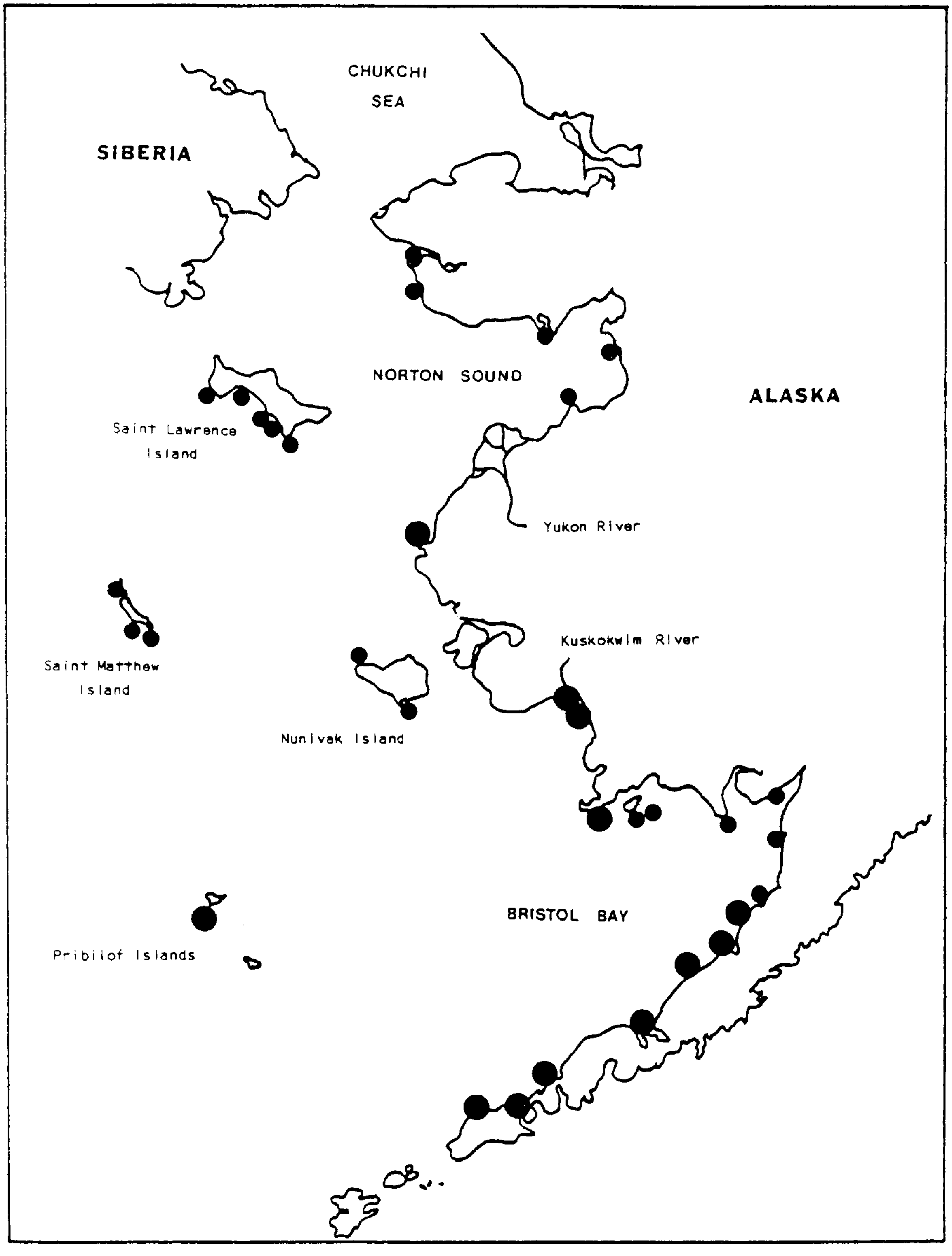

Figure 17. Map of the eastern Bering Sea showing major haulouts used by harbor and spotted seals. Large dots represent areas with maximum reported numbers of greater than 500 seals. Small dots represent haulouts of 100-500 seals.

C. Spotted Seal

In late winter and spring, spotted seals are distributed in and near the ice front of the Bering Sea, where they have their pups, breed, and molt from March to May or June. As the ice disintegrates and recedes north in spring, these seals move generally northward and toward the coast, where they spend the ice-free months feeding mainly in nearshore waters and hauling out on land (Fig. 17). Spotted seals remain in the coastal zone until late autumn or early winter, when the shorefast ice begins to form.

Areas of the North Aleutian Basin and Saint Matthew-Hall Basin where spotted and harbor seals co-occur were discussed in the previous section. Spotted seals occur in spring through autumn throughout the coastal regions of Saint Matthew-Hall Basin, including St. Matthew, Hall, and Nunivak islands and the coast of the Yukon-Kuskokwim Delta. Five or six hundred haul out at two main locations on St. Matthew Island and at one location on Hall Island. They are presumed to be spotted seals, based on a single animal collected in August 1973. Along the mainland coast, the largest haulout regularly used by spotted seals is Scammon Bay, where over 1,000 seals may be present. There are no major haulouts along the Yukon delta, although spotted seals are regularly present there in late summer and autumn.

From late May to July, and in some years to as late as August, herring and capelin spawn in northern Bristol Bay and along the coast of the Yukon-Kuskokwim Delta (Barton 1979). The distribution of major spawning areas for those species corresponds well to the distribution of major haulout areas for spotted and harbor seals. Spawning capelin and/or herring are found near Nanvak Bay, Cape Newenham north to Security Cove and Chagvan Bay, Goodnews Bay, Carter Bay, Quinhagak, Kwigillingok to Kipnuk, Toksook Bay to Tanunak, parts of Hazen Bay, Hooper Bay, Scammon Bay, and around Nunivak Island. Seals are reported from all of those areas, and each of the major haulouts is near one of those spawning locations. At many locations the appearance of large numbers of seals coincides with the arrival of schools of herring, capelin, salmon, or other forage fish.

Spotted seals are present during the ice-free months throughout Norton Basin, including Norton Sound, the southern Seward Peninsula, and St. Lawrence Island. They haul out on both rocky coastline and sandy beaches. There are no haulouts as large as those in Bristol Bay, but one to several hundred spotted seals regularly use areas near Stebbins/St. Michael, Besboro Island, Golovnin Bay, Cape Woolley, and Port Clarence. There are three major spotted seal haulouts on the south side of St. Lawrence Island, although they may haul out on rocks and bars along the entire south side of the island. Along the mainland coast, spotted seals are reportedly more abundant, or at least haul out in greater numbers and are more conspicuous, in late spring and autumn. As along the Yukon-Kuskokwim coast, the presence of seals often coincides with the arrival of schools of spawning herring or salmon. They leave as the shorefast ice begins to form.

D. Pacific Walrus

During the ice-free months, walruses haul out at many locations in the eastern Bering Sea. However, although we have collected sightings of animals hauled out at 39 specific locations, only 12 of those are regularly used by substantial numbers of animals (Fig. 18). Six of those locations are in the North Aleutian Basin, one is in the Saint Matthew-Hall Basin, and five are in the Norton Basin. Haulouts are generally in locations remote from civilization and, as indicated by Burns (1965), are generally on rock or gravel beaches near high promontories of islands or at the base of headlands projecting into the sea.

Available information on major walrus hauling areas in the eastern Bering Sea is summarized in Table 20. Fay (1957) stated that at that time the only regularly frequented hauling area in Alaska was the Walrus Islands in Bristol Bay. He also carefully documented the historical use of haulouts in the Bering and Chukchi seas. After 1960 and prior to 1978, eight locations were in regular use, all of which were probably traditionally used in the 1800's and early 1900's (Fay 1957). Based on available sightings, four additional hauling areas have become established since 1978. Although it is possible that walruses occasionally hauled out at Cape Seniavin and Cape Newenham prior to our first records in the 1960's and 1970's, St. Matthew and Hall islands were regularly visited by scientific parties, and King Island was annually inhabited by Eskimo hunters. Therefore, it is reasonable to assume that these are recently established haulouts, probably in some way resulting from the increase in size of the walrus population (Fay 1982). In almost all cases (Table 20), the maximum numbers of walruses seen on each haulout also have occurred in recent years. The only area which was definitely not used in historical times is King Island. Walruses did not haul out there when the village on the island was inhabited (Burns, unpubl.). The only major historical haulout that has not been reoccupied is on the Pribilof Islands, where thousands of males hauled out prior to their extirpation by commercial hunters.

Most of the major walrus haulouts in the southeastern Bering Sea are used principally by male walruses during late spring and summer (April-September). These animals do not follow the rest of the population on its northward migration but rather remain in the Bristol Bay region where they haul out to rest between feeding forays (Fay and Lowry 1981, Fay 1982). Most of this summering group moves westward in late autumn and winter to join groups of females and subadults on the sea ice.

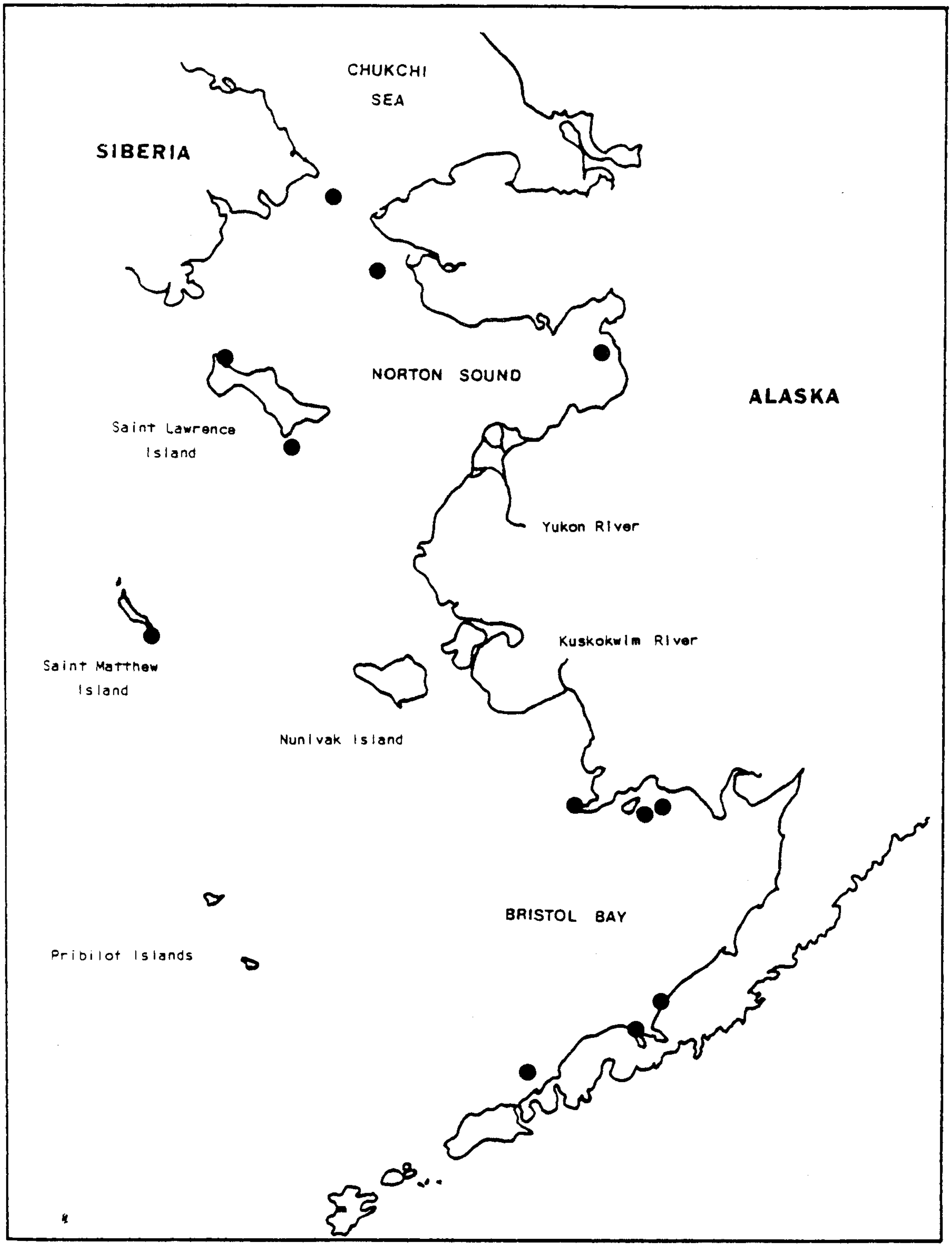

Figure 18. Map of the eastern Bering Sea showing major known haulouts of walruses.

Table 20. Summary of information on major walrus hauling areas in the eastern Bering Sea. Only those haulouts used in 2 or more consecutive years by more than 100 walruses are included.

Location	Documented "historical" use	Year of first recent sighting	Year of most recent sighting	Months used	Maximum number observed
Amak Island	yes	1962	1979	Apr-Oct	500 - Jun 1979
Port Moller	yes	1968	1982	Jan-May	2-4,000 - Apr-May 1979
Cape Seniavin	?	1978	1981	Apr-May	1,500-2,000 - Apr 1981
Big Twin Island	yes	1953	1976	May-Aug	1,000 - Jun 1976
Round Island	yes	1953	1981	Feb-Nov	11,600 - Jun and Aug 1980
Cape Newenham	?	1978	1981	Apr-Jul	450-500 - Jun 1978
Pribilof Islands	yes	--	--	--	--
St. Matthew and Hall islands	yes	1978	1982	Jul-Sep	550 - Sep 1980
Besboro Island	yes	1961	1981	Jun-Aug	200-400 - Jun-Jul 1963
Punuk Islands	yes	1930's	1981	Jun-Dec	50-60,000 - Oct-Nov 1978
St. Lawrence Island Chibukak Point	yes	1956	1981	Oct-Dec	"hundreds" - Nov-Dec 1978
King Island	no	1979	1982	Jun-Sep	5,000 - Jun-Sep 1980
Big Diomede Island	yes	1968	1981	Sep-Dec	5-10,000 - late 1970's and 1980's

The function of haulouts and seasonal cycle of animals using St. Matthew and Hall islands are probably similar to that described for Bristol Bay. Groups of animals that have been seen on Nunivak Island along the mainland coast of Kuskokwim Bay and the Yukon River delta are probably in transit on their spring or autumn migration.

In the northern Bering Sea and Norton Basin, hauling areas are of two principal types. The regularly used locations on Besboro and King islands, and occasional haulouts such as Egg Island, Cape Darby, and Sledge Island, are resting areas for animals during the summer feeding season. Most of these animals are adult males, although some females and juveniles occur on King Island (Burns, unpubl.). Hauling grounds on Big Diomede Island, St. Lawrence Island, and the Punuk Islands are centrally located in the walrus migratory path and are used in October through December by animals which are on their southward migration. The Diomede Islands are now used both as a summer haulout by males as well as a resting place for animals of both sexes during autumn. Fay and Kelly (1980) described an event in October-November 1978 when tens of thousands of walruses, including juveniles and adults of both sexes, hauled out at several locations on the Punuk Islands and St. Lawrence Island. If, as they suggest, animals hauled out on the eastern portion of St. Lawrence Island only when the Punuks were fully occupied, the total number of animals using the area would be 94-148,000, depending on whether or not the three areas on St. Lawrence Island were simultaneously occupied.

Although there have been no systematic attempts to annually census all major walrus haulouts in the eastern Bering Sea, available records suggest some features of their development and persistence. The best documented case is the Walrus Islands complex in northern Bristol Bay. Although walruses haul out occasionally on most of the islands in the group, Round Island is now the only one that is used regularly. The first record of walruses in the area was in 1935, when eight animals were seen on or near Hagemeister Island. In May 1953 a total of 1,000 animals was counted on Round Island and Big Twin Island. In late July of that year, 1,100 animals were on High Island and Big Twin Island, and none were seen on Hagemeister Island or Round Island. In May 1958, 2,500-3,000 walruses were seen on Round Island, 300 on Big Twin Island, and none on Hagemeister or High islands. Few observations were made during the 1960's and early 1970's. By 1976, most of the walruses were regularly using only Round Island, with occasional large sightings on Big Twin Island. Numbers of animals seen on Round Island have steadily increased until at least 1981, when more than 11,000 animals were counted on the haulout.

South of the Walrus Islands, three areas along the Alaska Peninsula have also been major walrus haulouts. We have records of a few hundred animals on Amak Island from 1962 through 1979 and of occasional large numbers in the vicinity of Port Moller since 1968. Beginning in 1978, 1-2,000 walruses have hauled out at Cape Seniavin for a brief period in April and May. This group is definitely related to the Round Island walruses since an animal that was tagged at Round Island was found dead at Cape Seniavin. It appears that since the major development of the Cape Seniavin haulout in 1980-81 walruses may no longer be regularly using Amak Island; none have been seen there after 1979 in nine surveys of the area. Fay and Lowry (1981) indicate that although only 1-2,000 walruses were seen hauled out at Cape Seniavin in April 1980 and 1981, 5-14,000 walruses were in the Alaska Peninsula region between Port Moller and Ugashik. During other months of the year, most walruses appear to be in the central and northwestern portions of Bristol Bay.

E. Belukha Whale

Belukhas spend the winter months offshore in the pack ice of the Bering Sea. In spring, as the ice begins to melt and recede northward, they move toward the coast. Some remain in the Bering Sea in Bristol Bay, along the Yukon-Kuskokwim coast, and in Norton Sound throughout the summer. Others travel north through Bering Strait to spend the summer in Kotzebue Sound, along the Chukchi coast north to Barrow, or in the eastern Beaufort Sea near the Mackenzie delta. Of an estimated population of 12-16,000, about 3,000 spend the summer in coastal regions of the Bering Sea.

There are three main concentration areas in the Bering Sea: inner Bristol Bay in Kvichak and Nushagak bays, off the mouths of the Yukon River, and northeastern Norton Sound from Golovnin Bay to and including Norton Bay (Fig. 19). Belukhas arrive in Kvichak Bay in April and May and usually slightly later in Nushagak Bay. They are seen in both areas throughout the summer, although there may be a directional movement from the Kvichak to the Nushagak in June or early July. The relationship between and the interchange among animals in the two areas are poorly understood. While in Kvichak and Nushagak bays, belukhas feed on smelt, outmigrating salmon fingerlings, and, after about mid-June, mostly adult salmon. Some ascend the rivers 16-32 km daily, while others remain in the bays, feeding over the extensive shallow tidal flats. Calving occurs in June and July. Large numbers of belukhas were present and calving in the shallows from the Igushik River to the Snake River in early July 1982. No similar "calving areas" have been identified in Kvichak Bay. Belukhas are commonly seen in Kvichak and Nushagak bays through August. There are few sightings there after that time. Presumably, the whales move offshore for the winter.

Belukhas are seen along the Yukon-Kuskokwim coast from spring through autumn. Although prior to the 1950's there may have been several major concentration areas, sightings in recent years have been irregular and of small numbers of animals. Moderately large groups of belukhas are seen feeding off the mouths of the Yukon River. They appear in May and June with the first salmon runs and remain until late September or October, by which time the salmon runs have diminished and the belukhas feed on saffron cod, which are abundant in the area.

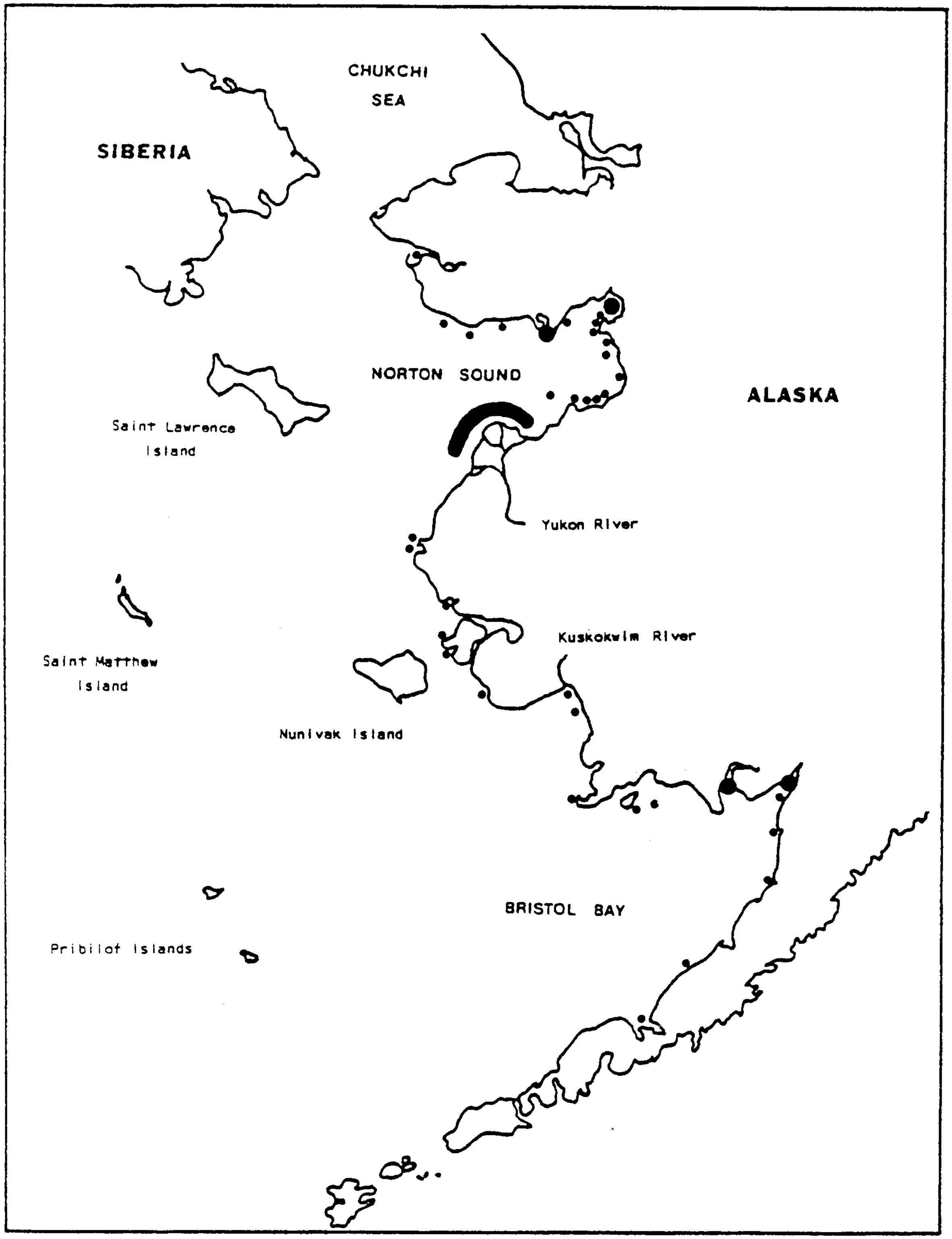

Figure 19. Map of the eastern Bering Sea showing sightings of belukha whales in the coastal zone. Small dots represent individual sightings. Large dots represent major concentration areas.

Belukhas occur throughout Norton Sound, but are particularly abundant in Norton and Golovnin bays. They are first seen in Norton Sound when the ice breaks up in April and are common along the coast from Stebbins to Norton Bay in April to mid-June, when they feed on schools of spawning herring and later on salmon. Belukhas are most frequently sighted in inner Norton Sound during spring and autumn and are apparently less common in summer. Some area residents believe they spend the summer off the mouths of the Yukon. In autumn, after the salmon runs are over, belukhas follow and feed on large schools of saffron cod found in nearshore areas such as St. Michael and Golovnin Bay. In several recent years, groups of up to several hundred have been seen feeding off Cape Nome in mid- to late November. Historically, belukhas were reported to be common in Grantley Harbor but in recent years have been seen there only occasionally and in small numbers. Belukhas are common around St. Lawrence Island, particularly the south side, during winter and spring but migrate north or toward the coast for the summer and autumn. They are rarely seen around either St. Lawrence Island or the Diomede Islands in summer.

F. Harbor Porpoise

Harbor porpoises are present along the entire coastal zone of western Alaska, but because they are difficult to see in anything but calm water there are relatively few reported observations (Fig. 20). Most sightings were of two to four individuals. The largest was of 16 animals feeding on capelin at the southeast end of Nunivak Island in June. Four of the reports from Norton Sound and one from the southern mouth of the Yukon were of harbor porpoises caught in salmon gillnets. However, those individuals from Norton Sound were not feeding on salmon but rather on saffron cod, which are extremely abundant in the Sound. Most sightings have been in June through August. The earliest was in April off the Alaska Peninsula, and the latest was in October off Cape Woolley northwest of Nome.

Harbor porpoises have been reported from the vicinity of Point Franklin to Point Barrow, Alaska (Hall and Bee 1954, Bee and Hall 1956) and from the Mackenzie River delta (Van Bree et al. 1977).

G. Killer Whale

Killer whales are seldom seen in the coastal zone of the Bering Sea. We located only one sighting of killer whales while preparing this report. That was of a single whale apparently feeding on salmon in northeastern Bristol Bay in June 1981. Other published sightings are described in section III and include the north side of the Alaska Peninsula; the Pribilof Islands; Bristol Bay; and St. Lawrence and King islands and the Diomede Islands (Fig. 21).

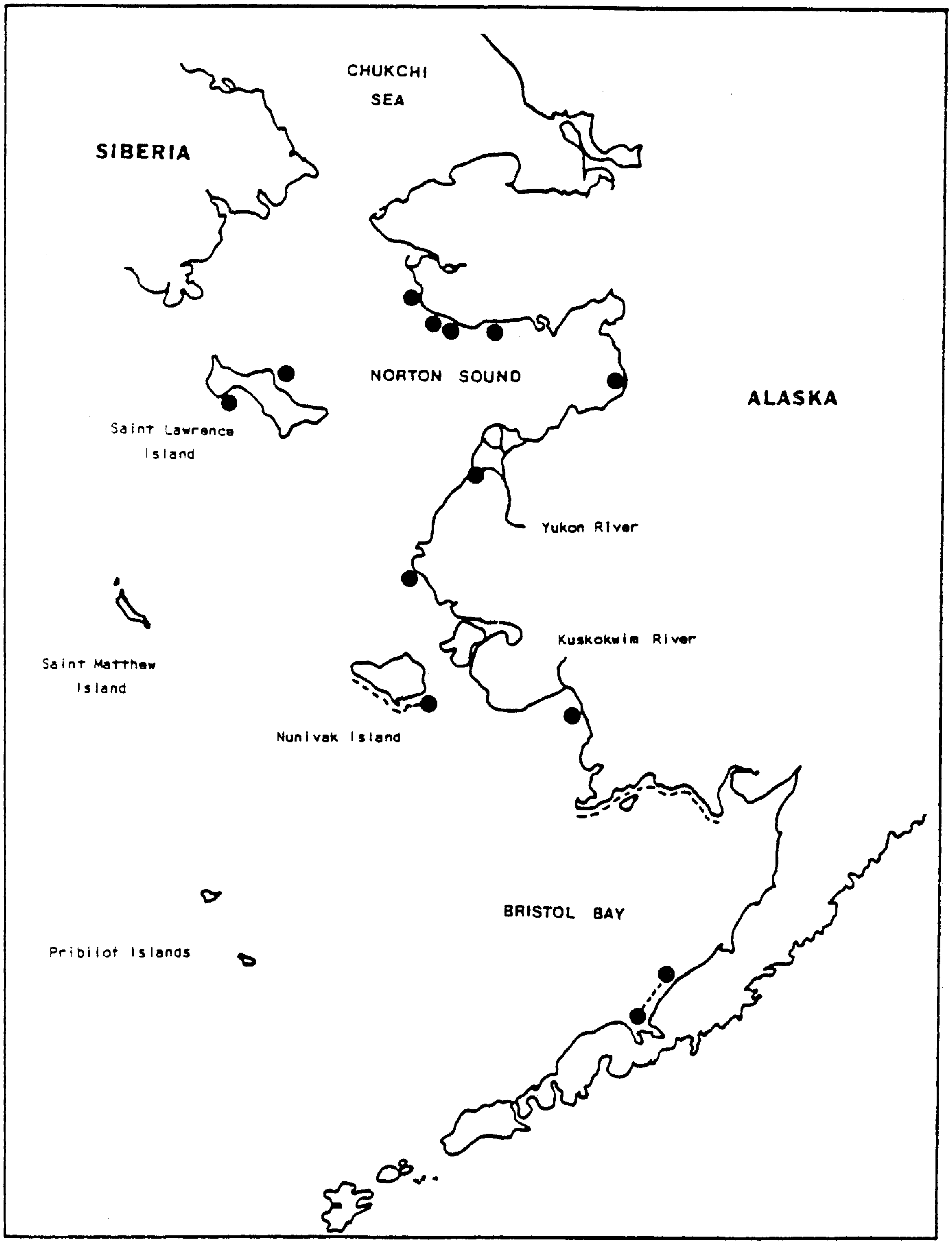

Figure 20. Map of the eastern Bering Sea showing sightings of harbor porpoises in the coastal zone.

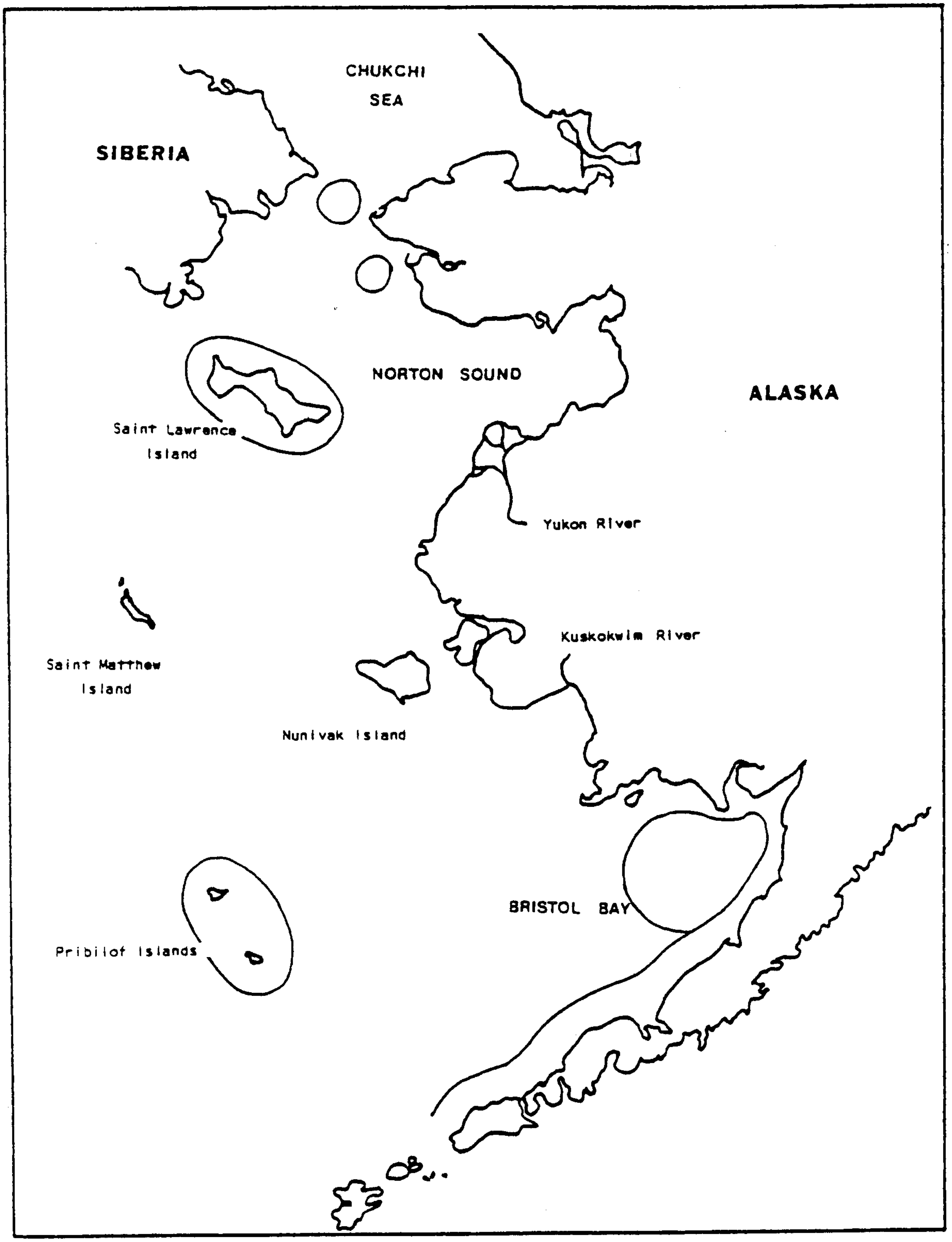

Figure 21. Map of the eastern Bering Sea showing areas where the presence of killer whales has been reported.

H. Minke Whale

We located relatively few sightings of minke whales in the coastal zone. They ranged from Unimak Island north to St. Lawrence Island and Golovnin Bay (Fig. 22). Sightings were made from April to October, with most in June. Most were of one or two individuals. One was reported taken by hunters from Gambell in August 1981 (Dronenberg et al. 1982).

I. Gray Whale

Information on the distribution and migration of gray whales is currently being compiled and summarized (Swartz et al., in prep.). Sightings accumulated by this project have been provided to the authors of a chapter for that book and will be incorporated with other data to produce a more complete picture of the distribution of gray whales in the Bering Sea.

Gray whales migrate annually from the coastal waters of Baja California and the southern Gulf of California to the northern Bering and southern Chukchi seas. They follow the coast closely as they move north along California, Oregon, Washington, Canada, and the Gulf of Alaska and enter the Bering Sea mostly through Unimak Pass in April through June. Prior to work conducted in the mid- and late 1970's, the literature suggested that, after moving through Unimak Pass, gray whales swam northward and toward the west end of St. Lawrence Island (Pike 1962). However, based on aerial surveys conducted in the Bering Sea in the mid-1970's, Braham et al. (1977a) suggested that gray whales remain near the coast considerably farther north on their migration, moving along the Alaska Peninsula, the northern coast of Bristol Bay, and then to the east end of St. Lawrence Island. Our sightings (Fig. 23) confirm those suggestions. Gray whales were regularly seen very close to the shore along the Alaska Peninsula east to Johnson Hill and then along the northern Bristol Bay coast from Cape Constantine to Cape Newenham. Few whales were seen in Kuskokwim Bay. They apparently swim directly from Cape Newenham to Nunivak Island. Most then move along the south side of Nunivak; a few have been sighted in Etolin Strait. We located no coastal sightings north of Nunivak until the whales reached St. Lawrence Island or Nome, where they may be seen from May or June until October. Most gray whales spend the summer feeding in the Chirikof Basin and Chukchi Sea. Some also feed quite close to shore at the southeastern and southwestern ends of St. Lawrence Island (Braham et al. 1977a). A few (up to 30 have been counted) remain and feed in Nelson Lagoon from April until October or November.

A few gray whales have been sighted around the Pribilofs in summer, and some whales are probably present there each year. They are also sighted around St. Matthew and Hall islands in June through August. In summer 1982, gray whales were regularly observed feeding within 1 km of the shore of St. Matthew Island.

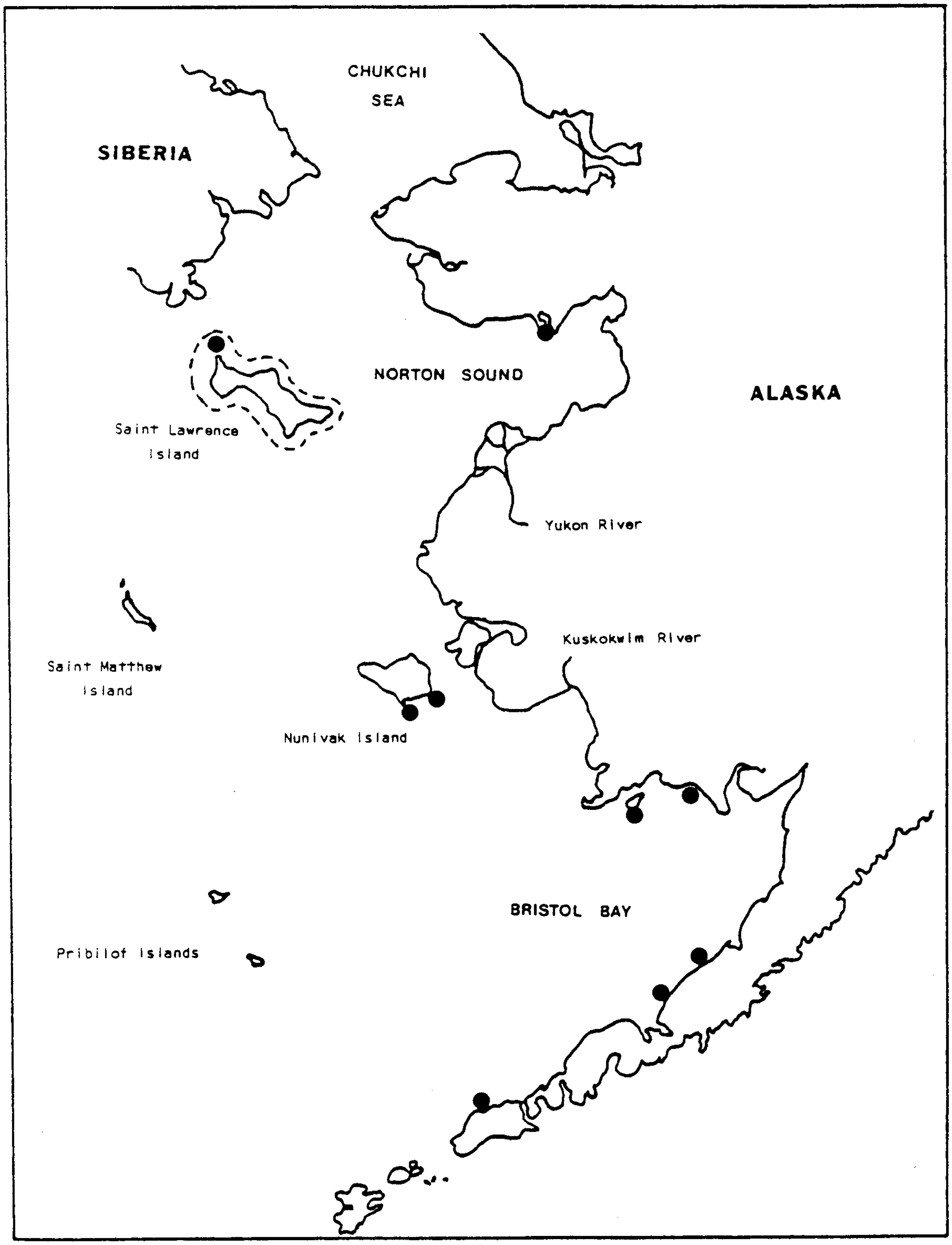

Figure 22. Map of the eastern Bering Sea showing sightings of minke whales in the coastal zone.

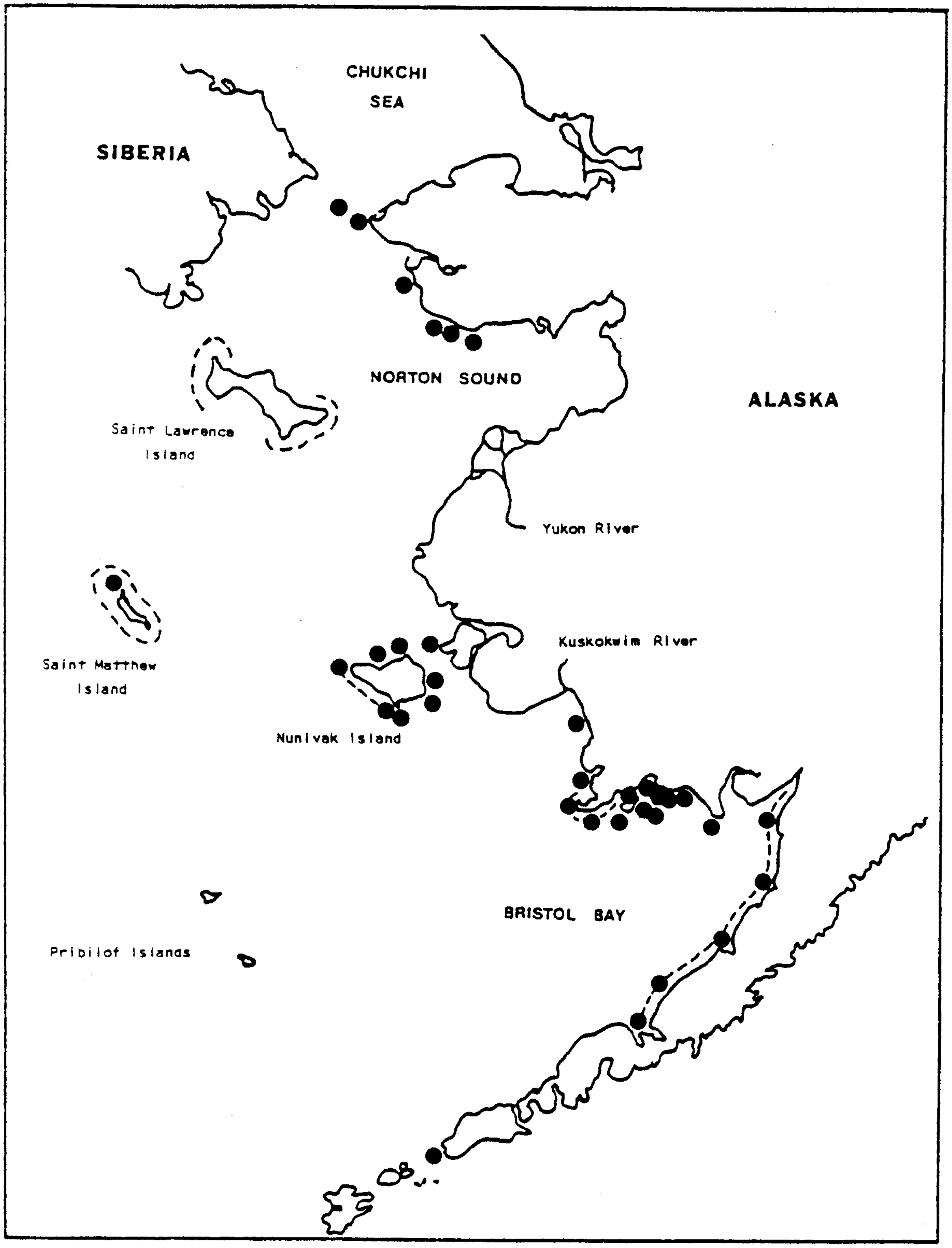

Figure 23. Map of the eastern Bering Sea showing locations where gray whales have been sighted.

Little is known about the route of gray whales on their southward migration. All except four of the sightings from the Alaska Peninsula (with the exception of Nelson Lagoon and Port Moller) Bristol Bay, and Nunivak Island were made in April through June. The remaining four were in early July. The migration through Unimak Pass takes place from October to early January, with the largest numbers passing through in late November and early December (Rugh and Braham 1979). The Bristol Bay coast has been flown repeatedly in autumn in conjunction with* surveys for other species, and no whales have been seen. Fay and Lowry (1981) flew over 1,600 km of survey trackline in Bristol Bay monthly from September to November 1980 and January to March 1981. They saw one gray whale near Port Moller in December. The absence of coastal sightings at this time suggests that the whales travel farther offshore on their southward migration.

J. Sea Otter

Sea otters occur along the Alaska Peninsula from Unimak Island northeast to Port Heiden and occasionally as far as Ugashik and Egegik bays (Fig. 24). The area inside the 60-m contour from Cape Mordvinof to Cape Lieskof was classified as critical sea otter habitat by Schneider (1976, 1981). In the mid-1970's, otter range and numbers were somewhat reduced due to heavy ice years in 1971, 1972, and 1974, and most otters were found west of Cape Leontovich. Since 1976 the range has again gradually expanded, and, in 1982, sightings were made as far east as Port Heiden. However, all large sightings continue to be in the area from about Bechevin Bay to Moffet Point. In April 1982, the sea ice advanced south to Cape Kutuzof (just north of Port Moller), and there were reports of weak or dead otters from Port Heiden and Port Moller. Although on a much smaller scale than the die-offs of the early 1970's, repeated events such as these undoubtedly prevent long-term expansion of sea otter range past Port Heiden.

The highest density (3-6/km^2) areas for otters along the Alaska Peninsula are in water depths less than 40 m, although some otters (< 1/km^2) may be found in water as deep as 80 m (Schneider 1981). Females and pups prefer the shallower waters. Animals seen in deep water are more likely to be adult males. There may be considerable onshore-offshore movement, depending on weather conditions and sea state.

A few sea otters are also present in the Pribilof Islands. Some were transplanted there in the 1950's and 1960's, and some may have arrived there on their own. In the 1970's a few sightings of one to two otters, none with pups, were made around St. George, St. Paul, and Otter Islands. In summer 1982, three otters were seen near Dalnoi Point on St. George, and two of those were accompanied by pups.

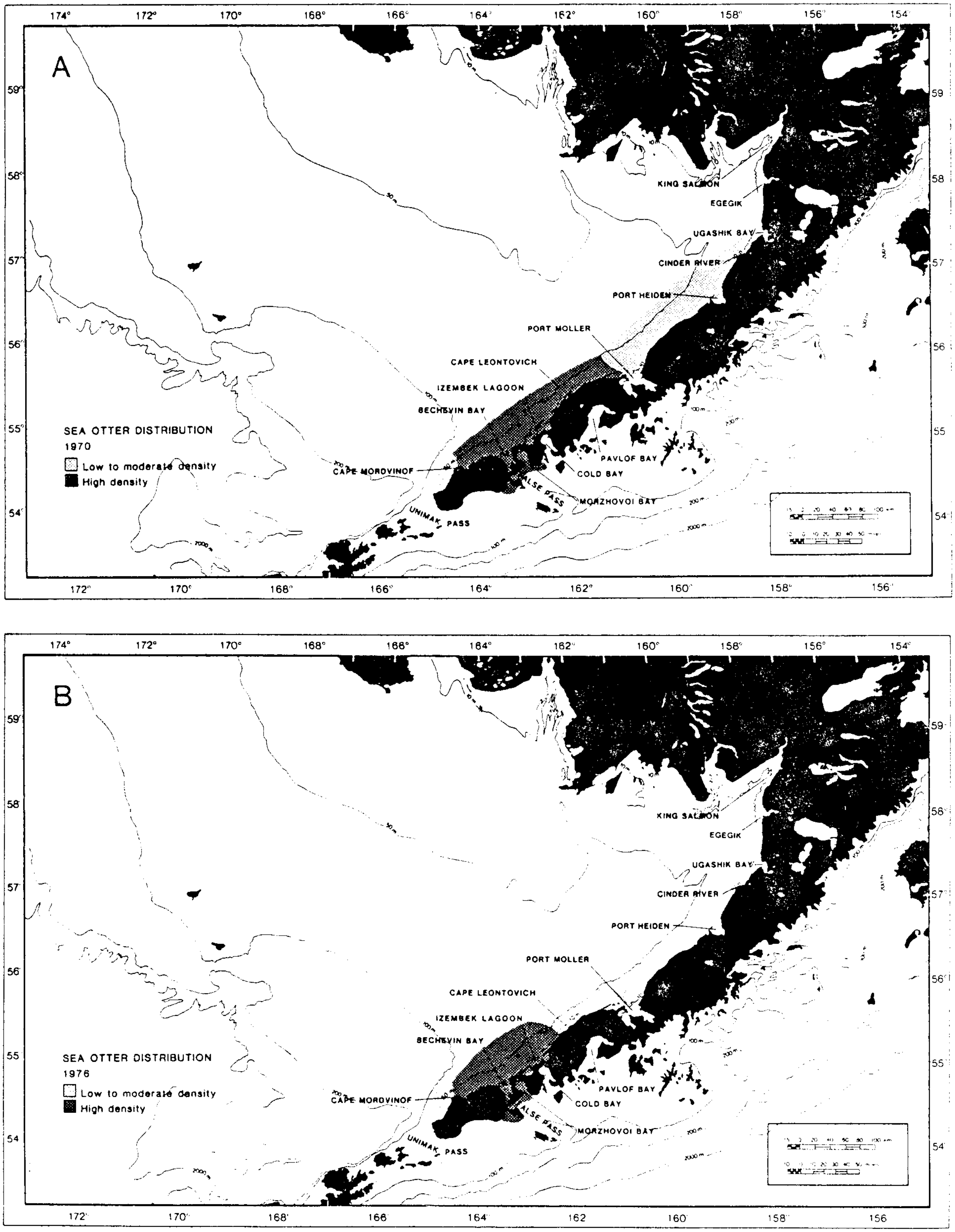

Figure 24. Distribution of sea otters north of the Alaska Peninsula and Unimak Island (a) in 1970 and (b) in 1976. Distribution in the early 1980's resembles that in 1970. (from Schneider 1981)

VIII. Conclusions

A. Adequacy of Sighting Data

The portion of the Alaska coastline included in this study is approximately 3,700 km in length, of which about 900 km are on offshore islands and the remainder on the mainland. This is obviously a very large area over which to document all localities used by marine mammals. However, most of this area can no longer be considered truly remote, and the combined observations of persons on shore, at sea, and in the air provide a wealth of information on where and when marine mammals occur. The inherent interest of local residents in the natural resources which surround them has been encouraged and supplemented by the work of biologists supported by OCSEAP, as well as other federal agencies, and the State of Alaska.

This has been the first comprehensive attempt to compile all existing data on coastal marine mammal distribution and abundance in the Bering Sea during the ice-free season. We generally did not attempt to collect new data nor did we have the funds necessary to interview coastal residents in the manner which would be necessary to maximize the value of existing local knowledge. Nonetheless, we have been very impressed by the amount of information which was available. Since much of the data available has been collected on an opportunistic basis, it is difficult to evaluate whether the composite picture derived from sightings accurately reflects the pattern of marine mammal distribution and abundance. In some cases such as on the north side of the Alaska Peninsula and Round Island, specific studies of marine mammals have been conducted. However, few such studies have been done on the offshore islands or along the mainland coast from northern Bristol Bay to Bering Strait. Since 1967, annual aerial surveys of herring spawning concentrations have been flown along most of the coast of the mainland and Nunivak Island in May and June. Large sections of the Yukon-Kuskokwim Delta have been annually surveyed since 1977, principally for seabirds. Sightings of marine mammals were routinely recorded on those surveys and are included in this report. In addition, much information has been collected by ADF&G area biologists and USFWS refuge managers throughout Alaskan waters but particularly in Bristol Bay, Norton Sound, and Bering Strait. We are confident that all major coastal areas utilized by marine mammals in summer and autumn have been identified in this report and that the data are adequate to describe, in a general sense, the use of various regions of the coast by marine mammals. This information should be of considerable value for planning and perhaps regulating the development of OCS hydrocarbon reserves. However, probably without exception, available data on the numbers, activities, and dynamics of marine mammals at specific locations are not sufficient to estimate total numbers of animals or to measure or monitor the impacts of OCS activities or other factors on them.

B. Importance of Coastal Regions to Marine Mammals

Marine mammals inhabit virtually the entire coastal zone of the eastern Bering Sea during summer and autumn. However, their distribution is far from uniform. The greatest concentration of marine mammals occurs in Bristol Bay, which is inhabited by 25-30,000 harbor seals; approximately 5,000 sea lions; perhaps 20,000 walruses; 1,000-1,500 belukhas; and about 17,000 sea otters. Sea lions are most abundant in rocky regions such as Amak Island and the western portion of the northern coast. Major concentrations of harbor seals occur along the northeastern portion of the Alaska Peninsula from Port Moller to Egegik. Sea otters are restricted to the southernmost portion of Bristol Bay, with the core of their range between Cape Mordvinof and Cape Lieskof. The largest walrus hauling area in Alaska is on Round Island in northwestern Bristol Bay; in recent years, substantial numbers of walruses have also hauled out at Cape Seniavin on the Alaska Peninsula. In Bristol Bay, belukhas are seen principally in Kvichak and Nushagak bays and their associated estuaries. Harbor porpoises, minke whales, and killer whales occur in the Bristol Bay area. Also, the majority of the gray whale population passes along the north side of the Alaska Peninsula and the north coast of Bristol Bay during its spring, northward migration.

Based on available sightings, it appears that fewer marine mammals utilize coastal regions of the mainland north of Bristol Bay. There are no major haulouts for sea lions or walruses, although substantial numbers of walruses occasionally haul out in Kuskokwim Bay and Norton Sound. Harbor and spotted seals haul out in large numbers on offshore bars in Kuskokwim Bay, and spotted seals regularly use several locations, particularly Golovnin Bay and Port Clarence. Belukhas are common off the mouths of the Yukon River but do not regularly utilize the bays along the Yukon-Kuskokwim Delta. They do regularly occur in Golovnin Bay and Norton Bay. Harbor porpoises are occasionally recorded along the coast, particularly in Norton Sound. Gray whales are only rarely seen along this portion of the mainland since their migration route appears to take them from Cape Newenham to Nunivak Island and then northward to St. Lawrence Island.

Offshore islands are also important marine mammal habitats, particularly for pinnipeds (Table 21). Sea lions regularly haul out on all of the Pribilof Islands, St. Matthew and nearby islands, and St. Lawrence Island. They are irregularly seen hauled out farther to the north. The only area presently used for breeding is Walrus Island in the Pribilofs. The major haulout for harbor seals is on Otter Island, where hundreds of animals including pups occur throughout the summer. Major areas for spotted seals are St. Matthew, Hall, and St. Lawrence islands. Major walrus haulouts occur on St. Lawrence Island, the Punuk Islands, and all islands north of there with the probable exception of Fairway Rock. Substantial numbers also use St. Matthew and Hall islands but not the Pribilof Islands.

Table 21. Maximum recorded numbers of pinnipeds hauled out on major offshore islands in the eastern Bering Sea, based on recent sightings.

	Sea lion	Harbor/ spotted seal	Walrus
St. George Island	3,000	small numbers	--
St. Paul Island	500	small numbers	--
Otter Island	1,000 males	1,300	1
Walrus Island	4-5,000 adults	--	1
Nunivak Island	< 100	100-200	--
St. Matthew Island	300	400-500	300
Hall Island	350	100	550
Pinnacle Island	150-200	--	--
St. Lawrence Island	1,000	hundreds	90,000
Punuk Islands	200	--	50-60,000
Sledge Island	irregular	irregular; small numbers	1,000
King Island	--	--	1,000
Fairway Rock	irregular	--	--
Diomede Islands	irregular	--	5-10,000

With the exception of gray whales which are seen occasionally near the Pribilofs and regularly near St. Lawrence Island, the distribution of cetaceans near offshore islands is poorly known. Belukha whales occur near Nunivak Island during ice-free months and are seen near St. Lawrence and Little Diomede islands during the spring and autumn migrations. Harbor porpoises and minke whales have been seen off the south and east sides of Nunivak Island, and minke whales are known to occur near St. Lawrence Island.

We have included killer whales and minke whales in this report since general information indicated that they are sometimes common in nearshore waters. The sightings we located have verified that minke whales regularly occur in coastal waters of the eastern Bering Sea. Fourteen sightings of minkes were recorded; four of those were off the north side of the Alaska Peninsula and five were near the mouth of Golovnin Bay. We located only one sighting of a single killer whale off Etolin Point (Nushagak Bay), although they are known to be present near Unimak Island. We conclude that killer whales are not a major component of the nearshore marine mammal fauna of the eastern Bering Sea.

C. Potential Effects of OCS Activities

The possible effects of OCS exploration and development in the Bering Sea are of two principal types: 1) those associated with hydrocarbons which are released into the environment, and 2) those related to disturbances which may affect the behavior and distribution of animals. Possible direct impacts of oil pollution have been discussed by Davis and Anderson (1976), Geraci and Smith (1976, 1977), Costa and Kooyman (1980), Geraci and St. Aubin (1980), and Cowles et al. (1981). Generally speaking, direct effects of oil are expected to be greatest on animals which rely on fur for insulation, which includes sea otters and the newborn young of ice-inhabiting seals. Effects of oil which may be ingested in the process of feeding or growing were discussed by Geraci and Smith (1976, 1977) and Cowles et al. (1981). Results available to date are inconclusive, although some physiological effects have been documented. Effects of oil on foods of Bering Sea marine mammals were discussed in detail in Lowry et al. (1981). In the remainder of this section we will discuss only the possible effects of disturbance on the abundance, distribution, and behavior of marine mammals in the coastal zone of the eastern Bering Sea.

There can be little question that air- and water-borne noise will in many cases be audible to marine mammals (e.g., see Myrberg 1978). The possible effects of such disturbances caused by noise or the physical presence of humans, vessels, or equipment are poorly known since very few studies have systematically addressed the question. Terhune et al. (1979) documented a decrease in vocalizations of harp seals (Phoca groenlandicus) in the presence of an operating vessel, which they attributed primarily to motor noise. It has been suggested that an increase in "water tourism" has caused a decrease in abundance of harbor seals in the Netherlands (Bonner 1978). Disturbance by humans has caused an elevated mortality in recently born Hawaiian monk seals (Monachus schauinslandi) (Rice 1964) and reduced productivity of Mediterranean monk seals (Monachus monachus) (Sergeant et al. 1978). Salter (1979) has documented a number of behavioral responses of walruses to over-flying aircraft, and we have noted that seals, sea lions, and walruses almost invariably flee into the water when approached by humans or low-flying aircraft. Fay (pers. commun.) observed instances when walruses at Cape Seniavin were stampeded into the water by low-flying aircraft. When animals flee from the hauling areas, some mortality of animals, especially recently born young, will occur through injury or abandonment and subsequent starvation. The magnitude of this problem will vary by species, location, and time of year. In the case of walruses, regular human disturbance has prevented the long-term use of haulouts at Cape Newenham, Sledge Island, and to some extent King Island (ADF&G, unpubl.). Salter (1979) suggested that disturbances associated with the establishment of permanent bases in the Arctic may have caused changes in the summer distribution patterns of walruses.

Disturbance responses of cetaceans are more difficult to observe and quantify. Nishiwaki and Sasao (1977) believe that human activities, principally vessel traffic, have altered the migration routes of Baird's beaked whales (Berardius bairdii) and minke whales off the coast of Japan. In the case of minke whales, the greatest effect may have been on females with calves which avoided traditionally used coastal areas. Fraker (1977) discussed the effects of disturbance on belukha whales in the Mackenzie delta area. We have observed that outboard-powered boats affect belukha movements in rivers and bays. When a boat approached whales moving up the Snake River, they changed direction and moved downstream. When boats approached a large group of whales in shallow areas of western Nushagak Bay, they all turned and headed eastward toward deeper water. Changes in the summer distribution pattern of belukhas in Kotzebue Sound are closely correlated with changes in human activities and associated boat traffic (Burns et al., in prep.).

The actual results of responses to disturbances such as those discussed above are even less well known than the responses themselves. Mortality and injury of animals, particularly newborn or nursing young, will definitely occur in some circumstances, as has been documented for walruses and monk seals. More subtle effects on animal condition may also occur when disturbances interfere with normal activities such as nursing, resting, breeding, and molting. Perhaps most significant is the long-term displacement of animals that will be caused by continuous or regular and frequent disturbance. Since feeding is a major activity for marine mammals during summer and autumn, it is reasonable to assume that concentration areas of marine mammals occur in locations where they can obtain their food most efficiently. Pinnipeds require hauling areas on which to rest between feeding forays, and some species of cetaceans may likewise need protected areas in which to rest, care for young, and socialize. These coastal concentration areas occur at specific locations and are limited in number. Displacement from these areas will mean that those feeding grounds are abandoned or that animals will have to travel greater distances to reach them from the nearest refuge, either of which would be detrimental in energetic terms. One might speculate that such displacement would have the greatest effect on a species such as walrus, which feed on sessile organisms that occur abundantly only in limited areas. However, the principal prey of many other species such as capelin, herring, and salmon are equally concentrated at specific areas and times of year. Changes in distribution and abundance which prevent a species from exploiting its potential food resources in the most efficient manner will result in long-term changes in productivity, survival, and abundance.

IX. Needs for Further Study

This study covered a large portion of the Alaska coastline and included many of the locations which are important marine mammal habitats during spring and autumn. A similar report which will deal with the Chukchi Sea coast is in preparation and will be submitted by the end of 1982. Many coastal areas of the Aleutian Islands and the Gulf of Alaska are also important habitat for marine mammals, particularly sea lions, sea otters, and harbor seals. A review of available data on distribution and abundance of marine mammals in the coastal zone would be very useful for planning OCS activities in those areas.

This report includes all sighting data available to us up to the end of 1981. Some significant observations made in summer 1982 are also included. Undoubtedly, we have missed some past observations which should have been included. In addition, with the present intensity of field research in western Alaska, much new information will be generated each year. We consider this report to be a working document which will be of greatest value if it can encourage researchers to record their sightings of marine mammals and make them available to others. A single sighting which seems of little value in itself may become of substantial significance when considered in combination with all the other data available. Consideration should be given to updating and revising this report on a regular basis, perhaps every 2 years.

Although we have been able to describe general features of the distribution and abundance of marine mammals in the coastal areas of the eastern Bering Sea using the existing data base, with few if any exceptions the available data are not adequate to predict or monitor the effects of OCS development or other human activities on marine mammals. With the exception of walruses on Round Island, there have been no systematic studies which have described the distribution, abundance, and activities of marine mammals at a particular location throughout the time they occur there and for a series of years. The available data show quite conclusively that the number of animals using particular areas has changed over time, and we predict that such fluctuations will continue to occur during OCS exploration and development. Without some additional research on the biology of marine mammals in the coastal zone, it will be difficult to detect and measure the fluctuations and impossible to identify the causes.

We suggest that OCSEAP initiate studies that will deal with representative species and habitats in areas that are likely to be impacted by OCS activities in the near future. Some potential species and areas are as follows:

Steller sea lions - Amak Island, Walrus Island (Pribilof Islands)

Harbor seals - Otter Island

Spotted seals - Golovnin Bay, St. Matthew Island

Walruses - Cape Seniavin, Punuk Islands, Besboro Island

Belukha whales - Kvichak and Nushagak bays, Golovnin Bay

Gray whales - north side of the Alaska Peninsula, particularly
Nelson Lagoon

Of principal interest at each location is documentation of the seasonal cycle in numbers of animals using the area. Activity patterns should be examined as they relate to enumeration of animals as well as for documentation of "normal" activity. Present levels of disturbance and their effects, if any, should be monitored. Information should be gathered on the relationships among groups of animals at various locations; i.e., what is the rate of interchange among areas and what degree of fidelity do individuals have to particular locations. Research should include observations of group composition, birth and survival rates, and present causes of mortality. Finally, the significance of the area to the animals should be determined; i.e., is it used principally for feeding, birthing, breeding, or some combination of purposes. If such studies are begun prior to OCS leasing and continued at intervals after exploration and development begin, it will be possible to make some definitive statements regarding the effects of OCS activities.

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APPENDIX I.

Geographical Coordinates of Locations Referred to in Text

Name	Region	Latitude	Longitude
Aghnaghak Lagoon	NB 4	63°40'N	171°33'W
Alakanuk	SMH 3	62°41'20"N	164°37'00"W
Amak Island	NAB 1	55°25'N	163°08'W
Anerkochik River	SMH 3	61°06'N	165°09'W
Applegate Cove	NAB 1	55°13'N	162°52'W
Baird Inlet	SMH 3	60°45'N	164°00'W
Bald Head	NB 1	64°45'N	161°32'W
Bear River	NAB 1	56°10'N	160°26'W
Bechevin Bay	NAB 1	55°00'N	163°23'W
Beeson Slough	NB 1	64°15'N	161°00'W
Besboro Island	NB 1	64°07'45"N	161°18'30"W
Big Creek (near Egegik)	NAB 2	58°17'25"N	157°32'30"W
Binajoaksmiut Bay	SMH 2	59°51'N	166°31'W
Bird Rock	NAB 4	58°40'N	162°08'W
Black River	SMH 3	62°21'N	165°20'W
Black Rock	NAB 4	58°42'30"N	160°11'45"W
Bluff	NB 2	64°34'N	163°45'W
Booshu Camp	NB 4	63°28'N	171°48'W
Brevig Mission	NB 3	65°20'N	166°29'W

Name	Region	Latitude	Longitude
Calm Point	NAB 4	58°35'N	161°05'W
Carolyn Island	NB 2	64°27'N	162°53'W
Carter Bay	SMH 1	59°19'N	161°59'W
Cathedral River	NAB 1	55°37'N	162°19'W
Chagvan Bay	SMH 1	58°46'N	161°46'W
Chibukak Point	NB 4	63°47'N	171°39'W
Chichigof, Cape	NAB 2	58°20'N	157°32'W
Chiukak	NB 2	64°31'N	163°22'W
Chunak Point	NAB 1	55°02'N	163°27'W
Cinder River	NAB 2	57°22'30"N	158°07'30"W
Clarence, Port	NB 6	65°12'N	166°45'W
Constantine, Cape	NAB 3	58°23'30"N	158°53'30"W
Crooked Island	NAB 4	58°40'N	160°15'W
Dalnoi Point	SGB 1	56°36'40"N	169°46'30"W
Darby, Cape	NB 1	64°19'N	162°47'W
Datheekook Point	SMH 2	60°04'20"N	167°20'00"W
Deadman Sands	NAB 3	58°42'N	157°27'W
Deer Island	NAB 1	55°55'N	160°50'W
Denbigh, Cape	NB 2	64°23'N	161°32'W
Dexter, Point	NB 1	64°32'N	161°23'W
Dillingham	NAB 3	59°02'30"N	158°27'30"W
Diomede Island, Little	NB 6	65°47'N	169°W
Divide, Point	NAB 1	55°53'N	160°47'W
Douglas, Cape	NB 2	65°00'N	166°42'W

Appendix I

Name	Region	Latitude	Longitude
Eagle Bay	NAB 4	58°47'N	159°49'W
Egegik	NAB 2	58°13'N	157°22'W
Egegik Bay	NAB 2	58°13'N	157°31'W
Egegik River	NAB 2	58°12'N	157°24'W
Egg Island	NB 1	63°36'30"N	161°44'15"W
Ekuk	NAB 3	58°49'00"N	158°33'30"W
Elephant Rock	SMH 4	60°42'N	173°03'W
Elim	NB 1	64°37'N	162°15'W
Emeghee Point	NB 4	62°58'N	169°46'W
Emmonak	SMH 3	62°46'35"N	164°31'40"W
Estus Point	NAB 4	58°47'N	161°12'W
Etolin, Cape	SMH 2	60°26'N	166°09'W
Etolin Point	NAB 3	58°37'N	158°15'W
Etolin Strait	SMH 2-3	60°00'N	165°00'W
Gambell	NB 4	63°47'N	171°45'W
Glazenap, Cape	NAB 1	55°15'N	163°00'W
Glory of Russia, Cape	SMH 4	60°36'N	172°57'W
Golovin	NB 2	64°33'N	163°02'W
Golovnin Bay	NB 2	64°24'N	163°00'W
Goodnews Bay	SMH 1	59°03'N	161°49'W
Grantley Harbor	NB 3	65°17'N	166°15'W
Greig, Cape	NAB 2	57°43'N	157°41'W

Appendix I

Name	Region	Latitude	Longitude
Hagemeister Island	NAB 3	58°39'N	160°54'W
Hall Island	SMH 4	60°40'N	173°06'W
Hastings Creek	NB 2	64°32'N	165°06'W
Hazen Bay	SMH 2	61°01'N	165°20'W
Heiden, Port	NAB 2	56°54'N	158°48'W
Herendeen Bay	NAB 1	55°50'N	160°50'W
High Island	NAB 4	58°43'N	160°25'W
Hook Lagoon	NAB 2	57°17'N	158°20'W
Hooper Bay	SMH 3	61°27'N	166°00'W
Igushik	NAB 3	58°42'N	158°53'W
Ikook Point	SMH 2	60°12'50"N	167°27'30"W
Ikookstakswak Cove	SMH 2	60°13'30"N	167°20'00"W
Ilnik	NAB 2	56°36'N	159°37'W
Inglutalik River	NB 1	64°50'N	160°54'W
Isanotski Islands	NAB 1	55°00'N	163°19'W
Isanotski Strait	NAB 1	54°49'N	163°23'W
Izembek Lagoon	NAB 1	55°20'N	162°48'W
Jacksmith Bay	SMH 1	59°30'N	161°45'W
Johnson Hill	NAB 3	58°35'40"N	157°14'00"W
Kenmore Head	NAB 1	54°56'40"N	163°01'40"W
Kialegak Point	NB 4	62°59'N	169°32'W
Kigoumiut Bay	SMH 2	60°13'50"N	167°07'00"W

Appendix I

Name	Region	Latitude	Longitude
King Island	NB 5	64°58'N	168°05'W
King Salmon	NAB 3	58°41'30"N	156°39'30"W
Kipnuk	SMH 2	59°56'N	164°03'W
Klikitarik	NB 1	63°28'N	161°28'W
Kongiganak	SMH 1	59°52'N	163°02'W
Kongkok Bay	NB 4	63°23'N	171°47'W
Kookoolik Cape	NB 4	63°42'N	170°21'W
Koozata Lagoon	NB 4	63°21'N	170°39'W
Koyuk	NB 1	64°56'N	161°09'W
Krenitzin, Cape	NAB 1	55°04'N	163°25'W
Kulukak Bay	NAB 4	58°49'N	159°44'W
Kulukak Point	NAB 4	58°50'N	159°39'W
Kvichak Bay	NAB 3	58°26'N	157°54'W
Kvichak River	NAB 3	58°52'N	157°03'W
Kwigillingok	SMH 1	59°51'N	163°08'W
Lapin, Cape	NAB 1	54°58'N	164°07'W
Leontovich, Cape	NAB 1	55°40'N	162°16'W
Lieskof, Cape	NAB 1	55°47'N	162°05'W
Little Cape Corwin	SMH 2	60°01'N	165°38'W
Lost River	NB 3	65°23'N	167°09'W
Lunda Bay	SMH 4	60°17'N	172°26'W
Lunda Point	SMH 4	60°17'N	172°25'W

Appendix I

Name	Region	Latitude	Longitude
Maknek River	NB 4	63°08'N	169°24'W
Maknik Lagoon	NB 4	63°11'N	169°15'W
Malikfik River	NB 1	64°24'N	161°17'W
Mekoryuk	SMH 2	60°23'20"N	166°11'00"W
Mekoryuk River	SMH 2	60°23'N	166°11'W
Mendenhall, Cape	SMH 2	59°45'N	166°10'W
Metervik Bay	NAB 4	58°49'N	159°46'W
Mikisagimiut	SMH 2	60°13'15"N	167°16'30"W
Moffet Lagoon	NAB 1	55°24'N	162°35'W
Moffet Point	NAB 1	55°27'20"N	162°32'00"W
Mohican, Cape	SMH 2	60°12'N	167°25'W
Moller, Port	NAB 2	55°53'N	160°28'W
Mordvinof, Cape	NAB 1	54°56'N	164°26'W
Moses Point	NB 1	60°45'30"N	161°45'00"W
Nabangoyak Rock	SMH 2	60°08'N	167°21'W
Nakeen	NAB 3	58°46'N	157°02'W
Naknek	NAB 3	58°43'40"N	157°00'45"W
Naknek River	NAB 3	58°43'N	157°04'W
Nanvak Bay	NAB 4	58°35'N	161°45'W
Nash Harbor	SMH 2	60°15'N	166°52'W
Nelson Lagoon	NAB 1	56°00'N	161°00'W
Neumann Island	NAB 1	55°26'00"N	162°36'30"W
Newenham, Cape	NAB 4	58°39'00"N	162°10'30"W
Nome	NB 2	64°30'N	165°25'W

Appendix I

Name	Region	Latitude	Longitude
Nome, Cape	NB 2	64°26'N	165°00'W
Norma Bay	NAB 1	55°12'N	163°02'W
North Cove	SMH 4	60°40'N	173°05'W
North Creek	NAB 1	54°54'23"N	163°59'00"W
Northeast Cape	NB 4	63°18'N	168°42'W
Northeast Point	SGB 1	57°14'50"N	170°05'50"W
Norton Bay	NB 1	64°30'N	162°00'W
Nunivak Island	SMH 2	60°00'N	166°00'W
Nushagak Bay	NAB 3	58°30'N	158°30'W
Nushagak Peninsula	NAB 3	58°39'N	159°03'W
Nushagak River	NAB 3	59°03'N	158°23'W
Oksenof Point	NAB 1	54°53'N	164°33'W
Operl Island	NAB 1	55°23'N	162°46'W
Otter Island	SGB 1	57°02'45"N	170°24'00"W
Otter Point	NAB 1	55°03'N	163°47'W
Pastol Bay	NB 1	63°12'N	163°15'W
Pastolik River	SMH 3	63°02'N	163°20'W
Peirce, Cape	NAB 4	58°33'15"N	161°46'00"W
Penny River	NB 2	64°32'N	165°45'W
Pilot Point	NAB 2	57°33'50"N	157°34'45"W
Pinnacle Island	SMH 4	60°12'N	172°46'W
Platinum	SMH 1	59°00'45"N	161°49'00"W
Powooiliak Camp	NB 4	63°22'N	171°17'W

Appendix I

Name	Region	Latitude	Longitude
Pribilof Islands	SGB 1	57°N	170°W
Protection Point	NAB 3	58°29'30"N	158°41'45"W
Punuk Islands	NB 4	63°05'N	168°49'W
Quinhagak	SMH 1	59°45'N	161°54'W
Red Bluffs	SGB 1	56°32'20"N	169°38'00"W
Red Mountain	NAB 4	58°57'15"N	161°44'30"W
Reindeer Cove	NB 1	64°31'N	161°10'W
Right Hand Point	NAB 4	58°46'10"N	159°54'00"W
Rocky Point	NAB 1	54°56'30"N	163°26'30"W
Rocky Point	NB 2	64°24'N	163°08'W
Rodney, Cape	NB 2	64°39'N	165°24'W
Romanzof, Cape	SMH 3	61°49'N	166°06'W
Round Island	NAB 4	58°36'N	159°58'W
Safety Sound	NB 2	64°29'N	164°45'W
Saint George Island	SGB 1	56°35'N	169°35'W
Saint Lawrence Island	NB 4	63°30'N	170°30'W
Saint Lawrence Island, NE of	NB 4	63°46' to 64°02'N	167°44' to 168°51'W
Saint Matthew Island	SMH 4	60°24'N	172°42'W
Saint Michael	NB 1	63°29'N	162°02'W
Saint Michael Bay	NB 1	63°27'N	162°00'W
Saint Paul Island	SGB 1	57°10'N	170°15'W

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Name	Region	Latitude	Longitude
Salghat Beach	NB 4	63°20'N	169°12'W
Sarichef, Cape	NAB 1	54°35'50"N	164°55'30"W
Sarichef Strait	SMH 4	60°37'N	173°00'W
Savoonga	NB 4	63°42'N	170°29'W
Scammon Bay	SMH 3	61°55'N	165°50'W
Sea Lion Point	NAB 1	54°34'N	164°56'W
Sea Lion Rock	SGB 1	57°06'15"N	170°17'30"W
Sea Lion Rocks	NAB 1	55°27'40"N	163°12'00"W
Seal Islands	NAB 2	56°42'N	159°21'W
Security Cove	NAB 4	58°41'30"N	161°54'00"W
Sekinak Lagoon	NB 4	63°05'N	169°48'W
Seniavin, Cape	NAB 1	56°24'N	160°09'W
Sennet Point	NAB 1	54°29'N	164°54'W
Sevuokuk Mountain	NB 4	63°46'N	171°42'W
Shaiak Island	NAB 4	58°33'30"N	161°40'00"W
Shaktoolik	NB 1	64°20'N	161°09'W
Shaktoolik River	NB 1	64°22'N	161°11'W
Siknik	NB 4	63°11'N	170°18'W
Sineak	NB 1	64°25'N	161°24'W
Sinuk River	NB 2	64°35'N	166°15'W
Sledge Island	NB 2	64°29'N	166°13'W
Snake River	NB 2	64°30'N	165°25'W
Snake River	NAB 3	58°52'N	158°45'W
Southeast Cape	NB 4	62°56'10'N	169°39'00"W
Southwest Cape	NB 4	63°19'N	171°27'W

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Name	Region	Latitude	Longitude
Spencer, Point	NB 3	65°17'N	166°50'W
Stebbins	NB 1	63°31'20"N	162°17'20"W
Stephens, Cape	NB 1	63°32'30"N	162°18'40"W
Stolbi Rocks	NB 4	63°38'N	170°06'W
Strogonof Point	NAB 1	56°50'N	158°52'W
Stuart Island	NB 1	63°35'N	162°30'W
Summit Island	NAB 4	58°50'N	160°12'W
Swanson Lagoon	NAB 1	55°02'N	163°36'W
Tanunak	SMH 3	60°37'N	165°15'W
Taphook Point	NB 4	63°37'N	171°15'W
Teller	NB 3	65°16'N	166°22'W
Togiak Bay	NAB 4	58°51'N	160°30'W
Toksook Bay	SMH 3	60°31'45"N	165°06'00"W
Toksook River	SMH 3	60°30'N	165°00'W
Tolstoi Point	SGB 1	56°35'40"N	169°28'00"W
Tongue Point	NAB 4	58°49'N	160°50'W
Topkok Head	NB 2	64°33'N	163°58'W
Tvativak Bay	NAB 4	58°50'N	159°33'W
Twins, The	NAB 4	58°35'N	160°18'W
Ugashik Bay	NAB 2	57°35'N	157°42'W
Ugashik River	NAB 2	57°30'N	157°37'W
Unalakleet	NB 1	63°52'N	160°47'W
Unimak Island	NAB 1	54°45'N	165°00'W

Appendix I

Name	Region	Latitude	Longitude
Upright, Cape	SMH 4	60°19'N	172°15'W
Urilia Bay	NAB 1	54°55'N	164°18'W
Vancouver, Cape	SMH 3	60°33'N	165°25'W
Wagon Box Creek	NB 1	63°29'N	161°15'W
Walrus Cove	SMH 4	60°20'N	172°20'W
Walrus Island	SGB 1	57°11'N	169°56'W
Walrus Islands	NAB 4	58°43'N	160°15'W
Wood Point	NB 1	63°28'N	161°40'W
Wood River	NAB 3	59°03'N	158°25'W
Woolley, Cape	NB 2	64°48'N	166°28'W
Yukon River mouths	SMH 3	62°32'N	163°54'W

Appendix II.

Source Names Index

Appendix II

Benson, J. - SGB 1
seabird observer, Seabird Colony Status Program, USFWS, Anchorage

Bill, D. - NAB 3
ADF&G, Commercial Fish Division, King Salmon

Braham, H. - NAB 4
National Marine Mammal Laboratory, Seattle

Braham and Krogman 1977 - NAB 1

Braham et al. 1977a - NAB 4, SGB 1, NB 4

Braham et al. 1980 - NAB 1, SMH 3

Bricker, M. - NAB 1
ADF&G, F.R.E.D. Division, Cold Bay

Brink, K. - SGB 1
pers. commun. to K. Frost, ADF&G, Fairbanks

Brooks, J. - NAB 3, NAB 4
ADF&G Annual Reports 1955 and 1959, and from files of F. H. Fay, Univ. Alaska, Fairbanks; ADF&G, Game Division

Buckley, J. - NAB 4
from files of F. H. Fay, Univ. Alaska, Fairbanks

Burns, J. - NAB 1, NAB 2, NAB 4, SGB 1, SMH 2, SMH 3, SMH 4, NB 1, NB 2, NB 3, NB 4, NB 6

ADF&G, Nome, 1962-69; Fairbanks, 1969-present, Marine Mammal Research Coordinator

Burns, J. - NAB 1, NAB 2
RESOLUTION cruise

Burns 1965 - NAB 3, NB 1, NB 4

Burns, J., Jr. - SMH 3
pers. commun. to J. Burns, ADF&G, Fairbanks; ADF&G seasonal employee

Byrd, V. - NAB 1
seabird observer, Seabird Colony Status Program, USFWS, Anchorage

Calkins, D. - NAB 3, NAB 4, SMH 1
ADF&G, Marine Mammal Section, Anchorage

Cape Newenham NWR Annual Reports January 1966, 1971 - NAB 4

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Clarence Rhodes NWR Annual Reports 1979, 1981 - NAB 4, SMH 2

Crosby, V. - NAB 4
    from files of F. H. Fay, Univ. Alaska, Fairbanks

Curtis 1930 - SMH 2

Dau, C. - NAB 1
    Refuge Manager, Izembek NWR, Cold Bay

Degange, A. - SMH 2
    seabird observer, Seabird Colony Status Program, USFWS, Anchorage

Dick, M. - NAB 1, NAB 2, NAB 4
    Cape Newenham report 1971, also aerial surveys for herring;
    ADF&G seasonal employee

Dinneford, B. - NAB 4, SMH 3
    ADF&G, Game Division, Bethel

Dittmer, J. - NAB 4
    from files of F. H. Fay, Univ. Alaska, Fairbanks

Divoky, G. - NAB 1
    seabird observer, Seabird Colony Status Program, USFWS, Anchorage

Drew, J. - NAB 3
    pers. commun. to C. Smith

Drury, W. - NB 1, NB 2
    seabird observer, Seabird Colony Status Program, USFWS, Anchorage;
    and OCSEAP Annual Report March 1976

Everitt and Braham 1980 - NAB 1, NAB 2

Faro, J. - NAB 2, NAB 4
    from files of F. H. Fay, Univ. Alaska, Fairbanks; ADF&G, Game
    Division, Anchorage

Fay, F. - NAB 4, NB 4
    walrus researcher, Institute Marine Science, Univ. Alaska, Fairbanks

Fay, F. - NAB 1, NAB 2
    RESOLUTION cruise

Fay 1957 - NAB 4

Fay and Kelly 1980 - NB 4

Fay and Lowry 1981 - NAB 2

FEIS 1978 - NAB 1, NAB 4, SGB 1
See "Interagency Task Group 1978" in section X, Literature Cited

Fiscus, C. - NAB 4
National Marine Mammal Laboratory, Seattle

Fish and Vania 1971 - NAB 3

Fleek, W. - NAB 1, NAB 2
Fish and Wildlife Protection Division, Alaska Department of Public Safety

Foster, W. - NB 3
commercial pilot, Foster Aviation, Nome

Fried et al. 1979 - NAB 3

Frost, K. - NAB 1, NAB 2, NAB 4, SGB 1, SMH 2, NB 1, NB 2, NB 3, NB 4
ADF&G, Marine Mammal Section, Fairbanks

Giddings 1964, 1977 - NB 2

Gill, R. - NAB 1, NAB 2, NAB 3, NAB 4, SMH 3
bird surveys; USFWS, Anchorage

Gologergan, T., Jr. - NB 4
from files of F. H. Fay, Univ. Alaska, Fairbanks; Savoonga resident

Goro, F. - NAB 4
from files of F. H. Fay, Univ. Alaska, Fairbanks

Gray, D. - NAB 4
from files of F. H. Fay, Univ. Alaska, Fairbanks

Hall, J. - NAB 2
pers. commun. to K. Frost, ADF&G, Fairbanks

Hall 1979 - NAB 1

Handel, C. - SMH 3, SMH 4
seabird observer, Seabird Colony Status Program, USFWS, Anchorage

Hanna 1920 - SMH 4

Harrison 1979 - NB 4

Harrison and Hall 1978 - NAB 2, NAB 3, SMH 3, NB 1

Hemming, J. - NAB 1
pers. commun. to F. H. Fay, Univ. Alaska, Fairbanks

Henslee, L. - SMH 3
pers. commun. to R. Nelson, ADF&G, Nome; Fish and Wildlife Protection Division, Alaska Department of Public Safety

Hood, L. - NAB 1
USFWS, Anchorage

Hotchkiss, L. - NAB 3, NAB 4
Assistant Refuge Manager, Togiak NWR

Hunt, C. - SMH 3
Kotlik resident, Native Liaison, Yukon Delta NWR

Ichihara 1958 - NB 4

Irons, D. - SMH 4
St. Matthew Island field party, summer 1982, USFWS, Anchorage

Izembek NWR Annual Reports 1960, 1980 - NAB 1

Izembek NWR Files - NAB 1

Johnson, B. and P. - NAB 4, SGB 1
field report from Nanvak Bay, summer 1975; ADF&G seasonal employees

Jonrowe, D. - NAB 4, SMH 1, SMH 2, SMH 3
aerial surveys for herring; ADF&G, Commercial Fish Division, Bethel

Kelly, B. - NAB 4, SGB 1, NB 4
ADF&G; Institute Marine Science, Univ. Alaska, Fairbanks

Kenyon, K. W. - NAB 1
National Marine Mammal Laboratory, Seattle

Kenyon 1958 - NAB 4

Kenyon 1960a, 1962b - NAB 1

Kenyon 1962a - SGB 1

Kenyon 1969 - NAB 1

Kenyon and Rice 1961 - NAB 1, NAB 4, SGB 1, SMH 2, SMH 4, NB 4, NB 6

Kenyon and King 1965 - NAB 1

King, R. - NAB 1, NAB 4
aerial surveys for waterfowl; USFWS, Fairbanks

Koozuna, J. - NB 5
pers. commun. to J. Burns, ADF&G, Fairbanks; King Island and Nome resident

Kulukhon, L. - NB 4
from files of F. H. Fay, Univ. Alaska, Fairbanks; Gambell resident

Lensink, C. - SMH 2, SMH 3
USFWS, Anchorage

Lensink 1960 - NAB 1

Lensink 1961 - SMH 1, SMH 3, NB 1, NB 4, NB 6

Ljungblad, D. - SMH 3, NB 2
Naval Oceans Systems Center, San Diego, CA

Ljungblad et al. 1981 - NB 4

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Lowry, L. - NAB 1, NAB 2, NAB 3, NAB 4, SGB 1, NB 2, NB 3, NB 5
ADF&G, Marine Mammal section, Fairbanks

MacIntosh, R. - NAB 4
from files of F. H. Fay, Univ. Alaska, Fairbanks; National Marine Fisheries Service, Kodiak

Mahaffey, R. - NAB 4
from files of F. H. Fay, Univ. Alaska, Fairbanks

Mathisen and Lopp 1963 - NAB 1, NAB 2, NAB 4

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McCutcheon, S. - NAB 4
from files of F. H. Fay, Univ. Alaska, Fairbanks

McDonald, D. - NAB 4
seabird observer, Seabird Colony Status Program, USFWS, Anchorage

Melchior, H. - NB 2
ADF&G, Game Division, Barrow

Muktoyuk, E. - NB 3, NB 5
pers. commun. to F. H. Fay, Univ. of Alaska, Fairbanks and
J. J. Burns, ADF&G, Fairbanks; ADF&G, King Island/Nome

Naveen, R. - NAB 3
National Marine Fisheries Service, Washington, DC

Nelson 1887 - SMH 1, SMH 3, NB 1

Nelson, M. - NAB 4
aerial surveys for herring; ADF&G, Commercial Fish Division,
Dillingham

Nelson, R. - SMH 1, NB 1, NB 2, NB 4
ADF&G, Game Division, Nome

Nerini et al. 1980 - NB 4

Nunivak NWR Annual Report 1978 - SMH 2

Pegau, R. - SMH 3
ADF&G, Game Division, Nome

Pelowook, G. - NB 4
pers. commun. to F. H. Fay, Univ. Alaska, Fairbanks; Northeast Cape
resident

Pike 1962 - NB 4

Pitcher, K. - NAB 1, NAB 2, NAB 3, NAB 4
ADF&G, Marine Mammal Section, Anchorage

Ponaganuk, T. - SMH 3
Hooper Bay resident

Prescott and Fiorelli 1980 - SBG 1

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Pribilof Islands Program, Annual Report 1981 - SGB 1
See NOAA 1981 in section X, Literature Cited

Randall, R. - NAB 3
ADF&G seasonal employee

Ray, G. - NAB 1, NAB 4
Univ. Virginia, Charlottesville

Ray 1964, 1975 - SMH 3, NB 1, NB 2, NB 3

Reynolds, S. - NAB 1
Fish and Wildlife Protection Division, Alaska Department of Public Safety

Rice and Wolman 1971 - SGB 1, SMH 4

Ritchie 1978 - SMH 2

Rugh 1981 - NAB 1

Rugh and Braham 1979 - NAB 1

Sarvis, J. - NAB 1, NAB 2
Refuge Manager, Izembek NWR

Scheffer 1977 - SGB 1

Schmitt, T. - NAB 1
USFWS, Anchorage

Schneider, K. - NAB 1
ADF&G, Game Division, Research Coordinator-Marine Mammals, Anchorage

Schneider 1976 - NAB 1

Schneider 1981 - SGB 1

Schwarz, L. - NB 1
aerial surveys for herring; ADF&G, Commercial Fish Division, Nome

Seaman, G. - NB 1, NB 2, NB 3
ADF&G seasonal employee (marine mammals)

Seaman and Burns 1981 - SMH 3

Searing, G. - NB 4
seabird observer, Seabird Colony Status Program, USFWS, Anchorage

Sellers, R. - NAB 1
ADF&G, Game Division, King Salmon

Seybert, O. - NAB 2
President, Peninsula Airways, King Salmon

Sholes, W. - NAB 4
from files of F. H. Fay, Univ. Alaska, Fairbanks; ADF&G

Slwooko, V. - NB 4
pers. commun. to F. H. Fay, Univ. Alaska, Fairbanks, and J. J. Burns, ADF&G, Fairbanks; Gambell resident

Smith, C. - NAB 1, NAB 2, NAB 3
ADF&G, Game Division, King Salmon

Smith, M. - SMH 3
Assistant Manager, Yukon Delta NWR

Smith, T. - SMH 2
ADF&G, Game Division, Nome

Sowls, A. - SMH 4
seabird observer and coordinator, Seabird Colony Status Program, USFWS, Anchorage

Steele, L. - NAB 1
Fish and Wildlife Protection Division, Alaska Department of Public Safety

Steen, N. - NAB 3
ADF&G, Game Division, King Salmon

Stephenson, R. - NB 4
ADF&G, Game Division, Fairbanks

Strickland, D. - NB 6
ADF&G seasonal employee

Strode, J. - NAB 4
ADF&G

Taggart, J. and C. Zabel - NAB 4
field report, Walrus Island, summer 1980; ADF&G seasonal employees

Taylor, K. - NAB 4
ADF&G, Game Division, Dillingham

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Thomas 1982 - NB 1

Tibbitts, A. - NAB 2
pilot, Peninsula Airways, King Salmon

Togiak NWR Annual Report 1981 - NAB 4

Toolie, G. - NB 4
pers. commun. to J. Burns, ADF&G, Fairbanks

Tremaine, R. - NAB 1, NAB 4, SMH 1, SMH 2, SMH 3, NB 1, NB 2
ADF&G seasonal employee (marine mammals)

USFWS (U.S. Fish and Wildlife Service) BB Management Plan Maps - NAB 1, NAB 4

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USFWS/SBCS Reports - NAB 1, NAB 4, SGB 1, SMH 4, NB 4
Seabird Colony Status Program, USFWS, Anchorage

USFWS Walrus Harvest Reports 1980, 1981 - NB 2, NB 4, NB 6
from Diomede, Wales, Nome, Gambell, and Savoonga

USFWS Walrus Survey - NAB 4, SMH 2, SMH 4
aerial survey 22-23 September 1980; flew from Barrow to Nome along coast, south side of St. Lawrence Is., and St. Matthew Is., north side of Nunivak Is., then Toksook Bay to King Salmon along coast

Vania, J. - NAB 4
ADF&G, Game Division, Anchorage

Ward, M. - SMH 4
St. Matthew Island field party, summer 1982, USFWS, Anchorage

Whitaker, N. - NB 6
from files of F. H. Fay, Univ. Alaska, Fairbanks

Wilkalkia, H. - NB 2
pers. commun. to R. Nelson, ADF&G, Nome; resident of Norton Sound area, Nome and Cape Nome, for 35+ years

Williamson, F. - NAB 4
from files of F. H. Fay, Univ. Alaska, Fairbanks

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Winjum, J. - NAB 3
from files of C. Smith

Wolfe 1981 - SMH 3, NB 1

DISTRIBUTION OF MARINE MAMMALS IN THE COASTAL ZONE OF THE EASTERN CHUKCHI SEA DURING SUMMER AND AUTUMN

by

Kathryn J. Frost, Lloyd F. Lowry, and John J. Burns

Alaska Department of Fish and Game
1300 College Road
Fairbanks, Alaska 99701

Assisted by

Susan Hills, Kathleen Pearse, and Jesse Venable

Final Report
Outer Continental Shelf Environmental Assessment Program
Research Unit 613, Contact Number NA 81 RAC 000 50

1 March 1983

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I. Summary

A study was conducted with the objectives of compiling all available sightings of marine mammals in the coastal zone of the eastern Chukchi Sea during summer and autumn and evaluating the importance of coastal areas to the various species. Specific attention was given to identification of terrestrial hauling areas used by pinnipeds, and bays, lagoons, and estuaries utilized by cetaceans. The study area included the mainland coast from Cape Prince of Wales to Point Barrow.

Based on available sightings, it was possible to identify in general terms the areas of greatest importance to marine mammals, as well as to examine some aspects of seasonal distribution and abundance in specific areas. Although marine mammals inhabit the entire coastal zone of the eastern Chukchi Sea during summer and autumn, their distribution is far from uniform. Spotted seals haul out in large numbers at Cape Espenberg and near Utukok and Akoliakatat passes in Kasegaluk Lagoon. They are abundant but do not haul out in large numbers in Eschscholtz Bay, Hotham Inlet, the Noatak and Kukpuk River estuaries, throughout Kasegaluk Lagoon, and in the mouths of the Kuk and Kugrua rivers. The only regularly used haulout for walruses is at Cape Lisburne. Major concentration areas for belukhas occur in Kotzebue Sound, particularly Eschscholtz Bay, and near Kasegaluk Lagoon. Harbor porpoises are occasionally present along the entire mainland coast. Killer whales occur regularly in low numbers, often in pursuit of gray or belukha whales. We located only three sightings of minke whales in the coastal zone, in Kotzebue Sound and off Cape Lisburne. Gray whales occur all along the coast but are especially numerous between Icy Cape and Point Barrow.

Available data indicate substantial fluctuations in numbers of animals at particular locations but are not adequate to measure those fluctuations or explain their causes. We suggest that OCSEAP initiate studies on representative species and areas, particularly spotted seals at Cape Espenberg and Kasegaluk Lagoon and belukhas in Kotzebue Sound and Kasegaluk Lagoon, in order that the effects of OCS activities on marine mammals in the coastal zone can be rigorously evaluated.

II. Introduction

The marine mammal fauna of the Chukchi Sea is much less diverse than that of the Bering Sea. Of the 26 species found in the Bering Sea, 10 are known to regularly occur in Alaskan waters north of Bering Strait. During approximately 9 months of the year, the northern seas are covered by ice, and the marine mammals present then--ringed seals (Phoca hispida), bearded seals (Erignathus barbatus), and polar bears (Ursus maritimus)--are those that are strongly ice associated and adapted to living in the pack or landfast ice. During summer months these species remain ice associated and move northward and offshore to summer in the pack ice. During the ice-free months there is an influx of species from the south. Some, such as spotted seals (Phoca largha), belukha whales (Delphinapterus leucas), and walruses (Odobenus rosmarus divergens), are ice associated during winter but prefer the more open ice front or pack, and some, such as harbor porpoises (Phocoena phocoena) and gray whales (Eschrichtius robustus), are not ice-adapted species. Not all of the species present during ice-free months are found nearshore. Those species regularly or potentially utilizing the coastal zone during summer and autumn include the spotted seal, walrus, belukha whale, harbor porpoise, and gray whale.

Killer whales (Orcinus orca) and minke whales (Balaenoptera acutorostrata) may occasionally be present in the Chukchi Sea, including the coastal zone. Although they are not known to occur there in significant numbers, they were included in this report. Polar bears are not regular summer-autumn inhabitants of the coastal zone; however, they do come ashore in early winter to den and have their young. Bowhead whales (Balaena mysticetus) migrate through the Chukchi and western Beaufort seas twice annually. Although they may sometimes pass through the coastal zone, they do not linger there; they are generally found farther offshore.

Nearshore areas are attractive to marine mammals for a variety of reasons. While in the coastal zone, spotted seals, belukha whales, and harbor porpoises forage on the abundant food resources available in nearshore waters. Spotted seals and walruses haul out at specific coastal locations where they rest between feeding forays. Gray whales are probably not specifically attracted to the coastal zone but utilize it as a continuum of the shallow feeding areas of the Chukchi platform.

While major features of the distribution and biology of these species are generally known (e.g., Lowry et al. 1982b), specific published information on their utilization of coastal waters of the Chukchi Sea is generally not available. Proposed OCS leases will offer for sale much of the area adjacent to important coastal marine habitats in the Chukchi Sea. Potential effects of OCS exploration, development, and production activities on marine mammals include not only chronic and catastrophic discharge of hydrocarbons into the environment, but also disturbance factors associated with both onshore and offshore activities. Information on the distribution of marine mammals in the coastal zone must be of adequate resolution to provide input for tract selections, selection of onshore facilities sites, designation of transportation corridors, and design of stipulations relating to the nature and timing of activities. In addition, such information is required in order to evaluate "normal" changes in the distribution and numbers of marine mammals in coastal areas, as well as to monitor the future impacts of OCS activities.

This project has included two major components. The first involved field work, designed to increase the data available on distribution and food habits of marine mammals along the western coast of Alaska. Included were shipboard and aerial surveys and collections of animals conducted during May to October 1981. Results of the field studies have been compiled and reported (Lowry et al. 1982a). The second component consisted of a compilation of all available data on distribution and abundance of marine mammals in the coastal zone of western Alaska during summer and autumn. The compilation of distributional information has been prepared in two parts, a previous report covering the Bering Sea coast, which was prepared and submitted to OCSEAP in September 1982, and this report, which covers the Chukchi Sea.

III. Current State of Knowledge

A. Spotted Seals

Published information on the distribution of spotted seals is limited to general descriptive accounts of their overall distribution (Shaughnessy and Fay 1977, Bigg 1981) or of their distribution in the Bering Sea ice front in spring (Burns 1970; Fay 1974; Burns and Harbo 1977; Burns et al. 1980; Braham et al., in press a). In late winter and spring, the entire Bering-Chukchi population is concentrated in or near the ice front (Burns and Harbo 1977, Burns 1978), with major pupping and breeding concentrations in the Bristol Bay-Pribilof Islands region, Karaginski Bay, and the Gulf of Anadyr (Shaughnessy and Fay 1977). As the ice disintegrates and recedes in spring, spotted seals move generally northward and toward the coast. During summer they are common along the eastern Bering and Chukchi Sea coasts, where they haul out on land, particularly isolated, sandy beaches and barrier islands. They are common in bays, at the mouths of major rivers, and in estuaries (Burns and Morrow 1975). A few animals move eastward into the Beaufort Sea (Burns 1978). In autumn and early winter, as shorefast ice begins to form, spotted seals move offshore and southward to the edge of the pack ice (Fay 1974).

The population of spotted seals in the Bering-Chukchi region has been estimated at 280,000-300,000, of which 80,000 occur in Karaginski Bay (Burns 1978).

B. Pacific Walrus

Pacific walruses inhabit the broad continental shelf of the Bering and Chukchi seas. They migrate seasonally from wintering areas in the Bering Sea to summering grounds on the coast of the Bering and Chukchi seas and the Chukchi Sea ice edge. Based on observations conducted from 1960 to 1976, there are two areas of concentration in late winter and early spring, one south and west of St. Lawrence Island and the other in Bristol Bay (Fay 1982). The actual location of these concentrations is somewhat dependent on the extent of ice in the Bering Sea, which the animals use as a resting platform when not engaged in other activities such as feeding and breeding. Mating occurs in February-March, and females give birth in April-May while moving north with the receding ice edge. Much of the population migrates northward through Bering Strait in April and May. Subadults and females with young follow the retreating ice edge northward and summer primarily in the northern Chukchi Sea (Estes and Gilbert 1978). Adult males form large herds on hauling grounds in Bristol Bay, Bering Strait, and along the Chukchi Peninsula.

Most aerial surveys of walruses have been conducted over the pack ice in Bering Sea in spring or over the Chukchi Sea ice edge and coastal rookeries along the Chukchi Peninsula in late summer-early autumn. Thus, there are numerous accounts of winter-spring distribution in the offshore Bering Sea (e.g., Kenyon 1960b, Kenyon 1972, Burns and Harbo 1977, Krogman et al. 1979) and summer distribution in the Chukchi Sea (e.g., Fedoseev 1962, Gol'tsev 1972).

Fay (1957) summarized the historical and present status of walruses and reported that in the 1930's walrus herds were present on hauling grounds at Cape Thompson, Cape Lisburne, and Icy Cape. By the 1950's, however, there were no regular hauling grounds in Alaska except the Walrus Islands in Bristol Bay. Fay also noted that, after 1900, records of walruses east of Point Barrow were rare.

Dunbar (1949), Bee and Hall (1956), and Harington (1966) discussed the occurrence of walruses east of Point Barrow. All reported that walruses were occasionally seen along the northern Alaskan and Canadian coasts east to Hershel Island and rarely at Banks Island in the eastern Beaufort Sea. Bee and Hall listed 12 records of sightings between Point Barrow and the Alaska-Yukon border.

Fedoseev (1962) discussed the distribution and status of Pacific walruses based on aerial surveys flown in autumn 1960. He noted that walruses were most abundant in the vicinity of Wrangel Island and that they hauled out on land at five locations, including Wrangel and Herald islands and three locations on the Chukchi Peninsula. Fedoseev's surveys did not include the American sector of the Chukchi Sea, but he cited Fay in saying there were no extant haulouts along the Alaskan Chukchi coast.

Gol'tsev (1972) reported on an autumn 1970 aerial survey for walruses in the western Chukchi Sea. He found that there were four onshore hauling grounds: one in the Gulf of Anadyr, two in Bering Strait, and one along the Chukchi coast. His surveys did not extend to the American Chukchi coast.

In autumn 1975, Gol'tsev (1976) again conducted aerial surveys of walruses in the Soviet sector of the Chukchi and northern Bering seas. He reported nine coastal hauling grounds, two of which were in the Chukchi Sea, and noted that a substantial increase in the Pacific walrus population had occurred since his previous survey. As in 1970, the 1975 survey included only the Soviet sector of the Arctic.

Krogman et al. (1979) summarized the historical and recent distribution and abundance of walruses. They noted that walruses have always been abundant along the Alaskan Chukchi coast but that few are found east of Point Barrow. They estimated that from July through September about 40% of the population along the Chukchi Sea ice front is located between 161°W and 166°W.

The best synoptic overview of walrus distribution in Alaska is provided by Fay (1982), in which he maps and discusses distribution by month. He states that solitary animals may overwinter near Point Hope, but that most walruses migrate southward through Bering Strait in October-December. Most return northward in April-July to spend the summer in the pack ice of the Chukchi Sea. From July through September, many are concentrated in the ice off the coast from Icy Cape to Barrow. He reported no recently used haulouts along the Alaskan Chukchi coast.

C. Belukha Whale

Belukha whales are widely though not uniformly distributed throughout seasonally ice-covered waters of Alaska. They spend the winter in offshore waters associated with drifting ice. In spring, as soon as the ice begins to break up and move offshore, they move toward the coast, some making extensive northward migrations in excess of 2,000 km, while others move relatively short distances. Most belukhas appear to spend the summer in coastal waters, concentrating in shallow bays or estuaries of large rivers, although an unknown proportion may remain associated with offshore pack ice. In late summer to late autumn, they move generally south and away from the coast, ahead of or with the advancing pack ice (Kleinenberg et al. 1964, Fay 1974, Gurevich 1980, Seaman and Burns 1981). Major summer concentrations in the Chukchi Sea occur in Kotzebue Sound and along the coast from Cape Lisburne to Point Barrow, primarily in the Kasegaluk Lagoon region (Seaman and Burns 1981; Burns et al., in prep.).

General accounts of the distribution of belukhas in Alaskan waters have been presented by Nelson (1887), Gurevich (1980), Seaman and Burns (1981), and Burns et al. (in prep.). Nelson found belukhas to be common summer residents from Bristol Bay north to Point Barrow. He considered them to be migratory over most of their range, moving north in spring as the ice melted and receded and south in autumn as the pack ice advanced. Seaman and Burns, and Burns et al. summarized the distribution of belukhas by 2-month intervals and also concluded that most belukhas winter in the drifting ice of the Bering Sea, move northward and toward the coast in spring and summer, and leave the coastal zone in late summer to late autumn. Burns et al. (in prep.) present a detailed discussion of the distribution of belukhas in the Chukchi Sea.

Braham et al. (in press b) plotted more than 400 sightings of a total of almost 2,000 belukhas. Many sightings were made in conjunction with spring bowhead whale surveys from Point Hope to just east of Point Barrow. They described the spring migration of belukhas from the Bering Sea through the Chukchi Sea to the eastern Beaufort Sea, noting that those whales summering in the Canadian Beaufort pass through the Chukchi in mid- to late April and May, using the nearshore lead. In May 1976 numerous belukhas were seen between Icy Cape and Point Barrow, and offshore to the northeast of Point Barrow. On three survey flights in May 1977, about 250 belukhas were seen from Cape Krusenstern to Cape Thompson. In transitting the Beaufort Sea to Banks Island, belukhas use offshore lead systems, rather than remaining nearshore as they do in the Chukchi Sea. Sightings in August through October suggest that the westward autumn migration of belukhas past Point Barrow is predominantly offshore.

Harrison and Hall (1978) presented results from 80,000 km of aerial survey tracklines, 6,000 km of which were in the Beaufort Sea and 2,000 in the Chukchi Sea. They observed belukhas in July and August in the western Beaufort Sea; all sightings occurred approximately 100 km offshore in water depths of 1,800 m. In the Chukchi Sea, surveys were flown in June, August, and October, and no live belukhas were seen. Harrison and Hall concluded that few belukhas remain in offshore waters of the Chukchi Sea during summer.

Ljungblad (1981) and Ljungblad et al. (1982) reported the results of aerial surveys for endangered whales in the northern Bering, Chukchi, and Beaufort seas. In spring 1980 they made 284 sightings of 3,404 belukhas, 2,042 of which were from the Chukchi and Beaufort seas. Over 1,900 of those were seen in the Beaufort, and virtually all were in offshore waters. Belukhas were sighted on two of three flights in the Chukchi Sea and 14 of 28 flights in the Beaufort. In August through October, whales were seen on only one of 41 flights in the Beaufort and on none of four flights conducted in the southern Chukchi Sea in late October. In 1981, belukhas were sighted in the Chukchi Sea on four of six spring flights and five of 12 summer flights. Most survey tracklines were in offshore waters. Monthly coastal surveys were conducted from Nome to Deadhorse in April through July. Most belukhas were seen in April (213) and May (79), with very few sighted in June (14) and July (1). On mid-June surveys of the southern Chukchi, belukhas were seen in Eschscholtz Bay and along the coast from Sheshalik to Cape Krusenstern.

Johnson (1979) reported sightings of belukha whales in conjunction with aerial surveys for birds in the central Beaufort Sea. In September 1977 he observed 75-100 belukhas swimming westward near Pingok Island, and in September 1978 an estimated 35 belukhas were seen near Thetis Island. In two summers of field work in Simpson Lagoon, no whales were seen between the barrier islands and the coast.

Fraker et al. (1978) and Fraker (1979) discussed the spring migration of belukhas in the Beaufort Sea in light of ice conditions and aerial surveys flown in the eastern Beaufort. They, like Braham and Krogman (1977), concluded that belukhas migrate eastward in the offshore leads in the polar pack rather than in the nearshore leads along the mainland coast.

D. Harbor Porpoise

Harbor porpoises are the smallest cetaceans found in Alaskan waters. They are commonly found near the coasts, often in waters less than 20 m deep (Tomilin 1957, Leatherwood and Reeves 1978). Limited evidence from the North Atlantic indicates that they migrate inshore in spring and offshore in autumn (Prescott and Fiorelli 1980). They are apparently poorly suited to living in extremely cold water; their metabolic rate is high despite a blubber layer comprising 40% of total body weight, and their body surface to volume ratio is greater than for other cetaceans (Prescott and Fiorelli 1980).

There are few published records of harbor porpoises north of Bering Strait. Hall and Bee (1954) reported the taking of two harbor porpoises, an adult female and several days later a calf, off Point Barrow in August 1954. Van Bree et al. (1977) reported a sighting of two, one of which was killed and retrieved by an Inuit hunter, in July 1973 in the Mackenzie River delta. Burns and Morrow (1975), based on personal observations and conversations with Eskimo residents, indicated that harbor porpoises probably occur in low numbers in the Chukchi Sea every summer.

E. Killer Whale

There is very little published information on the distribution of killer whales in Alaska. Tomilin (1957) reported that they occur in the southern Chukchi Sea in August and September. Dahlheim (1981) summarized their worldwide distribution and reported that killer whales occur north into the Chukchi and Beaufort seas. Ivashin and Votrogov (1981a) noted that killer whales were relatively scarce in the Chukchi Sea but migrated near Mys Uelen, Mys Ikigur, and Mys Serdtse Kamin. In the southern Chukchi, they were found farther from the coast.

F. Minke Whale

Pacific minke whales are distributed widely in inshore waters, often within 160 km of the coast, as well as in the southern edge of seasonal pack ice (Omura and Sakiura 1956, Tomilin 1957). There is little specific information on their distribution in the coastal waters of western Alaska. Tomilin (1957) reported that Pacific minke whales occur from the Chukchi Sea and Bering Strait to the coasts of Korea and China, and to Mexico. Along the west coast of North America, he reported them to occur from Kotzebue Sound to California. Most sightings from northern waters were made in summer, particularly August and early September, and most animals were observed to be feeding. Tomilin believed that whales occurring in the Chukchi Sea migrated south in winter.

Ivashin and Votrogov (1981b) described sightings of minke whales along the Chukchi Peninsula north to Mys Serdtse Kamin. They found these whales to be present in the coastal zone from about June to October, usually within 24 km and often within 1-3 km of the shore. Their sightings suggested that minke whales in the Chukchi Sea are present in low numbers and that they occur mostly as solitary individuals.

G. Gray Whale

The eastern Pacific stock of gray whales winters in the warm coastal waters of Baja California and the southern Gulf of California. From late February to May, the whales begin a northward migration, following the coast closely and occasionally stopping to rest or feed (Pike 1962). They enter the Bering Sea through passes in the eastern Aleutian Islands, particularly Unimak Pass, in April and May and continue moving along the coast of Bristol Bay and southern Nunivak Island, then toward St. Lawrence Island, where they arrive in May or June (Pike 1962, Braham et al. 1977, Frost et al. 1982). Upon reaching the vicinity of St. Lawrence Island, the whales disperse to spend the summer feeding in the shallow waters (usually less than 50-60 m deep) of the northern and western Bering Sea, the Chukchi Sea, and, to a much lesser extent, the Beaufort Sea (Pike 1962, Rice and Wolman 1971). Gray whales begin their southward migration in September or October, passing through Unimak Pass between late October and early January, and arrive in Baja California mainly in December to January (Pike 1962, Rugh and Braham 1979, Rugh 1981).

The eastern Pacific gray whale population was once severely depleted by commercial whaling but has since recovered to near pre-exploitation levels (Scheffer 1976, Blokhin 1979, Rugh and Braham 1979). Ohsumi (1975) estimated an original population of about 15,000 and suggested that it declined to a low of 4,400 in 1875. By the early 1970's, the population had increased to an estimated 11,000 (Rice and Wolman 1971, Mitchell 1973) and by 1980 to between 16,500 (Reilly et al. 1980) and 18,500 (Herzing and Mate 1981).

The distribution and migration of gray whales has been described most completely by Pike (1962) and Rice and Wolman (1971). Pike noted that gray whales do not move into the Chukchi Sea until the ice leaves, but that they are abundant along the Chukchi coast from July through September. He reported northward-migrating gray whales off Cape Thompson in the first half of July and southward-migrating whales as early as August near Wainwright and Cape Prince of Wales. He found gray whales to be present near Point Barrow until mid-September but generally scarce in that region. Rice and Wolman (1971) summarized northward and southward migrations.

Maher (1960) reported on recent records of gray whales along the north coast of Alaska. He presented the details of 10 animals killed at Wainwright and Barrow and described observations of gray whales near Cape Sabine, Wainwright, and Barrow. Based on those observations and information from the Eskimos, Maher mapped the movements of gray whales along the Chukchi coast, concluding that these whales arrive off Wainwright and Barrow in late June or early July and depart for the south in August or September, depending on ice conditions.

Wilke and Fiscus (1961) reported several sightings of gray whales in the southern Chukchi, although not in the coastal zone. On 10 and 16 August 1959, groups of about 100 were seen feeding in the southeastern Chukchi Sea. Additional sightings of 2-20 whales were made from 19-29 August. A group of 20 was seen on 29 August traveling generally southward.

Marquette and Braham (1982) discussed the distribution and catch of gray whales by Alaskan Eskimos. They noted that, although gray whales are common in the Chukchi Sea, most are seen in offshore areas. The exception is near Cape Lisburne, where gray whales are seen nearshore east of the cape in August and September. Marquette and Braham also reported that gray whales are seen regularly in low numbers near Wainwright and Barrow in July through September and occasionally at considerable distances to the east of Barrow.

Ljungblad (1981) and Ljungblad et al. (1982) reported on aerial surveys of endangered whales in the Beaufort, Chukchi, and northern Bering seas. In spring 1980 and 1981, they saw no gray whales north of Bering Strait. In July 1980, gray whales were sighted close to the beach near Point Hope, Cape Lisburne, Point Franklin, and Barrow, and in late October a few were seen just north of Bering Strait. In June 1981, gray whales were sighted nearshore near Wainwright; in July they were seen from Kivalina to Cape Lisburne, near Icy Cape, and near Point Franklin; and in August off Wainwright.

IV. Study Area

The principal emphasis of this study has been to document marine mammal utilization of coastal areas of western Alaska. This report covers information obtained for the eastern Chukchi Sea, which includes the Alaska coast from Bering Strait to Point Barrow. The study area was divided into two major sub-areas which correspond to the U.S. Department of Interior Outer Continental Shelf planning areas (Fig. 1). For purposes of cataloging information and for presentation of results, each planning area was divided into geographical regions which are described in Table 1. Geographical coordinates of specific locations referred to in text are given in Appendix I.

Our intention in this report has been to include all sightings of relevance to marine mammal distribution in the coastal zone. While it is obvious that sightings of animals hauled out on land or in lagoons and estuaries are significant, the evaluation of sightings made at sea is less straightforward. We did not attempt to review and compile all of the available pelagic sighting data. In general, all sightings made within 5 km of the coast have been included. For gray whales, sightings made somewhat farther offshore are listed.

V. Methods

We have attempted to make a complete review of all available sightings of marine mammals in the coastal zone of the Chukchi Sea during summer and autumn. Our intention in restricting the study to the summer-autumn period was to eliminate the seasons when the coastal zone is covered by shorefast ice, which excludes most species of marine mammals. By so doing, we have eliminated from our study ringed seals and bearded seals, which, in Alaska, only very rarely utilize terrestrial haulouts. We have included in this report any sightings of the seven species discussed in section II which occurred during the open-water season.

As discussed in section IV, the study area has been limited to the coastal zone of the Chukchi Sea. Emphasis was given to identification of terrestrial hauling areas of pinnipeds, and lagoons, bays, and estuaries regularly utilized by cetaceans and pinnipeds. We have not reviewed all available pelagic sightings of cetaceans and generally have included only sightings made within 5 km of the shore. We have dealt primarily with sightings made since 1950 and have not attempted a complete review of earlier historical information, since what is available is usually presented in general terms and is of anecdotal value. Reports and sightings of beached, dead animals have not usually been included.

The idea of cataloging sightings and information on distribution of Chukchi Sea marine mammals is not new. In fact, a number of investigators have maintained files of sightings, and we have benefited greatly from their efforts. Although some relevant information is contained

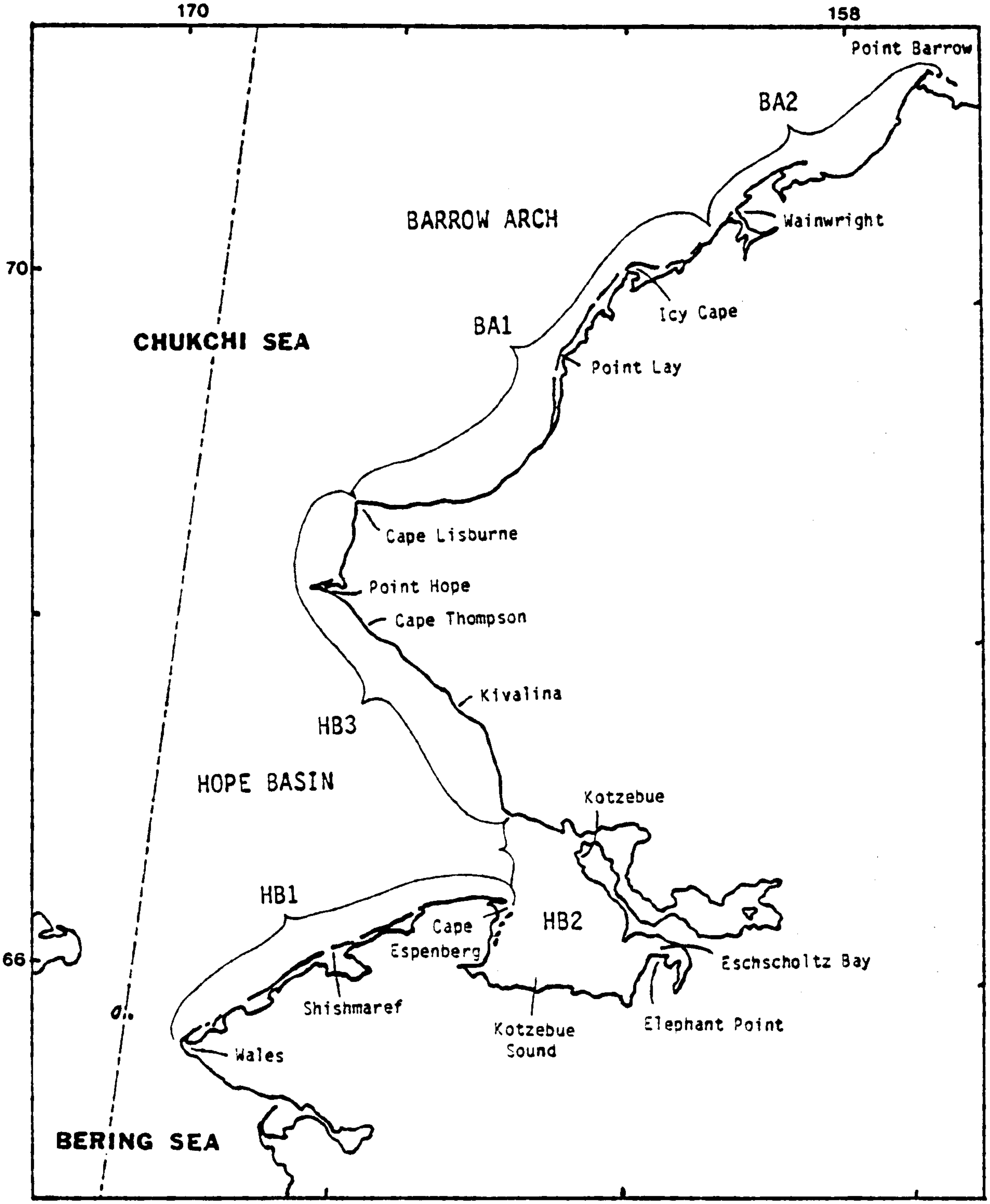

Figure 1. Map of the study area showing Outer Continental Shelf planning areas and subdivisions used in data compilation.

in published literature (e.g., see section III), much of the specific information on sightings is usually lost in the process of data reduction. We have therefore, to the maximum extent possible, derived sighting information from original sources, which are usually the files of individual investigators or agencies and notes and observations of field biologists. Sources which we have used, in addition to published literature (section X), are given in Table 2. The observations and files of personnel associated with the U.S. Fish and Wildlife Service wildlife refuge system and with the Alaska Department of Fish and Game have been particularly useful. Dr. F. H. Fay (University of Alaska, Institute of Marine Science) contributed much from the wealth of data he has collected during many years of observing Alaskan marine mammals.

Data were recorded on formatted sighting cards, which were cataloged by species and area. Geographical subunits of the study area are shown and described in section IV. Depending on the specificity of the data source, we recorded for each sighting the species, number of animals, date, time, location, and any other significant observations such as sex/age classes, apparent behavior, etc.

We have presented our results principally in a series of tables in which sightings are ordered by species, location, and time of year. The location given to each sighting is generally the nearest recognized geographical locale. For example, sightings of both seals hauled out at and whales swimming by Cape Lisburne are recorded as at Cape Lisburne. Place names and associated geographical coordinates are from Orth (1971) and are listed in Appendix I. Some place names not in Orth (1971) are included in tables, maps, and Appendix I; latitudes and longitudes of those places were determined from 1:250,000 USGS maps. Acronyms for sources given in data tables are explained in Appendix II. We have indicated the source from which we obtained the data, which may not in all cases be the original observer. Sightings for a particular species and area are arranged by time of year to elucidate seasonal patterns in abundance.

Although the data-compilation phase of this project terminated at the end of calendar year 1981, new information has been regularly received during the course of preparation of the report. We have incorporated as much of this new information as possible; however, we do not consider the data included for the summer of 1982 to be complete.

VI. Results

A. Hope Basin (Figure 2; Tables 3-5)

Spotted Seal

Spotted seals are present along the entire northern coast of the Seward Peninsula, but there are no major haulout sites in that region. At Cape Espenberg, however, over 1,000 seals have been seen hauled out in late August, making this the largest known hauling area in Hope Basin. In late September 1981, at least 400 seals were present in that area, all of which were seen in the water.

Spotted seals are present throughout Kotzebue Sound, but there are no major haulouts comparable to that at Cape Espenberg. Seals haul out on the rocks near Chamisso Island in late summer and autumn. Many are present in late summer and autumn in Eschscholtz Bay, particularly at the mouth of the Buckland River. They occasionally haul out on the tip of Elephant Point. These seals are also present in Hotham Inlet, sometimes in Selawik Lake, and around the islands of the Noatak River delta, where they occasionally haul out. They do not, however, haul out there in large numbers on a regular basis due to intense human activity along the north coast of Kotzebue Sound.

Spotted seals are present but not particularly abundant in summer along the coast from Cape Krusenstern to Cape Thompson and Point Hope. However, in autumn they are quite numerous in the Kukpuk River estuary (near Point Hope) and up to 30 km upriver, where they congregate to feed on locally abundant fishes such as salmon (*Oncorhynchus* spp.) and smelt (*Osmerus mordax*). In November 1959, there was reported to be an unusually large number of seals in Kivalik channel and also many arctic cod (*Boreogadus saida*) in the area. There is no indication that seals haul out near Point Hope, probably due to human activity there.

Table 1. Geographical subdivisions of the Chukchi Sea study area.

Hope Basin

HB 1 - north coast of Seward Peninsula from Cape Prince of Wales to and including Cape Espenberg

HB 2 - Kotzebue Sound from just south of Cape Espenberg to, but not including, Cape Krusenstern

HB 3 - coast from Cape Krusenstern to, but not including, Cape Lisburne

Barrow Arch

BA 1 - Cape Lisburne to just south of Wainwright

BA 2 - Wainwright to and including Point Barrow

Table 2. Information sources consulted in addition to published literature.

ADF&G (Alaska Department of Fish and Game) Annual Project Segment Reports - Federal Aid in Wildlife Restoration Projects, 1960-1981.

ADF&G Files - Fairbanks, Nome

ADF&G Herring Surveys - southern Chukchi Sea to Kotzebue Sound, aerial surveys

ADF&G Marine Mammal Field Reports - cruises and aerial surveys

ADF&G Marine Mammal Harvest Data

Alaska Maritime NWR (National Wildlife Refuge) - letter to refuge manager requesting information from files

Burns, J. - ADF&G, field notes 1962-1982

Entuziast cruise report - joint US/USSR marine mammals cruise in August 1982

Fay, F. - Institute of Marine Science, Univ. Alaska, Fairbanks

Field, P. - ADF&G, field notes 1979 (Point Hope)

Frost, K. - ADF&G, field notes 1975-1982

Hills, S. - ADF&G, field notes

Kelly, B. - Institute of Marine Sciences, Univ. Alaska, Fairbanks; and ADF&G; field notes 1977-1982

Lowry, L. - ADF&G, field notes 1975-1982

Table 2., continued

Melchior, H. - ADF&G, personal communication

Nelson, R. - ADF&G, field notes, field reports

Quinlan, S. - ADF&G, seabird biologist; personal communication

Schamel, D. - Institute of Arctic Biology, Univ. Alaska, Fairbanks; personal communication

Seaman, G. - ADF&G, field notes, field reports 1975-1980

Selawik NWR - Annual Report 1981 and letter to refuge manager requesting data from files

Shanahan, C. - ADF&G, field notes 1967 (Wainwright)

Springer, A. - seabird biologist, personal communication

Strickland, D. - ADF&G, field notes 1978 (Wainwright)

USFWS (U.S. Fish and Wildlife Service) Aerial Surveys for waterfowl - NPRA (National Petroleum Reserve Alaska)
- Barrow to Wainwright to Utukok Pass; 28 May 1978; R. King
- Agiak - Cape Sabine - Point Lay - Icy Cape - Wainwright - Peard Bay - Barrow; 16 August 1978; R. King
- Barrow - Dillingham; 15-22 September 1977; R. King
- Barrow - Point Lay; 21 September 1978; R. King

USFWS SBCS (Seabird Colony Status) Reports - files of all sightings/ censuses/visits to established seabird colonies along entire Alaskan coast, usually visited during breeding season; 1976-- A. Springer and D. Roseneau; 1977 - A. Degange and A. Sowls

USFWS Walrus Harvest Reports - 1980 and 1981

USFWS Walrus Survey - joint project with ADF&G and Soviet Union, 10-23 September 1980, Barrow to Bristol Bay.

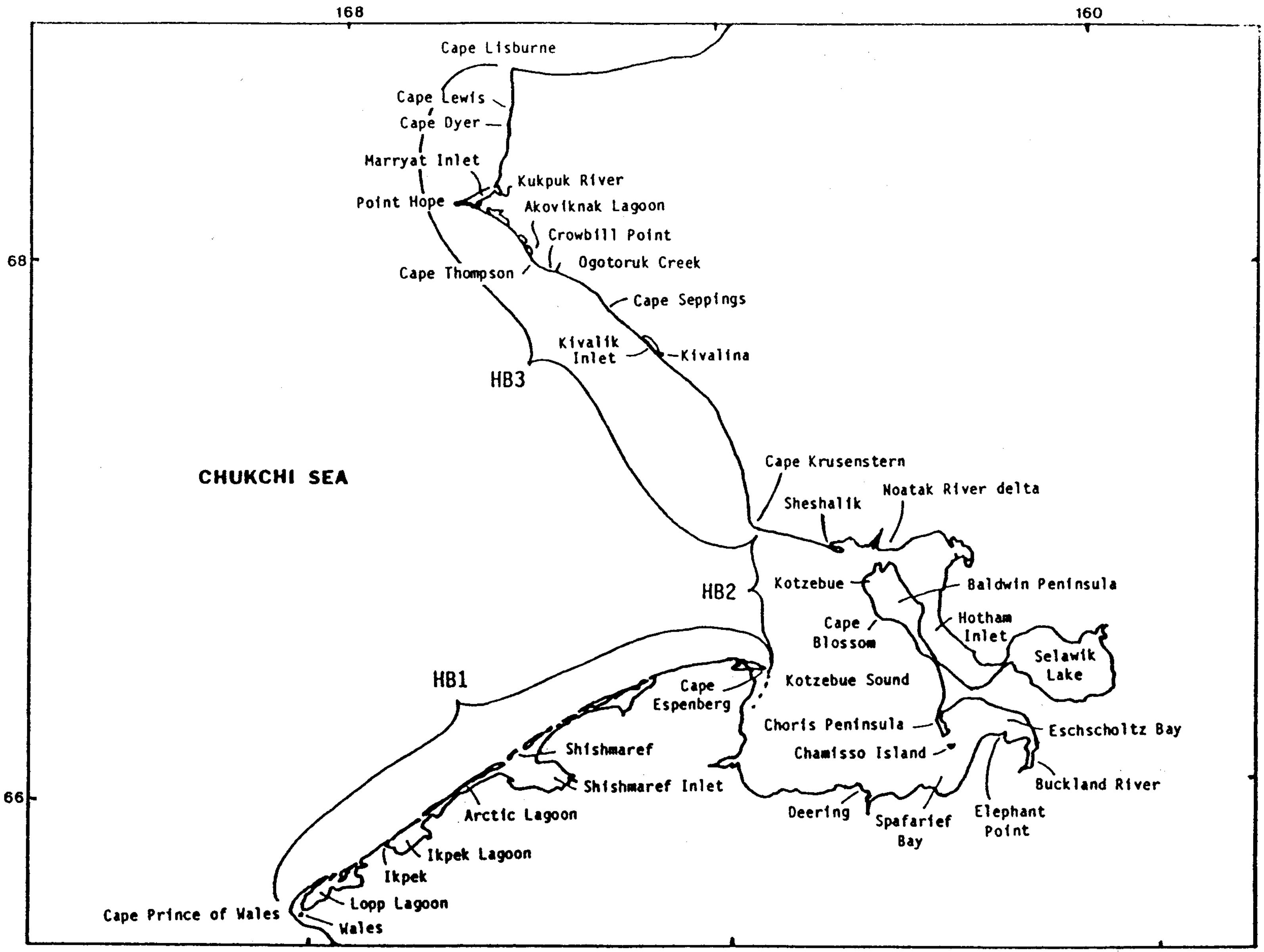

Figure 2. Map of the Hope Basin, regions HB 1, HB 2, and HB 3.

Table 3. Sightings of coastal marine mammals along the northern Seward Peninsula, Hope Basin, region HB 1.

Location	Date	Number	Comments	Source
SPOTTED SEAL				
Wales	Jun	very abundant		Bailey and Hendee 1926
Wales to Shishmaref	10 Jun 81	many	hauled out on broken-up ice floes	K. Frost*
Wales	11 Jun 72	present	1st of year taken	J. Burns
	22 Jun 66	some	1st of spring taken	"
	summer-autumn	many	present in any of bays, lagoons, or estuaries, including Lopp, Ikpek, and Arctic lagoons and Shishmaref Inlet; haulout depends on intensity of human activity; present throughout summer, move into rivers and haul out more in autumn	"
Shishmaref	late Jun - early Jul 71	present	hunted	"
	Jul-Aug 72	present	"	"
Shishmaref Inlet	late summer-autumn	many	inside and outside the inlet; hunted	Shishmaref residents through G. Seaman
Shishmaref spit	late summer-autumn	present	sometimes haul out	"
Shismaref	10 Sep 65		26 killed	ADF&G, Nome files
	autumn	present	often hunted	F. Goodhope through J. Burns
	late Nov 72	present	hunted	J. Burns
Shishmaref-Cape Espenberg	summer-autumn	many	hauled out on low sand beach	Alaska Planning Group
Cape Espenberg	late Aug	1,000 +	year unknown; hauled out; photos to document	F. Fay
	21 Sep 81	400	at least 1 seal had been hauled out on the spit off the Cape--others were moving from the lagoon to the ocean through the pass	L. Lowry
	summer-autumn	> 1,000	hauled out at tip of the Cape	Alaska Planning Group
	summer-autumn	many	excellent hauling area; many seals use this area	J. Burns

Table 3., continued

Location	Date	Number	Comments	Source
BELUKHA WHALE				
Cape Prince of Wales, 3 mi NW of	Feb 77	3 +	trapped in ice	Wales hunters through G. Seaman
Wales	late Mar - early Apr	many	moving N; ice present; usually pass by at this time	residents through R. Tremaine
Cape Prince of Wales, 20-30 mi N	6 Apr 81	> 150	including cow/calf pairs	Ljungblad et al. 1982
	28 May 79	2 small pods	close to shore; 1 pod of 8+; hunted	R. Tremaine
Wales	5 Jun 81	2	seen moving N offshore by Fred Ozenna	USFWS walrus harvest rep. 1981
	8 Jun - 3 Dec	present		Lensink 1961
Wales to Shishmaref	Oct 75	few present	aerial survey	G. Ray
Ikpek to Cape Espenberg	breakup and throughout summer	common	once seen commonly in this area	Shishmaref residents through G. Seaman
Lopp and Arctic lagoons	late Jun, Jul early 1900's	present	seen by reindeer herders of Wales and Shishmaref; some years a few, others there were several hundred; would remain for several weeks if undisturbed	"
Shishmaref, 15-20 mi W and S of	5 Mar 76	30-35	apparently trapped on ice; hunted	Shishmaref hunters through G. Seaman
Shishmaref, 4 mi W near shore	4 Jun 79	20 +	1 gray, 1 part gray	C. Weyiouanna through R. Tremaine
Shishmaref Inlet	Jul	present	occasionally entered during periods of high water	Shishmaref residents through G. Seaman
Shishmaref, along coast	Jul-freeze-up	present	sometimes caught in nets set in drifting ice near village at freeze-up; not often sighted near Shishmaref in recent years	"
Shishmaref	early Oct	present	used to go in west channel; sometimes tangled in seal nets in early Oct	C. Weyiouanna
HARBOR PORPOISE				
Chukchi Sea	summer	present	probably present in low numbers every summer based on personal observations and Eskimo residents	Burns and Morrow 1975

Table 3., continued

Location	Date	Number	Comments	Source
KILLER WHALE				
Chukchi Sea	summer	present	probably present every summer in low numbers; occasionally in the coastal zone	coastal residents through J. Burns
Shishmaref Inlet	summer, 1970's	1	reliable source	Shishmaref residents through G. Seaman
Shishmaref	summers	present	residents see every summer	"
Ikpek to Cape Espenberg	29 Jul 80	1	dead on beach	D. Stewart through J. Burns
GRAY WHALE				
Wales	May-Jul 78, 79	present	many moving northward close to shore in May Jun, fewer in Jul	S. Hills
Cape Prince of Wales	10 Jun 81	1	swimming, leaving mud trail	K. Frost
	1 Jul 77	30-50	appeared to be feeding	"
Cape Prince of Wales to Icy Cape	Jul 58	"many"	feeding 8-15 mi from shore; seen from tugboat Neptune	Pike 1962
Cape Prince of Wales, N of	Aug 58	1	feeding in 5 fathoms of water; mud trail seen from tugboat Neptune	"
	24 Aug 59	20	moving S, scattered	Wilke and Fiscus 1961

Table 4. Sightings of coastal marine mammals in Kotzebue Sound, Hope Basin, region HB 2.

Location	Date	Number	Comments	Source
SPOTTED SEAL				
Chamisso Is.	late summer/ autumn	present	haulout	USFWS 1969
	12 Aug 77	20	hauled out on rocks between Chamisso and Puffin islands	USFWS/SBCS Rep., A. Degange/A. Sowls
	Sep to freeze-up	present	hunted regularly by local people; eating flatfishes	J. Burns
	20 Sep 81	4	hauled out on small rock off NE end of Chamisso Is.	L. Lowry
Eschscholtz Bay	late summer-autumn	many	present all over bay, particularly E end in mouth of Buckland River; occasionally haul out on tip of Elephant Pt.	Buckland residents through G. Seaman
Buckland R., mouth of, Igloo Pt. to first main upstream island	Sep - Oct	many	in the mouth of the river	"
Hotham Inlet	summer-autumn	very common	probably as abundant as in Eschscholtz Bay	Kotzebue residents through G. Seaman
Selawik Lake	summer-autumn	present		"
Noatak Delta islands	ice-free months	present	occasionally haul out	Foote and Williamson 1966
BELUKHA WHALE				
Deering	summer	uncommon	whales prefer northern and eastern Kotzebue Sound	Deering residents through G. Seaman
Eschscholtz Bay, NW end of bay	8 Jun 79	200 +	moving into bay, in channel	NANA pilot and N. Lee through G. Seaman
Chamisso Is., S of	11 Jun 78	20-25	in open water; 1st confirmed sighting of year	Kotzebue hunter through G. Seaman
Elephant Pt., 3 mi W of	12 Jun 78	50-150	nearshore, W of 1st point from Elephant Pt.	Deering hunters through G. Seaman
Eschscholtz Bay	12 Jun 79	100's (300+)	moving into bay through deep channel on high tide; 1st day of hunting	hunters through G. Seaman
Eschscholtz Bay, along NE shore	13 Jun 78	500-700 +	spread along deep channel; hunted	"
Eschscholtz Bay	14 Jun 78	many	most coming into bay; hunted	"

Table 4., continued

Location	Date	Number	Comments	Source
BELUKHA WHALE, cont.				
Eschscholtz Bay, by Gallahan on N side of bay	15-16 Jun 79	low 100's (200 +)		belukha hunters through G. Seaman
Eschscholtz Bay	15-18 Jun 80	many	hunted	K. Frost
	15-16 Jun 81	present	hunted	J. Burns
Eschscholtz Bay, W end	16 Jun 78	100-150 seen, more present	hunted	hunters through G. Seaman
Eschscholtz Bay	17, 18 Jun 78	present	hunted	G. Seaman
Spafarief Bay	18 Jun 79	30-40	hunted; ice not far offshore	Deering hunter through G. Seaman
Chamisso Is., N and W of	19 Jun 79	300-600		Munz Airlines pilot and NANA pilot through G. Seaman
Eschscholtz Bay, near mouth	19 Jun 78	50-100 +		belukha hunters through G. Seaman
Eschscholtz Bay	19 Jun 81	few		J. Burns
Eschscholtz Bay, central	20 Jun 78	50-75		hunters through G. Seaman
Eschscholtz Bay, NE corner	21 Jun 82	100 +	seen at night	A. Fields through J. Burns
Chamisso Is.	21 Jun 79	about 100	moving into bay	hunters through G. Seaman
Eschscholtz Bay	22 Jun 82	present	1st hunt of the year	J. Burns
	23 Jun 80	800 +		Elephant Pt. hunters through J. Burns
Chamisso Is., N of	Jul 60	900-1,200	moving N along Choris and Baldwin Peninsula	J. Burns
Buckland R., N of mouth of	4 Jul 78	several hundred	along shore	L. Thomas
Eschscholtz Bay, along NW shore	8 or 9 Jul 78	900-1,000	appeared to be milling; new calves present; seen from air	N. Lee
Kotzebue Sound and Hotham Inlet	spring-summer	present - "large numbers"	". . . feed in the shallow, warm waters near the river deltas."	Foote and Williamson 1966
Kotzebue Sound	31 May - 23 Oct	present		Lensink 1961
	summer	present	very abundant at times	Nelson 1887

Table 4., continued

Location	Date	Number	Comments	Source
BELUKHA WHALE, cont.				
Kotzebue Sound, near Baldwin Peninsula	Jun or Jul 77	present	calving	D. Krammer through G. Seaman
Kotzebue, S of near Cape Blossom	1 or 2 Jun 79	30 +		Kotzebue pilot through G. Seaman
Kotzebue, 10+ mi S of, near Riley wreck	6 Jun 79	80-100	appeared to be following channel; in open water; ice 5-6 mi to S	G. Barr
Choris Peninsula, N of	12 Jun 81	2		Kotzebue hunters through J. Burns
Choris Peninsula, off of	Jun 73	1,000 +	covered area 1/2 mi by 5 mi	J. Jacobson through J. Burns
Kotzebue area	13 Jun 80	lots		hunters through K. Frost
Kotzebue, 10+ mi S of, near Riley wreck	13 Jun 81	1,000 +		pilot through J. Burns
Kotzebue Sound, along Baldwin Peninsula	13 or 14 Jun 79	200-300 +	aerial observation; 5 mi N of channel between Chamisso Is. and peninsula	Kotzebue pilot with Sheldon's through G. Seaman
Kotzebue Sound, Baldwin Peninsula, W of	14 Jun 81	200-300 +		Kotzebue pilot with Sheldon's through J. Burns
Kotzebue Sound, SE	15 Jun 81	± 100		Ljungblad et al. 1982
Kotzebue, 10+ mi S of, near Riley wreck	16 Jun 81	± 50	aerial observation	J. Walker to J. Burns
Kotzebue Sound, Cape Blossom	16 Jun 81	± 60	aerial observation	K. Persons
Kotzebue Sound, Baldwin Peninsula, S coast	20 Jul 77	66	headed WNW	ADF&G herring survey
Kotzebue to Cape Krusenstern	16 Jun 81	± 40		Ljungblad et al. 1982
Kotzebue Sound, Hotham Inlet	late Jun and Jul	a few small groups	may be present but usually scared away by boat traffic	Kotzebue residents through G. Seaman
Sheshalik	summers until 1965	present	commercial salmon fishery developed in 1965, not as abundant now	Seaman and Burns 1981
Sheshalik to Cape Krusenstern	7 Jun 82, late that week	large numbers	moved into shore between Sheshalik and Cape Krusenstern, then moved SE toward Kotzebue Sound; locals say belukhas move clockwise into Kotzebue Sound	W. Goodwin through J. Burns

Table 4., continued

Location	Date	Number	Comments	Source
BELUKHA WHALE, cont.				
Sheshalik area	15-25 Jun 79	groups of 10's to 75-100		Sheshalik/Kotzebue people through G. Seaman
Sheshalik	21 Jun 82	present	as of this date, ± 20 whales had been netted	local hunters through J. Burns
HARBOR PORPOISE				
Kotzebue Sound, W of Cape Blossom	summer	present	source described porpoise fitting description of harbor porpoise	Y. Wilson through G. Seaman
Kotzebue Sound	summer	present	sometimes caught in salmon nets	Kotzebue residents through J. Burns
KILLER WHALE				
Eschscholtz Bay	late Jun 79	3 or 4	chasing either gray or minke whale	G. Seaman
	summer	present	occur regularly in summer; sometimes there when belukhas are there	Buckland residents through G. Seaman
Buckland R. mouth	summer, late 70's	1	good source	Buckland resident through G. Seaman
MINKE WHALE				
Kotzebue Sound	summer	present		Y. Wilson through G. Seaman
Eschscholtz Bay	autumn 78 or 79	2	beached in mouth of Buckland River; Seaman has one of skulls	G. Seaman
GRAY WHALE				
Kotzebue Sound, W of Baldwin Peninsula	summers	present		Kotzebue Sound residents through G. Seaman
off Kotzebue Sound	Jul 58	present	feeding	Pike 1962
Kotzebue Sound	10-20 Aug 59	200 +	feeding	Wilke and Fiscus 1961
Sheshalik	early Jul 80	1	18- or 19-ft gray whale killed by hunters	P. Merrit through J. Burns

Table 5. Sightings of coastal marine mammals from Cape Krusenstern to Cape Lisburne, Hope Basin, region HB 3.

Location	Date	Number	Comments	Source
SPOTTED SEAL				
Pt. Hope	summers	few	hunted; in estuaries in area	Johnson et al. 1966
Pt. Hope area	Jun-Jul 59	present	migrating by; hunted	Foote 1960
Kukpuk R. delta	Sep-Nov 59	numerous	congregate in river to feed on fish; hunted by local residents	"
Kukpuk R., Marryat Inlet	late summer-autumn	numerous	found up to 20 mi up the Kukpuk R. feeding on smelt, herring, salmon	North Slope Planning Document
Kukpuk R.	late Oct	many	concentrated near river outlet; no indication that they haul out	Johnson et al. 1966
Kivalik channel	Nov 59	present	about 10 taken with ringed seals; unusually large numbers of seals; many arctic cod in area	Saario and Kessel 1966
WALRUS				
Kivalina, 2.5 mi SE	31 Oct 59	1	sleeping on beach; killed	Saario and Kessel 1966
Cape Thompson	summer 1930's, 1940's	occasionally large numbers	not known to haul out there in recent years; photo of haulout from 40's	F. Fay
Pt. Hope	summer-autumn	present	infrequently haul out at tip of Pt. Hope spit and along sandy beaches of barrier islands at N end of Marryat Inlet	North Slope Planning Document
	7 Sep 59	1	on beach; killed	Foote 1960
Pt. Hope	winter	few	solitary animals occasionally overwinter near Pt. Hope	J. Burns
Cape Lewis	11 Aug 80	1	bull; hauled out	B. Kelly
	14 Aug 80	4	bulls; hauled out	"
BELUKHA WHALE				
Kivalina	Mar-Apr	present	move N in leads in ice	Saario and Kessel 1966
	25 May 79	12-13	in heavy ice	local pilot through G. Seaman

Table 5., continued

Location	Date	Number	Comments	Source
BELUKHA WHALE, cont.				
Pt. Hope to Barrow	28 Apr- 22 May 76	present	at least 2 "waves;" most sightings from Wainwright to Barrow	Marquette 1977; Braham et al., in press b
Pt. Hope	30 Apr - 16 May	present	seen	Fiscus and Marquette 1975
Pt. Hope, 15 mi SE	May 76	several groups of 8-15	swimming S along shore ice toward Kotzebue Sound	Pt. Hope residents through G. Seaman
Pt. Hope	2 May - 12 May	present	main concentrations	Fiscus and Marquette 1975
	1 May 79	10	moving N in lead in ice	P. Field
	2 May 79	15	"	"
	3 May 79	30	"	"
	4 May 79	30	"	"
	5 May 79	60	"	"
	6 May 79	1500 +	"	"
	7 May 79	some	"	"
	8 May 79	50	"	"
	9 May 78	present		"
	19 May 80	± 1000	1st verified major movement of year by Pt. Hope	D. Smullen
Pt. Hope, S shore	late Jun 79	75 + 100	moving N	D. Frankson
Pt. Hope	20 Jul 1887	present	females with calves plus 2 or 3 males near each female; swimming up and down the shore	Nelson 1887
	Sep-Oct	present	moving S along shore	Pt. Hope seal hunters through G. Seaman
HARBOR PORPOISE				
off Cape Thompson	18 Sep 81	2	boat observation; water depth 5 m	L. Lowry
off Cape Dyer	18 Sep 81	3	boat observation; water depth 25 m	"

Table 5., continued

Location	Date	Number	Comments	Source
KILLER WHALE				
Kivalina	summer	present	regularly seen; when present, they drive belukhas in close to shore, making them easy to hunt	Y. Wilson through G. Seaman
	summer - date unknown	1	male; chased pod of belukhas close to shore; captured and killed adult (white) whale; story related in Jun 1980	Kotzebue hunter through J. Burns
Pt. Hope area	summer	present	at least 2 known recent instances of killer whales killing gray whales; long history (20-30 yr ago and more) of killer whales beaching gray whales N of the point	village residents through G. Seaman
GRAY WHALE				
Kivalina to Cape Thompson	8 Jul 81	present	very near shore	Ljungblad et al. 1982
Kivalina, S of	25 Jul 81	present		"
Cape Thompson	summer	1	within 50 ft of beach	D. Craighead
	1st half of Jul each yr	present	moving northward; from residents through F. Fay	Pike 1962
Ogotoruk Cr. mouth, 0.8 km S of (Cape Thompson vicinity)	9 Aug 76	3	rolling, blowing, diving, heads out of water; then moved N up coast; within 100 m of shore	Springer and Roseneau 1977
Cape Thompson	10 Aug 76	5	2 moving rapidly N about 100-200 m offshore; 3 within 50 m of beach, rolling, sounding, extending heads out of water, "wallowing"	"
Crowbill Pt.	13 Aug 76	1 +		USFWS/SBCS Rep., A. Springer/ D. Roseneau
Cape Thompson, 5.6 km S of	20 Aug 76	1	"playing" at surf line within 100 m of beach	Springer and Roseneau 1977
Cape Thompson, 7.2 km N of (N end Akoviknak Lagoon)	20 Aug 76	1	traveling steadily northward within 50 m of shore	"

Table 5., continued

Location	Date	Number	Comments	Source
GRAY WHALE, cont.				
Pt. Hope, N of	20 Jul 80	2	within 2 km of beach; feeding and social behavior	Ljungblad 1981
Pt. Hope to Cape Lisburne	20 Jul 80	3	aerial survey for bowheads	Hobbs and Goebel 1982
Pt. Hope	8 Jul 81	present	feeding; 3 cow/calf pairs	Ljungblad et al. 1982
	summer	present		Durham 1979
	25 Jul 81	present		Ljungblad et al. 1982
Pt. Hope to Cape Lisburne	summer-autumn	present		Marquette and Braham 1982
Pt. Hope, W of, to Cape Lisburne	Aug 82	11	one 10 mi W Cape Lisburne; two 10-15 mi SSW Pt. Hope; eight about 20 mi W Kivalina	Fay and Kelly 1982

Walrus

There are no major hauling areas for walruses in Hope Basin. In the 1930's and 1940's, large numbers occasionally hauled out at Cape Thompson; however, none have been known to haul out there in recent years. Single animals or small groups are occasionally seen on the beach from Cape Krusenstern to Cape Lewis. Walruses infrequently haul out on the tip of Point Hope spit and on the barrier islands at the north end of Marryat Inlet.

Belukha Whale

Belukhas are seen migrating along the coast of the Seward Peninsula through leads in the ice from late March until June but apparently no longer frequent that area during the summer. According to long-time residents of Shishmaref, these whales were once commonly seen from breakup through summer all along the coast. In some years up to several hundred might be present in Arctic or Lopp Lagoon, where they would remain for several weeks if undisturbed. They also occasionally entered Shishmaref Inlet. Near Shishmaref, belukhas were sometimes caught in nets set in drifting ice in early October. Residents report that belukhas have not often been sighted near Shishmaref in recent years.

Belukhas are very common in Kotzebue Sound during summer, generally first arriving in early June. The largest sightings have been made in and near Eschscholtz Bay. Over 1,000 whales were seen in June 1973; 900-1,000 on 8 or 9 July 1978; 500-700 on 13 June 1978; 800+ on 23 June 1980; and over 1,000 on 13 June 1981. Sightings of groups of several hundred whales are common. Belukhas are reported to move into Eschscholtz Bay on rising tides and leave on falling tides. They are commonly seen along the western shore of the Baldwin Peninsula and in northern Kotzebue Sound in the Sheshalik area, where sightings of groups of 75-100 whales are not uncommon.

Northward migrating belukhas are seen swimming through leads in the ice along the coast from Cape Krusenstern to Point Hope (primarily near Point Hope) during late March through June or early July. Near Kivalina in June 1979 200-300 whales were seen moving northwest along the coast. Belukhas are also reported to be common near Kivalina during the first 3 weeks of September but rare after then. At Point Hope most sightings are in April and May of whales on their way to the Mackenzie River estuary. Some sightings have been made in June and July. In September and October, belukhas are seen moving south along the shore near Point Hope.

Harbor Porpoise

Reports by residents of villages along the Chukchi coast suggest that harbor porpoises are probably present in low numbers every summer. Harbor porpoises are reported by residents of Kotzebue Sound to be present there in summer. They are occasionally caught in salmon nets.

Harbor porpoises probably occur all along the coast from Cape Krusenstern to Cape Lisburne. Two sightings were made on 18 September 1981: two individuals were seen in 5-m water depth off Cape Thompson, and three were seen in 25 m of water off Cape Dyer.

Killer Whale

Killer whales are present in the Chukchi Sea in low numbers every year. Residents of Shishmaref report seeing them every summer. During the mid-1970's, one killer whale entered and was seen inside Shishmaref Inlet. A dead one washed up on the beach between Ikpek and Cape Espenberg in July 1980.

In late June 1979, three or four killer whales were seen chasing a gray or minke whale in Eschscholtz Bay. In the late 1970's, a single animal was seen in the mouth of the Buckland River. Older residents report that killer whales occur quite reqularly outside the entrance to Eschscholtz Bay. They sometimes co-occur with belukhas, scaring them into the Bay and preventing them from coming back out.

At Kivalina, residents also report that killer whales are regularly seen, sometimes chasing belukhas in close to shore and killing them. At Point Hope there is a long history of killer whales killing or beaching gray whales north of the Point.

Minke Whale

We located only two sightings of minke whales in Hope Basin. In autumn 1978 or 1979, two of these whales beached themselves in the mouth of the Buckland River. A resident of the Kotzebue area reported that whales fitting the description of minke whales are sometimes present in summer in Kotzebue Sound.

Gray Whale

Gray whales have been seen moving north by Cape Prince of Wales in May through early July. They were seen feeding in that area in June through August.

Gray whales have been seen in Kotzebue Sound, sometimes in substantial numbers. In August 1959 over 200 were reported to be feeding there. They are more regularly seen and reported along the coast from Kivalina to Cape Lisburne, where sightings of small groups including cows with calves have been made in July and August. Animals were often sighted within 100-200 m of shore and were sometimes engaged in feeding or social behavior.

B. Barrow Arch (Figure 3; Tables 6-7)

Spotted Seal

Spotted seals are present in the water near Cape Lisburne in summer and autumn but do not haul out there due to unsuitable terrain. They are extremely abundant to the north in Kasegaluk Lagoon, where they are ubiquitous from the south end of the lagoon to the north end. They become common there in mid- to late July and remain so through September. On 18 September 1974, there were an estimated 2,500-3,000 seals in the lagoon. The two major haulout areas in the lagoon are on the sandbars just east of Utukok Pass and on the sandbars and spits on either side of Akoliakatat Pass. Sightings at Utukok Pass include 700-900 seals on 10 July 1978; 400-500 on 19 and 20 July 1979; 1,000 on 15 August 1981; and 300 on 17 September 1981. At Akoliakatat Pass, the largest sighting was of approximately 1,000 seals on 15 August 1981. Other haulout areas include Kukpowruk Pass, the entrance to Avak Inlet, and several spits 5-10 km up Avak Inlet. Spotted seals are often present but do not haul out in the lagoon and mouth of the Kokolik River near Point Lay, where they feed on salmon, smelt, and other fishes.

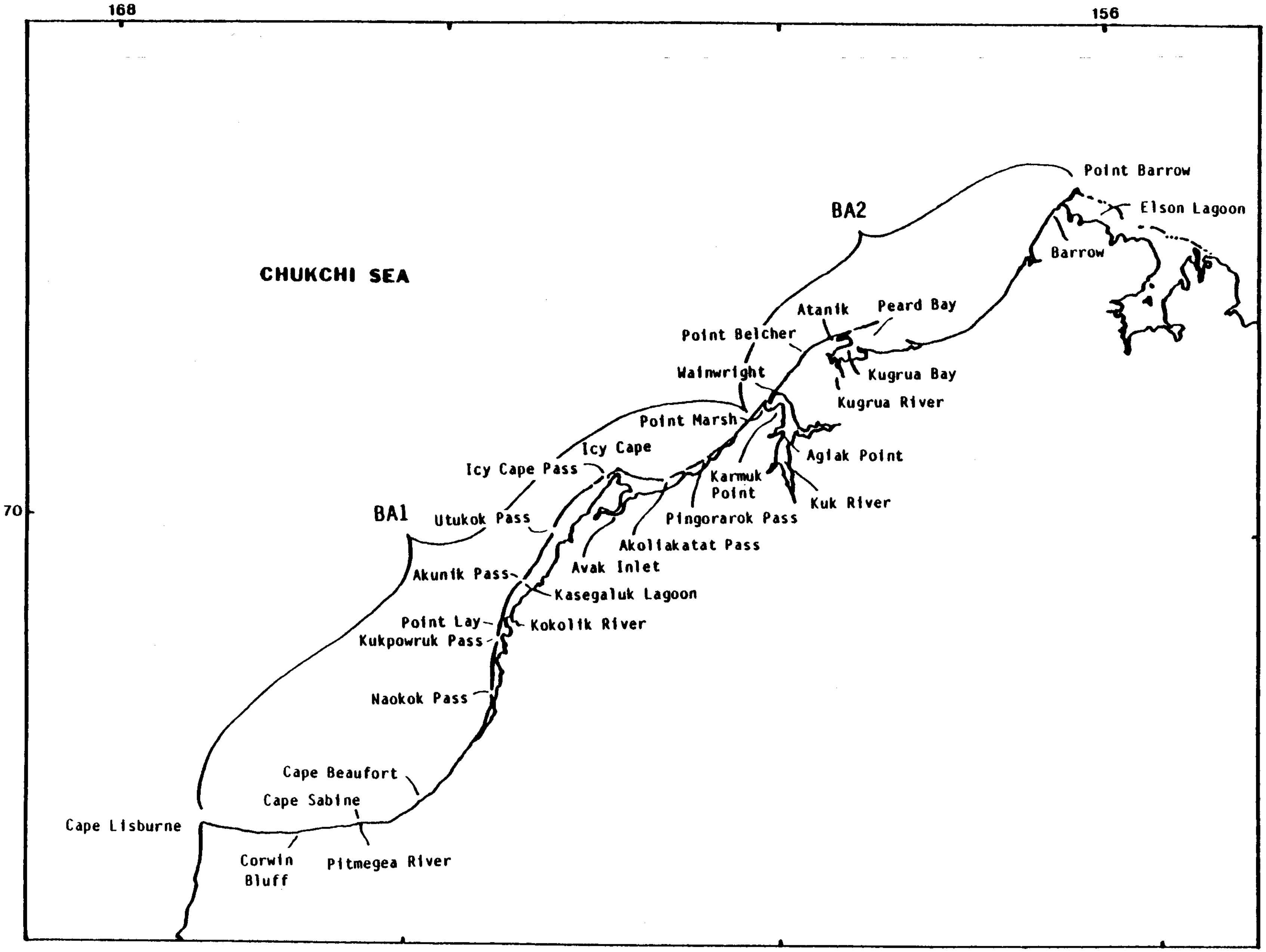

Figure 3. Map of the Barrow Arch, regions BA 1 and BA 2.

Table 6. Sightings of coastal marine mammals from Cape Lisburne to Wainwright, Barrow Arch, region BA 1.

Location	Date	Number	Comments	Source
SPOTTED SEAL				
Cape Lisburne	summer	present	in water, but this is not a good hauling area	J. Burns
	14 Aug 80	4-10	in water about 1/4 mi offshore of Ayugatak Lagoon	B. Kelly
Cape Lisburne area	19 Aug 80	numerous		"
Kasegaluk Lagoon	summer-autumn 70's	numerous	1st became common in mid- to late Jul; moving N at this time	G. Seaman
Kasegaluk Lagoon, near Pt. Lay	Jul 78, 79	small number	mostly moving N along outside of islands; some haul out occasionally on N side of Kukpowruk Pass	"
	8 Jul 78	± 50	in lagoon	D. Strickland
	18 Sep 74	2500-3000 est.	aerial survey; single group of 500-700; ubiquitous from N end to S end of of lagoon; haulouts were on insides of islands near entrances	J. Burns
Kukpowruk Pass	summer 78	small numbers	occasionally haul out	G. Seaman
Pt. Lay, Kokolik R.	summer-autumn	present	feed in river mouth on salmon, smelt, etc.	North Slope Planning Document
Utukok Pass, sandbar just E of the pass	10 Jul 78	700-900 est.	hauled out; "probably most predictable haulout area in Kasegaluk Lagoon area . . . hot spot all years there. . . ."	G. Seaman
	19 & 20 Jul 79	400-500 each day	"	"
Utukok Pass	15 Aug 81	1000	2 haulout sites--1 N side of pass, 1 on inside of island; many in water in pass and lagoon	R. Nelson
	17 Sep 81	300	some (about 60) had been hauled out at the N side of the pass--many moving into lagoon; 5 collected, stomachs empty	L. Lowry
Icy Cape lagoons	summers	present		Bailey and Hendee 1926

Table 6., continued

Location	Date	Number	Comments	Source
SPOTTED SEAL, cont.				
Icy Cape	summer 80	21 sightings, both individuals & loose groups of up to 10 animals	most often seen in the lagoon or near a pass between the lagoon and sea; none seen on land but Natives said they haul out at Akoliakatat Pass and along the spit at the mouth of Avak Inlet.	Lehnhausen and Quinlan 1981
Icy Cape Pass	15 Aug 81	many	in water	R. Nelson
Avak Inlet, W side	Jul 78 & 79	± 50 to 75	haulout area of secondary importance	G. Seaman
Avak Inlet, W side and middle inlet	Jul 78 & 79	< 50 average	"	"
Akoliakatat Pass, W side	10 Jul 78	100 +	primary haulout area	"
	19 Jul 79	40-50	"	"
Akoliakatat Pass, E of	15 Aug 81	1000	± 100 hauled out, rest in water	R. Nelson
Akoliakatat Pass	16 Sep 81	200	hauled out and in water; some had been hauled out on small spit about 2 mi E of the pass on the lagoon side of barrier island	L. Lowry
WALRUS				
Cape Lisburne	summer	present	historically hauled out E of the cape prior to construction of DEW-line station	North Slope Planning Document
	summer 79	300 +	most bulls, some cows and calves; hauled out; on 10-15 Aug they moved 27 mi E to Corwin Bluff	A. Springer
	Jul 38	"hundreds"		G. Collins through F. Fay
	22 Jul - 22 Aug 78	± 200	hauled out; probably there for the previous week also; approximately 75% bulls, rest cows with older calves	A. Springer
	Aug 42	present	"small herd most every summer"	G. Wilson through F. Fay

Table 6., continued

Location	Date	Number	Comments	Source
<u>WALRUS</u>, cont.				
Cape Lisburne, cont.	11 Aug 80	6	hauled out; 3 bulls, 2 immatures, 1 adult of unknown sex	B. Kelly
	18 Aug 80	2	1 bull, 1 immature	"
	24 Aug 80	4	bulls; hauled out; 4 others offshore	"
	26 Aug 80	7	in water	"
	28 Aug 80	30-40	hauled out; mostly bulls with a few immatures	"
Cape Lisburne, about 10 miles S	25 Aug - 3 Sep 76	4	old cow, immature and 1 cow, 1 bull; old cow was probably 1st seen at site that year	A. Springer
Cape Lisburne	approx. 10 Aug 77	± 25	hauled out; did not arrive before 10 Aug; remained until early Sep	"
	8 Sep 75	30	in water immediately offshore; aerial survey	J. Burns
Cape Lisburne, S of	21 Sep 78	100	aerial survey for waterfowl	R. King
Cape Lisburne	last week Oct 78	± 500	hauled out	R. Pegau, from Cape Lisburne personnel
Kukpowruk Pass, S of	Jun or Jul, late 70's	1	hauled out; another sighting several days later of 1 walrus in same area but on lagoon side of the island	G. Seaman
Icy Cape	spring and autumn	present	infrequently haul out on seaward beaches of barrier islands near Icy Cape during spring and autumn migrations	North Slope Planning Document
off Icy Cape	10 Jun 81	500-1000	some (100+) in water; most hauled out on ice	K. Frost
Icy Cape to Barrow	Jul - Sep	present	on ice, several thousand	Fay 1982
Icy Cape	23 Aug 80	present	small animal in water; small number seen going by on ice earlier in season but no date	Lehnhausen and Quinlan 1981

Table 6., continued

Location	Date	Number	Comments	Source
BELUKHA WHALE				
Cape Lisburne, N of	10 Jun 81	± 15	swimming NE about 1/4 mi off edge of ice	K. Frost
Cape Sabine, mouth of Pitmegea River	24 Jun 58	50 +		Childs 1969
Cape Sabine to Cape Beaufort	3 Jul 82	2000-2500 +	swimming N parallel to shore; extended 20 miles along coast; lead group with 500 + whales, calves present	R. Quimby through J. Burns
Cape Sabine to Naokok Pass	6 Jul 82	500-1,000	close to shore; milling, diving, stirring up mud; survey did not extend N of Naokok Pass	T. Smith, J. Rudd through J. Burns
near Cape Sabine	8 Jul 81	1		G. Seaman
Cape Beaufort to Icy Cape	early 1800's	present		Bee and Hall 1956
Cape Beaufort, N of	May & Jun	present	in open water	Braham et al., in press b
Cape Beaufort	3 Jul 79	500 +	quite close to shore	E. Tounai
Naokok Pass, 2 mi S	9 Jul 79	400-500 +	heading N; many, many "as far as observers could see"	A. Agnassagga
Naokok Pass	2 Jul 78	100 +	among 1st of year; moving N close to shore	Pt. Lay people through G. Seaman
Kukpowruk Pass, ocean side	22 Jun 79	100 +	1st of year; hunted; very early breakup	Pt. Lay hunters through G. Seaman
Kukpowruk Pass	30 Jun 79	400-500	assembled in pass	Cape Smythe Air Service pilot through G. Seaman
	2 Jul 79	"many"	nearshore and in lagoon	W. Neakok
	3 Jul 78	40-50		G. Seaman
	10 Jul 78	1,000 +	moving S; about half of those seen were in or just outside pass, rest to S; those in mouth were floating or milling; 703 actually counted from aerial photographs	"
	12 Jul 79	250-300 +		C. Agnassagga

Table 6., continued

Location	Date	Number	Comments	Source
<u>BELUKHA WHALE</u>, cont.				
Kasegaluk Lagoon	late Jun or Jul until late Jul or mid-Aug	many	usually appear 1st at southern end of lagoon; depart to the N, occasionally following coast by Wainwright	Pt. Lay residents through G. Seaman
Pt. Lay, old town site	24 Jun 79	many groups for 3/4 to 1 hr	moving S	G. Agnassagga
	28 or 29 Jun 79	many groups - probably 100's +	heading N	"
	4-7 Jul 78	groups of 50's - 100's	moving both N and S; inside and outside lagoon	Pt. Lay people through G. Seaman
Pt. Lay, near old village site	5 Jul 81	> 100	moving S; "chased" by killer whales; very shallow water	villagers through G. Seaman
Pt. Lay, old town site	8 Jul 78	50-75	inside lagoon; moving N	G. Seaman
	8 Jul 78	some	Eskimos witnessed birth of calf; Seaman saw cow with newborn calf	"
	8 Jul 78	20 +	1 pod	"
	9 Jul 78	100-150	moving S, ocean side	"
	10 Jul 79	350 +	steady flow of whales nearshore for ± 5 hr	"
	13 Jul 79	100 +	heading N nearshore, 0200-0300	"
	15 Jul 79	3-5	pursued by killer whale	"
Pt. Lay to Icy Cape	16 May 81	present	aerial survey	Ljungblad et al. 1982
Akunik Pass (Kokolik Pass)	8 Jul 81	60-70 +	moving N, within 200 yd of shore	G. Seaman
Akunik Pass	9 Jul 79	300-500+	moving S; headed out to open water	B. Neakok
near Akunik Pass	10 Jul 78	2	cow with newborn calf in lagoon	G. Seaman
Utukok R., shallows of	general	present	frequently use shallows of Utukok R.	W. Bodfish
Utukok Pass, 3-4 mi N of	3 Jul 79	25 +	many with calves; at least 2 were newborns	G. Seaman

Table 6., continued

Location	Date	Number	Comments	Source
BELUKHA WHALE, cont.				
Utukok Pass	8 Jul 79	500 +	N side; in area 2 or 3 days	B. Neakok
Icy Cape to Barrow	22 May 80	± 60	aerial survey	Ljungblad 1981 *
Icy Cape, SW of, near pass	4 Jul 79	200 +		Cape Smythe pilot through G. Seaman
S Icy Cape	6 Jul 81	5 +	nearshore	G. Seaman
Icy Cape, N of	6 Jul 81	10 +	"	"
Icy Cape Pass	8 Jul 81	400-600 +	more than half with calves; most in ice-free muddy water	"
Icy Cape	11 Jul 80	28 counted; 50 est.	moving N just off barrier islands to 1/2 km offshore; several gray animals with group	Lehnhausen and Quinlan 1981
S Icy Cape Pass	11 Jul 81	35-45 +	up to 300 yd offshore	G. Seaman
Icy Cape Pass, S of	11 Jul 81	5 or 6		"
Akoliakatat Pass	13 Jul 79	1600-1700	whales present from 13-18 Jul; ice nearshore S of Wainwright; 1104 actually counted from aerial photographs; 80% of whales within 2 mi of the pass, rest spread out to the NE	"
	15 Jul 79	2300-2400	1601 actually counted from aerial photographs; very concentrated in or just outside of pass; smaller numbers distributed up the coast for about 10 mi	"
	15 Jul 81	75-100	feeding?--swimming around a small area; adults, immatures, and cows with calves present; shallow water	K. Frost
Pingorarok Pass	19 Jul 79	1000 +	moving N; one large group > 1 mi long	W. Negovanna through G. Seaman
KILLER WHALE				
Pt. Lay, old town site	5 Jul 81	present	chasing belukhas	villagers through G. Seaman

Table 6., continued

Location	Date	Number	Comments	Source
KILLER WHALE, cont.				
Pt. Lay, old town site, cont.	15 Jul 79	1	chasing 3-5 belukhas; killed belukha calf < 100 yd offshore	G. Seaman
N Utukok Pass	11 Jul 81	1	about 50 yd offshore	"
MINKE WHALE				
Cape Lisburne area	19 Aug 80	1	< 1 mi offshore; off Ayugatak Lagoon	B. Kelly
GRAY WHALE				
Cape Lisburne	8 Jul 81	present		Ljungblad et al. 1982
Cape Lisburne, S of	20 Jul 80	2	feeding and social behavior; within 12 km of beach	Ljungblad 1981
Cape Lisburne, E of	summer-autumn	present		Marquette and Braham 1982
Cape Lisburne	11 Aug 80	1	adult; swimming W in the surf zone	B. Kelly
Cape Lisburne to Cerush Bluff	19 Aug 80	many	close to shore (< 1 mi off); included cow with calf	"
Cape Sabine	3-5 Aug 59	"a few"	moving SW	Maher 1960
Cape Sabine, off mouth of Pitmegea River	5 Aug 59	10-12	feeding; 3 calves with females, plus 4-6 other adults; gone the following day	"
Cape Beaufort, NW of	Jul 79	4 +	offshore	G. Seaman
Naokok Pass, 5-7 mi N of	10 Jul 78	3	moving N along outside of islands; 100-150 yd from shore	"
near Pt. Lay	8 Jul 81	3	swimming N about 3 mi offshore; seen from shore	"
	11 Jul 81	1	about 3 mi out	"
Utukok Pass, S of	11 Jul 81	10	3/4-1 mi offshore; some 2 mi off	"
Utukok Pass, N of	22 Jul 81	3	about 3/4 mi off beach	R. Nelson
Icy Cape, S of	8 Jul 81	1		G. Seaman

Table 6., continued

Location	Date	Number	Comments	Source
GRAY WHALE, cont.				
near Icy Cape Pass	8 Jul 81	2	2 octas of ice	G. Seaman
Icy Cape	17 Jul - 4 Aug 80	several separate sightings	moving N	Lehnhausen and Quinlan 1981
	25 Jul 81	present		Ljungblad et al. 1982
	4-15 Aug 80	several - one group?	feeding, resting offshore near Cape Island	Lehnhausen and Quinlan 1981
	21 Aug 80	1	heading S; last one seen that summer	"
Icy Cape to Barrow	summer	common	seen nearshore by Eskimos	Maher 1960

Table 7. Sightings of coastal marine mammals from Wainwright to Barrow, Barrow Arch, region BA 2.

Location	Date	Number	Comments	Source
SPOTTED SEAL				
Kuk River area	summer-autumn	present	present all summer; enter river and haul out more in autumn	J. Burns
	summers	present	occasionally used haulouts at Pt. Marsh, Karmuk Pt., and S of Agiak Pt.	G. Seaman
Wainwright	15-21 Jul 67	none		C. Shanahan
	28 Jul 75	1 shot, 2 others seen	1st of season; drifting pack ice	J. Burns
	1 Aug 65	present	hunted	"
	4 & 11 Aug 75	present	"	"
	4, 7, & 16 Aug 64	present	"	"
	late summer-autumn	present	small numbers most years; 1st ones arrive mid-Aug	"
Kugrua R. area	summer	present	haul out on land	Wainwright villagers through J. Burns in 1964
Peard Bay, including Kugrua R.	summer	present	haul out but not as many as in Kasegaluk Lagoon	J. Burns
WALRUS				
Wainwright area	Jul 67	very few	bad hunting year	J. Burns
Wainwright	31 Jul 66	30		ADF&G, Nome files
Wainwright to Barrow	8 Jul 78	5000-10,000	on ice	T. Brower through D. Strickland
near Barrow	12 Mar 78	2		H. Melchior
Barrow	1st week of Aug 66	1		ADF&G, Nome files
BELUKHA WHALE				
Wainwright and Barrow	spring	common	1st ones seen in March, most in Apr and May on northward migration	Nelson 1969; ADF&G files
Wainwright	spring 52	2		Bee and Hall 1956

Table 7., continued

Location	Date	Number	Comments	Source
BELUKHA WHALE, cont.				
Wainwright, cont.	27 Apr - 19 May 78	large numbers	moved N through leads in ice	R. Tremaine
	9 May (1920's ?)	present	moving N; 1st ones seen that year	Bailey and Hendee 1926
Wainwright, 18 mi off	1 May 79	± 70	1 pod	J. Burns
Wainwright to Barrow	late May 76	many		Braham et al. 1980
Wainwright Inlet, mouth of Kuk River	summers "long ago"	moderate numbers	sometimes congregated at mouth of inlet and moved into Kuk River	Wainwright residents through G. Seaman
Wainwright	Jul	present	after ice had gone out; hunted	Van Valin 1941
	Jul & Aug	present	usually moving NE along coast; most common in these 2 months	Nelson 1969
	15 Jul 78	± 100	headed NE	D. Strickland
	17-18 Jul 79	pod	traveling NE along coast; hunted on 2 days; took 4 on the 17th, 34 the 18th	R. Tremaine and G. Seaman
Wainwright village	17 Jul 79	100's (probably about 200)	moving N	Wainwright people through G. Seaman
Wainwright village	19 Jul 79	200 +	early morning; moving N	Wainwright hunters through G. Seaman
Wainwright village and near Kuk R.	19 Jul 79	500 +	observed moving N, 2200-2300; probably same group seen at Pingorarok Pass	"
Wainwright village	20 Jul 79	100's (400-500 +)	passed by the coast for hours; moving N	R. Tremaine
Wainwright, NW of	20 Jul 80	2		Ljungblad 1981
Wainwright	Aug 75	many	aerial survey	G. Ray
	Sep	rare		Wainwright residents through G. Seaman
	3 Sep 75	numerous		Fiscus et al. 1976
Wainwright to Barrow	11-13 Sep 75	small groups		"
Pt. Franklin, N of	20 Jul 80	1	aerial survey for bowheads	Hobbs and Goebel 1982
Pt. Franklin	20 Jul 80	2		Ljungblad 1981

Table 7., continued

Location	Date	Number	Comments	Source
BELUKHA WHALE, cont.				
off Barrow	28 May 78	15	aerial survey for birds	R. King
	20 Jul 80	1	feeding in 5/10 ice coverage, less than 1 km off beach	Ljungblad* 1981
Barrow	summer 1881-83	large groups	passed by as soon as there was open water off the beach and again 7-10 days later	Murdoch 1885
	every summer	once common	once commonly seen near village every summer before so much noise from boats and the town	Barrow residents through G. Seaman
	28 Sep 1881	100 +	within 20 yd of beach; Sep sightings uncommon	Murdoch 1885
Barrow	unspecified	present		Bee and Hall 1956
HARBOR PORPOISE				
Pt. Franklin, NW part Kugrua Lagoon	1 Aug 37	2	young (about 1-1/3 m long); chasing fish in shallow water 3 m from shore	Bee and Hall 1956
	1930	2	1 large, 1 small; same part of lagoon as those seen in 1937	"
Wainwright, 11 mi NE	1 Sep 33	1	dead on beach	"
Wainwright	every year	present	seen every year at Pt. Barrow and Wainwright as long as Eskimos can recall, only 5 or 6 each each season; from Pete Sovalik and Adam Levitt	"
Atanik	1 Sep 33	1	dead on beach	"
Barrow	every year	present	seen every year at Pt. Barrow and Wainwright as long as Eskimos can recall, only 5 or 6 each season; from Pete Sovalik and Adam Levitt	"
	"in last few years" (1952)	present	seen on several occasions by Pete Sovalik	"

Table 7., continued

Location	Date	Number	Comments	Source
HARBOR PORPOISE, cont.				
Barrow, cont.	summer 52	1		Bee and Hall 1956
Barrow, NW Elson Lagoon	6 Aug 52	1	adult female caught in gillnet	"
	23 Aug 52	1	recently born calf	"
KILLER WHALE				
Wainwright	summer	present	regularly seen; have been seen pursuing gray whales	village residents through G. Seaman
	13 Jul 78	some	breaching	village residents through D. Strickland
Barrow	summer	present	occasionally sighted	village residents through G. Seaman
	summer 78 or 79	several	seen from Borough building	J. Adams through H. Melchior
GRAY WHALE				
Wainwright	summer 1924	present	1 or 2	Bailey and Hendee 1926
	summer 1934	present	2 taken	Maher 1960
Wainwright, S of and NE of	summer	present		Marquette and Braham 1982
near Wainwright	10 Jun 81	10	swimming NE; no mud trails; several "groups;" in lead in ice	K. Frost
Wainwright	10 Jun 81	3	swimming NE in lead in ice	"
Wainwright, N of to S end of Peard Bay	10 Jun 81	15	close to shore	Ljungblad et al. 1982
Wainwright	5 Jul 54	many	heading N right after ice went out; 1/2-1 mi off beach	Maher 1960
Wainwright, just N of Kuk River	6 Jul 81	1		G. Seaman
Wainwright, SW of	20 Jul 80	1	aerial survey for bowheads	Hobbs and Goebel 1982
Wainwright	25 Jul 75	30-40	some drifting pack ice	J. Burns
	9-10 Aug 53	50-100	moving S; seen from beach	Maher 1960

Table 7., continued

Location	Date	Number	Comments	Source
GRAY WHALE, cont.				
Wainwright, cont.	9-15 Aug 54	1	killed	Maher 1960
	24 Aug 81	6		Ljungblad et al. 1982
Wainwright to Peard Bay	10 Jun 81	13		K. Frost
	20 Jul 80	4	aerial survey for bowheads	Hobbs and Goebel 1982
Wainwright and Barrow	late Jun - early Jul	present	1st arrive	Maher 1960
Wainwright to Pt. Barrow	18 Jul - 13 Sep 54-59	9	taken by residents	Maher 1960
Wainwright, ± 15 mi NE of	22 Jul 81	3	breaching and feeding; cow with calf and another, about 1/2 mi off beach	R. Nelson
Pt. Belcher	6 Jul 81	3	about 3/4 mi offshore; less than 1 octa ice	G. Seaman
Pt. Franklin	25 Jul 81	present		Ljungblad et al. 1982
Pt. Franklin to about 20 mi SW of Barrow	Jul 81	many	*Polar Star* cruise; "hot spot" for many things--many seals, walruses, heavy phytoplankton and zooplankton blooms	F. Fay
	Jul-Aug 82	300	*Entuziast* cruise, between shore and ice edge; "hot spot"	Fay and Kelly 1982
Barrow	summer	common	appear "settled"	Maher 1960
Pt. Barrow	summer	present	frequently seen	Durham 1979
	general	uncommon	reported by Pete Sovalik	Bee and Hall 1956
Barrow, SW of	20 Jul 80	1	aerial survey for bowheads	Hobbs and Goebel 1982
Pt. Barrow	Jul-Aug 78	16	in a 40-day period	Marquette and Braham 1982
	18, 19 Jul 59	3	hunted; calf and lactating female, plus calf	Maher 1960
	Aug 78 or 79	6 +	moving W	H. Melchior
	Aug - mid-Sep 1950's	present	may begin moving southward in early Aug	Maher 1960
	Aug 54	1	playing in surf	"
	10 Aug 54	2	calf associated with an adult	"

Table 7., continued

Location	Date	Number	Comments	Source
GRAY WHALE, cont.				
Pt. Barrow, cont.	mid-Sep 58	present	2 killed	Maher 1960
	mid-Sep 59	some	3 killed, including lactating cow with calf and another calf	"
Barrow, 20-30 mi SW of (71°08'N, 158°00'W)	12 Sep 81	20-25	feeding; kittiwakes active in area	L. Lowry
Pt. Barrow	Sep 78	2	very close to beach	Durham 1979
	late autumn 78	20	migrating westward; information from T. Brower	"

Spotted seals are less abundant to the north of Kasegaluk Lagoon. However, they are present during summer and autumn in and around the Kuk River near Wainwright and the Kugrua River in southern Peard Bay. As along the rest of the Bering and Chukchi sea coasts, they enter the rivers and haul out more often in autumn. In the Kuk River, occasionally used haulouts include Point Marsh, Karmuk Point, and south of Agiak Point. Seals also haul out near the mouth of the Kugrua River.

Walrus

There are no major terrestrial walrus haulouts along the coast of the Barrow Arch planning area, although many walruses are seen from June through September hauled out on the drifting offshore pack ice. Cape Lisburne was historically used as a haulout prior to construction of the DEW-line station there, with a sighting of "hundreds" in July 1938. Since 1975 some walruses have hauled out near Cape Lisburne every year, usually in August or September. The largest reported sightings were during summer 1978, when about 200 animals were hauled out in July and August, 100 in late September, and 500 during the last week in October. In other years, sightings did not exceed 30-40 animals. Lone walruses have occasionally been seen hauled out on the barrier islands of Kasegaluk Lagoon.

Belukha Whale

Belukhas are very abundant in the Kasegaluk Lagoon region of the Barrow Arch planning area. They are first seen south of the lagoon at Cape Sabine and Cape Beaufort and in the southernmost passes (Naokok Pass and Kukpowruk Pass) in late June or early July. They usually appear from north of Point Lay to Icy Cape in the first or second week of July and from Icy Cape to Wainwright slightly later, usually during the third week of July. The whales are frequently seen concentrated in or near the passes into the lagoons and sometimes in the deeper channels of the lagoons themselves. Calving has been observed on several occasions. The largest single sightings in the Kasegaluk Lagoon area were on 3 July 1982, when 2,000-2,500 belukhas were seen swimming north along the coast between Cape Sabine and Cape Beaufort, and on 15 July 1979, when over 2,000 belukhas were concentrated in or near Akoliakatat Pass. That group was reported to be present from 13 July until 18 July, when they moved north. A group of over 1,000 was seen at Pingorarok Pass on 19 July 1979, and on 19 and 20 July over 1,000 were seen moving north by Wainwright. Sightings of 300 or more whales have been made at all major passes in Kasegaluk Lagoon, including Naokok, Kukpowruk, Akunik, Utukok, Ice Cape, Akoliakatat, and Pingorarok passes. In the 3 years (1978, 1979, 1981) when aerial surveys were conducted, major sightings occurred from late June through the third week in July. In some years the whales are present in this region until mid-August. Near Wainwright, belukhas may be present in July and August and are considered rare in September. In 1978-1980, most sightings were in the third week of July. Few belukhas are seen during summer nearshore between Wainwright and Barrow.

Harbor Porpoise

We located no sightings of harbor porpoises along the coast from Cape Lisburne to Wainwright. However, they are reported to be present in small numbers every year at Wainwright and Barrow. In the 1930's, two were found dead on the beaches near Wainwright, and several were seen at the south end of Peard Bay in Kugrua Lagoon. In summer 1952, one was reported off Barrow, and in August of the same year a cow and calf were caught in the northwestern portion of Elson Lagoon.

Killer Whale

Killer whales are probably present during most summers along this section of the coast. They were seen chasing belukhas very close to shore near Point Lay in July 1979 and 1981. On 11 July 1981, a single killer whale was seen within 50 m of the beach north of Utukok Pass. They are sighted regularly at Wainwright, where they have been seen in pursuit of gray whales, and occasionally at Barrow.

Minke Whale

We are aware of a single minke whale sighting in the Barrow Arch planning area. One whale was seen close to shore near Cape Lisburne on 19 August 1980.

Gray Whale

Gray whales are regularly seen all along the coast from Cape Lisburne to Barrow during summer. Most sightings are in July and August, although a few whales are seen in June and September. They are often seen within 1-2 km of the beach, sometimes feeding. In July most whales for which directional swimming is reported are moving northward, whereas in August they are moving southward. The largest reported sightings were of 50-100 whales seen off Wainwright on 9-10 August 1953 and of over 200 seen near Point Franklin in July and August 1982.

VII. Discussion

A. Spotted Seal

In late winter and spring, spotted seals are distributed in and near the ice front of the Bering Sea, where they have their pups, breed, and molt from March through May or June. As the ice disintegrates and recedes north in spring, these seals move generally northward and toward the coast, where they spend the ice-free months feeding mainly in nearshore waters and hauling out on land. Some remain in the Bering Sea throughout the summer (see Frost et al. 1982), while others move farther north to the Chukchi Sea (Fig. 4). Spotted seals remain in the coastal zone until late autumn when the shorefast ice begins to form.

Spotted seals are present in coastal areas of Hope Basin from the time the ice breaks up in spring until freeze-up. They are found along the entire northern coast of the Seward Peninsula and may be present in any of the bays, lagoons, or estuaries, including Lopp, Ikpek, and Arctic lagoons and Shishmaref Inlet. They haul out, particularly in autumn, on the low sandy beaches characteristic of this section of the coast, in areas that are relatively free from human activity. The largest haulout in Hope Basin is at Cape Espenberg, where over 1,000 seals have been seen hauled out in August. Although they do not haul out in large numbers elsewhere, they are abundant, particularly in late summer and autumn, in Eschscholtz Bay, particularly at the mouth of the Buckland River; in Hotham Inlet and at the mouth of the Noatak River; and in the Kukpuk River estuary. They congregate in these areas to feed on locally abundant fishes such as salmon, herring (Clupea harengus), smelt, or saffron cod (Eleginus gracilis).

Spotted seals are present along virtually the entire northern Chukchi coast but are most abundant in three areas: Kasegaluk Lagoon, the mouth of the Kuk River near Wainwright, and the mouth of the Kugrua River in southern Peard Bay. Over 2,000 seals seasonally utilize Kasegaluk Lagoon, with major haulouts near Utukok Pass and Akoliakatat Pass. Fewer seals are present in the Kuk and Kugrua rivers, but there are no estimates of actual numbers. As in other areas of the Bering and Chukchi seas, spotted seals congregate near rivers and haul out more in late summer and autumn.

B. Walrus

As the ice breaks up in spring, walruses leave their wintering grounds in the Bering Sea and move north to the Chukchi Sea, where most spend the summer feeding on the shallow Chukchi platform. Subadults and females with young summer primarily in the pack ice in the northern Chukchi Sea (Estes and Gilbert 1978), while adult males form large herds on hauling grounds in Bristol Bay, Bering Strait, and along the Chukchi Peninsula.

A substantial proportion of the walrus population is concentrated in the ice off the Alaskan coast from Icy Cape to Barrow from June or July through September (Krogman et al. 1976, Fay 1982). However, there are no large, regularly used haulouts along the Alaskan Chukchi coast. In the 1930's, walrus herds were present on hauling grounds at Cape Thompson, Cape Lisburne, and Icy Cape, but by the 1950's those haulouts were no longer used (Fay 1957). Since 1975 some walruses have again begun to haul out near Cape Lisburne every year (Fig. 5). Sightings

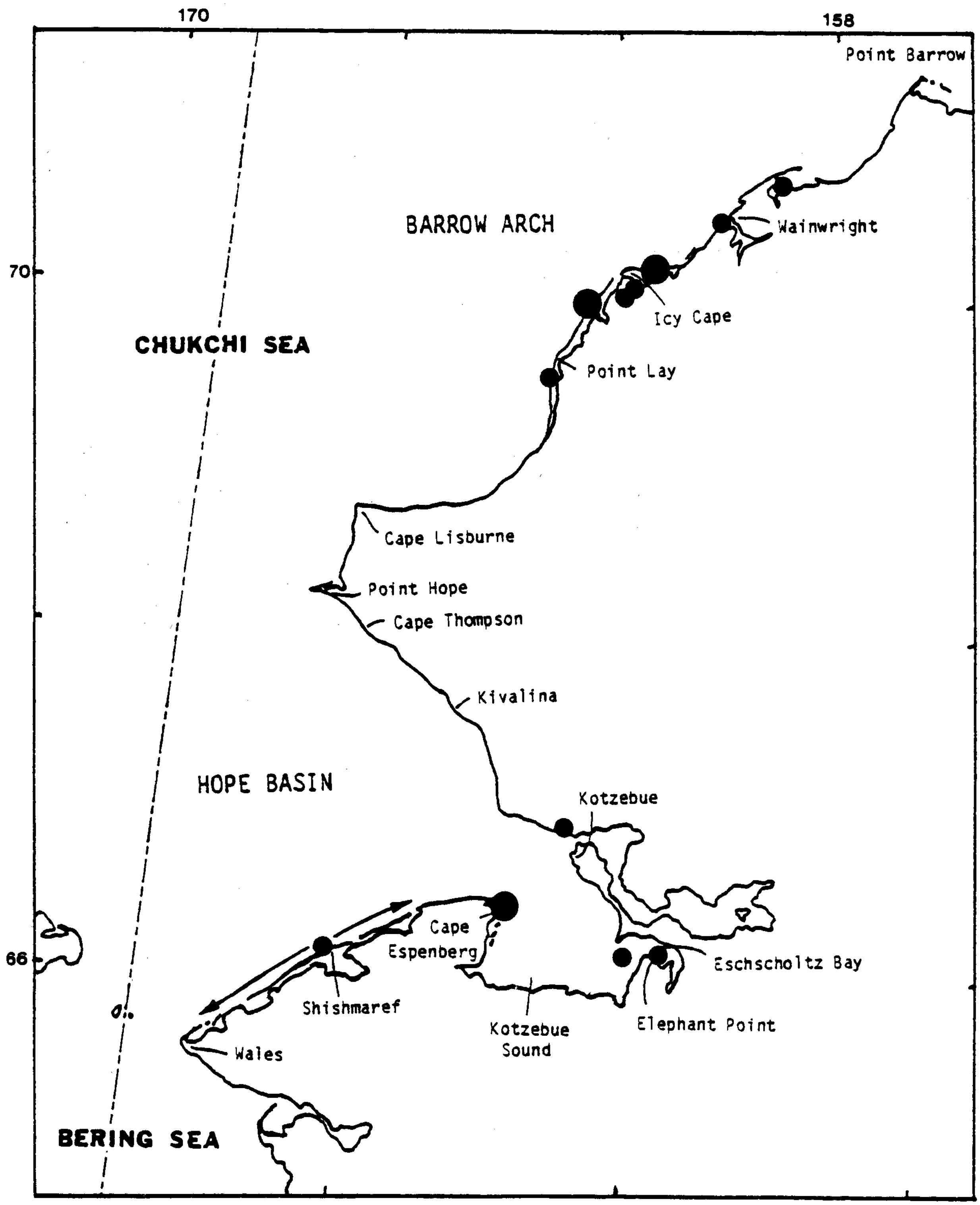

Figure 4. Map of the eastern Chukchi Sea showing major haulouts used by spotted seals. Large dots represent areas with maximum reported numbers of greater than 500 seals. Small dots represent haulouts of less than 500 seals.

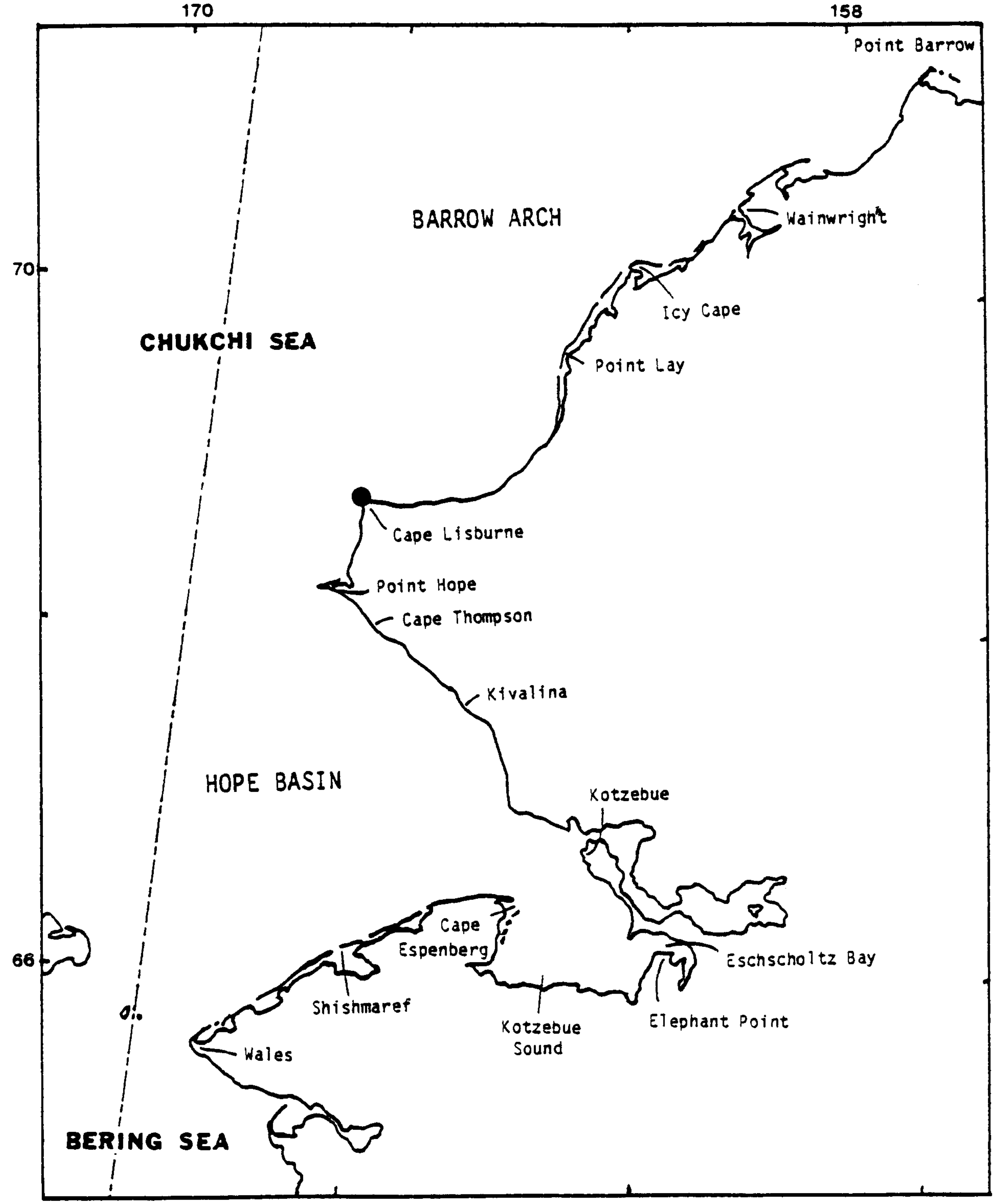

Figure 5. Map of the eastern Chukchi Sea showing the only regularly used walrus haulout in the coastal zone.

have ranged from 30-40 in some years to approximately 500 in late October 1978. Single animals or small groups have been seen hauled out on the beach from Cape Krusenstern to Cape Lewis and on the barrier islands of Kasegaluk Lagoon.

C. Belukha Whale

Belukhas spend the winter months offshore in the pack ice of the Bering Sea. In spring, as the ice begins to melt and recede northward, they move toward the coast. Some remain in the Bering Sea throughout the summer. Others travel north through Bering Strait to spend the summer in Kotzebue Sound, along the Chukchi coast north to Barrow, or in the eastern Beaufort Sea near the Mackenzie delta. Of an estimated population of 12-16,000, about 2,500-4,800, depending on the year, spend parts of the summer in coastal regions of the Chukchi Sea.

There are two main concentration areas for belukhas in the Chukchi Sea: Kotzebue Sound, particularly Eschscholtz Bay in Hope Basin; and in and adjacent to Kasegaluk Lagoon in the Barrow Arch (Fig. 6). Belukhas appear in northern Kotzebue Sound from Sheshalik to Cape Blossom in late May to mid-June, usually during or shortly after breakup. They appear slightly later in Eschscholtz Bay, usually in mid-June. There appears to be considerable movement of belukhas in Kotzebue Sound, with the whales seen near Sheshalik, Kotzebue, and Cape Blossom almost certainly part of the same group seen in Eschscholtz Bay. Some whales remain in the Sound until autumn; however, most sightings are in June and July.

The largest sightings of belukhas have been of over 1,000 whales in and near Eschscholtz Bay in June and July. Considering all observations, we estimate that the peak number of whales in Kotzebue Sound/ Eschscholtz Bay during summer ranges from 500 to 1,800, with considerable year-to-year variability which cannot at present be explained.

Belukhas feed in Kotzebue Sound, probably following local movements of fish and feeding on species which are particularly abundant at certain times (Seaman et al. 1982). In Eschscholtz Bay there are sizable runs of herring, smelt, char (Salvelinus alpinus), and salmon, in addition to large numbers of saffron cod (Barton 1979; Burns, Frost, and Seaman, pers. observations). Calving has been reported in coastal regions of the Sound in June and July. Most observations are from near Sheshalik and from the eastern end of Eschscholtz Bay, particularly the latter in recent years. Local residents indicate that belukhas are less common in nearshore areas near Sheshalik and Kotzebue than they once were but remain common offshore. This change has been attributed to increased boat traffic and perhaps other noises associated with modernization.

Historically, belukhas were also common along the northern Seward Peninsula from Ikpek to Cape Espenberg during breakup and throughout

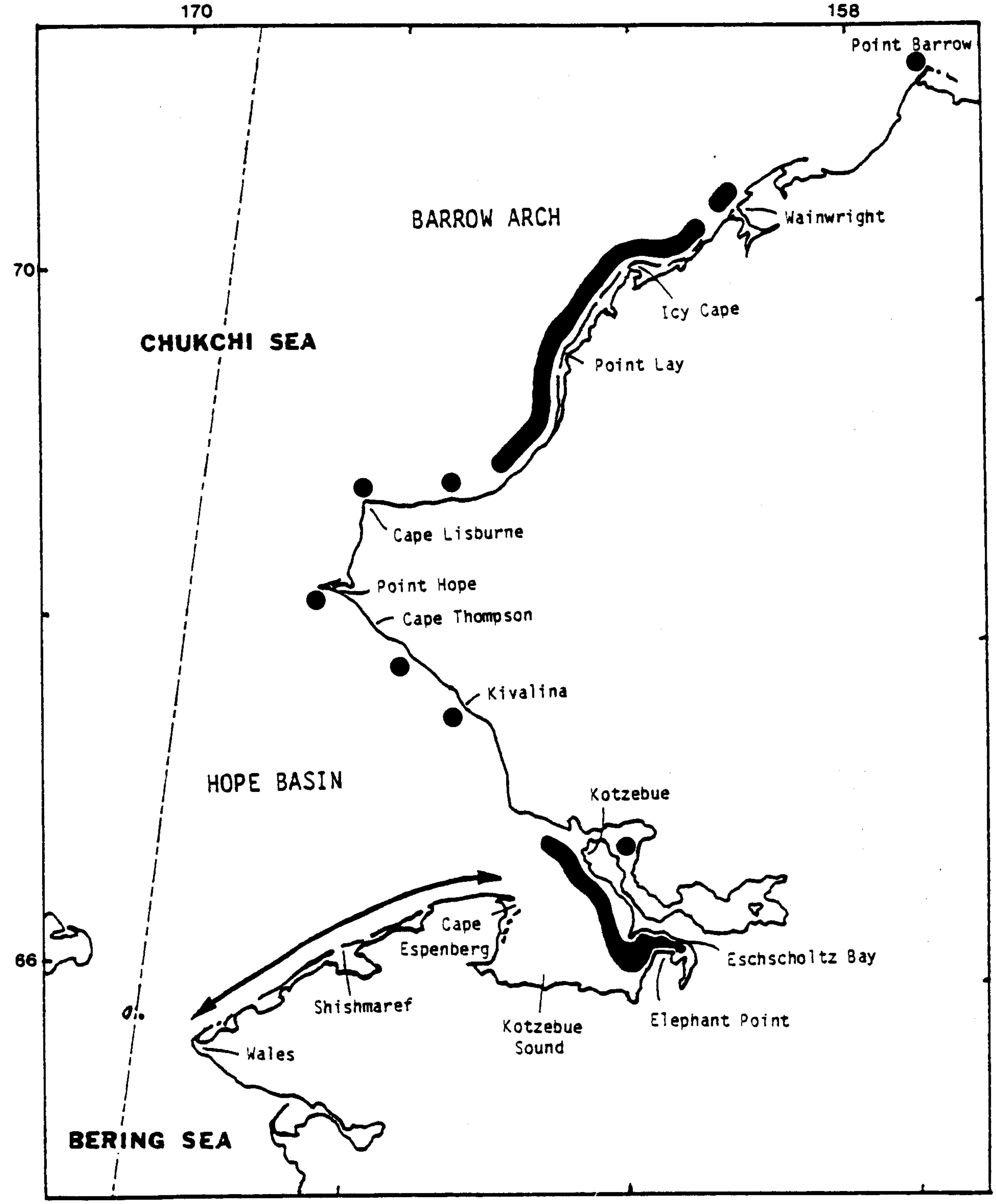

Figure 6. Map of the eastern Chukchi Sea showing sightings of belukha whales in the coastal zone. Dark bands represent concentration areas.

summer but in recent years have been sighted infrequently. As in the Kotzebue area, this change has been attributed to increased boat traffic.

Belukhas are present in the Kasegaluk Lagoon area from late June until late July or mid-August. They characteristically appear in the southern part of the region near Ledyard Bay in mid- to late June and move gradually northward following the retreat of seasonal ice. They may be found both outside the barrier islands and in deeper portions of Kasegaluk Lagoon, although nearshore waters outside the lagoon are used most extensively. They are usually concentrated in and outside of major passes, particularly Kukpowruk, Utukok, Icy Cape, and Akoliakatat, and to a lesser extent Akunik, and within 1/2-3/4 km from shore. The whales usually depart to the north, moving offshore or occasionally following the coast where they are seen at Wainwright and less commonly at Barrow. We estimate that 2,000-3,000 belukhas may occur near Kasegaluk Lagoon in most years, although in some years the abundance of whales in the area may be considerably less.

Belukha whales calve in and near Kasegaluk Lagoon. Although little is known about their food habits or the local fish fauna in this area, they probably feed on fishes such as salmon, char, or saffron cod.

Belukhas are now seen less frequently at Wainwright and Barrow during the ice-free period. Historically, they sometimes congregated at the mouth of Wainwright Inlet and the Kuk River, but they no longer do so.

D. Harbor Porpoise

Harbor porpoises probably occur occasionally during summer along the entire Chukchi coast, but because they are difficult to see and identify there are relatively few reported observations (Fig. 7). Most sightings were of one or two individuals. In several instances, females with small calves were seen. Sightings were usually made in August; the latest were on 18 September off Cape Thompson and Cape Dyer. In Kotzebue Sound and near Barrow, harbor porpoises are sometimes caught in gillnets.

E. Killer Whale

Sighting records suggest that killer whales are quite widely distributed in low numbers in the coastal zone of the Chukchi Sea (Fig. 8). Residents of Shishmaref report seeing them every summer. Hunters from Eschscholtz Bay, Kivalina, Point Hope, Point Lay, and Wainwright relate that killer whales regularly occur in those areas in summer. The whales are often seen chasing belukha or gray whales, sometimes stranding gray whales in shallow water or driving belukhas nearshore or into bays or lagoons where they can be easily hunted.

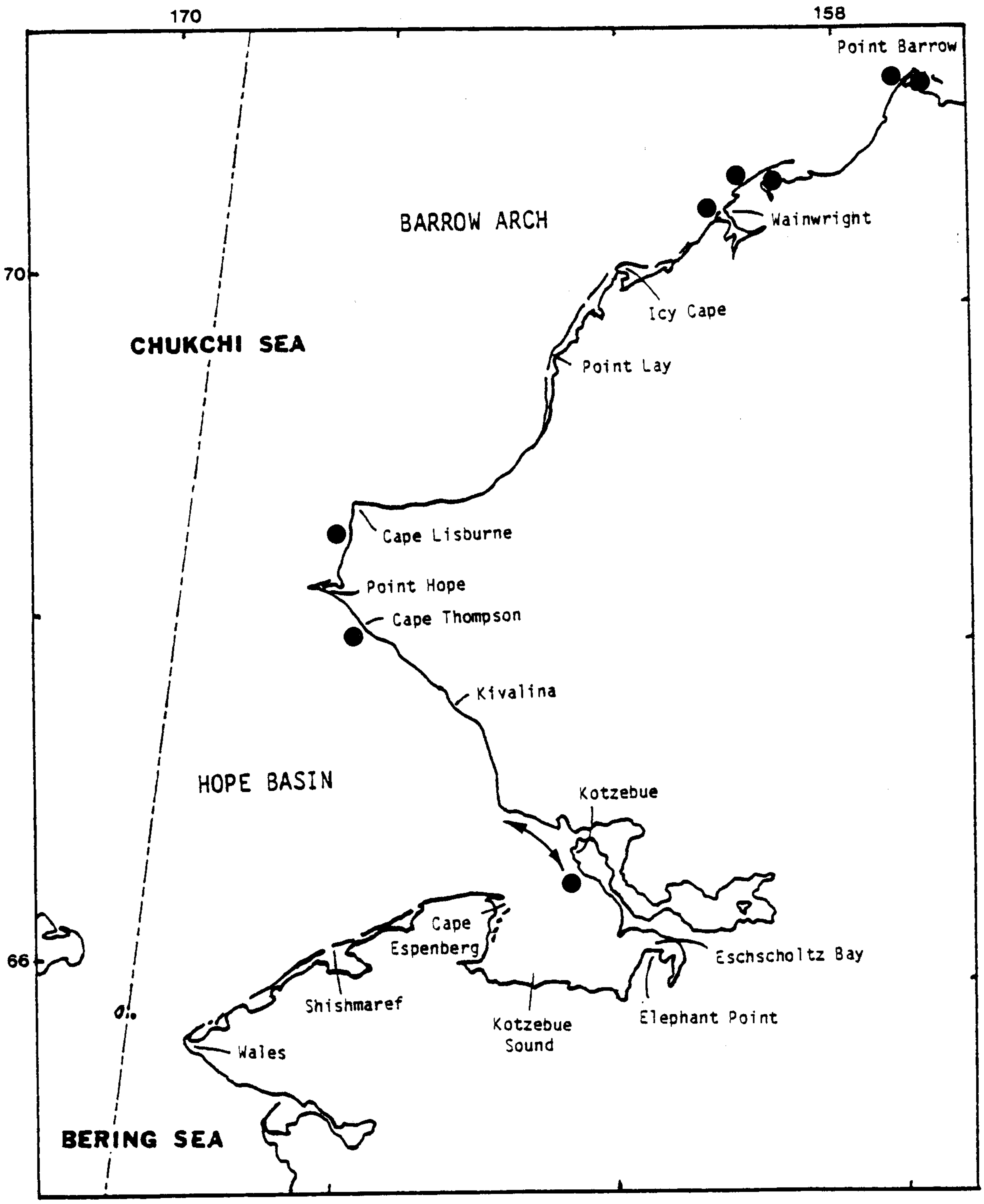

Figure 7. Map of the eastern Chukchi Sea showing sightings of harbor porpoises in the coastal zone.

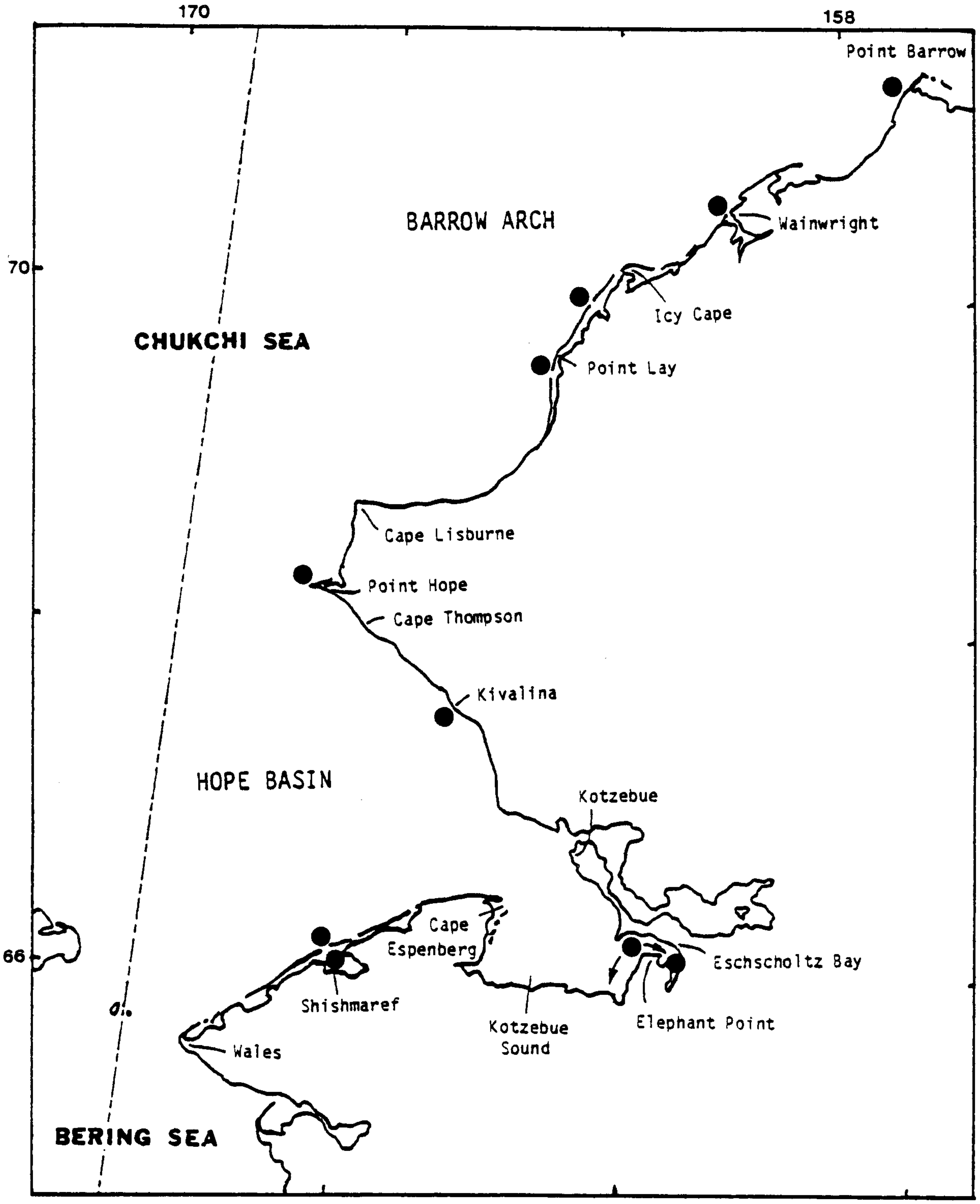

Figure 8. Map of the eastern Chukchi Sea showing sightings of killer whales in the coastal zone.

F. Minke Whale

We are aware of only three sightings of minke whales in the coastal zone of the Chukchi Sea. Two were from Kotzebue Sound in summer and autumn, and the third was from Cape Lisburne in August (Fig. 9). One of the Kotzebue Sound reports was of two whales that beached themselves at the mouth of the Buckland River.

G. Gray Whale

Gray whales migrate annually from the coastal waters of Baja California and the southern Gulf of California to the northern Bering and Chukchi seas. They follow the coast closely as they move north, entering the Bering Sea mostly through Unimak Pass in April through June, thence north toward the Chirikof Basin and Bering Strait. Most gray whales spend the summer feeding in the Chirikof Basin and Chukchi Sea. Those entering the Chukchi Sea move through Bering Strait in May through early July and are seen along the coast from Wales to Barrow (Fig. 10) in June through September, with most sightings in July and August. Sightings, many within 1-2 km of the beach, are usually of small groups, often including cows with calves. Feeding animals trailing visible mud plumes are often seen. Through July most traveling gray whales move northward, whereas after early August most are swimming southward. Few are seen in the Chukchi Sea after mid-September. There are no obvious concentration areas for gray whales in the coastal zone of the Chukchi Sea; however, they are apparently somewhat more common from Icy Cape to Barrow. The largest reported sightings anywhere along the Chukchi coast were near Wainwright and Point Franklin.

VIII.Conclusions

A. Adequacy of Sighting Data

The portion of the Alaska coastline included in this study is approximately 1,200 km in length. This is a large and relatively remote area over which to document all localities used by marine mammals. Nonetheless, the combined observations of persons who have worked onshore, at sea, and in the air provide considerable information on where and when marine mammals occur. The inherent interest of local residents in the natural resources which surround them has been encouraged and supplemented by the work supported by OCSEAP, as well as other federal agencies, and the State of Alaska.

This has been the first attempt to compile all existing data on coastal marine mammal distribution and abundance in the Chukchi Sea during the ice-free season in a comprehensive manner. We generally did not attempt to collect new data nor did we have the funds necessary to interview coastal residents in the manner which would be necessary to maximize the value of existing local knowledge. However, through

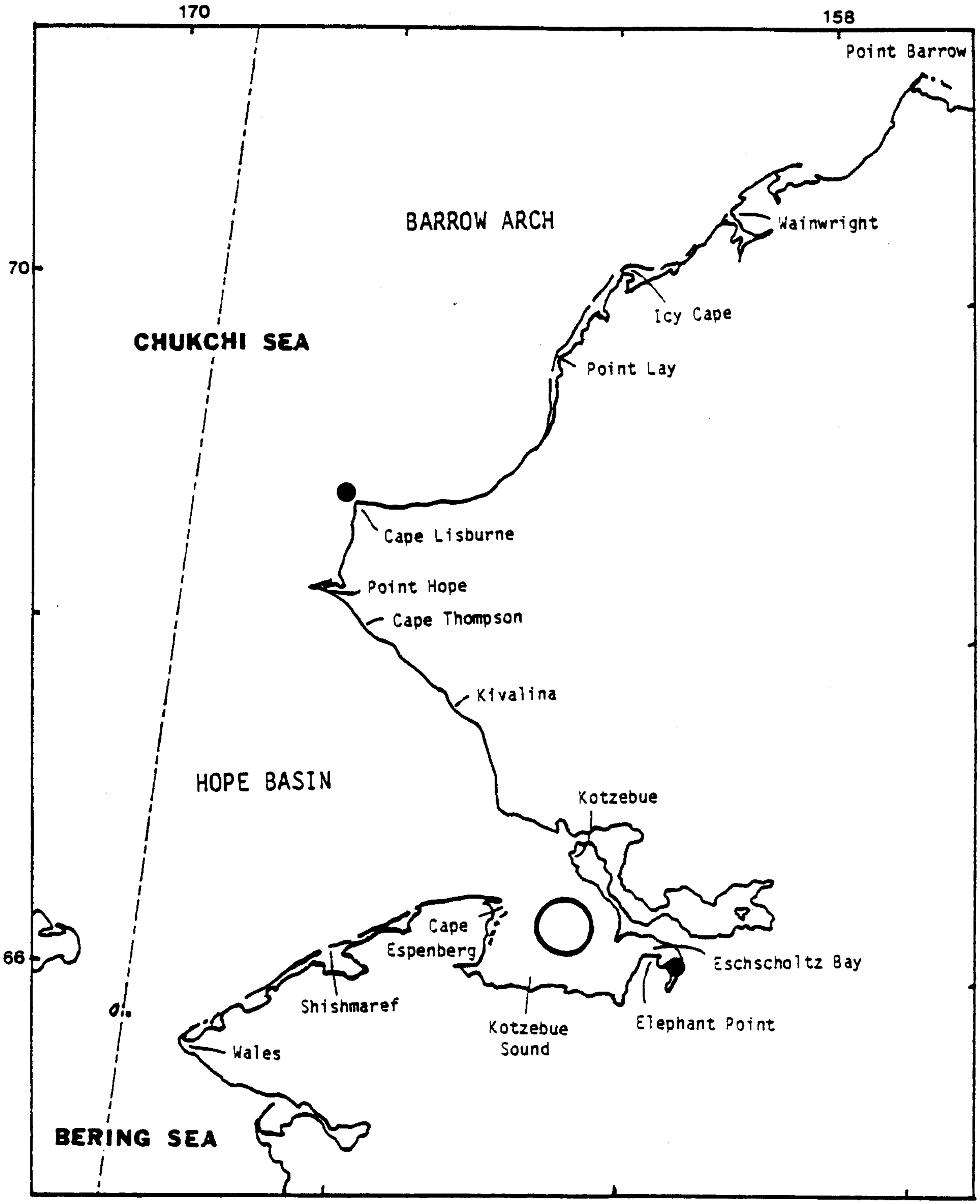

Figure 9. Map of the eastern Chukchi Sea showing sightings of minke whales in the coastal zone.

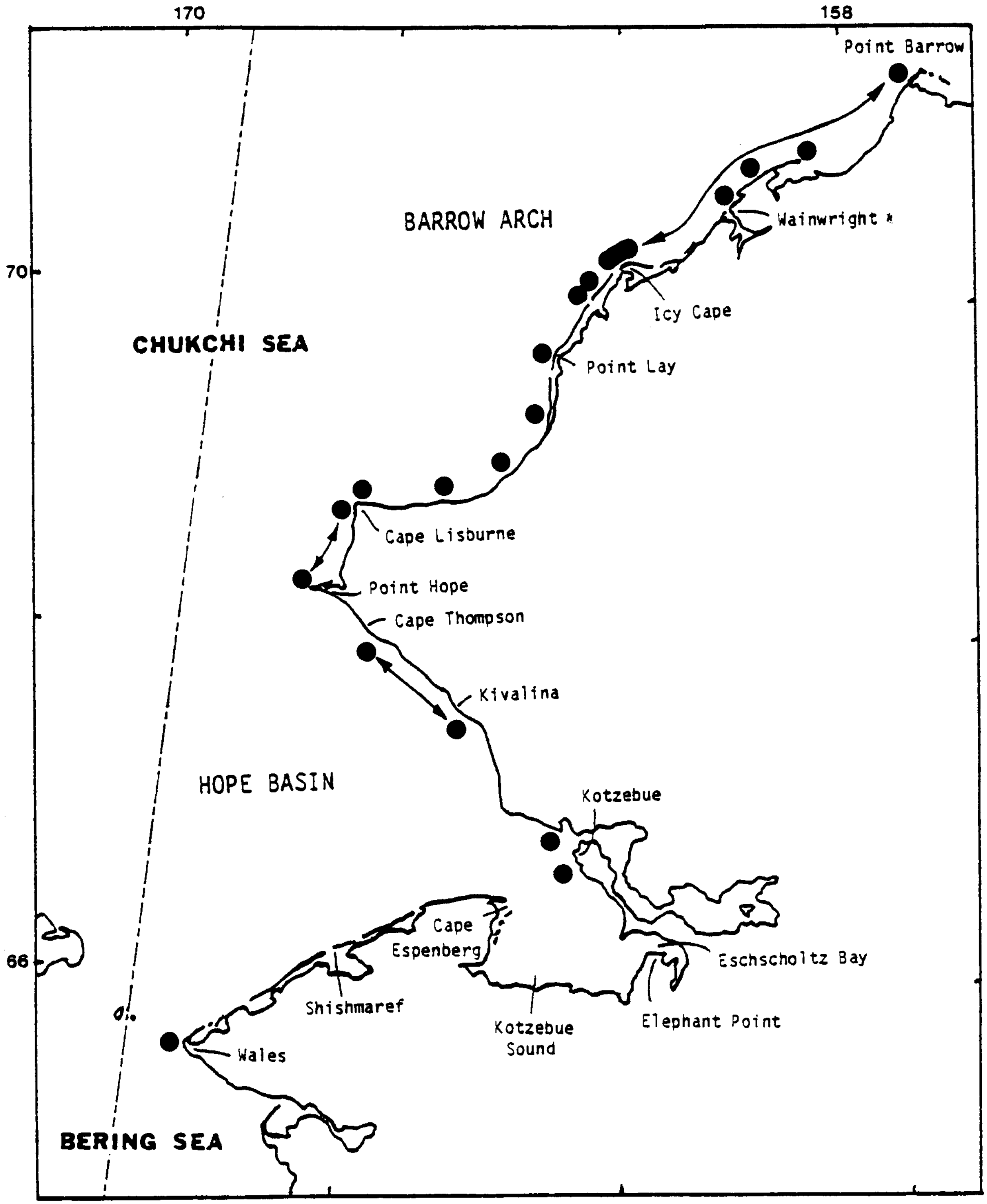

Figure 10. Map of the eastern Chukchi Sea showing sightings of gray whales in the coastal zone.

the research projects conducted by ADF&G over the past 23 years, several investigators have had the opportunity to spend time in most of the villages along the Chukchi coast and to discuss marine mammal distribution and abundance with residents. ADF&G employees visited Wales, Shishmaref, Wainwright, and Barrow in the course of pinniped and polar bear studies and Elephant Point, Kotzebue, Point Hope, and Point Lay while studying belukhas. Since much of the data available has been collected on an opportunistic basis, it was sometimes difficult to evaluate whether the composite picture derived from sightings accurately reflects the pattern of marine mammal distribution and abundance. This was particularly true when data were derived from informants who were present in or made observations of an area for only part of the ice-free season. In some cases, such as Eschscholtz Bay and Kasegaluk Lagoon, specific studies of belukha whales have been conducted, but information on other species in those areas, such as spotted seals, has not been collected in a systematic manner. Few studies have been done along the remainder of the Chukchi coast. Several site-specific studies of seabird colonies have been conducted over the past 10 years, and marine mammal observations made in the course of those studies have been included in this report. In 1976-77, ADF&G personnel conducted annual surveys of herring spawning concentrations along most of the coast from Bering Strait to northern Kotzebue Sound, and marine mammal observations were recorded on those flights.

We are confident that most major coastal areas utilized by marine mammals in summer and autumn have been identified in this report and that data are adequate to describe, in a general sense, the use of various regions of the coast by marine mammals. This information should be of considerable value for planning and, where necessary, perhaps regulating the development of OCS hydrocarbon reserves. However, without exception, available data on the numbers and activities of marine mammals at specific locations are not sufficient to estimate total numbers of animals or to measure or monitor the impacts of OCS activities or other factors on them.

B. Importance of Coastal Regions to Marine Mammals

Marine mammals inhabit virtually the entire coastal zone of the eastern Chukchi Sea during summer and autumn. However, their distribution is not uniform. In Hope Basin the greatest concentration of marine mammals occurs in Kotzebue Sound, which is inhabited by up to 2,000 + belukhas and an unknown but large number of spotted seals. Belukhas are most concentrated and predictably present offshore from Sheshalik, west of the Baldwin Peninsula, and particularly in Eschscholtz Bay. In Kotzebue Sound, spotted seals are most numerous in Eschscholtz Bay, Hotham Inlet, and at the mouth of the Noatak River. They are also present and haul out at locations along the coast from Wales to Cape Espenberg. Cape Espenberg and the string of islands extending south of it are the largest known spotted seal haulouts in Hope Basin. Harbor porpoises, killer whales, minke whales, and gray whales occur in Hope Basin. Gray whales are most frequently seen from Kivalina to Cape Lisburne. There are no regularly used walrus haulouts in Hope Basin.

In the Barrow Arch, the greatest concentration of marine mammals occurs in and near Kasegaluk Lagoon, which is used by 2,000-3,000 belukhas and at least 2,000-3,000 spotted seals. Belukhas are usually concentrated near the major passes, particularly Kukpowruk, Utukok, Icy Cape, and Akoliakatat. Spotted seals are abundant throughout Kasegaluk Lagoon and haul out in large numbers at Utukok and Akoliakatat passes. They are less numerous but still abundant near the mouth of the Kuk River near Wainwright and the Kugrua River in southern Peard Bay.

There are no major, regularly used haulouts for walruses in the northeastern Chukchi Sea, although some have hauled out at Cape Lisburne each summer since 1975.

Killer whales are seen off Point Lay and Wainwright in most years, and minke whales have been sighted at Cape Lisburne. Harbor porpoises have been seen near Wainwright, in Peard Bay, and near Barrow, and probably pass along all of the coast. Gray whales are present and feed along the entire northeastern Chukchi coast during summer and autumn. They are most common between Icy Cape and Barrow, particularly off Wainwright and Point Franklin.

C. Potential Effects of OCS Activities

The possible effects of OCS exploration and development in the Chukchi Sea are of two principal types: 1) those associated with hydrocarbons which are released into the environment, and 2) those related to disturbances which may affect the behavior and distribution of animals. Possible direct impacts of oil pollution have been discussed by Davis and Anderson (1976), Geraci and Smith (1976, 1977), Costa and Kooyman (1980), Geraci and St. Aubin (1980, 1982), and Cowles et al. (1981). Generally speaking, direct effects of oil are expected to be greatest on animals which rely on fur for insulation, which includes polar bears and the newborn young of ice-inhabiting seals. Effects of oil which may be ingested in the process of feeding or growing were discussed by Geraci and Smith (1976, 1977) and Cowles et al. (1981). Results available to date are inconclusive, although some physiological effects have been documented. Effects of oil on foods of marine mammals in the Chukchi Sea were discussed in detail in Lowry et al. (1981). In the remainder of this section we will discuss only the possible effects of disturbance on the abundance, distribution, and behavior of marine mammals in the coastal zone of the eastern Chukchi Sea.

There can be little question that air- and water-borne noise will in many cases be audible to marine mammals (e.g., see Myrberg 1978). The possible effects of such disturbances caused by noise or the physical presence of humans, vessels, or equipment are poorly known since very few studies have systematically addressed the question. Terhune et al. (1979) documented a decrease in vocalizations of harp seals (*Phoca groenlandicus*) in the presence of an operating vessel, which they attributed primarily to motor noise. It has been suggested that an increase in "water tourism" has caused a decrease in abundance of harbor seals (*Phoca vitulina*) in the Netherlands (Bonner 1978). Disturbance by humans has caused an elevated mortality in recently born Hawaiian monk seals (*Monachus schauinslandi*) (Rice 1964) and reduced productivity of Mediterranean monk seals (*Monachus monachus*) (Sergeant et al. 1978). Salter (1979) has documented a number of behavioral responses of walruses to over-flying aircraft, and we have noted that seals, sea lions (*Eumetopias jubatus*), and walruses almost invariably flee into the water when approached by humans or low-flying aircraft. Fay (pers. commun.) observed instances when walruses at Cape Seniavin were stampeded into the water by low-flying aircraft. When animals flee from the hauling areas, some mortality, especially of recently born young, will occur through injury or abandonment and subsequent starvation. The magnitude of this problem will vary by species, location, and time of year. In the case of walruses, regular human disturbance has prevented the long-term use of haulouts at Cape Newenham, Sledge Island, and to some extent King Island in the Bering Sea (ADF&G, unpubl.). Salter (1979) suggested that disturbances associated with the establishment of permanent bases in the Arctic may have caused changes in the summer distribution patterns of walruses, and, in fact, construction of the DEW-line station at Cape Lisburne did alter haulout patterns of walruses there (ADF&G, unpubl.).

Disturbance responses of cetaceans are more difficult to observe and quantify. Nishiwaki and Sasao (1977) are of the opinion that human activities, principally vessel traffic, have altered the migration routes of Baird's beaked whales (*Berardius bairdii*) and minke whales off the coast of Japan. In the case of minke whales, the greatest effect may have been on females with calves which avoided traditionally used coastal areas. Fraker (1977) discussed the effects of disturbance on belukha whales in the Mackenzie delta area. We have observed that outboard-powered boats affect belukha movements in rivers and bays. When a boat approached whales moving up the Snake River, they changed direction and moved downstream. When boats approached a large group of whales in shallow areas of western Nushagak Bay, they all turned and headed eastward toward deeper water. Changes in the summer distribution pattern of belukhas in Kotzebue Sound are closely correlated with changes in human activities and associated boat traffic (Burns et al., in prep.).

The actual results of responses to disturbances such as those discussed above are even less well known than the responses themselves. Mortality and injury of animals, particularly newborn or nursing young, will definitely occur in some circumstances, as has been documented for walruses and monk seals. More subtle effects on animal condition may also occur when disturbances interfere with normal activities such as nursing, resting, breeding, and molting. Perhaps most significant is the long-term displacement of animals that will be caused by continuous or regular and frequent disturbance. Since feeding is a major activity for marine mammals during summer and autumn, it is reasonable to assume that concentration areas of most marine mammals occur mainly in locations where they can obtain their food most efficiently. Pinnipeds require hauling areas on which to rest between feeding forays, and some species of cetaceans may likewise need protected areas in which to rest, care for young, and socialize. These coastal concentration areas occur at specific locations and are limited in number. Displacement from these areas will mean that those feeding grounds are abandoned or that animals will have to travel greater distances to reach them from the nearest resting area, either of which would be detrimental in energetic terms. One might speculate that such displacement would have the greatest effect on a species such as walrus, which feed on sessile organisms that occur abundantly only in limited areas. However, the principal prey of many other marine mammal species such as capelin (Mallotus villosus), herring, and salmon are equally concentrated at specific areas and times of year. Changes in distribution and abundance which prevent a species from exploiting its potential food resources in the most efficient manner will result in long-term changes in productivity, survival, and abundance.

IX. Needs for Further Study

This study covered the portion of the Alaska coastline from Bering Strait to Point Barrow and included several locations which are important marine mammal habitats during spring and autumn. A similar report dealing with the Bering Sea coast was submitted in September 1982. Many coastal areas of the Aleutian Islands and the Gulf of Alaska are also important habitat for marine mammals, particularly sea lions, sea otters, and harbor seals. A review of available data on distribution and abundance of marine mammals in the coastal zone would be very useful for planning OCS activities in those areas.

This report includes all sighting data available to us up to the end of 1981. Some significant observations made in summer 1982 are also included. Undoubtedly, we have missed some past observations which should have been included. In addition, with the present intensity of field research in western Alaska, much new information will be generated each year. We consider this report to be a working document which will be of greatest value if it can encourage researchers to record their sightings of marine mammals and make them available to others. A single sighting which seems of little value in itself may be of substantial significance when considered in combination with all the other data available. Consideration should be given to updating and revising this report on a regular basis, perhaps every 2 years.

Although we have been able to describe general features of the distribution and abundance of marine mammals in the coastal areas of the eastern Chukchi Sea using the existing data base, with few if any exceptions the available data are not adequate to predict or monitor the effects of OCS development or other human activities on marine mammals. There have been no systematic studies which have described the distribution, abundance, and activities of marine mammals at a particular location throughout the time they occur there and for a series of years. The available data show quite conclusively that the number of animals using particular areas has changed over time, and we predict that such fluctuations will continue to occur during OCS exploration and development. Without some additional research on the biology of marine mammals in the coastal zone, it will be difficult to detect and measure the fluctuations and impossible to identify the causes.

We suggest that OCSEAP initiate studies that will deal with representative species and habitats in areas that are likely to be impacted by OCS activities in the near future. Some potential species and areas are as follows:

Spotted seals - Kasegaluk Lagoon, Cape Espenberg

Walruses - Cape Lisburne

Belukha whales - Kotzebue Sound, Kasegaluk Lagoon

Of principal interest at each location is documentation of the seasonal cycle in numbers of animals using the area. Activity patterns should be examined as they relate to enumeration of animals as well as for documentation of "normal" activity. Present levels of disturbance and their effects, if any, should be monitored. Information should be gathered on the relationships among groups of animals at various locations; i.e., what is the rate of interchange among areas and what degree of fidelity do individuals have to particular locations. Research should include, as possible, observations of group composition, birth and survival rates, and present causes of mortality. Finally, the significance of the area to the animals should be determined; i.e., is it used principally for feeding, birthing, breeding, or some combination of purposes.

More specifically, the distribution and movements of belukha whales along the Chukchi coast should be studied through application of tagging techniques being developed in Bristol Bay and should be conducted in conjunction with aerial surveys during times of peak abundance. Large aggregations of belukhas occur in two known locations in the eastern Chukchi Sea: Kotzebue Sound and the Kasegaluk Lagoon area. It is unknown whether these aggregations are two separate groups of animals or the same group moving up the coast as the season progresses. Food habits of belukhas in the Kasegaluk Lagoon area are unknown, as are the availability of prey and the probable importance of this section of the coast as a feeding area.

Relatively little is known about the use of Chukchi coastal areas by spotted seals. In late summer, large aggregations are known to occur at Cape Espenberg and Kasegaluk Lagoon. The actual number of seals using those areas, the duration of their stay, and their activity patterns while there are unknown. However, these are clearly two of the largest documented spotted seal aggregations along the entire coastline of northwest Alaska.

If such studies are begun prior to OCS leasing and continued at intervals after exploration and development begin, it should be possible to make some definitive statements regarding the effects of OCS activities.

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APPENDIX I.

Geographical Coordinates of Locations Referred to in Text

Name	Region	Latitude	Longitude
Agiak Point	BA 2	70°29'05"N	159°54'15"W
Akoliakatat Pass	BA 1	70°18'N	161°18'W
Akoviknak Lagoon	HB 3	68°12'N	166°02'W
Akunik Pass (Kokolik Pass)	BA 1	69°53'45"N	162°49'30"W
Arctic Lagoon	HB 1	66°12'N	166°09'W
Atanik	BA 2	70°50'N	159°21'W
Avak Inlet	BA 1	70°15'N	161°38'W
Baldwin Peninsula	HB 2	66°45'N	162°20'W
Barrow	BA 2	71°17'30"N	156°47'15"W
Barrow, Point	BA 2	71°23'29"N	156°28'30"W
Beaufort, Cape	BA 1	69°02'N	163°50'W
Belcher, Point	BA 2	70°47'40"N	159°39'02"W
Blossom, Cape	HB 2	66°44'N	162°30'W
Buckland River	HB 2	66°14'N	161°01'W
Chamisso Island	HB 2	66°13'N	161°50'W
Choris Peninsula	HB 2	66°17'N	161°53'W
Corwin Bluff	BA 1	68°52'40"N	165°03'15"W
Crowbill Point	HB 3	68°06'05"N	165°48'07"W
Deering	HB 2	66°04'N	162°42'W
Dyer, Cape	HB 3	68°39'08"N	166°13'50"W

Appendix I

Name	Region	Latitude	Longitude
Elephant Point	HB 2	66°16'N	161°20'W
Elson Lagoon	BA 2	71°15'N	155°51'W
Eschscholtz Bay	HB 2	66°20'N	161°30'W
Espenberg, Cape	HB 1	66°33'N	163°36'W
Franklin, Point	BA 2	70°54'28"N	158°47'50"W
Hope, Point	HB 3	68°20'20"N	166°50'40"W
Hotham Inlet	HB 2	67°00'N	162°00'W
Icy Cape	BA 1	70°20'N	161°52'W
Icy Cape Pass	BA 1	70°18'N	161°57'W
Ikpek	HB 1	65°54'N	167°17'W
Ikpek Lagoon	HB 1	65°56'N	167°00'W
Karmuk Point	BA 2	70°35'10"N	159°53'45"W
Kasegaluk Lagoon	BA 1	70°28'N to	160°29'W to
		69°16'N	163°18'W
Kivalik Channel (Inlet)	HB 3	67°47'N	164°41'W
Kivalina	HB 3	67°43'40"N	164°32'30"W
Kokolik Pass (Akunik Pass)	BA 1	69°53'45"N	162°49'30"W
Kokolik River	BA 1	69°45'15"N	163°00'W
Kotzebue	HB 2	66°54'N	162°35'W
Kotzebue Sound	HB 2	66°45'N	163°00'W

Name	Region	Latitude	Longitude
Krusenstern, Cape	HB 2	67°08'N	163°44'45"W
Kugrua Bay	BA 2	70°47'N	159°08'W
Kugrua River	BA 2	70°46'30"N	159°17'W
Kuk River	BA 2	70°35'N	159°53'W
Kukpowruk Pass	BA 1	69°40'30"N	163°06'W
Kukpuk River	HB 3	68°25'N	166°22'W
Lay, Point	BA 1	69°45'45"N	163°03'05"W
Lewis, Cape	HB 3	68°42'50"N	166°12'01"W
Lisburne, Cape	BA 1	68°53'N	166°13'W
Lopp Lagoon	HB 1	65°45'N	167°45'W
Marryat Inlet	HB 3	68°22'N	166°33'W
Marsh, Point	BA 2	70°36'25"N	160°07'W
Naokok Pass	BA 1	69°27'30"N	163°08'30"W
Noatak River delta	HB 2	67°00'N	162°30'W
Ogotoruk Creek	HB 3	68°05'52"N	165°45'15"W
Peard Bay	BA 2	70°51'N	158°48'W
Pingorarok Pass	BA 1	70°22'N	160°49'W
Pitmegea River	BA 1	68°54'40"N	164°37'W
Prince of Wales, Cape	HB 1	65°36'N	168°05'W

Name	Region	Latitude	Longitude
Sabine, Cape	BA 1	68°55'N	164°36'15"W
Selawik Lake	HB 2	66°30'N	160°45'W
Seppings, Cape	HB 3	68°58'N	165°11'W
Sheshalik	HB 2	66°59'30"N	162°49'45"W
Shishmaref	HB 1	66°15'N	166°04'W
Shishmaref Inlet	HB 1	66°15'N	166°05'W
Spafarief Bay	HB 2	66°08'N	161°51'W
Thompson, Cape	HB 3	68°08'40"N	165°58'40"W
Utukok Pass	BA 1	70°05'N	162°31'W
Wainwright	BA 2	70°38'15"N	160°01'45"W
Wales	HB 1	65°37'N	168°05'W

APPENDIX II.

Source Names Index

Appendix II

Burns and Morrow 1975 - HB 1

Childs 1969 - BA 1

Collins, G. - BA 1
    from files of F. H. Fay, Univ. Alaska, Fairbanks

Craighead, D. - HB 3
    ADF&G, Kotzebue

Degange, A. - HB 2
    seabird observer, Seabird Colony Status Program, USFWS, Anchorage

Durham 1979 - HB 3, BA 2

Fay, F. H. - HB 1, HB 3, BA 1, BA 2
    walrus researcher, Inst. Marine Science, Univ. Alaska, Fairbanks

Fay 1982 - BA 1

Fay and Kelly 1982 - HB 3, BA 2

Field, P. - HB 3
    ADF&G seasonal employee (marine mammals)

Fields, A. - HB 2
    Kotzebue resident; pers. commun. to J. Burns, ADF&G, Fairbanks

Fiscus and Marquette 1975 - HB 3

Fiscus et al. 1976 - BA 2

Foote 1960 - HB 2, HB 3

Foote and Williamson 1966 - HB 2

Frankson, D. - HB 3
    Point Hope resident

Frost, K. - HB 1, HB 2, BA 1, BA 2
    marine mammal researcher, ADF&G, Fairbanks

Goodhope, F. - HB 1
Shishmaref resident; pers. commun. to J. Burns, ADF&G, Fairbanks

Goodwin, W. - HB 2
employee of NANA Corp., Kotzebue; pers. commun. to J. Burns, ADF&G, Fairbanks

Hills, S. - HB 1
seabird observer, Univ. Washington; pers. commun. to K. Frost, ADF&G, Fairbanks

Hobbs and Goebel 1982 - HB 3, BA 2

Jacobson, J. - HB 2
Kotzebue resident; pers. commun. to J. Burns, ADF&G, Fairbanks

Johnson et al. 1966 - HB 3

Kelly, B. - HB 3, BA 1
marine mammal researcher, ADF&G and Inst. Marine Science, Univ. Alaska, Fairbanks

King, R. - BA 1, BA 2
aerial surveys for waterfowl, USFWS, Fairbanks

Krammer, D. - HB 2
Kotzebue resident; pers. commun. to G. Seaman, ADF&G, Anchorage

Lee, N. - HB 2
Buckland resident; pers. commun. to G. Seaman, ADF&G, Anchorage

Lehnhausen and Quinlan 1981 - BA 1

Lensink 1961 - HB 1, HB 2

Ljungblad 1981 - HB 3, BA 1, BA 2

Ljungblad et al. 1982 - HB 1, HB 2, HB 3, BA 1, BA 2

Lowry, L. - HB 1, HB 3, BA 1, BA 2
marine mammal researcher, ADF&G, Fairbanks

Maher 1960 - BA 1, BA 2

Marquette 1977 - HB 3

Marquette and Braham 1982 - HB 3, BA 1, BA 2

Melchior, H. - HB 3, BA 2
ADF&G, Area Biologist, Barrow

Merrit, P. - HB 2
ADF&G, FRED Division, Kotzebue

Murdoch 1885 - BA 2

Murphy, E. - HB 3
seabird researcher, Univ. Alaska, Fairbanks

Neakok, B. - BA 1
Point Lay resident; pers. commun. to G. Seaman, ADF&G, Anchorage

Neakok, W. - BA 1
Point Lay resident; pers. commun. to G. Seaman, ADF&G, Anchorage

Negovanna, W. - BA 1
Wainwright resident; pers. commun. to G. Seaman, ADF&G, Anchorage

Nelson 1887 - HB 2, HB 3

Nelson 1969 - BA 2

Nelson, R. - BA 1, BA 2
marine mammal researcher, ADF&G, Nome

North Slope Planning Document 1982 - HB 3, BA 1
unpublished report prepared by Maynard and Parch, Woodward-Clyde Consultants. Alaska Coastal Management Program.

Oktollik, J. - HB 3
Point Hope resident; pers. commun. to P. Field, ADF&G, Fairbanks

Pegau, R. - BA 1
ADF&G, Nome

Persons, K. - HB 2
pers. commun. to J. Burns, ADF&G, Fairbanks

Appendix II

Pike 1962 - HB 1, HB 2, HB 3

Quimby, R. - BA 1
    pers. commun. to J. Burns, ADF&G, Fairbanks

Ray, G. - HB 1, BA 2
    marine mammal researcher, Univ. Virginia, Charlottesville

Robus, M. - HB 3
    ADF&G, Fairbanks

Rudd, J. - BA 1
    pilot, Kotzebue

Saario and Kessel 1966 - HB 3

Seaman and Burns 1981 - HB 2

Seaman, G. - HB 1, HB 2, HB 3, BA 1, BA 2
    ADF&G, Anchorage

Shanahan, C. - BA 2
    pers. commun. to J. Burns, ADF&G, Fairbanks

Smith, T. - BA 1
    ADF&G, Nome

Smullen, D. - HB 3
    bowhead whale program, National Marine Fisheries Service, Seattle

Sowls, A. - HB 2
    seabird observer and coordinator, Seabird Colony Status Program,
    USFWS, Anchorage

Springer, A. - BA 1
    seabird researcher, LGL Ltd., Fairbanks

Springer and Roseneau 1977 - HB 3

Stewart, D. - HB 1
    NMFS, Anchorage; pers. commun. to J. Burns, ADF&G, Fairbanks

Strickland, D. - BA 1, BA 2
    ADF&G seasonal employee (marine mammals), Fairbanks

Thomas, L. - HB 2
Buckland resident; pers. commun. to G. Seaman, ADF&G, Anchorage

Tounai, E. - BA 1
Point Lay resident; pers. commun. to G. Seaman, ADF&G, Anchorage

Tremaine, R. - HB 1, BA 2
ADF&G seasonal employee (marine mammals), Fairbanks

USFWS (U.S. Fish and Wildlife Service) walrus harvest report, 1981 - HB 1

USFWS 1969 - HB 2

USFWS/SBCS Reports - HB 2, HB 3
Seabird Colony Status Reports, USFWS, Anchorage

Van Valin 1941 - BA 2

Walker, J. - HB 2
pilot, Walker Air, Kotzebue; pers. commun. to J. Burns, ADF&G, Fairbanks

Weyiouanna, C. - HB 1
Shishmaref resident; pers. commun. to R. Tremaine, ADF&G, Fairbanks

Wilke and Fiscus 1961 - HB 1, HB 2

Wilson, G. - BA 1
pers. commun. to F. H. Fay, Univ. Alaska, Fairbanks

Wilson, Y. - HB 2, HB 3
pers. commun. to G. Seaman, ADF&G, Anchorage

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