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Marine mammals of the Bering and southern Chukchi Seas

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I. Abstract

In Bristol Bay in April 1976, bearded seals were somewhat uniformly dispersed yet more frequent than larga seals west of 163° W. Longitude. Ringed seals were more numerous in the north~~east~~west part of the Bay. Walruses were clumped in the southeast, northeast and west ends of the Bay. Bearded seals were more frequent north of St. Lawrence Island than ringed seals, but ringed seals were more frequent southwest of St. Lawrence Island. More bearded seals and fewer ringed seals were seen than expected (X^2: $P < 0.01$). Bearded seals were less solitary than ringed seals ($P < 0.05$) in both the northern and southern Bering Sea. Larga seals were less solitary than either ($P < 0.01$); they appear to be pupping and pairing sooner in pack ice than near the ice front. Bearded seals appear to be pupping and pairing sooner in the northern Bering Sea than the southern Bering Sea.

The population of northern sea lions in the eastern Aleutian Islands appears to have declined by 50% since the 1950's. About 80% of the sea lion population in the study area occurs on islands of the Fox Islands group (eastern Aleutian Islands). Nine (9) new hauling areas were identified in 1976, but no new rookeries. Ugamak Island, Bogoslof Island and Cape Morgan (Akutan Island) are the major breeding areas for the species. The highest numbers of all counts in the eastern Aleutian Islands (i.e., 45-50%) came from these three islands. The Fox Islands were found to be a very important area for animals to haul out onto during the fall months.

Approximately 80% of all harbor seals sighted were found at eight hauling areas; of these, three were considered major. An unknown proportion of the winter population hauls out on ice, perhaps as a result of landfast ice invading the coastal bays.

Most large cetaceans appear to enter the southern Bering Sea in greatest numbers in June via the eastern Aleutian Islands. The species most sighted in the northern Bering Sea were the gray, humpback and sperm (off shelf) whales; in the southern Bering Sea, Dan porpoises and minke whales were most sighted. Gray whales have been found to migrate close to shore throughout Alaska while moving north. Part of their northern migration route north of Unimak Pass has been determined (quantified for the first time) to occur all along the coast of Bristol Bay. The species enters the Bering Sea at least by early April.

All data summarized in this report are preliminary, and are still undergoing final checking, editing and correcting. No data or conclusions should be quoted without the authors' approval.

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II. Introduction

The objective of Research Unit 67 is to summarize existing knowledge on the seasonal distribution and relative abundance of cetaceans and pinnipeds in [illegible], and to the extent possible, in the southern Chukchi Sea. To [illegible] this objective, we have supplemented the information found in published and unpublished accounts with data from our own aerial and vessel surveys.

Field research was divided into three sub-tasks: 1) ice seals; 2) sea lions and harbor seals; and 3) cetaceans. The reason for the division was that temporally and spatially the logistics, as well as the timing of the animals, [illegible] separate surveys. Surveys of ice seals are conducted during the late winter and early spring months, requiring a long-range survey aircraft. Harbor seal and sea lion studies must be conducted in the summer with a smaller, more maneuverable aircraft. Cetaceans, we have found, are generally best surveyed from sea-going vessels or from land stations, except where animals migrate near shore or through leads in the ice (e.g. , bowheads and belugas) . Specific studies on walruses and sea otters are under separate OCSEAP contract (RU 14 and 241, respectively), and are not covered in detail under RU 67. A detailed discussion of northern fur seal distribution will be made in the final report. Research in RU 67 overlaps with studies of bowhead and beluga whales (RU 69) and ringed and bearded seals (RU 230) in the Chukchi Sea, hence these topics received less treatment here.

The objectives of the ice seal study are to quantify discrete populations, and to assess their distribution with respect to the distribution of ice. This can best be accomplished while the animals are hauled out onto the ice just before, during, and after the breeding season (March through June). An assessment of their distribution at sea during the summer and fall months comes from incidental sightings, from the published literature, and from knowledgeable individuals. Unfortunately, it is almost impossible to adequately survey for these species during ice-free periods because of the animals' pelagic dispersal.

The objectives of the sea lion/harbor seal study are to quantify population sizes to determine seasonal movements and to assess the importance of areas of high density. Specifically, identification of important breeding sites and hauling grounds is paramount to this study. Since a major objective is to determine the maximum number of animals in the population, the breeding season (June-August) was chosen because this is the time most animals haul out onto land.

The primary objectives of the cetacean study are to delineate seasonal migration and local movements, but also to assess population sizes where possible. Thislattermeasurementis extremely difficult to quantify because of the lack of adequate survey methodology, as pointed out by Anderson, et al. (1976). The cetaceans presently considered most vulnerable to energy related activities in the Bering and Chukchi Seas (i.e., gray whale, harbor porpoise and bowhead whale) are also the most easily surveyed (except perhaps for the harbor porpoise) . Other species, which may be less vulnerable (e.g., the balaenopterids , killer whales, humpback whales and belugas) are much more difficult to study. (Note : gray, bowhead and humpback whales are endangered species.)

An adequate assessment of species effect cannot be made without some understanding of past and present population status. For some species, such as the walrus and northern fur seal, a considerable amount of information has been published. Little reliable information is available on harbor seals and sea lions, especially in the study area. Information on the ice seals (bearded, ringed, larga and ribbon) is limited, yet that which has been published clearly summarizes our present understanding (Burns, 1970; Fay, 1974). Important publications on cetaceans in the Bering Sea are few. A comprehensive list of published and unpublished materials located to date is available in "An Annotated Bibliography on Marine Mammals of Alaska" (Severinghaus and Nerini, 1977), This document was part of the RU 67 OCSEAP contract.

Two important factors relevant to assessing the interaction of energy development and marine mammal populations are sensitivity-resilience and vulnerability. In order for a species population to be viable (i.e., sustained at a definable level), three things must be present: 1) production, at least at the replacement level; 2) resource acquisition; and 3) temporal and spatial accessibility to the first two. Under the present scheme of research activities, the only realistic kinds of inputs from our research will relate to vulnerability (both species and habitat). (Note: the term "critical" is avoided here because no precise ecological definition is known to exist.) Vulnerability is defined here as any net adverse affect from a negative externality which has the potential. of temporarily or permanently decreasing the biological productivity (including production) of a population or sub-population.

Alaska's marine mammals are protected by U. S. law and international agreement (e.g., 1946 International Convention for the Regulation of Whaling; 1957 Interim Convention on Conservation of North Pacific Fur Seals; Marine Mammal Protection Act of 1972; and Endangered Species Act of 1973). Fortunately for marine mammals, then, the concept of Pareto Optimality[1/] seems to have been mandated by congressional statute. As such, proper safeguards related to energy development activities must be implemented based upon an evaluation of the information provided by OCSEAP contractees.

This report covers the first full year's work (1976) and includes data on harbor seals and sea lions collected in June and August 1975. Each appropriate chapter (i.e., Current State of Knowledge, Methods, Results and Discussion, etc.) is subdivided according to the three sub-tasks. A synthesis of our thoughts will be made in the Conclusions section, especially with regard to oil and gas exploitation; keep in mind, however, that our capability of interrelating effects to these species is extremely limited. Detailed information concerning energy development activities is not at our disposal, and an integration of our work with the exploratory and transportation disciplines is necessary before understanding is achieved. These topics are beyond the scope of this report.

1/ "...an allocation of resources is optimal if no reallocation could make some members of society [or an ecosystem] better off without making others worse off". (Meyers and Tarlock, 1971:3) (our brackets)

111. Current State of Knowledge

Ice seals

Bearded seal. The bearded seal (Erignathus barbatus) is usually found singly or in pairs, though during molting periods (summer months), as many as 30 may be grouped together. The species occurs throughout the area of seasonal ice cover- migrating north with the retreating ice. Bearded seals are generally found north of the other phocid seals, preferring heavier pack ice (Burns, 1970) . They rarely come ashore and are not known to use areas of unbroken landfast ice (Burns, 1973). Their greatest abundance is north of the ice edge zone and south of the Bering Strait (Burns, 1970) . Large concentrations have been seen near St. Lawrence Island, southeast of St. Matthew Island, south of Nunivak, and near Anadyr Bay (Kosygin, 1966). Localized distributions are probably related to food availability (Tikhomirov, 1964).

Bearded seals are believed to dive no deeper than 200 m during feeding (Popov, 1976), usually occurring in waters 100-150 m deep (Tikhomirov, 1966). Their spring and summer diet consists mostly of crustaceans -- especially anuran crabs and shrimp (Gragonidae) -- and mollusks (gastropod) , octopuses, polychaetes, and a 'variety of fishes (Johnson, et al. , 1966; Kosygin, 1971; Burns, 1973; Popov, 1976). Burns and Lowry (1976) have recently found that bearded seals prey mostly on decapod crustaceans near St. Lawrence Island while in Norton Sound , near Nome, bivalves and shrimp seem to be preferred.

The Bering Sea population has been estimated at 90,000 (Shustov, 1972) , 250,000 (Popov, 1976), 300,000 by Alaska Dept. Fish and Game (Burns, 1973), and 450,000 for a Soviet estimate (Burns, 1973) . Approximately 8,000-10,000 are harvested annually by U.S. Eskimos and the U.S.S.R. (Burns, 1973).

Larga seal. Phoca largha, the ice-inhabiting relative of the harbor seal (Phoca vitulina), is usually found singly or in pairs near the edge of the pack ice. Concentrations of 50-100 may occur on large floes during molting periods (May-July). Generally associated with the southern edge of the seasonal pack ice, larga seals move north and towards the Siberian and Alaskan coasts as the ice pack recedes. Large concentrations extend from the Pribilof Islands east to Bristol Bay and off Nunivak Island during winter and spring, generally 20-40 km offshore (Tikhomirov, 1966). The distance from shore varies with the extent of pack ice.

Larga seals haul out on land during ice-free periods from the northern Bering to the Beaufort Seas (Burns, 1973) . Although intermingling may occur between P. largha and P. vitulina during the winter, when the ice front is near the Alaska Peninsula, these species are considered to be reproductive isolates (Burns, 1970). Blood protein comparisons show similarities between them, suggesting recent stock separation or chance genetic interchange (Shaughnessy, 1975).

Fedoseev and Shmakova (1976) recognized three local populations of P. largha in the Bering Sea: in Karaginsky, Anadyr, and the eastern Bering Sea. The species is apparently more populus on the east side of the Bering Sea (Tikhomirov, 1966). In Alaska, larga seals are the dominant near-shore seal during the ice-free season (Burns, 1973) , and during periods of ice cover it is the dominant species south of St. Lawrence Island (Tikhomirov, 1964).

Phoca largha adults eat pelagic fish, octopuses, crustaceans, and in summer, salmonoids. Young prefer amphipods, shrimp and shoaling fish (Popov, 1976).

Population estimates are 135,000 (Shustov, 1972; Popov, 1976), 200,000-250,000 by Alaska Dept. Fish and Game (Burns, 1973), and 450,000, a Soviet estimate (Burns, 1973). Approximately 7,000 are harvested annually by U.S. Eskimos and the U.S.S.R. (Burns, 1973).

Ribbon seal. Ribbon seals (Phoca fasciata) are usually solitary animals though pairing occurs during the breeding (April) and molting (May-June) periods (Fay, 1974); even then they stay 10-30 m apart. Their distribution is not related to water depths or associated feeding grounds but to ice conditions (Shustov, 1965). During the winter and early spring the entire population can be found along the southern edge of the pack ice up to 150 km north of the front (Fay, 1974). During periods of parturition and lactation, ribbon seals usually keep to the seaward edge of floes or in the center of large ice masses 50-250 km offshore. While molting, the seals move closer to shore with the melting of the ice pack, usually coming to within 20-100 km (Tikhomirov, 1966). Fedoseev and Shmakova (1976) defined two reproductive groups in the eastern and western Bering Sea.

As the ice retreats northward in the summer, ribbon seals abandon the ice and become pelagic until ice reappears in the autumn (Burns, 1973). Their distribution extends into the southern Chukchi Sea after ice breakup (Burns, 1970). A major concentration of ribbon seals has been reported to occur between Anadyr Bay and St. Lawrence Island, with a gradual drop in abundance south of St. Lawrence (Tikhomirov, 1966). Burns (1973) describes the center of abundance in the mid-Bering Sea area.

The Bering Sea population has been estimated to be 60,000 (Shustov, 1972; Fedoseev, 1973; Popov, 1976); 80,000-90,000, a Soviet estimate (Burns, 1973) and 100,000 by Alaska Dept. Fish and Game (Burns, 1973). The numbers of ribbon seals have been declining through the past decade, a decline believed due to heavy commercial harvesting by the U.S.S.R. (Burns, 1973).

Ribbon seals usually feed in water depths of 60-100 m on the nektobenthos, diving up to 200 m on occasion (Shustov, 1965; Popov, 1976). Their scarcity south of St. Matthews and Nunivak Islands is probably related to decreased feeding resources (Shustov, 1965). Shrimp, crabs and mysids are preferred; less so are fishes and cephalopods (Shustov, 1965). This diet is intermediate to those of bearded and ringed seals.

Ringed seal. The ringed seal (Phoca hispida) is the smallest of the ice inhabiting pinnipeds and is the most dependent upon the ice. Individuals are solitary, though during periods of molting group sizes can increase dramatically. They range throughout the seasonal ice cover of the Bering and Chukchi Seas and north into the permanent pack ice of the Arctic Basin (Burns, 1973). Ringed seals have been reported to occur as far south as the Pribilof Islands during the winter and spring (Kenyon, 1960; Thomas and Scheffer, 1962), but are considered rare in the Bering Sea during non-ice conditions (Tikhomirov, 1964). Fedoseev (1975) suggests that there are two stocks of ringed seals in the study area, those of the drift ice (in the Okhotsk and Chukchi Seas) and those of the fast ice, in bays and gulfs. He describes several morphological differences.

Burns (1970) found that adult, and especially male, ringed seals prefer areas of extensive landfast ice. Breeding activities usually occur within 5-40 km offshore unless the ice is blown to sea (Tikhomirov, 1966) . The highly territorial breeding pairs (primarily the female) maintain a small breathing hole in the ice. The more dominant individuals maintain breathing holes and pupping dens in the fast ice, 'with juveniles and sub-adults more likely occurring farther offshore (Tikhomirov, 1966; Burns, 1973; Fay, 1974).

Ringed seals are the dominant seal species in near-shore area during periods of ice cover with densities of 3.70-5.36 seals/mi^2 along the coast in the Chukchi Sea between Pt. Lay and Wainwright (Burns and Harbo, 1972). A minimum population estimate of 11,612 animals was made by Burns and Harbo (1972) for the north coast of Alaska. The total population has been estimated at 50,000 (Shustov, 1972), 70,000-80,000 (Popov, 1976), and 250,000 (Burns, 1973). Some 12,000-16,000 are harvested annually, mostly by shore-based Eskimo hunters (Burns, 1973).

The ringed seal's diet is variable according to sea depth and location of food resource (Burns, 1973), and according to season (Johnson, et al., 1966; Popov, 1976). The dominant food item is shrimp, with preferences also shown for gamariid amphipods, mysids, euphausiids, saffron cod, polar cod, and sculpin (Pikharev, 1946; Kenyon, 1962; Burns, 1973; Popov, 1976). Burns and Lowry (1975) found that invertebrates (mysids and shrimp) were tine predominate food item near St. Lawrence Island, but fish predominated (>85%) in stomachs from seals taken near Nome (Norton Sound).

Sea lions and harbor seals

Northern sea lion. The northern sea lion (Eumetopias jubatus) is found along the North Pacific coast from San Miguel Island (34°N) California to the Pribilof Islands (57°N) in Alaska and west along the Aleutian Islands to Japan. In Alaska, breeding activity begins in late May when mature bulls begin to set up and defend territories. Pupping occurs throughout the month of June . Most females breed within a week to ten days after parturition (Sandegrin, 1970). Although females are capable of giving birth yearly (Gentry, 1970), it has been suggested that many animals give birth every other year (Sandegrin, 1970). Fiscus (pers. comm.) , though, believes that they do give birth yearly. Male territorial behavior begins to decrease the first week of July, and by mid-July, most breeding activity has ended. Non-mating bachelor males often congregate on hauling grounds adjacent to rookeries.

From 1956 to 1958, Mathisen and Lopp (1963) conducted intermittent aerial surveys along the eastern Aleutian Islands. They found seasonal variations in the number of animals hauled out during the Year- Generally, their counts were low in early spring, maximum in late summer, and declined toward the end of the year. They suggested two explanations for the apparent variation in the seasonal counts : 1) many animals may migrate from the area; and (more likely) 2) while foraging at sea, sea lions may spend increasing amounts of time away from the rookeries and hauling grounds.

Mathisen and Lopp (op. cit.) estimated the eastern Aleutian Island population to be 52,540 animals. Kenyon and Spencer surveyed the western Aleutian Islands in May 1959, and estimated the population to be 44,630 animals (Kenyon and Rice, 1961). They stated that the Aleutian Islands appear to be the center of abundance for the species. Unlike Mathisen and LOpp (op. cit.), Kenyon and Rice (op. cit.) believed that some sea lions migrate to the northern Bering Sea in the summer.

Wilke and Kenyon, on 4 April 1955, when the pack ice surrounded the Pribilof Islands, saw approximately 1,000 sea lions hauled out on Otter Island and several others resting on ice floes (Kenyon and Rice, 1961). Of the few animals which could be identified as to sex, all were males. It would appear that sea lions may haul out on ice floes during the early spring when the pack ice extends as far south as the Pribilof Islands.

Several aspects of the life history of the northern sea lion are unknown. For example, we do not know whether sea lions migrate to and from the study area. The feeding ground(s) for the species is also unknown. Fiscus (pers. comm.), during the summer of 1962, saw groups of 1,000 sea lions feeding in the Unimak Island bight area while commercial salmon gill netters and purse seiners fished there. It is not known whether these sea lions were from our study area or from the Kodiak archipelago. Although sea lions are believed to be an important predator on some commercially important fishes (e.g., salmon, halibut, ground fish), there is very little evidence to support this (Mathisen, et al., 1962; Fiscus and Baines, 1966).

Harbor seals. Land breeding harbor seals (Phoca vitulina richardsi) are abundant throughout the Alaska Peninsula and eastern Aleutian Island survey area (Alaska Dept. Fish and Game, 1973). The animals are primarily inhabitants of coastal waters, although occasional occurrences are known up to 50 mi offshore (Calkins, et al., 1975). These animals haul out on offshore rocks (swept at high tide), beaches, and sandbars exposed at low tide. The largest concentrations haul out on sandbars and islets at the mouths of rivers, such as the Cinder River, or in bays, such as Port Moller and Port Heiden. Stage of the tide and weather conditions are important factors determining timing and duration of haul out (Bishop, 1967).

During winter, some harbor seals are known to use the ice edge as a hauling area (Burns, pers. comm.). The harbor seal's versatility in habitat utilization is demonstrated by its wide range over varying bottom types, water clarity and salinity (Calkins, et al., 1975) and food resources (Spalding, 1964).

Little is known of the biology of P. vitulina in our study area. Bishop (1967) studied animals in the Kodiak area and determined sexual maturity for females at three to five years and males at five to six years. In the Gulf of Alaska, pupping begins in late May and lasts until early July (Calkins, et al., 1975).

Since regional variation is known to occur for reproductive timing in females (Bigg, 1973) a more exact determination of pupping activity in our survey area cannot yet be made.

Parturition takes place on land, and pups are almost immediately able to follow their mothers into the water (Klinkhart, 1967) . Weaning occurs in 3-4 weeks and ovulation about 2 weeks later (Bishop, 1967). Breeding is dependent on the female being in estrus (Bishop, 1967) . Breeding competition between males occurs, perhaps resulting in pods of only bachelors.

Food habit studies on harbor seals in our study area are lacking. Work in the Gulf of Alaska has revealed a wide variety of food items taken including herring, flounder, smelt, gadids, rockfish, sculpins, salmon, greenling, halibut, octopus, squid and shrimp (Imler and Sarber, 1947; Spalding, 1964; Calkins, et al., 1975).

Census of harbor seals in this study area are few and incomplete. Opportunistic recordings were made by Mathisen and Lopp (1963) in Port Heiden, Port Moller, and Izembek Bay during their sea lion survey, but no full counts were attempted. Harbor seal populations in the Gulf of Alaska have been determined by analysis of harvest data (Calkins, et al., 1975). This method is not, known to have been applied to seals in our study area.

Cetaceans

The literature records the Bering and Chukchi Seas as within the range of 18 species of cetaceans (Nasu, 1960; Sleptsov, 1961; Berzin and Rovnin, 1966; Moore, 1966; Nishiwaki, 1967, 1974). From 1958 to the present, 17 of these species have been seen in our study area (Table 1). As one would expect, there is some seasonality to distribution and relative abundance. The peak number of animals in the southern Bering Sea seems to occur in June, and later in the summer and fall (July-November) in the northern Bering and southern Chukchi Seas.

The four most commonly observed species of cetaceans in the Bering Sea are the Dan porpoise (Phocoenoides dallii), harbor porpoise (Phocoena phocoena), beluga (Delphinapterus leucas) and minke whale (Balaenoptera acutorostrata) (Mizue and Yoshida, 1965; Klinkhart, 1966; Nishiwaki, 1967). Harbor porpoises and belugas probably occur in the study area year round. Presumably, Dan porpoises and minke whales migrate from southern waters into the Bering and Chukchi Seas, like gray, humpback, fin and killer whales, to forage for food over the productive eastern shelf region.

Few data exist on the distribution of all cetaceans north of the North Pacific, and abundance estimates are essentially non-existent. Population estimates by species for the North Pacific are summarized by Fiscus, et al. (1976), and presumably at least part of the population in the North Pacific migrates into the Bering Sea. There is no quantitative information to suggest that the North Pacific and Bering Sea cetaceans are from different populations although seasonal separation does exist (Nemoto, 195?, 1959; Nasu, 1963, 1966; Nishiwaki, 1967; Shurunov, 1970).

One of the most carefully studied cetaceans, the gray whale (Eschrichtius robustus), spends approximately eight months in the Bering and southern

Table 1. Species of cetaceans observed (or claimed to have been*) in the Bering and/or southern Chukchi Sea since 1958. Information collected from [illegible] (see Severinghaus and Nerini, 1977, for a bibliographic [illegible].

Order: Mysticeti

- *Balaena glacialis* (right whale)
- *Balaena mysticetus* (bowhead whale)
- *Balaenoptera acutorostrata* (minke whale)
- *Balaenoptera borealis* (sei whale)
- *Balaenoptera musculus* (blue whale)
- *Balaenoptera physalus* (fin whale)
- *Eschrichtius robustus* (gray whale)
- *Megaptera novaengliae* (humpback whale)

Order: Odontoceti

- *Delphinapterus leucas* (beluga or white whale)
- * *Globicephala macrorhynchus* (short-finned pilot whale)
- * *Lagenorhynchus obliquidens* (Pacific white-sided dolphin)
- *Mesoplodon stejnegeri* (sabertooth whale)
- *Orcinus orca* (killer whale)
- *Phocoena phocoena* (harbor porpoise)
- *Phocoenoides dallii* (Dan porpoise)
- *Physeter macrocephalus* (sperm whale)
- *Ziphius cavirostris* (goosebeak whale)

Chukchi Seas (April-November), with peak abundance months from June through October. Gray whales migrate from their breeding grounds in lagoons of Baja California, Mexico, to arctic and sub-arctic feeding grounds in the summer. Their migration path has been shown to be coastal from California to south-east Alaska (Gilmore, 1959; Pike, 1962; Rice and Wolman, 1971; Hatler and Darling, 1974), however, almost no documented evidence exists for their migration route north of British Columbia (Wilke and Fiscus, 1961). It is generally agreed that the passage into the Bering Sea is through Unimak Pass or Isonatski Straits (Ichihara, 1958; Pike, 1962) but the route followed further north is surrounded by controversy. Areas of gray whale concentration are north of St. Lawrence Island to the Bering Strait (Ichihara, 1958; Nasu, 1960; Fay, pers. comm.). In the southern Chukchi Sea, most E. robustus are seen along the Siberian coast (Fedoseev and Golt'sev, pers. comm.) and in outer Kotzebue Sound (Wilke and Fiscus, 1961; Shurunov, 1970), although Maher (1960) reports sightings as far east as Barter Island (Beaufort Sea near U.S.-Canadian border).

IV. Study Area

The generalized RU 67 study area includes all of the Bering Sea over the continental shelf east of the US-USSR 1867 Convention line and north into the Chukchi Sea to approximately 68°20′ N. Latitude (Figure 1). Some areas cannot be covered by aerial survey (e.g., west and north of the Pribilof Islands). Data from these areas come from shipboard observations. Cetacean research covers the entire general study area as does the ice seal research, at least to the extent of maximum ice cover. Four geographic areas have been delineated for reporting cetacean sightings. Sector one roughly approximates the outer Bristol Bay oil lease area ("3" on Figure 1); sector two, the St. George Basin ("2") north to St. Matthew Island and south to the Aleutian Island oil lease area ("1"); sector three, north to the Bering Strait — including the Norton Basin ("4"), and sector four, north of the Bering Strait in the Kotzebue Basin lease area ("5" on Figure 1). The sea lion/harbor seal studies are conducted along the north coast of Bristol Bay and the Alaska Peninsula, & all of the islands in the eastern Aleutian Islands east from Samalga Island (52°45′ N. Lat., 169°15′ W. Long.) (Figure 2). Pelagic islands such as St. Matthew and Hall Islands (60"20′ N. Lat., 173°00′ W. Long.) and Amak Island (55°20′ N. Lat., 163"10′ W. Long.) are periodically surveyed.

V. Methods and Materials

Ice Seals

The pack ice in the Bering Sea was aerially surveyed and the numbers of ice seals encountered scored as to perpendicular distance from the aircraft trackline. Two survey periods were completed: 6-23 April and 8-14 June. Surveys for ice seals in the southern Bering Sea were based out of King Salmon, Alaska, 6-13 and 17-19 April. Surveys in the northern Bering Sea were based out of Nome, Alaska, from 13-15 and 19-23 April and 8-14 June 1976. There were no surveys in May because of other research commitments. March 1976 data are included in our analysis of the 1 April 1976 to 30 March 1977 data.

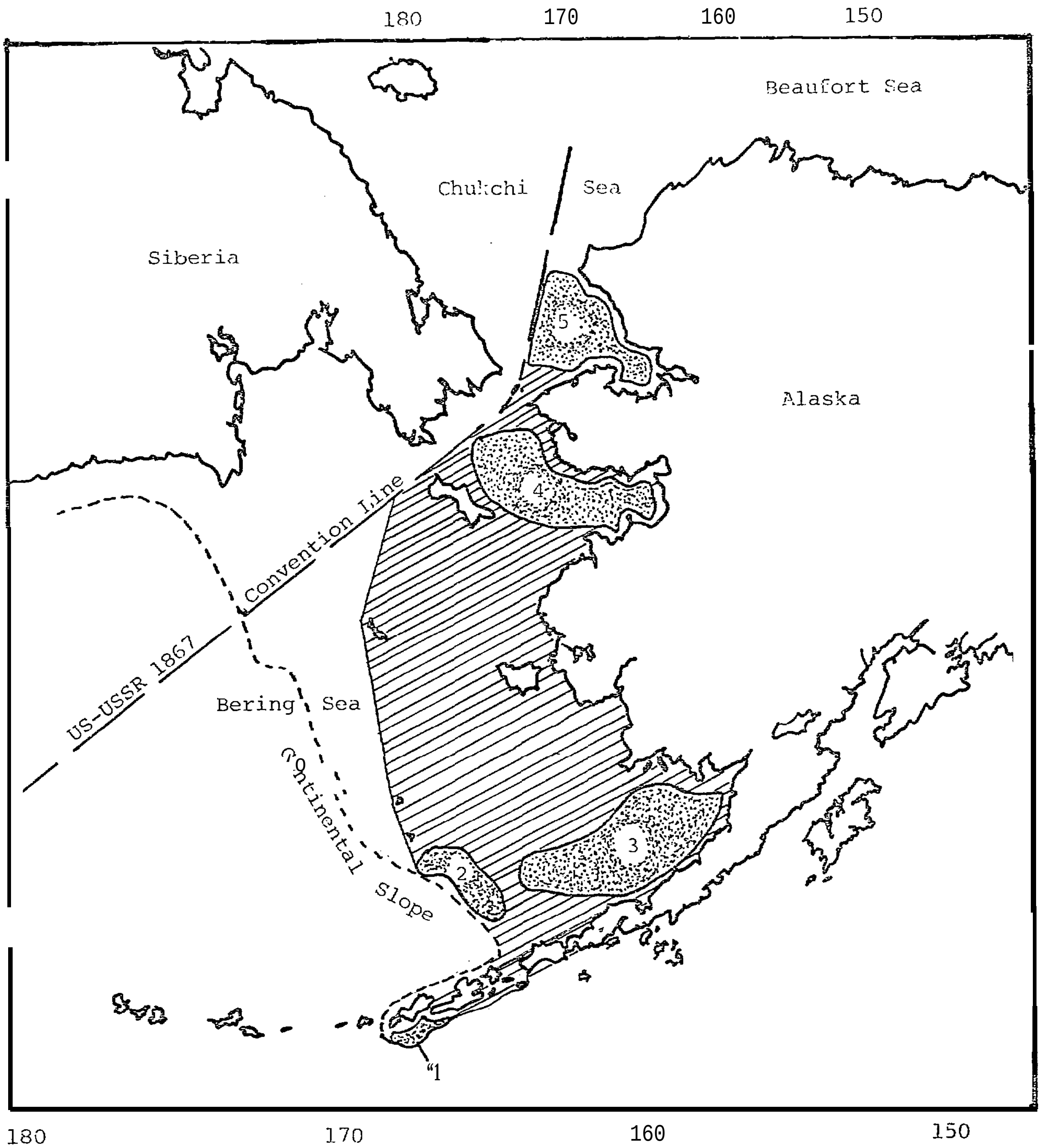


Figure 1. Study area for OCSEAP Research Unit 67 (hatching). OCS oil lease areas are noted (stippling) by number: 1 - Aleutian Basin; 2 - St. George Basin; 3 -- outer Bristol Bay; 4 - Norton Basin, and 5 - Kotzebue Basin.

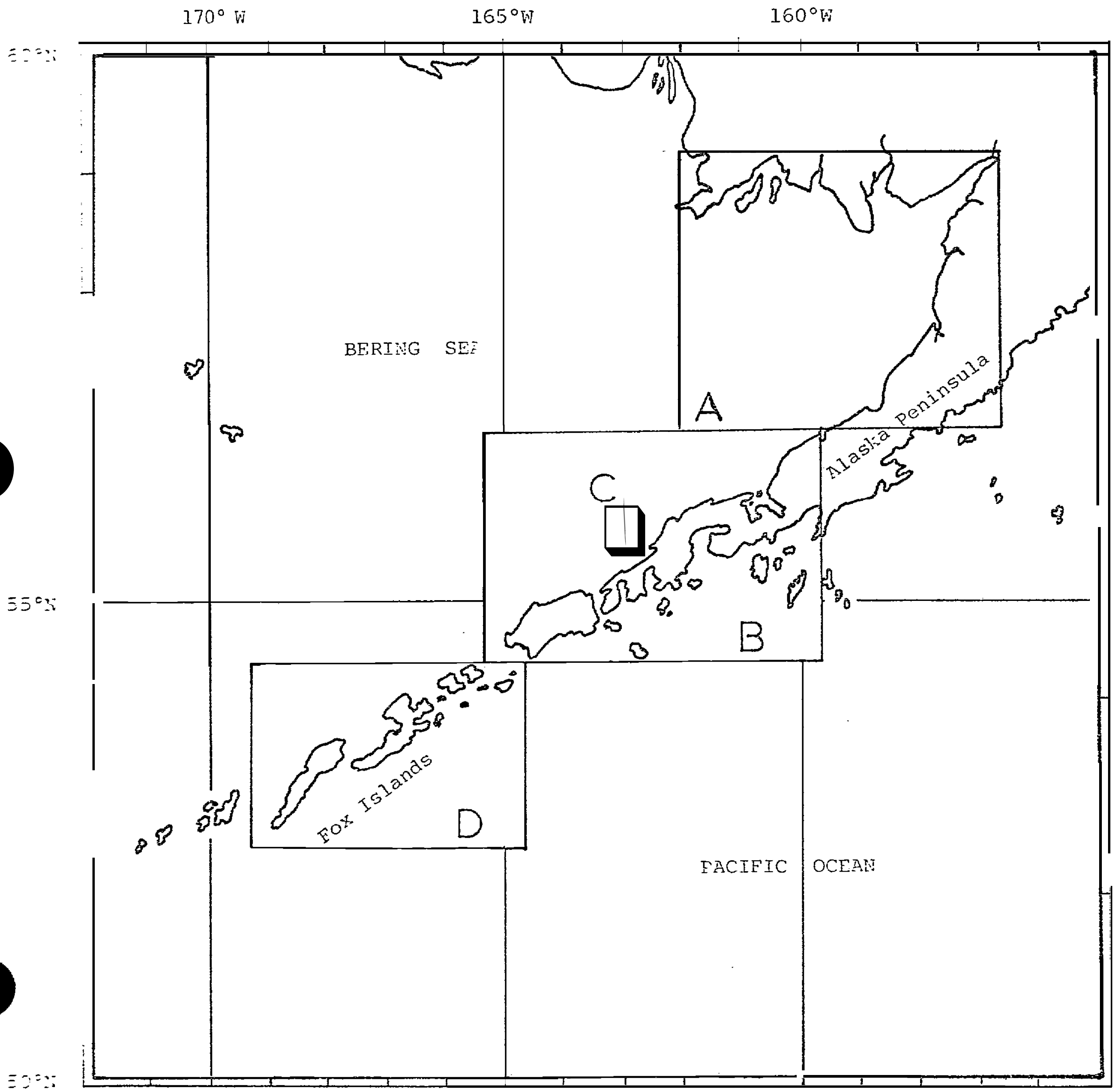


Figure 2. Overview of Alaska Peninsula and eastern Aleutian Islands northern sea lion — harbor seal study area. Boxed-in areas on this figure (A--D) are enlarged on succeeding figures.

Random. and systematic strip census transects were flown in areas of stratified and unstratified sample areas. For example, we knew from previous flights (March flights and preliminary flights in April) that walruses would be found north of St. Lawrence Island; thus, the area was stratified (geographic areas predetermined) and flown in a systematic manner. In Bristol Bay, however, lines of latitude were randomize; these lines were then chosen at random and flown.

Each survey was dividedinto several flight periods (distances) called LEGS. Some legs were systematic or random transects, others were deadheads. It was during these systematic or random LEG flights that data were scored. Figures 3-6 represent the tracklines flown throughout the Bering Sea in April and June. More random transects were flown in April than in June because the pack ice was much more extensive in April, with animals dispersed over a larger area.

Two aircraft were used during our surveys: a turbo jet powered amphibian Grumman Goose (N780) and a Neptune P2V. The P2V was used only on 13-15 April . Both aircraft were chartered from the Office of Aircraft Services, U.S. Fish and Wildlife Service, Anchorage, Alaska. Air speed was generally 120 kts and survey altitudes were between 200-1,000 ft. Most transect surveys were flown at 500 ft, a" compromise between maximum visibility and minimum disturbance to animals.

Data were scored by one recorder and two observers. Observers sat behind the pilot and co-pilot of the "Super Goose". As the plane flew along the trackline, animals directly below the aircraft could not be seen. Approximately 70% from the vertical out to 1/2 mile represented the area surveyed (area = 1 nmi^2) on either side of the aircraft. This represented a strip census method (Hayne, 1949; Robinette, et al., 1974; see Gilbert, 1975, for a general review). Data collection procedures were as follows: when animals were observed, the quantity and species identification were reported to the recorder who sat between the two observers. The right angle to the horizon was fixed to each sighting using an optical reading clinometer (model PM-5/360 PC; made by Suunto Oy of Finland) . This procedure allowed us to precisely determine the right angle distance of the animal from t'ne aircraft. This procedure has been shown to be a reliable method for establishing population density estimators (Burnham and Anderson, 1976) . During data analysis, using this angular method, we will be able to determine our effectiveness in observing certain species as the distance away from the plane increases. Also , this method will allow us statistical reliability of the survey strip with respect to the number of animals seen.

Time, weather and ice conditions were systematically recorded approximately every five minutes and where a sighting took place. Photographs were taken of large pods of animals (e.g., walrus) using a single lens reflex 35 mm F2 Nikon camera with automatic aperature and motor drive assemblies. Most aerial photographs were taken with 105 and 135 mm lenses, using high speed Ektachrome film (ASA 160) which proved to be the best compromise between high resolution and film speed. These photographs were used to count high density concentrations of animals. Counts of animals were made in the laboratory from slides projected onto a large piece of white paper. Precise geographic locations were fixed (to within 1 nmi^2) using an electronic

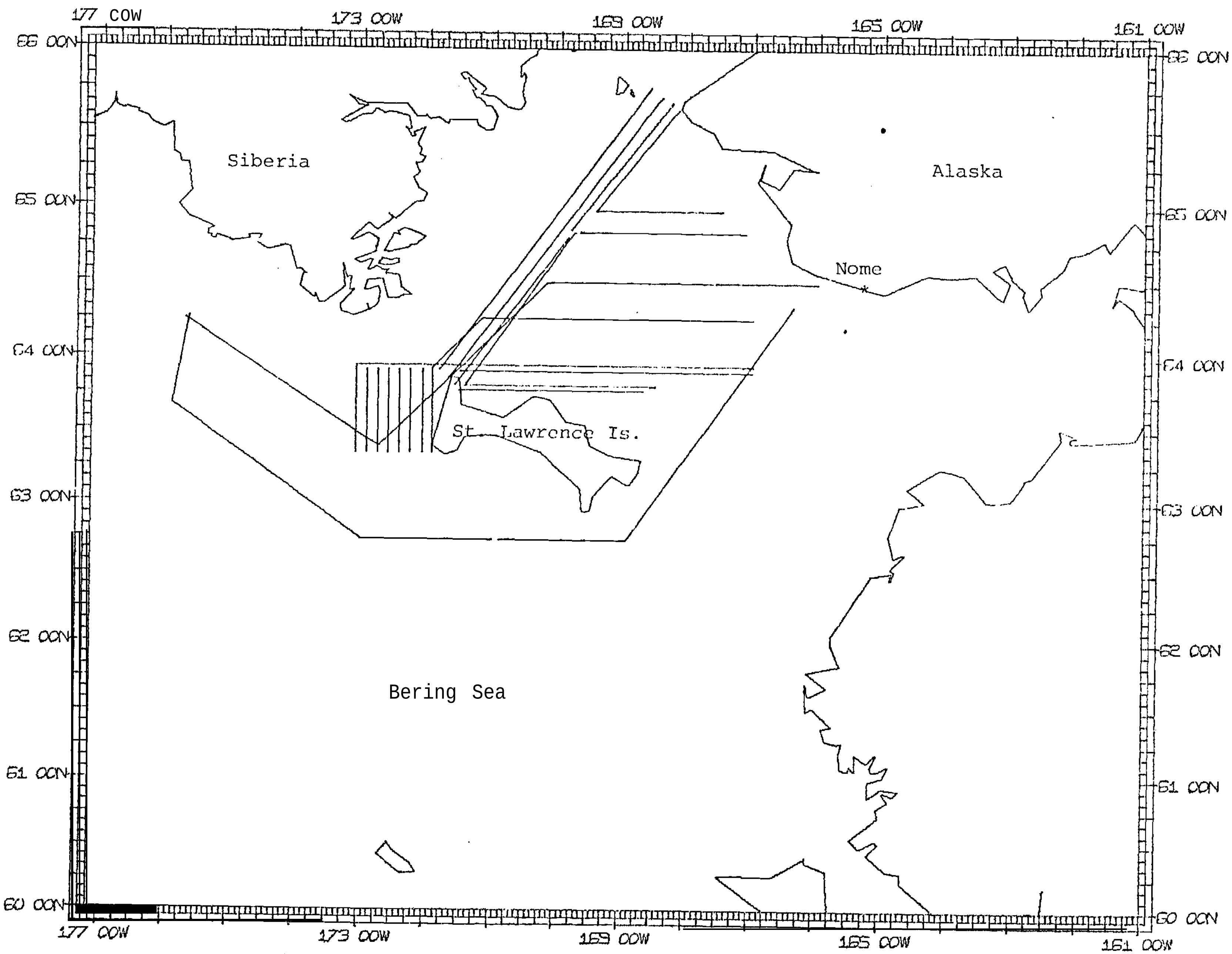


Figure 3. Aerial survey transect legs flown in the northern Bering Sea, 15-21 March 1976.

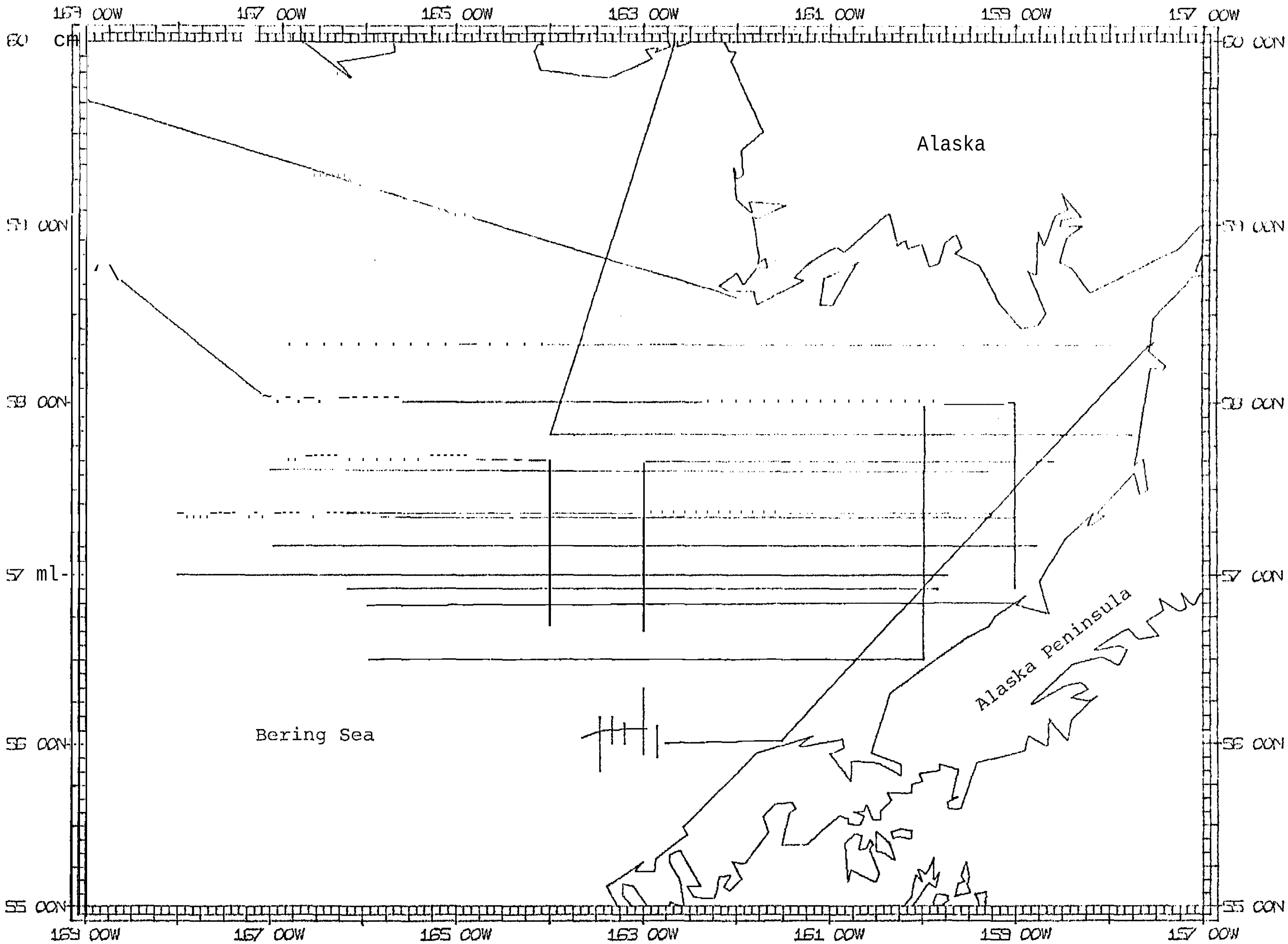


Figure 4. Aerial survey transect legs flown in southeastern Bering Sea, 6-13 and 15-19 April 1976.

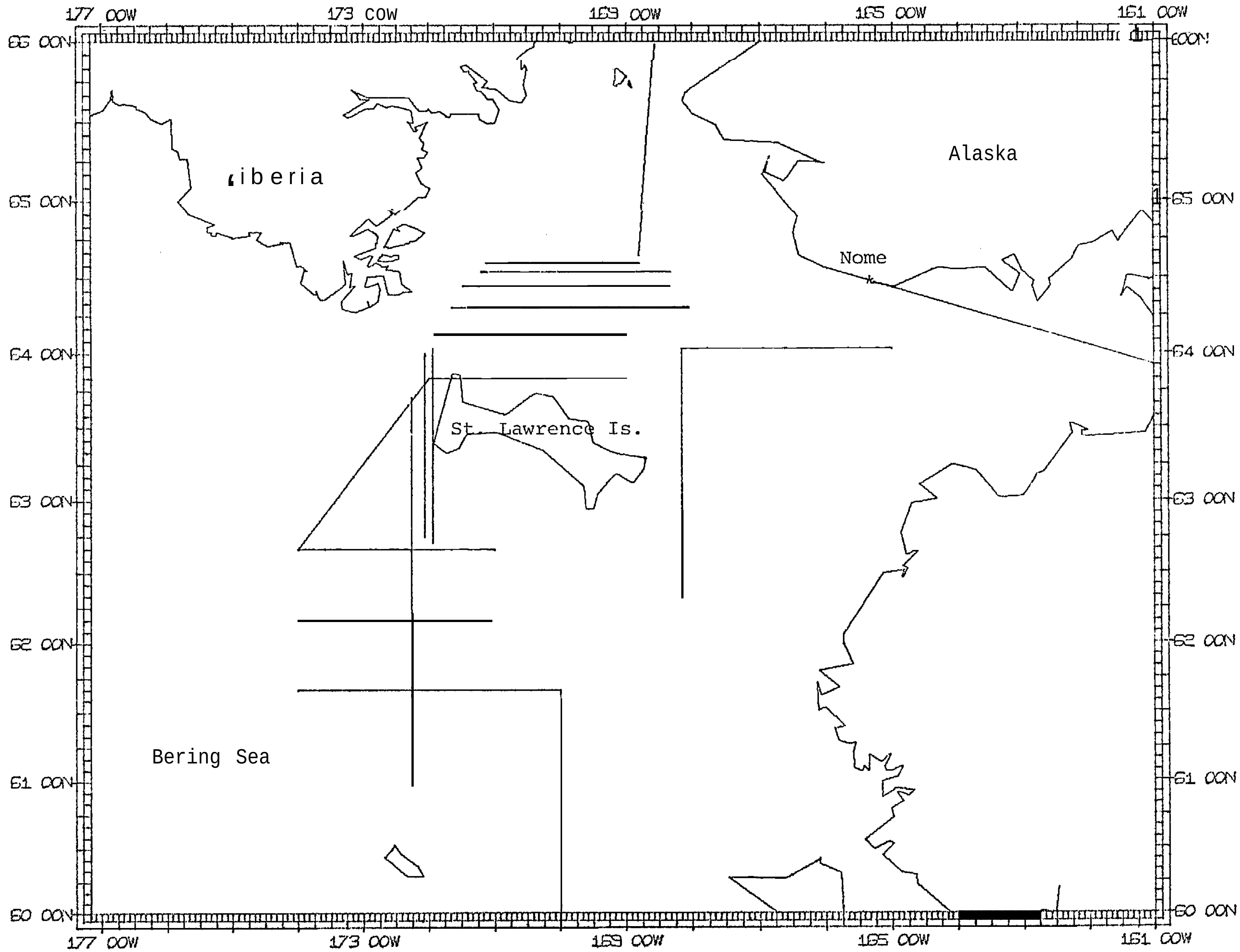


Figure 5. Aerial survey transect legs flown in the northern Bering Sea, 13-15 & 19-23 April 1976.

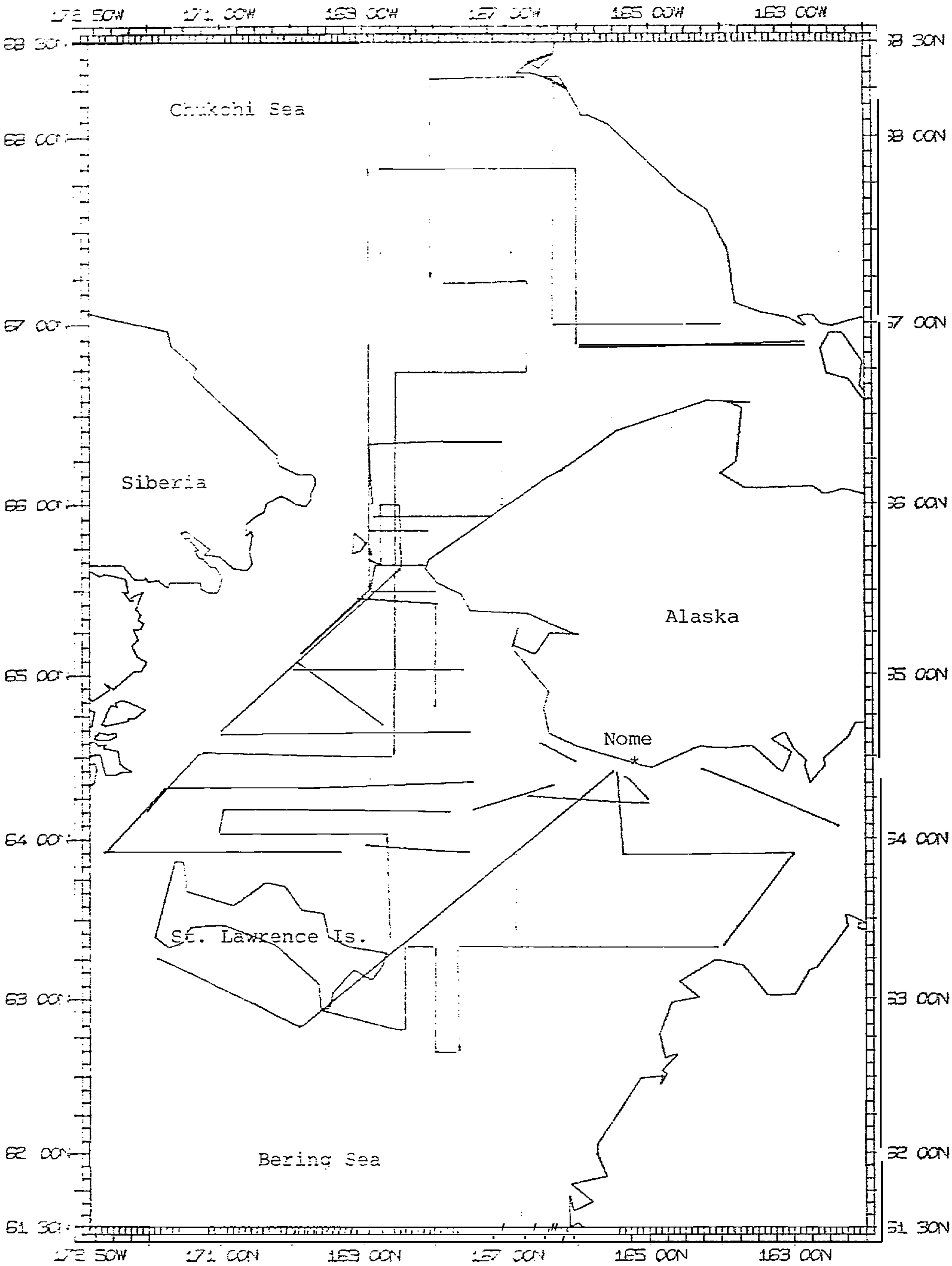


Figure 6. Aerial survey transect legs flown in the northern Bering and southern Chukchi Seas, 8-14 June 1976.

Global Navigation System (model GNS 500).

The recorder, front and aft observers rotated every hour to reduce fatique and to test for 1) variability in observer effectiveness, 2) bias due to right versus left side of aircraft, and 3) time of day. These and other aerial survey biases have been addressed by Erickson and Siniff (1963), Pennycuik and Western (1972) , Caughley (1974), Wild and Ames (1974), and Caughley, et al. (1976).

In the laboratory, data were carefully transferred from field log sheets to computer abstracts, and computer cards were made. Several quality control steps were performed, including writing programs to check, verify and edit the data.

Sea lions and harbor seals

Three aerial surveys were flown over the Alaska Peninsula and eastern Aleutian Islands in 1976: 14-20 June, 19-21 August and 21-25 October. The June and August surveys were made using a Grumman Widgeon aircraft (twin engine, amphibious) chartered from Peninsula Airways, King Salmon, Alaska (pilot: Orin Siebert, President of Peninsula Airways) . The October survey was made with a Bell 206B helicopter (pilot: Lt. William Harrigan, NOAA Corps) launched from the NOAA ship Surveyor during cruise RP-4-SU-76B, 18-29 October 1976 of the eastern Aleutian Islands.

During June and August systematic flights were made along the coast of the Alaska Peninsula and each island of the Fox Island group (eastern Aleutian Islands) as weather permitted. Sightings of marine mammals were made from altitudes of 200-500 feet. Immediate visual estimates of the number of animals present were made. of all sightings. Photographs were taken where appropriate to improve species identification and, for large pods, to verify counts. In the laboratory, the photographs were counted as described earlier. These counts replaced the estimated counts in the field logs.

Northern sea lion and harbor seal rookeries and hauling grounds were flown over at varying altitudes and distances to minimize disturbance to pinnipeds and birds while still getting close enough for accurate counts. Altitudes of 1,000-1,500 feet were flown near harbor seal hauling out areas in order to make overview maps of the many sites in Port Moller and Port Heiden where Phoca were observed.

In the Widgeon, two to four observers were used. One sat in the co-pilot's seat and acted as the primary photographer. The second (or more) observer(s) sat behind the forward observer. They made visual estimates of the number of animals and recorded the exact position of each sighting using detailed charts of the respective area. Because we were flying island surveys, only one side of the aircraft was used for observing. The pilot proved to be an important observer when animals occurred on the pilot's side of the aircraft. During the August survey, a communication system was installed between the pilot and observers to increase efficiency in observer interaction and to reduce fatigue due to noise. The system we used was a battery operated Miniamp intercom device (hark 2-D, 9v; Genie Electronics Co. , Inc. , Red Lion, PA) supplied with aircraft headsets (suggested by Don Calkins, Alaska Dept.

Fish and Game, RU 243).

Flights from the Surveyor in October were made on an opportunistic basis; t'bus, not all of the Fox Islands were surveyed. During the October cruise the helicopter surveys covered approximately 570 aerial track miles totalling 41 flight hours. Rookeries and hauling areas were surveyed from an altitude of about 700 ft. A continuous shipboard watch was maintained by one or more of five observers while the ship was underway. Total time on watch was 150 Pan/hours covering 828 nm. Land-based counts of sea lions and harbor seals were made on Bogoslof, Adugak (rocks on the northeast side) , Ogchul, and the north side of Amak Island. Aerial and land party photographs were taken to be used in ground truthing studies. Discrete hauling areas were identified for site 'by site comparisons. A total of 72 man/hours were spent on land.

Cetaceans

Sighting data on 'whales and porpoises came essentially from two sources: 1) during pinniped surveys, and 2) from Marine Mammal Division or other NOAA personnel aboard OCSEAP chartered NOAA ships in the Bering and Chukchi Seas.

Gray whales were surveyed in the southern Bering Sea in June (with the Widgeon aircraft) and in the northern Bering Sea (above 60° N. Lat.) in June (with the Goose) in conjunction with the sea lion/harbor seal and ice seal surveys. Altitudes of 500-1,000 feet are generally flown over open water, and speeds of 100-120 kts were maintained. This altitude range and aircraft speed have proven to be effective for most cetacean surveys.

Other cetaceans, especially minke and killer whales and Dan and harbor porpoises, were recorded as they were encountered. No specific sampling design was attempted. All sightings of cetaceans (except gray whales) during aerial surveys, therefore, were opportunistic.

Several NOAA ship and charter vessel cruises during 1976 provided important cetacean distribution sighting data. Table 2 summarizes the cruises whose data are reported in the Results and Discussion section of this report. Data recording procedures during the ship cruises are included in the annual report for RU 68.

Table 2. Ship cruises into the Bering and Chukchi Seas during 1976 from whit'h cetacean sighting data were submitted to date. MMD = Marine Mammal Division personnel aboard; POP-NOAA Corps officer from Platforms of Opportunity Program aboard; * - OCSEAP charters.

Ship	Dates		Location	Observer
Surveyor*	3-13/4-2	1976	ice edge (SE Bering Sea)	MMD
Oregon	4-4/11-18	"	Bering Sea	POP
Surveyor*	4-13/4-30	"	ice edge (SE Bering Sea)	m
Miller-Freeman*	4-24/5-13	"	SE Bering Sea	POP
Survey-or*	6-5/6-25	"	S Bering Sea	MMD
Arms Marie	6-12/6-19	"	SE Bering Sea	POP

Table 3. Ice seal observations in the southern Bering Sea (south of 60°N), Spring 1976.

Date	_E. barbatus_	_P. largha_	_P. hispida_	_P. fasciata_	Unidentified Pinniped
6 April	29	591[a]	0	0	5
8 "	64	53	1	0	0
9 "	51	158	0	9	17
12 "	42	44	6	1	10
13 "	89	1	35	0	4
15 "	3	77	1	2	30
17 "	15	64	23	0	12
13 "	12	60	2	0	7
19 "	8	14	6	0	4
Sum	313	471[c]	74	12	89
Mean[b]	1.17	1.56[c]	1.03	1.09	
S. D.	0.47	0.68	0.13	0.32	
n	268	292	71	11	

[a] This figure may include a large portion of _Phoca vitulina_

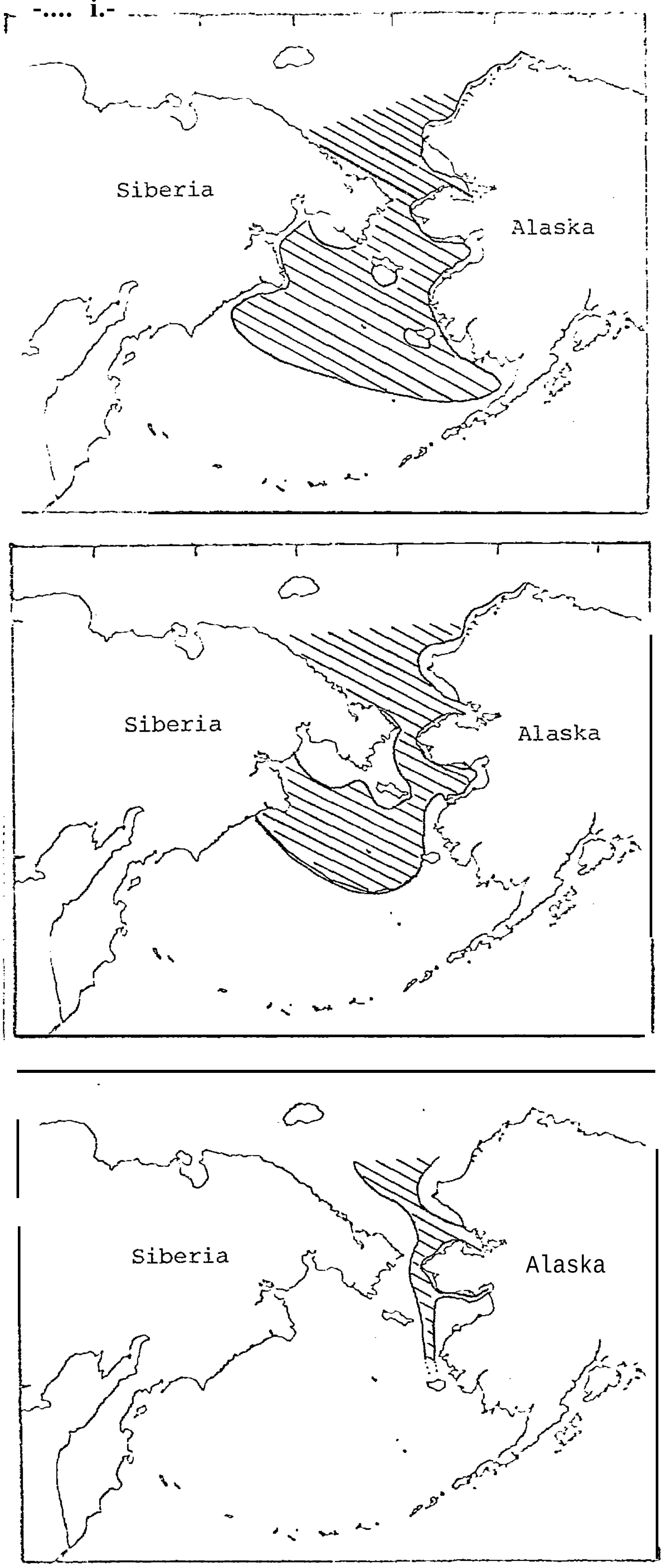
[b] Average group (pod) size -- number of animals per sighting

[c] Does not include data from 6 April

Table 4. Ice seal observations in the northern Bering and southern Chukchi Seas (north of 60°N), Spring 1976.

Date	E. barbatus	P. largha	P. hispida	Unidentified Pinniped
15 March				1
18 "	2			
19 "	1			
21 "	56			4
13 April	22	22	35	9
15 "	10			2
19 *'				
20 "	148		2	2
21 "	29			1
22 "	7			1
23 "	9		7	
8 June	6		3	1
9 "	53	1	13	13
10 "	128	2	43	6
11 "	233		68	12
12 "	246		155	10
Sum	950	24	326	62
Mean	1.35*		1.12	
S. D.	0.73		0.68	
n	638		290	

*not including 20 April with a mean of 4.23 ± 16.85 (S.D.), n=35, N=148



March-April 1976

May 1976

June 1976

Figure 7. General chart of the. 1976 spring ice conditions- Schematic summarized from NOAA-4 VHRR satellite photographs and from our field notes. (Photos from Environmental Products Group, NOAA-NESS, Washington, D. C.)

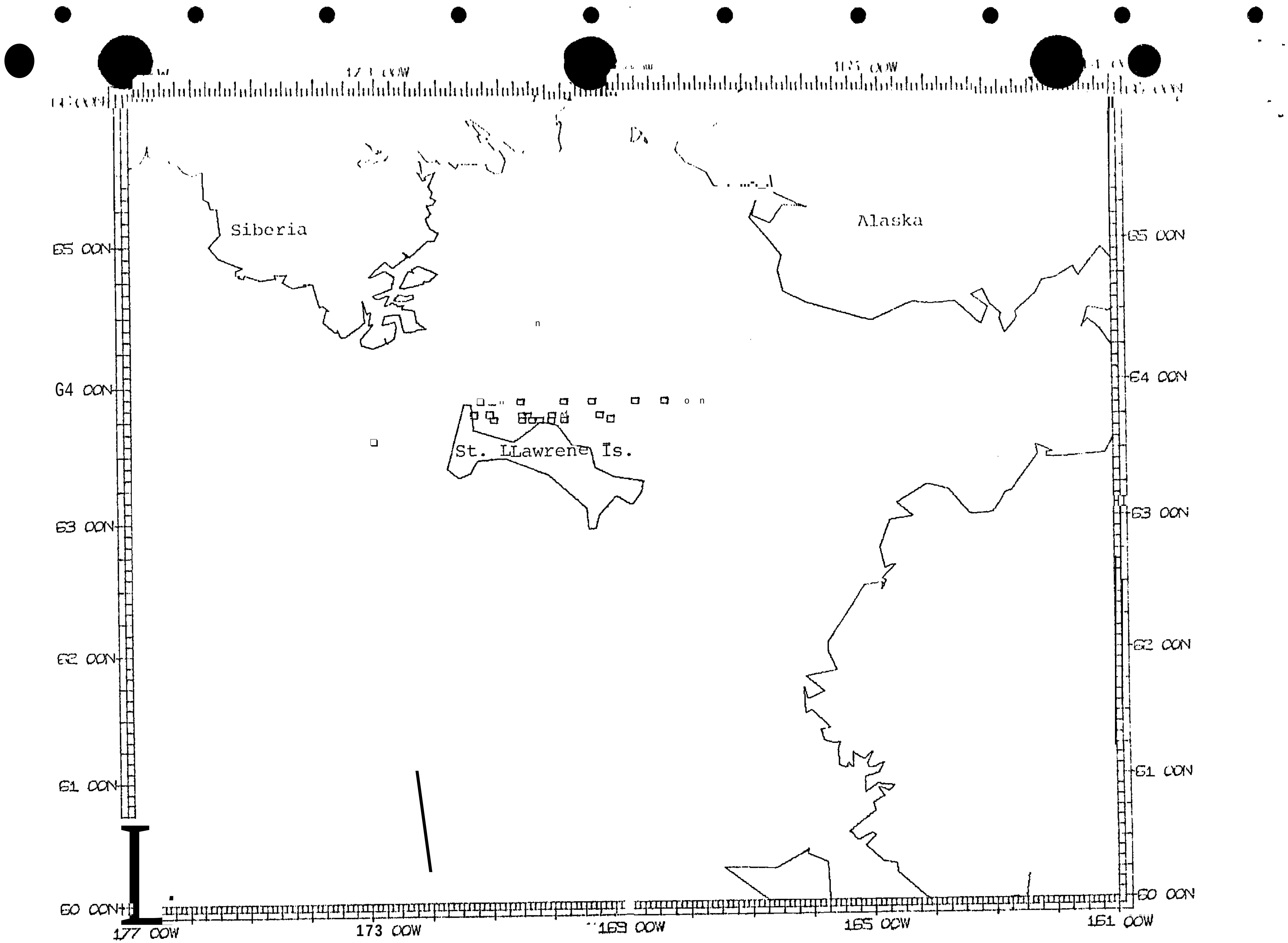


Figure 8. Sightings of Erignathus barbatus (bearded seal) in northern Bering Sea during March 1976 aerial surveys.

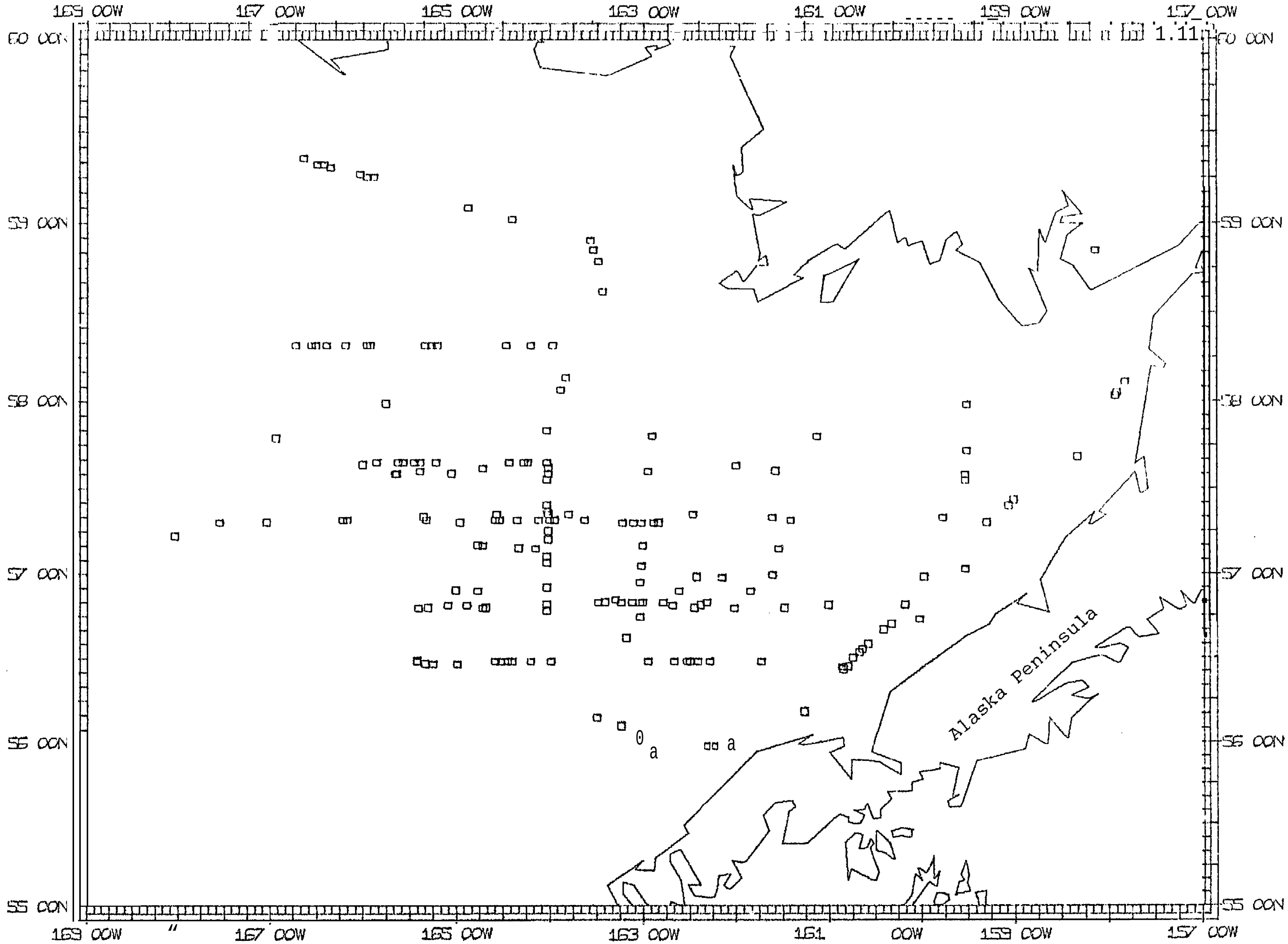


Figure 9. Sightings of Erignathus barbatus (bearded seal) in Bristol Bay during April 1976 aerial surveys.

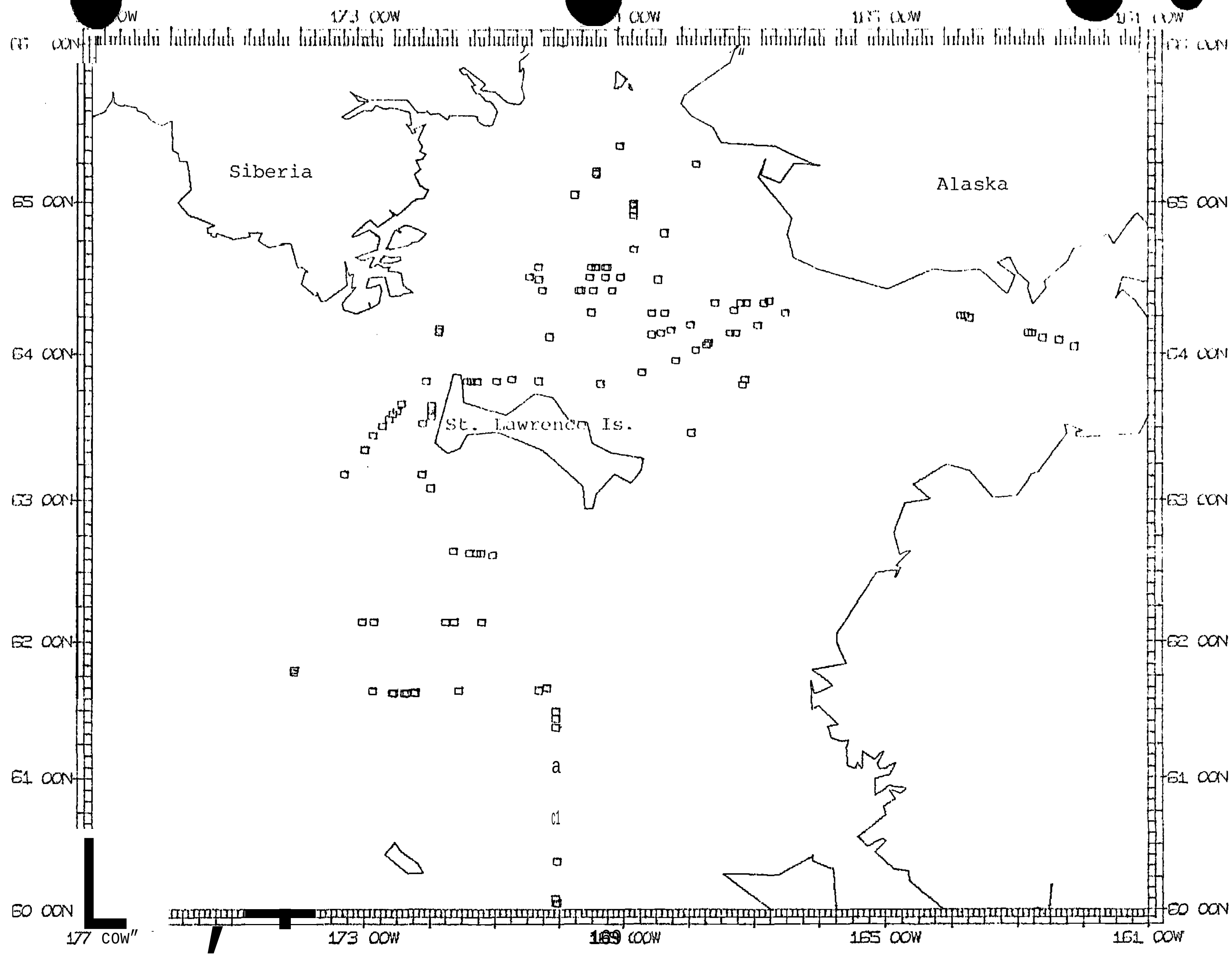


Figure 10. Sightings of Erignathus barbatus (bearded seal) in northern Bering Sea during April 1976 aerial surveys.

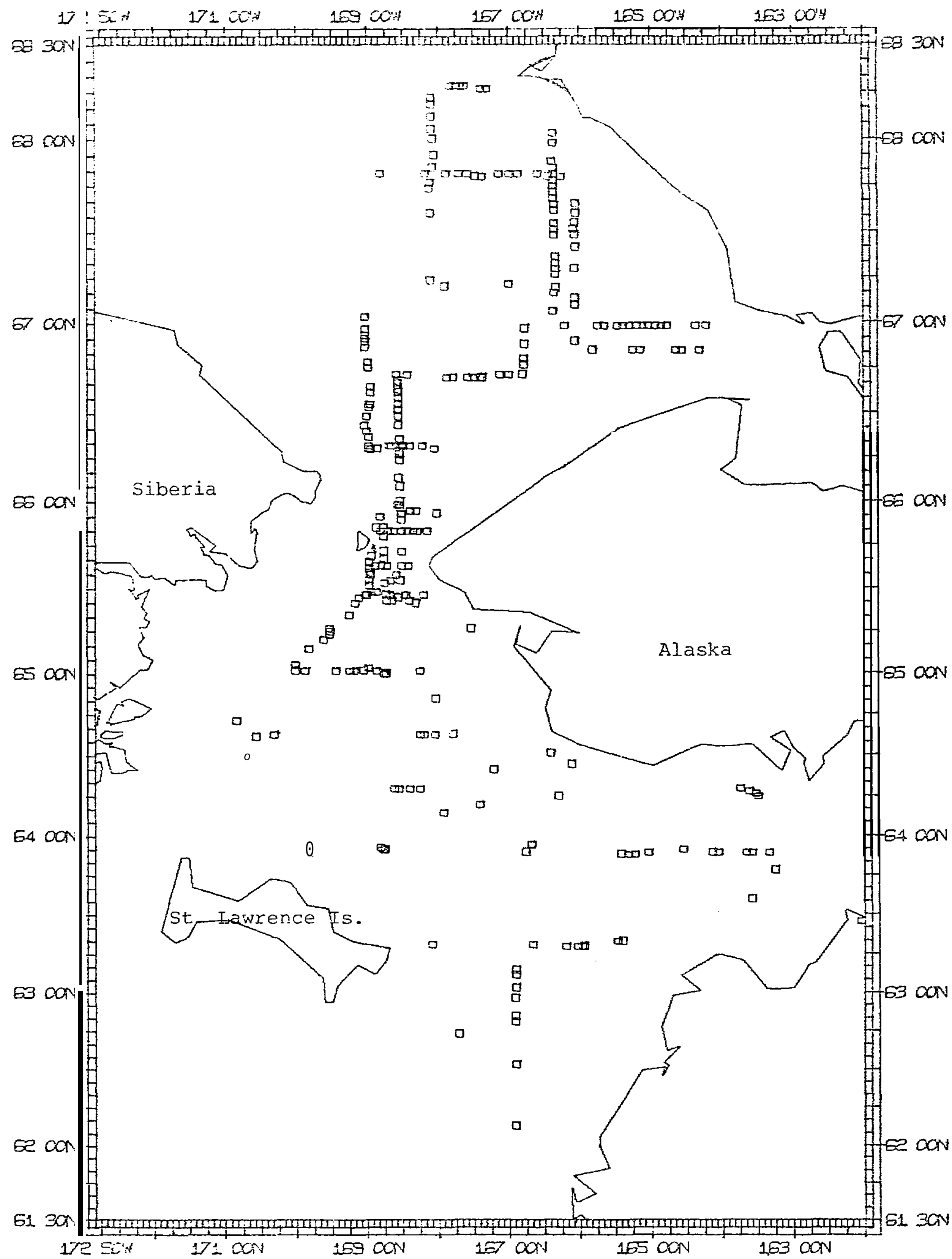


Figure 11. Sightings of Erignathus barbatus (bearded seal) in northern Bering and southern Chukchi Seas during June 1976 aerial surveys.

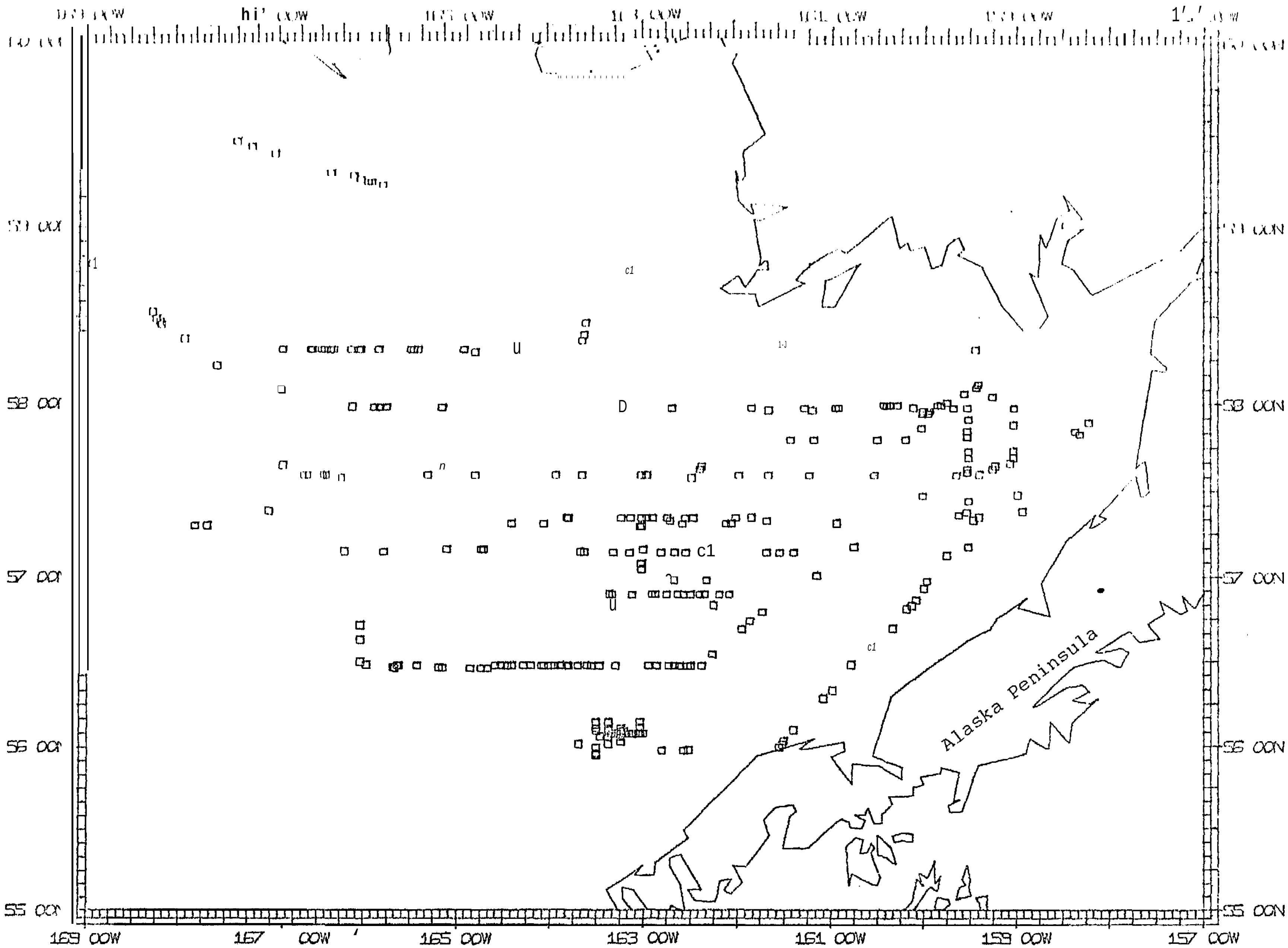


Figure 12. Sightings of Phoca largha (larga seal) in Bristol Bay during April 1976 aerial surveys.

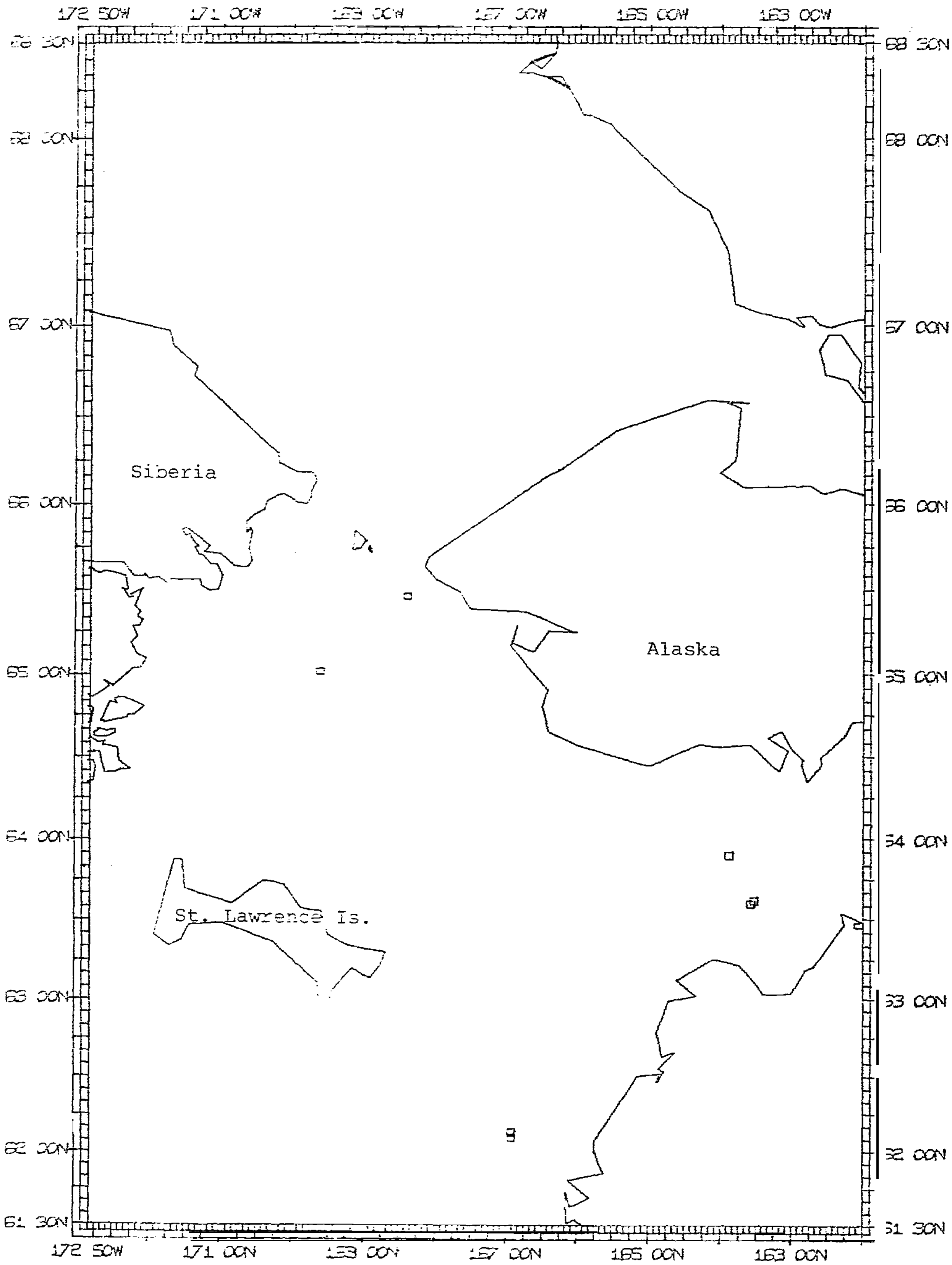


Figure 13. Sightings of Phoca largha (larga seal) in the northern Bering Sea during June 1976 aerial surveys.

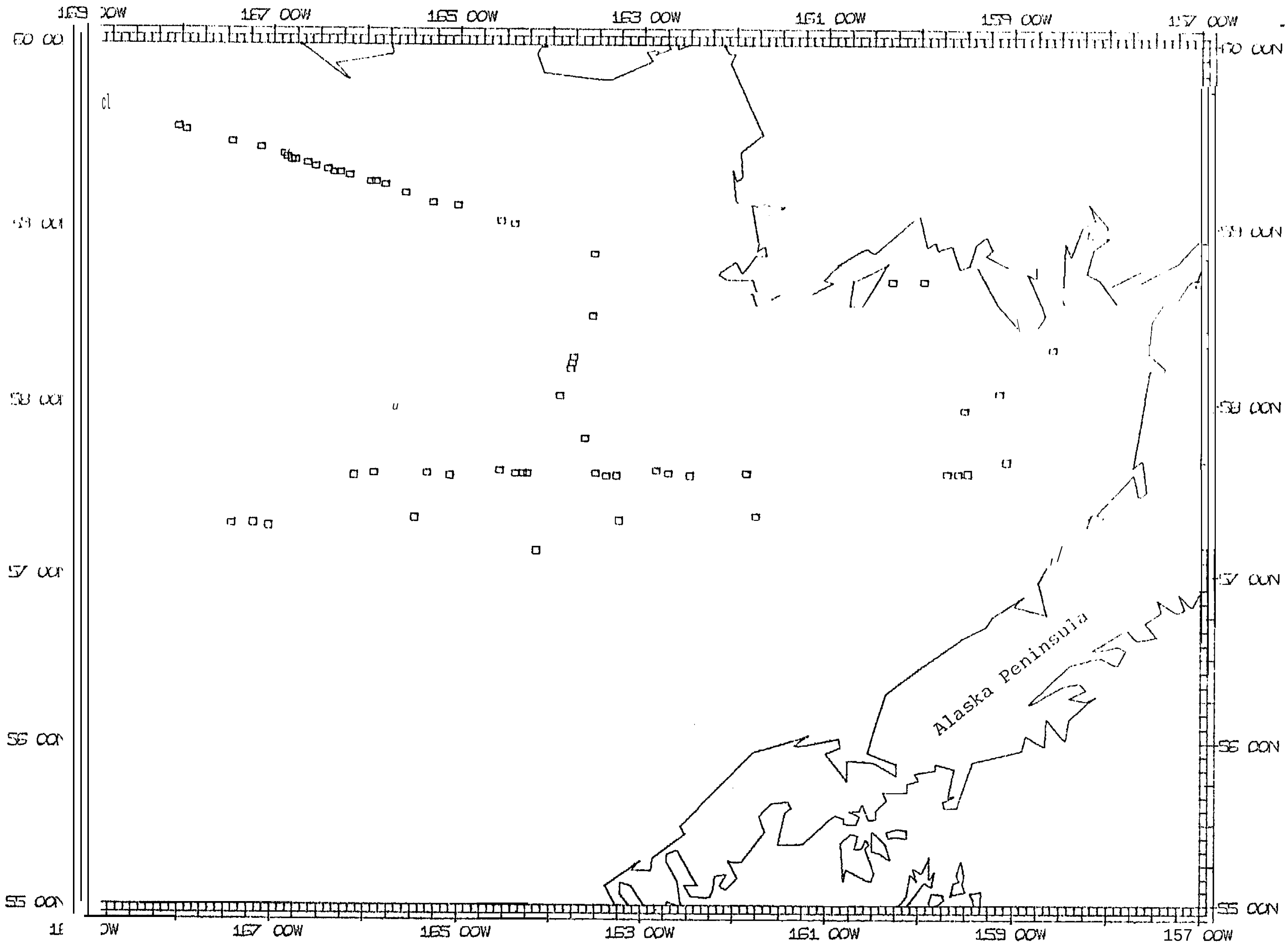


Figure 14. Sightings of <u>Phoca hispida</u> (ringed seal) in Bristol Bay during April 1976 aerial surveys.

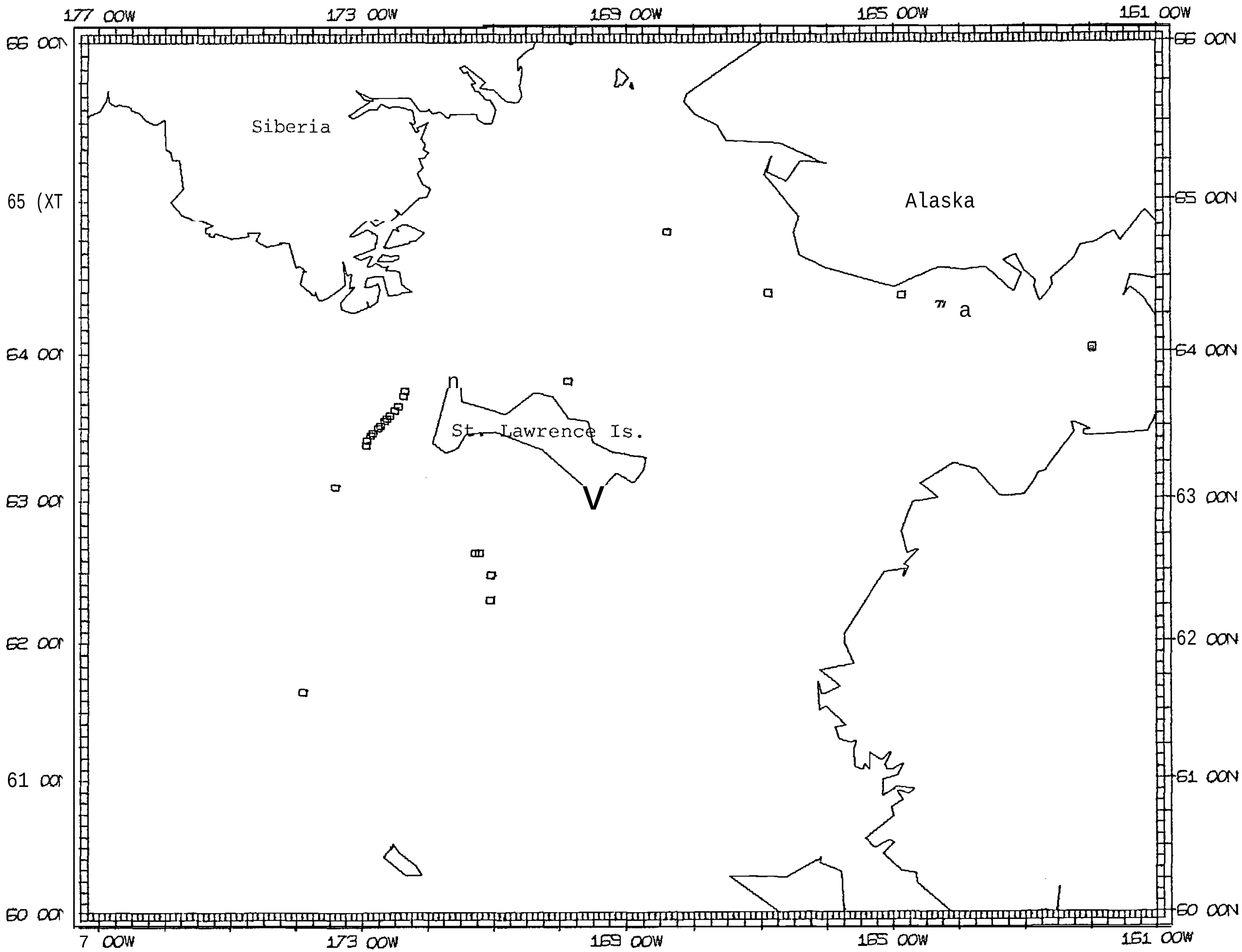


Figure15. Sightings of Phoca hispida (ringed seal) in northern Bering Sea during April 1976 aerial surveys.

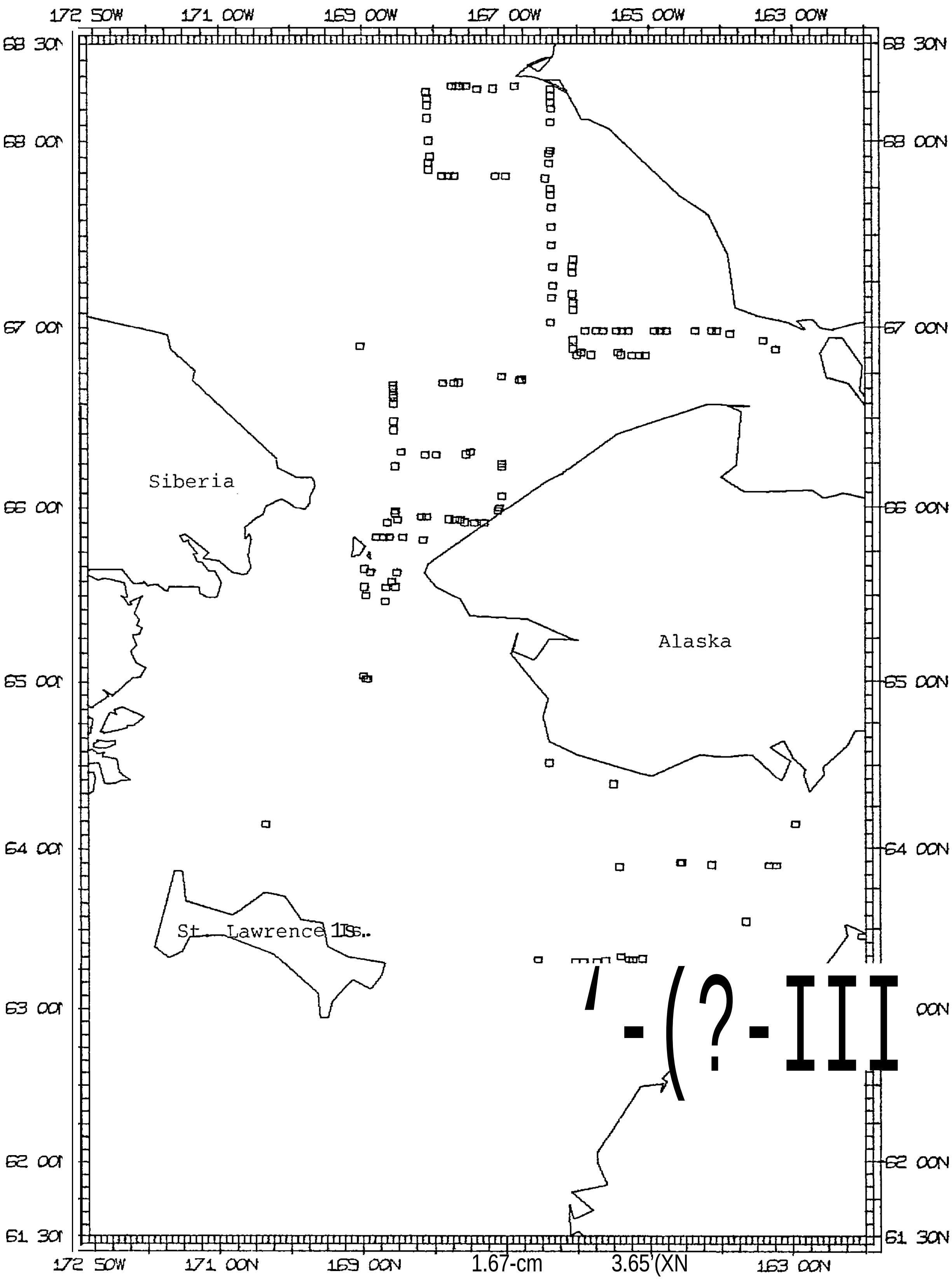


Figure 16. Sightings of Phoca hispida (ringed seal) in northern Bering and southern Chukchi Seas during June 1976 aerial surveys.

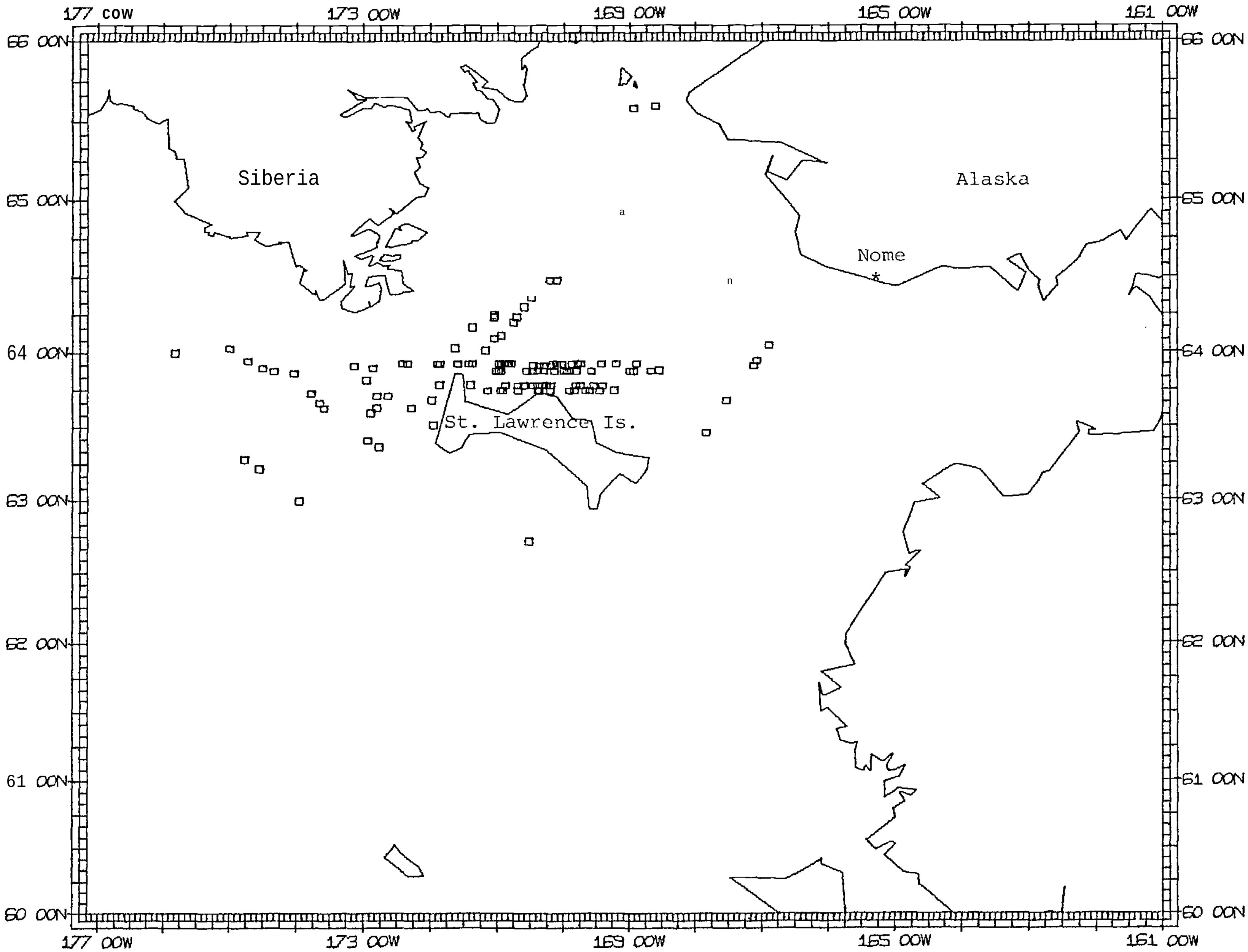


Figure 17. Sightings of <u>Odobenus rosmarus</u> (walrus) in the northern Bering Sea during March 1976 aerial surveys.

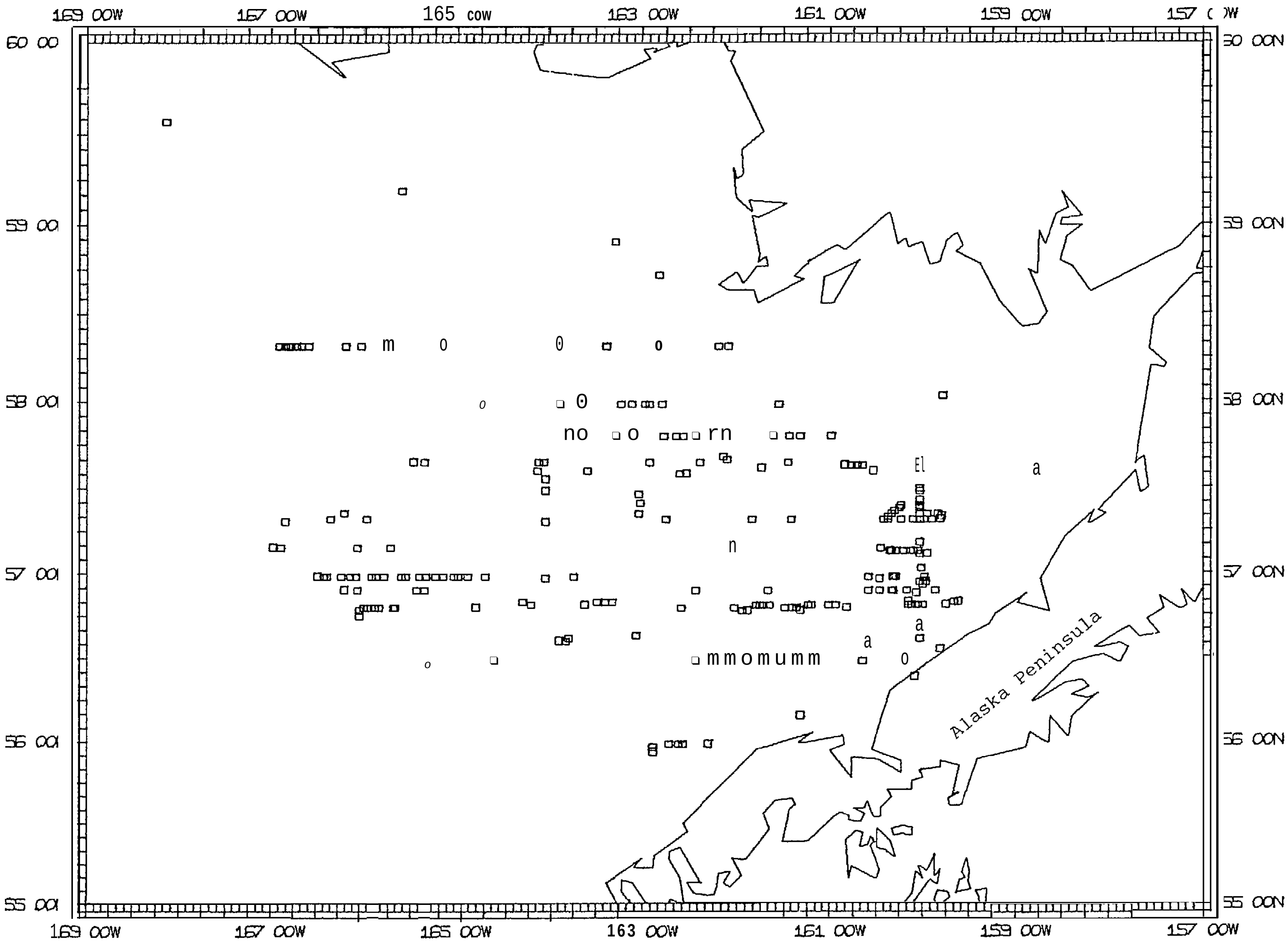


Figure 18. Sightings of Odobenus rosmarus (walrus) in Bristol Bay during April 1976 aerial surveys.

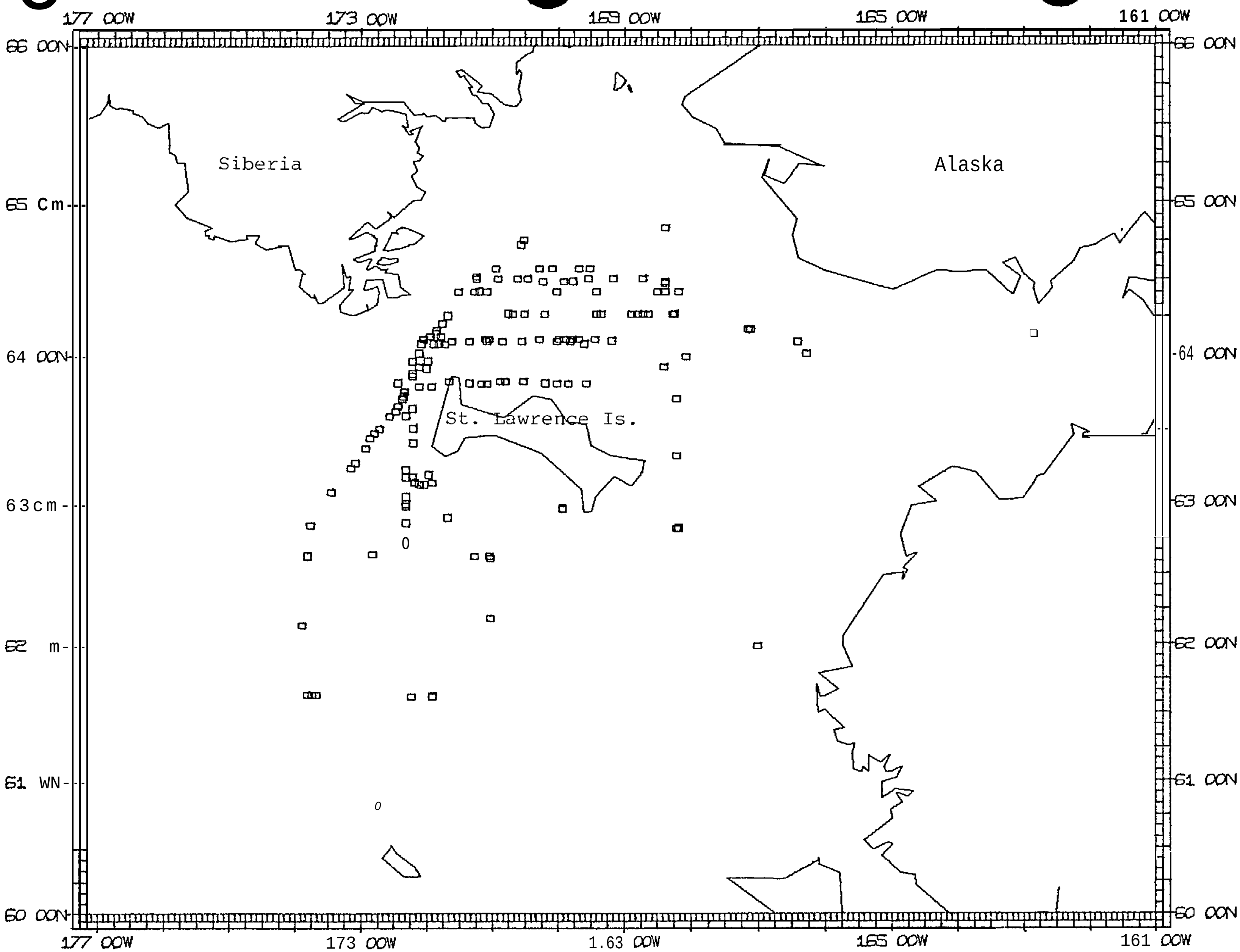


Figure 19. Sightings of Odobenus rosmarus (walrus) in northern Bering Sea during April 1976 aerial surveys.

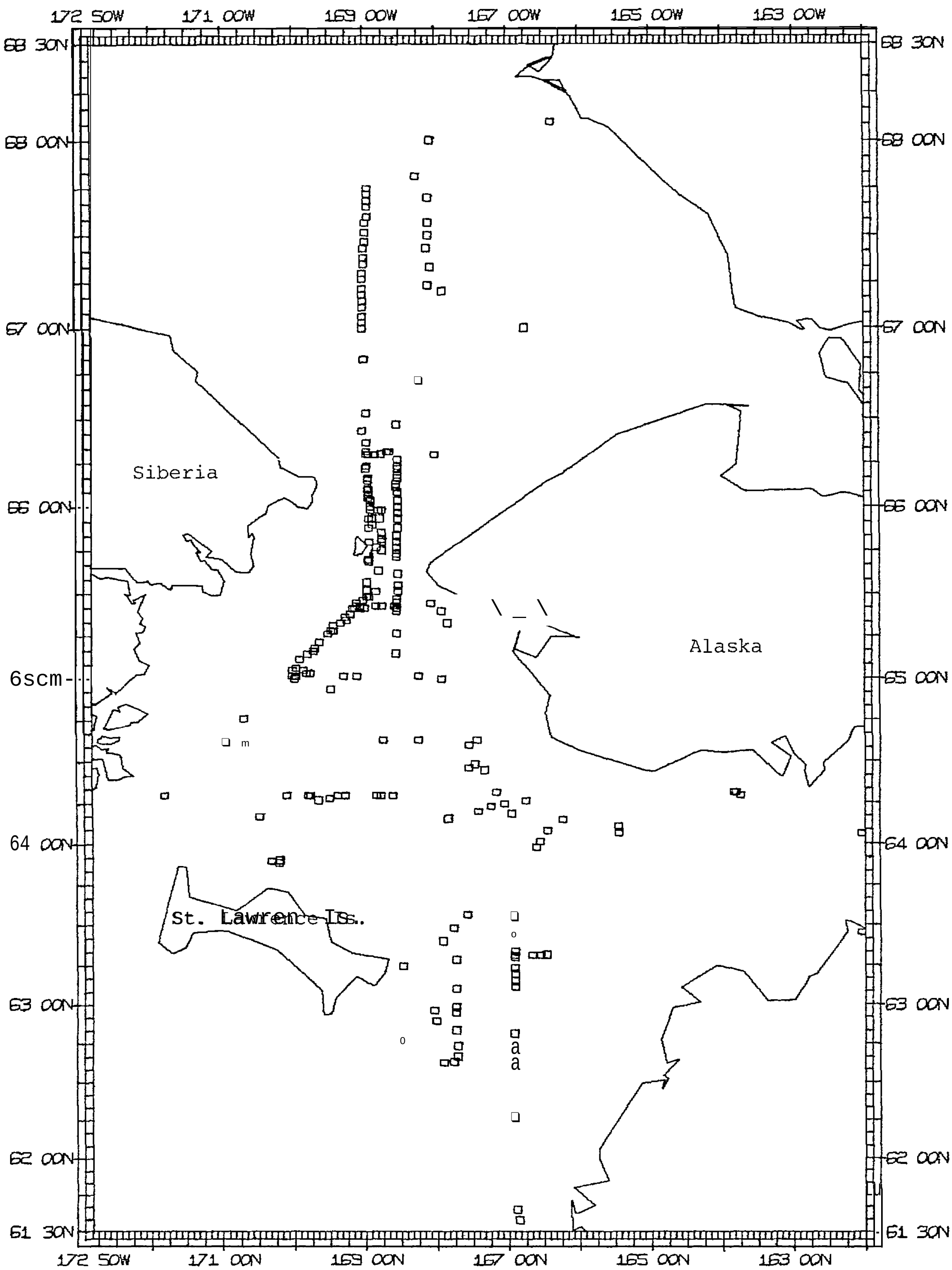


Figure 20. Sightings of <u>Odobenus rosmarus</u> (walrus) in the northern Bering and southern Chukchi seas during June 1976 aerial surveys.

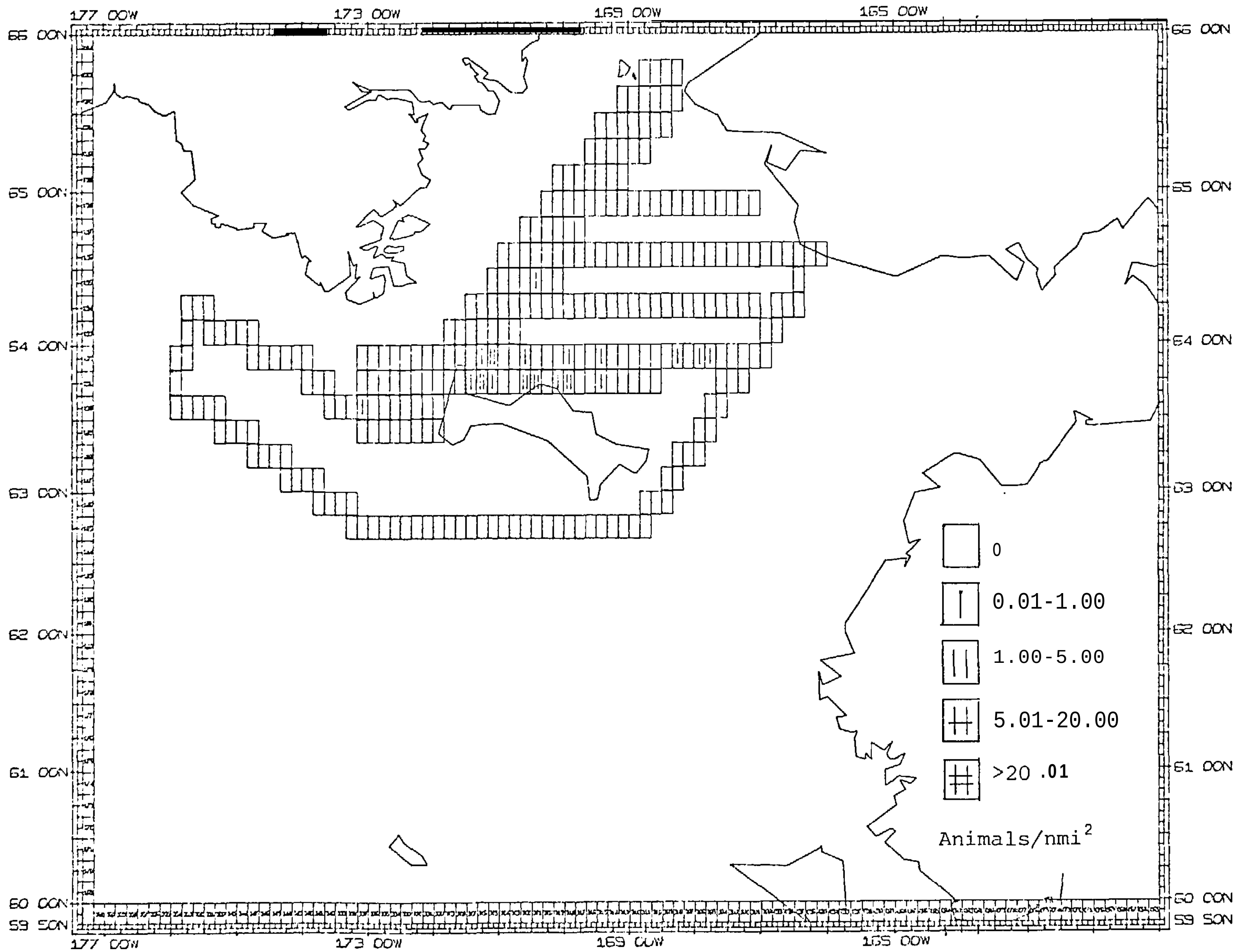


Figure 21. Density plot of bearded seals in northern Bering Sea, March 1976. The density estimates for all remaing charts are as follows:

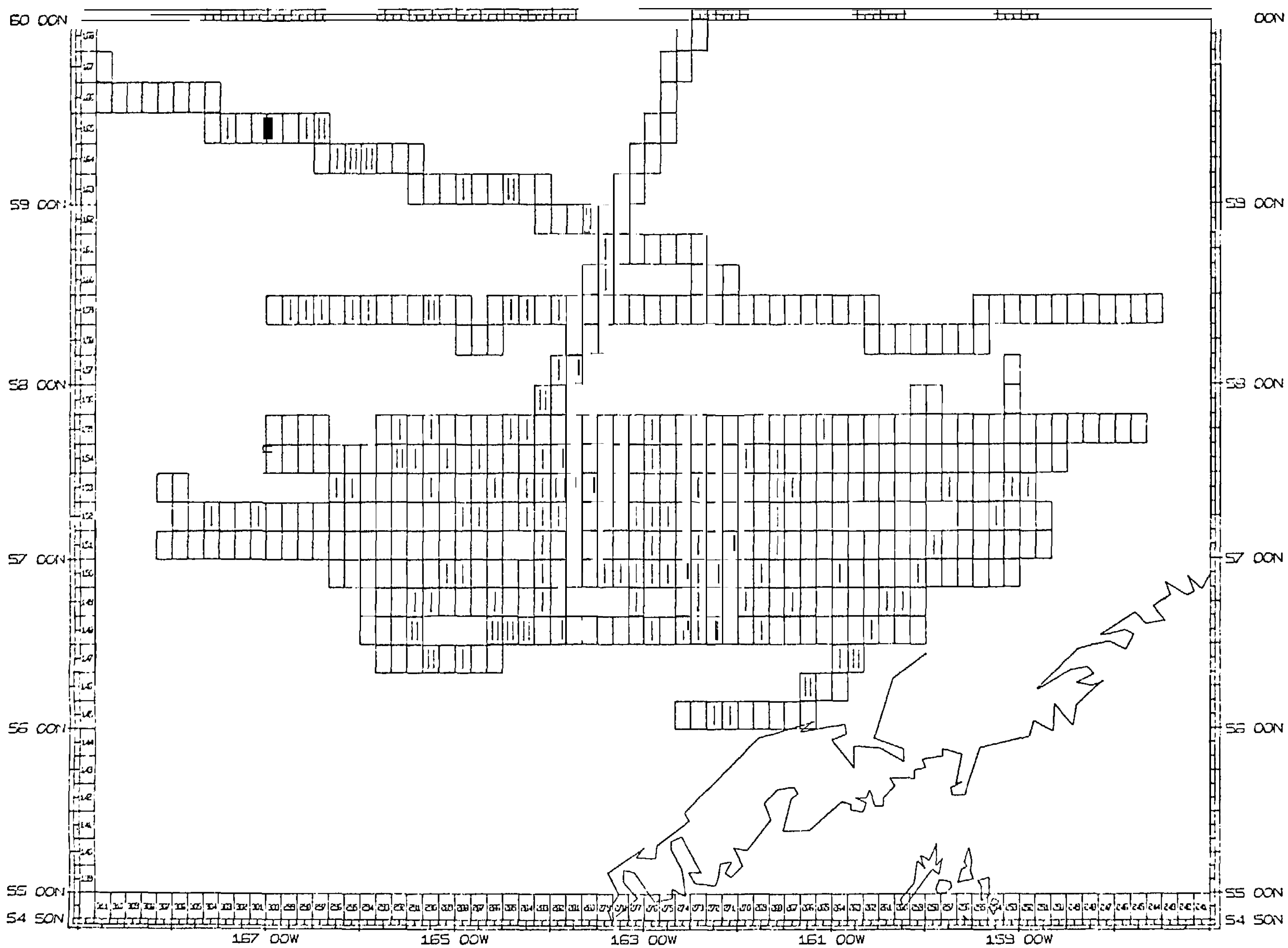


Figure 22. Density plot of bearded seals in Bristol Bay, April 1976.

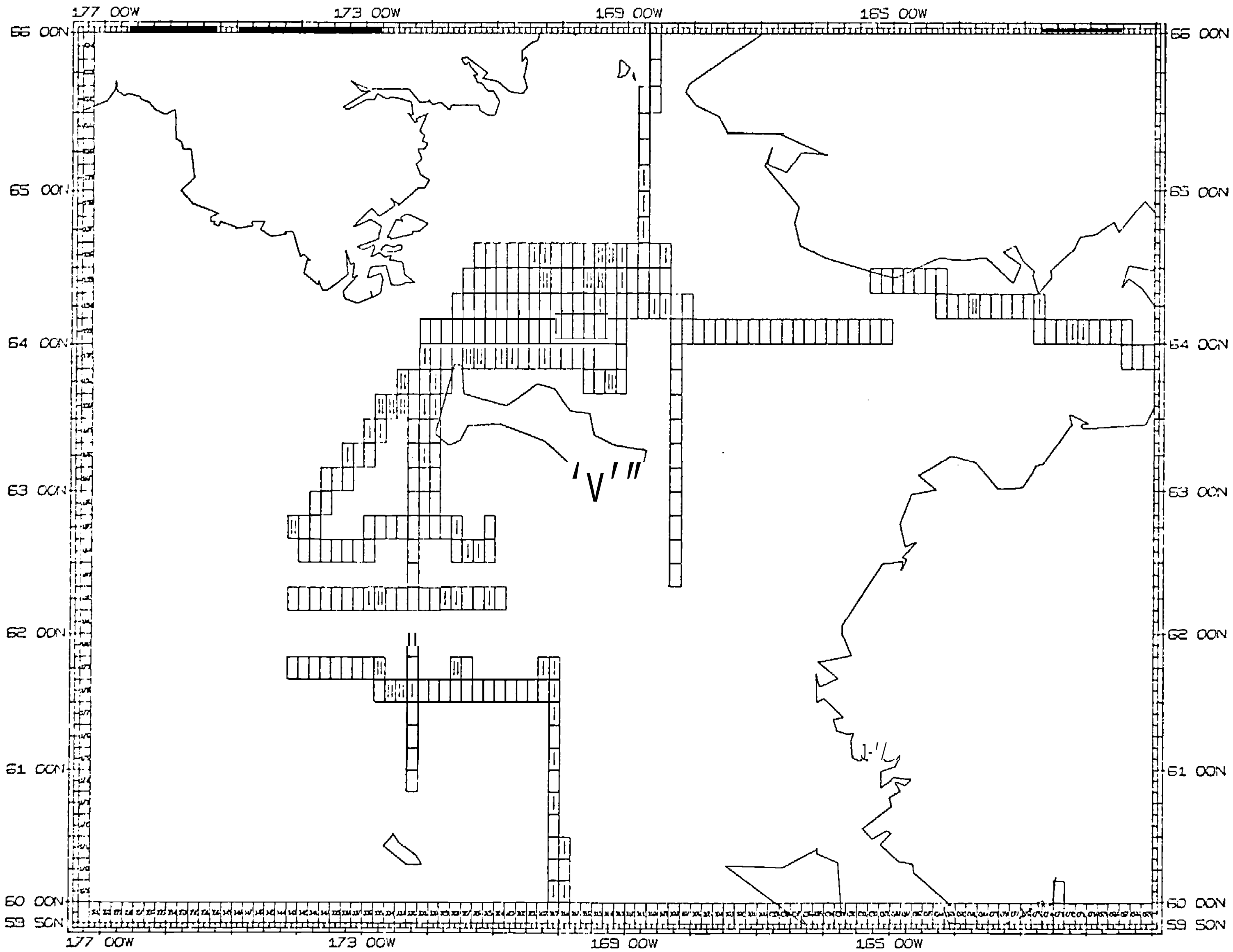


Figure 23. Density plot of bearded seals in northern Bering Sea, April 1976.

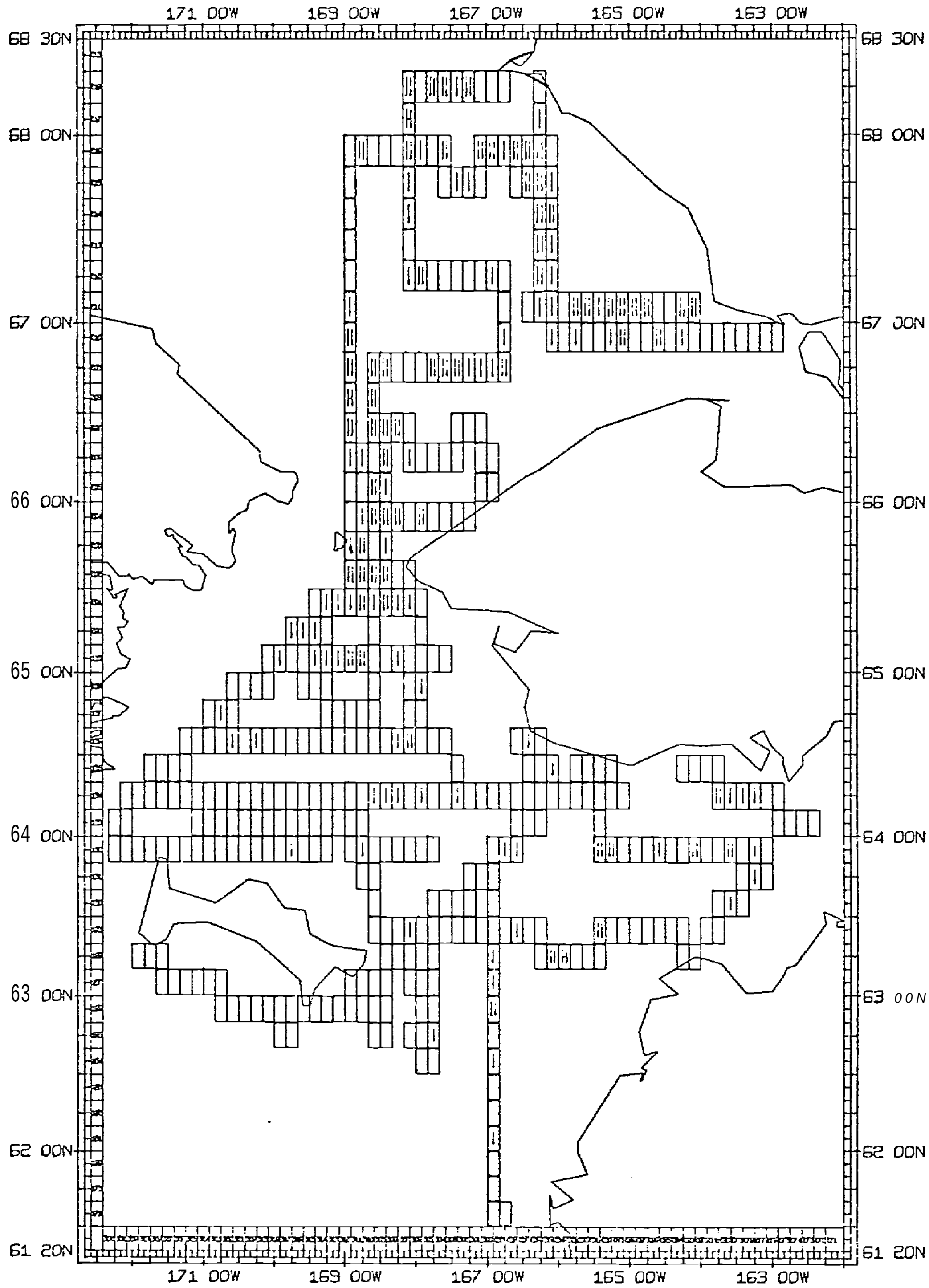


Figure 24. Density plot of bearded seals in northern Bering and southern Chukchi Seas, June 1976.

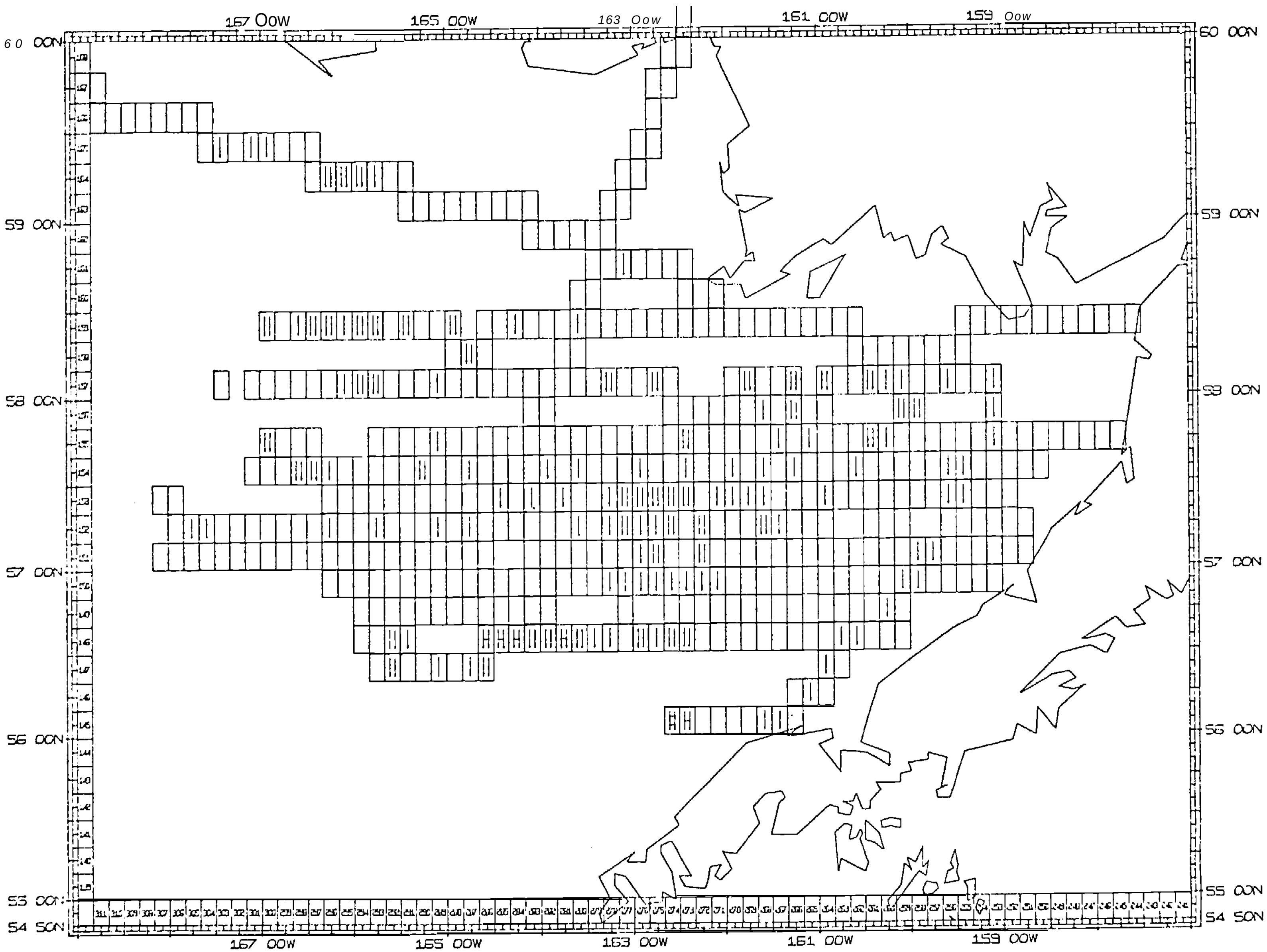


Figure 25. Density plot of larga seals in Bristol Bay, April 1976.

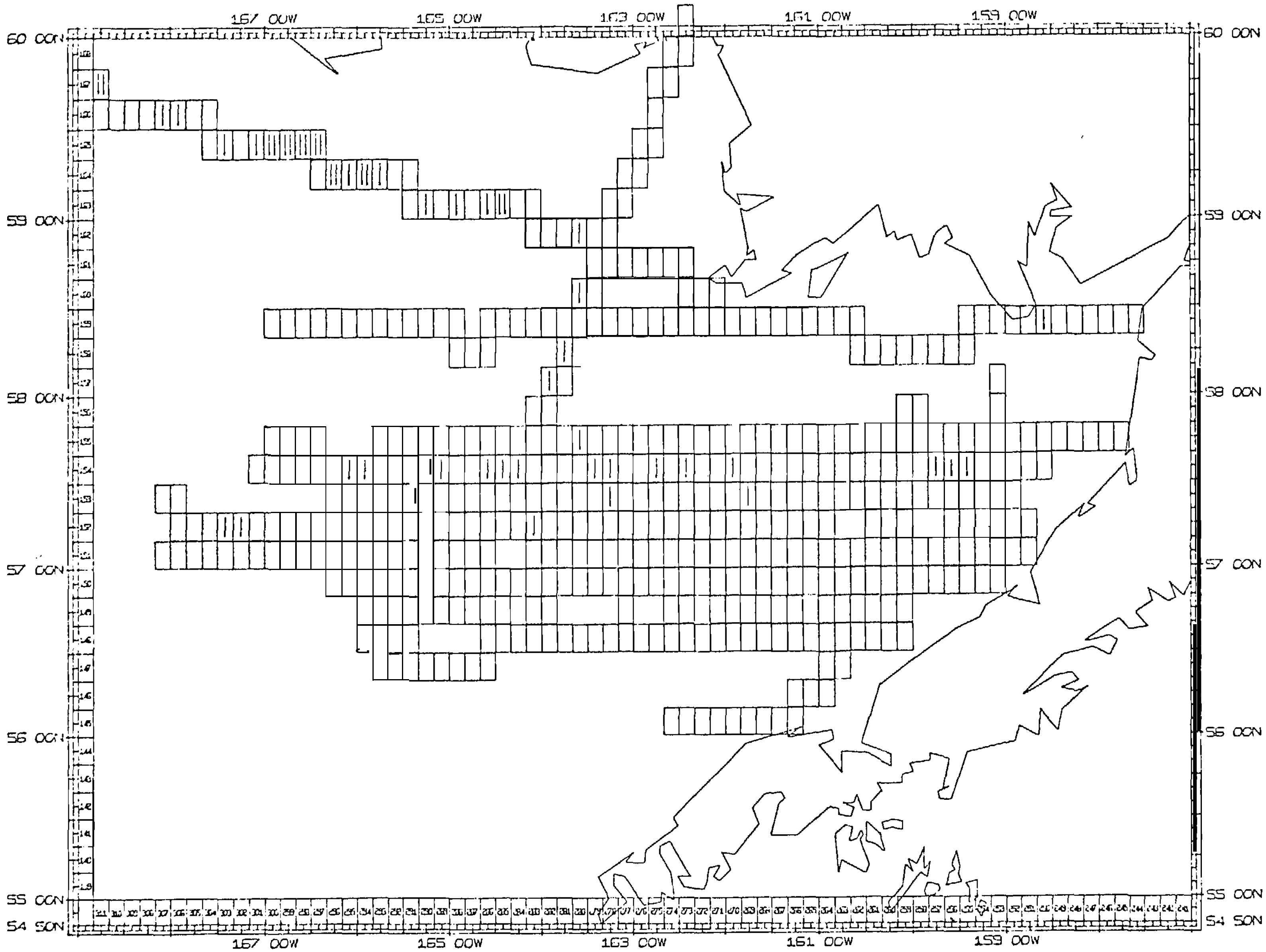


Figure 26. Density plot of ringed seals in Bristol Bay, April 1976.

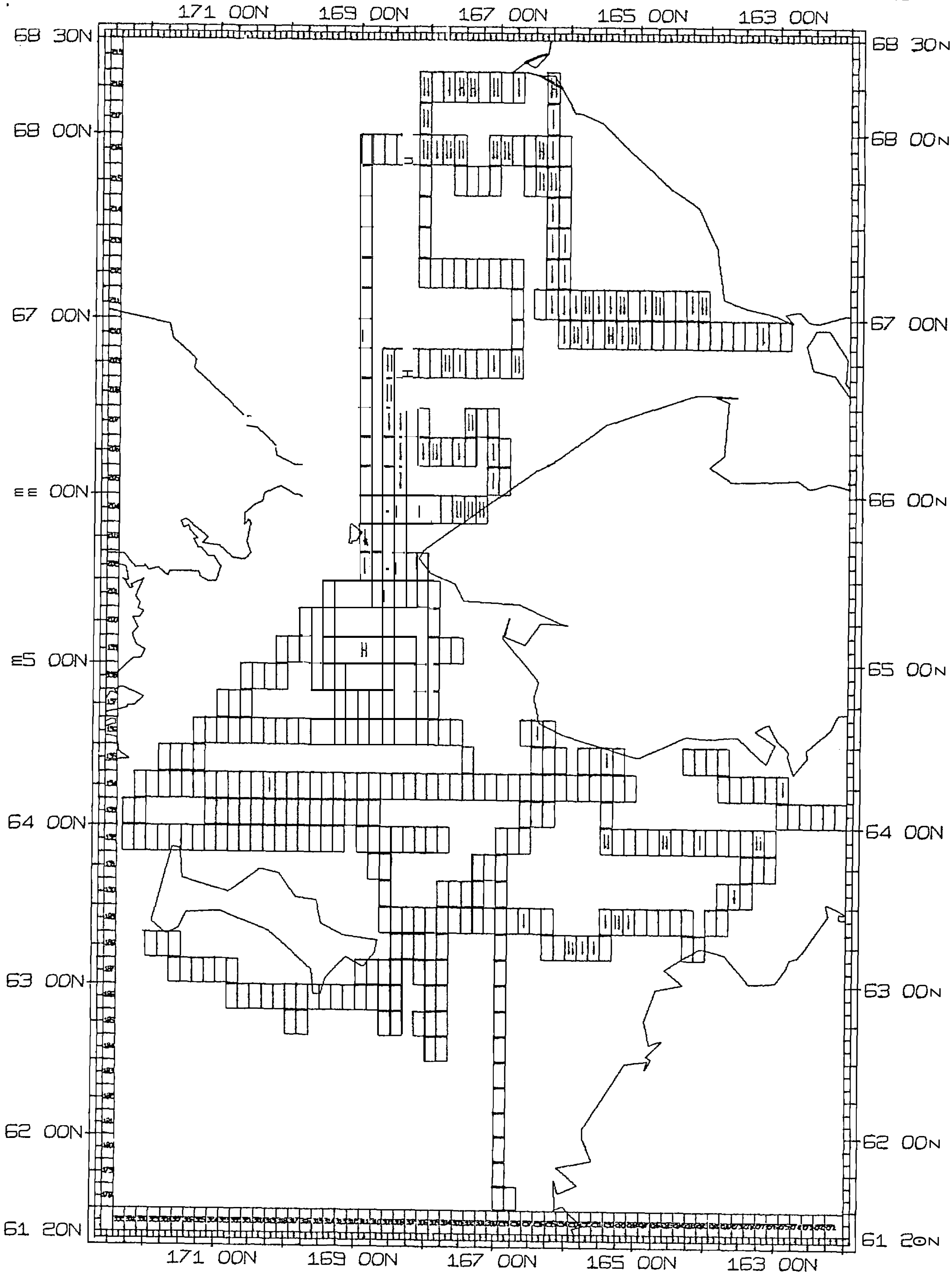


Figure 27. Density plots of ringed seals in the northern Bering Sea in June, 1976.

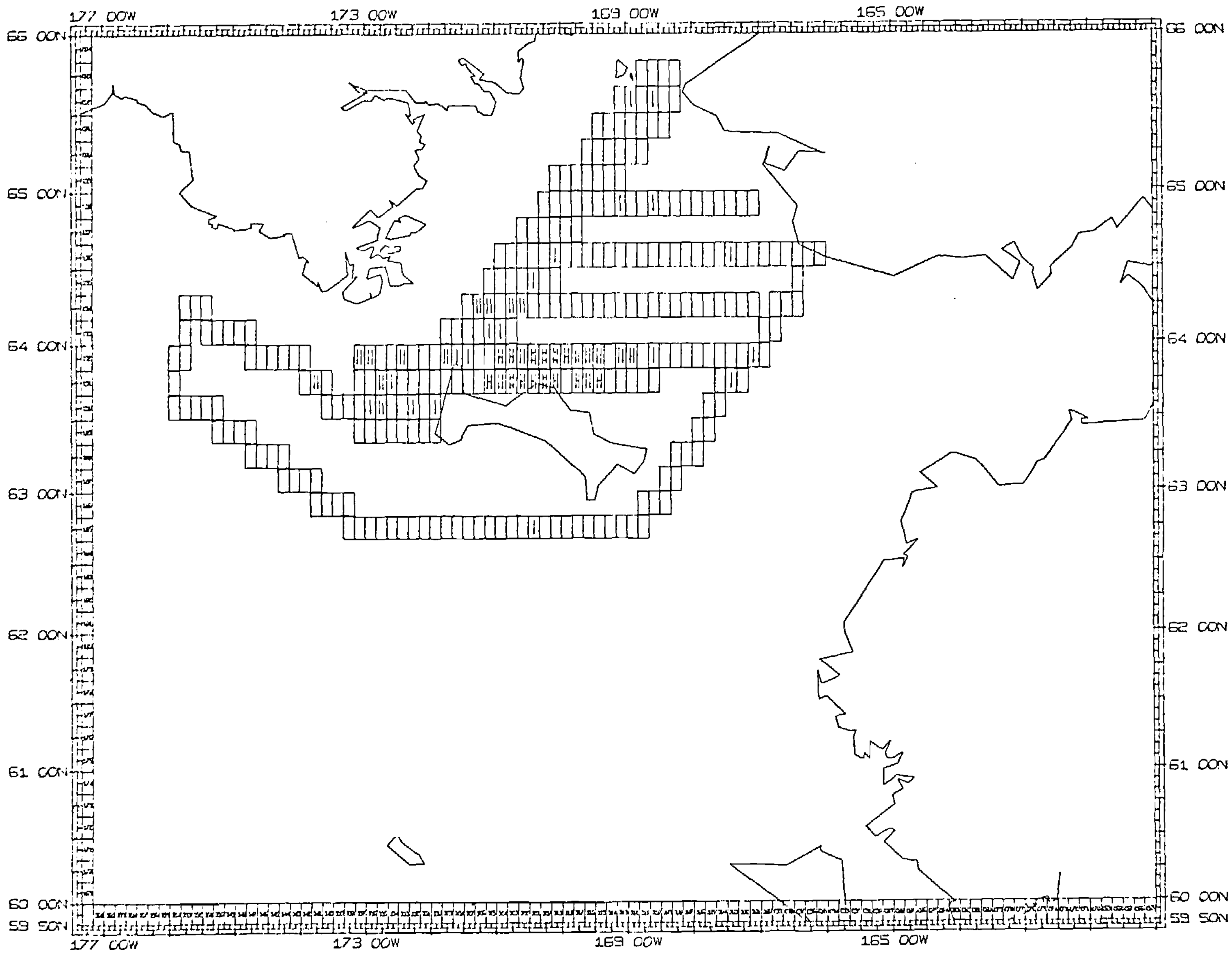


Figure 28. Density plot of walruses in the northern Bering Sea, March 1976.

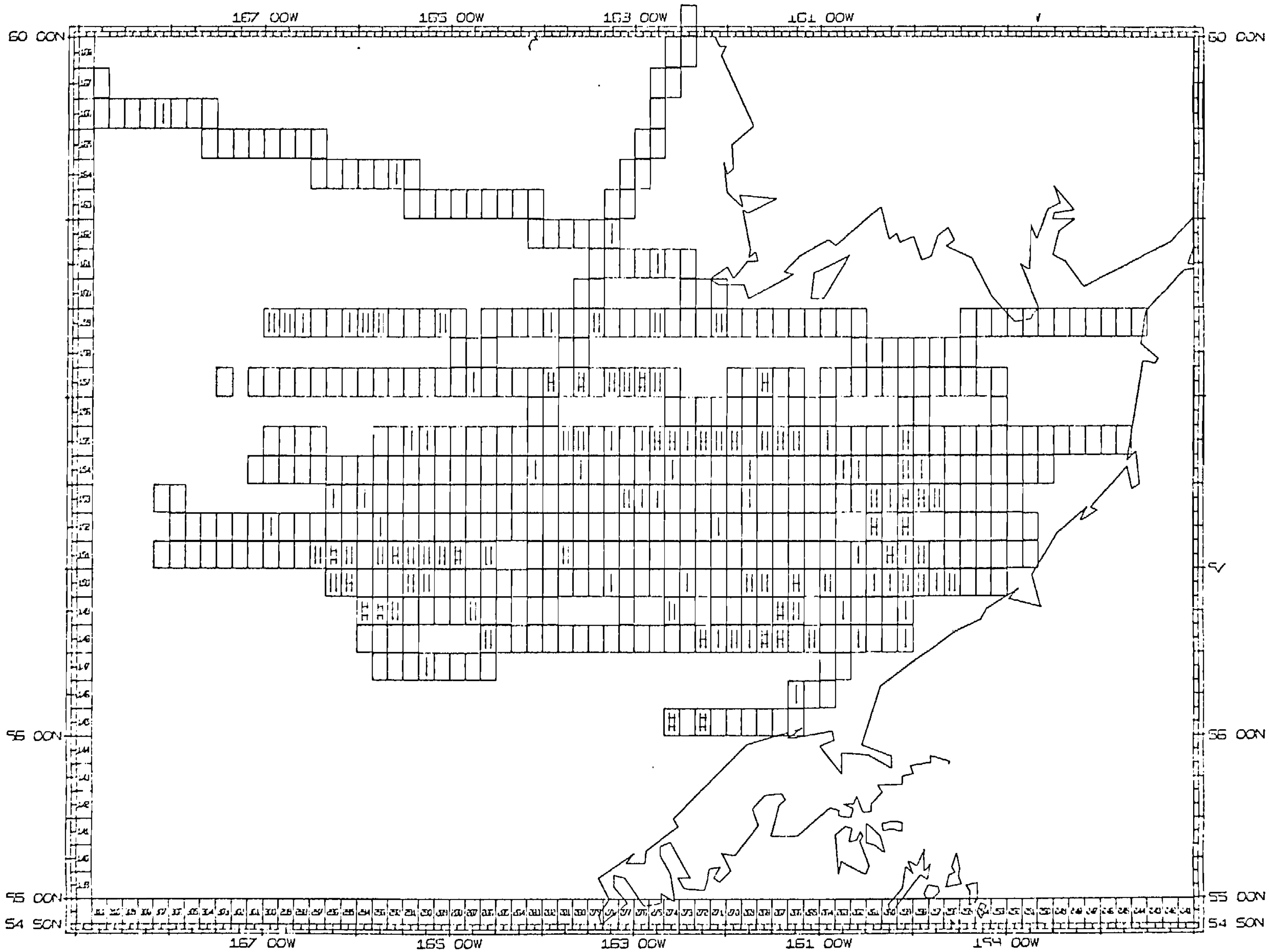


Figure 29. Density plot of walrus in Bristol Bay, April 1976.

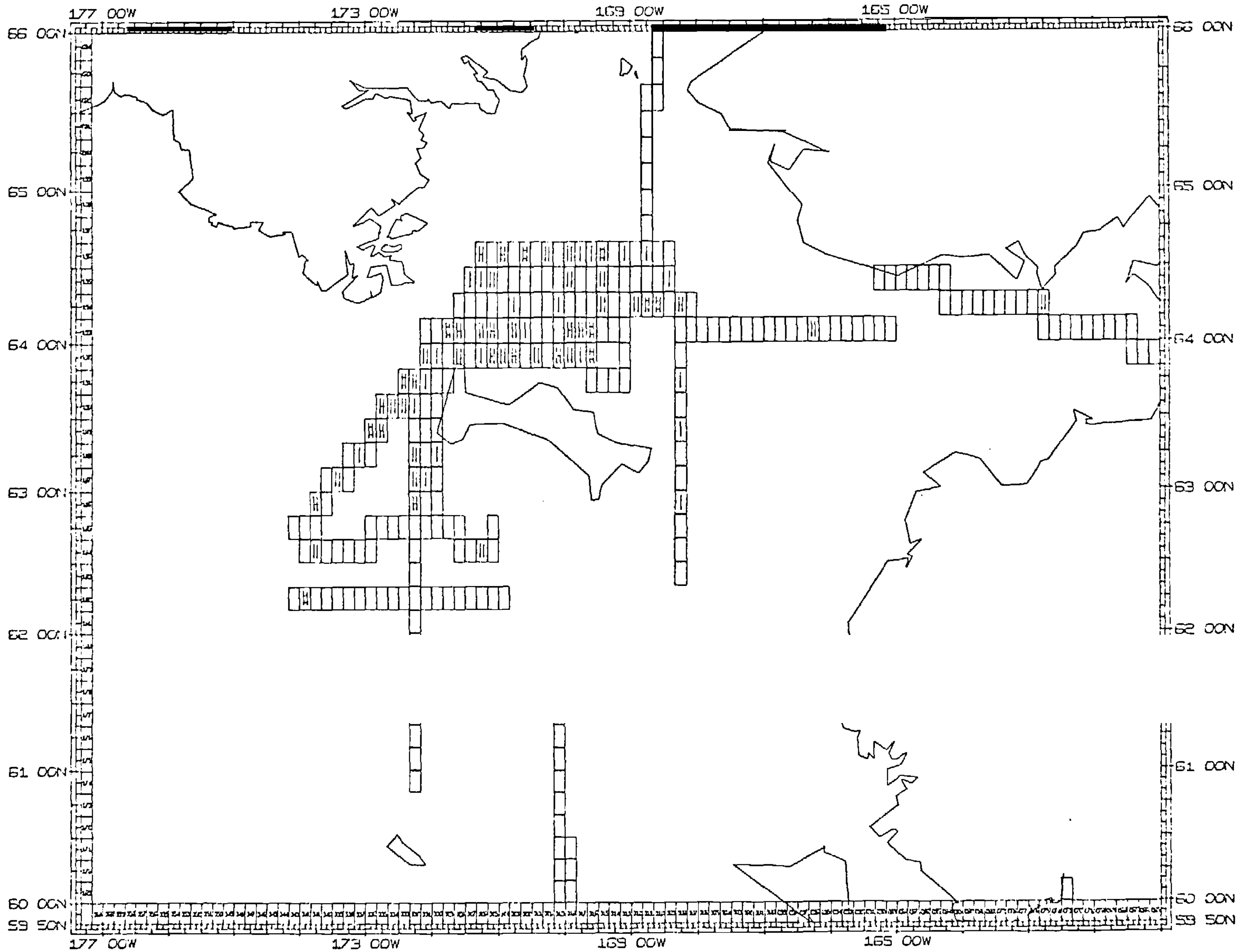


Figure 30. Density plot of walruses in northern Bering Sea, April 1976.

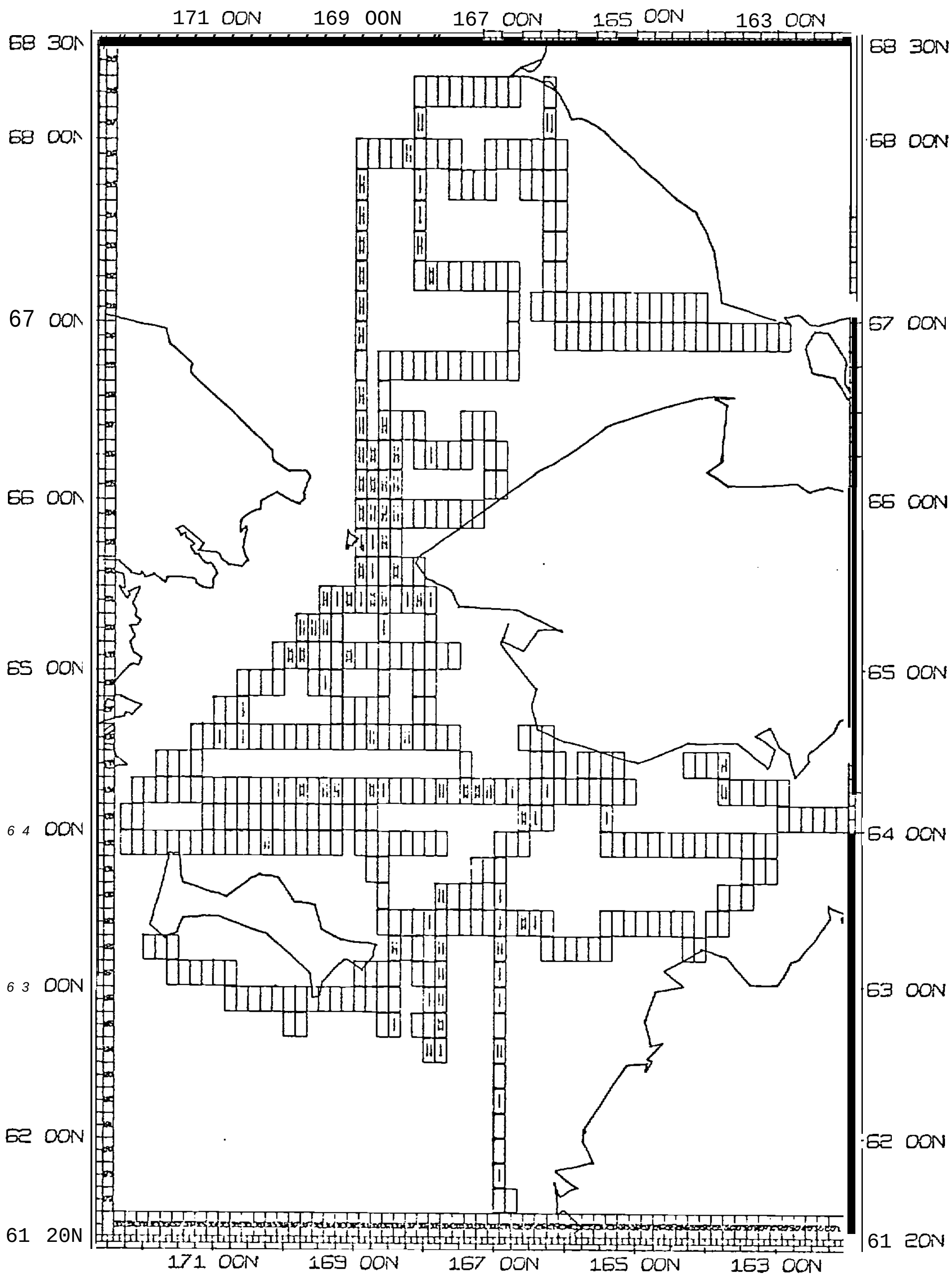


Figure 31. Density plot of walruses in northern Bering and southern Chukchi Seas, June 1976.

Table 5. Summary of the number of phocid seals and walruses per nmi^2 (density ± 95% confidence interval) for March and April in the northern Bering-southern Chukchi Sea (NBS) and southern Bering Sea (Bristol Bay) (SBS). These data are preliminary; they have not, as of yet, been corrected for time of day, daily variations, etc. April and June NBS density estimates are pending.

	Bearded Seal	Larga Seal	Ringed Seal	Walrus
March				
NBs	.052± .146	-----	-----	.224± .017
April				
SBS	.083± .036	.371± .365	.017± .014	.707± .165

Their distribution was more diffuse as evidenced by the density estimate (Table 5 and Figure 23). Ringed seal sightings were sparse, except southwest of St. Lawrence Island (Figure 15). Ringed seals normally occur near landfast ice. The animals depicted in Figure 15 were probably juveniles or immatures; or because of the heavy ice year, some may have moved further south . This past year (1976) was also a "good" polar bear year; with animals moving farther south perhaps in persuit of ringed seals (C.Grauvogel, ADF&G; J. Lentfer, USFWS, pers. comm.). Walrus sightings in April in the northern Bering Sea were more numerous than in March (Figure 19) , perhaps as a result of an influx of animals from southwest or west of St. Lawrence Island.

In June in the northern Bering Sea, all three species (bearded and ringed seals and walruses) were found in greatest numbers near the Bering Strait (Figures 11,16 and 20). Ringed seals were more numerous in the Kotzebue oil lease site than bearded seals or walruses, probably because bearded seals prefer the heavier drift ice (Fay, 1974) found farther offshore. Walruses were concentrated along a line approximating the US-USSR 1867 Convention line (Figure 20) because thick ice occurred to the east and open water to the west--as evidenced in Figure 7. Details of walrus distribution and abundance are covered in the Final Report of Research Unit 14, "Distribution and Relative Abundance of the Pacific Walrus", to be submitted in April 1977.

Larga seals were the most numerous phocid seal seen in April in Bristol Bay, followed by bearded, ringed and ribbon seals (Table 3) . Bearded seals were the most commonly seen in the northern Bering Sea, followed by ringed seals (Table 4). The number of sightings followed the same sequence; however, a test for goodness-of-fit between the numbers of bearded and ringed seals seen versus the number of sightings in the northern Bering Sea (chi-square 2 x 2 contingency table) indicates that fewer ringed seals were seen and more bearded seals were seen than expected by chance (X^2: $p < 0.01$) . This would seem to indicate that either 1) ringed seals were more abundant (than we scored) , 2) the data were biased because bearded seals were easier to see than ringed seals, or 3) ringed seals are less likely to group than bearded seals.

The numbers of bearded seals per sighting (a distribution indicator, i.e., are animals more likely to group together or remain solitary?) was greater ($\bar{x} = 1.35 \pm .06$, 95% C.I.) than that for ringed seals ($\bar{x} = 1.12 \pm .08$, 95% C.I.). The same relationship held true for bearded ($\bar{x} = 1.17 \pm .06$, 95% C.I.) and ringed seals ($\bar{x} = 1.03 \pm .04$, 95% C.I.) in Bristol Bay. Larga seals were less solitary than bearded or ringed seals (X^2: $P < 0.01$), which was not unexpected considering the species is believed to congregate near the ice front for purposes of reproduction (Burns, 1970; Fay, 1974) .

Plots of larga seal sightings indicate that many animals were found north of the ice front (Figures 12 and 25). It would seem that larga seals are more solitary near the ice front than in the pack ice (Figure 32) . Using John Burns' data, RU 231, collected between 8-23 April 1976 near the ice front in Bristol Bay, we find that the mean number of larga seals is greater in the pack ice ($\bar{x} = 1.56 \pm .10$, 99% C.I.) than at the ice front ($\bar{x} = 1.37 \pm .07$, 99% C.I.). The difference is statistically significant. This may

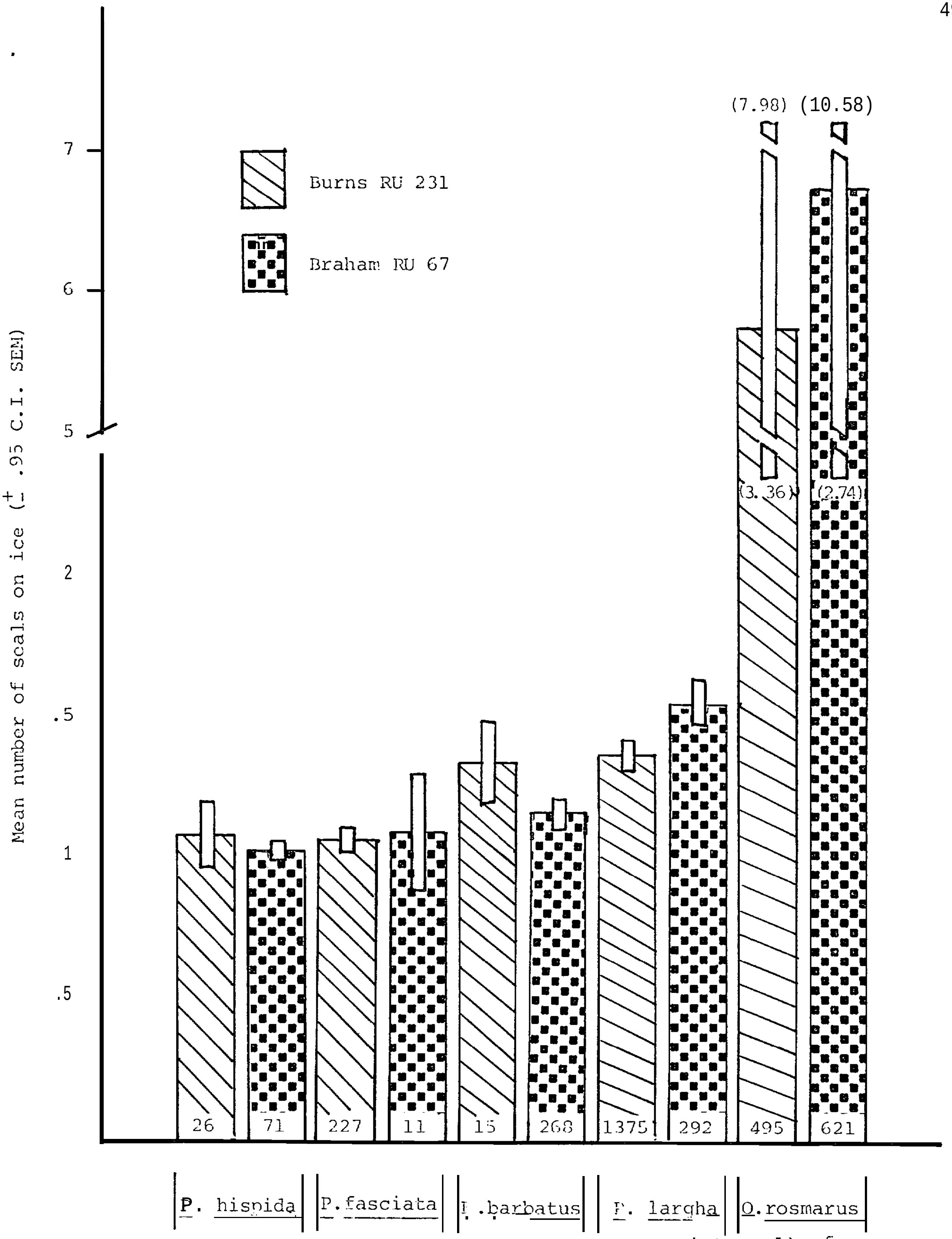


Figure 32. Species group sizes ($\bar{x}$ ± .95 confidence interval) of pagophilic seals from the ice front (Burns) and pack ice (Braham) in the southeast Bering Sea, 8-23 April 1976. The number at the bottom of each bar represents n number of sightings not N number of animals observed.

mean that 1) pairing and pupping occurs earlier or with greater relative frequency in the pack ice zone than near the ice front (i.e., there may be more juveniles or immatures at the front) , or that 2) some bias existed between the way we scored data and that of Burns. The first explanation is probably the most likely. The numbers of animals per sighting for larga seals increased from about 1.3 to 1.7 from 8 April to 18 April, perhaps indicating that greater pairing and pupping was occurring as the breeding season progressed (Figure 33) .

Many more ringed seals were seen in the northern Bering Sea than in the southern Bering Sea in April (Tables 3 and 4) . This was not surprising, as the species is noted as being primarily a shore-fast ice animal (Burns, 1970) . Apparently, _P. hispida_ does not migrate with the drift ice during the winter and early spring to the extent that bearded and larga seals do.

During April, bearded seals were more numerous (per sighting) in the northern Bering Sea than in Bristol Bay than would be expected (X2: $P < 0.01$). This suggests that pairing and/or pupping was more common to the north. Again, greater numbers of non-breeding animals might migrate farther to the south than mature adults, thus inflating our figures. This relationship needs testing. Burns' April 1976 data compared to ours (Figure 32) indicates that more bearded seals per sighting occurred at the ice front ($\bar{x} = 1.27 \pm .60$, 95% C.I.) than farther back in the Bristol Bay pack ice ($\bar{x} = 1.17 \pm .06$, 95% C.I.). Although the difference is not statistically significant (it is at the 0.10 level) , if young bearded seals are grouped at the front, then the northern extent of the pack ice represents a more important breeding area for the species than the southern extent.

Sea lions and harbor seals

Over 2400 nm of aerial survey were conducted during 1975 and 1976 along Alaska Peninsula-Bristol Bay (from Cape Newenham to Unimak Island) and in the eastern Aleutian Islands (Table 6). The first three surveys (A1,A2,A6) covered the entire study area, except where fog or weather prevented flying. Survey A8 covered all areas except the Bristol Bay coast, and survey B1 (flown with the Bell 206B helicopter) covered the Krenitzen Islands, south end of Umnak Island, the northeast side of Unalaska Island, and the Amak Island group.

Table 6. Northern sea lion and harbor seal aerial survey dates.

Survey	Date	Data recordings*	Survey track miles**
A1	17-20 June 1975	1810	540
A2	9-13 August 1975	1760	527
A6	14-20 June 1976	1840	587
A8	19-21 August 1976	1350	510
B1	21-25 October 1976	861	277
		7621	2441

* A "data recording" is a single logged entry at a specific time and location, and represents one or more animals.
** In nautical miles (1 nm = 0.87 statute miles)

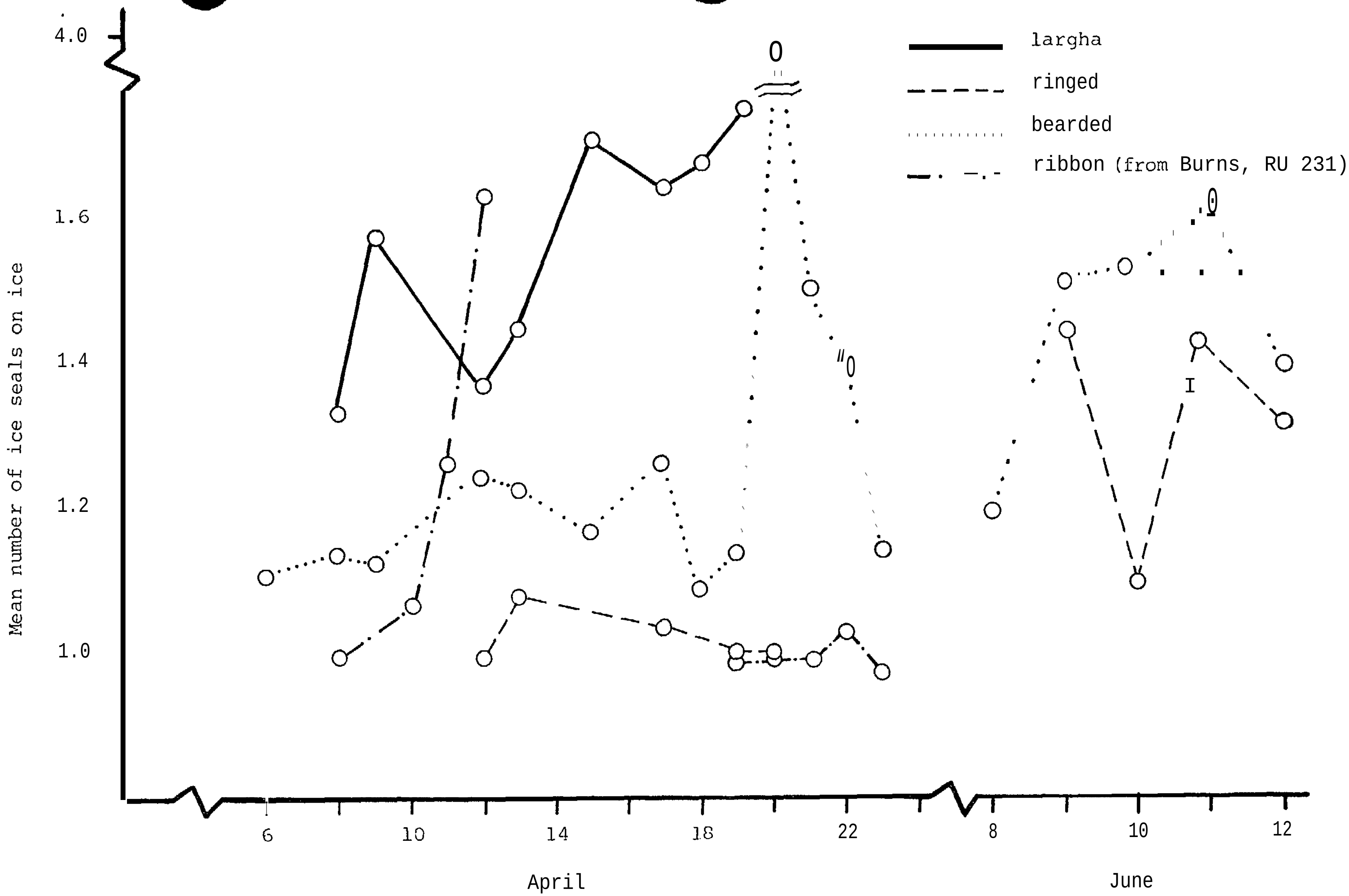


Figure 33 Mean number of ice seals (total number per sighting) with respect to the breeding season (April) and molting period (June-July) scored during aerial surveys of the Bering and Chukchi Seas, 1976. Larga and ribbon seal data from Bristol Bay; ringed seal data from the northern Bering sea, and bearded seal data from both survey areas.

Northern Sea Lions

Sea lion rookery (R) and hauling areas (H) were identified during our surveys to precise location (Figures 34 and 35). The number of animals seen by location is covered in Table 7. Rookeries were identified by the presence of pups. All other areas were deemed hauling grounds. Whenever possible, photographs were taken and the numbers on each slide later scored. In a few instances (due to poor survey conditions) photographs were not taken and the visual estimate was used. Preliminary analysis (chi-square and students t-statistic) revealed that for model data (Table 8) no significant difference existed for a population estimate (taken from several locations) when comparing visual estimates and photographic counts ($P > 0.05$) . Differences between certain individual location estimates (e.g., Ugamak Island aerial versus photos) were, however, significant (see Σx^2 for each cell in Table 8) . The reason for no difference between the two population estimate methods was because of the large sample variances. It is clear that a greater statistical bias exists between location samples (e.g., A VS. B; Table 8) than the overall effect on the total population estimate (i.e. ,locations summed). These tests suggest that ground truth counts are needed to satisfactorily evaluate population abundance estimates.

In all cases it was difficult to identify pups from slides or when in the field. Many were obscured on the photos, hidden by other animals, in rocks or crevasses, etc. ; therefore, no reliable pup data has been collected. Those pups that were counted are included in the total rookery count in our data.

In the survey area sea lions are concentrated in the eastern Aleutian Islands (Ugamak Island to Adugak Island), accounting for approximately 80% of all animals observed. The Amak Island group (Figure 34) accounted for the remaining 20%, with a small number (300-400) hauled out on Round Island (Walrus Island group) in northern Bristol Bay.

Several new hauling areas were identified from our surveys that had not been reported by Kenyon and Rice (1961) and Mathisen and Lopp (1963). These areas include: Polivnoi Rock, Bishop Point, Old Man Rock, Cape Sedanka, Sedanka Island, Outer Signal, Battery Point, Rootok Island (rocks north) and Cape Chagak (Table 7, Figure 35) . Except at Bishop Point, Old Man Rocks, and Rootok Island, the remaining locations were found to have animals on them only once during our four surveys. Kenyon and Rice (1961) and Mathisen and Lopp (1963) recorded animals in many areas that we did not. This would indicate that sea lions are less selective of hauling grounds than of the more traditional rookery areas.

Our studies have shown a substantial decline in the numbers of northern sea lions in the eastern Aleutian Islands, when compared with earlier surveys (Figure 36). Population levels appear to be less than half of the estimated numbers in the late 1950's. The numbers of animals observed for seven of the most populous rookery/hauling grounds are shown in Figure 37. Bogoslof Island has a large number of animals present in June during the breeding and pupping period, with the numbers in August being smaller. In contrast, on Adugak Island, Cape Morgan, and Billings Head, more numbers of animals occur in August than in June. This suggests that these areas are more

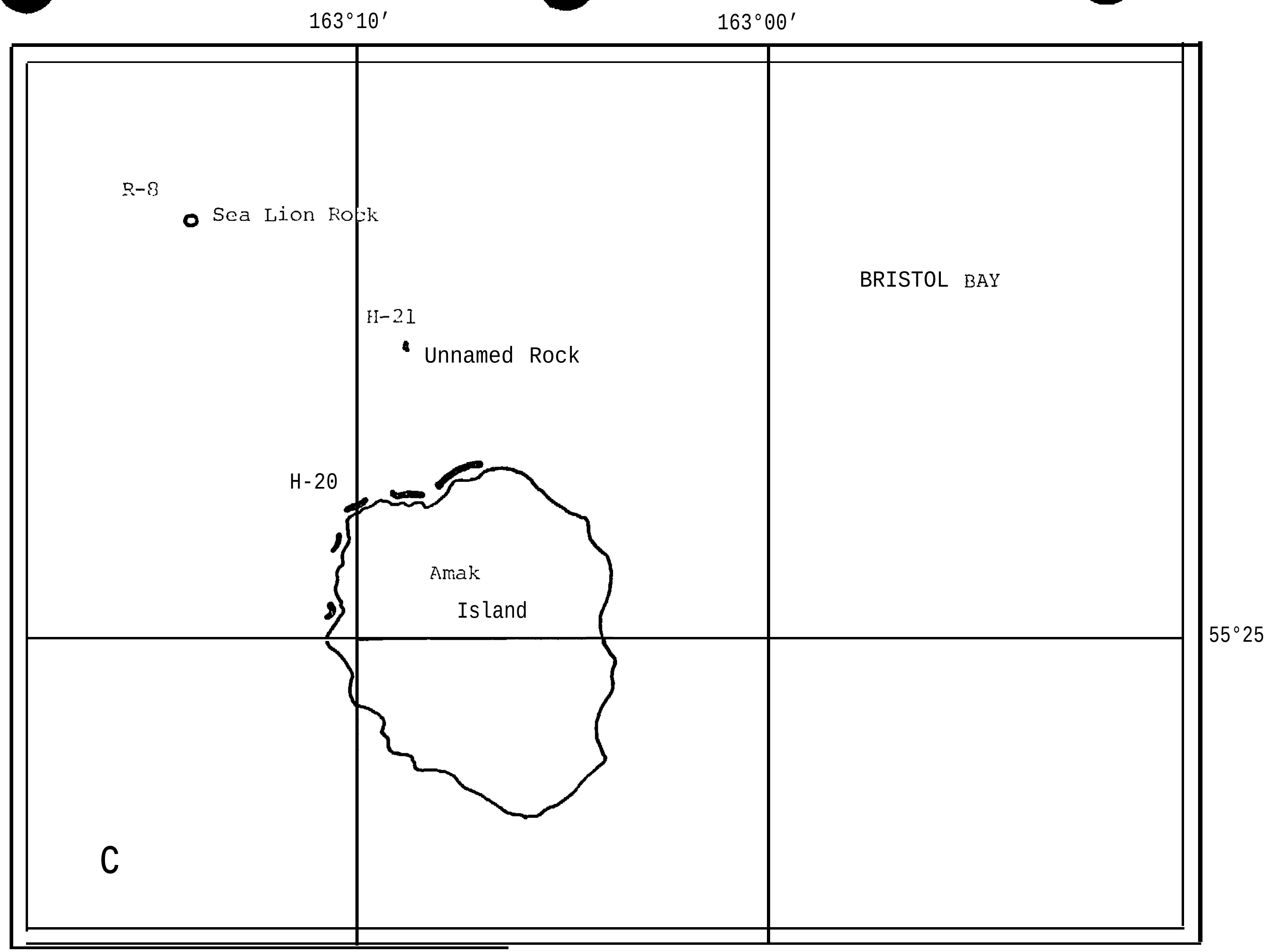


Figure 34. Eumetopias jubatus rookery (R) and hauling grounds on and near Amak Island, located northwest of Izembeck Lagoon, on the Alaska Peninsula.

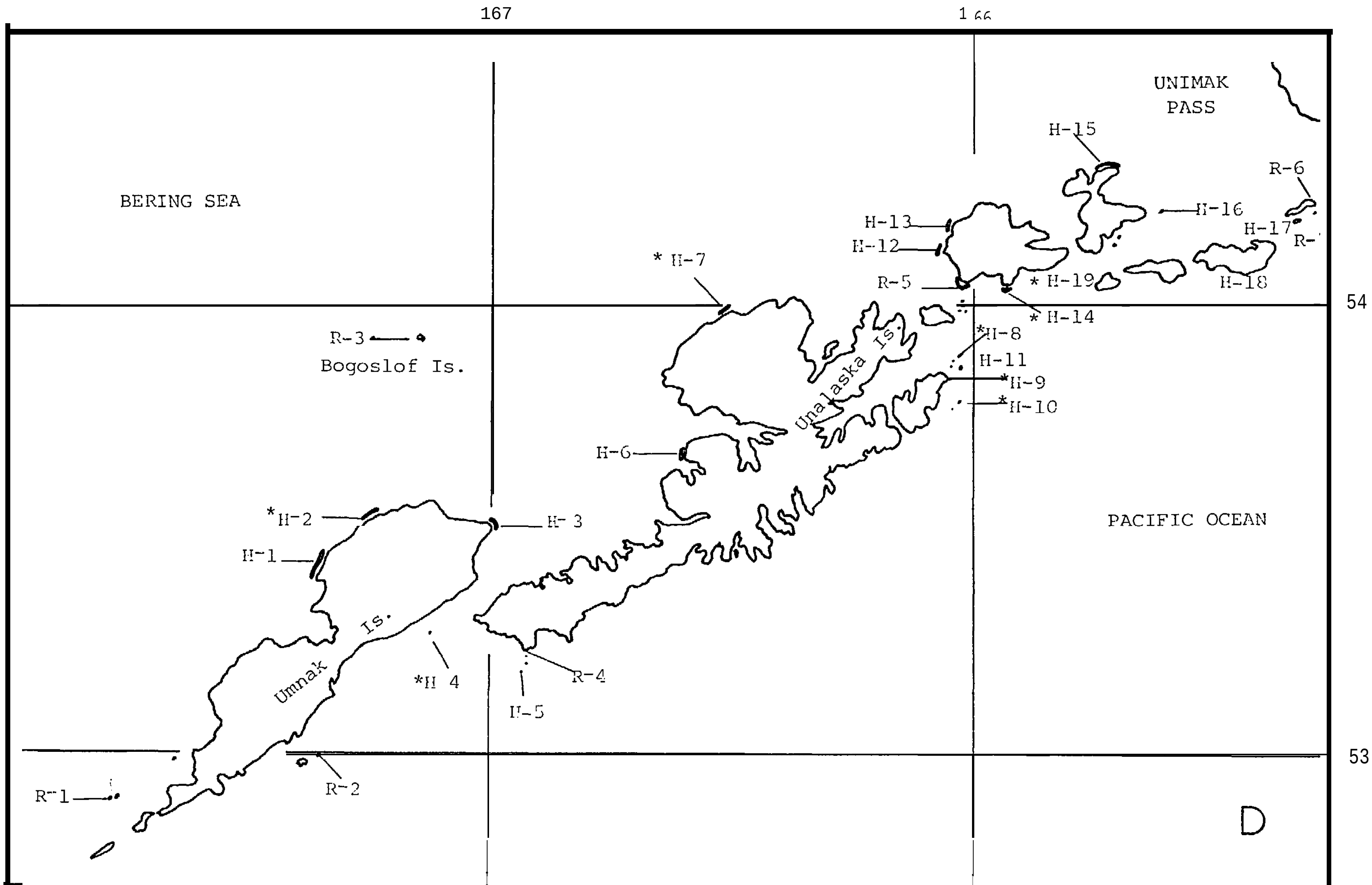


Figure 35. Eumetopias jubatus rookeries (R) and hauling grounds (H) along the eastern Aleutian Islands (Fox Island group). See Table for a listing of each R and H. Those with asterisks (*) are new locations identified during our June and/or August surveys in 1975 and 1976.

Table 7. Observations of northern sea lions (*Eumetopias jubatus*) from aerial surveys along the Alaska Peninsula, eastern Aleutian Islands, and Bristol Bay. Numbers are based on visual estimates or on counts taken from photographs (*). Dashed spaces indicate areas not surveyed; blank spaces mean no animals were observed.

General Location	Map Reference Number	Survey Date				
		June 1975	August 1975	June 1976	August 1976	October 1976
Adugak Is.	R 1		1,845*	1,177*	2,125	1,400*
Cape Aslik	H 1	285		221*	8	
Cape Chagak	H 2	20				
Cape Idak	H 3			223*		
Polivnoi Rock	H 4		131*			
Ogchul Is.	R 2		947*		1,138′	2,441*
Bogoslof Is.	R 3		1,872*	3,599*	2,127*	490*
South Rock	H 5		30	61*	8	
Cape Izigan	R 4		600	724*	1,102*	
Cape Starichkof	H 6	100		78*		
Bishop Pt.	H 7	172*	13	555*		136*
Old Man Rocks	H 8	180*	300	829*		
Cape Sedanka	H 9		200			
Outer Signal	H 10			68*		
Sedanka Is.	H 11			364*		
Cape Morgan	R 5	2,894*	3,118*	3,441*	5,924*	2,637*
Reef Bight	H 12	100	182*	874*		58*
Lava Bight	H 13	115	178*		300	208*
Battery Pt.	H 14	30				

Table 7 (cont.)

General Location	Map Reference Number	Survey Date				
		June 1975	August 1975	June 1976	August 1976	October 1976
Billings Head	H 15	748*	2,641*	613*	2,032*	1,130*
Tanginak Is.	H 16	470*	3	358*		60*
Rocks , n.e. of Tigalda Is.	H 17	80		274*	22	30*
Tigalda Is.	H 18			314*		
Ugamak Is.	R 6	3,940*	4,630*	4,673*	2,939*[1]	3,765*
Round Is.	R 7		175*	246*	213*	158*
Rock , north of Rootok Is.	H 19	118*	46*			66*
Amak Is.	H 20	1,095*	2,316*	1,777*	1,356*	905*
Sea Lion Rock	R 8	2,006*	2,126*	1,944*	2,331*	1,836*
Unnamed Rock (near Amak Is.)	H 21	108*	234*	132*	355*	110*
The Twins, (Walrus Islands)	H 22	50	30			
Round Is.	H 23	325*	244*	296*		

[1]partial survey

Table 8. Northern sea lion (*Eumetopias jubatus*) population estimates comparing aerial versus photographic counts of animals observed on selected rookery and hauling grounds in the eastern Aleutian Islands, 18-28 October 1976.

Day	Location	Aerial Estimate (A)	Photo Count (B)	Estimate Difference	Σ Chi-Square[4/] within cell. (A VS. B)
21	Ugamak Is.	2,985	3,765		19.16
21	Tigalda Is.	40	30	+	3.37
21	Tanginak Is.	105	60	+	19.93
21	Billings Head[1/]	1,097	1,103		12.46
22	Ogchul Is.	1,235	2,441		98.65[5/]
22	Adugak Is.	975	1,400		23.26
23	Bishop Pt.[2/]	100	136		1.26
23	Bogoslof Is.	350	490		6.34
24	Amak Is.	825	905		1.80
24	Sea Lion Rock	1,860	1,836	+	26.30
25	Billings Head[1/]	1,025	913	+	35.35
25	Rootok Is.	100	66	+	13.05
25	Cape Morgan[3/]	2,317	2,437		13.34
25	Reef Bight[3/]	63	58	+	1.71
25	Lava Bight[3/]	195	208		0.85
	N =	13,329	16,605		$\Sigma x^2 = 361.07$
	t =	1.83			$\chi^2_{.001(14)} \geq 32$
	$t_{.05(14)}$ =	2.15			

1/ Akun Is.
2/ Unalaska Is.
3/ Akutan Is.
4/ A+B X^2 within cells pooled.
5/ removing this estimate and recalculating does not change t or x^2 test results.

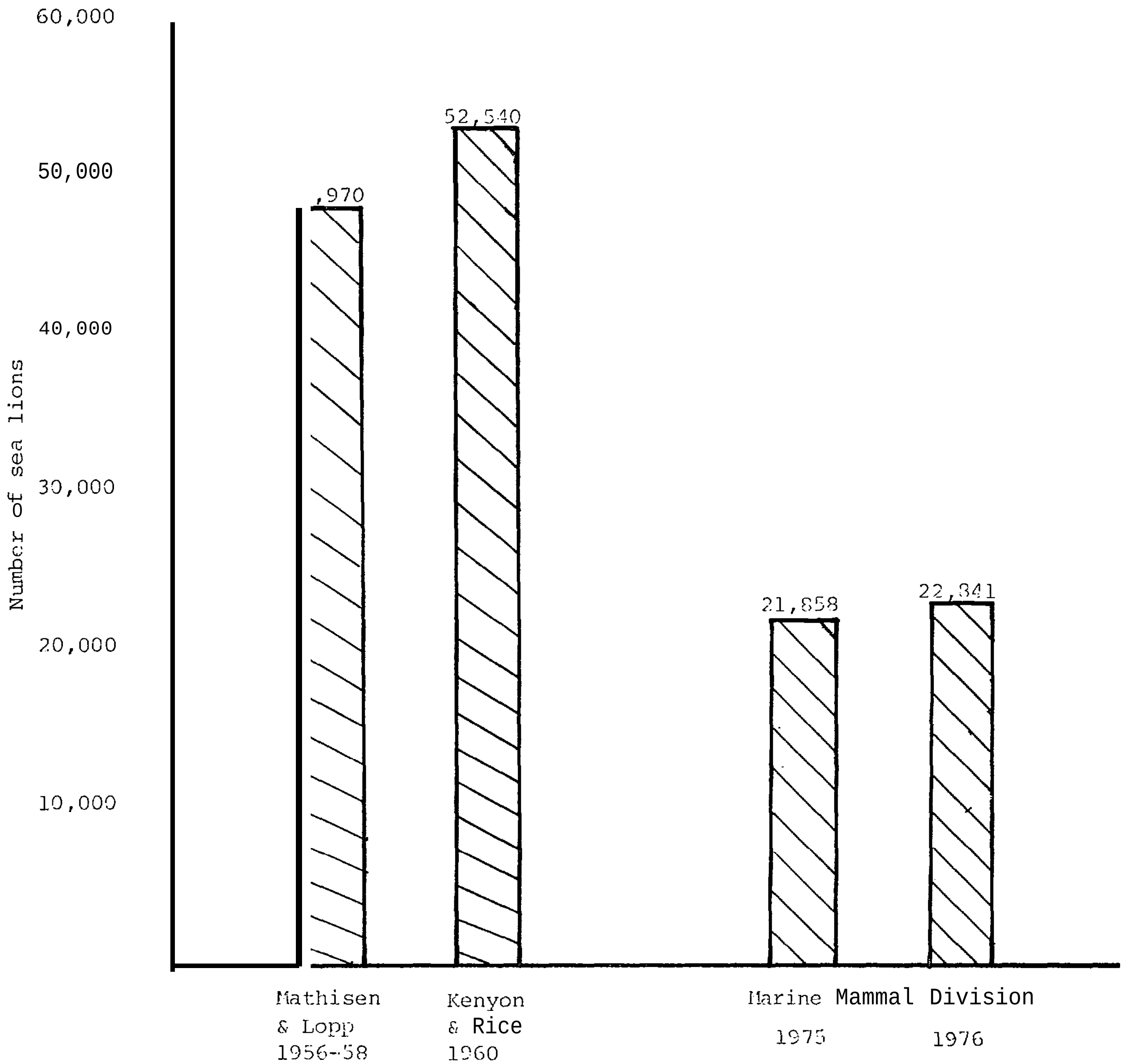


Figure 36. Comparison between the numbers of northern sea lions, Eumetopias jubatus, seen in the late 1950's-early 1960's, and during RU 67 OCSEAP studies along the eastern Aleutian Islands in Alaska. See Kenyon and Rice (1962) and Mathisen and LOpp (1'363) for details of survey location.

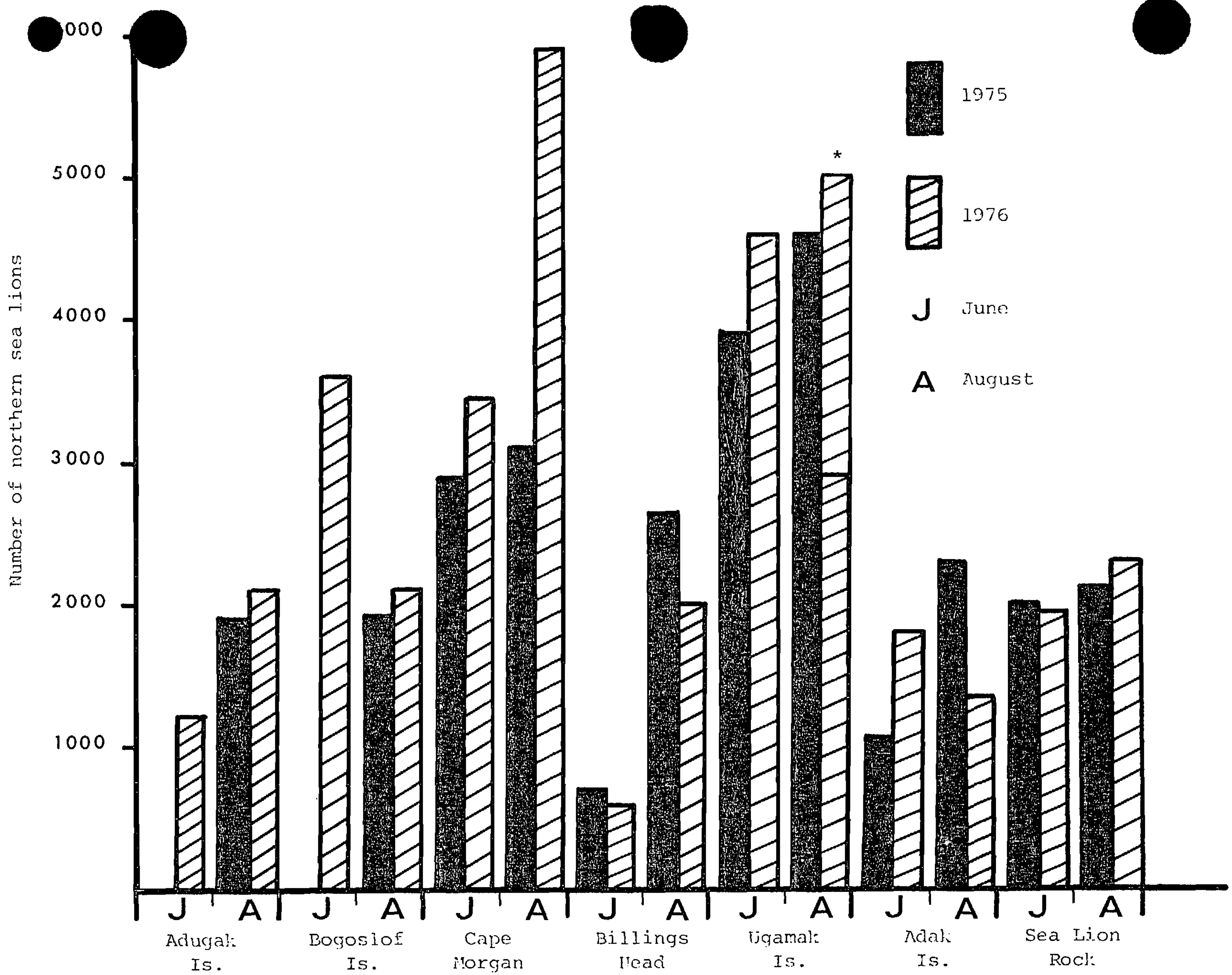


Figure 37. Northern sea lion population estimates from photographs taken of hauling grounds/rookeries of the eastern Aleutian Islands and Alaska Peninsula for June and August of 1975 and 1976. (*Data incomplete; estimate considered extremely reliable.)

important as hauling grounds than as breeding rookeries. Sea lion numbers on Ugamak Island, Amak Island and Sea Lion Rock appear to be similar during both June and August,

Data summarized in Figures 38 and 39 were done to answer two questions: 1) what are the relative differences in the numbers of animals between locations as a function of time (a spatial question) and 2) what effect does month have on the number of animals at any one location (a temporal question) . In 1), the highest monthly estimate is used to determine the relative percent of the population for a month at each location. In 2), the highest estimate by location is used to predict relative percent between months.

When these seven hauling ground/rookeries are compared, on a percent basis, to the maximum population estimate for the eastern Aleutian Islands in 1976 (about 23,000 animals), the overall contribution of each location to the total population becomes more clear (Figure 40). The largest percentage of the population of northern sea lions for all months survey (June, August and October) can be found at Ugamak Island and Cape Morgan (Akutan Island) . Cape Morgan and Ugamak Island also accounted for the major concentrations during the non-breeding month of August (Figures 38 and 39). The decrease in numbers on Bogoslof Island in August are matched by an increase in numbers at Billings Head. We are not suggesting, however, that the same animals are moving to Billings Head from Bogoslof Island. It must be pointed out that haulout areas also exist next to areas we have designated as rookeries. The extent of haulout behavior and group composition of non-breeding and breeding animals has not been characterized for these areas.

The numbers of sea lions observed during the October 1976 survey of the eastern Aleutian Islands are summarized in Table 8. Although northern sea lions were not as abundant during October as in either June or August 1976, we have established that the islands represent important haulout areas for the species during the fall months. Comparing similarly sampled islands for all three months (n = 10) , we found that 68% (N = 17,876) and 63% (N = 19,424) of the numbers of animals seen in June and August respectively were present in October (N = 12,234). Comparing just August (N = 20,862) and October (N = 14,883) for twelve (n = 12) surveyed islands, only 29% fewer animals were counted. These results indicate that more sea lions remain on these islands during the fall than was expected.

Shipboard counts of pinnipeds from the Surveyor during October 1976 were: 134 *E. jubatus*; 25 *P. vitulina*; 18 *C. ursinus*; and 3 unidentified. Besides the total of 16,605-sea lions counted from the helicopter, 1,217 harbor seals and 146 sea otters (*Enhydra lutris*) were observed. See the 1 September - 31 December 1976 quarterly report for more details of the October survey (e.g., counts of dead animals, tissue samples collected, etc.)

Harbor Seals

Harbor seals are present throughout the survey area, though the majority of animals (80%) were observed in a few major hauling areas along the north side of the Alaska Peninsula (Table 9). Harbor seal distribution in the survey area is illustrated in Figures 41-43. The most important hauling

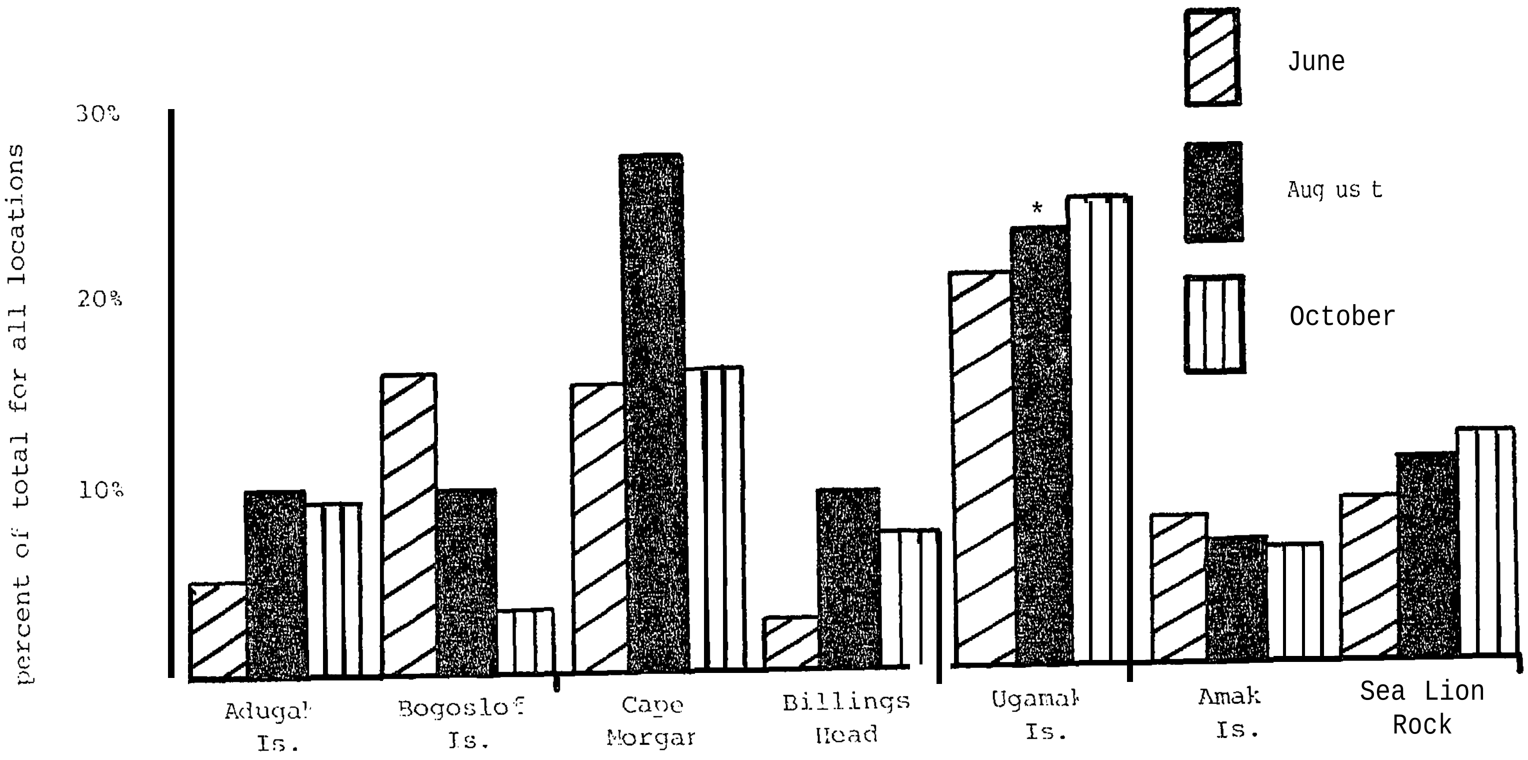


Figure 38. Relative percentage of the total 1976 northern sea lion population comparing locations by separate months. For example, Ugamak Is. had the largest percent of the population in June (20%) and October (23%), and Cape Morgan in August (27%). (*Data incomplete, estimate considered extremely reliable.)

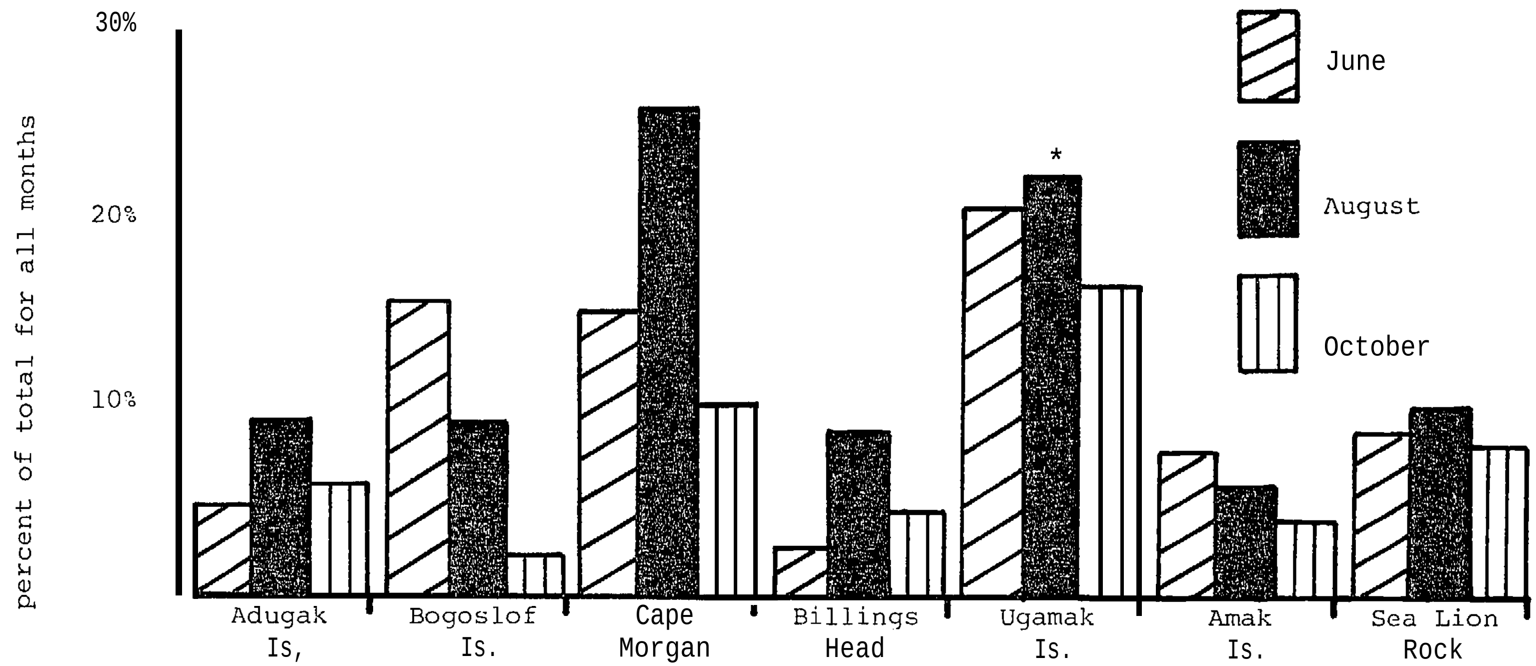


Figure 39 Relative percentage of the total 1976 northern sea lion population comparing the three months at each location separately. , For example, the largest percentage of the animals found at Adugak Is. was in August (9%), then October (5%) , then June (4%). (*Data incomplete, estimate considered extremely reliable.)

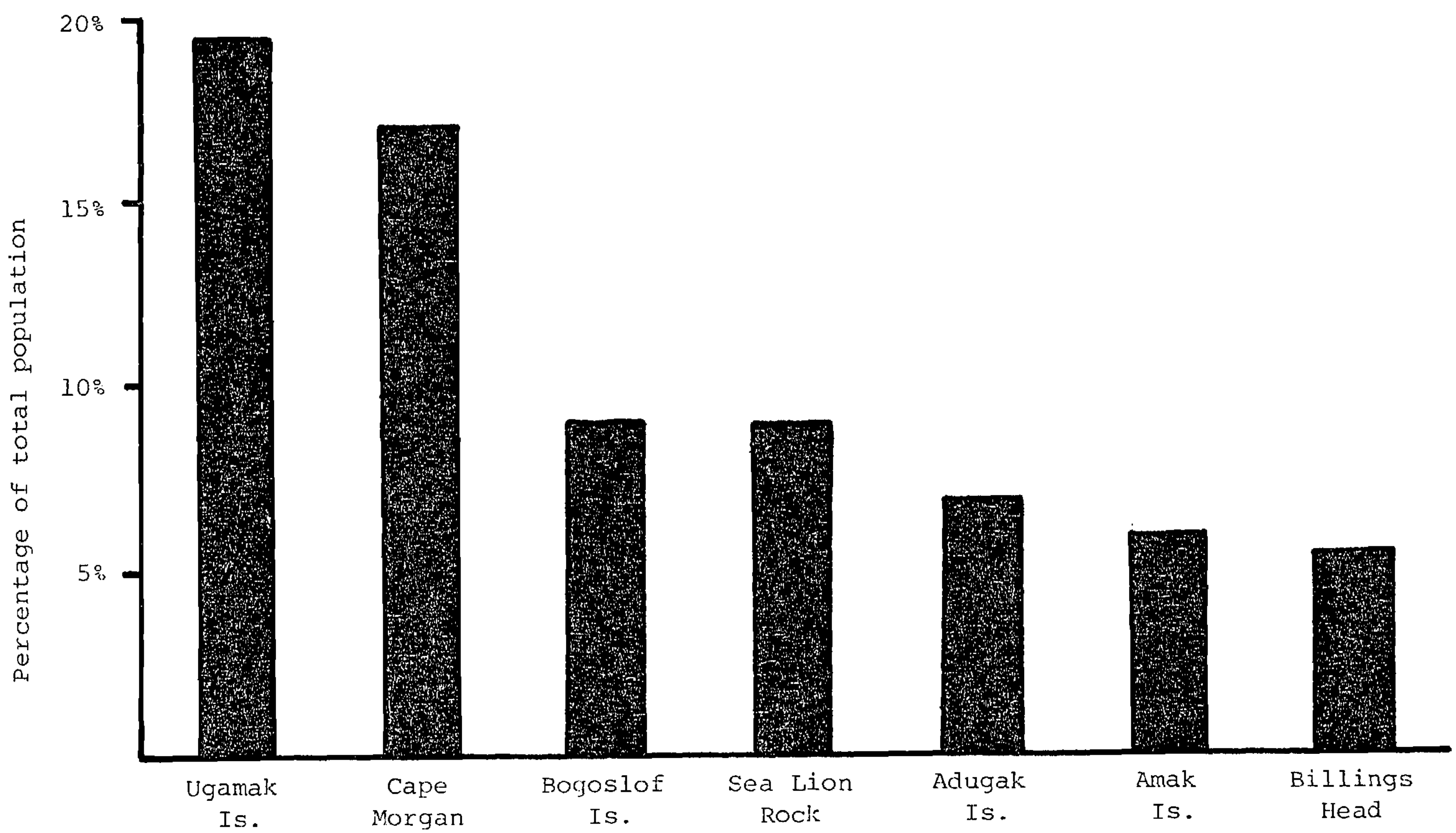


Figure 40. Percent of the total eastern Aleutian Island-Alaska Peninsula northern sea lion population seen at seven hauling ground/ rookeries during three aerial surveys in 1976. The number of animals counted at the above locations represented 75% of the total population count in June, 90% in August, and 52% in October

Table 9. Observations of harbor seals (*Phoca vitulina richardsi*) from aerial surveys at major hauling areas along the Alaska Peninsula. Numbers are based on visual estimates or on counts taken from photographs (*). Dashed spaces indicate areas not surveyed; blank spaces mean no animals were observed.

General Location	Map Reference Number	Survey Date: June 1975		August 1975[3]		June 1976			August 1976[4]	
		18	20	11	13	15	18	20	19	21
Eggegik R.	1		50*					70		
Ugashik Bay	2	150	196*		2		65*	163*	438*	-
Cinder R.	3	925*	2,867*	3	113*	3,062*	800	4,503*	966*	-
Port Heiden	4	4,774*	5,273*	2,605*	3,453*	4,776*	2,486*	10,548*	4,770*	-
Seal Is.	5	1,137*	155*		75	246*	30	786*	241*	35*
Port Moller[1]	6	4,563*	6,078'	885*	1,053*	5,177*	671'	7,968*	1,088*	1,701*
Izembeck Lagoon[2]	7		2,034*				2	548*	-	1,204*
Izonotski Is.	8		258*	-	414*		98*	·		171*

[1] includes Nelson Lagoon

[2] includes Moffet Pt.

[3] surveyed during high tide

[4] heavy fog north side of Alaska Peninsula

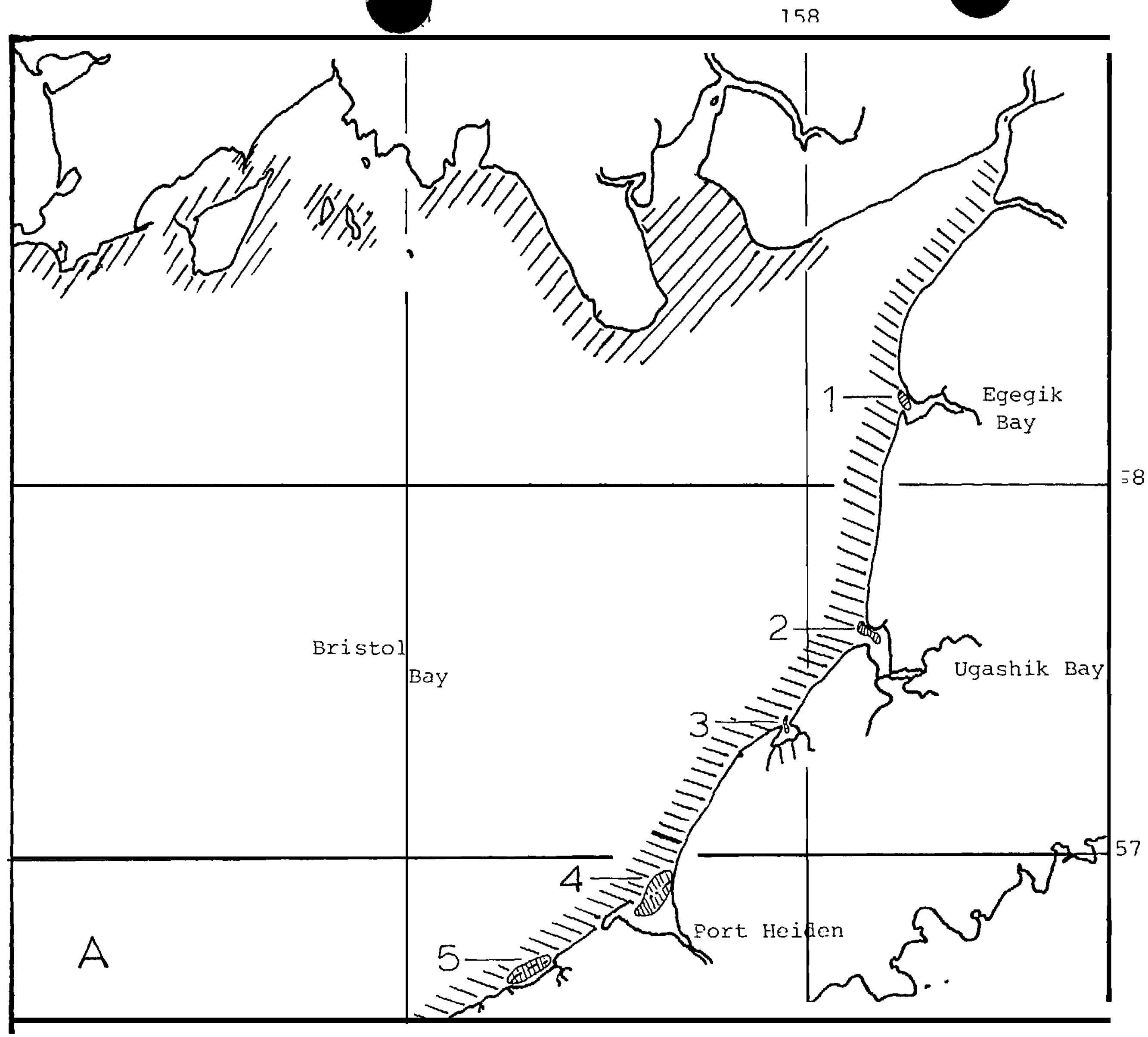


Figure 41. Major hauling areas and breeding grounds for *Phoca vitulina* along the north coast of the Alaska Peninsula: 1 - Egegik Bay; 2 - Ugashik Bay; 3 - Cinder River; 4 - Port Heiden; 5 - Seal Islands. Hatched coastal areas are where animals have been observed during June and August aerial surveys in 1975 and 1976. See Figure for key to adjacent areas.

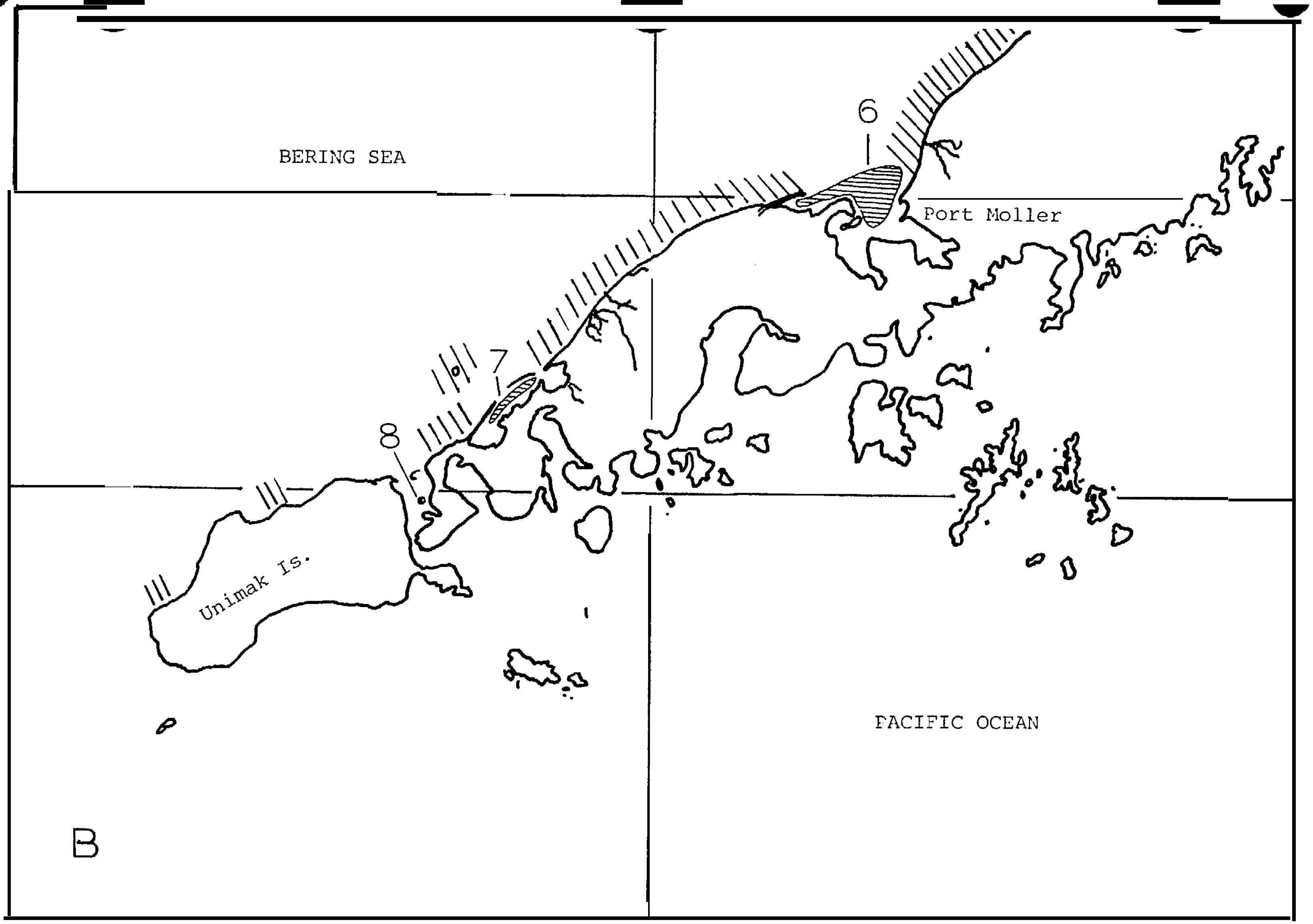


Figure 42. Major hauling areas and breeding grounds for Phoca vitulina along the north coast of the Alaska Peninsula: 6 - Port Moller; 7 - Izembek Lagoon; 8 - Bechevin Bay.

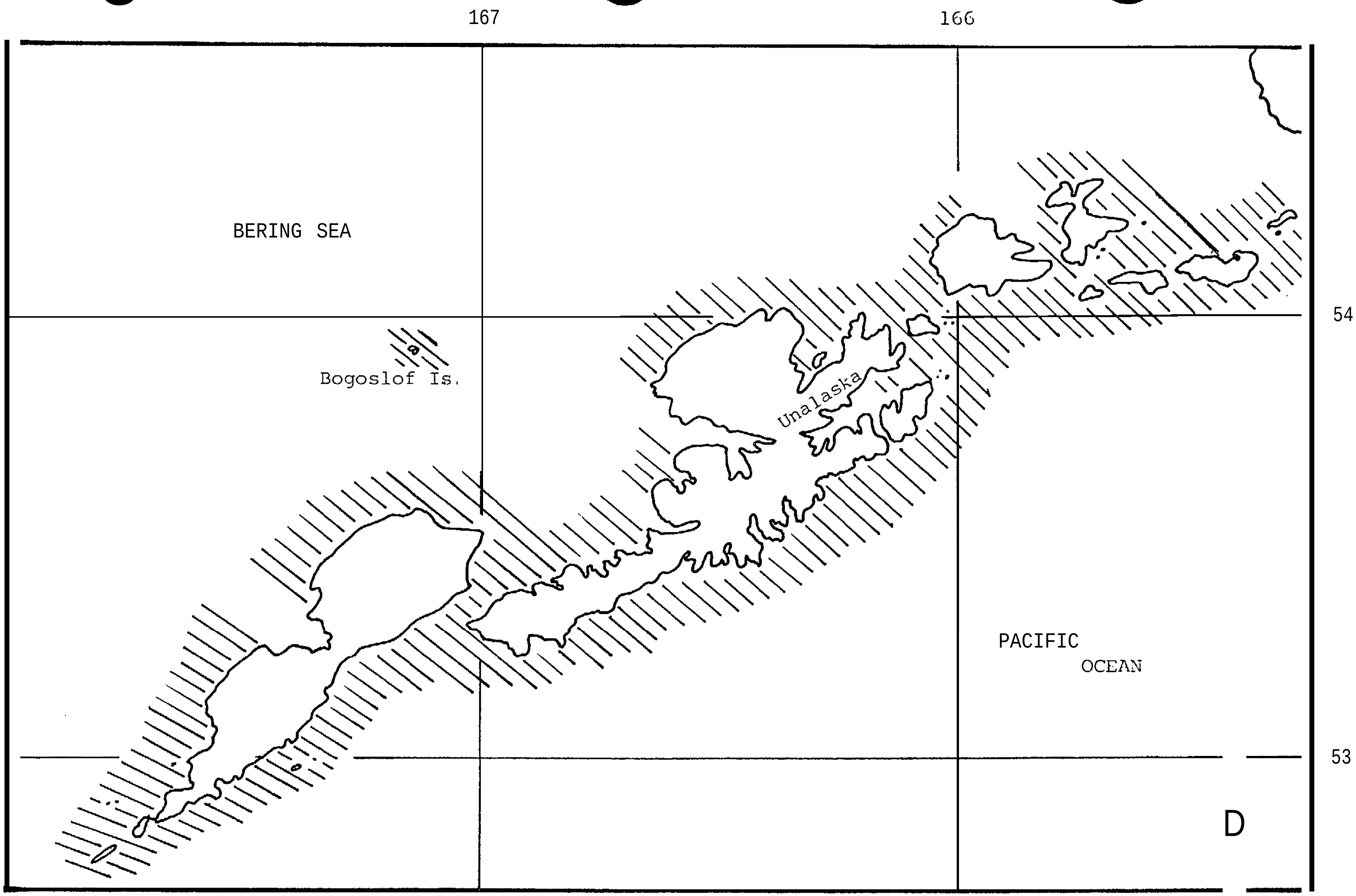


Figure 43. Hauling and breeding areas for *Phoca vitulina* on the eastern Aleutian Islands (Fox Islands group).

areas in terms of numbers of animals were Cinder River (#3) , Port Heiden and Port Moller (Table 9, Figures 41 and 42). Coastal areas not surveyed are depicted in Figure 43 as having no seals present, and include Inanudak Bay, Kashega Bay, Skan Bay, Makushin Bay, and Beaver Inlet (not labelled in figure). Togiak Bay and the north end of Nugashik Bay (Bristol Bay area) were not surveyed (Figure 41); however, harbor seals have been recorded in all of these areas in the past (Alaska Dept. Fish and Game, 1973).

Harbor seals are difficult to see and thus count when they are in the water. The majority of our estimates are from animals hauled out. Haulout areas are typically offshore rocks and rocky beaches in isolated areas of the eastern Aleutian Islands. Sandbars in bays exposed at low tide are especially favored by P. vitulina along the north side of the Alaska Peninsula. Seals were also observed in the water along the Peninsula and occasionally a small pod would be observed on a beach (e.g. , Cape Krenitzen, 20 June 1975, 110 animals) or by a river mouth (e.g., Bear River, 11 August 1975, 53 animals) .

Ideally, surveys for harbor seals are conducted during favorable weather conditions (to optimize visibility) and during low tides when sandbars are exposed, creating hauling areas. Practically, however, budgetary and time restrictions prevented some surveys from being conducted during optimum periods.

The importance of tidal influence on hauling behavior is evident from differences in numbers of animals observed at the major hauling areas. On 20 June 1975, 16,911 animals were observed at the major areas versus 4,696 on 13 August 1975. Tidal differences were great: 3-4 feet rising, range 10-12 feet on 20 June 1975, and 10-11 feet rising, range 10-12 feet on 13 August 1975. This disparity was observed again in June and August 1976 (24,586 animals on 20 June versus 4,452 on 18 June and 7,503 on 19 August). The tides averaged much lower on 20 June (3-4 feet rising, range 9-10 feet) than 18 June (7-8 feet falling, range 9-10 feet) and 19 August (8-10 feet rising, range 10-11 feet) . Figure 44 dramatically illustrates these differences.

It is obvious that the high tides, which covered sandbars and reduced the haulout area, account for the lower number of animals observed. The observation of fewer animals (N) and fewer sightings (n) in both June and August 1976 at plus tides support this (Figure 44). However, since no minus tide surveys were made, movement of animals at the end of the breeding season and seasonal distribution ranges (Calkins, et al. , 1975) cannot be discounted as explanations for disparities in numbers of seals observed. Since harbor seals molt from late July to late September (Bishop, 1967) one might expect to see more animals hauled out during August than June. We will attempt to arrange a minus tide survey for August 1977 to examine this.

Movements of harbor seals are poorly understood. In April 1976 we surveyed the Port Heiden-Port Moller area. This was a heavy ice year, and both bays were frozen over; consequently no animals were observed. In less severe years animals have been observed to haul out in these areas during the late winter and early spring (Mathisen and Lopp, 1963) , though in numbers greatly reduced from those of June and August. Burns (pers. comm.) has collected

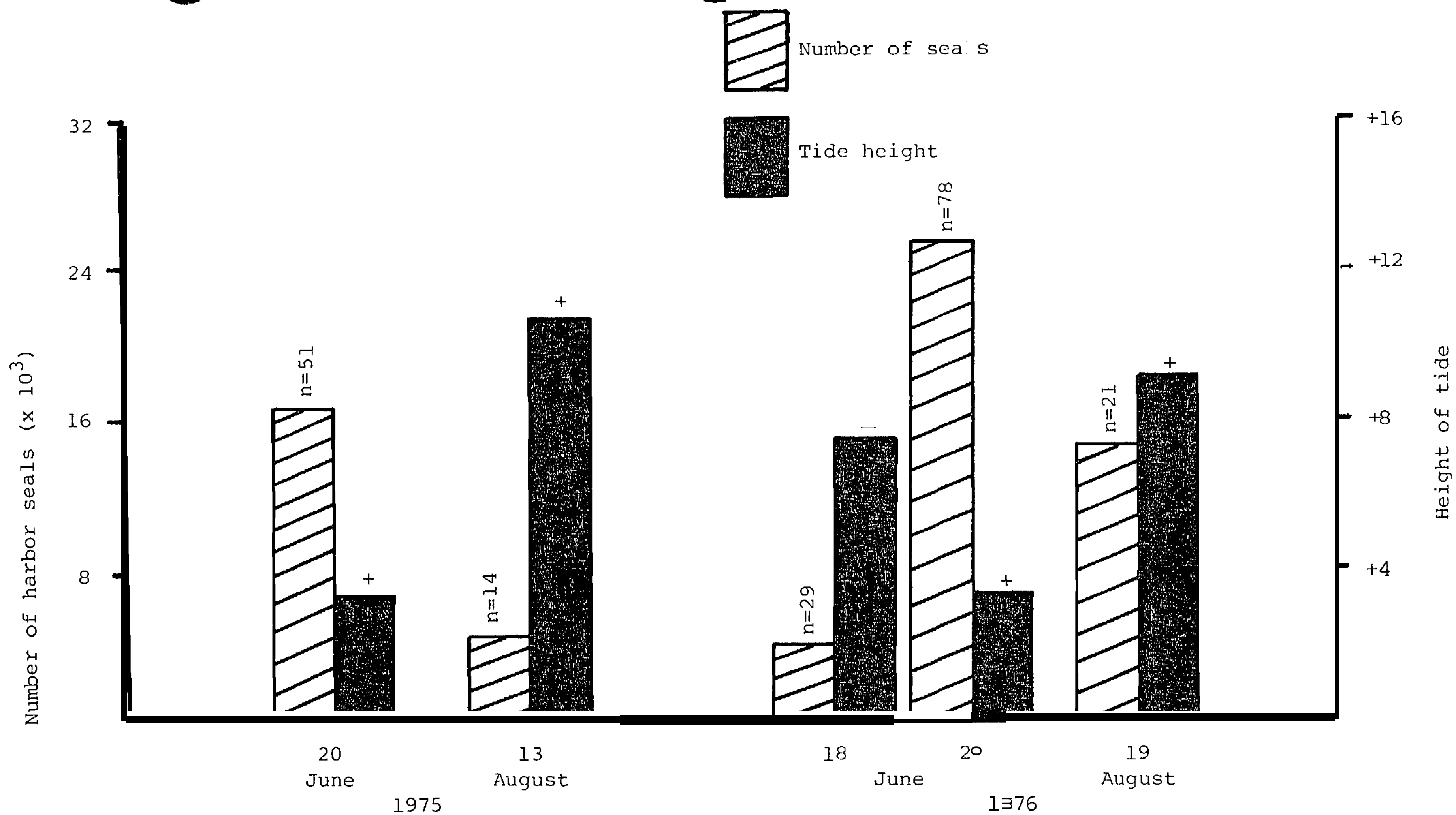


Figure 44. Numbers of harbor seals (Phoca vitulina) hauled out along the north coast of the Alaska Peninsula with respect to tidal conditions. n = the number of sightings, and ± whether the tide was rising or falling. Tide height was averaged for each survey day.

a few land-breeding <u>Phoca vitulina</u> from the ice edge in March and April 1976. Apparently some animals disperse to the pack ice in winter. This might be especially true if the pack ice extended far into the southern Bering Sea as it did in 1976. What proportion of the population doing this is inknown, and whether this is a yearly behavior or something that occurs only when landfast ice is extensive is as yet unclear. It is also possible that an unknown proportion of the population shifts to the ice-free Aleutian Islands in winker. A survey of these areas would be useful.

Surveys for harbor seals on the north coast of Bristol Bay did not reveal any major hauling areas, although pods were observed on Hagemeister Island (20-200 animals) during the June and August 1975 surveys. Small groups (1-5) were observed in the water throughout the coastal area.

Harbor seals were present throughout the eastern Aleutian Islands. Heavy concentrations were regularly observed on the Baby Islands and rocks off the northwest end of Tigalda Island. In all other areas, animals were observed in small groups hauled out on rocks and beaches. Tidal influence is important in this area too, as many of the offshore rocks used by seals are awash at high tide.

The survey in June 1976 gave us our largest count of harbor seals, throughout the study area. The total number of animals observed during this survey was 25,802. Heavy fog on the south side of Umnak and Unalaska Islands prevented a survey there. A total of 912 animals were observed in the Aleutian Islands during this survey. Obviously many more would have been counted had weather permitted.

In August 1976, favorable weather (plus lower tides) allowed for a total survey of the eastern Aleutian Islands; 4,023 harbor seals were observed. Using this total with the June figures for the north side of the Peninsula and Bristol Bay, an estimate of at least 28,000-30,000 animals were present in the study area.

Pups were observed in all areas surveyed. Since pups are considerably smaller and darker than adults and thus easily missed, few observations were made and no reliable estimate can be made at this time from our data. Assuming that 32% of the female population was parturient (Bishop, 1967), we expect at least 8,900-9,600 pups were produced in 1976.

<u>Cetaceans</u>

Data on cetacean distribution and relative agundance throughout Alaska come primarily from NOAA ships chartered under OCSEAP, and from those ships participating in the Platform of Opportunity Program. Sighting records came from observers onboard vessels from 1958 to the present.

The number of whales and porpoises sighted during the 1976 field season (other than bowhead and beluga whales) are summarized chronologically in Table 10. Cruise periods from which data were collected are listed in Table 2. Most large cetaceans appeared in the Bering Sea from May to October, with the peak abundance occurring in June (Figure 45) . The total number of species by sector and total number of sightings for all cetaceans

Table 10. Sighting records of cetaceans during vessel and aerial surveys in the study area in 1976.

Survey Dates	General Location	Species 1/	Number of Animals	Type of Survey 2/
2 April	off S. Unimak Is.	13A	1	V
9 "	Unimak Pass	OO	10	V
13 "	E. Aleutian Is.	OO	3	V
16 "	20 mi. S. of St. George	BA	1	V
21 "	central Aleutian 1s.	PP	5	V
24 "	S.W. Bristol Bay	BA	2	V
25 "	S.W. Bristol Bay	BA	1	V
26 "	S.W. Bristol Bay	BA	1	V
26 "	100 mi. W. of St. Paul Is.	BA	1	V
27 "	100 mi. W. of St. Paul Is.	BA	4	V
27 "	E. Aleutian Is.	00	3	V
30 "	off St. Paul Is.	00	1	V
Apri 1	S. central Bering Sea	PD	51	V
11 May	W. St. Paul Is.	PP	5	V
25 "	N. of Unimak Is.	ZC	1	V
27 "	N. of Pribilof Is.	OO	3	V
May	central Aleutian Is.	PD	10	V
May	S. of Pribilof Is.	PD	23	V
7 June	off tip of Alaska Peninsula	BA	1	V
12 "	N. of Unalaska Is.	BA	3	V
12 "	240 mi. E. of Pribilof Is.	BP	4	V
13 "	S. E. Bering Sea	BB	1	V
13 "	240 mi. E. of Pribilof Is.	BP	2	V
18 "	E. Aleutian Is.	PP	5	V
18 "	N. of Unalaska 1s.	BA	1	V
20 "	N. of Unalaska Is.	BA	1	V
30 "	central Bristol Bay	PP	2	V
30 "	western Bristol Bay	BA	1	V
June	E. Aleutian 1s.	PD	2	V
22 July	60 mi. S. of St. George	BA	1	V
July	S. E. Bering Sea	PD	3	V

Table 10. cont.

Survey Dates	General Location	Species 1/	Number of Animals	Type of Survey 2/
18 August	Unimak Pass	BA	7	A
19 "	Unimak Pass	BA	8	A
20 "	Unimak Pass	00	13	A
21 "	Unimak Pass	BA	2	A
24 "	N. of St. Lawrence Is.	MN	10	A
24 "	N. of St. Lawrence Is.	00	3	A
25 "	W. Bering Strait	MN	4	A
21 October	Unimak Pass	BA	1	V
October	Unimak Pass	PD	5	V

1/ BA - minke whale
BB - sei whale
PD - Dan porpoise
00 - killer whale
PP - harbor porpoise
BP - fin whale
ZC - goosebeaked whale
MN - humpback whale

2/ A - aerial
V - vessel

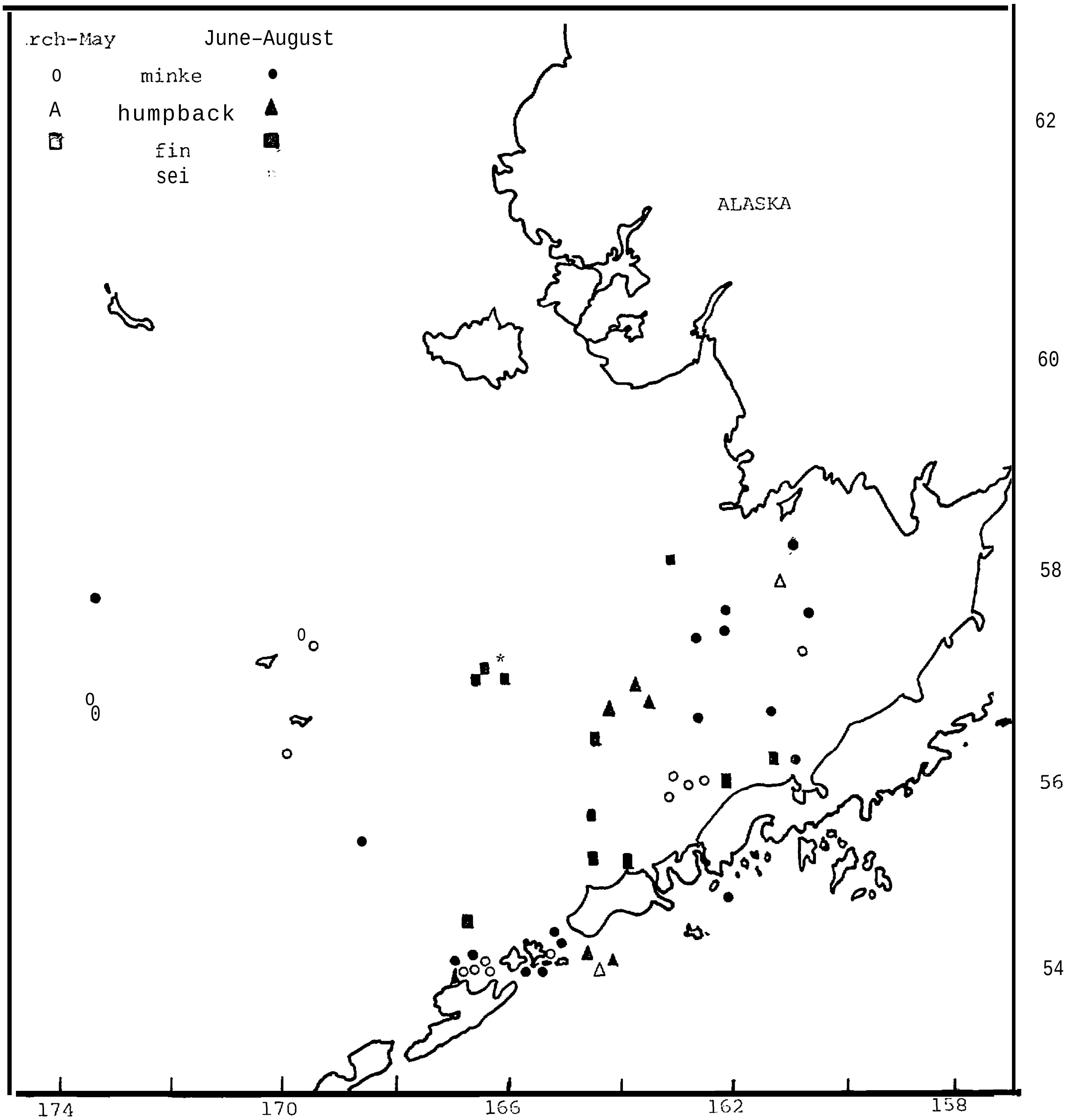


Figure 45. Seasonal sightings of large cetaceans in the S.E. Bering Sea from 1952 to 1976.

from vessel data are listed in Table 11. Again, the month with the greatest relative percent of all sightings was June. We have not been able to quantify sightings per unit effort, thus the interpretation of peak abundance in June is biased because more ships were in the Bering Sea during the summer than during other months. This interpretation is, however, consistent with the general movements of some whales reported by Nasu (1963, 1966) and Ivashin and Rovnin (1967).

The two most common species sighted in the southern Bering Sea were the Dan porpoise and the minke whale. A plot of Dan porpoise sightings is in Figure 46. North of 59° N. Lat., gray, humpback and sperm whales were the most frequently sighted. Harbor and Dan porpoise and minke and fin whales appear more frequently south of 61° N. Lat. (Figures 45 and 46) . Killer whale sightings in the southern Bering Sea are plotted in Figure 47.

Some species are not commonly found in the Bering Sea. Since 1958, a few sightings have been made south of 61° N. Lat. : goosebeaked whale (1); pilot whale (3); false killer whale (l); Pacific white-sided dolphin (l); blue whale (l); and right whale (l). We can only speculate at this time as to the reliability of some of these sightings.

During our October 1976 cruise along the Fox Islands in the eastern Aleutian Islands, 45 cetaceans were observed: 30 Dan porpoises; 4 killer whales; 2 minke whales; 2 sei whales; 1 fin whale; 2 humpback whales; and 4 unidentified whales. High winds reduced sighting ability. The objective of this cruise was to ascertain if the gray whale migrates south through Unimak Pass in the fall; however, no gray whales were seen.

During surveys of the Bering Sea in 1976, gray whales were the most common cetacean sighted. A chronological summary of all reported 1976 sightings is reported in Table 12. The earliest known sightings of gray whales in the Bering Sea were recorded during 1976 on 10, 18 and 24 April by independent observers (Table 12) . The 18 April sightings were made within a few kilometers of the north side of the Alaska Peninsula. It was along this same stretch of coast that many sightings were made in June during the sea lion-harbor seal survey. The consistency of the numbers of grays migrating along this part of the coast suggests that the species remains as close to shore as it does in California.

The literature would suggest a direct northerly migration across the Bering Sea to the west side of St. Lawrence Island (for a complete summary, see Rice and Wolman, 1971). If this were the case, one would expect more sightings near the Pribilof Islands than are known to exist (Gilmore, 1959; Fay, pers. comm.; our data). We believe that gray whales remain near the coast throughout their migration north, moving along the Alaska Peninsula, north coast of Bristol Bay, and then to the east end of St. Lawrence Island. Aerial surveys from 1976 support this hypothesis (Figure 48) .

Several hundred gray whale sightings were made north, west and east of St. Lawrence Island in June 1976 (Table 12, Figure 49). The chief behavior observed was feeding. Although it has been well established that gray whales feed near St. Lawrence Island and in the northern Bering Sea and southern Chukchi Seas (Ichihara, 1958; Nasu, 1960; Wilke and Fiscus, 1961;

Table 11. Numbers of cetaceans and sightings in four geographic areas of the Bering and Chukchi Seas studied under RU 67. Maximum sightings have been converted to a percent value for the month with the greatest number of sightings. The most common species seen is also reported by sector. See text for a description of the sectors with respect to Figure 1.

Sector	Total Sighting	Total Species	Max. Sightings Percent-Month	Most Common Species Seen
1	629	12	49.3% June	Dan Porpoise Minke Whale
2	1029	12	24.2% June	Dan Porpoise Minke Whale
3	27	2	48.1% June	Dan Porpoise Killer Whale
4	115	5	84.3% June	Gray Whale Sperm Whale

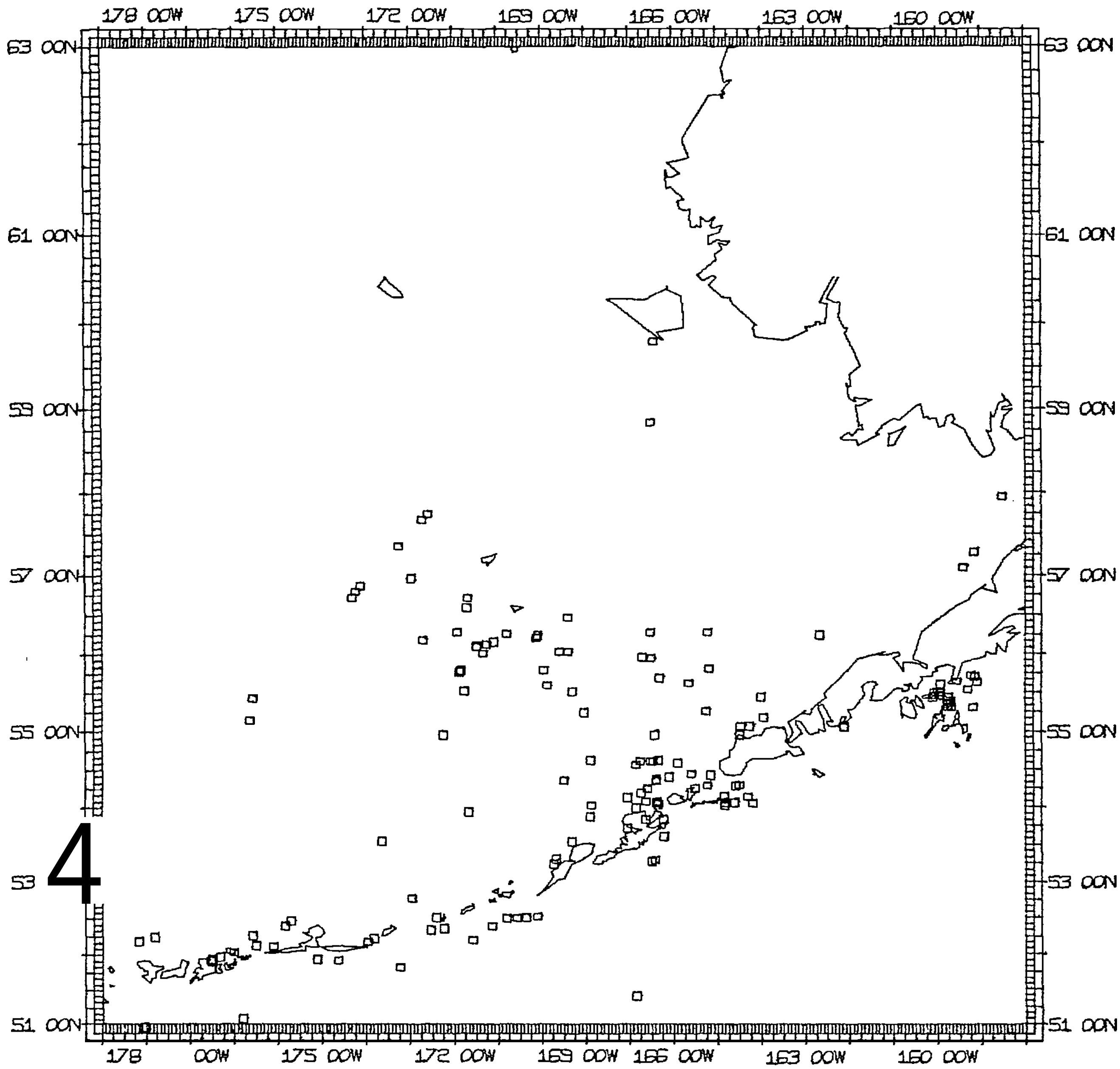


Figure 46. Dan porpoise (<u>Phocoenoides dallii</u>) sightings in the southern Bering Sea and North Pacific, collected since 1958. Most sightings occurred in the summer months.

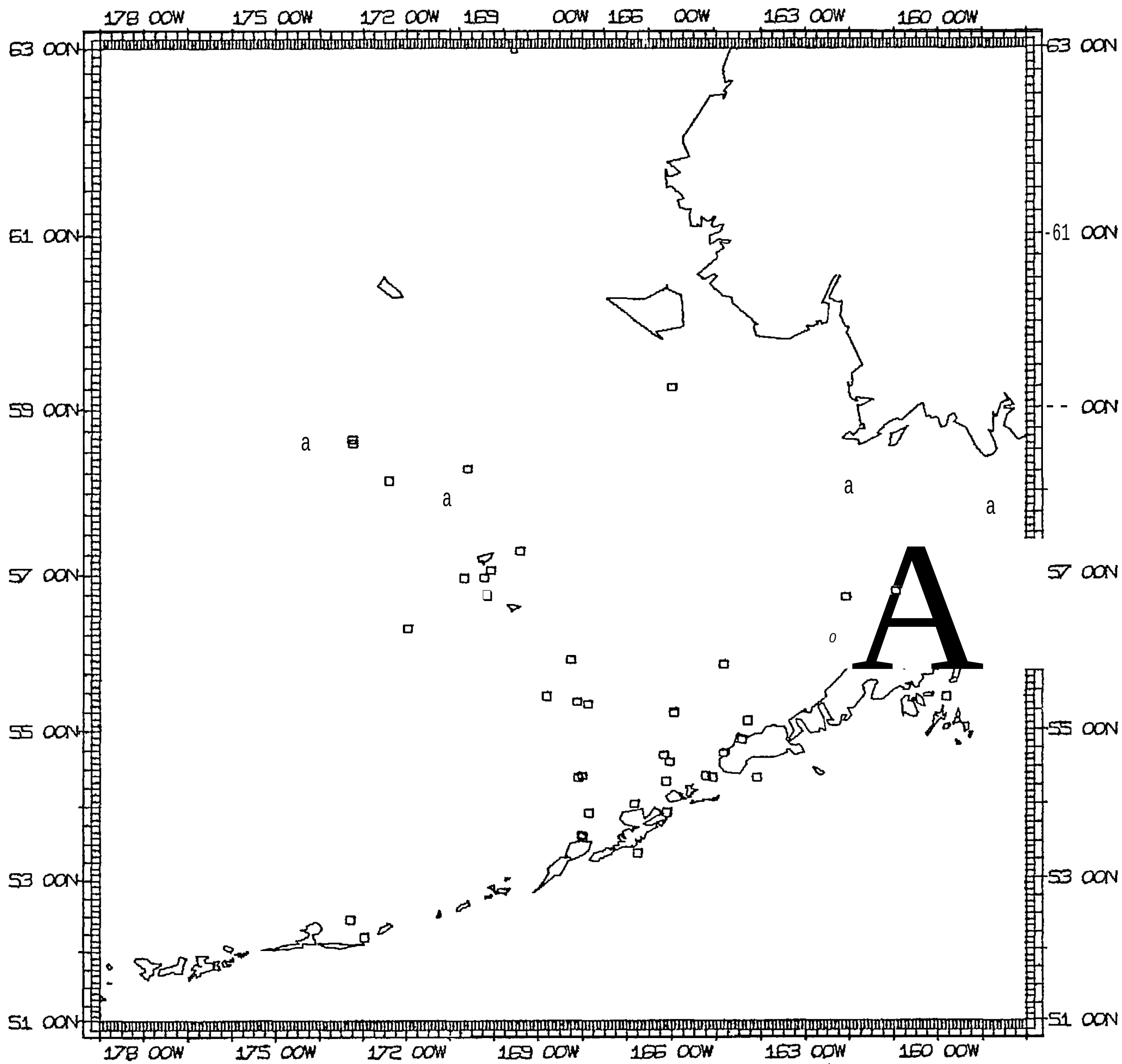


Figure 47. Killer whale (Orcinus orca) sightings in the southern Bering Sea from data collected since 1958. Most sightings occurred in the summer months.

Table 12. Sighting records of gray whales (Eschrichtius robustus) during vessel and aerial surveys in the study area in 1976. Numbers may include replicate sightings on succeeding days (e.g., 11 & 12 June: St. Lawrence Is.) or replicates on the same day (e.g. , 15 June: 55 one way, 51 return trip).

Survey Dates	General Location	Number of Animals	Type of Survey 1/
10 April	E. of Pribilof Islands (ice edge)	1	FF
18 "	S. E. Bristol Bay, along coast	5	A
24 "	S. Bristol Bay	3	V
3 May	near Pribilof Islands (west side)	4	V
7 "	between St. Lawrence Is. & Cape Romanoff	2	F
12 "	just south of St. George	1	V
26 "	S. W. Bristol Bay	1	V
30 "	along Alaska Pen.; Pt. Heiden - Pt. Moller	35	FF
8 June	Unimak Pass	5	V
9 "	120 mi. S. of St. George	2	V
9 "	N. of St. Lawrence Is.	73	A
10 "	N. of St. Lawrence Is.	21	A
11 "	N. of St. Lawrence Is.	145	A
12 "	N. of St. Lawrence Is., and E. & W. coasts	281	A
12 "	W. side of St. Paul	3	V
14 "	20 mi. S. of St. George	1	V
15 "	King Salmon to Pt Moller	106	A
18 "	Alaska Peninsula	54	A
20 "	Alaska Peninsula	76	A
19 August	off Pt. Moller	1	A
20 "	W. along coast of Pt. Barrow	1	A
21 "	N. mouth of Kotzebue Sound	4	A
23 "	mid-Chukchi Sea	6	A
24 "	30 mi. off N.E. coast of St. Lawrence Is.	8	A
25 "	just S. of Bering Strait	24	A
25 "	S. coast of St. Lawrence 1s.	5	A
25 "	midway, St. Lawrence Is. & Seward Pen.	33	A
16 September	W. of Barrow, along coast	1	A

1/ F = G. Fedoseev, TINRO, Magaden, USSR
FF = F. Fay, Univ. Alaska, Fairbanks
A = OCSEAP aerial survey
V = OCSEAP vessel survey

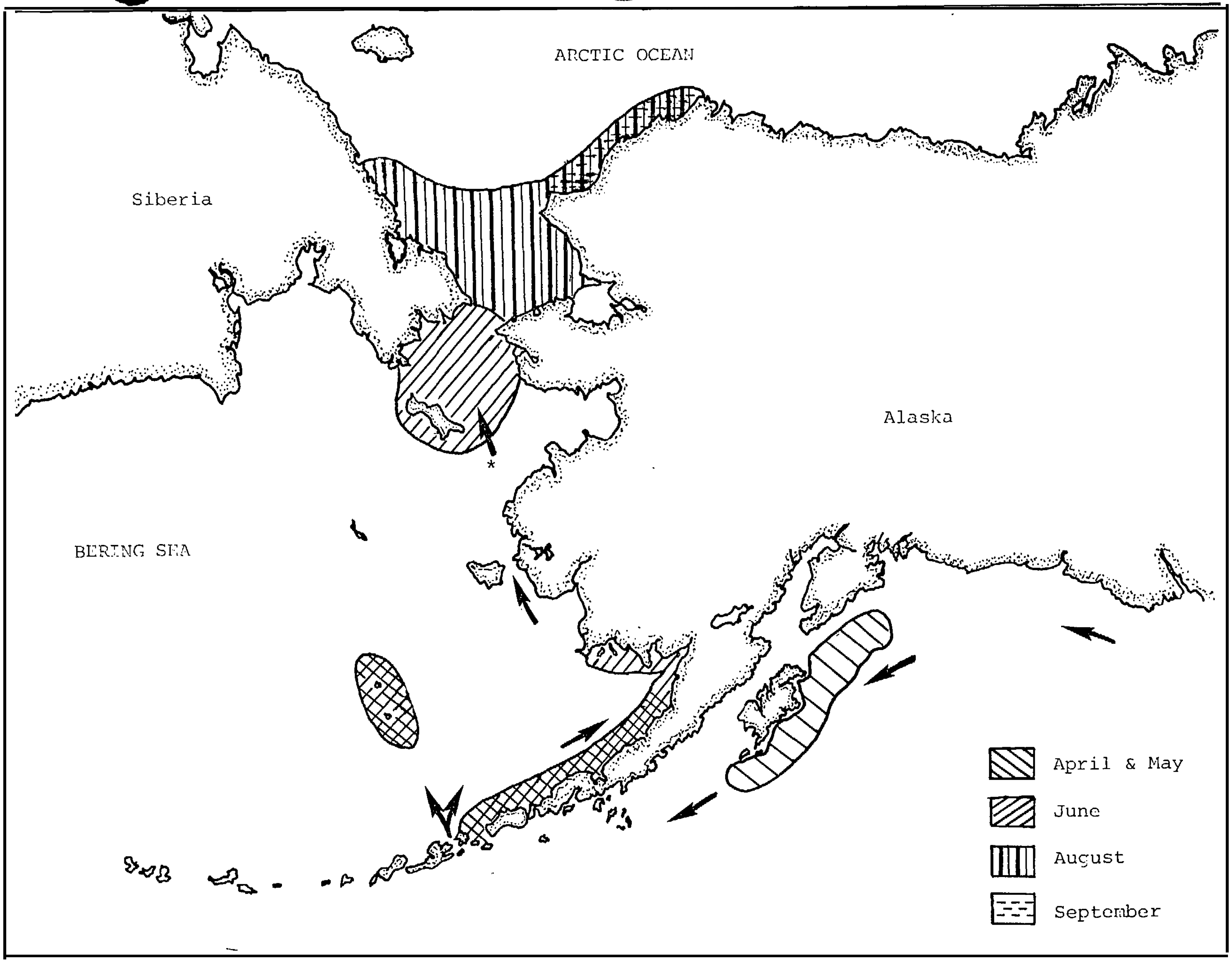


Figure 48. Monthly Eschrichtius robustus distribution projections based on RU 67 and RU 68 OCSEAP data and historical records. Arrows depict the projected migration route. The asterisk (*) depicts May 1976 sighting from G. Fedoseev (pers. comm.). See text for explanation of fall migration route.

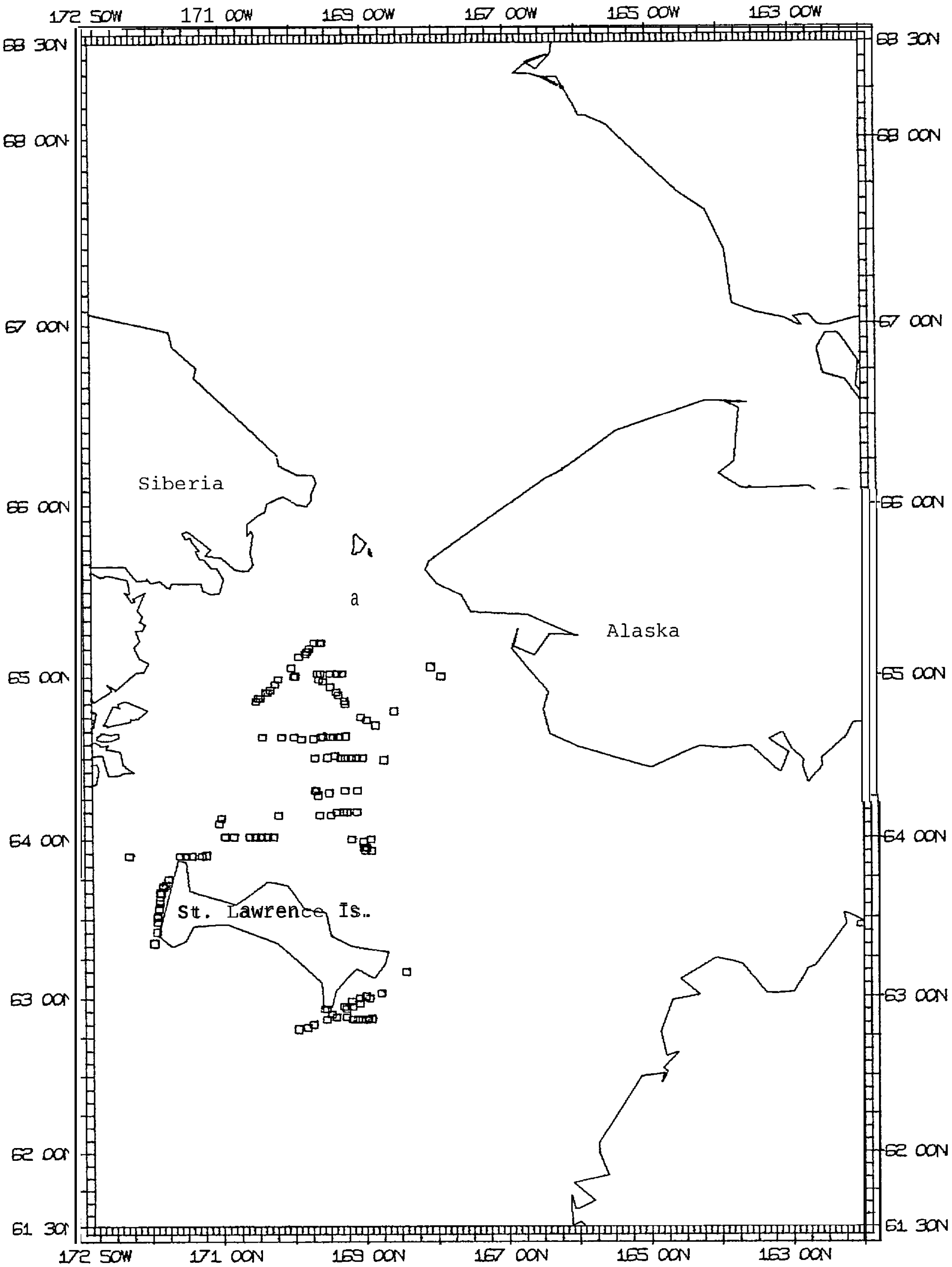


Figure 49. Gray whale (Eschrichtius robustus) sightings in the northern Berinq Sea in June 1976.

Rice, 1965; Fedoseev, 1966; Shurunov, 1970), our sightings strongly suggest that the lagoons and near-shore coastal areas southeast and west of St. Lawrence Island are very important feeding grounds for this species.

VII. Conclusions and Recommendations

Through analysis of the sighting information from the literature, from unprocessed data in our files, and from our records in the field over the past two years, several important patterns are beginning to emerge. The most important of these is that, for the Bering and Chukchi Seas, we generally have good quantitative and qualitative information on pinnipeds, but for most cetaceans very little is known. This is especially true for the lesser known species, and for those not generally harvested in the North Pacific. The second most striking problem is that temporally and spatially the range of information about most species varies dramatically. For instance, in outer Bristol Bay, assuming a heavy ice year, a good amount of sighting information exists (more for pinnipeds than for cetaceans) during the spring and early summer, yet very little is known about marine mammals' distribution in the fall and winter. The reverse is generally true for the northern Bering Sea-Chukchi Sea, especially for cetaceans in the fall (some good information) and spring (very little information). It is also apparent that for certain times of the year, with respect to certain species, the various oil lease sites change in importance (Table 13). For example, if a heavy ice year occurs, breeding ice seals are likely to haul out on ice which has formed in the St. George and Bristol Bay oil lease basins. Unfortunately, many data gaps still exist.

To illustrate the discrepancies in the amount of information that is known (+) or not known (-) -- data that tell us if a species is or is not expected to occur in a particular oil lease area and/or if the animal exhibits any seasonal behavior -- a simple rank test of + versus - information can be made (from Table 13). By scoring the number of species for each oil lease area as to 1) animal not known to occur in area (+A) [blanks in Table 13], 2) animal may exhibit migration, feeding or breeding behavior but specific information is lacking (-B) [dashes and * in Table 13] , and 3) some details of habitat use are known (+C) [W,Sp,Su,F in Table 13], a better fix on our state of knowledge can be gained.

	Number of Animals of 24 spp.		
	(+A)	(-B)	(+C)
Aleutian Shelf	7	11	6
St, George Basin	2	12	10
Bristol Bay	7	8	9
Norton Basin	3	12	9
Kotzebue Basin	2	13	9
Total (÷5)	4.2	11.2	8.6

Of the 24 species of marine mammals that are believed to occur in the Bering Sea, we have little or no reliable information on 11 (an average for all lease sites). Approximately nine species are reasonably well understood (i.e., natural history and distribution/abundance information has been quantified in at least a general way) , and on the average, four species are absent from each lease area. Accordingly, we have information on about 50% of the species of marine mammals in the oil lease areas, which means

Table 13. Summary of proposed marine mammal habitat use by season in the Bering Sea and Chukchi Sea OCS oil lease areas (or important adjacent area*). Three major use factors were selected for comparison: mig = migration; rep = reproductive behavior (breeding and calving/pupping); fed = feeding. The seasons are: winter (W) = January-March; spring (Sp) = April-June; summer (Su) = July-September; fall (F) = October-December; Yr = year round. Blanks represent data gaps; dashes (-) mean that species is not known to occur or behavior is not noted for this lease area; asterisk (*) means that behavior or occurrence exists but no specific details are known; Bn = basin.

Species	OCS Oil-Gas Lease Areas														
	E.Aleutian*			St.George			Bristol Bay			Norton Bn.			Kotzebue Bn.		
	Mig	Rep	Fed	Mig	Rep	Fed	Mig	Rep	Fed	Mig	Rep	Fed	Mig	Rep	Fed
Carnivores															
bearded seal				WSp	Sp	WSp	WSp	Sp	WSp	WSu	Sp	Yr	W	Sp	Yr
harbor seal		Sp	Yr		Sp	Yr	FW	Sp	Yr						
larga seal				W	Sp	WSp	W	Sp	WSp	WSp		SUF	F		SUF
no. fur seal	FSp		F	FSP	SpSu	Su									
no. sea lion		SpSu	Yr	SpSu	SpSu	Yr	Sp	SpSu	Yr						
ribbon seal			-	WSp	Sp	WSp	WSp	Sp	WSp	Su		SUF	Su		
ringed seal				WSp	Sp	WSp	WSp	Sp	WSp	W	Sp	Yr	W	Sp	Yr
sea otter		SuYr	Yr					SuYr	Yr						
walrus				WSp	-	WSp	WSp		WSp	WSp	Sp	WSp	WSp	Sp	Yr
Baleen whales															
blue	*	*	*												
bowhead				*			*			Sp			Sp		
fin	Sp		Su	Su		Su				SUF		Su	SUF		Su
gray	F?			Sp	-	Su	Sp	-	Sp	SpF		Spsu	SUF		Spsu
humpback							Spsu	-		Su		Su	Su		Su
minke	Sp		Spsu												
right	*	*	*												
sei	*	*	*	*											

Table 13. cont.

Species	E.Aleutian* Mig	Rep	Fed	St.George Mig	Rep	Fed	Bristol Bay Mig	Rep	Fed	Norton Bn. Mig	Rep	Fed	Kotzebue Bn. Mig	Rep	Fed
Toothed whales															
beluga									Yr			Yr		Su	Yr
Dan porpoise	*	*	*	*	*	*	*	*	*						
goosebeaked															
harbor porpoise	*		*	*		*	*		Yr	*		*	*		*
killer	*		*	*		*	*		*	SUF		Su	SUF		Su
sabertooth															
sperm						Su									

(OCS Oil-Gas Lease Areas)

a 50% data gap for the RU 67 study area!

From the 1976 data, the following recommendations are presently considered the most important:

1. The gray whale migration route should be completely delineated, and the importance of specific feeding areas in the Norton and Hope Basin oil lease sites should be determined. No energy development activity should begin until we can predict (with better certainty) how vulnerable the species might be to coastal and offshore perturbations.

2. Two problems with respect to cetacean sightings must be resolved -- one, reliability of sightings is presently only good to poor, owing to lack of training for non-scientific personnel; and two, much data exist on cetaceans in the Bering Sea but no resources are available to extract the records. Support for the Platforms of Opportunity Program and/or more trained observers aboard more vessels is essential.

3. Ground truth methodology must be determined and a reliable means of assessing population abundance estimates made before any adequate sampling can be done for a monitoring program once energy development activities commence. For pinnipeds, sea lions are the best choice, and for coastal cetaceans, gray whales are best.

4. An assessment of harbor seal (especially) and northern sea lion movement onto and off of rookeries and ice during the winter and early spring months should be made. Harbor seals' apparent dependency upon protected tidal bays make them vulnerable to direct impact. Sea otters probably pose the same kind of habitat vulnerability problem (e.g., in Bechevin Bay).

5. A true "synthesis" of data means that comparable data are pooled and treated (tested) together. A summary or compilation of statistically measurable variables does no juctice to the overall enhancement of sample size when tested together. We recommend that funding be made available to one group or a team of investigators who can, first, identify the data overlaps and synthesize all comparable marine mammal data collected under OCSEAP, and then expand this to include other ecosystem-related parameters.

LITERATURE CITED

NOTE : Complete citations for those sources listed in incomplete form will be found in An Annotated Bibliography on Marine Mammals of Alaska by Nancy Severinghaus and Mary Nerini. (See this list.)

Alaska Department of Fish and Game.
1973. Alaska's wildlife and habitat. Alaska Dep. Fish Game, State of Alaska, 144 p.

Anderson, D. R., J. L. Laake, B. R. Crain and K. p. Burnham.
1976. Guidelines for line transect sampling of biological populations. Utah Cooperative Wildl. Res. Unit, Utah State Univ. , Logan, 27 p.

Berzin and Rovnin, 1966.

Bigg, 1973.

Bishop, 1967.

Burnham, K. P. and D. R. Anderson.
1976. Mathematical models for nonparametric inferences from line transect data. Biometrics 32:325-336.

Burns, 1970, 1973.

Burns and Harbo, 1972.

Burns, J. and L. Lowry.
1976. Trophic relationships among ice inhabiting phocid seals. OCSEAP July-September quarterly rep., RU 232, p. 127-143.

Calkins et al., 1975.

Caughley, G.
1974. Bias in aerial survey. J. Wildl. Manage. 38(4) :921-933.

Caughley, G., R. Sinclair and D. Scott-Kemmis.
1976. Experiments in aerial survey. J. Wildl. Manage. 40(2):290-300.

Erickson, A. W. and D. B. Siniff.
1963. A statistical evaluation of factors influencing aerial survey results on brown bears. Trans. 28th No. Amer. Wildl. Nat. Res. Conf. , 4-6 March 1963, p. 391-409.

Fay, 1974. (1974a in Bibliography).

Fedoseev, 1966, 1973, 1975.

Fedoseev and Shmakova, 1976.

Fiscus and Baines, 1966.

Fiscus et al., 1976.

Gentry, Roger L.
1970. Social behavior of the Steller sea lion. Ph.D. dissert., Univ. Calif., Santa Cruz, 113 p.

Gilbert, J. R.
1975. Review of census methods for marine mammals. Mar. Mamm. Comm. final rep., Contract MMC-20, 122 p. (unpublished manuscr.)

Gilmore, 1959.

Hatler and Darling, 1974.

Hayne, D. W.
1949. An examination of the strip census method for examining animal populations. J. Wildl. Manage. 13(2):145-157.

Ichihara, 1958.

Imler and Sarber, 1947.

Ivashin and Rovnin, 1967.

Johnson, M. L., et al., 1966.

Kenyon, 1960 (1960b in Bibliography), 1962 (1962b in Bibliography).

Kenyon and Rice, 1961.

Klinkhart, 1966, 1967.

Kosygin, 1966 (1966c in Bibliography), 1971.

Maher, 1960.

Mathisen, et al., 1962.

Mathisen and Lopp, 1963.

Meyers, C. J. and A. D. Tarlock.
1971. Selected legal and economic aspects of environmental protection. The Foundation Press, Inc., Mineola, N. Y., 410 p.

Mizue and Yoshida, 1965.

Moore, 1966.

Nasu, 1960, 1963, 1966.

Nemoto, 1957, 1959.

Nishiwaki, 1967.

Nishiwaki, M.
1974. Status of marine mammals in the Bering Sea. In D. W. Hood and E. J. Kelley (eds.), Oceanography of the Bering Sea, with emphasis on renewable resources. Occasional Publ. No. 2, Inst. Mar. Sci., Univ. Alaska, Fairbanks, p. 279-281.

Nishiwaki, et al., 1956.

Pennycuik, C. J. and D. Western.
1972. An investigation of some sources of bias in transect sampling of large mammal populations. E. Afr. Wildl. J. 10(3):175-191.

pike, 1962.

Pikharev, 1946.

pOpOV, 1976.

Rice, 1965.

Rice and Wolman, 1971.

Robinette, W. L., C. M. Loveless and D. A. Jones.
1974. Field tests of strip census methods. J. Wildl. Manage. 38(l): 81-96.

Sandegren, F. E.
1970. Breeding and maternal behavior of the Steller sea lion (Eumetopias jubata) in Alaska. Master's thesis, Univ. Alaska.

Severinghaus, N. C. and M. K. Nerini.
1977. An annotated bibliography on marine mammals of Alaska. Processed rep. , U. S. Dep. Commer. , Natl. Oceanic Atmos. Admin., Natl. Mar. Fish. Serv., Mar. Mamm. Div., Seattle, Washington, 125 p.

Shaughnessy, 1975.

Shurunov, 1970.

Shustov, 1965 (1965c in Bibliography), 1972.

Sleptsov, 1961 (1961a in Bibliography).

Spalding, 1964.

Thomas and Scheffer, 1962.

Tikhomirov, 1964 (1964a in Bibliography), 1966 (1966b in Bibliography).

Wild, P. W. and J. A. Ames.
1974. A report on the sea otter, Enhydra lutris L., in California. Calif. Dep. Fish Game, Mar. Res. Tech. Rep. No. 20:20-23.

Wilke and Fiscus. 1961.

VIII. Summary of 4th quarter operations - Ru 67

A. Ship or laboratory activities.

1. Ship or field trip schedule.

NOAA ship Miller Freeman, So. Bering Sea (ice front), 14-25 March 1977.

2. Scientific party.

Patrick McGuire, Marine Mammal Division, Seattle, Washington.

3. Methods: field sampling or laboratory analysis.

At the time of this writing, the Miller Freeman has not returned. Discussion of methods deferred.

The major accomplishments of this project during the past quarter involved the finalization of logging, formatting and transforming of data collected during the summer and fall of 1976. Laboratory activities consisted principally of reducing the data to a form which could be easily accessed and thus plotted and synthesized. Computer programming (approximately 10 programs were written by our group) played a major part in making the data available for analysis.

Field format finalization was accomplished. This was necessary to reduce the time it takes to record data in the field, yet provide the maximum amount of information needed for proper reporting. Although we cannot report on the precision of reporting data in this report, after the 1977 spring field season an analysis of data collection procedures will be made. We expect that the results from this analysis of methodology could prove to be one of the most important scientific accomplishments concerning aerial survey techniques.

Other procedures and laboratory activities were completed, including:

a. An aerial survey training package including slides of species encountered, ice conditions and types, etc. The objectives of this project were to minimize internal errors associated with human observational differences by standardizing all aspects of the data collection procedure. This package was a refinement of the one developed prior to the 1976 field season.

b. Completed cataloging of all photographic slides by species and area by research unit. Some 9,000 photographs were processed.

c. Development of a computer accessing report and complete format procedures for logging data and processing the data. These manual-type reports will be included with the final report.

d. Submission in January of "An Annotated Bibliography on Marine Mammals of Alaska".

4. Sample localities/ship or aircraft tracklines.

N/A

5. Data collected or analyzed.

Untold numbers of analyses were performed on the 1976 data. Most dealt with verification of computerized formatting, as well as plotting, density and abundance estimates, tracklines vs. sighting data verification, and incorporation of RU 230 spring data into our storage bank. Some 21,000 nautical miles of trackline flown during 1976 were reviewed during the fourth quarter. Accuracy was verified with respect to location of trackline legs and sighting data.

6. Milestone chart and data submission schedule.

a. Milestone chart for 1977.

Activity	Months - FY 77						
	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.
Aerial survey-Bering/Chukchi Seas	—	— 2	— 3		— ?	—	
Aerial survey-Alaska Peninsula			— 4	—			
Submission of aerial survey data			— 1	— 2,3 4			
Field camp-ground truth study			—	—			
Anticipated vessel cruises-Bering/Chukchi Seas			—	—	—	—	—
Evaluation/analysis of spring data				—	—	—	
Report writing			—			—	

b. Data submission schedules.

The following survey dates have been sent to the Juneau project office in accompaniment with this report. Some (*) were sent in September and November 1976, but an updated format change necessitated resubmission.

15 March	12 April
18 March	13 April
19 March	15 April
21 March	17-22 April
6 April	8-15 June
8 April	18-20 June
9 April	

The following survey dates have either not been processed or not passed our quality control inspection. These surveys will be completed as time permits, but in no case later than the next reporting quarter.

17-20 June 1975
9-13 August 1975
9-14 October 1975
9-10 June 1976
17-27 August 1976
21-25 October 1976

The only remaining survey data in the RU 67 contract area are those from vessels and NOAA ships. Some cruises (5) include data collected by our own personnel, but because of limitations of money and people, we have not completed the computerization (most of the data were analyzed by hand and are included in the Annual Report). Approximately 40 cruises with sighting data have been or are expected to be sent, from OCSEAP and non-OCSEAP ships. Most of these data are incomplete. At this time, we do not have the resources to process them.

B. Problems encountered/recommended changes

It has taken us approximately one quarter longer to finalize data management and processing. The reasons are varied (and mostly of our own doing) ; but formatting, computer delays (e.g. , card punchers were on strike for 2 months) and severe self-imposed quality control measures were pivotal.

We suggest (a reitteration) that a list of PI's and their addresses and telephone numbers be sent to each PI.

C. Estimate of funds expended

Salaries (plus overtime, benefits, etc.)	$12,709.00
Trave 1	204.00
Per Diem	319.00
Equipment/supplies	572.90
Miscellaneous (computer, etc.) (approx.)	1,200.00
	$14,704.90

D. Other activities

1. Conference

Howard Braham, U. S. delegate to the US-USSR Marine Mammal Agreement on Environmental Protection. Summarized OCSEAP research, planned cooperative research with Soviets in the Bering and Chukchi Seas. January 1977, Southwest Fisheries Center, NMFS, NOAA, La Jolla, California.

2. Training

David Rugh, David Withrow and Bruce Krogman attended a course at the University of Washington on marine mammals, in preparation for the forthcoming field season.