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Environmental Assessment of the Alaskan Continental Shelf

Annual Reports of Principal Investigators for the year ending March 1977

Volume III. Receptors — Birds

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration

U.S. DEPARTMENT OF INTERIOR
Bureau of Land Management

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Outer Continental Shelf Environmental Assessment Program

Boulder, Colorado

March 1977

U.S. DEPARTMENT OF COMMERCE
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Environmental Research Laboratory

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Bureau of Land Management

DISCLAIMER

VOLUME III

RECEPTORS -- BIRDS

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ANNUAL REPORT

NOAA OCSEAP
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Research Unit #237

BIRDS OF COASTAL HABITATS ON THE SOUTH SHORE OF THE SEWARD PENINSULA, ALASKA

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March 1977

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A. Objective: To survey major concentrations of marine birds.

1. Seabirds

a) We conclude that the cliffs at Bluff are of major importance to the seabird populations of Norton Sound. The cliffs at King Island are of major international importance.

b) We have identified as secondary but important as alternative population centers the colonies at Sledge Island, Topkok Head, Square Rock, Cape Denbigh, Egg Island and the sand island at the ferry at Safety Lagoon. Other important colony sites for species with dispersed distributions are at Rocky Point, Cape Darby and western Stuart Island.

c) Wide variations in numbers occur hourly, daily and between years. These variations in response to environmental changes mean that one cannot assign a single number to the total population of birds or of breeding pairs at the colonies. It means that about five censuses spaced at weekly intervals are needed to establish a valid spread in numbers.

2. Waterfowl

a) The wetlands in the delta of the Fish River and flats at the head of Golovin Lagoon are the major fall concentrations of waterfowl. Other important areas are at the delta of the Kwik River and at the depositional fan of the Koyuk and Inglutalik Rivers.

Smaller areas such as the wetlands next to the Stuart Island Canal, Taylor Lagoon, the area at the mouth of Bonanza River and the area of the Flambeau and Eldorado Rivers include areas of dense waterfowl gatherings but they are smaller than the major ones.

3. Shorebirds

The mudflats extending northwest from the ferry at Safety Lagoon seem to be the major late summer gathering area for sandpipers and plovers.

B. Objective: To relate marine birds to the ecological structure of the northern Bering Sea.

1. The edges of drift ice, the leads in fast ice and the open water at the mouths of rivers are important gathering places for seabirds and waterfowl in spring.

2. Preliminary surveys over water suggest that murres, kittiwakes and auklets feed in the areas of the main northward flow of water west of Sledge Island rather than in the less saline "gyre" in Norton Sound. The areas southwest, west and northwest of King Island appear to be especially important. Kittiwakes also feed not far off shore. Puffins and cormorants in most cases feed close to their nesting sites.

3. Gatherings of kittiwakes, puffins (and rarely murres) into feeding mélés with which Minke Whales are often associated, have been a conspicuous feature of the near shore waters. The prey appears to be Ammodytes hexapterus.

4. The fish remains most usually found on nesting ledges are Ammodytes, Lumpenus and Oncorhynchus.

5. A storm in late August 1975 evidently caused high mortality of birds (most evidently kittiwakes) nesting on the lowest ledges at Bluff Cliffs. A set of circumstances which suggest food failure are associated with virtually total reproductive failure in kittiwakes and much lowered reproductive success in murres in 1976.

C. Objective: To relate the biological studies to the implications of oil and gas development.

1. Oil spills

a) Sledge Island, King Island and presumably the islands in the Bering Strait, being in the main northward flow of water from the Bering Sea into the Chukchi Sea, are especially vulnerable to oil spills. Oil spills over a wide area of the Norton Basin will probably drift past these colonies. The colonies at Bluff Cliffs and especially those in eastern Norton Sound are out of the main currents. Oil spills there might dissipate slowly.

b) Leads in the ice and at the mouths of rivers are places where marine birds gather in spring and where oil would gather if spilled, thus compounding serious hazards.

The tidal lagoons behind sand bars at Golovin Lagoon, Safety Lagoon and Moses Point (Kwik River) are vulnerable to oil which would persist on the flats if the oil got into the lagoons. This hazard applies primarily to shorebirds.

2. Secondary construction

a) A number of the places where waterfowl gather would be attractive as port sites and for onshore facilities. Traffic of boats and aircraft associated with these activities promise to disturb wildfowl. Helicopter traffic has been shown to cause very serious disturbance and mortality at nesting cliffs.

b) The increase in number of people, especially those of the get-rich-quick attitudes associated with big construction operations in other parts of Alaska, imply disturbance and exploitation of wildlife by "outsiders". The effects include activities associated with housing, recreational travel and hunting.

c) We anticipate direct conflicts of interest between the native claims to private property rights at traditional villages and the state and federal responsibilities toward public property rights to wildlife and the habitat the wildlife depends upon.

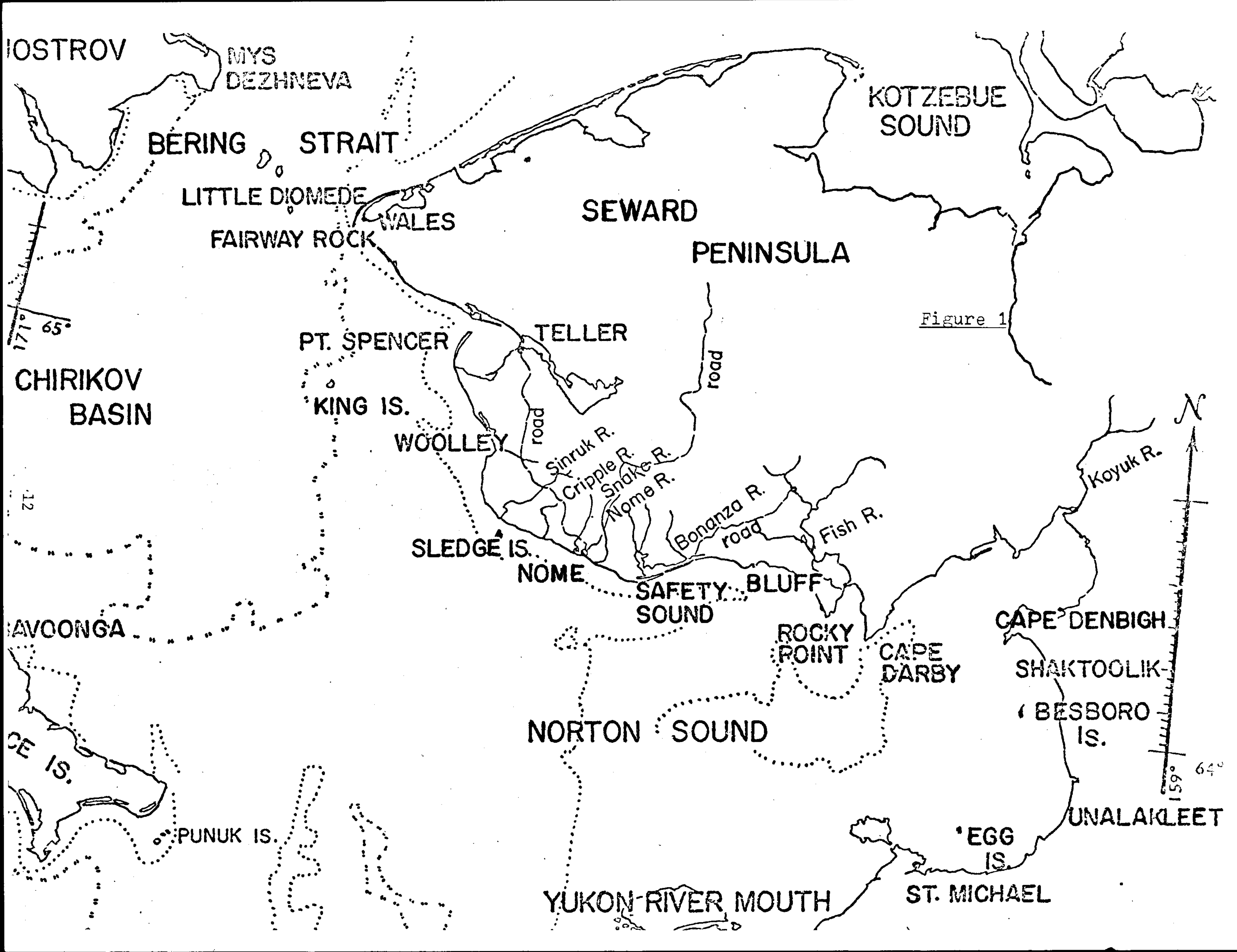
II. INTRODUCTION

A. General nature and scope of the research

This report is part of a study of seabirds in the biological structure of the northern Bering Sea. Its objectives are 1) to increase the knowledge of the ecology of this major world center of number and diversity of seabirds, and 2) to gather information relevant to the formulation of guidelines and stipulations for mineral development.

The Bering Sea is a complex water mass divisible into two major parts. The first occupies a deep basin north of the Aleutian Islands, and the second is spread over a shallow continental shelf extending north from the Pribilof and Saint Matthew Islands through the Bering Strait. The outflow of the Yukon River dominates the shelf waters in the eastern Bering Sea, including the waters of Norton Sound (Figure 1). North Pacific water flows through deep passes between the Aleutian Islands. Some of this water probably contributes to the highly saline water which flows out of the Gulf of Anadyr into the Chirikov Basin and joins with the northwest drift of Yukon River water to move through the Bering Strait. This saline water is characterized by impressively high primary productivity. The Chirikov Basin and western Bering Strait also benefit from unusually high productivity at the ice edges as drift ice retreats northward.

Reportedly, cold bottom water has prevented commercially valuable fishes from extending their ranges into the Chirikov Basin to crop the high diversity of benthic life. But other vertebrates have. Walruses, Bearded Seals, Ringed Seals and Spotted Seals are abundant at the ice edge. Bowhead and Beluga Whales are part of the under-ice and ice-edge fauna. There seabirds formed the food base of a sophisticated pre-colonial Eskimo culture in the Saint Lawrence Island waters and Bering Strait.



OSTROV
MYS DEZHNEVA
BERING STRAIT
KOTZEBUE SOUND
LITTLE DIOMEDE
WALES
FAIRWAY ROCK
SEWARD PENINSULA
171° 65°
TELLER
PT. SPENCER
road
CHIRIKOV BASIN
KING IS.
WOOLLEY
road
Sinruk R.
Cripple R.
Snake R.
Nome R.
Koyuk R.
Bonanza R.
road
Fish R.
SLEDGE IS.
NOME
SAFETY SOUND
BLUFF
AVOONGA
ROCKY POINT
CAPE DARBY
CAPE DENBIGH
SHAKTOOLIK
BESBORO IS.
NORTON SOUND
159° 64°
UNALAKLEET
PUNUK IS.
EGG IS.
ST. MICHAEL
YUKON RIVER MOUTH

Figure 1

Although seabirds are numerous in Norton Sound, fewer species and smaller numbers occur there than in the Saint Lawrence Island waters and Bering Strait. Our research examines why there are similarities and differences.

B. Specific objectives

Specifically this study is a survey of the seabirds, waterfowl and shorebirds along the shores and islands of the Seward Peninsula. What marine birds occur in what numbers and at what places? What is the schedule of breeding events and how is that schedule related to the weather? What natural sources of stress affect them? Which areas are most important for wildlife?

The study is divided into three main parts. The first examines the coastal distribution of waterfowl. What is the seasonal distribution of waterfowl in coastal waters, lagoons and beaches? What fresh and brackish wetlands are most important gathering places before and during migration? What redundancy of resources is necessary to allow populations to survive periods of stress? Are there obvious effects of out-of-season hunting?

The second part of this study examines the distribution of sandpipers and plovers. What habitats are used by shorebirds for breeding or for gatherings before and on migration? Does the presence of people disturb them on their breeding or gathering areas?

The third study is the main focus. It is a study of the breeding biology of seabirds. This project is in two parts:

1) Continuing detailed studies are being made at the cliffs at Bluff between Nome and Golovin. At Bluff we have established 19 study sites at which individual nests of kittiwakes, murres and puffins are

mapped and visited every other day. Events at the nests were recorded between the end of May and the second week of October in 1976.

2) Surveys, censuses and short-term studies have been made at other colonies such as the major one on King Island and the minor ones on Sledge Island, Cape Denbigh, Egg Island, Cape Darby and Topkok. We have surveyed the shore and islands of the Seward Peninsula for all the seabird nesting areas between Teller and Stebbins. In the future we hope a) to survey the important colonies at Fairway Rock and on Little Diomede Island, and b) to work on the distribution, behavior and diet of birds offshore on their feeding grounds.

C. Relevance to problems of petroleum development

As we argued at a symposium on marine birds held at Seattle in May 1975, it appears that the sweeping generalizations of most current ecological theory will not be helpful in plans to assist seabird populations through the periods of stress promised by economic development in the Bering Sea.

It is our experience that the awkward details of seabirds' daily behavior, many of which seem to clash with general theory, are the "stuff" which really makes natural systems work. But there is not enough time to carry out the detailed studies needed to identify the critical population-habitat interactions before designing programs to help seabirds maintain their numbers. Because detailed studies take too much time and because much ecosystem theory is more of "heuristic" than practical value, we conclude that it is necessary to identify those biological characteristics of seabirds which are most relevant to their survival. A knowledge of these ecological characteristics and habitat needs will allow us to make predictions about the impacts which development of mineral resources may bring.

III. CURRENT STATE OF KNOWLEDGE

A. Recently, knowledge of numbers and distribution of marine birds at sea on Alaska's continental shelf and on shore has increased phenomenally.

1) A good deal is now known about species' distributions and the numbers of individuals which make up the major and most of the minor sea-bird colonies. There are still some colonies on the American shore for which recent counts are not available, and little is known about the colonies on the Siberian shore. As to Norton Basin, colonies in the Bering Strait need to be surveyed. Most of the data have been gathered by recent OCSEA projects, but valuable data including historical changes have been gathered by staff of the U.S. Fish and Wildlife Service and the Alaska Department of Fish and Game.

2) The U.S. Fish and Wildlife surveys of waterfowl breeding grounds made during the last four decades have established the distribution of breeding grounds of ducks, geese and swans in northwestern Alaska. We have surveyed the south shore of the Seward Peninsula for the wetlands where migrating waterfowl concentrate. Air transects indicate that waterfowl gather in leads in sea ice in spring. Shipboard transects indicate that they remain within a few miles of the shore during the summer.

3) Little is known about the details of the breeding distribution and numbers of shorebirds, although we have gathered some scattered data at places accessible along the roads out of Nome.

4) A few transects of the waters of Norton Sound and the Chirikov Basin have been taken. During the last two years air surveys have been made in a systematic way, but the surface transects are still primarily on "ships of opportunity". These scattered transects suggest a number of ideas, but are too scattered to allow conclusions.

B. Beginnings have been made in studying the relation of seabirds to their food supply.

1) Studies of the food of the seabirds at Cape Thompson include data on Common and Thick-billed Murres, Black-legged Kittiwakes, Glaucous Gulls and Horned Puffins (Swartz, 1966). Studies of the food of auklets on northwest Saint Lawrence Island were reported by Bédard (1969). We have collected fish that are brought in and dropped on the nesting ledges and have observed fish brought to the cliffs by parents (primarily Common Murres and Horned Puffins).

2) Preliminary check-lists and identification keys to the species of teleost fish and crustacea are available for identifying specimens.

3) Sanger has studied the relation of seabirds to marine food webs of the northeastern Pacific Ocean and Cooney has studied the place of zooplankton in the food webs of the southern Bering Sea. Similar studies are lacking on the small fish (Ammodytes, Osmerus, Mallotus, Lumpenus, Arctogadus, Boreogadus) and larger crustacea (Copepods, Amphipods, Mycids and Euphansids) which would shed light directly on the place of seabirds in the food webs.

C. Studies of physical and chemical oceanography of the Bering Sea have mostly been made in the area of Bristol Bay, the Aleutian Islands and the Bering Sea gyre (Hood and Kelley, Eds., 1974). Some data on water masses and currents in the Bering Strait and Chukchi Sea are published in Wilimovsky and Wolfe (1966) and in Coachman, Aagaard and Tripp (1975). The reasons for the high productivity of the Bering Sea are discussed in general terms. It appears that conditions are sufficiently different in the different parts of the Bering Sea to make it difficult to synthesize the data and ideas. The studies now in progress by Hood, Feder et al., in "the Golden Triangle", and by Alexander, et al., at the ice edge should help to clarify this. The biological structure of the Chirikov Basin and Bering Strait deserves attention because the water masses, currents and food chains seem to have their own peculiar characteristics.

D. The phytoplankton of the Bering Sea region evidently "pumps" an "excess" of energy into the local biological system. These communities take on certain forms and functions to use that energy. How one interprets these forms and functions depends upon assumptions inherent in the thermodynamic models ("open" and "closed" of von Bertelanffy, or "far-from-equilibrium" of Prigogine) one uses to describe the flow of energy through physical (and hence biological) systems. The models used have important implications as to what one expects of the biological structure and species interactions (Drury and Nisbet, 1971), hence the predictions one makes as to environmental impacts.

Because our intellectual models for biological systems are open, we see a number of biological and historical accidents as primary forces determining the fate of the energy which primary producers pump into themselves via photosynthesis. We think that what happens to that energy depends upon local "extemporizations", i.e., the responses of those species that happen to be around.

Because we see the structure of communities as reflecting primarily opportunistic interactions among temporary members, we prefer to regard ecosystem structure only in the most general terms (e.g., Elton's pyramid of numbers) and to concentrate on the natural history characteristics of the species present. Much recent theoretical work has formalized how the "strategies" of one set of organisms, e.g., predators, "should" regularly interact with the "strategies" of other species. Most of these formalizations use deterministic models, i.e., assume that consistent or preferred configurations of species in communities exist over long periods of time. We assume that the general case is changing "partners" in highly fluid community structures, e.g., in some cases predation may lead to decreased diversity at "lower trophic levels"; in other cases predation may result in increased diversity.

We feel that there is some value to identifying the sorts of resources a species needs to find in trophic levels "below" it, but we have found little that is enlightening in discussions of what levels can or should exist in the trophic structures "above" a certain species.

In a paper presented at the Symposium on the Conservation of Marine Birds in Seattle, May 1975, I described those adaptive characteristics of seabirds which determine their responses to the environment or to changes in their environment. The following section is taken from that paper.

E. Some biological characteristics of marine birds and waterfowl.

1. Habitat. Although the shallow oceans, islands and seashores are among the most permanent features of the earth in general, the details of their numbers and distribution change rapidly. Sandy shores are obviously being reworked even in the short time span of one person's lifetime. Distribution of islands and the sediment load, extent and strengths of currents vary constantly in space and change in time.

The food that seabirds use is patchy and subject both to short-term and long-term fluctuations in numbers and shifts in geography. Suitable breeding habitat is scattered and in many places where oceanic conditions provide a good food supply there are no nesting sites. Consequently seabirds aggregate into colonies, often dense ones, and the colonies are clumped for geographical as well as biological reasons.

Lack (1966) discussed some general features of how the breeding adaptations of seabirds are adjusted to the distances the birds must go to find food. a) The species which feed close to the nest characteristically establish isolated territories or nest in small groups, and they will accept many different kinds of nesting substrate. Their clutch-sizes are large and individuals move nesting sites readily. Their young grow rapidly. b) Species which feed far at sea aggregate in large colonies. These species are often rigid in their requirements for suitable nesting sites, their clutches are usually reduced to one egg per season, and there seems to be strong attachment to traditional colony sites. Their young grow slowly.

2. Breeding. Ashmole (1963) suggested that the clutch-size of some oceanic birds is small and colonies occupy only part of the available habitat because food resources within commuting distance of the breeding site are limited. We can see this effect in the usual failure of Common Terns to raise a third chick, even on those colonies which are surrounded by favorable habitat (Nisbet 1973). Herring Gulls whose colonies are close to sources of human refuse raise more young than do those whose colonies are at some distance (Drury 1963; Kadlec and Drury 1968; Hunt 1972).

Ashmole (1963) suggested that during the course of the breeding season the birds exhaust the available food supply. The validity of this is reflected in the long distances some species (petrels, boobies, murres, dovekies) go for food when feeding their young. Therefore one would expect that early nesting pairs would be more successful, and this seems to be the case in Black-legged Kittiwakes (Coulson 1966), Herring Gulls (Nisbet and Drury 1972), and Red-billed Gulls (Mills 1973).

If food is in short supply and parents have to seek over a wide area for food so that they can only bring back a little food at long time intervals, one would expect these birds to have a small clutch and their young to grow slowly, as is the case. One would also expect seabird colonies situated near oceanic currents to be larger and more successful because food is continuously renewed. Conversely one would expect colonies next to still waters to be smaller and less successful.

The small clutch-size of seabirds means that when a population has been reduced, it will grow slowly toward its former abundance. The growth rates of seabirds on the New England coast since their release from human predation reflects this. Species such as Black Guillemot (clutch 2) and Herring Gull (clutch 3) have increased more slowly than have the populations of Common Eiders (clutch 3-6) or Double-crested Cormorants (clutch 3-6) (Drury 1973).

If the species which nest in colonies show a high degree of site tenacity, they are not likely to reestablish a colony once it has been eliminated. An exception to this is the food subsidy provided by man which seems to have been important in creating a non-breeding population of Herring Gulls large enough to form a "critical mass" for the formation of a new gullery.

3. Age structure. Because the main element of population size -- the number of breeding adults -- is limited by the number of breeding colonies and the food available to those colonies, one assumes that the total

numbers of seabirds is less than could be supported by the large areas of productive oceans. Hence one suspects that there is lessened competition for food outside the breeding season and that lack of competition for food is a major reason for seabirds being long-lived, often to extremes little suspected until recently. Mortality rates of 10-12% per year are common and some as low as 4% (Wandering Albatross) (Tickell 1968) have been recorded.

In contrast, large-clutched songbirds such as the titmice studied by Kluyver (1951) produce a large number of young with whom they and other adults must compete for food during the winter period of food shortage. Because the titmice are resident they occupy all of the available habitat throughout the year. Hence titmice suffer intense intraspecific competition and the survival of adults is shortened by it. Kluyver's experiments (1966) on nest boxes used by Great Tits in a closed population on the island Vlieland, the Netherlands, showed that by artificially reducing clutch-size he increased the survival of adults.

Similar competition for the few territories available on marshes and consequent shortened life expectancy, exists in large-brooded waterfowl. It should be less the case with smaller-clutched geese nesting on less confined habitats.

The long life span of seabirds means that a population will have a large component of older age categories and this characteristic has several implications.

a) It means that the population can survive years of reproductive failure without the observable immediate effects that would be manifest in titmice, grouse or rabbits. Near failure of reproduction during a breeding season among arctic seabirds was reported by Bertram et al. (1934) at Bear Island. Similar observations have been made in many places for many species since then: Pitelka et al. (1955) reported such a case among skuas and gulls at Point Barrow; Drury (1961) for Snow Geese at Bylot Island; Jones (1970) for Black Brant gathering at Isambek Lagoon on the Alaska Peninsula; Snarski (1975) for kittiwakes in Cook Inlet. In some cases reproductive failure can be chronic as observed by Nisbet (1972) for terns at Cape Cod, Massachusetts, or by Drury (1963) and Hunt (1972) for Herring Gulls on the outer islands on the coast of Maine.

When reproductive failure becomes chronic, as occurred in Peregrine Falcons (Hickey et al. 1969) and Ospreys (Ames and Mersereau 1964), the population of adults may hold on for a number of years without evident decline. Damage to the structure of the whole population may be serious before any numerical results are evident.

b) Although there may not be intensive competition for food in the habitat away from breeding colonies, there is intense competition for food and breeding sites at and around the colonies. Hence age and previous experience assume importance in establishing territory and in breeding success in seabirds. Associated with this is the tendency for immature birds to delay breeding until they are several years old and for the immatures to remain on feeding grounds at some distance from the colonies. In some cases young birds may "hang around" breeding colonies and even feed some of the young. When young birds do first breed they usually lay smaller clutches and raise fewer young than do older birds. The importance of age and experience on breeding success has been well documented for Black-legged Kittiwakes (Coulson 1966) and Red-billed Gulls (Mills 1973).

The fundamental biological importance of this delayed maturity seems to be emphasized by the persistence for several years of immature plumages, so clearly identifiable that even a human observer can recognize the age of an individual. One assumes such an evident feature must have adaptive significance.

4. Wintering grounds. When colonial nesting seabirds leave their breeding islands for their wintering grounds their identification with that island is lost as far as population effects are concerned, because birds from many colonies mingle together on the wintering grounds. Major mortality takes place on the wintering grounds and must therefore act on the species population as a whole rather than differentially upon individuals associated with especially dense colonies. Such a direct relation between colony density and mortality would be necessary for density-dependent mortality to regulate the number of birds on a breeding colony. Conversely one cannot expect that all colonies will decrease equally because mortality should be equally distributed if all the population gathers on a common wintering ground. Thus density-dependence acts only in a very general way upon the sum of animals conceived as an abstract whole -- the population.

In fact, on the wintering grounds, as shown by a graph of numbers of gulls reported on Christmas Counts on Cape Cod, Massachusetts (Kadlec and Drury 1968), Herring Gulls are very responsive to local conditions and move several tens of miles to gather at favorable feeding sites. An aerial survey of the gulls on the East Coast of the United States (Kadlec and Drury 1968) showed that over half the gulls were gathered near major food sources in large metropolitan districts. A majority of the remainder were gathered near small fishing ports. Very few were scattered along the shoreline in what one assumes is the traditional gull habitat. Later analyses of the relation between the distribution of banding recoveries of birds in their first winter and the distribution of immatures as found on this winter census (Drury and Nisbet 1972) suggested that proportionately more first-year gulls died in those areas where the birds were sparsely distributed than died in the crowded metropolitan areas.

These results suggest both a) that there is not a direct feed-back between reproductive rate and mortality, and b) that on wintering grounds mortality may be even inversely density-dependent. The last runs counter to traditional ecological ideas that density causes a change in mortality rate. The idea that individuals gather where "living is easy" and mortality rates are low is consistent with the theory of natural selection. One would not expect the food of the gulls to be evenly distributed, and one would expect individuals to move away from areas where food is scarce and mortality is high.

5. Differences in breeding success between colonies. Breeding success has been shown to vary among individual pairs of gulls (Drost *et al*. 1961). Groups of individuals nesting in patches within a single colony have greater breeding success than do others (Coulson 1968; Drury and Nisbet in prep.). Differences in breeding success also occur between colonies (Frazar-Darling 1938; Kadlec and Drury 1968; Drury and Nisbet 1972). Some colonies reproduce consistently better than others -- for example, the gull colonies close to fishing ports and metropolitan areas. Other colonies produce consistently fewer young, such as the colonies on the outer islands in the Gulf of Maine (Drury 1963; Kadlec and Drury 1968; Hunt 1972). The populations on successful colonies grow while the numbers on unsuccessful

colonies decline even during a period of general population increase (Kadlec and Drury 1968).

Although in many cases colonies have been eliminated by predation, the differences between success and failure, growth and decline, appear in these cases to have been in the food available. Colonies grew where breeding success was high, while colonies decreased where breeding success was low. One important reason seems to be that adult gulls may move to a more productive colony even after they have nested on a colony (Drury and Nisbet 1972; Kadlec 1971). These adaptations can be viewed as being adjustments by which individuals meet the requirements of an environment in which food and other necessities are patchy and shifting.

6. Dispersal. In general terms the willingness for some individuals to disperse while the majority of individuals remain loyal to a colony can be considered to be a major mechanism of population maintenance. If conditions deteriorate seriously at one place so that the local populations decline or go extinct, dispersal from other centers can be expected to repopulate the area as soon as local conditions again become suitable. This subject has been treated in more detail elsewhere (Drury and Nisbet 1972; Drury 1974).

Occupation of new or return to former nesting sites has been recorded in detail for Fulmars (Fisher 1952) and for Herring Gulls (Kadlec and Drury 1968). Dispersal is also known for waterfowl. King (1970) said: "Hansen and Nelson (1957) discussing some 8,000 brant banded in mid-summer on the Yukon Delta, reported eight recoveries from northern Siberia and 28 recoveries from northern Alaska and Arctic Canada. More than accidental exchange between breeding areas is indicated, possibly as a result of pairing on the wintering grounds". Similarly, wide dispersal seems to be the case in Pintails, Mallards and Wood Ducks.

The general tendency for some individuals to disperse and the frequency of "extra limital" breeding attempts is especially well established in the Bering Sea region, in part at least because vagrants from Siberia or North America are readily identified as such. In the Aleutian Islands, Emison _et al_. (1971) and Byrd _et al_. (1974) have enumerated the nesting vagrants. For the Pribilof Islands, Kenyon and Phillips (1965), Sladen (1966) and Thompson and DeLong (1969) have recorded the repeated occurrence of birds of Siberian distribution. Fay and Cade (1959) and Sealy _et al_. (1971) did the same for Saint Lawrence Island.

One can conclude that a few individuals are constantly trying to settle in new geographical areas. As climatic and habitat conditions change some populations are able to become established; for example, southern species such as Mockingbirds, Cardinals and Tufted Titmice have settled in southeastern New England during the last two decades. These southern species have received much publicity. But at the same time, a less publicized dispersal of White-throated Sparrows, Hermit Thrushes and Dark-eyed Juncos has resulted in new nesting records of more northerly species, also in southeastern New England.

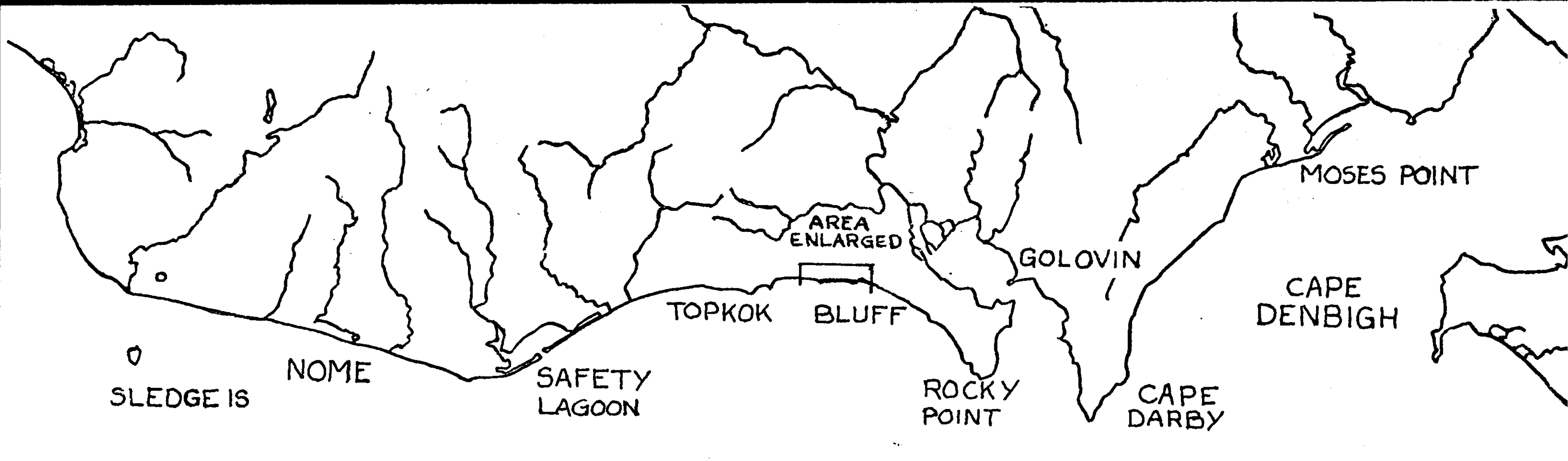
The ability (and lack of ability) of some organisms to expand their ranges over time has been a subject of consideration for a number of years by plant and animal geographers. An important botanical paper on this subject in the Bering Sea region was presented by Hultén (1937) who analyzed the ranges of plants of the area of Kamchatka, eastern Siberia, Alaska and northwest Canada showing that diverse floras occur in some restricted geographic areas. He called these areas "refugia", and postulated that many species had survived Pleistocene glaciations in them because these refugia remained ice-free. He, like Fernald (1925), was puzzled as to why only certain species had been able to expand their ranges outward from these "areas of persistence", while other species apparently more "conservative" were unable to do so. Similarly, there appear to be conservative endemic bird species of the Bering Sea region: the extinct Commander Islands Cormorant, Steller's Eider, Spectacled Eider, Emperor Goose, Whiskered Auklet, Least Auklet, Parakeet Auklet, Aleutian Tern, Red-legged Kittiwake, Bristle-thighed Curlew, Long-billed Dowitcher, Surfbird, Black Turnstone, Rock Sandpiper and Western Sandpiper.

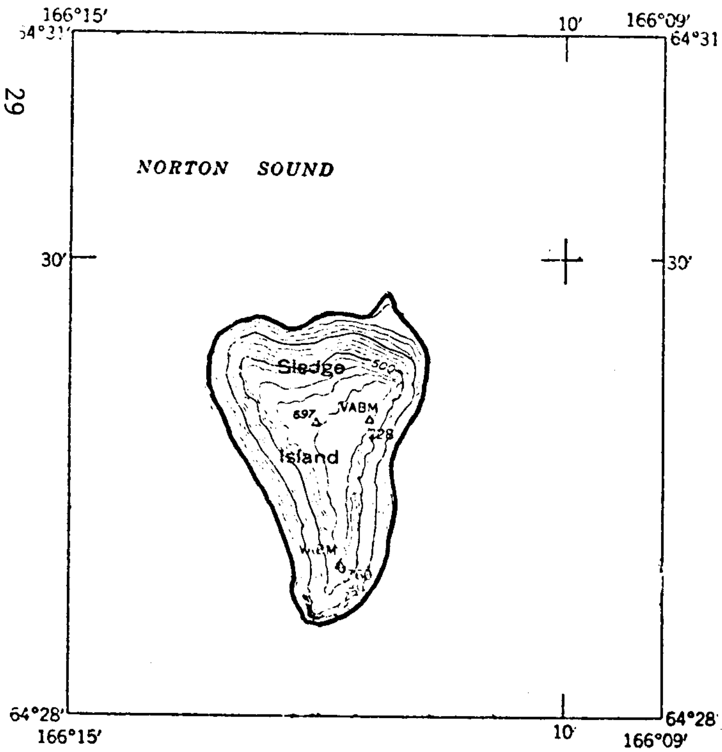
The ranges of Horned Puffins, Kittlitz's Murrelet and, perhaps, Crested Auklet suggest that some species of "Beringian" seabirds have expanded their ranges from Hultén's "refugium".

7. Dispersal and regional persistence of marginal populations. The presence of several subelements of a species population and therefore the opportunity for dispersion among alternative breeding sites may be an important factor in the regional persistence of a species on the margin of its range, as can be illustrated by the history of Laughing Gulls in New England.

Between 1875 and 1900 there were fewer than 50 Laughing Gulls in Massachusetts (Mackay 1893) and about 35 in Maine (Norton 1924). In Massachusetts the Laughing Gulls all settled on one large island, Muskeget, where by 1940 there were about 20,000 pairs (Noble and Würm 1943). Meanwhile in Maine the population had been disturbed by sheep and men and had moved about among seven islands. The Maine population grew to only about 350 pairs by 1940 (Palmer 1949).

The Laughing Gull population in both states has decreased since 1940. In Massachusetts, where all pairs occupied one island, the population had fallen to about 250 pairs by 1972, but the Maine population, still divided into five colonies, remained at 250 pairs, i.e., equal to instead of 1% of the Massachusetts population.





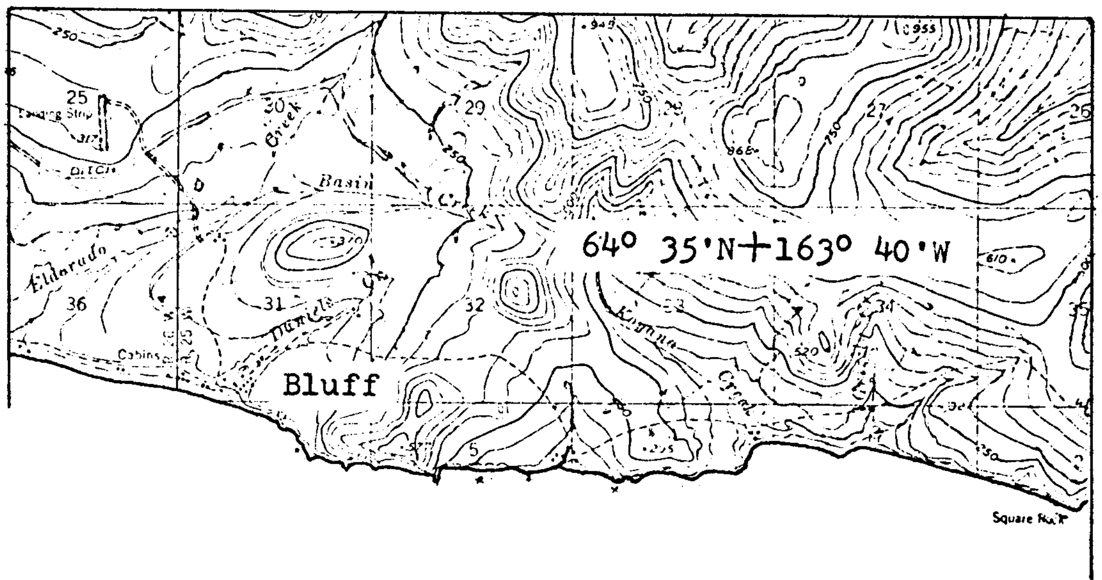


Figure 2

Map of major study areas

IV. STUDY AREA

The study area for this project, shown in Figure 1, consisted of the shore of Norton Sound from Brevig Mission near Teller in the north to Stuart Island in the south, including Egg Island, Besboro Island and Sledge Island. Coastal lagoons, wetlands, and seabird colonies were surveyed. Studies of reproductive success were made at the seabird colonies at Sledge Island, Egg Island, Cape Denbigh, Square Rock and the cliffs at Bluff. During 1976 studies were carried out for ten days at Sledge Island and for four and a half months at Bluff. Sketches of these five colonies can be found in Appendix A.

Sledge Island (Figure 2) is located about 5 miles offshore and 25 miles west of Nome. It measures approximately 1 mi by 1.5 mi and has a flat top at about 700 feet and steep sides with talus and grassy slopes. The nesting cliffs for kittiwakes, murres and cormorants are on the south tip. Puffins and cormorants nest on the south and northeast corners. Sledge Island is accessible by small boat from Nome. There is a good campsite on a gravel spit on the north end. Fresh water is available in small quantities.

The cliffs at Bluff (Figures 2 and 3a) are approximately 55 miles east of Nome on the mainland. They consist of vertical cliffs extending up to 500 feet, with rounded hills at the top. The cliffs are approximately 3 miles long and are mostly 100 to 200 feet high. Bluff is accessible by boat and small airplane. An airstrip is located near the abandoned community and mine on Daniels Creek at the west end of the cliffs and another marginally usable one is located near a cabin on Koyana Creek on the east end.

Study sites were set up at both Sledge Island and Bluff. Six of the 19 study sites at Bluff are described and sketched in Appendix A.

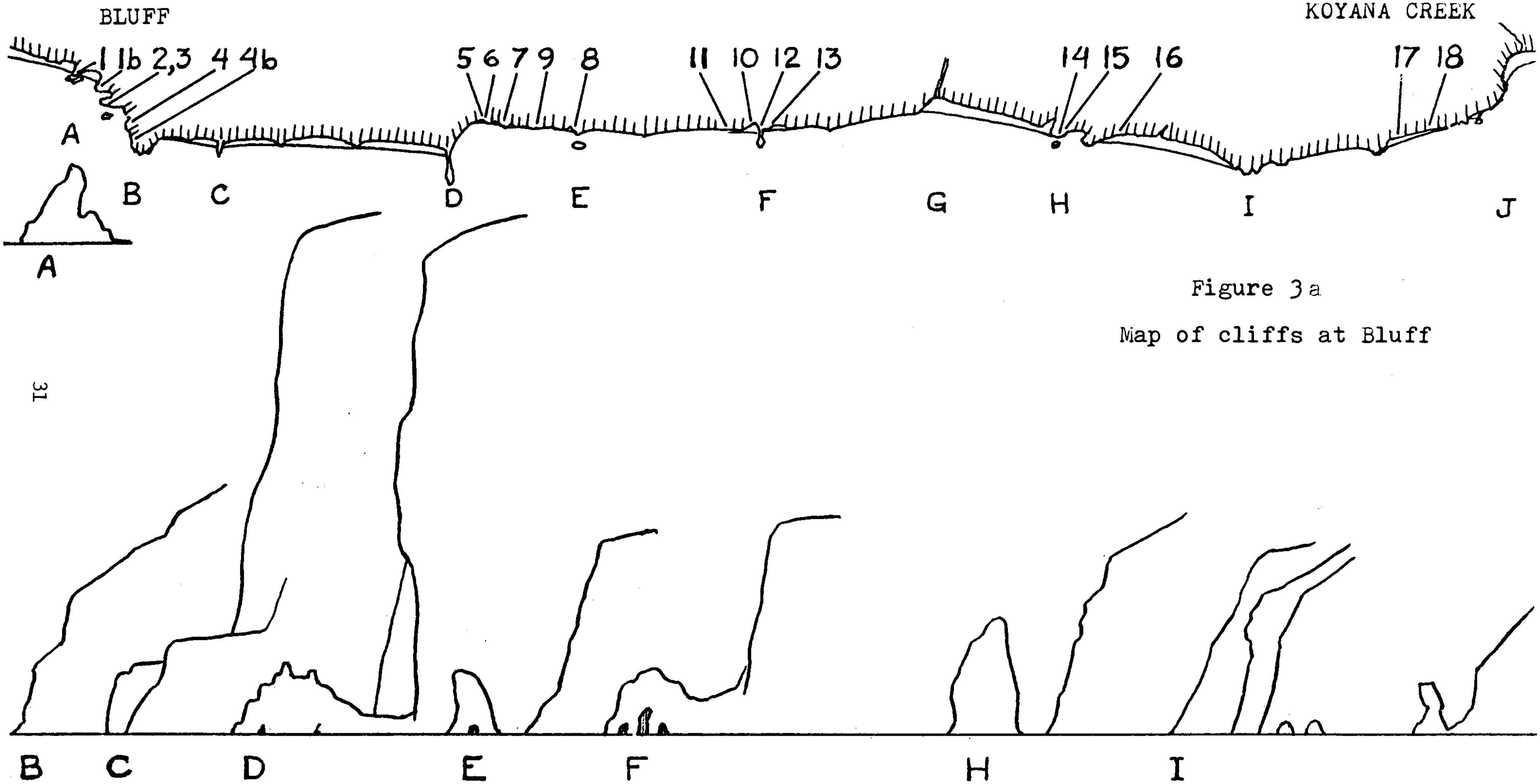


Figure 3a
Map of cliffs at Bluff

Figure 3a
Map of cliffs at Bluff

V. SOURCES, METHODS AND RATIONALE OF COLLECTING DATA

A. Methods

1. Cliff censuses

Censuses of breeding colonies were made by two methods: from a small plane, and from a small open boat. Two colonies were censused from a Cessna 170 flying at about 90 mph directly in front of the cliffs. Three observers in the plane were each assigned a species. Numbers were estimated either by a direct estimate of a whole section of cliff or by counting by hundreds. These numbers were compared to counts made from a small boat. Table 1 compares counts of kittiwakes with estimates made from a plane. It shows that the first estimate made was the most accurate and within 20% of the counts. Some variation in the number of birds on the cliff between different dates is to be expected.

The second and most common method of censusing was to move slowly past the front of the cliff in a small boat and count each species by ones, tens, or hundreds. We repeatedly had two people count the same species in order to "calibrate observers" or to compare counts. Table 2 shows counts of murres made by three observers at Bluff.

Experience has shown that the higher estimates are closer to the real number. In both counts each observer total was within 20% of the highest estimate. Twenty percent is less than the daily fluctuation of numbers of birds on the cliff.

It was impossible to tell the difference between Thick-billed and Common Murres while counting. Sample counts of murres were made to determine the proportion of Thick-billed to Common Murres.

As a boat approaches one sees large numbers of murres flying, either scared off the cliff by the approach of the boat or circling sites. Nests were located on sketch maps so that observers could record events at each nest during each visit to the site. Study sites were visited approximately every other day from June 6 to September 22. Each observer watched a set of nests for 30 minutes using binoculars or a telescope, and usually could see what was under about 90% of the incubating or brooding birds as birds got up to change positions. The observer was at the top of the cliff some distance away so that there was minimal disturbance.

To increase the size of the sample we made additional counts of nests and chicks in late August. These counts were made from several other spots along the top of the cliff. These counts were made only once, during the period when chicks were big but not yet fledged.

At Sledge Island, which was visited only once during 1976, counts were made at the two study sites to determine the proportion of incubating or brooding adults to the number of nests.

Similar counts were made from a small boat at each major colony in Norton Sound during mid-August. Although some birds that appear to be incubating do not have eggs and eggs are sometimes left unattended, this measure of reproductive success is suitable for comparing different colonies and different years. Table 3 shows that reproduction appeared higher at the cliffs at Bluff by both methods.

TABLE 3

Percentage of kittiwake nests with eggs or incubating adults

	From small boat	From top of cliff
Bluff	16%	29%
Sledge Island	4%	15%

Table 1. Estimates and counts of Kittiwakes.

8/20 estimate from small plane				8/9/76-8/10/76 counted from small boat	percent difference (first estimate)
Cape Denbeigh North Colony					
1st	2nd	3rd			
1,320	1,500	----		1,200	10%
Cape Denbeigh South Colony					
600	700	800		650	8%
Egg Island South Colony					
1st	2nd	3rd	4th		
650	750	850	900	525	14%

Table 2. Counts of Murres at Bluff.

Section	Observer A	Observer B	Observer C
July 11, 1976			
1	34	12	8
2	650	760	700
3	555	605	605
4	520	440	480
5	1,330	1,270	950
6	800	830	500
7	3,230	2,220	2,960
8	2,500	1,820	1,670
9	570	710	410
TOTAL	10,189	8,667	8,283
June 17, 1976			
TOTAL	3,505	4,190	3,600

before landing. This number of flying birds often consisted of a large portion of the total. It is presumed that the murres that are easily scared off are less attached to the cliff and are probably non-breeding birds. Hence, a count that is made after a lot of birds have flown is closer to the number of breeding birds than is a count of the total number of birds on the undisturbed cliff. During all counts from a boat the number of flying murres was counted separately from the number of birds on the cliff. During aerial censuses two passes were made; one to count the flyers and one to count the birds remaining on the cliff.

A test was made at Bluff to see if the number of flyers is a fixed number and to observe the amount of disturbance caused by a plane flying slowly in front of the cliffs. Seven observers were positioned along one-half mile of the cliffs at the top. These observers recorded the number of birds that left and the amount of disturbance as a Cessna 170 made four passes perpendicular to the edge of the cliff and three passes parallel to the cliffs. These were made at different altitudes and at different distances from the cliff.

This test showed that a small plane did not cause a measurable amount of disturbance. Some birds flew off but these were non-breeders. No bird with a chick or egg was seen to fly off. Repeated flights at the same distance from the cliff did not increase the disturbance caused after the first pass.

2. Reproductive success

a) Kittiwakes

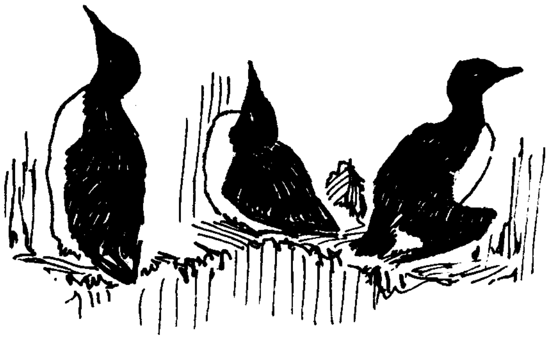
Reproductive activities at Bluff were monitored throughout the breeding season by watching numbered individual nests at established study

We also tested a "remote sensing" technique for measuring kittiwake reproductive success. This consisted of photographing sections of the cliff from a small plane. We used a Penta 35mm camera and both a 135mm and 300mm lens. Pictures were taken out of an open side window of the airplane which was flying at about 90 mph. This technique was used at Bluff, Cape Denbigh and Egg Island. Counts made on photographs were compared to counts made from a small boat on the same day at Bluff and several days earlier at Cape Denbigh and Egg Island. This technique is not very satisfactory for two reasons: 1) It is difficult to focus the telephoto lens; and 2) most samples taken by air are of exposed outer faces where reproductive rate is low. Sheltered sites where reproductive rate is high are not adequately represented in the samples.

b) Murres

It is often impossible to see under a murre on a crowded ledge to see if there is an egg or chick. Therefore it is hard to follow the progress of the breeding season. We did develop measures of reproductive success that are sufficient for comparing different years.

At study sites where there was a close view of a discrete ledge or an easily definable area where we could count murres, we recorded the total number of murres and the number of murres that appeared to be incubating. We made both counts each time we visited the site. By "incubating murres" we refer to those birds in a posture which we recognize as different from that of birds without an egg or chick. They stand facing the back of the ledge, not the sea. They lower their wing on one or both sides or assume a lower posture with their body closer to the ledge. Often they crouch right against the angle of the back wall with their bill pointed up. The two birds on the right in the drawing are in "incubator" postures.



Not incubating Incubating

However, we watched several birds squatting or with lowered wings who later got up and revealed no eggs. Likewise, there would sometimes be an egg under a murre that was standing on a ledge looking no different than the birds without eggs. By repeated mapping of the position of known eggs and incubators, however, we were able to gain an idea of how many eggs were on a ledge. In some cases the number of eggs on a particular ledge changed markedly from day to day; lots of eggs disappeared and new ones would be laid.

In most cases, we were able to tell the total number of chicks that jumped from a ledge. This is because two or three days before they jump the chicks often stand by themselves beside a parent and are visible. This, coupled with the fact that there are fewer murres on the cliff at this time of year, made it possible for us to see almost all chicks that were produced on a given ledge.

Because most ledges have a large number of murres that do not reproduce, it is hard to establish a number for the "nests" or mated pairs on a ledge. Thus there is no simple unequivocal number on which to base the measure of reproductive success. This technique, then, cannot tell the absolute reproductive success of a murre ledge but is suitable for comparing sites and years.

c) Horned Puffins

Reproductive success of puffins is difficult to measure, as the burrows at Bluff are on the cliff faces and inaccessible. We did find a few burrows that we could see into from the top of the cliff. These were monitored every other day. However, because we could not recognize a burrow unless there was an egg in it, our sample does not include burrows where an attempt was made to reproduce but no egg was produced. This technique had the further difficulty that a white egg is easy to see in a crevice but a black, downy chick is difficult to see.

There were also a few burrows that were possible to climb to, which were checked every week. This sample, however, was small.

With puffins as with murres, there are a lot of non-breeders present on the cliff so it is difficult to get an idea of the number of breeding pairs. Counts of puffins visible on a section of cliff were made every other day throughout the summer to try to determine just when the breeding pairs were there. The numbers vary widely.

d) Cormorants, Glaucous Gulls, Ravens and swans

Reproductive success of these species was measured by counting the numbers of young in each family. Cormorant, Glaucous Gull and Raven nests at Bluff were observed every other day and mortality was noted. At Sledge Island young were counted only once when the young were big enough to be seen but not yet fledged. Swan families were observed in ponds or on the marshy tundra, during waterfowl surveys described later.

We prepared an age structure for Glaucous Gulls based on counts of adults, subadults and chicks during flights along beaches where gulls gathered near walrus carcasses. One survey was made of the Bonanza River at the peak of the post-spawning die-off of salmon. These flights were usually made at an altitude of 50 to 100 feet.

3. Breeding schedule

The schedule of the breeding cycle was determined by recording dates of laying, hatching, fledging and leaving the cliffs for each numbered nest at the study areas. At other colonies which were visited only once or twice, observations were made to compare the schedule with that at Bluff.

4. Attendance at the cliff

The pattern of monthly, weekly and daily attendance of birds on the cliff was determined by counts of birds on discrete sections of cliffs that were visible from the top. These counts were made approximately every other day and at different times during the day to determine the hourly attendance. In addition, during one whole day we made counts every three hours to see how the attendance changed and how quickly.

5. Traffic to and from the cliffs

The number of birds flying to and from the cliffs at different times of day was determined by standard 5-minute watches through binoculars looking at the area in front of the cliffs. The binoculars were aimed well away from the cliff so that circling birds would not be counted. Several observation points were used so that traffic in different directions could be monitored.

In order to see if traffic returned to or departed from the cliffs in one direction more than in another, we ran two semicircular transects at about one mile from the cliff at Bluff. Birds flying to or from the cliff and their directions were recorded during each 5-minute segment of the arc. One transect was made when more birds were leaving the cliff and one when more were returning, to see if they returned from different directions than when they left. This also helped to determine where the birds were feeding.

6. Distribution at sea

Observations were made from on board the NOAA ship Surveyor while she followed transect lines across Norton Sound. Two airplane flights were made to see if the same information could be collected more quickly and cheaply from a plane.

The Surveyor cruise trackline was planned to cover as much of Norton Sound as possible and to provide radial transects from the major breeding colonies. During transects an observer on the flying bridge (at a height of 11 meters) recorded species, number, activity, direction of flight and distance from the ship within a 300 meter zone on one side of the ship. Standard 10-minute transects were taken almost continually during daylight hours. Identification was made to species except in the case of some of the murres. For each transect personnel of the Surveyor calculated starting and ending position, time, wind speed and direction, depth and surface temperature of the water, barometric pressure, distance run and speed.

The possibility of gathering the same data from a plane was tested because it would be cheaper and quicker. We chartered two types of twin-engine aircraft from Nome. One was a 9-passenger Islander which could fly at approximately 100 knots at about 100 feet altitude. This plane afforded good visibility for one observer in the co-pilot's seat, but other observers' vision was partially blocked by the engines and landing gear. The second plane was a Cessna Skymaster with one engine in front and one behind. The landing gear is below the fuselage so there is good sideways visibility for four observers in the back seats. This plane could fly at about 100 mph at 100 feet altitude.

We feel that by using the Skymaster with two observers on each side, as many birds will be seen as would be seen from the ship. The disadvantages of a plane versus a ship are:

a) Unless the plane has sophisticated navigation equipment, it is difficult to tell exactly where you are.

b) Identification to species is more difficult.

The advantages of a plane are:

a) It takes less time.

b) It is cheaper.

c) Birds do not follow a plane as they sometimes do a ship.

d) One is freer to choose the best weather -- light wind and calm sea -- for seeing birds on the surface.

Unless it is necessary to get specimens for feeding studies, and this is very difficult from a large ship, the advantages of a plane outweigh the disadvantages.

The use of a helicopter was tested for observing birds at sea but the noise caused many birds to dive before they could be identified.

7. Prey species

Two methods were used to determine the species of fish that murres and puffins were eating.

Adult murres and puffins often return to the cliff with fish in their bills to feed to their mates or chicks. With a telescope, observers at the top of the cliff can usually identify the fish by the portion that sticks out of the bill. This technique is most useful for puffins, moderately good for murres and almost useless for kittiwakes because they carry fish in their stomachs. Searches were made for visible fish during regular visits to study sites. The species seen may not necessarily represent a good sample of what is being fed to chicks as a lot of what appear to be non-breeding murres stand around on the cliff with fish in their bills. This sample also may represent different items than the adults eat themselves. It does, however, represent a sample of food caught and brought back to the colony.

The second method of obtaining sample prey items was to climb to ledges and collect fish that had been dropped. These fish were preserved in dilute formalin and were identified at the Museum of Comparative Zoology at Harvard. It is assumed that these do not represent food items that are rejected by chicks.

The best method for getting a sample of food items is to capture birds and examine the contents of their stomachs. However, the few birds that we shot on the colony had empty stomachs and we did not have the logistics to capture birds on the feeding grounds.

8. Density and distribution of waterfowl.

Concentrations of waterfowl were identified by aerial surveys conducted mostly at the beginning and end of the breeding season. These were made from a small aircraft flying at between 100 and 150 feet at 100-120 mph air speed. An observer on each side of the aircraft recorded numbers of each species seen. Flights were made over known gathering grounds for waterfowl. In the spring these focused on leads in the shore-fast ice, leads caused by rivers and on thawed ponds. In August, September and October the flights concentrated over lagoons, ponds and marshy tundra, intertidal mudflats, and river deltas and channels. The coast of the Seward Peninsula was covered between the Brevig Lagoon on the northwest and the village of Saint Michael in the southeast. Each flight consisted of transects between recognizable landmarks. Time of start and stop, air speed and altitude were recorded.

The transects were not straight lines, rather they followed the land forms: river channels, series of ponds, beaches, or mudflats. The areas visited were those where waterfowl were most likely to be found. The flights included many zig-zags and circles to get a better view of some birds. Maps were drawn for each transect to show the approximate area covered.

Only an experienced observer can identify ducks as to species from 100 feet up moving at 100 mph, particularly from the back section of a small plane. Consequently some of the ducks were recorded as unidentified, and there is some error in the ones that were identified. The numbers are mostly estimates but are accurate enough for purposes of comparison. The data may not be accurate enough to draw conclusions about the latest period of migration for a particular species. The surveys did not extend late enough in the season.

These aerial transects were supplemented with trips to several lagoons in a small boat or trips in a car. During these surveys all species seen were counted and recorded. These surveys were conducted throughout the summer and were used to take samples of shorebird distribution and densities as well as waterfowl.

Spring waterfowl movement was monitored by daily observation of the lead at the mouth of the Snake River in Nome.

Inland shorebird censuses were also conducted by surveys on foot and from a car along the three roads that go out of Nome. These were not done quantitatively and serve only to indicate the presence of species and their relative densities.

9. Weather

To determine how the behavior, movement, reproductive success and feeding of the birds related to the prevailing weather, observations of the weather were made whenever data was being collected. Wind speed was estimated using the Beaufort scale. Wind direction, sea state, cloud cover, temperature and visibility were also recorded several times during each day.

B. Amount of data collected

1. Censuses

At Bluff 10 censuses were made from a boat and one from the top of the cliff. Eight of them included both murres and kittiwakes.

At Sledge Island two censuses were made from a boat in July.

Censuses from both a boat and an airplane were made at Egg Island and Cape Denbigh. Boat censuses were also made at a number of other smaller colonies along the shore of Norton Sound.

2. Study site visits

At Bluff 51 visits were made to each of 19 study sites to determine reproductive success, breeding schedule, attendance at the cliff, food brought in, and to report general observations. Each site had several species visible, so each one was divided into several subareas for study.

Table 4 shows the number of study areas for each species at Bluff. It includes areas where nests were monitored for breeding activities and areas where counts were made to monitor attendance at the cliff. It also shows the number of nests studied.

At Sledge Island two study sites were established in 1975 and each was visited once in 1976. These included 6 kittiwake study areas and 6 Common and Thick-billed Murre areas. We measured reproductive success in 92 cormorant nests.

3. Age structure flights

Age structure of gulls were recorded during 850 miles of aerial transects.

4. Watches for traffic to and from the cliffs

A total of 105 standard 5-minute watches were made from three different locations at Bluff to determine the schedule and the numbers of birds moving towards and away from the cliff.

Two transects around Bluff were made to determine the directions of birds departing from and returning to the cliffs.

5. Sea transects

On board the OSS Surveyor 110 standardized 10-minute watches were made during 170 nautical miles on 15 tracklines. In addition, transects were made covering 465 nautical miles during two aerial flights over the ocean.

Table 4. Number of study sites at Bluff.

	Kittiwake	Common Murres	Thick-billed Murres	Horned Puffins	Pelagic Cormorants	Glaucous Gulls	Raven
number of study areas	9	19	2				
number of nests monitored	280			18	7	7	2
number of areas counted	5	8	4	9			

6. Prey species

A total of 99 prey items were collected from the cliffs at Bluff and 23 from the colony at Sledge Island.

7. Waterfowl aerial flights

Approximately 1800 miles of transects on 16 different days were flown over lagoons, ponds and tundra on waterfowl surveys between Brevig Lagoon on the northwest and Stuart Island on the southeast. These consisted of a total of 92 transects of between 2 and 15 minute duraction. The area covered and the number of transects flown are shown below:

Area	Number of Transects
Nome-Teller Coastal	25
Safety Lagoon Basin	25
Golovin Lagoon-Fish River	13
Behind Moses Point	10
Koyuk to Shaktoolik	10
Stuart Island	7
Brevig Lagoon	2

8. Data were also collected on 6 surveys in the car and approximately 15 surveys totaling 50 miles on foot. Surveys by car were made out of Nome on roads going towards Teller, Taylor (Kougarok Road) and Safety Lagoon (Council Road). Surveys on foot were made on the tundra around Nome and on the tundra around Bluff.

Data were also collected during short trips in a small boat on 20 different days.

9. Weather

Local weather conditions were recorded daily at Bluff from June 5 to October 11. Weather was recorded at Sledge Island from July 22 to August 3, and also occasionally in Nome and other spots along the coast.

Table 5. 1976 Colony Censuses.

	Pelagic Cormorant individuals/nests	Glaucous Gull individuals/nests	Black-legged Kittiwakes	Aleutian Tern	Arctic Tern	Murre	Ratio Common:Thick-billed Murres	Pigeon Guillemot	Horned Puffin	Tufted Puffin	Parakeet Auklet	Other species
Cape Riley	100								100			
Cape Spencer		71										
Cape Douglas		32/15										
Sledge Island	280/150	8/6	1,300			2,900	30:1	4	160	13	85	1 Peregrine Falcon 1 pair Ravens
Safety Lagoon												
1)				35	10							
2)				2	10							
3)					9							
Topkok Head	319/147	188/36						9	280	34		1 Peregrine Falcon
Head E. of Topkok	59/8	32/2							31			1 pair Ravens 1 pair gyrfalcons
Bluff Cliffs	125/57	120/12	7,000			56,000	100:1		800	5	45	2 pair Ravens 1 pair Peregrine Falcon 1 pair Golden Eagle

Table 5., Page 2.

Square Rock	13/2	50/15	550		4,000	100:0	100	1		1 pair Peregrine Falcon 1 pair Raven
Little Rocky Point	12/6	100/5-10					10			1 pair Peregrine
Rocky Point	416/208	71/6					68	4		2 pair Ravens
Cape Darby W.	19/2	65/10					100	1		6 Ravens 1 pair Peregrine Falcon
Cape Darby E.	300/90	225/37					475	50		
Cape Denbeigh N.	75/23	30	1,200		5,900	100:1	40	3		1 pair Peregrine Falcon
Cape Denbeigh S.	75/24	20	650		4,300	100:1	35			2 Ravens 1 pair Gyrfalcon
Egavik*	4	5					12			
Tolstoi Point	50	10					15-20			
Egg Island	1	2	525		2,000	100:2	210	25	5	1 Raven
Black Point	25	3		8			200			
Whale Islands*		6					10			
Stuart Island	1	105		6			185	15		2 pair Ravens
Klikitarik				4						

* May not be a breeding colony

VI. RESULTS

A. Seabirds

1. Cliff censuses

Results of all 1976 censuses of colonies are shown on Table 5. They include numbers of actual nests for only Glaucous Gulls and Pelagic Cormorants. Locations of the colonies are shown on maps in Appendix B.

Observations at the cliffs at Bluff indicate that the number of birds on the cliff fluctuate widely from hour to hour and from day to day. We believe that these differences reflect the number of non-breeding or prospecting birds that are present. Therefore, a count on a given day does not necessarily represent the number of breeding pairs or even the total number of birds that associate themselves with that colony. In cases where two or more censuses were made -- at Sledge Island, Bluff, Square Rock, Cape Denbigh and Egg Island -- the accuracy is greater. The figures of the highest counts are represented in Table 5. These approximate the total number of birds that associate with that colony.

A number of very small colonies of cormorants and puffins are found along the shore of Norton Sound. There are also several colonies of species that nest on flat areas, such as Glaucous Gulls and terns. These and Besboro Island, which in 1975 had 40-50 cormorants, 150-200 Horned Puffins and 15 Glaucous Gulls, are omitted from Table 5.

Other seabird species that were found nesting but are not included in the table include one Mew Gull and one Red-breasted Merganser near Safety Lagoon. In addition, one Black Guillemot and three Kittlitz's Murrelets were found near Sledge Island, but not known to be breeding.

When censusing a breeding colony of murres from a small boat or plane, a large percentage of the murres are frightened off. This percentage,

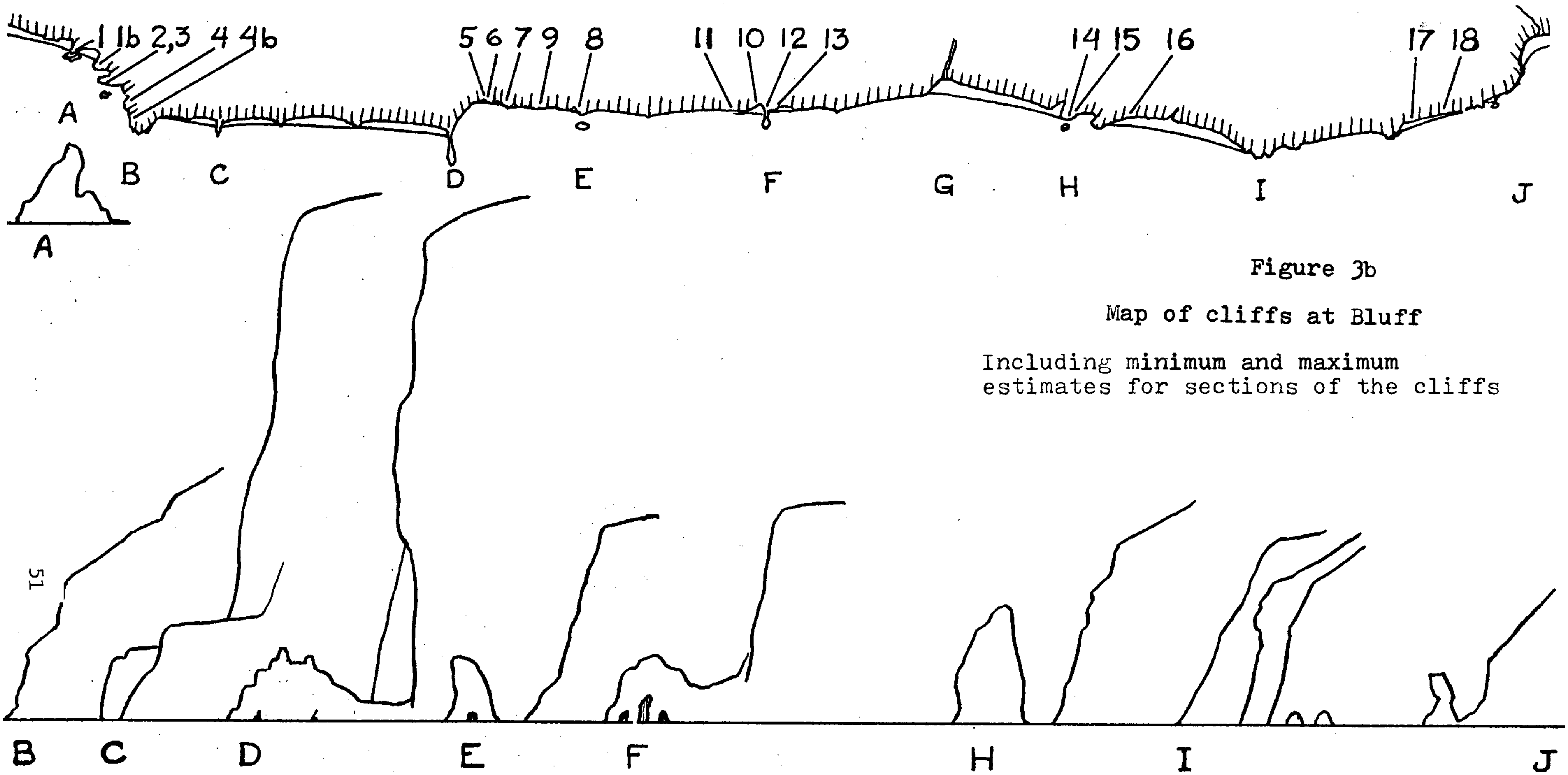


Figure 3b

Map of cliffs at Bluff

Including minimum and maximum estimates for sections of the cliffs

	←A	A-C	C-D	D-E	E-F	F-G	G-H	H-I	I-J
P Cormorant		23	19		3	12			
Gl Gull	7	15	35		15	10	10	15	5
B-l Kittiwake	50/260	320/1160	130/1260	315/1130	460/1210	375/700	160/780	620/825	115/270
murre	230/2920	300/7220	200/8880	220/3990	490/4350	420/3130	730/1700	640/1800	150/360
murre fliers	30/700	260/1100	600/3200	700/6500	1140/2800	380/4100	100/860	1040/3100	60/1030
Horned Puffin	20/40	12/77	49/210	34/84	33/110	12/48	25/67	35/82	55/85
Tufted Puffin			1		1		1		2

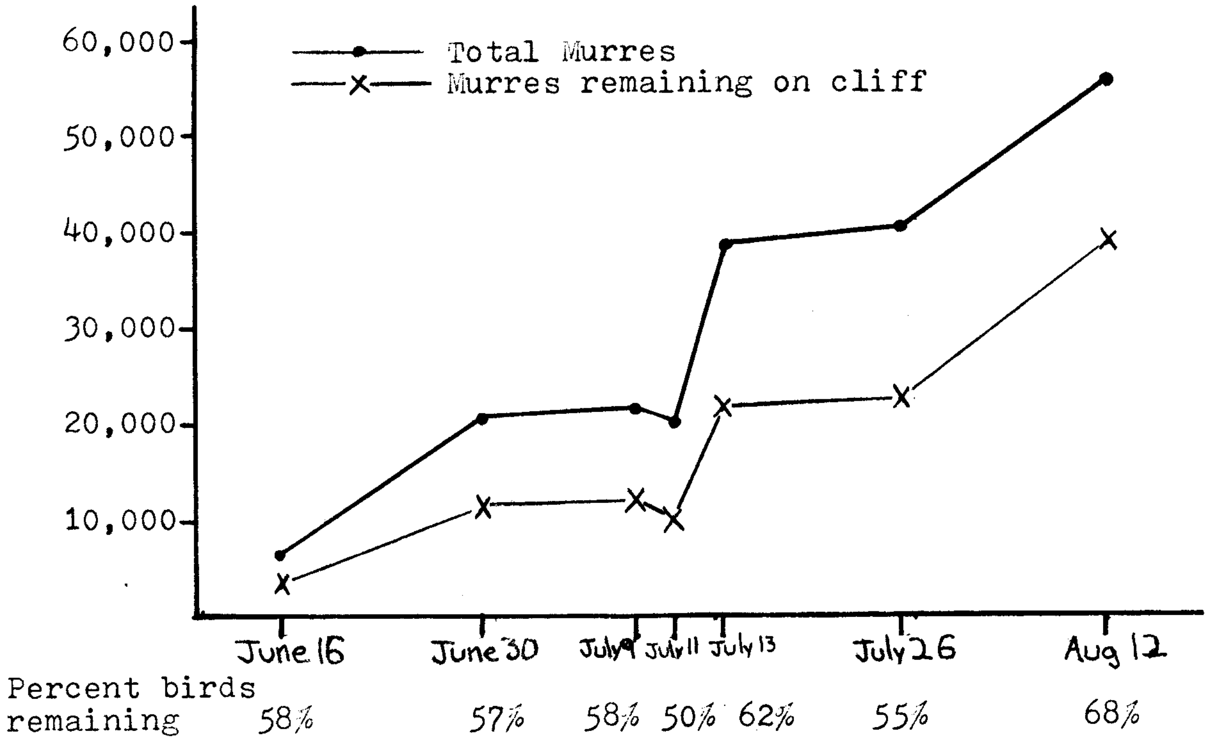


Figure 4 . 1976 counts of murres at Bluff

which varies between 30% and 50%, represents the birds that are not strongly attached to the cliff, e.g., non-breeding birds. Birds about to lay an egg or already protecting an egg or chick do not readily leave the cliff. Therefore, a count of the birds that remain on the cliff after eggs have been laid gives a best estimate of the breeding population.

Figure 3b shows the area of murre censuses during 1976 at Bluff. Each of these censuses was made from a small boat. At the top of Figure 3b is a map of the cliffs from Daniels Creek (Bluff) on the west to Koyana Creek (Farland's) on the east. The location of study sites (stake numbers) are indicated by the numbers. The locations used to subdivide the cliffs for census purposes are shown by the capital letters. These are also shown on Figures 33 and 34.

In the middle are sketches of each of the lettered locations as seen from the east. At the bottom there are listed for each section of the cliffs the number of Pelagic Cormorant nests, the usual number of Glaucous Gulls and the minimum/maximum counts of the other species, including the numbers of murres seen flying off the cliffs during censuses.

In Figure 4 both the total numbers and the number that remained on the cliff are shown. On days when there are a lot of murres on the cliff, more non-breeders remain and as a result the estimate of breeding pairs is misleadingly high.

Because of a delay in the breeding season, discussed under Reproductive Success, many breeding birds were away from the cliff until July 23 and most of the eggs laid before then were lost. Consequently the census made on July 26 probably represents our best estimate of breeding pairs, as any bird which had a chance of being successful would have to have an egg at this time. During this count 23,000 murres

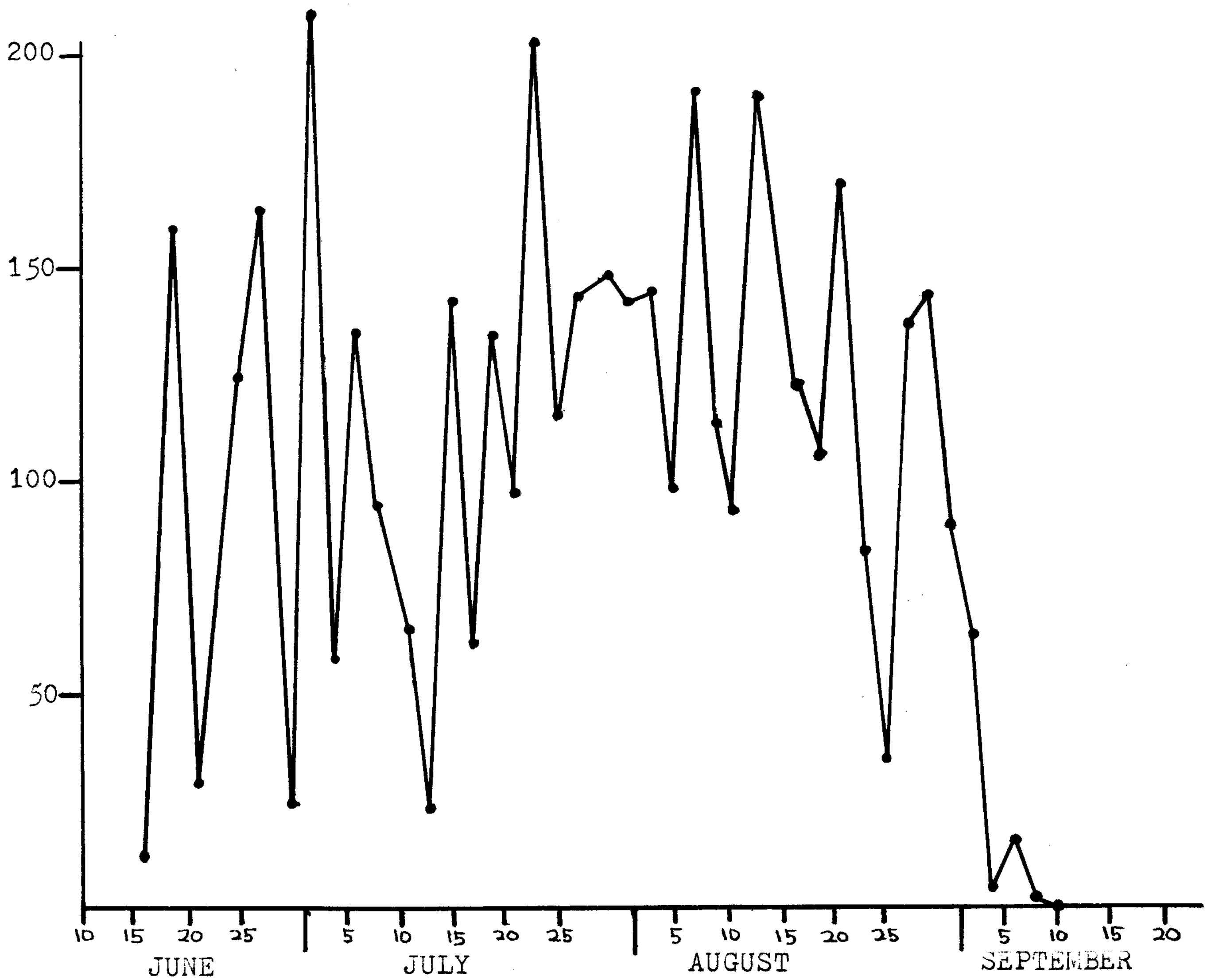


Figure 5. Common Murre numbers at site 15

Table 6. Probable number of breeding pairs of Murres in relation to July 30 counts.

Study Site	Probable Breeding Pairs	7/30 Count	Percentage
1b A (sm.face)	7	11	64
1b B (to left)	17	21	81
1b C (upper)	19	27	70
1b D (lower)	16	21	76
4	24	127	19
4b	12	16	75
5 left	27	44	61
5 right	25	48	52
6	12	19	63
7 upper	25	138	18
7 middle	23	34	68
7 lower	58	101	57
9 upper	35	52	67
9 lower	43	82*	52
10 map	16	37	43
10 right	32	81	40
12	32	95	34
Total	423	954	44

* Count from 7/27 because there was no count on 7/30.

remained on the cliff. Assuming that this includes some non-breeders, we can estimate the number of breeding pairs at around 20,000.

As an alternative method of calculating the number of breeding pairs, we determined the percentage of breeding pairs included in the total of birds at study sites and related that figure to a cliff census.

Figure 5 shows the wide fluctuations of numbers of murres at an individual study site. Because we did not make any counts at study sites at the same time as we made a cliff census, it is difficult to determine how a cliff census relates to the figures at study sites. However, numbers were fairly constant in a period from July 27 to August 3 and a census was made just previous to this on July 26. During this period all successfully reproducing murres would have eggs. The counts made at study sites on July 27 included some sites having no murres. July 30 counts appeared to be at levels equivalent to that of the July 26 census.

Table 6 relates July 30 counts at study sites with the number of breeding pairs at each site. The determination of breeding pairs is discussed under Reproductive Success. The percentage of breeding pairs varies widely, but the average of 17 sites is 44%. If we apply 44% to the total census count of 40,000 on July 26, we get 17,600 breeding pairs. Thus from these two methods we get an estimate of breeding pairs of between 15,000 and 20,000.

The increase in numbers of birds on the cliffs after July 30 reflects appearance of a large number of non-breeders. The highest count of the season was made on August 2 when we counted 56,000 murres. During the count about 65% of the birds remained on the cliff -- a proportion similar to that found during other counts. Consequently a count of birds remaining on the cliff in August does not constitute a reliable method

Table 7. Comparison of estimates of populations of Murres and Kittiwakes in 1975 and 1976.

	1975	1976	changes
Bluff			
Murres (breeding pairs)	25,000	13,000	50% decrease
Murres (highest count)	90,000	56,000	40% decrease
Kittiwakes	7,250	7,000	Not significant
Square Rock			
Murres	6,000	4,000	30% decrease
Kittiwakes	800	575	30% decrease
Sledge Island			
Murres	2,300	2,800	Not significant
Kittiwakes	1,250	1,300	Not significant
Cape Denbeigh N.			
Murres	8,500	6,000	Not significant
Cape Denbeigh S.			
Murres	4,000	4,300	Not significant
Egg Island			
Murres	1,250	2,000	60% increase

of estimating breeding pairs. Late July appeared to be the best time for such counts in 1976, as all the successful breeders had to be there and large numbers of non-breeders had not arrived yet.

Similar, but not as complete, information from 1975 shows a much larger total population as well as larger numbers of breeding pairs. A July 3 count showed 22,000 murres that stayed on the cliff and the highest count showed a total of 90,000 murres. The number of breeding pairs was estimated to be between 20,000 and 25,000 or 25% to 30% higher than in 1976.

Although census figures for birds on the cliffs are low in June compared to the rest of the season, a count of murres on the water in front of the cliff on May 30 of 40,000 closely approximates the July 26 count. This was made on a calm day with no ice drifting past the foot of the cliff. Apparently most of the birds associated with a colony arrive at the beginning of the season even though many do not breed but leave and return in late July and August.

Several counts of murres on Sledge Island in mid-July 1976 showed the minimum number of murres that remained on the cliffs to be 870. As three counts showed a similar number, we can assume that the number of breeding pairs on Sledge Island is approximately 900 or about 60% of the birds counted on one day.

Table 7 shows 1975 and 1976 census figures for colonies that were censused both years. They show a decrease in murres at Bluff and at Square Rock, two miles east of Bluff. Other colonies were not censused as often. In 1975 Egg Island and Cape Denbigh were only censused from a plane. It is difficult to establish a difference in population because of the large fluctuations in the number of murres from day to day. Several censuses at Sledge Island taken each year gave results that indicate little change in population. The same is true for the colonies in eastern Norton Sound except that at Egg Island estimates made from an airplane in mid-August indicated a larger population in 1976.

Kittiwake numbers were virtually identical for both years at all cliffs except at Square Rock where several censuses both years indicated a 30% decrease in numbers in 1976.

2. Reproductive schedule

a) Black-legged Kittiwake

When we arrived at Bluff on May 29 some kittiwakes had already arrived and about 10% were occupying sites on the cliff. Of these, about 20% were in pairs. Fights for nesting sites and copulations were observed. During the early part of the season numbers varied greatly from day to day and from hour to hour.

We counted the number of birds seen in pairs to determine when pairing took place. Figure 6 shows the percentage of birds on the cliff that were in pairs through the summer. In June the number of pairs was high when kittiwakes were forming pairs and mating. In late June and early July more single birds were on the cliff, presumably because one member of a pair was off feeding. The food shortage discussed earlier would have exaggerated this effect. Another peak of presence of pairs occurred around August 1. This probably reflects the return of the food source which allowed birds to return to the cliff. Pairs that had failed earlier apparently tried to nest again.

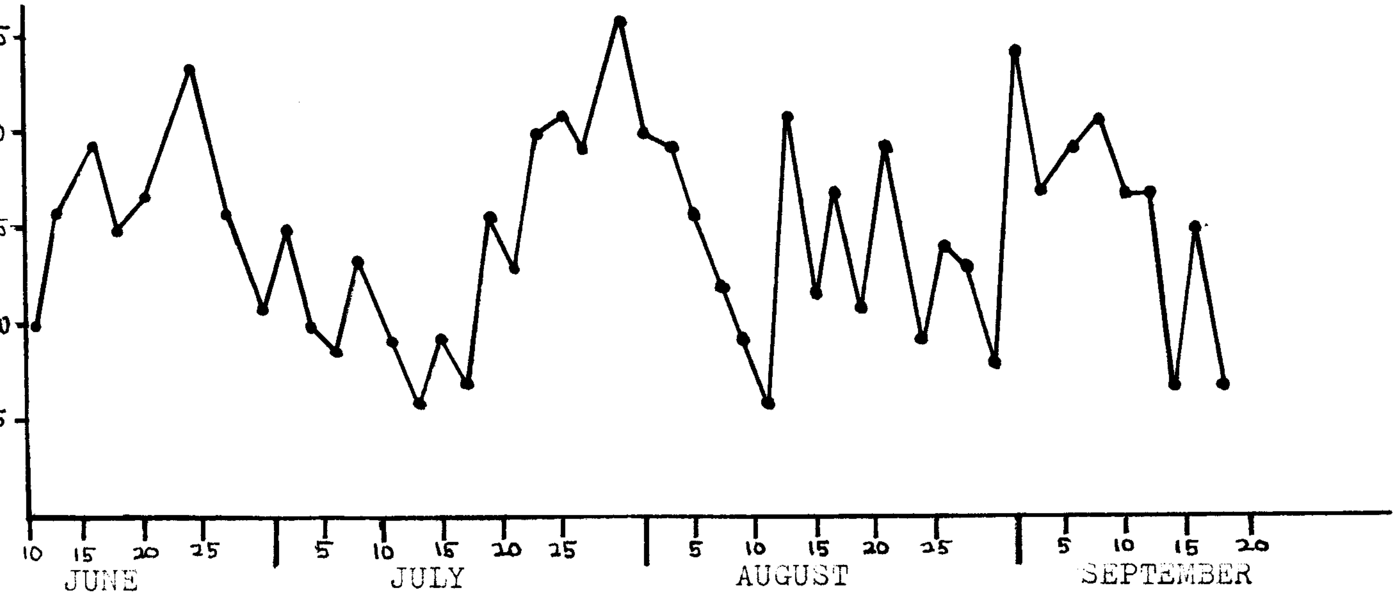


Figure 6. Percentage of kittiwakes in pairs

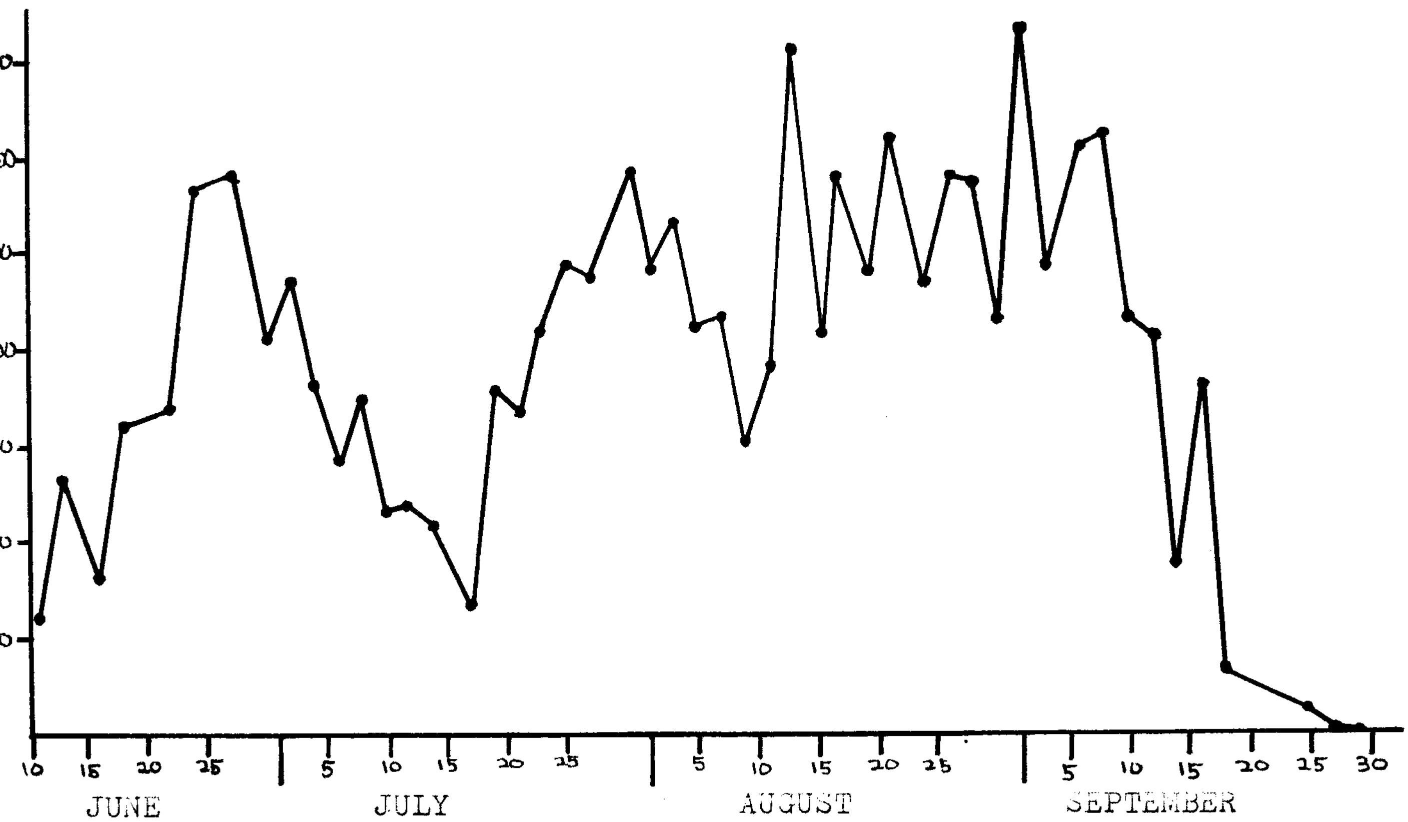


Figure 7. Kittiwake numbers at all study sites

In the latter part of August many birds that had not reproduced during 1976 came to the cliff and competed for territories and mates. These non-breeders appeared irregularly and their presence is reflected in the fluctuations in numbers of pairs observed. Many fights for territories, nest-building, "begging" and calling associated with pre-copulation behavior, and copulations were observed during the second half of August.

Figure 7 -- kittiwake numbers from all study sites -- indicates a striking similarity between the percentage of pairs and the total number of kittiwakes at study sites. Apparently when the non-breeding birds came to the cliff, they came in pairs. Numbers are highest in the second half of August and the first part of September.

Because of the presence of large numbers of non-breeders in the season, it is difficult to tell when the breeding birds left. It is our observation that they left gradually through the month of September. Their numbers stayed higher during this period than did those of murres. Kittiwake chicks remained later than the adults. By the last week of September there were few kittiwakes landing on the cliff but groups of 30 to 100 could be seen circling offshore or sitting on the water. The flocks persisted into October. They could be seen occasionally further offshore until we left on October 10. The groups seen after the first few days of October may have been migrating birds.

Figure 8 summarizes the events of the breeding schedule for kittiwakes. The sample size for hatching and fledging is very small because 1976 was such a poor reproductive year. We believe that the laying period was cut short by the lack of food.

Because parents that were successful tended to sit tighter on their nests, it was difficult to see exactly when an egg was laid or a chick

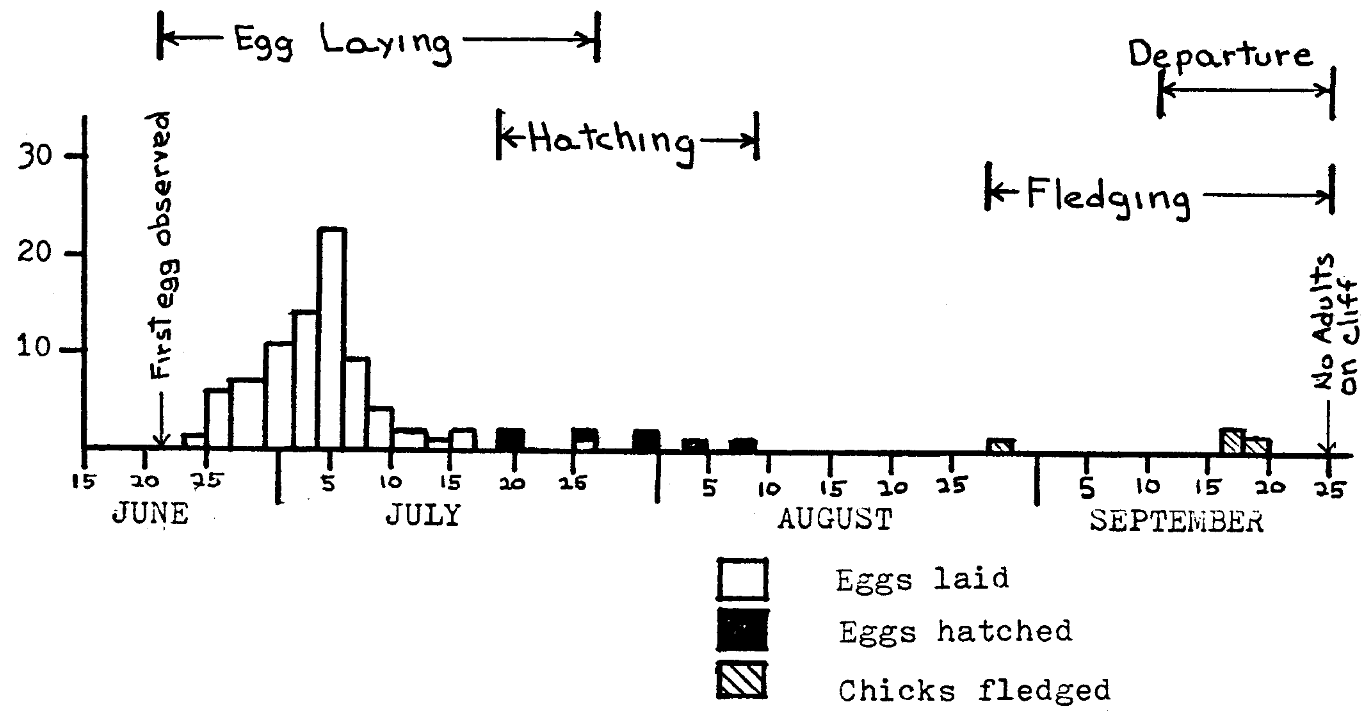


Figure 8. Kittiwake Breeding schedule

hatched. Data on date of laying and date of hatching on three nests showed an incubation period of between 31 and 35 days, and a fledging period between 39 and 43 days after hatching. These incubation periods are conspicuously longer (6-10 days) than those reported by Coulson (e.g., 25 days in Cramp et al. 1974) for British Black-legged Kittiwakes). The fledging period is, however, comparable to what has been reported (about six weeks). The unusually long incubation is another indication of unfavorable conditions during that period. The situation appears to have moderated by August.

b) Murres

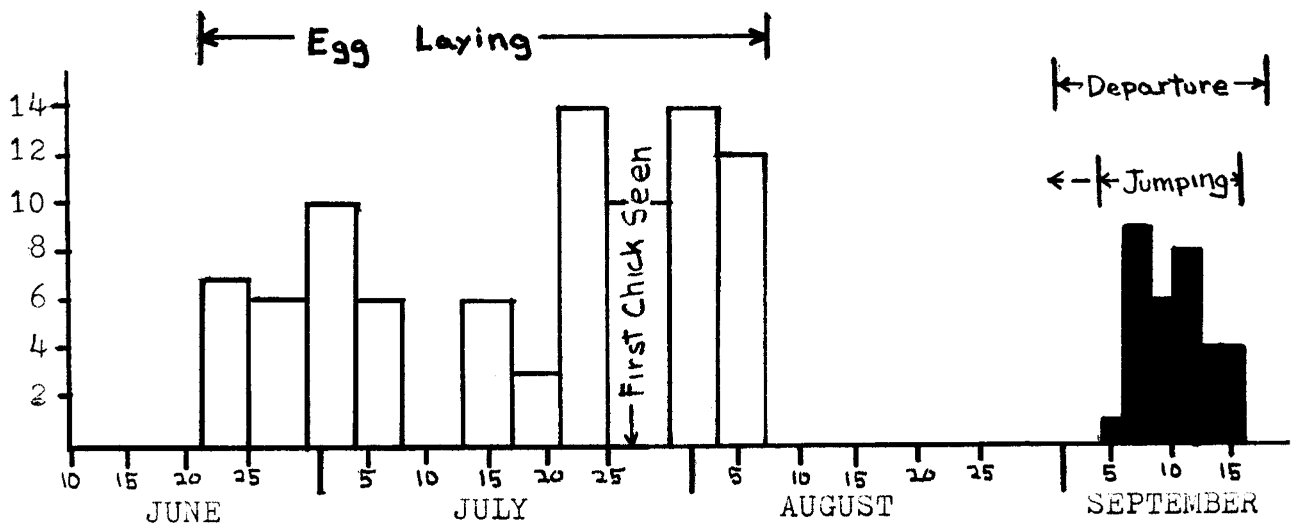
When we first arrived in Nome on May 27, murres were present in leads in the sea ice. The murres which we saw at the mouth of the Snake River at Nome were mostly Thick-billed Murres.

On May 30 a large number of murres were sitting on the water in front of the cliffs at Bluff. We counted 40,000 which was the highest count made until August. Murre numbers were very low at the cliff in the first week of June while ice floes were floating past, even though kittiwakes were present. Throughout June and during the first half of July our counts remained below 25,000 birds at the cliff although apparently more murres than that were present on some nights.

On May 30 and 31 we estimated that 10% of the murre nesting areas were occupied. The birds were very easily scared off the cliff and hesitant to return while we were sitting at the top. During this period we observed copulation, fights for nesting sites, and mutual preening. This social behavior increased during June.

Figure 9 shows events during the breeding season for both Common and Thick-billed Murres. In this figure a dotted arrow on the ends of

Common Murres



Thick-billed Murres

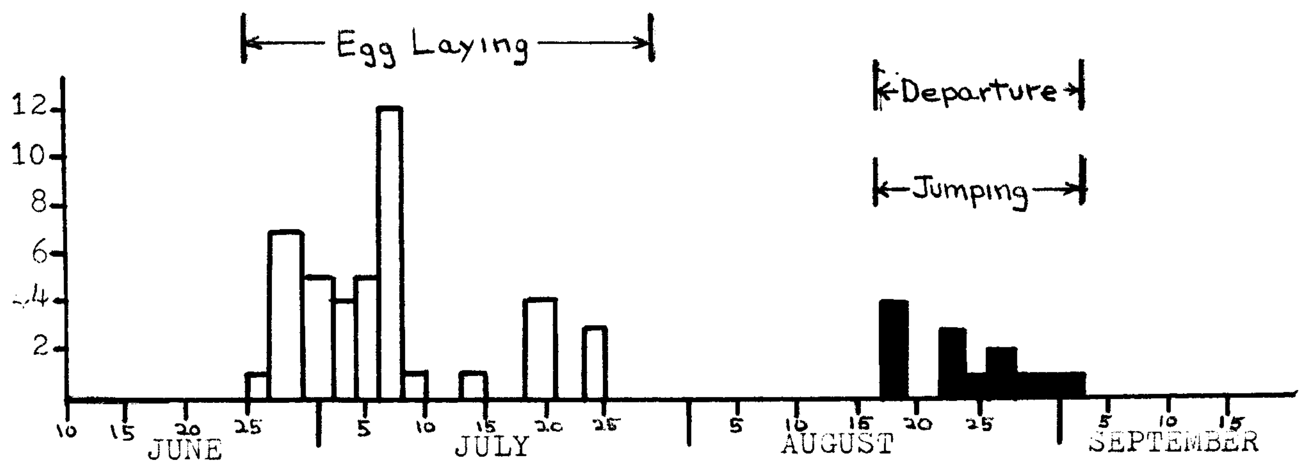


Figure 9. Common and Thick-billed Murre breeding schedule

a period indicates that the activity probably continued beyond what we observed.

The first murre eggs were seen on June 21. We could not tell which species the eggs were because they were found at the top of the cliff near a Raven's nest. It is noteworthy that Ravens found and were eating eggs before we had seen any from any of the study sites.

Common Murre egg-laying was delayed and probably extended because of the lack of food discussed earlier. The end of the laying period was difficult to determine because there were many murres on the cliff at this time. The end of egg-laying indicated in Figure 17 is when the number of "incubators" counted started decreasing. However, egg-laying may have stopped before or after then. Egg-laying in Thick-billed Murres may have started earlier than in Commons even though Thick-billed eggs were not reported at study sites until after Common Murres had been observed in incubating postures. One small sample of Thick-bills precludes our getting an accurate range for egg-laying. The data on fledging of chicks indicate that the Thick-billed Murres' schedule was earlier than the Commons' schedule.

We have no data on hatching dates because it is impossible to tell from the posture of an adult if it is incubating or brooding. The only sure method we found for obtaining these data is to scare all the adults off a ledge and count eggs and chicks. We did this on August 18 on several different ledges accessible from the sea, and found 40% chicks and 60% eggs, indicating that this was before the peak of hatching. This late peak of hatching is probably related to the delay of egg-laying created by the food shortage. The first chick seen was on July 27, but this was certainly not the first chick hatched.

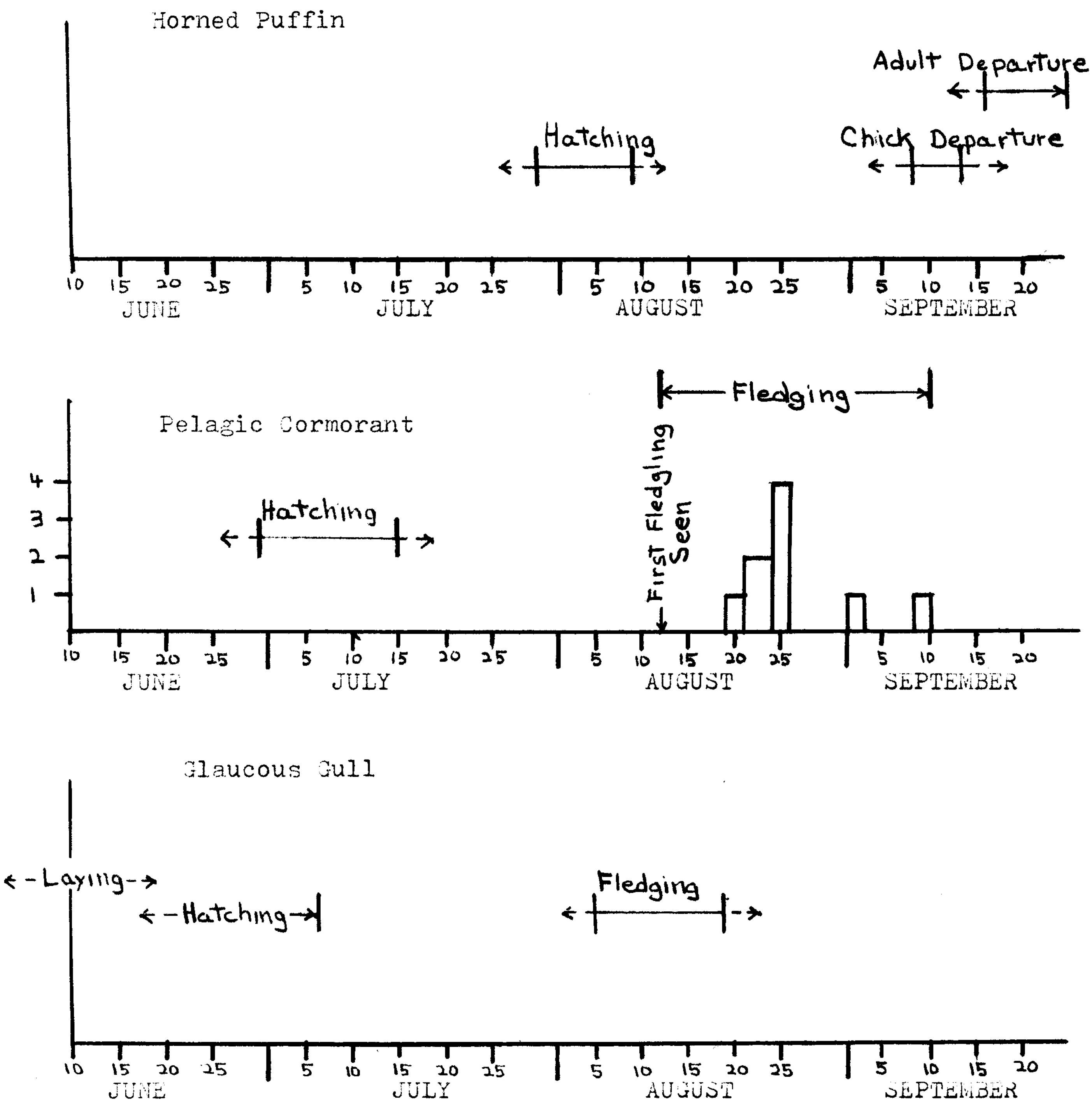


Figure 10. Events of the breeding schedule for three species

In both species, the period during which chicks jumped agreed closely with the period during which adults left the cliffs. Near the end of this period, for both species, almost every one of the adults on the cliff accompanied a chick.

We observed that murres left in patches; that is, all murres on one ledge disappeared on the same day, occasionally leaving behind a few adults, each of which accompanied a chick too young to jump. These chicks suffered high mortality from predation. All murres had left the cliff by September 18.

c) Other species

Figure 10 shows information we have on reproductive schedules of other species at Bluff. Because of the small number of visible nests of these species it is difficult to determine the peak or end point of each period.

Data on Horned Puffin numbers on the cliff are shown in Figure 23. Puffins arrived in early June, slightly later than murres and kittiwakes. Their numbers, like murre numbers, varied over wide extremes. The apparent fluctuations may be even more severe than the actual changes in numbers because when adult puffins are in their burrows, they can seldom be seen. Consequently, even if observers recorded no puffins, incubating adults could be present. As with other species, total numbers and the amount of fluctuation increases during August and early September. We have concluded that this increase reflects the arrival of non-breeding birds. We presume that these are pre-breeders, prospecting and competing for nesting sites for the next year. Because of the comings and goings of these birds, it is difficult to tell when the breeders leave.

Pelagic Cormorants and Glaucous Gulls are the earliest species to arrive at the cliff in the spring and the latest to depart in the fall. On May 30 cormorants were carrying nesting material and full clutches of eggs were observed in five nests on June 8. The first fledged cormorant chick was seen at the foot of the cliff on August 12 although some chicks in nests which we were monitoring did not fledge until August 19. Cormorant reproductive schedule at Rocky Point appeared to be ahead of Bluff. The chicks we saw on July 10 appeared to be older than those at Bluff.

When we left Bluff on October 11 both adult and immature cormorants were still present along the foot of the cliffs.

Glaucous Gulls were incubating eggs when we first got to Bluff on May 30. Hatching and fledging appeared to be earlier than in cormorants. Immatures, subadults and adults were still present at the cliffs when we left on October 11. These were often seen feeding with groups of seals near shore waters.

We also observed the reproductive schedule of two other species at Bluff. One nest of Ravens had 3 downy young in it when we arrived on May 30. All three fledged around July 2. One Golden Eagle fledged on July 29. The fledging seemed to be timed to coincide with the abundance of chicks on the cliff.

3. Hourly variation in numbers

a) Murres

We visited the study sites at many different times of day and therefore can show how numbers vary during the day. At some areas we averaged all the counts made in each two-hour period of the day during approximately

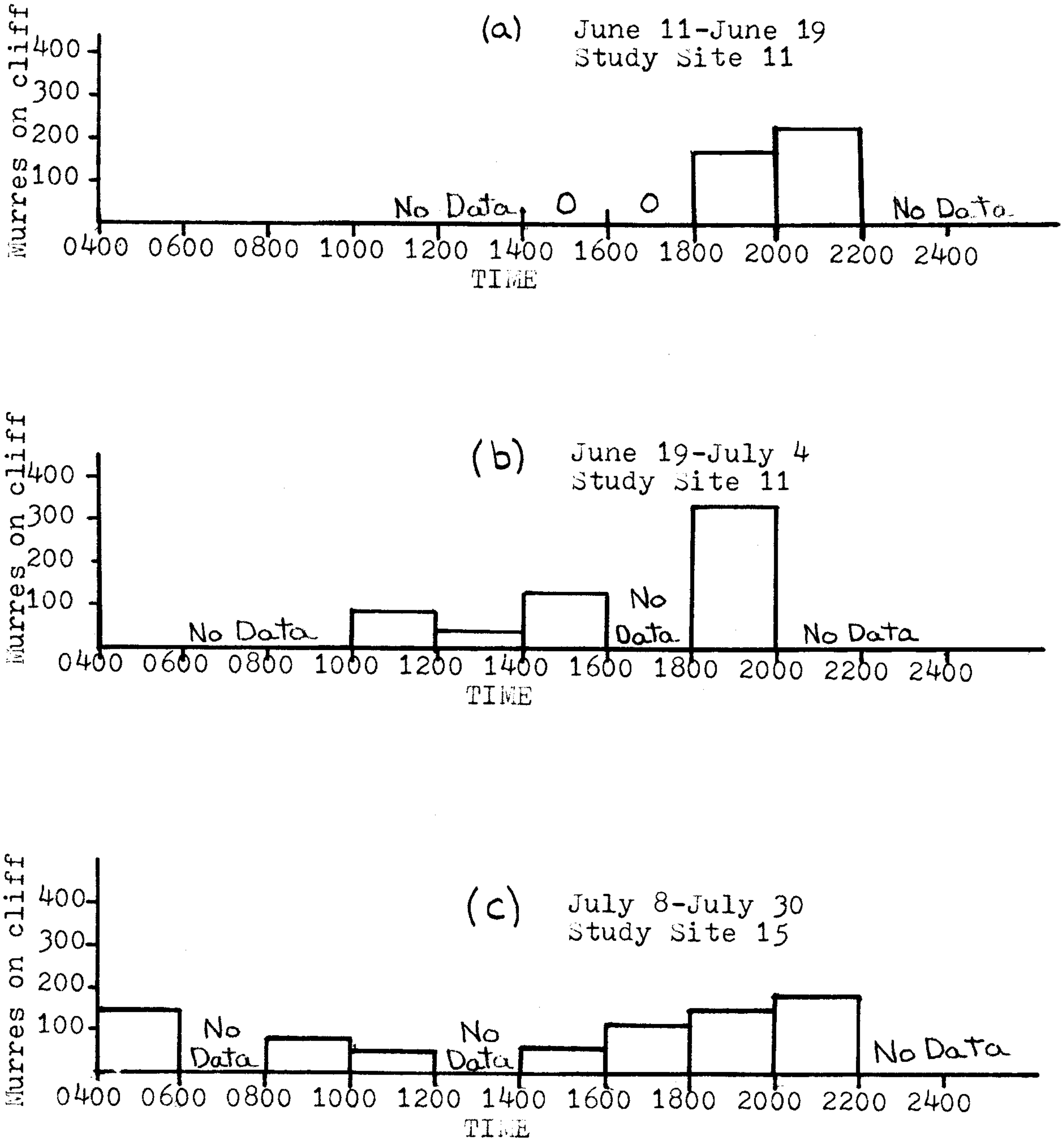


Figure 11. Hourly variation in murre numbers

two weeks of observation. The two-week periods and the study sites were chosen to include as broad a range of times of day as possible. Because the total population and amount of fluctuation varies during the season, we did not average our numbers over periods longer than 2 1/2 weeks.

Figure 11a shows data in the first part of June. There were no birds on the cliff before 1800, and the numbers increased rapidly after that. The number of points are few and the differences are probably not significant. However, these data are consistent with our general observations. We did not often make observations before 1800 because there were so few birds on the cliff then.

Figure 11b shows data for June 19 to July 4, tracing the same rapid increase during the afternoon and perhaps a low point just after 1200.

Later in July (Figure 11c) data indicate the same low point in the middle of the day, with numbers decreasing during the morning and increasing during the afternoon.

Apparently the murres left to feed during the day and returned during the night even though night during this time of year is very short and not very dark.

The variation during the day in mid-season was much less than earlier in the season. In the period from July 8 to 30 the lowest two-hour period is 40% of the highest period, while from June 19 to July 4 the lowest period was only 10% of the highest period. Our data on flights to and from the cliff show a similar variation during the day.

Figures 12 and 13 show results of standardized five-minute watches, regarding the direction of murre traffic. These figures may include some puffins as it is difficult to detect a few puffins in a skein of

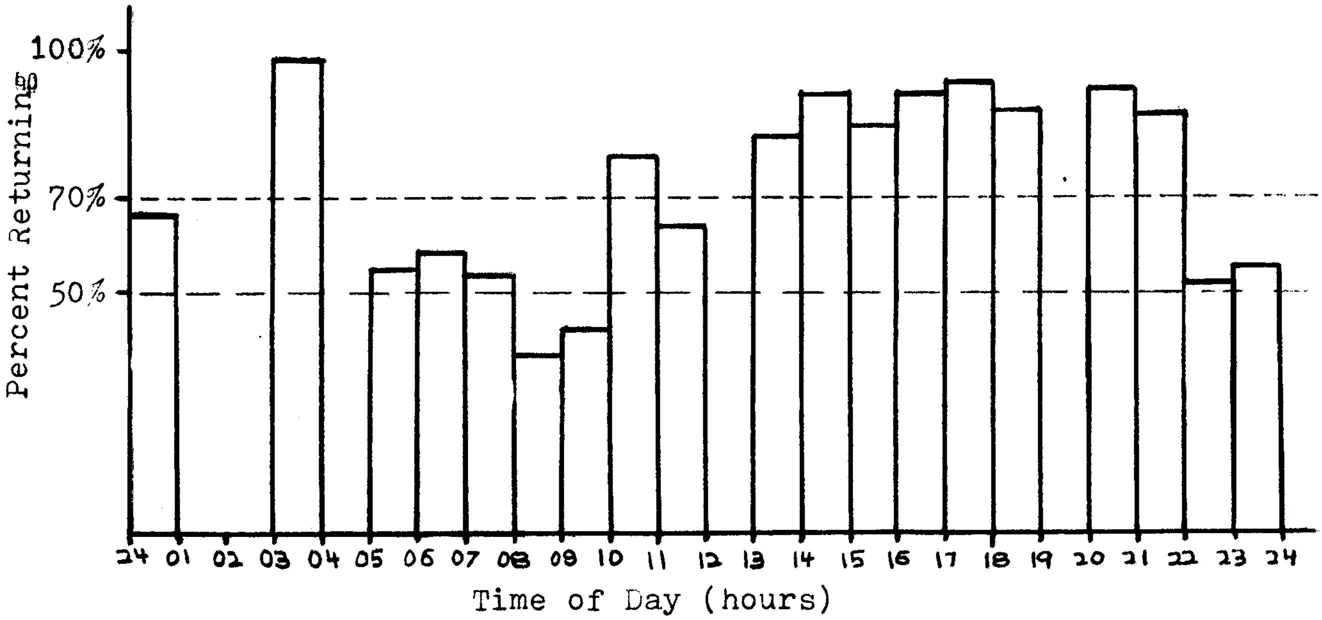


Figure 12. Murres returning to the cliff in percent of the total seen during 5 minute watches

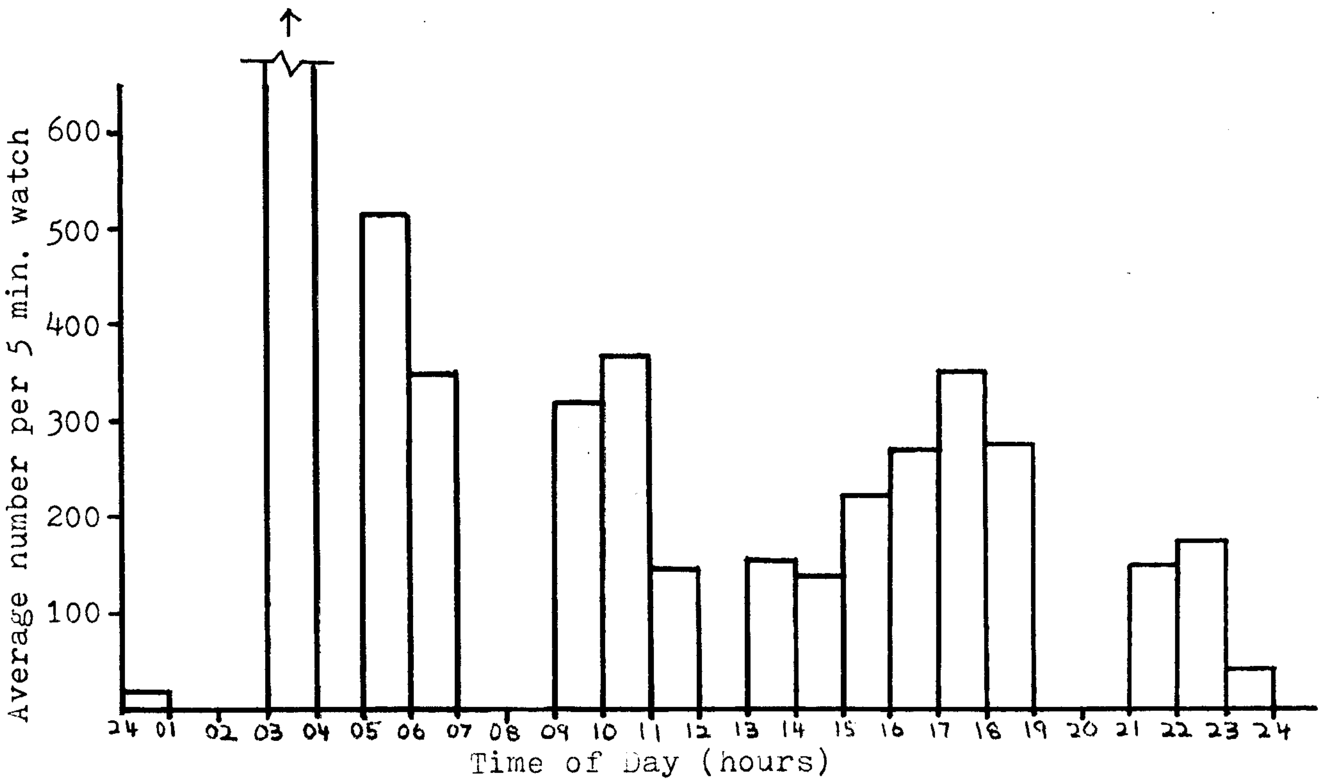


Figure 13. Average number of birds counted in 5 minute watches in relation to time of day

50 murres at a great distance. These data were primarily taken from the period July 16 to July 29.

Figure 12 shows, for each hour, the percentage of the total number of birds that were flying towards the cliff. The most notable thing about this graph is that it suggests that more than 50% of the total birds flying were flying towards the cliff except for two of the periods. Although the number of murres on the cliff did increase during this period, there certainly must have been many more murres leaving the cliff than our data show. There are three possible explanations for observers recording more birds returning than leaving.

First, murres may have departed in large numbers during the time periods in which we have no data. It is unlikely that this is more than a partial explanation as the longest period for which we have no data is two hours and the data taken during periods before and after that gap show a large percentage of birds returning.

A second possibility is that murres fly away from cliffs in a different direction than they return from. As most observation points were near the east end of the cliff, most of the birds we saw were flying to or from the southeast. If murres left the cliffs heading due south to get to feeding grounds and returned from the southeast or returned by following the shore until they got to the cliffs, then we would have seen more returning birds from our observation points. To see if this was true we made a transect in front of the cliffs in a small boat, recording numbers and direction of flights of murres. This transect followed a semi-circular arc so that we would spend equal amounts of time at all directions from the cliff. The transect was made about one mile from the

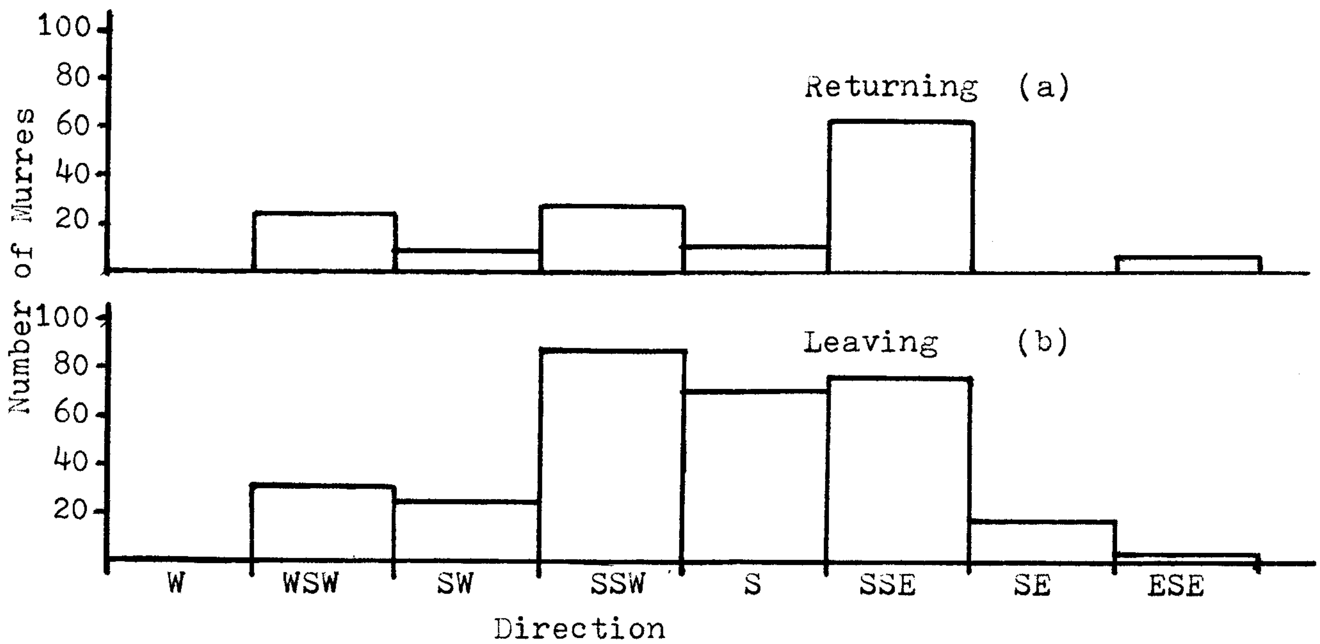
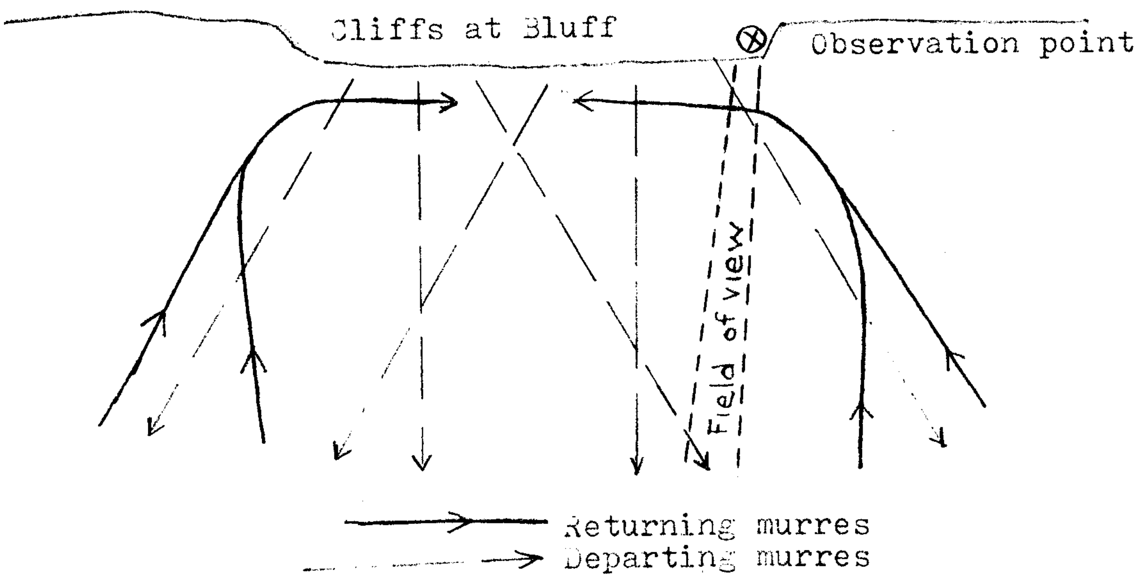


Figure 14. Number of murres in relation to direction of flight to or from the cliff

cliff to eliminate local traffic. The results are shown in Figure 14. It is evident that a greater percentage do not return from the southeast than depart in that direction. A greater percentage of the returning birds came from the south-southeast than left in that direction, which may have partially caused us to record more incoming birds.

The third and most likely explanation for this apparent discrepancy between returning and leaving birds depends upon observations of the behavior of commuting murres. Murres leaving the cliff fly singly or in small, loose groups low over the water. Hence they are inconspicuous. Most murres return in groups of 5 to 50 in a string or "V" formation at about 10 to 100 meters over the water. Consequently they are more visible. These groups were observed to come near the cliff close to the end of it and fly along parallel to it with individuals peeling off as they reached their nesting sites. This would cause a greater proportion of the returning murres to be visible from the end of the cliff. The effects of this "leading line" on observers has been discussed in European studies of visible diurnal migration.



According to this diagram, which exaggerates the situation, only 1/3 to 1/6 of the departing birds would be obvious while nearly 1/2 of the returning ones would be. A semi-circular transect would not suggest murres returning from a different direction than they are departing toward. This is supported further by the fact that observers situated in the middle of the cliff almost always reported a higher percentage of birds leaving than did the observers at the east end. Thus we conclude that we missed seeing a lot of murres departing the cliff.

To arrive at a percentage which represents an equal number of birds leaving and returning, we used the average of all five-minute watches from each one-hour period and summed them for all 24 hours. These totals showed around 70% of the birds counted were returning and 30% were leaving. If we use 70% returning as the point where an equal number of birds were going in either direction, Figure 12 makes more sense. Half of the hourly figures are above the average and half below it.

If one assumes 70% to be the mid-point, Figure 12 shows that murres generally left the cliff between 0500 and 1000 and returned between 1300 and 2200. They appear to start leaving again at 2200 but the few data and poor light during that time of the day make the data suspect. The peak of returning birds between 0300 and 0400 was observed on July 23, just after a period of high winds and rain that had probably caused a lot of murres to stay away from the cliff. It also was just before a very high number of murres was recorded at study sites; thus the arriving birds probably included a large number of non-breeders (see Figure 22).

Figure 13 is a measure of the amount of commuting going on during the day. It shows the average number of birds counted during five-minute periods within each hour. These data come from only one observation point because some observation points consistently had higher counts than others. This figure, combined with data shown in Figure 20a shows that the highest flow of traffic leaving the cliff was from 0500 to 0600 and that traffic flow decreased later in the morning. Returning trips to the cliff started after 1300 and increased up to 1800. After 2100 there was much less flow of traffic. Again we assume that the large peak between 0300 and 0400 is caused by factors other than the regular daily schedules.

One would expect from this that numbers of murres on the cliff would be low during the middle of the day and increase in the afternoon, which is what was found during visits to study sites.

b) Black-legged Kittiwakes

Figure 15 shows attendance at the cliff by hour for kittiwakes. The same periods are covered as were covered for murres except that data are omitted for the period in early June when kittiwake numbers were too erratic to show any trends. Figure 15a, covering late June, suggests changes similar to those shown by murres, with a low point in the middle of the day and increase in the afternoon. There may also be a decrease in the morning. The variation appears to be less than in murres. Figures 15b and 15c both cover the same period in July and suggest that kittiwake attendance does not vary with the time of day.

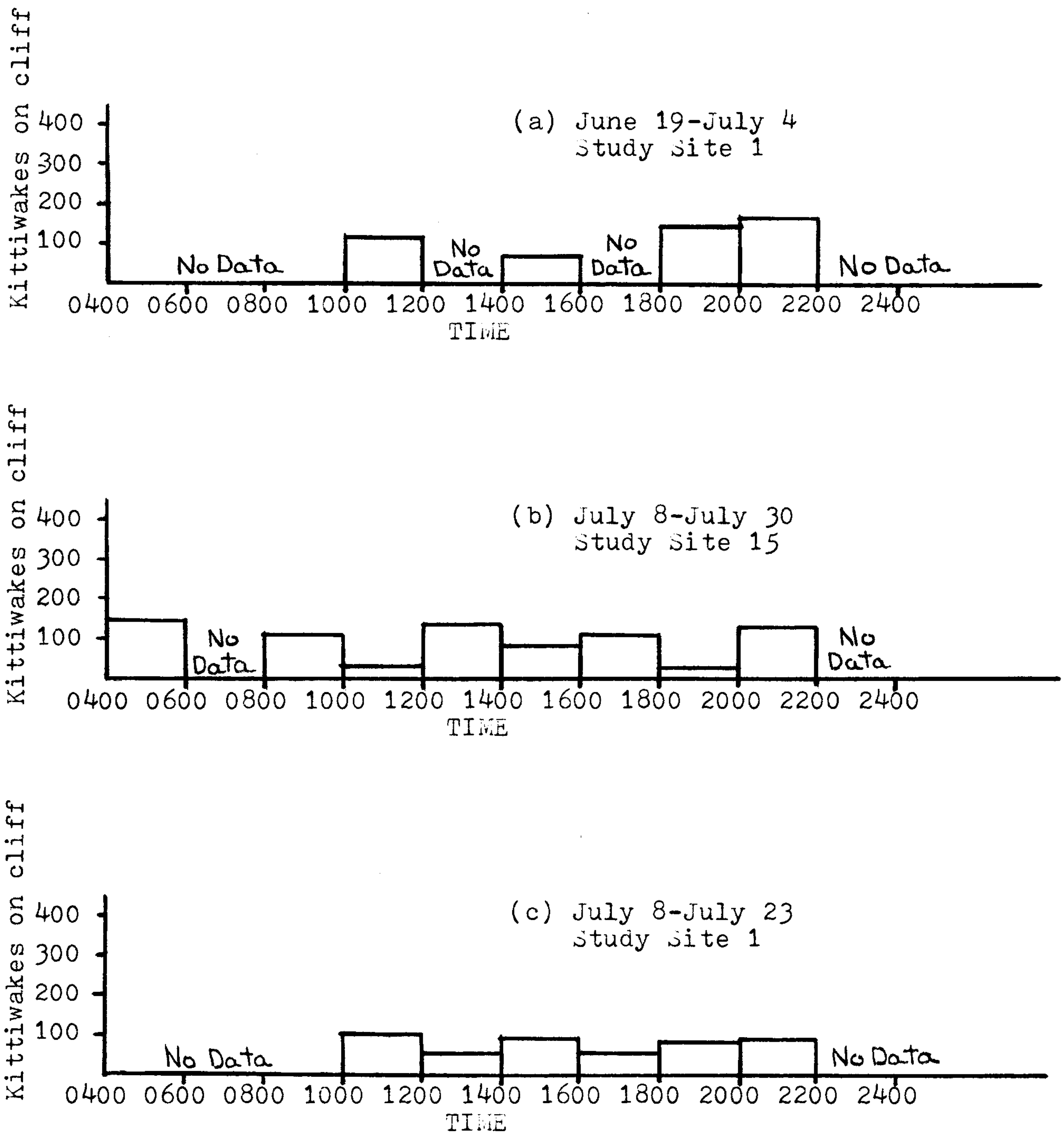


Figure 15. Hourly variation in kittiwake numbers

Table 8. Comparison of methods of measuring reproductive success at Bluff.

method	# of nests in sample	reproductive success	measurements
study sites	515	.29	eggs per nest
counts from boat	2,123	.16	chicks or incubating parents per nest
counts in late August from top of cliff	1,750	.02	nearly fledged chicks per nest
study sites	515	.02	fledged chicks per nest
counts of photos	228	.01	chicks per nest

Table 9. Kittiwake reproductive success.

colony	from boat chicks & incubating adults per nest	from top of cliff, chicks per nest	from photos chicks per nest	1975 chicks per nest
Sledge Island	.04 .15*			.35
Bluff	.17	.02	.01	.42
Square Rock	.08	.02		
Cape Denbeigh	.27		.10	.50
Egg Island	.38		.11	

* These figures were obtained from counts of "incubators" from the top of the cliffs.

4. Reproductive success

a) Black-legged Kittiwake

Reproduction in kittiwakes was very poor at all colonies in Norton Sound in 1976. On the basis of data presented in this section, we have concluded that this was caused by the lack of a food source. We collected data on reproductive success at Bluff by four different methods: 1) visits to study sites; 2) counts from a small boat on August 12; 3) counts from the top of the cliff in late August; and 4) counts made from photographs taken from a small plane flying in front of the cliff on August 20. Table 8 compares these methods.

In Table 8 the highest reproductive success is indicated by counts of eggs from study sites. This is because it includes all eggs that were laid at one time or another during the summer. The count from the boat is an instantaneous count and occurred after many of the eggs had been destroyed. The counts of chicks are all very low as many eggs never hatched, and there was some chick mortality.

These results indicate that data obtained by these methods is comparable and that data taken at other colonies from a small boat or by photos can indicate relative reproductive success with reasonable accuracy.

Table 9 compares kittiwake reproductive success at all kittiwake colonies in Norton Sound. Several different methods are shown and the figures obtained in 1975.

It appears that in general, colonies in eastern Norton Sound, Cape Denbigh, and Egg Island had better reproduction both years than colonies further west. In both years, Sledge Island appears to have had slightly less reproductive success than Bluff.

The counts in Table 9 made from photos show the results of an experimental technique of measuring reproductive success using 35mm photographs taken from a small plane. The photographs were later analyzed and chicks and nests counted. During the two years we have tested three different lenses. A 135mm lens produced pictures in which chicks were too small to identify, while a 400mm lens proved to be difficult to use inside a small plane. The 300mm used this year produced the best pictures, but the plane was still close enough so the lens could not be focused on infinity. Some pictures were out of focus but most were usable. There is still a difficulty in seeing all the chicks as some may be hidden by an adult or a piece of cliff. Because of this, the pictures that are blown up as prints or in a slide projector are the best. Limits are set by the resolution of a 35mm negative.

These problems could perhaps be solved by using a slightly larger lens such as a 400mm or a camera with a larger negative size.

Taking the pictures in late August just before chicks were likely to fledge would also make it easier to see them. The pictures in 1976 were taken on August 20 when some chicks were still small.

The results obtained by this technique (Table 9) seem to indicate much lower success than those obtained by other methods. This is probably because chicks are hidden behind adults or pieces of rock; also the sheltered parts of the cliff with better reproduction are under-represented.

However, the values obtained do follow the same trend of the lowest value at Bluff and highest at Egg Island. This indicates that the technique is valid at least for comparing colonies and it deserves further development.

A major cause of poor reproduction is shown in detailed data from study sites at Bluff in 1976. Figure 16 shows the total number of eggs and chicks present at the study sites in which kittiwake nests were mapped (280 nests). From June 25 to July 8 the number of eggs increases as one would expect during the early part of the laying period. Rather than leveling off and gradually declining, the number of eggs declines sharply from July 8 to 25. After July 25 the number of eggs and chicks declines slowly, presumably as a result of average mortality. Periods of high wind and rain denoted as storms on Figure 16 are not associated with any sharp decline. Therefore, adverse weather was probably not the major direct cause of kittiwake reproductive failure.

Figure 17 gives some insight as to whether the decrease in number of eggs was caused by an increase in mortality or a lack of production of eggs. Figure 17 shows the number of eggs produced during each two-day period between visits to study sites. One would expect this graph to be a normal bell-shaped curve with a broad top in the middle of the laying period. The actual curve rises as would a normal curve, but has a sharp peak and declines rapidly after July 6 before the center of the laying period should have been reached.

Figure 17 also shows egg mortality calculated as a percentage of the eggs present. If the reproductive failure had been caused by a major environmental event, one would expect a sharp peak in mortality on that day. As it is, mortality rises gradually throughout July and has a high point of 47% on a day when there were only 19 eggs in the study sites (and, consequently, low accuracy). The fluctuations in the curve after July 15 reflect the small sample. Mortality during 1976 was probably

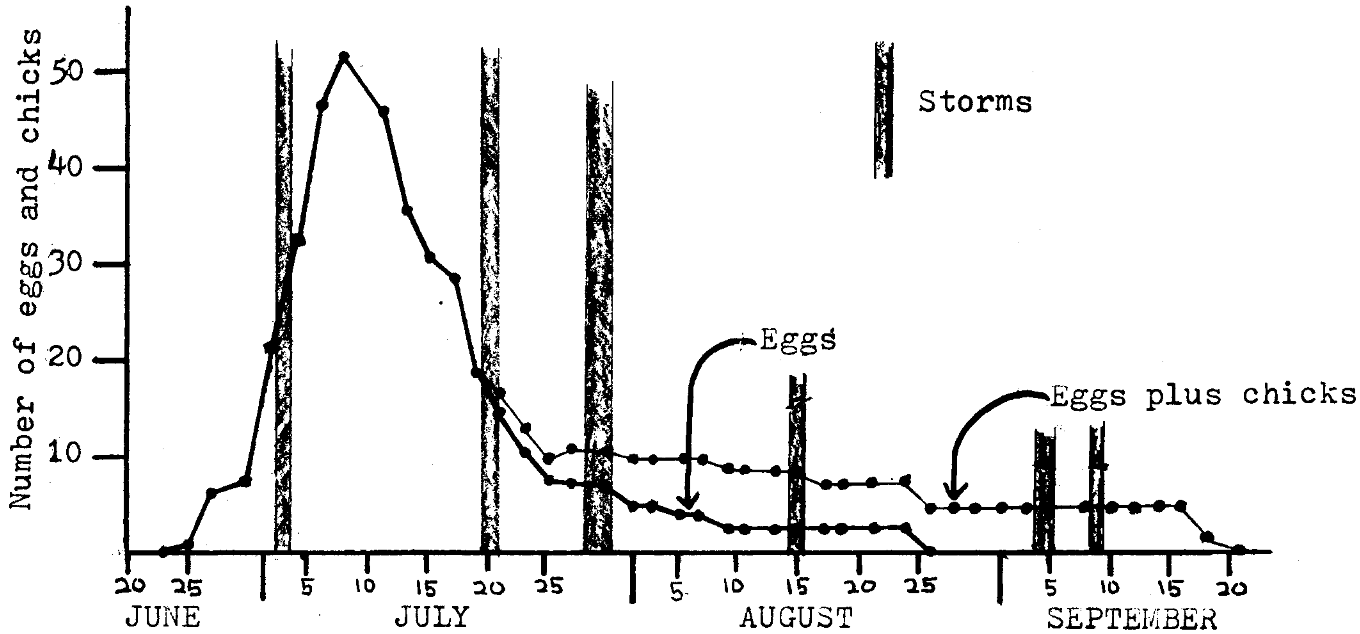


Figure 16. Number of kittiwake eggs and chicks at study sites

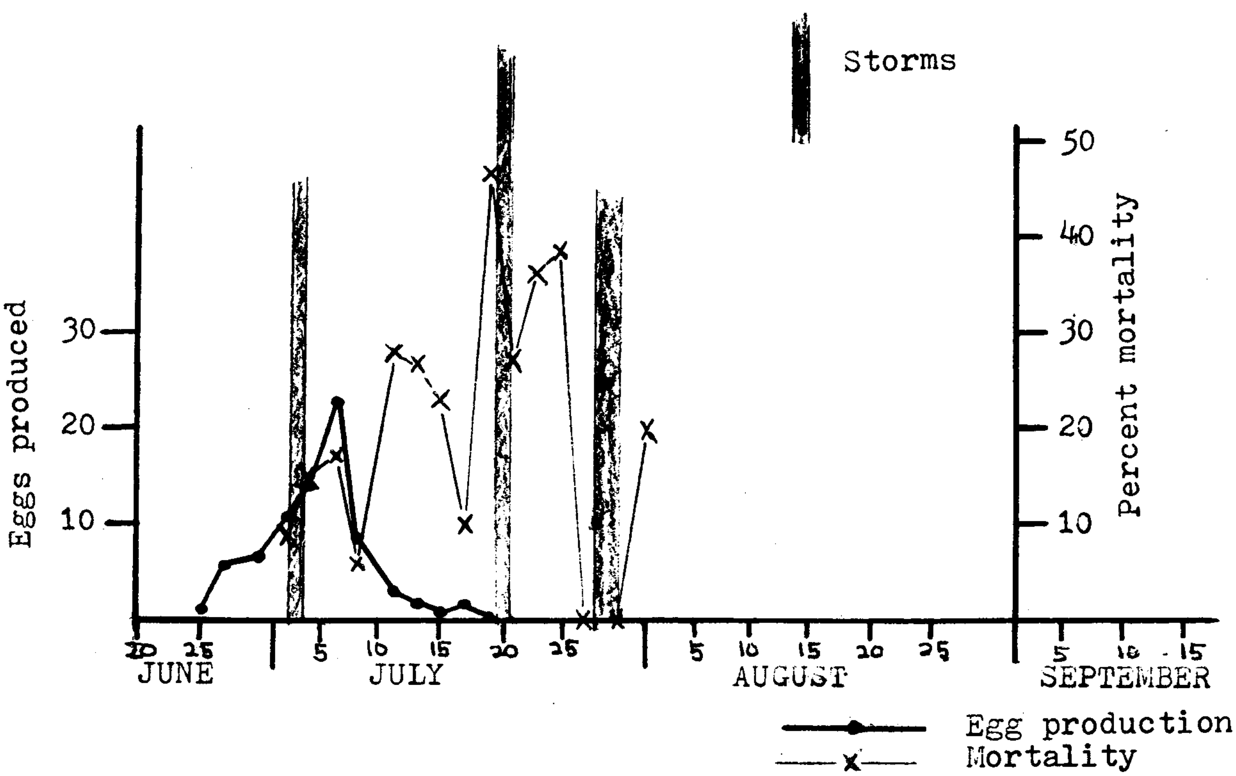


Figure 17. Kittiwake egg production and mortality at study sites

greater than in a "normal" year, but it appears to be less of a factor in the reproductive failure than the lack of production of eggs.

Failure did not occur on a single date, but during a period from July 6 to approximately July 25. During this period there was low egg production and fairly high mortality.

The reason for poor egg production is at least partially explained by Figure 18 which shows total kittiwake numbers throughout the season at study site 1. The numbers on the cliff dropped sharply after a short but severe storm on July 3. Some returned after the storm, but after July 9 the numbers again dropped sharply without any obvious environmental reason. The bulk of kittiwakes did not return until July 25.

Therefore, it looks as if the cause of the lack of production of eggs from July 6 to 25 is absence of adults from the colony. As most storms only have a short-term effect, it would seem that there must be other causes than weather. The most likely explanation is a lack of food so that adults had to spend most of their time searching for food and could not return to the colony. Those that did return lacked enough energy to lay or incubate eggs. Many of the eggs that had already been laid were observed to be abandoned or left exposed to predators.

Kittiwakes are observed to feed mainly in feeding "mélés" which consist of a group of 10-100 birds circling and calling and diving into a school of fish, creating a lot of noise and movement which is visible from a great distance. This suggests that kittiwakes rely on others to happen upon a school and communicate its presence to other birds. The mélés usually occur within sight of shore -- not at long distnaces from the colony. Kittiwakes seem to feed primarily on sand launce (<u>Ammodytes</u>).

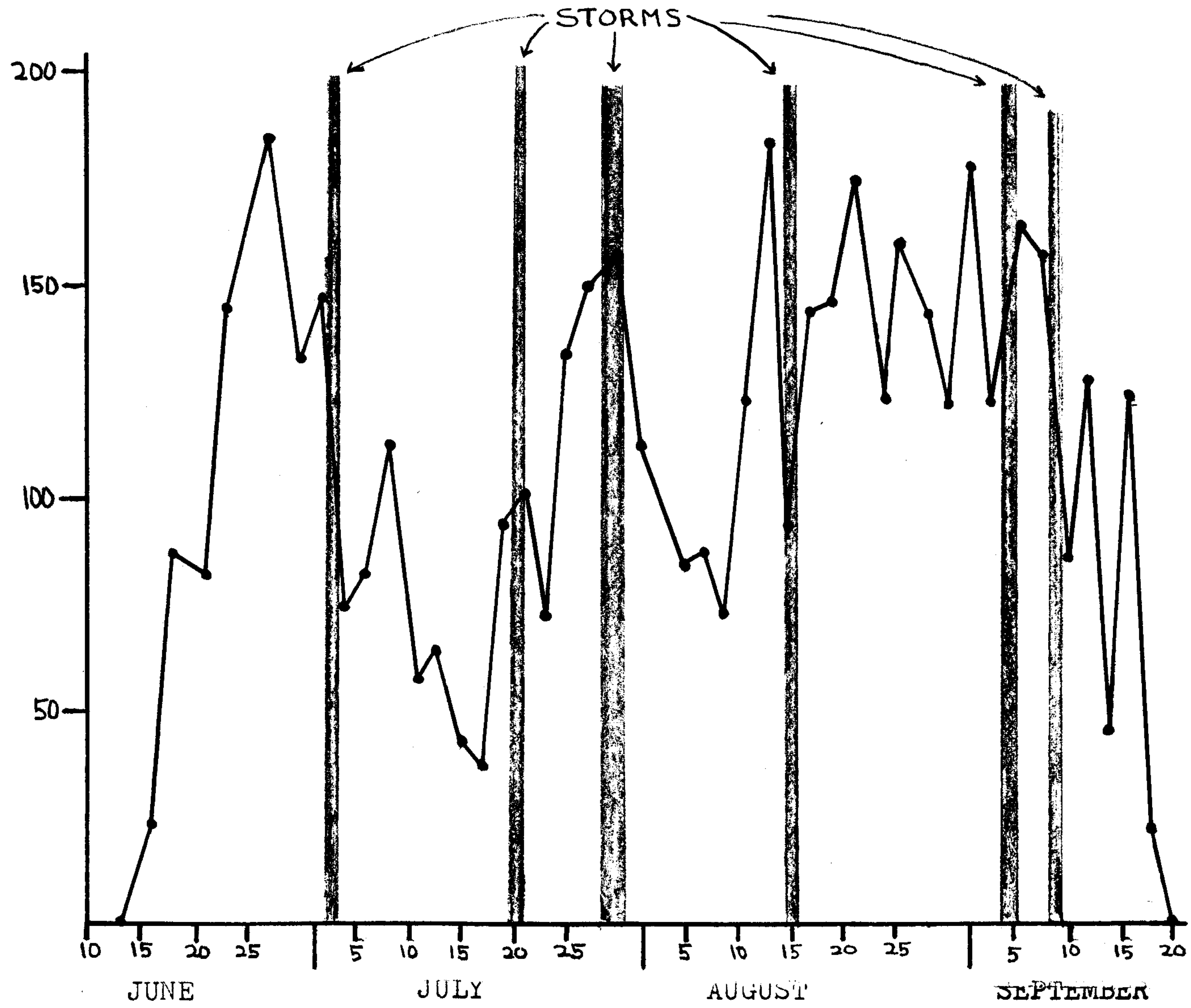


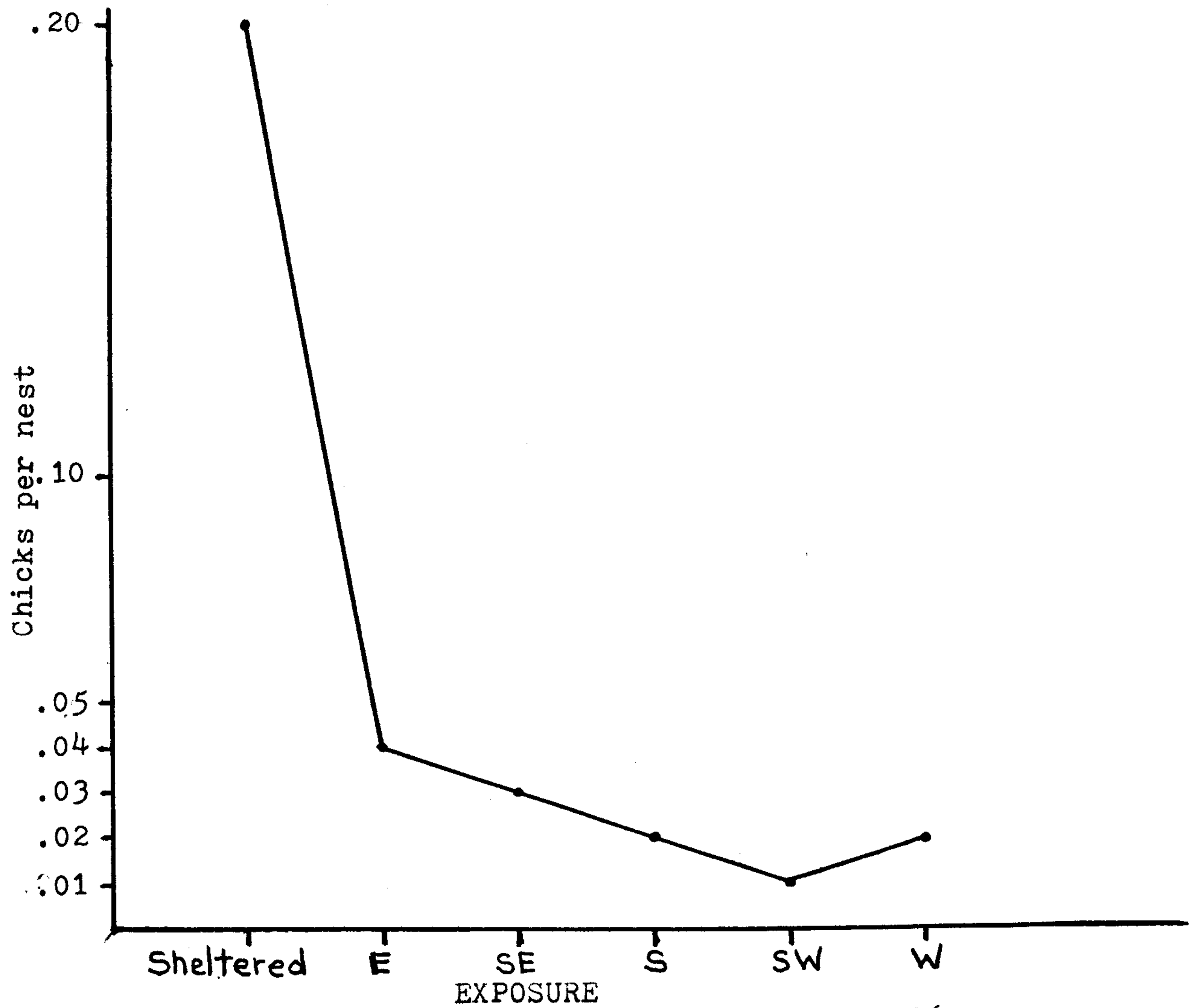
Figure 18. Kittiwake numbers at site 1.

We conclude that lack of food in near-shore waters caused the reproductive failure in kittiwakes; however, lack of more data on kittiwakes' feeding tactics, their prey preference and the abundance of prey species in 1976 makes this only a guess.

The fact that weather, especially wind, also had an effect on reproductive success is documented by Figure 19 in which reproductive success is graphed in relation to the "exposure" of the section of cliff where they nested. These data were taken from 32 samples along the cliff, including 14 regular study sites. Numbers of nests and chicks were counted as well as the average direction of exposure of the nests. The most sheltered areas are between stacks and the cliffs and never receive direct winds.

The data indicate that areas exposed to the southwest had the lowest reproductive success. Areas facing west and south may have been slightly sheltered from some high winds and produced slightly more chicks. Cliff faces exposed to the east and southeast produced the most young of any of the exposed areas. Our weather records show that all strong winds in June, July and most of August came from the southeast.

Thus, Figure 19 implies that wind had a negative effect on kittiwake reproduction. Although the differences are slight among exposed areas, there is a large difference between success in exposed and in sheltered areas. This suggests that weather is one factor in the poor kittiwake reproduction. That it is not the major cause is demonstrated by the fact that the reduction in egg production did not occur during a storm and the fact that 1976 reproduction in the sheltered areas (.20 fledged chicks per nest) was still far below the average for the whole cliff in 1975 (.42 chicks fledged per nest).



	Sheltered	E	SE	S	SW	W
Nests	33	190	538	793	505	226
Chicks Fledged	8	8	14	12	7	5
Chicks per nest	.20	.04	.03	.02	.01	.02

Figure 19. Reproductive Success in relation to exposure

b) Murres

Reproduction of Common Murres, like Black-legged Kittiwakes, was very low in 1976. Thick-billed Murre reproduction was higher. Determination of reproductive success is much more difficult for murres than for kittiwakes.

Of the several techniques which we used to measure murre reproductive success, the most successful was to map the location of each murre on a study area during each visit and to note the presence of an adult in incubating posture, or visible eggs, or chicks, etc. This enables one to determine the history of a successful nest. When a chick disappears one can check to see if a parent has been there long enough to have reared a chick to jumping age.

However, because Common Murres nest in crowded areas it is almost impossible to identify individual sites. In 1976 we found only one area where the murres on a ledge were clearly defined enough to be mapped from the beginning of the season. This consisted of 30 sites. Because Thick-billed Murres nest on smaller ledges, they tend to be more spread out. Consequently, despite the low number of Thick-billed Murres at Bluff, we were able to map the location of birds at two study areas with a total of 38 sites.

A second technique which we used to measure murre reproductive success was to count the birds in a circumscribed area throughout the season and to map the position of each bird in incubating posture on a sketch map. This gave a consistent count of the number of incubators or eggs and also showed egg mortality. It also enabled us to follow the schedule of an individual egg and chick.

With either of these methods one usually spots a chick before it jumps, because larger chicks often stand apart from their parents for tens of minutes at a time. When murre chicks are big enough to jump they have white breasts and white chins. Their feathers, rather than being grey, fluffy down, are small, smoother and darker than the down. Occasionally, however, an adult that appeared to have been brooding for a long period left without our seeing a chick during the previous week.

By these two methods, the number of chicks that survive to jump can usually be determined, but the number of breeding pairs, nests or total number of adults attempting to breed is a difficult number to determine. Our experience suggests that the average number of birds present during the second half of June represents the number of pairs that are trying to breed. We used this figure to calculate reproductive success. Data from mapped birds at site 10 indicate that all which had an egg at one time or another during the summer were present on several days in late June. They were never all there on the same day so the count for an individual day might be lower than the number of breeding pairs.

However, this lower number is off-set by the fact that on some days both adults are present. At most sites the average number in late June closely approximated the lowest count made during the second half of July, when any pair which is going to raise a chick would have to have an egg. At study sites with poor reproductive success, the numbers late in July were even lower than counts in late June. Because of this, the average number of birds in late June is a better measure of breeding pairs than the lowest numbers in July.

The numbers of murres on ledges fluctuates widely throughout the season, including June, so that the number of breeding pairs cannot be

Table 10. Comparison of three possible figures for the number of breeding pairs.

site no.	June 16-30 counts	corrected average	lowest number July 15-31	highest number of incubators recorded
10	0+, 26+, 18, 15, 5+	17	11	16*
1b(MD)	6, 4, 10, 0+, 25+	7	5	5
1b(MT)	0+, 22, 17, 10, 4+	11	16	10
7(upper)	24, 28, 24, 18, 31	25	33	9
6	39+, 16, 7, 11, 14	12	0	3
5(left)	35, 1+, 22, 0+, 20, 31, 3+	27	5	13

* At this site, the birds were mapped so this is the known number of birds that had eggs at one time or another.

+ Numbers to be discarded.

Table 11. Murre reproductive success.

	study area	probable # breeding pairs	highest count	# chicks jumped	chicks per breeding pair
Common Murres	1b A	7	11	0-1	0-.14
	1b B	17	35	1-3	.06-.18
	1b C	19*	27	1-3	.05-.16
	1b D	16*	22	0	0
	4	24	127	0	0
	4b	12*	15	4-7	.33-.58**
	5 left	27	56	4-5	.15-.19
	5 right	25	45	0	0
	6	12	19	0	0
	7 upper	25	105	0-1	0-.08
	7 middle	23	42	0	0
	7 lower	58	87	0	0
	9 upper	35	59	1-2	.03-.06
	9 lower	43	72	0	0
	10 map	16	52	5	.31
	10 right	32	81	5-7	.16-.22
	12	32	95	3-5	.09-.16
	TOTAL	423	950	24-39	.06-.09
Thick-billed Murres	2	23	31	4-7	.17-.30
	15	15	18	7-8	.47-.53
	TOTAL	38			.29-.40

* Data unavailable in June. This is an average obtained during the early incubation period, 7/18-7/31.

** This figure does not represent a random sample because this area was chosen in July because it had a large number of eggs on it.

arrived at by averaging all numbers recorded in the second half of June. In calculating this average we disregarded those numbers that were conspicuously higher than the others. We assumed that those counts included a large number of loafers and birds prospecting for sites who actually had no chance of reproducing that year. Similarly, zeros or any numbers obviously much lower than the average were disregarded, as on many days during June very few murres were on the cliff at all. Very low numbers were usually present during the middle of the day. Table 10 shows a comparison of three possible figures for the number of breeding pairs.

The first three examples show sites where all three possible measures of breeding pairs are in good agreement with each other. The fourth is a site where very few eggs were produced although most of the birds remained throughout July. At the last two sites most or all of the birds left during July. The erratic numbers that were eliminated to obtain a usable average figure are marked "†".

Table 11 shows murre reproductive success at 19 study sites using this method of calculating the number of probable breeders. The number of chicks produced is indicated as a range in several cases because many adults that appeared to be incubating or brooding for a long time left without an observer seeing a chick. In these cases it is possible that a chick departed the cliff with its parent, but we cannot be sure.

Reproductive success varied widely. At many areas, no murre chicks were produced and at others success was high. One reason for this variation may be in the structure of the ledges. The four study sites which had the best success record, i.e., the map at 10, the map at 4b, the area to the right of 10, and to the left at 5, all were small ledges on which nest sites were somewhat separated. Murres were not bunched together in a mob, as they are on broad ledges.

This difference in reproductive success may reflect differences in our ability to measure reproduction on these two types of ledges. On small ledges and cracks with distinct sites, it is easier to see individual birds, their incubating posture, eggs and chicks. In a tightly packed mass of birds it is more difficult to tell how many adults are rearing young.

The almost total absence of murres from the cliffs around July 17 supports our conclusion of low reproductive success on large ledges. Many ledges had few or no murres on them at this time; therefore few or no chicks could have jumped before September 4, 48 days late (assuming the minimum incubation period of 30 days and minimum chick growth period of 18 days reported by Tuck (1960)).

For an adult to be successful and leave before September, it must have been on the ledge during the middle of July.

Thus, we have concluded that the large differences in measurement of reproductive success between different sites reflect real differences. It appears as if tightly packed ledges are not as suitable for reproduction as are the individual sites that are slightly separated from each other. A possible reason for this would be that when the birds on a wide ledge are panicked by a Raven, a person, or a helicopter the large numbers of birds trying to leave the ledge tend to kick off eggs and chicks, while on a small ledge that has only one row of murres on it, they can leave without having to go over other eggs or chicks that are closer to the edge of the ledge.

This difference in success between types of ledges would also result if more non-breeding or inexperienced birds are present on large crowded ledges. The presence of more non-breeders throughout the year would increase the number that we assume to be the breeding pairs and thus lower the measure of breeding success. Less experienced breeders are not likely to be as successful as older birds in gaining and holding territories. They would be expected to lay eggs near the edge of a ledge where the eggs are more likely to be knocked off. Presumably, the dominant birds establish territories in the protected breeding sites near the back of the ledge. This is consistent with our observations that on crowded ledges incubators were most often seen along the back corner of the ledge.

Because eggs are present at a time when there are large numbers of murres on the ledges and because they are hard to see, we have a limited amount of information on the eggs produced per breeding pair. Areas where eggs and incubators were mapped do give rough estimates of the number of eggs present, however. Data on some of these sites is shown in Table 12. This data should be regarded as approximate except in the case of the two sites that were mapped. However, some generalizations can be made that help explain the apparently low level of Common Murre reproduction.

First, there are three sites at which more eggs were produced than the number of breeding pairs we estimated. This is possible even though murres raise only one young, because they are capable of replacing an egg that is lost. Tuck (1960) has reported this and the local Eskimos say that the murres replace eggs that they collect. Our detailed data

Table 12. Schedule of production of eggs.

study site	probable no. breeding prs.	no. eggs produced	eggs per breeding pr.	chicks per egg
Common Murres				
4	24	2	.08	0
4b map	12	10*	.83	.40-.70
5 left	27	13	.48	.31-.38
5 right	25	2	.08	0
6	12	3-4	.25-.33	0
10 map	16	19-21	1.19-1.3	.23-.26
10 to right	32	16	.50	.31-.44
12	32	16	.50	.19-.31
TOTAL	180	81-84	.45-.47	.29-.48
Thick-billed Murres				
2	23	27	1.17	.15-.26
15	15	15-16	1.00-1.07	.44-.53
TOTAL	38	42-43	1.05-1.13	.26-.37

* This site was not observed in June, so some eggs produced then and destroyed are not included. However, it was also picked as an area with a lot of eggs, so it is expected to be high.

from areas that were mapped showed that eggs were replaced in at least seven cases. Sixteen mapped Common Murre sites showed only one lost egg that was replaced and that egg did not produce a chick. Thirty-eight sites of Thick-billed Murres showed six sites at which eggs were lost and replaced. One of these eggs successfully hatched and a chick jumped.

Second, Table 12 shows that egg production varies widely as did overall reproductive success shown in Table 11. Areas that did produce chicks, however, had equivalent levels of success. All areas that produced eggs at a rate of more than .35 eggs per breeding pair also produced chicks. This suggests that the period of most stress in 1976 was the period of egg-laying and incubating. If our numbers for breeding pairs are correct and we are correct in our conclusion that Common Murre reproduction was very low, then the period that caused the poor reproduction was similar to the period that caused failure in kittiwakes.

It is also interesting to note that although egg production in Thick-billed Murres was much higher than in Commons, the ratio of chick to eggs is similar. This suggests that the chick to egg ratio for Common Murres was valid and that the cause of poor reproductive success was failure to lay eggs.

The fact that the only sites showing an eggs to breeding pairs ratio greater than one are areas where nest sites were mapped, indicates that mapping is a preferable way of determining where eggs are. Undoubtedly, we missed some eggs at other study sites. However, we feel that the large differences between sites indicate real variation between sites in the number of eggs produced.

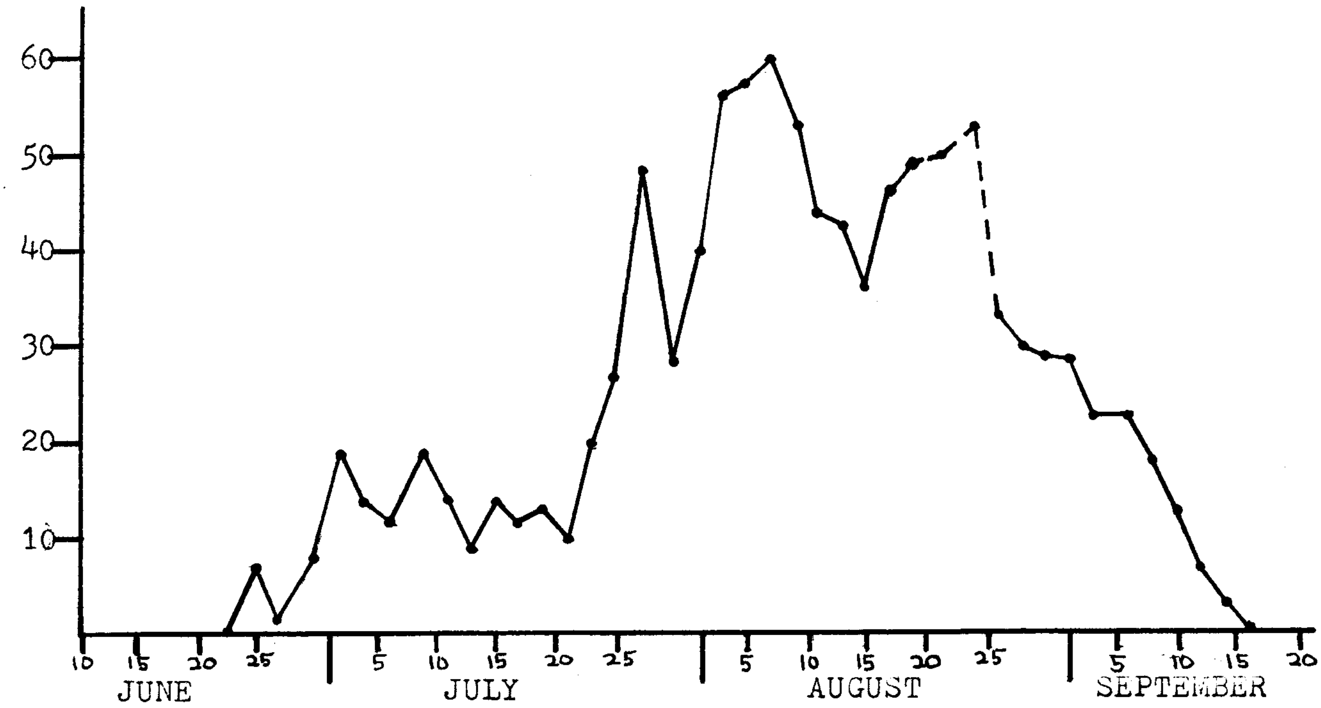


Figure 20. Common Murre incubators and brooding adults at all sites

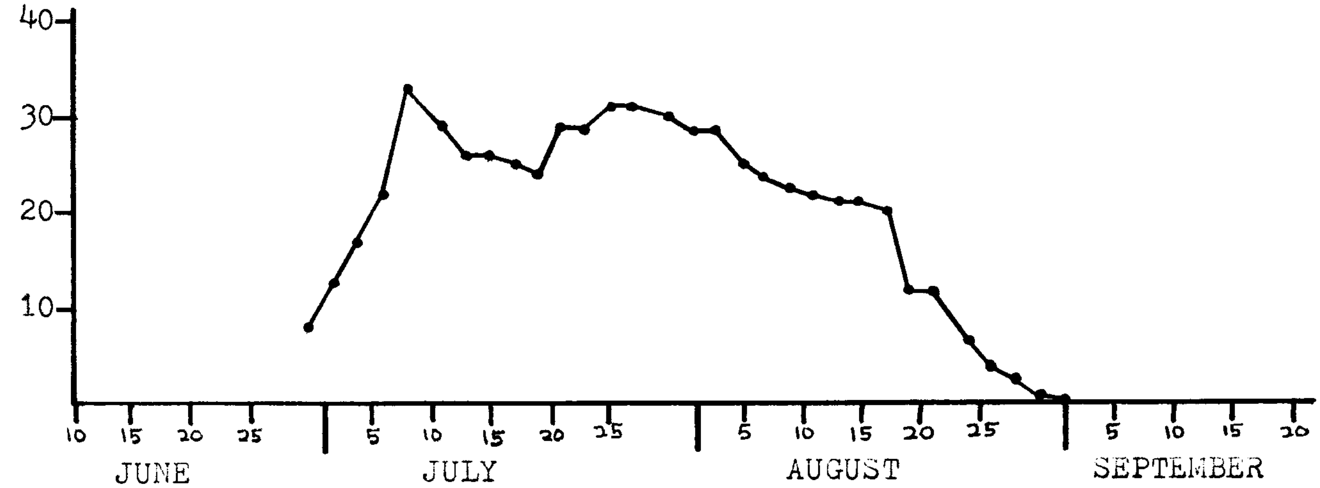


Figure 21. Thick-billed Murre incubators and brooding adults at sites 2 and 15

Table 13. Number of Common Murre incubators in early August 1975 and 1976.

site	1975	1976
1b left	10	3
1b small face	28	5
5 left	23	7
5 right	16	0
9 upper	36	4
9 crack	14	6
12	21	6

As both Thick-billed Murre areas show ratios of eggs to breeding pairs greater than one, it is tempting to conclude that Thick-billed Murres are better able to replace eggs. However, the small amount of data prevents us from drawing this conclusion.

Further evidence of 1976 being a poor reproductive year for Common Murres is shown on Table 13. This table compares the number of birds in incubating posture on ledges that were used as study areas both in 1975 and 1976. In this table the term "incubator" includes brooding adults and chicks seen. Differences in judgment of "incubators" between 1975 and 1976 may lead to difference in numbers between the years. Observers in 1975 tended to be more liberal in their counts of incubators. However, because the difference in numbers is so great, it suggests that there were many more eggs on these ledges in 1975 than in 1976. The fact that the population of murres was much lower at Bluff in 1976 than in 1975 should not change the number of incubators on these ledges which appeared to be filled to capacity in 1976.

It is apparent that Common Murres reproduced poorly in 1976 while Thick-billed Murres did better. There is evidence to suggest that, as with the Black-legged Kittiwake, the failure occurred during the egg-laying period. Figure 20 shows a measure of Common Murre reproduction throughout the season. The count is of adults that were judged to be incubating or brooding. The dotted section of the curve represents a period when observers had changed and the number of incubators recorded were widely out of line with what was recorded before and after those two days.

The figure represents a total of all study sites so that some irregularities are eliminated; however, the roughness of the curve reflects primarily judgments as to which birds have eggs.

The number of incubators increased rapidly from June 27 to July 2 but then stayed at the same level until July 23 when a steep increase was resumed. From July 2 to July 23 reproduction is severely affected as it was in kittiwakes. During this period, there are large fluctuations in numbers of birds. This fluctuation is consistent with our observation that almost all the eggs produced at study sites during this period lasted only 2-6 days. The number of murres during this period was very low which made it easier to keep track of eggs that appeared but also made eggs more susceptible to predation by Ravens and Glaucous Gulls. Also during this period observers were learning how to recognize the posture of incubating adults and the methods of determining them were changing. It is evident that the number of eggs did not increase during this period.

This period of population fluctuation coincides with that of the decline in production of kittiwake eggs although it appears to start a little earlier -- July 4 rather than July 8. This could be due to a short but severe storm on July 2 and 3 which may have affected the murres more than the kittiwakes.

Murres continued to produce eggs after this period of stress while kittiwakes did not. Murres also produced eggs later in the season, possibly due to their ability to replace an egg that had been lost. However, an egg laid on July 23 will not produce a chick large enough to jump until at least September 12 (30 days incubation and 18 days on the ledge). By September 10 most of the murres had left and the chances of a chick surviving until after September 12 with deteriorating weather and increased predation pressure were poor. Our data from mapped sites indicate that most murre chicks came from eggs that were laid in early July and survived the period of stress. Therefore egg production after the period of stress was probably fruitless.

On August 4 the number of incubators reached a first peak. As the mortality rate surpasses the egg production rate, the number of incubators declines. Chicks started to jump in late August. The second peak that occurs around August 21 probably reflects a decrease in adult murres which made it easier to recognize the remaining birds that had eggs or chicks. During this later period we realized that adults which had not been counted as incubators earlier, proved to have eggs or chicks. These data suggest that the counts of incubators during the peak were about 20% low.

Figure 21 graphs similar data for Thick-billed Murres, all from mapped areas. These data suggest that reproduction in Thick-billed Murres was not as severely affected as it was for Common Murres or kittiwakes. Generally the number of eggs increased in early July, then leveled off as laying stopped and gradually declined as mortality had its effects and chicks jumped. However, there is a slight drop in incubators during the same period of stress shown in the other two species. The number of incubators increased again around July 23 after the period of stress.

Closer examination of the two graphs shows that the decline in the number of Thick-billed Murre incubators occurred on July 8, four days after reproduction fell apart in Commons. This could reflect inaccuracies in the data or fluctuations in the curves, but it is more likely that it shows that Thick-billed Murres were able to continue normal egg production after Common Murre egg production had virtually stopped.

The probable reason for the difference in reproduction lies in food. Thick-billed Murres are reported to have a more diverse food source than Common Murres and Black-legged Kittiwakes.

Another possible reason for the better reproductive rate in Thick-billed Murres may be that their breeding schedule was slightly earlier than that of Common Murres. On July 3 Thick-billed Murres had already laid approximately 40% of the total number of eggs laid, while Common Murres had laid only 30% of a very low annual total. This difference in date of laying was observed in 1975 and may represent a real difference.

Figure 22 shows the numbers of both Common and Thick-billed Murres over the season at one large study area. It shows that numbers of both species fluctuate widely from day to day. Apparently both species are affected by similar environmental factors or the species affect each other. It is notable that the one point at which fluctuations diverge is from July 8 to July 11, during which Common Murre numbers declined sharply while Thick-billed Murres increased and stayed the same. Again, this is the period during which Common Murre and kittiwake reproduction was failing and hence further supports the hypothesis that access to different food sources may have led to the difference in reproductive performance between the two murre species.

Figure 22 also shows that the numbers of Common Murres decrease proportionally much more during the suggested period of stress than they did during late July and August. The decreases in numbers of Thick-billed Murres, however, during this period are no more marked than at other times during the summer. This is also consistent with our hypothesis about food.

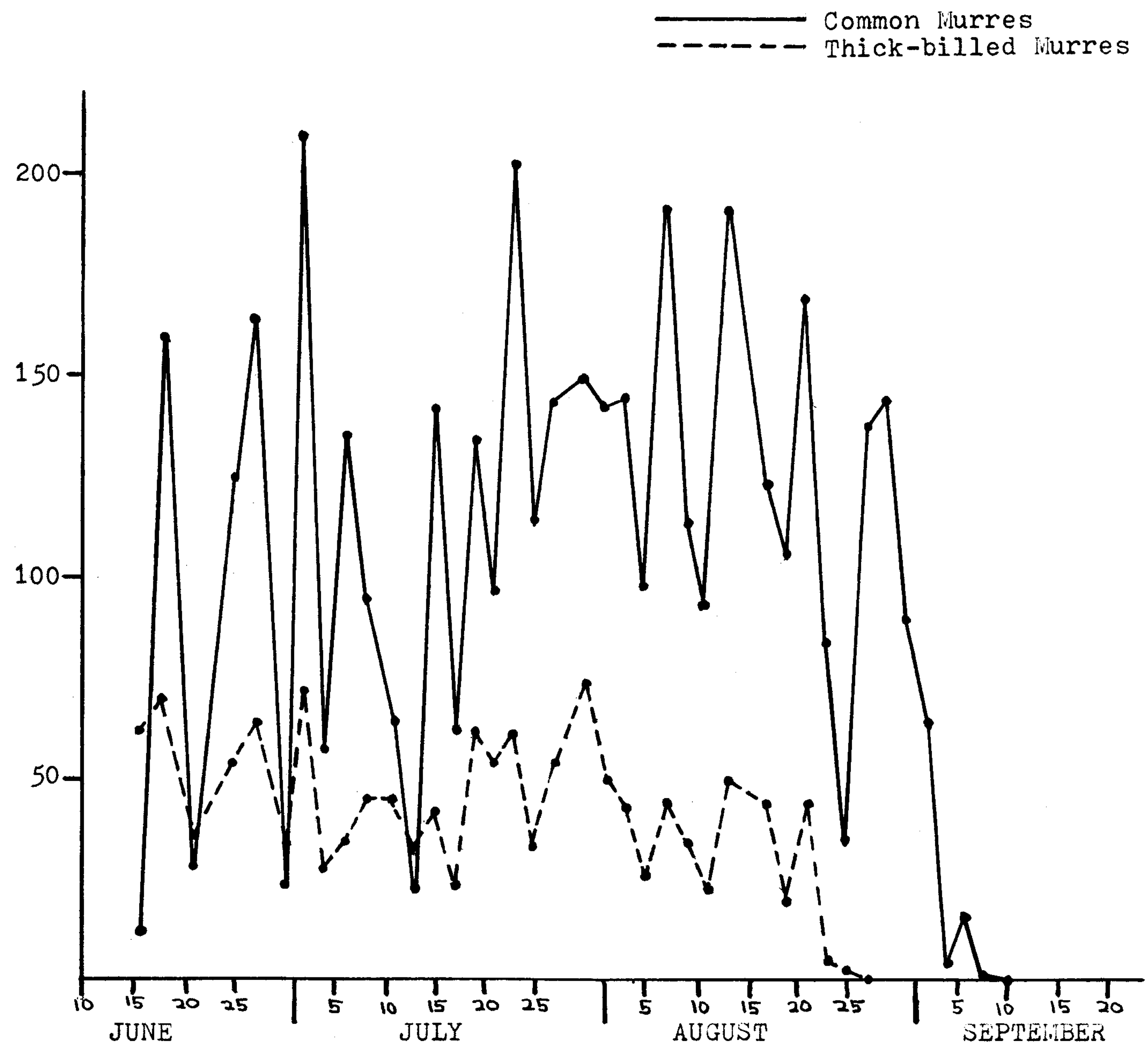


Figure 22. Numbers of Common and Thick-billed Murres at Site 15

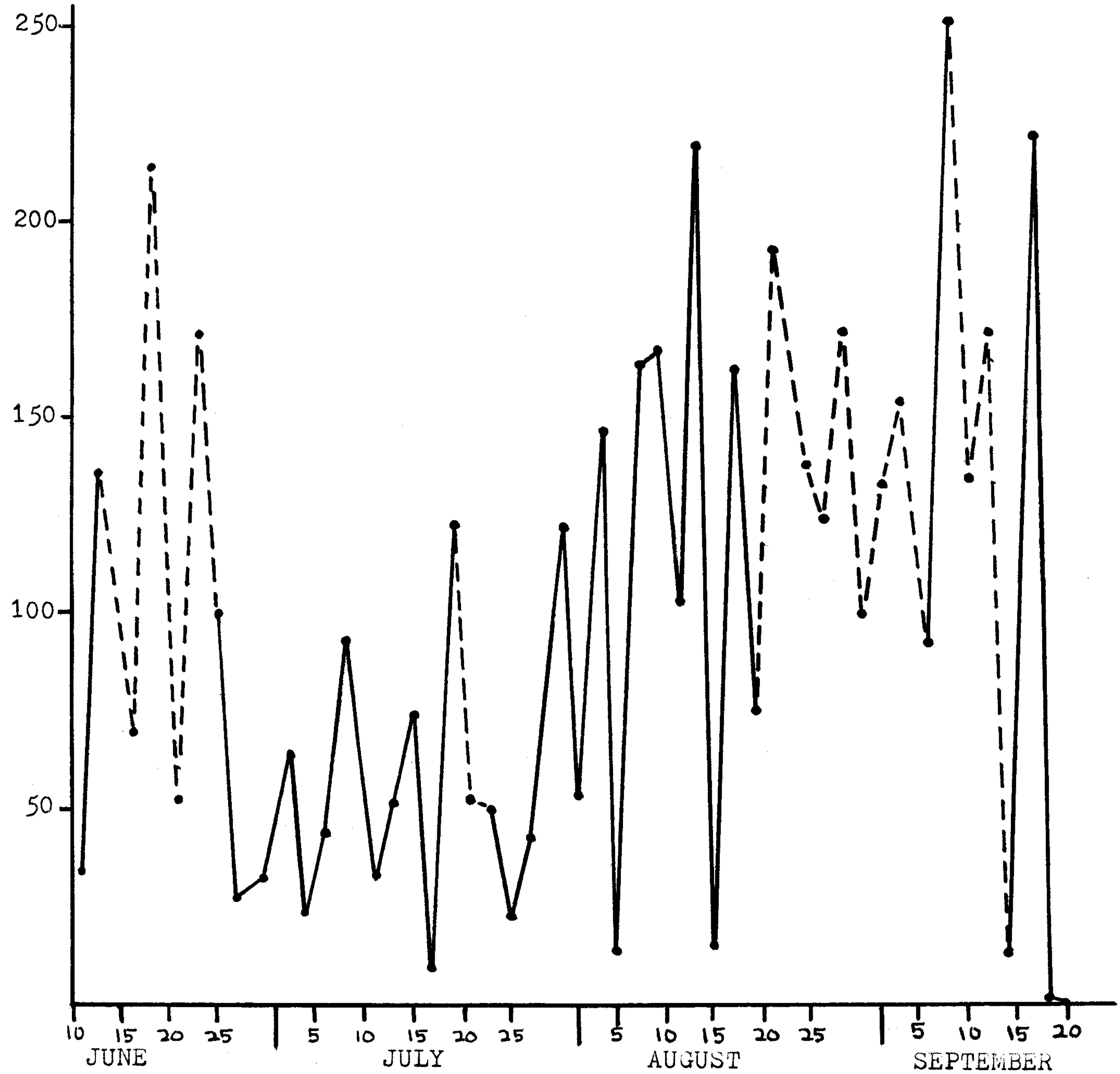


Figure 23. Horned Puffin numbers at study sites 5, 6, 7, 12, and 18

Our data on food sources in 1976 are limited but indicate that Common Murres feed primarily on prickleback (Lumpenus) but also to some extent on Sand Launce (Ammodytes) which seems to be the main source of food for kittiwakes. Our small amount of data on Horned Puffins' food shows that they feed almost entirely on sand launce although on smaller sizes than those taken by kittiwakes and Common Murres. Puffins are usually seen in near-shore feeding mélés with kittiwakes. This suggests that Horned Puffins would be affected in the same way as kittiwakes.

c) Horned Puffin

Because puffin burrows are inaccessible we have little data on reproductive success. It is difficult to tell whether a hole visible from the top of the cliff is a burrow unless it has an egg in it; so we have no data on eggs per nesting pair. Sixteen burrows with eggs produced 7-11 chicks (in several cases we were unable to tell if a chick survived). This represents success of .4 to .7 chicks per eggs and probably indicates good success among those pairs that laid eggs.

We have no data on the early part of the season to see if Horned Puffins did as poorly as kittiwakes and Common Murres. Counts of puffins on the cliff throughout the season, shown in Figure 23, shows the same low period in early July as found for murres and kittiwakes. During this period the low counts were not much below average but the peak numbers were also low. This indicated the general absence of puffins other than those that were highly motivated.

The dotted portions of the graph are dates on which data were not taken at one or more sites. In these cases we used an average based on counts made three days before and after.

Table 14. Pelagic Cormorant reproductive success in 1976.

Colony	nests with: 0 chicks	1 chick	2 chicks	3 chicks	4 chicks	chicks per nest
Bluff	2	2	2	1	0	1.3
Sledge I.						
study site 1	3	4	17	11	2	2.1
study site 2	0	0	5	4	0	1.9
high nests on south end	2	4	15	15	6	2.5
NE corner	4	0	0	0	0	0
TOTAL Sledge I.	9	8	37	30	8	2.2
Cape Darby E.	6	2	12	6	2	1.9
Cape Darby W.	1	1	5	1	0	1.8
	16	4	10	8	0	1.3
TOTAL Cape Darby	23	7	27	15	2	1.5
TOTAL	34	17	66	46	10	1.9

Determining the number of breeding pairs is difficult because when adults are in their burrows they are not visible from the top of the cliff and also because high numbers must represent primarily the presence of non-breeding birds.

d) Pelagic Cormorant

Cormorants nest in small numbers all along the shore of Norton Sound, usually in association with Horned Puffins and a few Glaucous Gulls. They also nest on the major bird colonies.

Data on cormorant reproductive success was collected at Bluff and Sledge Island. Seven nests at Bluff were monitored throughout the season and chicks were counted in nests in late July at Sledge Island. Table 14 shows results.

Sledge Island appears to have supported the highest level of reproduction. Sledge is also the largest cormorant colony at which reproductive success was measured (150 nests). At Bluff, which shows the lowest reproductive success, we counted only 57 nests. Cape Darby is intermediate in both the number of nests and reproductive success. This suggests that larger colonies have better reproductive success. Data from 1975 showed a similar relation within the three colonies studied.

TABLE 15

Pelagic Cormorant reproductive success - 1975

Colony	Number of Nests	Chicks per Nest
Sledge Island	80	1.9
Topkok	75-125	1.6
Bluff	20-25	1.5

Because of small samples it is doubtful that this relation is significant. More colonies should be monitored.

Numbers of nests appear to differ significantly between years at Bluff and Sledge, but the difference at Sledge primarily reflects a greater effort to find cormorant nests in 1976 by climbing around the cliffs. The differences at Bluff are probably real.

At Bluff in 1976 the counts of nests early in the season are suspect because they were made from a small boat in a swell, making it difficult to use binoculars to identify nests high up on a cliff. Chick counts are more accurate as these were made on calmer days or from the shore.

Both years we observed that within each colony there were one or more sections of cliff where almost all the nests were abandoned. In 1975 at Topkok one subsection of 20 nests was abandoned. In 1976 on the northeast corner of Sledge Island all four nests were abandoned, and one area at Cape Darby West had 16 abandoned nests.

Detailed data at Bluff on 6 nests showed that at least 14 eggs were produced, or 2.3 eggs per nest. These produced 8 chicks or 0.6 chicks per egg or 1.3 chicks per nest. Mortality appeared to occur mostly in late July, not on any specific date.

e) Glaucous Gull

Glaucous Gulls nest in two markedly different habitats. Some nest on cliffs among other colonial seabirds. These pairs defend large territories along the cliff and although they permit other individuals in their territory, they do not permit other nests. Glaucous Gulls also nest in dense colonies on tundra islands in the middle of large thaw-lakes.

We monitored seven nests at Bluff during the season and counted adults and chicks at nine other colonies during sea and air surveys. Results are shown in Table 16.

Table 16. Glaucous Gull reproductive success.

Colony	# adult pairs	# chicks	chicks per pair
Cape Denbeigh	34	29	0.9
Cape Darby	145	41	0.3
Cape Woolley	32	15	0.5
Safety Lagoon	8	2	0.3
Sunset-Sunrise	30	18	0.6
Bluff	6	4	0.67
TOTAL	327	114	0.3

Table 17. Age structure of Glaucous Gulls in 1975 and 1976.

	Adults	Intermediates	Chicks
Air - August 29, 1975	416	155	
	73%	27%	
Air - early September 1975	210	72	
	75%	26%	
Surface counts - September 11-18, 1975	392	83	79
	71%	15%	14%
Air - East Norton Sound August 20, 1976	1,021	317	149
Air - Mid Norton Sound August 14, 1976	227	93	
Air - West Norton Sound August 13, 1976	137	20	
Air - on colonies	1,385	440	300
	65%	21%	14%

At Bluff most nests started with 3 eggs (an average of 2.8 eggs per nest) and chicks were produced at the rate of 0.3 chicks per egg. The total figure for Bluff of .67 chicks per nest is similar to those found in 1975 (.67 young per nest at Topkok and slightly under .5 young per nest at Bluff).

In addition to these figures, a colony on an island near Point Spencer contained 71 adult pairs and only 5 chicks. We did not include these data in the average reproductive success because the estimate was made from the air and the colony may have contained a large number of non-breeding adults when it was surveyed.

Glaucous Gulls are inconspicuous in Norton Sound in June and early July. Their numbers increase especially in early July as the salmon die after spawning and the number of walrus carcasses increase. We flew the beaches between Cape Spencer and Saint Michael in late August of both 1975 and 1976 counting Glaucous Gulls by age categories (gray-backed adults, buffy or splotched subadults, and tan-brown chicks just fledged). Data are shown in Table 17.

We searched the same area in both years, adding the Bonanza River, littered with dead salmon in 1976. The counts are probably more representative in 1976 because all flocks were included and the birds were well scattered along the beaches. It was discovered after the surveys in 1975 that one observer omitted all flocks too large to count directly.

It appears that many Glaucous Gulls gather on the south shore of the Seward Peninsula in the summer, but it is not clear to what degree these gulls constitute a discrete population. There seemed to be many more gulls along the eastern Norton Sound beaches in 1976 than in 1975.

There appear to be differences in the age structure between the two years although the proportion of chicks which are probably produced locally seemed to hold steady. The differences between the two years must then reflect differences in the numbers of adults and subadults present. The proportion of subadults to adults was about 17% in 1975 and about 24% in 1976. This element of the population can be expected to be the most mobile. Thus it would be dangerous to draw conclusions as to population trends from these small samples which appear to be subject to the effects of population exchange between regions.

f) Other species

We have a small amount of data on the reproductive performance of several other species. Of the two Raven nests on the cliffs at Bluff, one produced three offspring and the other two. The Golden Eagle nest raised two eaglets to fledging size but one disappeared after it should have fledged.

5. Effects of predation

The seabirds at Bluff are subject to predation by Ravens, Glaucous Gulls, Golden Eagles, Peregrine Falcons, Red Foxes, Shorttail Weasels and humans. Predators take adults, eggs and chicks. The greatest proportional amount of predation appears to take place during two periods: a) early in the season when eggs are first laid and adults are few and easily scared off; and b) late in the season when only a few chicks are left on the cliff and also very few adults. During 1976 we did not make measurements of the amount of predation although it is possible to make a few estimates.

a) Ravens

Ravens are a major predator on seabirds. In 1976 there were two nests on the cliff at Bluff, one of which raised two young and the other three. In addition to these families, other Ravens were seen flying inland in two different directions carrying murre eggs, indicating that two more nests may have used seabirds as part of their summer food. Almost all other seabird colonies, including small cormorant and puffin colonies, had families of Ravens present.

In September Ravens from other areas concentrated at Bluff. On September 3 we counted 20 and on the 10th a group of 30 was seen harassing an immature Golden Eagle that was attempting to eat.

In late June and throughout July, Ravens were often seen carrying eggs, mostly of murres, in their beaks. They were observed taking eggs from murre ledges, especially when most of the adults had flushed. We found broken kittiwake and puffin eggs at the top of the cliff and observed a Raven taking a puffin egg out of a burrow.

On June 21 when we saw the first eggs on the cliff, we counted shells from 17 murre eggs, 2 kittiwake eggs and 1 puffin egg on the top of the cliff directly above the nest that fledged 3 young Ravens. These had not been there when we visited this study site three days earlier. If these eggs were all taken by the neighboring Raven family, this indicates an average of 5.7 murre eggs per day for this nest. This is a minimum number as other eggshells may have been dropped at other places. Using this figure, we can guess what the consumption of murre eggs might have been.

If a family of 5 Ravens consumed 5.7 eggs per day, the other nest on the cliff, with 4 Ravens, may have consumed 4.5 eggs per day leading to a total of around 10 eggs per day. Assuming that eggs are available from June 21 to August 7, a minimum of 47 days, Ravens could have taken 470 eggs. If we assume 15,000 to 20,000 breeding pairs of murres and around .45 eggs per pair, the total eggs produced on the cliff is 7000-9000. Thus Ravens could have caused the loss of 5% to 7% of the eggs. It should be noted that although 470 should represent a minimum number taken, this take occurred in a year when the total population was low, making it harder for murres to protect their eggs. This calculation assumes that the taking of eggs was constant throughout the season, which is not likely.

In addition to preying on eggs, towards the end of the season Ravens took chicks. This activity increased as the number of murres on the cliff decreased and most of the adults which were still present were protecting chicks. A Raven seems capable of outmaneuvering a couple of murres defending a chick, but not a whole mob. In one 30-minute watch from a study site on September 14, we observed 3 murre chicks being taken. In one case an adult murre knocked the Raven off a ledge, but in the process fell off itself. The Raven was able to return sooner and grab a chick away from the only remaining adult.

Murre eggs and chicks are much better protected when the numbers of adults on a ledge are high. In several cases we observed neighboring adults help defend an egg or chick. In some cases these adults had eggs or chicks of their own, but in most cases they appeared to be either mates or non-breeders.

Ravens do not eat only seabirds. They were also seen feeding on blueberries, Alaska Ground Squirrels and marine mammal carcasses.

b) Glaucous Gulls

Glaucous Gulls also account for a large amount of predation. Gulls were often seen taking and carrying eggs and broken eggs were evident around every nest.

Whenever we were at the cliff, either in a small boat or at study sites, we caused some amount of disturbance. Sometimes murres flushed because of a Glaucous Gull's alarm cry. Gulls seemed to use these disturbances to gain access to murre ledges. In late June we often saw all the eggs from a particular ledge being taken by gulls. Whether this occurs to the same extent without our presence is impossible to tell, as we can never assume that we cause no disturbance.

Although we have not seen Glaucous Gulls take murre chicks off ledges, a lot are taken immediately after they jump. In 1975 we observed that of the chicks that jumped without a parent, one in three was taken by a Glaucous Gull. In 1976 we saw no chicks taken by Glaucous Gulls, probably because of the fewer number of chicks, although gulls often swooped over chicks accompanied by adults in the water.

Glaucous Gulls were often seen eating adult murres and kittiwakes, although we presume that these died of other causes.

We have no measure of the amount of predation by Glaucous Gulls but we do know that the 12 or more nests on the cliff derived at least part of their food from seabirds. In addition to the 12 nests which we observed at the Bluff Cliffs we saw other adults and bands of subadults. These may have contributed to predation although subadults were most often seen around walrus or seal carcasses along the beach. Gulls were also seen eating blueberries and, in one instance, fish that had been dropped on a ledge by murres.

c) Golden Eagle

The family of Golden Eagles at Bluff fed primarily on the Alaska Ground Squirrel, or "Sik-sik", and Snowshoe Hare, judging by bones and remains on their roosts. Patches of murre feathers were often evident at the top of the cliff in the vicinity of the eyrie indicating that they also took a number of adult murres. We saw at least 10 of these patches although many more murres may have been taken and not torn apart at the top of the cliff. We identified one carcass on the eyrie as that of a murre.

d) Peregrine Falcon

A pair of Peregrines was seen so regularly on the highest section of the cliff that we concluded that they had a nest although we never saw it. We never saw them preying. Most of the seabird colonies that we visited in a boat had either a pair of Peregrines or Gyrfalcons associated with it.

e) Red Fox

Red Foxes became conspicuous in the fall at Bluff. We recognized 6 different individuals by their different color patterns. These appeared to feed primarily on small mammals which were abundant at Bluff this year. We assume that their use of seabirds is limited by the inaccessibility of the nesting areas.

A dead Arctic Fox was observed on Sledge Island in June 1975, and this year one was seen by a member of the crew of a tug that anchored in the lee of the island during a storm. Sea ice adequate to permit easy passage of foxes from the mainland to Sledge Island regularly persists into June.

f) Weasels

During September and October we saw a large number of Shorttail Weasels at Bluff. We estimated 3 to 5 separate burrow systems along the top of the cliff. As none were seen in 1975, we suspect that a large number of offspring survived in 1976 because of the large population of smaller mammals. Several grassy slopes were riddled with small mammal burrows. It does not seem likely that 5 weasel families would have an effect on the seabird population, but they may play a role in the distribution of nests. Weasels can climb very easily in the broken rock at the top of the cliff and probably prevent puffins from nesting right at the top of the cliff. They also search the accessible beaches at the bottom of the cliff and the ledges just above them.

Although we spent only one week on Sledge Island we saw one Shorttail Weasel. While foxes may have trouble getting to most auklet burrows, weasels can easily gain access to auklets nesting in broken rock.

g) Humans

Eskimos traditionally visit seabird cliffs and gather eggs, although recently this is not done as much as it was. There are stakes driven into the ground in several places along the top of the cliffs at Bluff for people to lower themselves to collect eggs. One sea stack that is covered with murres has a nylon rope attached to the top to make climbing easier. There are also several other places where ledges are accessible from a boat. The stack with a rope may have 150 to 250 eggs on it and other accessible places fewer.

During 1975 we were told that about 450 eggs were taken. In 1976 only two parties visited Bluff to collect eggs -- one on June 28 and one on July 1. The first party left to participate in a rescue after collecting only on the stack which had the rope on it. The second party had difficulty landing because of waves. Our party collected a few eggs for pesticide analyses.

6. Prey species

Species and numbers of fish collected from ledges at three colonies is presented in Table 18. The majority of the fish found are *Lumpenus* (Prickleback) and *Ammodytes* (Sand Launce). At Bluff we collected almost equal numbers of these two species. These were collected almost entirely from Common Murre ledges. The small sample collected at Sledge Island was taken below kittiwake nests and is almost all *Ammodytes*.

7. Distribution at sea

Results and discussion of our transects at sea, both aerial and surface, are discussed in the report on King Island, Research Unit #447.

Table 18. Fish specimens collected at Bluff and Sledge Island.

	Bluff	Sledge
SALMONIDAE		
Oncorhynchus keta	13	--
OSMERIDAE		
Osmerus mordax	3	--
Mallotus villosus	2	--
GADIDAE		
Boreogadus saida	--	--
Eleginus gracilis	4	--
cf. *Gadus macrocephalus*	1	--
unidentified	2	--
STICHAEIDAE		
Lumpenus cf. *fabricii*	36	--
unidentified	1	1
AMMODYTIDAE		
Ammodytes hexapterus	37	22
COTTIDAE		
unidentified	--	--

B. Waterfowl

1. Spring migration

In the springs of 1976 and 1975 we observed waterfowl concentrations on open shore leads particularly at the mouths of rivers. These areas appear to be of prime importance to the spring migration. Waterfowl were seen flying both east and west, presumably looking for open leads further to the north and returning to open water. Red-breasted Mergansers and Harlequin Ducks were often seen in the water at Bluff during early June.

2. Fall migration

In August, September and October we made extensive aerial surveys of coastal lagoons and marshes between Brevig Mission in the north and Saint Michael in the south looking for the areas of prime importance to migrating waterfowl. Areas covered by surveys are shown in Figure 24. Because of the wandering search path of our transects, we based our measures of density on time in the air rather than distance covered. The results are summarized on maps (Figures 25 to 31). Each area covered by transects has a graph to show the highest per minute counts of the total birds, plus separate graphs for 6 individual species. These numbers should not be looked upon as representing the highest concentrations of birds using each area because the numbers changed from day to day. Glaucous Gull counts were eliminated from the data and were treated separately.

Our data show that the most important coastal staging area is Golovin Lagoon, shown in Figure 28. The shallow areas at the northwest edge of the lagoon contained geese, ducks and swans at densities ten times greater than any other areas. This area accounted for the highest total

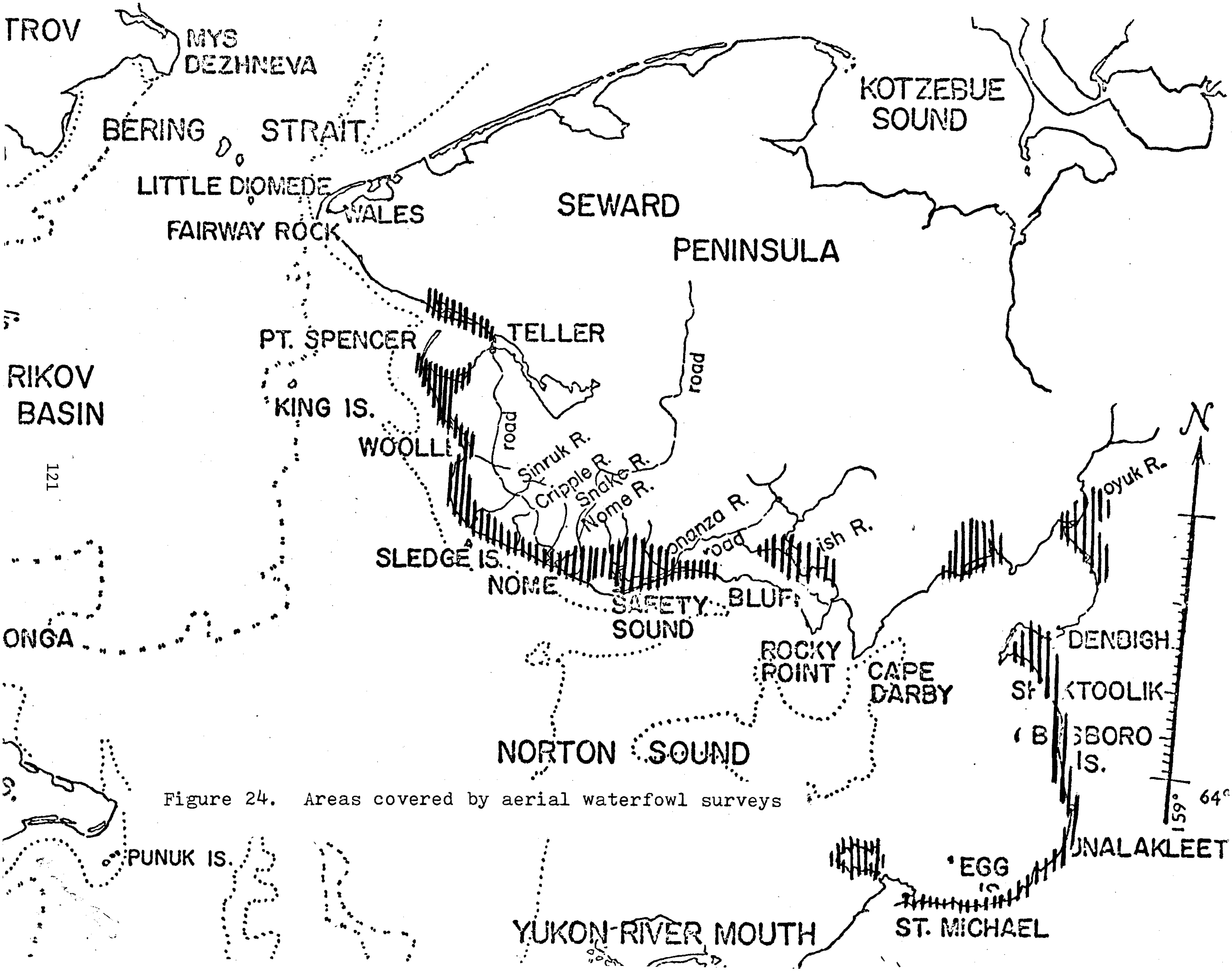


Figure 24. Areas covered by aerial waterfowl surveys

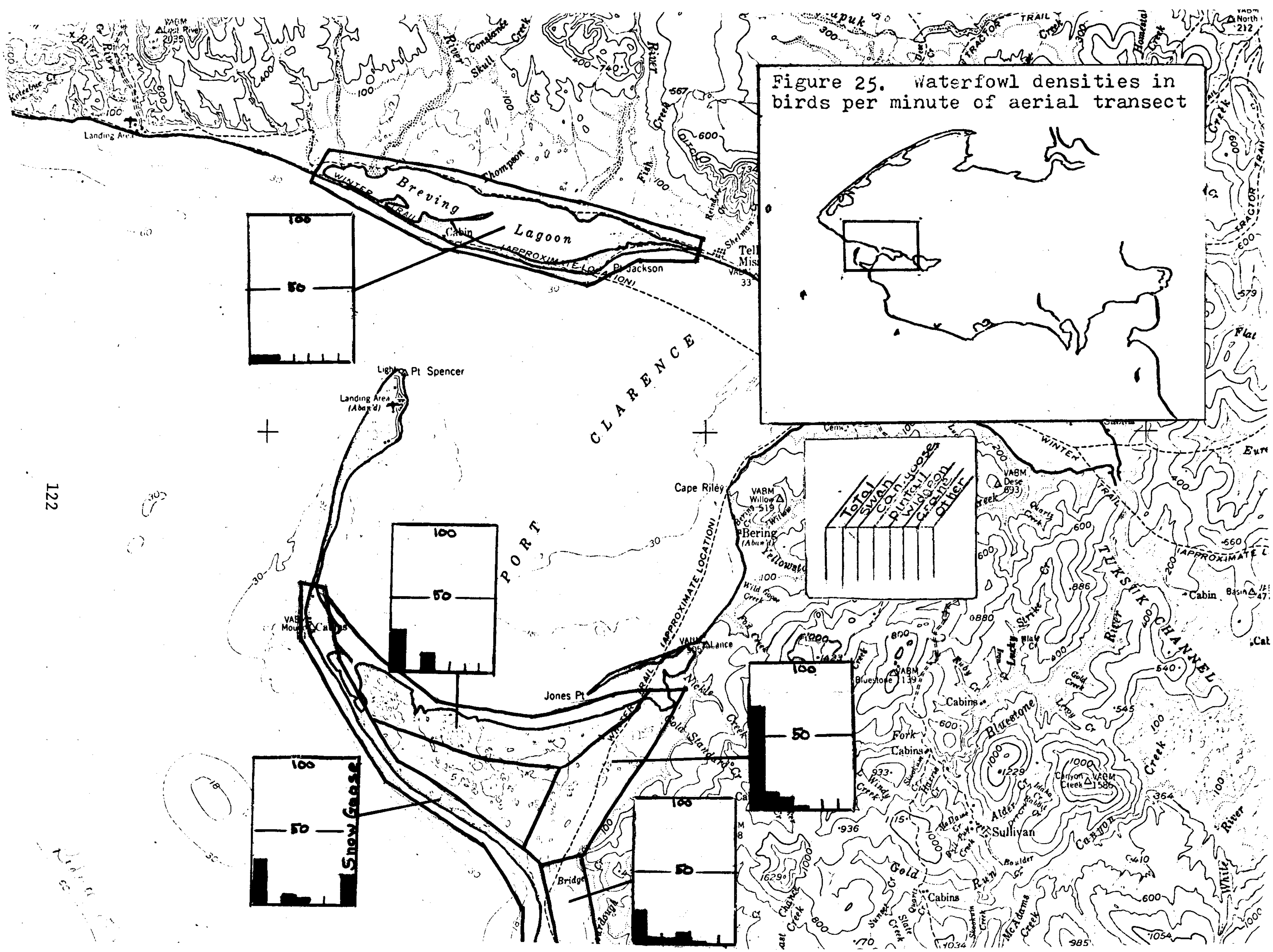


Figure 25. Waterfowl densities in birds per minute of aerial transect

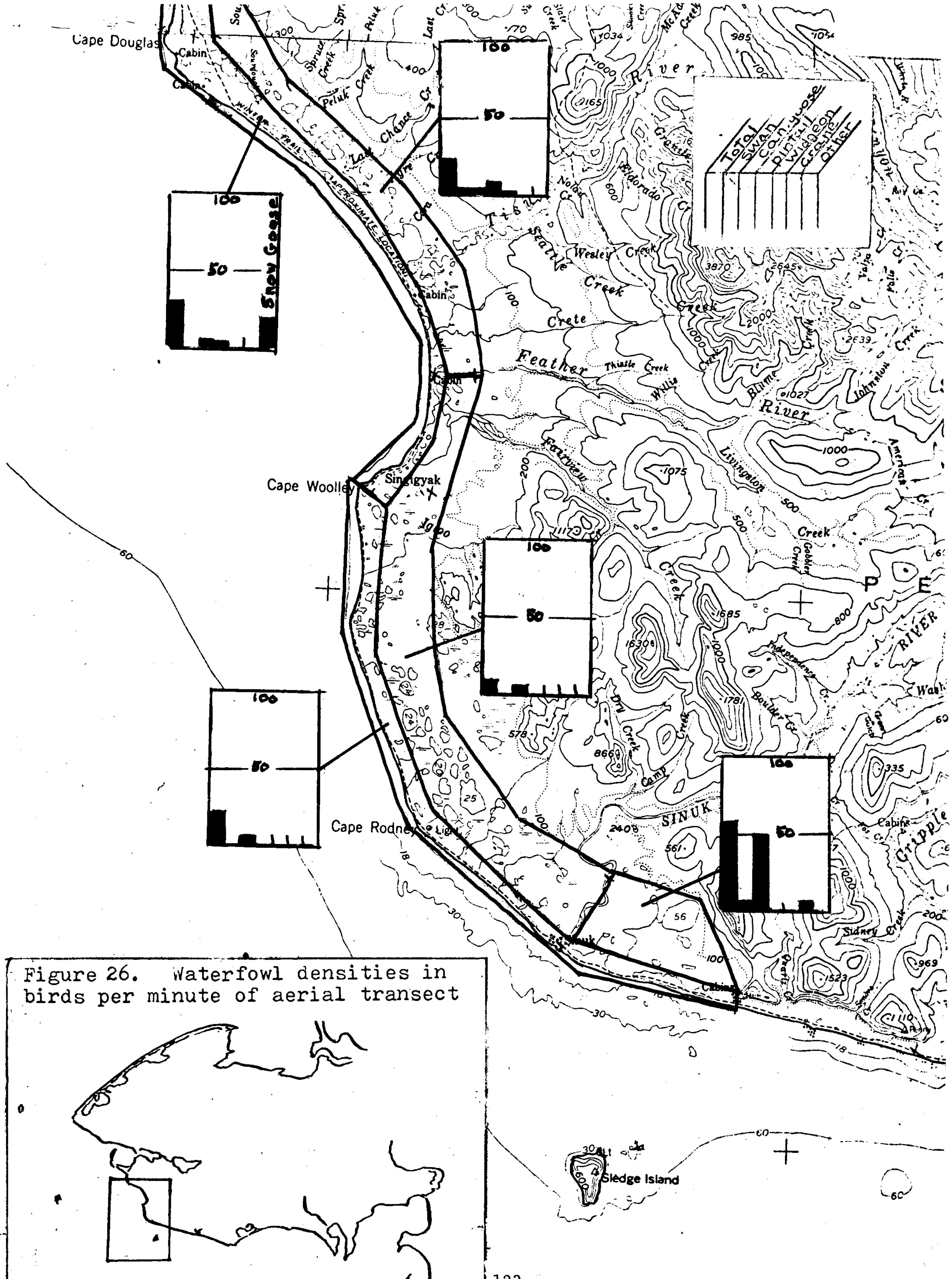


Figure 26. Waterfowl densities in birds per minute of aerial transect

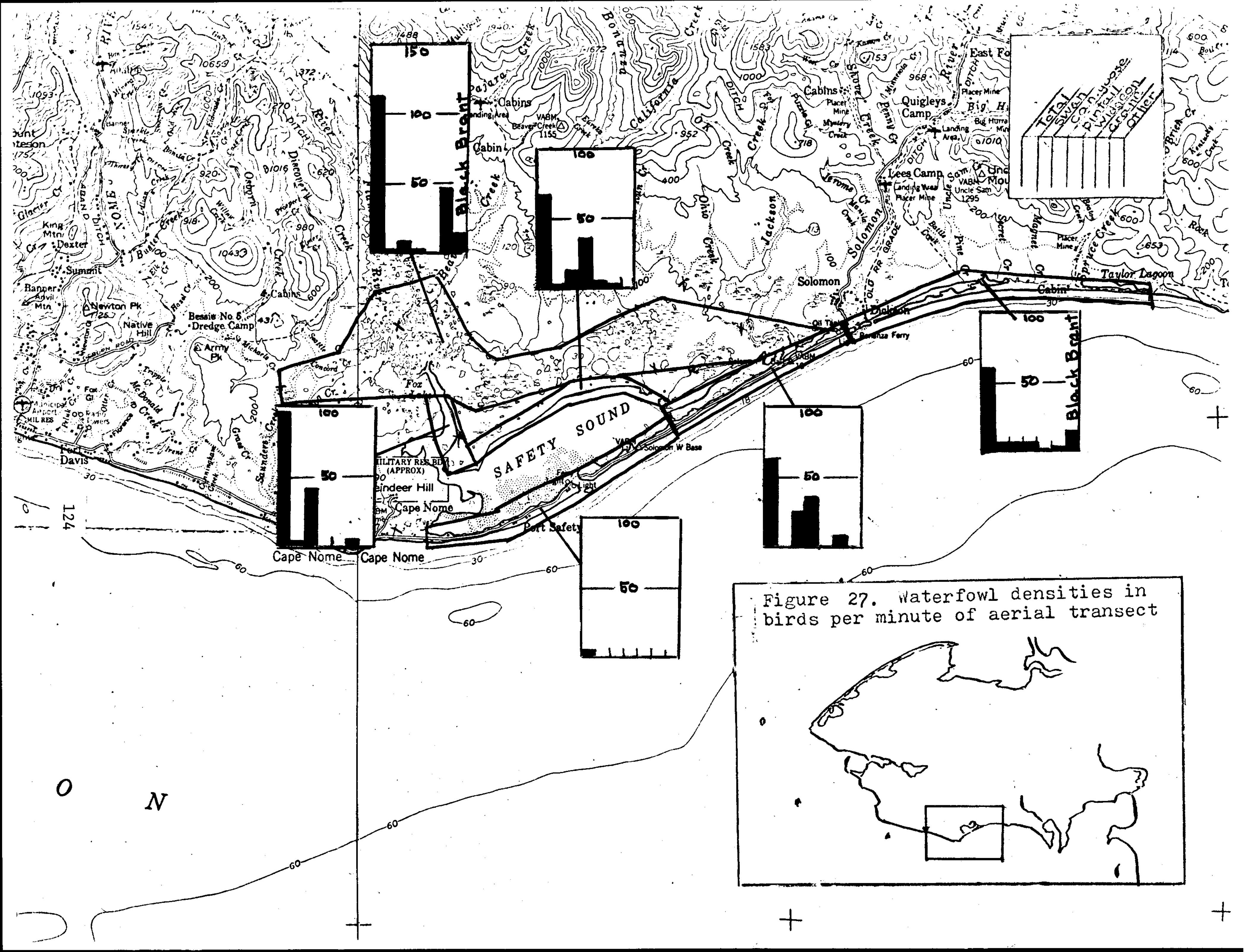


Figure 27. Waterfowl densities in birds per minute of aerial transect

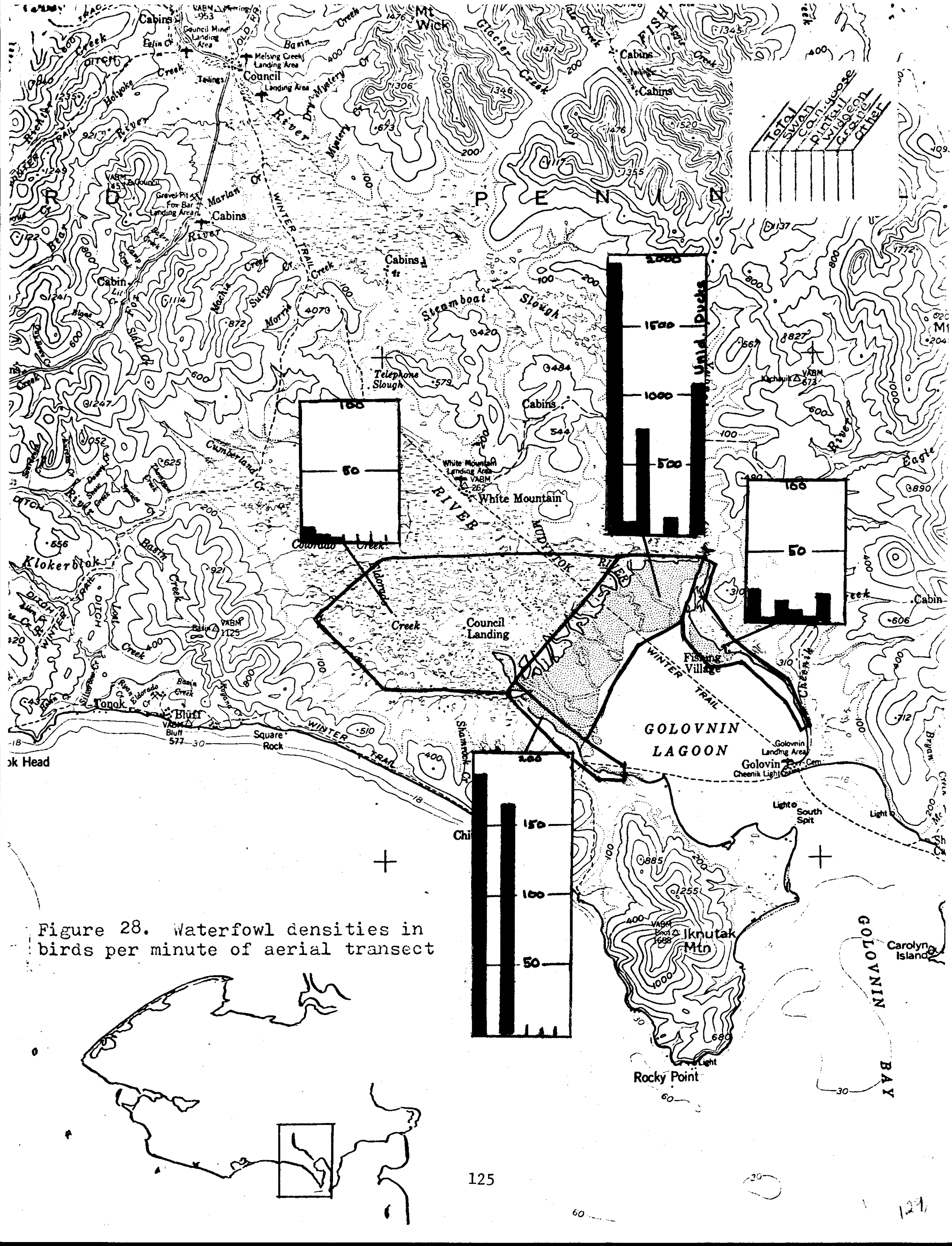


Figure 28. Waterfowl densities in birds per minute of aerial transect

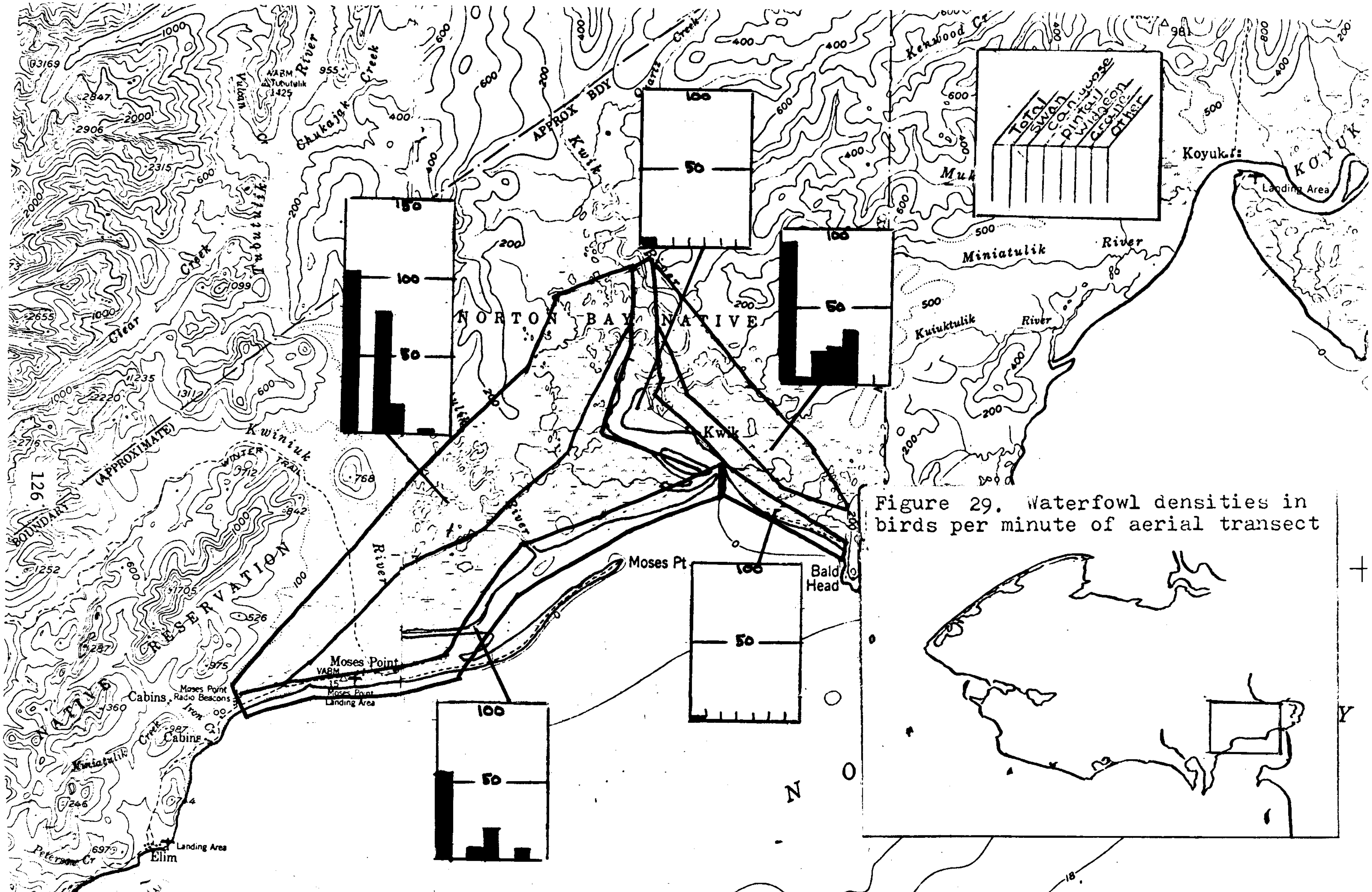


Figure 29. Waterfowl densities in birds per minute of aerial transect

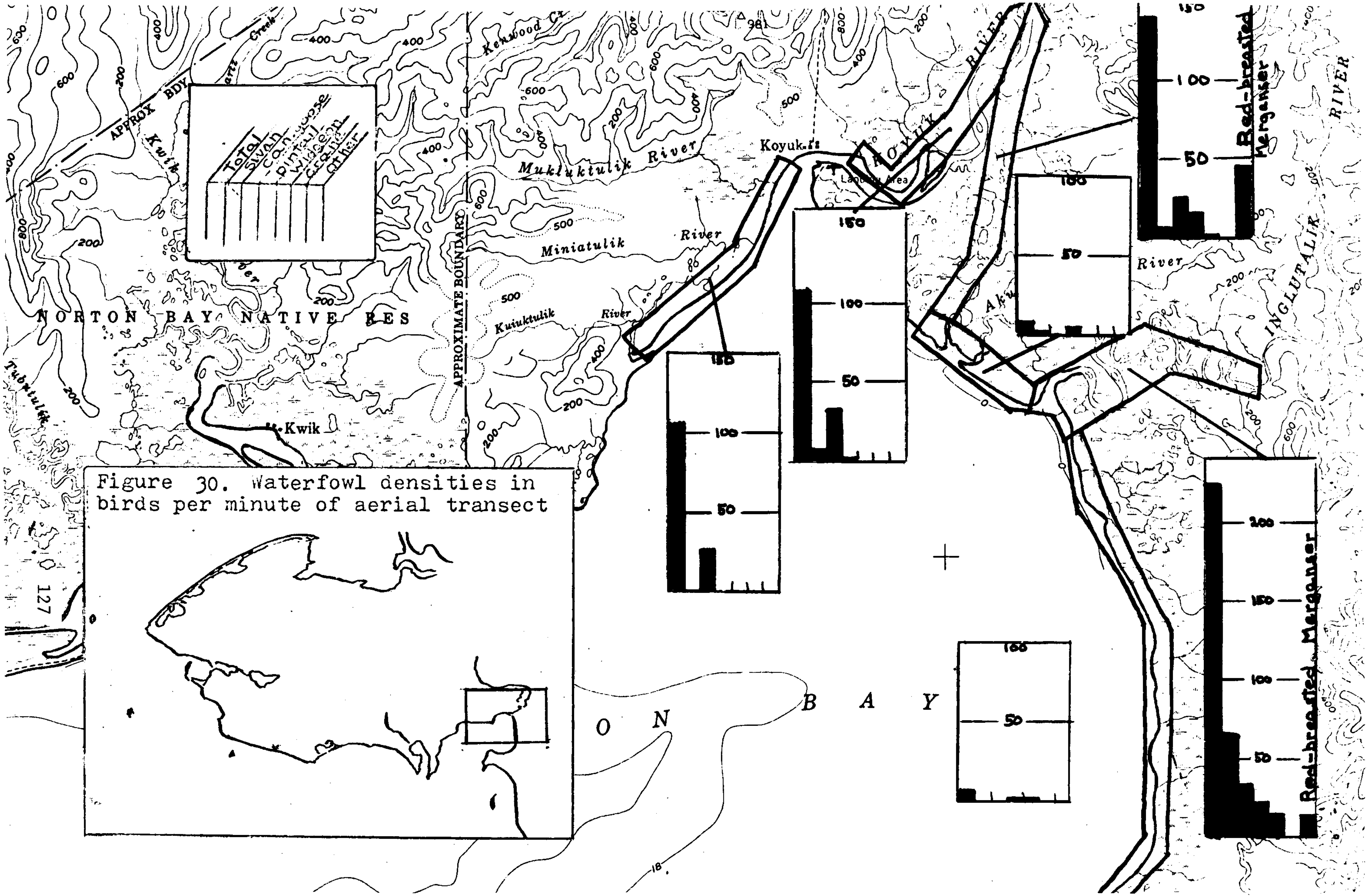


Figure 30. Waterfowl densities in birds per minute of aerial transect

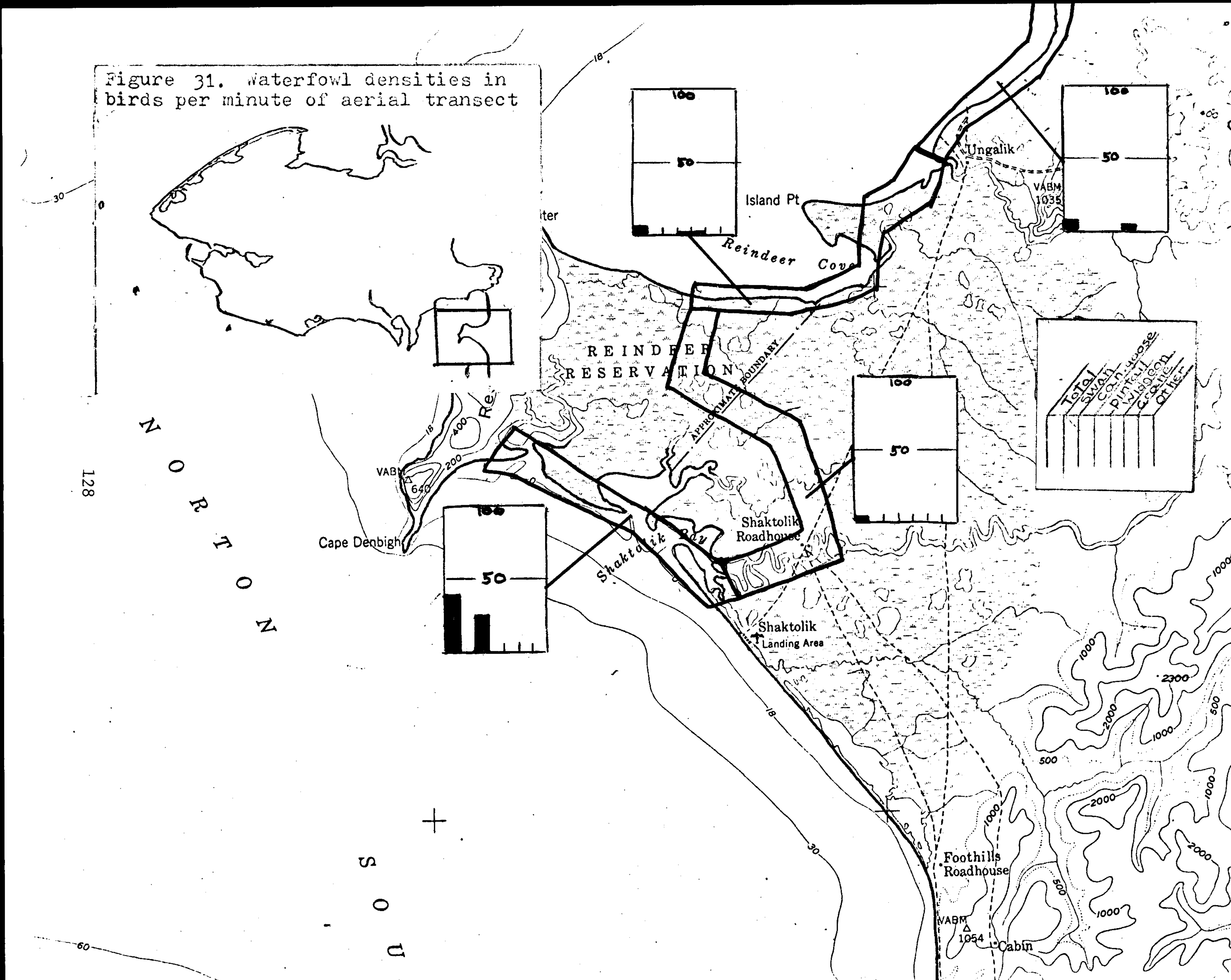


Figure 31. Waterfowl densities in birds per minute of aerial transect

of all areas surveyed. The inland marshy area northwest of Golovin Lagoon, including the Fish River delta, had much lower concentrations. It should be noted that in Figure 28 the graph for the central area is on a scale 1/10 that of the other graphs.

The second most important area according to our data is the marshes, ponds and river channels around the village of Koyuk (Figure 30). High densities were recorded on and adjacent to the Inglutalik River, 10 miles southeast of Koyuk. This area contained high concentrations of swans, geese and ducks. Other concentrations in this area occurred along the Koyuk River and in a shallow area on the shore of Norton Bay to the west of Koyuk.

Another important area which showed relatively high densities over a large area is the lowlands and marshes north of Moses Point, along the lower reaches of the Kwik River (Figure 29). Inland ponds accounted for the highest concentration of waterfowl, while shallow areas at the edge of Norton Bay had large numbers of Glaucous Gulls. The channel of the Kwik River had very few birds.

Three more areas showed high densities locally, but relatively low total numbers. These were a) the channel running between Solomon and Safety Sound (Figure 27), b) the inland portion of Point Spencer lowland near Teller (Figure 25), and c) the canal crossing Stuart Island (which is not represented in Figures 25 to 31). Waterfowl were concentrated in small sections of these areas -- not evenly distributed.

As most transects were over five minutes long, the averages shown in Figures 25 and 27 are low because nothing was recorded during most of the transect.

Despite the large amount of potential habitat between Nome and Point Spencer (Figure 26) we found no major waterfowl concentrations. It was characterized by a fairly even, but thin distribution of waterfowl. Another area with a large amount of habitat that appears suitable but contains few waterfowl is the marshes and ponds north of Shaktoolik, behind Cape Denbigh (Figure 31). Only a few Canada Geese and Glaucous Gulls were seen in this area.

The areas surrounding Brevig Lagoon and Grantly Harbor, near Teller (Figure 25) appear to be potential habitat but contained almost no birds. Our surveys showed that Grantly Harbor has steep banks on the sides and Brevig Lagoon has a sandy substrate with very little vegetation.

In general, productive waterfowl habitat decreases progressively as one goes northwest from Safety Lagoon, according to Jim King of the Alaska Department of Fish and Game.

3. Whistling Swan reproductive success

Numbers of adults and young swans on the tundra were recorded during waterfowl survey flights in late August and early September. Data were collected during seven flights, each on a different day.

Young swans stay with their parents until they fledge. These family groups are easy to pick out and young can easily be identified because of their brown or gray plumage. One often encounters single birds or a pair of adults with no brood. These could either be non-breeding birds or breeders that failed to reproduce.

We observed large groups of adults that definitely did not breed, e.g., a flock of 20-30 seen regularly at Taylor Lagoon between Topkok and Safety Lagoon throughout the summer both in 1976 and 1975. This

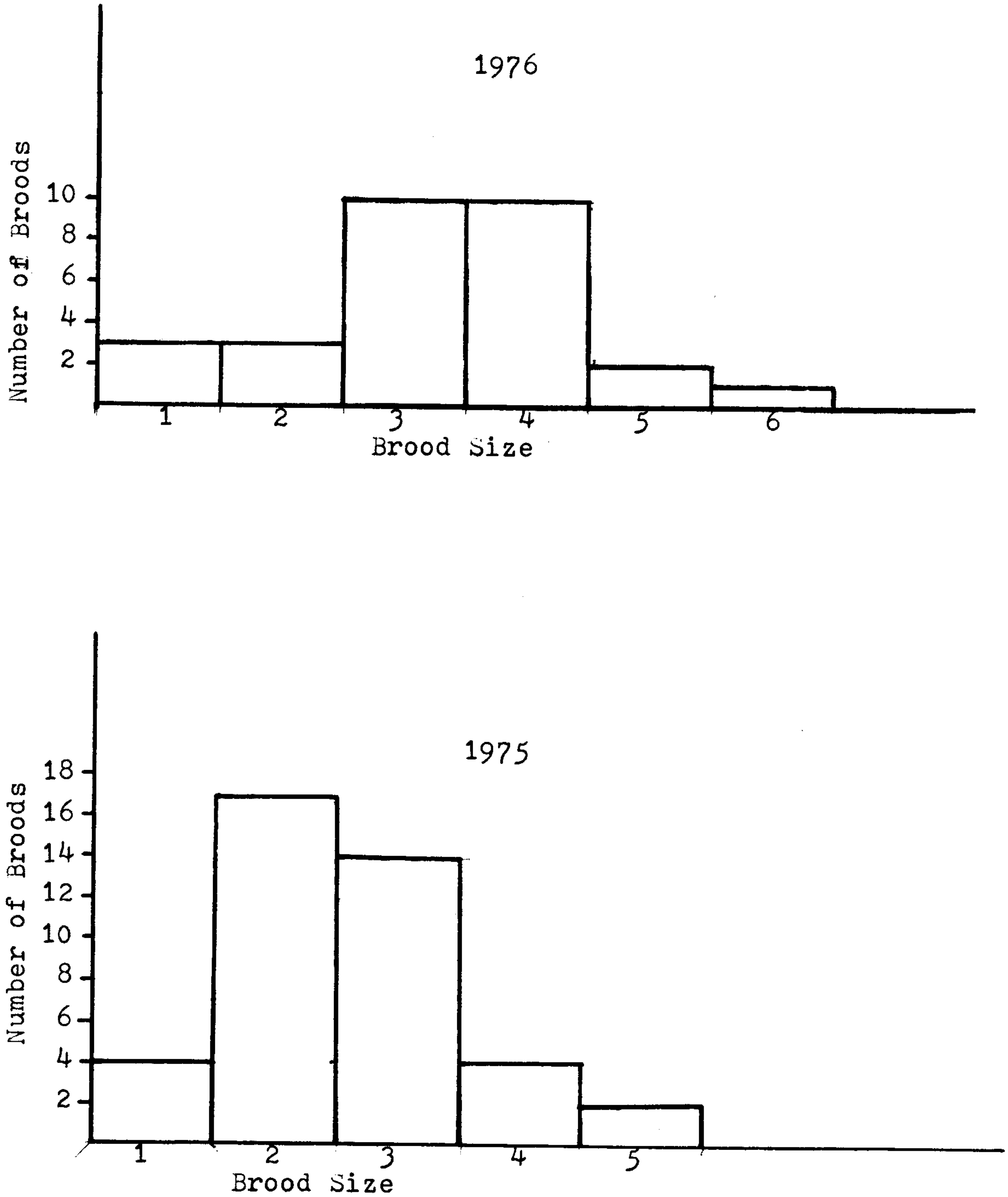


Figure 32. Whistling Swan brood size

probably represents a group of pre-breeders. We saw other groups of 5 to 25 adults whose breeding status we did not know.

We assumed that all singles or pairs of birds on the tundra were breeding pairs that had failed and assumed that all groups of three or more without young were non-breeding individuals. This method showed a total rate of reproductive success of 1.5 young per breeding pair. This is based on 134 young and 88 pairs seen along the coastal area between Teller and Shaktoolik.

A similar calculation in 1975 between Nome and Teller showed 49 pairs and 43 young or .9 young per pair.

A total of 64 pairs seen, 29 of which were successful, indicated 45% successful pairs in 1976. In 1975, 19 successful pairs out of 49 showed an apparently lower success rate of 38%. Both of these indicate good rate of success in relation to a range of between 15% to 50% success found on the Yukon Delta on the basis of nine years of data (Lensink 1973). However, our figures may be inflated because in September some of the unsuccessful pairs may have joined flocks of non-breeders.

Figure 32 shows the frequencies of different brood sizes for 1975 and 1976. Apparently brood sizes in 1975 were generally smaller than in 1976.

In 1975 the average brood size was 2.6 cygnets per successful pair compared to 3.3 per pair in 1976. Lensink (1973) reports a range in average brood size of 2.52 to 3.63. This further indicates that 1976 was a more successful year than 1975.

Lensink states that the length of the summer is a major factor in determining swan reproductive success. This apparently was not the cause of lower success in 1975, as local residents reported that tundra ponds thawed earlier in 1975 than 1976.

4. Other species

On foot surveys yielded a small amount of data on other species. We saw one Pintail brood with 6 ducklings and one with 4. We also observed Green-winged Teal broods of 5 and 6.

VII. DISCUSSION

This section only contains discussion of major findings. More detailed discussion is included, together with the data, in the Results section.

A. Census techniques

Because of the extreme daily variation in numbers of murres, kittiwakes and puffins, it is necessary to make several counts at a colony to obtain a reliable estimate of the population. For murres the best time of year for this is July when all breeding birds will be present, but few non-breeders prospecting for nesting sites have arrived. A rough estimate of the total population can also be made in late May or early June when murres first arrive at a colony and sit in calm water at the foot of the cliffs.

An estimate of the number of breeding pairs can be made from the number of murres that do not flush when a cliff colony is approached in a small boat. Late July is also the best time to make this estimate as all breeders that will be successful must have eggs or chicks then.

B. Numbers

Data from 1975 and 1976 indicate that populations of seabirds, murres in particular, can vary widely between years. Numbers on the colonies at Bluff and on Square Rock dropped by around 40% from 1975 to 1976. Some colonies, Sledge Island for example, stayed approximately the same, while Egg Island increased its numbers from 1975 to 1976. Although we could not isolate the factors controlling the numbers of birds on an individual colony, this does indicate that colonies are not similarly influenced by over-riding environmental factors. Different colonies are affected by different factors and the populations vary independently.

The census figures and information from study sites at Bluff Cliffs show that there is a large portion of non-breeders on the colony. At times this is over 50% of the birds present. Presumably the birds that come and go are capable of breeding, but are excluded because of competition for suitable nesting sites.

C. Distribution

Pelagic Cormorants, Horned Puffins and Glaucous Gulls are evenly distributed throughout Norton Sound at small colonies as well as major colonies. Kittiwakes and Common Murres are evenly distributed but concentrated at major colonies. On the other hand, species such as Tufted Puffins, Thick-billed Murres, auklets and Pigeon Guillemots are present mainly in the Chirikov Basin at King Island, Saint Lawrence Island, and the Diomedes. We suggest that this distribution is related to oceanographic conditions although the details are not clear.

It also seems that predation, especially by land mammals, affects the distribution of seabirds. Sections of the cliff at Bluff above beaches which are accessible to land mammals have very few murres and kittiwakes nesting on them. These areas include sections near each end of the cliff and a section in the middle of the cliff where a gully comes down to the beach. Other sections of the cliff either have no beach at the bottom or have a beach blocked at each end by the cliff dropping straight into the water. The accessibility of the beach in the middle of the cliff was demonstrated by our observation of both a Red Fox and a

Shorttail Weasel on it. When the fox sighted us he easily scrambled half way up the cliff and stopped there to watch us.

We also observed a lack of murres and kittiwakes above accessible beaches at Square Rock, and suggest that it may be one reason why they do not nest on the smaller mainland cliffs around Norton Sound.

These predators may also be a reason for the absence of breeding auklets on apparently suitable habitat on Sledge Island and Besboro Island. Predators have access to both these islands in the winter over shore-fast ice, while King Island, which has auklets, is usually surrounded by broken ice floes. We observed both a Shorttail Weasel and an unidentified fox on Sledge Island this year, and a dead Arctic Fox in 1975. King Island has a population of Arctic Foxes but it has only a low potential for being invaded by mainland foxes. We observed no weasels on King Island.

Bird predators probably do not affect the distribution of seabirds but may have an effect on population levels. Our observations indicate that significant numbers of eggs and chicks are taken by Ravens and Glaucous Gulls. This effect could become severe if Ravens and Glaucous Gulls were subsidized by a proliferation of garbage dumps or other human refuse, as has happened with Herring Gulls on the East Coast.

D. Reproductive success

Data comparing 1975 and 1976 show that reproductive success can vary widely between years. In 1976 kittiwakes reproduced at a level that was 5% of the level of reproduction in 1975. Kittiwakes throughout Norton Sound and at King Island apparently all reproduced at low levels. Common Murres at Bluff also had low levels of reproduction and there is evidence to suggest that puffins suffered from some disturbances. Thick-billed Murres, on the other hand, reproduced at a higher level.

All evidence points to lack of food as the cause. Limited information shows that Common Murres, kittiwakes and puffins feed mainly on two species of fish, Lumpenus and Ammodytes, while Thick-billed Murres eat crustacea as well. The reproductive schedule in all three affected bird species was disrupted between July 6 and July 23, the beginning and ending date appearing to be almost exactly the same for all three species. This period was marked by poor egg production and exceptionally low attendance at the cliff, presumably because adults were off searching for food. Egg mortality was fairly high and incubation periods in kittiwakes were much longer than has been observed elsewhere.

It is unlikely that the failure was caused by weather factors because the storms in this period do not relate directly to the low numbers of adults and mortality does not have sudden peaks aligned with poor weather. Areas of the cliff that are sheltered from high winds, although producing more chicks, still produced at a level far below that of 1975.

This demonstrates the importance of the food source in maintaining seabirds in Norton Sound. The food supply is a major factor controlling the level of reproduction and thus the numbers of birds in Norton Sound.

The methods we used to measure reproductive success in kittiwakes and murres appear to be adequate. Kittiwake reproductive success can be measured by several methods including taking photographs from a small plane. Murre reproductive success is more difficult to measure and requires monitoring a ledge throughout the season. The number of adults that attempt to reproduce can be counted in late June. The best method includes mapping individual nest sites but this is impossible in most cases. Although one seldom sees eggs, their locations can usually be determined by an identifiable posture in the adult (page 27). This posture is, however, not obvious and observations are more valid if incubating birds are located on sketch maps so they can be checked regularly. The chances of seeing all chicks on a ledge before they jump are increased by the tendency of the chick to stand apart from their parents one or two days before they jump.

Observation of food brought in and samples collected at Bluff and Sledge Island indicate that Common Murres, puffins and kittiwakes exist on a very narrow food source. Seventy-three percent of the fish collected at Bluff were of two species. The narrowness of their food base was probably responsible for the poor reproduction observed in these species.

VIII. CONCLUSIONS

These conclusions apply to the whole geographic area of our study, including King Island and coastal habitats of Norton Sound. We present our conclusions under headings equivalent to our major objectives.

1. What seabird cliffs, islands, lagoons, wetlands, river mouths and other habitat features are of first importance for breeding, migrating, or wintering populations?

We have observed that certain relatively small areas are disproportionately important for the survival of some species during periods of stress. These areas need to be given special protection by suitable political institutions.

a) We are confident of our conclusions that the seabird cliffs at Bluff and King Island are of major importance to the survival of seabirds in this region. However, not only the big colonies are important. The cliffs at the southern end of Cape Denbigh, at Square Rock, at Egg Island and at Sledge Island, although supporting much smaller populations of murres, kittiwakes and puffins, are of considerable importance. This importance of the secondary colonies in Norton Sound reflects not simply the numbers of birds which breed there, but the possibility that these colonies will serve as alternative refuges if disasters befall the Bluff Cliffs.

Several species, such as Pelagic Cormorants, Glaucous Gulls, Horned Puffins and Tufted Puffins nest in smaller clusters at many places around the shore of Norton Sound. For these species the problems are more complex. The rock faces on Cape Darby, Rocky Point and Topkok are as important for Pelagic Cormorants and Glaucous Gulls as are those at Bluff for kittiwakes and murres. The colonies on the west side of Stuart Island, at Besboro Island and at Cape Darby, although moderately sized, are important to the Horned Puffin population.

Why do these differences exist? We can say as biologists that the number and size of the nesting aggregates occupied by each species reflects the distance the birds usually forage for food. Murres and kittiwakes feed at great distances from their cliffs. Puffins and cormorants feed closer to their nests. Therefore, one cannot say that the smaller dispersed colonies are less important to Horned Puffins, Tufted Puffins or Pelagic Cormorants than the conspicuous sites at Cape Denbigh, Bluff and King Island are to murres and kittiwakes.

b) We are confident that certain wetlands were of major importance to waterfowl in August and September 1975 and 1976:

i) the delta of the Fish River, including the head of Golovin Lagoon;

ii) the depositional fans of the Koyuk and Inglutalik Rivers;

iii) the delta of the Kwik River.

Of second importance are:

iv) the wetlands along the Stuart Canal at Stuart Island, Taylor Lagoon and along the Eldorado Flambeau and Bonanza Rivers emptying into Safety Lagoon;

v) the wetlands at the base of Cape Spencer.

These areas are relatively large and only part of them was densely occupied by waterfowl.

In general, waterfowl gather much more in the wetlands east of Safety Lagoon than in the wetlands to the west. Certain other areas, however, wherever they are (e.g., recently drained lagoons) may have dense populations of Pintail and shorebirds.

We have concluded that redundancy of resources available is important for the survival of waterfowl and shorebirds. If, during some years, the wetlands which are heavily used are temporarily unsuitable, the birds must seek out other areas. If in the process of development "less important" wetlands are changed, then, when environmental stresses occur, the waterfowl and shorebirds may not have access to alternatives. One way to avoid this is to establish management areas in the most important gathering grounds. To the degree that waterfowl and shorebird populations are maintained by management programs, they become partially domesticated. If management proves necessary, the loss of the wild atmosphere by this semi-domestication should be included in the financial and social costs of developments.

2. What local natural stresses influence the activities and breeding schedule of marine birds? What adaptations do the local species have to meet these stresses?

The major natural stresses appear to be: a) the short season during which temperatures are high enough for plant and animal growth to proceed; b) the occurrence of storms, high seas, rain and fog during this period; c) the patchy distribution and unpredictable size of the populations of food species;and d) the presence of bird and mammal (including fox, weasel and human) predators. A major adaptation to these stresses is the long life expectancy and delayed reproduction evident in most species of seabirds.

a) The short growing season and suddenness of its arrival are responsible for strong selective pressures for breeding birds to return as early as possible in the spring. This means that the returning birds crowd into leads along shore in the case of waterfowl or at the foot of cliffs, soon after the leads open in the case of seabirds. These early flocks include virtually all effective breeders, and censusing them in suitable weather gives a good measure of the size of the breeding population. These leads crowded with bird life are therefore places where the bird life is especially vulnerable to oil spills or to disturbance caused by hunting.

The short growing season imposes time limits on the breeding cycle. This means that if eggs arelost or temporarily abandoned because of storms, human disturbance or food shortage, it is unlikely that replacement eggs can hatch and the chicks fledge from the cliff before autumn storms. Our observations on the effects of an environmental catastrophe during 1976 supports this conclusion.

b) During storms in the summers of 1975 and 1976 there were unusually low numbers of birds on the cliffs. In some cases after storms or rough seas had subsided observers saw unusually high numbers of birds returning to the cliff with food.

A storm in August of 1975 resulted in measurable loss of nests and chicks in lower ledges. Data collected in 1975 and 1976 showed that nests exposed to winds from the southwest were less successful than those sheltered from those winds.

Arctic seabirds have several special adaptations to the stresses of their environment: i) the slow growth rates of some chicks (so they are able to survive food shortages); ii) the ability of some chicks to shift their growth rate to an even slower one (kittiwakes in 1976; and iii) the adaptations of murres to leave the ledges before they can fly in order to join their parents on the feeding grounds.

We are confident that seabird nesting areas and their feeding grounds should be as little disturbed as possible because the natural stresses they are exposed to are already near the limits of tolerance. Not all human activities cause serious disturbance, however (see below).

c) The patchiness of resources means that those habitats which are suitable (see the first section of conclusions) cannot be readily replaced by second choices. This conclusion has been overlooked by many who see all wetlands as similar.

Patchiness in food resources means that food supply for a colony may fail in one or several years. Such a failure occurred in 1976 so that reproduction was poor over nearly all of the study area. The observations of the Hunt's party on the Pribilof Islands, however, indicated that seabird reproduction there was similar to that in 1975.

Our observations during transects of potential feeding grounds indicated that murres and puffins were flying unexpectedly long distances searching for food. This suggests that some birds are able to compensate partially for local food shortages by searching over large areas.

d) Predators are present at all major bird colonies, although their effects vary. In our experience the effects of predators are inversely proportional to the population level for a given year. During a low year such as 1976 the number of birds taken by predators represents a larger proportion of the population and, therefore, potentially causes greater damage.

The bird predators that appear to have the most effect -- Ravens and Glaucous Gulls -- are species which can profit from the spread of development by utilizing garbage dumps and the dumping of refuse at sea. This proliferation of human refuse may increase pressure on seabirds by providing food for a larger population of the predators.

Mammalian predators may affect the distribution of seabirds. Foxes may prevent birds from nesting on sections of cliff and in those burrows accessible to them. Weasels may prevent auklets from nesting on certain sites.

e) As we pointed out in the section on current state of knowledge, a number of influences have converged on adaptations among seabirds such as delayed reproduction, small clutches and hence long life expectancy. The slow growth of young and long adult life allow the species to survive reproductive failure for one or several years. The resulting large number of non-breeding (excluded) or pre-breeding (too young) birds at colonies means that breeding numbers will probably not immediately reflect the effects of a major reproductive failure or mortality.

If, however, several years of failure follow in sequence or if after the "non-breeding" birds are all "committed" into the breeding population, further kills occur, the results will be serious indeed because of the low rate of production of young, slow growth to maturity and hence low rate of population turn-over.

In practical terms this means that managers could be lulled into a false sense of security if oil spills or bird kills in the early stages of development do not seem to have a direct measurable impact on the number of birds at the major cliffs.

3. What human activities disturb, damage, or change the behavior of wildlife either directly or indirectly?

a) We conclude with some confidence that the present level of egg collecting at the major colonies has little impact on the populations, except on those few ledges that are accessible. The large areas of inaccessible ledges form a population and breeding reservoir that keeps the croppable ledges fully occupied. We consider this to be a satisfactory situation for both egging and the seabirds. The activity of egging does not appear to disturb the colony except temporarily.

It may be that egging has lowered the whole population at Egg Island because the ledges are nearly all accessible. It is probably the case that egging, like fox predation, has eliminated a number of marginal breeding ledges at Sledge Island and King Island. King Islanders, Ed Muktoyuk, John Pullock and Mike Saclamanna, agree that many ledges have been reoccupied in the 10-15 years since egging virtually stopped at King Island.

b) Hunting seems to have a minor impact on the populations of waterfowl as a whole. However, hunting and the alarm resulting from hunting has virtually eliminated waterfowl and some other bird species from areas within easy access of summer camps along rivers or barrier beaches. Our data, although general, strongly support this.

We have seen people shooting at the seabird cliffs and at waterfowl along the beaches in spring, and on the wetland gathering grounds in late summer. Shooting at the cliffs causes a major panic and shooting over wetlands moves the ducks, geese, swans and cranes out to other grounds.

Although shooting may not have direct or measurable impact on populations, it does appear to have a strong effect on behavior and habitat occupation. In view of our previous comments about the scarcity of really favorable habitats and the periodic severe natural stresses, it would appear prudent to establish areas where the disturbance of shooting is not permitted.

c) As we observed with egging, an ideal circumstance for cropping seems to be that in which there is an undisturbed productive reservoir from which surplus population moves into a cropped area. If waterfowl and seabirds are to be managed as croppable resources, some such planning of habitat by large areas is necessary. One management alternative that might be useful exists in public lands in some western states. In these cases, a core area where disturbance of populations (including hunting) is prohibited is surrounded by areas in which habitat is maintained and hunting is allowed, while outside that area private property rights apply.

In this context, our major conclusion is that special institutional status is needed for critical wildlife areas such as the major seabird breeding colonies and the major waterfowl gathering grounds. These political institutions may involve easements or other formal agreements. It will doubtless be best in the long-term interests of the people cropping the resource for the cropped populations to have secure core areas where they can reproduce free of the disturbing aspects of human activities.

d) Overflights of aircraft cause many birds to fly from the ledges. In most cases these birds are primarily non-breeders and little effect probably results. Close overflights, however, resulting in sudden appearance and a loud noise, causes panics during which eggs may be pushed off the ledges. These do cause damage; perhaps 20-30% of the eggs and chicks may be lost. Helicopter overflights, especially close ones, associated with parties landing at the foot, top or beside the cliffs, consistently cause major panics and should be categorically forbidden except when absolutely necessary.

e) The distribution of driftwood along the beaches on the south shore of the Seward Peninsula many tens of miles from forested regions indicates a westward flow of water in the northern part of Norton Sound. The presence of a northwestward trending sandspit and gravel bar on the northern tip of Sledge Island indicate that the predominant flow of water is northwestward there. ComSAT photos have reportedly shown traces of the "plume" of the Yukon River silts extending through the Bering Strait. Our observations on the movement of drift ice past King Island indicated that there is a constant flow. Occasionally the flow is from the north but nearly always it is from the south.

The continuous flow of water past King Island from the southeast and, as reported in the literature, southwest, suggests that contamination by oil or other industrial chemicals spilled almost anywhere in the Norton Basin will probably reach this island or the equally important breeding colonies in the Bering Strait. Such contamination will even more probably pass through the widely dispersed feeding grounds of the local seabirds and sea mammals.

IX. NEEDS FOR FURTHER STUDY

We direct these comments to the needs for study of the whole geographical area where we have been working. We include comments on the relation of the needs to the programs already in progress.

Many of these comments are quoted from a paper on the population dynamics of marine birds given at a symposium on the conservation of northern marine birds, Seattle, Washington, in May 1975.

A. Waterfowl and Shorebirds

There is an important need to learn the places where seabirds, waterfowl and shorebirds gather on migration and during the winter in order to identify those areas which need special protection from effects of economic development.

We have carried out aerial and surface surveys to locate the coastal areas where waterfowl and shorebirds gather on breeding grounds, on migration, for moulting and during the winter. These surveys should be continued and be put into a systematic plan. We should examine: Which leads in the ice and patches of open water at the mouths of rivers are of special importance in spring? What shorelines and beaches act as "leading lines" during migration? Which capes and points result in concentrated overflights of migrating waterfowl, and hence are locations of unusually high hunter kills? What wetlands, bogs, coastal ponds, lakes and lagoons are used as gathering grounds? How much redundancy of wetlands is needed to make the wetlands system maximally productive for waterfowl and shorebirds?

Answers to these questions will identify those geographic areas which deserve special protection during development. The answers will also identify the kinds of influences which might lower the contribution of each critical area to the populations of seabirds, waterfowl and shorebirds using them.

B. Seabirds

The work in progress should be continued in order to know the full and average extent of annual variation. There is an important need:

1. To learn the distribution and relative importance of seabird colonies.

2. To establish annual similarities and differences in a) the number of nesting pairs and non-breeding individuals at each colony; b) the timing of breeding activities; and c) the effects of weather on breeding activities.

We should continue our studies on the relation of the counts made at several seasons to the number of pairs actually breeding. We have found that counts made very early when the birds first arrive and counts made when most birds are incubating eggs approximate the number of breeders. We need to test how to estimate the numbers of breeding auklets.

We should continue to monitor the colonies in Norton Sound and should survey colonies such as King Island, Fairway Rock and Little Diomede Island. Most of this work may possibly be done from a moderate sized boat so as to avoid having to put a party onto the islands.

3. There is a need to establish similarities and differences in breeding success among colonies by year and location. It is important to know which colonies are producing an excess of young or barely holding their own.

a) We should continue to examine the relation of breeding success of Black-legged Kittiwakes to that of murres and puffins. It appeared at the start of the 1976 season that kittiwake success was low but murre reproduction was the same as in 1975; but further study showed marked lowering of production by murres and some indications of disturbance of breeding activities among Horned Puffins. If a correlation exists, kittiwakes, whose reproductive success is easily measured, can be used as "indicator species". We need to test the use of photography in late August as a "remote sensing" technique for measuring success in kittiwakes. There are many difficulties but the technique holds promise.

b) We should put a party on Sledge Island, and perhaps King Island and Little Diomede Island, during late July to make detailed counts of the reproductive performance of murres. Such studies would indicate whether it will be possible other years to make short visits in order to count total birds and birds in an incubating posture to measure reproductive success. It may be possible to make such counts from the relatively stable platform of a moderately large boat.

c) We should learn how to measure the breeding success of crevice, scree and hole nesting species, especially auklets. This topic deserves high priority.

4. There is an important need to examine the behavior and impact of predators at seabird colonies, especially Ravens; but the impact of Glaucous Gulls, foxes, weasels and people should also be considered.

5. There is an important need to examine the interactions of the seabirds with their food supply. In order to pursue this study we will need to operate a moderate sized (40-50 ft.) vessel which would allow us dependable but flexible transportation to feeding grounds. Such a vessel would supply a base for operating small boats to shoot birds (for studies

of food) and to census close to the bird cliffs. More specifically, it is important:

a) To locate areas over which seabirds are distributed at sea and where they are concentrated. What relations do these areas have to underwater topography, to the distribution of crustacea and small fish? What seasonal and annual differences exist?

b) To carry on studies over several years to learn the effects of varying amounts of food on breeding behavior and performance.

i) What are the effects of food abundance in early spring on date of laying and egg size? What effects do quantitative and qualitative (species of prey) changes in food supply have on the survival of chicks?

ii) What effects do storms have at different stages of the reproductive schedule?

iii) What are the similarities and differences in the food of similar species such as Tufted and Horned Puffins, Thick-billed and Common Murres?

iv) What are the similarities and differences between what parents eat and what they feed their chicks?

C. Baitfish and larger zooplankton (Beyond our competence)

It is important, both for its relevance to fundamental biological questions and for its relevance to oil development, to study the relation of the abundance and distribution of key prey species to their availability to birds, as Bedard showed for *Calanus* to Least Auklets, and *Thysanoessa* to Crested Auklets; and Nettleship and Tuck showed for Capelin to Atlantic Puffins and murres.

In general the population size of terrestrial predators has been reported to have a direct and marked effect on the population size in their prey. It seems to be the more general case in marine environments that population sizes of predators vary widely without having a marked effect on the numbers of their prey. Does high seas commercial fishing for large, predatory fish (pollock and salmon) have a measurable effect on the zooplankton available to smaller alcids? Do marine birds affect a fishery?

It is generally accepted that the OCSEAP in its larger context needs to know about the breeding areas, reproductive rates, growth rates and dispersal routes and rates of major food species of larger vertebrates including commercial fish, marine mammals and marine birds. In most regions a few species of teleost fish (e.g., Ammodytes, Mallotus, Boreogadus) or crustacea (e.g., copepods, euphausids, mycids, or amphipods) make up the great majority (65%-80%) of the food of seabirds. Yet the barest minimum is known about the biology of such species. A good approximation of the "condition" of a marine environment may possibly be made by measuring reproductive and growth rates of key species whose numbers dominate the top trophic levels in each locality. Monitoring reproduction in seabirds may fill this function.

D. Oceanography of shallow shelf waters (Beyond our competence)

It is relevant to the larger problems of OCSEAP as well as to our project to know more about the oceanography of continental shelf waters, more specifically the waters between 6 meters and 60 meters deep. The shallow waters of continental shelves are some of the most productive of sea waters, but are among the least studied. Although some species (Black-legged Kittiwakes, Tufted Puffins and Fulmars) move into deep waters, many species of marine birds of northern waters gather in large numbers on or near the edges of continental shelves during the winter.

It is important to know why there are differences in the trophic structures at different areas of the Bering Sea. Why are these differences reported in the species and trophic proportions of benthos, ground fish and the mid-water faunas of 1) Bristol Bay, 2) the slope of the continental shelf, and 3) the top of the shelf? What species predominate in the biomass of the Norton Basin and what are their reproductive adaptations hence turn-over rates?

E. Beringian faunal and floristic geography

In the largest context, the applied studies in this area need to address questions of 1) how the fauna reached its present numbers and diversity and 2) how these are maintained. Some of the faunal characteristics of the Bering Sea region are consistent with traditional lines of evidence that the area must have been geologically stable for many millions of years to have such a diverse fauna and flora. The long list of endemic species which have apparently been "unable" to extend their ranges outside the Bering Sea area (Hultén 1939), suggest "conservative" characteristics that should, if true, make them vulnerable to disturbance.

However, there are dynamic processes in action at present. The area is one in which the Eurasian fauna and North American fauna (like the tectonic plates which the faunas ride upon) rub against each other. Species from both continental masses occur as stragglers readily identified as the rarities of special interest to amateur "bird watchers" who flock to western Alaska every summer.

Some seem to be able to settle (e.g., Bar-tailed Godwits and Yellow Wagtails in Alaska and Snow Geese and Sandhill Cranes in Siberia) but most hold on for a few years and fail. Studies on Saint Lawrence Island (Fay and Cade, Sealy et al.), on the Pribilofs (Kenyon and Phillips, Thompson and DeLong, Sladen, etc.) and on the Aleutians (Byrd et al., Emison et al.,) document the ebb and flow of colonists. This subject is reviewed in the section on the current state of knowledge.

Salomonsen, while studying the distribution of seabirds in Greenland, pointed out the fallacy of trying to put seabirds into geographic rules developed for land animals. One of these inapplicable rules is the one that describes a latitudinal trend of decreasing species diversity extending from the Tropics to the North. Udvardy has shown that seabirds have greater diversity in higher latitudes in both hemispheres.

E. Predictive models (Beyond our competence)

A number of fundamental differences of opinion exist about the operation and structure of natural communities. These differences will undoubtedly color the predictions made as to the impacts of development. Until these fundamental differences are resolved, it seems prudent to deal empirically with the evidence available on what is happening in specific places and between specific groups of species. An illustration is offered in the publication "An oil slick analysis for the North Atlantic outer continental shelf lease area" by Smith, Slack and Davis (1976).

A coordinated effort is needed to prepare a matrix of probabilities of contamination of breeding and feeding areas (summer, winter, and during migration) and the impact of such events upon wildlife and public opinion, using existing knowledge of:

1) areas of proposed mineral development;
2) areas which will be influenced by secondary development such as dredging new harbors, laying subsurface pipelines;
3) tidal and oceanic currents;
4) numbers of marine birds or waterfowl dependent upon specific geographic areas and habitats (e.g., waters below nesting cliffs, feeding grounds, wintering grounds, and gatherings during migration);
5) the distribution and patchiness of habitats (i.e., the redundancy among and within habitats and the degree to which populations exchange between alternative habitats);
6) the biological importance of species in local ecosystems (Are they predators whose effects increase diversity or do they seem to be irrelevant in the "system"?);
7) the human importance of the species (Are they endemics? Do they have unusual "charisma" for the public?);
8) the vulnerability of the species (Is its distribution restricted? Is it subject to oil pollution? Are their preferred grounds near areas of high development potential?);
9) the types of biological effects (e.g., oil contamination of plumage, PCB contamination of food chains);
10) whether the potential impacts are reversible or irreversible and to what degree.

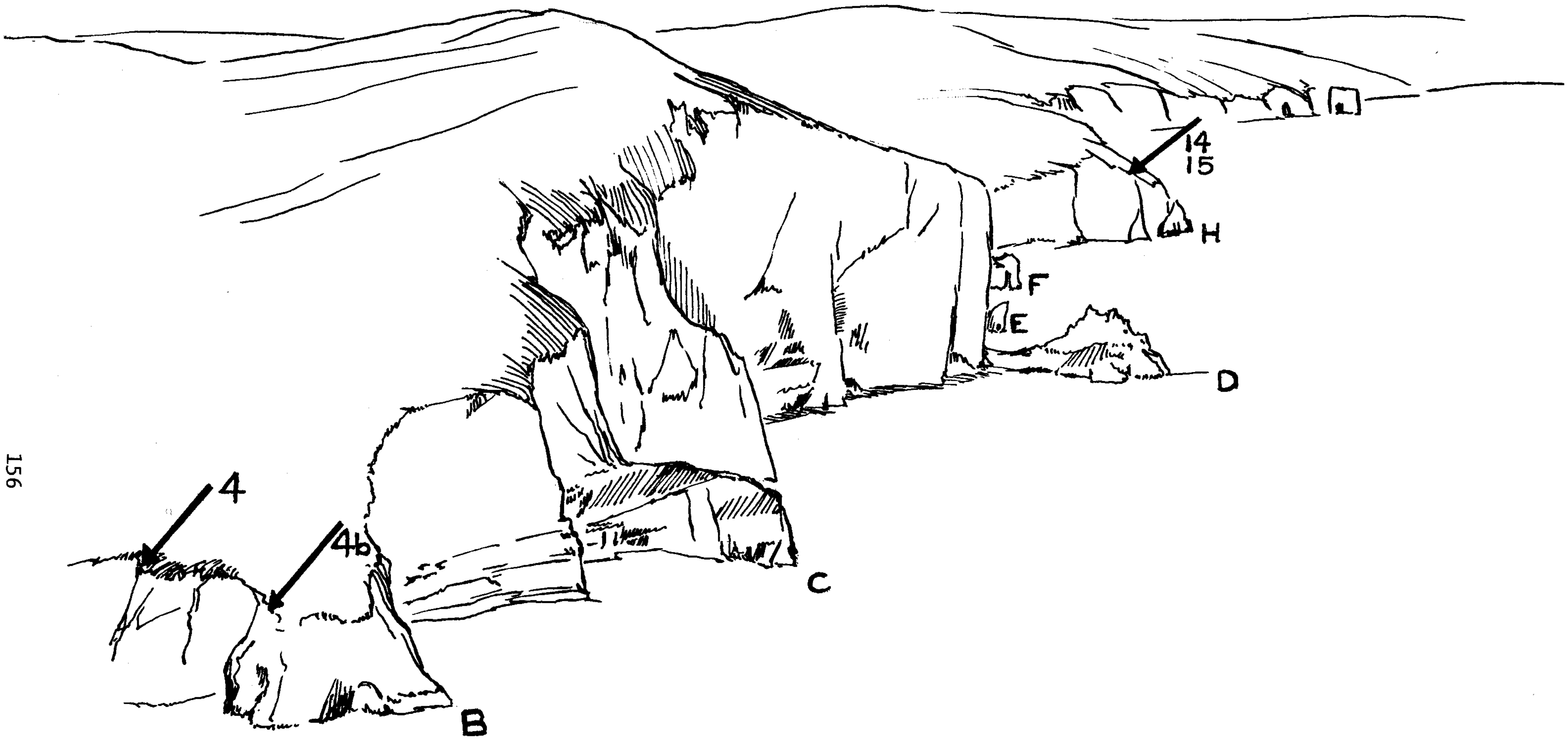


Figure 33. Cliffs at Bluff

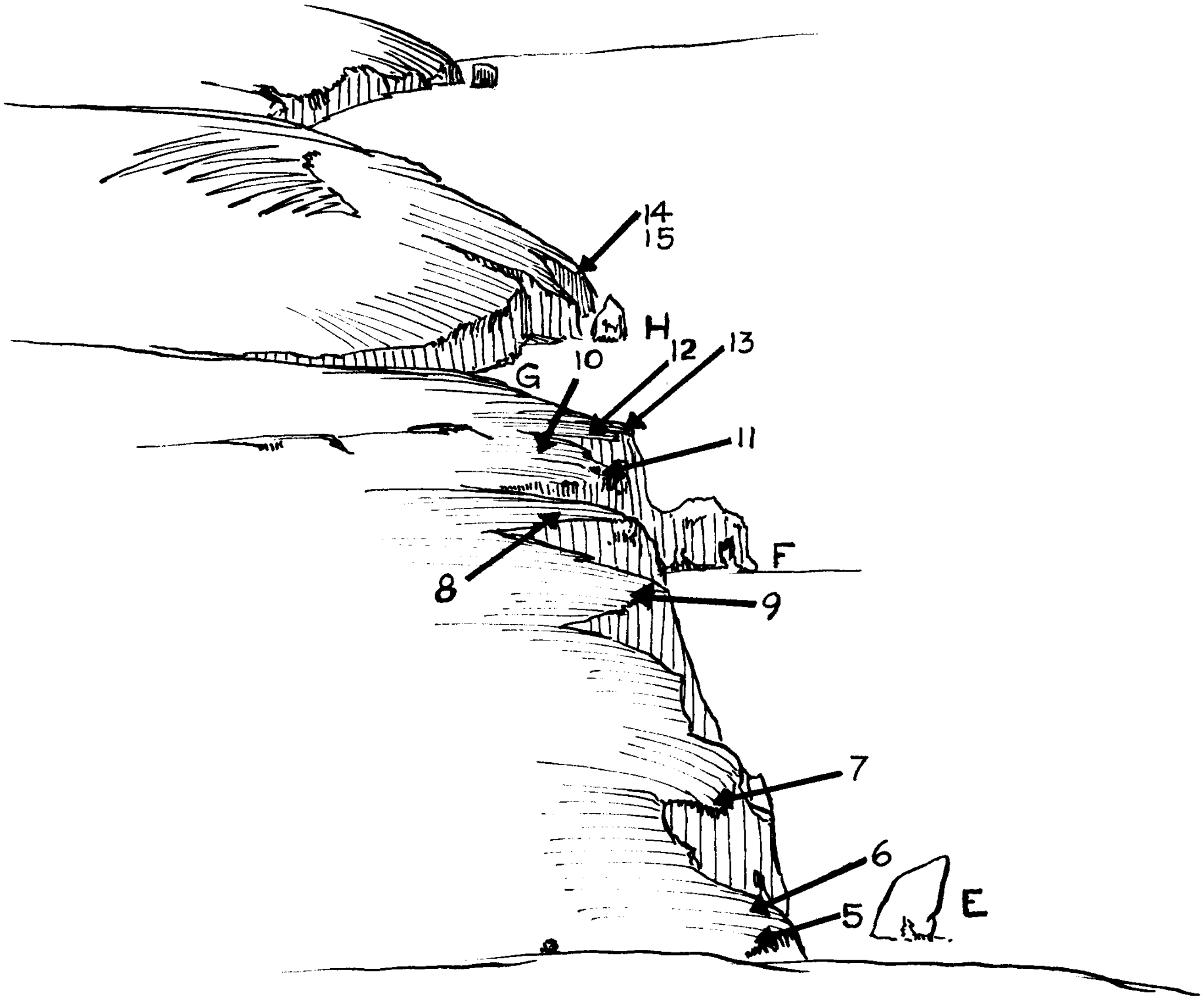


Figure 34. Cliffs at Bluff

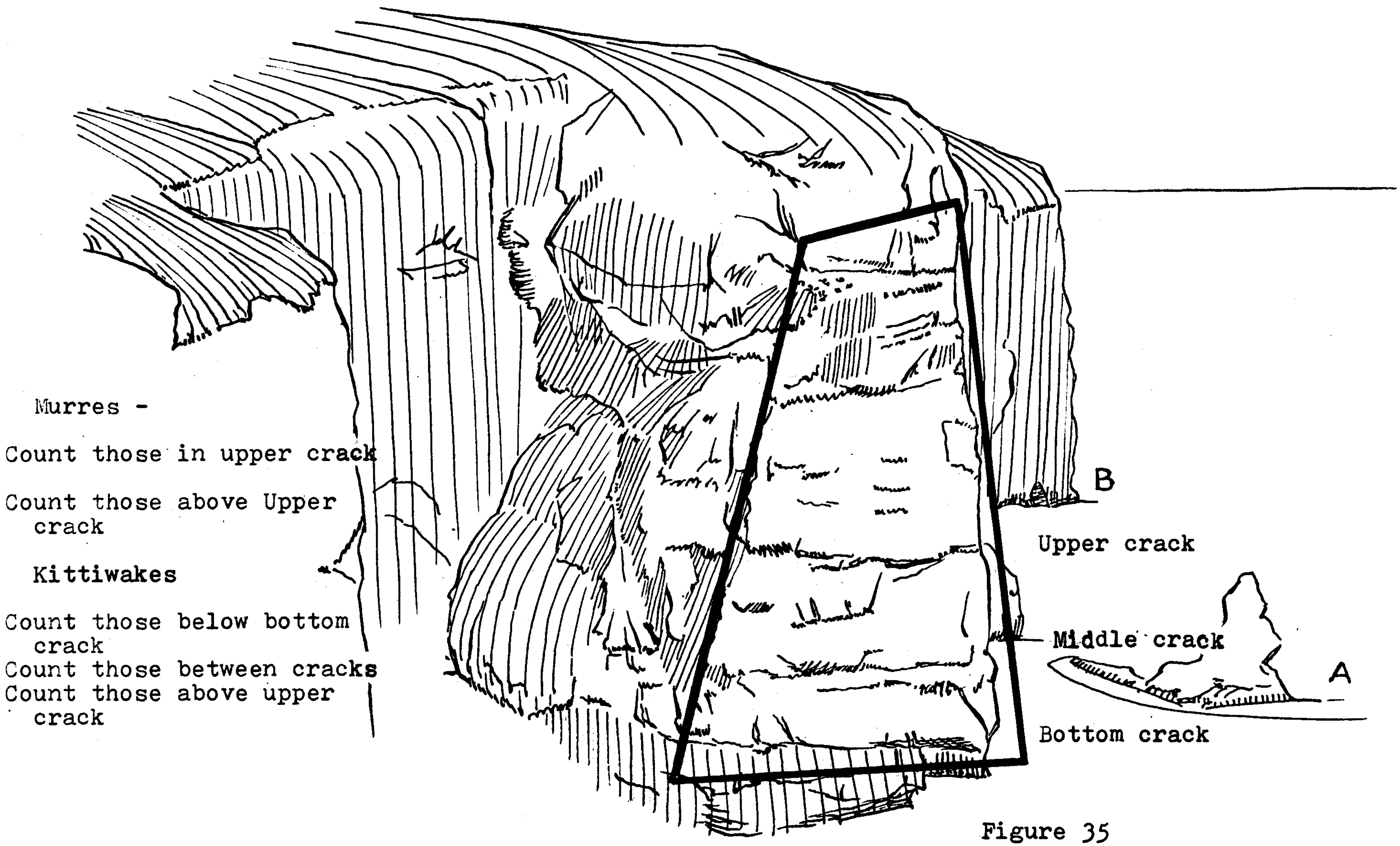


Figure 35

Study Site 1

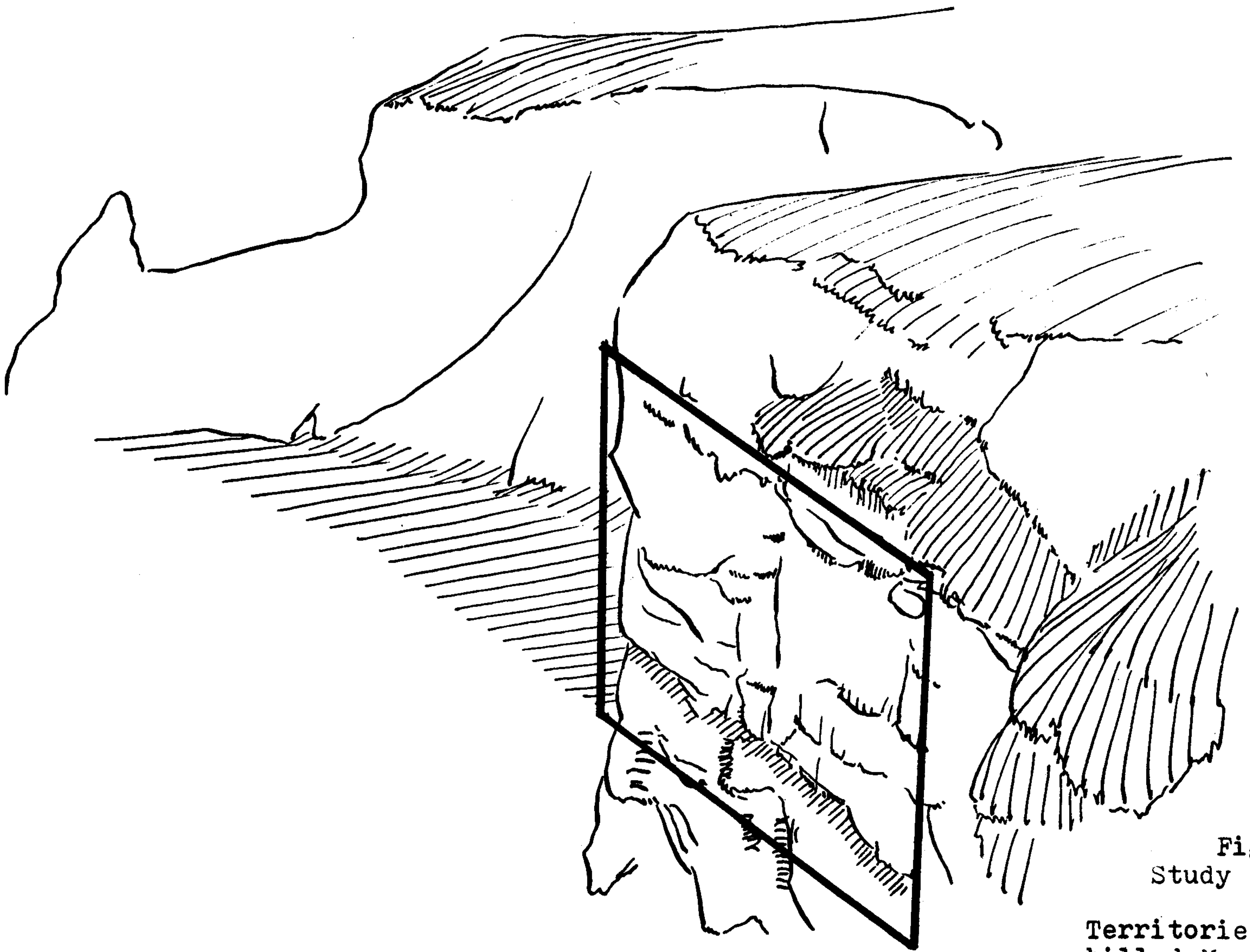


Figure 36
Study Site 2

Territories of Thick-billed Murres mapped on the entire face

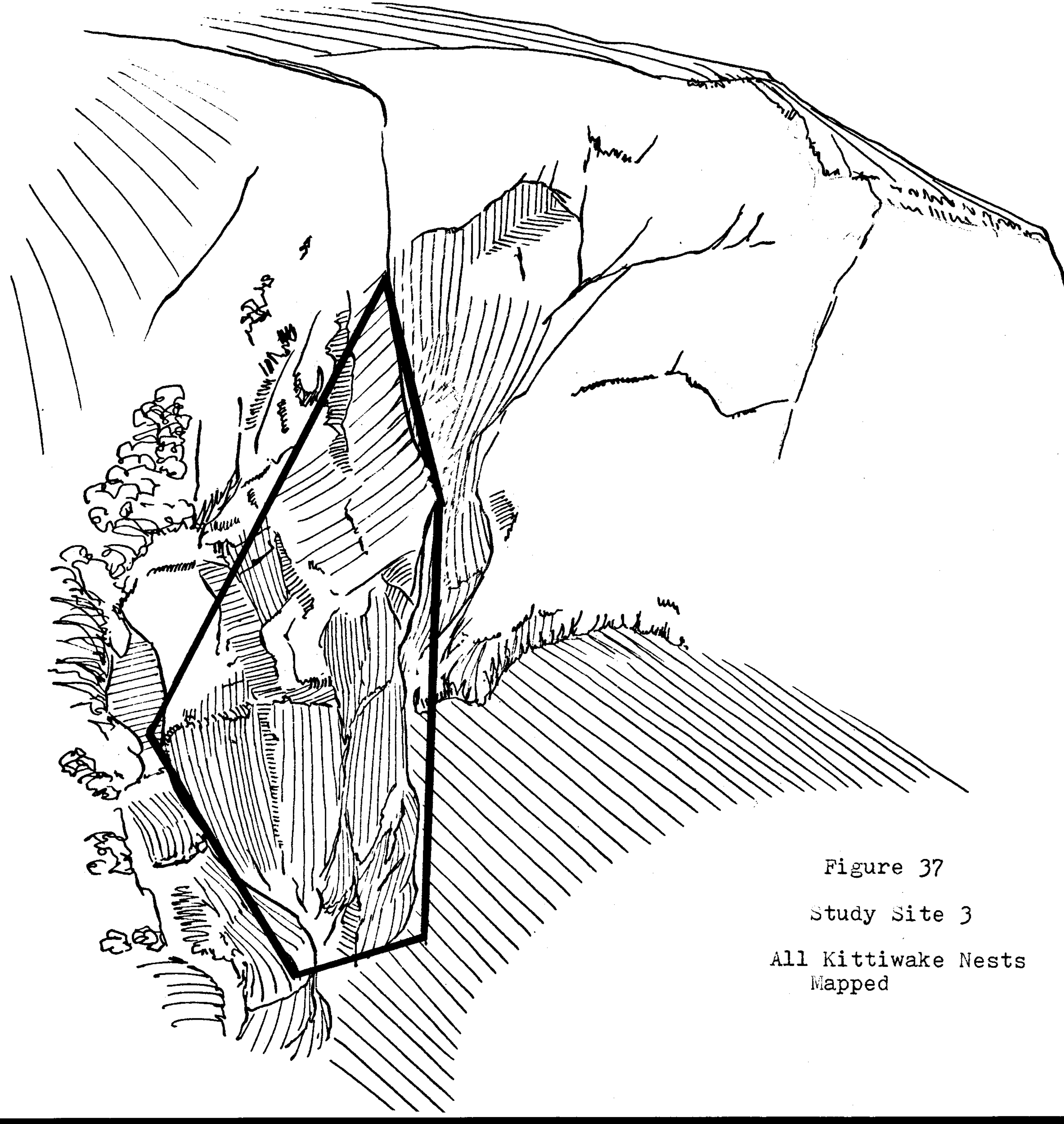


Figure 37

Study Site 3

All Kittiwake Nests
Mapped

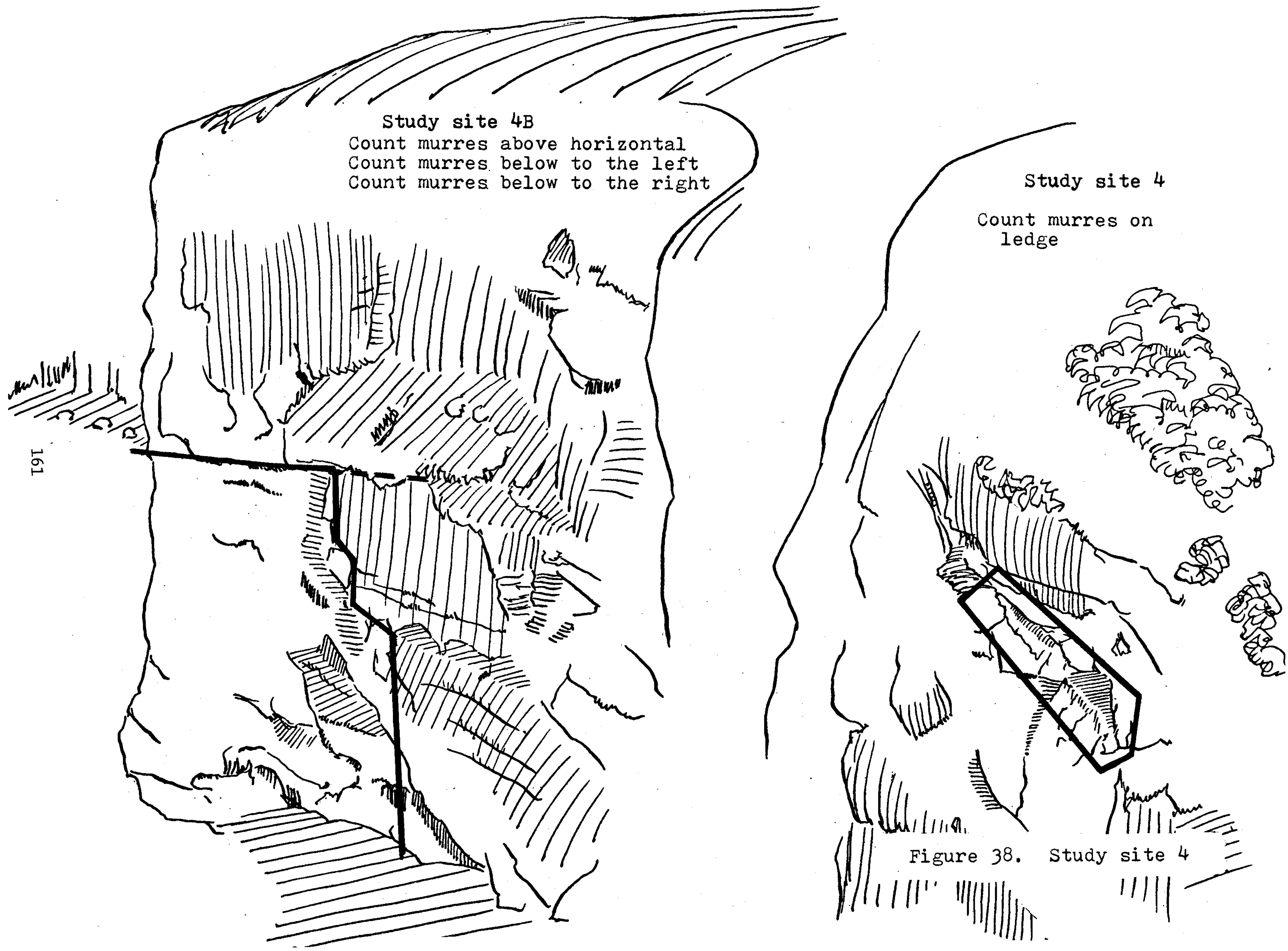


Figure 38. Study site 4

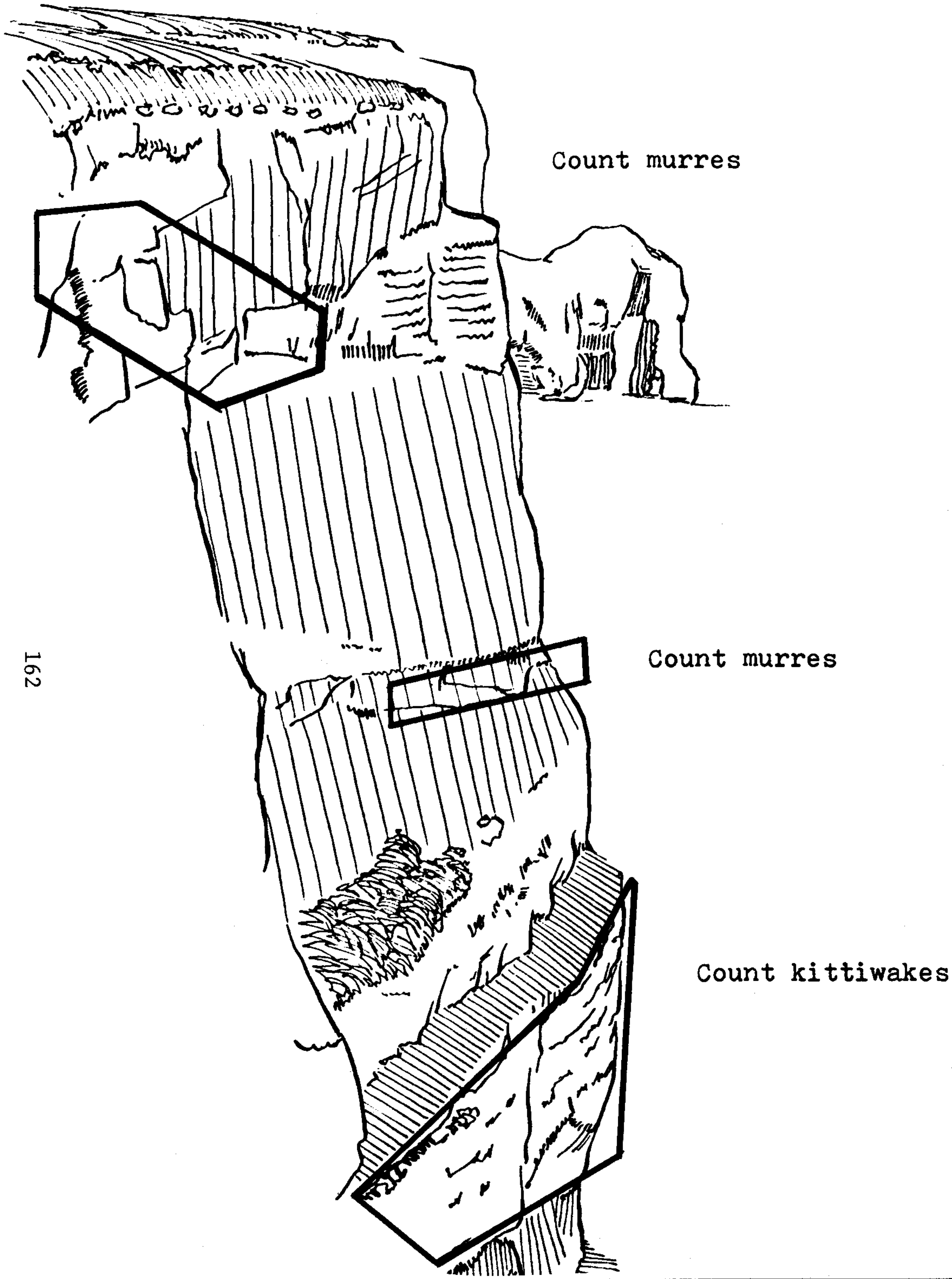


Figure 39

Study site 9

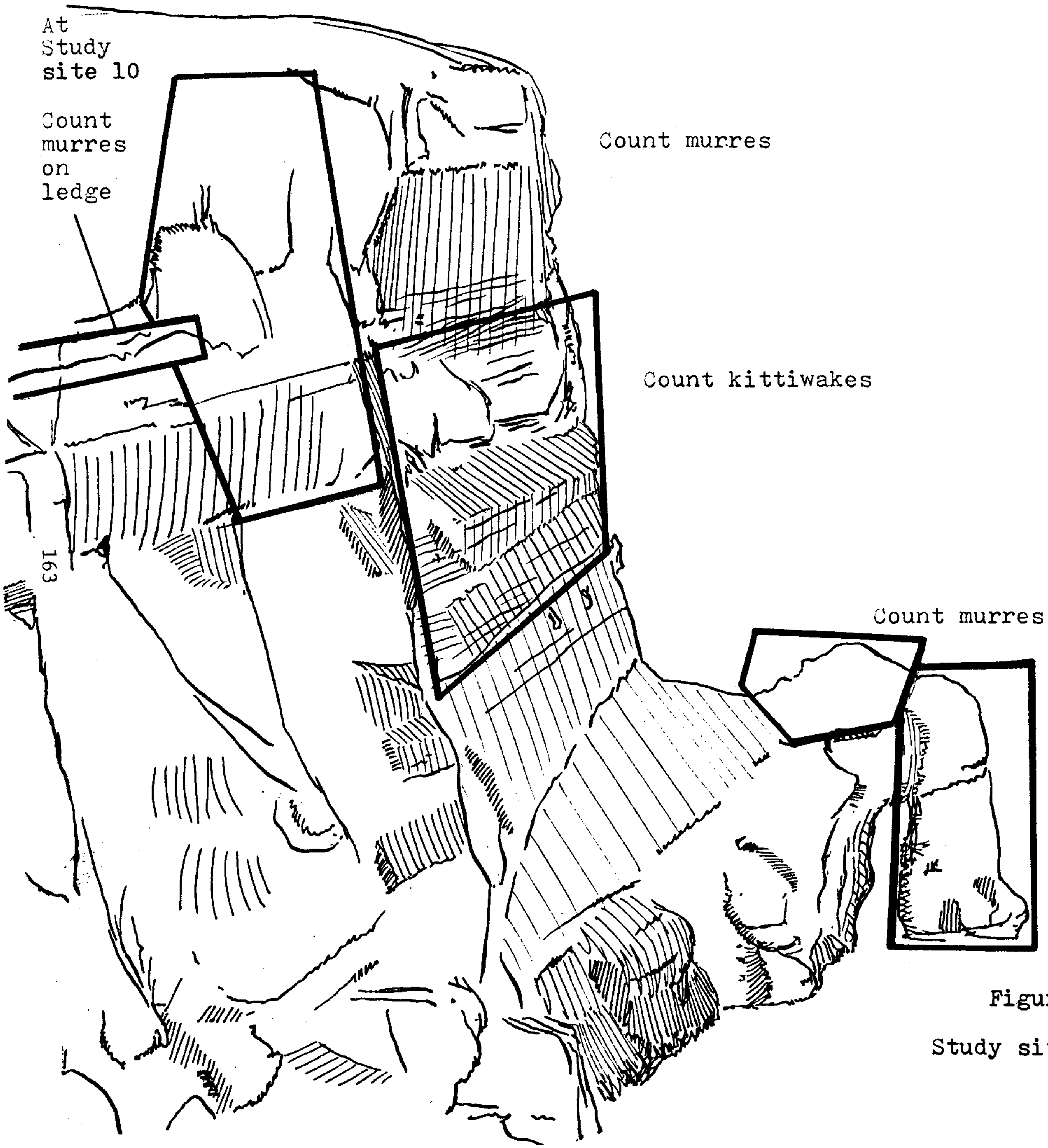


Figure 40

Study sites 10 and 11

APPENDIX A

MAJOR COLONIES OF NORTON SOUND

Ink drawings are presented in Figures 33 through 44 of the largest seabird colonies. Where appropriate, the areas of cliffs occupied by birds are marked by lines drawn below the cliffs.

Bluff Cliffs

Two views are shown. Figure 33 is an air view from the westernmost end of the cliffs looking east. The cliffs in the foreground are 400-500 feet high. Figure 34 is from the top of the high cliffs looking east along the cliff tops in the section where most of the study sites are located. The cliffs in this area are 150-200 feet high.

Square Rock, a separate colony 1.5 miles east, is shown in the background of Bluff in both pictures. Common Murres, Horned Puffins and Black-legged Kittiwakes nest along all the cliff faces shown from study site 4 on the west, to study sites 14 and 15 shown to the east. The densely occupied cliffs extend several hundred yards beyond study sites 14 and 15 but beyond there murres or kittiwakes are scattered in patches. Horned Puffins are relatively numerous along the cliffs of poorly consolidated sediments that outcrop between location H and Square Rock.

The points which we used to separate subsections of the cliffs for censusing are indicated by letters. The endpoints of these subsections are conspicuous rock formations located on the sketches by letters. These are also indicated in Figure 3. From west to east, these are:

A. Metal barge at west end (not shown).

B. Figures 33 and 35. Outside corner where the cliff turns from facing southwest to facing south.

C. Low promontory shaped like an axe head with grass on top.

D. Promontory that looks like a castle.

E. Small stack shaped like a thumb.

F. Promontory with two natural arches under it.

G. Abandoned mining camp with a conspicuous jack pole and mine shafts in the cliff.

H. Stack with a nylon rope on it (in 1976) used for egging.

I. Point with a tall, shallow cavern with a rounded roof (not shown).

J. Stack at east end.

Counts made in 1975 and 1976 within these subsections are being archived on computers at the Juneau Project Office.

Numbers in Figures 3, 33 and 34 indicate the location of study sites from which counts of murres, kittiwakes and puffins were made, nests were monitored, and general observations were made. Each is marked (in 1976) by a large tent peg driven into the ground.

Figures 35 to 40 detail the areas observed from 6 of the study sites. Specific study areas are outlined.

Figure 35 shows site 1 where kittiwakes and Common Murres were counted in areas delineated by two prominent horizontal cracks. Puffins were also counted on the whole face.

Figure 36 shows site 2 where all visible Thick-billed Murres were mapped.

Figure 37 shows site 3 where kittiwake nests were mapped on the closer section of the cliff.

Figure 38 shows two parts of site 4. On the far cliff shown on the left, Common and Thick-billed Murres and Horned Puffins were counted. The closer area is a distinct hole where Common Murres were watched.

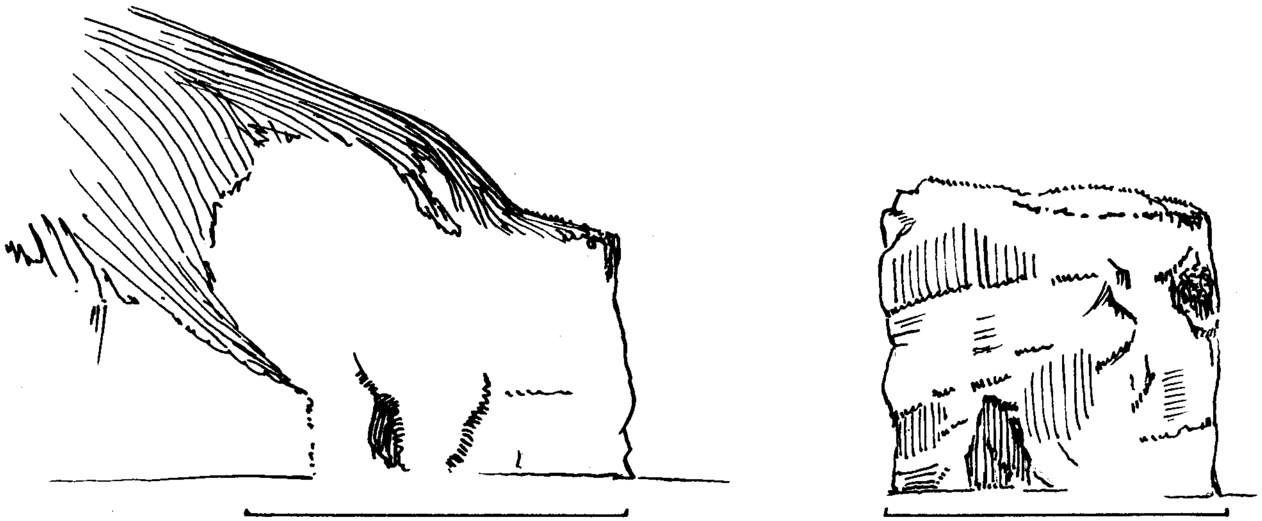


Figure 41. Square Rock

Figure 39 is site 9 at which Common Murres were studied in an area near the top of the cliff and on a horizontal crack half way down. Kittiwakes were counted below the flat shelf at the bottom and all puffins visible were counted.

Figure 40 is the view from site 11 and also shows areas studied from site 10. Kittiwakes were counted on the outer leg of the arch. Common Murres were counted on the top of the arch and between two vertical cracks. From site 10 Common Murres were mapped on a horizontal ledge and kittiwakes were mapped on a section further out on the cliff.

Figures 41 to 44 are sketches of the other major colonies in Norton Sound. Cliff faces with nesting murres and kittiwakes are indicated with brackets. Location of these colonies are shown earlier in Figure 1.

Square Rock -- Figure 41

This discrete colony is shown in the distance from the west in Figures 33 and 34. Murres and kittiwakes nest on the rock stack and on the mainland cliff. A mob of Common Murres gathers on the top of Square Rock leaving "sterilized" zones in the three-four Glaucous Gull territories. The occupied area on the mainland extends about 150 meters along the face.

Sledge Island -- Figure 42

Sledge Island, about 700 feet high, is illustrated as seen from the south at a distance of about 10 nautical miles. The seabirds nest on the lower parts of the slopes on the near part of the island. Pelagic Cormorants nest on the low slopes as well as on rock stacks high on the slopes. There is a small group of Pelagic Cormorants, Horned Puffins and perhaps Parakeet Auklets which nest around some small rocky faces at the distant corner on the east side of the island.

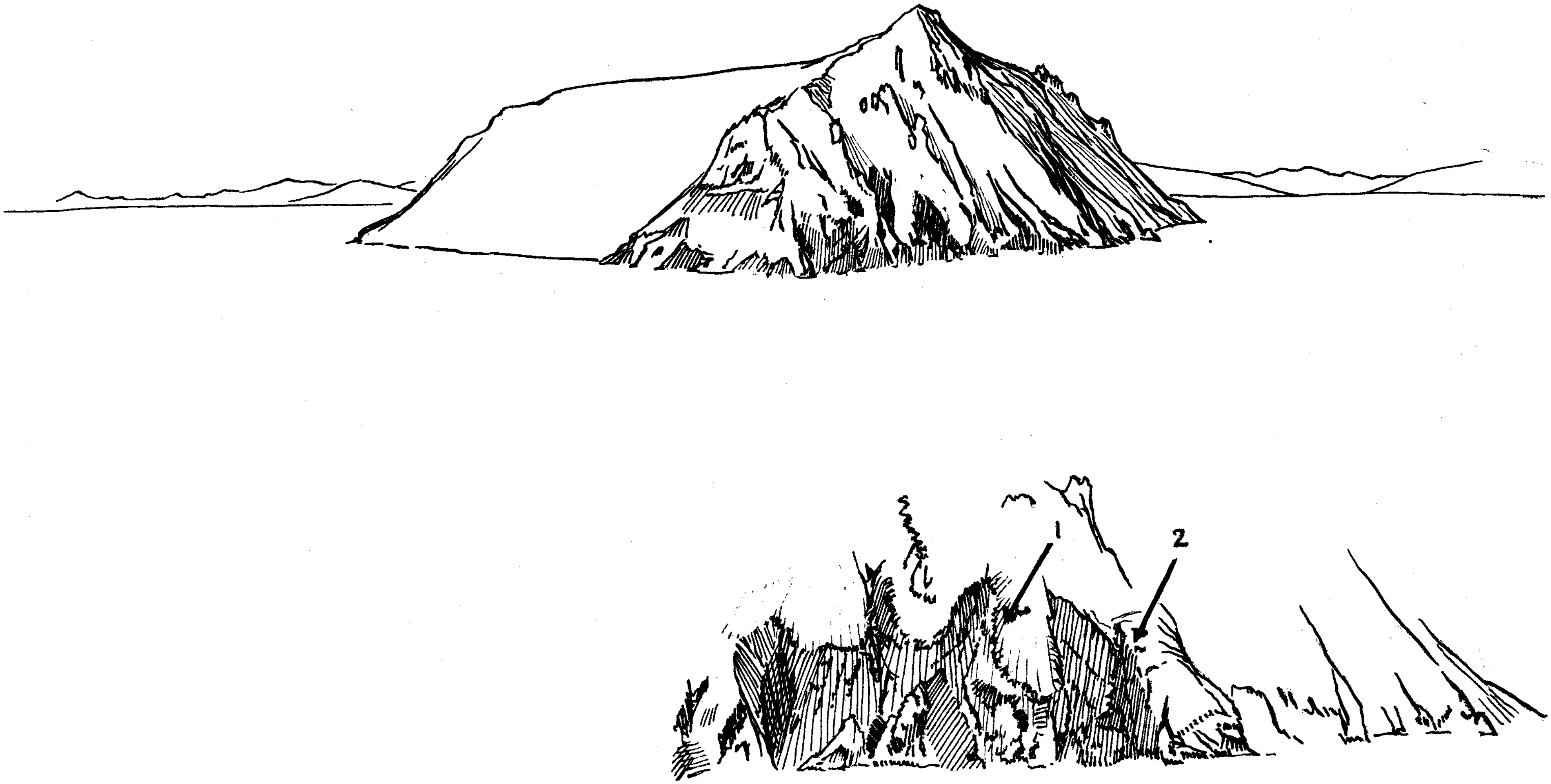


Figure 42. Sledge Island

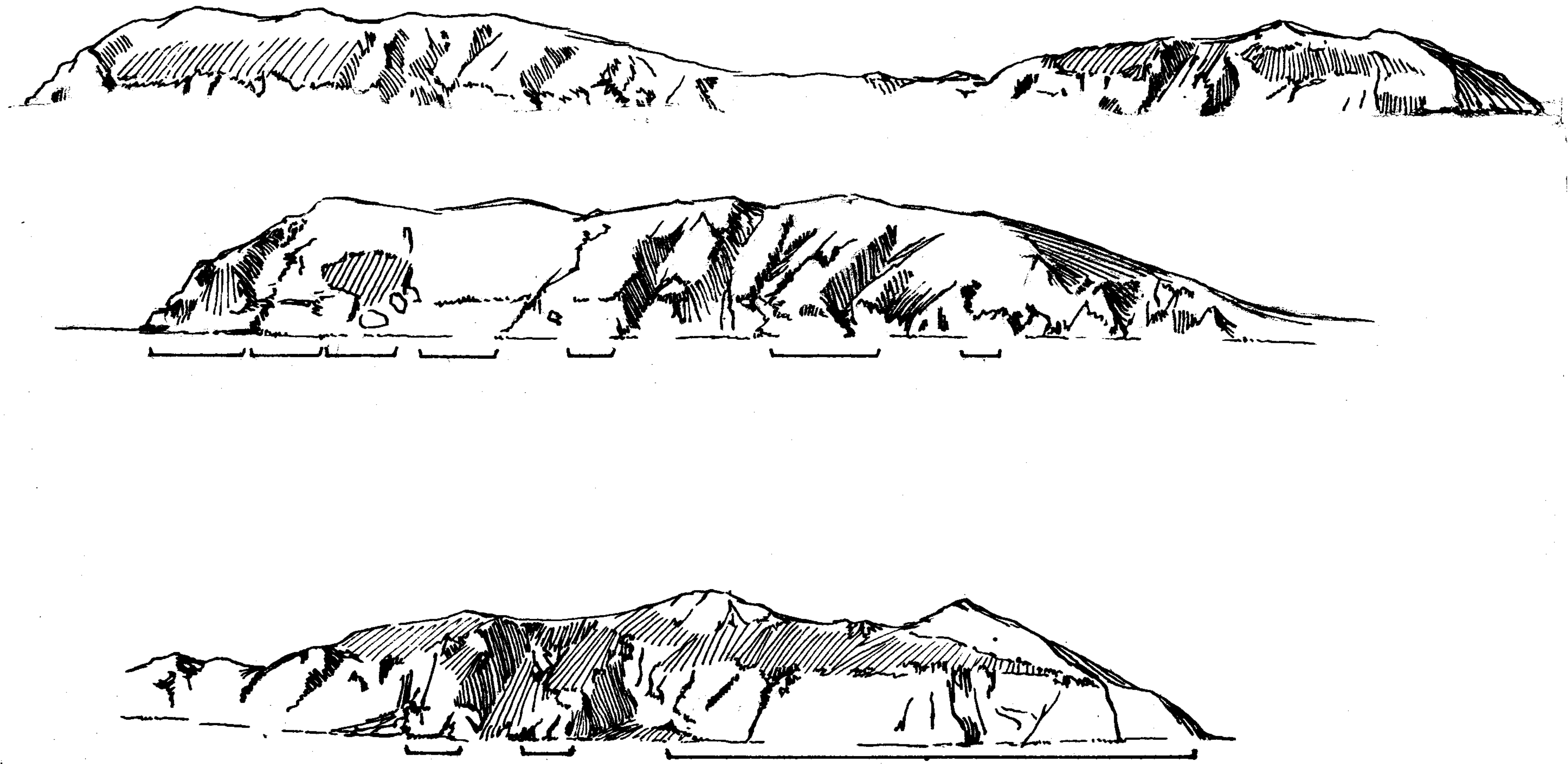


Figure 43. Cape Denbigh

Cape Denbigh -- Figure 43

The seabird cliffs at Cape Denbigh are on the southern point which extends south from the main cape. The whole point, as seen from the west, is shown in the top drawing of Figure 43. The cliffs are occupied in two portions. The northern one is shown in the middle drawing of Figure 43. Most of the murres and kittiwakes are crowded in two sections at the northernmost end. In addition, there are a number of small sparsely occupied patches of murres, kittiwakes and cormorants on faces further south, as indicated by brackets. The nesting in the southern section (lower drawing) consists of a few dense patches separated by a beach. A large, long and high (120 ft.) section of cliffs at the southermost end is densely occupied by murres and kittiwakes.

Egg Island -- Figure 44

Figure 44 (top) shows a view of the cliffs seen from the northwest and from the air. The cliffs are very low (20-25 ft.) between a rubble depositional slope and the turf of the top of the island.

The lower drawing shows the entire area occupied by murres and kittiwakes seen from just west of north. Most of the murres and nearly all the kittiwakes nest in the large outcrops under the place where the turf is lowest on the north corner. Other murres nest in small patches further east. It appears that nearly all nesting ledges are accessible to egg collecting. Horned Puffins seemed to be most numerous on the northwest, north and northeast sides of the island. We saw a few Parakeet Auklets near the eastern edge of the nesting area. The southern part of this island is made up of blocks of columnar basalt. The same rock extends from Tolstoi Point to Stuart Island. The cracks in the basalt seem to be used as nesting crevices by Horned Puffins at several places.

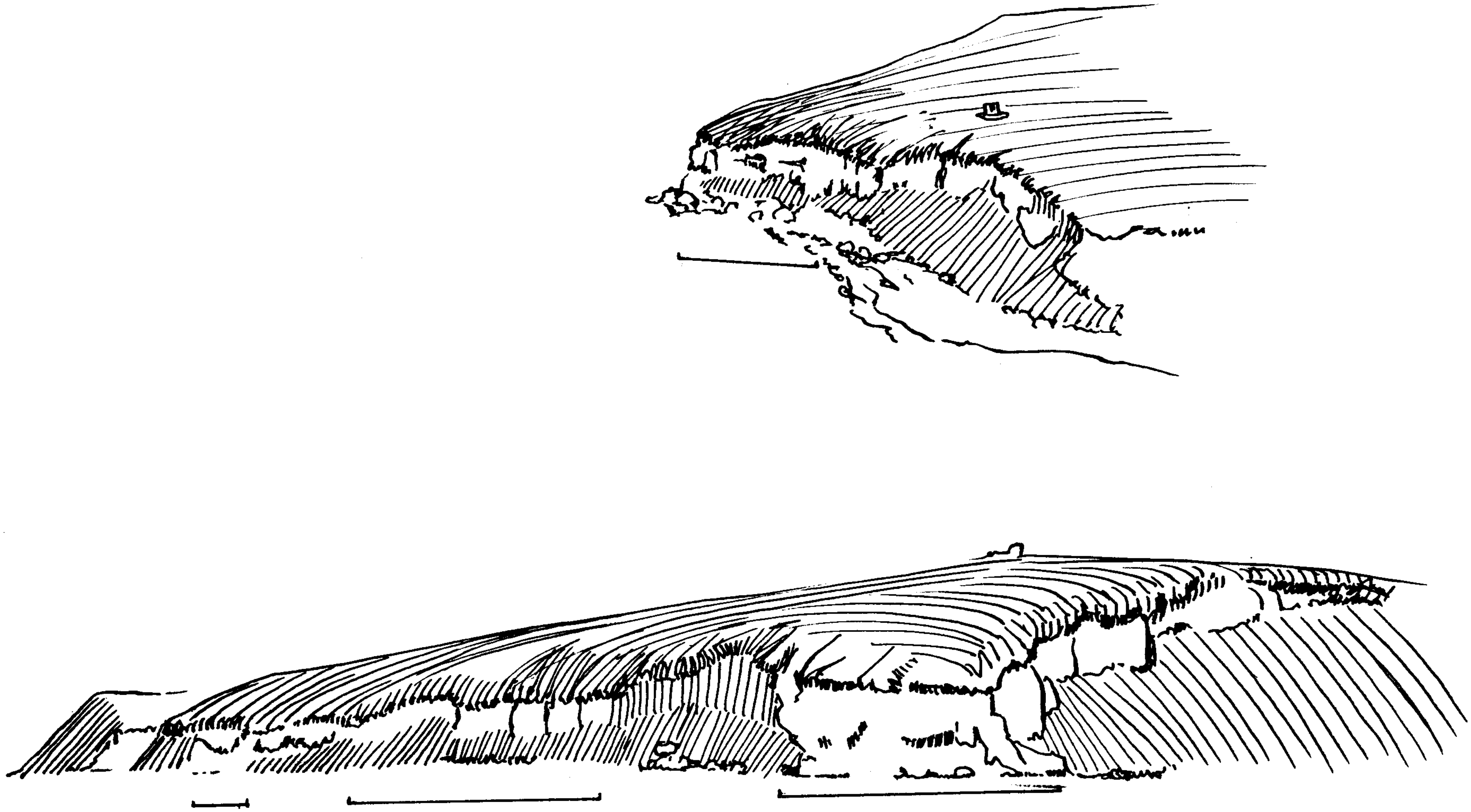


Figure 44. Egg Island

APPENDIX B

LOCATION OF BREEDING COLONIES IN NORTON SOUND

Figures 45 through 50 show the location of breeding colonies for nine species in Norton Sound.

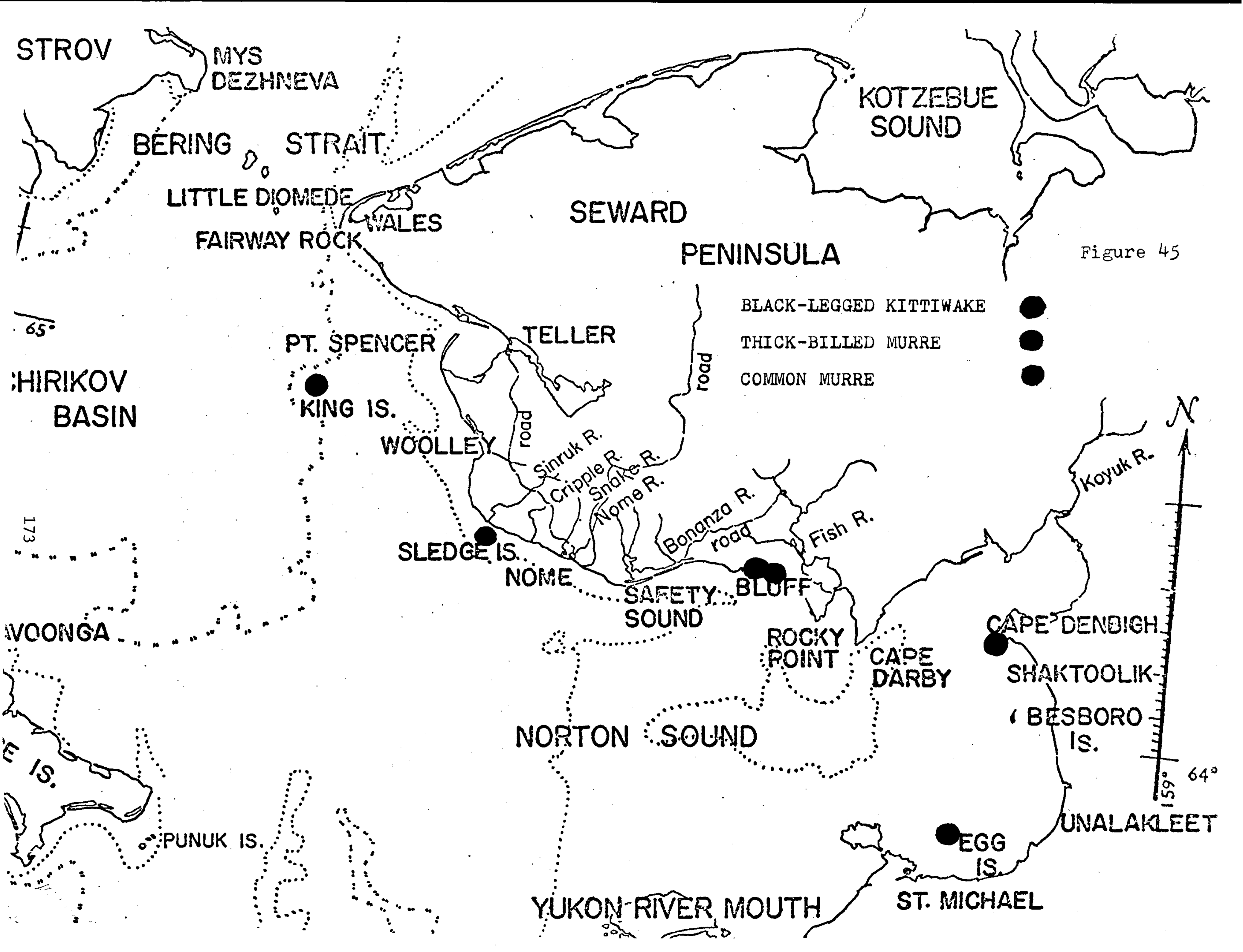

STROV
MYS DEZHNEVA
BERING STRAIT
LITTLE DIOMEDE
FAIRWAY ROCK
WALES
KOTZEBUE SOUND
SEWARD PENINSULA
BLACK-LEGGED KITTIWAKE
THICK-BILLED MURRE
COMMON MURRE
65°
PT. SPENCER
TELLER
road
HIRIKOV BASIN
KING IS.
WOOLLEY
road
Sinruk R.
Cripple R.
Snake R.
Nome R.
Bonanza R.
road
Fish R.
Koyuk R.
N
SLEDGE IS.
NOME
SAFETY SOUND
BLUFF
VOONGA
ROCKY POINT
CAPE DARBY
CAPE DENBIGH
SHAKTOOLIK
BESBORO IS.
NORTON SOUND
E IS.
159°
64°
UNALAKLEET
PUNUK IS.
EGG IS.
ST. MICHAEL
YUKON RIVER MOUTH

Figure 45

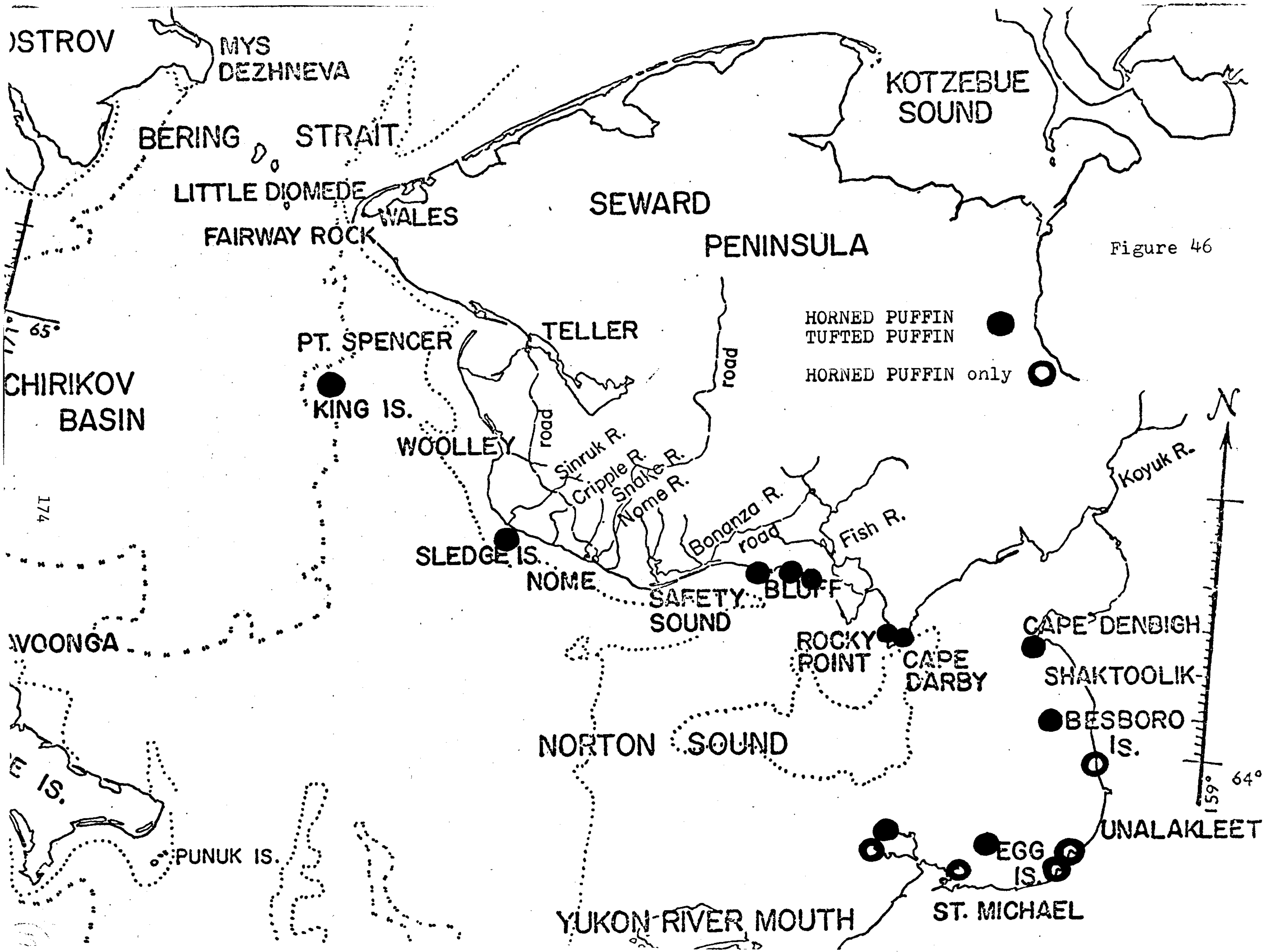

OSTROV
MYS DEZHNEVA
BERING STRAIT
LITTLE DIOMEDE
FAIRWAY ROCK
WALES
SEWARD PENINSULA
KOTZEBUE SOUND
HORNED PUFFIN
TUFTED PUFFIN
HORNED PUFFIN only
TELLER
PT. SPENCER
KING IS.
CHIRIKOV BASIN
WOOLLEY
road
Sinruk R.
Cripple R.
Snake R.
Nome R.
Bonanza R.
Fish R.
Koyuk R.
SLEDGE IS.
NOME
SAFETY SOUND
BLUFF
ROCKY POINT
CAPE DARBY
CAPE DENBIGH
SHAKTOOLIK
BESBORO IS.
NORTON SOUND
UNALAKLEET
EGG IS.
ST. MICHAEL
YUKON RIVER MOUTH
PUNUK IS.
VOONGA
65°
64°
171°
159°
N

Figure 46

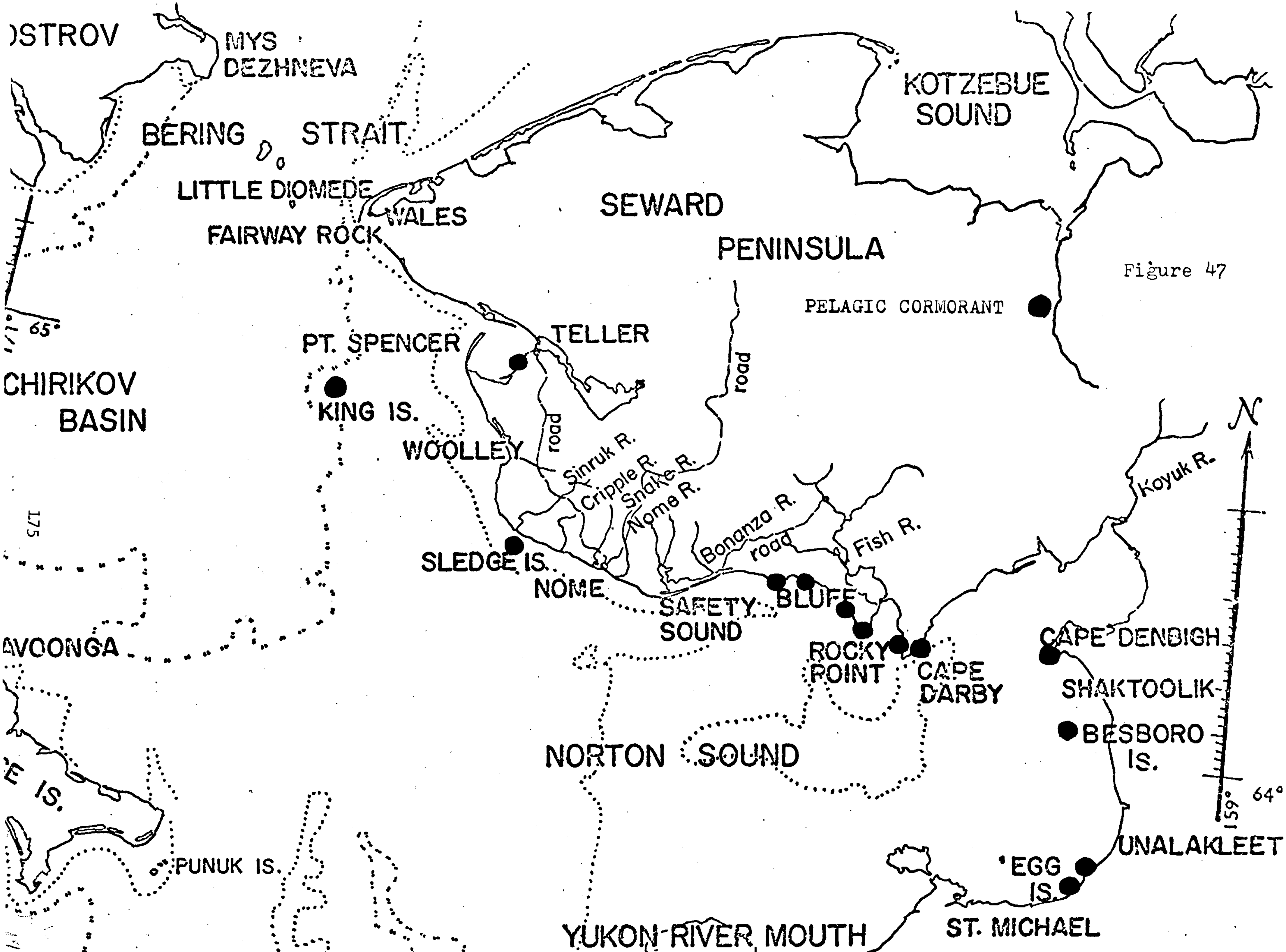
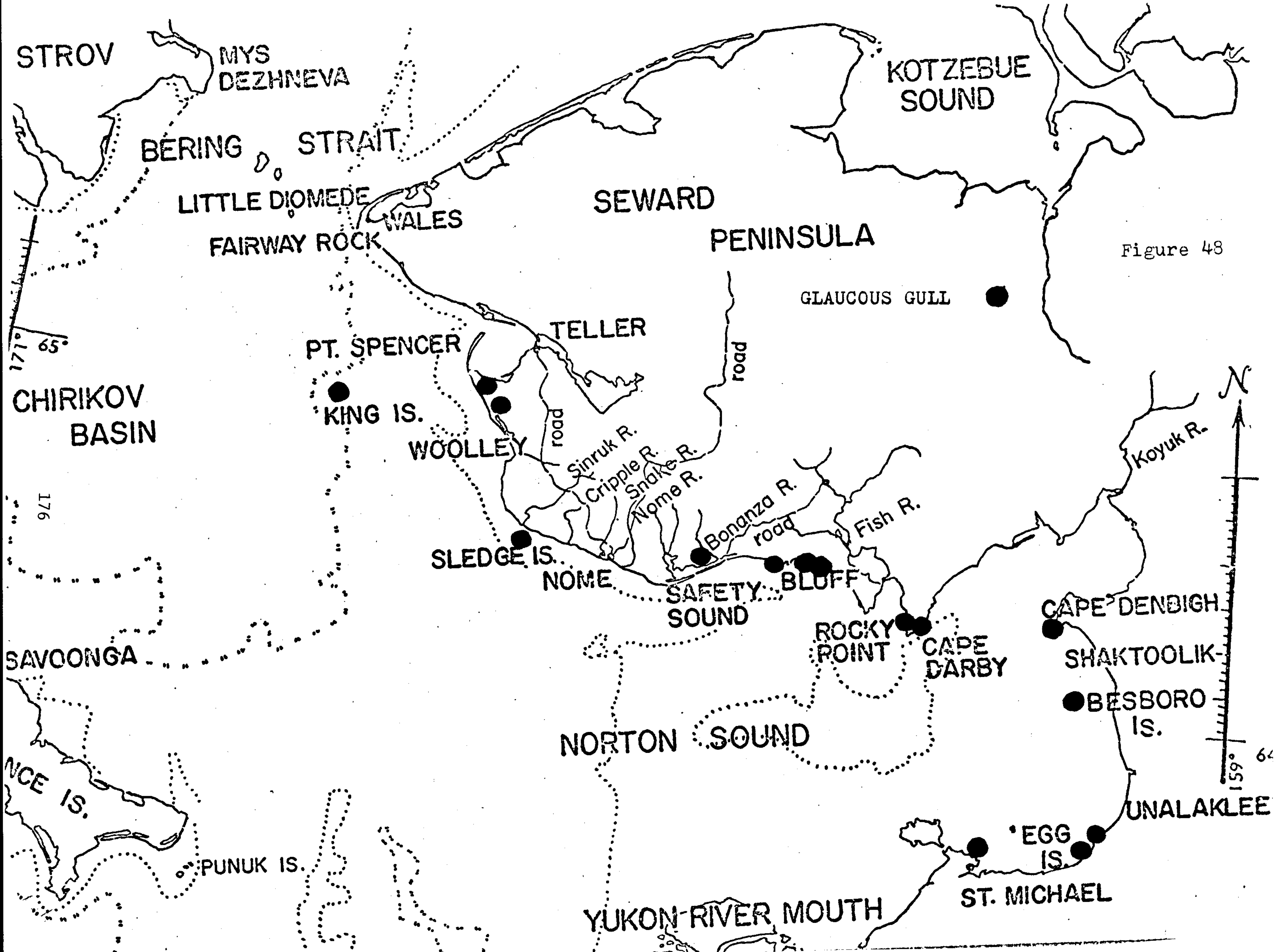
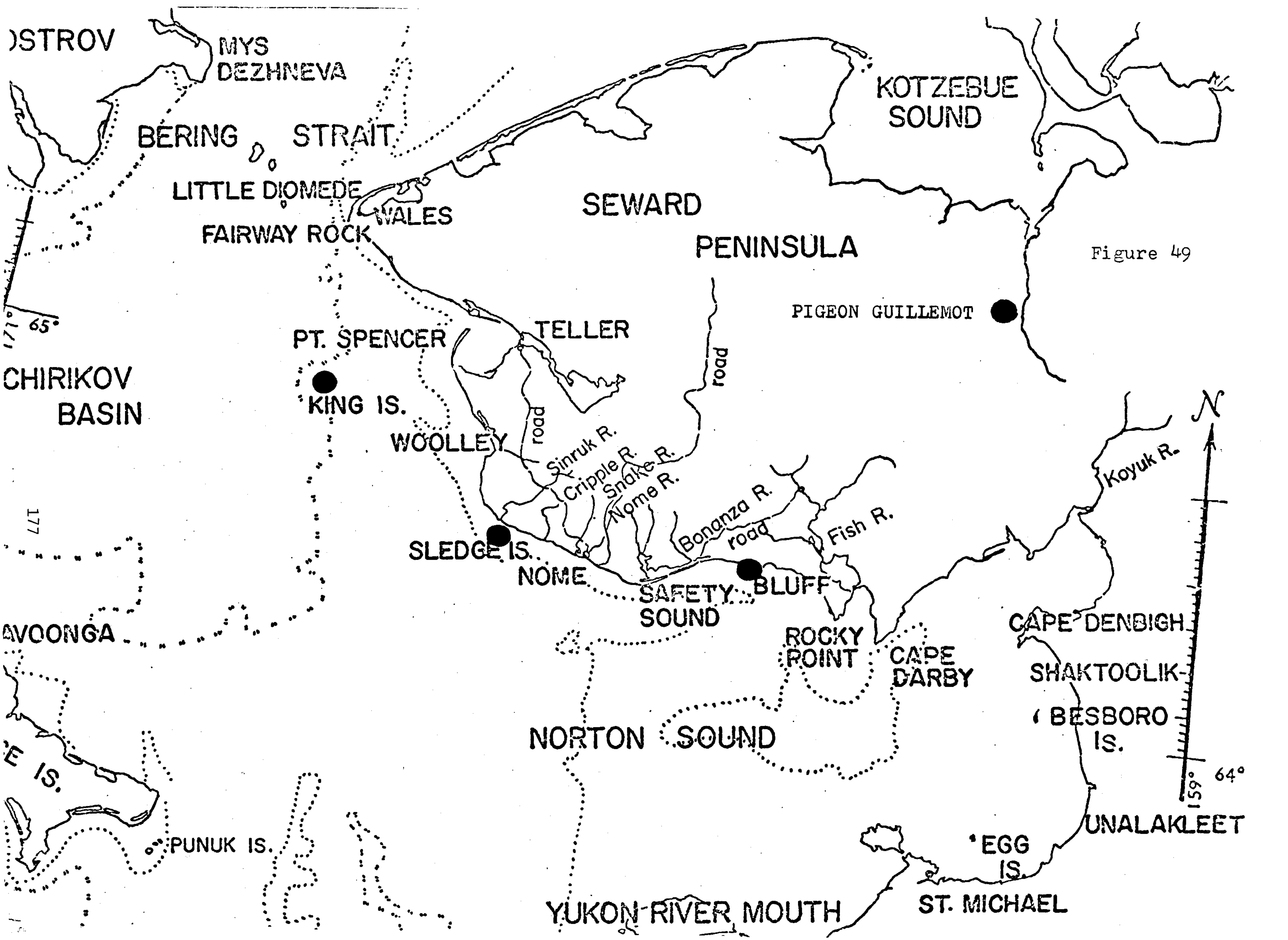

OSTROV
MYS DEZHNEVA
BERING STRAIT
LITTLE DIOMEDE
FAIRWAY ROCK
WALES
SEWARD PENINSULA
KOTZEBUE SOUND
PELAGIC CORMORANT
65°
PT. SPENCER
TELLER
CHIRIKOV BASIN
KING IS.
road
WOOLLEY
Sinruk R.
Cripple R.
Snake R.
Nome R.
Bonanza R.
Fish R.
Koyuk R.
175
SLEDGE IS.
NOME
SAFETY SOUND
BLUFF
ROCKY POINT
CAPE DARBY
CAPE DENBIGH
SHAKTOOLIK
BESBORO IS.
AVOONGA
NORTON SOUND
E IS.
PUNUK IS.
159°
64°
UNALAKLEET
EGG IS.
ST. MICHAEL
YUKON RIVER MOUTH

Figure 47


STROV
MYS DEZHNEVA
BERING STRAIT
LITTLE DIOMEDE
FAIRWAY ROCK
WALES
SEWARD PENINSULA
KOTZEBUE SOUND
GLAUCOUS GULL
TELLER
PT. SPENCER
KING IS.
CHIRIKOV BASIN
WOOLLEY
road
Sinruk R.
Cripple R.
Snake R.
Nome R.
Bonanza R.
Fish R.
Koyuk R.
SLEDGE IS.
NOME
SAFETY SOUND
BLUFF
ROCKY POINT
CAPE DARBY
CAPE DENBIGH
SHAKTOOLIK
BESBORO IS.
NORTON SOUND
SAVOONGA
NCE IS.
PUNUK IS.
UNALAKLEET
EGG IS.
ST. MICHAEL
YUKON RIVER MOUTH
171°
65°
176
159°
64
N
Figure 48



OSTROV
MYS DEZHNEVA
BERING STRAIT
LITTLE DIOMEDE
FAIRWAY ROCK
WALES
SEWARD PENINSULA
KOTZEBUE SOUND
PIGEON GUILLEMOT
TELLER
PT. SPENCER
KING IS.
CHIRIKOV BASIN
WOOLLEY
road
Sinruk R.
Cripple R.
Snake R.
Nome R.
Bonanza R.
Fish R.
Koyuk R.
SLEDGE IS.
NOME
SAFETY SOUND
BLUFF
ROCKY POINT
CAPE DARBY
CAPE DENBIGH
SHAKTOOLIK
BESBORO IS.
AVOONGA
NORTON SOUND
PUNUK IS.
UNALAKLEET
EGG IS.
ST. MICHAEL
YUKON RIVER MOUTH
171°
65°
159°
64°
177
N

Figure 49

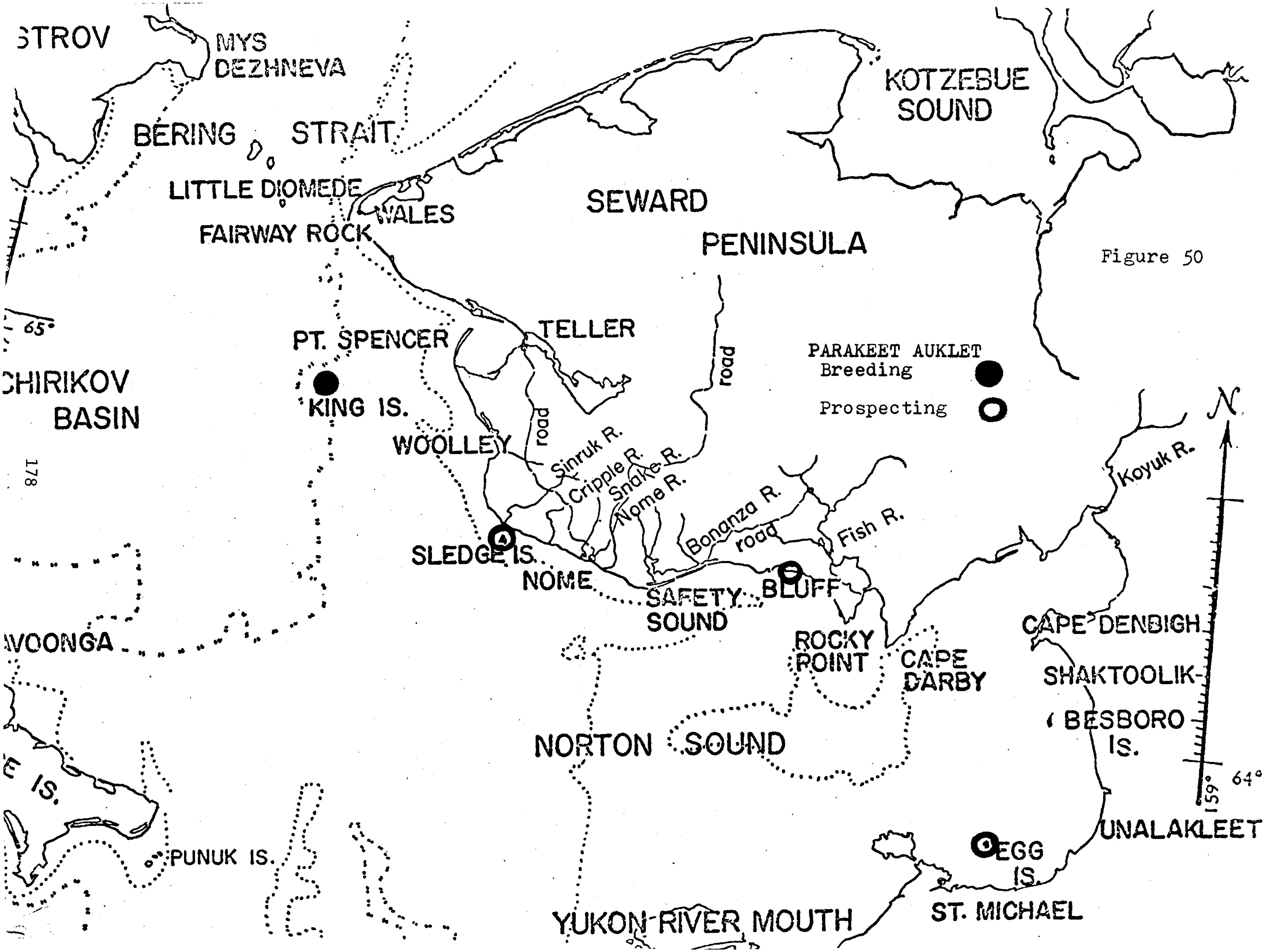

STROV
MYS
DEZHNEVA
BERING
STRAIT
LITTLE DIOMEDE
WALES
FAIRWAY ROCK
KOTZEBUE
SOUND
SEWARD
PENINSULA
TELLER
PT. SPENCER
CHIRIKOV
BASIN
KING IS.
WOOLLEY
road
Sinruk R.
Cripple R.
Snake R.
Nome R.
Bonanza R.
road
Fish R.
SLEDGE IS.
NOME
SAFETY
SOUND
BLUFF
Koyuk R.
PARAKEET AUKLET
Breeding
Prospecting
N
VOONGA
ROCKY
POINT
CAPE
DARBY
CAPE DENBIGH
SHAKTOOLIK
BESBORO
IS.
NORTON SOUND
65°
64°
159°
E IS.
PUNUK IS.
UNALAKLEET
EGG
IS.
ST. MICHAEL
YUKON RIVER MOUTH

Figure 50

OUTER CONTINENTAL SHELF ENVIRONMENTAL ASSESSMENT PROGRAM
(BERING SEA - GULF OF ALASKA)

ANNUAL REPORT

RESEARCH UNIT # 239 (University of Calgary)
CONTRACT # 03-5-022-78
NUMBER OF PAGES # 5 + 1 Table + 6 Maps.

"Ecology and Behavior of Southern Hemisphere Shearwaters (Genus Puffinus) and other Seabirds, when over the Outer Continental Shelf of Bering Sea and Gulf of Alaska during the Northern Summer".

SUBJECT: Submit Data Report. Field work carried out in Gulf of Alaska and Bering Sea during July and August, 1976.

Dr. M.T. Myres
Dept. of Biology
University of Calgary

Juan Guzman
Dept. of Biology
University of Calgary

March, 1977.

I. TASK OBJECTIVES.

The revised objectives of this project, based on field experience and what proved to be practical, have been to obtain and analyze data on:

A.- The latitudinal - longitudinal distribution of the Short-tailed Shearwater (Puffinis tenuirostris) and the Sooty Shearwater (Puffinus griseus) during the Northern summer in two areas, the Northern Gulf of Alaska (NEGOA and NWGOA) and the Bering Sea. In particular the relationships between the distribution of these Shearwaters and a) the distance fron the coast of Alaska, b) whether the birds were most abundant over the Continental Shelf or beyond it, and c) the foods available to them.

B.- The plumage and molt condition of living and / or collected specimens.

C.- The behavioral dynamics of shearwaters at both the individual and flock (social) levels.

II. FIELD ACTIVITIES, JULY AND AUGUST 1976.

A. Ship Schedule: In accordance with the schedules of the NOAA Research Vessels, we decided to make use of DISCOVERER, during the month of July and SURVEYOR during August .

Juan Guzman, boarded DISCOVERER in Seattle on July 15, 1976, made a transit across the Gulf of Alaska and disembarked in Kodiak on July 31. He transfered there immediately to SURVEYOR and stayed aboard until August 20, 1976, the date of her return to Kodiak from the Bering Sea.

B. Scientific Party: The active participant in the field activities for this Research Unit was Juan Guzmân, Graduate Student of the University of Calgary.

C. Methods: On DISCOVERER, Normal Transects of 10 minutes period were carried out from the flying bridge (atop the Wheelhouse), from which a virtually unobstructed view was obtained. The Stations Observations were made from the flying bridge and main deck, as described in previous reports.

When shearwaters were seen beyond the range of Normal Transects, E-Transects were taken instead. In E-Transects the duration of recording as well as the distance were variable, and also could include one or both sides of the ship.

On SURVEYOR, Normal Transects and Stations were carried out during this cruise. When shearwaters were seen at other times, E-Transects were taken as described above, including observations from the helicopter.

D. Sample Localities:

1.DISCOVERER Cruise: During this cruise the ship covered one transit from Seattle to Kodiak and one leg in Northeastern Gulf of Alaska (NEGOA).

2. SURVEYOR Cruise: During this cruise the ship covered one transit from Kodiak to Nome, one leg in Norton Sound and one transit from Nome to Kodiak.

E. Data Collected: All the field data were collected on the same 1975-type U.S. Fish & Wildlife Service forms provided to us previously. The data collected have been plotted on the maps attached to this report.

With the assistance of ship's personnel and other biologists on board one Sooty Shearwater (*Puffinus griseus*) was collected from a whaleboat nearby Long Island (Kodiak) on August 20, 1976.

Gaps between observation records on the maps represent periods when no observations were made because of darkness, fog or other activities.

III. RESULTS.

A total number of 263 observations were recorded during July and August, 1976. Of this number, 221 are Normal Transects, 26 E-Transects and 16 are Stations Records. A list of the species observed is provided in Table 1.

The distribution of Sooty Shearwaters (*P. griseus*) and Short-tailed Shearwaters (*P. tenuirostris*), is shown in Maps 4 -6. Data collected in May and June, 1976, not previously submitted as maps, appears in Maps 1 - 3.

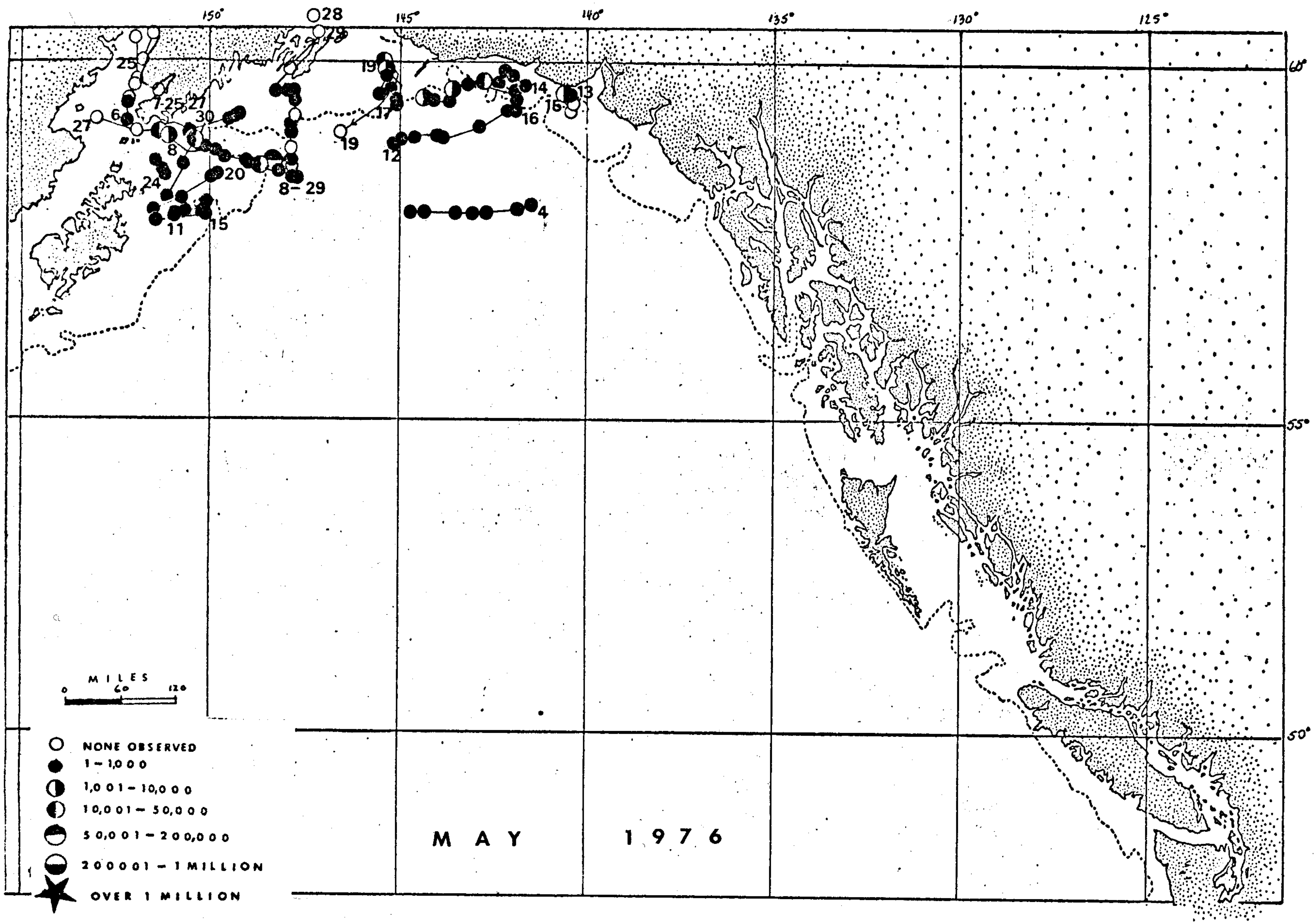
IV. PRELIMINARY INTERPRETATION OF RESULTS.

A simple analyses of the data collected in July and August, shows that in the pelagic zone the shearwaters are predominant (92.23% of all birds seen). This is because in July and August most North Pacific seabirds are still breeding, so they are attached to colonies or breeding areas. If any species of breeding seabirds goes at all far offshore to feed, it is evidently widely scattered over the ocean and is much less conspicuous than the very abundant shearwaters. We did not find any feeding concentrations.

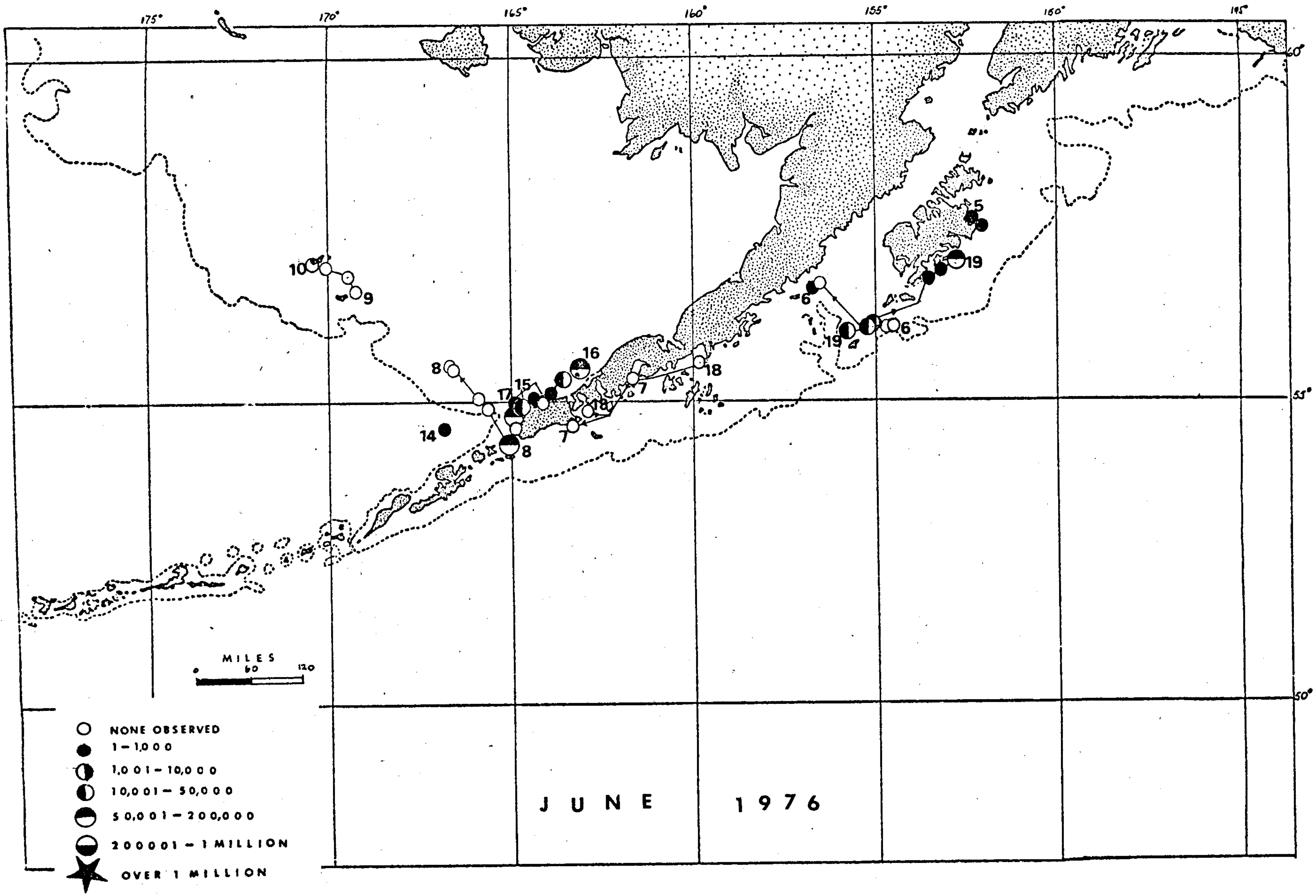
The distributional maps show that the shearwaters are mostly concentrated over the Continental Shelf or in waters close to the edge of it. Also there was a substancial change in both the distribution and numbers of shearwaters in the NEGOA between May and July. A definite explanation for this reduction is not known, but we believe that in May shearwaters were still moving through this region during their spring migration. It is very likely that during the spring migration Sooty Shearwaters move close to the North American Coastline. This coastal movement is to be expected because the Continental Shelf off Southeast Alaska is narrow, so that feeding is probably only possible if the migration there is close to shore. Crossings over the open ocean, would have to be made quickly and under favorable weather conditions.

TABLE 1.- LIST OF SPECIES SEEN DURING JULY AND AUGUST, 1976. INCLUDES OBSERVATIONS IN GULF OF ALASKA AND BERING SEA
TOTAL NUMBER OF RECORDS (INCLUDING ALL TRANSECTS AND STATIONS)= 263
TOTAL NUMBER OF BIRDS SEEN = 51,277

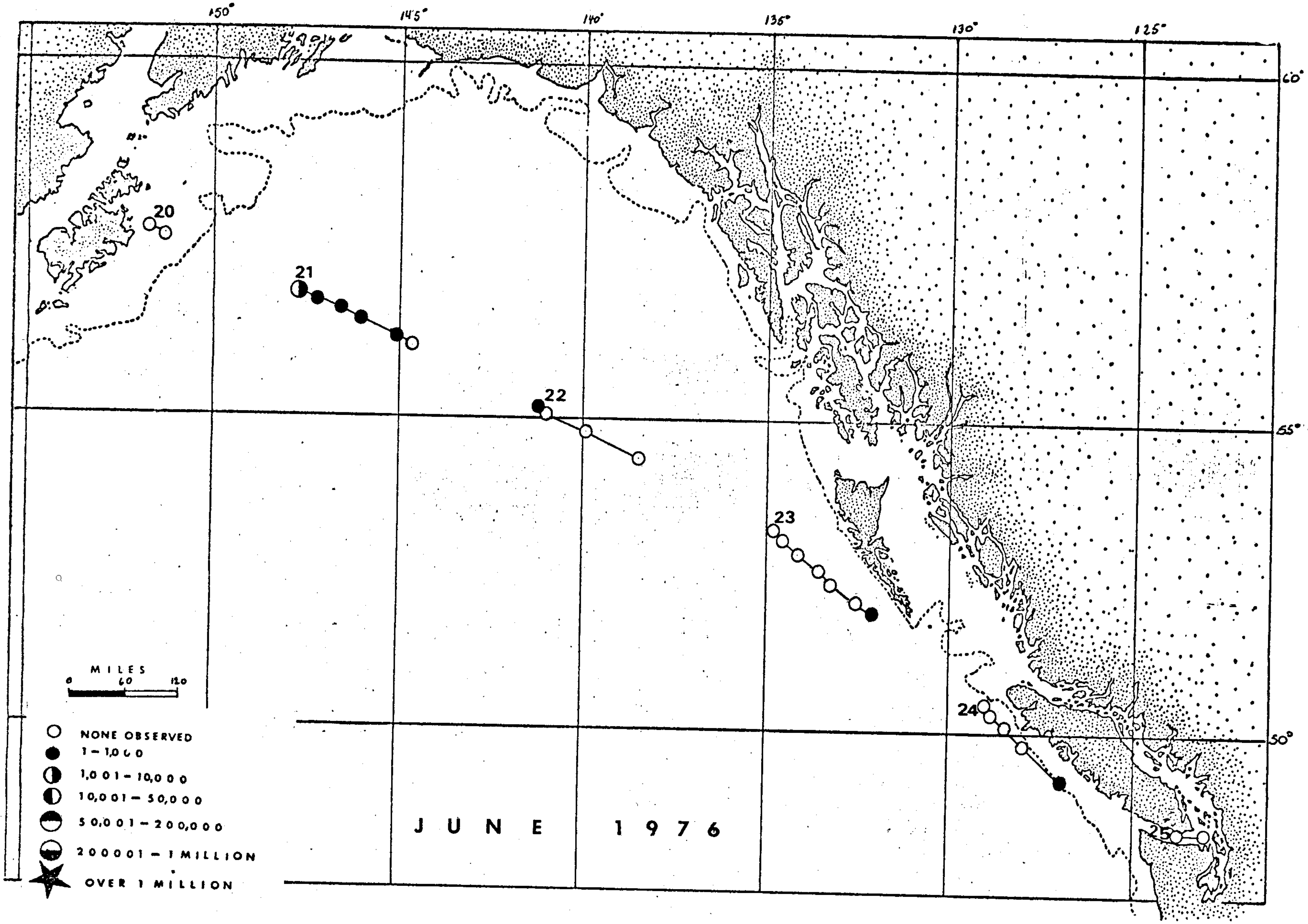
Species Observed	Computer Codes	No. of Records n=263	Maximun No. of Birds seen in a Single Record	Total No. of Birds Recorded (by Species).	% of the total of all species.
Arctic Loon	8801010103	1	2	2	0.004
Laysan Albatross	8803010103	1	1	1	0.002
Black-footed Albatross	8803010102	19	33	98	0.191
Northern Fulmar	8803020201	91	329	1,297	2.529
Short-tailed Shearwater	8803020408	46	2,520	6,620	12.910 }
Sooty Shearwater	8803020407	36	4,000	4,482	8.741 } 92.23%
Shearwater(Sh.-tailed &/or Sooty)		63	16,850	36,190	70.578 }
New Zealand Shearwater	8803020406	1	1	1	0.002
Manx Shearwater	8803020409	1	1	1	0.002
Fork-tailed Petrel	8803030201	93	189	732	1.428
Leach's Petrel	8803030202	74	39	290	0.566
Scaled Petrel	8803020503	8	17	31	0.061
Pelagic Cormorant	8804040105	1	1	1	0.002
Cormorant sp.	88040401	1	1	1	0.002
Oldsquaw	8806011301	1	8	8	0.016
White-winged Scoter	8806011802	1	1	1	0.002
Black Turnstone	8810040102	2	1	2	0.004
Northern Phalarope	8810060301	7	23	34	0.066
Phalarope sp.	88100603	1	4	4	0.008
Shorebird sp.		3	3	5	0.010
Parasitic Jaeger	8810070102	3	2	4	0.008
Pomarine Jaeger	8810070101	12	3	17	0.033
Long-tailed Jaeger	8810070103	6	6	14	0.027
Jaeger sp.	88100701	4	1	4	0.008
Skua	8810070201	1	1	1	0.002
Glaucous Gull	8810080101	4	1	4	0.008
Glaucous-winged Gull	8810080103	17	147	238	0.464
Herring Gull	8810080108	2	1	2	0.004
Gull sp.	88100801	2	1	2	0.004
Black-legged Kittiwake	8810080301	55	50	127	0.248
Kittiwake	88100803	1	17	17	0.033
Arctic Tern	8810080704	7	4	13	0.025
Tern sp.	88100807	2	2	3	0.006
Common Murre	8810100301	27	44	130	0.254
Thick-billed Murre	8810100302	2	1	2	0.004
Murre sp.	88101003	43	1,561	731	2.963
Horned Puffin	8810101302	15	41	147	0.287
Tufted Puffin	8810101401	86	91	565	1.102
Least Auklet	8810101102	1	2	2	0.004
Marbled Murrelet	8810100601	2	1	2	0.004
Kittlitz's Murrelet	8810100602	1	2	2	0.004
Ancient Murrelet	8810100801	1	2	2	0.004
Parakeet Auklet	8810101001	3	3	7	0.014
Rhinoceros Auklet	8810101201	1	1	1	0.002
Small Alcids sp.	881010	6	5	12	0.023
TOTAL				52,680	



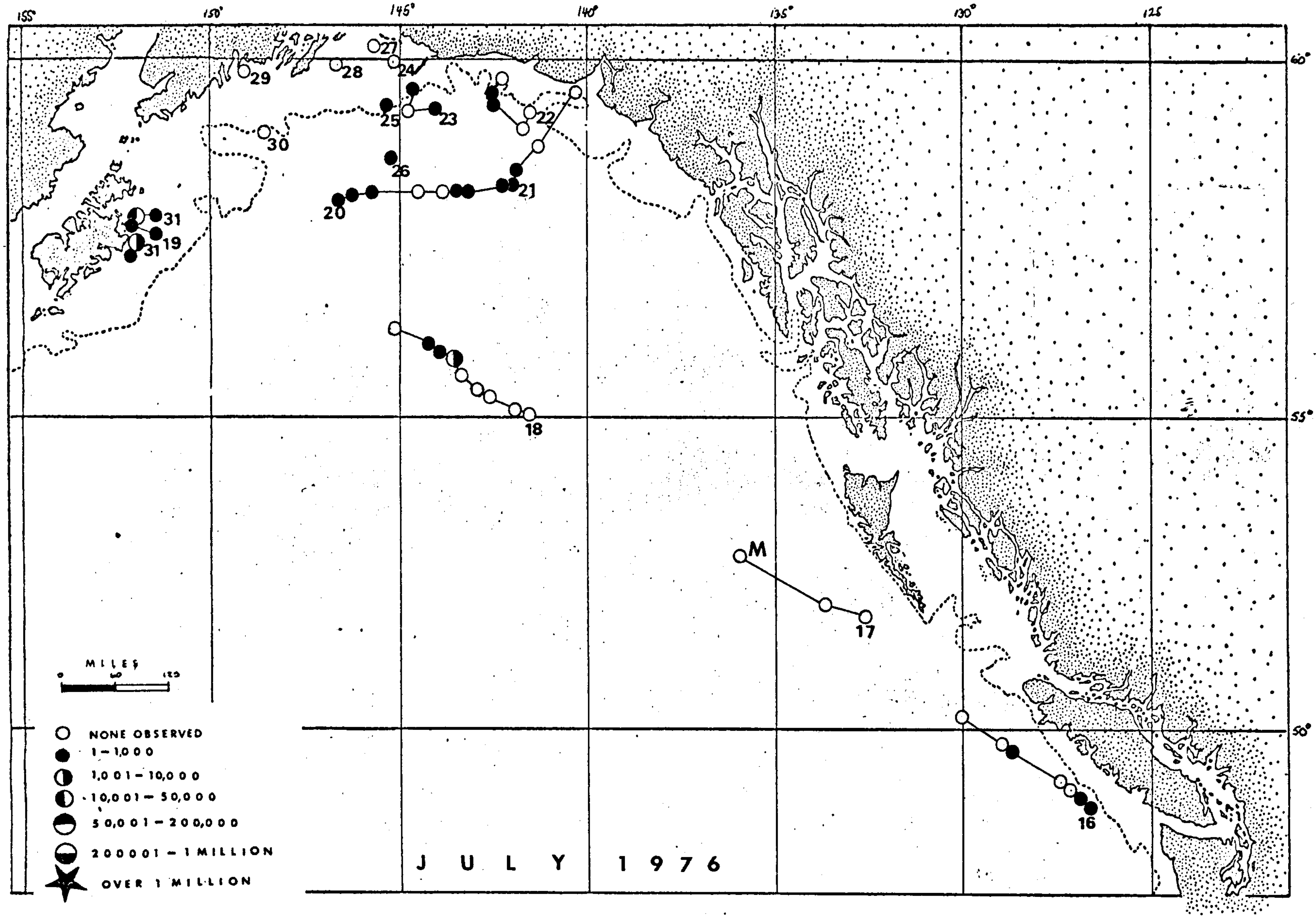
Map 1. Distribution of shearwaters during the month of May, 1976.



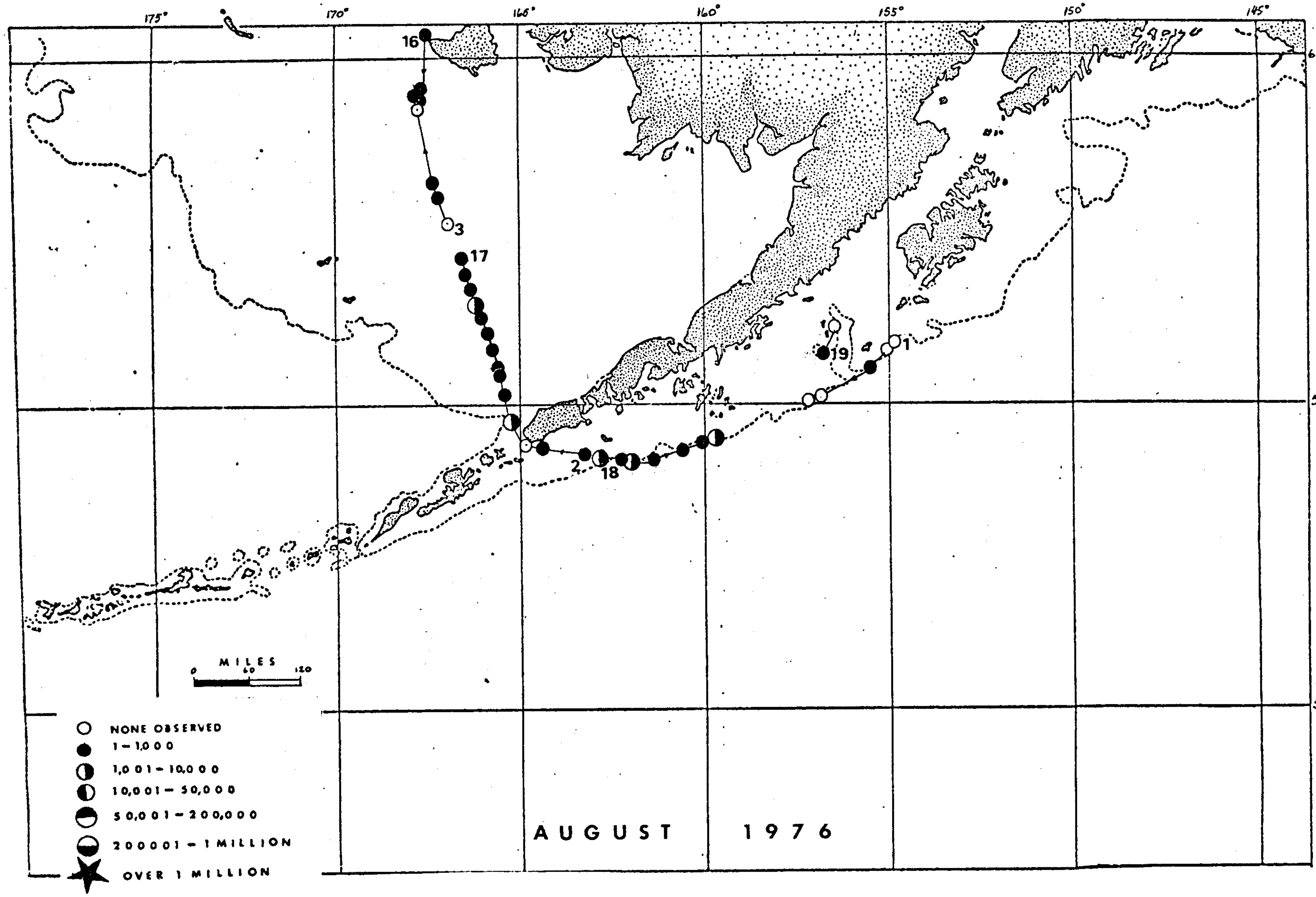
Map 2. Distribution of shearwaters during the month of June, 1976



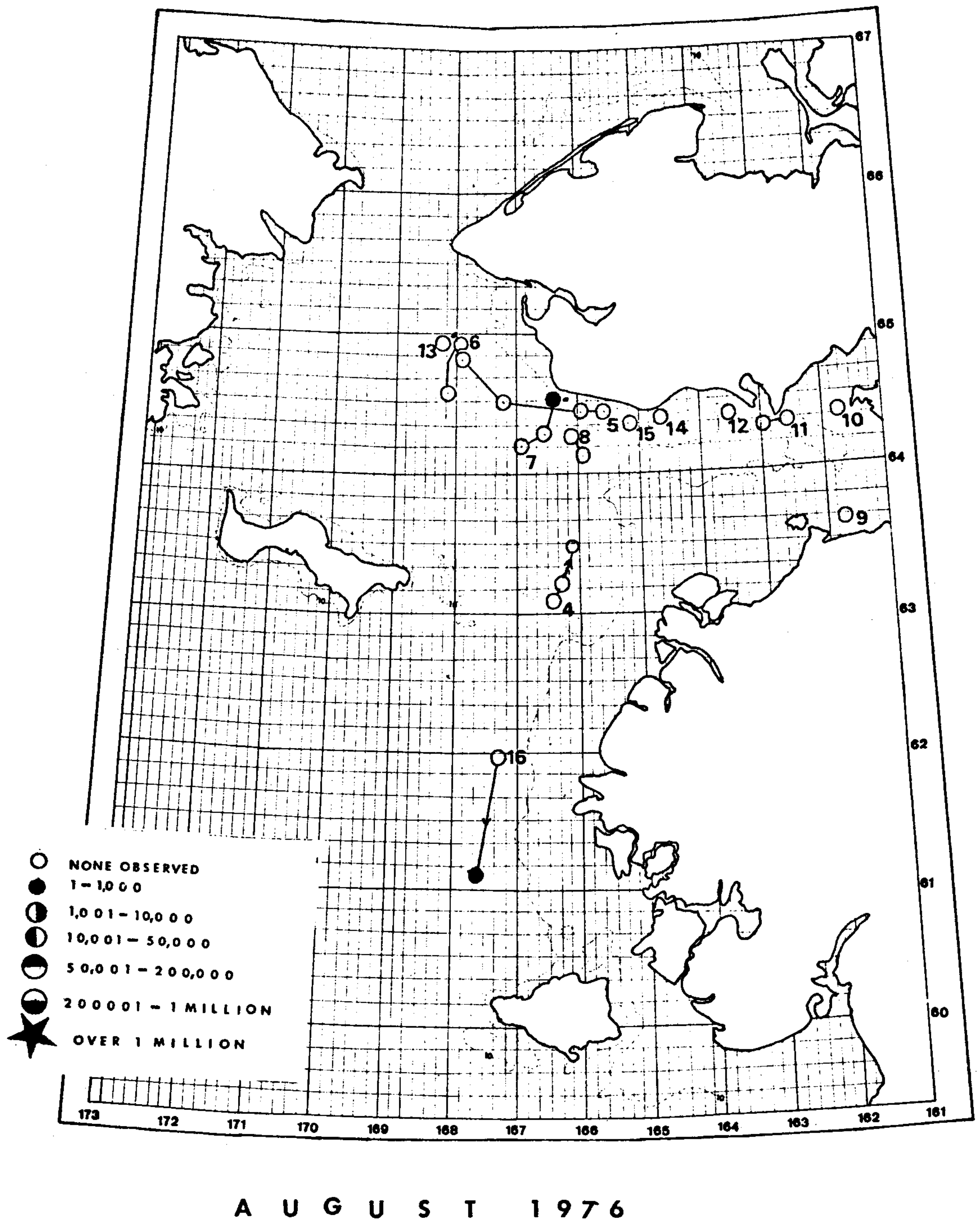
Map 3. Distribution of shearwaters during the month of June, 1976. Transit from Kodiak to Seattle.



Map 4. Distribution of shearwaters during the month of July, 1976. Transit from Seattle to Kodiak and leg in NEGOA.



Map 5. Distribution of shearwaters during the month of August, 1976. Transit from Kodiak to Nome and transit from Nome to Kodiak.



Map 6. Distribution of shearwaters during the month of August, 1976. Transit from Kodiak to Nome, leg in Norton Sound and transit from Nome to Kodiak.

ANNUAL REPORT

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Research Unit: RU-337
Reporting Period: April 1, 1976 to
March 31, 1977
Number of Pages: i-v & 1-88

SHIPBOARD SURVEYS OF MARINE BIRDS

By

Patrick J. Gould

Part I

Of

SEASONAL DISTRIBUTION AND ABUNDANCE OF MARINE BIRDS

James C. Bartonek
Patrick J. Gould
Craig S. Harrison
Gerald A. Sanger
Co-principal Investigators

U. S. Fish and Wildlife Service
Office of Biological Services - Coastal Ecosystems
800 A Street - Suite 110
Anchorage, Alaska 99501

April 1, 1977

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INTRODUCTION

This report summarizes shipboard observations of marine birds obtained during 1976-77 by U.S. Fish and Wildlife Service personnel, contractees, and collaboraters under Research Unit 337 of Contract 01-5-022-2538. Observations of marine birds from aircraft are summarized in the companion report entitled "Seasonal Distribution and Abundance of Marine Birds: Part II. Aerial Surveys." A detailed analysis of bird distribution will be deferred until the final report.

The objective of this research unit is to describe the seasonal density of marine birds in those portions of the Gulf of Alaska, the Bering Sea, the Chukchi Sea, and the Beaufort Sea that have been identified by the U.S. Department of the Interior for leasing and development of their oil and gas potentials. This research unit considers only the offshore environment and does not include species generally confined to the nearshore and littoral habitats. It does not directly consider the distribution of pelagic species when they occupy shoreline habitats such as during the breeding season. The onshore distribution of pelagic birds is summarized in a report on Research Unit No. 343.

Understanding the varied and complex patterns of distribution and abundance for each of the nearly hundred species of birds that frequent the waters over the Alaskan outer continental shelf is prerequisite to identifying their critical habitats and periods of vulnerability and to providing clues as to their oftentimes less than obvious relationships with the marine environment. This kind of information is but a part of that required by natural resource management agencies in order to eliminate, minimize, or mitigate adverse impacts upon birds resulting from oil and gas development and all of its ancillary activities.

CURRENT STATE OF KNOWLEDGE

Published assessments of seasonal densities of birds in the marine waters off the Alaskan coast are both scanty and patchy in coverage. Shuntov (1961, 1962, 1963, 1966, 1968, 1972), with his studies of birds in the northern North Pacific Ocean and the Bering Sea, presents the most comprehensive and generalized pictures of bird distribution and abundance in the ice-free waters concerned with outer continental shelf development. Sanger (1972), using original data and that of Shuntov, estimates the numbers and biomass of birds in various oceanographic domains within the northern North Pacific Ocean and the Bering Sea during the summer and winter. Isleib and Kessel (1973), qualitatively and quantitatively characterized the avifauna of the northern Gulf of Alaska and Prince William Sound regions, emphasizing the onshore and nearshore areas. Arnold (1948) quantitatively described the birds seen while transiting between Kodiak, Unalaska, and Attu Islands during the summer. Kuroda (1955, 1960) reported bird densities and oceanographic relationships in the vicinity of the Kurile Islands and the western Aleutian Islands. Laing (1925) and Jaques (1930) provided annotated remarks of birds seen while in the Bering Sea. Bartonek and Gibson (1972) described bird distribution and abundance in Bristol Bay during a summer. Irving _et al_. (1970) reported the wintering birds seen along a short track of an ice-breaker in the Bering Sea ice. Swartz (1967) and Watson and Divoky (1972) provided data on bird distribution during mid- to late summer in the Chukchi Sea. Frame (1973) and Watson and Divoky (1975) describe the birds in the ice of the western Beaufort Sea during late summer.

Some unpublished reports and unanalyzed data exist for birds in these marine waters, but they are obviously not readily obtainable to all potential users. Those data which lend themselves to incorporation into our data system will be reported in subsequent reports upon receiving permission of the investigators. Considerable information on bird densities in Prince William Sound during four seasons of the year was obtained by U.S. Fish and Wildlife Service personnel from 1973 through 1975; but the death of Larry Haddock, principal investigator, while making an aerial survey of marine birds has delayed the interpretation and analysis of those data. King and McKnight (1969) and Montgomery (1972) report bird densities in Bristol Bay during a fall and spring, respectively. Unanalyzed data on birds observed in the Bering Sea are irregularly published with the oceanographic and fisheries records of the RV Osharo Maru (Hokkaido University, 1957). King *et al*. (1974) provided quantitative assessments of the birds in the eastern Bering Sea in winter. Trapp (1975) reports bird densities in summer throughout the Aleutian Chain. Divoky (1972) described the birds of late summer in the Chukchi Sea. Bartels (1971), 1973) described the bird populations seen from shipboard and aerial surveys during summer in the Beaufort Sea.

By and large all of the published and unpublished information on the seasonal densities of birds at sea have been acquired from platforms of opportunity. Since bird observers have almost "traditionally" been aboard vessels on a noninterference basis, the observations have usually been collected on an "opportunistic" sampling scheme during daylight hours. Few observers were able to repeat a survey along the same cruise track at a later date, and even fewer observers could designate the track to be taken. In general, the reports present fragmentary information on bird distribution and densities from which generalizations for even some of the more abundant and widely occurring species would be improper.

Files of the U.S. Fish and Wildlife Service, Office of Biological Services-Coastal Ecosystems, contain extensive data and reports on marine birds in Alaskan waters. These data and reports have been collected and written under Research Unit 337, and have been summarized in annual reports by Lensink and Bartonek (1975, 1976).

STUDY AREA

Observations of birds at sea were conducted in the North Pacific and Arctic Oceans from Seattle, Washington, Honolulu, Hawaii, and Hokkaido, Japan, to and including the southern Chikchi Sea. Most observations, however, were made in the Gulf of Alaska and in the southern and eastern Bering Sea. Observations made outside of Alaskan waters, however, are not included in this report.

Data are summarized by month for each of 25 regions (Figure 1). These regions have been subjectively delineated and represent, in part, regions encompassing sedimentary basins that were identified by the U.S. Department of the Interior, as having potential for oil and gas development, political boundaries, and regions having similiar oceanographic qualities. Data, however, can be retreived for analysis using regions and time periods other than those that we selected.

METHODS

There are many types and variations of data gathering techniques which can be used on ship cruises. In order to standardize our procedures as much as possible, we have established five major experimental designs including: Transect Censuses, Ship Follower Surveys, Station Surveys, General Observations, and Collecting.

Transects taken at intervals along predetermined or opportunistic cruise tracks, are our most important and profitable technique. Transect boundaries define a rectangle with a width of 300 meters and a length of 10 minutes cruising time (= 3087 m at a speed of 10 knots). The average area encompassed by a transect during these investigations was 1.17 km2. The basic method is for the ship to steam in a straight path at a constant speed while the observer counts all birds observed forward of his observing position and to 300 meters laterally on one side of his position.

In theory, we would like to get an "instantaneous" count of birds within the transect boundaries. This is difficult from a shipboard platform. Flying birds present a particular problem in this respect. If the observer counted all the individuals of a large flock flying across the transect area, the eventual estimate of bird density would be greatly exaggerated. We use several techniques to reduce this sort of bias:

1. Periodic instantaneous estimates are made of flying birds within discrete portions of the transect area and the average is used to calculate birds per km^2.

2. In the case of birds streaming perpendicularly across the bow of the ship, the number of birds crossing per minute within a specific distance (e.g., 1000 m for shearwaters, 500 m for storm petrels) are counted. Three to five of these counts are made during the course of one 10-minute transect. The average time it takes for one bird to cross the 300 m zone is also measured. With these two pieces of data the number of birds per km^2 is calculated.

The timing and number of transects on each day of a cruise depends on the ships' and observers' routine. We try to have at least one transect completed in as many 10-minute latitude-longitude blocks as possible. Counting distances are determined by use of a range finder developed by Dennis Heinemann and Wayne Hoffman of Oregon State University under Research Unit No. 108. Ship following birds are not included in density estimates but their presence is always noted. If a bird originates within a transect area and subsequently becomes a ship follower, then it is counted in the transect where it was first observed. Ship followers may also be treated by a separate experimental design.

A ship follower survey is sometimes used to obtain an index of ship follower abundance. Several complete circuits of the ship are made noting behavior patters of birds around the ship. After five minutes the maximum number of individuals observed at any one time is recorded.

Station surveys are used whenever the ship is staionary or drifting. The survey area consists of three concentric zones with the ship at the center. Each zone is 200 m wide. All birds are counted within each zone by making as rapid a circular sweep of the entire area as is consistent with detecting and counting birds. Only one sweep is made per survey. If a bird moves from one zone to another it is recorded only as having occurred in the first zone in which it was seen.

General observations are made whenever time and circumstances permit, and whenever transects and station surveys are not possible. These include all miscellaneous observations made throughout a cruise and all small boat surveys.

Collecting is done whenever possible to verify species identification and to aid in studies on the trophic relationships of birds at sea.

Vessels used for these surveys include: NOAA research vessels (Discoverer, Surveyor, Miller Freeman, Moana Wave), the Lindblad Explorer, and a vessel (Nordic Prince) chartered by the U.S. Fish and Wildlife Service. Since only the charter vessel had completely dedicated shiptime for these bird surveys, our observers were usually aboard on a "noninterference" basis and the regions surveyed and timing of surveys were mostly dictated by other projects.

This report summarizes transect data from 44 pelagic surveys made from February 15, 1976, through February 20, 1977 (Table 1). Data obtained from station surveys and other techniques are deferred until the final report. An effort was made in the 1976-77 pelagic surveys to fill monthly and regional data gaps in the 1975 investigations, and to obtain complimentary data in important regions such as the Gulf of Alaska and Bering Sea areas. Table 2 compares the level of effort and overall sea bird densities of the two investigation periods.

Miscellaneous marine mammal observations have been collected by U.S. Fish and Wildlife Service personnel under RU 337. These data have and will continue to be sent to the National Marine Fisheries Service, Northwest and Alaska Fisheries Center, Seattle, in the form of computer generalized lists of sightings, for inclusion in their various marine mammals projects. These data will not be addressed in this report.

RESULTS/DISCUSSION

A total of 3,316 transects were completed during the 1976-77 season. Seabird densities per transect ranged from 0-22,990 birds km^2 with an overall average of 63 birds/km2. Considerable variations occurred between some regions and some months (Tables 3-27, Figures 2-12). These variations are partly the result of the "opportunistic" nature of the surveys, but most reflect actual differences resulting from migratory pathways, differences in the number and size of breeding colonies within the area, and many diverse environmental parameters such as depth, surface water conditions, weather, and time of the day. The effects of these variables on pelagic seabird densities will be analyzed in the April, 1978, Annual Report.

Figure 13 compares monthly mean seabird densities in five broad offshore Alaskan areas. Data are most complete for the Gulf of Alaska where the seasonal trend of low winter, high migration, and moderate summer densities are fairly typical of northern bird populations. There are, however, several unexpected features that cannot be explained at present. These include uniformly very low August densities in all areas surveyed, lack of a spring migration peak in the Bering Sea, and relatively low fall migration density in the Gulf of Alaska.

Tables 28-52 summarize the occurrence and relative density of 79 species recorded during shipboard surveys in the 1976-77 season. Species richness was greatest in the Northeast Gulf of Alaska, Northwest Gulf of Alaska, Kodiak Basin, and Saint George Basin areas with 42-45 species recorded in each. Ten species or species pairs had regional densities greater than 10 birds/km^2 including in descending order: Sooty/Short-tailed Shearwater, Common/Thick-billed Murre, Northern Fulmar, Tufted Puffin, Least Auklet, Fork-tailed Storm Petrel, Black-legged/Red-legged Kittiwake, Pigeon Guillemot, Parakeet Auklet, and Crested Auklet. With the exception of Sooty and Short-tailed Shearwaters, all of the above species breed in Alaskan areas. The Shearwaters breed in subantarctic areas and spend their non-breeding season (April-November) in Arctic and subarctic areas.

CONCLUSIONS

Alaskan waters support a rich and extremely dense pelagic avifauna. Using density and species richness as the major criteria, the following broad conclusions are available from the 1976-77 data:

1. The continental shelf and shelfbreak areas of the Kodiak Basin, Saint George Basin, and Alaska Peninsula south are the most important Alaskan waters for seabirds.

2. May through September is the most important time of year for seabirds in Alaskan waters.

3. Sooty/Short-tailed Shearwaters, Common/Thick-billed Murres, Northern Fulmars, Tufted Puffins, Least Auklets, Fork-tailed Storm Petrels, Black-legged Kittiwakes, Parakeet Auklets, and Crested Auklets are, in decending order, the most important species in Alaskan waters.

Density and species richness are but two of the criteria often used to assess the importance of habitats and species. Other criteria would include location and number of breeding colonies, food supply, variations in weather and water conditions, etc. It should also be realized that the above conclusions apply only on a broad regional basis and that local conditions will often be quite variable.

These conclusions are based strictly on seabirds in offshore waters. Final decision on the importance of any area or species will depend on an integration of these data with colony studies, sea watch surveys, food web studies, coastline studies, etc.

NEEDS FOR FURTHER STUDY

Data gaps have been identified in Table 2, and can be further interpreted from Tables 28-52. The most critical of these gaps is the lack of August and September observations from the Gulf of Alaska, in particular the northwest and northeast regions. August and September are important migration periods and data from this time period is absolutely vital in understanding the population dynamics of seabirds in the area. Data gaps also occur, but to a lesser extent in April-May for the Bering Sea and winter for all regions.

Another type of data gap exists which, although not included in RU 337, is important in understanding the distribution and abundance of Alaskan seabirds, This is our lack of knowledge on the dispersal patterns of seabirds into areas outside subarctic waters. We particularly need to know how important oceanic waters of the North-Central Pacific are to wintering and migrant Alaskan seabirds.

SUMMARY OF FOURTH QUARTER OPERATIONS

Shipboard activities for the fourth quarter operations are summarized in Tables 1, 15, 20, 24-27. A large percentage of our fourth quarter efforts have been dedicated to the coding and computerization of existing raw data and to the verification of keypunched data. We have also spent considerable time in summarizing and presenting data at the Northeast Gulf of Alaska and Kodiak Basin synthesis meetings.

A number of problems have been encountered, most of which center around logistics and priorities. We are, for the most part, dependent upon "ships of opportunity" so that if no ship is going into a particular area at a particular time, then data gaps are created. Although we have received some dedicated ship time, bird studies have consistently been given bottom priority and have been the first to suffer from delays and schedule changes. On some ships, and under some chief scientists, this "low man on the totem pole" position has been reflected in the attitudes of ships' personnel and non-biological scientists, and has affected, to varying degrees, the quality and quantity of our work. It is, for example, very difficult for our personnel to function at peak levels when they are left out of strategy meetings or when an announcement is made over the ships' loud speaker for "all scientists AND bird watchers" to report to the bridge.

The problem of no ships being available in a certain area at a particular period is understandable, and data gaps thus created will be filled when such areas are visited in the proper future season. It should be understood, however, that this problem increases the time and expense of our operations. The priority problem is, of course, an administrative one and priorities will and should be established by decision-makers. Shipboard routines and attitudes, on the other hand, can be improved by supervisors informing ships officers and chief scientists that bird studies are important and ornithologists are part of the scientific community.

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TABLE 1. O.B.S. Shipboard Field Operations in 1976-1977.

OPERATION NUMBER	DATES	OBSERVERS	OBS REGIONS*	NUMBER OF TRANSECTS	KM^2 SURVEYED	NUMBER OF STATIONS
FW6-002	15 Feb. to 20 Feb.	M. Phillips, G. Sanger, M. Kirchhoff, D. Hardy	NEGOA, BCS, NWGOA, SEAS	72	193.9	0
FW6-004	23 Feb. to 04 Mar.	M. Kirchhoff	NEGOA, PWS, NWGOA	53	71.2	60
FW6-005	23 Feb. to 27 Feb.	D. Frazer, D. Hardy	BCS, OBS, OGOA, KB	119	162.4	0
FW6-007	01 Mar. to 11 Mar.	D. Frazer	NEGOA, KB, NWGOA	110	115.9	118
FW6-008	09 Mar. to 12 Mar.	C. Handel	BCS, OBC, OGOA	47	77.7	0
FW6-009	08 Mar. to 25 Mar.	M. Phillips	KB, APS, BB, SGB	81	117.3	35
FW6-010	17 Mar. to 21 Mar.	G. Sanger, S. Bates, C. Handel, M. Rauzon, T. Schad	BCS, SEAS, NEGOA, KB	149	181.4	0
FW6-011	16 Mar. to 29 Mar.	M. Kirchhoff	NWGOA, PWS, NEGOA	85	128.5	44
FW6-012	24 Mar. to 21 Apr.	M. Rauzon	NWGOA, KB, BB, APS, SGB, SCB	92	101.5	52

TABLE 1. Continued.

OPERATION NUMBER	DATES	OBSERVERS	OBS REGIONS*	NUMBER OF TRANSECTS	KM^2 SURVEYED	NUMBER OF STATIONS
FW6-013	30 Mar. to 15 Apr.	D. Frazer	NWGOA, LCI, UCI	113	107.9	115
FW6-016	06 Apr. to 13 Apr.	C. Harrison	NWGOA, KB, LCI, UCI, NEGOA, PWS	91	114.6	0
FW6-018	14 Apr. to 30 Apr.	T. Schad	NWGOA, SEAS, NEGOA	57	61.5	4
FW6-019	21 Apr. to 01 May	A. DeGange	NEGOA, PWS, NWGOA, KB, OGOA	63	72.3	23
FW6-021	25 Apr. to 13 May	D. Forsell	OA, SCB, NAV, SGB	100	113.9	14
FW6-025	01 May to 11 May	A. Moe	NWGOA, KB	14	11.5	0
FW6-026	18 May to 20 May	C. Harrison	NWGOA, PWS NEGOA	25	22.5	0
FW6-027	22 May to 08 Jun.	J. Bartonek A. Sowls G. Sanger	NWGOA, KB, SS, APS, BB, SGB	130	136.4	0
FW6-028	17 Jun.	C. Handel	PWS	3	2.5	0
FW6-029	18 Jun. to 26 Jun.	C. Handel G. Sanger	NWGOA, KB	20	15.3	0

TABLE 1. Continued.

OPERATION NUMBER	DATES	OBSERVERS	OBS REGIONS*	NUMBER OF TRANSECTS	KM^2 SURVEYED	NUMBER OF STATIONS
FW6-050	04 May to 05 May	P. Gould M. Rauzon	NEGOA,KB	42	54.7	0
FW6-051	06 May to 08 May	P. Gould M. Rauzon	NWGOA,LCI	46	54.6	5
FW6-052	12 May to 20 May	P. Gould	NEGOA,KB, NWGOA	110	129.4	1
FW6-057	18 May to 03 Jun.	D. Forsell	OA,SCB,UMB, SCB,BB,NAV, APS,SS,NWGOA	113	126.6	11
FW6-058	07 May to 21 May	A. DeGange	NWGOA,SS,KB, LCI,APS	88	77.4	24
FW6-064	25 May to 03 Jun.	P. Gould C. Larson	NWGOA,KB, NEGOA	35	34.1	0
FW6-066	26 May to 05 Jun.	K. Metzner	KB,APS,BB, SGB,ECB	59	58.6	0
FW6-067	06 Jun. to 20 Jun.	K. Metzner	SGB,BB,ECB, APS,KB	99	101.5	15
FW6-068	30 May to 16 Jun.	M. Rauzon	BCS,SEAS,PWS, NEGOA,KB,SS, NWGOA,APS,SCB, OGOA	37	43.1	0

TABLE 1. Continued.

OPERATION NUMBER	DATES	OBSERVERS	OBS REGIONS*	NUMBER OF TRANSECTS	KM^2 SURVEYED	NUMBER OF STATIONS
FW6-070 FW6-071	07 Jun. to 23 Jun.	P. Baird	KB,APS,UMB, BB,SGB,OAP, OSK,OBC	110	139.4	4
FW6-074	26 Jun. to 16 Jul.	D. Forsell	KB,SCB,APS, ECB,BB,UMB	170	166.9	0
FW6-077	16 Jul. to 19 Jul.	K. Metzner	BCS,OBC,KB, OGOA	49	65.1	1
FW6-078	20 Jul. to 31 Jul.	K. Metzner	NEGOA,KB	26	31.6	0
FW6-082	08 Jul. to 29 Jul.	S. Bates C. Handel	NEGOA,SEAS, ECB,HB,NAV, BWR	33	46.5	0
FW6-083	22 Jul. to 31 Jul.	C. Harrison	NWGOA,SS,KB, APS,OAP,OGOA	94	96.5	0
FW6-085	04 Aug. to 14 Aug.	K. Metzner	KB,APS,SGB, ECB,NB,HB	60	75.2	0
FW6-084 FW6-087	25 Aug. to 02 Sep.	P. Baird	BCS,OBC,OSK, KB,APS,SGB, ECB	76	88.7	1
FW6-088	01 Sep. to 16 Sep.	P. Gould	KB,APS,SGB, ECB,NB,WCS,HB	182	175.4	0
FW6-089	20 Sep. to 01 Oct.	P. Gould	KB,APS,BB, SGB,ECB	77	71.8	0

TABLE 1. Continued.

OPERATION NUMBER	DATES	OBSERVERS	OBS REGIONS*	NUMBER OF TRANSECTS	KM^2 SURVEYED	NUMBER OF STATIONS
FW6-092	18 Oct. to 29 Oct.	A. Sowls	LCI,SS, NWGOA	70	80.6	0
FW6-094	23 Oct. to 31 Oct.	P. Gould	KB,APS,OAP	46	40.0	0
FW6-095	04 Nov. to 23 Nov.	P. Baird	NWGOA,OGOA, NEGOA,KB, LCI,SS	71	83.2	0
FW7-026	20 Jan. to 08 Feb.	P. Baird	BCS,SEAS, NWGOA,KB	90	88.1	3
FW7-027	15 Feb. to 20 Feb.	G. Sanger M. Peterson	BCS,OBC, OGOA	109	146.9	0
TOTALS						
45	15 Feb. to 20 Feb.	20	25	3,316	3884.1	530

* = Refer to Figure 1 for area definitions

TABLE 2. Summary of 1975-1976 Shipboard Transect Data.

AREA	DATE	TRANSECTS/BIRDS PER KM^2					
		JAN	FEB	MAR	APR	MAY	JUN
WCS	1975	0/-	0/-	0/-	0/-	0/-	0/-
	1976	0/-	0/-	0/-	0/-	0/-	0/-
BB	1975	0/-	0/-	0/-	0/-	0/-	0/-
	1976	0/-	0/-	0/-	0/-	0/-	0/-
NB	1975	0/-	0/-	0/-	0/-	0/-	0/-
	1976	0/-	0/-	0/-	0/-	0/-	0/-
ECB	1975	0/-	0/-	0/-	0/-	0/-	9/21
	1976	0/-	0/-	0/-	0/-	0/-	20/15
NAV	1975	0/-	0/-	0/-	0/-	0/-	9/20
	1976	0/-	0/-	0/-	6/2	40/80	0/-
BB	1975	0/-	0/-	0/-	0/-	0/-	29/520
	1976	0/-	0/-	19/130	17/28	46/38	49/89
SGB	1975	0/-	0/-	0/-	0/-	60/30	39/110
	1976	0/-	0/-	26/33	45/49	74/31	143/19
SCB	1975	0/-	0/-	0/-	0/-	5/24	7/14
	1976	0/-	0/-	0/-	20/9	5/57	0/-
BWR	1975	0/-	0/-	0/-	0/-	0/-	0/-
	1976	0/-	0/-	0/-	0/-	0/-	0/-
OA	1975	0/-	0/-	0/-	0/-	0/-	0/-
	1976	0/-	0/-	0/-	1/41	9/52	0/-
UMB	1975	0/-	0/-	0/-	0/-	7/13	0/-
	1976	0/-	0/-	0/-	0/-	9/33	6/47
APS	1975	0/-	0/-	0/-	0/-	13/60	4/40
	1976	0/-	0/-	25/15	4/12	30/574	84/106
KB	1975	0/-	0/-	0/-	0/-	42/64	15/21
	1976	0/-	5/2	99/9	11/25	95/589	72/208
	1977	9/22	32/27	0/-			
SS	1975	0/-	0/-	0/-	0/-	14/16	0/-
	1976	0/-	0/-	0/-	0/-	17/418	25/58

TABLE 2. Continued.

AREA	DATE	TRANSECTS/BIRDS PER KM^2					
		JAN	FEB	MAR	APR	MAY	JUN
UCI	1975	0/-	0/-	0/-	0/-	0/-	0/-
	1976	0/-	0/-	0/-	3/1	0/-	0/-
LCI	1975	0/-	0/-	0/-	0/-	0/-	0/-
	1976	0/-	0/-	0/-	110/12	28/12	0/-
PWS	1975	0/-	0/-	0/-	0/-	15/102	3/38
	1976	0/-	3/4	1/2	16/3	7/29	5/11
NWGOA	1975	0/-	5/7	4/4	7/12	40/88	10/126
	1976	0/-	8/6	65/8	77/15	75/107	23/132
	1977	26/42	0/-	0/-			
NEGOA	1975	0/-	60/12	0/-	27/440	134/355	74/31
	1976	0/-	52/8	189/8	82/16	128/137	23/79
OAP	1975	0/-	0/-	0/-	0/-	0/-	0/-
	1976	0/-	0/-	0/-	0/-	0/-	6/8
OSK	1975	0/-	0/-	0/-	0/-	0/-	0/-
	1976	0/-	0/-	0/-	0/-	0/-	9/6
OGOA	1975	8/2	0/-	9/5	0/-	9/7	10/27
	1976	0/-	34/2	16/2	5/74	0/-	5/14
	1977	0/-	33/5	0/-			
OBC	1975	17/2	0/-	2/4	0/-	10/4	17/7
	1976	0/-	69/3	22/1	0/-	0/-	22/17
	1977	0/-	66/1	0/-			
SEAS	1975	0/-	0/-	0/-	0/-	0/-	0/-
	1976	0/-	21/21	33/12	4/6	1/6	0/-
	1977	11/7	0/-	0/-			
BCS	1975	4/27	0/-	0/-	0/-	8/6	26/39
	1976	0/-	38/7	30/10	0/-	0/-	1/9
	1977	12/16	10/1	0/-			

TABLE 2. Continued.

AREA	DATE	TRANSECTS/BIRDS PER KM^2 JUL	AUG	SEP	OCT	NOV	DEC
WCS	1975	0/-	0/-	0/-	0/-	0/-	0/-
	1976	0/-	0/-	22/358	0/-	0/-	0/-
HB	1975	0/-	0/-	27/6	0/-	0/-	0/-
	1976	2/19	13/4	43/34	0/-	0/-	0/-
NB	1975	0/-	0/-	27/50	0/-	0/-	0/-
	1976	0/-	19/1	38/42	0/-	0/-	0/-
ECB	1975	14/32	43/880	20/12	10/10	14/11	0/-
	1976	5/12	6/12	38/3	0/-	0/-	0/-
NAV	1975	6/2	1/138	3/268	0/-	0/-	0/-
	1976	2/106	0/-	0/-	0/-	0/-	0/-
BB	1975	11/189	19/29	56/54	59/49	9/5	0/-
	1976	39/61	0/-	15/13	0/-	0/-	0/-
SGB	1975	28/220	139/300	158/139	22/281	42/24	0/-
	1976	38/99	13/24	80/202	0/-	0/-	0/-
SCB	1975	0/-	0/-	17/12	4/11	0/-	0/-
	1976	0/-	0/-	0/-	0/-	0/-	0/-
BWR	1975	0/-	0/-	0/-	0/-	0/-	0/-
	1976	4/31	0/-	0/-	0/-	0/-	0/-
OA	1975	0/-	0/-	23/32	0/-	0/-	0/-
	1976	0/-	0/-	0/-	0/-	0/-	0/-
UMB	1975	3/74	20/38	23/19	0/-	1/29	0/-
	1976	3/18	0/-	0/-	0/-	0/-	0/-
APS	1975	34/138	27/226	39/203	18/160	27/48	0/-
	1976	30/207	9/6	27/109	6/40	0/-	0/-
KB	1975	51/51	38/45	52/84	27/33	21/11	0/-
	1976	77/51	12/38	6/42	21/52	24/33	0/-
SS	1975	0/-	12/22	0/-	5/3	4/2	0/-
	1976	1/15	0/-	0/-	9/3	12/59	0/-

TABLE 2. Continued.

AREA	DATE	TRANSECTS/BIRDS PER KM^2					
		JUL	AUG	SEP	OCT	NOV	DEC
UCI	1975	0/-	0/-	0/-	0/-	0/-	0/-
	1976	0/-	0/-	0/-	0/-	0/-	0/-
LCI	1975	0/-	0/-	7/147	2/5	2/5	0/-
	1976	0/-	0/-	0/-	53/3	1/39	0/-
PWS	1975	0/-	0/-	2/1	56/11	0/-	0/-
	1976	0/-	0/-	0/-	0/-	0/-	0/-
NWGOA	1975	0/-	11/52	15/14	33/16	22/7	2/3
	1976	22/140	0/-	0/-	8/31	14/13	0/-
NEGOA	1975	0/-	2/10	71/10	56/14	62/7	0/-
	1976	25/7	0/-	0/-	0/-	7/13	0/-
OAP	1975	0/-	0/-	26/6	0/-	6/2	0/-
	1976	9/16	0/-	0/-	22/6	0/-	0/-
OSK	1975	0/-	9/5	12/1	0/-	9/4	0/-
	1976	0/-	6/17	0/-	0/-	0/-	0/-
OGOA	1975	15/34	7/12	0/-	0/-	1/1	0/-
	1976	20/31	0/-	0/-	0/-	13/5	0/-
OBC	1975	26/47	31/1	12/1	0/-	18/3	0/-
	1976	16/1	36/1	0/-	0/-	0/-	0/-
SEAS	1975	0/-	2/1	5/17	7/9	0/-	7/6
	1976	18/18	0/-	0/-	0/-	0/-	0/-
BCS	1975	8/20	10/6	0/-	0/-	0/-	9/8
	1976	11/5	9/8	0/-	0/-	0/-	0/-

TABLE 3. Estimated Seabird Densities in the WESTERN CHUKCHI SEA Area from Shipboard Transects in 1976.

DATES	NUMBER OF TRANSECTS	BIRDS/KM^2 MEAN	RANGE	WEIGHTED MEAN
08-14 Sep.	22	358	12-4891	358

TABLE 4. Estimated Seabird Densities in the HOPE BASIN Area from Shipboard Transects in 1976.

DATES	NUMBER OF TRANSECTS	BIRDS/KM^2 MEAN	RANGE	WEIGHTED MEAN
23-24 Jul.	2	19	10-23	19
10-14 Aug.	13	4	0-17	4
01-16 Sep.	43	34	1-295	34

TABLE 5. Estimated Seabird Densities in the NORTON BASIN Area from Shipboard Transects in 1976.

DATES	NUMBER OF TRANSECTS	BIRDS/KM^2 MEAN	RANGE	WEIGHTED MEAN
07-10 Aug.	19	1	0-12	1
01-16 Sep.	38	42	2-234	42

TABLE 6. Estimated Seabird Densities in the EAST CENRAL BERING SEA Area from Shipboard Transects in 1976.

DATES	NUMBER OF TRANSECTS	BIRDS/KM^2 MEAN	RANGE	WEIGHTED MEAN
01-02 Jun.	2	1	0-1	
10-14 Jun.	6	5	0-17	
30 Jun.	12	23	4-44	15
01 Jul.	4	15	7-29	
22 Jul.	1	2	-	12

TABLE 6. Continued.

DATES	NUMBER OF TRANSECTS	BIRDS/KM² MEAN	RANGE	WEIGHTED MEAN
07 Aug.	6	12	5-26	12
01-02 Sep.	10	2	0-26	
01-16 Sep.	22	4	0-26	
24-25 Sep.	6	2	0-5	3

TABLE 7. Estimated Seabird Densities in the NAVARIN BASIN Area from Shipboard Transects in 1976.

DATES	NUMBER OF TRANSECTS	BIRDS/KM² MEAN	RANGE	WEIGHTED MEAN
26 Apr.	6	2	0-8	2
07-10 May	32	24	2-130	
27-28 May	8	305	11-1081	80
26 Jul.	2	106	69-145	106

TABLE 8. Estimated Seabird Densities in the BRISTOL BAY BASIN Area from Shipboard Transects in 1976.

DATES	NUMBER OF TRANSECTS	BIRDS/KM² MEAN	RANGE	WEIGHTED MEAN
16-20 Mar.	19	130	1-1260	130
03-19 Apr.	17	28	3-150	28
20-25 May	30	33	0-310	
31 May	9	84	8-353	
29-31 May	7	3	0-10	38
01-05 Jun.	16	243	3-2452	
06-16 Jun.	27	16	0-287	
12 Jun.	6	10	3-33	89
01-06 Jul.	39	61	0-318	61
26-28 Sep.	15	13	1-27	13

TABLE 9. Estimated Seabird Densities in the SAINT GEORGE BASIN Area from Shipboard Transects in 1976.

DATES	NUMBER OF TRANSECTS	BIRDS/KM² MEAN	RANGE	WEIGHTED MEAN
17-23 Mar.	26	33	3-507	33
02-19 Apr.	33	46	2-863	
27-30 Apr.	12	56	7-361	49
01-13 May	41	38	1-357	
20-31 May	28	27	0-155	
29-31 May	5	1	0-1	31
01 Jun.	2	19	8-31	
01 Jun.	1	66	-	
04-05 Jun.	38	25	0-167	
06-18 Jun.	48	7	0-52	
12-18 Jun.	37	29	1-100	
28-30 Jun.	12	10	3-128	
06-09 Jun.	8	22	13-39	19
07-14 Jul.	38	99	3-1044	99
05-06 Aug.	10	7	0-22	
31 Aug.	3	80	?	24
01 Sep.	3	14	8-21	
01-16 Sep.	33	333	7-5032	
21-29 Sep.	44	117	1-3873	202

TABLE 10. Estimated Seabird Densities in the SOUTH CENTRAL BERING SEA Area from Shipboard Transects in 1976.

DATES	NUMBER OF TRANSECTS	BIRDS/KM² MEAN	RANGE	WEIGHTED MEAN
05-21 Apr.	15	11	0-49	
25 Apr.	5	1	0-3	9
13 May	3	6	0-11	
19 May	2	134	118-151	57

TABLE 11. Estimated Seabird Densities in the BOWER'S BANK Area from Shipboard Transects in 1976.

DATES	NUMBER OF TRANSECTS	BIRDS/KM^2 MEAN	RANGE	WEIGHTED MEAN
28-29 Jul.	4	31	13-14	31

TABLE 12. Estimated Seabird Densities in the OCEANIC ALEUTIAN Area from Shipboard Transects in 1976.

DATES	NUMBER OF TRANSECTS	BIRDS/KM^2 MEAN	RANGE	WEIGHTED MEAN
25 Apr.	1	41	-	41
18-19 May	9	55	9-115	52

TABLE 13. Estimated Seabird Densities in the UMNAK BASIN Area from Shipboard Transects in 1976.

DATES	NUMBER OF TRANSECTS	BIRDS/KM^2 MEAN	RANGE	WEIGHTED MEAN
19-20 May	9	33	1-232	33
12-18 Jun.	6	47	9-110	47
09 Jul.	3	18	13-27	18

TABLE 14. Estimated Seabird Densities in the ALASKA PENINSULA SOUTH Area from Shipboard Transects in 1976.

DATES	NUMBER OF TRANSECTS	BIRDS/KM^2 MEAN	RANGE	WEIGHTED MEAN
11-23 Mar.	19	11	1-84	
30-31 Mar.	6	26	9-51	15
01 Apr.	4	12	2-22	12

TABLE 14. Continued.

DATES	NUMBER OF TRANSECTS	BIRDS/KM^2 MEAN	RANGE	WEIGHTED MEAN
18-20 May	12	1397	4-6996	
30 May	13	26	3-189	
28 May	5	25	0-111	574
05-10 Jun.	10	154	8-1206	
01-02 Jun.	7	70	18-175	
05-06 Jun.	29	49	2-535	
18-19 Jun.	5	14	4-24	
11-19 Jun.	17	211	20-1001	
27-28 Jun.	16	113	7-690	106
14-15 Jul.	17	314	14-1402	
22-31 Jul.	13	67	12-192	207
04-05 Aug.	6	3	0-9	
29 Aug.	3	12	10-12	6
01-16 Sep.	18	144	26-406	
30 Sep.	9	38	6-185	109
01 Oct.	1	19	-	
24-25 Oct.	5	44	0-121	40

TABLE 15. Estimated Seabird Densities in the KODIAK BASIN Area from Shipboard Transects in 1976-1977.

DATES	NUMBER OF TRANSECTS	BIRDS/KM^2 MEAN	RANGE	WEIGHTED MEAN
26-31 Jan.	9	22	3-46	22
1-8 Feb.	32	27	4-198	
27 Feb.	5	2	1-3	24
01-10 Mar.	9	27	12-53	
11-25 Mar.	17	11	1-37	
17-21 Mar.	62	7	0-36	
23-30 Mar.	11	6	2-17	9
06-13 Apr.	4	5	1-9	
29-30 Apr.	7	37	20-80	25

TABLE 15. Continued.

DATES	NUMBER OF TRANSECTS	BIRDS/KM² MEAN	RANGE	WEIGHTED MEAN
01-02 May	6	51	14-85	
05 May	9	108	33-242	
01-21 May	57	602	5-22990	
12 May	9	2225	12-19044	
23-24 May	6	17	3-26	
25 May	6	44	27-70	
25-27 May	2	5	2-7	589
07 Jun.	27	140	7-2146	
04-11 Jun.	3	27	10-67	
19-20 Jun.	13	336	1-2130	
08-10 Jun.	7	37	16-60	
25-26 Jun.	12	59	5-116	
26-27 Jun.	10	575	16-5274	208
15-16 Jul.	19	166	9-1014	
16-19 Jul.	4	8	3-16	
20-31 Jul.	7	28	0-197	
22-31 Jul.	47	12	0-122	51
04 Aug.	6	68	3-259	
29 Aug.	6	8	3-16	38
01-16 Sep.	6	42	27-73	42
01 Oct.	2	29	19-38	
23-24 Oct.	19	54	7-230	52
10-19 Nov.	24	33	3-246	33

TABLE 16. Estimated Seabird Densities in the SHELIKOF STRAIT Area from Shipboard Transects in 1976.

DATES	NUMBER OF TRANSECTS	BIRDS/KM² MEAN	RANGE	WEIGHTED MEAN
01-14 May	14	506	1-6185	
24 May	3	6	2-13	418
02-03 Jun.	12	86	5-792	
07-08 Jun.	13	32	2-271	58

TABLE 16. Continued.

DATES	NUMBER OF TRANSECTS	BIRDS/KM² MEAN	RANGE	WEIGHTED MEAN
22-31 Jul.	1	15	-	15
18-29 Oct.	9	3	0-11	3
11-12 Nov.	12	59	10-549	59

TABLE 17. Estimated Seabird Densities in the UPPER COOK INLET Area from Shipboard Transects in 1976.

DATES	NUMBER OF TRANSECTS	BIRDS/KM² MEAN	RANGE	WEIGHTED MEAN
04 Apr.	1	0	-	
07 Apr.	2	1	0-1	1

TABLE 18. Estimated Seabird Densities in the LOWER COOK INLET Area from Shipboard Transects in 1976.

DATES	NUMBER OF TRANSECTS	BIRDS/KM² MEAN	RANGE	WEIGHTED MEAN
01-14 Apr.	86	15	0-119	
07-09 Apr.	24	2	0-20	12
14 May	1	72	-	
06-08 May	27	10	0-22	12
18-29 Oct.	53	3	0-34	3
11 Nov.	1	39	-	39

TABLE 19. Estimated Seabird Densities in the PRINCE WILLIAM SOUND Area from Shipboard Transects in 1976.

DATES	NUMBER OF TRANSECTS	BIRDS/KM² MEAN	RANGE	WEIGHTED MEAN
29 Feb.	3	4	0-13	4

TABLE 19. Continued.

DATES	NUMBER OF TRANSECTS	BIRDS/KM² MEAN	RANGE	WEIGHTED MEAN
21 Mar.	1	4	-	2
11-12 Apr.	10	2	0-6	
26-27 Apr.	6	5	0-9	3
18-19 May	7	29	1-101	29
02 Jun.	2	10	8-11	
17 Jun.	3	11	4-19	11

TABLE 20. Estimated Seabird Densities in the NORTHWEST GULF OF ALASKA from Shipboard Transects in 1976-1977.

DATES	NUMBER OF TRANSECTS	BIRDS/KM² MEAN	RANGE	WEIGHTED MEAN
25-31 Jan.	26	42	0-240	42
20 Feb.	7	5	2-12	
22 Feb.	1	11	-	6
01-04 Mar.	14	11	0-32	
10 Mar.	3	30	18-39	
18-29 Mar.	26	6	0-30	
23 Mar.	6	11	4-42	
30-31 Mar.	16	5	0-11	8
04-15 Apr.	10	5	1-12	
06-12 Apr.	49	18	0-156	
27-29 Apr.	10	22	5-32	
14-17 Apr.	8	5	3-13	15
02-11 May	8	125	10-419	
07-15 May	4	169	10-546	
08-09 May	19	126	31-355	
20 May	13	85	43-144	
18-20 May	15	35	0-394	
22 May	8	50	8-127	
25-26 May	8	244	13-269	107

TABLE 20. Continued.

DATES	NUMBER OF TRANSECTS	BIRDS/KM^2 MEAN	RANGE	WEIGHTED MEAN
03-04 Jun.	6	337	40-1384	
08 Jun.	5	39	9-88	
03-12 Jun.	4	49	13-80	
18-19 Jun.	8	77	16-231	132
22-31 Jul.	22	140	12-1035	140
18-29 Oct.	8	31	0-169	31
05-17 Nov.	14	13	7-26	13

TABLE 21. Estimated Seabird Densities in the NORTHEAST GULF OF ALASKA Area from Shipboard Transects in 1976.

DATES	NUMBER OF TRANSECTS	BIRDS/KM^2 MEAN	RANGE	WEIGHTED MEAN
19-20 Feb.	17	10	3-26	
24-29 Feb.	35	7	0-90	8
02-10 Mar.	98	8	0-48	
17-21 Mar.	33	12	0-63	
19-26 Mar.	58	6	0-54	8
11 Apr.	2	1	1-1	
21-25 Apr.	35	21	1-100	
16-28 Apr.	45	13	0-130	16
04-05 May	33	78	5-215	
12-20 May	88	169	0-6178	
18-19 May	3	15	13-16	
31 May	4	14	9-28	137
02-03 Jun.	21	84	2-960	
01 Jun.	2	24	20-28	79
11 Jul.	6	22	3-91	
20-31 Jul.	19	2	0-8	7
07-08 Nov.	7	13	7-36	13

TABLE 22. Estimated Seabird Densities in the OCEANIC ALASKAN PENINSULA SOUTH Area from Shipboard Transects in 1976.

DATES	NUMBER OF TRANSECTS	BIRDS/KM² MEAN	RANGE	WEIGHTED MEAN
19 Jun.	6	8	?	9
22-31 Jul.	9	16	0-66	16
25-27 Oct.	22	6	0-34	6

TABLE 23. Estimated Seabird Densities in the OCEANIC SOUTH KODIAK Area from Shipboard Transects in 1976.

DATES	NUMBER OF TRANSECTS	BIRDS/KM² MEAN	RANGE	WEIGHTED MEAN
20 Jun.	9	6	?	6
28 Aug.	6	17	2-39	17

TABLE 24. Estimated Seabird Densities in the OCEANIC GULF OF ALASKA Area from Shipboard Transects in 1976-1977.

DATES	NUMBER OF TRANSECTS	BIRDS/KM² MEAN	RANGE	WEIGHTED MEAN
20 Feb.	33	5	1-15	
27 Feb.	34	3	1-14	4
12 Mar.	16	2	0-7	2
30 Apr.	5	74	18-213	74
13-15 Jun.	5	14	5-23	14
16-19 Jul.	18	33	0-432	
20-31 Jul.	2	11	10-13	31
09-20 Nov.	13	5	2-14	5

TABLE 25. Estimated Seabird Densities in the OCEANIC BRITISH COLUMBIA Area from Shipboard Transects in 1976-1977.

DATES	NUMBER OF TRANSECTS	BIRDS/KM^2 MEAN	RANGE	WEIGHTED MEAN
18-19 Feb.	66	1	0-5	
25-26 Feb.	69	3	0-12	2
10-11 Mar.	22	1	0-6	1
20-22 Jun.	22	17	?	17
16-19 Jul.	16	1	0-2	1
26-28 Aug.	36	1	0-6	1

TABLE 26. Estimated Seabird Densities in the SOUTHEAST ALASKAN SHELF Area from Shipboard Transects in 1976-1977.

DATES	NUMBER OF TRANSECTS	BIRDS/KM^2 MEAN	RANGE	WEIGHTED MEAN
22-24 Jan.	11	7	3-11	7
18-19 Feb.	21	21	1-133	21
17-21 Mar.	33	12	0-91	12
28-29 Apr.	4	6	2-15	6
30 May	1	6	-	6
08-11 Jul.	18	18	1-100	18

TABLE 27. Estimated Seabird Densities in the BRITISH COLUMBIA SHELF Area from Shipboard Transects in 1976-1977.

DATES	NUMBER OF TRANSECTS	BIRDS/KM^2 MEAN	RANGE	WEIGHTED MEAN
20-21 Jan.	12	16	5-58	16
17 Feb.	27	7	2-20	
24-25 Feb.	11	6	1-12	
15-16 Feb.	10	1	0-7	6

TABLE 27. Continued.

DATES	NUMBER OF TRANSECTS	BIRDS/KM² MEAN	RANGE	WEIGHTED MEAN
09 Mar.	9	3	0-8	
17-21 Mar.	21	10	1-27	8
15 Jun.	1	8	-	8
16-19 Jul.	11	5	0-22	5
25-26 Aug.	9	8	1-28	8

TABLE 28. Relative Density of Seabirds in the WESTERN CHUKCHI SEA Area from Shipboard Transects in 1976.

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Unidentified Loon	-[a]	-	-	-	-	-	-	-	+[b]	-	-	-
Northern Fulmar	-	-	-	-	-	-	-	-	+	-	-	-
Short-tailed Shearwater	-	-	-	-	-	-	-	-	+++	-	-	-
Unidentified Shearwater	-	-	-	-	-	-	-	-	++++	-	-	-
Steller's Eider	-	-	-	-	-	-	-	-	+	-	-	-
Unidentified Eider	-	-	-	-	-	-	-	-	+	-	-	-
Unidentified Shorebird	-	-	-	-	-	-	-	-	+	-	-	-
Red Phalarope	-	-	-	-	-	-	-	-	+	-	-	-
Unidentified Phalarope	-	-	-	-	-	-	-	-	+	-	-	-
Pomarine Jaeger	-	-	-	-	-	-	-	-	+	-	-	-
Unidentified Jaeger	-	-	-	-	-	-	-	-	+	-	-	-
Glaucous Gull	-	-	-	-	-	-	-	-	+	-	-	-
Unidentified Kittiwake	-	-	-	-	-	-	-	-	+	-	-	-
Sabine's Gull	-	-	-	-	-	-	-	-	+	-	-	-
Unidentified Murre	-	-	-	-	-	-	-	-	+	-	-	-
Parakeet Auklet	-	-	-	-	-	-	-	-	++	-	-	-
Crested Auklet	-	-	-	-	-	-	-	-	+	-	-	-
Least Auklet	-	-	-	-	-	-	-	-	++	-	-	-
Horned Puffin	-	-	-	-	-	-	-	-	+	-	-	-
Unidentified Alcid	-	-	-	-	-	-	-	-	++	-	-	-
Unidentified Bird	-	-	-	-	-	-	-	-	+	-	-	-

[a] area not surveyed

[b] + = 0-9 birds/km^2, ++ = 10-29 birds/km^2, +++ = 30-99 birds/km^2, ++++ = 100+ birds/km^2

TABLE 29. Relative Density of Seabirds in the HOPE BASIN Area from Shipboard Transects in 1976.

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Arctic Loon	-[a]	-	-	-	-	-	o[b]	o	+	-	-	-
Yellow-billed Loon	-	-	-	-	-	-	o	o	+	-	-	-
Unidentified Loon	-	-	-	-	-	-	o	o	+	-	-	-
Northern Fulmar	-	-	-	-	-	-	o	o	+	-	-	-
Sooty Shearwater	-	-	-	-	-	-	o	o	+	-	-	-
Short-tailed Shearwater	-	-	-	-	-	-	o	o	++	-	-	-
Unidentified Shearwater	-	-	-	-	-	-	o	o	+	-	-	-
Unidentified Cormorant	-	-	-	-	-	-	o	o	+	-	-	-
Oldsquaw	-	-	-	-	-	-	o	o	+	-	-	-
Unidentified Eider	-	-	-	-	-	-	o	o	+	-	-	-
Unidentified Shorebird	-	-	-	-	-	-	o	o	+	-	-	-
Unidentified Phalarope	-	-	-	-	-	-	o	o	+	-	-	-
Pomarine Jaeger	-	-	-	-	-	-	o	o	+	-	-	-
Parasitic Jaeger	-	-	-	-	-	-	o	o	+	-	-	-
Unidentified Jaeger	-	-	-	-	-	-	o	o	+	-	-	-
Glaucous Gull	-	-	-	-	-	-	o	o	+	-	-	-
Glaucous-winged Gull	-	-	-	-	-	-	o	+	o	-	-	-
Black-legged Kittiwake	-	-	-	-	-	-	+	+	o	-	-	-
Unidentified Kittiwake	-	-	-	-	-	-	o	o	+	-	-	-
Common Murre	-	-	-	-	-	-	+	+	o	-	-	-
Thick-billed Murre	-	-	-	-	-	-	+	o	o	-	-	-
Unidentified Murre	-	-	-	-	-	-	+	+	+	-	-	-
Parakeet Auklet	-	-	-	-	-	-	+	o	+	-	-	-
Crested Auklet	-	-	-	-	-	-	o	+	+	-	-	-
Least Auklet	-	-	-	-	-	-	o	o	+	-	-	-
Horned Puffin	-	-	-	-	-	-	+	o	+	-	-	-
Tufted Puffin	-	-	-	-	-	-	+	o	+	-	-	-
Unidentified Alcid	-	-	-	-	-	-	+	+	+	-	-	-
Unidentified Bird	-	-	-	-	-	-	o	o	+	-	-	-

[a] area not surveyed

[b] o = no birds, + = 0-9 birds/km^2, ++ = 10-29 birds/km^2, +++ = 30-99 birds/km^2, ++++ = 100+ birds/km^2

TABLE 30. Relative Density of Seabirds in the NORTON BASIN Area from Shipboard Transects in 1976.

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Arctic Loon	-[a]	-	-	-	-	-	-	o[b]	+	-	-	-
Northern Fulmar	-	-	-	-	-	-	-	o	+	-	-	-
Short-tailed Shearwater	-	-	-	-	-	-	-	o	+	-	-	-
Unidentified Shearwater	-	-	-	-	-	-	-	o	+	-	-	-
Pelagic Cormorant	-	-	-	-	-	-	-	o	+	-	-	-
Unidentified Cormorant	-	-	-	-	-	-	-	o	+	-	-	-
Oldsquaw	-	-	-	-	-	-	-	o	+	-	-	-
Unidentified Duck	-	-	-	-	-	-	-	+	+	-	-	-
Unidentified Shorebird	-	-	-	-	-	-	-	o	+	-	-	-
Northern Phalarope	-	-	-	-	-	-	-	o	+	-	-	-
Unidentified Phalarope	-	-	-	-	-	-	-	o	+	-	-	-
Pomarine Jaeger	-	-	-	-	-	-	-	o	+	-	-	-
Parasitic Jaeger	-	-	-	-	-	-	-	o	+	-	-	-
Glaucous Gull	-	-	-	-	-	-	-	o	+	-	-	-
Glaucous-winged Gull	-	-	-	-	-	-	-	+	o	-	-	-
Thayer's Gull	-	-	-	-	-	-	-	o	+	-	-	-
Vega Gull	-	-	-	-	-	-	-	o	+	-	-	-
Black-legged Kittiwake	-	-	-	-	-	-	-	+	o	-	-	-
Unidentified Kittiwake	-	-	-	-	-	-	-	o	+	-	-	-
Sabine's Gull	-	-	-	-	-	-	-	o	+	-	-	-
Unidentified Gull	-	-	-	-	-	-	-	+	+	-	-	-
Common Murre	-	-	-	-	-	-	-	+	o	-	-	-
Unidentified Murre	-	-	-	-	-	-	-	+	+	-	-	-
Pigeon Guillemot	-	-	-	-	-	-	-	o	+	-	-	-
Parakeet Auklet	-	-	-	-	-	-	-	o	+	-	-	-
Crested Auklet	-	-	-	-	-	-	-	o	++	-	-	-
Least Auklet	-	-	-	-	-	-	-	o	+	-	-	-
Horned Puffin	-	-	-	-	-	-	-	+	+	-	-	-
Tufted Puffin	-	-	-	-	-	-	-	o	+	-	-	-
Unidentified Alcid	-	-	-	-	-	-	-	o	+	-	-	-
Unidentified Bird	-	-	-	-	-	-	-	+	+	-	-	-

[a] area not surveyed

[b] o = no birds, + = 0-9 birds/km^2, ++ = 10-29 birds/km^2, +++ = 30-99 birds/km^2, ++++ = 100+ birds/km^2

TABLE 31. Relative Density of Seabirds in the EAST CENTRAL BERING SEA Area from Shipboard Transects in 1976.

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Arctic Loon	-[a]	-	-	-	-	o[b]	o	o	+	-	-	-
Unidentified Loon	-	-	-	-	-	o	o	o	+	-	-	-
Northern Fulmar	-	-	-	-	-	+	+	+	+	-	-	-
Sooty Shearwater	-	-	-	-	-	o	o	o	+	-	-	-
Short-tailed Shearwater	-	-	-	-	-	o	o	o	+	-	-	-
Unidentified Shearwater	-	-	-	-	-	+	o	o	+	-	-	-
Unidentified Cormorant	-	-	-	-	-	o	+	o	o	-	-	-
Harlequin Duck	-	-	-	-	-	+	o	o	o	-	-	-
Steller's Eider	-	-	-	-	-	o	o	o	+	-	-	-
White-winged Scoter	-	-	-	-	-	o	+	o	+	-	-	-
Unidentified Shorebird	-	-	-	-	-	o	o	o	+	-	-	-
Red Phalarope	-	-	-	-	-	o	+	o	o	-	-	-
Pomarine Jaeger	-	-	-	-	-	+	o	o	+	-	-	-
Glaucous Gull	-	-	-	-	-	o	o	o	+	-	-	-
Glaucous-winged Gull	-	-	-	-	-	+	o	o	+	-	-	-
Mew Gull	-	-	-	-	-	o	o	o	+	-	-	-
Black-legged Kittiwake	-	-	-	-	-	+	+	+	+	-	-	-
Red-legged Kittiwake	-	-	-	-	-	o	o	o	+	-	-	-
Unidentified Kittiwake	-	-	-	-	-	+	+	o	+	-	-	-
Unidentified Gull	-	-	-	-	-	+	o	o	+	-	-	-
Thick-billed Murre	-	-	-	-	-	+	+	o	+	-	-	-
Common Murre	-	-	-	-	-	+	+	+	+	-	-	-
Unidentified Murre	-	-	-	-	-	+	+	o	+	-	-	-
Pigeon Guillemot	-	-	-	-	-	o	+	o	o	-	-	-
Ancient Murrelet	-	-	-	-	-	o	o	o	+	-	-	-
Parakeet Auklet	-	-	-	-	-	o	+	o	+	-	-	-
Horned Puffin	-	-	-	-	-	+	+	o	+	-	-	-
Tufted Puffin	-	-	-	-	-	+	+	+	+	-	-	-
Unidentified Alcid	-	-	-	-	-	+	+	o	o	-	-	-
Unidentified Bird	-	-	-	-	-	+	+	+	+	-	-	-

[a] - = area not surveyed
[b] o = no birds, + = 1-9 birds/km^2, ++ = 10-29 birds/km^2, +++ = 30-99 birds/km^2
++++ = 100+ birds/km^2

TABLE 32. Relative Density of Seabirds in the NAVARIN BASIN from Shipboard Transects in 1976.

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Northern Fulmar	-[a]	-	-	+[b]	++	-	++	-	-	-	-	-
Fork-tailed Storm Petrel	-	-	-	+	+	-	+	-	-	-	-	-
Unidentified Cormorant	-	-	-	o	o	-	+	-	-	-	-	-
Harlequin Duck	-	-	-	o	+	-	o	-	-	-	-	-
Wood Sandpiper	-	-	-	o	+	-	o	-	-	-	-	-
Dunlin	-	-	-	o	+	-	o	-	-	-	-	-
Red Phalarope	-	-	-	o	o	-	+	-	-	-	-	-
Pomarine Jaeger	-	-	-	o	+	-	o	-	-	-	-	-
Parasitic Jaeger	-	-	-	o	+	-	o	-	-	-	-	-
Long-tailed Jaeger	-	-	-	o	+	-	o	-	-	-	-	-
Glaucous Gull	-	-	-	o	+	-	o	-	-	-	-	-
Glaucous-winged Gull	-	-	-	+	+	-	o	-	-	-	-	-
Herring Gull	-	-	-	o	+	-	o	-	-	-	-	-
Thayer's Gull	-	-	-	o	+	-	o	-	-	-	-	-
Slaty-backed Gull	-	-	-	o	+	-	o	-	-	-	-	-
Black-legged Kittiwake	-	-	-	+	+	-	++	-	-	-	-	-
Red-legged Kittiwake	-	-	-	+	+	-	o	-	-	-	-	-
Unidentified Kittiwake	-	-	-	+	+	-	o	-	-	-	-	-
Common Murre	-	-	-	o	+	-	+	-	-	-	-	-
Thick-billed Murre	-	-	-	+	+	-	+	-	-	-	-	-
Unidentified Murre	-	-	-	+	+	-	+++	-	-	-	-	-
Pigeon Guillemot	-	-	-	o	o	-	+	-	-	-	-	-
Ancient Murrelet	-	-	-	+	o	-	o	-	-	-	-	-
Parakeet Auklet	-	-	-	o	+	-	+	-	-	-	-	-
Least Auklet	-	-	-	o	+++	-	+	-	-	-	-	-
Horned Puffin	-	-	-	o	o	-	+	-	-	-	-	-
Tufted Puffin	-	-	-	o	o	-	+	-	-	-	-	-
Unidentified Alcid	-	-	-	+	++	-	+	-	-	-	-	-

[a] - = area not surveyed

[b] o = no birds, + = 1-9 birds/km^2, ++ = 10-29 birds/km^2, +++ = 30-99 birds/km^2, ++++ = 100+ birds/km^2

TABLE 33. Relative Density of Seabirds in the BRISTOL BAY Area from Shipboard Transects in 1976.

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Arctic Loon	-[a]	-	o[b]	o	+	o	o	-	o	-	-	-
Common Loon	-	-	o	o	+	o	o	-	o	-	-	-
Unidentified Loon	-	-	o	o	o	o	o	-	+	-	-	-
Northern Fulmar	-	-	+	+	+	+	+	-	+	-	-	-
Sooty Shearwater	-	-	o	o	+	+	o	-	+	-	-	-
Short-tailed Shearwater	-	-	o	o	+	+++	o	-	+	-	-	-
Unidentified Shearwater	-	-	o	o	++	+	+++	-	+	-	-	-
Fork-tailed Storm Petrel	-	-	+	o	o	+	o	-	+	-	-	-
Leach's Storm Petrel	-	-	o	o	+	o	o	-	o	-	-	-
Unidentified Procellarid	-	-	o	o	+	o	o	-	o	-	-	-
Red-faced Cormorant	-	-	+	+	o	+	+	-	o	-	-	-
Unidentified Cormorant	-	-	+	+	+	+	+	-	o	-	-	-
Emperor Goose	-	-	o	o	o	o	+	-	o	-	-	-
Unidentified Goose	-	-	o	o	+	o	o	-	o	-	-	-
Oldsquaw	-	-	o	o	o	o	o	-	+	-	-	-
Common Eider	-	-	o	o	+	o	o	-	o	-	-	-
White-winged Scoter	-	-	o	+	o	o	o	-	o	-	-	-
Black-bellied Plover	-	-	o	o	o	+	o	-	o	-	-	-
Red Phalarope	-	-	o	o	o	+	+	-	o	-	-	-
Northern Phalarope	-	-	o	o	o	o	+	-	o	-	-	-
Unidentified Phalarope	-	-	o	o	+	o	o	-	o	-	-	-
Pomarine Jaeger	-	-	o	o	+	+	+	-	+	-	-	-
Parasitic Jaeger	-	-	o	o	o	+	o	-	+	-	-	-
Long-tailed Jaeger	-	-	o	o	o	+	+	-	o	-	-	-
Unidentified Jaeger	-	-	o	o	o	o	+	-	o	-	-	-
Glaucous Gull	-	-	+	o	+	o	+	-	o	-	-	-
Glaucous-winged Gull	-	-	+	+	+	+	o	-	+	-	-	-
Mew Gull	-	-	+	o	+	o	o	-	o	-	-	-
Ivory Gull	-	-	+	o	o	o	o	-	o	-	-	-
Black-legged Kittiwake	-	-	+	+	+	+	+	-	+	-	-	-
Red-legged Kittiwake	-	-	o	+	+	o	+	-	o	-	-	-
Unidentified Kittiwake	-	-	o	o	+	+	+	-	o	-	-	-

TABLE 33. Continued.

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Sabine's Gull	-	-	o	o	+	o	o	-	o	-	-	-
Common Murre	-	-	o	+	+	+	+	-	o	-	-	-
Thick-billed Murre	-	-	+	++	+	+	+	-	o	-	-	-
Unidentified Murre	-	-	+++	++	+	+	++	-	+	-	-	-
Ancient Murrelet	-	-	o	o	o	o	o	-	+	-	-	-
Parakeet Auklet	-	-	+	+	+	o	o	-	+	-	-	-
Crested Auklet	-	-	+	o	o	o	o	-	o	-	-	-
Least Auklet	-	-	+	o	o	o	o	-	o	-	-	-
Horned Puffin	-	-	o	o	+	o	+	-	+	-	-	-
Tufted Puffin	-	-	o	o	+	+	+	-	+	-	-	-
Unidentified Alcid	-	-	o	o	+	+	+	-	+	-	-	-
Savannah Sparrow	-	-	o	o	+	o	o	-	o	-	-	-
Unidentified Bird	-	-	o	o	+	+	+	-	o	-	-	-

[a] - = area not surveyed

[b] o = no birds, + = 1-9 birds/km^2, ++ = 10-29 birds/km^2, +++ = 30-99 birds/km^2, ++++ = 100+ birds/km^2

TABLE 34. Relative Density of Seabirds in the SAINT GEORGE BASIN Area from Shipboard Transects in 1976.

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Arctic Loon	-[a]	-	o[b]	o	o	o	o	o	+	-	-	-
Unidentified Loon	-	-	o	o	o	o	o	o	+	-	-	-
Black-footed Albatross	-	-	o	o	o	o	o	o	+	-	-	-
Northern Fulmar	-	-	++	+	+	+	++	+	+	-	-	-
Sooty Shearwater	-	-	o	o	o	+	+	+	+	-	-	-
Short-tailed Shearwater	-	-	o	o	o	+	+	+	++++	-	-	-
Unidentified Shearwater	-	-	o	o	+	+	+++	++	+	-	-	-
Unidentified Procellarid	-	-	o	o	+	+	o	o	o	-	-	-
Fork-tailed Storm Petrel	-	-	+	+	+	+	+	+	+	-	-	-
Unidentified Storm Petrel	-	-	o	o	+	+	o	o	o	-	-	-
Double-crested Cormorant	-	-	o	+	o	o	o	o	o	-	-	-
Pelagic Cormorant	-	-	o	o	o	o	o	o	+	-	-	-
Red-faced Cormorant	-	-	o	+	+	+	+	o	+	-	-	-
Emperor Goose	-	-	o	o	+	o	o	o	o	-	-	-
Greater Scaup	-	-	o	o	+	o	o	o	o	-	-	-
Oldsquaw	-	-	+	o	+	o	o	o	o	-	-	-
Harlequin Duck	-	-	o	o	+	o	o	o	o	-	-	-
Steller's Eider	-	-	o	o	+	o	o	o	o	-	-	-
Common Eider	-	-	o	o	+	o	o	o	o	-	-	-
King Eider	-	-	o	o	+	o	o	o	o	-	-	-
White-winged Scoter	-	-	+	o	o	o	o	o	o	-	-	-
Unidentified Duck	-	-	o	o	+	+	o	o	o	-	-	-
Semipalmated Plover	-	-	o	o	o	o	o	o	+	-	-	-
Black Turnstone	-	-	o	o	o	o	o	o	+	-	-	-
Unidentified Shorebird	-	-	o	o	+	+	+	o	+	-	-	-
Red Phalarope	-	-	o	o	o	+	+	o	+	-	-	-
Northern Phalarope	-	-	o	o	o	o	o	o	+	-	-	-
Pomarine Jaeger	-	-	o	o	+	+	+	o	+	-	-	-
Parasitic Jaeger	-	-	o	o	o	o	o	o	+	-	-	-
Unidentified Jaeger	-	-	o	o	o	o	o	o	+	-	-	-

TABLE 34. Continued.

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Arctic Tern	-	-	o	o	o	+	o	+	+	-	-	-
Glaucous Gull	-	-	+	+	+	+	+	o	+	-	-	-
Glaucous-winged Gull	-	-	+	+	+	+	+	+	+	-	-	-
Herring Gull	-	-	o	o	+	o	o	o	o	-	-	-
Thayer's Gull	-	-	o	o	+	o	o	o	o	-	-	-
Slaty-backed Gull	-	-	o	o	+	o	o	o	o	-	-	-
Black-headed Gull	-	-	o	o	+	o	o	o	o	-	-	-
Black-legged Kittiwake	-	-	+	+	+	+	+	+	+	-	-	-
Red-legged Kittiwake	-	-	o	+	+	+	+	o	o	-	-	-
Unidentified Kittiwake	-	-	+	+	+	+	+	o	+	-	-	-
Sabine's Gull	-	-	o	o	o	o	o	o	+	-	-	-
Unidentified Gull	-	-	o	o	+	o	o	o	o	-	-	-
Common Murre	-	-	o	+	+	+	+	+	+	-	-	-
Thick-billed Murre	-	-	+	+	+	+	+	o	+	-	-	-
Unidentified Murre	-	-	+	++	+	+	++	+	+	-	-	-
Black Guillemot	-	-	o	o	+	o	o	o	o	-	-	-
Pigeon Guillemot	-	-	+	+	+	o	+	o	o	-	-	-
Marbled Murrelet	-	-	o	+	o	o	o	o	o	-	-	-
Ancient Murrelet	-	-	o	o	o	+	+	o	+	-	-	-
Parakeet Auklet	-	-	o	o	+	+	+	o	+	-	-	-
Crested Auklet	-	-	+	o	+	+	+	o	+	-	-	-
Whiskered Auklet	-	-	o	o	o	+	+	o	+	-	-	-
Least Auklet	-	-	+	+	+	+	+	o	+	-	-	-
Cassin's Auklet	-	-	o	+	o	o	o	o	o	-	-	-
Horned Puffin	-	-	+	o	+	+	+	o	+	-	-	-
Tufted Puffin	-	-	o	o	++	+	+	+	+	-	-	-
Unidentified Alcid	-	-	+	+	+	+	+	+	+	-	-	-
Unidentified Passerine	-	-	o	o	+	+	o	o	+	-	-	-
Unidentified Bird	-	-	o	o	+	o	+	o	+	-	-	-

a - = area not surveyed

b o = no birds, + = 1-9 birds/km^2, ++ = 10-29 birds/km^2, +++ = 30-99 birds/km^2, ++++ = 100+ birds/km^2

TABLE 35. Relative Density of Seabirds in the SOUTH CENTRAL BERING SEA Area from Shipboard Transects in 1976.

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Laysan Albatross	-[a]	-	-	o[b]	+	-	-	-	-	-	-	-
Northern Fulmar	-	-	-	+	++	-	-	-	-	-	-	-
Fork-tailed Storm Petrel	-	-	-	+	+	-	-	-	-	-	-	-
Unidentified Storm Petrel	-	-	-	o	+	-	-	-	-	-	-	-
Glaucous Gull	-	-	-	o	+	-	-	-	-	-	-	-
Glaucous-winged Gull	-	-	-	+	+	-	-	-	-	-	-	-
Black-legged Kittiwake	-	-	-	+	+	-	-	-	-	-	-	-
Unidentified Murre	-	-	-	+	+	-	-	-	-	-	-	-
Least Auklet	-	-	-	+	+	-	-	-	-	-	-	-
Tufted Puffin	-	-	-	+	++	-	-	-	-	-	-	-
Unidentified Alcid	-	-	-	+	+	-	-	-	-	-	-	-
Unidentified Bird	-	-	-	o	+	-	-	-	-	-	-	-

[a] - = area not surveyed

[b] o = no birds, + = 1-9 birds/km^2, ++ = 10-29 birds/km^2, +++ = 30-99 birds/km^2, ++++ = 100+ birds/km^2

TABLE 36. Relative Density of Seabirds in the BOWER'S BANK Area from Shipboard Transects in 1976.

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Laysan Albatross	-[a]	-	-	-	-	-	+[b]	-	-	-	-	-
Northern Fulmar	-	-	-	-	-	-	+	-	-	-	-	-
Short-tailed Shearwater	-	-	-	-	-	-	+	-	-	-	-	-
Unidentified Shearwater	-	-	-	-	-	-	+	-	-	-	-	-
Scaled Petrel	-	-	-	-	-	-	+	-	-	-	-	-
Fork-tailed Storm Petrel	-	-	-	-	-	-	+	-	-	-	-	-
Leach's Storm Petrel	-	-	-	-	-	-	+	-	-	-	-	-
Unidentified Storm Petrel	-	-	-	-	-	-	+	-	-	-	-	-
Unidentified Procellarid	-	-	-	-	-	-	+	-	-	-	-	-
Parasitic Jaeger	-	-	-	-	-	-	+	-	-	-	-	-
Glaucous-winged Gull	-	-	-	-	-	-	+	-	-	-	-	-
Black-legged Kittiwake	-	-	-	-	-	-	+	-	-	-	-	-
Unidentified Murre	-	-	-	-	-	-	+	-	-	-	-	-
Crested Auklet	-	-	-	-	-	-	+	-	-	-	-	-
Whiskered Auklet	-	-	-	-	-	-	+	-	-	-	-	-
Least Auklet	-	-	-	-	-	-	+	-	-	-	-	-
Horned Puffin	-	-	-	-	-	-	+	-	-	-	-	-
Tufted Puffin	-	-	-	-	-	-	+	-	-	-	-	-
Unidentified Alcid	-	-	-	-	-	-	+	-	-	-	-	-

[a] - = area not surveyed

[b] o = no birds, + = 1-9 birds/km^2, ++ = 10-29 birds/km^2, +++ = 30-99 birds/km^2, ++++ = 100+ birds/km^2

TABLE 37. Relative Density of Seabirds in the OCEANIC ALEUTIAN Area from Shipboard Transects in 1976.

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Laysan Albatross	-[a]	-	-	+[b]	+	-	-	-	-	-	-	-
Northern Fulmar	-	-	-	o	+	-	-	-	-	-	-	-
Short-tailed Shearwater	-	-	-	o	+	-	-	-	-	-	-	-
Unidentified Shearwater	-	-	-	o	+	-	-	-	-	-	-	-
Unidentified Procellarid	-	-	-	o	+	-	-	-	-	-	-	-
Unidentified Cormorant	-	-	-	o	+	-	-	-	-	-	-	-
Glaucous Gull	-	-	-	o	+	-	-	-	-	-	-	-
Glaucous-winged Gull	-	-	-	o	+	-	-	-	-	-	-	-
Black-headed Gull	-	-	-	o	+	-	-	-	-	-	-	-
Black-legged Kittiwake	-	-	-	o	+	-	-	-	-	-	-	-
Unidentified Gull	-	-	-	o	+	-	-	-	-	-	-	-
Unidentified Murre	-	-	-	o	+	-	-	-	-	-	-	-
Ancient Murrelet	-	-	-	+	o	-	-	-	-	-	-	-
Parakeet Auklet	-	-	-	o	+	-	-	-	-	-	-	-
Crested Auklet	-	-	-	o	+	-	-	-	-	-	-	-
Least Auklet	-	-	-	o	+	-	-	-	-	-	-	-
Unidentified Alcid	-	-	-	+++	++	-	-	-	-	-	-	-

a - = area not surveyed

b o = no birds, + = 1-9 birds/km^2, ++ = 10-29 birds/km^2, +++ = 30-99 birds/km^2
++++ = 100+ birds/km^2

TABLE 38. Relative Density of Seabirds in the UMNAK BASIN Area from Shipboard Transects in 1976.

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Northern Fulmar	-[a]	-	-	-	o[b]	+	o	-	-	-	-	-
Unidentified Procellarid	-	-	-	-	+	o	o	-	-	-	-	-
Pelagic Cormorant	-	-	-	-	o	+	o	-	-	-	-	-
Unidentified Shorebird	-	-	-	-	+	o	o	-	-	-	-	-
Glaucous-winged Gull	-	-	-	-	+	o	+	-	-	-	-	-
Black-legged Kittiwake	-	-	-	-	+	o	o	-	-	-	-	-
Unidentified Kittiwake	-	-	-	-	o	+	o	-	-	-	-	-
Unidentified Gull	-	-	-	-	+	o	o	-	-	-	-	-
Common Murre	-	-	-	-	+	+	o	-	-	-	-	-
Unidentified Murre	-	-	-	-	+	o	+	-	-	-	-	-
Pigeon Guillemot	-	-	-	-	o	+	+	-	-	-	-	-
Kittlitz's Murrelet	-	-	-	-	o	o	+	-	-	-	-	-
Ancient Murrelet	-	-	-	-	+	o	+	-	-	-	-	-
Least Auklet	-	-	-	-	+	o	o	-	-	-	-	-
Horned Puffin	-	-	-	-	o	+	o	-	-	-	-	-
Tufted Puffin	-	-	-	-	++	+++	+	-	-	-	-	-
Unidentified Alcid	-	-	-	-	+	o	+	-	-	-	-	-

[a] - = area not surveyed

[b] o = no birds, + = 1-9 birds/km^2, ++ = 10-29 birds/km^2, +++ = 30-99 birds/km^2, ++++ = 100+ birds/km^2

TABLE 39. Relative Density of Seabirds in the ALASKA PENINSULA SOUTH Area from Shipboard Transects in 1976.

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Unidentified Loon	- [a]	-	o [b]	o	o	o	o	o	+	o	-	-
Black-footed Albatross	-	-	o	o	o	o	o	o	o	+	-	-
Laysan Albatross	-	-	+	o	+	+	o	o	o	+	-	-
Northern Fulmar	-	-	+	+	+	+	+	+	+	+	-	-
Sooty Shearwater	-	-	o	o	++	o	+	+	+	+	-	-
Short-tailed Shearwater	-	-	o	o	o	+	o	o	+	+	-	-
Unidentified Shearwater	-	-	o	o	++++	++++	++++	+	+++	++	-	-
Scaled Petrel	-	-	o	o	o	o	o	o	o	+	-	-
Fork-tailed Storm Petrel	-	-	o	o	+	+	+	+	+	+	-	-
Leach's Storm Petrel	-	-	o	o	+	+	+	+	+	+	-	-
Unidentified Storm Petrel	-	-	o	o	+	+	o	+	o	o	-	-
Pelagic Cormorant	-	-	o	o	o	+	o	o	o	o	-	-
Red-faced Cormorant	-	-	+	o	+	+	+	o	o	o	-	-
Unidentified Cormorant	-	-	+	+	+	+	o	o	o	o	-	-
Oldsquaw	-	-	+	o	o	o	o	o	o	o	-	-
Harlequin Duck	-	-	o	o	o	+	o	o	o	o	-	-
Unidentified Shorebird	-	-	o	o	+	o	o	o	o	o	-	-
Red Phalarope	-	-	o	o	+	+	+	o	o	o	-	-
Northern Phalarope	-	-	o	o	+	o	+	o	+	o	-	-
Unidentified Phalarope	-	-	o	o	o	+	+	o	o	o	-	-
Pomarine Jaeger	-	-	o	o	o	+	+	o	+	+	-	-
Parasitic Jaeger	-	-	o	o	o	o	o	o	+	o	-	-
Unidentified Jaeger	-	-	o	o	o	+	+	o	o	o	-	-
Glaucous Gull	-	-	o	o	o	+	o	o	+	o	-	-
Glaucous-winged Gull	-	-	+	+	+	+	+	+	+	+	-	-
Black-legged Kittiwake	-	-	+	+	+	+	+	+	+	+	-	-
Red-legged Kittiwake	-	-	o	o	o	o	o	o	o	+	-	-
Unidentified Kittiwake	-	-	o	o	o	o	o	o	+	+	-	-
Arctic Tern	-	-	o	o	o	+	+	o	+	o	-	-
Aleutian Tern	-	-	o	o	o	o	o	o	+	o	-	-

TABLE 39. Continued.

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Common Murre	-	-	+	+	+	+	+	o	o	o	-	-
Thick-billed Murre	-	-	+	o	o	+	o	o	o	o	-	-
Unidentified Murre	-	-	+	+	+	+	+	+	+	+	-	-
Pigeon Guillemot	-	-	+	o	+	+	o	o	o	o	-	-
Marbled Murrelet	-	-	o	o	o	+	o	o	+	o	-	-
Kittlitz's Murrelet	-	-	o	o	+	o	o	o	o	o	-	-
Ancient Murrelet	-	-	o	+	+	+	+	o	+	o	-	-
Rhinocerous Auklet	-	-	o	o	o	+	o	o	o	o	-	-
Parakeet Auklet	-	-	o	o	o	+	+	+	+	+	-	-
Crested Auklet	-	-	o	o	o	+	+	o	o	o	-	-
Least Auklet	-	-	o	o	+	o	o	o	o	o	-	-
Cassin's Auklet	-	-	o	o	+	+	+	o	+	o	-	-
Horned Puffin	-	-	o	o	+	+	+	+	+	+	-	-
Tufted Puffin	-	-	o	o	+	+	++	+	+	+	-	-
Unidentified Alcid	-	-	+	o	+	+	+	o	+	+	-	-
Unidentified Bird	-	-	o	o	o	+	o	o	o	o	-	-

[a] - = area not surveyed

[b] o = no birds, + = 1-9 birds/km^2, ++ = 10-29 birds/km^2, +++ = 30-99 birds/km^2, ++++ = 100+ birds/km^2

TABLE 40. Relative Density of Seabirds in the KODIAK BASIN Area from Shipboard Transects in 1976-1977.

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Black-footed Albatross	o[b]	o	o	o	+	o	+	o	+	+	+	-[a]
Laysan Albatross	o	o	+	o	+	o	o	o	o	o	o	-
Northern Fulmar	+	+	+	+	+	++	+	+	+	+	++	-
Sooty Shearwater	o	o	o	+	++	+	+	+++	+	+	+	-
Short-tailed Shearwater	o	o	o	o	+	o	+	+	+	+	o	-
Unidentified Shearwater	o	o	+	+	++++	++++	+++	+	++	++	+	-
Scaled Petrel	o	o	o	o	o	o	+	o	o	+	o	-
Fork-tailed Storm Petrel	o	+	+	+	+	+	+	+	+	+	+	-
Leach's Storm Petrel	o	o	o	o	+	+	+	+	+	o	o	-
Unidentified Storm Petrel	o	o	o	o	o	+	+	o	o	o	o	-
Unidentified Procellarid	o	o	o	+	o	+	o	o	o	o	o	-
Double-crested Cormorant	o	o	+	o	+	+	o	o	o	o	o	-
Pelagic Cormorant	o	o	+	o	+	+	o	o	o	o	o	-
Red-faced Cormorant	o	o	o	o	o	+	o	o	o	+	o	-
Unidentified Cormorant	o	+	+	+	+	+	+	o	o	o	o	-
Oldsquaw	o	o	+	o	+	o	o	o	o	o	o	-
Harlequin Duck	o	o	o	o	o	o	o	o	o	+	o	-
Unidentified Eider	o	o	o	o	+	o	o	o	o	o	o	-
White-winged Scoter	o	o	+	o	o	o	o	o	o	o	o	-
Unidentified Duck	o	o	o	o	o	o	o	o	o	o	+	-
Red Knot	o	o	o	+	o	o	o	o	o	o	+	-
Unidentified Shorebird	o	o	o	o	+	o	o	o	o	o	o	-
Red Phalarope	o	o	o	o	+	+	o	o	o	o	o	-
Northern Phalarope	o	o	o	o	o	+	+	o	o	o	o	-
Unidentified Phalarope	o	o	o	o	+	o	+	o	o	o	o	-
Skua	o	o	o	o	o	o	+	o	o	o	o	-
Pomarine Jaeger	o	o	o	o	+	+	+	o	o	+	+	-
Parasitic Jaeger	o	o	o	o	o	+	+	o	o	+	o	-
Long-tailed Jaeger	o	o	o	o	o	o	+	o	o	o	o	-
Unidentified Jaeger	o	o	o	o	+	+	o	o	o	o	o	-

TABLE 40. Continued.

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Glaucous Gull	o	+	+	o	+	o	+	o	o	o	o	-
Glaucous-winged Gull	+	+	+	+	+	+	+	o	o	+	+	-
Herring Gull	o	+	+	o	+	o	o	o	o	o	+	-
Mew Gull	o	o	+	o	o	+	+	o	o	o	o	-
Black-legged Kittiwake	+	+	+	+	+	+	+	o	o	+	o	-
Red-legged Kittiwake	+	+	o	o	o	o	o	o	o	o	+	-
Unidentified Kittiwake	o	o	o	o	o	o	+	+	o	o	+	-
Unidentified Gull	+	+	+	+	+	o	+	+	o	o	+	-
Arctic Tern	o	o	o	+	+	+	+	+	+	o	o	-
Aleutian Tern	o	o	o	o	o	o	+	o	o	o	o	-
Common Murre	o	+	+	o	+	+	+	o	o	+	o	-
Thick-billed Murre	+	+	+	o	o	+	+	o	o	+	+	-
Unidentified Murre	++	+	+	+	+	+	+	+	+	+	+	-
Pigeon Guillemot	++	o	o	o	+	+	+	o	o	o	o	-
Marbled Murrelet	o	o	o	o	+	+	+	o	o	o	o	-
Ancient Murrelet	o	o	+	o	o	+	+	o	o	o	o	-
Rhinocerous Auklet	o	o	o	o	o	o	o	o	o	+	o	-
Parakeet Auklet	o	o	o	o	+	+	o	+	+	o	o	-
Crested Auklet	o	o	o	o	o	+	+	o	+	o	o	-
Cassin's Auklet	o	o	o	o	+	+	o	o	+	+	+	-
Horned Puffin	o	+	o	o	+	+	+	o	+	+	+	-
Tufted Puffin	+	+	+	o	+	+	+	+	+	+	+	-
Unidentified Alcid	+	+	+	o	+	+	+	+	+	+	+	-
Fox Sparrow	o	o	o	+	+	o	o	o	o	o	o	-
Unidentified Bird	o	o	+	+	+	+	o	+	o	o	+	-

[a] - = area not surveyed

[b] o = no birds, + = 1-9 birds/km^2, ++ = 10-29 birds/km^2, +++ = 30-99 birds/km^2, ++++ = 100+ birds/km^2

TABLE 41. Relative Density of Seabirds in the SHELIKOF STRAITS Area from Shipboard Transects in 1976.

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Unidentified Loon	-[a]	-	-	-	+[b]	o	o	-	-	o	o	-
Northern Fulmar	-	-	-	-	+	+	+	-	-	o	+	-
Pink-footed Shearwater	-	-	-	-	o	o	o	-	-	o	+	-
Sooty Shearwater	-	-	-	-	o	+	o	-	-	o	+	-
Short-tailed Shearwater	-	-	-	-	o	+	o	-	-	o	o	-
Unidentified Shearwater	-	-	-	-	++++	+	o	-	-	+	++	-
Fork-tailed Storm Petrel	-	-	-	-	+	+	+	-	-	o	+	-
Unidentified Procellarid	-	-	-	-	o	+	o	-	-	o	o	-
Unidentified Cormorant	-	-	-	-	o	o	o	-	-	o	+	-
Unidentified Duck	-	-	-	-	o	o	o	-	-	+	o	-
Unidentified Shorebird	-	-	-	-	+	o	o	-	-	o	o	-
Red Phalarope	-	-	-	-	+	+	o	-	-	o	o	-
Unidentified Phalarope	-	-	-	-	+	o	o	-	-	o	o	-
Pomarine Jaeger	-	-	-	-	o	+	o	-	-	o	o	-
Parasitic Jaeger	-	-	-	-	o	o	o	-	-	o	+	-
Glaucous Gull	-	-	-	-	+	+	o	-	-	o	+	-
Glaucous-winged Gull	-	-	-	-	+	+	o	-	-	+	+	-
Herring Gull	-	-	-	-	+	o	o	-	-	o	o	-
Black-legged Kittiwake	-	-	-	-	+	+	o	-	-	o	o	-
Unidentified Kittiwake	-	-	-	-	o	o	o	-	-	+	++	-
Unidentified Gull	-	-	-	-	+	o	o	-	-	o	+	-
Arctic Tern	-	-	-	-	+	o	o	-	-	o	o	-
Common Murre	-	-	-	-	+	+	o	-	-	o	o	-
Unknown Murre	-	-	-	-	+	+	+	-	-	+	+	-
Pigeon Guillemot	-	-	-	-	o	+	o	-	-	o	o	-
Marbled Murrelet	-	-	-	-	o	+	o	-	-	o	o	-
Ancient Murrelet	-	-	-	-	o	+	o	-	-	o	o	-
Cassin's Auklet	-	-	-	-	o	o	o	-	-	o	+	-

TABLE 41. Continued.

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Horned Puffin	-	-	-	-	o	o	o	-	-	o	+	-
Tufted Puffin	-	-	-	-	+	+	+	-	-	+	+	-
Unidentified Alcid	-	-	-	-	+	+	o	-	-	o	+	-
Unidentified Bird	-	-	-	-	o	o	o	-	-	o	+	-

[a] - = area not surveyed
[b] o = no birds, + = 1-9 birds/km^2, ++ = 10-29 birds/km^2, +++ = 30-99 birds/km^2, ++++ = 100+ birds/km^2

TABLE 42. Relative Density of Seabirds in the UPPER COOK INLET Area from Shipboard Transects in 1976.

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Mew Gull	-[a]	-	-	+[b]	-	-	-	-	-	-	-	-

[a] - = area not surveyed
[b] o = no birds, + = 1-9 birds/km^2, ++ = 10-29 birds/km^2, +++ = 30-99 birds/km^2, +++ = 100+ birds/km^2

TABLE 43. Relative Density of Seabirds in the LOWER COOK INLET Area from Shipboard Transects in 1976.

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Arctic Loon	-[a]	-	-	o[b]	+	-	-	-	-	o	o	-
Unidentified Loon	-	-	-	o	+	-	-	-	-	+	o	-
Northern Fulmar	-	-	-	o	o	-	-	-	-	+	+	-
Sooty Shearwater	-	-	-	o	o	-	-	-	-	+	o	-
Unidentified Shearwater	-	-	-	o	+	-	-	-	-	+	++	-
Double-crested Cormorant	-	-	-	+	o	-	-	-	-	o	o	-
Pelagic Cormorant	-	-	-	+	o	-	-	-	-	o	o	-
Unidentified Cormorant	-	-	-	o	+	-	-	-	-	o	o	-
Pintail	-	-	-	+	+	-	-	-	-	o	o	-
Oldsquaw	-	-	-	+	o	-	-	-	-	o	o	-
Common Eider	-	-	-	+	o	-	-	-	-	o	o	-
White-winged Scoter	-	-	-	+	+	-	-	-	-	+	o	-
Unidentified Duck	-	-	-	+	+	-	-	-	-	o	o	-
Unidentified Shorebird	-	-	-	o	+	-	-	-	-	o	o	-
Northern Phalarope	-	-	-	o	+	-	-	-	-	o	o	-
Red Phalarope	-	-	-	o	+	-	-	-	-	o	o	-
Pomarine Jaeger	-	-	-	o	o	-	-	-	-	+	o	-
Glaucous-winged Gull	-	-	-	+	+	-	-	-	-	+	o	-
Herring Gull	-	-	-	+	o	-	-	-	-	o	o	-
Mew Gull	-	-	-	+	o	-	-	-	-	+	o	-
Black-legged Kittiwake	-	-	-	+	+	-	-	-	-	+	o	-
Unidentified Kittiwake	-	-	-	o	o	-	-	-	-	+	+	-
Unidentified Gull	-	-	-	+	+	-	-	-	-	o	o	-
Arctic Tern	-	-	-	o	+	-	-	-	-	o	o	-
Common Murre	-	-	-	o	+	-	-	-	-	o	o	-
Unidentified Murre	-	-	-	+	+	-	-	-	-	+	+	-
Pigeon Guillemot	-	-	-	+	+	-	-	-	-	o	o	-
Marbled Murrelet	-	-	-	+	+	-	-	-	-	o	o	-
Kittlitz's Murrelet	-	-	-	+	o	-	-	-	-	o	o	-
Ancient Murrelet	-	-	-	+	o	-	-	-	-	o	o	-

TABLE 43. Continued.

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Parakeet Auklet	-	-	-	+	o	-	-	-	-	o	o	-
Tufted Puffin	-	-	-	o	+	-	-	-	-	+	+	-
Unidentified Alcid	-	-	-	+	+	-	-	-	-	o	o	-
Northwestern Crow	-	-	-	+	o	-	-	-	-	o	o	-
Unidentified Passerine	-	-	-	+	o	-	-	-	-	o	o	-
Unidentified Bird	-	-	-	o	o	-	-	-	-	o	+	-

[a] - = area not surveyed
[b] o = no birds, + = 1-9 birds/km^2, ++ = 10-29 birds/km^2, +++ = 30-99 birds/km^2, +++ = 100+ birds/km^2

TABLE 44. Relative Density of Seabirds in the PRINCE WILLIAM SOUND **Area** from Shipboard Transects in 1976.

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Common Loon	-[a]	o[b]	o	o	+	o	-	-	-	-	-	-
Fork-tailed Storm Petrel	-	o	o	+	+	o	-	-	-	-	-	-
Oldsquaw	-	o	o	o	+	o	-	-	-	-	-	-
Northern Phalarope	-	o	o	o	+	o	-	-	-	-	-	-
Glaucous-winged Gull	-	+	+	+	+	o	-	-	-	-	-	-
Herring Gull	-	o	+	+	o	o	-	-	-	-	-	-
Mew Gull	-	+	o	o	o	o	-	-	-	-	-	-
Black-legged Kittiwake	-	o	o	+	+	+	-	-	-	-	-	-
Unidentified Gull	-	o	+	+	+	o	-	-	-	-	-	-
Arctic Tern	-	o	o	o	+	o	-	-	-	-	-	-
Common Murre	-	o	o	o	o	+	-	-	-	-	-	-
Thick-billed Murre	-	o	o	o	o	+	-	-	-	-	-	-
Unidentified Murre	-	+	o	+	+	+	-	-	-	-	-	-
Pigeon Guillemot	-	o	o	+	+	+	-	-	-	-	-	-
Marbled Murrelet	-	o	o	+	+	+	-	-	-	-	-	-
Ancient Murrelet	-	o	o	+	o	o	-	-	-	-	-	-

TABLE 44. Continued

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Tufted Puffin	-	o	o	o	+	o	-	-	-	-	-	-
Unidentified Alcid	-	+	o	+	+	o	-	-	-	-	-	-

[a] - = area not surveyed

[b] o = no birds, + = 1-9 birds/km^2, ++ = 10-29 birds/km^2, +++ = 30-99 birds/km^2, ++++ = 100+ birds/km^2

TABLE 45. Relative Density of Seabirds in the NORTHWEST GULF OF ALASKA Area from Shipboard Transects in 1976-1977.

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Arctic Loon	o[b]	o	o	+	o	o	o	-[a]	-	o	o	-
Common Loon	o	o	o	o	+	o	o	-	-	o	o	-
Yellow-billed Loon	o	o	o	o	o	o	o	-	-	+	o	-
Unidentified Loon	o	o	o	o	+	+	o	-	-	o	o	-
Black-footed Albatross	o	o	+	o	+	o	+	-	-	o	o	-
Northern Fulmar	+	+	+	+	+	+	+	-	-	+	+	-
Sooty Shearwater	o	o	o	+	+	+	o	-	-	o	+	-
Short-tailed Shearwater	o	o	o	+	+	+	+++	-	-	o	o	-
Unidentified Shearwater	o	o	o	+	+++	++++	+++	-	-	++	+	-
Fork-tailed Storm Petrel	o	o	+	+	++	+	++	-	-	+	+	-
Leach's Storm Petrel	o	o	o	o	o	o	+	-	-	o	o	-
Unidentified Procellarid	o	o	o	+	o	o	o	-	-	o	o	-
Double-crested Cormorant	o	o	o	o	o	+	o	-	-	o	o	-
Pelagic Cormorant	o	o	o	+	o	+	o	-	-	o	o	-
Red-faced Cormorant	o	o	o	o	+	+	o	-	-	o	o	-
Unidentified Cormorant	o	o	+	+	+	+	o	-	-	o	+	-
Oldsquaw	o	o	o	o	+	o	o	-	-	o	o	-
Harlequin Duck	o	o	o	o	o	o	o	-	-	+	o	-
White-winged Scoter	o	o	o	o	o	o	o	-	-	+	o	-

TABLE 45. Continued

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Golden Plover	o	o	o	o	+	o	o	-	-	o	o	-
Unidentified Shorebird	o	o	o	o	+	o	o	-	-	o	o	-
Red Phalarope	o	o	o	o	+	+	o	-	-	o	o	-
Northern Phalarope	o	o	o	o	+	+	+	-	-	o	o	-
Unidentified Phalarope	o	o	o	o	+	o	+	-	-	o	o	-
Pomarine Jaeger	o	o	o	o	o	o	+	-	-	o	o	-
Long-tailed Jaeger	o	o	o	o	o	o	+	-	-	o	o	-
Unidentified Jaeger	o	o	o	o	+	o	o	-	-	o	o	-
Glaucous Gull	o	o	+	o	o	o	o	-	-	o	o	-
Glaucous-winged Gull	+	+	+	+	+	+	+	-	-	+	+	-
Herring Gull	+	+	+	+	o	o	o	-	-	o	+	-
Slaty-backed Gull	+	o	o	o	o	o	o	-	-	o	o	-
Mew Gull	o	o	+	o	+	+	o	-	-	o	+	-
Black-legged Kittiwake	+	o	+	+	+	+	+	-	-	+	+	-
Red-legged Kittiwake	+	o	+	o	o	o	o	-	-	o	+	-
Unidentified Kittiwake	o	o	o	o	o	o	+	-	-	o	o	-
Sabine's Gull	o	o	o	o	o	o	o	-	-	o	+	-
Unidentified Gull	+	+	+	+	+	+	o	-	-	o	+	-
Arctic Tern	o	o	o	+	+	o	+	-	-	o	o	-
Aleutian Tern	o	o	o	o	o	o	+	-	-	o	o	-
Common Murre	+	+	+	+	+	+	o	-	-	o	+	-
Thick-billed Murre	+	o	+	o	o	o	o	-	-	o	o	-
Unidentified Murre	++	+	+	+	+	+	+	-	-	+	+	-
Pigeon Guillemot	o	o	o	o	+	+	o	-	-	o	o	-
Marbled Murrelet	o	o	+	+	+	+	+	-	-	o	o	-
Kittlitz's Murrelet	+	o	o	o	o	o	o	-	-	o	o	-
Ancient Murrelet	o	o	+	o	+	o	+	-	-	o	o	-
Rhinocerous Auklet	o	o	o	o	+	o	+	-	-	o	o	-
Parakeet Auklet	o	o	o	o	o	+	+	-	-	o	o	-
Cassin's Auklet	o	o	o	o	+	o	+	-	-	o	o	-
Horned Puffin	o	o	o	+	+	+	+	-	-	o	+	-
Tufted Puffin	+	o	+	+	+	+	+	-	-	+	+	-
Unidentified Alcid	+	+	+	+	+	+	+	-	-	o	+	-

TABLE 45. Continued

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Bald Eagle	o	o	o	o	+	o	o	-	-	o	o	-
Unidentified Passerine	o	o	o	+	o	o	o	-	-	o	o	-
Unidentified Bird	+	o	o	o	+	o	o	-	-	o	+	-

[a] - = area not surveyed
[b] o = no birds, + = 1-9 birds/km^2, ++ = 10-29 birds/km^2, +++ = 30-99 birds/km^2, ++++ = 100+ birds/km^2

TABLE 46. Relative Density of Seabirds in the NORTHEAST GULF OF ALASKA Area from Shipboard Transects in 1976-1977.

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Arctic Loon	-[a]	o[b]	o	o	+	o	o	-	-	-	o	-
Common Loon	-	o	o	o	+	o	o	-	-	-	o	-
Yellow-billed Loon	-	o	o	o	+	o	o	-	-	-	o	-
Unidentified Loon	-	+	o	+	+	o	o	-	-	-	o	-
Black-footed Albatross	-	o	o	+	+	+	+	-	-	-	o	-
Laysan Albatross	-	o	o	o	o	+	o	-	-	-	o	-
Northern Fulmar	-	+	+	+	+	+	+	-	-	-	+	-
Sooty Shearwater	-	o	o	+	++	+	+	-	-	-	o	-
Short-tailed Shearwater	-	+	o	+	+++	+	o	-	-	-	o	-
Unidentified Shearwater	-	o	+	+	+++	+++	+	-	-	-	o	-
Scaled Petrel	-	o	o	o	+	o	+	-	-	-	o	-
Fork-tailed Storm Petrel	-	+	+	+	+	+	+	-	-	-	+	-
Leach's Storm Petrel	-	o	o	o	o	o	+	-	-	-	o	-
Unidentified Storm Petrel	-	o	+	+	o	o	o	-	-	-	o	-
Pelagic Cormorant	-	o	o	+	o	o	o	-	-	-	o	-
Unidentified Cormorant	-	+	+	+	o	o	o	-	-	-	o	-

TABLE 46. Continued.

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Black Brant	-	o	o	+	o	o	o	-	-	-	o	-
Unidentified Goose	-	o	o	o	+	o	o	-	-	-	o	-
Mallard	-	o	o	o	+	o	o	-	-	-	o	-
Pintail	-	o	o	+	o	o	o	-	-	-	o	-
Oldsquaw	-	o	o	o	+	o	o	-	-	-	o	-
White-winged Scoter	-	o	+	o	o	o	+	-	-	-	o	-
Unidentified Duck	-	+	+	+	+	o	o	-	-	-	o	-
Unidentified Shorebird	-	o	o	o	+	+	+	-	-	-	o	-
Red Phalarope	-	o	o	o	+	+	o	-	-	-	o	-
Northern Phalarope	-	o	o	o	+	+	o	-	-	-	o	-
Unidentified Phalarope	-	o	o	o	+	o	o	-	-	-	o	-
Pomarine Jaeger	-	o	o	o	+	+	o	-	-	-	o	-
Parasitic Jaeger	-	o	o	o	+	o	+	-	-	-	o	-
Long-tailed Jaeger	-	o	o	o	+	o	+	-	-	-	o	-
Unidentified Jaeger	-	o	o	o	+	o	o	-	-	-	o	-
Glaucous Gull	-	o	+	+	+	o	o	-	-	-	o	-
Glaucous-winged Gull	-	+	+	+	+	+	+	-	-	-	+	-
Herring Gull	-	+	+	+	+	+	+	-	-	-	o	-
Thayer's Gull	-	o	o	+	o	o	o	-	-	-	o	-
Mew Gull	-	o	+	+	+	o	o	-	-	-	o	-
Black-legged Kittiwake	-	+	+	+	+	+	+	-	-	-	+	-
Sabine's Gull	-	o	o	o	+	+	o	-	-	-	+	-
Unidentified Gull	-	+	+	+	+	o	o	-	-	-	+	-
Arctic Tern	-	o	o	+	+	+	+	-	-	-	o	-
Aleutian Tern	-	o	o	o	+	+	o	-	-	-	o	-
Unidentified Tern	-	o	o	o	+	o	o	-	-	-	o	-
Common Murre	-	+	o	+	+	+	+	-	-	-	o	-
Unidentified Murre	-	+	+	+	+	+	o	-	-	-	o	-
Pigeon Guillemot	-	o	o	o	+	o	o	-	-	-	o	-
Marbled Murrelet	-	o	+	+	+	+	o	-	-	-	o	-
Kittlitz's Murrelet	-	o	o	+	+	+	o	-	-	-	o	-

TABLE 46. Continued.

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Ancient Murrelet	-	o	+	+	o	o	+	-	-	-	o	-
Rhinocerous Auklet	-	o	o	+	o	o	+	-	-	-	o	-
Parakeet Auklet	-	o	o	o	o	+	+	-	-	-	o	-
Cassin's Auklet	-	o	+	+	o	o	+	-	-	-	o	-
Horned Puffin	-	+	+	o	+	+	o	-	-	-	o	-
Tufted Puffin	-	+	+	+	+	+	+	-	-	-	+	-
Unidentified Alcid	-	+	+	+	+	o	+	-	-	-	+	-
Unidentified Bird	-	+	o	o	+	+	o	-	-	-	o	-

[a] - = area not surveyed

[b] o = no birds, + = 1-9 birds/km^2, ++ = 10-29 birds/km^2, +++ = 30-99 birds/km^2, ++++ = 100+ birds/km^2

TABLE 47. Relative Density of Seabirds in the OCEANIC ALASKA PENINSULA SOUTH Area from Shipboard Transects in 1976-1977.

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Unidentified Loon	-[a]	-	-	-	-	o[b]	o	-	-	+	-	-
Black-footed Albatross	-	-	-	-	-	o	+	-	-	+	-	-
Laysan Albatross	-	-	-	-	-	o	o	-	-	+	-	-
Northern Fulmar	-	-	-	-	-	+	+	-	-	+	-	-
Sooty Shearwater	-	-	-	-	-	o	o	-	-	+	-	-
Short-tailed Shearwater	-	-	-	-	-	o	o	-	-	+	-	-
Unidentified Shearwater	-	-	-	-	-	+	+	-	-	+	-	-
Scaled Petrel	-	-	-	-	-	o	+	-	-	+	-	-
Fork-tailed Storm Petrel	-	-	-	-	-	+	+	-	-	+	-	-
Leach's Storm Petrel	-	-	-	-	-	+	+	-	-	+	-	-
Unidentified Storm Petrel	-	-	-	-	-	+	o	-	-	o	-	-

TABLE 47. Continued.

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Unidentified Phalarope	-[a]	-	-	-	-	o[b]	+	-	-	o	-	-
Pomarine Jaeger	-	-	-	-	-	o	+	-	-	+	-	-
Parasitic Jaeger	-	-	-	-	-	o	o	-	-	+	-	-
Unidentified Jaeger	-	-	-	-	-	o	+	-	-	o	-	-
Glaucous-winged Gull	-	-	-	-	-	o	o	-	-	+	-	-
Herring Gull	-	-	-	-	-	o	o	-	-	+	-	-
Black-legged Kittiwake	-	-	-	-	-	+	o	-	-	+	-	-
Parakeet Auklet	-	-	-	-	-	o	o	-	-	+	-	-
Horned Puffin	-	-	-	-	-	+	o	-	-	+	-	-
Tufted Puffin	-	-	-	-	-	o	+	-	-	+	-	-
Unidentified Alcid	-	-	-	-	-	+	o	-	-	o	-	-
Winter Wren	-	-	-	-	-	o	o	-	-	+	-	-
Water Pipit	-	-	-	-	-	o	o	-	-	+	-	-
Unidentified Bird	-	-	-	-	-	o	o	-	-	+	-	-

[a] - = area not surveyed

[b] o = no birds, + = 1-9 birds/km^2, ++ = 10-29 birds/km^2, +++ = 30-99 birds/km^2, ++++ = 100+ birds/km^2

TABLE 48. Relative Density of Seabirds in the OCEANIC SOUTH KODIAK Area from Shipboard Transects in 1976-1977.

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Black-footed Albatross	-	-	-	-	-	o	-	+	-	-	-	-
Northern Fulmar	-	-	-	-	-	+	-	o	-	-	-	-
Sooty Shearwater	-	-	-	-	-	o	-	+	-	-	-	-
Unidentified Shearwater	-	-	-	-	-	+	-	+	-	-	-	-
Scaled Petrel	-	-	-	-	-	+	-	+	-	-	-	-
Fork-tailed Storm Petrel	-	-	-	-	-	+	-	o	-	-	-	-
Leach's Storm Petrel	-	-	-	-	-	+	-	o	-	-	-	-

TABLE 48. Continued.

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Unidentified Storm Petrel	-	-	-	-	-	o	-	+	-	-	-	-
Tufted Puffin	-	-	-	-	-	+	-	o	-	-	-	-

[a] - = area not surveyed
[b] o = no birds, + = 1-9 birds/km^2, ++ = 10-29 birds/km^2, +++ = 30-99 birds/km^2, ++++ = 100+ birds/km^2

TABLE 49. Relative Density of Seabirds in the OCEANIC GULF OF ALASKA Area from Shipboard Transects in 1976-1977.

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Black-footed Albatross	-[a]	o[b]	o	o	-	o	+	-	-	-	o	-
Northern Fulmar	-	+	+	+	-	+	+	-	-	-	+	-
Sooty Shearwater	-	o	o	+	-	o	+++	-	-	-	o	-
Unidentified Shearwater	-	o	+	+++	-	+	o	-	-	-	o	-
Scaled Petrel	-	o	o	o	-	+	+	-	-	-	o	-
Fork-tailed Storm Petrel	-	+	o	+	-	+	+	-	-	-	+	-
Leach's Storm Petrel	-	o	o	o	-	+	+	-	-	-	+	-
Unidentified Storm Petrel	-	+	o	+	-	o	o	-	-	-	o	-
Black Brant	-	o	o	+	-	o	o	-	-	-	o	-
Pomarine Jaeger	-	o	o	o	-	o	+	-	-	-	o	-
Long-tailed Jaeger	-	o	o	o	-	o	+	-	-	-	o	-
Unidentified Jaeger	-	o	o	+	-	o	+	-	-	-	o	-
Glaucous-winged Gull	-	+	+	+	-	o	o	-	-	-	+	-
Herring Gull	-	o	o	o	-	o	o	-	-	-	+	-
Black-legged Kittiwake	-	+	+	+	-	o	o	-	-	-	o	-
Unidentified Kittiwake	-	o	o	o	-	o	o	-	-	-	+	-
Unidentified Gull	-	+	o	o	-	o	+	-	-	-	o	-

TABLE 49. Continued.

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Unidentified Murre	-	+	+	o	-	o	o	-	-	-	+	-
Parakeet Auklet	-	o	o	o	-	o	+	-	-	-	o	-
Horned Puffin	-	+	o	o	-	o	+	-	-	-	+	-
Tufted Puffin	-	+	+	+	-	o	o	-	-	-	+	-
Unidentified Alcid	-	+	o	o	-	o	o	-	-	-	o	-
Unidentified Bird	-	o	o	o	-	o	o	-	-	-	+	-

[a] - = area not surveyed
[b] o = no birds, + = 1-9 birds/km^2, ++ = 10-29 birds/km^2, +++ = 30-99 birds/km^2, ++++ = 100+ birds/km^2

TABLE 50. Relative Density of Seabirds in the OCEANIC BRITISH COLUMBIA Area from Shipboard Transects in 1976-1977.

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Black-footed Albatross	-[a]	+[b]	+	-	-	+	+	+	-	-	-	-
Laysan Albatross	-	o	o	-	-	o	o	o	-	-	-	-
Northern Fulmar	-	+	+	-	-	+	o	o	-	-	-	-
Sooty Shearwater	-	o	o	-	-	+	+	+	-	-	-	-
Short-tailed Shearwater	-	o	o	-	-	o	o	+	-	-	-	-
Unidentified Shearwater	-	o	+	-	-	+	+	o	-	-	-	-
Scaled Petrel	-	o	o	-	-	+	o	o	-	-	-	-
Fork-tailed Storm Petrel	-	+	+	-	-	+	o	+	-	-	-	-
Leach's Storm Petrel	-	+	o	-	-	+	+	+	-	-	-	-
Unidentified Storm Petrel	-	+	o	-	-	+	+	+	-	-	-	-
Unidentified Procellarid	-	o	+	-	-	o	o	o	-	-	-	-
Skua	-	o	o	-	-	+	o	o	-	-	-	-
Glaucous-winged Gull	-	+	+	-	-	o	o	o	-	-	-	-
Herring Gull	-	+	+	-	-	o	o	o	-	-	-	-

TABLE 50. Continued.

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Black-legged Kittiwake	-	+	+	-	-	o	o	o	-	-	-	-
Unidentified Kittiwake	-	+	o	-	-	o	o	o	-	-	-	-
Unidentified Gull	-	+	+	-	-	o	o	o	-	-	-	-
Arctic Tern	-	o	o	-	-	+	o	+	-	-	-	-
Unidentified Murre	-	o	+	-	-	o	o	o	-	-	-	-
Ancient Murrelet	-	+	o	-	-	+	o	o	-	-	-	-
Rhinocerous Auklet	-	+	o	-	-	o	o	o	-	-	-	-
Cassin's Auklet	-	+	o	-	-	+	o	o	-	-	-	-
Horned Puffin	-	o	o	-	-	+	o	o	-	-	-	-
Tufted Puffin	-	+	o	-	-	+	+	o	-	-	-	-
Unidentified Alcid	-	+	+	-	-	+	o	o	-	-	-	-

[a] - = area not surveyed

[b] o = no birds, + = 1-9 birds/km^2, ++ = 10-29 birds/km^2, +++ = 30-99 birds/km^2, ++++ = 100+ birds/km^2

TABLE 51. Relative Density of Seabirds in the SOUTHEAST ALASKA SHELF Area from Shipboard Transects in 1976-1977.

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Unidentified Loon	o[b]	+	o	o	+	-[a]	o	-	-	-	-	-
Common Loon	o	+	o	o	+	-	o	-	-	-	-	-
Black-footed Albatross	o	o	+	o	o	-	o	-	-	-	-	-
Northern Fulmar	o	+	+	o	o	-	+	-	-	-	-	-
Fork-tailed Storm Petrel	o	o	+	o	o	-	+	-	-	-	-	-
Double-crested Cormorant	o	o	o	o	o	-	+	-	-	-	-	-
Pelagic Cormorant	o	+	+	o	o	-	o	-	-	-	-	-
Unidentified Cormorant	+	+	o	o	o	-	o	-	-	-	-	-
Emperor Goose	o	+	o	o	o	-	o	-	-	-	-	-
Barrow's Goldeneye	+	o	o	o	o	-	o	-	-	-	-	-
Common Merganser	o	+	o	o	o	-	o	-	-	-	-	-

TABLE 51. Continued.

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Red-breasted Merganser	o	+	o	o	o	-	o	-	-	-	-	-
Surf Scoter	o	o	o	o	o	-	+	-	-	-	-	-
Unidentified Scoter	o	o	o	o	o	-	+	-	-	-	-	-
Unidentified Duck	o	+	o	o	o	-	o	-	-	-	-	-
Northern Phalarope	o	o	o	o	o	-	+	-	-	-	-	-
Glaucous-winged Gull	o	+	+	o	+	-	+	-	-	-	-	-
Herring Gull	+	+	+	o	o	-	+	-	-	-	-	-
Mew Gull	+	+	+	o	o	-	o	-	-	-	-	-
Black-legged Kittiwake	o	+	+	o	o	-	+	-	-	-	-	-
Unidentified Kittiwake	o	o	+	o	o	-	o	-	-	-	-	-
Unidentified Gull	+	+	+	o	+	-	o	-	-	-	-	-
Common Murre	o	+	+	o	o	-	+	-	-	-	-	-
Thick-billed Murre	o	+	+	o	o	-	o	-	-	-	-	-
Unidentified Murre	+	+	+	+	o	-	+	-	-	-	-	-
Pigeon Guillemot	o	+	o	o	o	-	+	-	-	-	-	-
Marbled Murrelet	o	+	o	o	+	-	+	-	-	-	-	-
Kittlitz's Murrelet	o	o	o	o	+	-	+	-	-	-	-	-
Ancient Murrelet	o	+	+	o	o	-	o	-	-	-	-	-
Cassin's Auklet	o	+	o	o	o	-	o	-	-	-	-	-
Tufted Puffin	o	o	+	o	o	-	o	-	-	-	-	-
Unidentified Alcid	+	+	+	+	o	-	+	-	-	-	-	-
Bald Eagle	+	+	o	o	o	-	+	-	-	-	-	-
Unidentified Bird	o	+	+	o	o	-	o	-	-	-	-	-

[a] - = area not surveyed

[b] o = no birds, + = 1-9 birds/km^2, ++ = 10-29 birds/km^2, +++ = 30-99 birds/km^2, ++++ = 100+ birds/km^2

TABLE 52. Relative Density of Seabirds in the BRITISH COLUMBIA SHELF Area from Shipboard Transects in 1976-1977.

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Unidentified Loon	o[b]	+	o	-[a]	-	o	o	o	-	-	-	-
Common Loon	o	+	o	-	-	o	o	o	-	-	-	-
Yellow-billed Loon	o	o	+	-	-	o	o	o	-	-	-	-
Black-footed Albatross	o	o	+	-	-	o	+	o	-	-	-	-
Northern Fulmar	o	+	+	-	-	+	o	+	-	-	-	-
Sooty Shearwater	o	o	o	-	-	o	o	+	-	-	-	-
Unidentified Shearwater	o	o	o	-	-	o	+	+	-	-	-	-
Fork-tailed Storm Petrel	o	+	+	-	-	o	+	+	-	-	-	-
Leach's Storm Petrel	o	o	o	-	-	o	+	+	-	-	-	-
Unidentified Storm Petrel	o	o	o	-	-	o	o	+	-	-	-	-
Pelagic Cormorant	+	o	o	-	-	o	o	o	-	-	-	-
Unidentified Cormorant	+	+	+	-	-	o	o	o	-	-	-	-
Bufflehead	+	o	o	-	-	o	o	o	-	-	-	-
White-winged Scoter	+	o	o	-	-	o	o	o	-	-	-	-
Unidentified Duck	+	o	+	-	-	o	o	o	-	-	-	-
Unidentified Phalarope	o	o	o	-	-	o	o	+	-	-	-	-
Glaucous-winged Gull	o	+	+	-	-	o	o	+	-	-	-	-
Herring Gull	+	+	+	-	-	o	o	+	-	-	-	-
Thayer's Gull	o	+	o	-	-	o	o	o	-	-	-	-
Western Gull	o	+	o	-	-	o	o	o	-	-	-	-
Mew Gull	+	+	+	-	-	o	o	o	-	-	-	-
Black-legged Kittiwake	o	+	+	-	-	o	o	o	-	-	-	-
Bonaparte's Gull	o	+	o	-	-	o	o	o	-	-	-	-
Sabine's Gull	o	o	o	-	-	+	o	+	-	-	-	-
Unidentified Gull	+	+	+	-	-	o	o	+	-	-	-	-
Common Murre	o	+	o	-	-	o	o	+	-	-	-	-
Thick-billed Murre	o	o	o	-	-	o	o	+	-	-	-	-
Unidentified Murre	+	+	+	-	-	o	+	o	-	-	-	-

TABLE 52. Continued.

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Ancient Murrelet	o	+	+	-	-	o	o	o	-	-	-	-
Rhinocerous Auklet	o	+	o	-	-	o	o	o	-	-	-	-
Parakeet Auklet	o	+	o	-	-	o	+	o	-	-	-	-
Cassin's Auklet	o	+	+	-	-	o	o	o	-	-	-	-
Tufted Puffin	o	o	o	-	-	o	+	o	-	-	-	-
Unidentified Alcid	+	+	+	-	-	o	+	+	-	-	-	-
Bald Eagle	+	o	o	-	-	o	o	o	-	-	-	-
Northwestern Crow	+	o	o	-	-	o	o	o	-	-	-	-
Unidentified Bird	o	o	o	-	-	o	o	+	-	-	-	-

[a] - = area not surveyed

[b] o = no birds, + = 1-9 birds/km^2, ++ = 10-29 birds/km^2, +++ = 30-99 birds/km^2, ++++ = 100+ birds/km^2

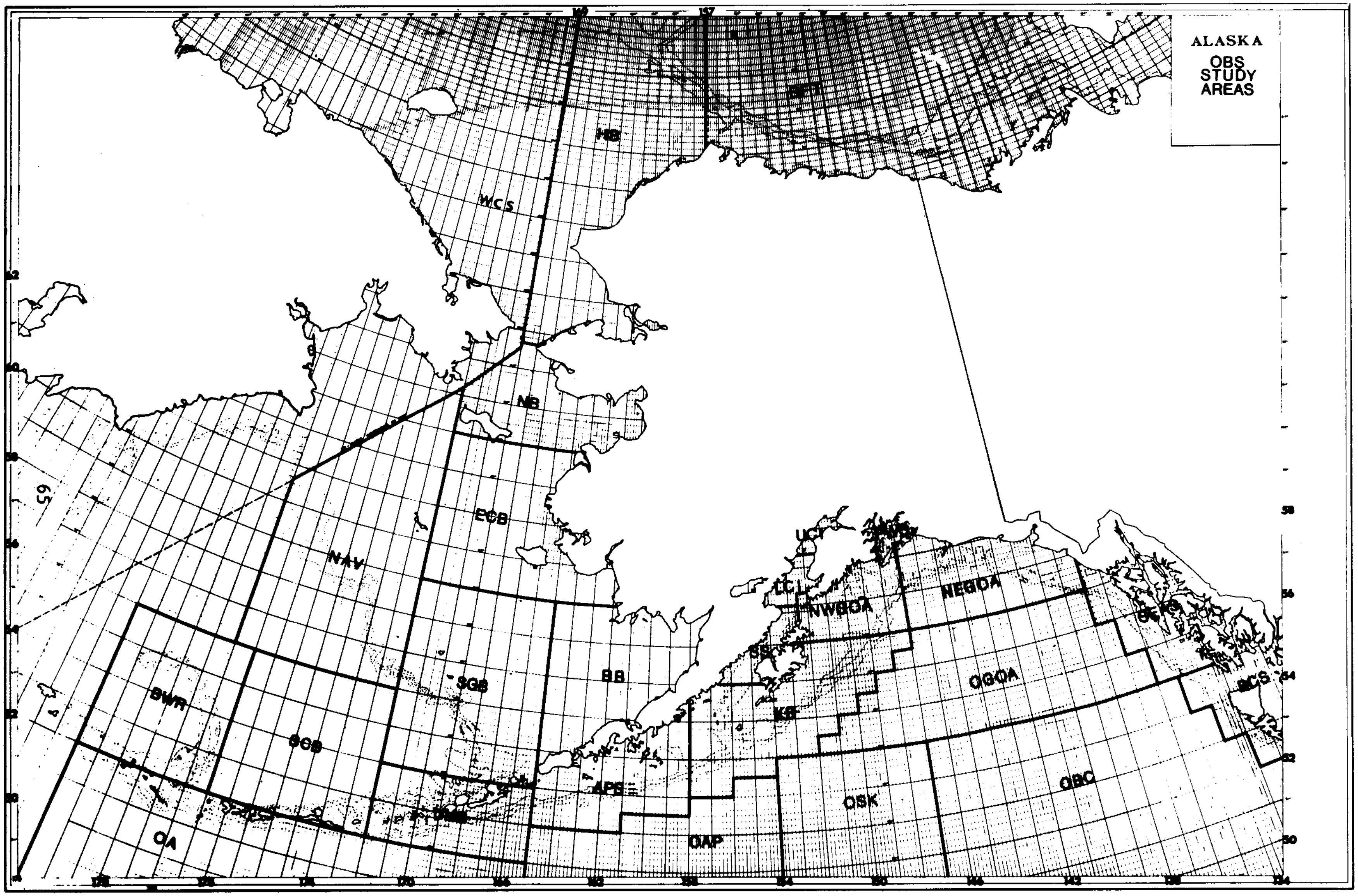
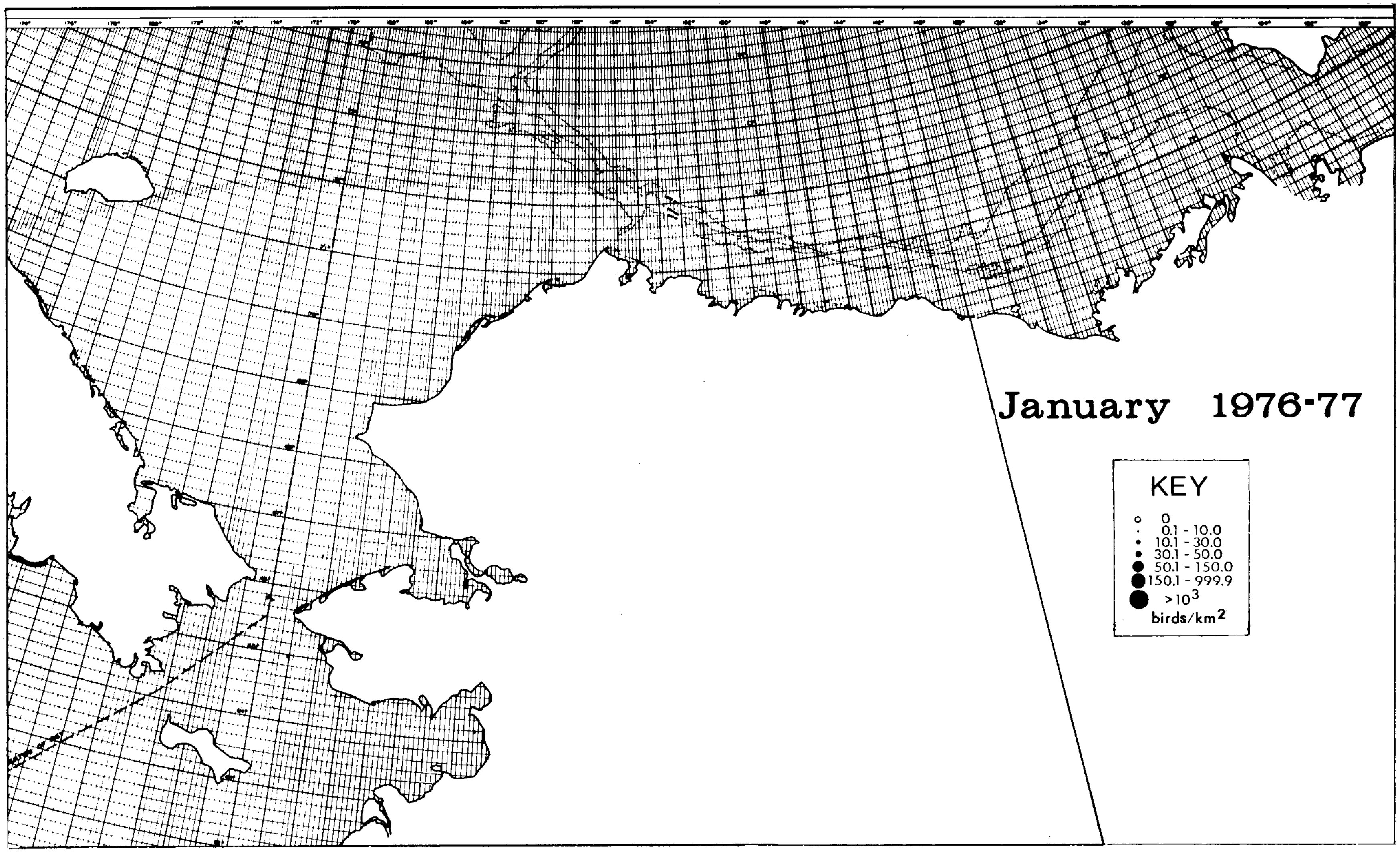


FIGURE 1. OCEANOGRAPHIC REGIONS FOR WHICH BIRD SURVEY DATA ARE SUMMARIZED.


January 1976-77
KEY
0
0.1 - 10.0
10.1 - 30.0
30.1 - 50.0
50.1 - 150.0
150.1 - 999.9
>10^3
birds/km^2

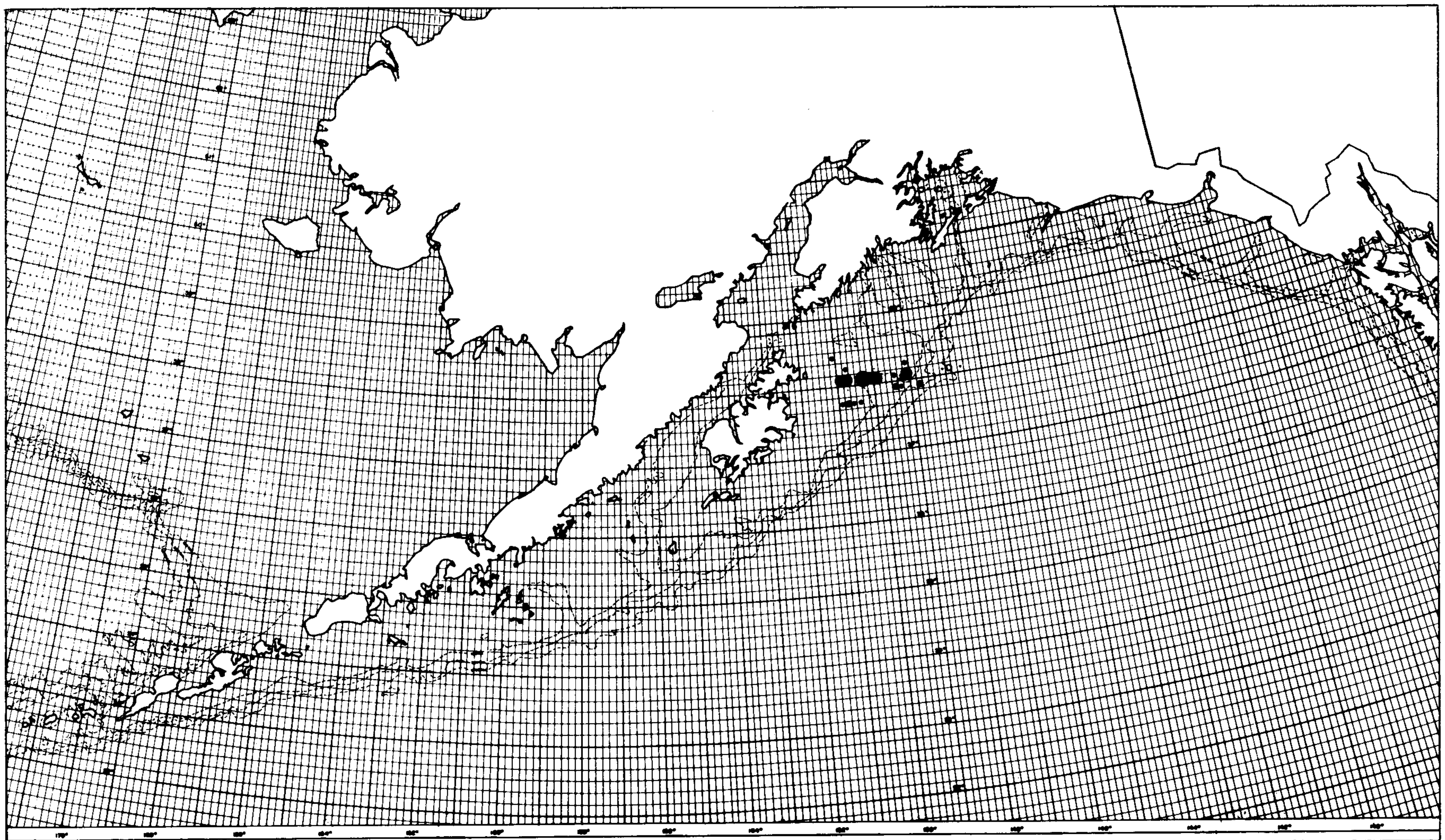
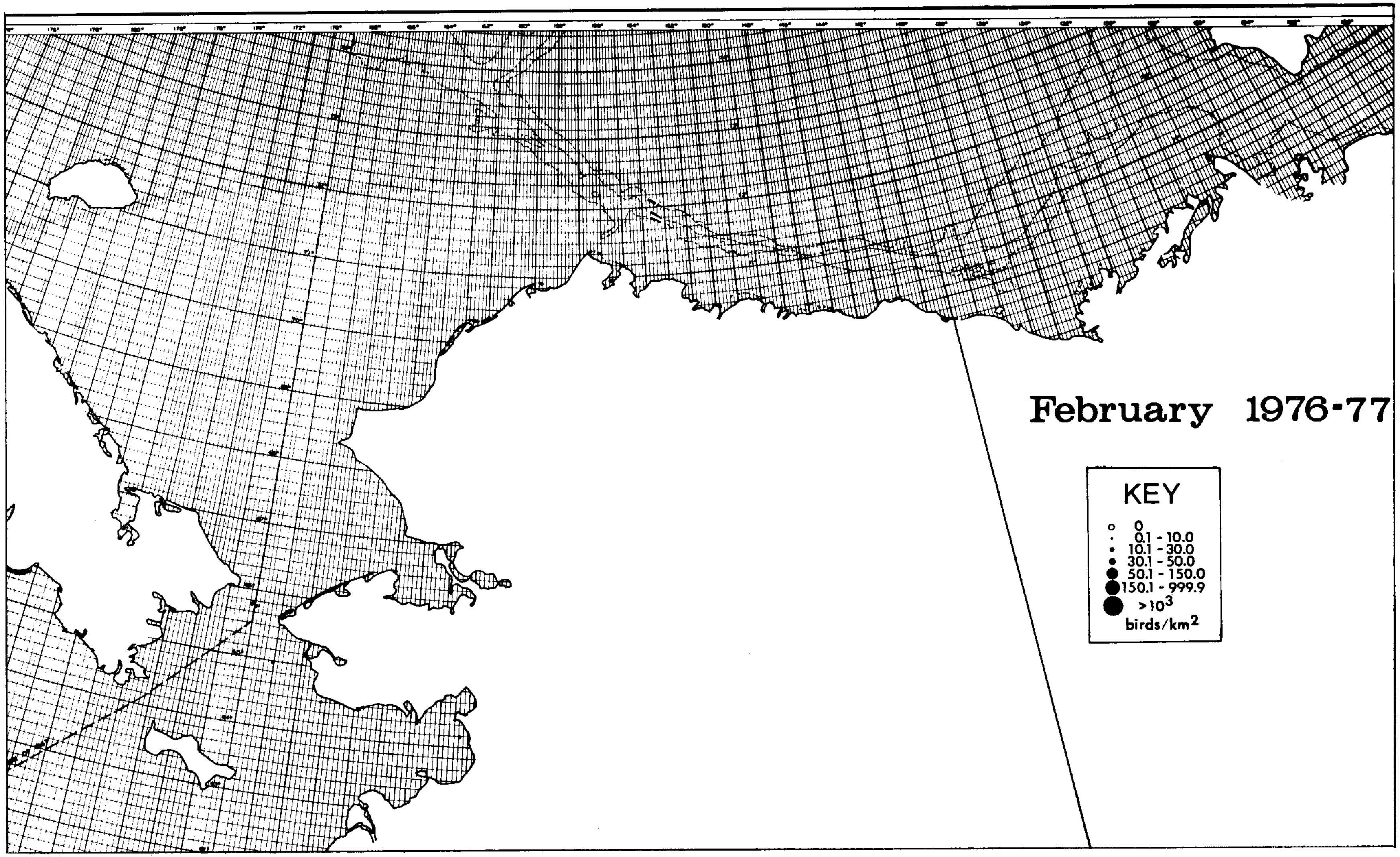


FIGURE 2. SHIPBOARD TRANSECTS SHOWING DENSITY OF BIRDS PER KM^2, JANUARY 1976 AND 1977.


February 1976-77
KEY
0
0.1 - 10.0
10.1 - 30.0
30.1 - 50.0
50.1 - 150.0
150.1 - 999.9
>10^3
birds/km^2

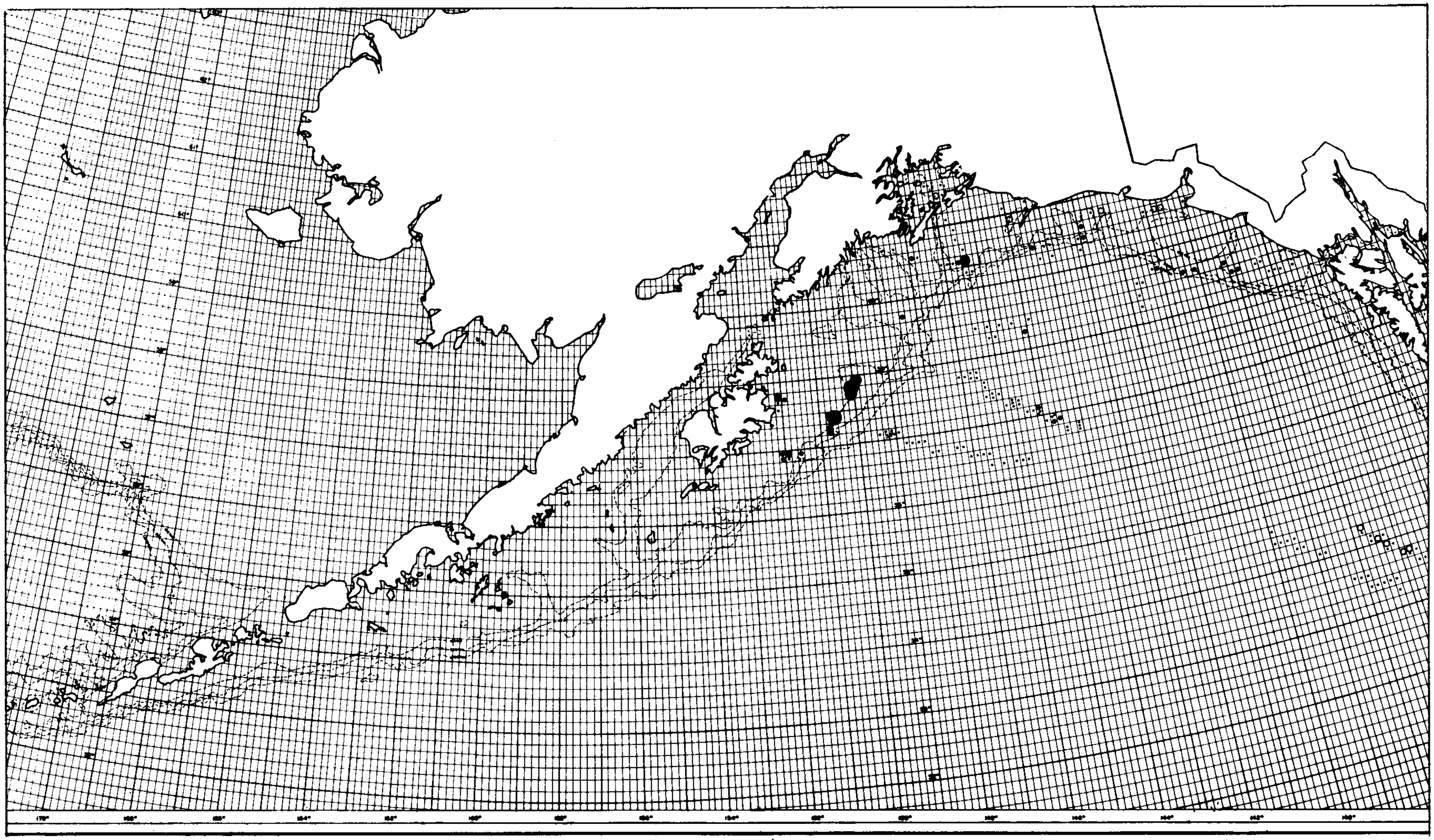
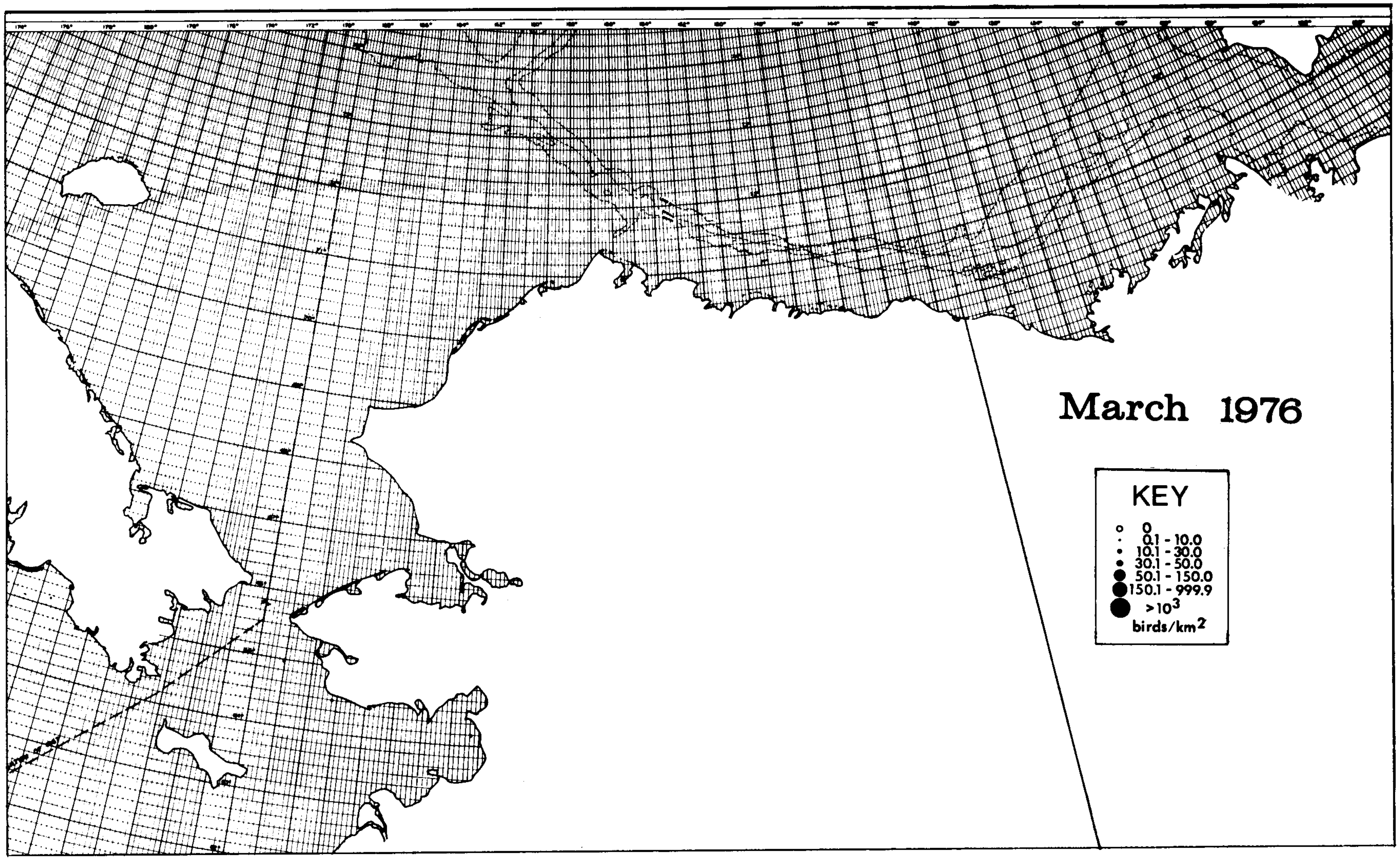


FIGURE 3. SHIPBOARD TRANSECTS SHOWING DENSITY OF BIRDS PER KM^2, FEBRUARY 1976 AND 1977.


March 1976
KEY
0
0.1 - 10.0
10.1 - 30.0
30.1 - 50.0
50.1 - 150.0
150.1 - 999.9
>10³
birds/km²

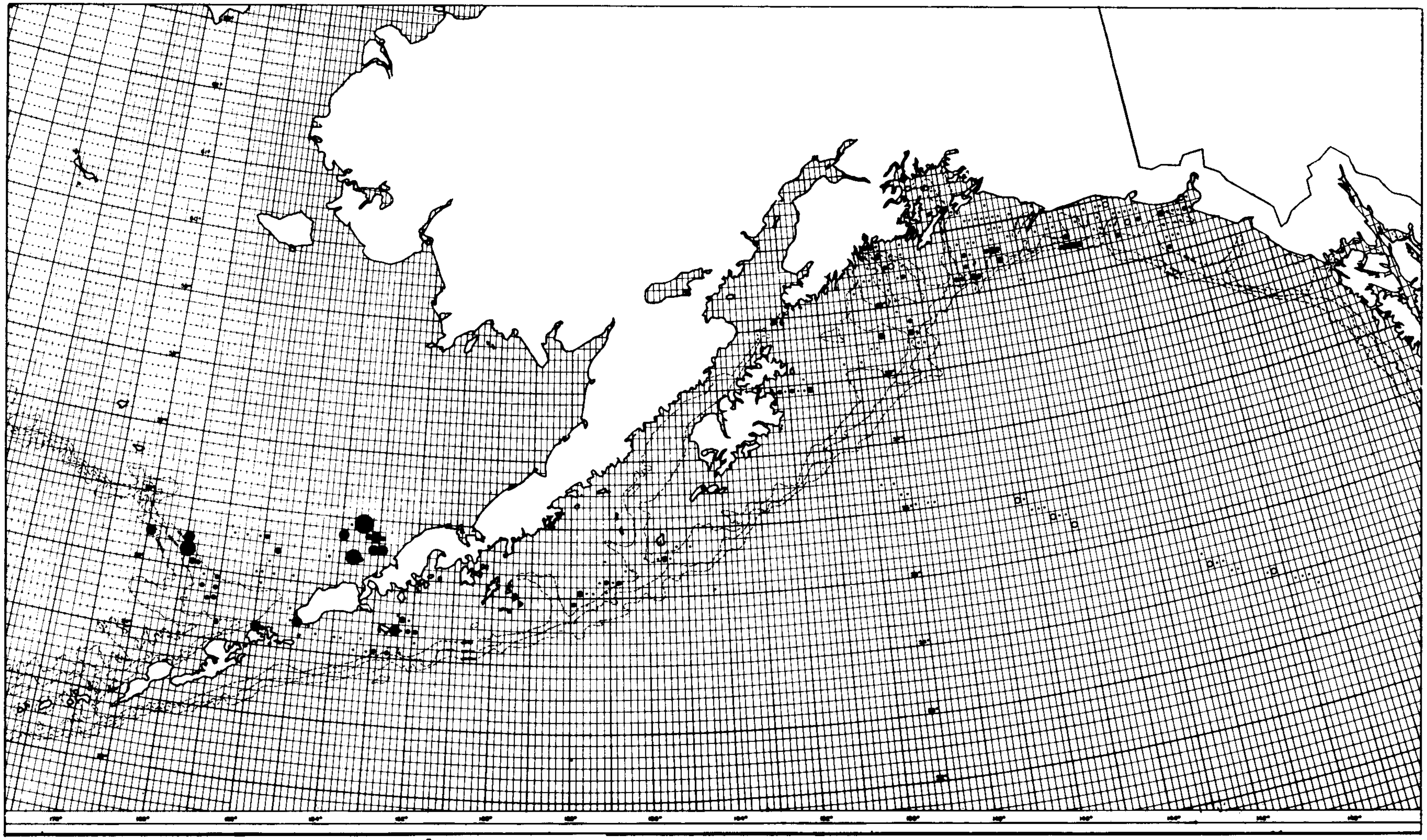
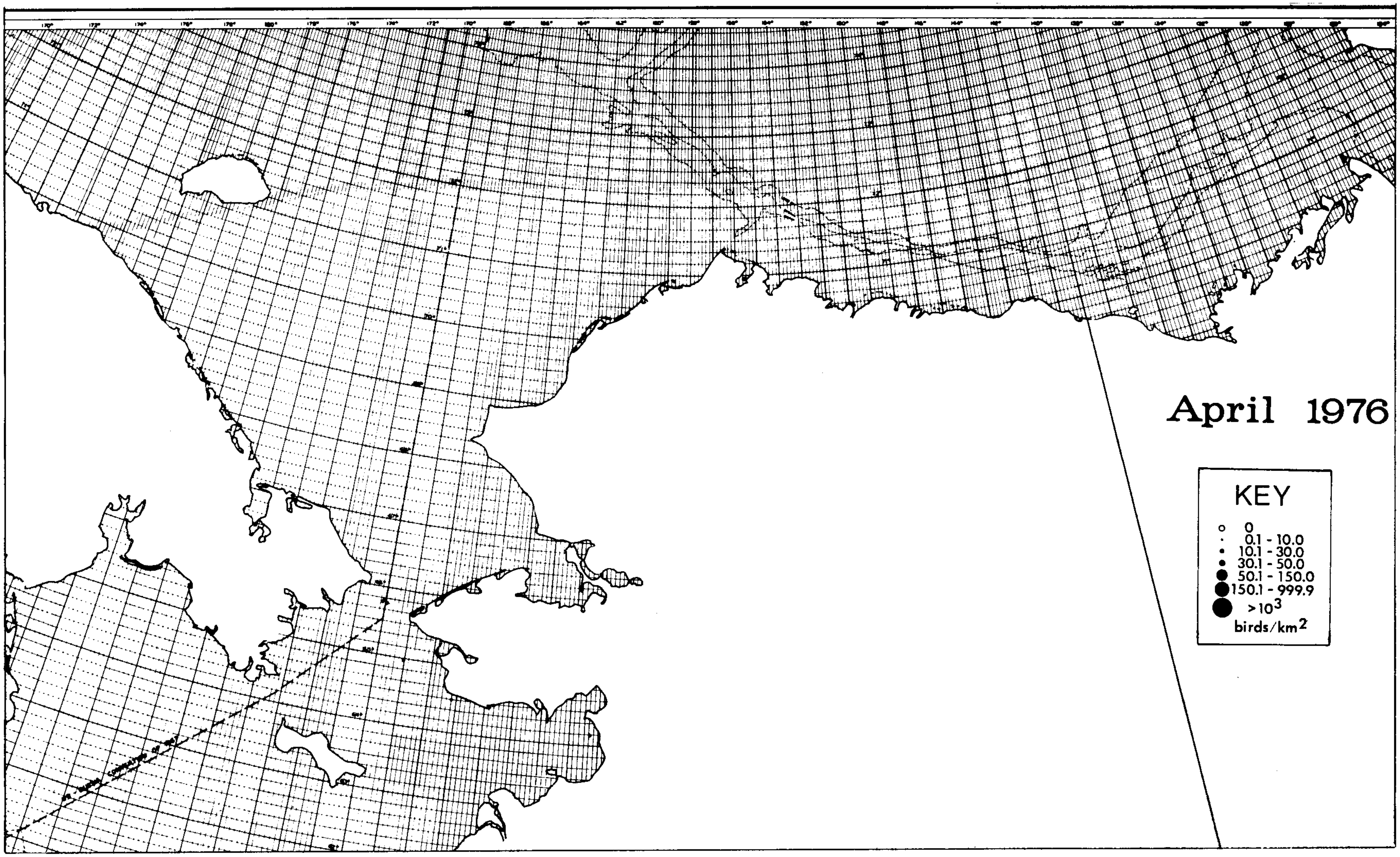


FIGURE 4. SHIPBOARD TRANSECTS SHOWING DENSITY OF BIRDS PER KM^2, MARCH 1976.


April 1976
KEY
0
0.1 - 10.0
10.1 - 30.0
30.1 - 50.0
50.1 - 150.0
150.1 - 999.9
>10³
birds/km²

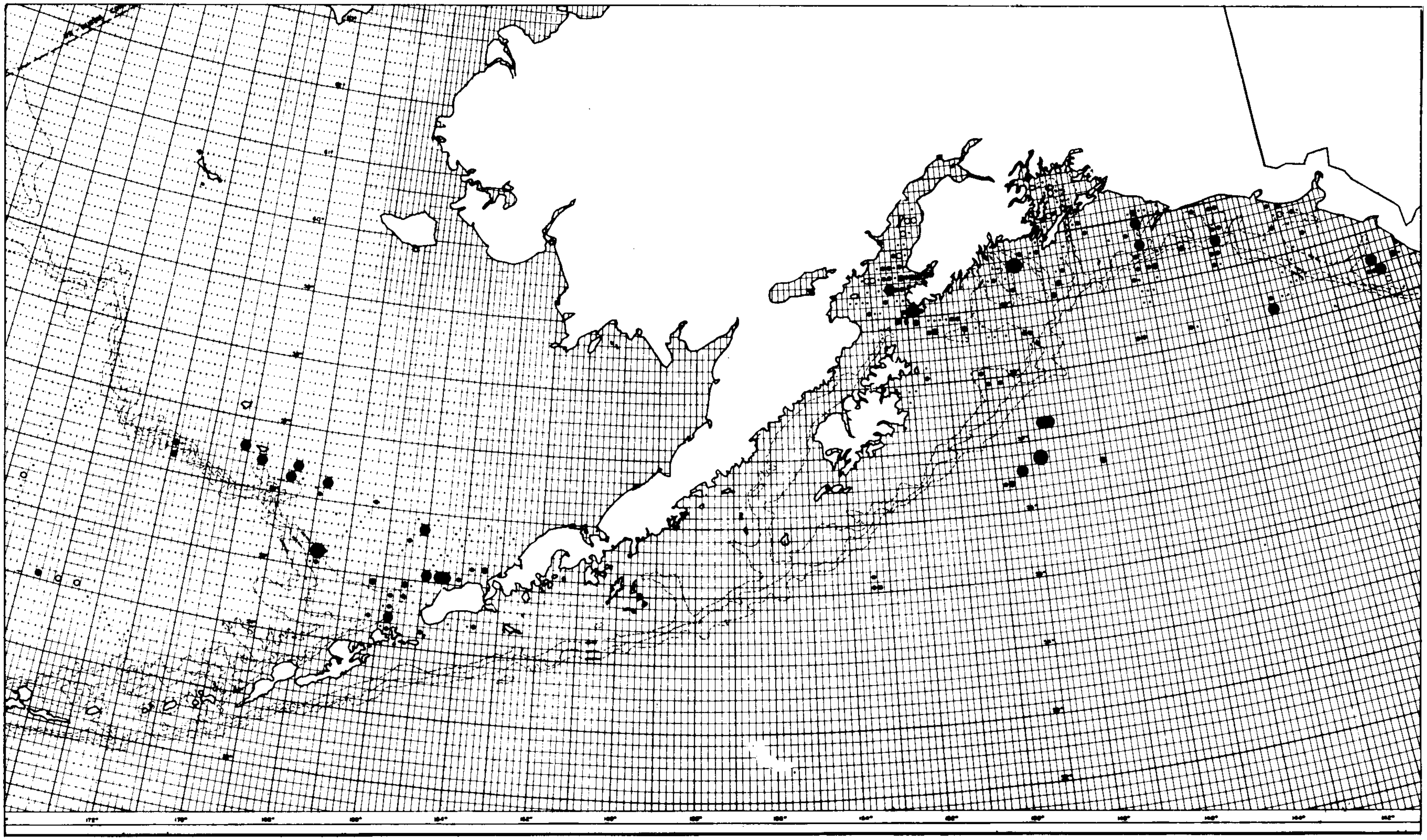
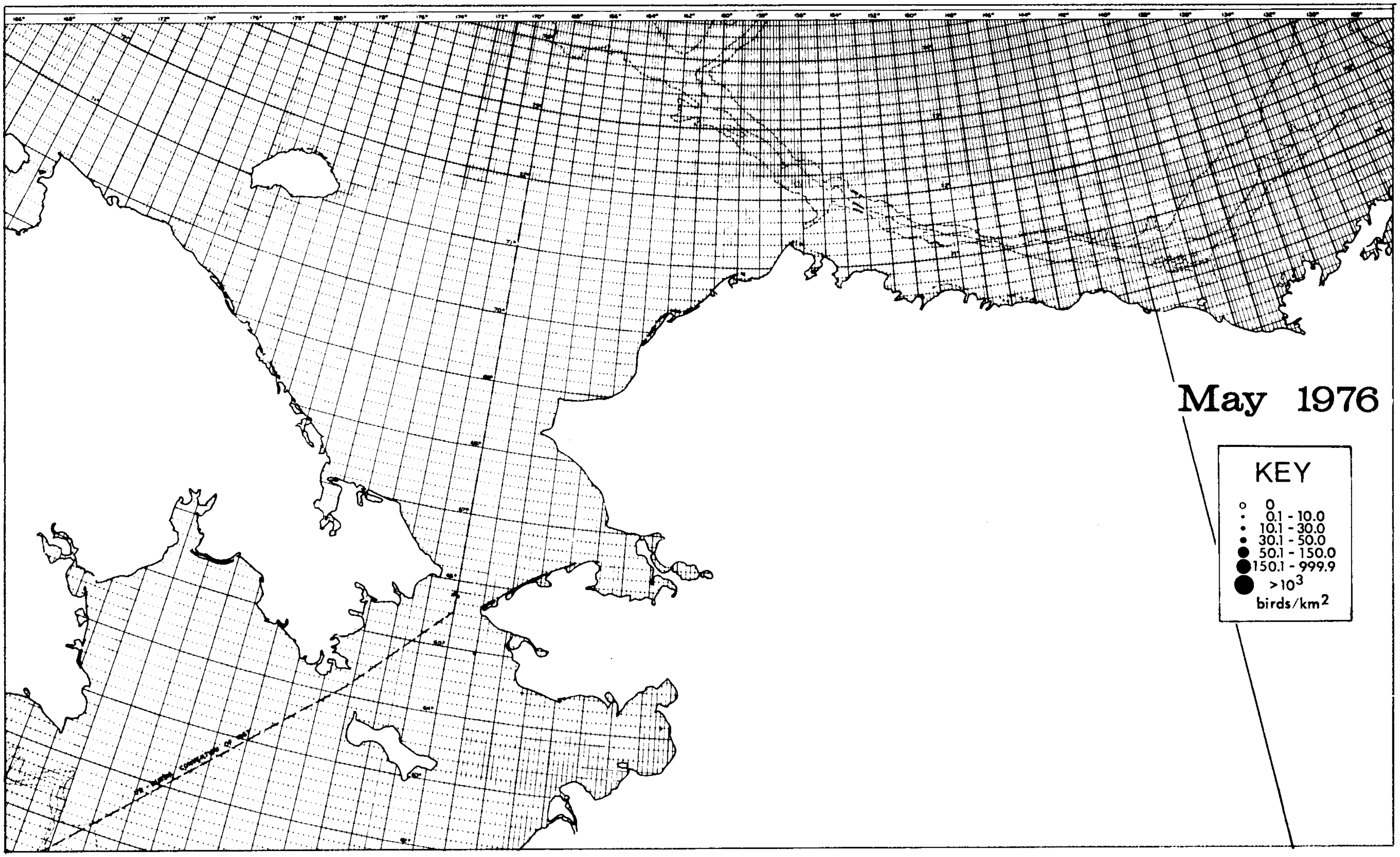


FIGURE 5. SHIPBOARD TRANSECTS SHOWING DENSITY OF BIRDS PER KM^2, APRIL 1976.


May 1976
KEY
0
0.1 - 10.0
10.1 - 30.0
30.1 - 50.0
50.1 - 150.0
150.1 - 999.9
>10^3
birds/km^2

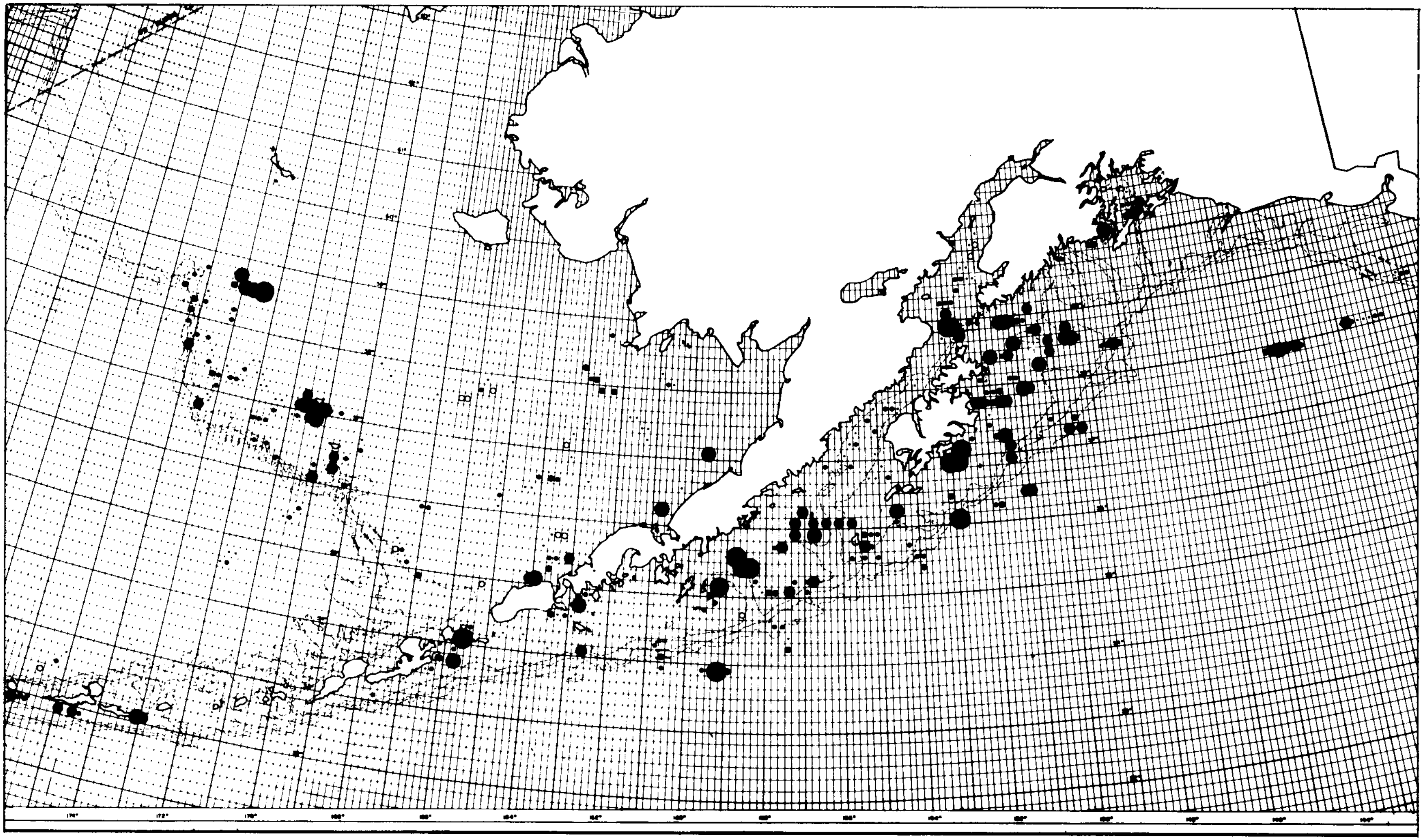
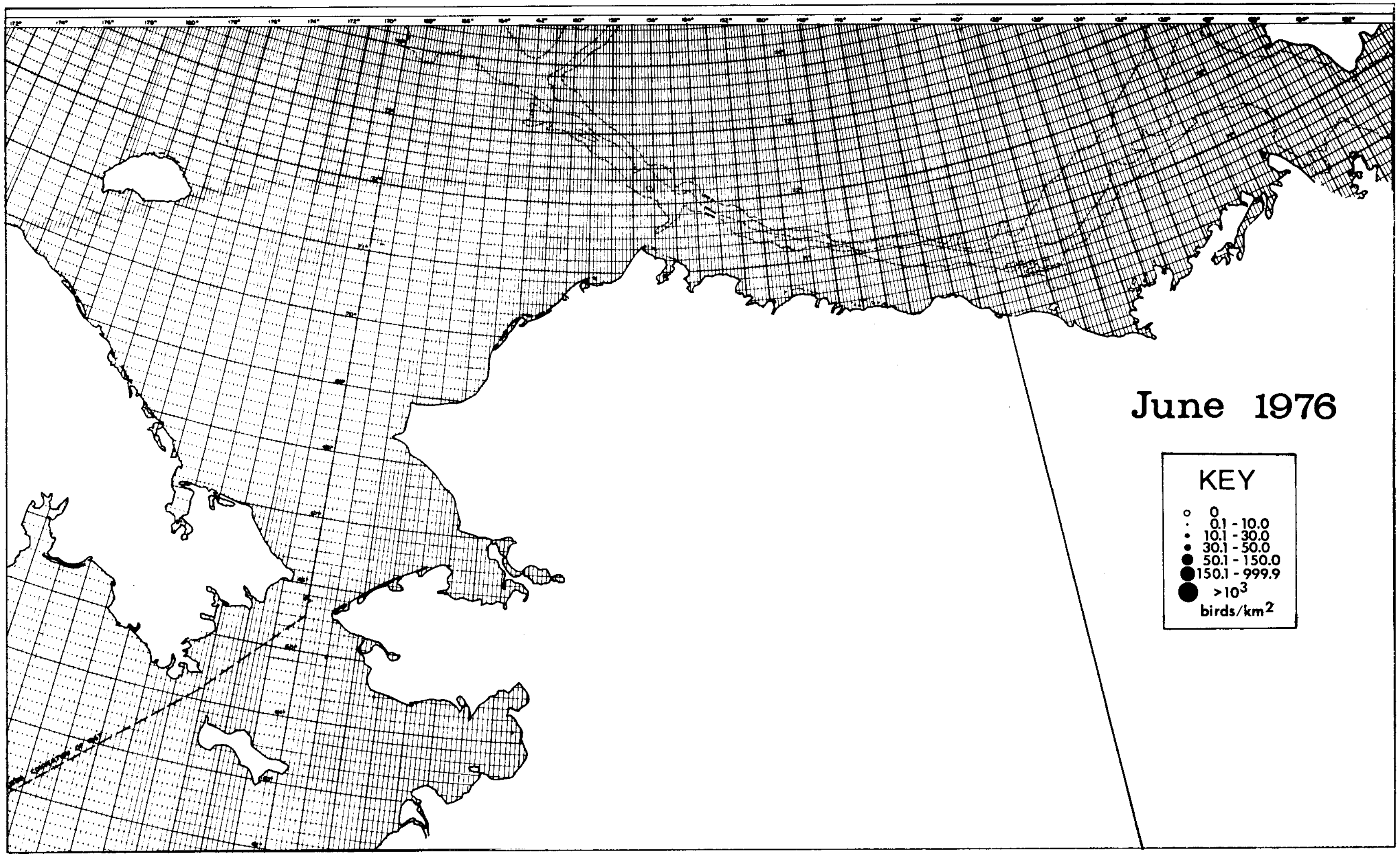


FIGURE 6. SHIPBOARD TRANSECTS SHOWING DENSITY OF BIRDS PER KM^2, MAY 1976.


June 1976
KEY
0
0.1 - 10.0
10.1 - 30.0
30.1 - 50.0
50.1 - 150.0
150.1 - 999.9
>10³
birds/km²

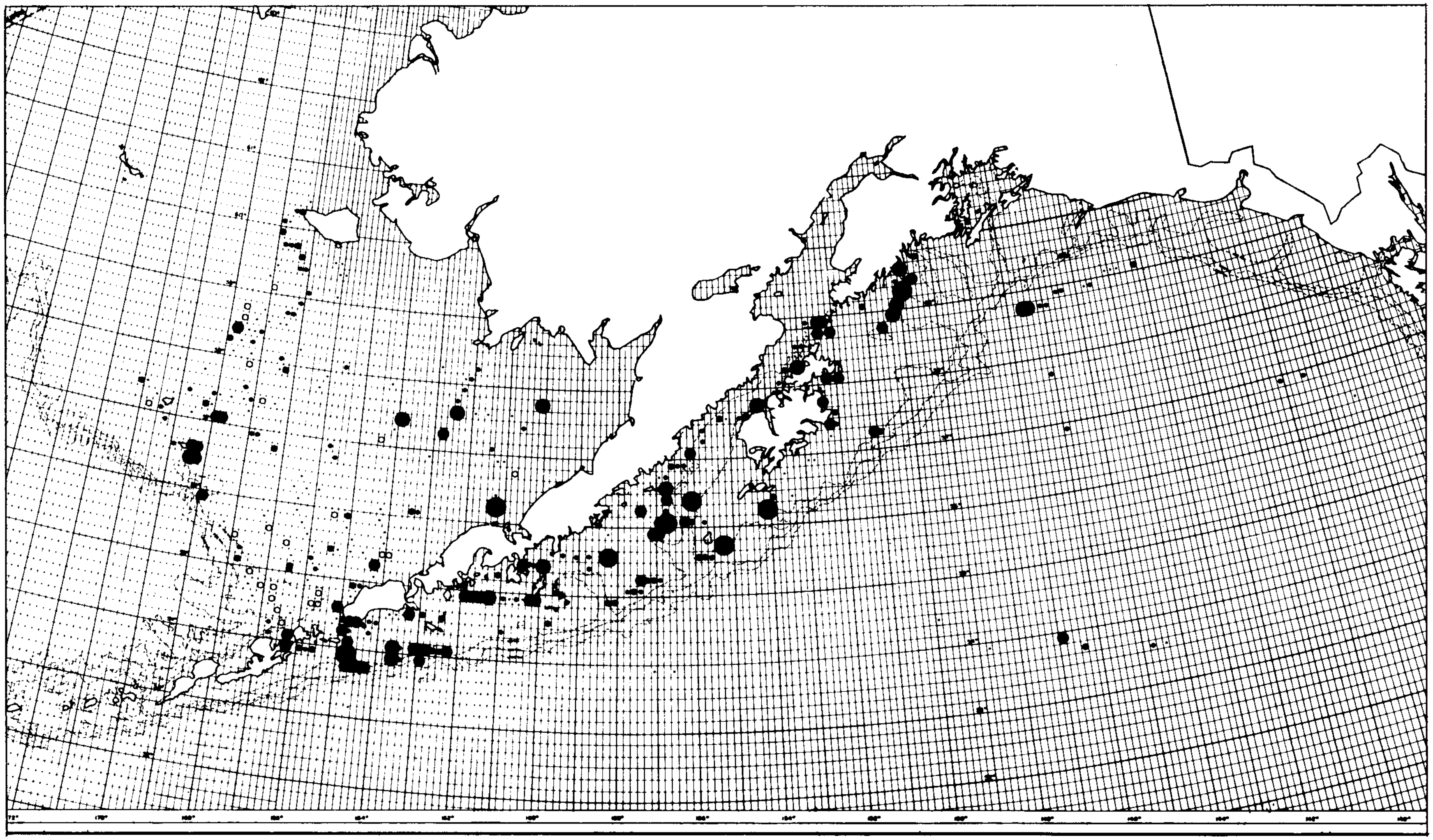
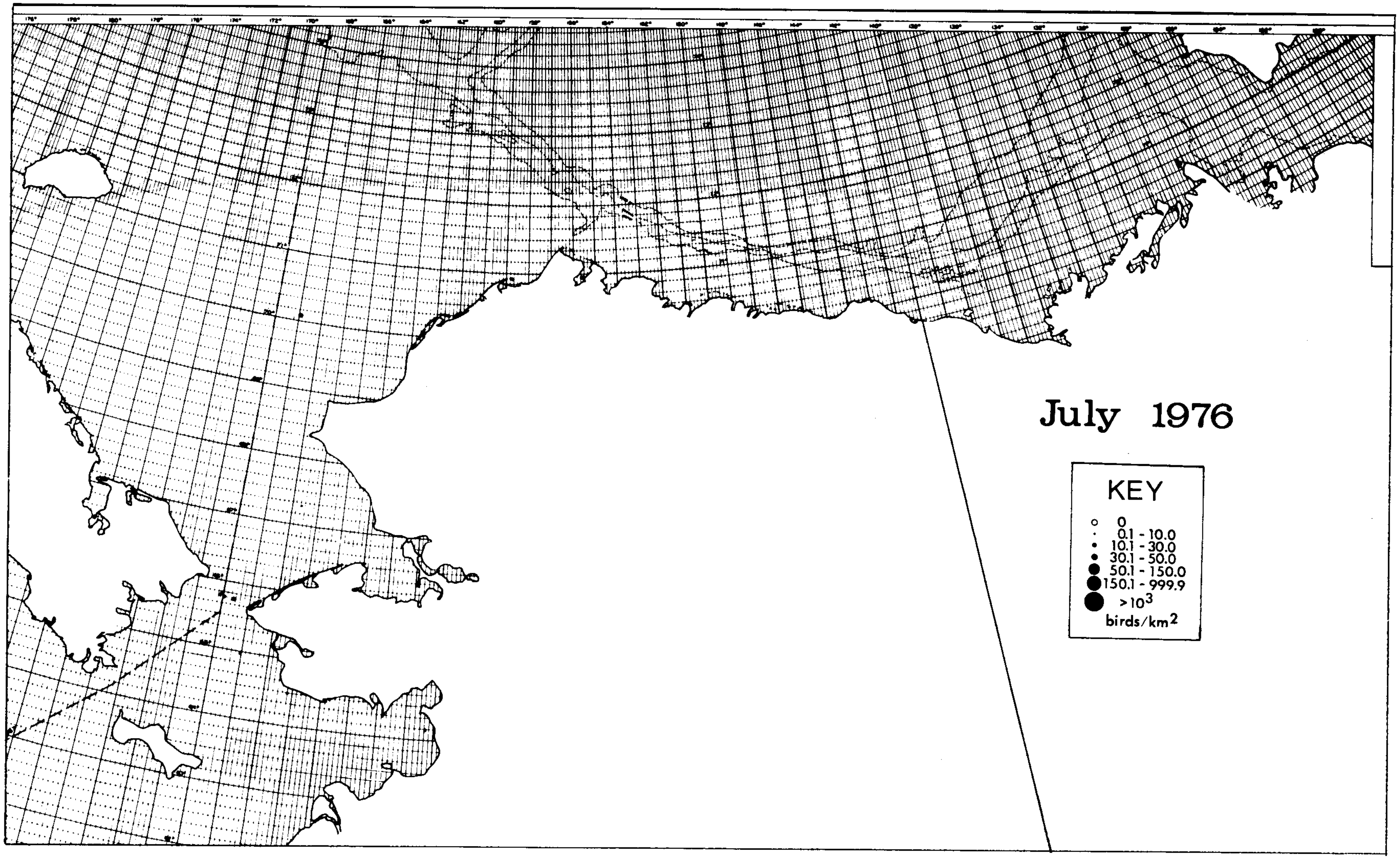


FIGURE 7. SHIPBOARD TRANSECTS SHOWING DENSITY OF BIRDS PER KM^2, JUNE 1976.


July 1976
KEY
0
0.1 - 10.0
10.1 - 30.0
30.1 - 50.0
50.1 - 150.0
150.1 - 999.9
>10³
birds/km²

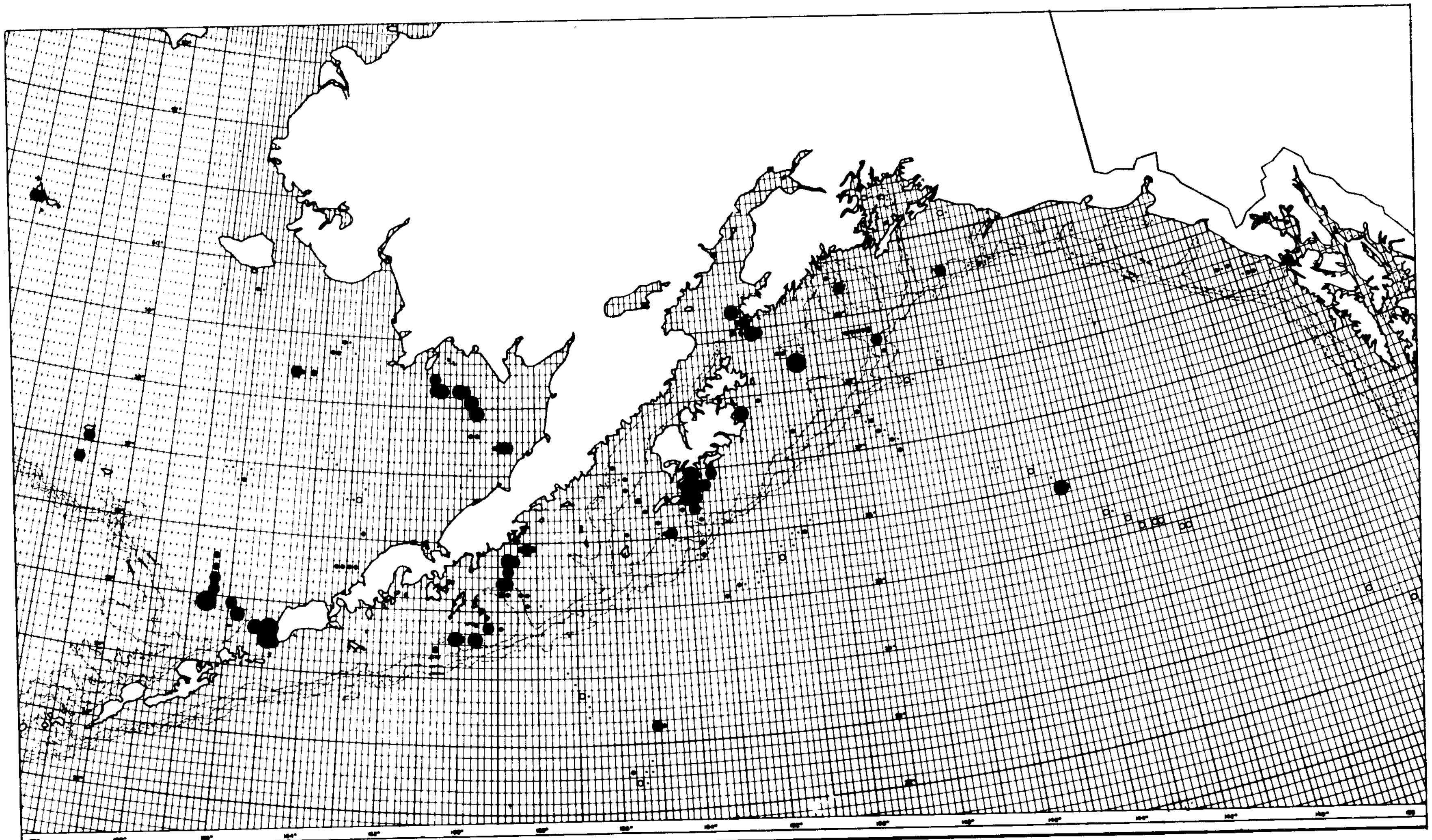
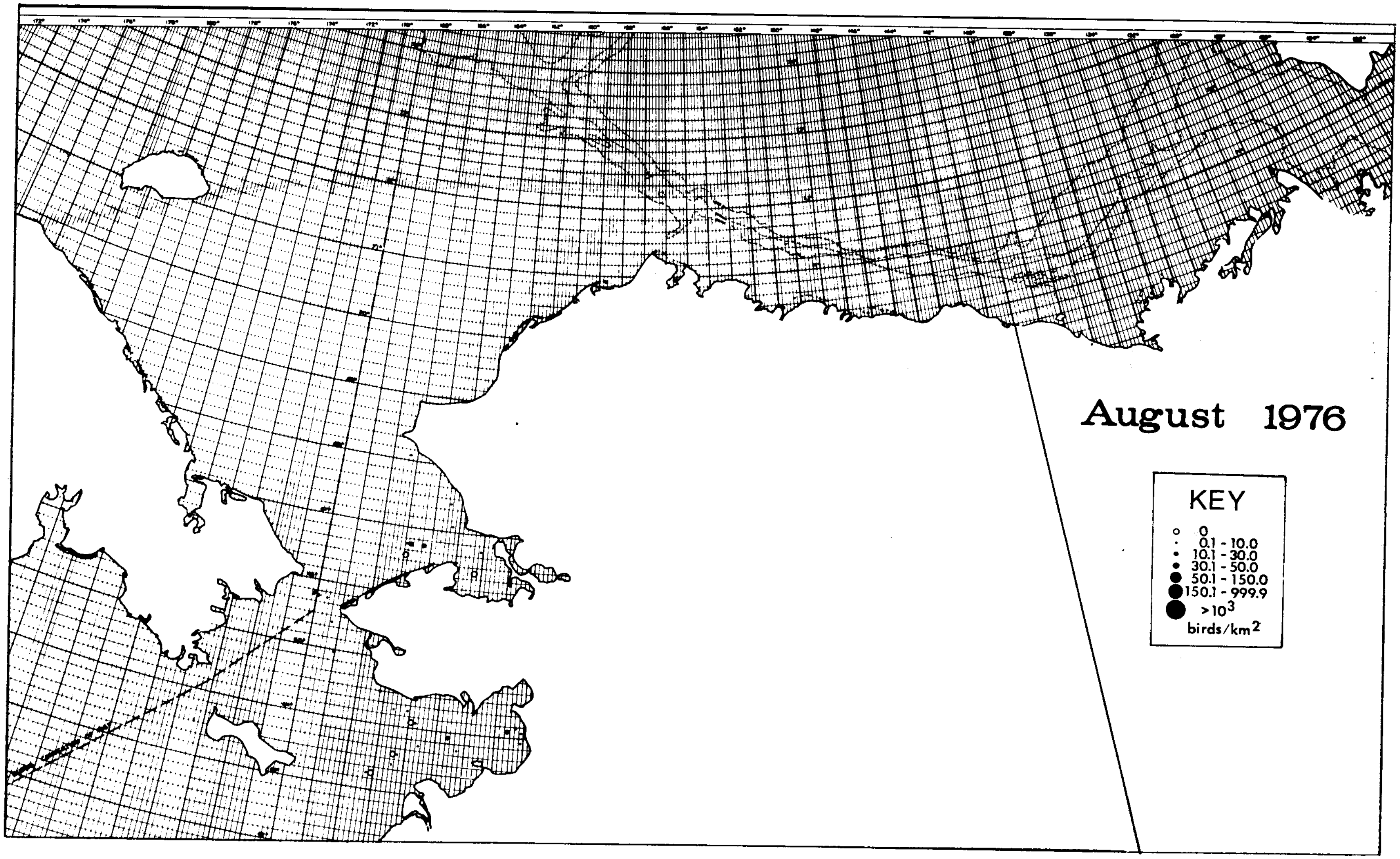


FIGURE 8. SHIPBOARD TRANSECTS SHOWING DENSITY OF BIRDS PER KM^2, JULY 1976.



August 1976
KEY
0
0.1 - 10.0
10.1 - 30.0
30.1 - 50.0
50.1 - 150.0
150.1 - 999.9
>10³
birds/km²

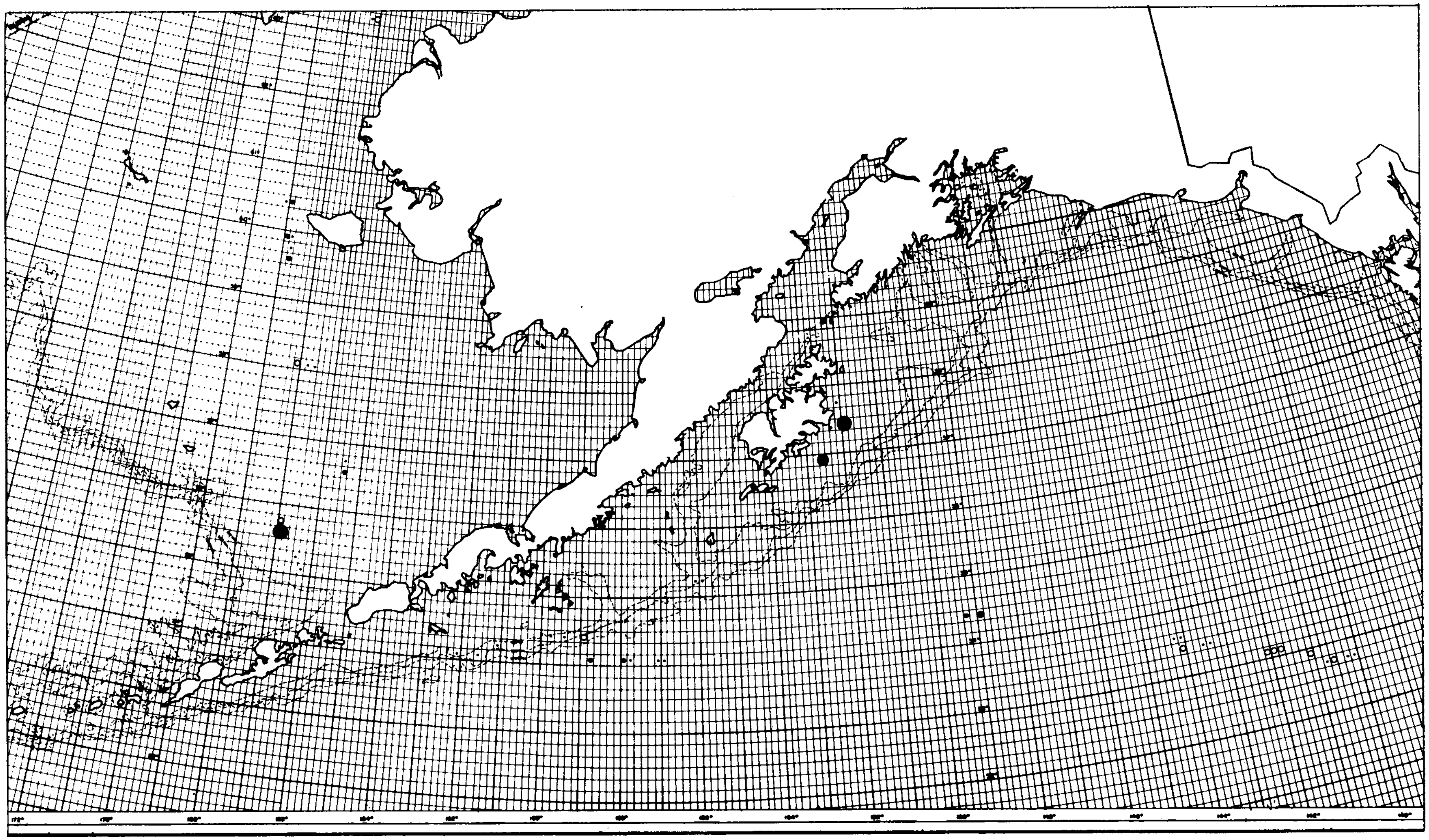
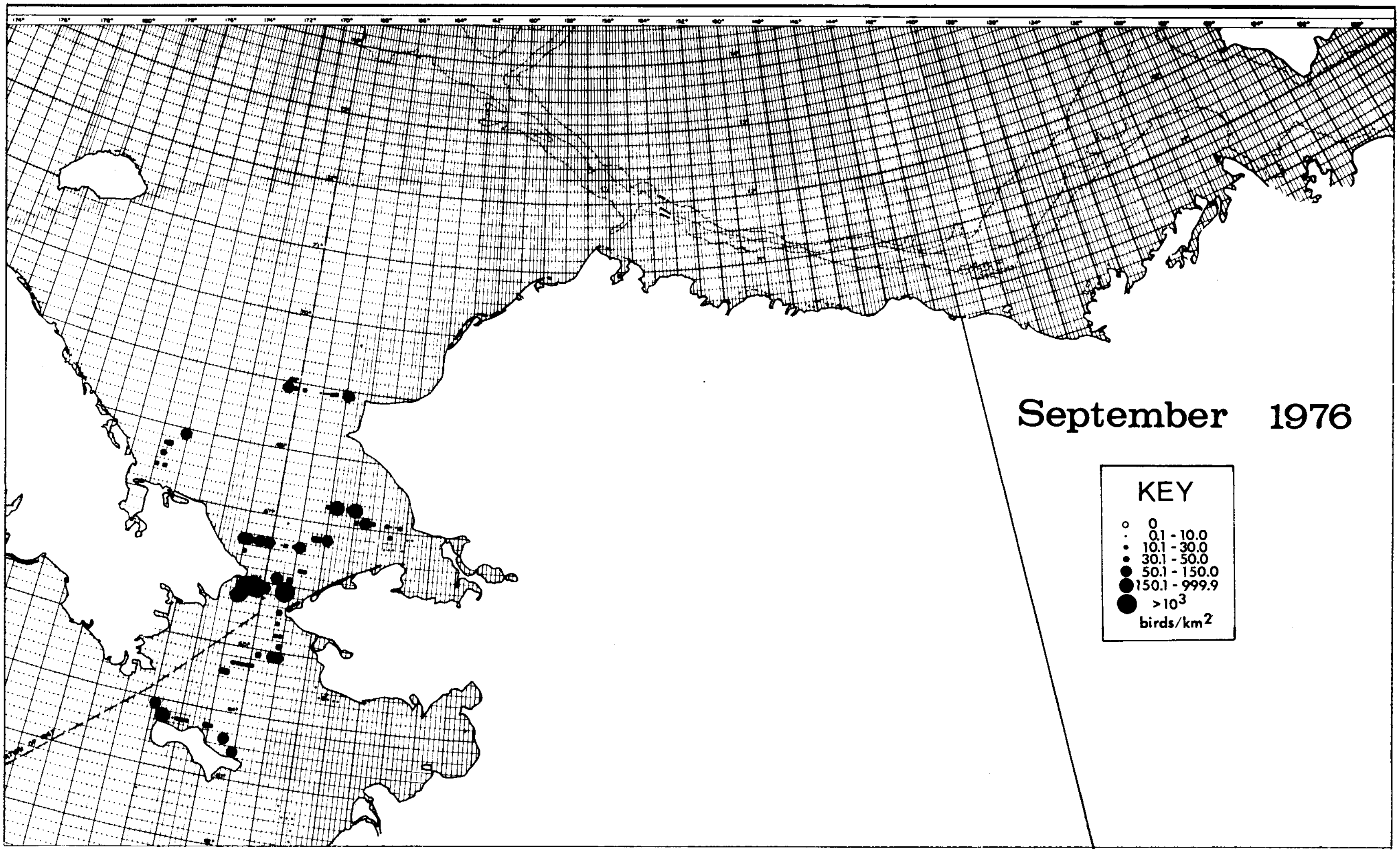


FIGURE 9. SHIPBOARD TRANSECTS SHOWING DENSITY OF BIRDS PER KM^2, AUGUST 1976.


September 1976
KEY
0
0.1 - 10.0
10.1 - 30.0
30.1 - 50.0
50.1 - 150.0
150.1 - 999.9
>10^3
birds/km^2

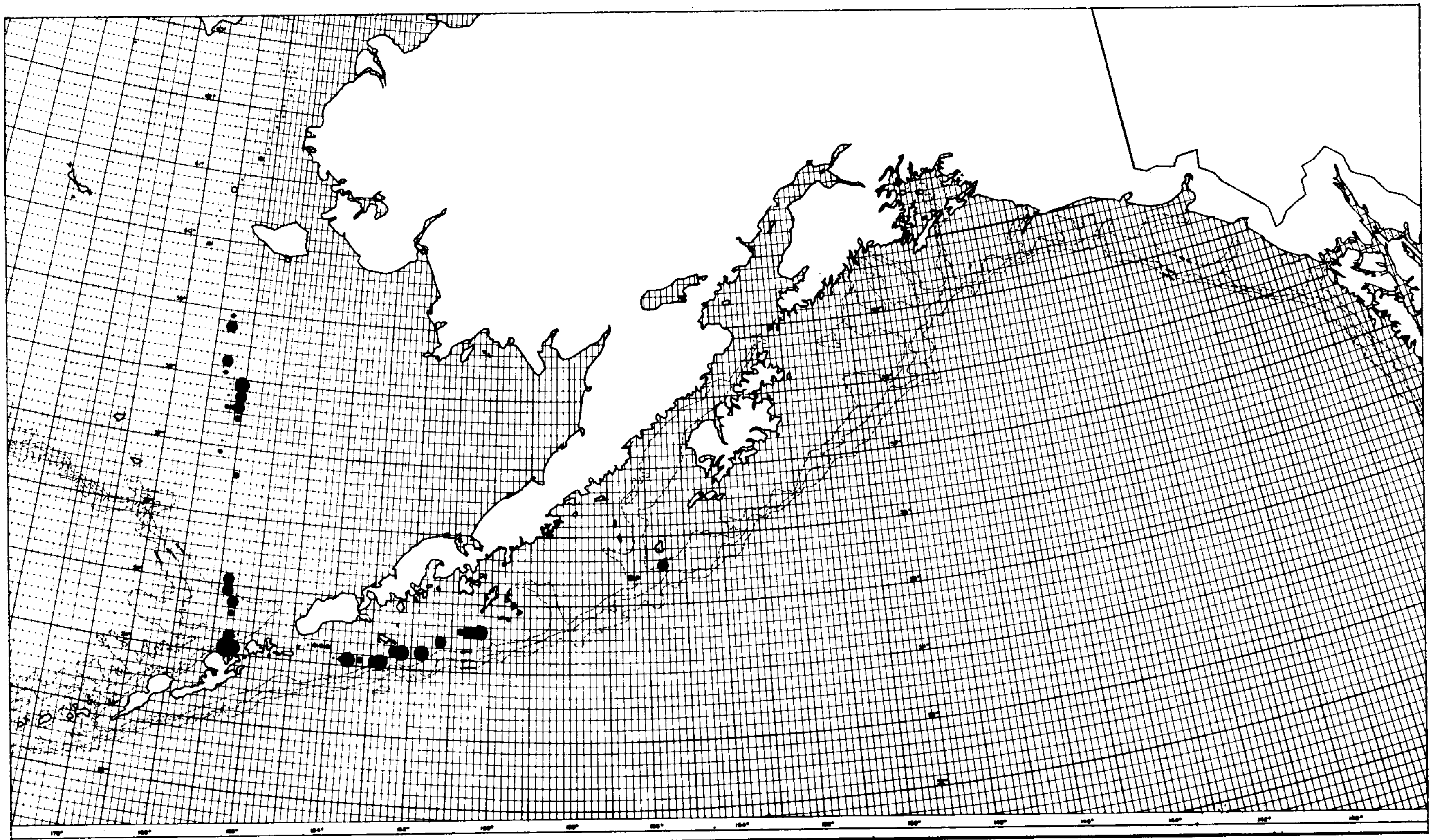
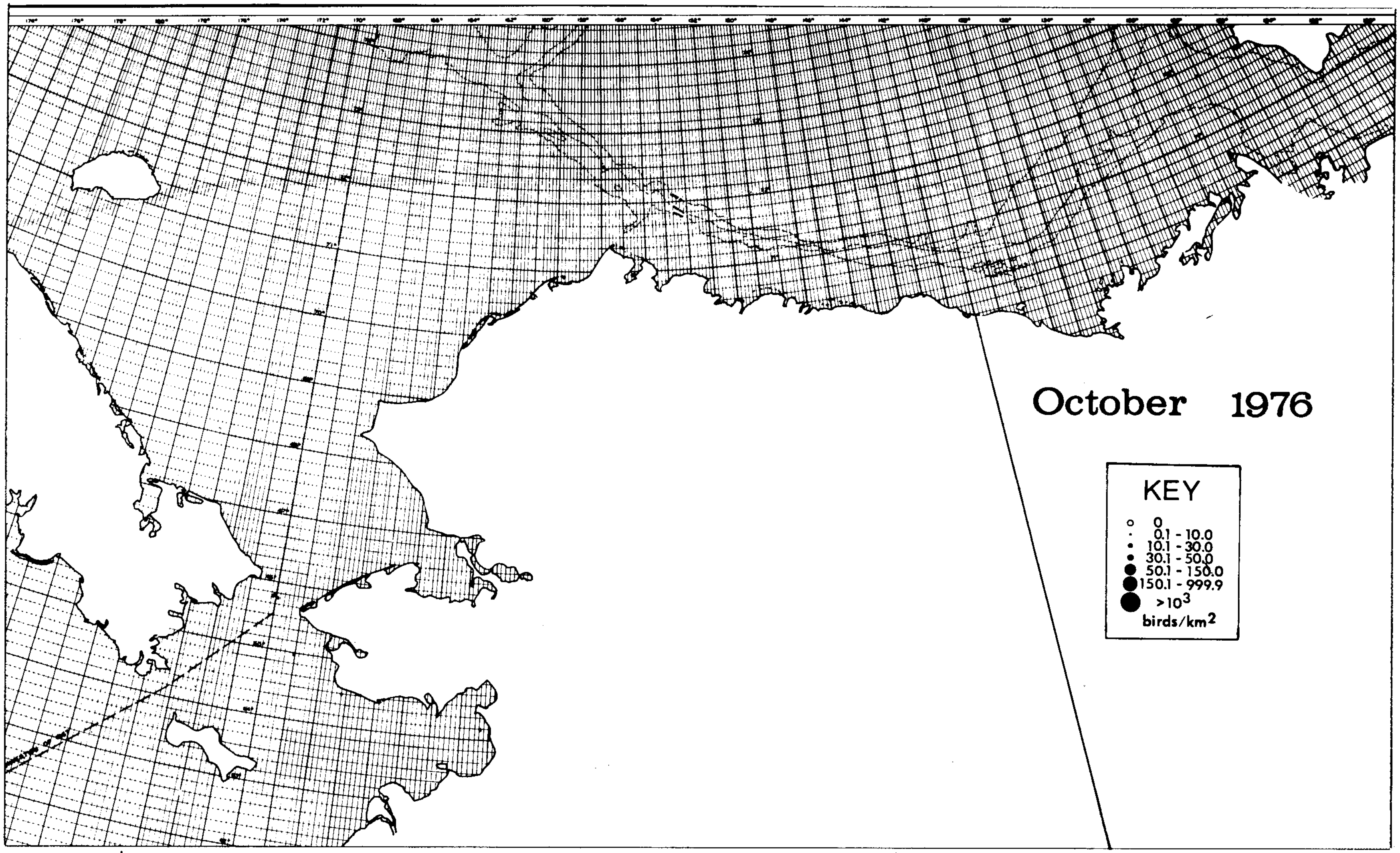


FIGURE 10. SHIPBOARD TRANSECTS SHOWING DENSITY OF BIRDS PER KM^2, SEPTEMBER 1976.


October 1976
KEY
0
0.1 - 10.0
10.1 - 30.0
30.1 - 50.0
50.1 - 150.0
150.1 - 999.9
>10^3
birds/km^2

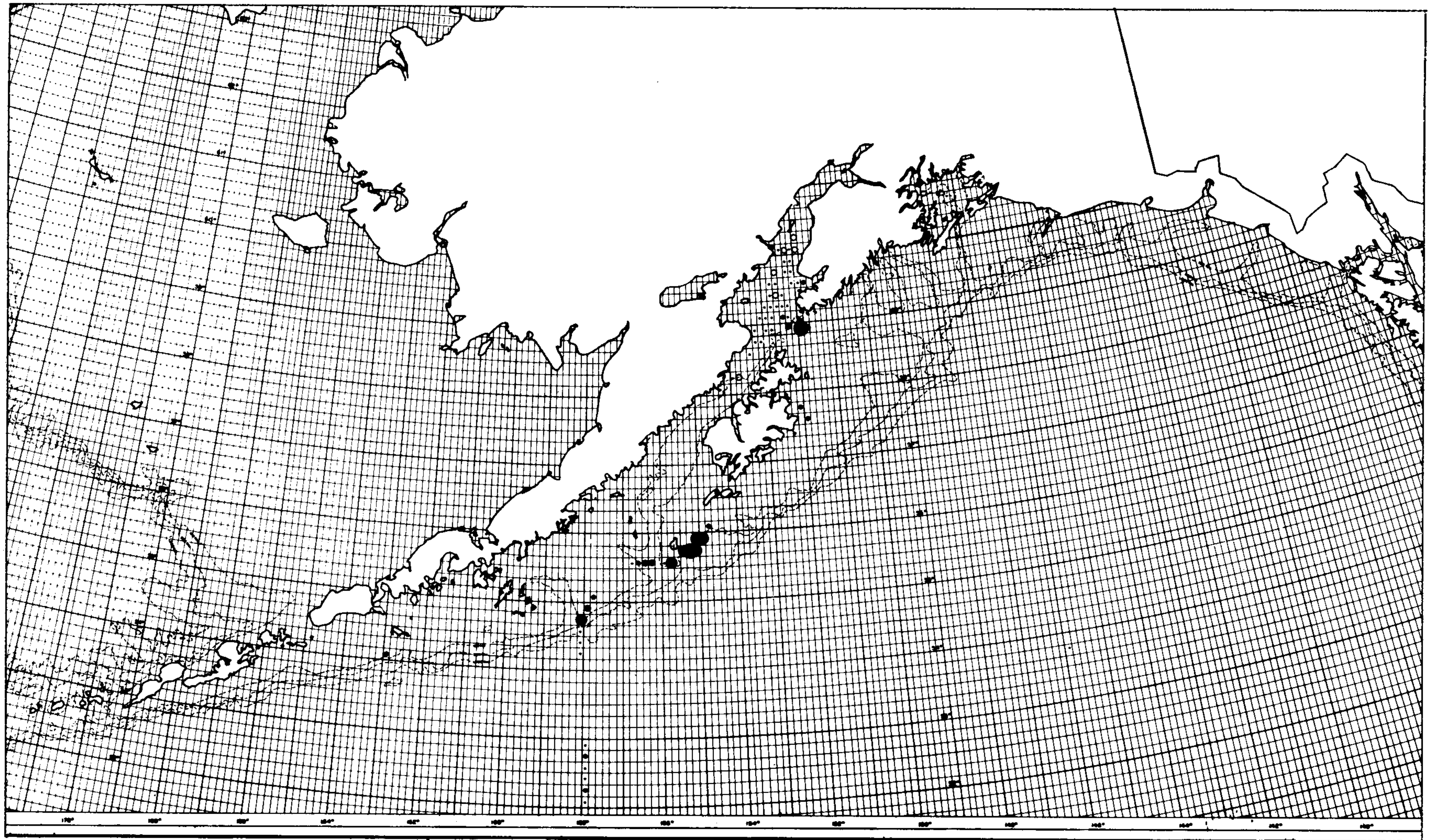
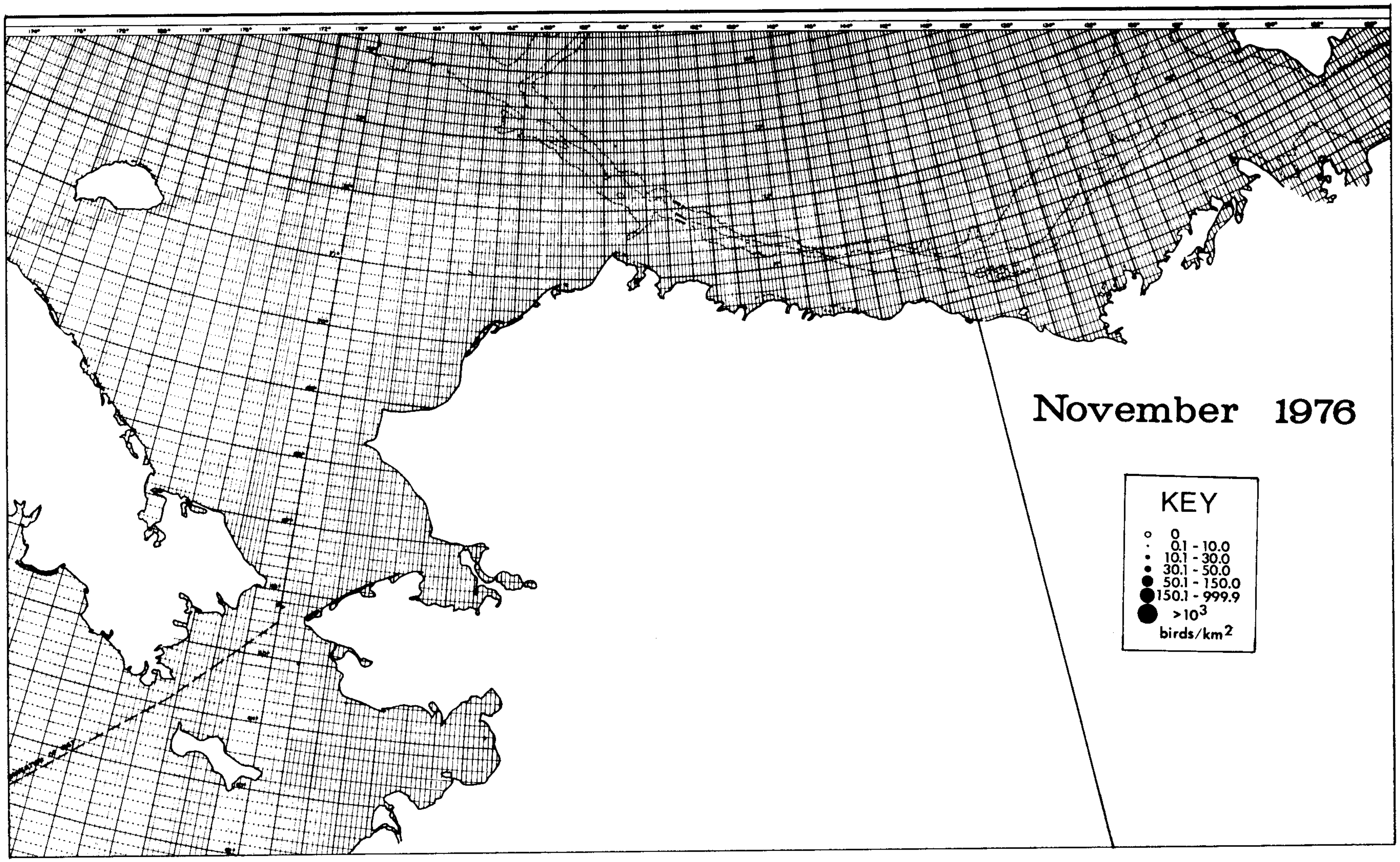


FIGURE 11. SHIPBOARD TRANSECTS SHOWING DENSITY OF BIRDS PER KM^2, OCTOBER 1976.


November 1976
KEY
0
0.1 - 10.0
10.1 - 30.0
30.1 - 50.0
50.1 - 150.0
150.1 - 999.9
>10^3
birds/km^2

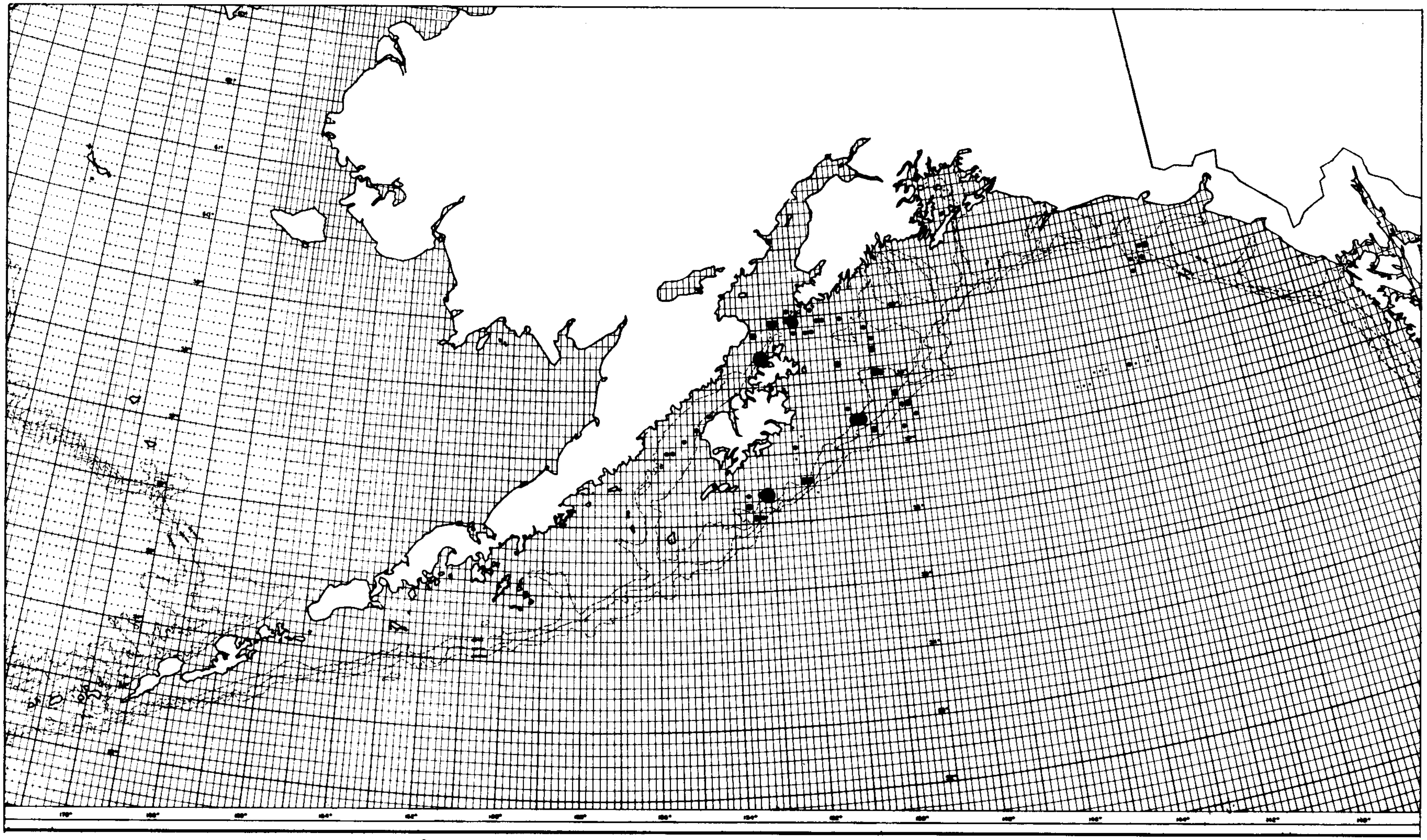


FIGURE 12. SHIPBOARD TRANSECTS SHOWING DENSITY OF BIRDS PER KM^2, NOVEMBER 1976.

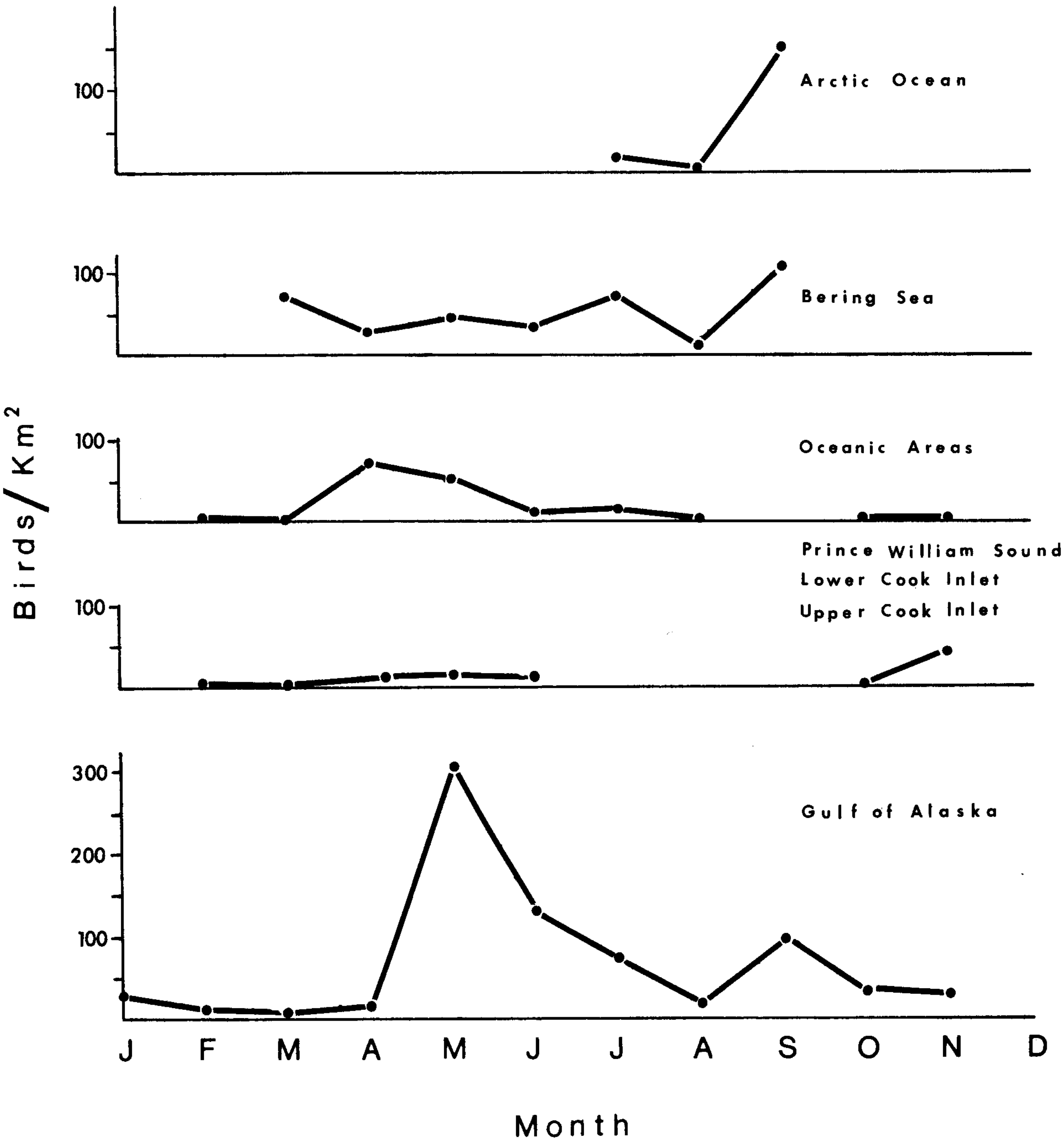


Figure 13. Mean seabird density in offshore Alaskan regions, 1976 - 1977.

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AERIAL SURVEYS OF MARINE BIRDS

By

Craig S. Harrison

PART II

Of

SEASONAL DISTRIBUTION AND ABUNDANCE OF MARINE BIRDS

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1 April 1977

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30 Bird observations on aerial transects, St. George Basin, March, 1976.

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30 Distribution and abundance of eiders in the Chukchi Sea in August.

31 Distribution and abundance of eiders in the Chukchi Sea in October.

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33 Distribution and abundance of scoters in the Chukchi Sea in August.

34 Distribution and abundance of scoters in the Chukchi Sea in October.

35 Distribution and abundance of phalaropes in the Chukchi Sea in August. No phalaropes were observed in June.

36 Distribution and abundance of phalaropes in the Chukchi Sea in October.

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41 Distribution and abundance of glaucous gulls in the Chukchi Sea in August.

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43 Distribution and abundance of black-legged kittiwakes in the Chukchi Sea in June.

44 Distribution and abundance of black-legged kittiwakes in the Chukchi Sea in August.

45 Distribution and abundance of black-legged kittiwakes in the Chukchi Sea in October.

46 Distribution and abundance of Sabine's gulls in the Chukchi Sea in August. No Sabine's gulls were observed in June or October.

47 Distribution and abundance of arctic terns in the Chukchi Sea in June.

48 Distribution and abundance of arctic terns in the Chukchi Sea in August.

49 Distribution and abundance of arctic terns in the Chukchi Sea in October.

50 Distribution and abundance of Aleutian terns in the Chukchi Sea in August. No Aleutian terns were observed in June or October.

51 Distribution and abundance of murres in the Chukchi Sea in June.

52 Distribution and abundance of murres in the Chukchi Sea in August.

53 Distribution and abundance of murres in the Chukchi Sea in October.

54 Distribution and abundance of small alcids in the Chukchi Sea in June.

55 Distribution and abundance of small alcids in the Chukchi Sea in August.

56 Distribution and abundance of small alcids in the Chukchi Sea in October.

57 Distribution and abundance of black guillemots in the Chukchi Sea in August. No black guillemots were observed in June or October.

58 Distribution and abundance of parakeet auklets in the Chukchi Sea in August. No parakeet auklets were identified in June.

59 Distribution and abundance of parakeet auklets in the Chukchi Sea in October.

60 Distribution and abundance of crested auklets in the Chukchi Sea in August. No crested auklets were identified in June.

61 Distribution and abundance of crested auklets in the Chukchi Sea in October.

62 Distribution and abundance of least auklets in the Chukchi Sea in August. No least auklets were identified in June.

63 Distribution and abundance of least auklets in the Chukchi Sea in October.

64 Distribution and abundance of horned puffins in the Chukchi Sea in August. No horned puffins were observed in June.

65 Distribution and abundance of horned puffins in the Chukchi Sea in October.

66 Distribution and abundance of tufted puffins in the Chukchi Sea in August. No tufted puffins were observed in June or October.

67 Distribution and abundance of loons in the Bering Sea in June. No loons were observed in February or March.

68 Distribution and abundance of loons in the Bering Sea in August.

69 Distribution and abundance of loons in the Bering Sea in October.

70 Distribution and abundance of shearwaters in the Bering Sea in June. No shearwaters were observed in February or March.

71 Distribution and abundance of shearwaters in the Bering Sea in July.

72 Distribution and abundance of shearwaters in the Bering Sea in August.

73 Distribution and abundance of shearwaters in the Bering Sea in October.

74 Distribution and abundance of fulmars in the Bering Sea in February.

75 Distribution and abundance of fulmars in March.

76 Distribution and abundance of fulmars in the Bering Sea in June.

77 Distribution and abundance of fulmars in the Bering Sea in July.

78 Distribution and abundance of fulmars in August.

79 Distribution and abundance of fulmars in the Bering Sea in October.

80 Distribution and abundance of fork-tailed petrels in the Bering Sea in February.

81 Distribution and abundance of fork-tailed petrels in the Bering Sea in July. No fork-tailed petrels were observed in March or June.

82 Distribution and abundance of fork-tailed petrels in the Bering Sea in October.

83 Distribution and abundance of Leach's petrels in the Bering Sea in July. No observations of Leach's petrels were made in February, March, June, August or October.

84 Distribution and abundance of cormorants in the Bering Sea in February.

85 Distribution and abundance of cormorants in the Bering Sea in March.

86 Distribution and abundance of cormorants in the Bering Sea in June.

87 Distribution and abundance of cormorants in the Bering Sea in July.

88 Distribution and abundance of cormorants in the Bering Sea in August.

89a Distribution and abundance of cormorants in the Bering Sea in October.

89b Distribution and abundance of oldsquaw in the Bering Sea in February.

90 Distribution and abundance of oldsquaw in the Bering Sea in June. No oldsquaw were observed in March.

91 Distribution and abundance of oldsquaw in October. No oldsquaw were observed in July or August.

92 Distribution and abundance of harlequin ducks in October. No harlequin ducks were observed in February, March, June, July or August.

93 Distribution and abundance of eiders in the Bering Sea in February.

94 Distribution and abundance of eiders in the Bering Sea in March.

95 Distribution and abundance of eiders in the Bering Sea in June.

96 Distribution and abundance of eiders in the Bering Sea in August. No eiders were observed in July.

97 Distribution and abundance of eiders in October.

98 Distribution and abundance of scoters in the Bering Sea in February.

99 Distribution and abundance of scoters in the Bering Sea in March.

100 Distribution and abundance of scoters in the Bering Sea in June.

101 Distribution and abundance of scoters in the Bering Sea in July.

102 Distribution and abundance of scoters in the Bering Sea in August.

103 Distribution and abundance of scoters in the Bering Sea in October.

104 Distribution and abundance of phalaropes in the Bering Sea in July. No phalaropes were observed in February, March or June.

105 Distribution and abundance of phalaropes in the Bering Sea in August.

106 Distribution and abundance of phalaropes in the Bering Sea in October.

107 Distribution and abundance of jaegers in the Bering Sea in June. No jaegers were observed in February or March.

108 Distribution and abundance of jaegers in the Bering Sea in July.

109 Distribution and abundance of jaegers in the Bering Sea in August.

110 Distribution and abundance of jaegers in the Bering Sea in October.

111 Distribution and abundance of glaucous gulls in the Bering Sea in June. No glaucous gulls were identified in February or March.

112 Distribution and abundance of glaucous gulls in the Bering Sea in August. No glaucous gulls were observed in July.

113 Distribution and abundance of glaucous gulls in the Bering Sea in October.

114 Distribution and abundance of glaucous-winged gulls in the Bering Sea in February.

115 Distribution and abundance of glaucous-winged gulls in the Bering Sea in March.

116 Distribution and abundance of glaucous-winged gulls in the Bering Sea in June.

117 Distribution and abundance of glaucous-winged gulls in the Bering Sea in July.

118 Distribution and abundance of glaucous-winged gulls in the Bering Sea in October. No glaucous-winged gulls were identified in August.

119 Distribution and abundance of herring gulls in the Bering Sea in June. No herring gulls were identified in February or March.

120 Distribution and abundance of herring gulls in the Bering Sea in August. No herring gulls were identified in July or October.

121 Distribution and abundance of mew gulls in the Bering Sea in June. No mew gulls were observed in February or March.

122 Distribution and abundance of mew gulls in the Bering Sea in August. No mew gulls were observed in July or October.

123 Distribution and abundance of ivory gulls in the Bering Sea in February. No ivory gulls were observed in March, June, July, August or October.

124 Distribution and abundance of black-legged kittiwakes in the Bering Sea in February.

125 Distribution and abundance of black-legged kittiwakes in the Bering Sea in March.

126 Distribution and abundance of black-legged kittiwakes in the Bering Sea in June.

127 Distribution and abundance of black-legged kittiwakes in the Bering Sea in July.

128 Distribution and abundance of black-legged kittiwakes in the Bering Sea in August.

129 Distribution and abundance of black-legged kittiwakes in the Bering Sea in October.

130 Distribution and abundance of red-legged kittiwakes in the Bering Sea in February.

131 Distribution and abundance of red-legged kittiwakes in the Bering Sea in March.

132 Distribution and abundance of red-legged kittiwakes in the Bering Sea in October. No red-legged kittiwakes were observed in June, July or August.

133 Distribution and abundance of Sabine's gulls in the Bering Sea in June. No Sabine's gulls were observed in February or March.

134 Distribution and abundance of Sabine's gulls in the Bering Sea in July.

135 Distribution and abundance of Sabine's gulls in the Bering Sea in August.

136 Distribution and abundance of Sabine's gulls in the Bering Sea in October.

137 Distribution and abundance of arctic terns in the Bering Sea in June. No arctic terns were observed in February or March.

138 Distribution and abundance of arctic terns in the Bering Sea in July.

139 Distribution and abundance of arctic terns in the Bering Sea in August. No arctic terns were observed in October.

140 Distribution and abundance of small alcids in the Bering Sea in February.

141 Distribution and abundance of small alcids in the Bering Sea in March.

142 Distribution and abundance of small alcids in the Bering Sea in June.

143 Distribution and abundance of small alcids in the Bering Sea in July.

144 Distribution and abundance of small alcids in the Bering Sea in August.

145 Distribution and abundance of small alcids in the Bering Sea in October.

146 Distribution and abundance of murres in the Bering Sea in February.

147 Distribution and abundance of murres in the Bering Sea in March.

148 Distribution and abundance of murres in the Bering Sea in June.

149 Distribution and abundance of murres in the Bering Sea in July.

150 Distribution and abundance of murres in the Bering Sea in August.

151 Distribution and abundance of murres in the Bering Sea in October.

152 Distribution and abundance of parakeet auklets in the Bering Sea in February.

153 Distribution and abundance of parakeet auklets in the Bering Sea in August. No parakeet auklets were identified in March, June or July.

154 Distribution and abundance of parakeet auklets in the Bering Sea in October.

155 Distribution and abundance of crested auklets in the Bering Sea in February.

156 Distribution and abundance of crested auklets in the Bering Sea in March.

157 Distribution and abundance of crested auklets in the Bering Sea in August. No crested auklets were identified in June or July.

158 Distribution and abundance of crested auklets in the Bering Sea in October.

159 Distribution and abundance of least auklets in the Bering Sea in February.

160 Distribution and abundance of least auklets in the Bering Sea in August. No least auklets were observed in March, June or July.

161 Distribution and abundance of least auklets in the Bering Sea in October.

162 Distribution and abundance of Kittlitz's murrelet in the Bering Sea in February. No Kittlitz's murrelets were observed in March, June, July, August or October.

163 Distribution and abundance of tufted puffins in the Bering Sea in June. No tufted puffins were observed in February or March.

164 Distribution and abundance of tufted puffins in the Bering Sea in July.

165 Distribution and abundance of tufted puffins in the Bering Sea in August.

166 Distribution and abundance of tufted puffins in the Bering Sea in October.

167 Distribution and abundance of horned puffins in the Bering Sea in March. No horned puffins were observed in February.

168 Distribution and abundance of horned puffins in the Bering Sea in June.

169 Distribution and abundance of horned puffins in the Bering Sea in July.

170 Distribution and abundance of horned puffins in the Bering Sea in August.

ABSTRACT

Aerial surveys of marine birds were conducted in the Gulf of Alaska, the Bering Sea, the Chukchi Sea and the Beaufort Sea between 8 January and 15 October 1976 by the U.S. Fish and Wildlife Service. In total 2,438 quadrats or units of information were collected.

Summaries of bird population data are presented by species, 1-month intervals and oceanographic region in 34 tables. Monthly distribution and abundance data are mapped by species or species group for the Beaufort Sea, the Chukchi Sea and the Bering Sea in 171 figures. Monthly distribution and abundance data are mapped for total birds for the Gulf of Alaska in 3 figures.

Distributional data from aerial surveys are deemed inadequate to measure potential impacts of OCS leasing on avifauna in most regions during most of the year.

INTRODUCTION

This report considers the seasonal density and distribution of marine birds and the identification of critical species and areas with regard to possible effects of oil and gas development. Emphasis is on the pelagic environment and not on species generally confined to littoral habitats. Furthermore, this report does not directly address the distribution of pelagic species when they occupy shoreline habitats during the breeding season. The density and distribution of birds are mapped for various areas by species or species group. Key areas can be identified from this atlas and the seasonal patterns of distribution indicate which populations would be adversely impacted by outer continental shelf oil and gas development.

A large and growing literature has documented the impacts of oil and oil development on marine birds. Bourne, Parrack and Potts (1967) documented the known birds killed in the Torrey Canyon disaster in the English Channel and found that murres (Uria aalge) and razorbills (Alca torda) comprised 97% of the dead birds and that a high proportion of the oiled birds were immature. Brouwer (1953) found the most common victims of oil pollution on Dutch coasts to be common murres, razorbills, loons (Gavia sp.), black scoters (Melanitta nigra) and gannets (Morus bassanus) while black-legged kittiwakes (Rissa tridactyla) comprised only 5%. The majority of oiled birds washed ashore during the winter months. Greenwood (1970) included common eiders (Somateria mollissima) among the most common victims of oil pollution in Scotland. Smail, Ainley and Strong (1972) documented the loss of birds which resulted from a collision of oil tankers in San Francisco Bay and found that the heaviest losses were suffered by western grebes (Aechmophorus occidentalis), surf scoters (Melanitta perspicillata), white-winged scoters (M. deglandi) and common murres. Bourne (1968) commented on the behavior of murres and gulls when encountering oil and water and concluded that gulls take flight while murres dive and surface at random. These reactions help to explain why murres suffer heavy casualties while gulls can escape an oil spill relatively unharmed.

Although we have had little experience with oiled birds in Alaska, we can predict that the species most poorly adapted to land and flight will suffer the most from oil spills. These include loons, eiders, scoters, oldsquaw, cormorants, murres, puffins, auklets and murrelets. Effects would be most profound in areas where these species aggregate on the water and include feeding areas adjacent to breeding colonies in the summer and protected embayments in the winter.

CURRENT STATE OF KNOWLEDGE

We know of no published results on aerial surveys of marine birds in Alaskan waters. Unpublished reports and unanalyzed data from Alaskan waters do exist, and these have been previously cited in Lensink, Bartonek and Harrison (1976).

STUDY AREA

Aerial observations of seabirds have been made within 16 of 26 oceanographic regions identified in Figure 1. These oceanographic regions were subjectively delineated by us so as to, in part, encompass sedimentary basins identified by the U.S. Department of the Interior for leasing (Figure 2) and, in part, in consideration of political boundaries or oceanographic characteristics. Aerial surveys in 1976 were flown in the Gulf of Alaska, the Bering Sea, the Chukchi Sea and the Beaufort Sea. The boundaries have been the 142°W meridian to the east in the Gulf of Alaska, the 52°30'N parallel to the south in Umnak Basin, the 172°W meridian to the west in the Bering Sea and the 72°N parallel to the north in the Beaufort Sea.

METHODS

Aerial surveys were completed at various intervals in 1976 corresponding to areas and time periods when rapid changes of density or species composition in pelagic waters were anticipated and contingent on the availability of aircraft support and the vicissitudes of Alaskan weather conditions. Informational gaps from 1975 were identified and filled to the extent possible within funding limitations. Linear transects follow lines of longitude and latitude whenever possible and were selected to maximize the ratio of hours of actual survey time to total hours of flying time and to sample representative or critical areas. Large areas were surveyed over a few days time in order to provide a synoptic view of a large oceanographic area.

Due to the excessive cost of its operation, the P2V was removed from service and beginning August, 1976 we have utilized a turbo-goose with good forward and lateral visibility. The goose is equipped with a GNS 500 navigation system (Global Navigation, Inc.) which utilizes the Very Low Frequency (VLF) radio band. This system is capable of locating transects or transect segments within a tenth of an arc-minute. All observations were recorded by transect segment encompassing one minute of latitude (1 naut. mi.) for north-south censuses or 5 minutes of longitude (2.8 to 5.6 naut. mi. , depending on latitude) for east-west censuses. Supplementary data recorded for each segment included weather, sea state, wind, ceiling, altitude, aircraft speed, presence of fishing vessels, ice conditions and incidental observations of marine mammals.

We know of no published methodology for aerial surveys of marine birds at sea. Martinson and Kaczynski (1967) discuss aerial surveying terrestrial waterfowl populations and attempt to establish indices of air:ground estimates. They found that the species composition of waterfowl in aerial survey indices was biased due to the fact that some species were more obvious than others. This is less of a problem in the marine environment since there is no vegetation to obscure sea birds, but nevertheless there is the probability that small alcids and other birds which dive at the sound of an airplane are systematically underestimated. Correction factors for the underestimation of these species will be established. Numerous papers have addressed the problems of censusing mammals by aerial methods and many of the conclusions are valid for marine bird work. Caughley (1974) concluded that aerial censuses of terrestrial mammals are inaccurate because the observer misses a significant number of animals on the transect and that accuracy deteriorates progressively with increasing the width of the transect, cruising speed and altitude. LeResche and Rausch (1974) found that accuracy in counts of moose (Alces alces) were significantly affected by observer experience, by the number of observers and by terrain. They also found that experienced observers had internally consistent counts. Pennycuick and Western (1972) concluded in an aerial sampling of large mammal populations that low altitudes give bigger population estimates than high and that narrow strips gave bigger estimates than wide. Leatherwood and Platter (1975) have censused marine mammal populations and concluded that a strip census is superior to a line transect or random block design as long as a method of estimating transect width is available.

We have taken these results into consideration in the design of our aerial surveys. A narrow 100-m transect width has been used and this distance has been estimated using a clinometer, the aircraft altitude and elementary trigonometric functions. Altitude has been fixed at 100-120 feet, depending on flying conditions. Air speed has been maintained at 120 knots, thus, ground speed varied with wind direction and velocity. Observability varied somewhat due to overcast, glare and sea state but with experienced observers these factors are minimized and data of reasonably consistent quality are collected.

Three biologists were utilized simultaneously on aerial surveys. Two sat on either side of the goose and recorded observations to the most specific taxonomic group possible into a cassette recorder. Strip censuses of 50-m on each side of the airplane were used, resulting in a shadow or non-censused area underneath the plane along the flight line. The third biologist monitored the GNS 500 and recorded positions at appropriate intervals. Approximately every 30 minutes the biologists switched seating arrangements to combat aerial hypnosis and to allow one of the three to ease his eyestrain by diverting his attention to the GNS 500.

Synthesis reports for each aircraft survey period were prepared and estimates of pelagic birds/km^2 within each 10-minute block of latitude and and longitude in which censuses were conducted are available. Furthermore, complete transcripts of tapes, a preliminary mapping of total sea bird densities and surface synoptic weather charts for the periods surveyed are bound into the aerial synthesis reports and retained on file by the Fish and Wildlife Service.

on the water and are sluggish, will be particularly vulnerable to oil spills in their vicinity.

Fulmars were seen in modest numbers on all three cruises (Appendix I Fig. 6, 7, and 9). In early June they were generally scarce and seen in low numbers throughout the cruise, the only notable concentration occurring south of St. George Island. By July, the numbers of Fulmars had increased significantly. They were encountered in moderately large numbers 8-15 km west of St. Paul Island and east and west of St. George Island. South of St. George Island large numbers were seen flying south in the evening to join an enormous flock several miles long which trailed out down-wind from a factory ship southeast of St. George Island. This ship may have been responsible for the large numbers of Fulmars seen along the 200 meter curve on the July cruise. In August, the number of Fulmars seen had dropped off dramatically and most observations were of birds in deep water around the 200 meter curve.

Flight directions of Fulmars in selected grids during the July cruise are given in Appendix I Fig. 8. Of greatest interest are the morning and evening flight patterns south of St. George Island. In the evening the preponderance of birds were moving south and southeast, away from the island and apparently commuting to join the flock of birds associated with the factory ship. Several days later in the morning, most Fulmars seen were flying north toward the St. George Island. Likewise slightly later in a substantial population of black-legged kittiwakes. It is possible that the distribution of kittiwakes is an artifact of the reproduction failure in the Arctic Ocean in 1976. Glaucous gulls were a common species in Kotzebue Sound, perhaps partially due to human activity in that area. The Bering Strait and waters immediately north had significant numbers of shearwaters, fulmars, crested auklets, parakeet auklets and least auklets. The small alcids may be post-breeders or non-breeders associated with the Diomede Islands, but the possibility that some are birds from the Soviet Union cannot be discounted. Tufted puffins and horned puffins are also found in the Bering Straits area, and numbers of horned puffins are also found in the vicinity of Chamisso Island, a known breeding area for this species. Cape Espenberg and Eschscholtz Bay had large numbers of scoters, eiders and loons, in part a result of fresh water influx and shallow waters. Eschscholtz Bay and the Noatak estuary proved to be very important for thousands of shorebirds, eiders, greater scaup, goldeneyes and Canada geese.

Surveys in the Chukchi Sea during October indicated a great deal of bird movement both into and out of the area. Tufted puffins, horned puffins, crested auklets, parakeet auklets, arctic terns, fulmars and scoters were all still present but with much reduced numbers. Shearwaters apparently increased since August, probably moving in from feeding areas off the coast of Siberia. Black-legged kittiwakes and murres were the most widespread species in October, and the murre population had shifted somewhat from Cape Lisburne southward into Kotzebue Sound. Oldsquaw moved into the area between Cape Espenberg and the Baldwin Peninsula in very large numbers during October. This species had been unreported in June and August and its presence was unexpected.

Figures 67 to 171 illustrate the patterns of bird distribution in the Bering Sea in February, March, June, July, August and October. October is the only month in which adequate surveys of both northern and southern Bering Sea have been completed. February and July include extensive surveys of the southern Bering Sea and August has similar coverage of northern Bering Sea. March and June data are inadequate. Shearwaters were the dominant species in the Bering Sea during the summer months, but we do not know whether they arrived in April or May. They were present through at least October, but populations began to decline in August as breeding birds began their return to nesting areas in the Southern Hemisphere. Fulmars were found along the shelf break and in waters deeper than 1,000-f during all months in which adequate surveys have taken place. A substantial summer population was in the Bering Straits area, perhaps birds from St. Matthew Island. Fulmars do not seem to range into Norton Sound or Bristol Bay. Fork-tailed petrels are in 1,000-f waters year-round but move into the slope area north of the Fox Islands during the summer months. Eiders and scoters are found in all months along the coasts of the Alaskan Bering Sea if open water is present, especially in Bristol Bay. Glaucous-winged gulls are a common species in the southern Bering Sea, especially in areas where there is significant fishing activity. Black-legged kittiwakes are a common species in the Bering Sea during the summer months but apparently move to deeper water off of the continental shelf during the winter. Murres are abundant along the ice edge in the southern Bering Sea in February and are the most widespread resident species in this area. They are especially abundant near the Pribilof Islands, Cape Newenham, Round Island, St. Lawrence Island, King Island and the Diomedes. The Diomedes are a crucial area for least, crested and parakeet auklets between June and September. Tufted puffins are a common fall species in the southern Bering Sea and scattered throughout the area during the summer.

The March surveys in the Gulf of Alaska (Figure 173ab) revealed that the open water south of the Alaska Peninsula is a crucial wintering area for large populations of eiders, scoters, murres, small alcids, cormorants and glaucous-winged gulls. In particular, the area south of Unimak Island, Cold Bay, Sanak Island, the Sandman Reefs and the Shumagin Islands had substantial numbers of birds. Umnak and the Shumagin Islands were important for emperor geese in intertidal areas and it is expected that they are present in similar habitat throughout the area. Unimak Pass, an important foraging area at other times of the year, did not support many wintering birds. Shelikof Strait had large numbers of eiders and murres and may represent a staging area for these species. Katmai Bay, Raspberry Strait and especially Kachemak Bay had substantial numbers of murres and waterfowl. The late March surveys in the northeast and northwest Gulf of Alaska indicated that large numbers of birds are not at this time in continental shelf waters although black-legged kittiwakes and murres were relatively abundant. Fulmars, tufted puffins and fork-tailed petrels appear to be present along the continental slope.

Although our survey of early April (Figure 174) had to be aborted due to a failure of the GNS 500 system, we did establish the fact that murres were present in the vicinity of the Barren Islands, perhaps early arrivals for that colony.

The January survey in the Kodiak area (Figure 172) emphasized the extreme importance of the nearshore areas of Shuyak, Afognak, Kodiak and the Trinity Islands for wintering scoters, eiders, oldsquaw, cormorants, murres and crested auklets. Furthermore, it indicated that tufted puffins and black-legged kittiwakes winter beyond the 1,000-f contour. It also established that a small remnant population of non-breeding shearwaters overwinters in Alaskan waters.

CONCLUSIONS

Tentative conclusions for the Beaufort Sea are that nearshore waters out to 5 miles are the most important for avian use. In keeping with the results referred to in the "current state of knowledge" section within this report, the most impacted species in this area would be oldsquaw, eiders and loons. These conclusions are based on July and August surveys and would be enhanced by data from late May or early June when birds arrive in this area.

Tentative conclusions for the Chukchi Sea are that nearshore areas are generally the most probable habitats for impacted bird species. Waters as much as 80 km around Cape Lisburne and Cape Thompson have large populations of murres June through October which would be vulnerable to oil development. The waters between Cape Espenberg and the Baldwin Peninsula are very important for oldsquaw in October. Eschscholtz Bay and the Noatak estuary have large concentrations of waterfowl in August and much of the coast between Cape Prince of Wales and Point Barrow is potentially critical habitat for eiders, but the movements of this species are too poorly known to specify exact locations.

Preliminary conclusions for the Bering Sea indicate that all areas which are known to have large populations of alcids and sea ducks would be severely impacted by OCS activity. During the summer months this includes the Pribilofs, King Island, the Diomedes, Fairway Rock, Cape Newenham, St. Matthew and St. Lawrence. Murres, parakeet auklets and least auklets winter near the ice edge and could be affected by oil leaks and spillage which might travel underneath the ice to the ice edge. Winter open water areas in Bristol Bay are very important for scoters, oldsquaw and eiders. These species have been among those most seriously affected by oil spills in European waters and undoubtedly the same would hold true in Alaska. Any tanker route through the Bering Straits would encounter hazardous fog conditions and endanger very large colonies of least, crested and parakeet auklets which nest on the nearby Diomedes.

Preliminary conclusions for the Gulf of Alaska again indicate that areas within feeding range of alcid colonies would have the greatest damage potential from oil spills and oil development. Wintering populations of sea ducks in Kachemak Bay, the Kodiak archipelago and the Shumagin Islands would be extremely vulnerable to oil and gas development. Sea birds are probably subjected to maximum physiological stress during the winter and are especially vulnerable to environmental disruption at this time. Furthermore, sea ducks tend to aggregate in large flocks in specific areas which would make an oil spill in such an area particularly disastrous for the population concerned. It is suggested that oil development be steered away from these areas to the extent practicable.

NEEDS FOR FURTHER STUDY

Major seasonal and geographic gaps in data from aerial surveys are identified in table 4. These include many areas totally uncensused and other areas inadequately censused during crucial times of the year. The need for complete seasonal and geographic coverage is illustrated by our October survey in the Chukchi Sea. We found a large concentration of oldsquaw in Kotzebue Sound, a species well-known to be impacted by oil development. We would have no way of predicting _a priori_ the movements of this species; in fact, it was not found during June and August surveys in the same area. There are many similar areas which have not been adequately censused. In particular, surveys between Bristol Bay and the Canadian border are needed from April to September to clarify the movements of king eiders, another species known to aggregate in large flocks and with a high vulnerability to oil pollution.

In 1976, a total of 2,438 aerial quadrats were censused compared to 3,316 shipboard quadrats. Each method has inherent advantages over the other for providing a reliable index of bird populations. Aerial surveys enable large areas to be surveyed and compared over a relatively short time period, and changes in distribution can be analyzed with most variables being held relatively constant. For example, distributional changes over the continental shelf, continental slope and deep water beyond the 1,000-f line can be emphasized on an aerial survey within a single day. Furthermore, geographic areas in which our knowledge is inadequate can be identified and surveyed as quickly as weather will permit. This is not possible on National Ocean and Atmospheric Administration ships where bird censuses are conducted on a non-interference basis and regions surveyed tend to be opportunistic. Aerial transects are easily replicated and are the only internally consistent method we can use for repetitive coverage of extensive areas. Aerial censusing is likely to be the only effective means for monitoring programs.

Shipboard censuses have some advantages over aerial surveys. The cost effectiveness of data acquisition is far greater as long as it is conducted on a non-interference basis; it is rarely cheaper if a vessel is specifically chartered solely to conduct pelagic surveys. Shipboard work allows for the gathering of a greater number of environmental parameters directly, such as sea temperature and depth. These have to be obtained indirectly for aerial surveys. There is an apparent tendency for shipboard censuses to obtain higher population estimates than aerial surveys, and the reasons for this have not yet been fully explored although it certainly differs according to species. One possibility is that censusing is, in part, a function of time, i.e., shipboard censuses count the number of birds which fly through the transect zone, whereas aerial surveys provide a more instantaneous view of birds within the zone surveyed. In summary, we believe that aerial and shipboard surveys conducted concurrently provide powerful tools to understand bird density and distribution. However, to permit a greater degree of congruity between the two types of survey estimates a method of inter-calibrating shipboard and aerial surveys is required. We will begin to develop such a method during FY 77.

SUMMARY OF 4TH QUARTER OPERATIONS

A single goose survey is listed in Table 1 and is the only survey conducted during the past quarter. Observers were Craig Harrison, Arthur Sowls and Colleen Handel and census area included parts of Lower Cook Inlet, Shelikof Strait, Northwest Gulf of Alaska and Kodiak Basin. Approximately 1500 miles of transect lines were flown and the continental shelf break again supported a large avian population.

Aerial survey expenditures through 31 March 1977 are:

October rental of turbo-goose	54.1 hours
March rental of turbo-goose	13.2
	67.3

67.3 hours @$350/hour =	$23,555
Per diem	3,975
	$27,530

Logistical funds remaining $31,445

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numbers were still to be found in the area to the east of St. George Island. This then represents a real change in distribution from that seen in mid July, and undoubtably reflects the dispersal of the auklets from their island nesting colonies.

E. SURVEY OF OTTER AND WALRUS ISLANDS

Slides taken during the August 1975 helicopter flight around Walrus Island confirmed observation made from the helicopter that the huge colony of Common Murres described in earlier literature was no longer present and has been replaced by large numbers of Steller's Sea Lions (Hunt 1976). The second helicopter survey in June 1976 confirmed observations made the previous August.

Although Causey did not have enough time to do a complete census of birds on the cliffs of Otter Island on 12 June 1976, he reported that the species composition was very similar to that of St. Paul. Thick-billed Murres were far more abundant than Common Murres, and almost all kittiwakes seen were Black-legs. Very few Red-legged Kittiwakes were present.

Table 3. Distribution of effort for censusing marine birds by the aerial transect method, 1975-1976.[1]

Region	Region Abbre-viation	Number of Quadrats												
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Alaska Peninsula South	APS	0	0	68	0	0	0	50	0	0	0	0	0	118
Bristol Bay	BB	0	67	0	0	0	0	94	49	0	122	0	13	345
Beaufort Basin	BFT	0	0	0	0	0	0	253	206	0	0	0	0	459
Eastern Central Bering Sea	ECB	0	0	0	0	0	11	0	119	0	23	0	0	153
Hope Basin	HB	0	0	0	0	0	41	0	480	0	173	0	0	694
Kodiak Basin	KB	70	0	24	3	0	15	22	0	0	0	0	0	134
Lower Cook Inlet	LCI	6	0	18	15	0	15	7	14	0	5	0	0	80
Navarin Basin	NAV	0	6	0	0	0	4	0	6	0	6	0	0	22
Norton Basin	NB	0	0	0	0	0	45	0	210	0	210	0	0	465
Northeast Gulf of Alaska	NEGOA	0	0	162	13	0	93	0	0	0	112	0	0	380
Northwest Gulf of Alaska	NWGOA	17	0	108	43	0	149	12	3	0	52	0	0	384
Prince William Sound	PWS	0	0	4	0	0	0	0	0	0	4	0	0	8
St. George Basin	SGB	0	98	18	0	0	0	148	0	0	151	0	0	415
Shelikof Strait	SS	2	0	17	2	0	5	27	0	0	0	0	0	53
Upper Cook Inlet	UCI	0	0	6	4	0	14	1	2	0	4	0	0	31
Umnak Basin	UMB	0	0	65	0	0	0	0	0	0	56	0	0	121
Total		95	171	490	80	0	392	614	1089	0	918	0	13	3862

[1]Includes USFWS data from June, 1972 and April, 1973.

Table 4. Data gaps for censusing marine birds by the aerial transect method.

Region	Region Abbreviation	Suggested Priorities[1]											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Alaska Peninsula South	APS		++		+++	++	+++	+	++	+++	++	+++	++
Bristol Bay	BB			++	+++	++	++			++		++	+
Beaufort Basin	BFT					++	+++			++			
Eastern Central Bering Sea	ECB					+++	+			+			
Hope Basin	HB					++	++	+++	++	++			
Kodiak Basin	KB				++	+++	++	+	++	+++	+	++	+
Lower Cook Inlet	LCI					+				+			
Navarin Basin	NAV			++			+++	++	+	+++	++	+	
Norton Basin	NB					+++		+		+++			
Northeast Gulf of Alaska	NEGOA					++		++	+	+++			
Northwest Gulf of Alaska	NWGOA					++		++	+	+++			
Prince William Sound	PWS						++	++	++				
St. George Basin	SGB				++	+++	+		++	+		+	
Shelikof Strait	SS									++	++		
Upper Cook Inlet	UCI												
Umnak Basin	UMB					++	+	++	+	++			

1 based on suspected importance of area and month for bird populations likely to be impacted by OCS oil and gas development
+++ is the highest priority

Table 5. Bird observations on aerial transects, Alaska Peninsula South, March, 1976.

Species Name	Occurence	% Occurence	No. Birds	Birds/Km^2
Common Loon				
Yellow-billed Loon				
Arctic Loon				
Red-throated Loon				
Unid. Loon				
Red-Necked Grebe				
Horned Grebe				
Western Grebe				
Black-footed Albatross				
Laysan Albatross				
Unid. Albatross				
Fulmar	11	16	15	0.2
Pink-footed Shearwater				
New Zealand Shearwater				
Sooty Shearwater				
Short-tailed Shearwater				
Unid. Shearwater				
Scaled Petrel				
Fork-tailed Storm Petrel	5	7	6	0.1
Leach's Storm Petrel				
Ashy Storm Petrel				
Unid. Storm Petrel				
Brown Pelican				
Double-crested Cormorant				
Brandt's Cormorant				
Pelagic Cormorant				
Red-faced Cormorant				
Unid. Cormorant	11	16	53	0.6
Whistling Swan				
Canada Goose				
Black Brant				
Emperor Goose	3	4	76	0.8
White-fronted Goose				

Species Name	Occurence	% Occurence	No. Birds	Birds/km^2
Snow Goose				
Unid. Goose				
Mallard	1	1	9	0.1
Gadwall				
Pintail				
Green-winged Teal				
American Widgeon				
Shoveler				
Redhead				
Canvasback				
Greater Scaup				
Lesser Scaup				
Unid. Scaup				
Common Goldeneye				
Barrow's Goldeneye				
Bufflehead	1	1	2	tr.
Oldsquaw	4	6	48	0.5
Harlequin Duck				
Steller's Eider	3	4	125	1.4
Common Eider	2	3	265	2.9
King Eider	5	7	92	1.0
Spectacled Eider				
Unid. Eider	3	4	27	0.3
White-winged Scoter	2	3	11	0.1
Surf Scoter				
Black Scoter	3	4	38	0.4
Unid. Scoter				
Unid. Duck	2	3	8	0.1
Red-breasted Merganser				
Bald Eagle	1	1	2	tr.
Gyrfalcon				
Peregrine Falcon				
Black Oystercatcher				

Table 5. Continued.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km^2
American Golden Plover				
Unid. Turnstone				
Ruddy Turnstone				
Black Turnstone				
Whimbrel				
Sharp-tailed Sandpiper				
Rock Sandpiper	1	1	50	0.6
Red Phalarope				
Northern Phalarope				
Unid. Phalarope				
Pomarine Jaeger				
Parasitic Jaeger				
Long-tailed jaeger				
Unid. Jaeger				
Skua				
Glaucous Gull				
Glaucous-winged Gull	18	27	178	2.0
Slaty-backed Gull				
Western Gull				
Herring Gull				
Herring/Glaucous-wg. Hyb.				
Thayer's Gull				
California Gull				
Ring-billed Gull				
Mew Gull				
Black-headed Gull				
Bonaparte's Gull				
Heermann's Gull				
Ivory Gull				
Unid. Kittiwake				
Black-legged Kittiwake	7	10	29	0.3
Red-legged Kittiwake				
Ross' Gull				
Sabine's Gull				
Unid. Immature Gull				
Unid. Gull				
Common Tern				
Arctic Tern				
Aleutian Tern				
Unid. Tern				
Common Murre				
Thick-billed Murre	1	1	2	tr.
Unid. Murre	23	34	571	6.3
Unid. Guillemot				
Black Guillemot				
Pigeon Guillemot				
Unid. Large Alcid				
Marbled Murrelet				
Kittlitz's Murrelet				
Xantus' Murrelet				
Ancient Murrelet	8	12	96	1.1
Unid. Murrelet				
Cassin's Auklet				
Parakeet Auklet				
Crested Auklet	4	6	122	1.4
Least Auklet				
Rhinoceros Auklet				
Unid. Small Alcid	1	1	107	1.2
Horned Puffin				
Tufted Puffin				
Unid. Puffin				
Short-eared Owl				
Snowy Owl				
Tree Swallow				
Black Swallow				
Unid. Swallow				

Table 5. Continued.

Species Name	Occurence	% Occurence	No. Birds	Birds/Km^2	Species Name	Occurence	% Occurence	No. Birds	Birds/km^2
Common Raven	1	1	3	tr.					
Water Pipit									
Bohemian Waxwing									
Orange-crowned Warbler									
Townsend's Warbler									
Wilson's Warbler									
Pine Siskin									
Savannah Sparrow									
White-crowned Sparrow									
Lapland Longspur									
Unid. Passerine									
Unid. Bird	5	7	18	0.2					
Totals/Average			1953	21.7					

Cruise numbers data are compiled from: 76-6

Table 6. Bird observations on aerial transects, Bristol Bay, February, 1976.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km^2
Common Loon				
Yellow-billed Loon				
Arctic Loon				
Red-throated Loon				
Unid. Loon				
Red-Necked Grebe				
Horned Grebe				
Western Grebe				
Black-footed Albatross				
Laysan Albatross				
Unid. Albatross				
Fulmar	3	4	9	0.1
Pink-footed Shearwater				
New Zealand Shearwater				
Sooty Shearwater				
Short-tailed Shearwater				
Unid. Shearwater				
Scaled Petrel				
Fork-tailed Storm Petrel				
Leach's Storm Petrel				
Ashy Storm Petrel				
Unid. Storm Petrel				
Brown Pelican				
Double-crested Cormorant				
Brandt's Cormorant				
Pelagic Cormorant				
Red-faced Cormorant				
Unid. Cormorant	5	7	30	0.3
Whistling Swan				
Canada Goose				
Black Brant				
Emperor Goose				
White-fronted Goose				
Snow Goose				
Unid. Goose				
Mallard				
Gadwall				
Pintail				
Green-winged Teal				
American Widgeon				
Shoveler				
Redhead				
Canvasback				
Greater Scaup				
Lesser Scaup				
Unid. Scaup				
Common Goldeneye				
Barrow's Goldeneye				
Bufflehead				
Oldsquaw	7	10	32	0.3
Harlequin Duck				
Steller's Eider				
Common Eider	2	3	16	0.2
King Eider	4	6	567	5.5
Spectacled Eider				
Unid. Eider	2	3	33	0.3
White-winged Scoter	2	3	3	tr.
Surf Scoter	1	1	1	tr.
Black Scoter				
Unid. Scoter				
Unid. Duck	1	1	60	0.6
Red-breasted Merganser				
Bald Eagle				
Gyrfalcon				
Peregrine Falcon				
Black Oystercatcher				

Additionally they are widespread in Alaska and are well studied by other OCSEAP investigators (see Appendix 2 for a partial compendium of 1976 Alaska work). Red-legged Kittiwakes that have the major portion of their entire population on St. George Island are relatively scarce on St. Paul Island and difficult to work with, but their world-wide rarity demands that their populations be monitored carefully. Finally, Thick-billed Murres as the most numerous of the seabirds of the Pribilofs deserve careful study as they would likely be heavily impacted by oil spill or disturbance.

The reproductive success of Red-faced Cormorants was similar in 1975 and 1976 on St. Paul and on St. George in 1976. For Red-faced Cormorants 1976 was a slightly better year, perhaps because late spring storms destroyed a number of low nests in 1975 on St. Paul. For Black-legged Kittiwakes, birds on St. George did slightly better than those on St. Paul. At present there is little additional data with which Pribilof Island Red-faced Cormorant can be compared, but more should soon be available through the OSEAP investigations.

Table 6. Continued.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km²	Species Name	Occurrence	% Occurence	No. Birds	Birds/km²
Common Raven									
Water Pipit									
Bohemian Waxwing									
Orange-crowned Warbler									
Townsend's Warbler									
Wilson's Warbler									
Pine Siskin									
Savannah Sparrow									
White-crowned Sparrow									
Lapland Longspur									
Unid. Passerine									
Unid. Bird	3	4	10	0.1					
Totals/Average			2485	24.2					

Cruise numbers data are compiled from: 76-6

Table 7. Bird observations on aerial transects, Bristol Bay, October, 1976.

Species Name	Occur-ence	% Occurence	No. Birds	Birds/Km^2	Species Name	Occur-ence	% Occurence	No. Birds	Birds/km^2
Unid. Bird	9	7	15	0.1	Black Brant				
Unid. Loon	13	10	45	0.2	Emperor Goose				
Yellow-billed Loon					Snow Goose				
Arctic Loon	2	2	3	tr.	Unid. Duck	5	4	59	0.3
Red-throated Loon					Mallard				
Red-necked Grebe					Gadwall				
Horned Grebe					Pintail				
Western Grebe					Green-winged Teal				
Unid. Albatross					American Widgeon				
Short-tailed Albatross					Shoveler				
Black-footed Albatross					Redhead				
Laysan Albatross					Canvasback				
Fulmar	19	15	69	0.4	Unid. Scaup				
Unid. Shearwater	4	3	362	2.0	Greater Scaup				
Pink-footed Shearwater					Lesser Scaup				
New Zealand Shearwater					Common Goldeneye				
Sooty Shearwater	1	1	4	tr.	Barrow's Goldeneye				
Short-tailed Shearwater					Bufflehead				
Unid. Petrel					Oldsquaw	5	4	9	tr.
Scaled Petrel					Harlequin Duck	1	1	29	0.2
Fork-tailed Storm Petrel	7	5	9	tr.	Unid. Eider	7	5	159	0.9
Leach's Storm Petrel					Steller's Eider				
Ashy Storm Petrel					Common Eider				
Brown Pelican					King Eider	2	2	9	tr.
Unid Cormorant	9	7	52	0.3	Spectacled Eider				
Double-crested Cormorant					Unid. Scoter	31	24	785	4.3
Brandt's Cormorant					White-winged Scoter	12	9	60	0.3
Pelagic Cormorant					Surf Scoter				
Red-faced Cormorant	1	1	4	tr.	Common Scoter	14	11	194	1.1
Whistling Swan					Red-breasted Merganser				
Unid. Goose					Bald Eagle				
Canada Goose					Gyrfalcon				
Brant					Peregrine Falcon				

Table 7. Continued.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km^2
Sandhill Crane				
Unid. Shorebird				
Black Oystercatcher				
American Golden Plover				
Unid. Turnstone				
Ruddy Turnstone				
Black Turnstone				
Whimbrel				
Unid. Sandpiper				
Sharp-tailed Sandpiper				
Unid. Phalarope	10	8	159	0.9
Red Phalarope				
Northern Phalarope				
Unid. Jaeger				
Pomarine Jaeger				
Parasitic Jaeger				
Long-tailed Jaeger				
Skua				
Unid. Gull	18	14	116	0.6
Glaucous Gull	16	12	34	0.2
Glaucous-winged Gull	24	18	104	0.6
Slaty-backed Gull				
Western Gull				
Herring Gull	2	2	11	0.1
Herring/Glaucous-wg. Hyb.				
Thayer's Gull				
Mew Gull				
Black-headed Gull				
Bonaparte's Gull				
Ivory Gull				
Unid. Kittiwake				
Black-legged Kittiwake	53	40	281	1.5
Red-legged Kittiwake				

Species Name	Occurrence	% Occurence	No. Birds	Birds/km^2
Ross' Gull				
Sabine's Gull	5	4	7	tr.
Unid. Tern				
Arctic Tern				
Aleutian Tern				
Unid. Large Alcid				
Unid. Murre	66	50	337	1.8
Common Murre				
Thick-billed Murre				
Unid. Guillemot				
Black Guillemot				
Pigeon Guillemot				
Unid. Small Alcid	16	12	36	0.2
Unid. Murrelet				
Marbled Murrelet				
Kittlitz's Murrelet				
Xantus' Murrelet				
Ancient Murrelet				
Cassin's Auklet				
Parakeet Auklet	19	15	76	0.4
Crested Auklet	2	2	3	tr.
Least Auklet	3	2	3	tr.
Rhinoceros Auklet				
Unid. Puffin				
Horned Puffin	3	2	4	tr.
Tufted Puffin	4	3	4	tr.
Short-eared Owl				
Unid. Passerine				
Unid. Swallow				
Tree Swallow				
Common Raven				
Water Pipit				
Bohemian Waxwing				

Table 7. Continued.

Species Name	Occur-ence	% Occurence	No. Birds	Birds/Km^2	Species Name	Occur-ence	% Occurence	No. Birds	Birds/km^2
Orange-crowned Warbler									
Townsend's Warbler									
Wilson's Warbler									
Pine Siskin									
Savannah Sparrow									
White-crowned Sparrow									
Lapland Longspur									
Totals/Average			3042	16.6					

* Cruise numbers data are compiled from: FW6-093

Table 8. Bird observations on aerial transects, Beaufort Sea, August, 1976.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km^2
Unid. Bird	2	1	5	tr.
Unid. Loon	6	3	13	0.1
Yellow-billed Loon	1	0.4	1	tr.
Arctic Loon	13	6	25	0.1
Red-throated Loon	2	1	4	tr.
Red-necked Grebe				
Horned Grebe				
Western Grebe				
Unid. Albatross				
Short-tailed Albatross				
Black-footed Albatross				
Laysan Albatross				
Fulmar				
Unid. Shearwater				
Pink-footed Shearwater				
New Zealand Shearwater				
Sooty Shearwater				
Short-tailed Shearwater				
Unid. Petrel				
Scaled Petrel				
Fork-tailed Storm Petrel				
Leach's Storm Petrel				
Ashy Storm Petrel				
Brown Pelican				
Unid Cormorant				
Double-crested Cormorant				
Brandt's Cormorant				
Pelagic Cormorant				
Red-faced Cormorant				
Whistling Swan				
Unid. Goose	1	0.4	14	0.1
Canada Goose				
Brant				

Species Name	Occurrence	% Occurence	No. Birds	Birds/km^2
Black Brant	3	1	68	0.3
Emperor Goose				
Snow Goose				
Unid. Duck				
Mallard				
Gadwall				
Pintail				
Green-winged Teal				
American Widgeon				
Shoveler				
Redhead				
Canvasback				
Unid. Scaup				
Greater Scaup				
Lesser Scaup				
Common Goldeneye				
Barrow's Goldeneye				
Bufflehead				
Oldsquaw	23	10	702	3.4
Harlequin Duck				
Unid. Eider	14	6	439	2.1
Steller's Eider				
Common Eider	1	0.4	1	tr.
King Eider	1	0.4	150	0.7
Spectacled Eider				
Unid. Scoter				
White-winged Scoter				
Surf Scoter				
Common Scoter				
Red-breasted Merganser				
Bald Eagle				
Gyrfalcon				
Peregrine Falcon				

Table 8. Continued.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km^2
Sandhill Crane				
Unid. Shorebird	4	2	69	0.3
Black Oystercatcher				
American Golden Plover				
Unid. Turnstone				
Ruddy Turnstone				
Black Turnstone				
Whimbrel				
Unid. Sandpiper				
Sharp-tailed Sandpiper				
Unid. Phalarope	6	3	37	0.2
Red Phalarope				
Northern Phalarope				
Unid. Jaeger	7	3	7	tr.
Pomarine Jaeger	2	1	2	tr.
Parasitic Jaeger	6	3	6	tr.
Long-tailed Jaeger	3	1	3	tr.
Skua				
Unid. Gull				
Glaucous Gull	22	10	80	0.4
Glaucous-winged Gull				
Slaty-backed Gull	1	0.4	1	tr.
Western Gull				
Herring Gull				
Herring/Glaucous-wg. Hyb.				
Thayer's Gull				
Mew Gull				
Black-headed Gull				
Bonaparte's Gull				
Ivory Gull				
Unid. Kittiwake				
Black-legged Kittiwake	7	3	73	0.4
Red-legged Kittiwake				

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km^2
Ross' Gull				
Sabine's Gull	3	1	8	tr.
Unid. Tern				
Arctic Tern	9	4	22	0.1
Aleutian Tern				
Unid. Large Alcid				
Unid. Murre				
Common Murre				
Thick-billed Murre				
Unid. Guillemot				
Black Guillemot				
Pigeon Guillemot				
Unid. Small Alcid				
Unid. Murrelet				
Marbled Murrelet				
Kittlitz's Murrelet				
Xantus' Murrelet				
Ancient Murrelet				
Cassin's Auklet				
Parakeet Auklet				
Crested Auklet				
Least Auklet				
Rhinoceros Auklet				
Unid. Puffin				
Horned Puffin				
Tufted Puffin				
Short-eared Owl				
Unid. Passerine				
Unid. Swallow				
Tree Swallow				
Common Raven				
Water Pipit				
Bohemian Waxwing				

Table 8. Continued.

Species Name	Occur-ence	% Occurrence	No. Birds	Birds/Km^2	Species Name	Occur-ence	% Occurrence	No. Birds	Birds/km^2
Orange-crowned Warbler									
Townsend's Warbler									
Wilson's Warbler									
Pine Siskin									
Savannah Sparrow									
White-crowned Sparrow									
Lapland Longspur									
Totals/Average			1730	8.5					

* Cruise numbers data are compiled from: FW6-086

Table 9. Bird observations on aerial transects, Eastern Central Bering Sea, August, 1976.

Species Name	Occur-ence	% Occurence	No. Birds	Birds/Km^2	Species Name	Occur-ence	% Occurence	No. Birds	Birds/km^2
Unid. Bird	2	2	2	tr.	Black Brant				
Unid. Loon	6	5	12	0.1	Emperor Goose				
Yellow-billed Loon					Snow Goose				
Arctic Loon	7	5	11	0.1	Unid. Duck	9	7	101	0.7
Red-throated Loon	2	2	5	tr.	Mallard	1	1	11	0.1
Red-necked Grebe					Gadwall				
Horned Grebe					Pintail	6	5	218	1.6
Western Grebe					Green-winged Teal				
Unid. Albatross					American Widgeon				
Short-tailed Albatross					Shoveler				
Black-footed Albatross					Redhead				
Laysan Albatross					Canvasback				
Fulmar	3	2	3	tr.	Unid. Scaup				
Unid. Shearwater	16	12	32	0.2	Greater Scaup				
Pink-footed Shearwater					Lesser Scaup				
New Zealand Shearwater					Common Goldeneye				
Sooty Shearwater	10	8	11	0.1	Barrow's Goldeneye				
Short-tailed Shearwater					Bufflehead				
Unid. Petrel					Oldsquaw				
Scaled Petrel					Harlequin Duck				
Fork-tailed Storm Petrel					Unid. Eider				
Leach's Storm Petrel					Steller's Eider				
Ashy Storm Petrel					Common Eider				
Brown Pelican					King Eider				
Unid Cormorant	6	5	78	0.6	Spectacled Eider				
Double-crested Cormorant					Unid. Scoter	7	5	162	1.2
Brandt's Cormorant					White-winged Scoter	5	4	49	0.4
Pelagic Cormorant					Surf Scoter	2	2	6	tr.
Red-faced Cormorant					Common Scoter	14	11	331	2.4
Whistling Swan					Red-breasted Merganser				
Unid. Goose					Bald Eagle				
Canada Goose					Gyrfalcon				
Brant					Peregrine Falcon				

Table 9. Continued.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km^2
Sandhill Crane				
Unid. Shorebird	9	7	1292	9.4
Black Oystercatcher				
American Golden Plover				
Unid. Turnstone				
Ruddy Turnstone				
Black Turnstone				
Whimbrel				
Unid. Sandpiper				
Sharp-tailed Sandpiper				
Unid. Phalarope	3	2	14	0.1
Red Phalarope				
Northern Phalarope				
Unid. Jaeger	6	5	10	0.1
Pomarine Jaeger	2	2	2	tr.
Parasitic Jaeger	2	2	2	tr.
Long-tailed Jaeger	2	2	2	tr.
Skua				
Unid. Gull	3	2	26	0.2
Glaucous Gull	17	13	101	0.7
Glaucous-winged Gull	4	3	13	0.1
Slaty-backed Gull				
Western Gull				
Herring Gull	2	2	2	tr.
Herring/Glaucous-wg. Hyb.				
Thayer's Gull				
Mew Gull	3	2	7	0.1
Black-headed Gull				
Bonaparte's Gull				
Ivory Gull				
Unid. Kittiwake				
Black-legged Kittiwake	50	39	419	3.0
Red-legged Kittiwake				

Species Name	Occurrence	% Occurence	No. Birds	Birds/km^2
Ross' Gull				
Sabine's Gull				
Unid. Tern				
Arctic Tern	10	8	31	0.2
Aleutian Tern				
Unid. Large Alcid	2	2	3	tr.
Unid. Murre	34	26	159	1.2
Common Murre				
Thick-billed Murre				
Unid. Guillemot				
Black Guillemot				
Pigeon Guillemot				
Unid. Small Alcid	5	4	10	0.1
Unid. Murrelet				
Marbled Murrelet				
Kittlitz's Murrelet				
Xantus' Murrelet				
Ancient Murrelet				
Cassin's Auklet				
Parakeet Auklet	4	3	6	tr.
Crested Auklet	1	1	1	tr.
Least Auklet	1	1	1	tr.
Rhinoceros Auklet				
Unid. Puffin				
Horned Puffin	5	4	89	0.6
Tufted Puffin	7	5	28	0.2
Short-eared Owl				
Unid. Passerine				
Unid. Swallow				
Tree Swallow				
Common Raven				
Water Pipit				
Bohemian Waxwing				

Table 9. Continued.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km²	Species Name	Occurrence	% Occurence	No. Birds	Birds/km²
Orange-crowned Warbler									
Townsend's Warbler									
Wilson's Warbler									
Pine Siskin									
Savannah Sparrow									
White-crowned Sparrow									
Lapland Longspur									
Totals/Average			3250	23.6					

* Cruise numbers data are compiled from: FW6-086

Table 10. Bird observations on aerial transects, Eastern Central Bering Sea, October, 1976.

Species Name	Occurence	% Occurrence	No. Birds	Birds/Km^2	Species Name	Occurence	% Occurence	No. Birds	Birds/km^2
Unid. Bird	1	9	1	tr.	Black Brant				
Unid. Loon	2	9	2	0.1	Emperor Goose				
Yellow-billed Loon					Snow Goose				
Arctic Loon	2	9	2	0.1	Unid. Duck	1	5	20	0.6
Red-throated Loon	1	5	1	tr.	Mallard				
Red-necked Grebe					Gadwall				
Horned Grebe					Pintail				
Western Grebe					Green-winged Teal				
Unid. Albatross					American Widgeon				
Short-tailed Albatross					Shoveler				
Black-footed Albatross					Redhead				
Laysan Albatross					Canvasback				
Fulmar	1	5	1	tr.	Unid. Scaup				
Unid. Shearwater					Greater Scaup				
Pink-footed Shearwater					Lesser Scaup				
New Zealand Shearwater					Common Goldeneye				
Sooty Shearwater					Barrow's Goldeneye				
Short-tailed Shearwater					Bufflehead				
Unid. Petrel					Oldsquaw	1	5	1	tr.
Scaled Petrel					Harlequin Duck				
Fork-tailed Storm Petrel					Unid. Eider	2	9	2	0.1
Leach's Storm Petrel					Steller's Eider				
Ashy Storm Petrel					Common Eider				
Brown Pelican					King Eider	1	5	1	tr.
Unid Cormorant					Spectacled Eider				
Double-crested Cormorant					Unid. Scoter	1	5	32	0.9
Brandt's Cormorant					White-winged Scoter	1	5	2	0.1
Pelagic Cormorant					Surf Scoter				
Red-faced Cormorant					Common Scoter	3	14	795	22.1
Whistling Swan					Red-breasted Merganser				
Unid. Goose					Bald Eagle				
Canada Goose	1	5	1	tr.	Gyrfalcon				
Brant					Peregrine Falcon				

Table 10. Continued.

Species Name	Occurence	% Occurence	No. Birds	Birds/Km²	Species Name	Occurence	% Occurence	No. Birds	Birds/km²
Sandhill Crane					Ross' Gull				
Unid. Shorebird	1	5	25	0.7	Sabine's Gull				
Black Oystercatcher					Unid. Tern				
American Golden Plover					Arctic Tern				
Unid. Turnstone					Aleutian Tern				
Ruddy Turnstone					Unid. Large Alcid				
Black Turnstone					Unid. Murre				
Whimbrel					Common Murre				
Unid. Sandpiper					Thick-billed Murre				
Sharp-tailed Sandpiper					Unid. Guillemot				
Unid. Phalarope	3	14	25	0.7	Black Guillemot				
Red Phalarope					Pigeon Guillemot				
Northern Phalarope					Unid. Small Alcid				
Unid. Jaeger					Unid. Murrelet				
Pomarine Jaeger					Marbled Murrelet				
Parasitic Jaeger					Kittlitz's Murrelet				
Long-tailed Jaeger					Xantus' Murrelet				
Skua					Ancient Murrelet				
Unid. Gull					Cassin's Auklet				
Glaucous Gull	11	50	23	0.6	Parakeet Auklet				
Glaucous-winged Gull					Crested Auklet				
Slaty-backed Gull					Least Auklet				
Western Gull					Rhinoceros Auklet				
Herring Gull					Unid. Puffin				
Herring/Glaucous-wg. Hyb.					Horned Puffin				
Thayer's Gull					Tufted Puffin				
Mew Gull					Short-eared Owl				
Black-headed Gull					Unid. Passerine				
Bonaparte's Gull					Unid. Swallow				
Ivory Gull					Tree Swallow				
Unid. Kittiwake					Common Raven				
Black-legged Kittiwake	3	14	4	0.1	Water Pipit				
Red-legged Kittiwake					Bohemian Waxwing				

Table 10. Continued.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km^2	Species Name	Occurrence	% Occurence	No. Birds	Birds/km^2
Orange-crowned Warbler									
Townsend's Warbler									
Wilson's Warbler									
Pine Siskin									
Savannah Sparrow									
White-crowned Sparrow									
Lapland Longspur									
Totals/Average			938	26.1					

* Cruise numbers data are compiled from: FW6-093

Table 11. Bird observations on aerial transects, Hope Basin, August, 1976.

Species Name	Occur-ence	% Occurence	No. Birds	Birds/km^2
Unid. Bird	9	2	14	tr.
Unid. Loon	4	1	7	tr.
Yellow-billed Loon	1	tr.	1	tr.
Arctic Loon	8	2	13	tr.
Red-throated Loon	1	tr.	1	tr.
Red-necked Grebe				
Horned Grebe				
Western Grebe				
Unid. Albatross				
Short-tailed Albatross				
Black-footed Albatross				
Laysan Albatross				
Fulmar	32	7	307	0.7
Unid. Shearwater	11	2	32	0.1
Pink-footed Shearwater				
New Zealand Shearwater				
Sooty Shearwater	11	2	33	0.1
Short-tailed Shearwater				
Unid. Petrel				
Scaled Petrel				
Fork-tailed Storm Petrel				
Leach's Storm Petrel				
Ashy Storm Petrel				
Brown Pelican				
Unid Cormorant				
Double-crested Cormorant				
Brandt's Cormorant				
Pelagic Cormorant				
Red-faced Cormorant				
Whistling Swan				
Unid. Goose				
Canada Goose				
Brant				

Species Name	Occur-ence	% Occurence	No. Birds	Birds/km^2
Black Brant				
Emperor Goose				
Snow Goose				
Unid. Duck	3	1	546	1.3
Mallard				
Gadwall				
Pintail				
Green-winged Teal				
American Widgeon				
Shoveler				
Redhead				
Canvasback				
Unid. Scaup				
Greater Scaup				
Lesser Scaup				
Common Goldeneye				
Barrow's Goldeneye				
Bufflehead				
Oldsquaw				
Harlequin Duck				
Unid. Eider	4	1	40	0.1
Steller's Eider	1	tr.	2	tr.
Common Eider				
King Eider	1	tr.	3600	7.4
Spectacled Eider				
Unid. Scoter				
White-winged Scoter				
Surf Scoter	3	1	272	0.6
Common Scoter				
Red-breasted Merganser				
Bald Eagle				
Gyrfalcon				
Peregrine Falcon				

Table 11. Continued

Species Name	Occurence	% Occurence	No. Birds	Birds/Km^2
Sandhill Crane				
Unid. Shorebird	2	tr.	6	tr.
Black Oystercatcher				
American Golden Plover				
Unid. Turnstone				
Ruddy Turnstone				
Black Turnstone				
Whimbrel				
Unid. Sandpiper				
Sharp-tailed Sandpiper				
Unid. Phalarope	45	9	708	1.6
Red Phalarope	1	tr.	10	tr.
Northern Phalarope				
Unid. Jaeger	1	tr.	1	tr.
Pomarine Jaeger	3	1	4	tr.
Parasitic Jaeger	2	tr.	2	tr.
Long-tailed Jaeger	2	tr.	2	tr.
Skua				
Unid. Gull	1	tr.	1	tr.
Glaucous Gull	44	9	117	0.3
Glaucous-winged Gull				
Slaty-backed Gull				
Western Gull				
Herring Gull				
Herring/Glaucous-wg. Hyb.				
Thayer's Gull				
Mew Gull				
Black-headed Gull				
Bonaparte's Gull				
Ivory Gull				
Unid. Kittiwake				
Black-legged Kittiwake	87	18	255	0.6
Red-legged Kittiwake				

Species Name	Occurence	% Occurence	No. Birds	Birds/Km^2
Ross' Gull				
Sabine's Gull	4	1	6	tr.
Unid. Tern				
Arctic Tern	27	6	94	0.2
Aleutian Tern	1	tr.	2	tr.
Unid. Large Alcid	5	1	5	tr.
Unid. Murre	135	28	1097	2.5
Common Murre	4	1	9	tr.
Thick-billed Murre	11	2	18	tr.
Unid. Guillemot				
Black Guillemot	2	tr.	2	tr.
Pigeon Guillemot				
Unid. Small Alcid	32	7	116	0.3
Unid. Murrelet				
Marbled Murrelet				
Kittlitz's Murrelet				
Xantus' Murrelet				
Ancient Murrelet				
Cassin's Auklet				
Parakeet Auklet	33	7	1271	2.9
Crested Auklet	27	6	1671	3.9
Least Auklet	14	3	1597	3.7
Rhinoceros Auklet				
Unid. Puffin				
Horned Puffin	8	2	20	tr.
Tufted Puffin	12	2	52	0.1
Short-eared Owl				
Unid. Passerine				
Unid. Swallow				
Tree Swallow				
Common Raven				
Water Pipit				
Bohemian Waxwing				

Table 11. Continued.

Species Name	Occurence	% Occurence	No. Birds	Birds/Km^2	Species Name	Occurence	% Occurence	No. Birds	Birds/km^2
Orange-crowned Warbler Townsend's Warbler Wilson's Warbler									
Pine Siskin Savannah Sparrow White-crowned Sparrow									
Lapland Longspur									
Total eliminating Noatak estuary and Diomedes			4035	9.4					
Totals/Average			11934	27.5					

* Cruise numbers data are compiled from: FW6-086

Table 12. Bird observations on aerial transects, Hope Basin, October, 1976.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km²
Unid. Bird	1	1	1	tr.
Unid. Loon	1	1	1	tr.
Yellow-billed Loon				
Arctic Loon	4	2	6	tr.
Red-throated Loon				
Red-necked Grebe				
Horned Grebe				
Western Grebe				
Unid. Albatross				
Short-tailed Albatross				
Black-footed Albatross				
Laysan Albatross				
Fulmar	10	6	16	0.1
Unid. Shearwater	13	8	491	2.8
Pink-footed Shearwater				
New Zealand Shearwater				
Sooty Shearwater	2	1	5	tr.
Short-tailed Shearwater	1	1	5	tr.
Unid. Petrel				
Scaled Petrel				
Fork-tailed Storm Petrel				
Leach's Storm Petrel				
Ashy Storm Petrel				
Brown Pelican				
Unid Cormorant	1	1	3	tr.
Double-crested Cormorant				
Brandt's Cormorant				
Pelagic Cormorant				
Red-faced Cormorant				
Whistling Swan				
Unid. Goose				
Canada Goose				
Brant				

Species Name	Occurrence	% Occurence	No. Birds	Birds/km²
Black Brant				
Emperor Goose				
Snow Goose				
Unid. Duck	2	1	4	tr.
Mallard				
Gadwall				
Pintail				
Green-winged Teal				
American Widgeon				
Shoveler				
Redhead				
Canvasback				
Unid. Scaup				
Greater Scaup	1	1	2	tr.
Lesser Scaup				
Common Goldeneye				
Barrow's Goldeneye				
Bufflehead				
Oldsquaw	16	9	597	3.4
Harlequin Duck				
Unid. Eider	1	1	3	tr.
Steller's Eider				
Common Eider	1	1	2	tr.
King Eider				
Spectacled Eider				
Unid. Scoter				
White-winged Scoter				
Surf Scoter	3	2	19	0.1
Common Scoter	2	1	9	0.1
Red-breasted Merganser				
Bald Eagle				
Gyrfalcon				
Peregrine Falcon				

Table 12. Continued.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km^2
Sandhill Crane				
Unid. Shorebird				
Black Oystercatcher				
American Golden Plover				
Unid. Turnstone				
Ruddy Turnstone				
Black Turnstone				
Whimbrel				
Unid. Sandpiper				
Sharp-tailed Sandpiper				
Unid. Phalarope	5	3	31	0.2
Red Phalarope				
Northern Phalarope				
Unid. Jaeger	1	1	2	tr.
Pomarine Jaeger	1	1	1	tr.
Parasitic Jaeger				
Long-tailed Jaeger				
Skua				
Unid. Gull				
Glaucous Gull	27	16	106	0.6
Glaucous-winged Gull				
Slaty-backed Gull				
Western Gull				
Herring Gull				
Herring/Glaucous-wg. Hyb.				
Thayer's Gull				
Mew Gull				
Black-headed Gull				
Bonaparte's Gull				
Ivory Gull				
Unid. Kittiwake				
Black-legged Kittiwake	41	24	261	1.5
Red-legged Kittiwake				

Species Name	Occurrence	% Occurence	No. Birds	Birds/km^2
Ross' Gull				
Sabine's Gull	1	1	1	tr.
Unid. Tern				
Arctic Tern	1	1	2	tr.
Aleutian Tern				
Unid. Large Alcid	2	1	2	tr.
Unid. Murre	51	30	328	1.9
Common Murre				
Thick-billed Murre				
Unid. Guillemot				
Black Guillemot				
Pigeon Guillemot				
Unid. Small Alcid	7	4	9	0.1
Unid. Murrelet				
Marbled Murrelet				
Kittlitz's Murrelet				
Xantus' Murrelet				
Ancient Murrelet				
Cassin's Auklet				
Parakeet Auklet	10	6	22	0.1
Crested Auklet	14	8	18	0.1
Least Auklet	8	5	25	0.1
Rhinoceros Auklet				
Unid. Puffin				
Horned Puffin	2	1	3	tr.
Tufted Puffin				
Short-eared Owl				
Unid. Passerine				
Unid. Swallow				
Tree Swallow				
Common Raven				
Water Pipit				
Bohemian Waxwing				

Table 12.Continued.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km^2	Species Name	Occurrence	% Occurence	No. Birds	Birds/km^2
Orange-crowned Warbler									
Townsend's Warbler									
Wilson's Warbler									
Pine Siskin									
Savannah Sparrow									
White-crowned Sparrow									
Lapland Longspur									
Totals/Average			1975	11.3					

*** Cruise numbers data are compiled from:** FW6-093

Table 13. Bird observations on aerial transects, Kodiak Basin, January, 1976.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km^2
Common Loon				
Yellow-billed Loon				
Arctic Loon				
Red-throated Loon				
Unid. Loon	1	1	1	tr.
Red-Necked Grebe				
Horned Grebe				
Western Grebe				
Black-footed Albatross				
Laysan Albatross				
Unid. Albatross				
Fulmar	21	30	71	0.8
Pink-footed Shearwater				
New Zealand Shearwater				
Sooty Shearwater				
Short-tailed Shearwater	1	1	1	tr.
Unid. Shearwater	4	6	25	0.4
Scaled Petrel				
Fork-tailed Storm Petrel				
Leach's Storm Petrel				
Ashy Storm Petrel				
Unid. Storm Petrel				
Brown Pelican				
Double-crested Cormorant				
Brandt's Cormorant				
Pelagic Cormorant				
Red-faced Cormorant				
Unid. Cormorant	7	10	31	0.3
Whistling Swan				
Canada Goose				
Black Brant				
Emperor Goose				
White-fronted Goose				

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km^2
Snow Goose				
Unid. Goose				
Mallard				
Gadwall				
Pintail				
Green-winged Teal				
American Widgeon				
Shoveler				
Redhead				
Canvasback				
Greater Scaup				
Lesser Scaup				
Unid. Scaup				
Common Goldeneye				
Barrow's Goldeneye				
Bufflehead				
Oldsquaw	2	3	9	0.1
Harlequin Duck				
Steller's Eider	1	1	2	tr.
Common Eider	1	1	50	0.5
King Eider	1	1	1	tr.
Spectacled Eider				
Unid. Eider	2	3	11	0.1
White-winged Scoter				
Surf Scoter	2	3	9	0.1
Black Scoter	7	10	101	1.1
Unid. Scoter	5	14	231	2.5
Unid. Duck				
Red-breasted Merganser				
Bald Eagle	1	1	1	tr.
Gyrfalcon				
Peregrine Falcon				
Black Oystercatcher				

Table 13. Continued.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km²
American Golden Plover				
Unid. Turnstone				
Ruddy Turnstone				
Black Turnstone				
Whimbrel				
Sharp-tailed Sandpiper				
Unid. Sandpiper				
Red Phalarope				
Northern Phalarope				
Unid. Phalarope				
Pomarine Jaeger				
Parasitic Jaeger				
Long-tailed jaeger				
Unid. Jaeger				
Skua				
Glaucous Gull				
Glaucous-winged Gull	26	37	252	2.8
Slaty-backed Gull				
Western Gull				
Herring Gull	1	1	1	tr.
Herring/Glaucous-wg. Hyb.				
Thayer's Gull				
California Gull				
Ring-billed Gull				
Mew Gull				
Black-headed Gull				
Bonaparte's Gull				
Heermann's Gull				
Ivory Gull				
Unid. Kittiwake				
Black-legged Kittiwake	16	23	73	0.8
Red-legged Kittiwake				
Ross' Gull				

Species Name	Occurrence	% Occurence	No. Birds	Birds/km²
Sabine's Gull				
Unid. Immature Gull				
Unid. Gull	1	1	1	tr.
Common Tern				
Arctic Tern				
Aleutian Tern				
Unid. Tern				
Common Murre				
Thick-billed Murre				
Unid. Murre	22	31	280	3.1
Unid. Guillemot				
Black Guillemot				
Pigeon Guillemot				
Unid. Large Alcid	5	14	6	0.1
Marbled Murrelet				
Kittlitz's Murrelet				
Xantus' Murrelet				
Ancient Murrelet				
Unid. Murrelet				
Cassin's Auklet				
Parakeet Auklet				
Crested Auklet				
Least Auklet				
Rhinoceros Auklet	1	1	3	tr.
Unid. Small Alcid	1	1	2	tr.
Horned Puffin				
Tufted Puffin	12	17	27	0.3
Unid. Puffin				
Short-eared Owl				
Snowy Owl				
Tree Swallow				
Black Swallow				
Unid. Swallow				

Table 13. Continued.

Species Name	Occurence	% Occurence	No. Birds	Birds/Km^2	Species Name	Occurence	% Occurence	No. Birds	Birds/km^2
Common Raven									
Water Pipit									
Bohemian Waxwing									
Orange-crowned Warbler									
Townsend's Warbler									
Wilson's Warbler									
Pine Siskin									
Savannah Sparrow									
White-crowned Sparrow									
Lapland Longspur									
Unid. Passerine									
Unid. Bird	1	1	1	tr.					
Totals/Average			545	5.9					

Cruise numbers data are compiled from: 76-1

Table 14. Bird observations on aerial transects, Kodiak Basin, March, 1976.

Species Name	Occurence	% Occurence	No. Birds	Birds/Km^2	Species Name	Occurence	% Occurence	No. Birds	Birds/km^2
Common Loon					Snow Goose				
Yellow-billed Loon					Unid. Goose				
Arctic Loon					Mallard				
Red-throated Loon					Gadwall				
Unid. Loon					Pintail				
Red-Necked Grebe					Green-winged Teal				
Horned Grebe					American Widgeon				
Western Grebe					Shoveler				
Black-footed Albatross					Redhead				
Laysan Albatross					Canvasback				
Unid. Albatross					Greater Scaup				
Fulmar	5	21	6	0.2	Lesser Scaup				
Pink-footed Shearwater					Unid. Scaup				
New Zealand Shearwater					Common Goldeneye				
Sooty Shearwater					Barrow's Goldeneye				
Short-tailed Shearwater					Bufflehead				
Unid. Shearwater					Oldsquaw				
Scaled Petrel					Harlequin Duck				
Fork-tailed Storm Petrel					Steller's Eider				
Leach's Storm Petrel					Common Eider	2	8	303	10.3
Ashy Storm Petrel					King Eider	3	12	80	2.7
Unid. Storm Petrel					Spectacled Eider				
Brown Pelican					Unid. Eider	3	12	79	2.7
Double-crested Cormorant					White-winged Scoter				
Brandt's Cormorant					Surf Scoter				
Pelagic Cormorant					Black Scoter				
Red-faced Cormorant					Unid. Scoter				
Unid. Cormorant					Unid. Duck				
Whistling Swan					Red-breasted Merganser				
Canada Goose					Bald Eagle				
Black Brant					Gyrfalcon				
Emperor Goose					Peregrine Falcon				
White-fronted Goose					Black Oystercatcher				

Table 14. Continued.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km²
American Golden Plover				
Unid. Turnstone				
Ruddy Turnstone				
Black Turnstone				
Whimbrel				
Sharp-tailed Sandpiper				
Unid. Sandpiper				
Red Phalarope				
Northern Phalarope				
Unid. Phalarope				
Pomarine Jaeger				
Parasitic Jaeger				
Long-tailed jaeger				
Unid. Jaeger				
Skua				
Glaucous Gull				
Glaucous-winged Gull	5	21	9	0.3
Slaty-backed Gull				
Western Gull				
Herring Gull				
Herring/Glaucous-wg. Hyb.				
Thayer's Gull				
California Gull				
Ring-billed Gull				
Mew Gull				
Black-headed Gull				
Bonaparte's Gull				
Heermann's Gull				
Ivory Gull				
Unid. Kittiwake				
Black-legged Kittiwake				
Red-legged Kittiwake				
Ross' Gull				

Species Name	Occurrence	% Occurence	No. Birds	Birds/km²
Sabine's Gull				
Unid. Immature Gull				
Unid. Gull				
Common Tern				
Arctic Tern				
Aleutian Tern				
Unid. Tern				
Common Murre				
Thick-billed Murre				
Unid. Murre	14	58	381	13.0
Unid. Guillemot				
Black Guillemot				
Pigeon Guillemot				
Unid. Large Alcid	1	4	15	0.5
Marbled Murrelet				
Kittlitz's Murrelet				
Xantus' Murrelet				
Ancient Murrelet	13		67	2.3
Unid. Murrelet				
Cassin's Auklet				
Parakeet Auklet	1	4	1	tr.
Crested Auklet				
Least Auklet				
Rhinoceros Auklet				
Unid. Small Alcid	3	12	6	0.2
Horned Puffin				
Tufted Puffin				
Unid. Puffin				
Short-eared Owl				
Snowy Owl				
Tree Swallow				
Black Swallow				
Unid. Swallow				

Table 14. Continued.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km^2	Species Name	Occurrence	% Occurence	No. Birds	Birds/km^2
Common Raven									
Water Pipit									
Bohemian Waxwing									
Orange-crowned Warbler									
Townsend's Warbler									
Wilson's Warbler									
Pine Siskin									
Savannah Sparrow									
White-crowned Sparrow									
Lapland Longspur									
Unid. Passerine									
Unid. Bird	4	17	15	0.5					
Totals/Average			962	32.8					

Cruise numbers data are compiled from: 76-6

Table 15. Bird observations on aerial transects, Kodiak Basin, April, 1976.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km²
Common Loon				
Yellow-billed Loon				
Arctic Loon				
Red-throated Loon				
Unid. Loon				
Red-Necked Grebe				
Horned Grebe				
Western Grebe				
Black-footed Albatross				
Laysan Albatross				
Unid. Albatross				
Fulmar				
Pink-footed Shearwater				
New Zealand Shearwater				
Sooty Shearwater				
Short-tailed Shearwater				
Unid. Shearwater				
Scaled Petrel				
Fork-tailed Storm Petrel				
Leach's Storm Petrel				
Ashy Storm Petrel				
Unid. Storm Petrel				
Brown Pelican				
Double-crested Cormorant				
Brandt's Cormorant				
Pelagic Cormorant				
Red-faced Cormorant				
Unid. Cormorant				
Whistling Swan				
Canada Goose				
Black Brant				
Emperor Goose				
White-fronted Goose				
Snow Goose				
Unid. Goose				
Mallard				
Gadwall				
Pintail				
Green-winged Teal				
American Widgeon				
Shoveler				
Redhead				
Canvasback				
Greater Scaup				
Lesser Scaup				
Unid. Scaup				
Common Goldeneye				
Barrow's Goldeneye				
Bufflehead				
Oldsquaw				
Harlequin Duck				
Steller's Eider				
Common Eider				
King Eider				
Spectacled Eider				
Unid. Eider				
White-winged Scoter				
Surf Scoter				
Black Scoter				
Unid. Scoter				
Unid. Duck				
Red-breasted Merganser				
Bald Eagle				
Gyrfalcon				
Peregrine Falcon				
Black Oystercatcher				

Table 15. Continued.

Species Name	Occurence	% Occurence	No. Birds	Birds/km²
American Golden Plover				
Unid. Turnstone				
Ruddy Turnstone				
Black Turnstone				
Whimbrel				
Sharp-tailed Sandpiper				
Unid. Sandpiper				
Red Phalarope				
Northern Phalarope				
Unid. Phalarope				
Pomarine Jaeger				
Parasitic Jaeger				
Long-tailed jaeger				
Unid. Jaeger				
Skua				
Glaucous Gull				
Glaucous-winged Gull	1	33	4	0.9
Slaty-backed Gull				
Western Gull				
Herring Gull				
Herring/Glaucous-wg. Hyb.				
Thayer's Gull				
California Gull				
Ring-billed Gull				
Mew Gull				
Black-headed Gull				
Bonaparte's Gull				
Heermann's Gull				
Ivory Gull				
Unid. Kittiwake				
Black-legged Kittiwake				
Red-legged Kittiwake				
Ross' Gull				

Species Name	Occurence	% Occurence	No. Birds	Birds/km²
Sabine's Gull				
Unid. Immature Gull				
Unid. Gull				
Common Tern				
Arctic Tern				
Aleutian Tern				
Unid. Tern				
Common Murre				
Thick-billed Murre				
Unid. Murre				
Unid. Guillemot				
Black Guillemot				
Pigeon Guillemot				
Unid. Large Alcid				
Marbled Murrelet				
Kittlitz's Murrelet				
Xantus' Murrelet				
Ancient Murrelet				
Unid. Murrelet				
Cassin's Auklet				
Parakeet Auklet				
Crested Auklet				
Least Auklet				
Rhinoceros Auklet				
Unid. Small Alcid				
Horned Puffin				
Tufted Puffin				
Unid. Puffin				
Short-eared Owl				
Snowy Owl				
Tree Swallow				
Black Swallow				
Unid. Swallow				

Table 15. Continued.

Species Name	Occurence	% Occurence	No. Birds	Birds/Km^2	Species Name	Occurence	% Occurence	No. Birds	Birds/km^2
Common Raven									
Water Pipit									
Bohemian Waxwing									
Orange-crowned Warbler									
Townsend's Warbler									
Wilson's Warbler									
Pine Siskin									
Savannah Sparrow									
White-crowned Sparrow									
Lapland Longspur									
Unid. Passerine									
Unid. Bird									
Totals/Average			4	0.9					

Cruise numbers data are compiled from: 76-15

Table 16. Bird observations on aerial transects, Lower Cook Inlet, January, 1976.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km^2
Common Loon				
Yellow-billed Loon				
Arctic Loon				
Red-throated Loon				
Unid. Loon				
Red-Necked Grebe				
Horned Grebe				
Western Grebe				
Black-footed Albatross				
Laysan Albatross				
Unid. Albatross				
Fulmar				
Pink-footed Shearwater				
New Zealand Shearwater				
Sooty Shearwater				
Short-tailed Shearwater				
Unid. Shearwater	1	17	1	tr.
Scaled Petrel				
Fork-tailed Storm Petrel				
Leach's Storm Petrel				
Ashy Storm Petrel				
Unid. Storm Petrel				
Brown Pelican				
Double-crested Cormorant				
Brandt's Cormorant				
Pelagic Cormorant				
Red-faced Cormorant				
Unid. Cormorant				
Whistling Swan				
Canada Goose				
Black Brant				
Emperor Goose				
White-fronted Goose				
Snow Goose				
Unid. Goose				
Mallard				
Gadwall				
Pintail				
Green-winged Teal				
American Widgeon				
Shoveler				
Redhead				
Canvasback				
Greater Scaup				
Lesser Scaup				
Unid. Scaup				
Common Goldeneye				
Barrow's Goldeneye				
Bufflehead				
Oldsquaw				
Harlequin Duck				
Steller's Eider				
Common Eider				
King Eider				
Spectacled Eider				
Unid. Eider				
White-winged Scoter				
Surf Scoter				
Black Scoter				
Unid. Scoter				
Unid. Duck				
Red-breasted Merganser				
Bald Eagle				
Gyrfalcon				
Peregrine Falcon				
Black Oystercatcher				

Table 16. Continued.

Species Name	Occurrence	% Occurence	No. Birds	Birds/km^2
American Golden Plover				
Unid. Turnstone				
Ruddy Turnstone				
Black Turnstone				
Whimbrel				
Sharp-tailed Sandpiper				
Unid. Sandpiper				
Red Phalarope				
Northern Phalarope				
Unid. Phalarope				
Pomarine Jaeger				
Parasitic Jaeger				
Long-tailed jaeger				
Unid. Jaeger				
Skua				
Glaucous Gull				
Glaucous-winged Gull	3	50	6	0.5
Slaty-backed Gull				
Western Gull				
Herring Gull				
Herring/Glaucous-wg. Hyb.				
Thayer's Gull				
California Gull				
Ring-billed Gull				
Mew Gull				
Black-headed Gull				
Bonaparte's Gull				
Heermann's Gull				
Ivory Gull				
Unid. Kittiwake				
Black-legged Kittiwake	1	17	2	0.2
Red-legged Kittiwake				
Ross' Gull				

Species Name	Occurrence	% Occurence	No. Birds	Birds/km^2
Sabine's Gull				
Unid. Immature Gull				
Unid. Gull	1	17	1	tr.
Common Tern				
Arctic Tern				
Aleutian Tern				
Unid. Tern				
Common Murre				
Thick-billed Murre				
Unid. Murre	3	50	15	1.4
Unid. Guillemot				
Black Guillemot				
Pigeon Guillemot				
Unid. Large Alcid				
Marbled Murrelet				
Kittlitz's Murrelet				
Xantus' Murrelet				
Ancient Murrelet				
Unid. Murrelet				
Cassin's Auklet				
Parakeet Auklet				
Crested Auklet				
Least Auklet				
Rhinoceros Auklet				
Unid. Small Alcid				
Horned Puffin				
Tufted Puffin				
Unid. Puffin				
Short-eared Owl				
Snowy Owl				
Tree Swallow				
Black Swallow				
Unid. Swallow				

Table 16. Continued.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km^2	Species Name	Occurrence	% Occurence	No. Birds	Birds/km^2
Common Raven									
Water Pipit									
Bohemian Waxwing									
Orange-crowned Warbler									
Townsend's Warbler									
Wilson's Warbler									
Pine Siskin									
Savannah Sparrow									
White-crowned Sparrow									
Lapland Longspur									
Unid. Passerine									
Unid. Bird									
Totals/Average			25	2.3					

Cruise numbers data are compiled from: 76-1

Table 17. Bird observations on aerial transects, Lower Cook Inlet, March, 1976.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km^2
Common Loon				
Yellow-billed Loon				
Arctic Loon				
Red-throated Loon				
Unid. Loon				
Red-Necked Grebe				
Horned Grebe				
Western Grebe				
Black-footed Albatross				
Laysan Albatross				
Unid. Albatross				
Fulmar				
Pink-footed Shearwater				
New Zealand Shearwater				
Sooty Shearwater				
Short-tailed Shearwater				
Unid. Shearwater				
Scaled Petrel				
Fork-tailed Storm Petrel				
Leach's Storm Petrel				
Ashy Storm Petrel				
Unid. Storm Petrel				
Brown Pelican				
Double-crested Cormorant				
Brandt's Cormorant				
Pelagic Cormorant				
Red-faced Cormorant				
Unid. Cormorant	6	46	129	6.9
Whistling Swan				
Canada Goose				
Black Brant				
Emperor Goose				
White-fronted Goose				
Snow Goose				
Unid. Goose				
Mallard				
Gadwall				
Pintail				
Green-winged Teal				
American Widgeon				
Shoveler				
Redhead				
Canvasback				
Greater Scaup				
Lesser Scaup				
Unid. Scaup				
Common Goldeneye				
Barrow's Goldeneye				
Bufflehead				
Oldsquaw	4	31	28	1.5
Harlequin Duck				
Steller's Eider				
Common Eider				
King Eider	1	8	50	2.7
Spectacled Eider				
Unid. Eider	3	23	37	2.0
White-winged Scoter	6	46	205	11.0
Surf Scoter	2	15	20	1.1
Black Scoter	5	38	272	14.6
Unid. Scoter	4	31	64	3.4
Unid. Duck	1	8	8	0.4
Red-breasted Merganser				
Bald Eagle	1	8	2	0.1
Gyrfalcon				
Peregrine Falcon				
Black Oystercatcher				

Table 17. Continued.

Species Name	Occur-ence	% Occurence	No. Birds	Birds/Km^2
American Golden Plover				
Unid. Turnstone				
Ruddy Turnstone				
Black Turnstone				
Whimbrel				
Sharp-tailed Sandpiper				
Unid. Sandpiper				
Red Phalarope,				
Northern Phalarope				
Unid. Phalarope				
Pomarine Jaeger				
Parasitic Jaeger				
Long-tailed jaeger				
Unid. Jaeger				
Skua				
Glaucous Gull				
Glaucous-winged Gull	8	62	25	1.3
Slaty-backed Gull				
Western Gull				
Herring Gull				
Herring/Glaucous-wg. Hyb.				
Thayer's Gull				
California Gull				
Ring-billed Gull				
Mew Gull	2	15	2	0.1
Black-headed Gull				
Bonaparte's Gull				
Heermann's Gull				
Ivory Gull				
Unid. Kittiwake				
Black-legged Kittiwake				
Red-legged Kittiwake				
Ross' Gull				

Species Name	Occur-ence	% Occurence	No. Birds	Birds/km^2
Sabine's Gull				
Unid. Immature Gull				
Unid. Gull	1	8	2	0.1
Common Tern				
Arctic Tern				
Aleutian Tern				
Unid. Tern				
Common Murre				
Thick-billed Murre				
Unid. Murre	9	69	192	10.3
Unid. Guillemot				
Black Guillemot				
Pigeon Guillemot				
Unid. Large Alcid				
Marbled Murrelet				
Kittlitz's Murrelet				
Xantus' Murrelet				
Ancient Murrelet				
Unid. Murrelet				
Cassin's Auklet				
Parakeet Auklet				
Crested Auklet				
Least Auklet				
Rhinoceros Auklet				
Unid. Small Alcid	3	23	32	1.7
Horned Puffin				
Tufted Puffin				
Unid. Puffin				
Short-eared Owl				
Snowy Owl				
Tree Swallow				
Black Swallow				
Unid. Swallow				

Table 17. Continued.

Species Name	Occurence	% Occurence	No. Birds	Birds/Km^2	Species Name	Occurence	% Occurence	No. Birds	Birds/km^2
Common Raven									
Water Pipit									
Bohemian Waxwing									
Orange-crowned Warbler									
Townsend's Warbler									
Wilson's Warbler									
Pine Siskin									
Savannah Sparrow									
White-crowned Sparrow									
Lapland Longspur									
Unid. Passerine									
Unid. Bird	3	23	17	0.9					
Totals/Average			1085	58.3					

Cruise numbers data are compiled from: 76-6 and 76-14

Table 18. Bird observations on aerial transects, Lower Cook Inlet, April, 1976.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km^2
Common Loon				
Yellow-billed Loon				
Arctic Loon				
Red-throated Loon				
Unid. Loon				
Red-Necked Grebe				
Horned Grebe				
Western Grebe				
Black-footed Albatross				
Laysan Albatross				
Unid. Albatross				
Fulmar				
Pink-footed Shearwater				
New Zealand Shearwater				
Sooty Shearwater				
Short-tailed Shearwater				
Unid. Shearwater				
Scaled Petrel				
Fork-tailed Storm Petrel				
Leach's Storm Petrel				
Ashy Storm Petrel				
Unid. Storm Petrel				
Brown Pelican				
Double-crested Cormorant				
Brandt's Cormorant				
Pelagic Cormorant				
Red-faced Cormorant				
Unid. Cormorant				
Whistling Swan				
Canada Goose				
Black Brant				
Emperor Goose				
White-fronted Goose				
Snow Goose				
Unid. Goose				
Mallard				
Gadwall				
Pintail				
Green-winged Teal				
American Widgeon				
Shoveler				
Redhead				
Canvasback				
Greater Scaup				
Lesser Scaup				
Unid. Scaup				
Common Goldeneye				
Barrow's Goldeneye				
Bufflehead				
Oldsquaw				
Harlequin Duck				
Steller's Eider				
Common Eider				
King Eider				
Spectacled Eider				
Unid. Eider				
White-winged Scoter				
Surf Scoter				
Black Scoter	1	7	2	0.1
Unid. Scoter				
Unid. Duck				
Red-breasted Merganser				
Bald Eagle				
Gyrfalcon				
Peregrine Falcon				
Black Oystercatcher				

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]				
[illegible]				
[illegible]				
[illegible]				
[illegible]				
Sharp-tailed Sandpiper				
Unid. Sandpiper				
Red Phalarope				
Northern Phalarope				
Unid. Phalarope				
Pomarine Jaeger				
Parasitic Jaeger				
Long-tailed Jaeger				
Unid. Jaeger				
Skua				
Glaucous Gull				
Glaucous-winged Gull	4	27	11	0.5
Slaty-backed Gull				
Western Gull				
Herring Gull				
Herring/Glaucous-wg. Hyb.				
Thayer's Gull				
California Gull				
Ring-billed Gull				
Mew Gull				
Black-headed Gull				
Bonaparte's Gull				
Heermann's Gull				
Ivory Gull				
Unid. Kittiwake				
Black-legged Kittiwake	1	7	60	3.0
Red-legged Kittiwake				
Ross' Gull				

Species	Occurrence	% Occurrence	No. Birds	Birds/km^2
Sabine's Gull				
Unid. Immature Gull				
Unid. Gull				
Common Tern				
Arctic Tern				
Aleutian Tern				
Unid. Tern				
Common Murre				
Thick-billed Murre				
Unid. Murre	4	27	56	2.8
Unid. Guillemot				
Black Guillemot				
Pigeon Guillemot				
Unid. Large Alcid				
Marbled Murrelet				
Kittlitz's Murrelet				
Xantus' Murrelet				
Ancient Murrelet				
Unid. Murrelet				
Cassin's Auklet				
Parakeet Auklet				
Crested Auklet				
Least Auklet				
Rhinoceros Auklet				
Unid. Small Alcid				
Horned Puffin				
Tufted Puffin				
Unid. Puffin				
Short-eared Owl				
Snowy Owl				
Tree Swallow				
Black Swallow				
Unid. Swallow				

Table 18. Continued.

Species Name	Occurence	% Occurence	No. Birds	Birds/Km²	Species Name	Occurence	% Occurence	No. Birds	Birds/Km²
Common Raven									
Water Pipit									
Bohemian Waxwing									
Orange-crowned Warbler									
Townsend's Warbler									
Wilson's Warbler									
Pine Siskin									
Savannah Sparrow									
White-crowned Sparrow									
Lapland Longspur									
Unid. Passerine									
Unid. Bird									
Totals/Average			[illegible]	[illegible]					

Cruise numbers data are compiled from 75-15

Table 19. Bird observations on aerial transects, Navarin Basin, February, 1976.

Species Name	Occur-ence	% Occurence	No. Birds	Birds/Km^2
Common Loon				
Yellow-billed Loon				
Arctic Loon				
Red-throated Loon				
Unid. Loon				
Red-Necked Grebe				
Horned Grebe				
Western Grebe				
Black-footed Albatross				
Laysan Albatross				
Unid. Albatross				
Fulmar				
Pink-footed Shearwater				
New Zealand Shearwater				
Sooty Shearwater				
Short-tailed Shearwater				
Unid. Shearwater				
Scaled Petrel				
Fork-tailed Storm Petrel				
Leach's Storm Petrel				
Ashy Storm Petrel				
Unid. Storm Petrel				
Brown Pelican				
Double-crested Cormorant				
Brandt's Cormorant				
Pelagic Cormorant				
Red-faced Cormorant				
Unid. Cormorant				
Whistling Swan				
Canada Goose				
Black Brant				
Emperor Goose				
White-fronted Goose				
Snow Goose				
Unid. Goose				
Mallard				
Gadwall				
Pintail				
Green-winged Teal				
American Widgeon				
Shoveler				
Redhead				
Canvasback				
Greater Scaup				
Lesser Scaup				
Unid. Scaup				
Common Goldeneye				
Barrow's Goldeneye				
Bufflehead				
Oldsquaw				
Harlequin Duck				
Steller's Eider				
Common Eider				
King Eider				
Spectacled Eider				
Unid. Eider				
White-winged Scoter				
Surf Scoter				
Black Scoter				
Unid. Scoter				
Unid. Duck				
Red-breasted Merganser				
Bald Eagle				
Gyrfalcon				
Peregrine Falcon				
Black Oystercatcher				

Table 19. Continued.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km^2
American Golden Plover				
Unid. Turnstone				
Ruddy Turnstone				
Black Turnstone				
Whimbrel				
Sharp-tailed Sandpiper				
Unid. Sandpiper				
Red Phalarope				
Northern Phalarope				
Unid. Phalarope				
Pomarine Jaeger				
Parasitic Jaeger				
Long-tailed jaeger				
Unid. Jaeger				
Skua				
Glaucous Gull				
Glaucous-winged Gull	1	17	1	0.1
Slaty-backed Gull				
Western Gull				
Herring Gull				
Herring/Glaucous-wg. Hyb.				
Thayer's Gull				
California Gull				
Ring-billed Gull				
Mew Gull				
Black-headed Gull				
Bonaparte's Gull				
Heermann's Gull				
Ivory Gull	1	17	1	0.1
Unid. Kittiwake				
Black-legged Kittiwake	1	17	1	0.1
Red-legged Kittiwake				
Ross' Gull				

Species Name	Occurrence	% Occurence	No. Birds	Birds/km^2
Sabine's Gull				
Unid. Immature Gull				
Unid. Gull				
Common Tern				
Arctic Tern				
Aleutian Tern				
Unid. Tern				
Common Murre				
Thick-billed Murre				
Unid. Murre	1	17	22	2.0
Unid. Guillemot				
Black Guillemot				
Pigeon Guillemot				
Unid. Large Alcid				
Marbled Murrelet				
Kittlitz's Murrelet				
Xantus' Murrelet				
Ancient Murrelet				
Unid. Murrelet				
Cassin's Auklet				
Parakeet Auklet	1	17	4	0.4
Crested Auklet				
Least Auklet	1	17	203	18.3
Rhinoceros Auklet				
Unid. Small Alcid				
Horned Puffin				
Tufted Puffin				
Unid. Puffin				
Short-eared Owl				
Snowy Owl				
Tree Swallow				
Black Swallow				
Unid. Swallow				

Table 19. Continued.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km^2	Species Name	Occurrence	% Occurence	No. Birds	Birds/km^2
Common Raven									
Water Pipit									
Bohemian Waxwing									
Orange-crowned Warbler									
Townsend's Warbler									
Wilson's Warbler									
Pine Siskin									
Savannah Sparrow									
White-crowned Sparrow									
Lapland Longspur									
Unid. Passerine									
Unid. Bird	1	17	5	0.5					
Totals/Average			237	21.4					

Cruise numbers data are compiled from: 76-6

Table 20. Bird observations on aerial transects, Navarin Basin, August, 1976.

Species Name	Occurence	% Occurence	No. Birds	Birds/Km²	Species Name	Occurence	% Occurence	No. Birds	Birds/km²
Unid. Bird					Black Brant				
Unid. Loon					Emperor Goose				
Yellow-billed Loon					Snow Goose				
Arctic Loon					Unid. Duck				
Red-throated Loon					Mallard				
Red-necked Grebe					Gadwall				
Horned Grebe					Pintail				
Western Grebe					Green-winged Teal				
Unid. Albatross					American Widgeon				
Short-tailed Albatross					Shoveler				
Black-footed Albatross					Redhead				
Laysan Albatross					Canvasback				
Fulmar	4	67	14	1.3	Unid. Scaup				
Unid. Shearwater	5	83	8	0.7	Greater Scaup				
Pink-footed Shearwater					Lesser Scaup				
New Zealand Shearwater					Common Goldeneye				
Sooty Shearwater	2	33	3	0.3	Barrow's Goldeneye				
Short-tailed Shearwater					Bufflehead				
Unid. Petrel					Oldsquaw				
Scaled Petrel					Harlequin Duck				
Fork-tailed Storm Petrel					Unid. Eider				
Leach's Storm Petrel					Steller's Eider				
Ashy Storm Petrel					Common Eider				
Brown Pelican					King Eider				
Unid Cormorant					Spectacled Eider				
Double-crested Cormorant					Unid. Scoter				
Brandt's Cormorant					White-winged Scoter				
Pelagic Cormorant					Surf Scoter				
Red-faced Cormorant					Common Scoter				
Whistling Swan					Red-breasted Merganser				
Unid. Goose					Bald Eagle				
Canada Goose					Gyrfalcon				
Brant					Peregrine Falcon				

Table 20. Continued.

Species Name	Occurrence	% Occurrence	No. Birds	Birds/Km²
Sandhill Crane				
Unid. Shorebird				
Black Oystercatcher				
American Golden Plover				
Unid. Turnstone				
Ruddy Turnstone				
Black Turnstone				
Whimbrel				
Unid. Sandpiper				
Sharp-tailed Sandpiper				
Unid. Phalarope	1	17	2	0.2
Red Phalarope				
Northern Phalarope				
Unid. Jaeger				
Pomarine Jaeger				
Parasitic Jaeger				
Long-tailed Jaeger				
Skua				
Unid. Gull				
Glaucous Gull	2	33	2	0.2
Glaucous-winged Gull				
Slaty-backed Gull				
Western Gull				
Herring Gull				
Herring/Glaucous-wg. Hyb.				
Thayer's Gull				
Mew Gull				
Black-headed Gull				
Bonaparte's Gull				
Ivory Gull				
Unid. Kittiwake				
Black-legged Kittiwake	2	33	2	0.2
Red-legged Kittiwake				

Species Name	Occurrence	% Occurrence	No. Birds	Birds/km²
Ross' Gull				
Sabine's Gull	1	17	1	0.1
Unid. Tern				
Arctic Tern				
Aleutian Tern				
Unid. Large Alcid				
Unid. Murre	6	100	369	33.2
Common Murre				
Thick-billed Murre				
Unid. Guillemot				
Black Guillemot				
Pigeon Guillemot				
Unid. Small Alcid				
Unid. Murrelet				
Marbled Murrelet				
Kittlitz's Murrelet				
Xantus' Murrelet				
Ancient Murrelet				
Cassin's Auklet				
Parakeet Auklet	2	33	139	12.5
Crested Auklet	4	67	1625	146.4
Least Auklet	2	33	187	16.8
Rhinoceros Auklet				
Unid. Puffin				
Horned Puffin				
Tufted Puffin	2	33	3	0.3
Short-eared Owl				
Unid. Passerine				
Unid. Swallow				
Tree Swallow				
Common Raven				
Water Pipit				
Bohemian Waxwing				

Table 20. Continued.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km^2	Species Name	Occurrence	% Occurence	No. Birds	Birds/km^2
Orange-crowned Warbler									
Townsend's Warbler									
Wilson's Warbler									
Pine Siskin									
Savannah Sparrow									
White-crowned Sparrow									
Lapland Longspur									
Totals/Average			2355	212.					

* Cruise numbers data are compiled from: FW6-086

Table 21. Bird observations on aerial transects, Navarin Basin, October, 1976.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km^2
Unid. Bird				
Unid. Loon				
Yellow-billed Loon				
Arctic Loon				
Red-throated Loon				
Red-necked Grebe				
Horned Grebe				
Western Grebe				
Unid. Albatross				
Short-tailed Albatross				
Black-footed Albatross				
Laysan Albatross				
Fulmar	1	17	1	0.1
Unid. Shearwater	3	50	13	1.2
Pink-footed Shearwater				
New Zealand Shearwater				
Sooty Shearwater	2	33	3	0.3
Short-tailed Shearwater				
Unid. Petrel				
Scaled Petrel				
Fork-tailed Storm Petrel				
Leach's Storm Petrel				
Ashy Storm Petrel				
Brown Pelican				
Unid Cormorant				
Double-crested Cormorant				
Brandt's Cormorant				
Pelagic Cormorant				
Red-faced Cormorant				
Whistling Swan				
Unid. Goose				
Canada Goose				
Brant				

Species Name	Occurrence	% Occurence	No. Birds	Birds/km^2
Black Brant				
Emperor Goose				
Snow Goose				
Unid. Duck				
Mallard				
Gadwall				
Pintail				
Green-winged Teal				
American Widgeon				
Shoveler				
Redhead				
Canvasback				
Unid. Scaup				
Greater Scaup				
Lesser Scaup				
Common Goldeneye				
Barrow's Goldeneye				
Bufflehead				
Oldsquaw				
Harlequin Duck				
Unid. Eider				
Steller's Eider				
Common Eider				
King Eider				
Spectacled Eider				
Unid. Scoter				
White-winged Scoter				
Surf Scoter				
Common Scoter				
Red-breasted Merganser				
Bald Eagle				
Gyrfalcon				
Peregrine Falcon				

Table 21. Continued.

Species Name	Occur-rence	% Occurrence	No. Birds	Birds/Km²
Sandhill Crane				
Unid. Shorebird				
Black Oystercatcher				
American Golden Plover				
Unid. Turnstone				
Ruddy Turnstone				
Black Turnstone				
Whimbrel				
Unid. Sandpiper				
Sharp-tailed Sandpiper				
Unid. Phalarope				
Red Phalarope				
Northern Phalarope				
Unid. Jaeger				
Pomarine Jaeger				
Parasitic Jaeger				
Long-tailed Jaeger				
Skua				
Unid. Gull				
Glaucous Gull	2	33	3	0.3
Glaucous-winged Gull				
Slaty-backed Gull				
Western Gull				
Herring Gull				
Herring/Glaucous-wg. Hyb.				
Thayer's Gull				
Mew Gull				
Black-headed Gull				
Bonaparte's Gull				
Ivory Gull				
Unid. Kittiwake				
Black-legged Kittiwake	1	17	1	0.1
Red-legged Kittiwake				

Species Name	Occur-ence	% Occurence	No. Birds	Birds/km²
Ross' Gull				
Sabine's Gull				
Unid. Tern				
Arctic Tern				
Aleutian Tern				
Unid. Large Alcid				
Unid. Murre	5	83	36	3.2
Common Murre				
Thick-billed Murre				
Unid. Guillemot				
Black Guillemot				
Pigeon Guillemot				
Unid. Small Alcid				
Unid. Murrelet				
Marbled Murrelet				
Kittlitz's Murrelet				
Xantus' Murrelet				
Ancient Murrelet				
Cassin's Auklet				
Parakeet Auklet	1	17	2	0.2
Crested Auklet	4	67	17	1.5
Least Auklet				
Rhinoceros Auklet				
Unid. Puffin				
Horned Puffin				
Tufted Puffin	3	50	4	0.4
Short-eared Owl				
Unid. Passerine				
Unid. Swallow				
Tree Swallow				
Common Raven				
Water Pipit				
Bohemian Waxwing				

Table 21. Continued.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km^2	Species Name	Occurrence	% Occurence	No. Birds	Birds/km^2
Orange-crowned Warbler									
Townsend's Warbler									
Wilson's Warbler									
Pine Siskin									
Savannah Sparrow									
White-crowned Sparrow									
Lapland Longspur									
Totals/Average			80	7.2					

* Cruise numbers data are compiled from: FW6-086

Table 22. Bird observations on aerial transects, Norton Basin, August, 1976.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km^2
Unid. Bird	4	2	7	tr.
Unid. Loon	4	2	4	tr.
Yellow-billed Loon	1	1	1	tr.
Arctic Loon				
Red-throated Loon	1	1	1	tr.
Red-necked Grebe				
Horned Grebe				
Western Grebe				
Unid. Albatross				
Short-tailed Albatross				
Black-footed Albatross				
Laysan Albatross				
Fulmar	25	11	35	0.2
Unid. Shearwater	68	30	821	3.1
Pink-footed Shearwater				
New Zealand Shearwater				
Sooty Shearwater	52	23	2102	8.0
Short-tailed Shearwater				
Unid. Petrel				
Scaled Petrel				
Fork-tailed Storm Petrel				
Leach's Storm Petrel				
Ashy Storm Petrel				
Brown Pelican				
Unid Cormorant	5	2	35	0.2
Double-crested Cormorant				
Brandt's Cormorant				
Pelagic Cormorant				
Red-faced Cormorant				
Whistling Swan				
Unid. Goose				
Canada Goose				
Brant				

Species Name	Occurrence	% Occurence	No. Birds	Birds/km^2
Black Brant				
Emperor Goose				
Snow Goose				
Unid. Duck	1	1	2	tr.
Mallard				
Gadwall				
Pintail				
Green-winged Teal				
American Widgeon				
Shoveler				
Redhead				
Canvasback				
Unid. Scaup				
Greater Scaup				
Lesser Scaup				
Common Goldeneye				
Barrow's Goldeneye				
Bufflehead				
Oldsquaw				
Harlequin Duck				
Unid. Eider	1	1	152	0.6
Steller's Eider				
Common Eider	1	1	2	tr.
King Eider				
Spectacled Eider				
Unid. Scoter	2	1	4	tr.
White-winged Scoter	2	1	103	0.4
Surf Scoter	1	1	25	0.1
Common Scoter	2	1	11	tr.
Red-breasted Merganser				
Bald Eagle				
Gyrfalcon				
Peregrine Falcon				

Table 22. Continued.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km^2
Sandhill Crane				
Unid. Shorebird				
Black Oystercatcher				
American Golden Plover				
Unid. Turnstone				
Ruddy Turnstone				
Black Turnstone				
Whimbrel				
Unid. Sandpiper				
Sharp-tailed Sandpiper				
Unid. Phalarope	15	7	134	0.5
Red Phalarope				
Northern Phalarope				
Unid. Jaeger	5	2	5	tr.
Pomarine Jaeger	2	1	2	tr.
Parasitic Jaeger				
Long-tailed Jaeger	1	1	1	tr.
Skua				
Unid. Gull				
Glaucous Gull	30	13	202	0.8
Glaucous-winged Gull				
Slaty-backed Gull				
Western Gull				
Herring Gull				
Herring/Glaucous-wg. Hyb.				
Thayer's Gull				
Mew Gull				
Black-headed Gull				
Bonaparte's Gull				
Ivory Gull				
Unid. Kittiwake				
Black-legged Kittiwake	64	29	168	0.6
Red-legged Kittiwake				

Species Name	Occurrence	% Occurence	No. Birds	Birds/km^2
Ross' Gull				
Sabine's Gull	1	1	1	tr.
Unid. Tern	1	1	1	tr.
Arctic Tern	1	1	1	tr.
Aleutian Tern	1	1	1	tr.
Unid. Large Alcid	5	2	5	tr.
Unid. Murre	98	44	2105	8.0
Common Murre				
Thick-billed Murre				
Unid. Guillemot				
Black Guillemot				
Pigeon Guillemot	1	1	57	0.2
Unid. Small Alcid	21	9	86	0.3
Unid. Murrelet				
Marbled Murrelet				
Kittlitz's Murrelet				
Xantus' Murrelet				
Ancient Murrelet				
Cassin's Auklet				
Parakeet Auklet	31	14	1341	5.1
Crested Auklet	47	21	2749	10.5
Least Auklet	28	12	1728	6.6
Rhinoceros Auklet				
Unid. Puffin				
Horned Puffin	15	7	54	0.2
Tufted Puffin	15	7	169	0.6
Short-eared Owl				
Unid. Passerine				
Unid. Swallow				
Tree Swallow				
Common Raven				
Water Pipit				
Bohemian Waxwing				

Table 22. Continued.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km^2	Species Name	Occurrence	% Occurence	No. Birds	Birds/km^2
Orange-crowned Warbler									
Townsend's Warbler									
Wilson's Warbler									
Pine Siskin									
Savannah Sparrow									
White-crowned Sparrow									
Lapland Longspur									
Totals/Average			12115	46.2					

* Cruise numbers data are compiled from: FW6-086

Table 23. Bird observations on aerial transects, Norton Basin, October, 1976.

Species Name	Occurence	% Occurence	No. Birds	Birds/Km^2
Unid. Bird	5	2	5	tr.
Unid. Loon	7	3	13	tr.
Yellow-billed Loon				
Arctic Loon	8	3	8	tr.
Red-throated Loon	1	1	1	tr.
Red-necked Grebe				
Horned Grebe				
Western Grebe				
Unid. Albatross				
Short-tailed Albatross				
Black-footed Albatross				
Laysan Albatross				
Fulmar	17	7	20	0.1
Unid. Shearwater	29	13	5677	21.6
Pink-footed Shearwater				
New Zealand Shearwater				
Sooty Shearwater	6	3	8	tr.
Short-tailed Shearwater				
Unid. Petrel				
Scaled Petrel				
Fork-tailed Storm Petrel				
Leach's Storm Petrel				
Ashy Storm Petrel				
Brown Pelican				
Unid Cormorant	1	1	3	tr.
Double-crested Cormorant				
Brandt's Cormorant				
Pelagic Cormorant	1	1	1	tr.
Red-faced Cormorant				
Whistling Swan				
Unid. Goose				
Canada Goose				
Brant				
Black Brant				
Emperor Goose				
Snow Goose				
Unid. Duck				
Mallard				
Gadwall				
Pintail				
Green-winged Teal				
American Widgeon				
Shoveler				
Redhead				
Canvasback				
Unid. Scaup				
Greater Scaup				
Lesser Scaup				
Common Goldeneye				
Barrow's Goldeneye				
Bufflehead				
Oldsquaw	8	3	49	0.2
Harlequin Duck				
Unid. Eider	3	1	29	0.1
Steller's Eider				
Common Eider	2	1	16	0.1
King Eider	6	3	33	0.1
Spectacled Eider				
Unid. Scoter	4	2	25	0.1
White-winged Scoter				
Surf Scoter	1	1	1	tr.
Common Scoter				
Red-breasted Merganser				
Bald Eagle				
Gyrfalcon				
Peregrine Falcon				

Table 23. Continued.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km^2	Species Name	Occurrence	% Occurence	No. Birds	Birds/km^2
Sandhill Crane					Ross' Gull				
Unid. Shorebird					Sabine's Gull	1	1	1	tr.
Black Oystercatcher					Unid. Tern				
American Golden Plover					Arctic Tern				
Unid. Turnstone					Aleutian Tern				
Ruddy Turnstone					Unid. Large Alcid	2	1	2	tr.
Black Turnstone					Unid. Murre	61	26	251	1.0
Whimbrel					Common Murre				
Unid. Sandpiper					Thick-billed Murre				
Sharp-tailed Sandpiper					Unid. Guillemot				
Unid. Phalarope	11	5	49	0.2	Black Guillemot				
Red Phalarope					Pigeon Guillemot				
Northern Phalarope					Unid. Small Alcid	13	6	15	0.1
Unid. Jaeger	2	1	2	tr.	Unid. Murrelet				
Pomarine Jaeger					Marbled Murrelet				
Parasitic Jaeger	1	1	1	tr.	Kittlitz's Murrelet				
Long-tailed Jaeger					Xantus' Murrelet				
Skua					Ancient Murrelet				
Unid. Gull	3	1	3	tr.	Cassin's Auklet				
Glaucous Gull	36	16	256	1.0	Parakeet Auklet	14	6	40	0.2
Glaucous-winged Gull					Crested Auklet	20	9	35	0.1
Slaty-backed Gull					Least Auklet	13	6	26	0.1
Western Gull					Rhinoceros Auklet				
Herring Gull					Unid. Puffin				
Herring/Glaucous-wg. Hyb.					Horned Puffin	2	1	2	tr.
Thayer's Gull					Tufted Puffin	8	3	14	0.1
Mew Gull					Short-eared Owl				
Black-headed Gull					Unid. Passerine				
Bonaparte's Gull					Unid. Swallow				
Ivory Gull					Tree Swallow				
Unid. Kittiwake					Common Raven				
Black-legged Kittiwake	57	25	172	0.7	Water Pipit				
Red-legged Kittiwake					Bohemian Waxwing				

Table 23. Continued.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km^2	Species Name	Occurrence	% Occurence	No. Birds	Birds/km^2
Orange-crowned Warbler									
Townsend's Warbler									
Wilson's Warbler									
Pine Siskin									
Savannah Sparrow									
White-crowned Sparrow									
Lapland Longspur									
Totals/Average			6758	25.6					

* Cruise numbers data are compiled from: FW6-093

Table 24. Bird observations on aerial transects, Northeast Gulf of Alaska, March, 1976.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km^2
Common Loon				
Yellow-billed Loon				
Arctic Loon				
Red-throated Loon				
Unid. Loon				
Red-Necked Grebe				
Horned Grebe				
Western Grebe				
Black-footed Albatross				
Laysan Albatross				
Unid. Albatross				
Fulmar	31	30	91	0.8
Pink-footed Shearwater				
New Zealand Shearwater				
Sooty Shearwater				
Short-tailed Shearwater				
Unid. Shearwater				
Scaled Petrel				
Fork-tailed Storm Petrel				
Leach's Storm Petrel				
Ashy Storm Petrel				
Unid. Storm Petrel				
Brown Pelican				
Double-crested Cormorant				
Brandt's Cormorant				
Pelagic Cormorant				
Red-faced Cormorant				
Unid. Cormorant	1	1	1	tr.
Whistling Swan				
Canada Goose				
Black Brant				
Emperor Goose				
White-fronted Goose				
Snow Goose				
Unid. Goose				
Mallard				
Gadwall				
Pintail				
Green-winged Teal				
American Widgeon				
Shoveler				
Redhead				
Canvasback				
Greater Scaup				
Lesser Scaup				
Unid. Scaup				
Common Goldeneye				
Barrow's Goldeneye				
Bufflehead				
Oldsquaw	3	3	9	0.1
Harlequin Duck				
Steller's Eider				
Common Eider				
King Eider				
Spectacled Eider				
Unid. Eider				
White-winged Scoter	2	2	3	tr.
Surf Scoter				
Black Scoter	3	3	27	0.2
Unid. Scoter	1	1	8	0.1
Unid. Duck				
Red-breasted Merganser	1	1	5	tr.
Bald Eagle				
Gyrfalcon				
Peregrine Falcon				
Black Oystercatcher				

Table 24. Continued.

Species Name	Occurence	% Occurence	No. Birds	Birds/Km²
American Golden Plover				
Unid. Turnstone				
Ruddy Turnstone				
Black Turnstone				
Whimbrel				
Sharp-tailed Sandpiper				
Unid. Sandpiper	1	1	25	0.2
Red Phalarope				
Northern Phalarope				
Unid. Phalarope				
Pomarine Jaeger				
Parasitic Jaeger				
Long-tailed jaeger				
Unid. Jaeger				
Skua				
Glaucous Gull				
Glaucous-winged Gull	23	21	54	0.5
Slaty-backed Gull				
Western Gull				
Herring Gull	5	5	5	tr.
Herring/Glaucous-wg. Hyb.				
Thayer's Gull				
California Gull				
Ring-billed Gull				
Mew Gull				
Black-headed Gull				
Bonaparte's Gull				
Heermann's Gull				
Ivory Gull				
Unid. Kittiwake				
Black-legged Kittiwake	53	52	158	1.4
Red-legged Kittiwake				
Ross' Gull				

Species Name	Occurence	% Occurence	No. Birds	Birds/km²
Sabine's Gull				
Unid. Immature Gull				
Unid. Gull	1	1	1	tr.
Common Tern				
Arctic Tern				
Aleutian Tern				
Unid. Tern				
Common Murre				
Thick-billed Murre				
Unid. Murre	24	24	89	0.8
Unid. Guillemot				
Black Guillemot				
Pigeon Guillemot				
Unid. Large Alcid				
Marbled Murrelet				
Kittlitz's Murrelet				
Xantus' Murrelet				
Ancient Murrelet				
Unid. Murrelet				
Cassin's Auklet				
Parakeet Auklet				
Crested Auklet				
Least Auklet				
Rhinoceros Auklet	1	1	7	0.1
Unid. Small Alcid	5	5	9	0.1
Horned Puffin				
Tufted Puffin	15	15	103	0.9
Unid. Puffin				
Short-eared Owl				
Snowy Owl				
Tree Swallow				
Black Swallow				
Unid. Swallow				

Table 24. Continued.

Species Name	Occur-ence	% Occurence	No. Birds	Birds/Km^2	Species Name	Occur-ence	% Occurence	No. Birds	Birds/km^2
Common Raven									
Water Pipit									
Bohemian Waxwing									
Orange-crowned Warbler									
Townsend's Warbler									
Wilson's Warbler									
Pine Siskin									
Savannah Sparrow									
White-crowned Sparrow									
Lapland Longspur									
Unid. Passerine									
Unid. Bird	2	2	3	tr.					
Totals/Average			598	5.3					

Cruise numbers data are compiled from: 76-14

Table 25. Bird observations on aerial transects, Northwest Gulf of Alaska, January, 1976.

Species Name	Occurence	% Occurence	No. Birds	Birds/Km^2	Species Name	Occurence	% Occurence	No. Birds	Birds/km^2
Common Loon					Snow Goose				
Yellow-billed Loon					Unid. Goose				
Arctic Loon					Mallard				
Red-throated Loon					Gadwall				
Unid. Loon					Pintail				
Red-Necked Grebe					Green-winged Teal				
Horned Grebe					American Widgeon				
Western Grebe					Shoveler				
Black-footed Albatross					Redhead				
Laysan Albatross					Canvasback				
Unid. Albatross					Greater Scaup				
Fulmar	4	23	17	0.6	Lesser Scaup				
Pink-footed Shearwater					Unid. Scaup				
New Zealand Shearwater					Common Goldeneye				
Sooty Shearwater					Barrow's Goldeneye				
Short-tailed Shearwater					Bufflehead				
Unid. Shearwater					Oldsquaw				
Scaled Petrel					Harlequin Duck				
Fork-tailed Storm Petrel					Steller's Eider	1	6	40	1.4
Leach's Storm Petrel					Common Eider				
Ashy Storm Petrel					King Eider				
Unid. Storm Petrel					Spectacled Eider				
Brown Pelican					Unid. Eider	2	12	145	5.0
Double-crested Cormorant					White-winged Scoter	2	12	3	0.1
Brandt's Cormorant					Surf Scoter				
Pelagic Cormorant					Black Scoter	1	6	52	1.8
Red-faced Cormorant					Unid. Scoter				
Unid. Cormorant	4	24	297	10.3	Unid. Duck				
Whistling Swan					Red-breasted Merganser				
Canada Goose					Bald Eagle				
Black Brant					Gyrfalcon				
Emperor Goose					Peregrine Falcon				
White-fronted Goose					Black Oystercatcher				

Table 25. Continued.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km²	Species Name	Occurrence	% Occurence	No. Birds	Birds/km²
American Golden Plover					Sabine's Gull				
Unid. Turnstone					Unid. Immature Gull				
Ruddy Turnstone					Unid. Gull				
Black Turnstone					Common Tern				
Whimbrel					Arctic Tern				
Sharp-tailed Sandpiper					Aleutian Tern				
Unid. Sandpiper					Unid. Tern				
Red Phalarope					Common Murre				
Northern Phalarope					Thick-billed Murre				
Unid. Phalarope					Unid. Murre	7	41	78	2.7
Pomarine Jaeger					Unid. Guillemot				
Parasitic Jaeger					Black Guillemot				
Long-tailed jaeger					Pigeon Guillemot				
Unid. Jaeger					Unid. Large Alcid	1	6	1	tr.
Skua					Marbled Murrelet				
Glaucous Gull					Kittlitz's Murrelet				
Glaucous-winged Gull	10	59	54	1.9	Xantus' Murrelet				
Slaty-backed Gull					Ancient Murrelet				
Western Gull					Unid. Murrelet				
Herring Gull					Cassin's Auklet				
Herring/Glaucous-wg. Hyb.					Parakeet Auklet				
Thayer's Gull					Crested Auklet				
California Gull					Least Auklet				
Ring-billed Gull					Rhinoceros Auklet				
Mew Gull					Unid. Small Alcid	8	47	174	6.0
Black-headed Gull					Horned Puffin				
Bonaparte's Gull					Tufted Puffin				
Heermann's Gull					Unid. Puffin				
Ivory Gull					Short-eared Owl				
Unid. Kittiwake					Snowy Owl				
Black-legged Kittiwake	5	29	12	0.4	Tree Swallow				
Red-legged Kittiwake					Black Swallow				
Ross' Gull					Unid. Swallow				

Table 25. Continued.

Species Name	Occurence	% Occurence	No. Birds	Birds/Km^2	Species Name	Occurence	% Occurence	No. Birds	Birds/km^2
Common Raven									
Water Pipit									
Bohemian Waxwing									
Orange-crowned Warbler									
Townsend's Warbler									
Wilson's Warbler									
Pine Siskin									
Savannah Sparrow									
White-crowned Sparrow									
Lapland Longspur									
Unid. Passerine									
Unid. Bird									
Totals/Average			873	30.3					

Cruise numbers data are compiled from: 76-1

Table 26. Bird observations on aerial transects, Northwest Gulf of Alaska, March, 1976.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km^2	Species Name	Occurrence	% Occurence	No. Birds	Birds/km^2
Common Loon					Snow Goose				
Yellow-billed Loon					Unid. Goose				
Arctic Loon					Mallard				
Red-throated Loon					Gadwall				
Unid. Loon					Pintail				
Red-Necked Grebe					Green-winged Teal				
Horned Grebe					American Widgeon				
Western Grebe					Shoveler				
Black-footed Albatross					Redhead				
Laysan Albatross					Canvasback				
Unid. Albatross					Greater Scaup				
Fulmar	10	15	130	1.6	Lesser Scaup				
Pink-footed Shearwater					Unid. Scaup				
New Zealand Shearwater					Common Goldeneye				
Sooty Shearwater					Barrow's Goldeneye				
Short-tailed Shearwater					Bufflehead				
Unid. Shearwater					Oldsquaw				
Scaled Petrel					Harlequin Duck				
Fork-tailed Storm Petrel	4	6	33	0.4	Steller's Eider				
Leach's Storm Petrel					Common Eider	1	2	7	0.1
Ashy Storm Petrel					King Eider				
Unid. Storm Petrel					Spectacled Eider				
Brown Pelican					Unid. Eider	2	3	101	1.3
Double-crested Cormorant					White-winged Scoter	1	2	3	tr.
Brandt's Cormorant					Surf Scoter				
Pelagic Cormorant					Black Scoter	2	3	24	0.3
Red-faced Cormorant					Unid. Scoter	2	3	14	0.2
Unid. Cormorant	6	9	33	0.4	Unid. Duck	1	2	3	tr.
Whistling Swan					Red-breasted Merganser				
Canada Goose					Bald Eagle				
Black Brant					Gyrfalcon				
Emperor Goose					Peregrine Falcon				
White-fronted Goose					Black Oystercatcher				

Table 26. Continued.

Species Name	Occurence	% Occurence	No. Birds	Birds/Km²
American Golden Plover				
Unid. Turnstone				
Ruddy Turnstone				
Black Turnstone				
Whimbrel				
Sharp-tailed Sandpiper				
Unid. Sandpiper				
Red Phalarope				
Northern Phalarope				
Unid. Phalarope				
Pomarine Jaeger				
Parasitic Jaeger				
Long-tailed jaeger				
Unid. Jaeger				
Skua				
Glaucous Gull				
Glaucous-winged Gull	27	41	200	2.5
Slaty-backed Gull				
Western Gull				
Herring Gull				
Herring/Glaucous-wg. Hyb.				
Thayer's Gull				
California Gull				
Ring-billed Gull				
Mew Gull	4	6	5	0.1
Black-headed Gull				
Bonaparte's Gull				
Heermann's Gull				
Ivory Gull				
Unid. Kittiwake				
Black-legged Kittiwake	24	36	190	2.4
Red-legged Kittiwake				
Ross' Gull				

Species Name	Occurence	% Occurence	No. Birds	Birds/km²
Sabine's Gull				
Unid. Immature Gull				
Unid. Gull	3	5	3	tr.
Common Tern				
Arctic Tern				
Aleutian Tern				
Unid. Tern				
Common Murre				
Thick-billed Murre				
Unid. Murre	38	58	311	3.9
Unid. Guillemot				
Black Guillemot				
Pigeon Guillemot				
Unid. Large Alcid				
Marbled Murrelet				
Kittlitz's Murrelet				
Xantus' Murrelet				
Ancient Murrelet				
Unid. Murrelet				
Cassin's Auklet				
Parakeet Auklet				
Crested Auklet	1	2	25	0.3
Least Auklet				
Rhinoceros Auklet				
Unid. Small Alcid				
Horned Puffin				
Tufted Puffin	2	3	7	0.1
Unid. Puffin				
Short-eared Owl				
Snowy Owl				
Tree Swallow				
Black Swallow				
Unid. Swallow				

Table 26. Continued.

Species Name	Occur-ence	% Occurence	No. Birds	Birds/Km^2	Species Name	Occur-ence	% Occurence	No. Birds	Birds/km^2
Common Raven									
Water Pipit									
Bohemian Waxwing									
Orange-crowned Warbler									
Townsend's Warbler									
Wilson's Warbler									
Pine Siskin									
Savannah Sparrow									
White-crowned Sparrow									
Lapland Longspur									
Unid. Passerine									
Unid. Bird	1	2	17	0.2					
Totals/Average			1106	13.9					

Cruise numbers data are compiled from: 76-6 and 76-14

Table 27. Bird observations on aerial transects, Northwest Gulf of Alaska, April, 1976.

Species Name	Occur-ence	% Occurence	No. Birds	Birds/Km^2	Species Name	Occur-ence	% Occurence	No. Birds	Birds/km^2
Common Loon					Snow Goose				
Yellow-billed Loon					Unid. Goose				
Arctic Loon					Mallard				
Red-throated Loon					Gadwall				
Unid. Loon					Pintail				
Red-Necked Grebe					Green-winged Teal				
Horned Grebe					American Widgeon				
Western Grebe					Shoveler				
Black-footed Albatross					Redhead				
Laysan Albatross					Canvasback				
Unid. Albatross					Greater Scaup				
Fulmar					Lesser Scaup				
Pink-footed Shearwater					Unid. Scaup				
New Zealand Shearwater					Common Goldeneye				
Sooty Shearwater					Barrow's Goldeneye				
Short-tailed Shearwater					Bufflehead				
Unid. Shearwater					Oldsquaw				
Scaled Petrel					Harlequin Duck				
Fork-tailed Storm Petrel					Steller's Eider				
Leach's Storm Petrel					Common Eider				
Ashy Storm Petrel					King Eider				
Unid. Storm Petrel					Spectacled Eider				
Brown Pelican					Unid. Eider				
Double-crested Cormorant					White-winged Scoter	1	14	3	0.3
Brandt's Cormorant					Surf Scoter				
Pelagic Cormorant					Black Scoter				
Red-faced Cormorant					Unid. Scoter				
Unid. Cormorant	3	43	9	0.9	Unid. Duck				
Whistling Swan					Red-breasted Merganser				
Canada Goose					Bald Eagle				
Black Brant					Gyrfalcon				
Emperor Goose					Peregrine Falcon				
White-fronted Goose					Black Oystercatcher				

Table 27. Continued.

Species Name	Occurence	% Occurence	No. Birds	Birds/Km^2	Species Name	Occurence	% Occurence	No. Birds	Birds/km^2
American Golden Plover					Sabine's Gull				
Unid. Turnstone					Unid. Immature Gull				
Ruddy Turnstone					Unid. Gull				
Black Turnstone					Common Tern				
Whimbrel					Arctic Tern				
Sharp-tailed Sandpiper					Aleutian Tern				
Unid. Sandpiper					Unid. Tern				
Red Phalarope					Common Murre				
Northern Phalarope					Thick-billed Murre				
Unid. Phalarope					Unid. Murre	7	100	58	5.8
Pomarine Jaeger					Unid. Guillemot				
Parasitic Jaeger					Black Guillemot				
Long-tailed jaeger					Pigeon Guillemot				
Unid. Jaeger					Unid. Large Alcid				
Skua					Marbled Murrelet				
Glaucous Gull					Kittlitz's Murrelet				
Glaucous-winged Gull	5	71	31	3.1	Xantus' Murrelet				
Slaty-backed Gull					Ancient Murrelet				
Western Gull					Unid. Murrelet				
Herring Gull					Cassin's Auklet				
Herring/Glaucous-wg. Hyb.					Parakeet Auklet				
Thayer's Gull					Crested Auklet				
California Gull					Least Auklet				
Ring-billed Gull					Rhinoceros Auklet				
Mew Gull					Unid. Small Alcid				
Black-headed Gull					Horned Puffin				
Bonaparte's Gull					Tufted Puffin				
Heermann's Gull					Unid. Puffin				
Ivory Gull					Short-eared Owl				
Unid. Kittiwake					Snowy Owl				
Black-legged Kittiwake	1	1	14	0.1	Tree Swallow				
Red-legged Kittiwake					Black Swallow				
Ross' Gull					Unid. Swallow				

Table 27. Continued.

Species Name	Occur-ence	% Occurence	No. Birds	Birds/Km^2	Species Name	Occur-ence	% Occurence	No. Birds	Birds/km^2
Common Raven									
Water Pipit									
Bohemian Waxwing									
Orange-crowned Warbler									
Townsend's Warbler									
Wilson's Warbler									
Pine Siskin									
Savannah Sparrow									
White-crowned Sparrow									
Lapland Longspur									
Unid. Passerine									
Unid. Bird	1	14	1	0.1					
Totals/Average			116	11.6					

Cruise numbers data are compiled from: 76-15

Table 28. Bird observations on aerial transects, Prince William Sound, March, 1976.

Species Name	Occur-ence	% Occurence	No. Birds	Birds/Km^2
Common Loon				
Yellow-billed Loon				
Arctic Loon				
Red-throated Loon				
Unid. Loon				
Red-Necked Grebe				
Horned Grebe				
Western Grebe				
Black-footed Albatross				
Laysan Albatross				
Unid. Albatross				
Fulmar				
Pink-footed Shearwater				
New Zealand Shearwater				
Sooty Shearwater				
Short-tailed Shearwater				
Unid. Shearwater				
Scaled Petrel				
Fork-tailed Storm Petrel				
Leach's Storm Petrel				
Ashy Storm Petrel				
Unid. Storm Petrel				
Brown Pelican				
Double-crested Cormorant				
Brandt's Cormorant				
Pelagic Cormorant				
Red-faced Cormorant				
Unid. Cormorant	1	25	1	0.2
Whistling Swan				
Canada Goose				
Black Brant				
Emperor Goose				
White-fronted Goose				

Species Name	Occur-ence	% Occurence	No. Birds	Birds/km^2
Snow Goose				
Unid. Goose				
Mallard				
Gadwall				
Pintail				
Green-winged Teal				
American Widgeon				
Shoveler				
Redhead				
Canvasback				
Greater Scaup				
Lesser Scaup				
Unid. Scaup				
Common Goldeneye				
Barrow's Goldeneye				
Bufflehead				
Oldsquaw				
Harlequin Duck				
Steller's Eider				
Common Eider				
King Eider				
Spectacled Eider				
Unid. Eider				
White-winged Scoter				
Surf Scoter				
Black Scoter				
Unid. Scoter				
Unid. Duck				
Red-breasted Merganser				
Bald Eagle				
Gyrfalcon				
Peregrine Falcon				
Black Oystercatcher				

Table 28. Continued.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km^2
American Golden Plover				
Unid. Turnstone				
Ruddy Turnstone				
Black Turnstone				
Whimbrel				
Sharp-tailed Sandpiper				
Unid. Sandpiper				
Red Phalarope				
Northern Phalarope				
Unid. Phalarope				
Pomarine Jaeger				
Parasitic Jaeger				
Long-tailed jaeger				
Unid. Jaeger				
Skua				
Glaucous Gull				
Glaucous-winged Gull				
Slaty-backed Gull				
Western Gull				
Herring Gull				
Herring/Glaucous-wg. Hyb.				
Thayer's Gull				
California Gull				
Ring-billed Gull				
Mew Gull				
Black-headed Gull				
Bonaparte's Gull				
Heermann's Gull				
Ivory Gull				
Unid. Kittiwake				
Black-legged Kittiwake	1	25	1	0.2
Red-legged Kittiwake				
Ross' Gull				

Species Name	Occurrence	% Occurence	No. Birds	Birds/km^2
Sabine's Gull				
Unid. Immature Gull				
Unid. Gull				
Common Tern				
Arctic Tern				
Aleutian Tern				
Unid. Tern				
Common Murre				
Thick-billed Murre				
Unid. Murre				
Unid. Guillemot				
Black Guillemot				
Pigeon Guillemot				
Unid. Large Alcid				
Marbled Murrelet				
Kittlitz's Murrelet				
Xantus' Murrelet				
Ancient Murrelet				
Unid. Murrelet				
Cassin's Auklet				
Parakeet Auklet				
Crested Auklet				
Least Auklet				
Rhinoceros Auklet				
Unid. Small Alcid				
Horned Puffin				
Tufted Puffin				
Unid. Puffin				
Short-eared Owl				
Snowy Owl				
Tree Swallow				
Black Swallow				
Unid. Swallow				

Table 28. Continued.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km²	Species Name	Occurrence	% Occurence	No. Birds	Birds/km²
Common Raven									
Water Pipit									
Bohemian Waxwing									
Orange-crowned Warbler									
Townsend's Warbler									
Wilson's Warbler									
Pine Siskin									
Savannah Sparrow									
White-crowned Sparrow									
Lapland Longspur									
Unid. Passerine									
Unid. Bird									
Totals/Average			2	0.3					

Cruise numbers data are compiled from: 76-14

Table 29. Bird observations on aerial transects, St. George Basin, February, 1976.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km²
Common Loon				
Yellow-billed Loon				
Arctic Loon				
Red-throated Loon				
Unid. Loon				
Red-Necked Grebe				
Horned Grebe				
Western Grebe				
Black-footed Albatross				
Laysan Albatross				
Unid. Albatross				
Fulmar	26	27	205	1.8
Pink-footed Shearwater				
New Zealand Shearwater				
Sooty Shearwater				
Short-tailed Shearwater				
Unid. Shearwater				
Scaled Petrel				
Fork-tailed Storm Petrel	14	14	49	0.4
Leach's Storm Petrel				
Ashy Storm Petrel				
Unid. Storm Petrel				
Brown Pelican				
Double-crested Cormorant				
Brandt's Cormorant				
Pelagic Cormorant				
Red-faced Cormorant				
Unid. Cormorant				
Whistling Swan				
Canada Goose				
Black Brant				
Emperor Goose				
White-fronted Goose				
Snow Goose				
Unid. Goose				
Mallard				
Gadwall				
Pintail				
Green-winged Teal				
American Widgeon				
Shoveler				
Redhead				
Canvasback				
Greater Scaup				
Lesser Scaup				
Unid. Scaup				
Common Goldeneye				
Barrow's Goldeneye				
Bufflehead				
Oldsquaw				
Harlequin Duck				
Steller's Eider				
Common Eider				
King Eider	1	1	150	1.3
Spectacled Eider				
Unid. Eider	1	1	8	0.1
White-winged Scoter				
Surf Scoter				
Black Scoter				
Unid. Scoter				
Unid. Duck				
Red-breasted Merganser				
Bald Eagle				
Gyrfalcon				
Peregrine Falcon				
Black Oystercatcher				

Table 29. Continued.

Species Name	Occurence	% Occurence	No. Birds	Birds/Km²	Species Name	Occurence	% Occurence	No. Birds	Birds/km²
American Golden Plover					Sabine's Gull				
Unid. Turnstone					Unid. Immature Gull				
Ruddy Turnstone					Unid. Gull	4	4	6	0.1
Black Turnstone					Common Tern				
Whimbrel					Arctic Tern				
Sharp-tailed Sandpiper					Aleutian Tern				
Unid. Sandpiper					Unid. Tern				
Red Phalarope					Common Murre				
Northern Phalarope					Thick-billed Murre				
Unid. Phalarope					Unid. Murre	25	25	3882	33.8
Pomarine Jaeger					Unid. Guillemot				
Parasitic Jaeger					Black Guillemot				
Long-tailed jaeger					Pigeon Guillemot				
Unid. Jaeger					Unid. Large Alcid	1	1	3	tr.
Skua					Marbled Murrelet				
Glaucous Gull					Kittlitz's Murrelet	2	2	3	tr.
Glaucous-winged Gull	13	13	28	0.2	Xantus' Murrelet				
Slaty-backed Gull					Ancient Murrelet				
Western Gull					Unid. Murrelet				
Herring Gull					Cassin's Auklet				
Herring/Glaucous-wg. Hyb.					Parakeet Auklet	4	4	6	0.1
Thayer's Gull					Crested Auklet	1	1	1	tr.
California Gull					Least Auklet	7	7	44	0.4
Ring-billed Gull					Rhinoceros Auklet				
Mew Gull					Unid. Small Alcid	5	5	5	tr.
Black-headed Gull					Horned Puffin				
Bonaparte's Gull					Tufted Puffin				
Heermann's Gull					Unid. Puffin				
Ivory Gull					Short-eared Owl				
Unid. Kittiwake					Snowy Owl				
Black-legged Kittiwake	6	6	9	0.1	Tree Swallow				
Red-legged Kittiwake	2	2	11	0.1	Black Swallow				
Ross' Gull					Unid. Swallow				

Table 29. Continued.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km^2
Common Raven				
Water Pipit				
Bohemian Waxwing				
Orange-crowned Warbler				
Townsend's Warbler				
Wilson's Warbler				
Pine Siskin				
Savannah Sparrow				
White-crowned Sparrow				
Lapland Longspur				
Unid. Passerine				
Unid. Bird	2	2	2	tr.
Totals/Average			4412	38.5

Species Name	Occurrence	% Occurence	No. Birds	Birds/km^2

Cruise numbers data are compiled from: 76-6

Table 30. Bird observations on aerial transects, St. George Basin, March, 1976.

Species Name	Occur-ence	% Occurence	No. Birds	Birds/Km^2
Common Loon				
Yellow-billed Loon				
Arctic Loon				
Red-throated Loon				
Unid. Loon				
Red-Necked Grebe				
Horned Grebe				
Western Grebe				
Black-footed Albatross				
Laysan Albatross				
Unid. Albatross				
Fulmar	5	28	14	0.7
Pink-footed Shearwater				
New Zealand Shearwater				
Sooty Shearwater				
Short-tailed Shearwater				
Unid. Shearwater				
Scaled Petrel				
Fork-tailed Storm Petrel				
Leach's Storm Petrel				
Ashy Storm Petrel				
Unid. Storm Petrel				
Brown Pelican				
Double-crested Cormorant				
Brandt's Cormorant				
Pelagic Cormorant				
Red-faced Cormorant				
Unid. Cormorant	3	17	12	0.6
Whistling Swan				
Canada Goose				
Black Brant				
Emperor Goose				
White-fronted Goose				

Species Name	Occur-ence	% Occurence	No. Birds	Birds/km^2
Snow Goose				
Unid. Goose				
Mallard				
Gadwall				
Pintail				
Green-winged Teal				
American Widgeon				
Shoveler				
Redhead				
Canvasback				
Greater Scaup				
Lesser Scaup				
Unid. Scaup				
Common Goldeneye				
Barrow's Goldeneye				
Bufflehead				
Oldsquaw				
Harlequin Duck				
Steller's Eider				
Common Eider				
King Eider				
Spectacled Eider				
Unid. Eider				
White-winged Scoter				
Surf Scoter				
Black Scoter				
Unid. Scoter	1	6	2	0.1
Unid. Duck				
Red-breasted Merganser				
Bald Eagle				
Gyrfalcon				
Peregrine Falcon				
Black Oystercatcher				

Table 30. Continued.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km^2
American Golden Plover				
Unid. Turnstone				
Ruddy Turnstone				
Black Turnstone				
Whimbrel				
Sharp-tailed Sandpiper				
Unid. Sandpiper				
Red Phalarope				
Northern Phalarope				
Unid. Phalarope				
Pomarine Jaeger				
Parasitic Jaeger				
Long-tailed jaeger				
Unid. Jaeger				
Skua				
Glaucous Gull				
Glaucous-winged Gull	10	56	26	1.3
Slaty-backed Gull				
Western Gull				
Herring Gull				
Herring/Glaucous-wg. Hyb.				
Thayer's Gull				
California Gull				
Ring-billed Gull				
Mew Gull				
Black-headed Gull				
Bonaparte's Gull				
Heermann's Gull				
Ivory Gull				
Unid. Kittiwake				
Black-legged Kittiwake	1	6	2	0.1
Red-legged Kittiwake				
Ross' Gull				

Species Name	Occurrence	% Occurence	No. Birds	Birds/km^2
Sabine's Gull				
Unid. Immature Gull				
Unid. Gull				
Common Tern				
Arctic Tern				
Aleutian Tern				
Unid. Tern				
Common Murre				
Thick-billed Murre	2	11	18	0.9
Unid. Murre	8	44	106	5.4
Unid. Guillemot				
Black Guillemot				
Pigeon Guillemot				
Unid. Large Alcid				
Marbled Murrelet				
Kittlitz's Murrelet				
Xantus' Murrelet				
Ancient Murrelet				
Unid. Murrelet				
Cassin's Auklet				
Parakeet Auklet				
Crested Auklet	1	6	3	0.2
Least Auklet				
Rhinoceros Auklet				
Unid. Small Alcid				
Horned Puffin	1	6	1	0.1
Tufted Puffin				
Unid. Puffin				
Short-eared Owl				
Snowy Owl				
Tree Swallow				
Black Swallow				
Unid. Swallow				

Table 30. Continued.

Species Name	Occurence	% Occurence	No. Birds	Birds/Km^2	Species Name	Occurence	% Occurence	No. Birds	Birds/km^2
Common Raven									
Water Pipit									
Bohemian Waxwing									
Orange-crowned Warbler									
Townsend's Warbler									
Wilson's Warbler									
Pine Siskin									
Savannah Sparrow									
White-crowned Sparrow									
Lapland Longspur									
Unid. Passerine									
Unid. Bird	1	6	1	0.1					
Totals/Average			185	9.4					

Cruise numbers data are compiled from: 76-6

Table 31. Bird observations on aerial transects, St. George Basin, October, 1976.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km²	Species Name	Occurrence	% Occurence	No. Birds	Birds/km²
Unid. Bird	1	1	3	tr.	Black Brant				
Unid. Loon	1	1	1	tr.	Emperor Goose	1	1	10	tr.
Yellow-billed Loon					Snow Goose				
Arctic Loon	1	1	4	tr.	Unid. Duck	1	1	2	tr.
Red-throated Loon					Mallard				
Red-necked Grebe					Gadwall				
Horned Grebe					Pintail				
Western Grebe					Green-winged Teal				
Unid. Albatross					American Widgeon				
Short-tailed Albatross					Shoveler				
Black-footed Albatross					Redhead				
Laysan Albatross					Canvasback				
Fulmar	17	70	16835	71.3	Unid. Scaup				
Unid. Shearwater	71	43	276	11.7	Greater Scaup				
Pink-footed Shearwater					Lesser Scaup				
New Zealand Shearwater					Common Goldeneye				
Sooty Shearwater	11	7	16	0.1	Barrow's Goldeneye				
Short-tailed Shearwater					Bufflehead				
Unid. Petrel					Oldsquaw	1	1	1	tr.
Scaled Petrel					Harlequin Duck				
Fork-tailed Storm Petrel	50	30	229	1.0	Unid. Eider				
Leach's Storm Petrel					Steller's Eider				
Ashy Storm Petrel					Common Eider				
Brown Pelican					King Eider	1	1	1	tr.
Unid Cormorant	13	8	52	0.2	Spectacled Eider				
Double-crested Cormorant					Unid. Scoter				
Brandt's Cormorant					White-winged Scoter				
Pelagic Cormorant					Surf Scoter				
Red-faced Cormorant					Common Scoter	2	1	2	tr.
Whistling Swan					Red-breasted Merganser				
Unid. Goose					Bald Eagle				
Canada Goose					Gyrfalcon				
Brant					Peregrine Falcon				

Table 31. Continued.

Species Name	Occurrence	% Occurrence	No. Birds	Birds/Km^2
Sandhill Crane				
Unid. Shorebird				
Black Oystercatcher				
American Golden Plover				
Unid. Turnstone				
Ruddy Turnstone				
Black Turnstone				
Whimbrel				
Unid. Sandpiper				
Sharp-tailed Sandpiper				
Unid. Phalarope	21	13	1246	5.3
Red Phalarope				
Northern Phalarope				
Unid. Jaeger	4	2	4	tr.
Pomarine Jaeger	2	1	2	tr.
Parasitic Jaeger				
Long-tailed Jaeger				
Skua				
Unid. Gull				
Glaucous Gull				
Glaucous-winged Gull	72	43	1198	5.1
Slaty-backed Gull				
Western Gull				
Herring Gull				
Herring/Glaucous-wg. Hyb.				
Thayer's Gull				
Mew Gull				
Black-headed Gull				
Bonaparte's Gull				
Ivory Gull				
Unid. Kittiwake				
Black-legged Kittiwake	91	55	1483	6.3
Red-legged Kittiwake	5	3	6	tr.

Species Name	Occurrence	% Occurrence	No. Birds	Birds/Km^2
Ross' Gull				
Sabine's Gull				
Unid. Tern				
Arctic Tern				
Aleutian Tern				
Unid. Large Alcid	3	2	9	tr.
Unid. Murre	96	58	1699	7.2
Common Murre				
Thick-billed Murre				
Unid. Guillemot				
Black Guillemot				
Pigeon Guillemot				
Unid. Small Alcid	17	10	30	0.1
Unid. Murrelet				
Marbled Murrelet				
Kittlitz's Murrelet				
Xantus' Murrelet				
Ancient Murrelet				
Cassin's Auklet				
Parakeet Auklet	14	8	57	0.2
Crested Auklet	8	5	25	0.1
Least Auklet	6	4	257	1.1
Rhinoceros Auklet				
Unid. Puffin				
Horned Puffin				
Tufted Puffin	85	51	495	2.1
Short-eared Owl				
Unid. Passerine				
Unid. Swallow				
Tree Swallow				
Common Raven				
Water Pipit				
Bohemian Waxwing				

Table 31. Continued.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km²	Species Name	Occurrence	% Occurence	No. Birds	Birds/km²
Orange-crowned Warbler									
Townsend's Warbler									
Wilson's Warbler									
Pine Siskin									
Savannah Sparrow									
White-crowned Sparrow									
Lapland Longspur									
Totals/Average			23927	101.4					

* Cruise numbers data are compiled from: FW6-093

Table 32. Bird observations on aerial transects, Shelikof Strait, January, 1976.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km^2
Common Loon				
Yellow-billed Loon				
Arctic Loon				
Red-throated Loon				
Unid. Loon				
Red-Necked Grebe				
Horned Grebe				
Western Grebe				
Black-footed Albatross				
Laysan Albatross				
Unid. Albatross				
Fulmar				
Pink-footed Shearwater				
New Zealand Shearwater				
Sooty Shearwater				
Short-tailed Shearwater				
Unid. Shearwater				
Scaled Petrel				
Fork-tailed Storm Petrel				
Leach's Storm Petrel				
Ashy Storm Petrel				
Unid. Storm Petrel				
Brown Pelican				
Double-crested Cormorant				
Brandt's Cormorant				
Pelagic Cormorant				
Red-faced Cormorant				
Unid. Cormorant				
Whistling Swan				
Canada Goose				
Black Brant				
Emperor Goose				
White-fronted Goose				
Snow Goose				
Unid. Goose				
Mallard				
Gadwall				
Pintail				
Green-winged Teal				
American Widgeon				
Shoveler				
Redhead				
Canvasback				
Greater Scaup				
Lesser Scaup				
Unid. Scaup				
Common Goldeneye				
Barrow's Goldeneye				
Bufflehead				
Oldsquaw				
Harlequin Duck				
Steller's Eider	1	50	700	190.
Common Eider				
King Eider				
Spectacled Eider				
Unid. Eider				
White-winged Scoter				
Surf Scoter				
Black Scoter				
Unid. Scoter				
Unid. Duck				
Red-breasted Merganser				
Bald Eagle				
Gyrfalcon				
Peregrine Falcon				
Black Oystercatcher				

Table 32. Continued.

Species Name	Occur-ence	% Occurence	No. Birds	Birds/Km²
American Golden Plover				
Unid. Turnstone				
Ruddy Turnstone				
Black Turnstone				
Whimbrel				
Sharp-tailed Sandpiper				
Unid. Sandpiper				
Red Phalarope				
Northern Phalarope				
Unid. Phalarope				
Pomarine Jaeger				
Parasitic Jaeger				
Long-tailed jaeger				
Unid. Jaeger				
Skua				
Glaucous Gull				
Glaucous-winged Gull	1	50	4	1.1
Slaty-backed Gull				
Western Gull				
Herring Gull				
Herring/Glaucous-wg. Hyb.				
Thayer's Gull				
California Gull				
Ring-billed Gull				
Mew Gull				
Black-headed Gull				
Bonaparte's Gull				
Heermann's Gull				
Ivory Gull				
Unid. Kittiwake				
Black-legged Kittiwake				
Red-legged Kittiwake				
Ross' Gull				

Species Name	Occur-ence	% Occurence	No. Birds	Birds/Km²
Sabine's Gull				
Unid. Immature Gull				
Unid. Gull				
Common Tern				
Arctic Tern				
Aleutian Tern				
Unid. Tern				
Common Murre				
Thick-billed Murre				
Unid. Murre				
Unid. Guillemot				
Black Guillemot				
Pigeon Guillemot				
Unid. Large Alcid	1	50	1	0.3
Marbled Murrelet				
Kittlitz's Murrelet				
Xantus' Murrelet				
Ancient Murrelet				
Unid. Murrelet				
Cassin's Auklet				
Parakeet Auklet				
Crested Auklet				
Least Auklet				
Rhinoceros Auklet				
Unid. Small Alcid				
Horned Puffin				
Tufted Puffin				
Unid. Puffin				
Short-eared Owl				
Snowy Owl				
Tree Swallow				
Black Swallow				
Unid. Swallow				

Table 32. Continued.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km^2	Species Name	Occurrence	% Occurence	No. Birds	Birds/km^2
Common Raven									
Water Pipit									
Bohemian Waxwing									
Orange-crowned Warbler									
Townsend's Warbler									
Wilson's Warbler									
Pine Siskin									
Savannah Sparrow									
White-crowned Sparrow									
Lapland Longspur									
Unid. Passerine									
Unid. Bird									
Totals/Average			705	191					

Cruise numbers data are compiled from: 76-1

Table 33. Bird observations on aerial transects, Shelikof Strait, March, 1976.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km²
Common Loon				
Yellow-billed Loon				
Arctic Loon				
Red-throated Loon				
Unid. Loon				
Red-Necked Grebe				
Horned Grebe				
Western Grebe				
Black-footed Albatross				
Laysan Albatross				
Unid. Albatross				
Fulmar	6	35	14	0.6
Pink-footed Shearwater				
New Zealand Shearwater				
Sooty Shearwater				
Short-tailed Shearwater				
Unid. Shearwater				
Scaled Petrel				
Fork-tailed Storm Petrel				
Leach's Storm Petrel				
Ashy Storm Petrel				
Unid. Storm Petrel				
Brown Pelican				
Double-crested Cormorant				
Brandt's Cormorant				
Pelagic Cormorant				
Red-faced Cormorant				
Unid. Cormorant	1	6	25	1.2
Whistling Swan				
Canada Goose				
Black Brant				
Emperor Goose				
White-fronted Goose				

Species Name	Occurrence	% Occurrence	No. Birds	Birds/km²
Snow Goose				
Unid. Goose				
Mallard				
Gadwall				
Pintail				
Green-winged Teal				
American Widgeon				
Shoveler				
Redhead				
Canvasback				
Greater Scaup				
Lesser Scaup				
Unid. Scaup				
Common Goldeneye				
Barrow's Goldeneye				
Bufflehead				
Oldsquaw				
Harlequin Duck				
Steller's Eider	1	6	1	tr.
Common Eider	4	23	156	7.2
King Eider				
Spectacled Eider				
Unid. Eider	1	6	5	0.2
White-winged Scoter	2	12	142	6.5
Surf Scoter				
Black Scoter	2	12	25	1.2
Unid. Scoter	2	12	175	8.1
Unid. Duck				
Red-breasted Merganser				
Bald Eagle				
Gyrfalcon				
Peregrine Falcon				
Black Oystercatcher				

Table 33. Continued.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km^2
American Golden Plover Unid. Turnstone Ruddy Turnstone				
Black Turnstone Whimbrel Sharp-tailed Sandpiper				
Unid. Sandpiper Red Phalarope Northern Phalarope				
Unid. Phalarope Pomarine Jaeger Parasitic Jaeger				
Long-tailed jaeger Unid. Jaeger Skua				
Glaucous Gull Glaucous-winged Gull Slaty-backed Gull	8	47	41	1.9
Western Gull Herring Gull Herring/Glaucous-wg. Hyb.				
Thayer's Gull California Gull Ring-billed Gull				
Mew Gull Black-headed Gull Bonaparte's Gull				
Heermann's Gull Ivory Gull Unid. Kittiwake				
Black-legged Kittiwake Red-legged Kittiwake Ross' Gull	6	35	21	1.0
Sabine's Gull Unid. Immature Gull Unid. Gull				
Common Tern Arctic Tern Aleutian Tern				
Unid. Tern Common Murre Thick-billed Murre				
Unid. Murre Unid. Guillemot Black Guillemot	11	65	289	13.3
Pigeon Guillemot Unid. Large Alcid Marbled Murrelet				
Kittlitz's Murrelet Xantus' Murrelet Ancient Murrelet				
Unid. Murrelet Cassin's Auklet Parakeet Auklet				
Crested Auklet Least Auklet Rhinoceros Auklet				
Unid. Small Alcid Horned Puffin Tufted Puffin				
Unid. Puffin Short-eared Owl Snowy Owl				
Tree Swallow Black Swallow Unid. Swallow				

Table 33. Continued.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km^2
Common Raven				
Water Pipit				
Bohemian Waxwing				
Orange-crowned Warbler				
Townsend's Warbler				
Wilson's Warbler				
Pine Siskin				
Savannah Sparrow				
White-crowned Sparrow				
Lapland Longspur				
Unid. Passerine				
Unid. Bird	1	6	5	0.2
Totals/Average			899	41.4

Cruise numbers data are compiled from: 76-6

Table 34. Bird observations on aerial transects, Shelikof Strait, April, 1976.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km^2
Common Loon				
Yellow-billed Loon				
Arctic Loon				
Red-throated Loon				
Unid. Loon				
Red-Necked Grebe				
Horned Grebe				
Western Grebe				
Black-footed Albatross				
Laysan Albatross				
Unid. Albatross				
Fulmar				
Pink-footed Shearwater				
New Zealand Shearwater				
Sooty Shearwater				
Short-tailed Shearwater				
Unid. Shearwater				
Scaled Petrel				
Fork-tailed Storm Petrel				
Leach's Storm Petrel				
Ashy Storm Petrel				
Unid. Storm Petrel				
Brown Pelican				
Double-crested Cormorant				
Brandt's Cormorant				
Pelagic Cormorant				
Red-faced Cormorant				
Unid. Cormorant	1	50	2	0.5
Whistling Swan				
Canada Goose				
Black Brant				
Emperor Goose				
White-fronted Goose				
Snow Goose				
Unid. Goose				
Mallard				
Gadwall				
Pintail				
Green-winged Teal				
American Widgeon				
Shoveler				
Redhead				
Canvasback				
Greater Scaup				
Lesser Scaup				
Unid. Scaup				
Common Goldeneye				
Barrow's Goldeneye				
Bufflehead				
Oldsquaw				
Harlequin Duck				
Steller's Eider				
Common Eider				
King Eider				
Spectacled Eider				
Unid. Eider				
White-winged Scoter				
Surf Scoter				
Black Scoter				
Unid. Scoter				
Unid. Duck				
Red-breasted Merganser				
Bald Eagle				
Gyrfalcon				
Peregrine Falcon				
Black Oystercatcher				

Table 34. Continued.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km^2
American Golden Plover				
Unid. Turnstone				
Ruddy Turnstone				
Black Turnstone				
Whimbrel				
Sharp-tailed Sandpiper				
Unid. Sandpiper				
Red Phalarope				
Northern Phalarope				
Unid. Phalarope				
Pomarine Jaeger				
Parasitic Jaeger				
Long-tailed jaeger				
Unid. Jaeger				
Skua				
Glaucous Gull				
Glaucous-winged Gull	1	50	3	0.8
Slaty-backed Gull				
Western Gull				
Herring Gull				
Herring/Glaucous-wg. Hyb.				
Thayer's Gull				
California Gull				
Ring-billed Gull				
Mew Gull				
Black-headed Gull				
Bonaparte's Gull				
Heermann's Gull				
Ivory Gull				
Unid. Kittiwake				
Black-legged Kittiwake				
Red-legged Kittiwake				
Ross' Gull				

Species Name	Occurrence	% Occurence	No. Birds	Birds/km^2
Sabine's Gull				
Unid. Immature Gull				
Unid. Gull				
Common Tern				
Arctic Tern				
Aleutian Tern				
Unid. Tern				
Common Murre				
Thick-billed Murre				
Unid. Murre	2	100	13	3.5
Unid. Guillemot				
Black Guillemot				
Pigeon Guillemot				
Unid. Large Alcid				
Marbled Murrelet				
Kittlitz's Murrelet				
Xantus' Murrelet				
Ancient Murrelet				
Unid. Murrelet				
Cassin's Auklet				
Parakeet Auklet				
Crested Auklet				
Least Auklet				
Rhinoceros Auklet				
Unid. Small Alcid				
Horned Puffin				
Tufted Puffin				
Unid. Puffin				
Short-eared Owl				
Snowy Owl				
Tree Swallow				
Black Swallow				
Unid. Swallow				

Table 34. Continued.

Species Name	Occur-ence	% Occurence	No. Birds	Birds/Km^2	Species Name	Occur-ence	% Occurence	No. Birds	Birds/km^2
Common Raven									
Water Pipit									
Bohemian Waxwing									
Orange-crowned Warbler									
Townsend's Warbler									
Wilson's Warbler									
Pine Siskin									
Savannah Sparrow									
White-crowned Sparrow									
Lapland Longspur									
Unid. Passerine									
Unid. Bird									
Totals/Average			18	4.9					

Cruise numbers data are compiled from: 76-15

Table 35. Bird observations on aerial transects, Upper Cook Inlet, March, 1976.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km^2	Species Name	Occurrence	% Occurence	No. Birds	Birds/km^2
Common Loon					Snow Goose				
Yellow-billed Loon					Unid. Goose				
Arctic Loon					Mallard				
Red-throated Loon					Gadwall				
Unid. Loon					Pintail				
Red-Necked Grebe					Green-winged Teal				
Horned Grebe					American Widgeon				
Western Grebe					Shoveler				
Black-footed Albatross					Redhead				
Laysan Albatross					Canvasback				
Unid. Albatross					Greater Scaup				
Fulmar					Lesser Scaup				
Pink-footed Shearwater					Unid. Scaup				
New Zealand Shearwater					Common Goldeneye				
Sooty Shearwater					Barrow's Goldeneye				
Short-tailed Shearwater					Bufflehead				
Unid. Shearwater					Oldsquaw				
Scaled Petrel					Harlequin Duck				
Fork-tailed Storm Petrel					Steller's Eider				
Leach's Storm Petrel					Common Eider				
Ashy Storm Petrel					King Eider				
Unid. Storm Petrel					Spectacled Eider				
Brown Pelican					Unid. Eider				
Double-crested Cormorant					White-winged Scoter				
Brandt's Cormorant					Surf Scoter				
Pelagic Cormorant					Black Scoter				
Red-faced Cormorant					Unid. Scoter				
Unid. Cormorant					Unid. Duck				
Whistling Swan					Red-breasted Merganser				
Canada Goose					Bald Eagle				
Black Brant					Gyrfalcon				
Emperor Goose					Peregrine Falcon				
White-fronted Goose					Black Oystercatcher				

Table 35. Continued.

Species Name	Occurence	% Occurence	No. Birds	Birds/Km²	Species Name	Occurence	% Occurence	No. Birds	Birds/km²
American Golden Plover					Sabine's Gull				
Unid. Turnstone					Unid. Immature Gull				
Ruddy Turnstone					Unid. Gull				
Black Turnstone					Common Tern				
Whimbrel					Arctic Tern				
Sharp-tailed Sandpiper					Aleutian Tern				
Unid. Sandpiper	1	50	25	7.1	Unid. Tern				
Red Phalarope					Common Murre				
Northern Phalarope					Thick-billed Murre				
Unid. Phalarope					Unid. Murre				
Pomarine Jaeger					Unid. Guillemot				
Parasitic Jaeger					Black Guillemot				
Long-tailed jaeger					Pigeon Guillemot				
Unid. Jaeger					Unid. Large Alcid				
Skua					Marbled Murrelet				
Glaucous Gull					Kittlitz's Murrelet				
Glaucous-winged Gull					Xantus' Murrelet				
Slaty-backed Gull					Ancient Murrelet				
Western Gull					Unid. Murrelet				
Herring Gull					Cassin's Auklet				
Herring/Glaucous-wg. Hyb.					Parakeet Auklet				
Thayer's Gull					Crested Auklet				
California Gull					Least Auklet				
Ring-billed Gull					Rhinoceros Auklet				
Mew Gull					Unid. Small Alcid				
Black-headed Gull					Horned Puffin				
Bonaparte's Gull					Tufted Puffin				
Heermann's Gull					Unid. Puffin				
Ivory Gull					Short-eared Owl				
Unid. Kittiwake					Snowy Owl				
Black-legged Kittiwake					Tree Swallow				
Red-legged Kittiwake					Black Swallow				
Ross' Gull					Unid. Swallow				

Table 35. Continued.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km^2	Species Name	Occurrence	% Occurence	No. Birds	Birds/km^2
Common Raven Water Pipit Bohemian Waxwing									
Orange-crowned Warbler Townsend's Warbler Wilson's Warbler									
Pine Siskin Savannah Sparrow White-crowned Sparrow									
Lapland Longspur Unid. Passerine Unid. Bird									
Totals/Average			25	7.1					

Cruise numbers data are compiled from: 76-14

Table 36. Bird observations on aerial transects, Upper Cook Inlet, April, 1976.

Species Name	Occur-ence	% Occurence	No. Birds	Birds/Km^2	Species Name	Occur-ence	% Occurence	No. Birds	Birds/Km^2
Common Loon					Snow Goose				
Yellow-billed Loon					Unid. Goose				
Arctic Loon					Mallard				
Red-throated Loon					Gadwall				
Unid. Loon					Pintail				
Red-Necked Grebe					Green-winged Teal				
Horned Grebe					American Widgeon				
Western Grebe					Shoveler				
Black-footed Albatross					Redhead				
Laysan Albatross					Canvasback				
Unid. Albatross					Greater Scaup				
Fulmar					Lesser Scaup				
Pink-footed Shearwater					Unid. Scaup				
New Zealand Shearwater					Common Goldeneye				
Sooty Shearwater					Barrow's Goldeneye				
Short-tailed Shearwater					Bufflehead				
Unid. Shearwater					Oldsquaw				
Scaled Petrel					Harlequin Duck				
Fork-tailed Storm Petrel					Steller's Eider				
Leach's Storm Petrel					Common Eider				
Ashy Storm Petrel					King Eider				
Unid. Storm Petrel					Spectacled Eider				
Brown Pelican					Unid. Eider				
Double-crested Cormorant					White-winged Scoter				
Brandt's Cormorant					Surf Scoter				
Pelagic Cormorant					Black Scoter				
Red-faced Cormorant					Unid. Scoter				
Unid. Cormorant					Unid. Duck				
Whistling Swan					Red-breasted Merganser				
Canada Goose					Bald Eagle				
Black Brant					Gyrfalcon				
Emperor Goose					Peregrine Falcon				
White-fronted Goose					Black Oystercatcher				

Table 36. Continued.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km^2
American Golden Plover				
Unid. Turnstone				
Ruddy Turnstone				
Black Turnstone				
Whimbrel				
Sharp-tailed Sandpiper				
Unid. Sandpiper				
Red Phalarope				
Northern Phalarope				
Unid. Phalarope				
Pomarine Jaeger				
Parasitic Jaeger				
Long-tailed jaeger				
Unid. Jaeger				
Skua				
Glaucous Gull				
Glaucous-winged Gull				
Slaty-backed Gull				
Western Gull				
Herring Gull				
Herring/Glaucous-wg. Hyb.				
Thayer's Gull				
California Gull				
Ring-billed Gull				
Mew Gull				
Black-headed Gull				
Bonaparte's Gull				
Heermann's Gull				
Ivory Gull				
Unid. Kittiwake				
Black-legged Kittiwake				
Red-legged Kittiwake				
Ross' Gull				

Species Name	Occurrence	% Occurence	No. Birds	Birds/km^2
Sabine's Gull				
Unid. Immature Gull				
Unid. Gull				
Common Tern				
Arctic Tern				
Aleutian Tern				
Unid. Tern				
Common Murre				
Thick-billed Murre				
Unid. Murre				
Unid. Guillemot				
Black Guillemot				
Pigeon Guillemot				
Unid. Large Alcid				
Marbled Murrelet				
Kittlitz's Murrelet				
Xantus' Murrelet				
Ancient Murrelet				
Unid. Murrelet				
Cassin's Auklet				
Parakeet Auklet				
Crested Auklet				
Least Auklet				
Rhinoceros Auklet				
Unid. Small Alcid				
Horned Puffin				
Tufted Puffin				
Unid. Puffin				
Short-eared Owl				
Snowy Owl				
Tree Swallow				
Black Swallow				
Unid. Swallow				

Table 36. Continued.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km^2	Species Name	Occurrence	% Occurence	No. Birds	Birds/km^2
Common Raven									
Water Pipit									
Bohemian Waxwing									
Orange-crowned Warbler									
Townsend's Warbler									
Wilson's Warbler									
Pine Siskin									
Savannah Sparrow									
White-crowned Sparrow									
Lapland Longspur									
Unid. Passerine									
Unid. Bird									
Totals/Average			0	0					

Cruise numbers data are compiled from: 76-15

Table 37. Bird observations on aerial transects, Umnak Basin, March, 1976.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km^2
Common Loon				
Yellow-billed Loon				
Arctic Loon				
Red-throated Loon				
Unid. Loon				
Red-Necked Grebe				
Horned Grebe				
Western Grebe				
Black-footed Albatross				
Laysan Albatross				
Unid. Albatross				
Fulmar	31	48	68	0.9
Pink-footed Shearwater				
New Zealand Shearwater				
Sooty Shearwater				
Short-tailed Shearwater				
Unid. Shearwater				
Scaled Petrel				
Fork-tailed Storm Petrel	3	5	5	0.1
Leach's Storm Petrel				
Ashy Storm Petrel				
Unid. Storm Petrel				
Brown Pelican				
Double-crested Cormorant				
Brandt's Cormorant				
Pelagic Cormorant				
Red-faced Cormorant				
Unid. Cormorant	8	12	22	0.3
Whistling Swan				
Canada Goose				
Black Brant				
Emperor Goose	3	5	316	4.0
White-fronted Goose				
Snow Goose				
Unid. Goose				
Mallard				
Gadwall				
Pintail				
Green-winged Teal				
American Widgeon				
Shoveler				
Redhead				
Canvasback				
Greater Scaup				
Lesser Scaup				
Unid. Scaup				
Common Goldeneye				
Barrow's Goldeneye				
Bufflehead				
Oldsquaw				
Harlequin Duck				
Steller's Eider	4	6	27	0.3
Common Eider	1	2	2	tr.
King Eider	2	3	5	0.1
Spectacled Eider				
Unid. Eider	7	11	29	0.4
White-winged Scoter	1	2	9	0.1
Surf Scoter				
Black Scoter				
Unid. Scoter	2	3	4	0.1
Unid. Duck				
Red-breasted Merganser				
Bald Eagle	3	5	7	0.1
Gyrfalcon				
Peregrine Falcon				
Black Oystercatcher				

Table 37. Continued.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km²	Species Name	Occurrence	% Occurence	No. Birds	Birds/km²
American Golden Plover					Sabine's Gull				
Unid. Turnstone					Unid. Immature Gull				
Ruddy Turnstone					Unid. Gull				
Black Turnstone					Common Tern				
Whimbrel					Arctic Tern				
Sharp-tailed Sandpiper					Aleutian Tern				
Unid. Sandpiper					Unid. Tern				
Red Phalarope					Common Murre				
Northern Phalarope					Thick-billed Murre	8	12	18	0.2
Unid. Phalarope					Unid. Murre	15	23	83	1.1
Pomarine Jaeger					Unid. Guillemot				
Parasitic Jaeger					Black Guillemot				
Long-tailed jaeger					Pigeon Guillemot				
Unid. Jaeger					Unid. Large Alcid				
Skua					Marbled Murrelet				
Glaucous Gull					Kittlitz's Murrelet				
Glaucous-winged Gull	14	22	598	7.6	Xantus' Murrelet				
Slaty-backed Gull					Ancient Murrelet				
Western Gull					Unid. Murrelet				
Herring Gull					Cassin's Auklet				
Herring/Glaucous-wg. Hyb.					Parakeet Auklet	2	3	3	tr.
Thayer's Gull					Crested Auklet	1	2	15	0.2
California Gull					Least Auklet				
Ring-billed Gull					Rhinoceros Auklet				
Mew Gull					Unid. Small Alcid	1	2	2	tr.
Black-headed Gull					Horned Puffin				
Bonaparte's Gull					Tufted Puffin				
Heermann's Gull					Unid. Puffin				
Ivory Gull					Short-eared Owl				
Unid. Kittiwake					Snowy Owl				
Black-legged Kittiwake	14	22	17	0.2	Tree Swallow				
Red-legged Kittiwake	1	2	1	tr.	Black Swallow				
Ross' Gull					Unid. Swallow				

Table 37. Continued.

Species Name	Occurrence	% Occurence	No. Birds	Birds/Km^2	Species Name	Occurrence	% Occurence	No. Birds	Birds/km^2
Common Raven									
Water Pipit									
Bohemian Waxwing									
Orange-crowned Warbler									
Townsend's Warbler									
Wilson's Warbler									
Pine Siskin									
Savannah Sparrow									
White-crowned Sparrow									
Lapland Longspur									
Unid. Passerine									
Unid. Bird	2	3	2	tr.					
Totals/Average			1233	15.8					

Cruise numbers data are compiled from: 76-6

Table 38. Bird observations on aerial transects, Umnak Basin, October, 1976.

Species Name	Occurrence	% Occurrence	No. Birds	Birds/Km²
Unid. Bird	1	1	1	tr.
Unid. Loon				
Yellow-billed Loon				
Arctic Loon				
Red-throated Loon				
Red-necked Grebe				
Horned Grebe				
Western Grebe				
Unid. Albatross				
Short-tailed Albatross				
Black-footed Albatross	5	7	6	0.1
Laysan Albatross	1	1	1	tr.
Fulmar	39	57	302	3.5
Unid. Shearwater	21	31	38	0.4
Pink-footed Shearwater				
New Zealand Shearwater				
Sooty Shearwater	5	7	7	0.1
Short-tailed Shearwater	1	1	2	tr.
Unid. Petrel				
Scaled Petrel				
Fork-tailed Storm Petrel	13	19	18	0.2
Leach's Storm Petrel	1	1	1	tr.
Ashy Storm Petrel				
Brown Pelican				
Unid Cormorant	7	10	27	0.3
Double-crested Cormorant				
Brandt's Cormorant				
Pelagic Cormorant				
Red-faced Cormorant	2	3	2	tr.
Whistling Swan				
Unid. Goose				
Canada Goose				
Brant				

Species Name	Occurrence	% Occurrence	No. Birds	Birds/km²
Black Brant				
Emperor Goose				
Snow Goose				
Unid. Duck				
Mallard				
Gadwall				
Pintail				
Green-winged Teal				
American Widgeon				
Shoveler				
Redhead				
Canvasback				
Unid. Scaup				
Greater Scaup				
Lesser Scaup				
Common Goldeneye				
Barrow's Goldeneye				
Bufflehead				
Oldsquaw				
Harlequin Duck				
Unid. Eider	1	1	4	tr.
Steller's Eider				
Common Eider	1	1	25	0.3
King Eider				
Spectacled Eider				
Unid. Scoter	2	3	6	0.1
White-winged Scoter	1	1	10	0.1
Surf Scoter				
Common Scoter	3	4	4	tr.
Red-breasted Merganser				
Bald Eagle				
Gyrfalcon				
Peregrine Falcon				

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Table 38. Continued.

Species Name	Occurence	% Occurence	No. Birds	Birds/Km^2	Species Name	Occurence	% Occurence	No. Birds	Birds/Km^2
Sandhill Crane					Ross' Gull				
Unid. Shorebird					Sabine's Gull	1	1	1	tr.
Black Oystercatcher					Unid. Tern				
American Golden Plover					Arctic Tern				
Unid. Turnstone					Aleutian Tern				
Ruddy Turnstone					Unid. Large Alcid	4	6	5	0.1
Black Turnstone					Unid. Murre	17	25	62	0.7
Whimbrel					Common Murre				
Unid. Sandpiper					Thick-billed Murre				
Sharp-tailed Sandpiper					Unid. Guillemot				
Unid. Phalarope	7	10	42	0.5	Black Guillemot				
Red Phalarope					Pigeon Guillemot				
Northern Phalarope					Unid. Small Alcid	14	21	21	0.2
Unid. Jaeger					Unid. Murrelet				
Pomarine Jaeger					Marbled Murrelet				
Parasitic Jaeger	1	1	1	tr.	Kittlitz's Murrelet				
Long-tailed Jaeger					Xantus' Murrelet				
Skua					Ancient Murrelet				
Unid. Gull	1	1	1	tr.	Cassin's Auklet				
Glaucous Gull					Parakeet Auklet				
Glaucous-winged Gull	12	18	41	0.5	Crested Auklet				
Slaty-backed Gull					Least Auklet	1	1	2	tr.
Western Gull					Rhinoceros Auklet				
Herring Gull					Unid. Puffin				
Herring/Glaucous-wg. Hyb.					Horned Puffin	3	4	3	tr.
Thayer's Gull					Tufted Puffin	7	10	9	0.1
Mew Gull					Short-eared Owl				
Black-headed Gull					Unid. Passerine				
Bonaparte's Gull					Unid. Swallow				
Ivory Gull					Tree Swallow				
Unid. Kittiwake					Common Raven				
Black-legged Kittiwake	43	63	237	2.8	Water Pipit				
Red-legged Kittiwake					Bohemian Waxwing				

Table 38. Continued.

Species Name	Occurence	% Occurence	No. Birds	Birds/Km^2	Species Name	Occurence	% Occurence	No. Birds	Birds/km^2
Orange-crowned Warbler									
Townsend's Warbler									
Wilson's Warbler									
Pine Siskin									
Savannah Sparrow									
White-crowned Sparrow									
Lapland Longspur									
Totals/Average			879	10.3					

* Cruise numbers data are compiled from: FW6-093

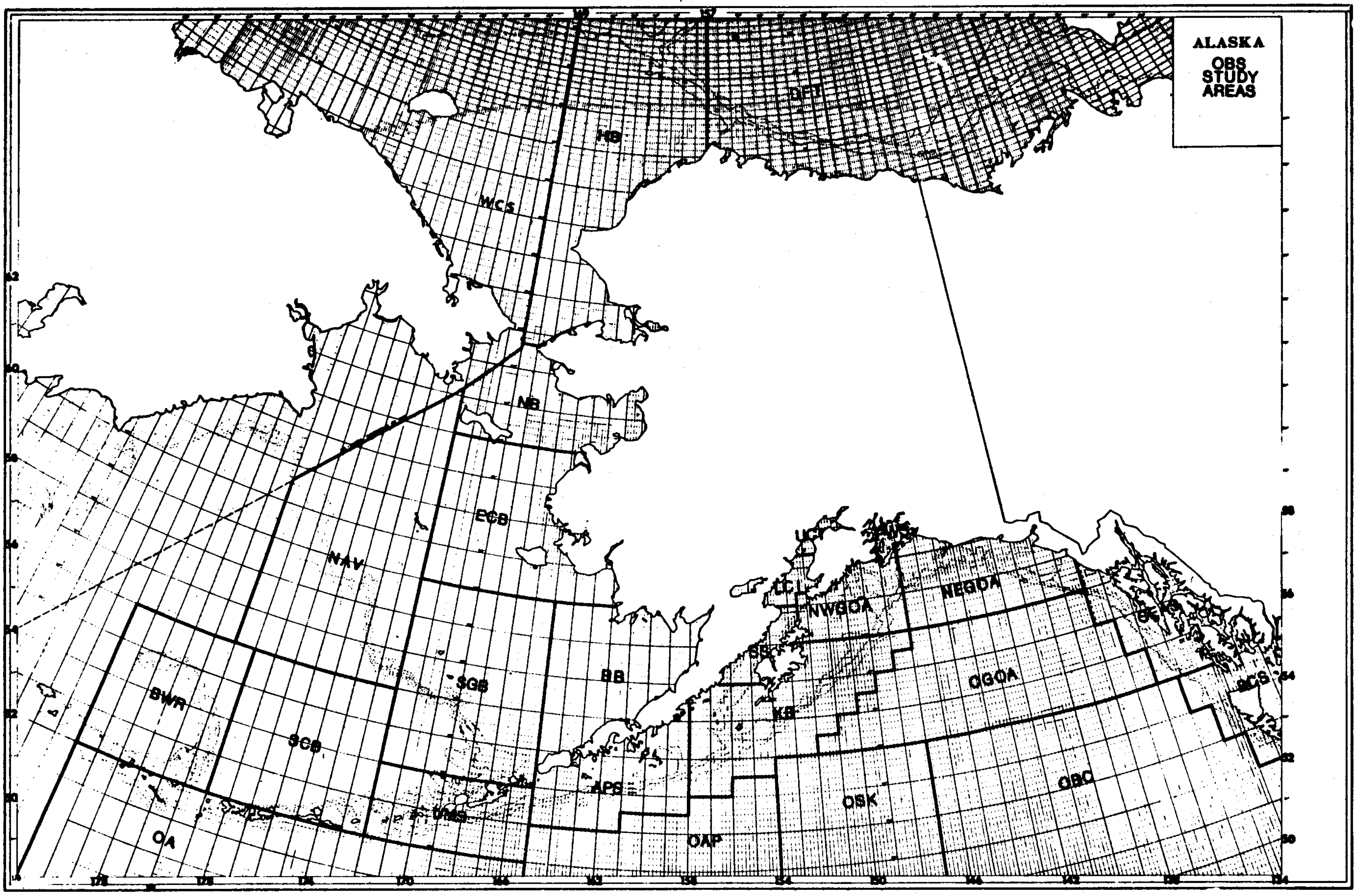

FIGURE 1. OCEANOGRAPHIC REGIONS FOR WHICH BIRD SURVEY DATA ARE SUMMARIZED.

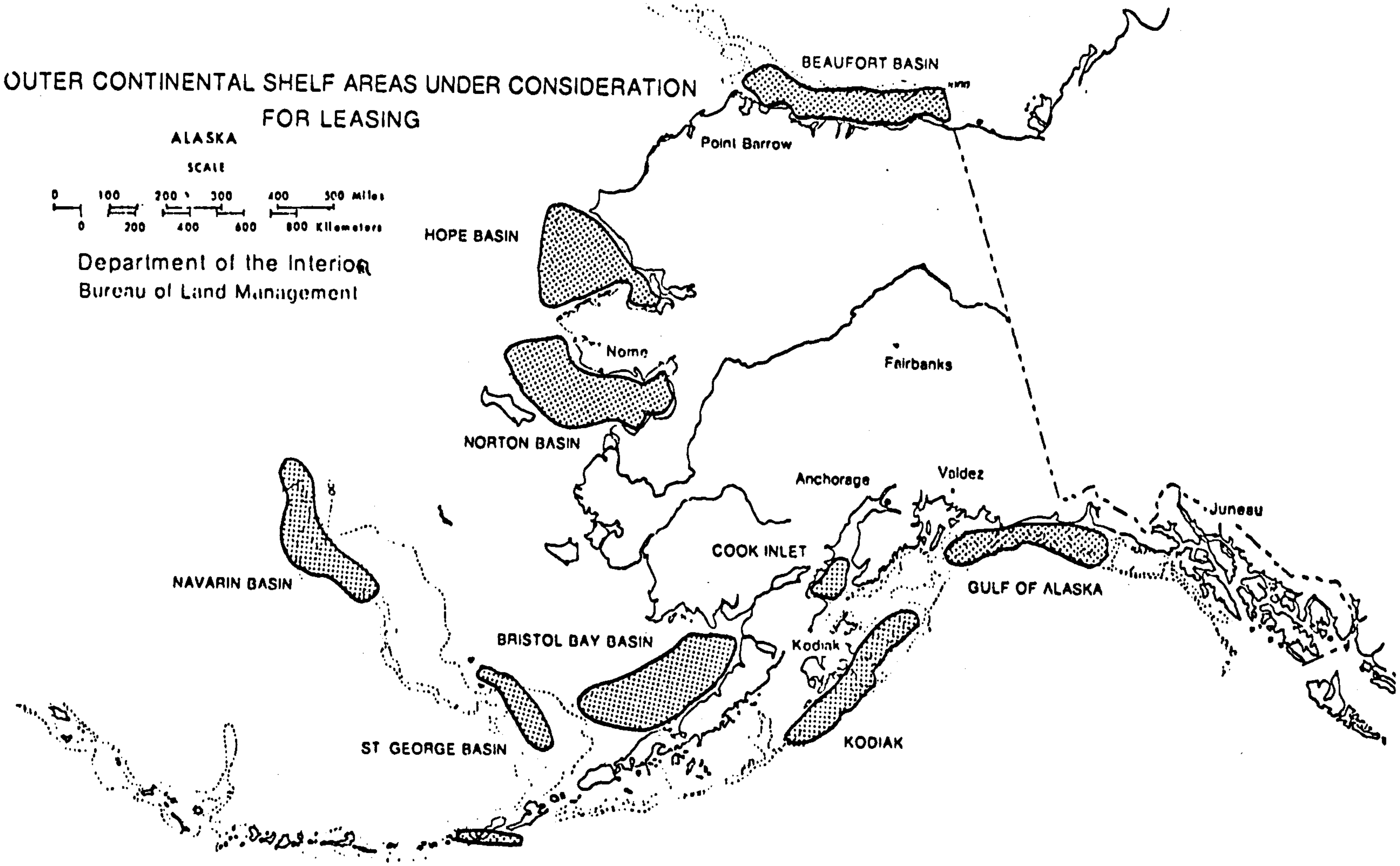

Figure 2. Outer continental shelf areas under consideration for leasing (From U.S.D.I. News Release, BLM, November 14, 1974, "BLM announces tentative OCS lease sale schedule through 1978").

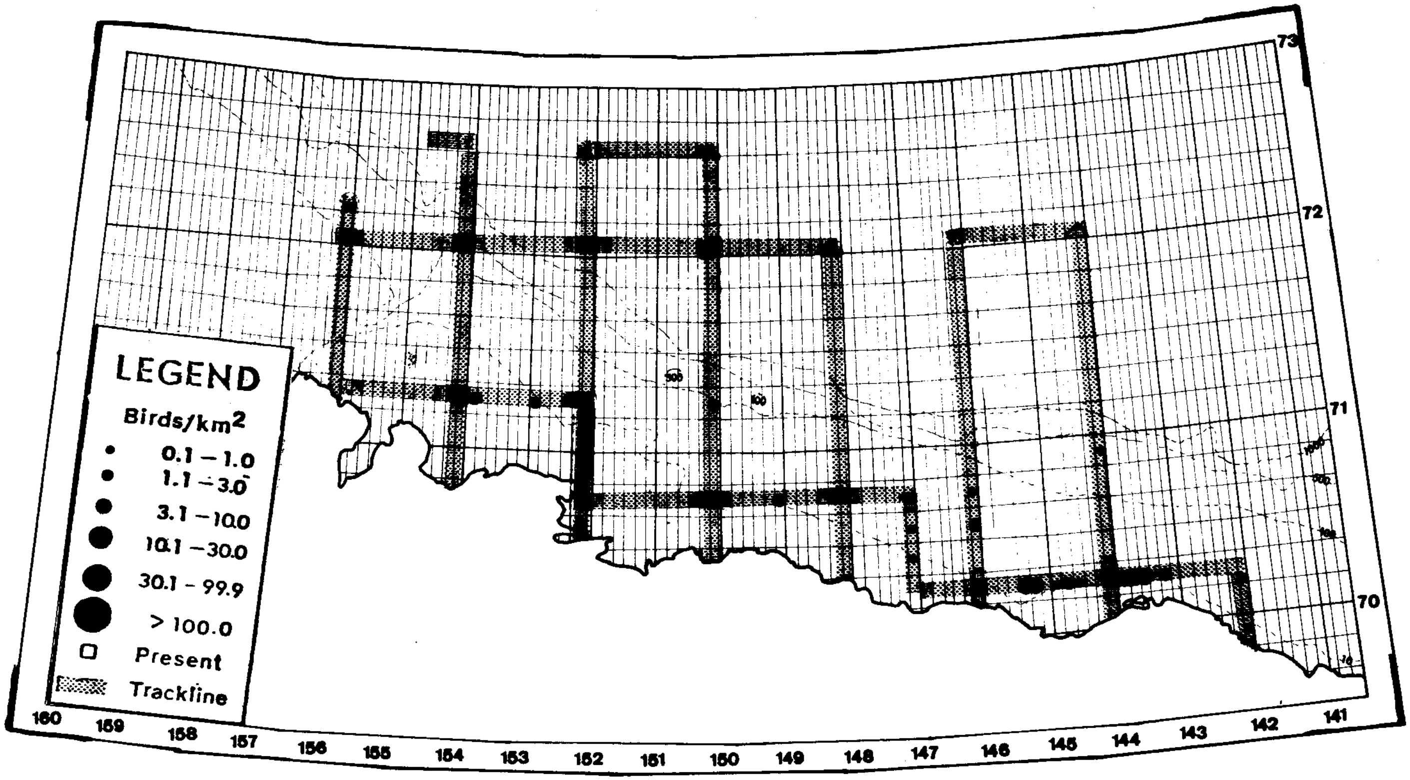

Figure 3. Distribution and abundance of loons in the Beaufort Sea in July.

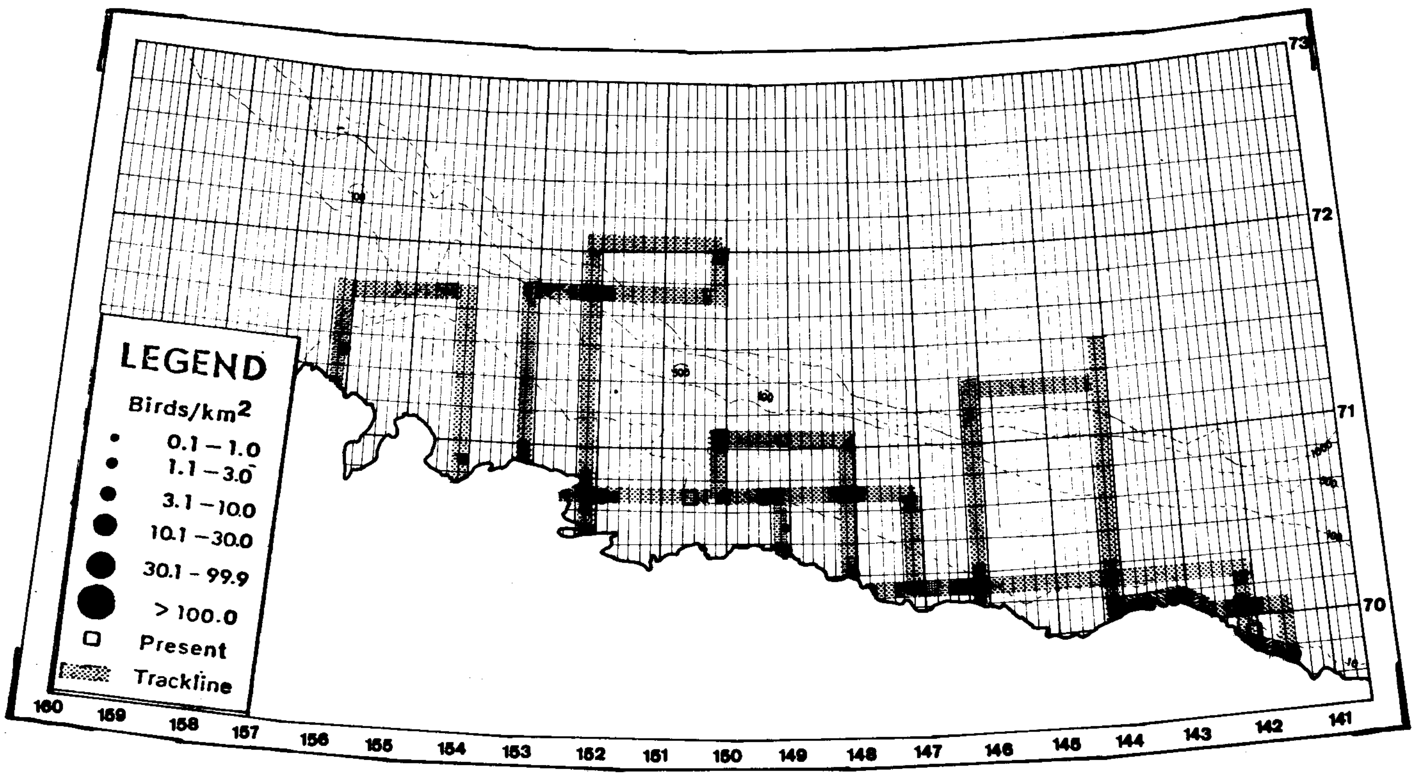

Figure 4. Distribution and abundance of loons in the Beaufort Sea in August.

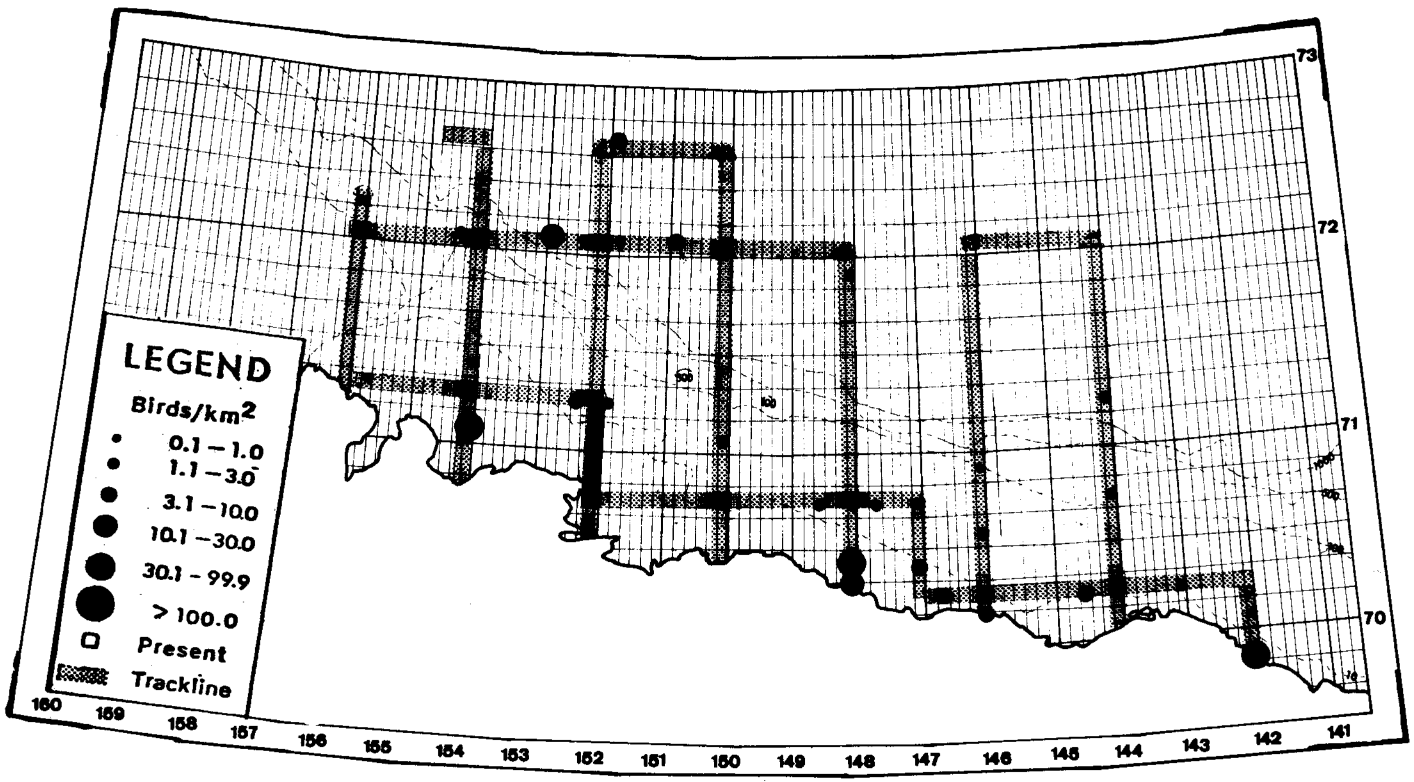

Figure 5. Distribution and abundance of Oldsquaw in the Beaufort Sea in July.

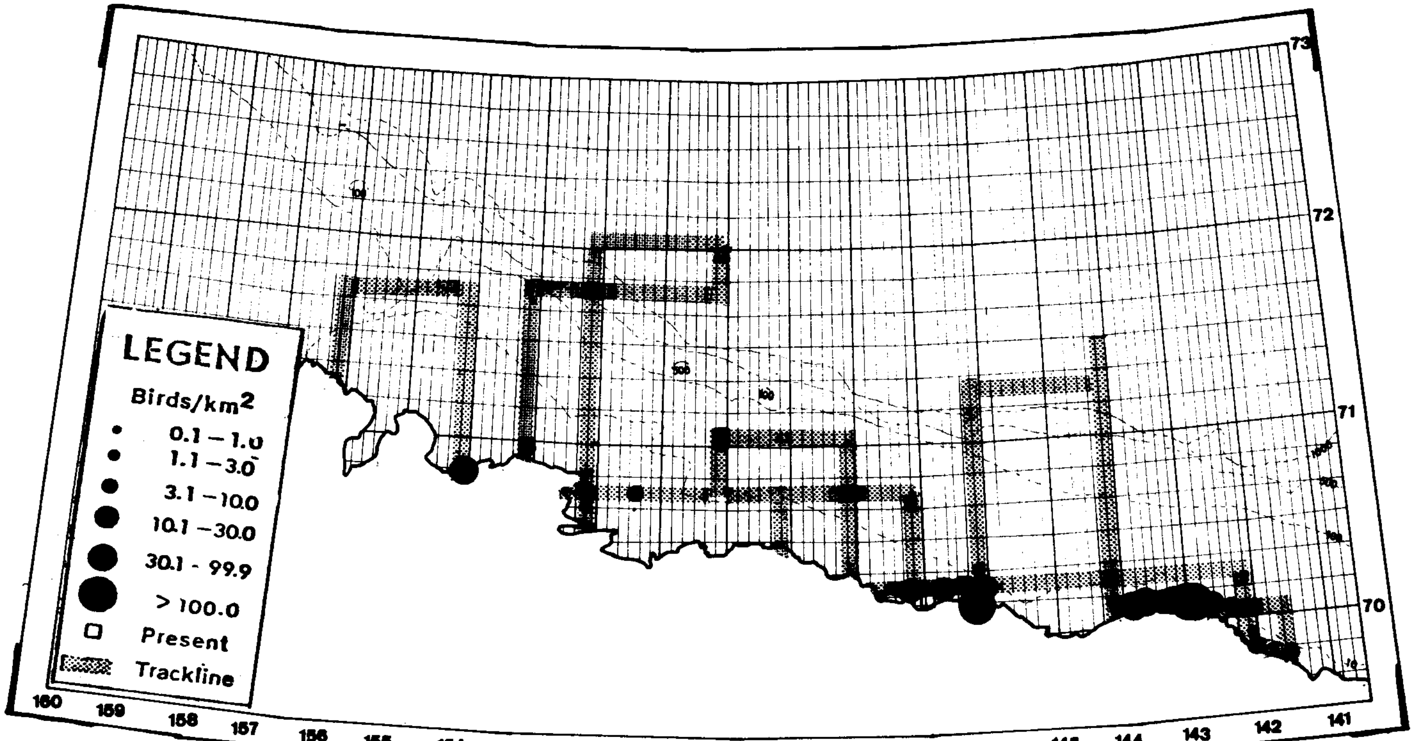

Figure 6. Distribution and abundance of Oldsquaw in the Beaufort Sea in August.

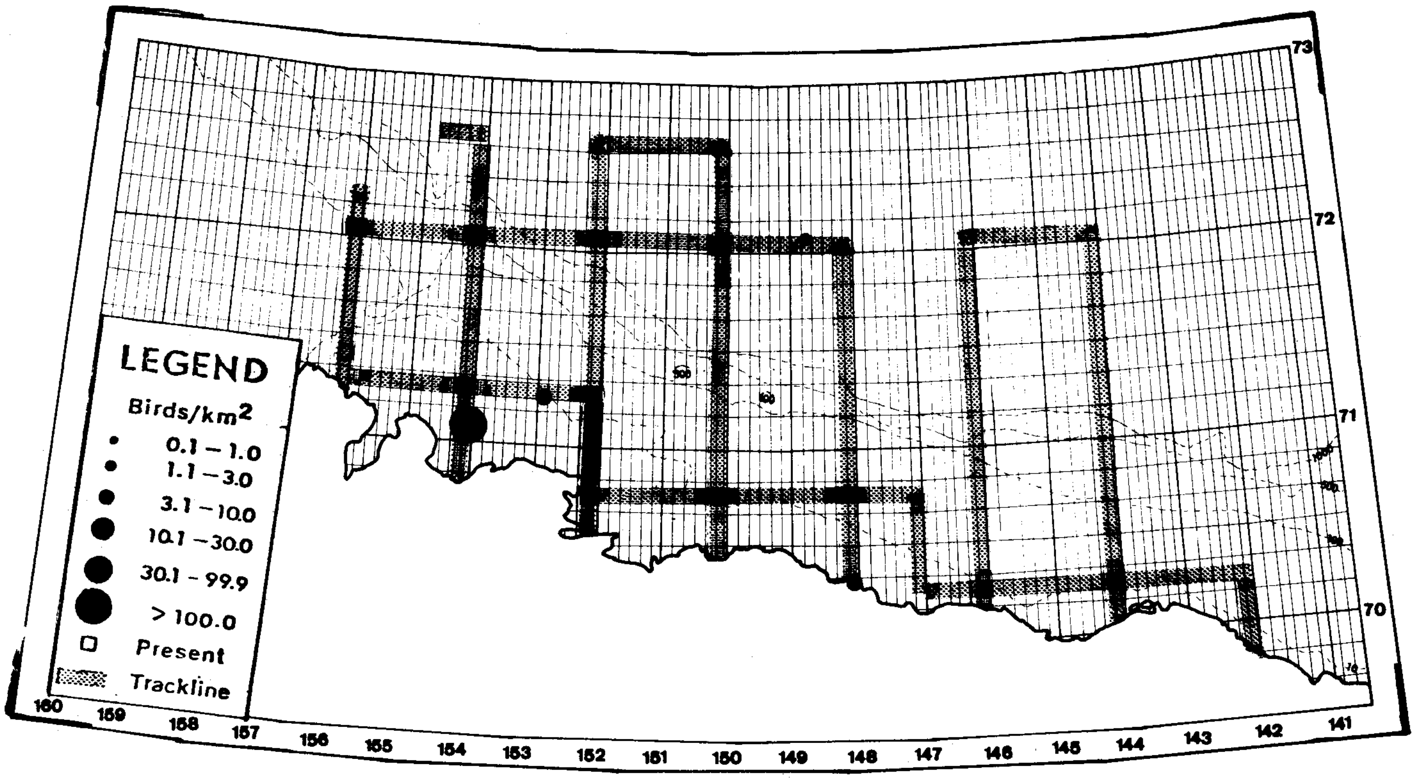

Figure 7. Distribution and abundance of eiders in the Beaufort Sea in July.

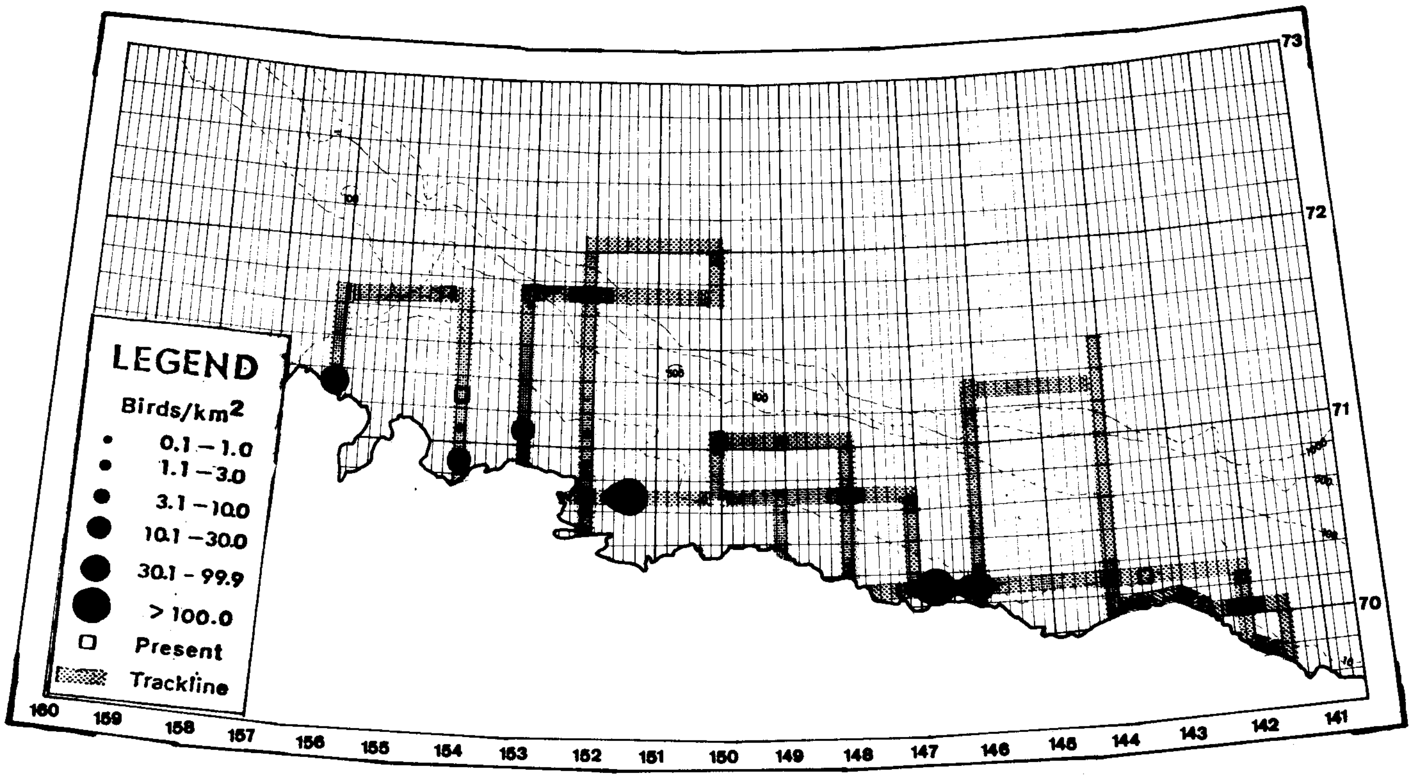

Figure 8. Distribution and abundance of eiders in the Beaufort Sea in August.

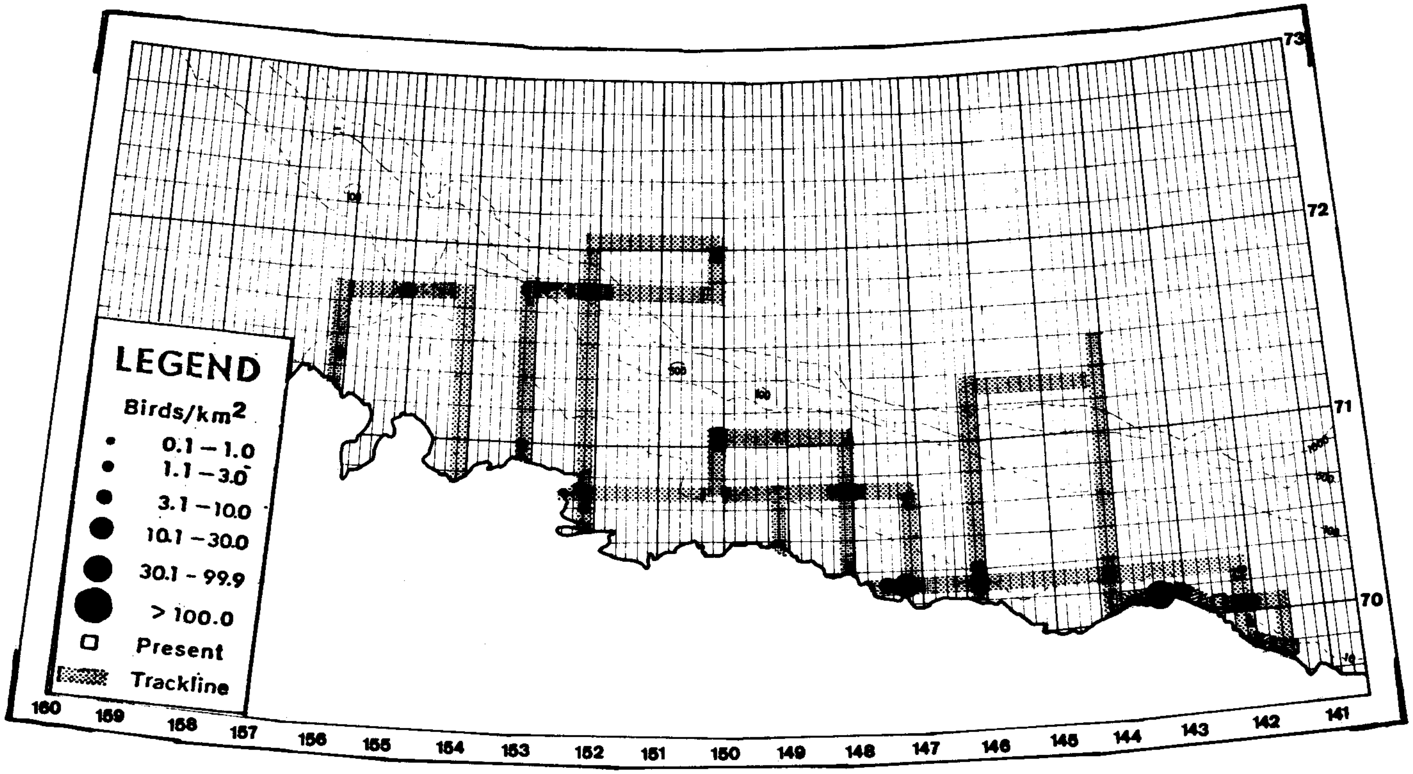

Figure 9. Distribution and abundance of phalaropes in the Beaufort Sea in August. No phalaropes observed in July.

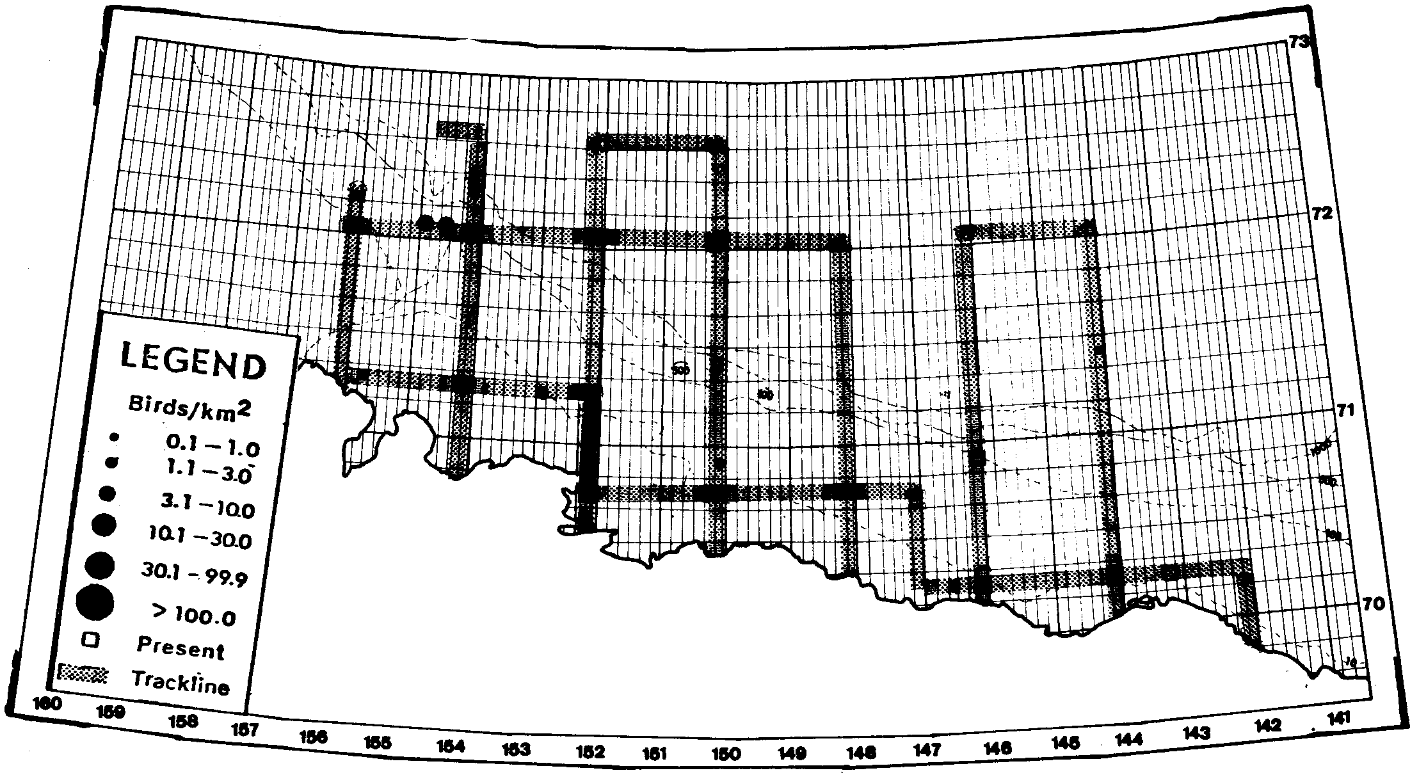

Figure 10. Distribution and abundance of jaegers in the Beaufort Sea in July.

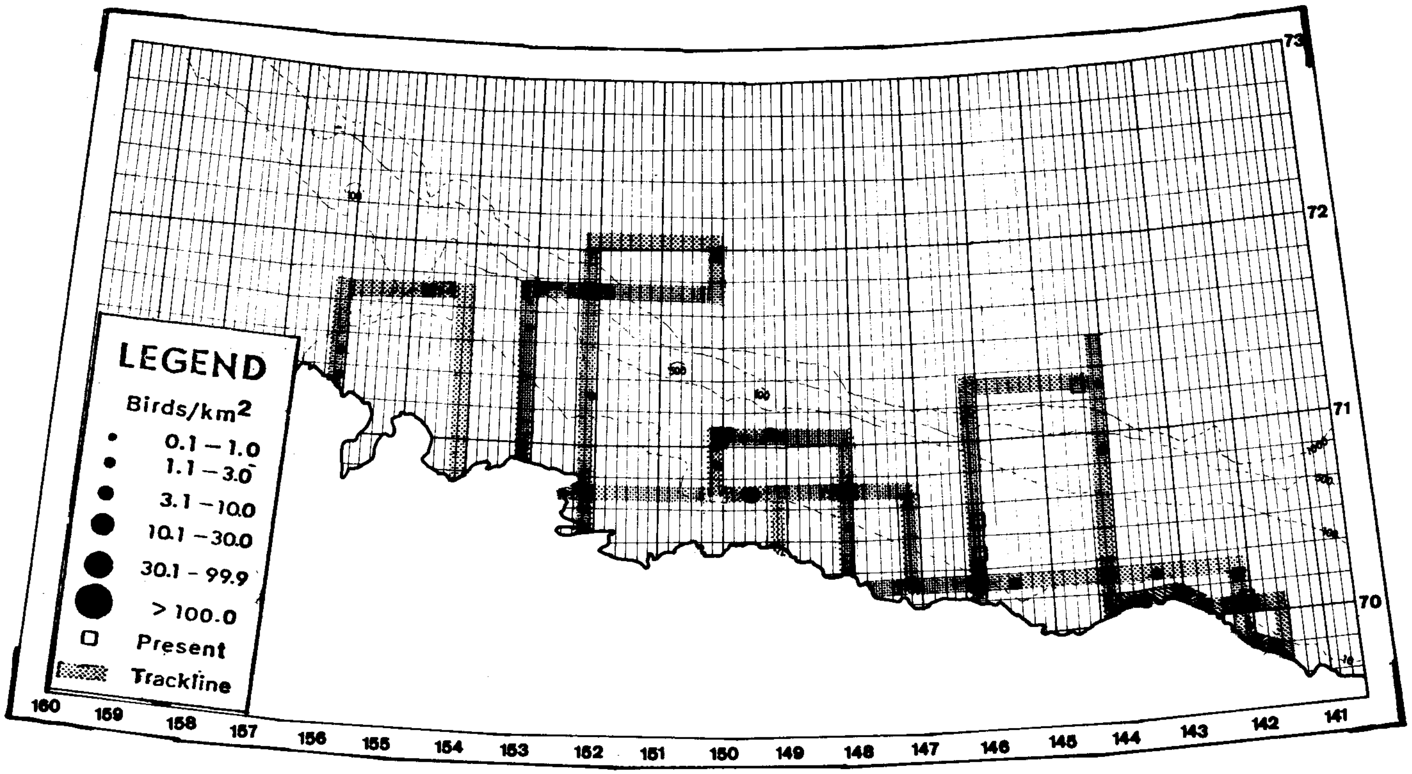

Figure 11. Distribution and abundance of jaegers in the Beaufort Sea in August.

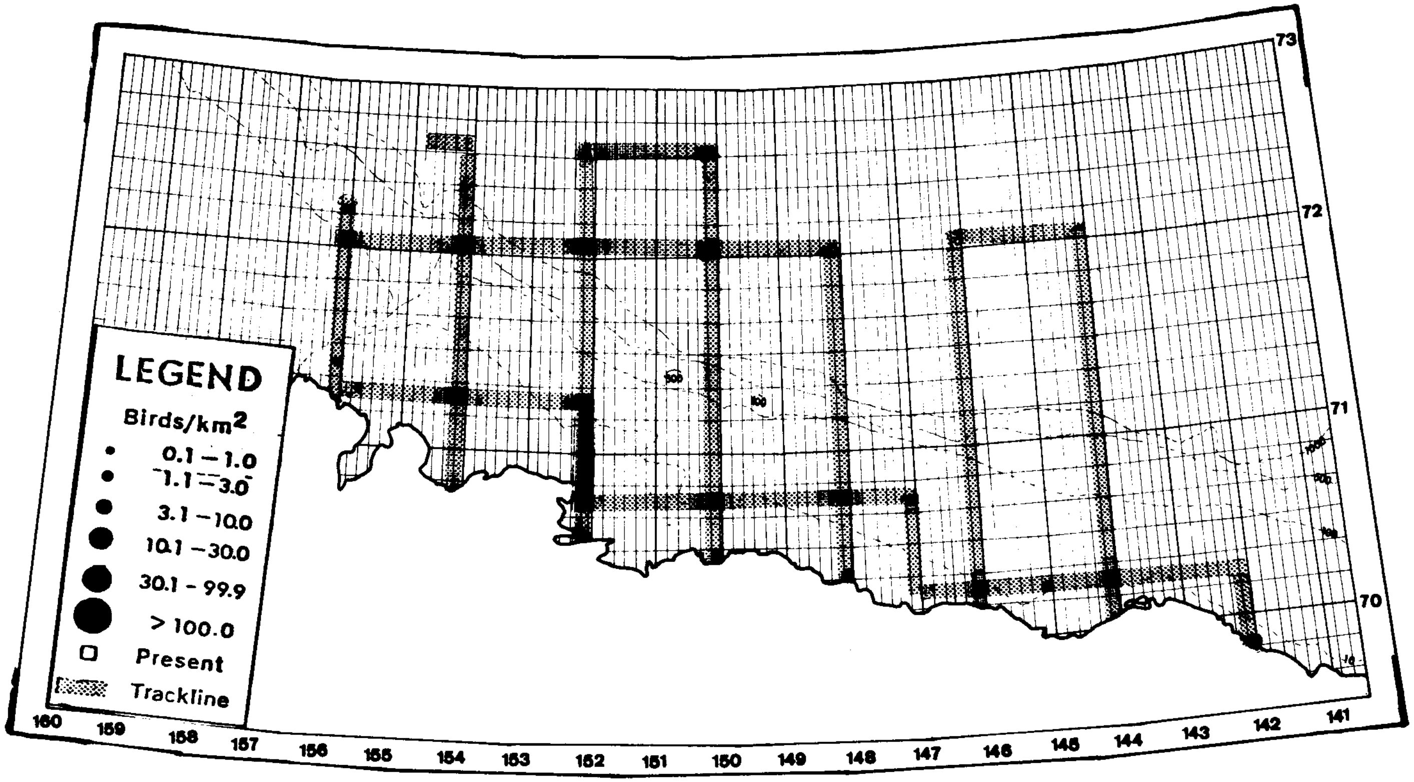

Figure 12. Distribution and abundance of glaucous gulls in the Beaufort Sea in July.

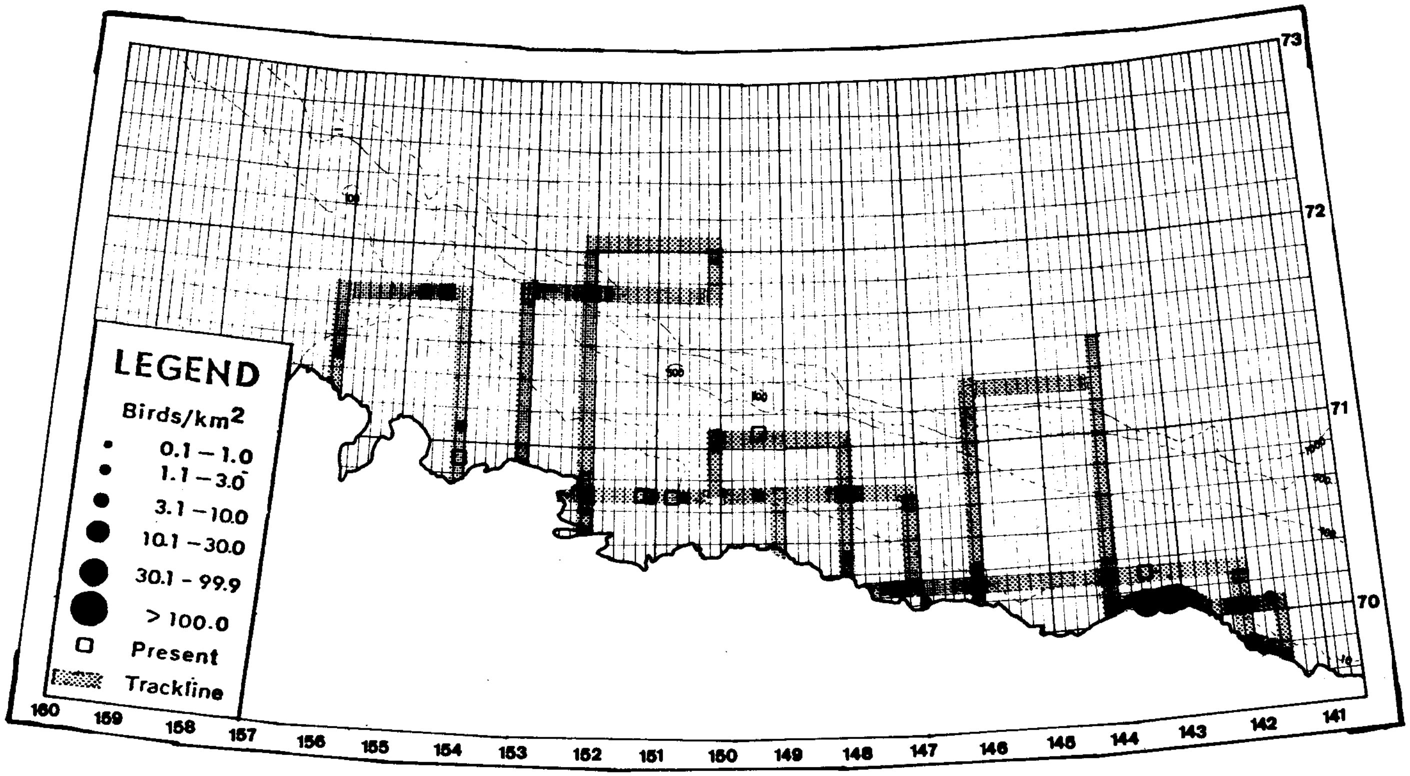

Figure 13. Distribution and abundance of glaucous gulls in the Beaufort Sea in August.

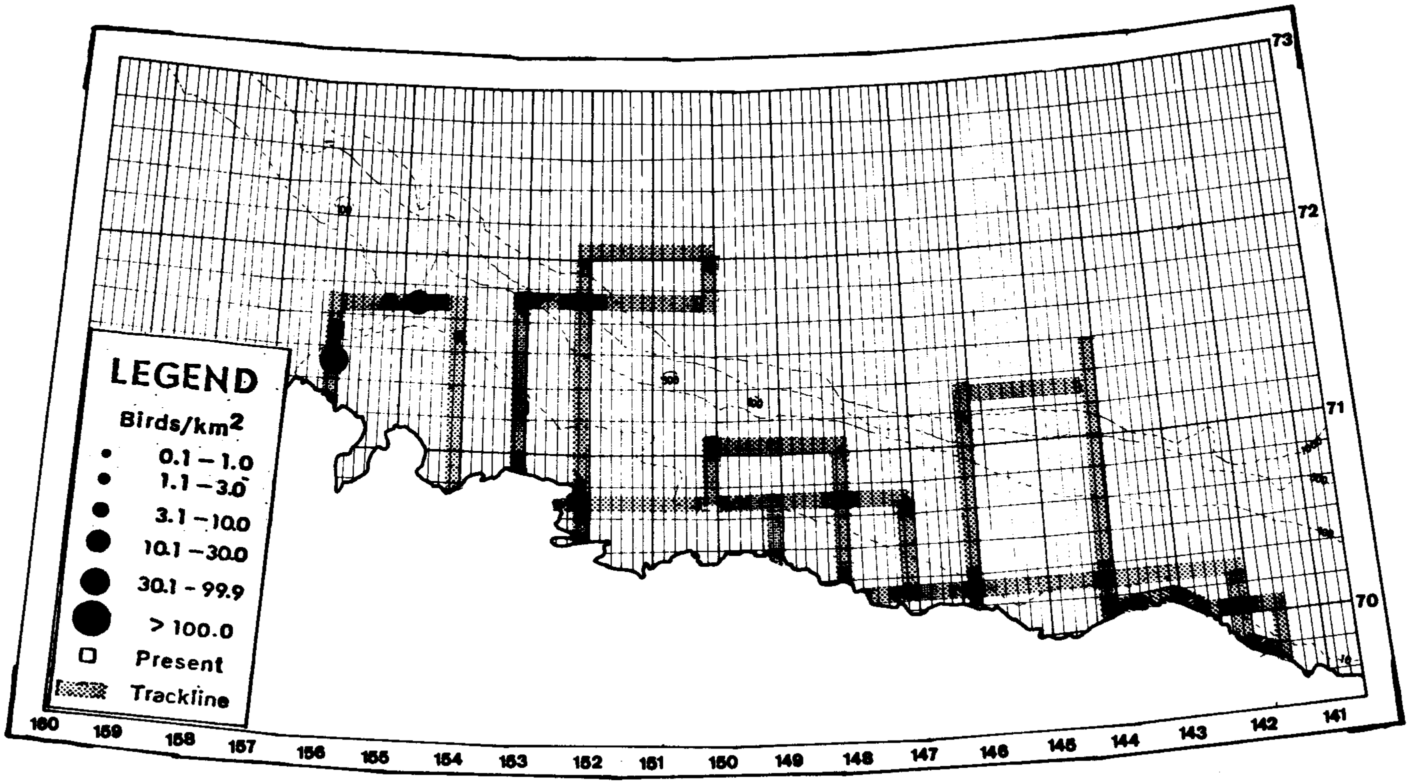

Figure 14. Distribution and abundance of black-legged kittiwakes in the Beaufort Sea in August. No black-legged kittiwakes were observed in July.

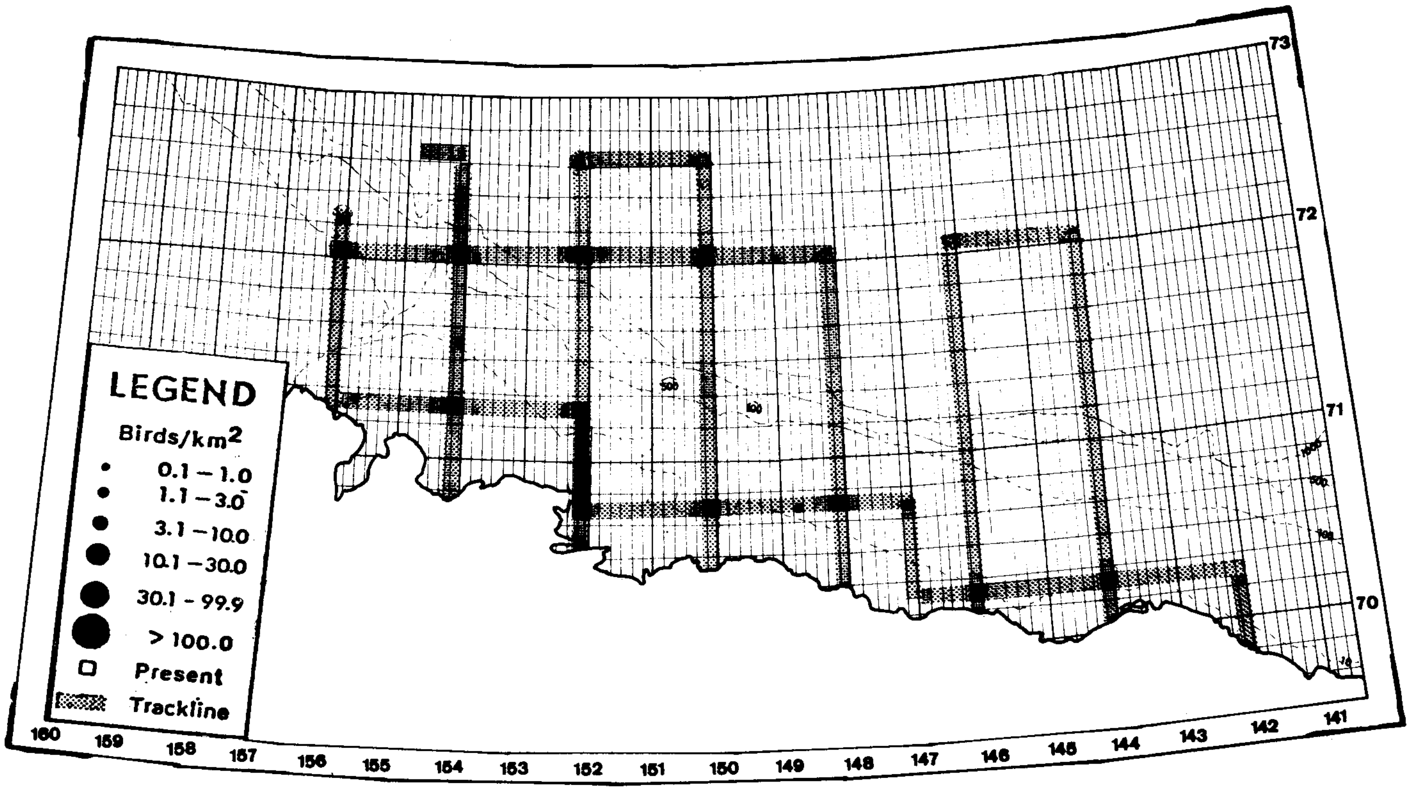

Figure 15. Distribution and abundance of slaty-backed gulls in the Beaufort Sea in July.

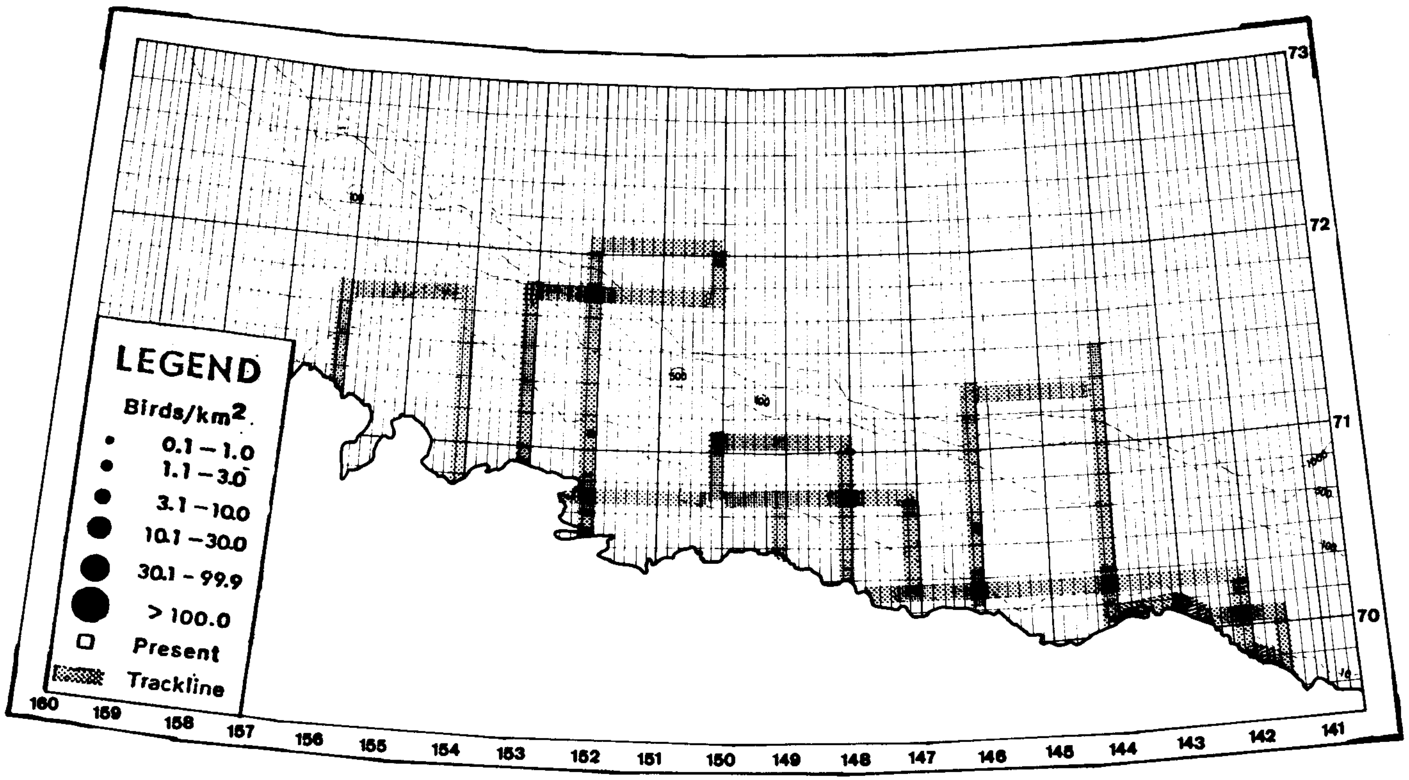

Figure 16. Distribution and abundance of slaty-backed gulls in the Beaufort Sea in August.

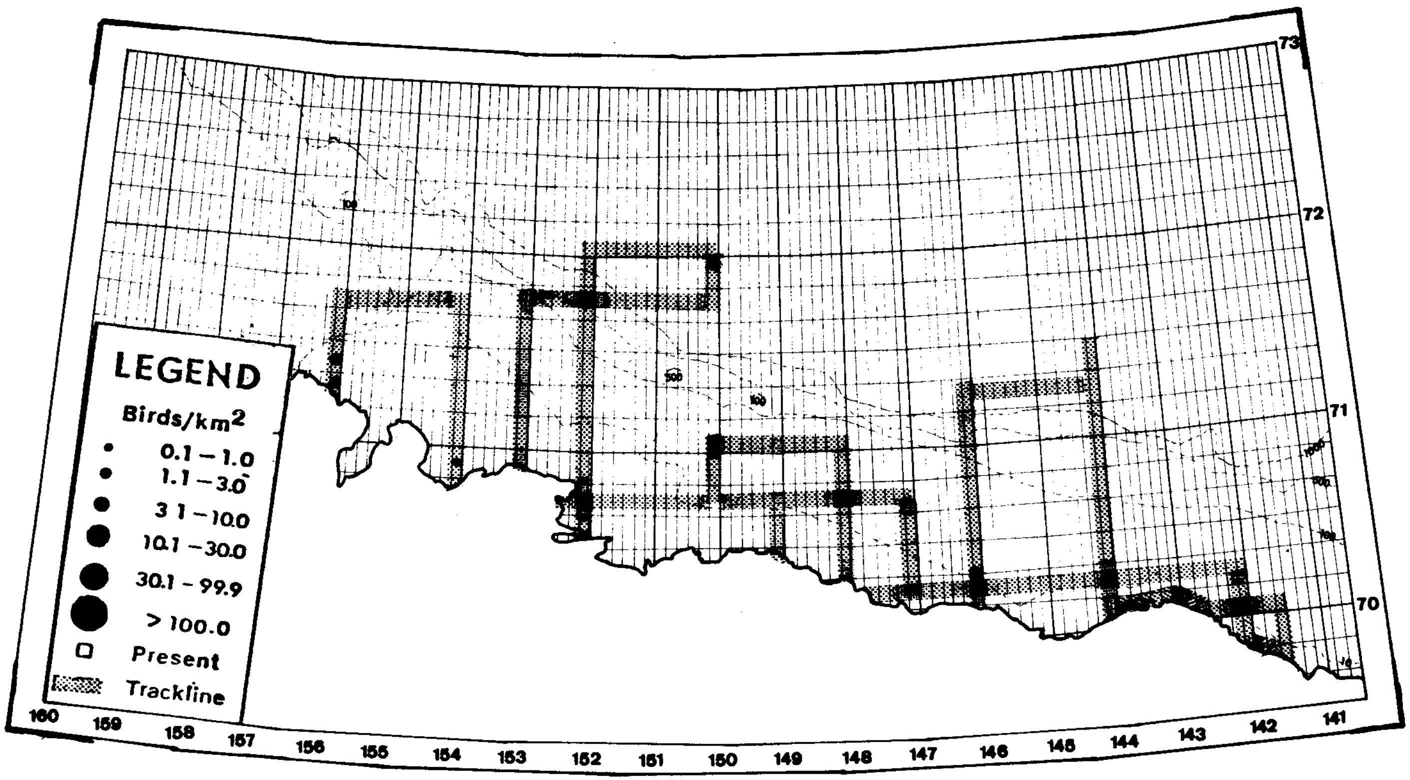

Figure 17. Distribution and abundance of Sabine's gulls in the Beaufort Sea in August. No Sabine's gulls were observed in July.

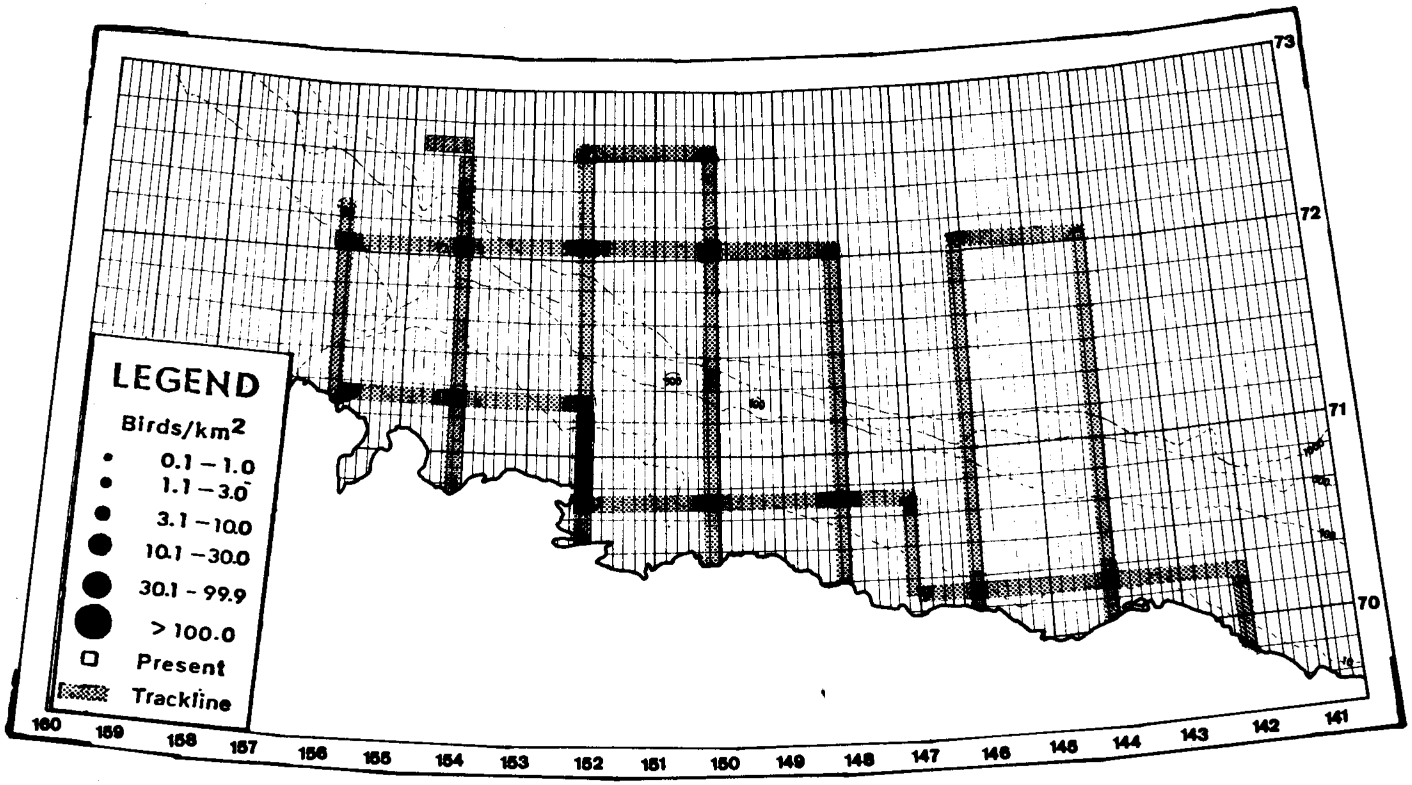

Figure 18. Distribution and abundance of arctic terns in the Beaufort Sea in July.

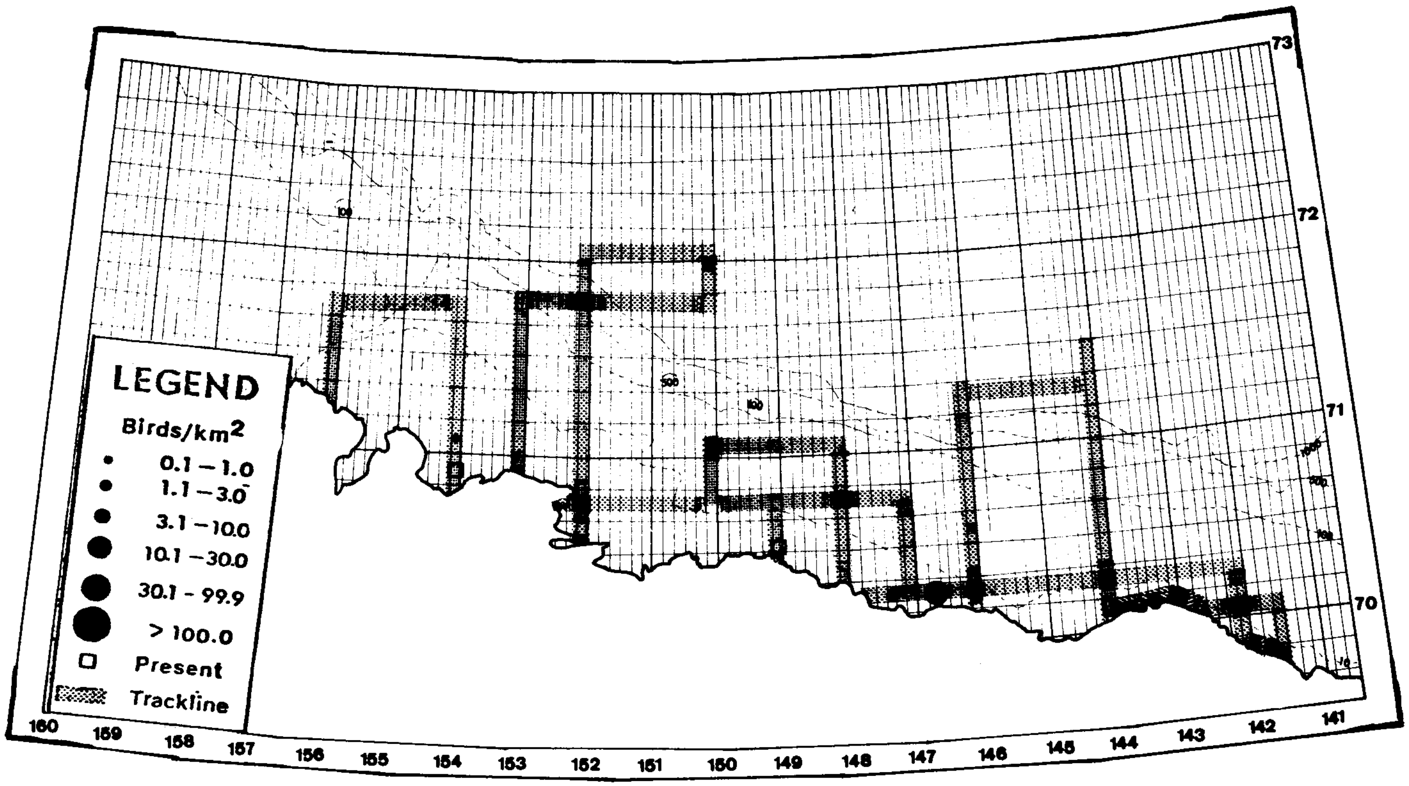

Figure 19. Distribution and abundance of arctic terns in the Beaufort Sea in August.

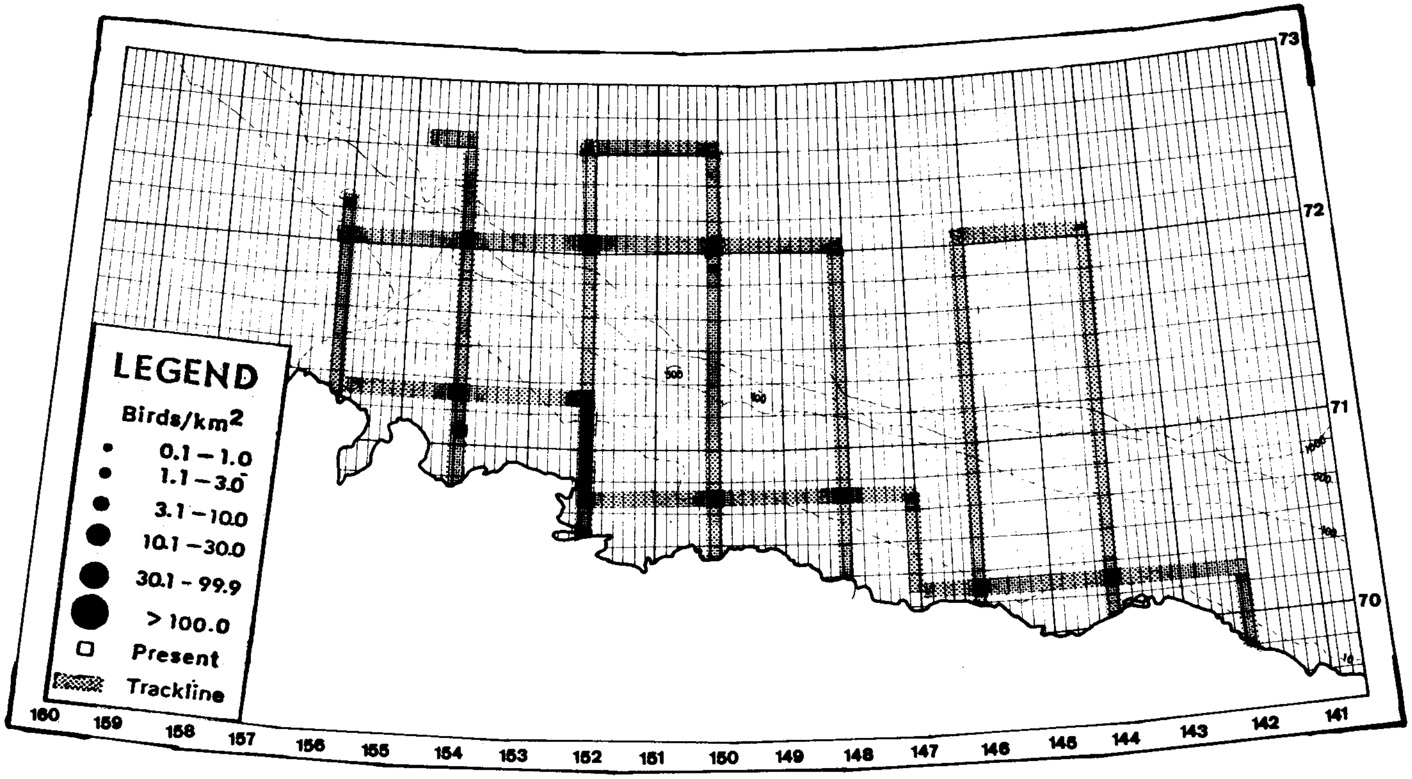

Figure 20. Distribution and abundance of murres in the Beaufort Sea in July. No murres were observed in August.

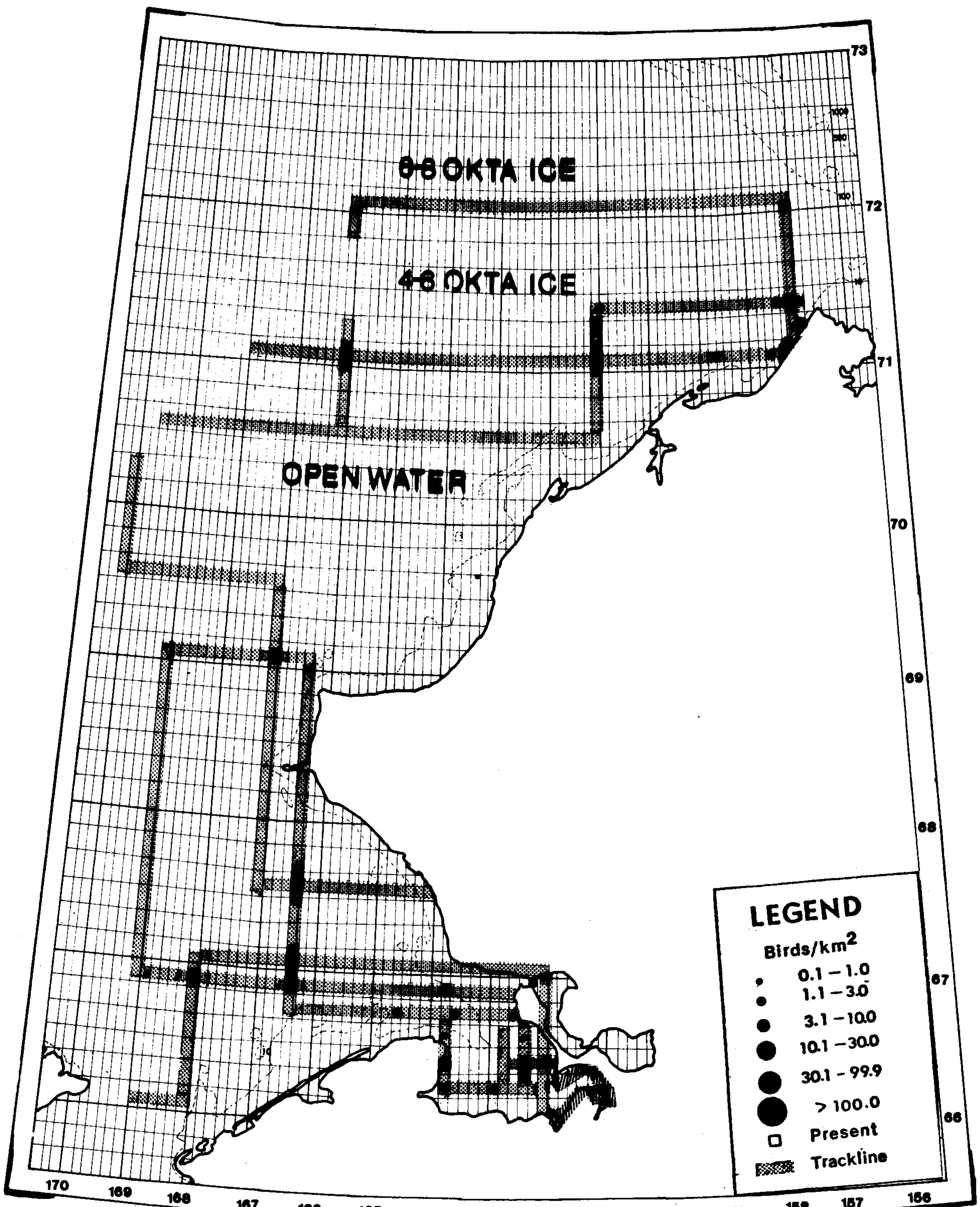

Figure 21. Distribution and abundance of loons in the Chukchi Sea in August. No loons were observed in June.

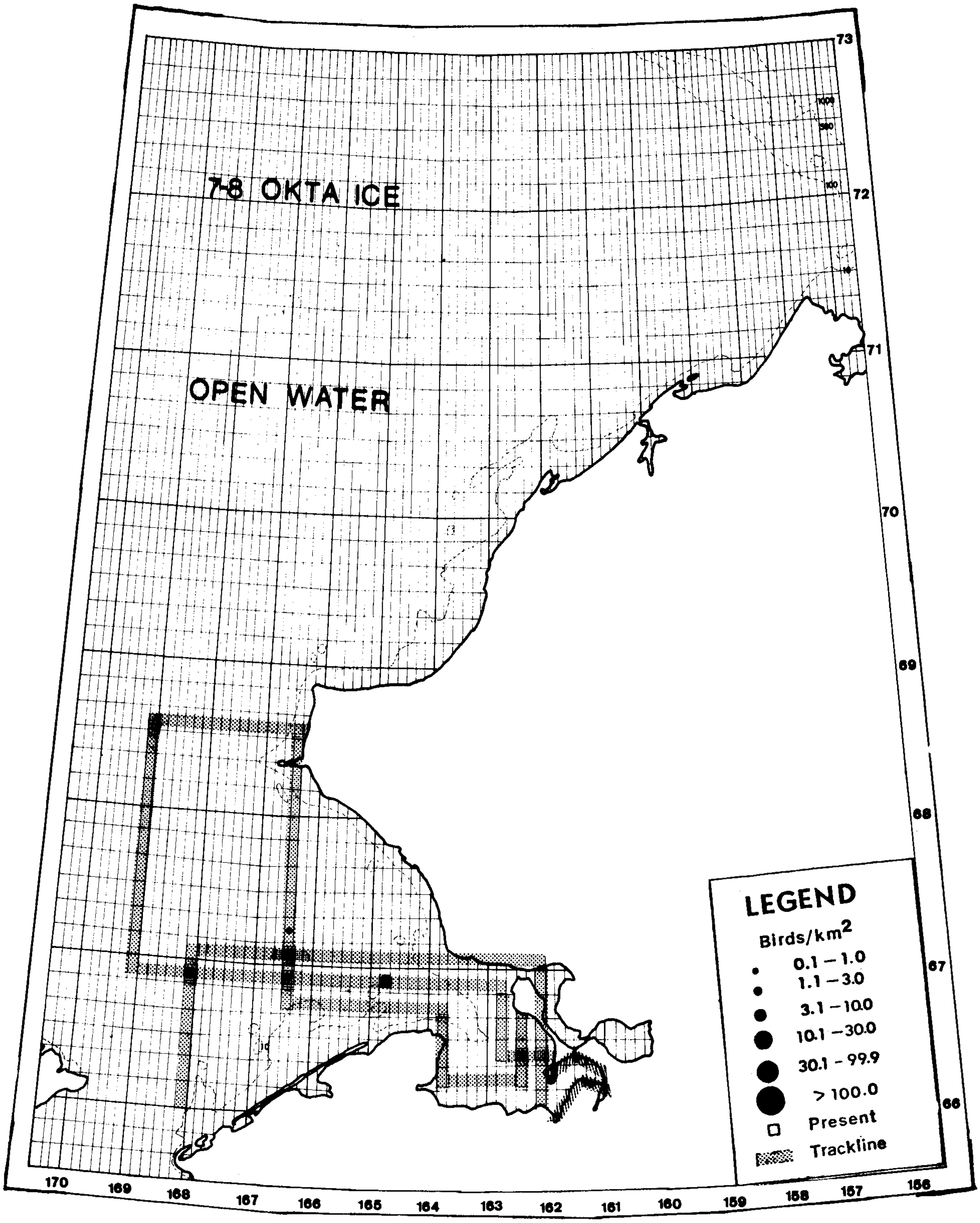

Figure 22. Distribution and abundance of loons in the Chukchi Sea in October.

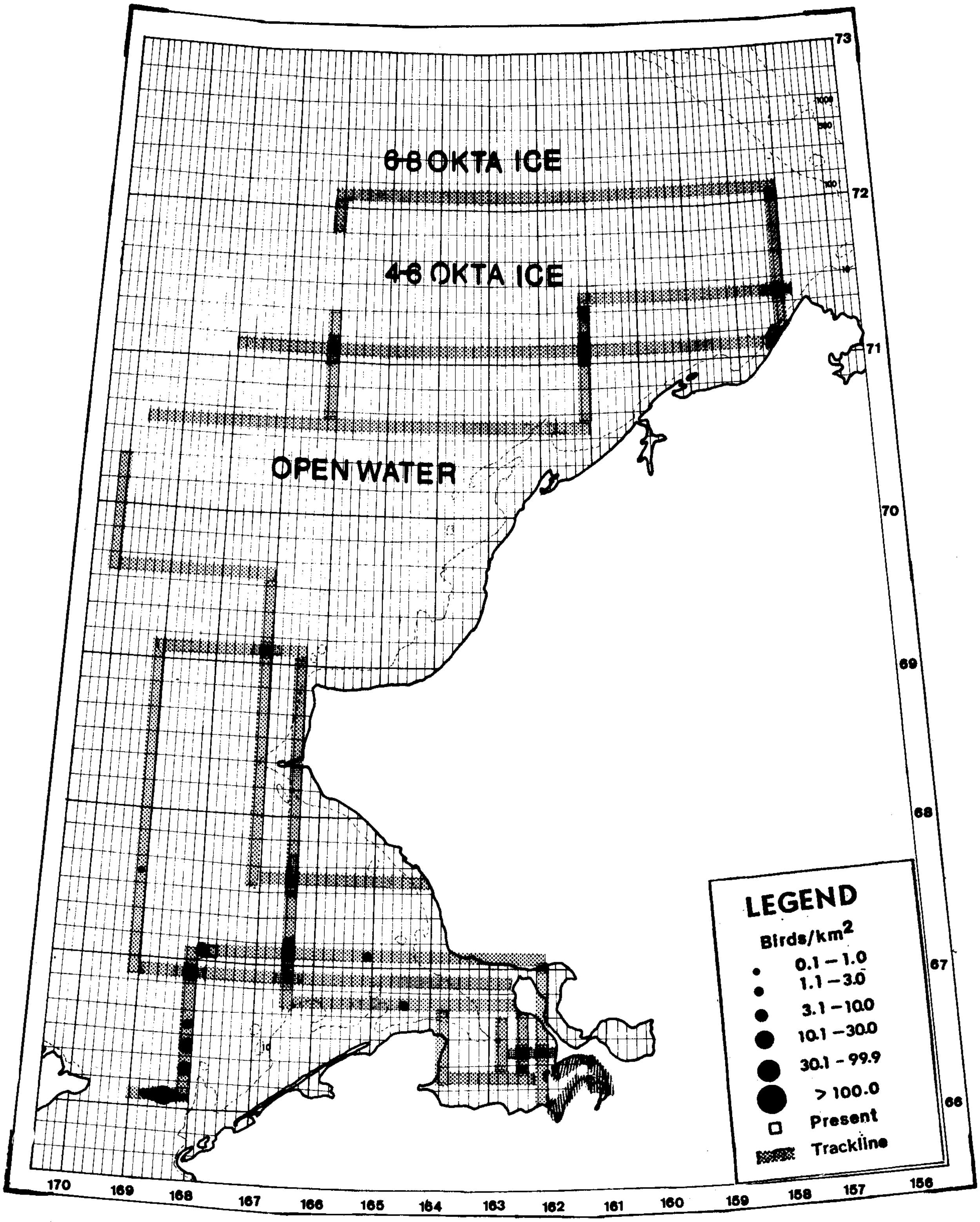

Figure 23. Distribution and abundance of shearwaters in the Chukchi Sea in August. No shearwaters were observed in June.

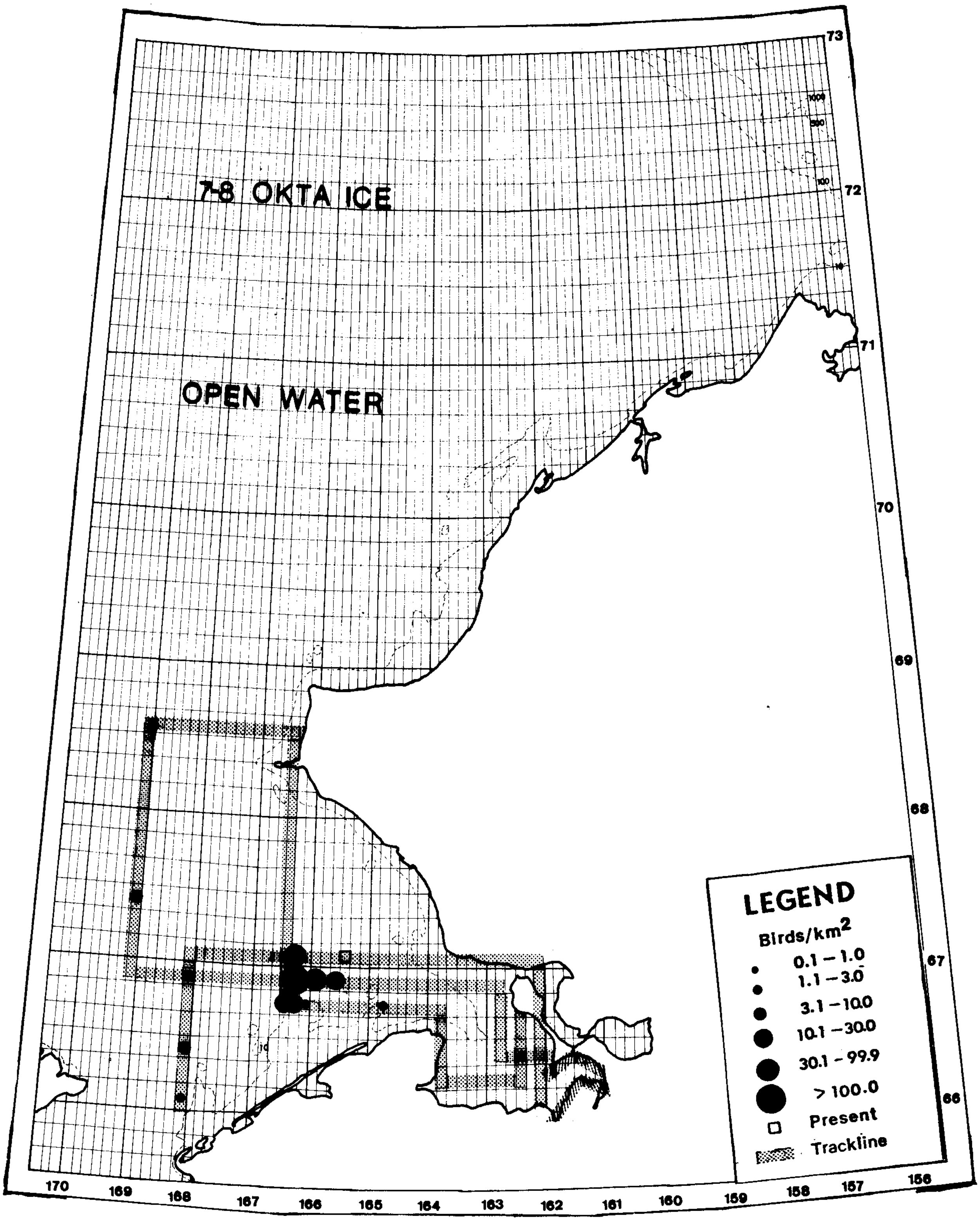

Figure 24. Distribution and abundance of shearwaters in the Chukchi Sea in October.

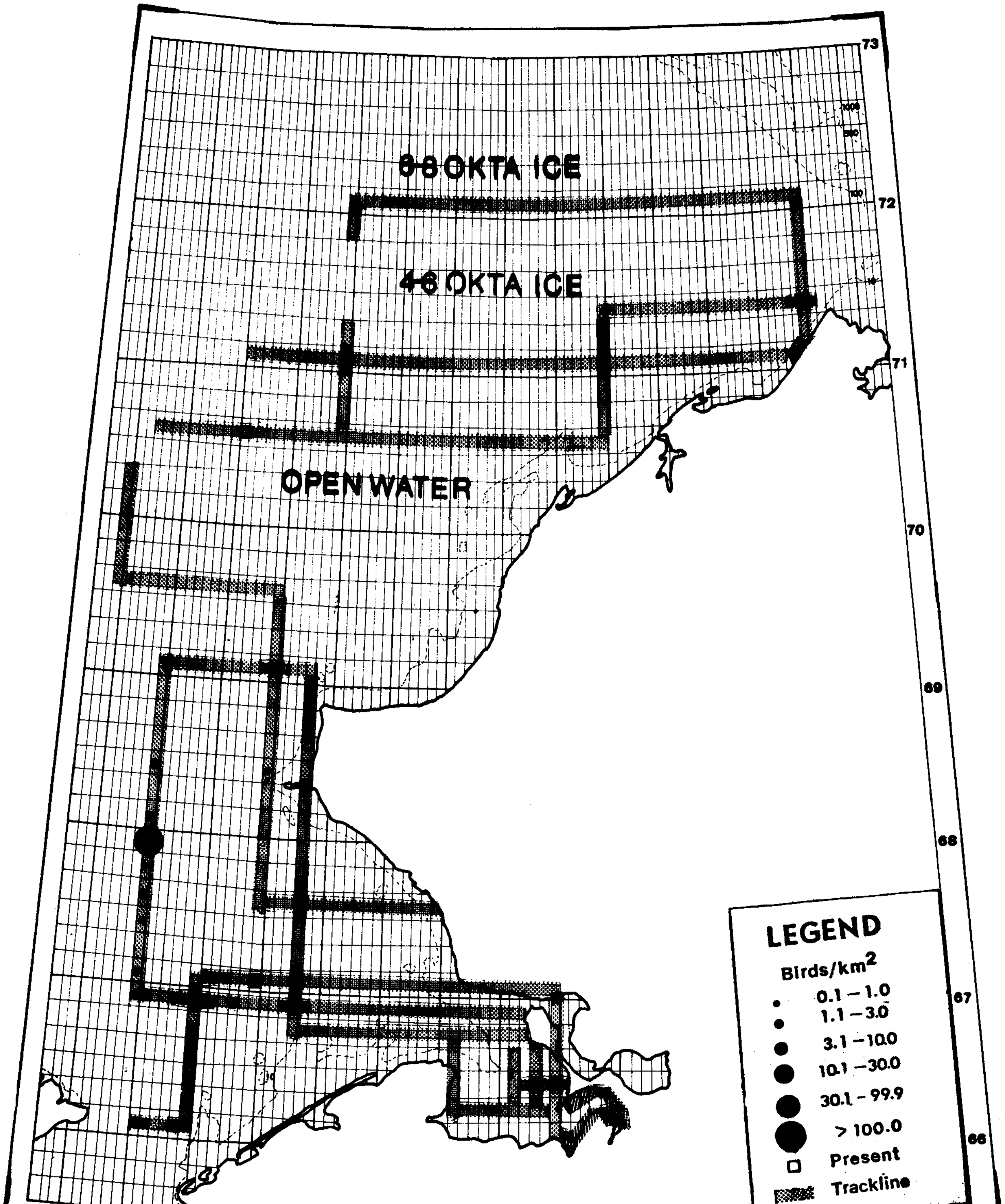

Figure 25. Distribution and abundance of fulmars in the Chukchi Sea in August. No fulmars were observed in June.

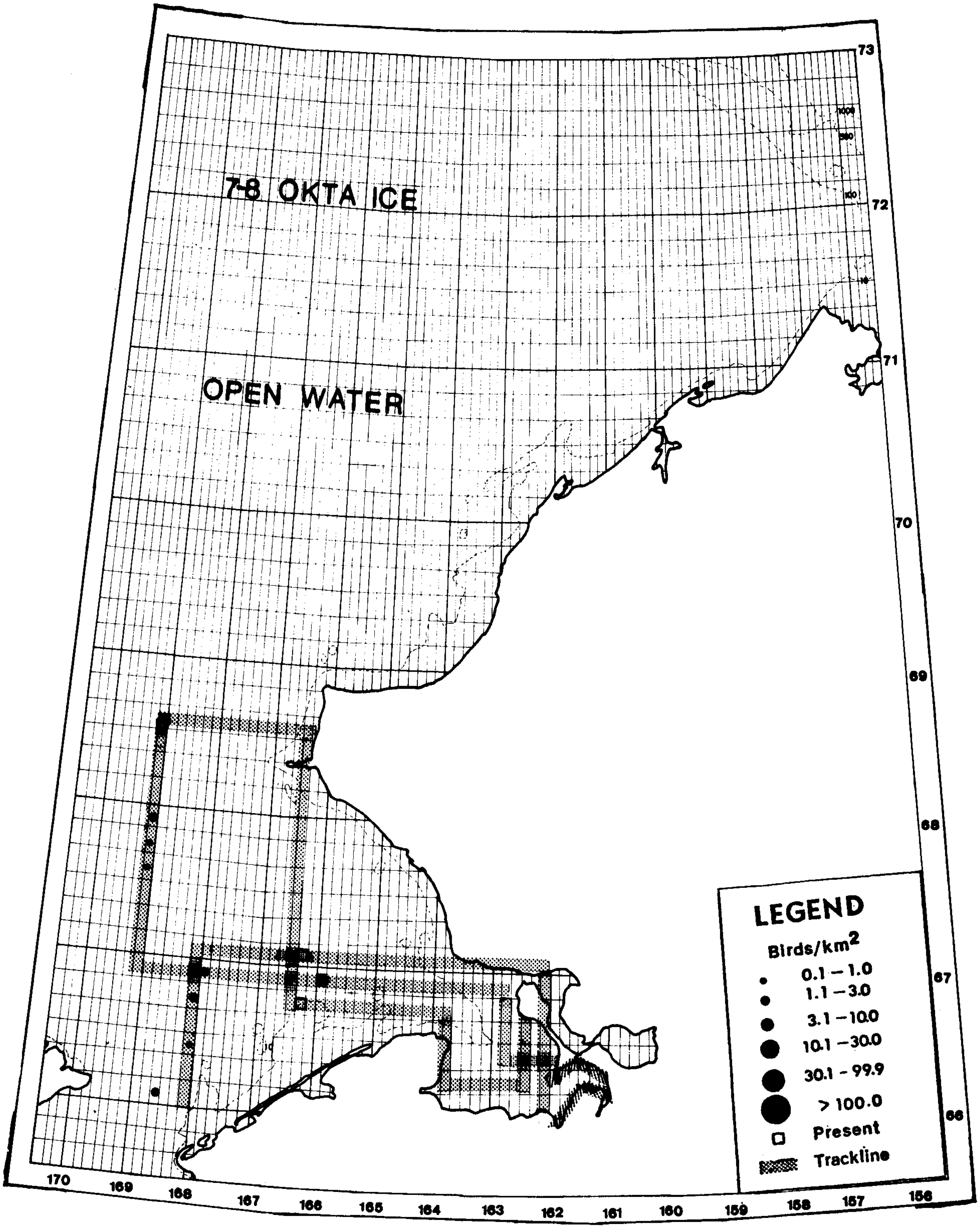

Figure 26. Distribution and abundance of fulmars in the Chukchi Sea in October.

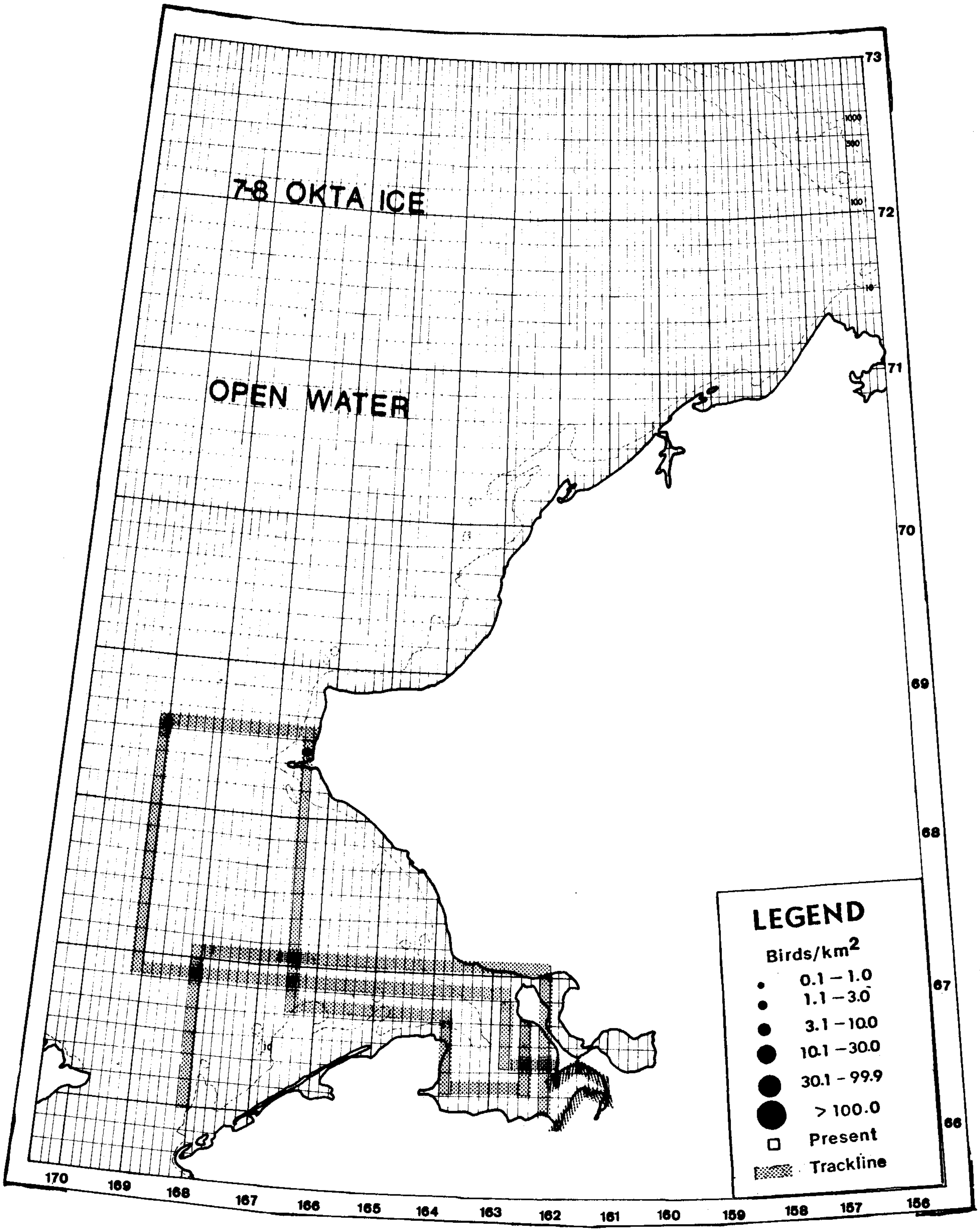

Figure 27. Distribution and abundance of cormorants in the Chukchi Sea in October. No cormorants were observed in June or August.

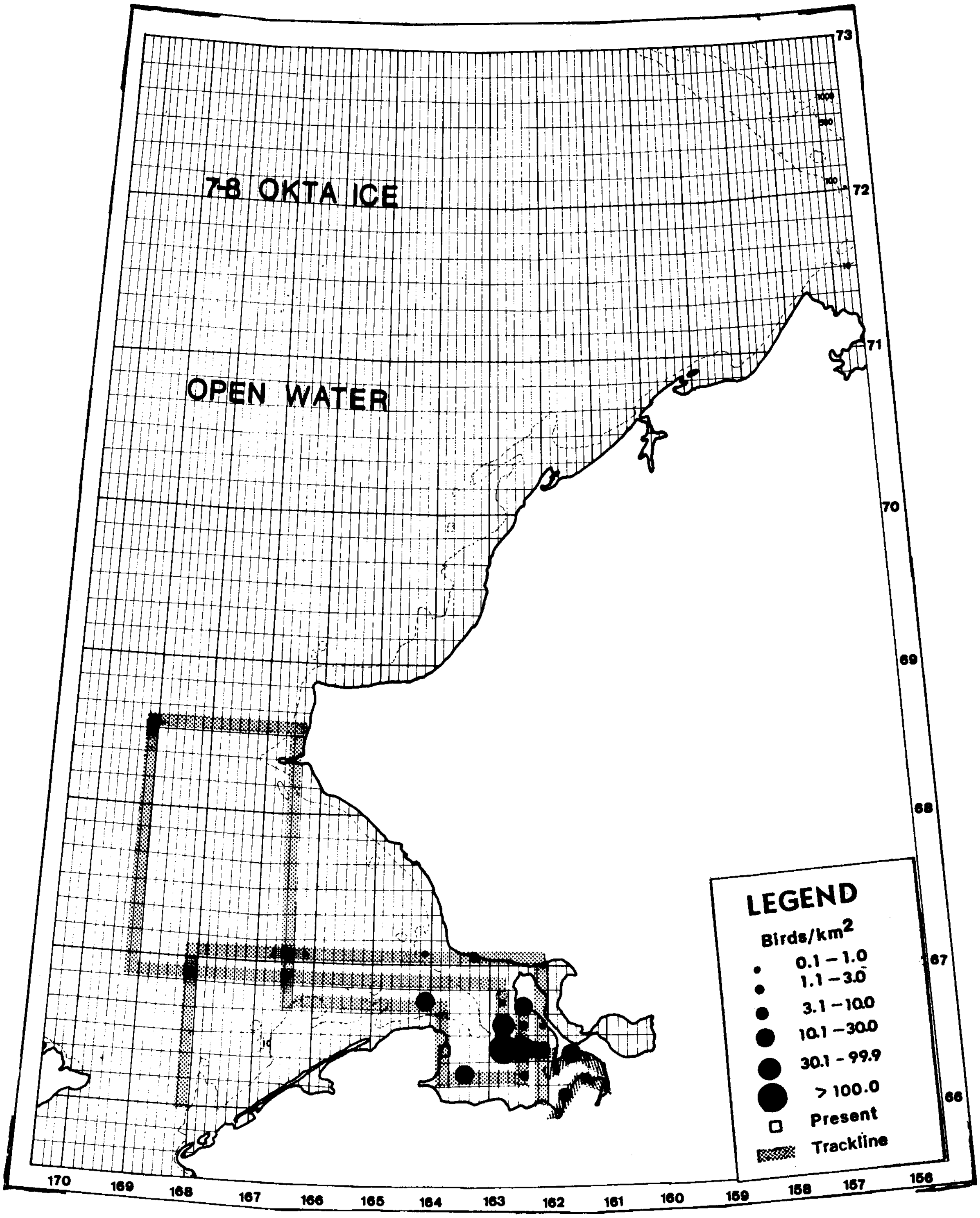

Figure 28. Distribution and abundance of oldsquaw in the Chukchi Sea in October. No oldsquaw were observed in June or August.

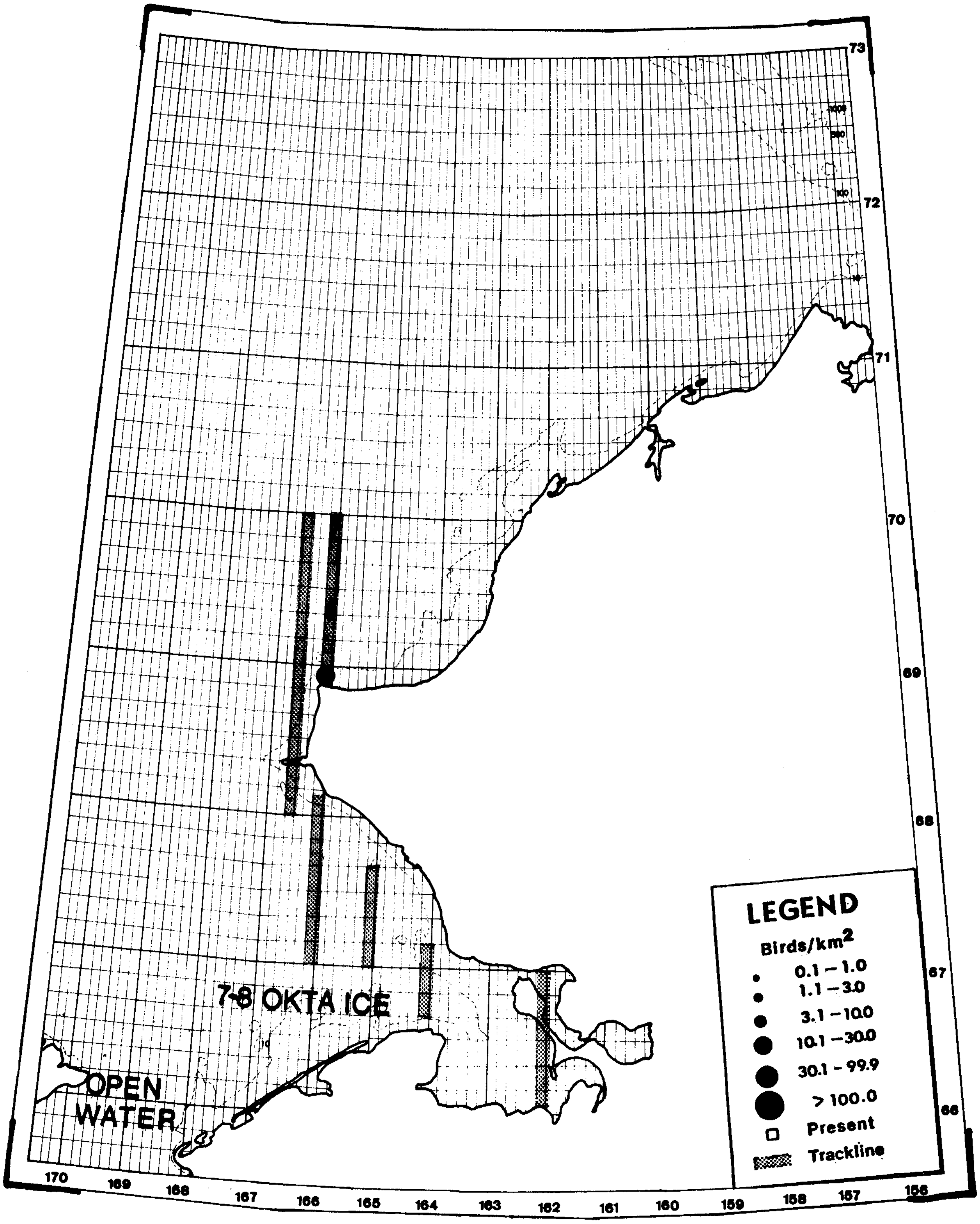

Figure 29. Distribution and abundance of eiders in the Chukchi Sea in June.

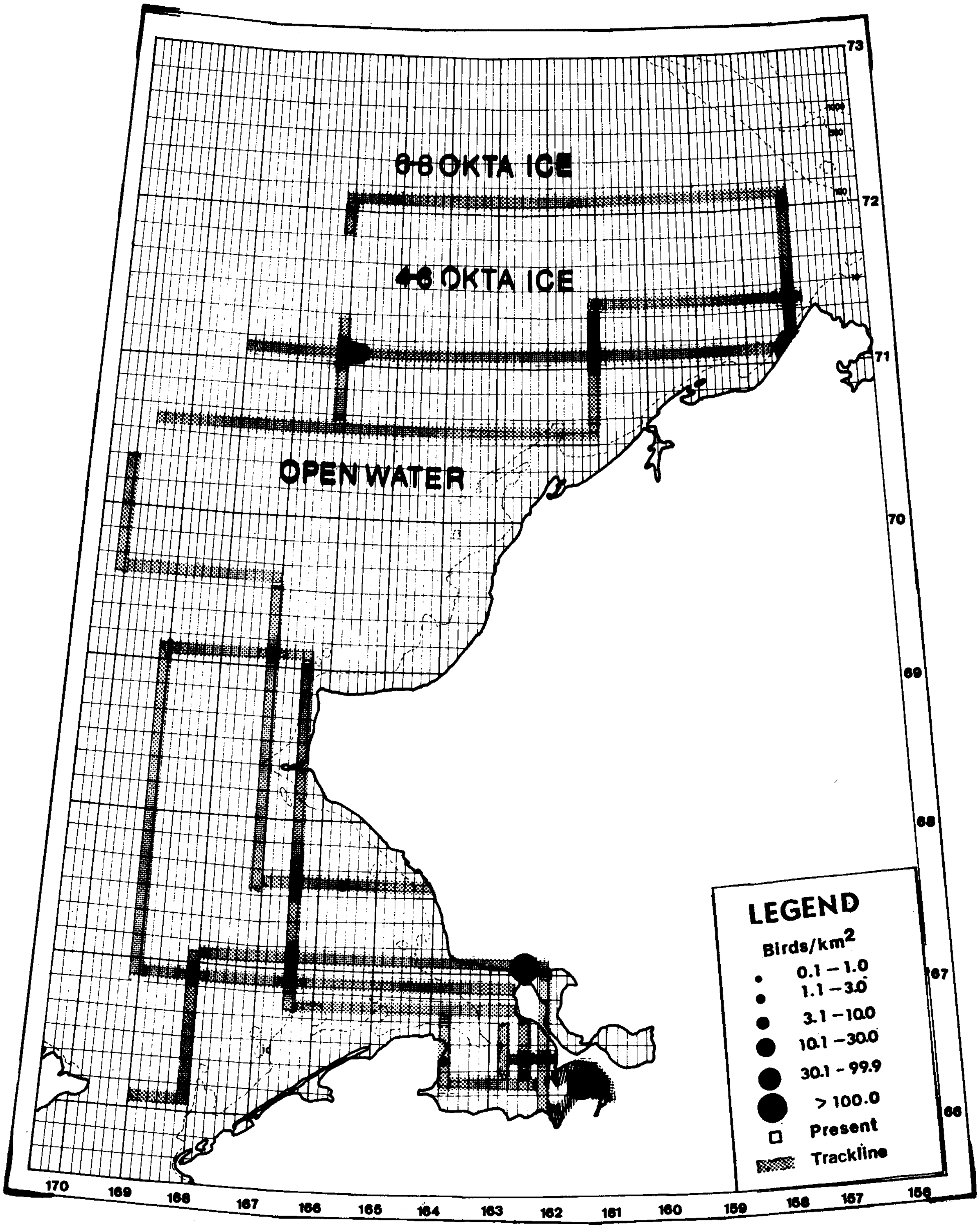

Figure 30. Distribution and abundance of eiders in the Chukchi Sea in August.

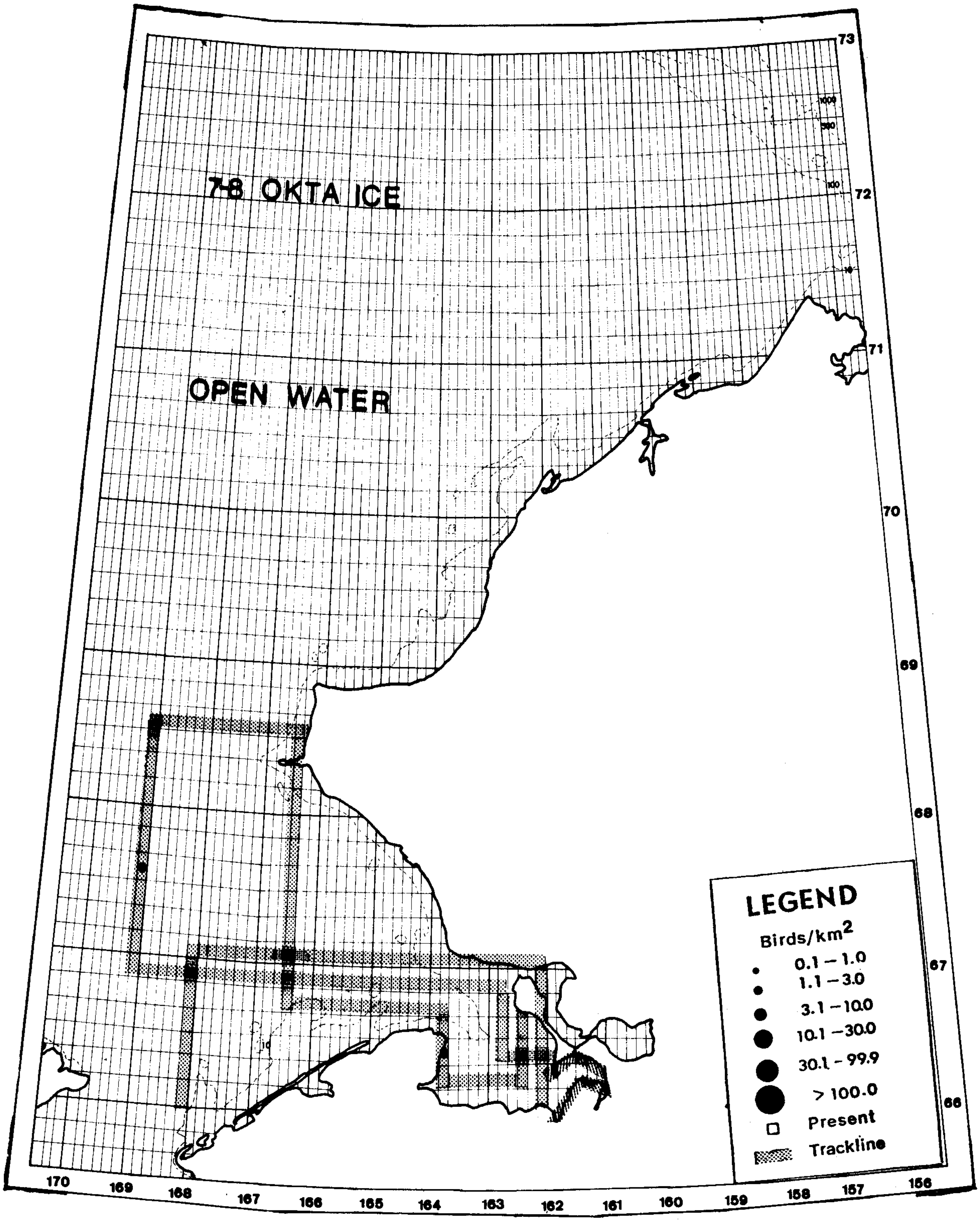

Figure 31. Distribution and abundance of eiders in the Chukchi Sea in October.

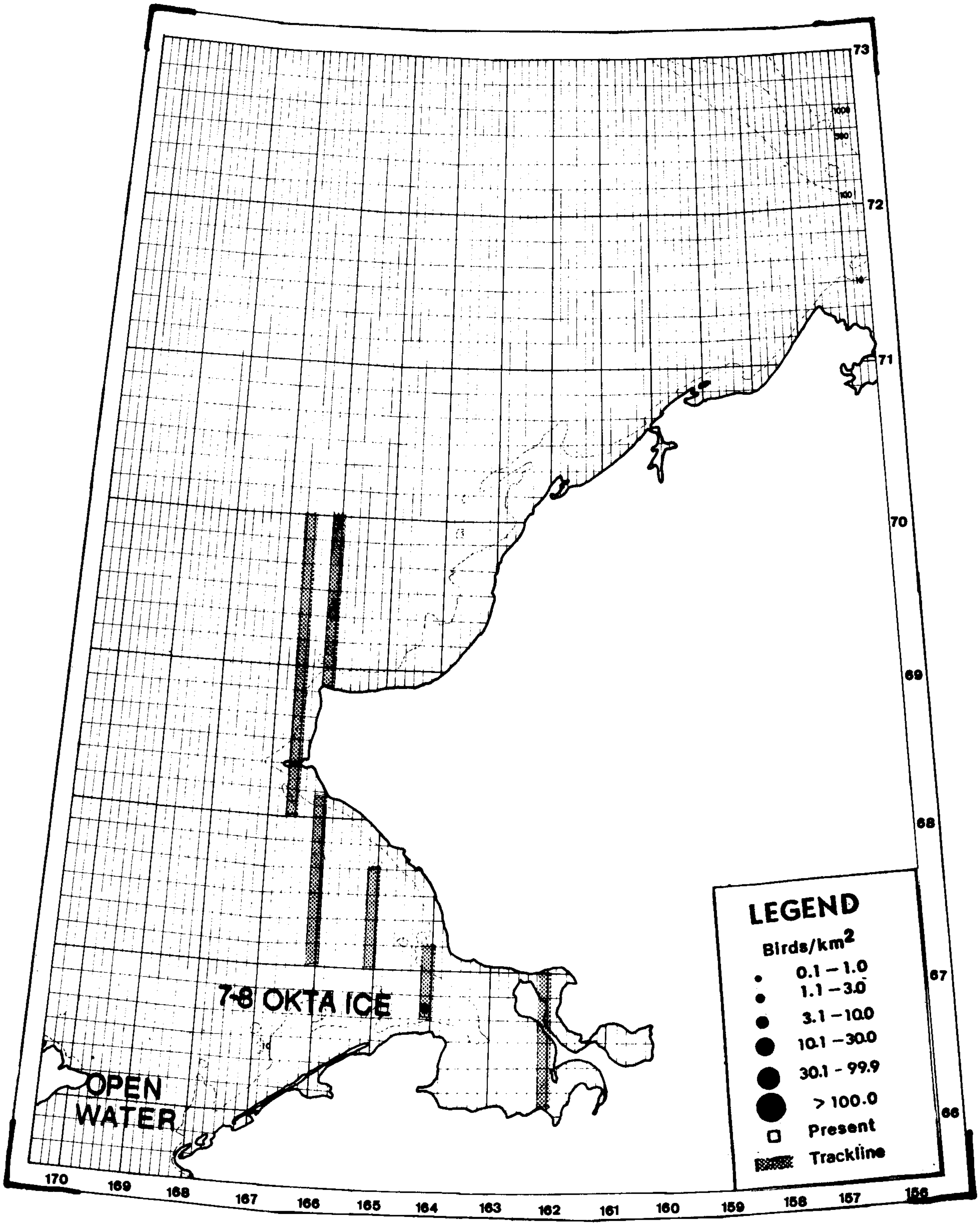

Figure 32. Distribution and abundance of scoters in the Chukchi Sea in June.

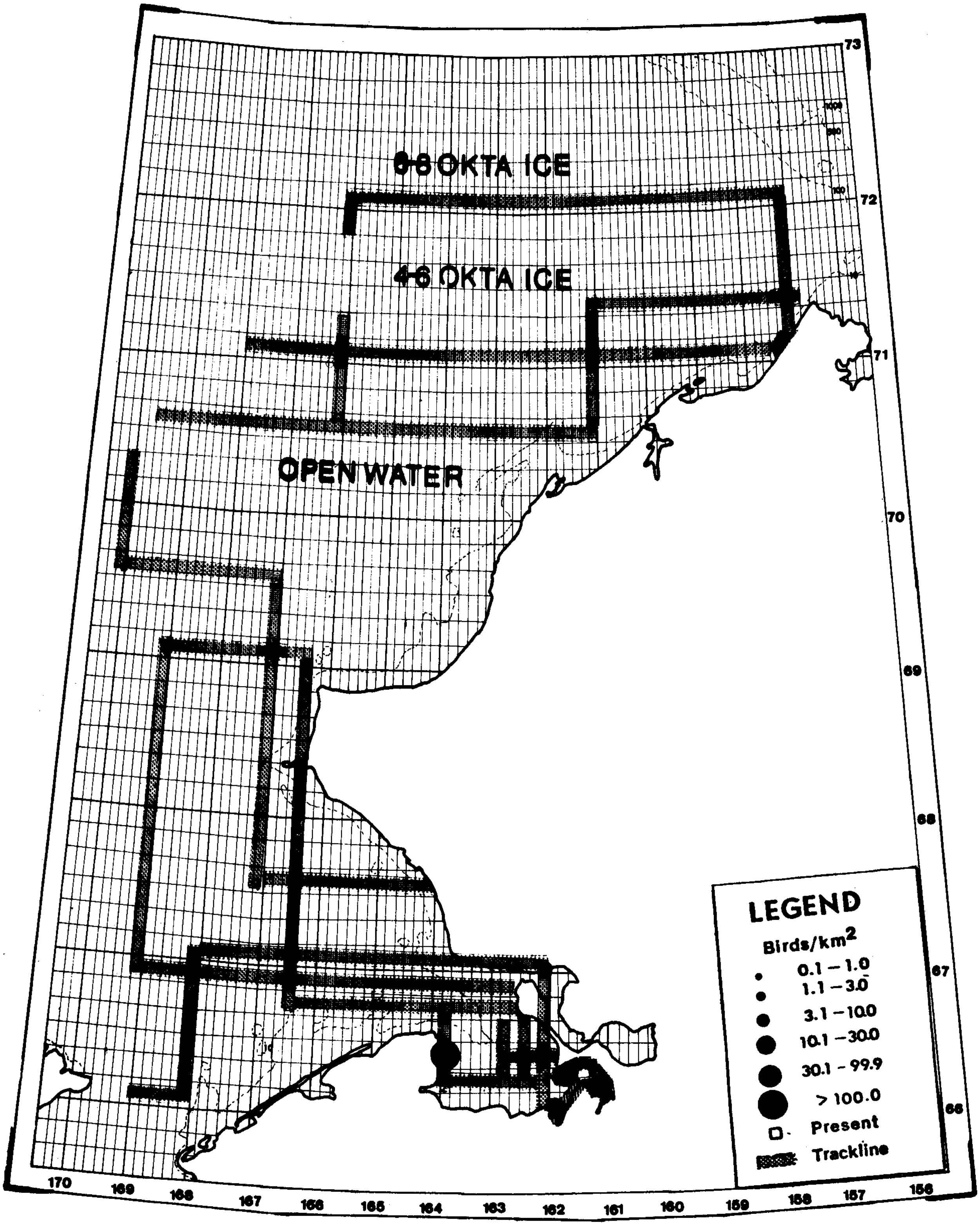

Figure 33. Distribution and abundance of scoters in the Chukchi Sea in August.

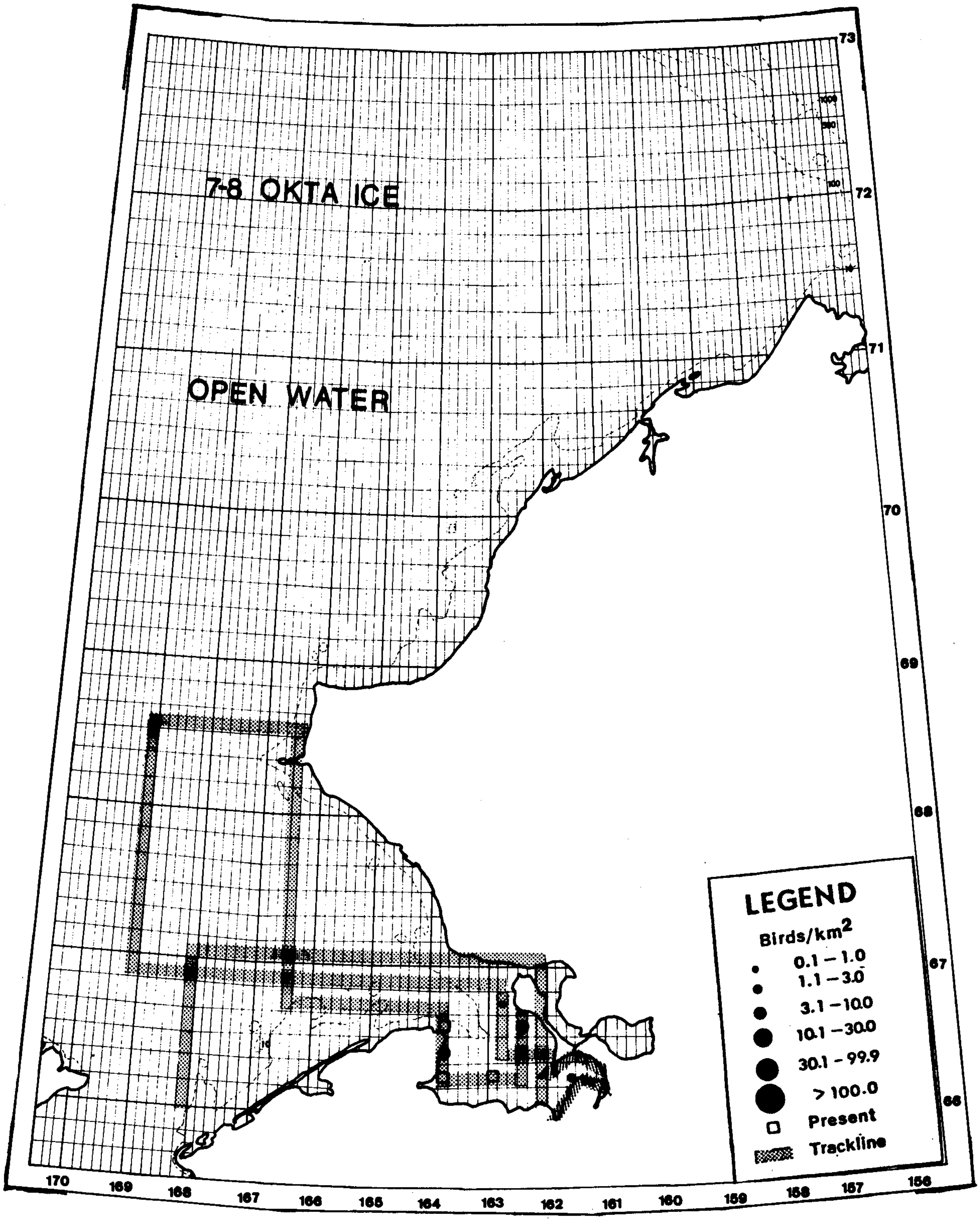

Figure 34. Distribution and abundance of scoters in the Chukchi Sea in October.

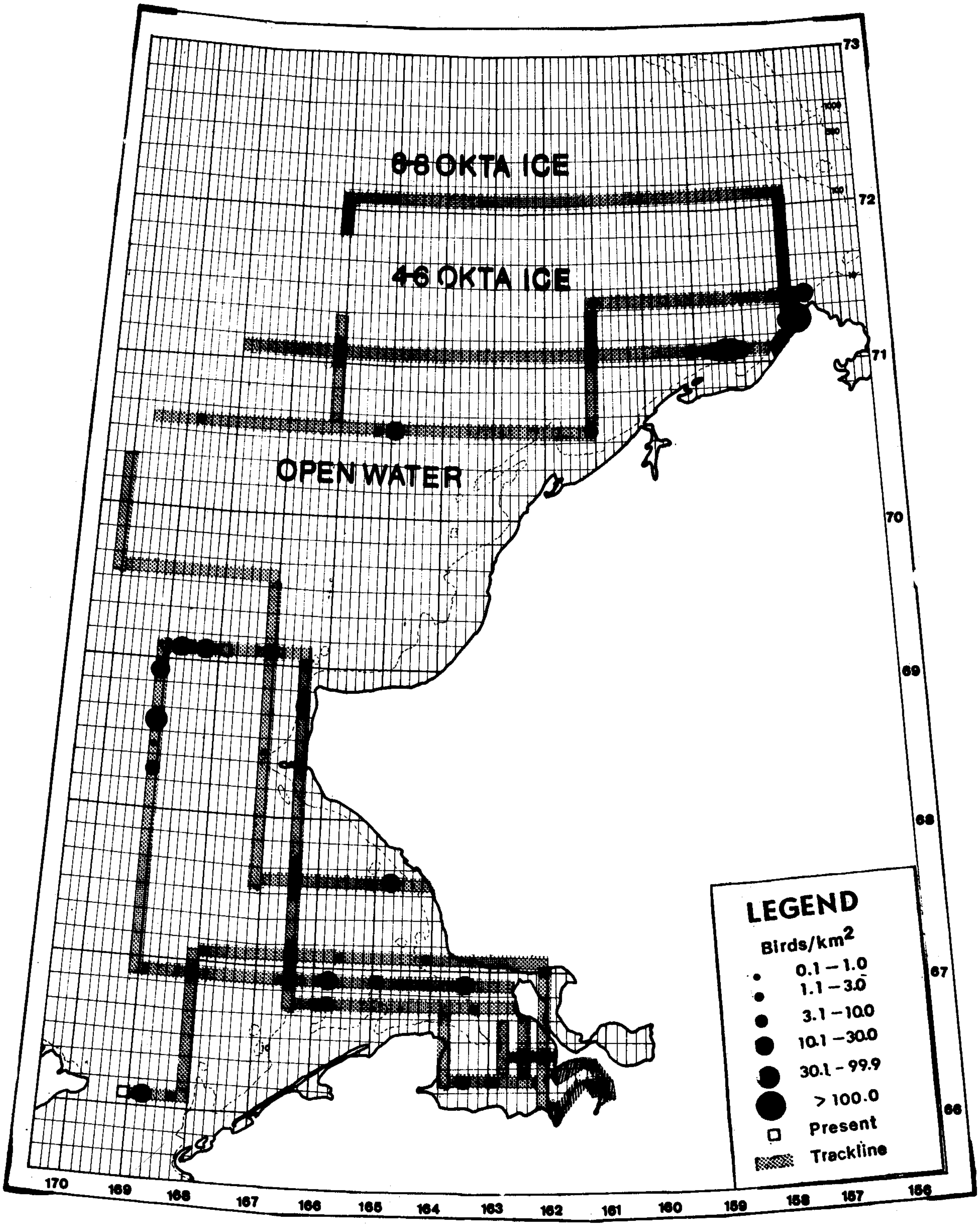

Figure 35. Distribution and abundance of phalaropes in the Chukchi Sea in August. No phalaropes were observed in June.

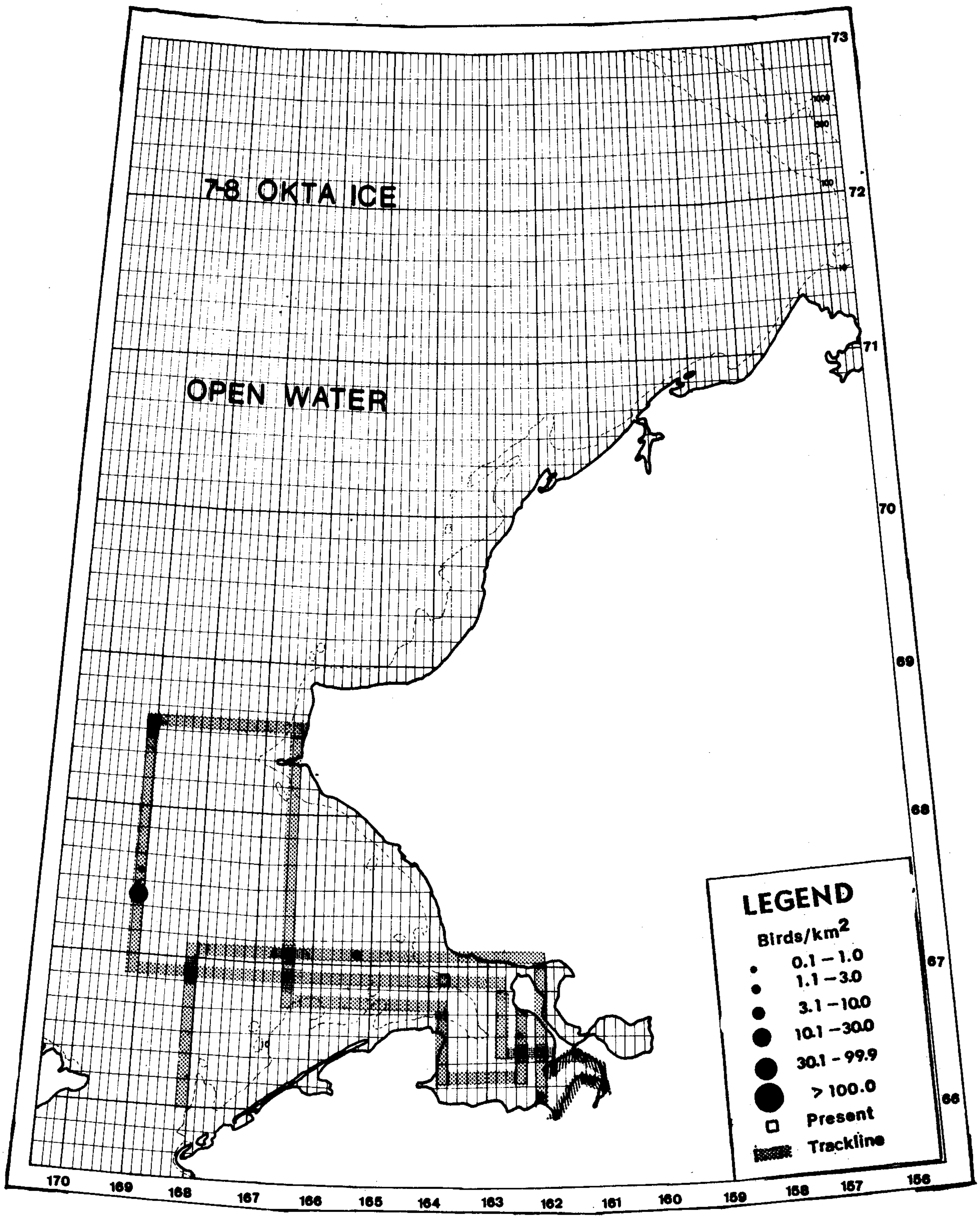

Figure 36. Distribution and abundance of phalaropes in the Chukchi Sea in October.

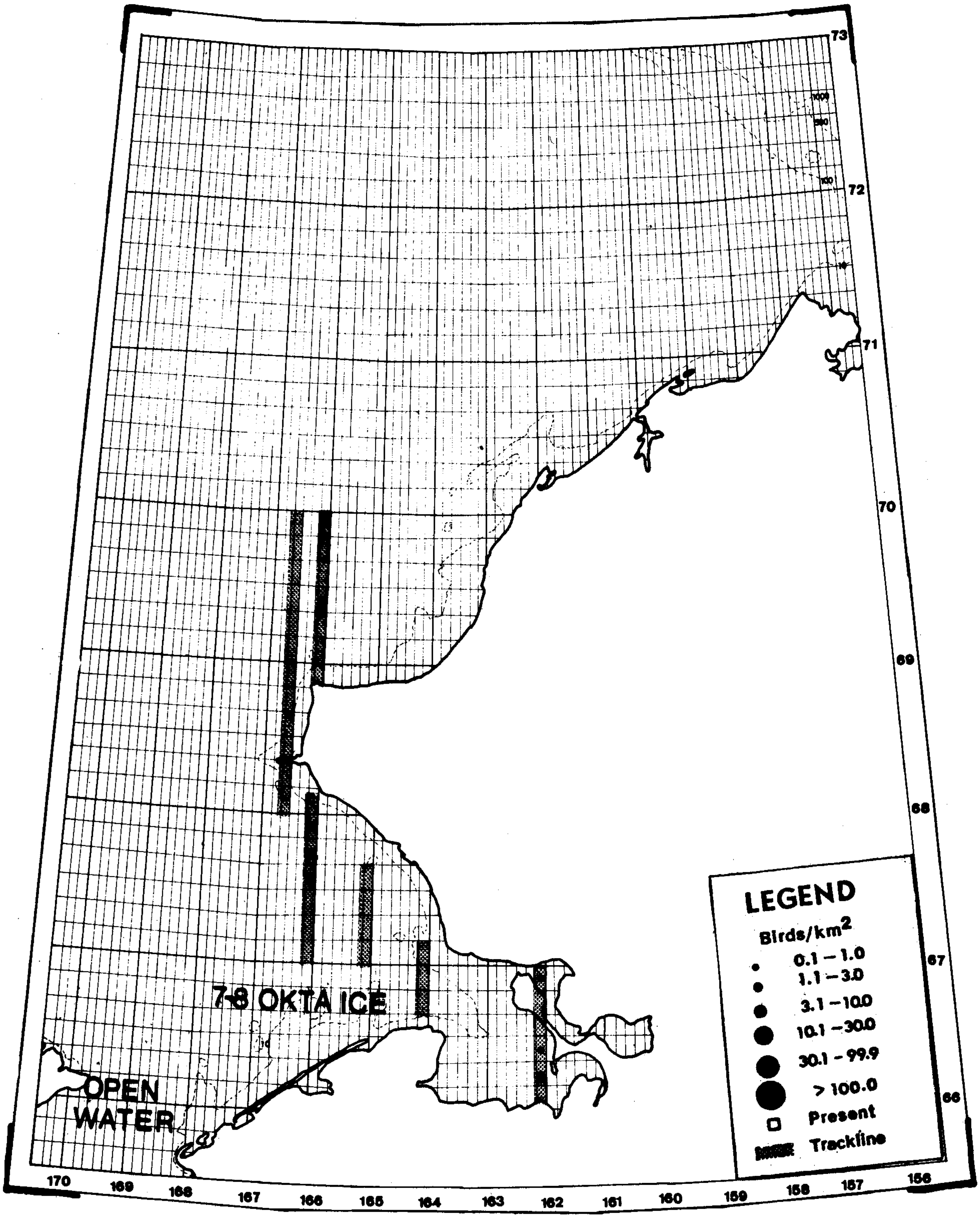

Figure 37. Distribution and abundance of jaegers in the Chukchi Sea in June.

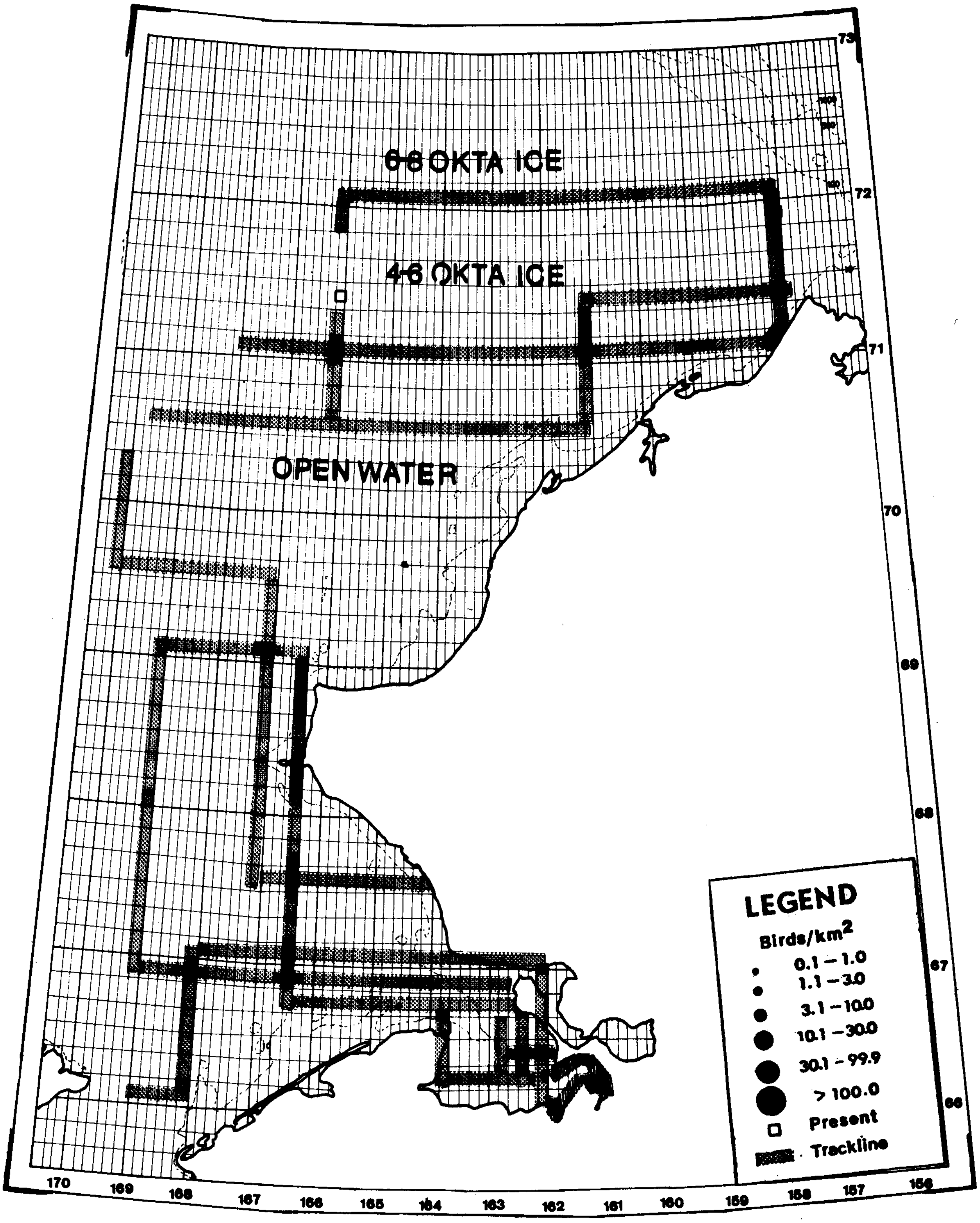

Figure 38. Distribution and abundance of jaegers in the Chukchi Sea in August.

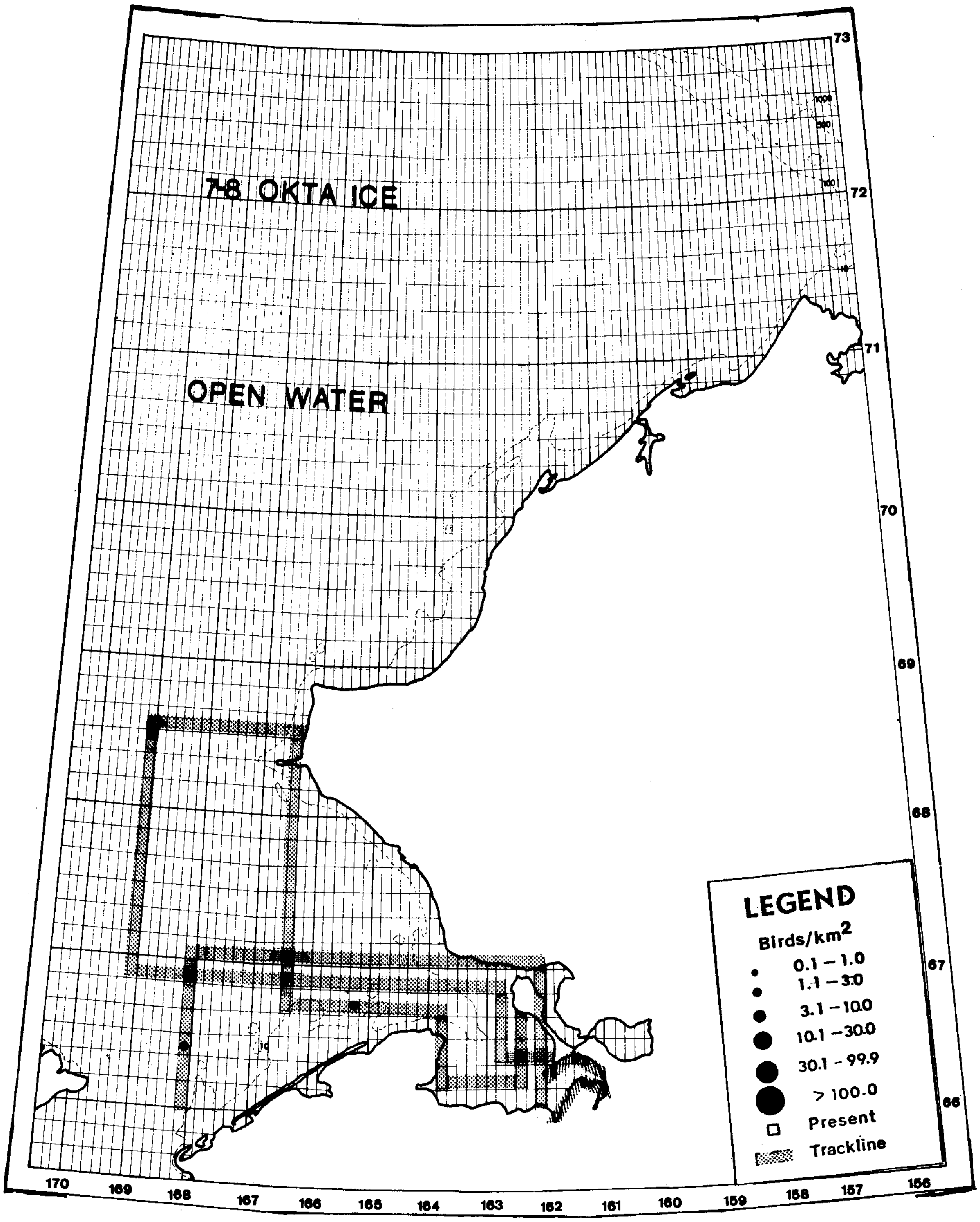

Figure 39. Distribution and abundance of jaegers in the Chukchi Sea in October.

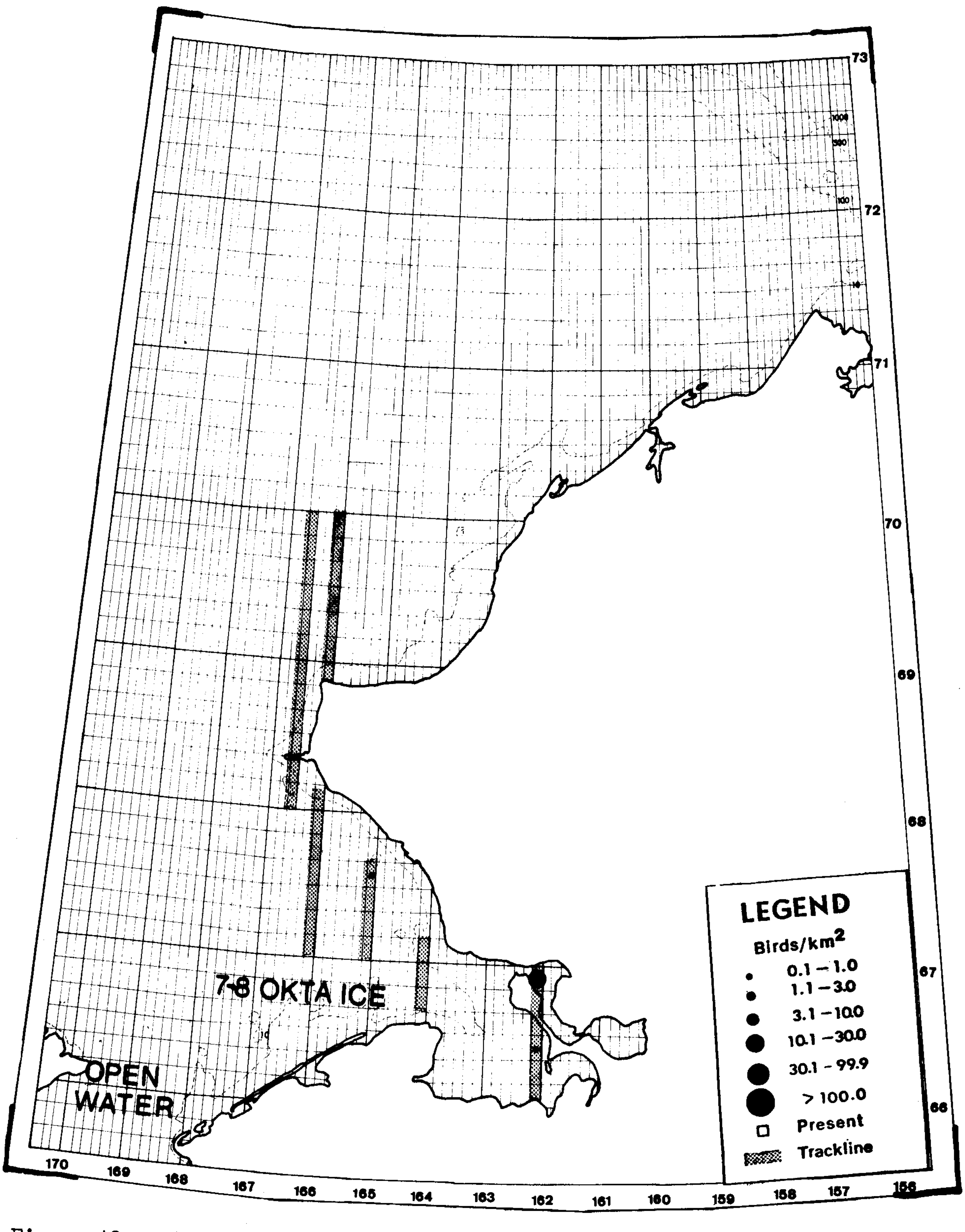

Figure 40. Distribution and abundance of glaucous gulls in the Chukchi Sea in June.

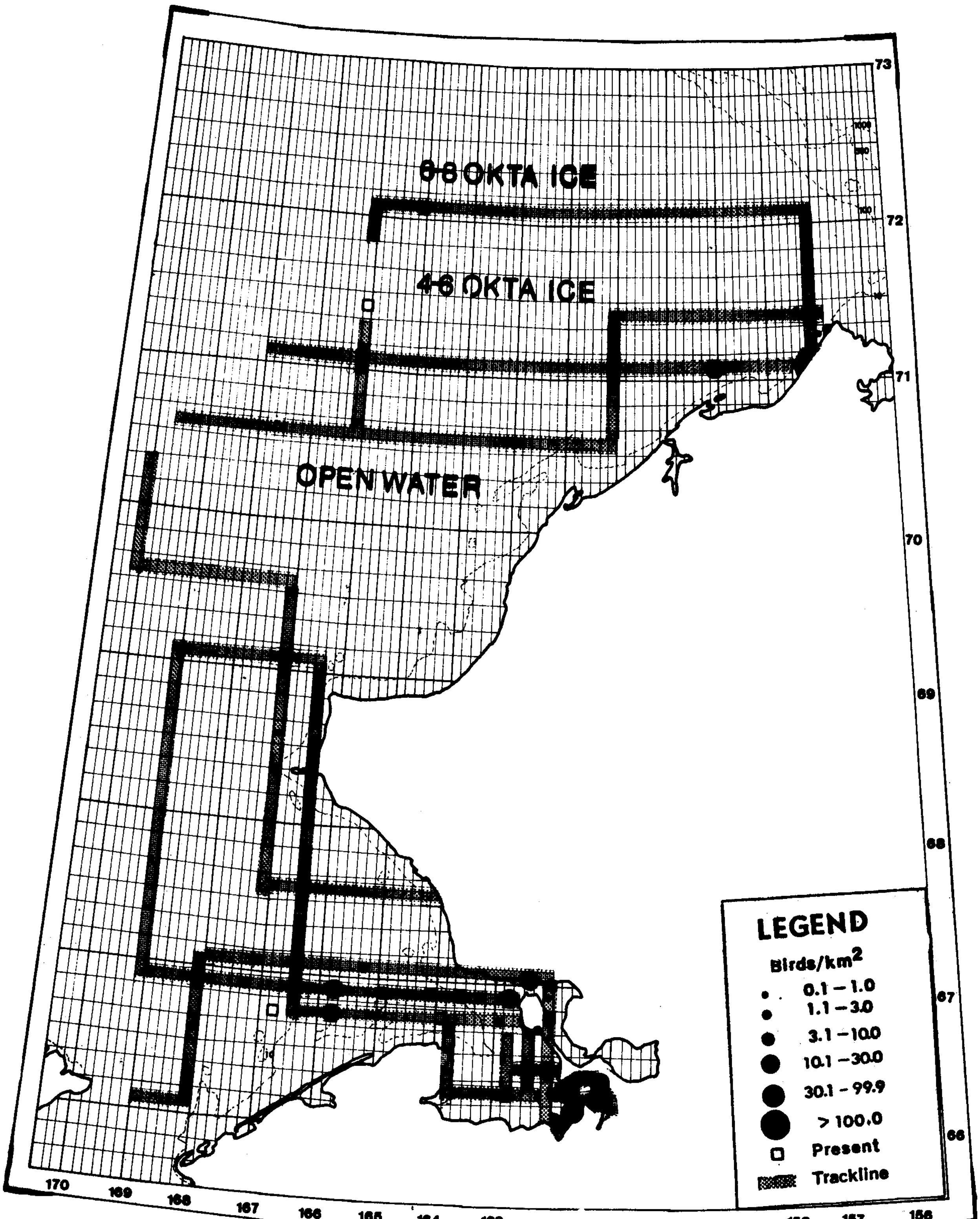

Figure 41. Distribution and abundance of glaucous gulls in the Chukchi Sea in August.

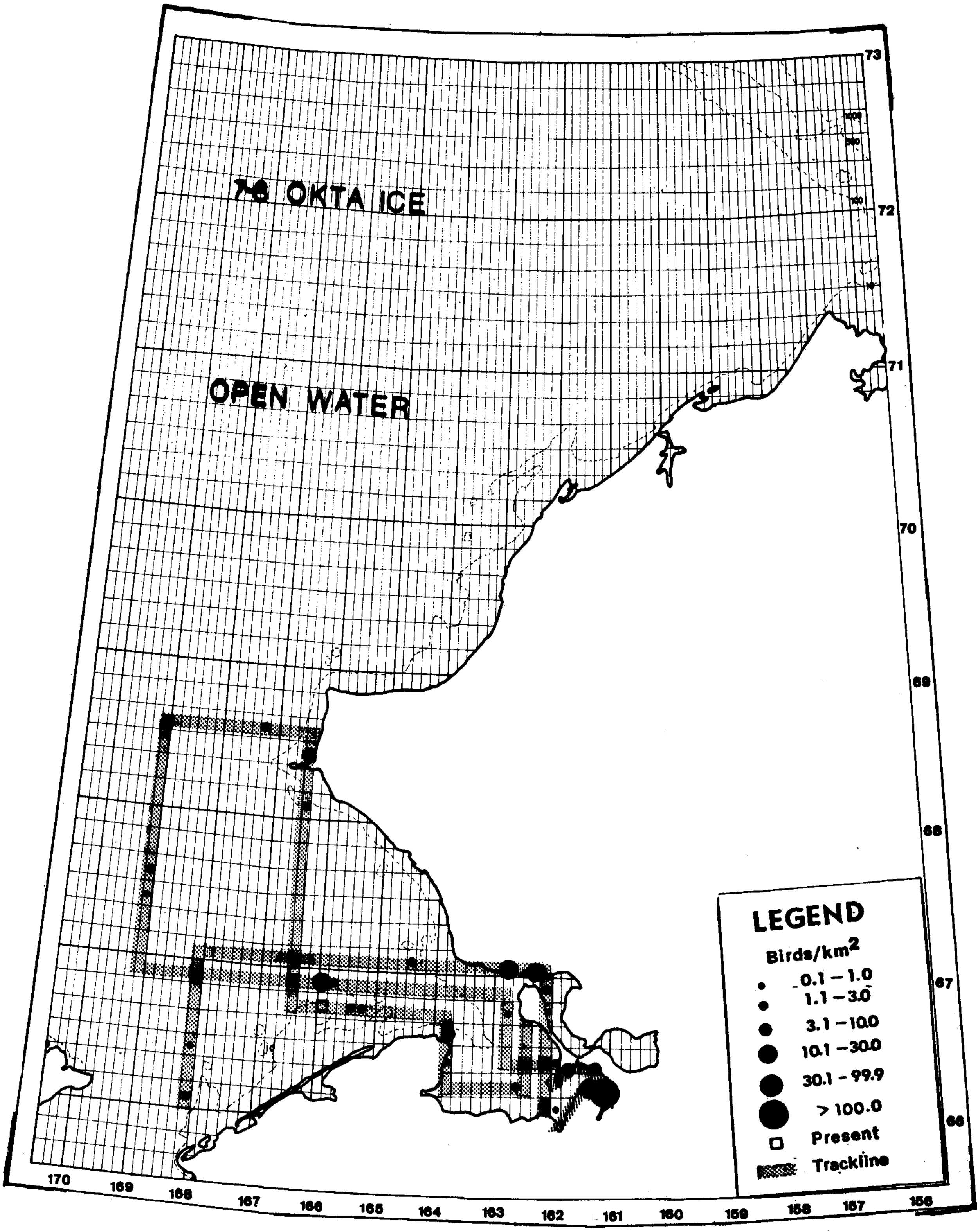

Figure 42. Distribution and abundance of glaucous gulls in the Chukchi Sea in October.

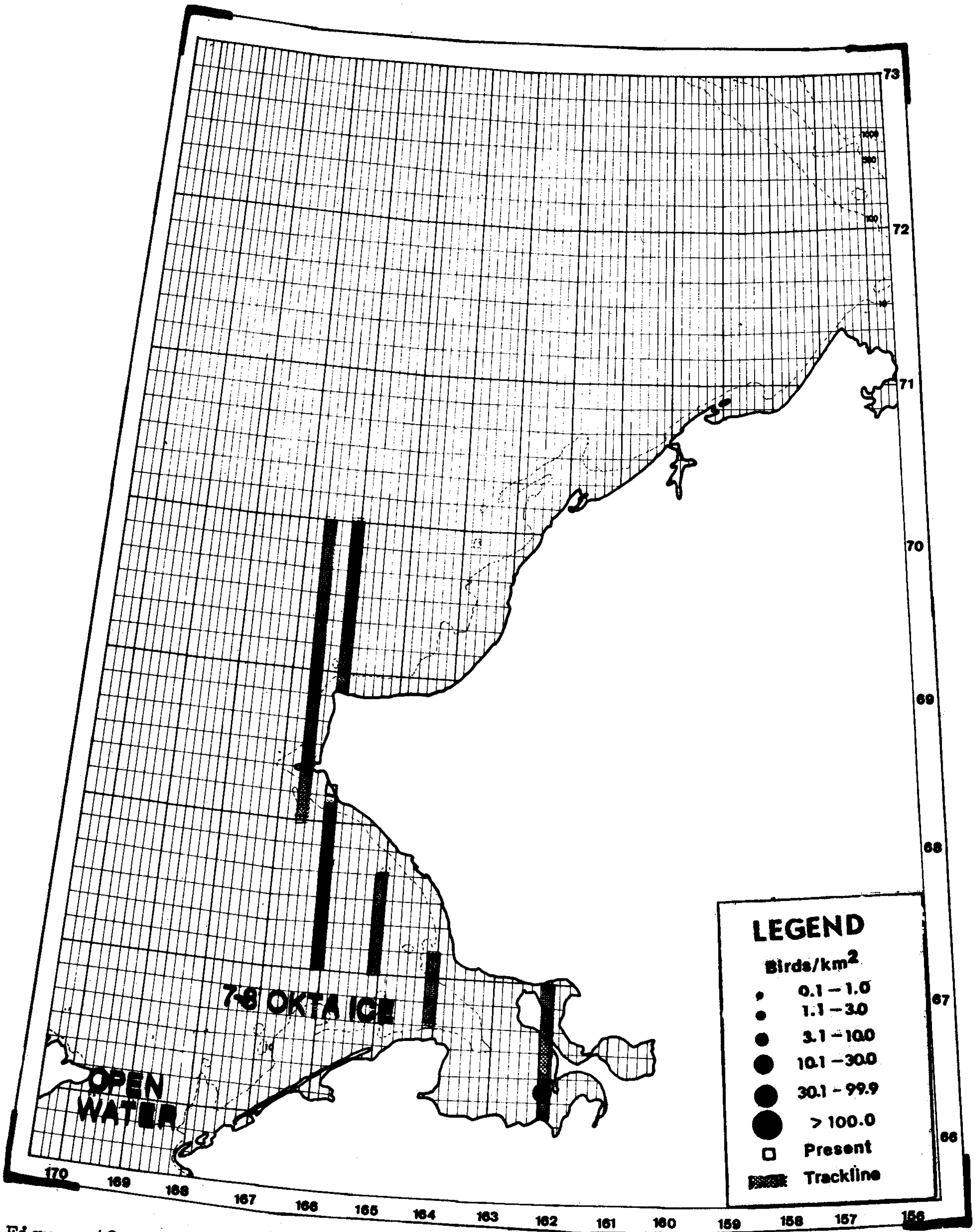

Figure 43. Distribution and abundance of black-legged kittiwakes in the Chukchi Sea in June.

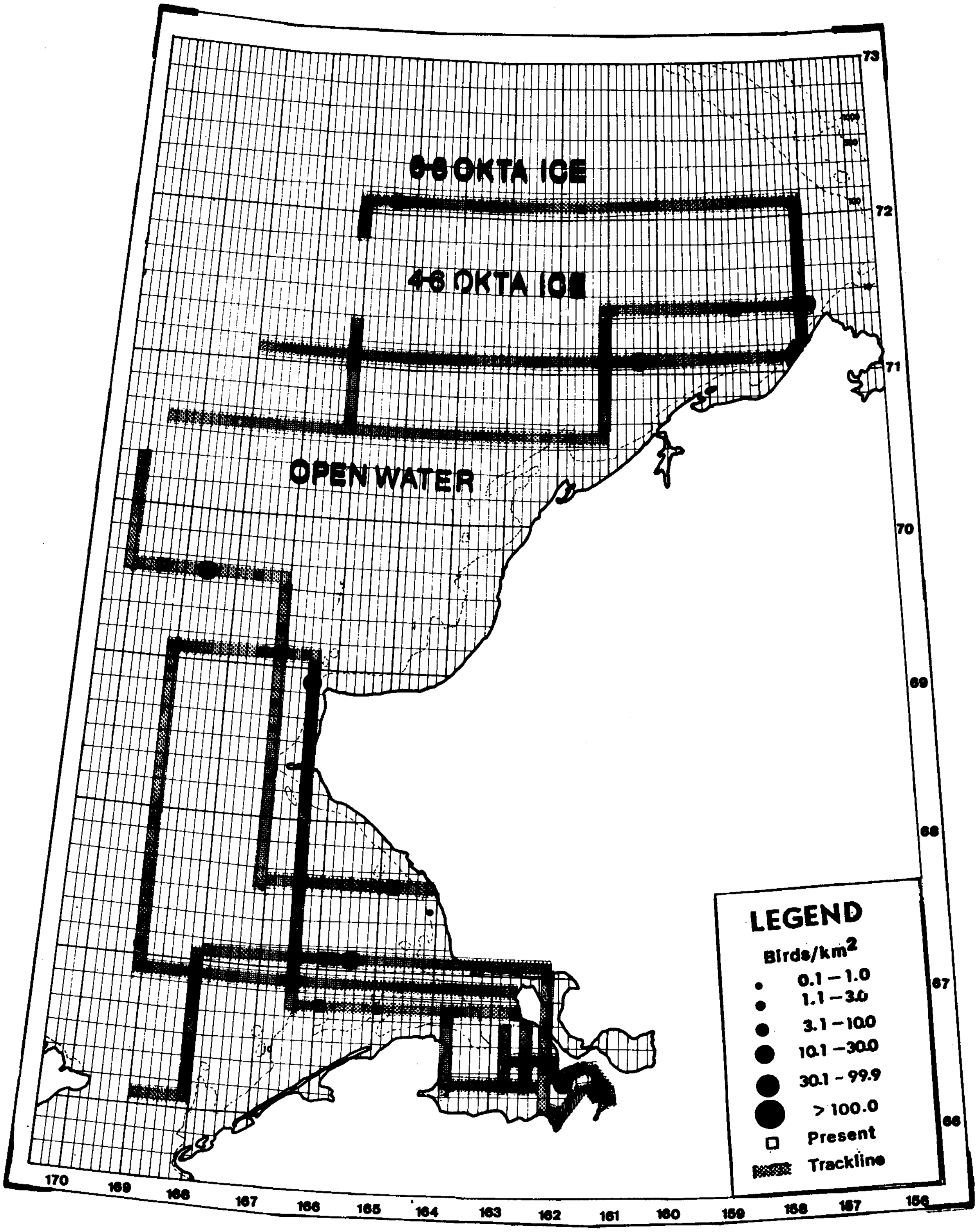

Figure 44. Distribution and abundance of black-legged kittiwakes in the Chukchi Sea in August.

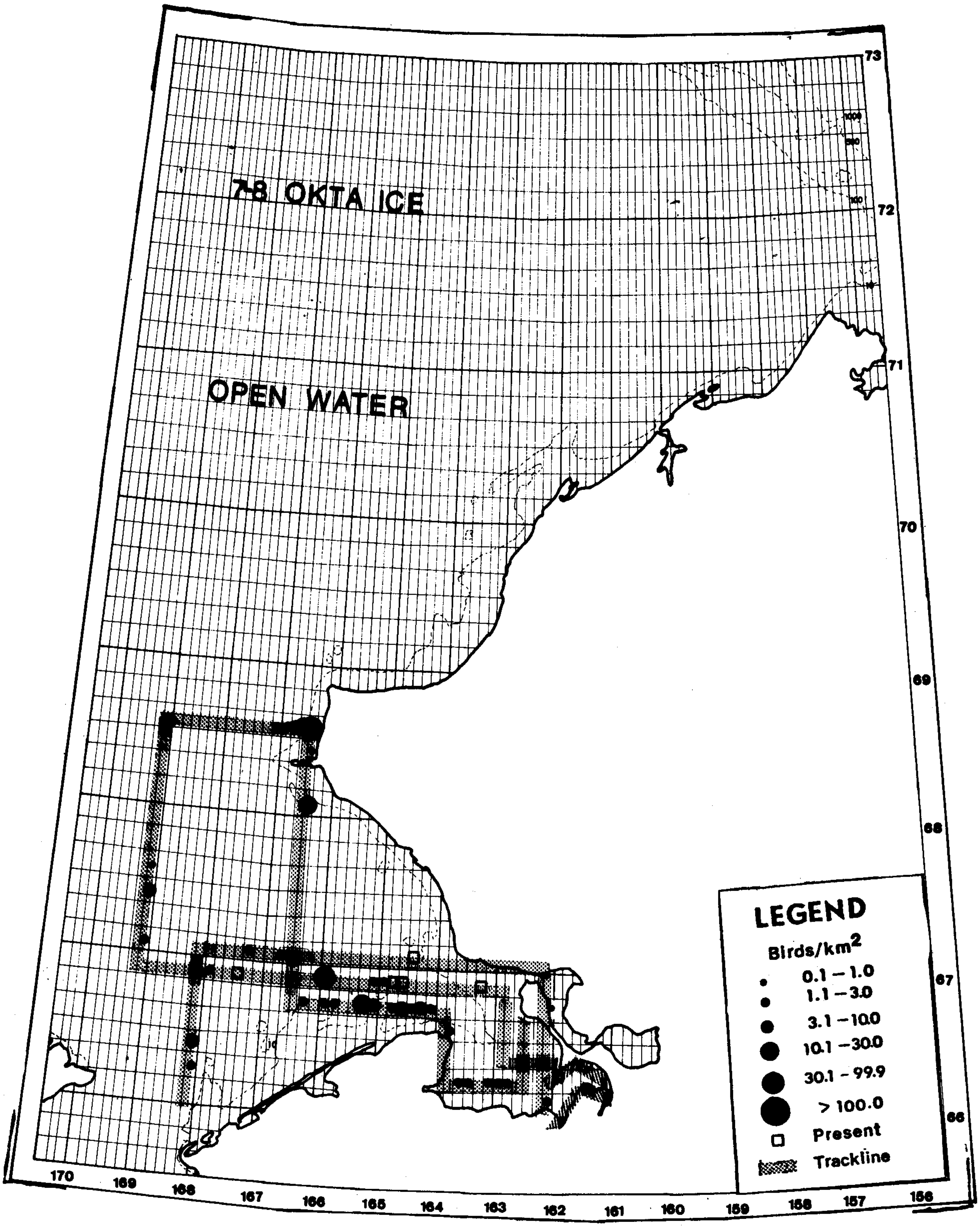

Figure 45. Distribution and abundance of black-legged kittiwakes in the Chukchi Sea in October.

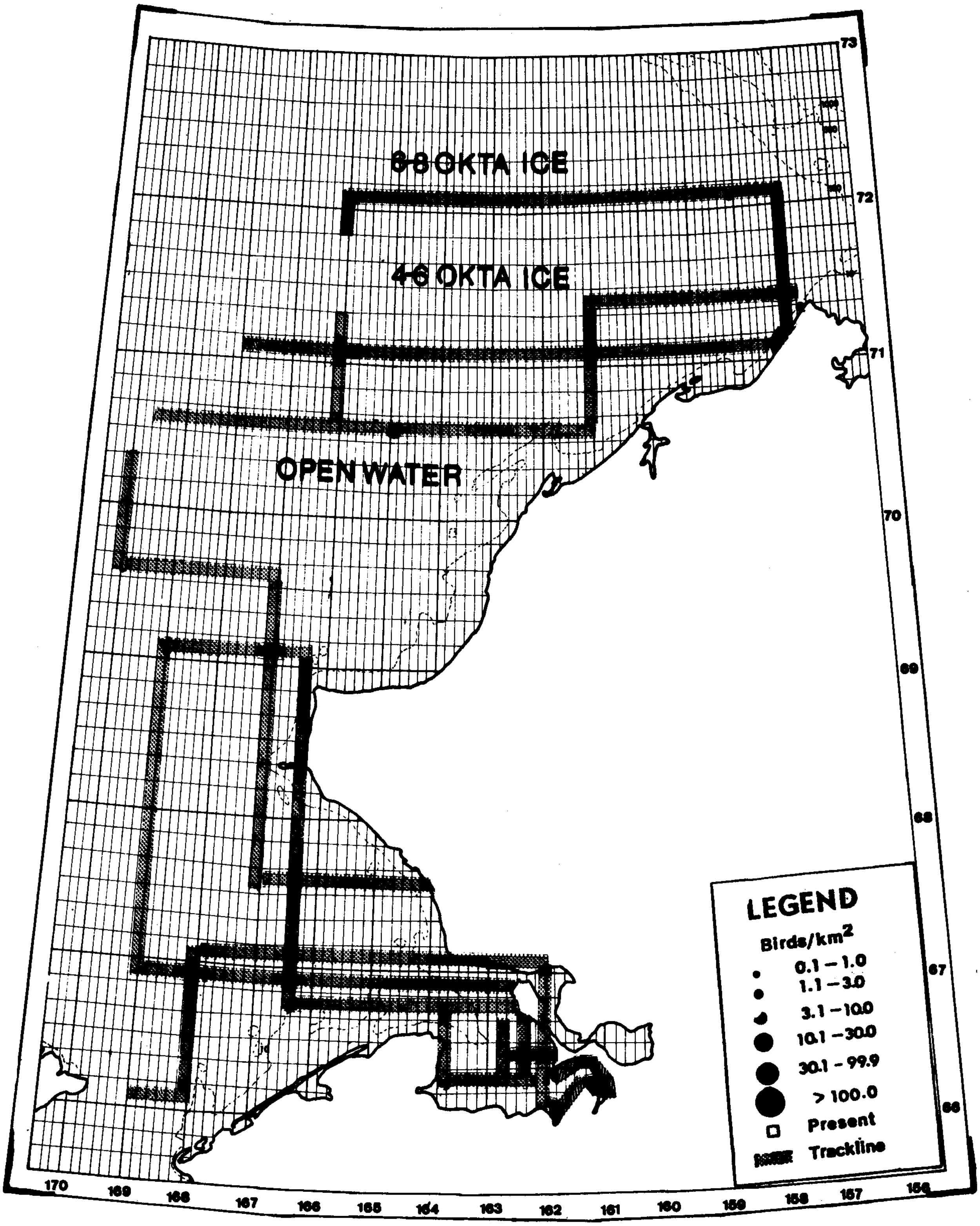

Figure 46. Distribution and abundance of Sabine's gulls in the Chukchi Sea in August. No Sabine's gulls were observed in June or October.

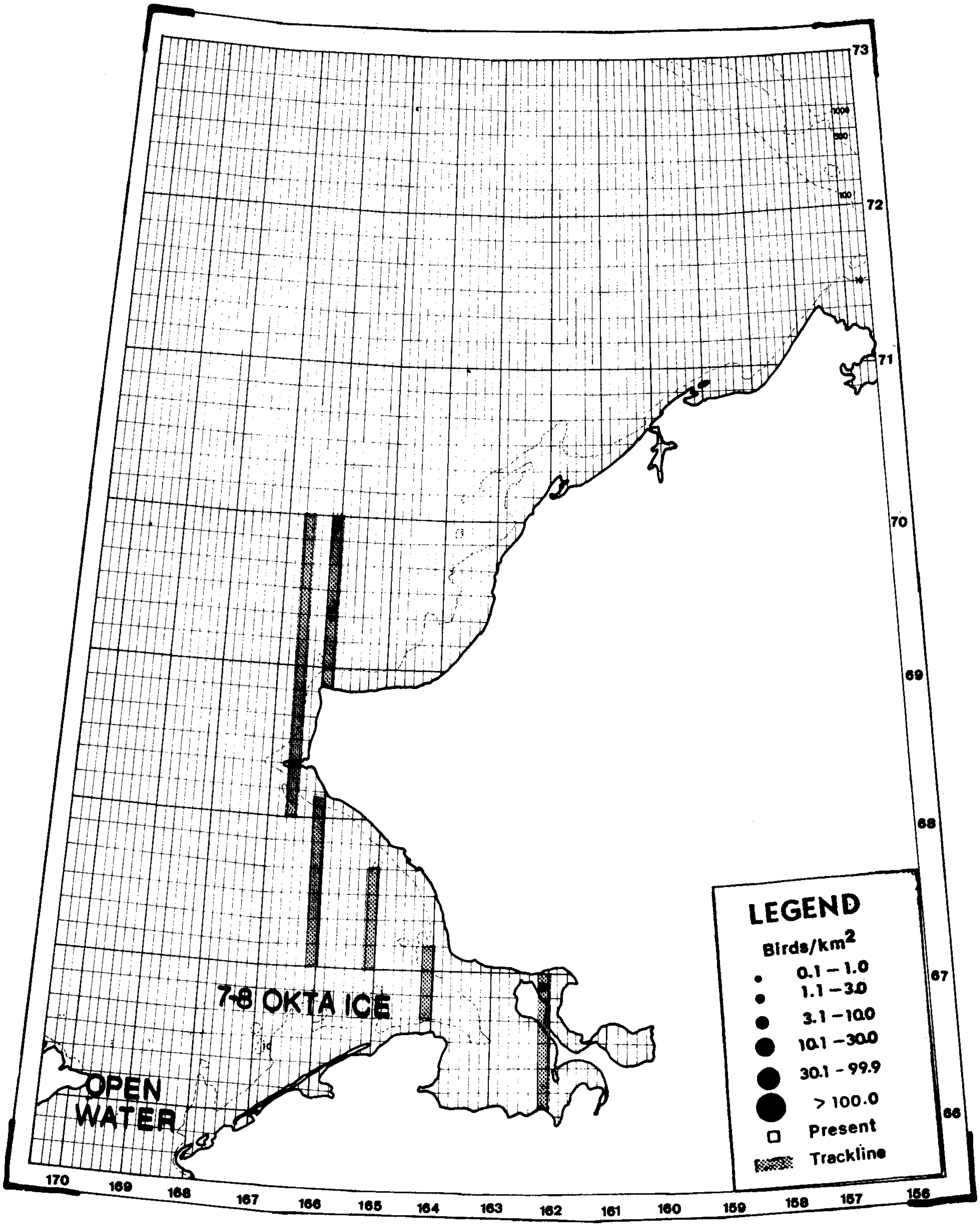

Figure 47. Distribution and abundance of arctic terns in the Chukchi Sea in June.

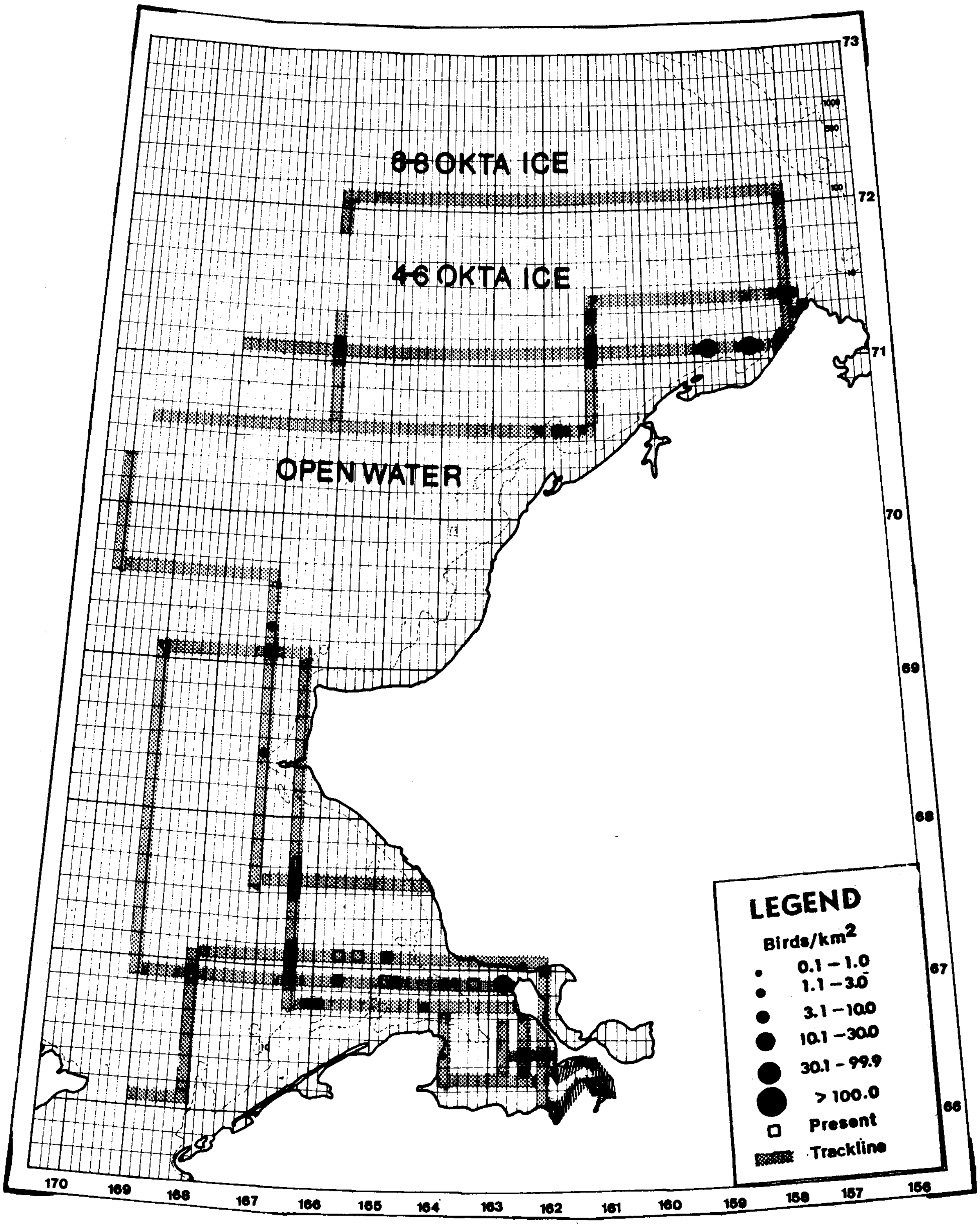

Figure 48. Distribution and abundance of arctic terns in the Chukchi Sea in August.

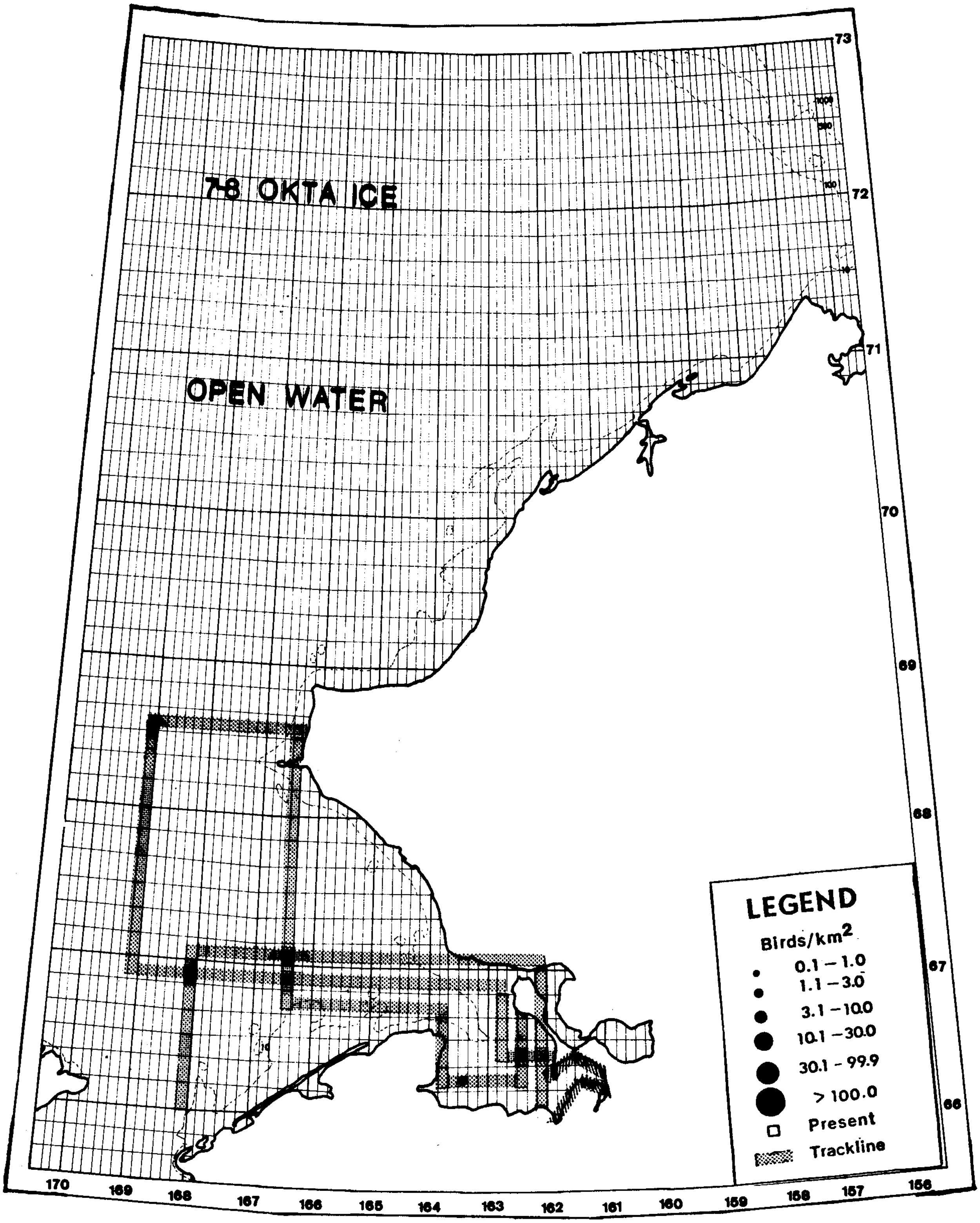

Figure 49. Distribution and abundance of arctic terns in the Chukchi Sea in October.

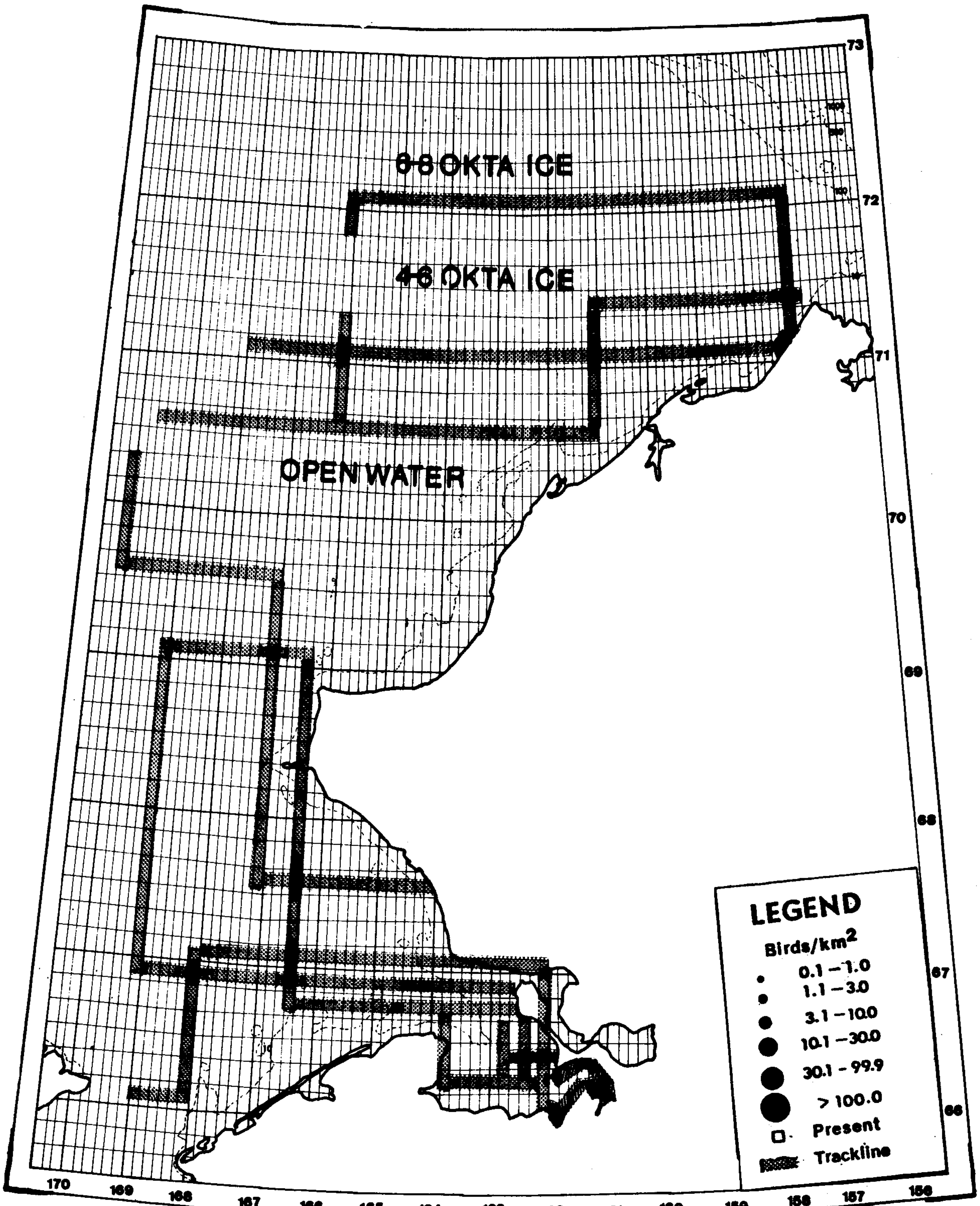

Figure 50. Distribution and abundance of Aleutian terns in the Chukchi Sea in August. No Aleutian terns were observed in June or October.

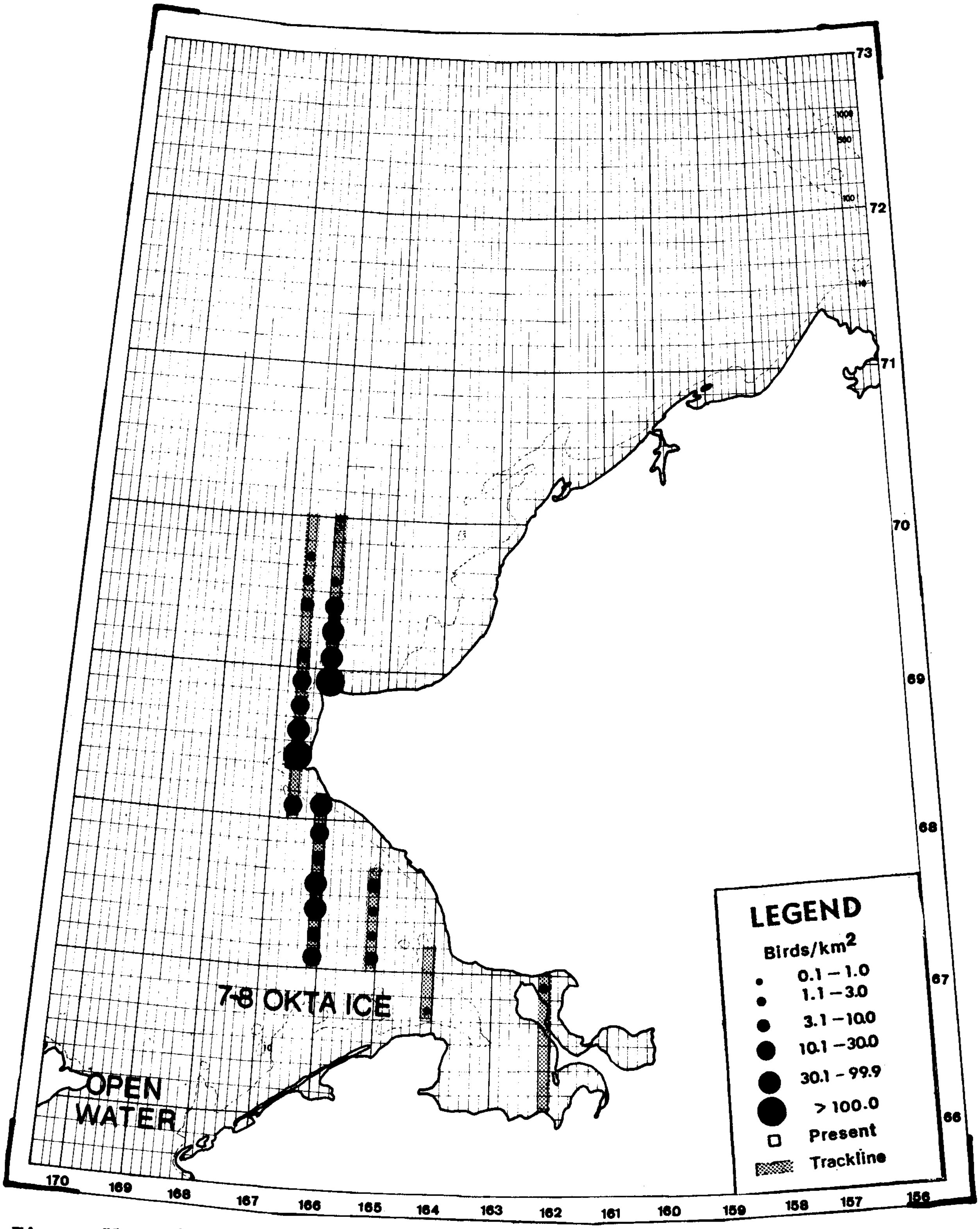

Figure 51. Distribution and abundance of murres in the Chukchi Sea in June.

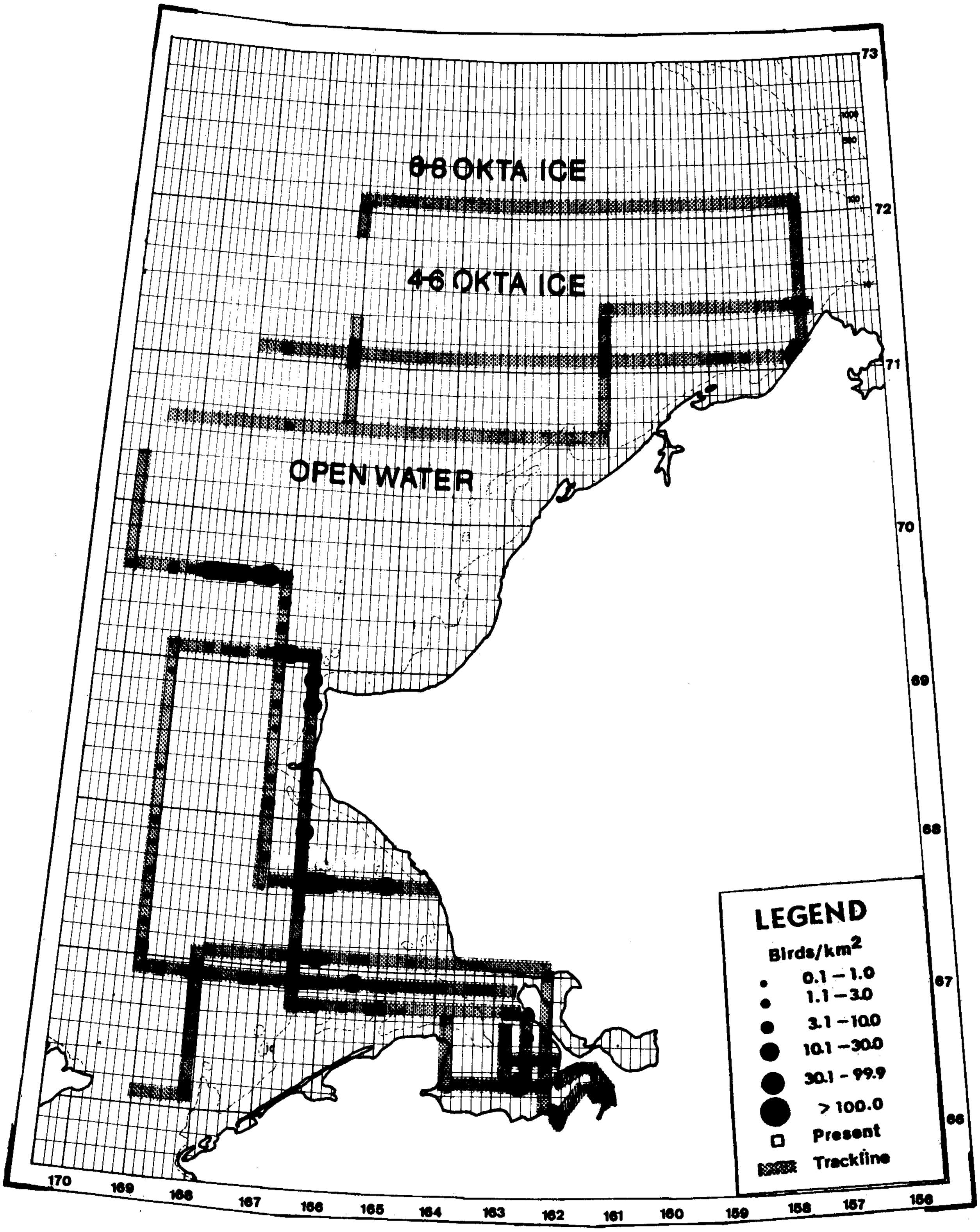

Figure 52. Distribution and abundance of murres in the Chukchi Sea in August.

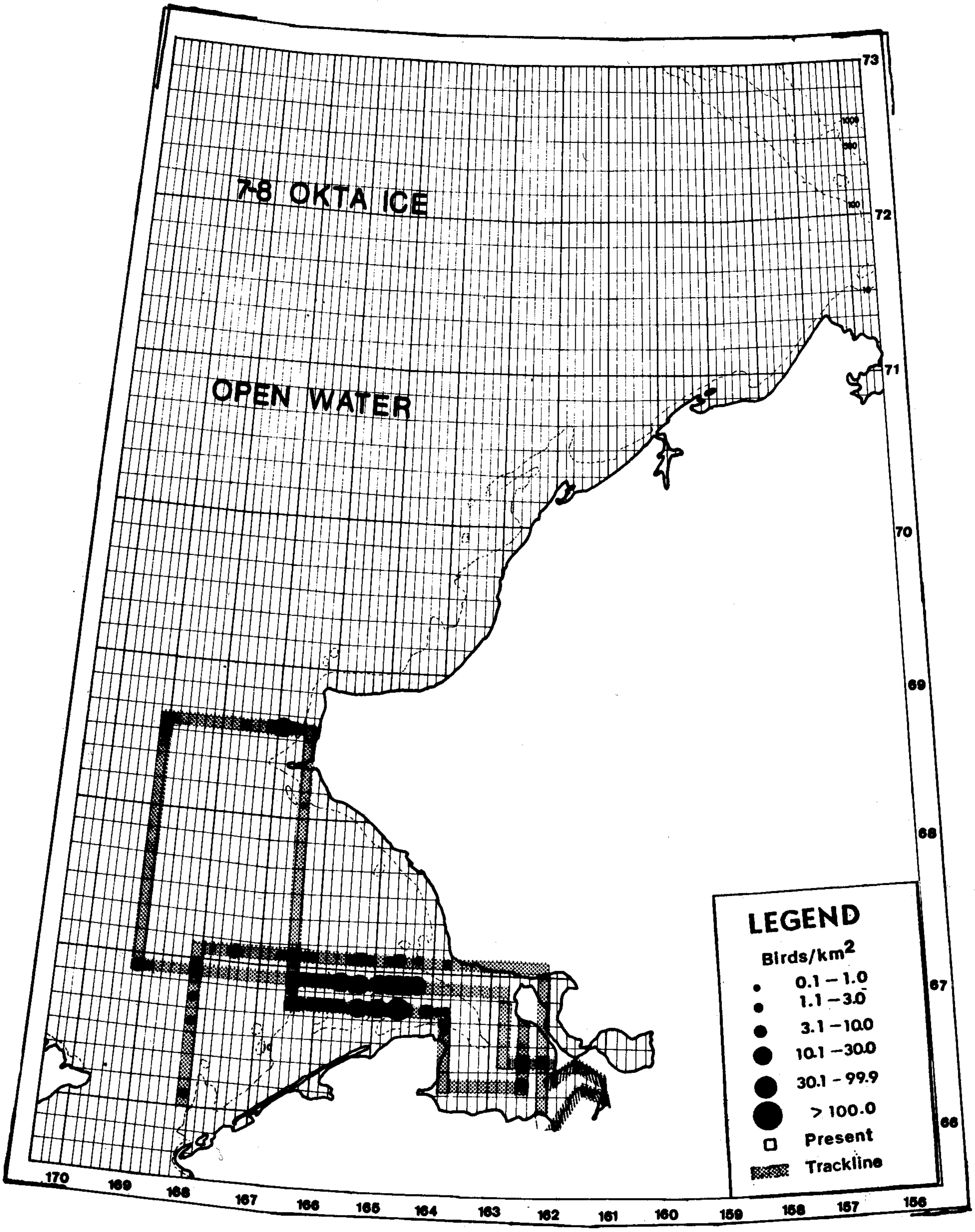

Figure 53. Distribution and abundance of murres in the Chukchi Sea in October.

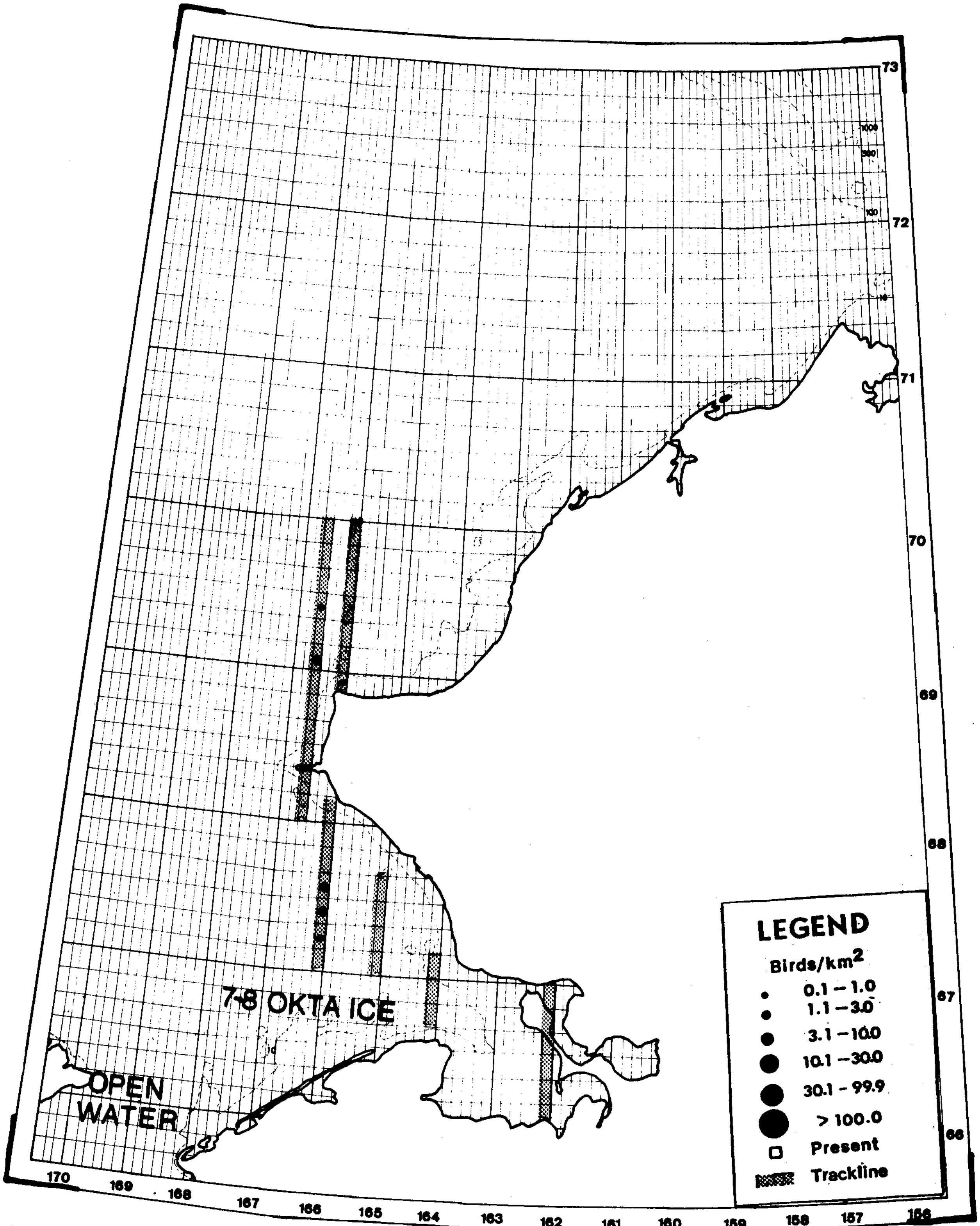

Figure 54. Distribution and abundance of small alcids in the Chukchi Sea in June.

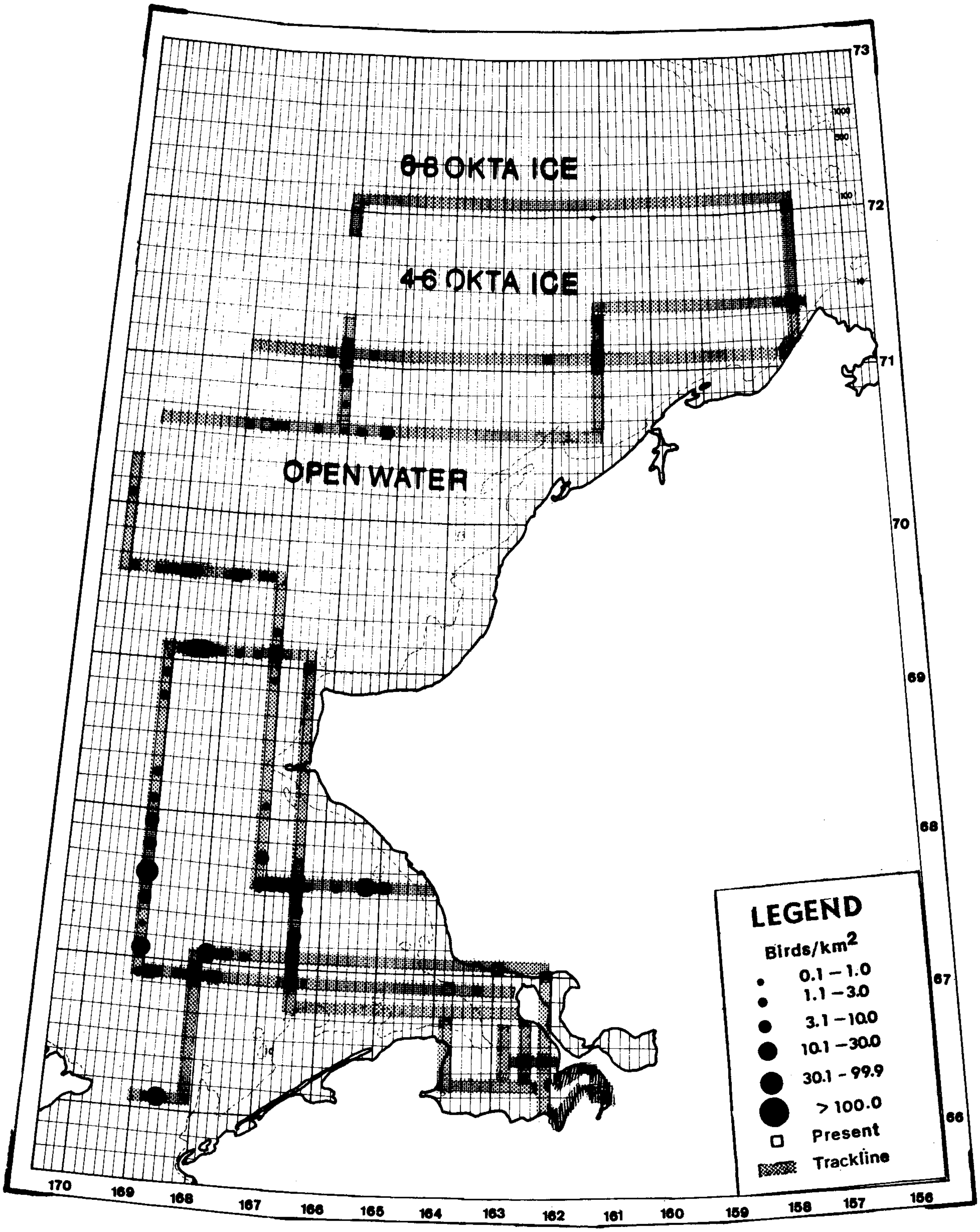

Figure 55. Distribution and abundance of small alcids in the Chukchi Sea in August.

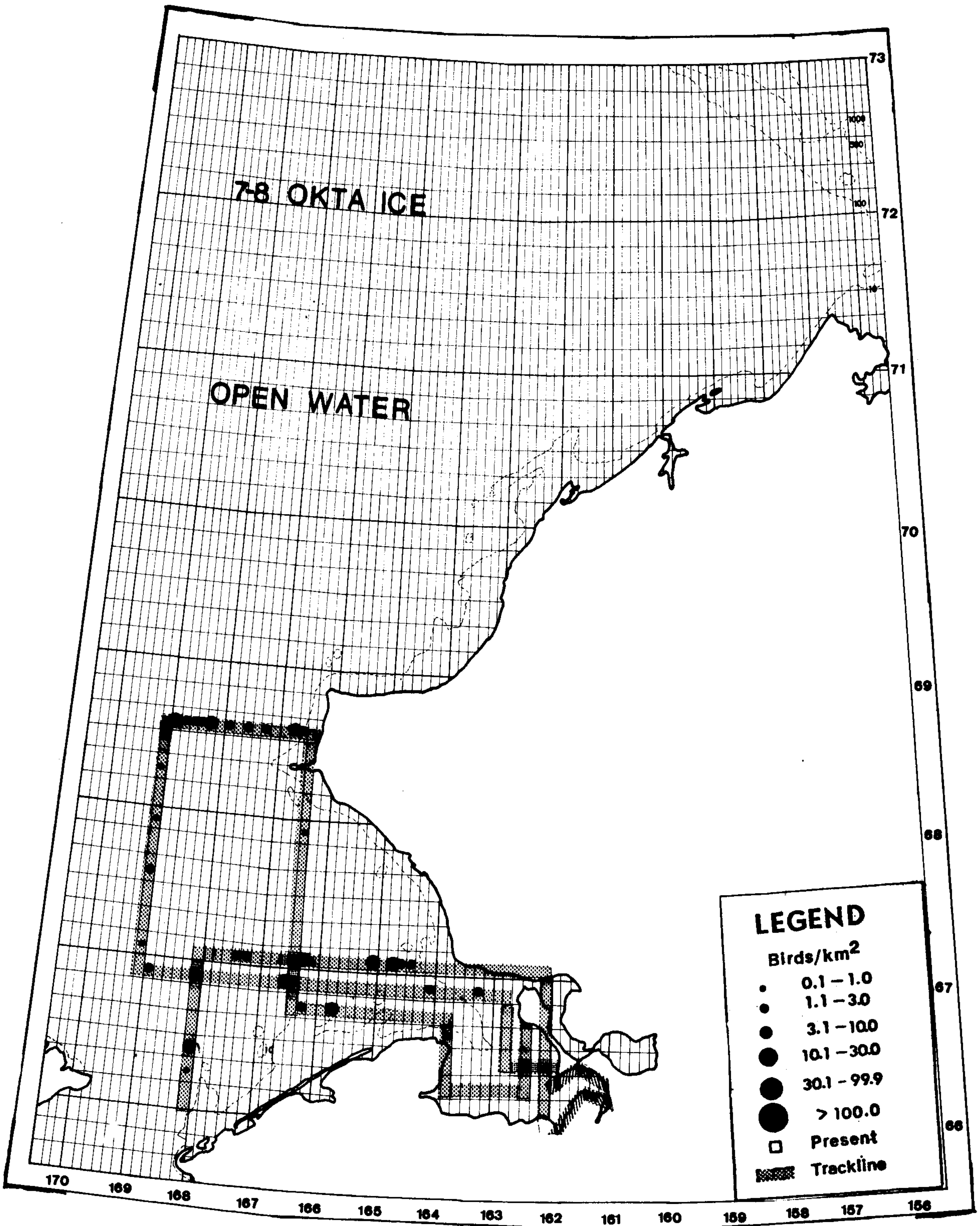

Figure 56. Distribution and abundance of small alcids in the Chukchi Sea in October.

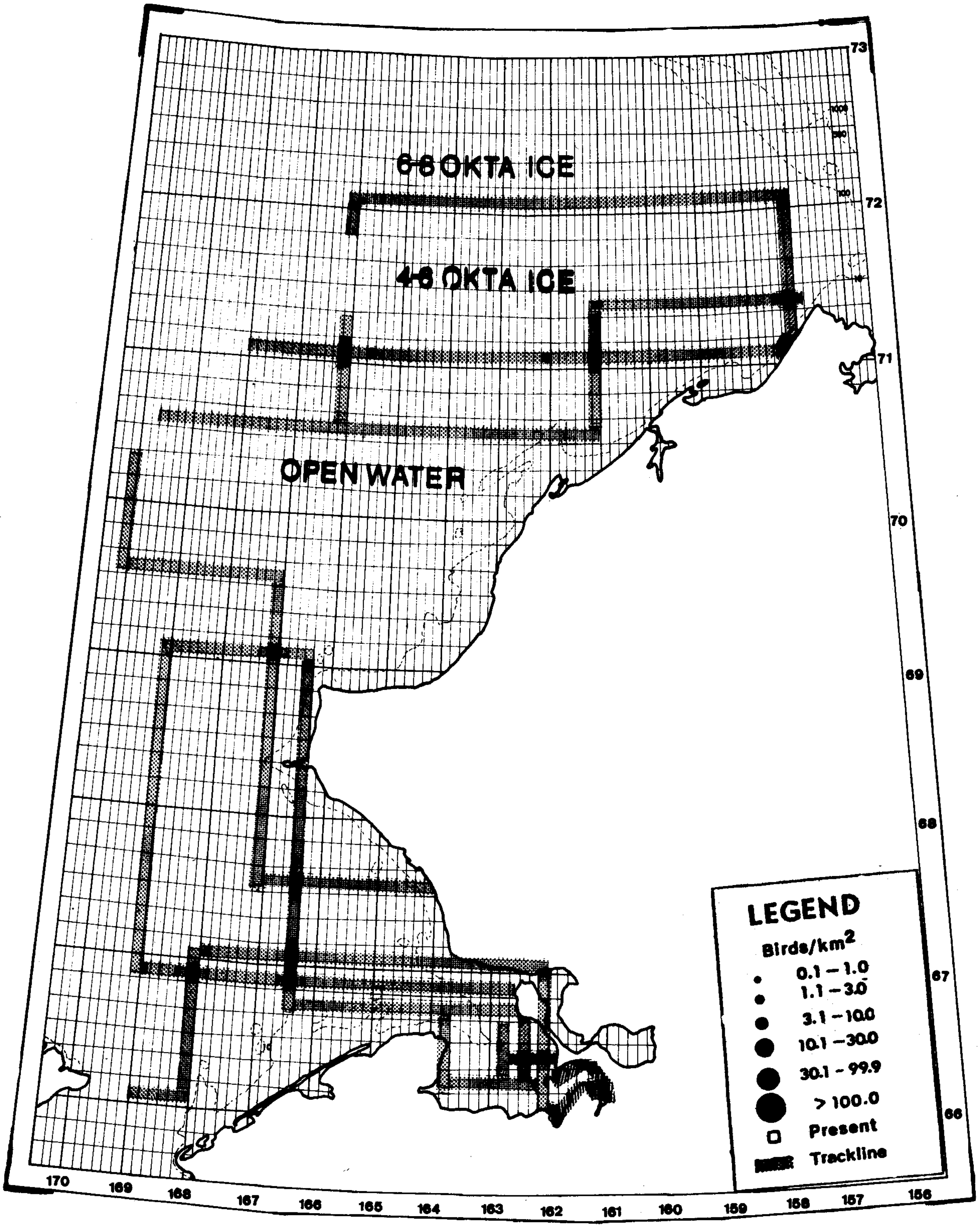

Figure 57. Distribution and abundance of black guillemots in the Chukchi Sea in August. No black guillemots were observed in June or October.

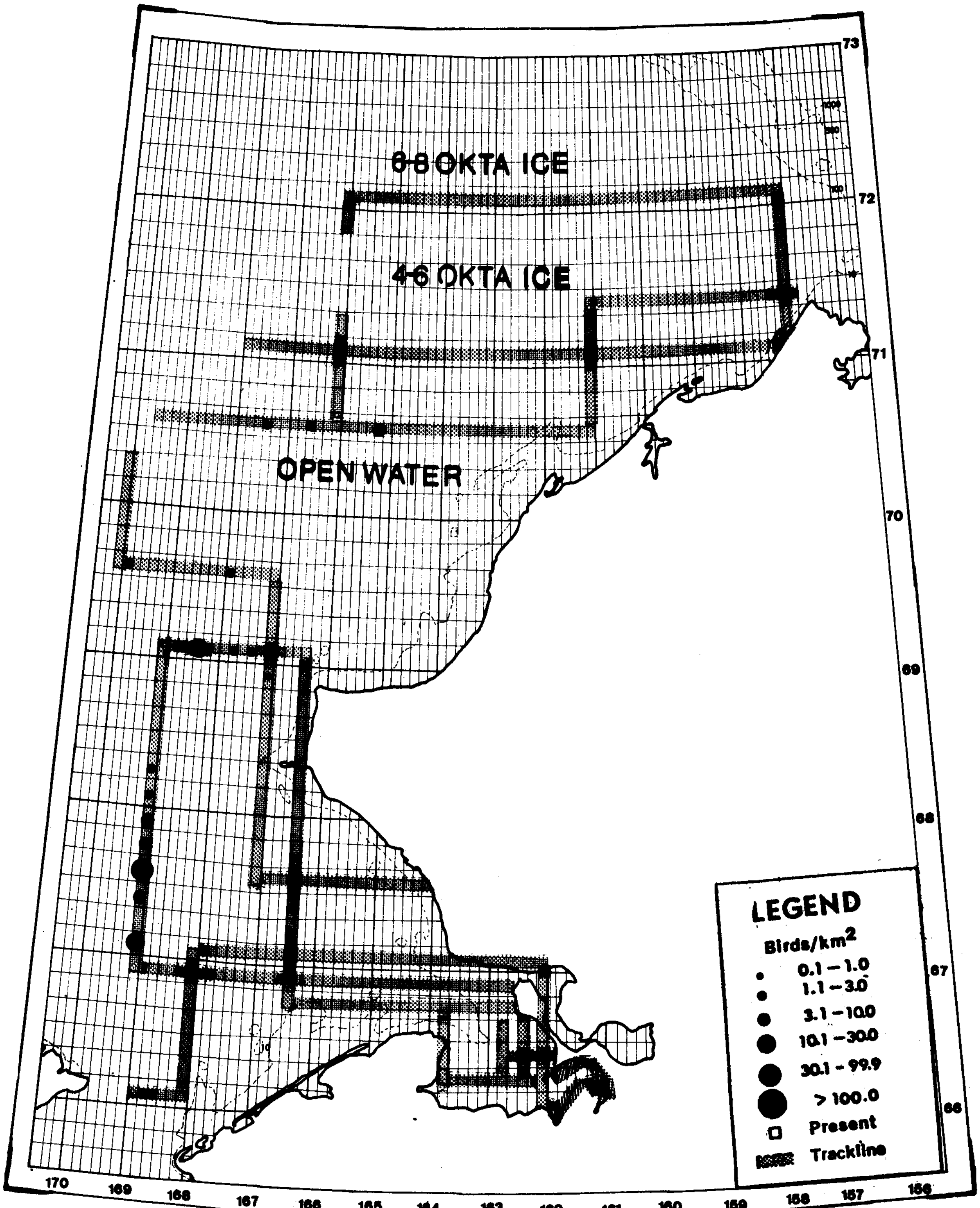

Figure 58. Distribution and abundance of parakeet auklets in the Chukchi Sea in August. No parakeet auklets were identified in June.

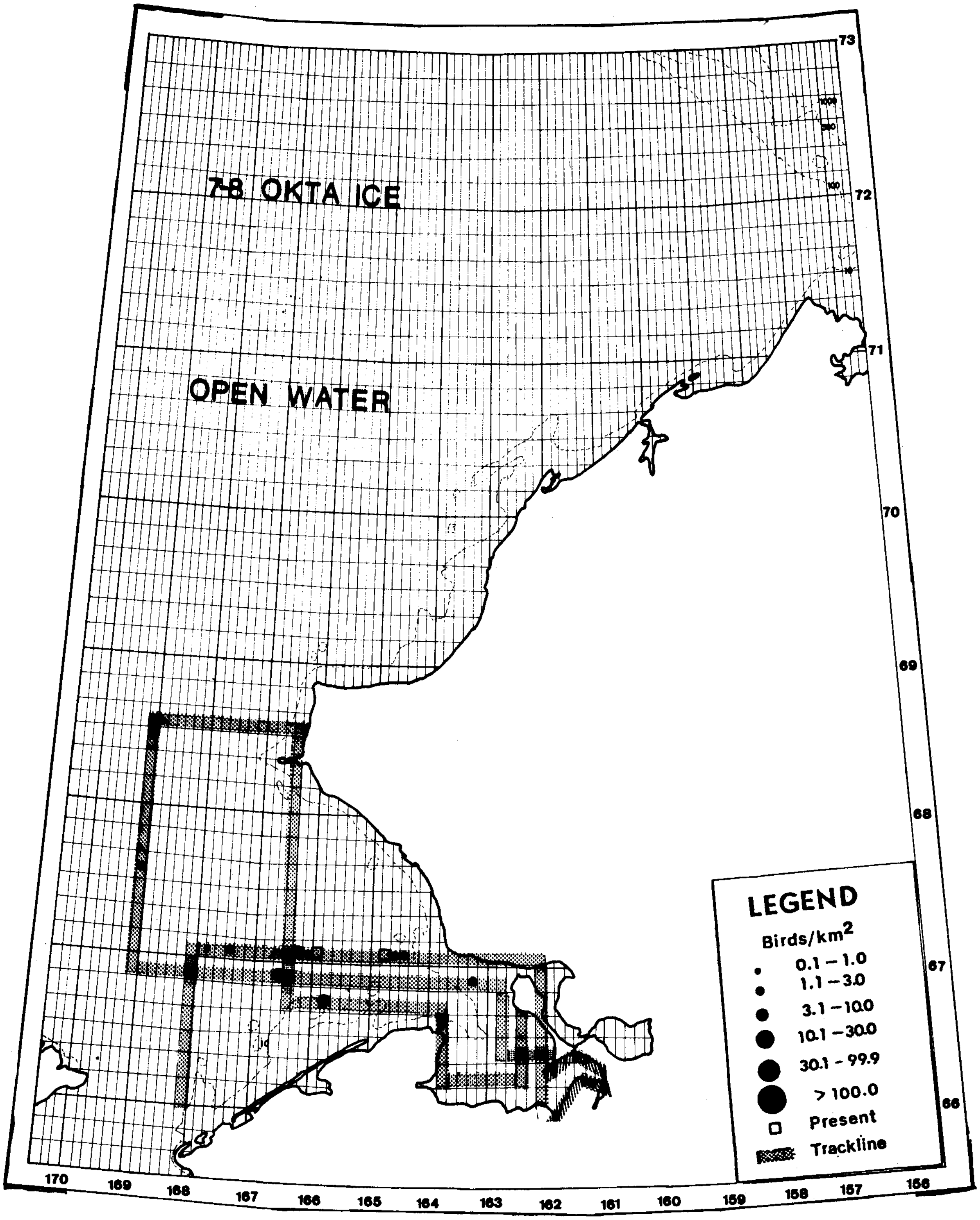

Figure 59. Distribution and abundance of parakeet auklets in the Chukchi Sea in October.

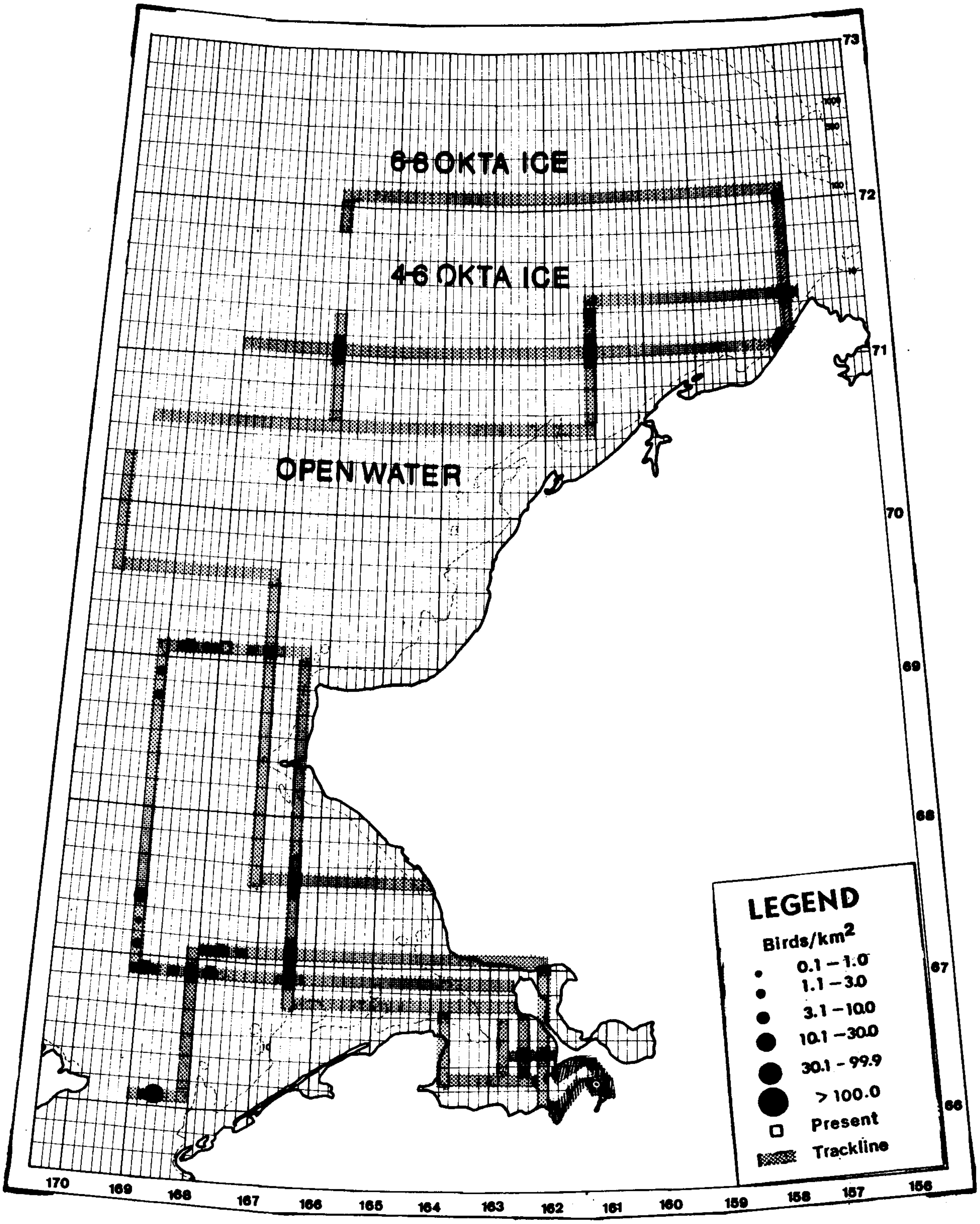

Figure 60. Distribution and abundance of crested auklets in the Chukchi Sea in August. No crested auklets were identified in June.

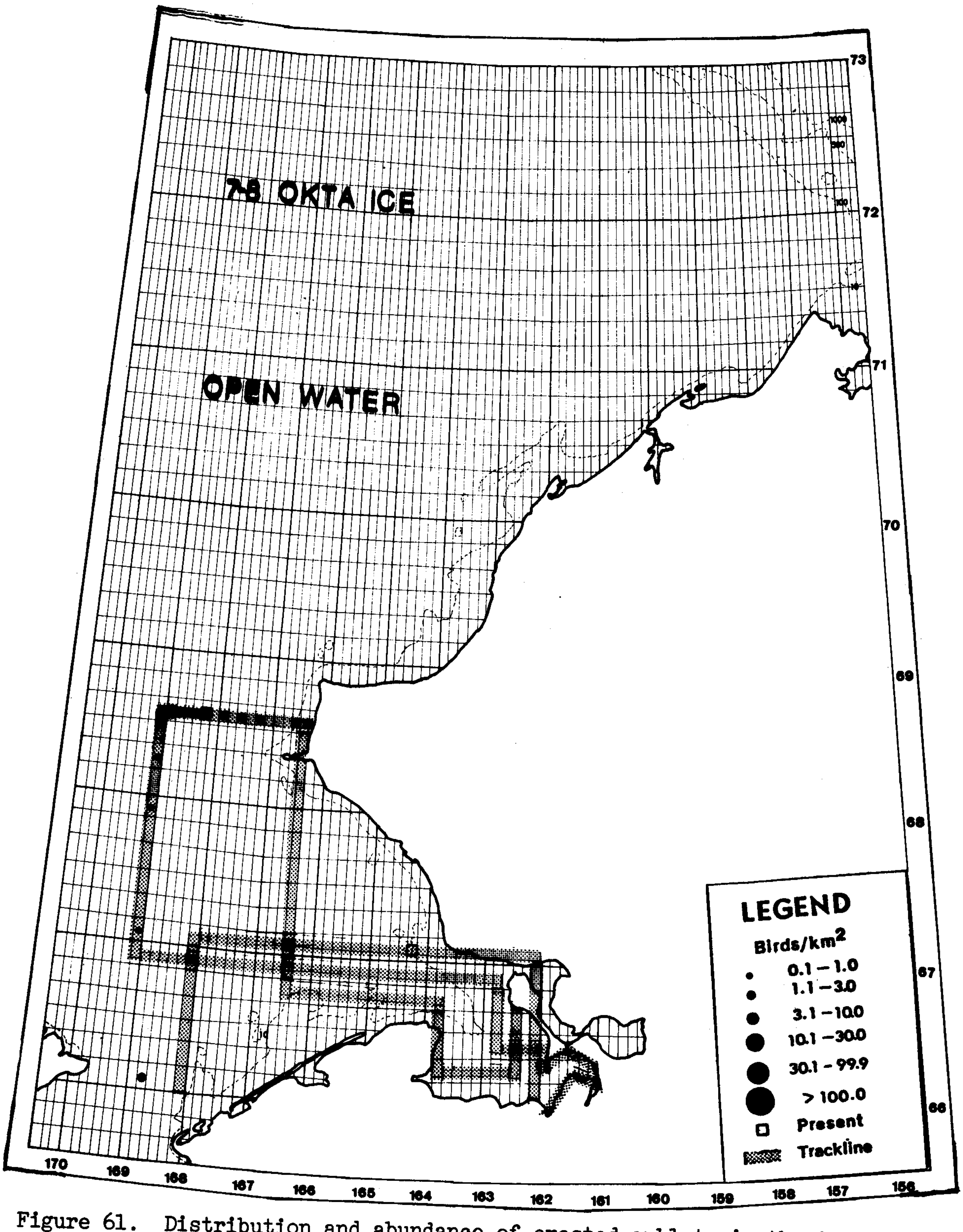

Figure 61. Distribution and abundance of crested auklets in the Chukchi Sea in October.

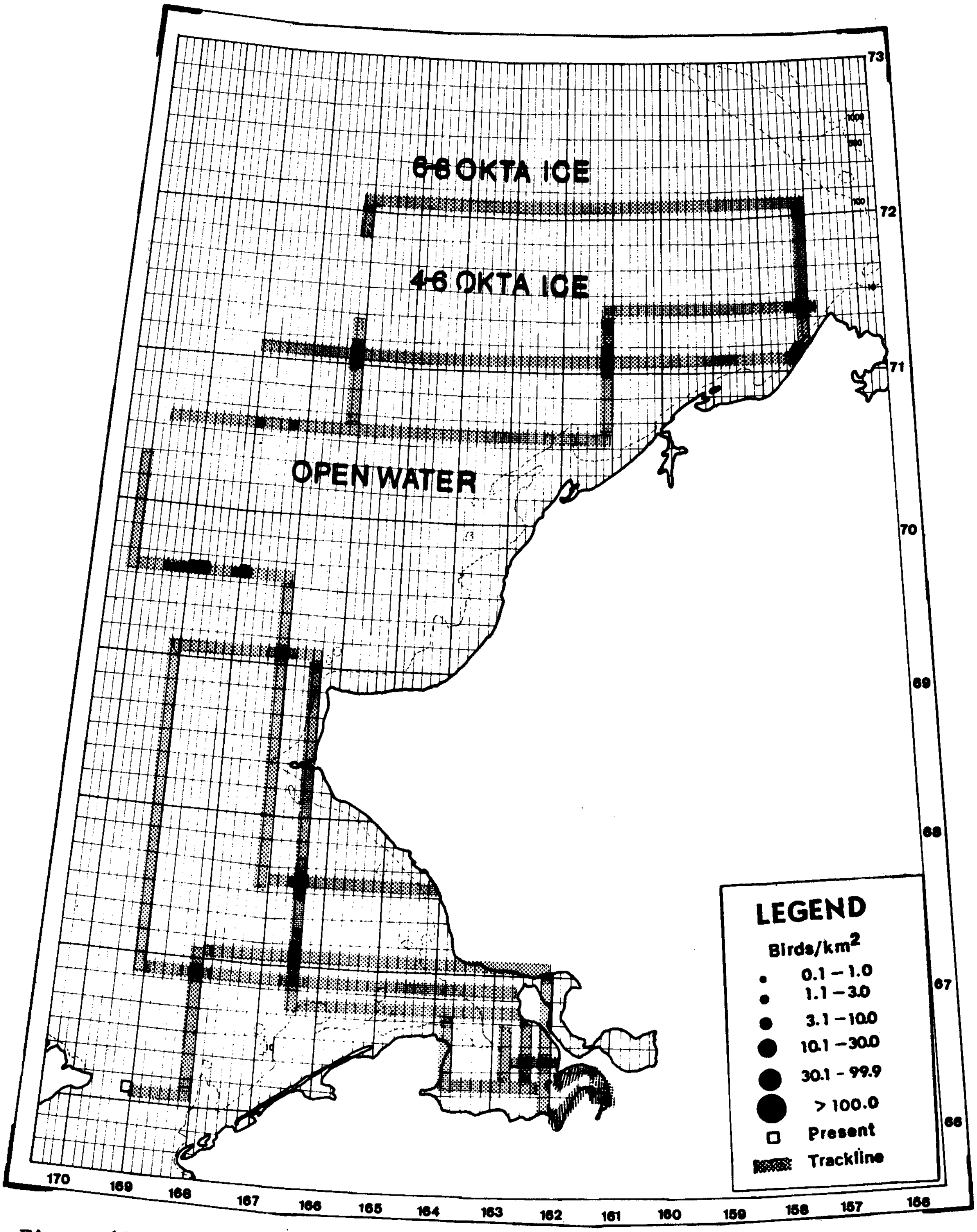

Figure 62. Distribution and abundance of least auklets in the Chukchi Sea in August. No least auklets were identified in June.

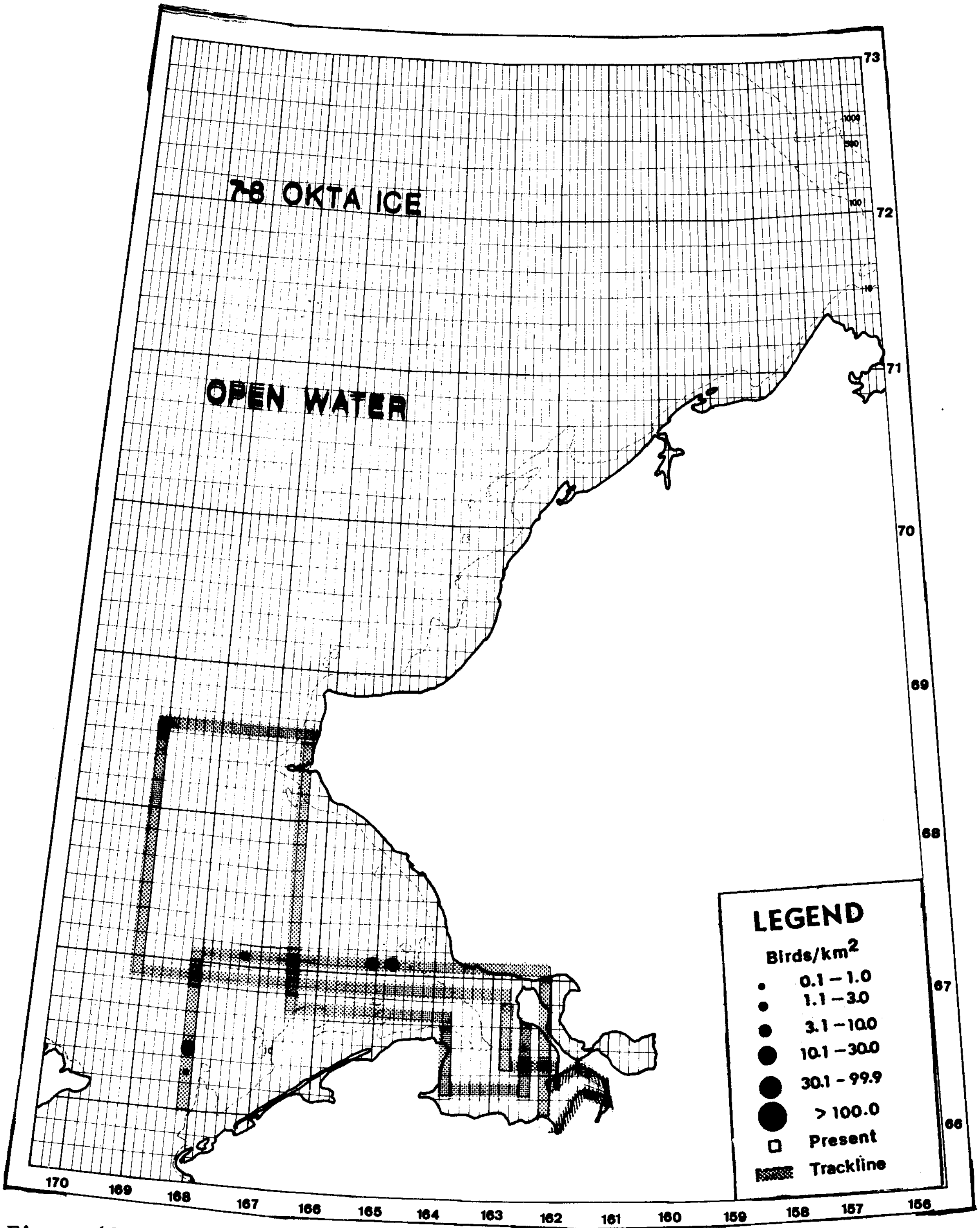

Figure 63. Distribution and abundance of least auklets in the Chukchi Sea in October.

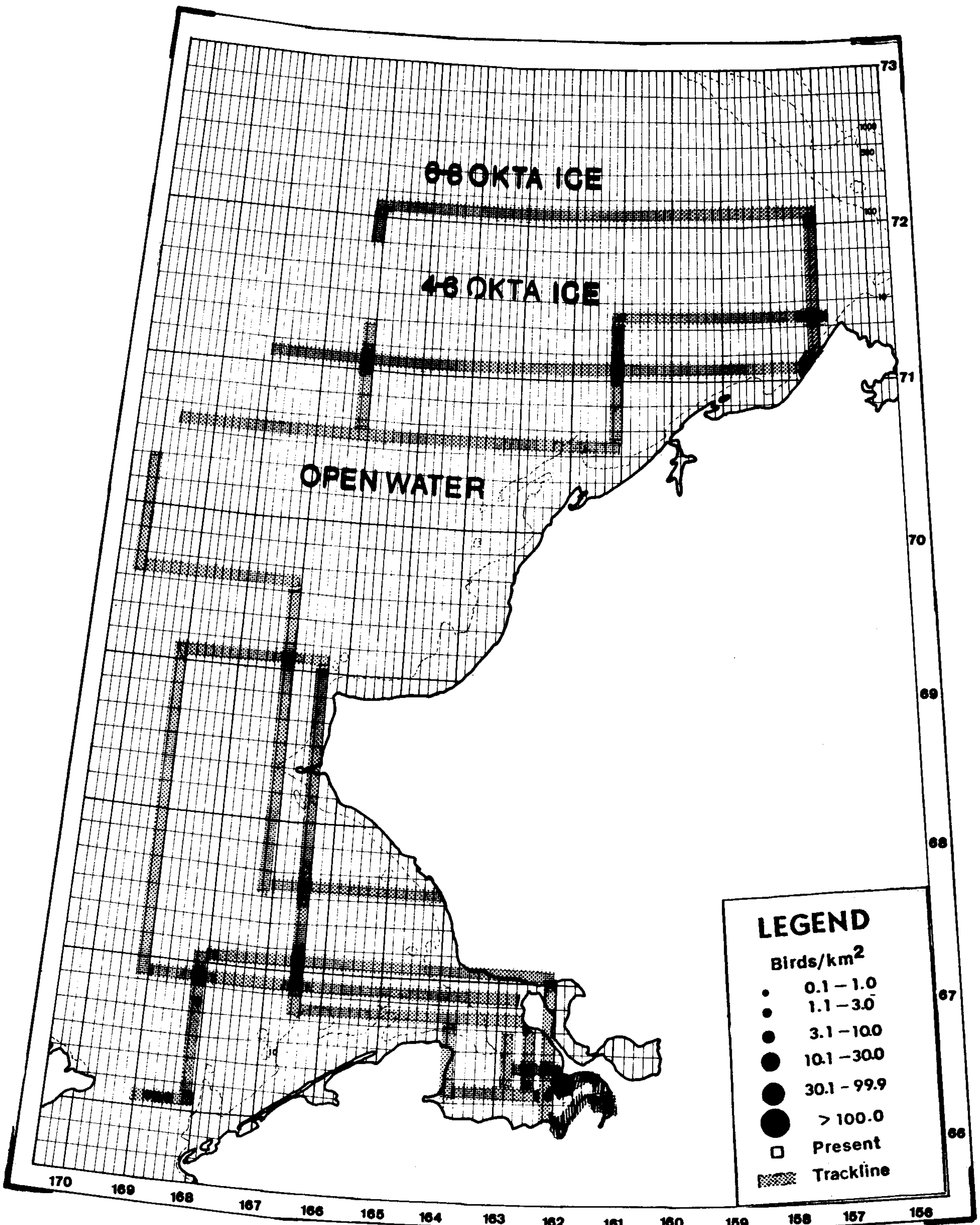

Figure 64. Distribution and abundance of horned puffins in the Chukchi Sea in August. No horned puffins were observed in June.

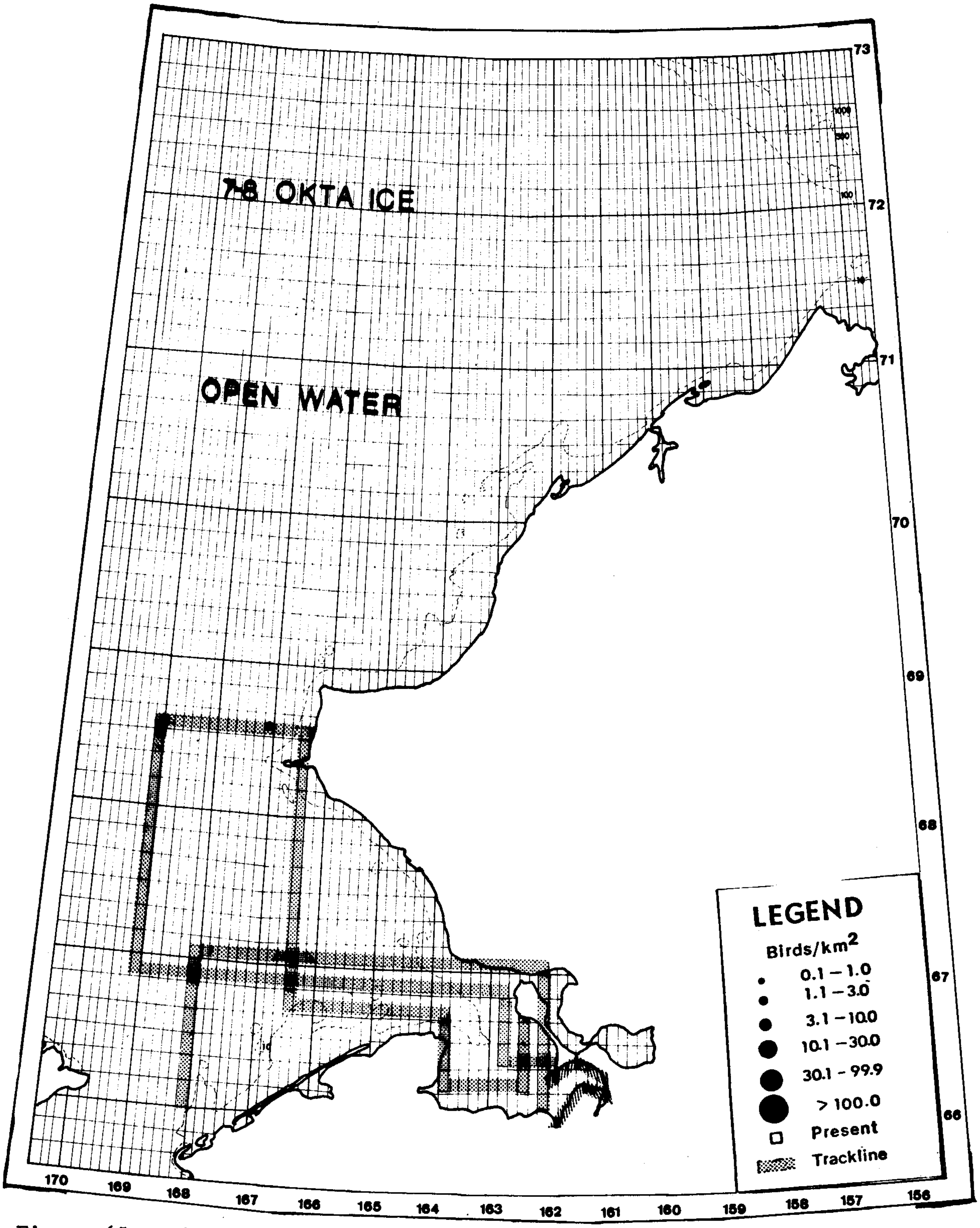

Figure 65. Distribution and abundance of horned puffins in the Chukchi Sea in October.

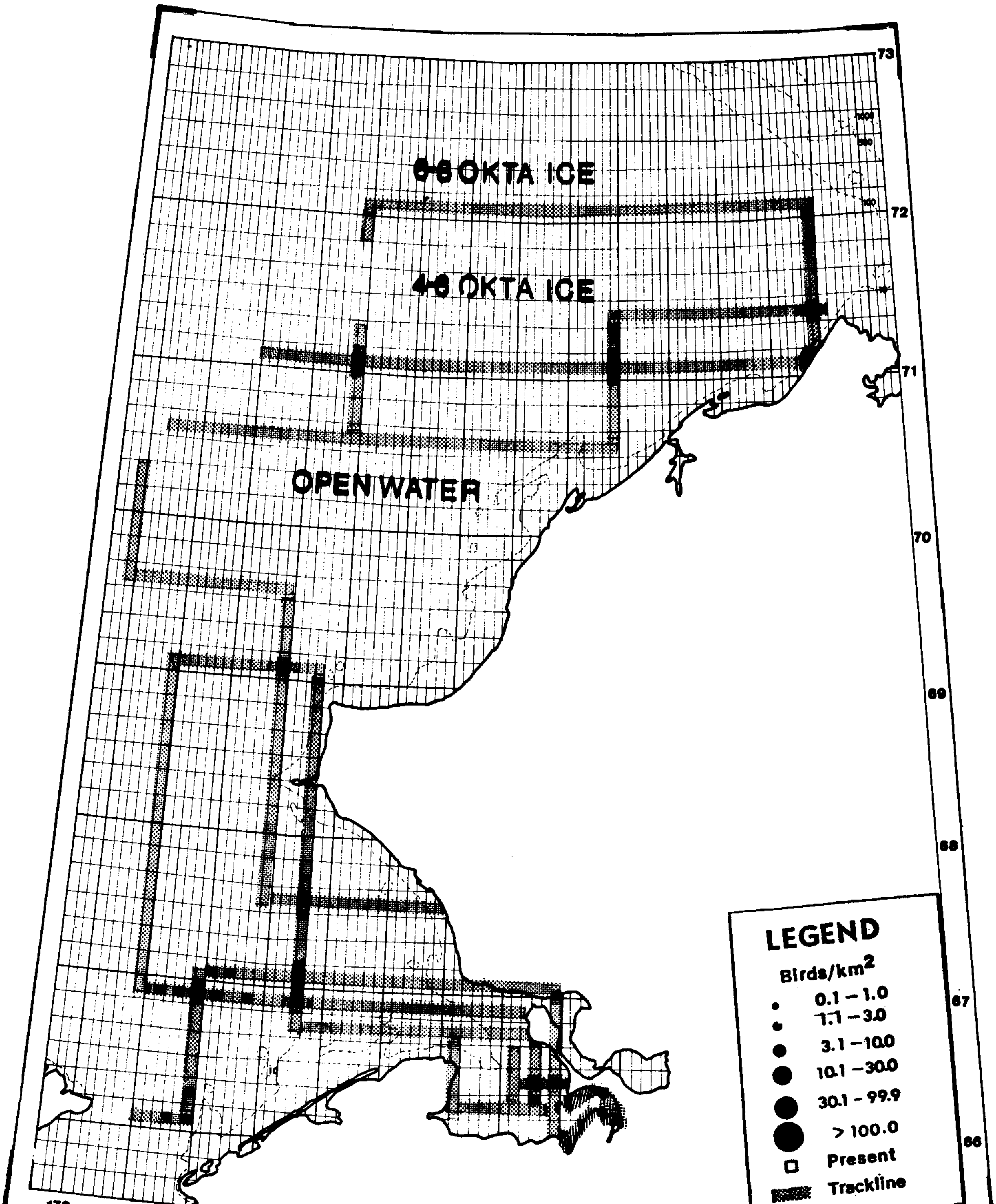

Figure 66. Distribution and abundance of tufted puffins in the Chukchi Sea in August. No tufted puffins were observed in June or October.

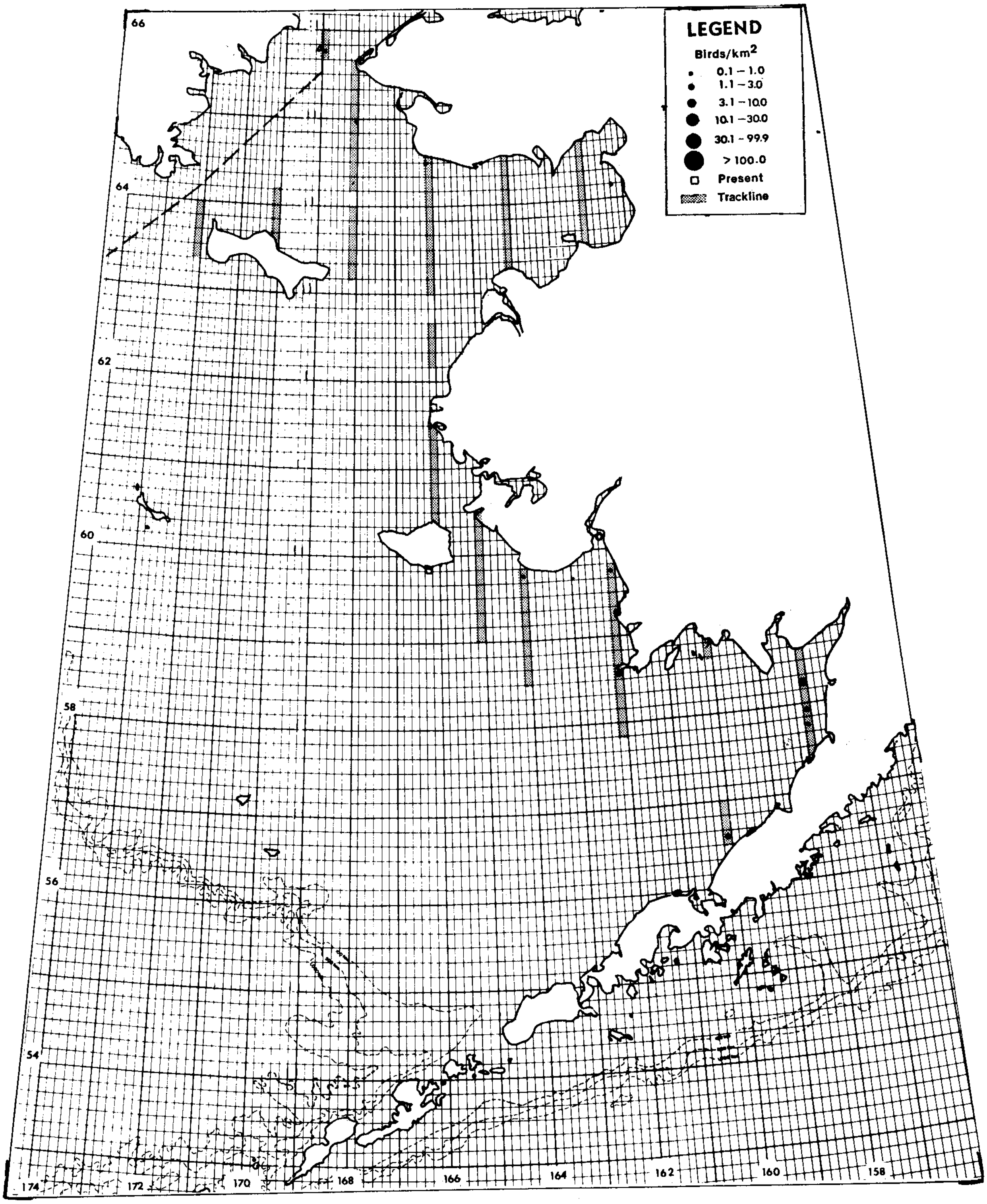

FIGURE 67. DISTRIBUTION AND ABUNDANCE OF LOONS IN THE BERING SEA IN JUNE. NO LOONS WERE OBSERVED IN FEBRUARY OR MARCH.

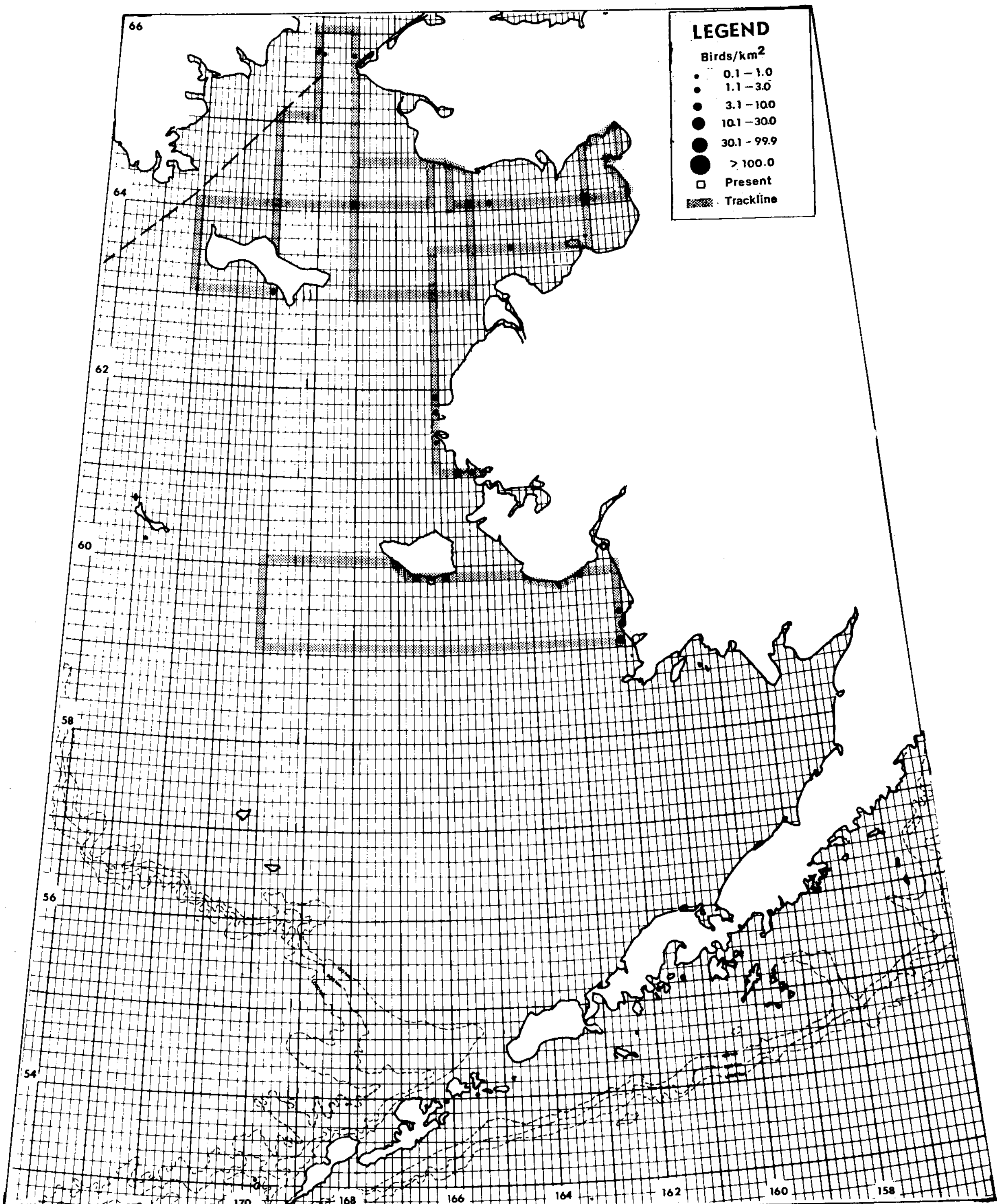

Figure 68. Distribution and abundance of loons in the Bering Sea in August.

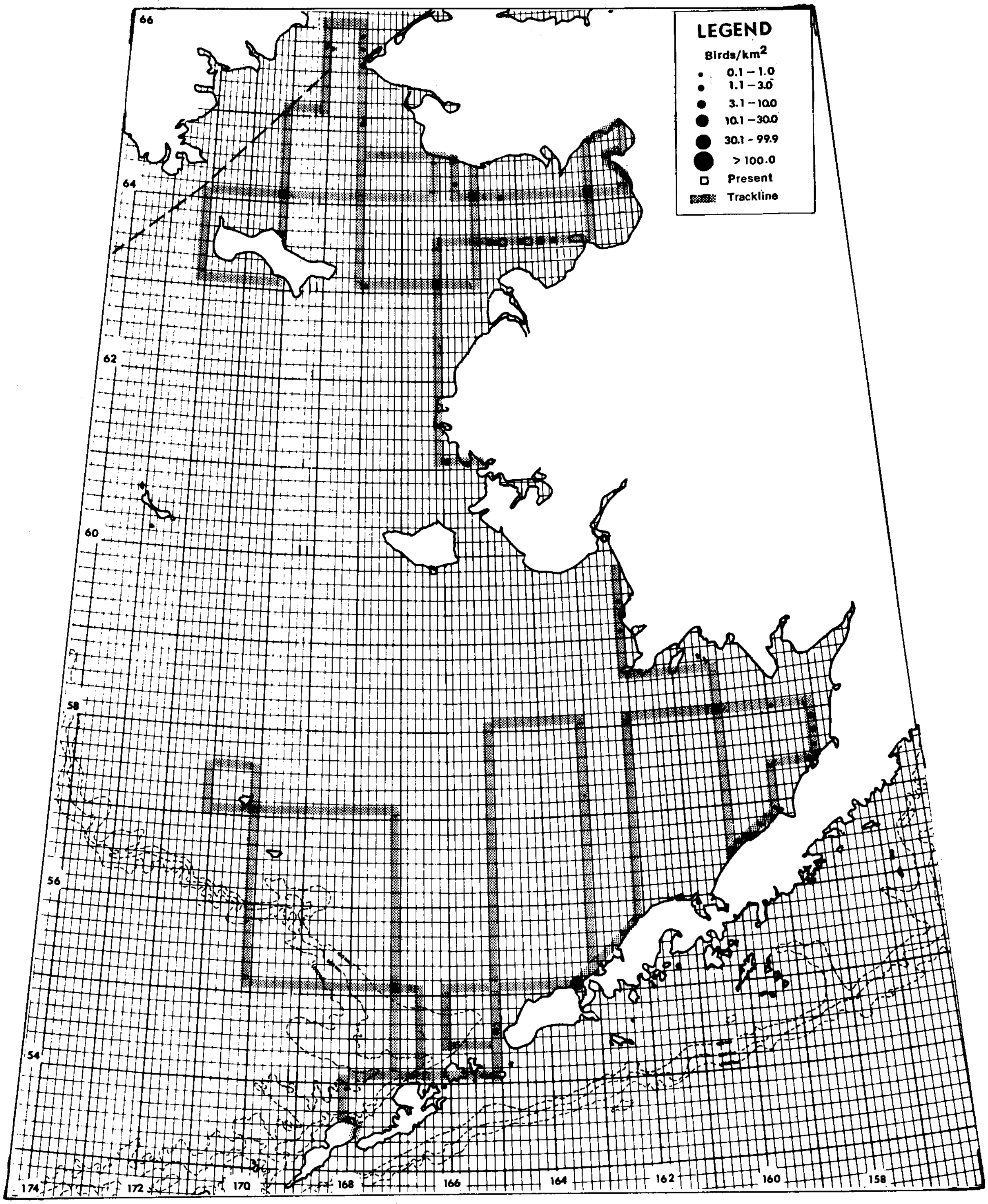

FIGURE 69. DISTRIBUTION AND ABUNDANCE OF LOONS IN THE BERING SEA IN OCTOBER.

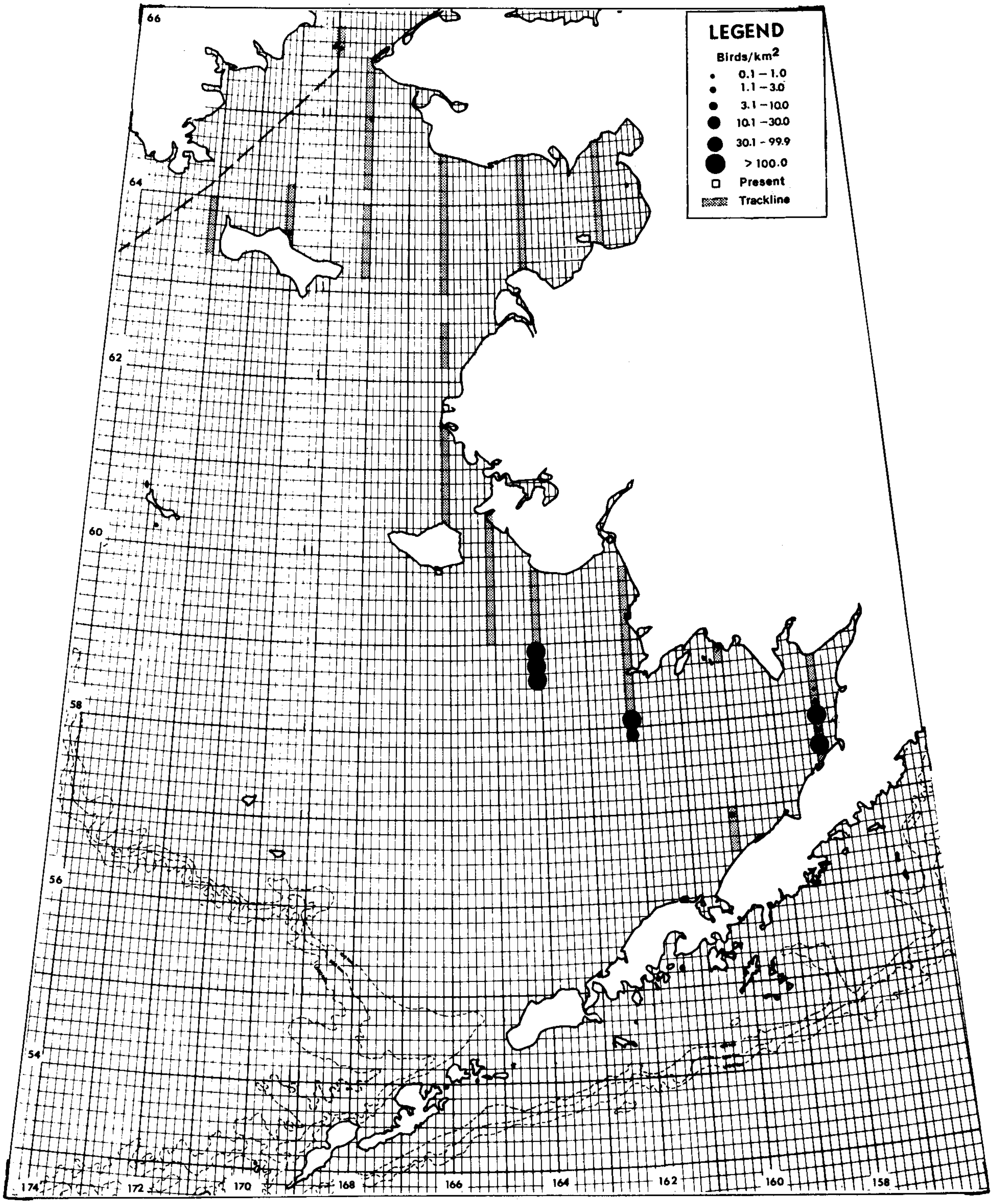

FIGURE 70. DISTRIBUTION AND ABUNDANCE OF SHEARWATERS IN THE BERING SEA IN JUNE. NO SHEARWATERS WERE OBSERVED IN FEBRUARY OR MARCH.

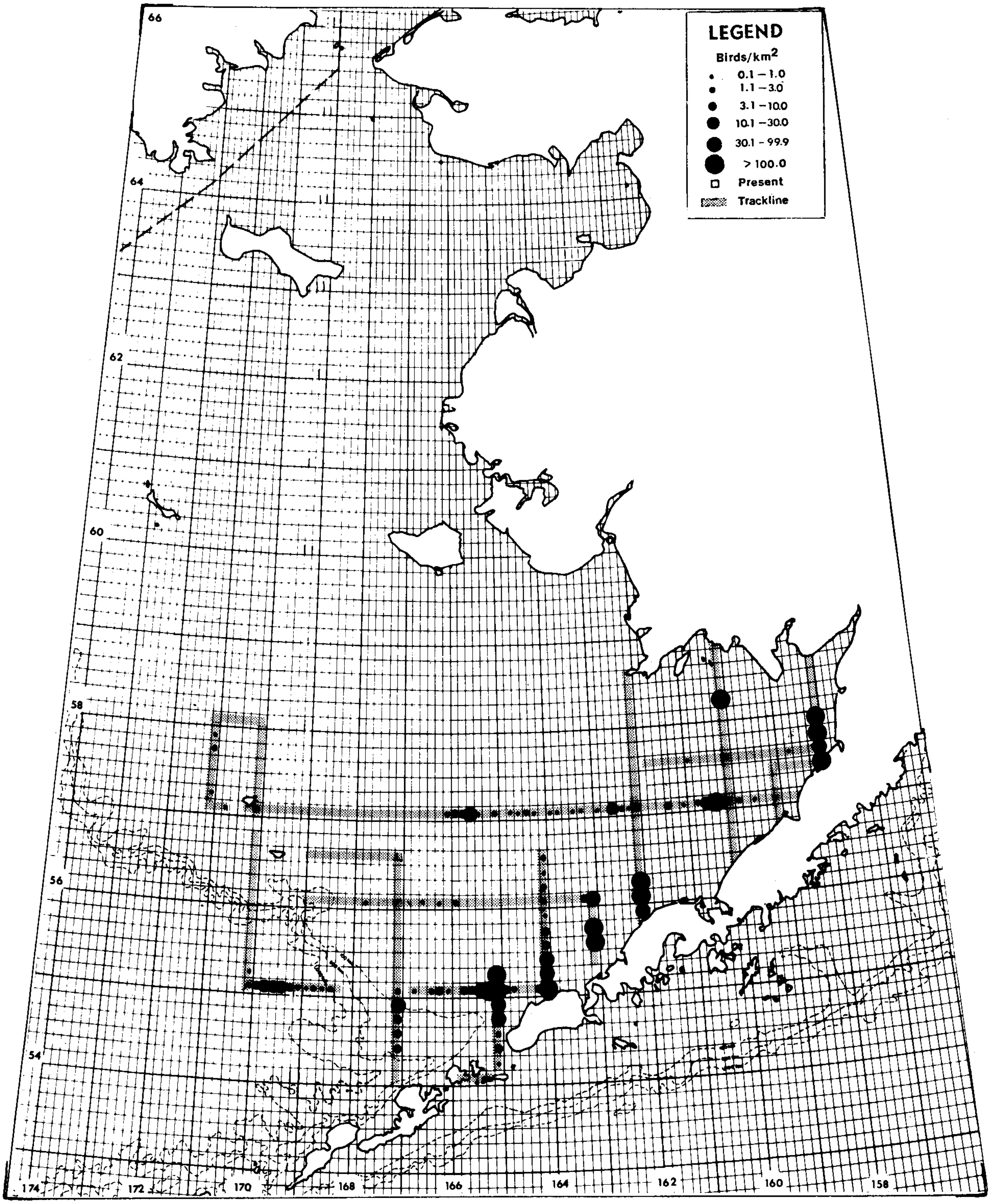

FIGURE 71. DISTRIBUTION AND ABUNDANCE OF SHEARWATERS IN THE BERING SEA IN JULY.

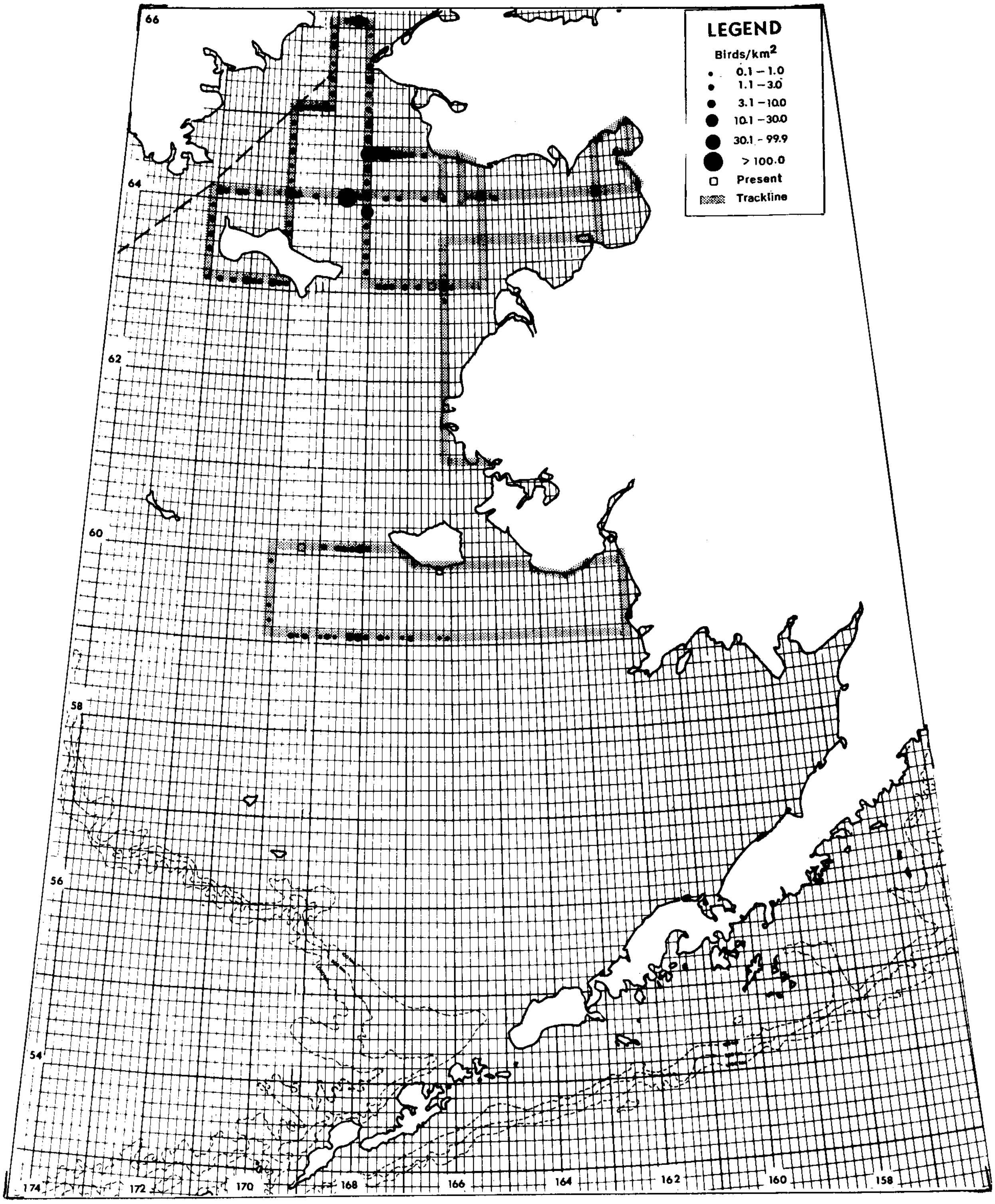

FIGURE 72. DISTRIBUTION AND ABUNDANCE OF SHEARWATERS IN THE BERING SEA IN AUGUST.

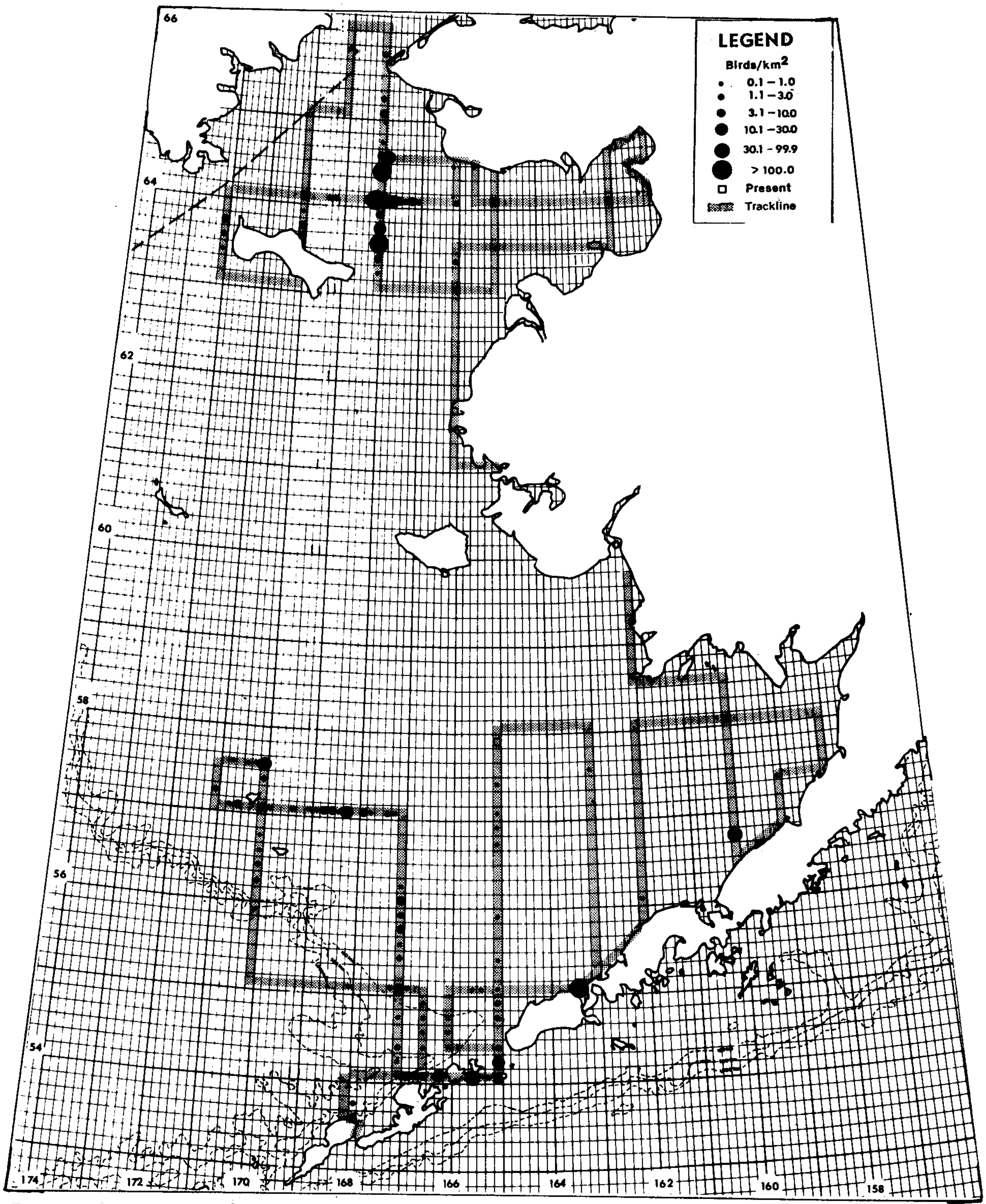

FIGURE 73. DISTRIBUTION AND ABUNDANCE OF SHEARWATERS IN THE BERING SEA IN OCTOBER.

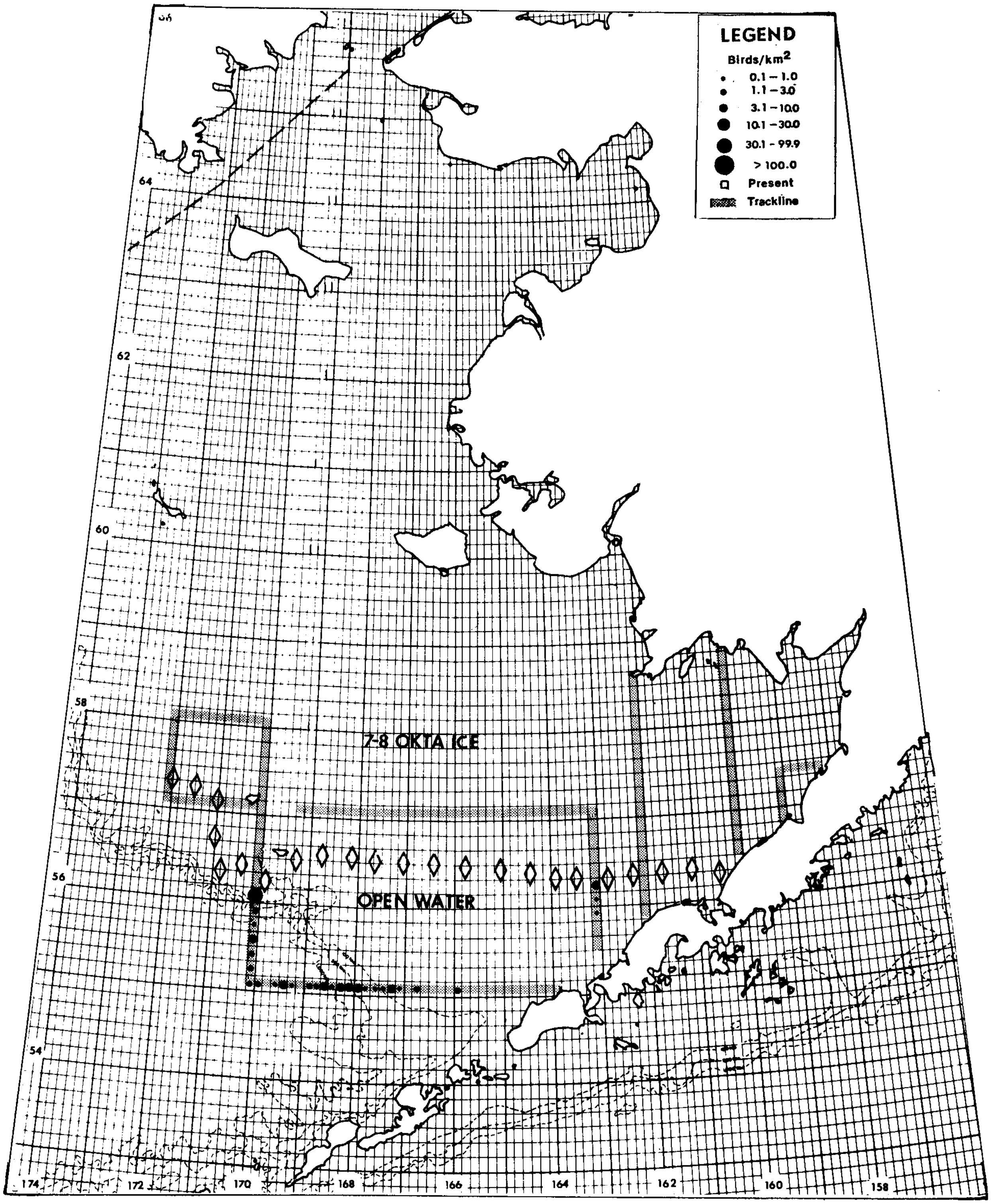

FIGURE 74. DISTRIBUTION AND ABUNDANCE OF FULMARS IN THE BERING SEA IN FEBRUARY.

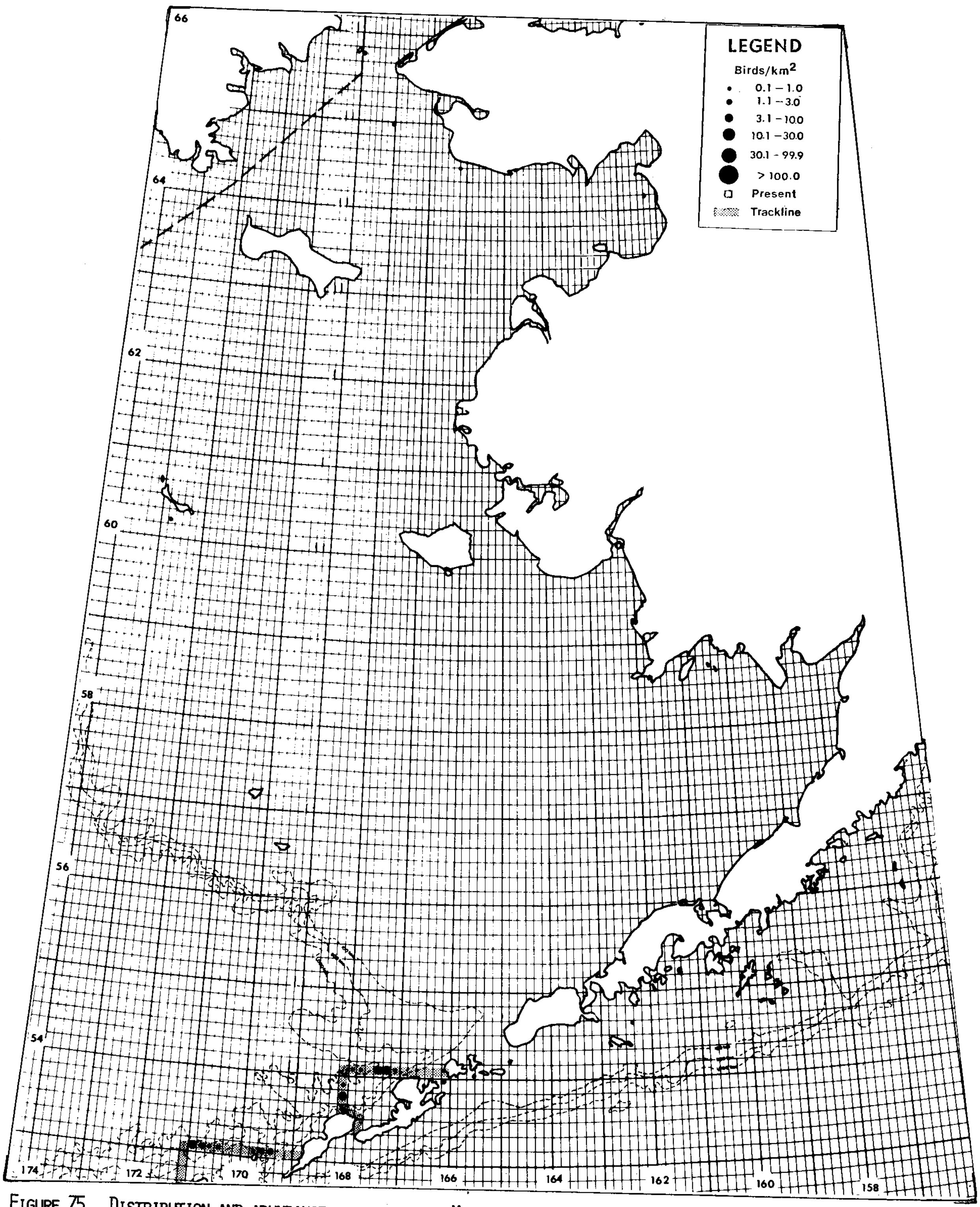

FIGURE 75. DISTRIBUTION AND ABUNDANCE OF FULMARS IN MARCH.

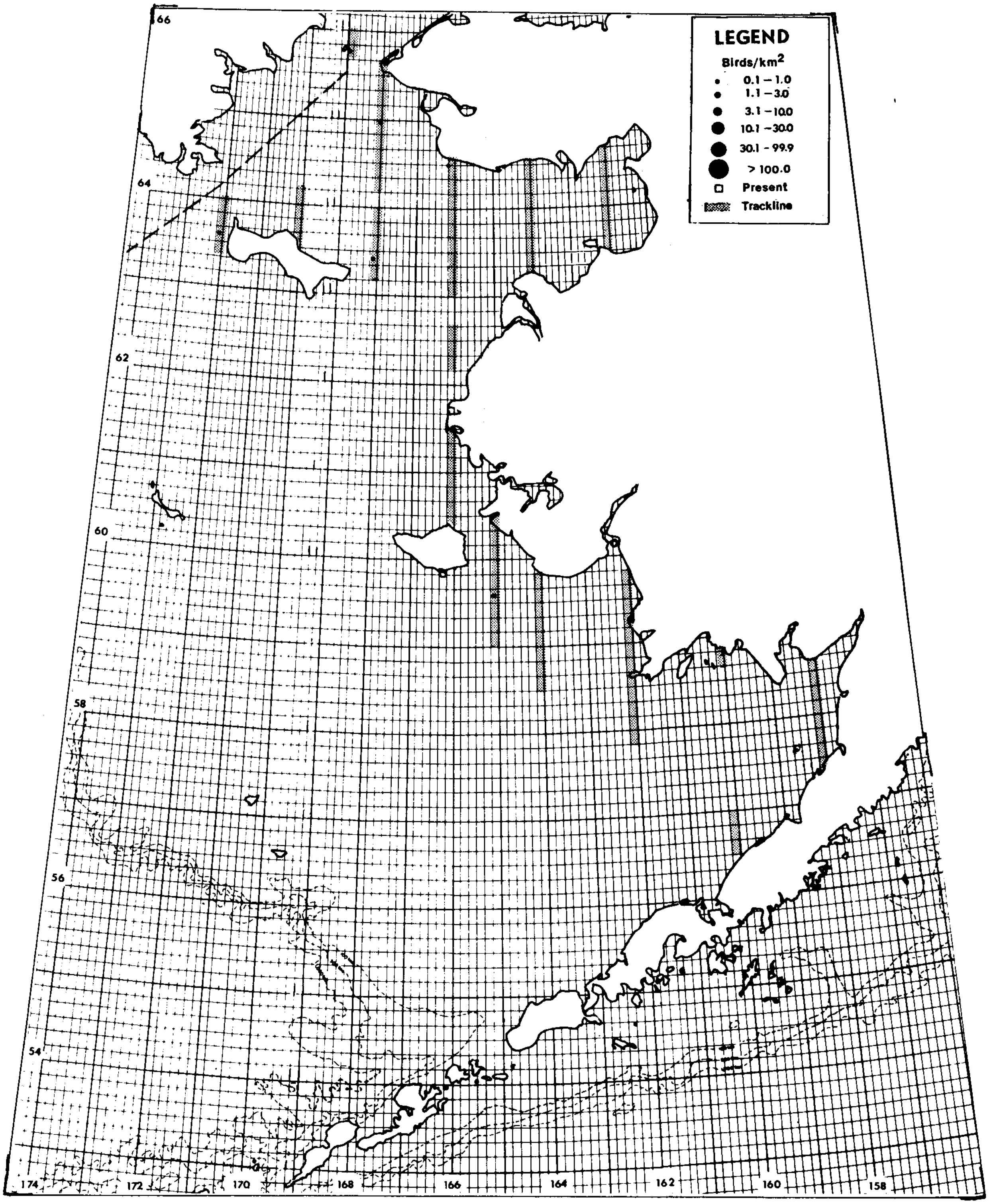

FIGURE 76. DISTRIBUTION AND ABUNDANCE OF FULMARS IN THE BERING SEA IN JUNE.

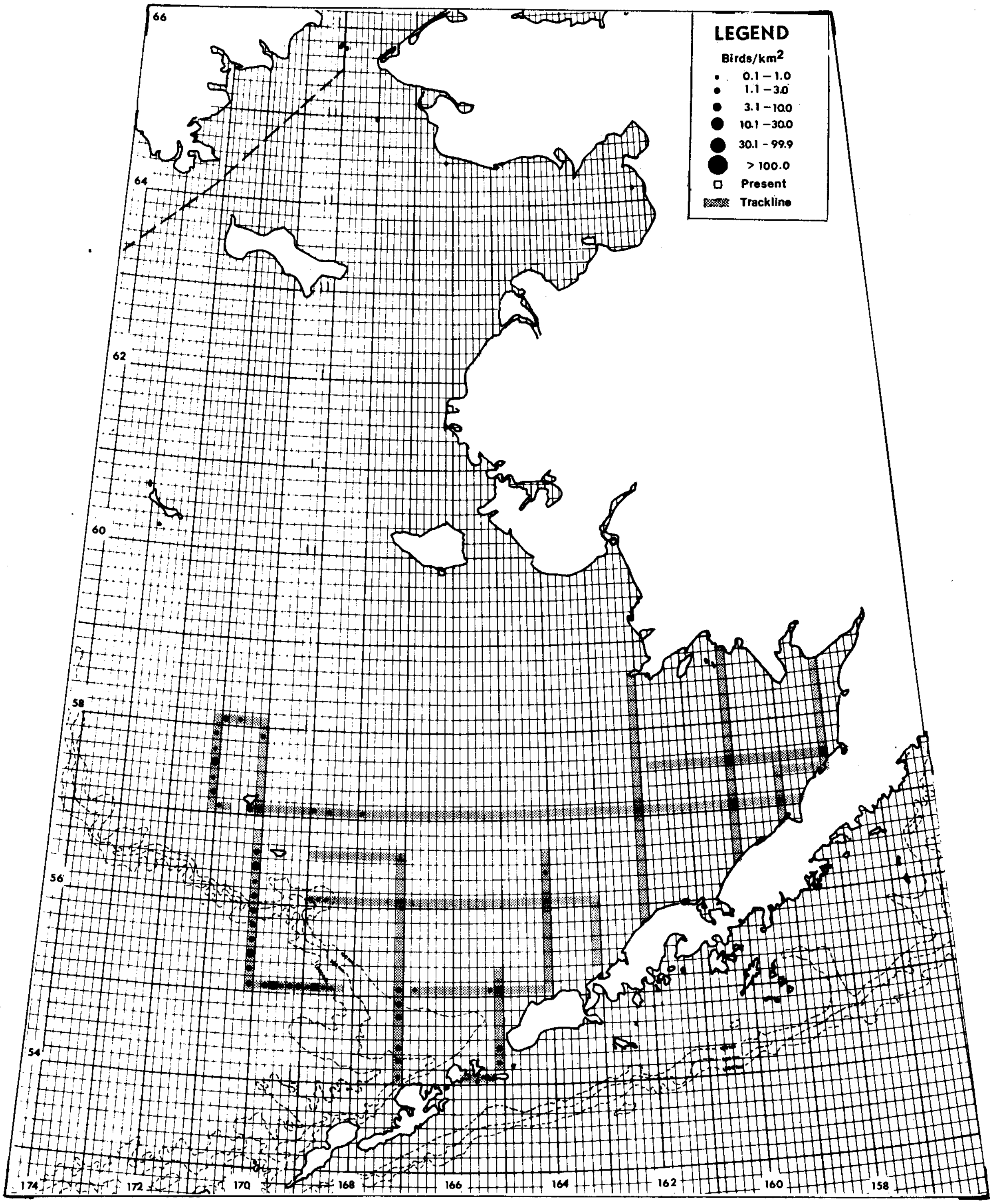

FIGURE 77. DISTRIBUTION AND ABUNDANCE OF FULMARS IN THE BERING SEA IN JULY.

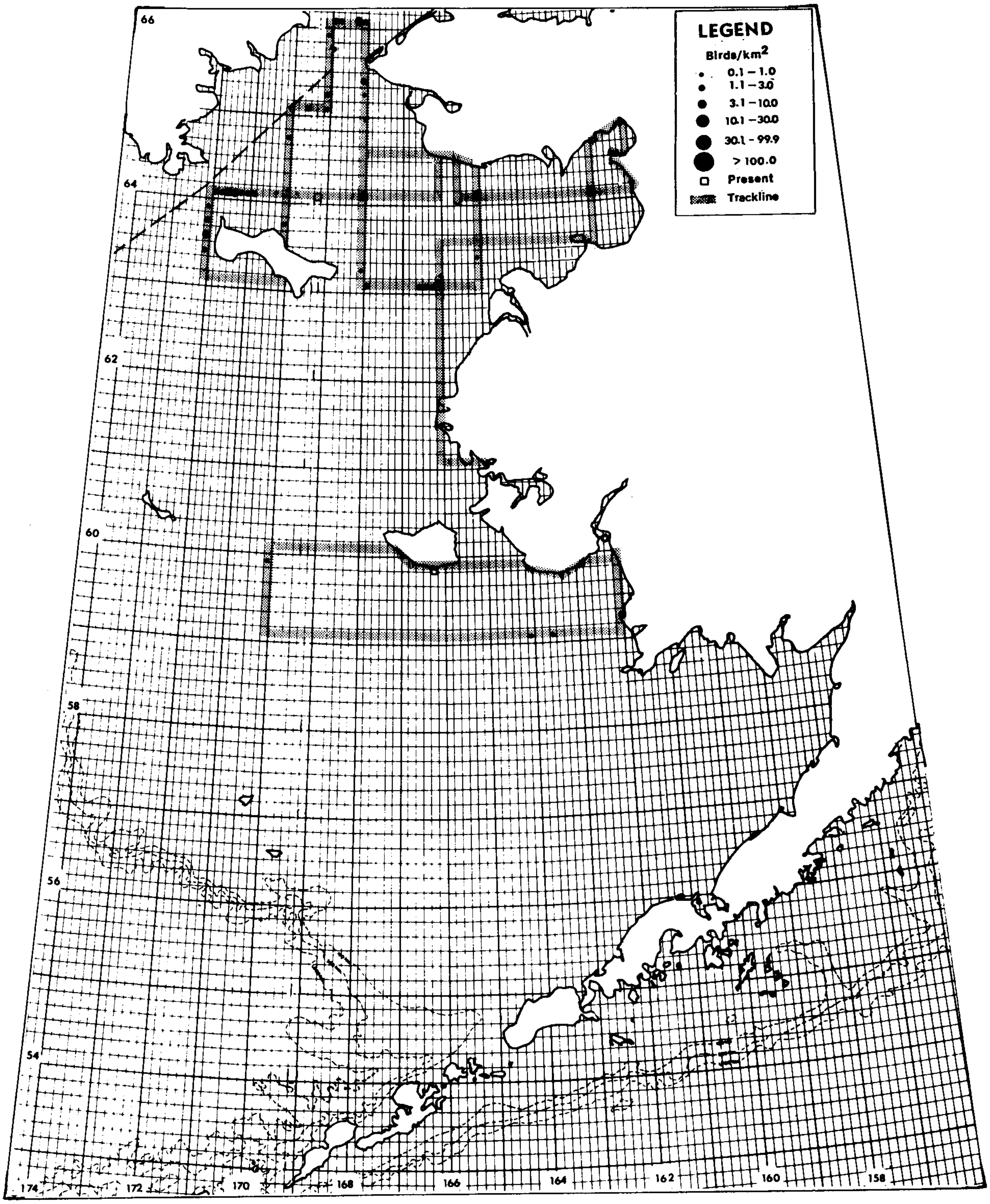

FIGURE 78. DISTRIBUTION AND ABUNDANCE OF FULMARS IN AUGUST.

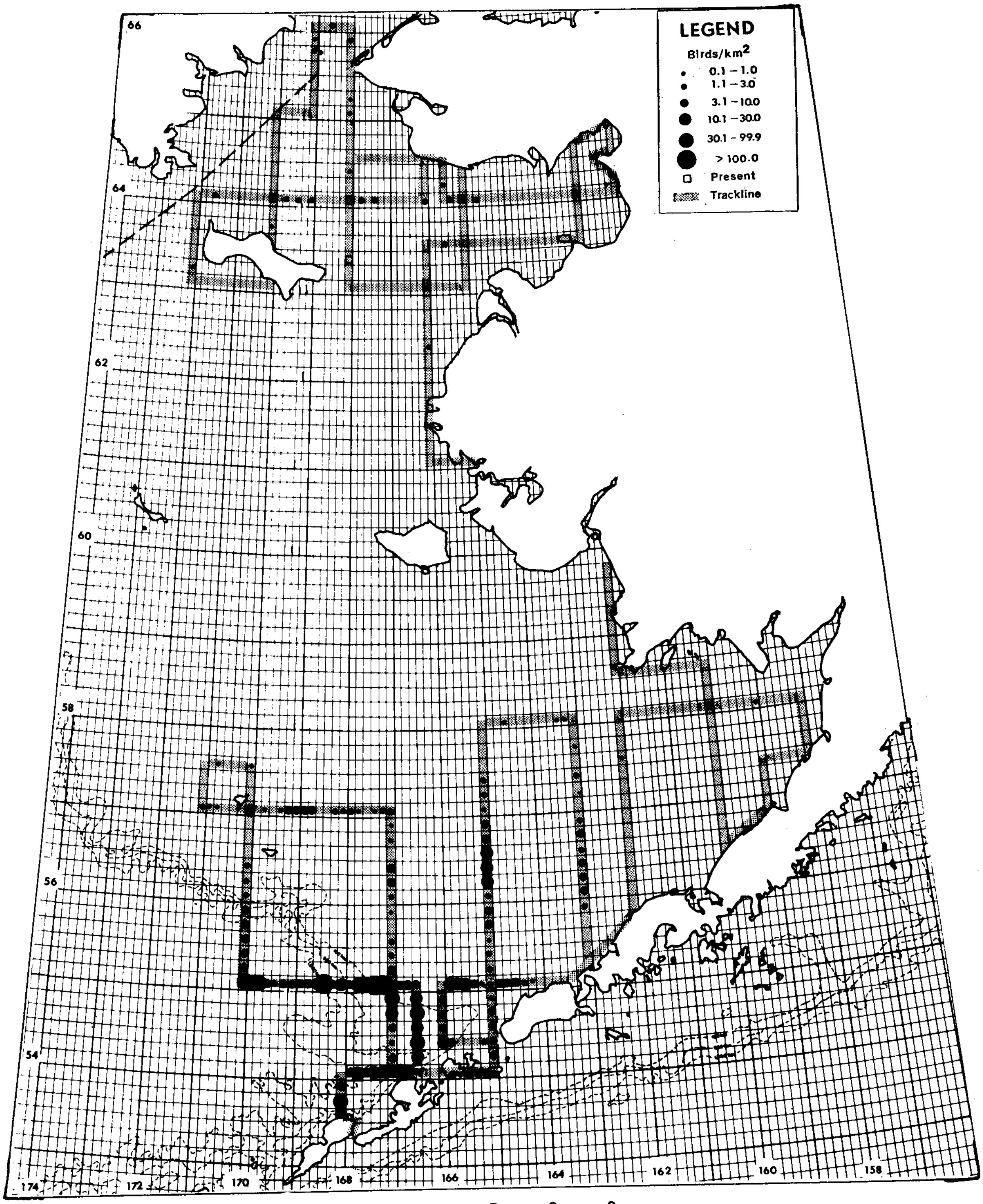

FIGURE 79. DISTRIBUTION AND ABUNDANCE OF FULMARS IN THE BERING SEA IN OCTOBER.

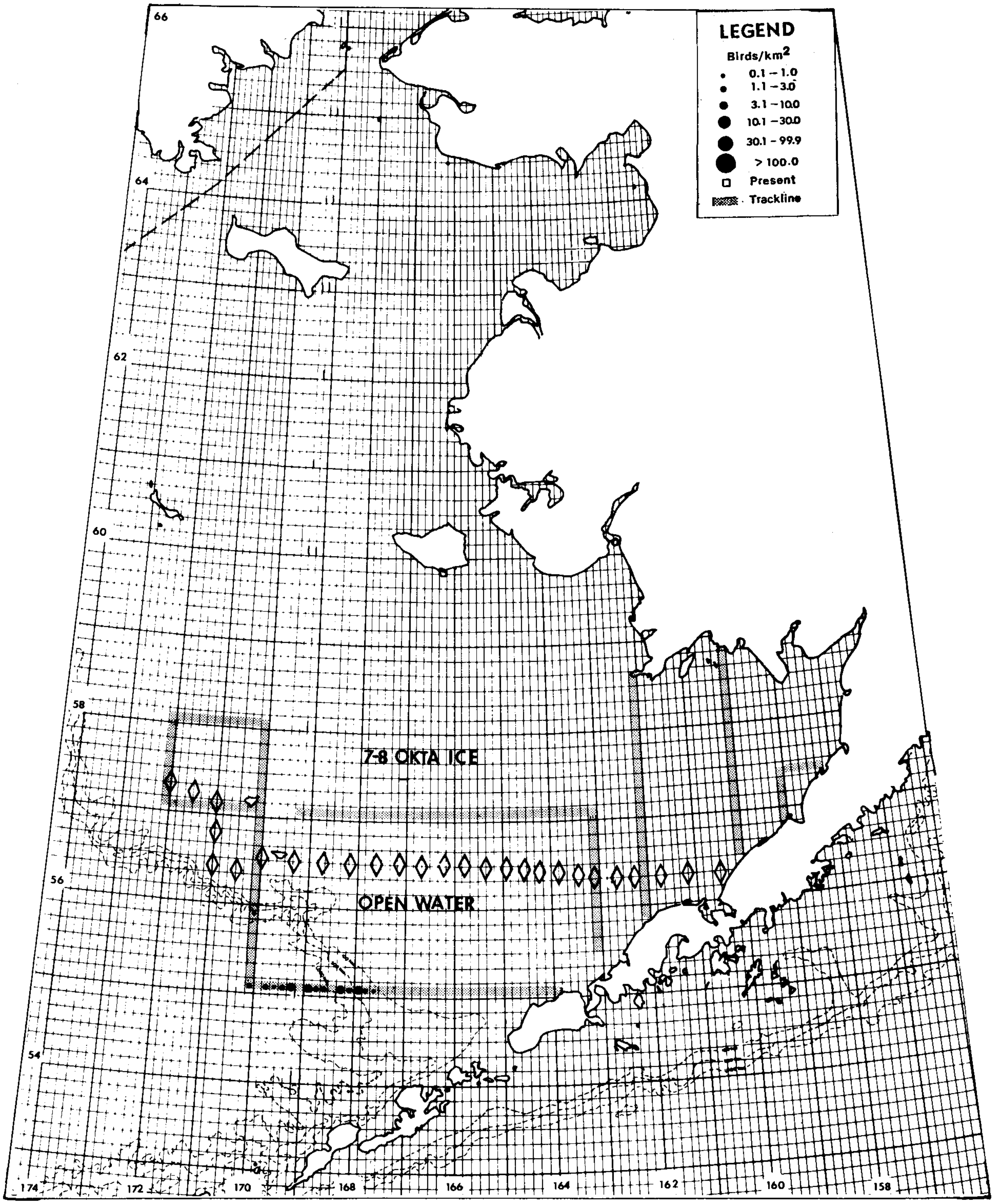

FIGURE 80. DISTRIBUTION AND ABUNDANCE OF FORK-TAILED PETRELS IN THE BERING SEA IN FEBRUARY.

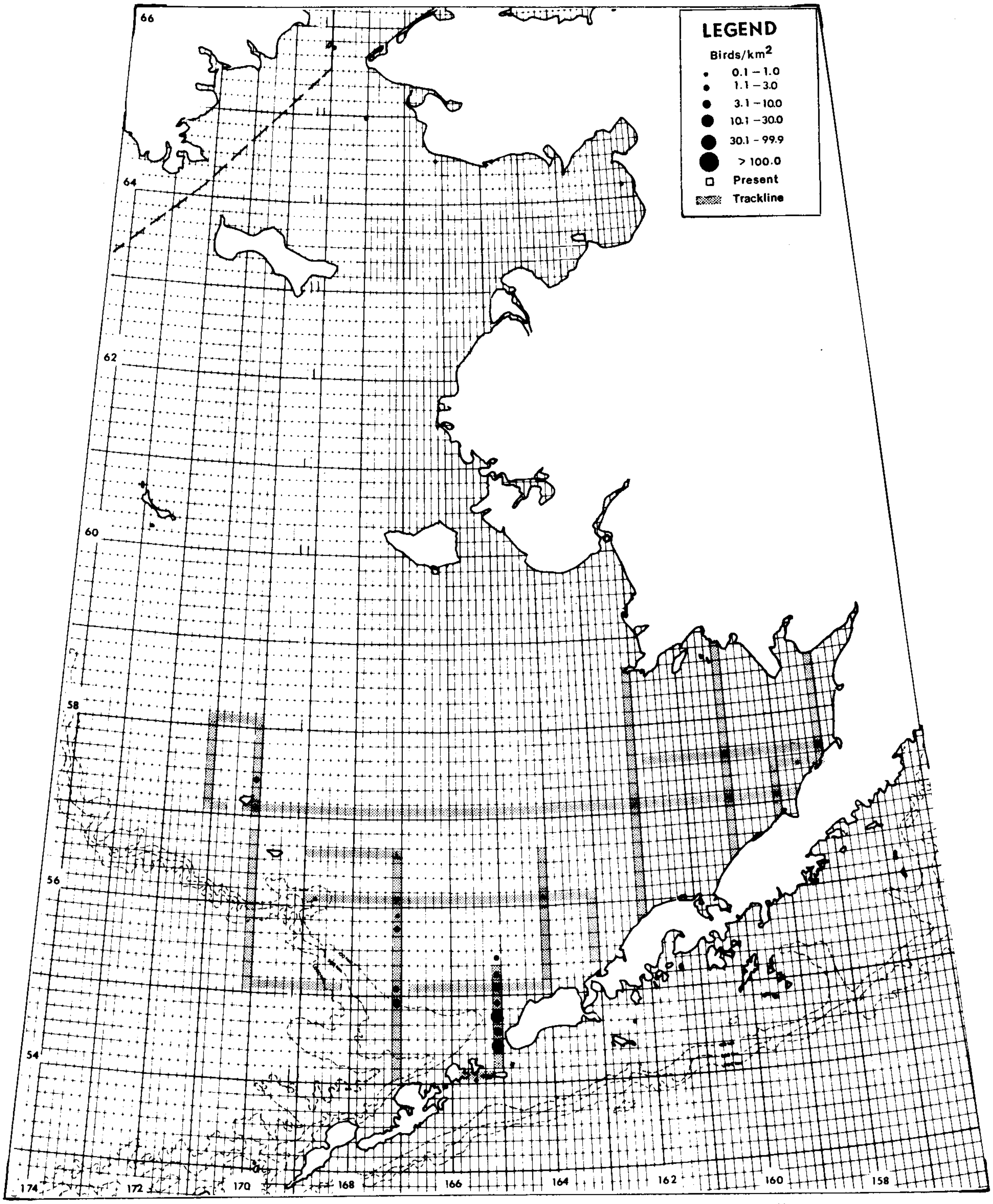

FIGURE 81. DISTRIBUTION AND ABUNDANCE OF FORK-TAILED PETRELS IN THE BERING SEA IN JULY. NO FORK-TAILED PETRELS WERE OBSERVED IN MARCH OR JUNE.

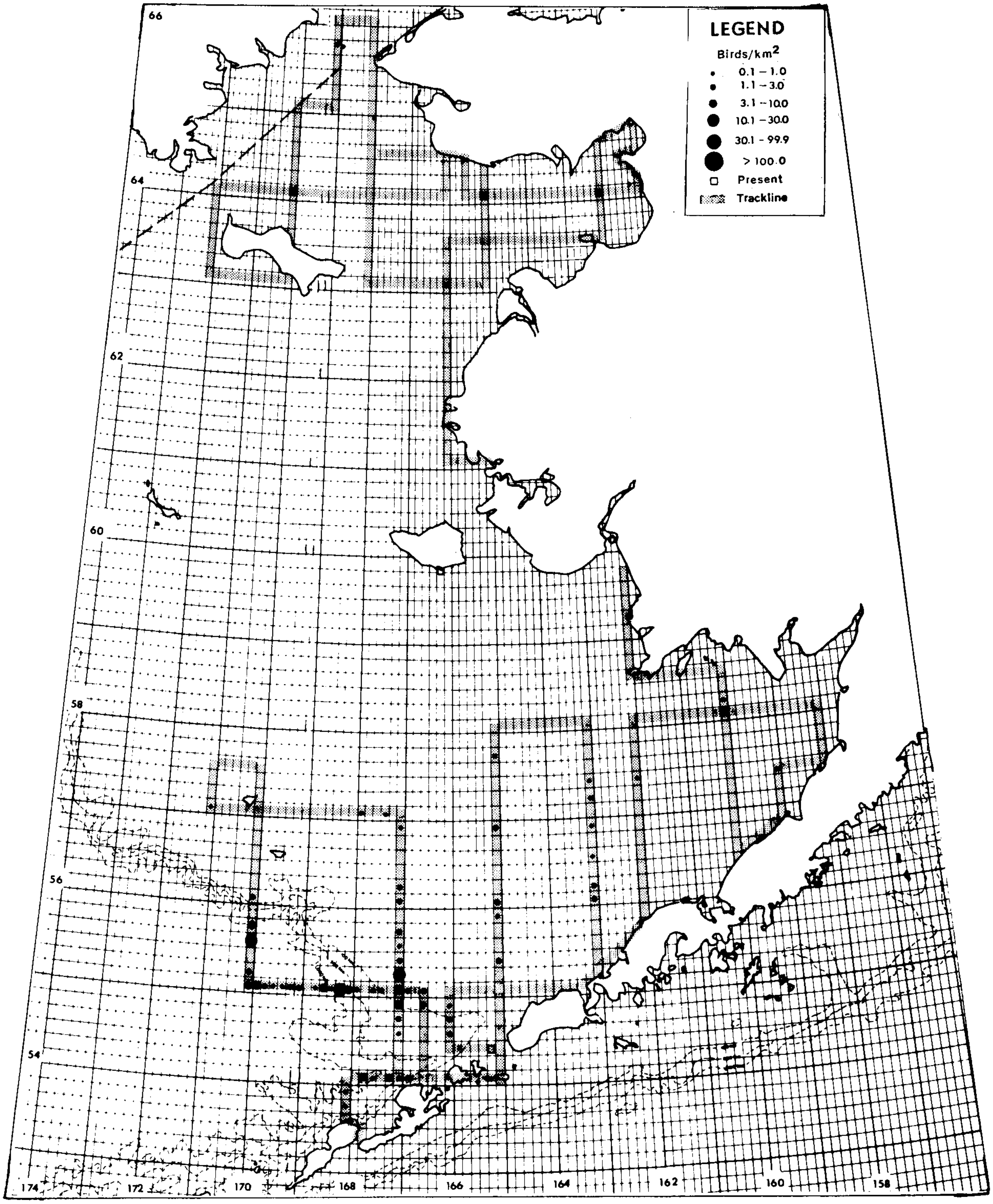

FIGURE 82. DISTRIBUTION AND ABUNDANCE OF FORK-TAILED PETRELS IN THE BERING SEA IN OCTOBER.

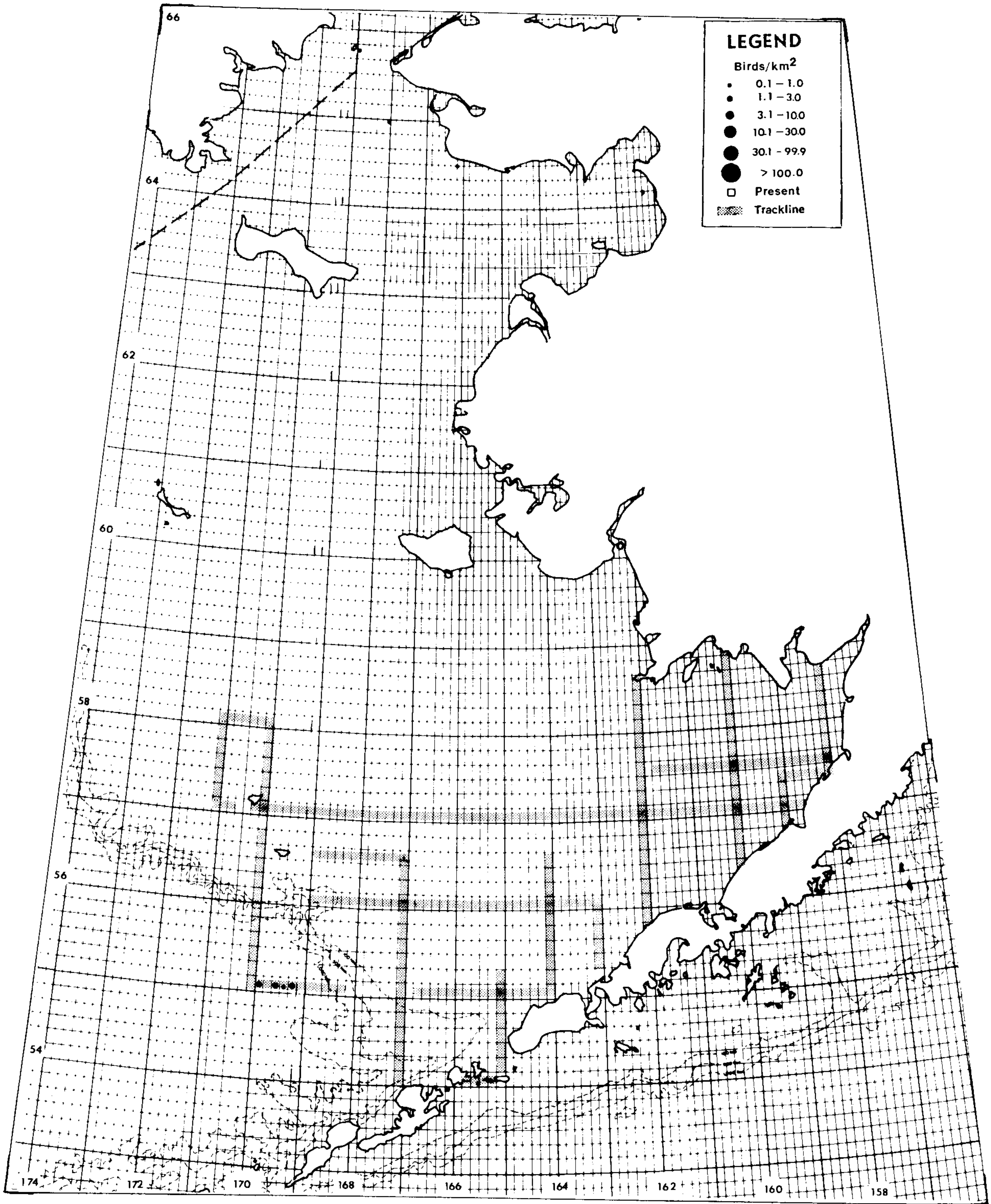

FIGURE 83. DISTRIBUTION AND ABUNDANCE OF LEACH'S PETRELS IN THE BERING SEA IN JULY. NO OBSERVATIONS OF LEACH'S PETRELS WERE MADE IN FEBRUARY, MARCH, JUNE, AUGUST OR OCTOBER.

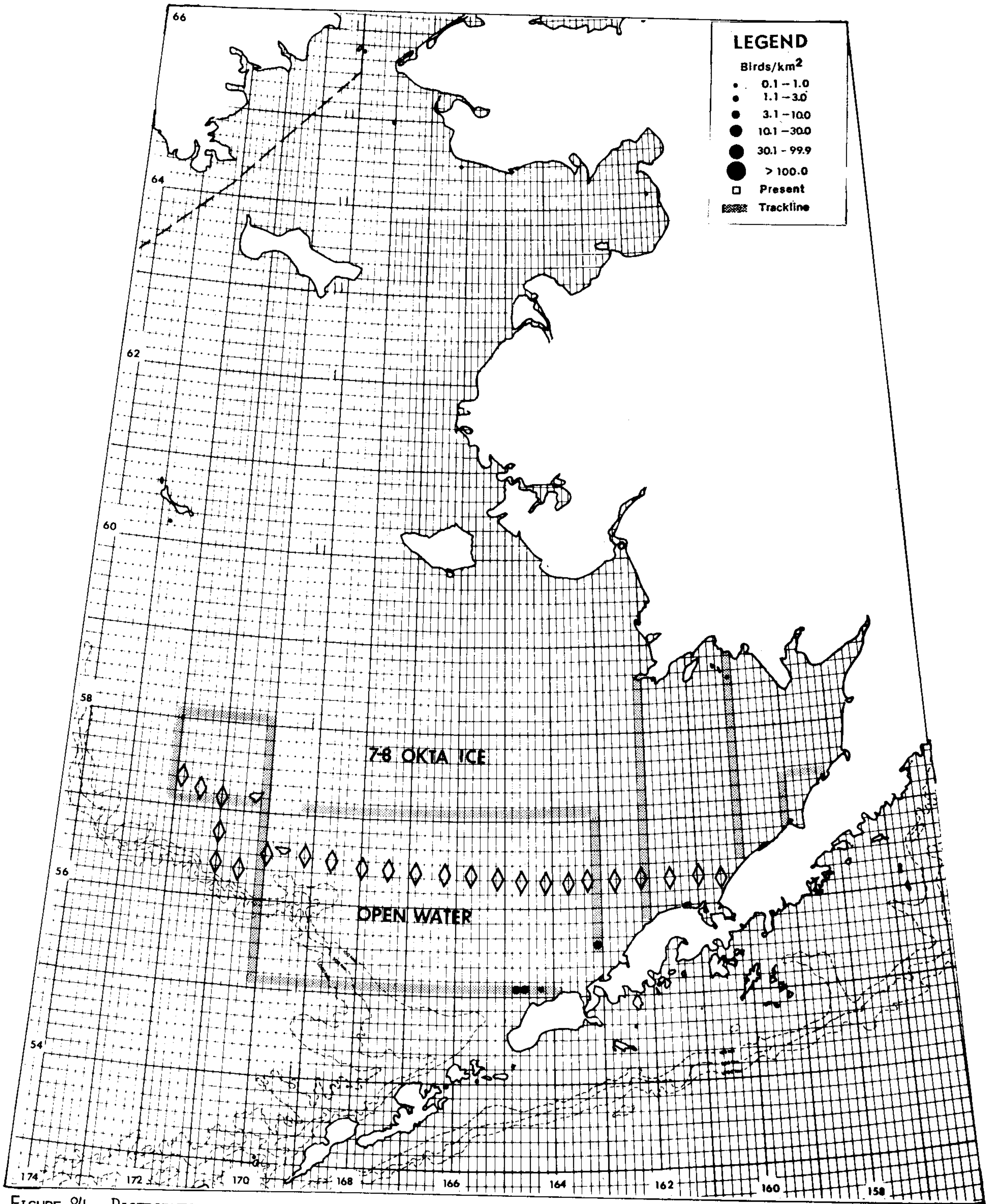

FIGURE 84. DISTRIBUTION AND ABUNDANCE OF CORMORANTS IN THE BERING SEA IN FEBRUARY.

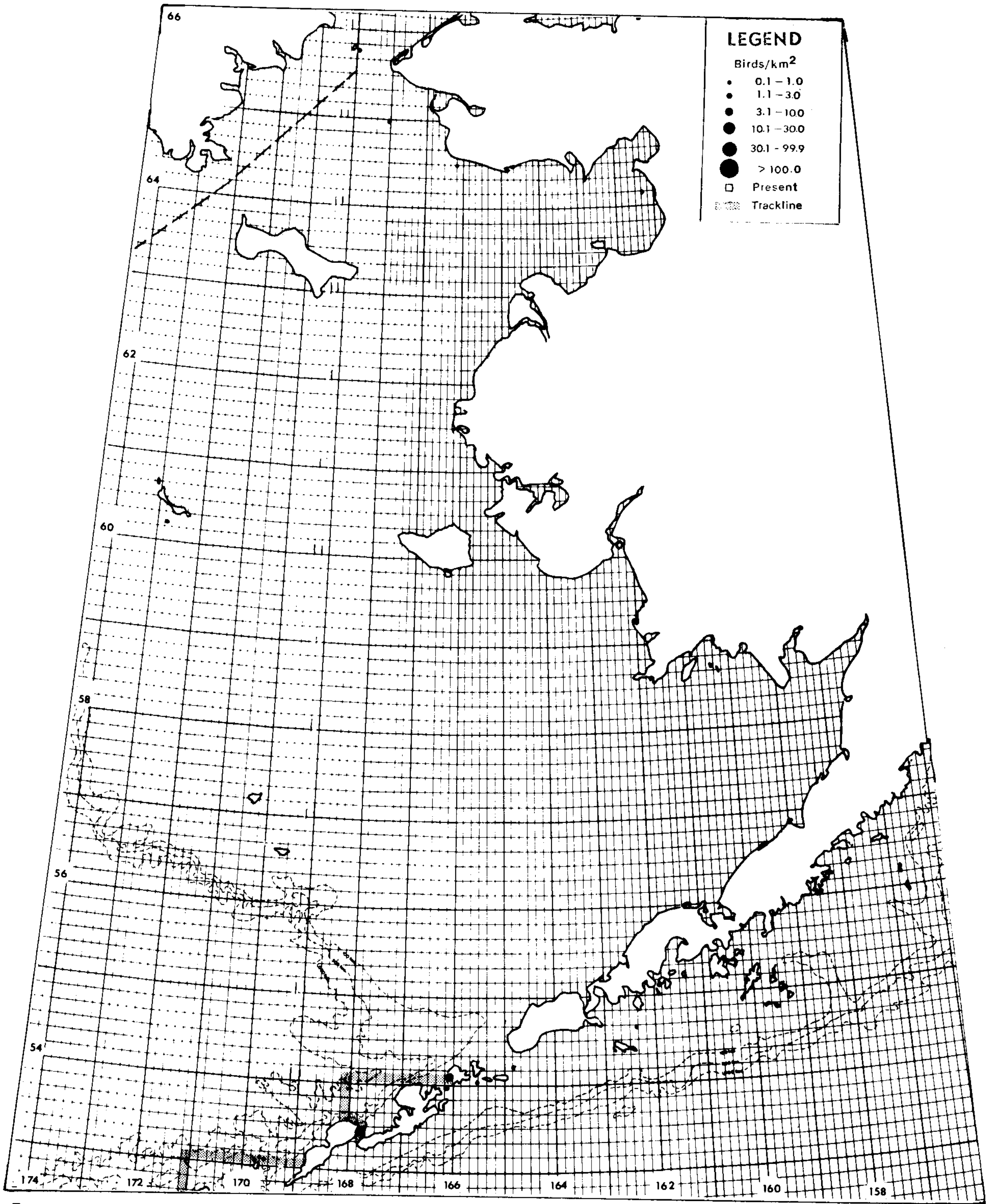

FIGURE 85. DISTRIBUTION AND ABUNDANCE OF CORMORANTS IN THE BERING SEA IN MARCH.

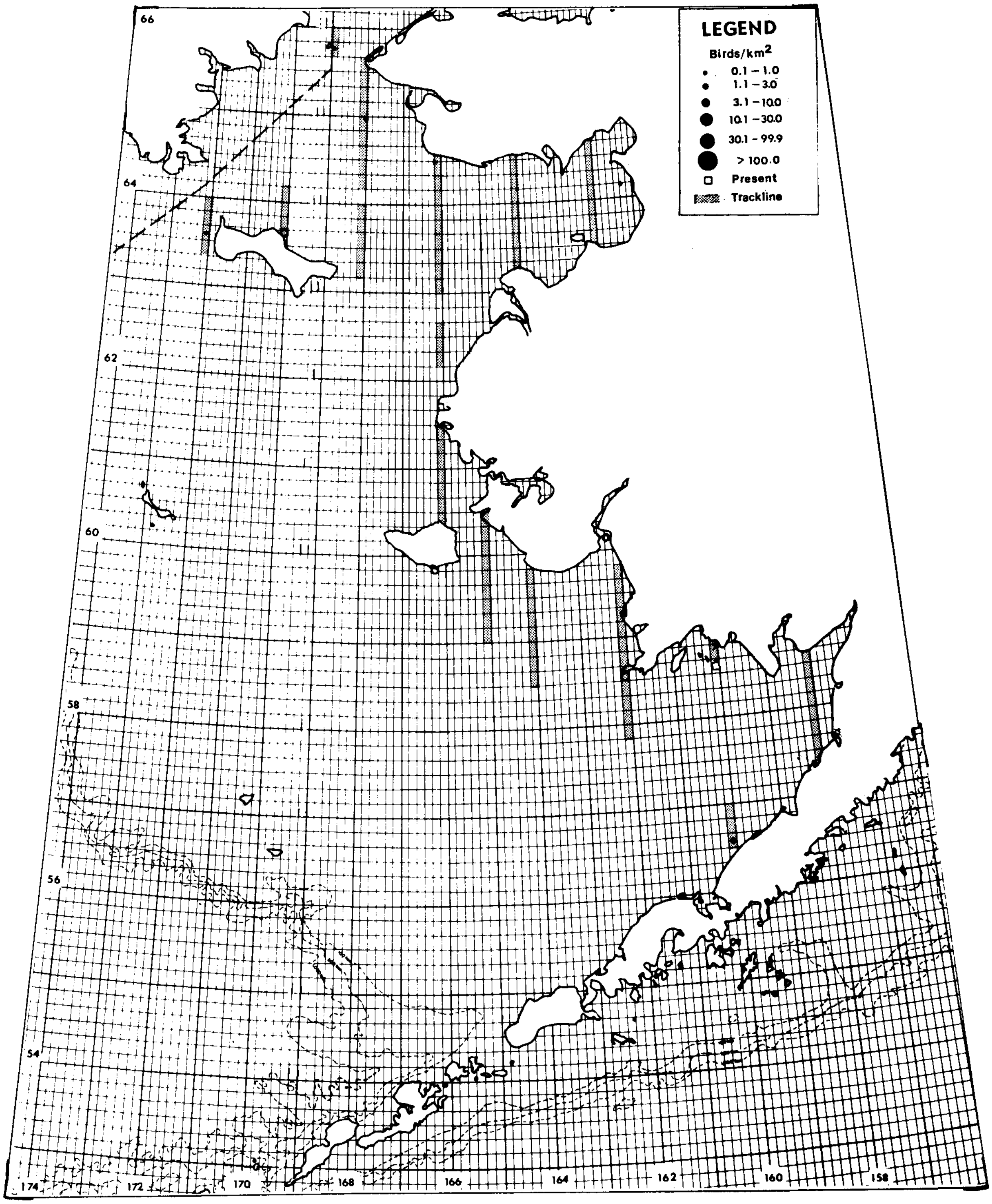

FIGURE 86. DISTRIBUTION AND ABUNDANCE OF CORMORANTS IN THE BERING SEA IN JUNE.

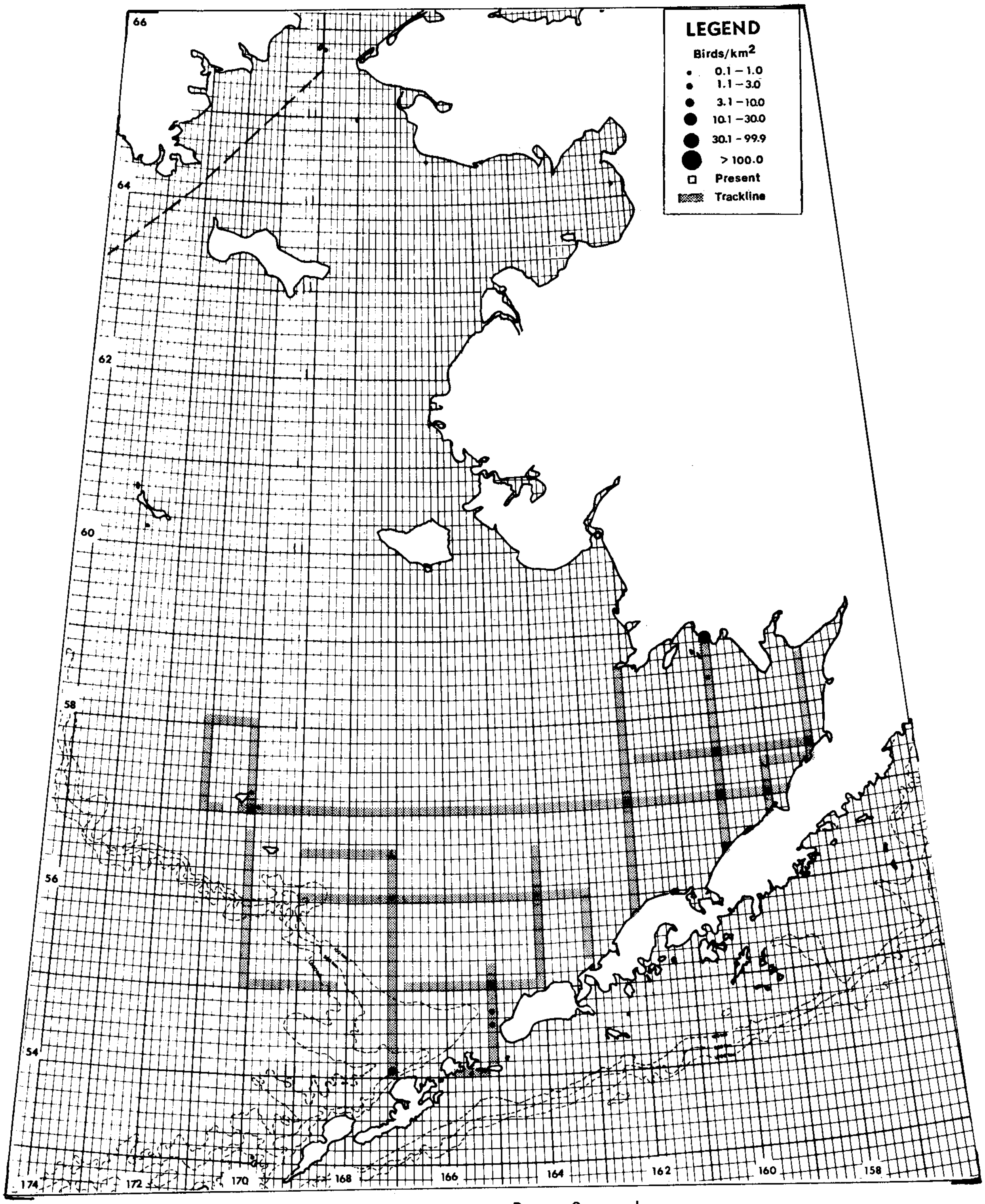

FIGURE 87. DISTRIBUTION AND ABUNDANCE OF CORMORANTS IN THE BERING SEA IN JULY.

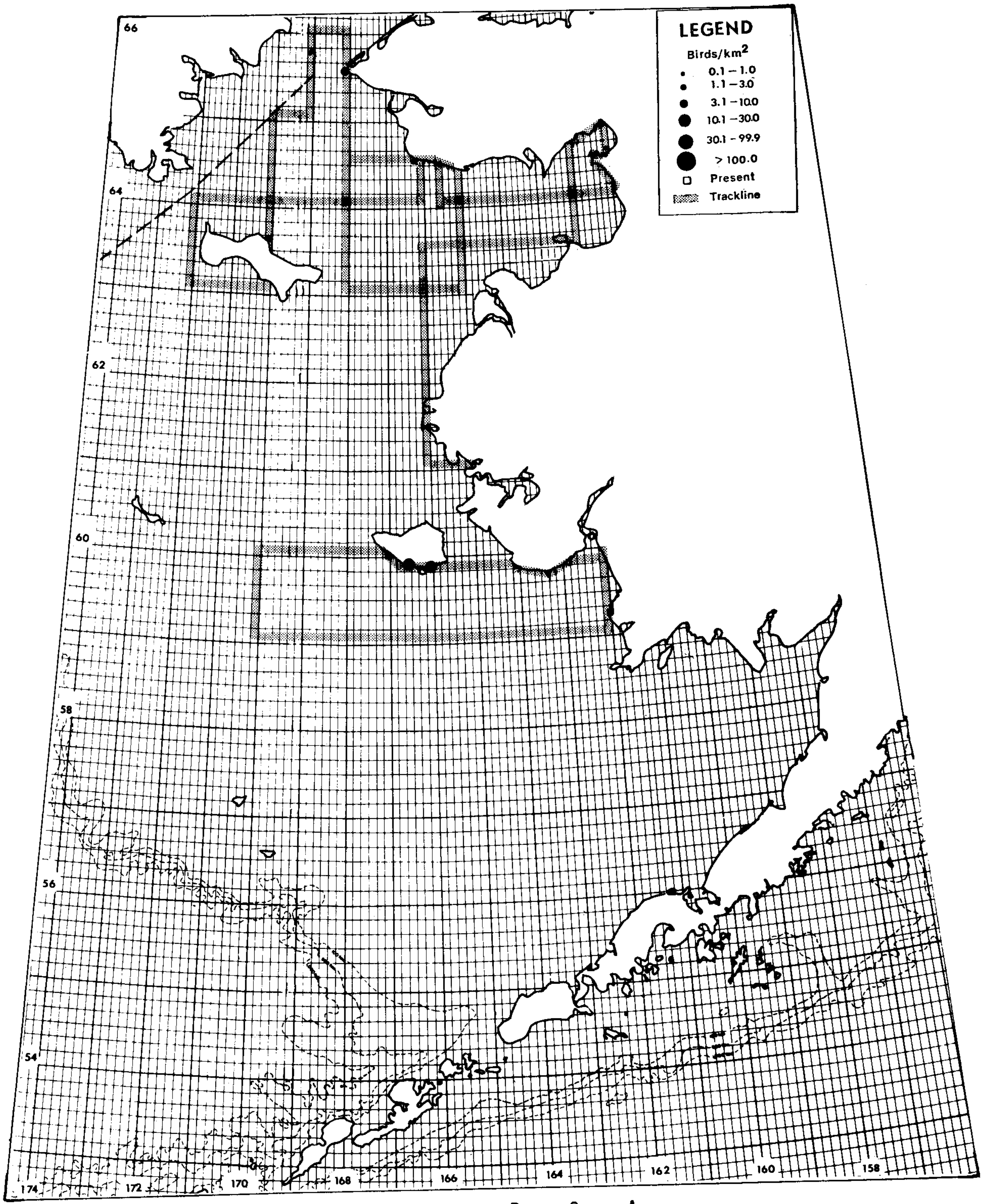

FIGURE 88. DISTRIBUTION AND ABUNDANCE OF CORMORANTS IN THE BERING SEA IN AUGUST.

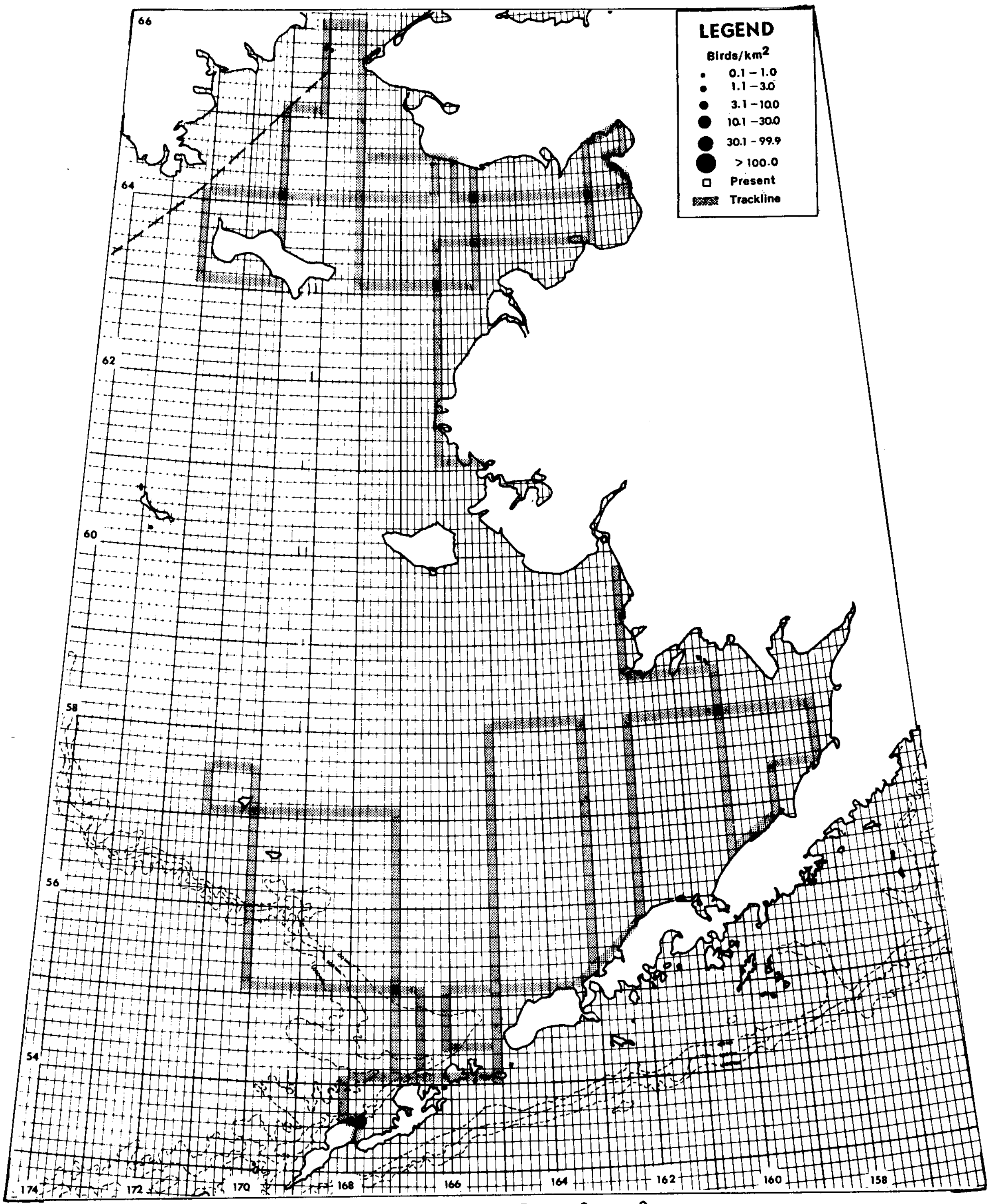

FIGURE 89A. DISTRIBUTION AND ABUNDANCE OF CORMORANTS IN THE BERING SEA IN OCTOBER.

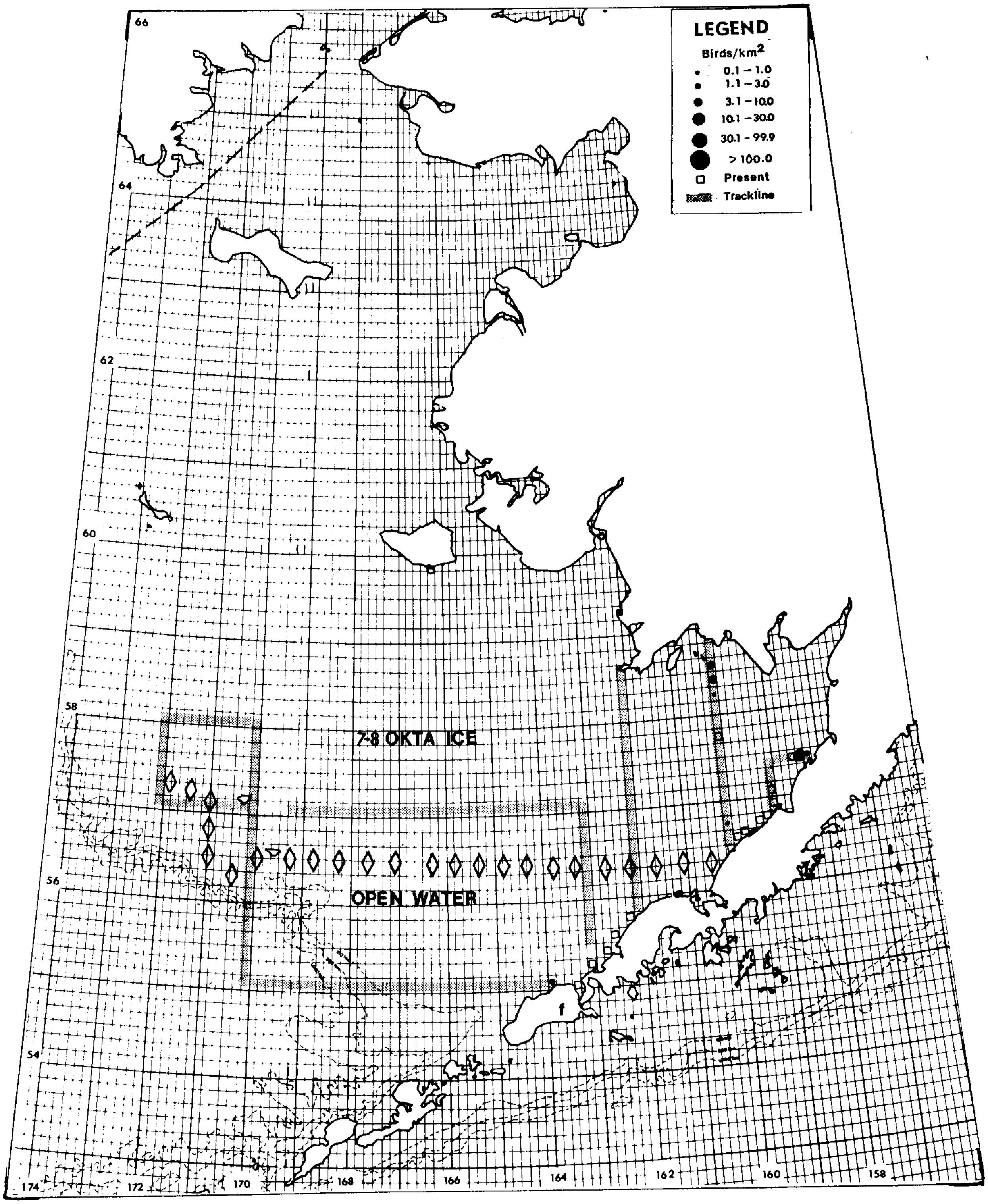

FIGURE 89. DISTRIBUTION AND ABUNDANCE OF OLDSQUAW IN THE BERING SEA IN FEBRUARY.

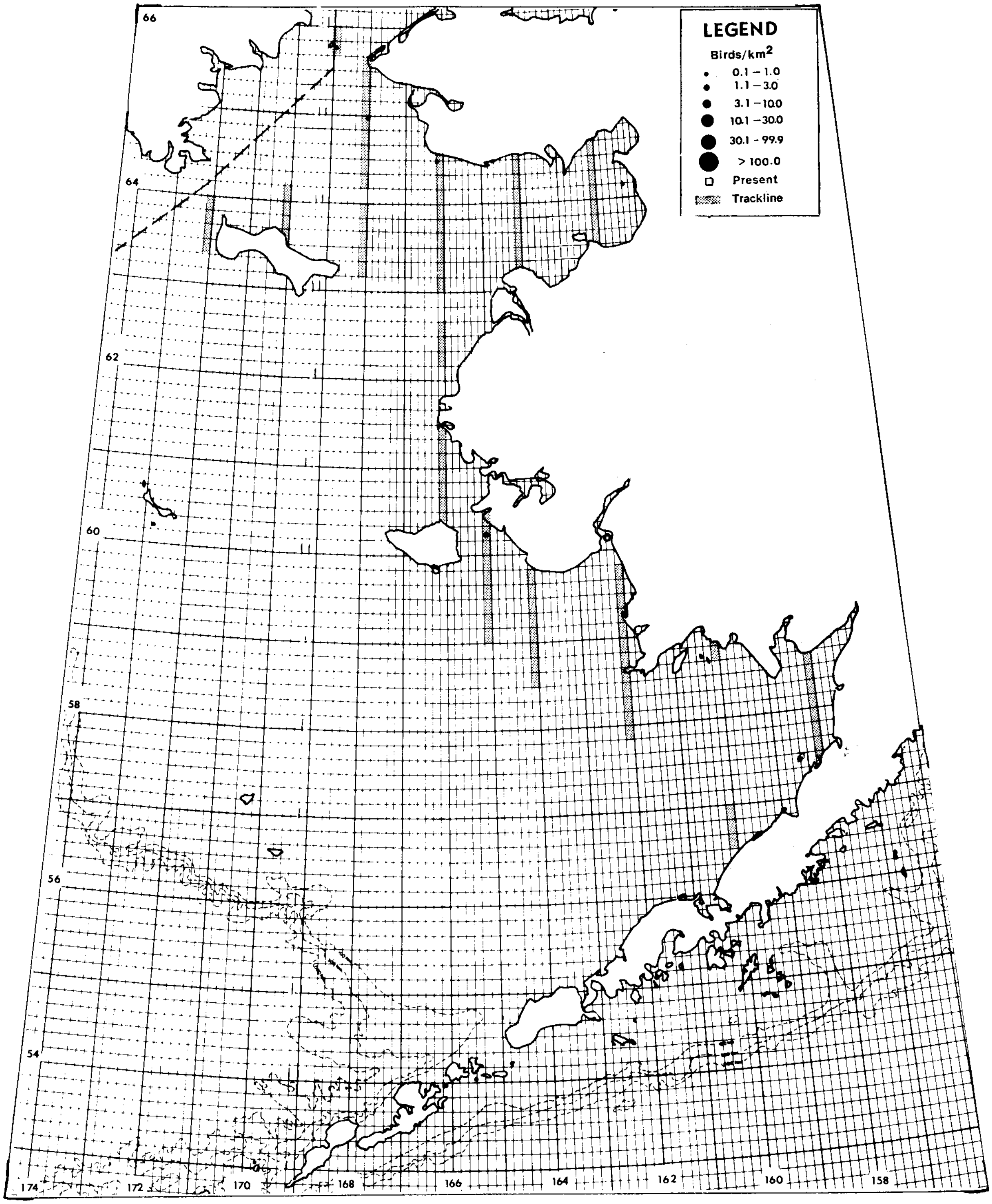

FIGURE 90. DISTRIBUTION AND ABUNDANCE OF OLDSQUAW IN THE BERING SEA IN JUNE. NO OLDSQUAW WERE OBSERVED IN MARCH.

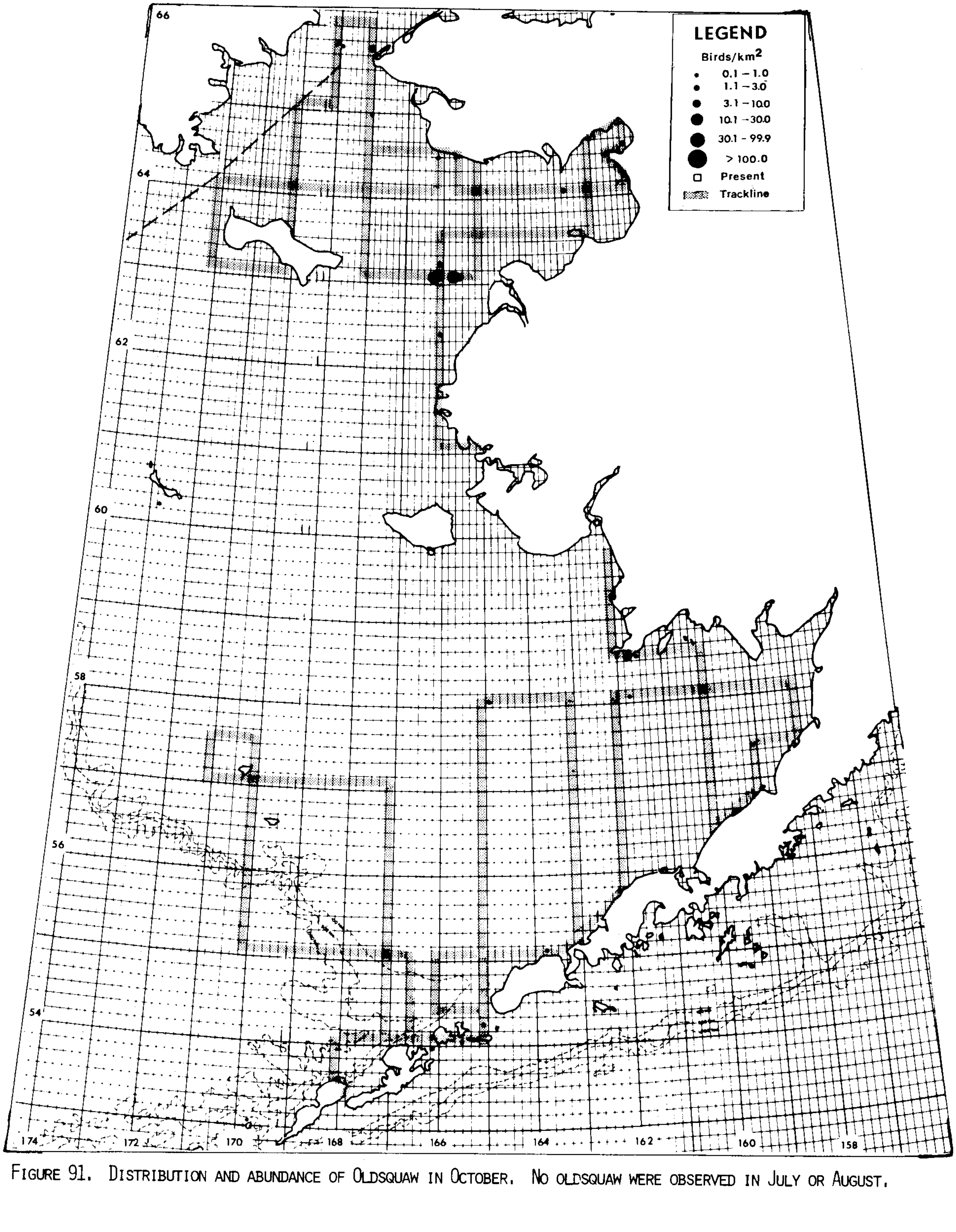

FIGURE 91. DISTRIBUTION AND ABUNDANCE OF OLDSQUAW IN OCTOBER. NO OLDSQUAW WERE OBSERVED IN JULY OR AUGUST.

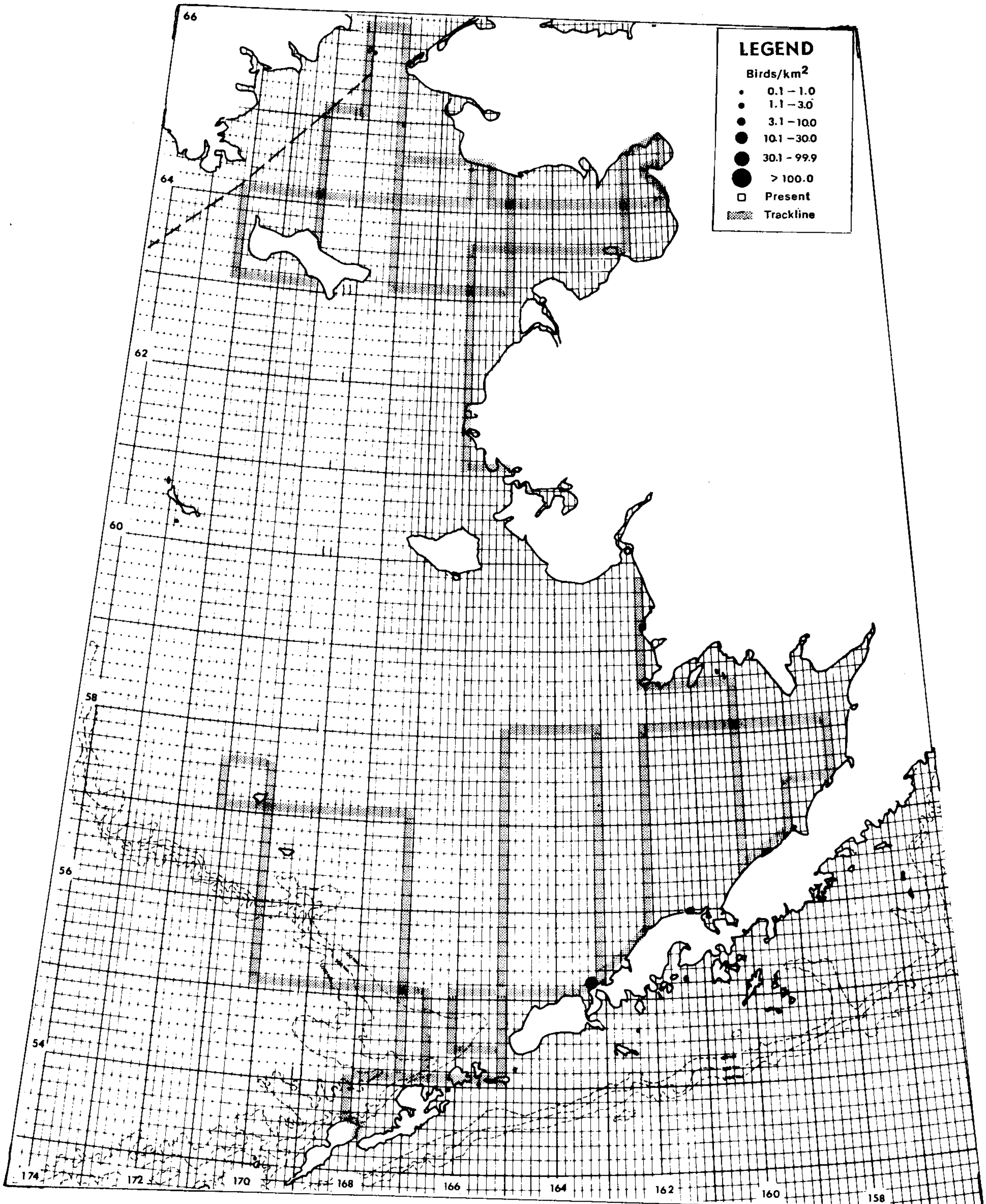

FIGURE 92. DISTRIBUTION AND ABUNDANCE OF HARLEQUIN DUCKS IN OCTOBER. NO HARLEQUIN DUCKS WERE OBSERVED IN FEBRUARY, MARCH, JUNE, JULY OR AUGUST.

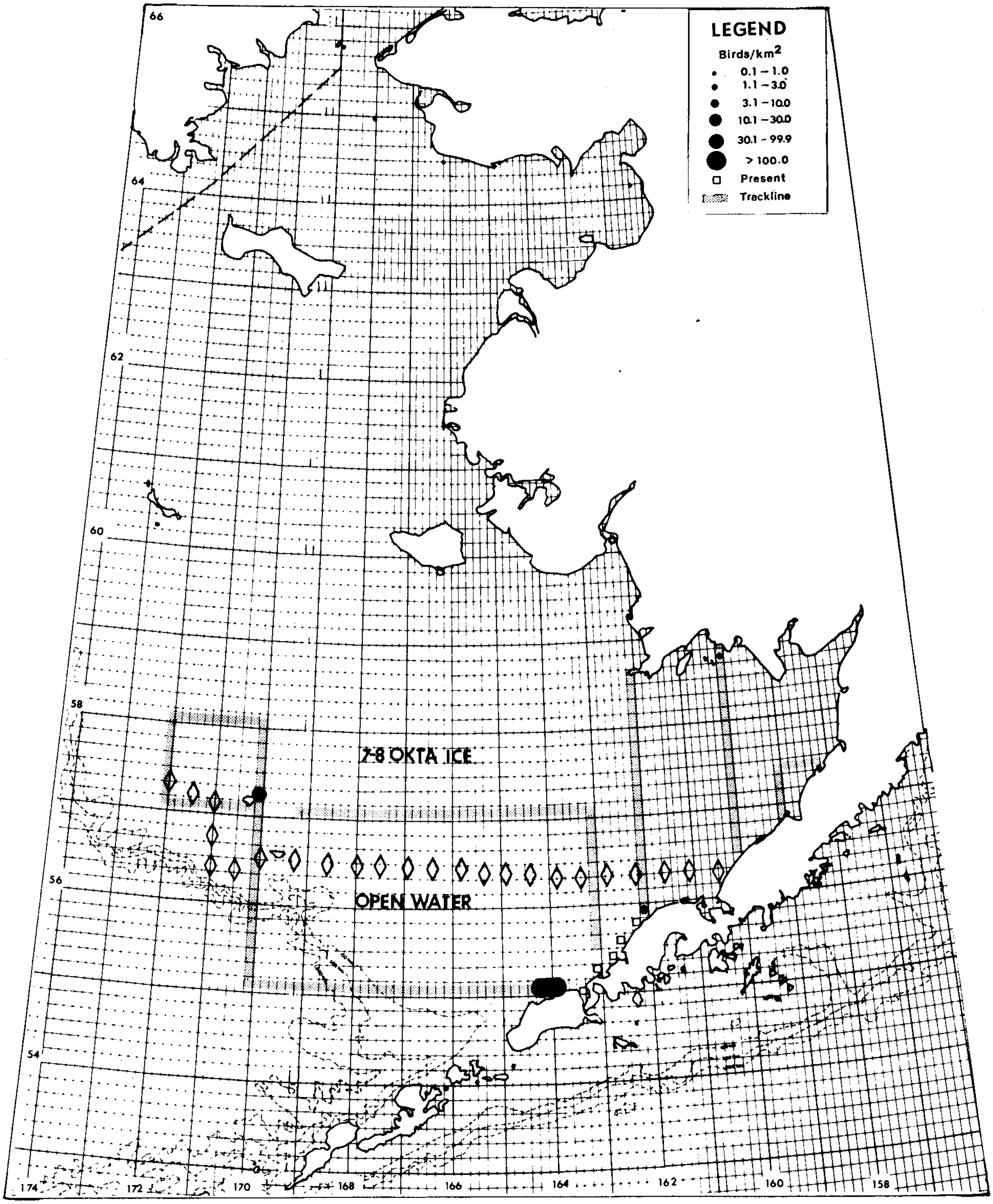

FIGURE 93. DISTRIBUTION AND ABUNDANCE OF EIDERS IN THE BERING SEA IN FEBRUARY.

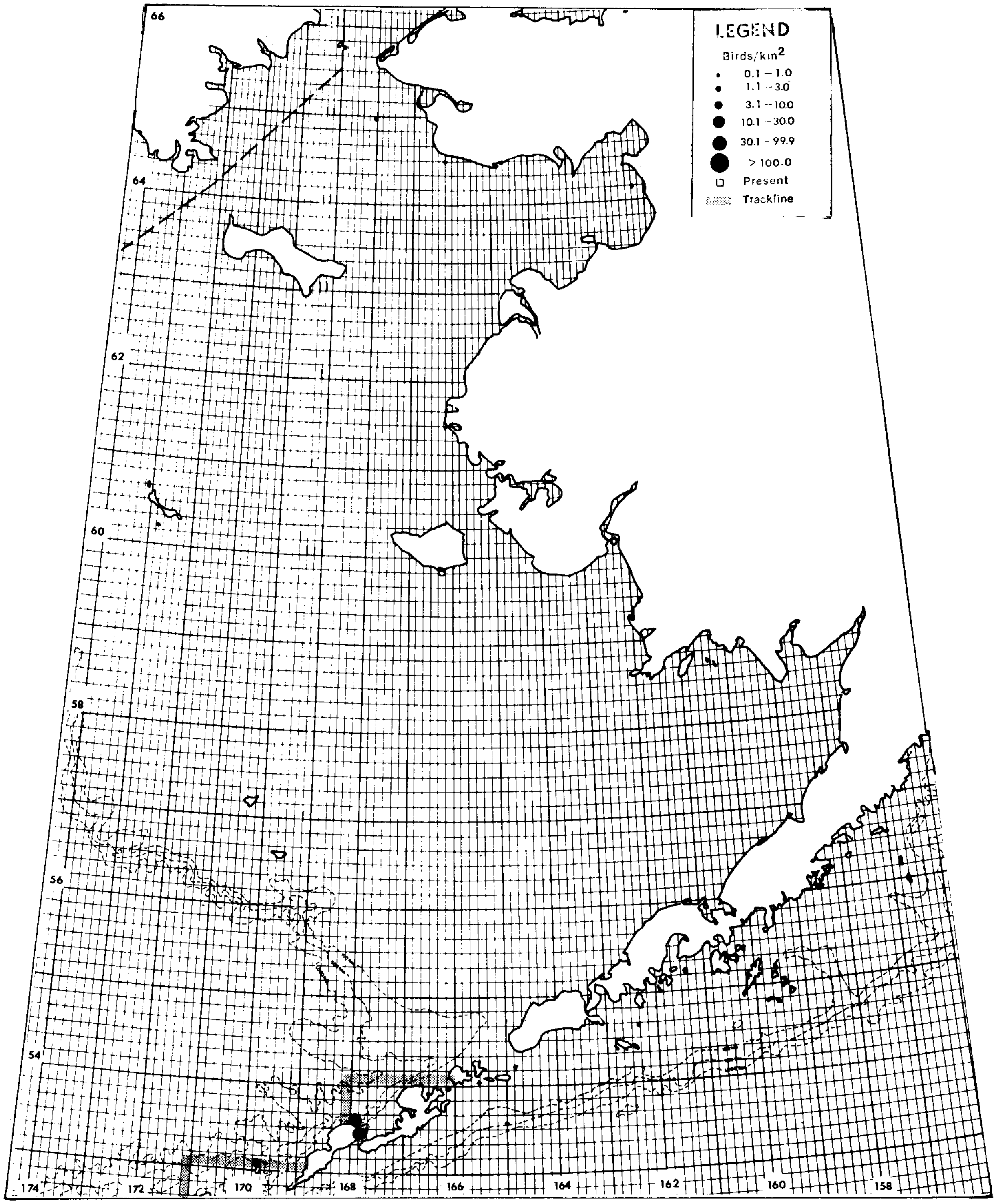

FIGURE 94. DISTRIBUTION AND ABUNDANCE OF EIDERS IN THE BERING SEA IN MARCH.

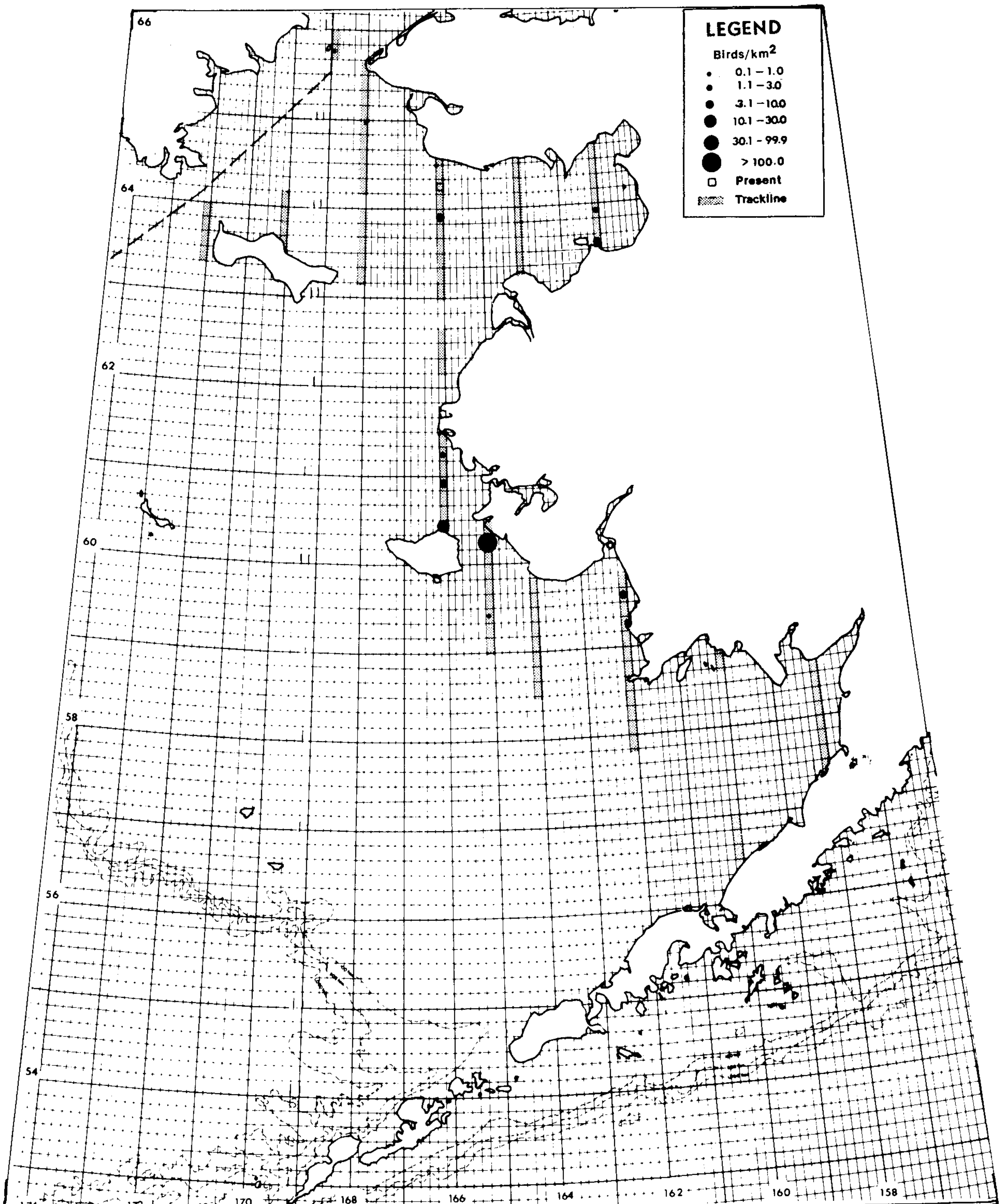

FIGURE 95. DISTRIBUTION AND ABUNDANCE OF EIDERS IN THE BERING SEA IN JUNE.

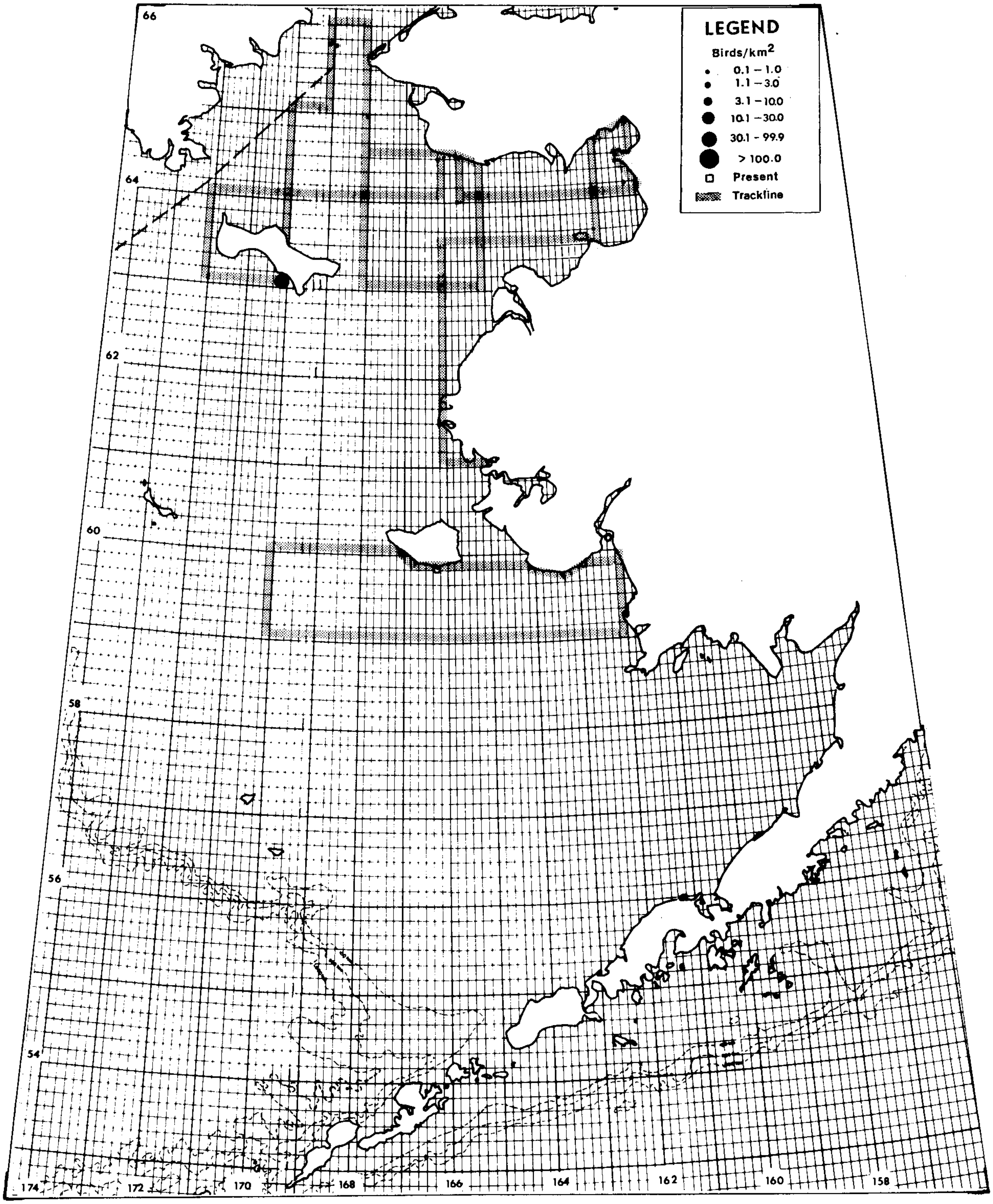

FIGURE 96. DISTRIBUTION AND ABUNDANCE OF EIDERS IN THE BERING SEA IN AUGUST. NO EIDERS WERE OBSERVED IN JULY.

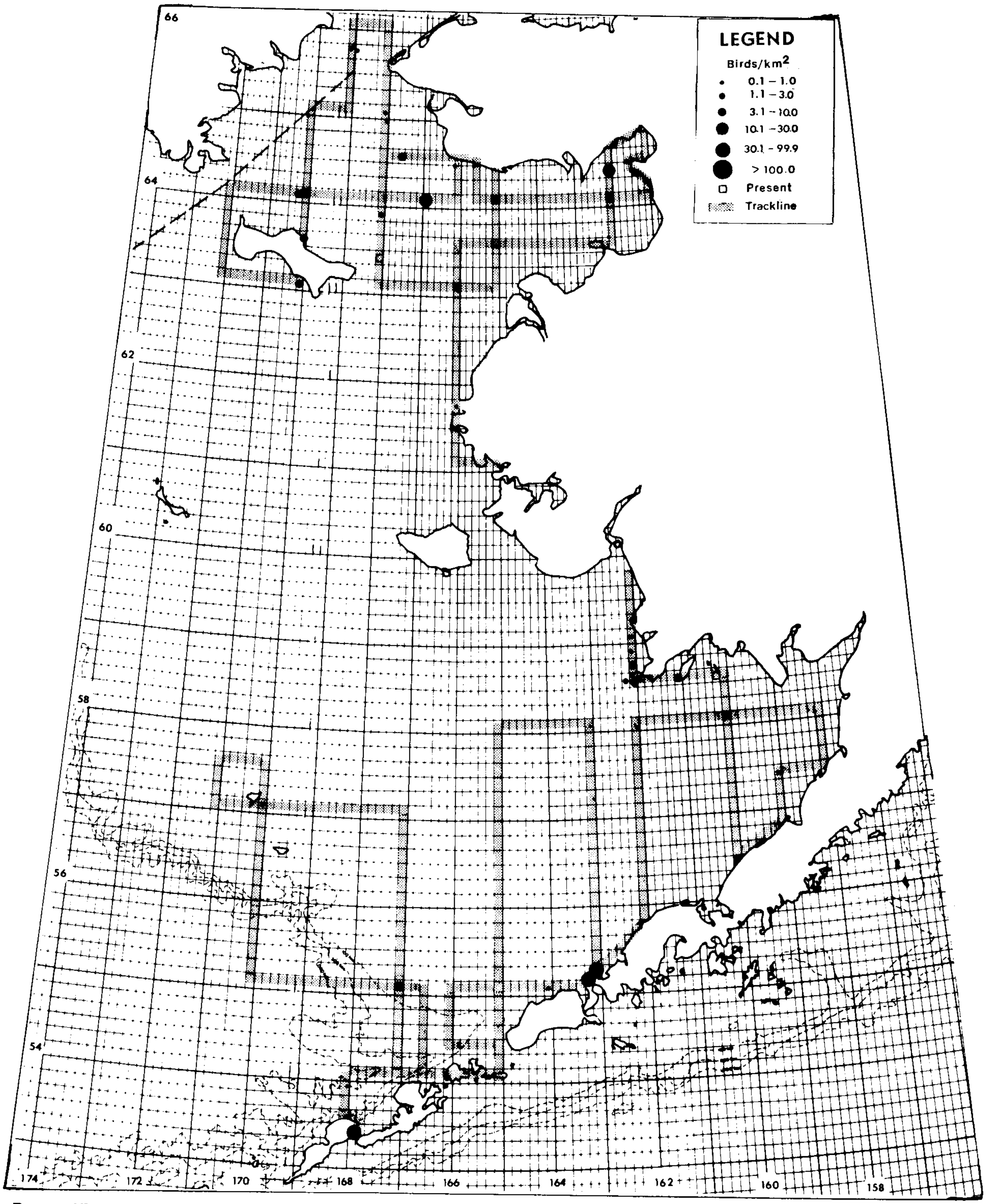

FIGURE 97. DISTRIBUTION AND ABUNDANCE OF EIDERS IN OCTOBER.

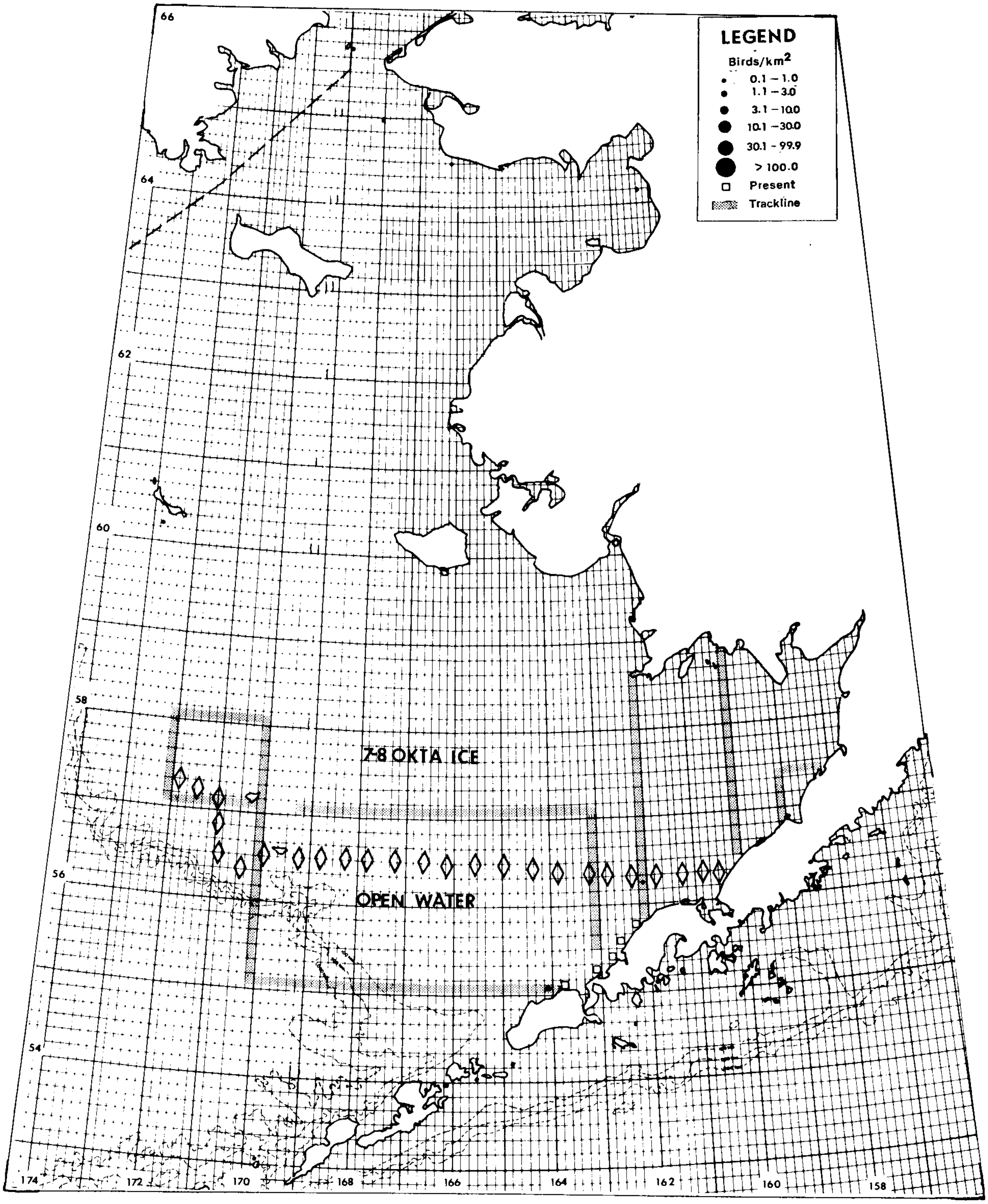

FIGURE 98. DISTRIBUTION AND ABUNDANCE OF SCOTERS IN THE BERING SEA IN FEBRUARY.

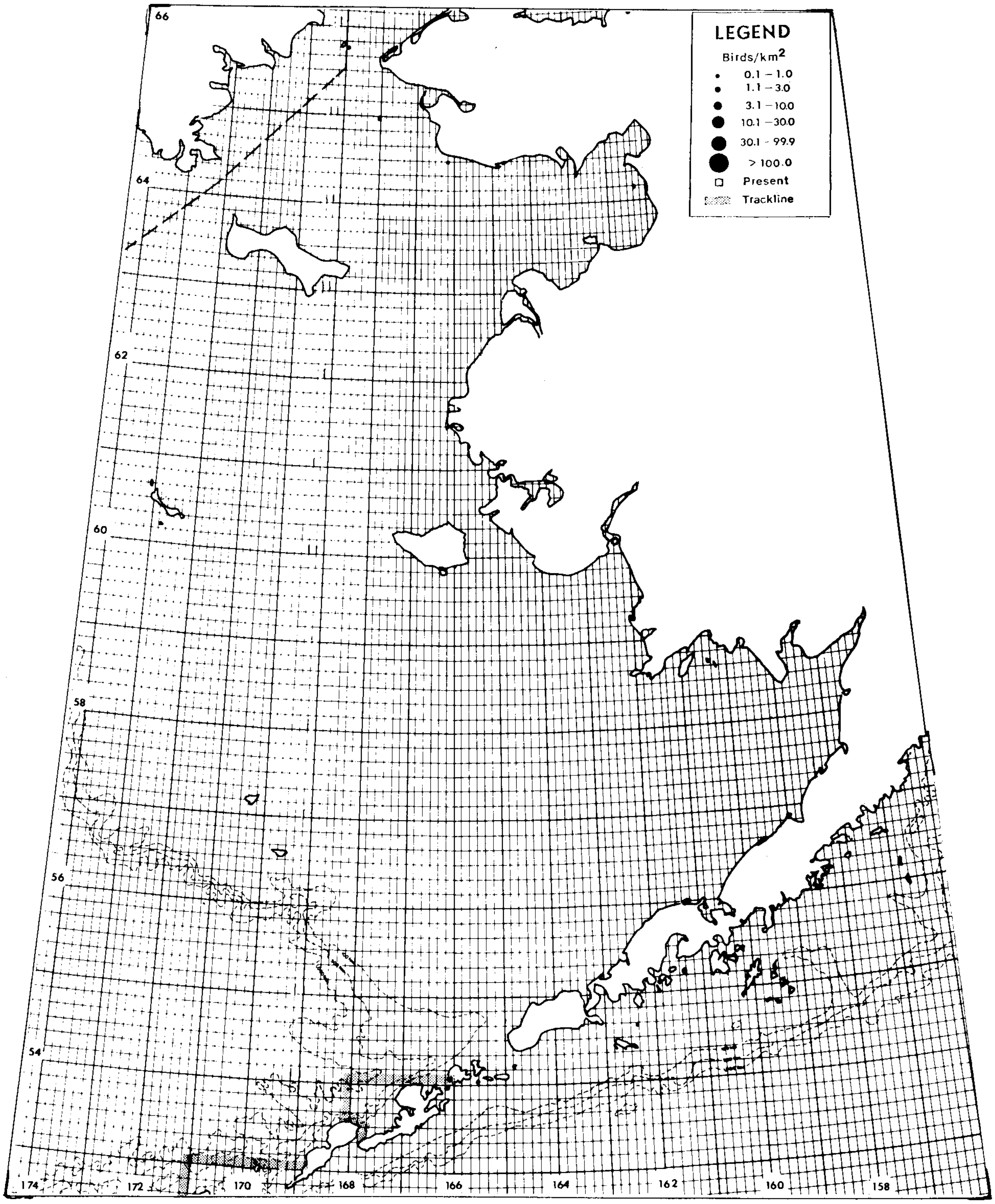

FIGURE 99. DISTRIBUTION AND ABUNDANCE OF SCOTERS IN THE BERING SEA IN MARCH.

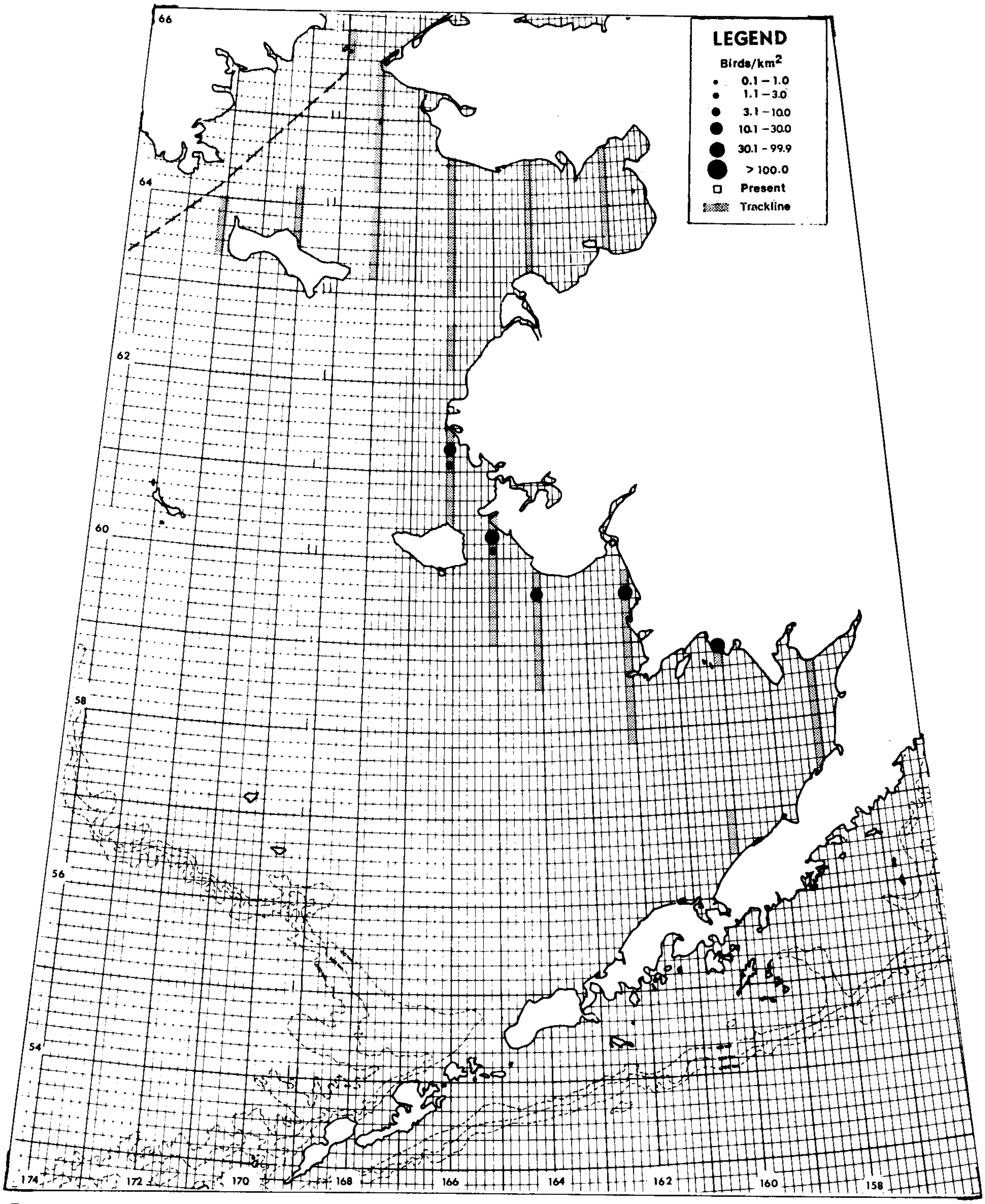

FIGURE 100. DISTRIBUTION AND ABUNDANCE OF SCOTERS IN THE BERING SEA IN JUNE.

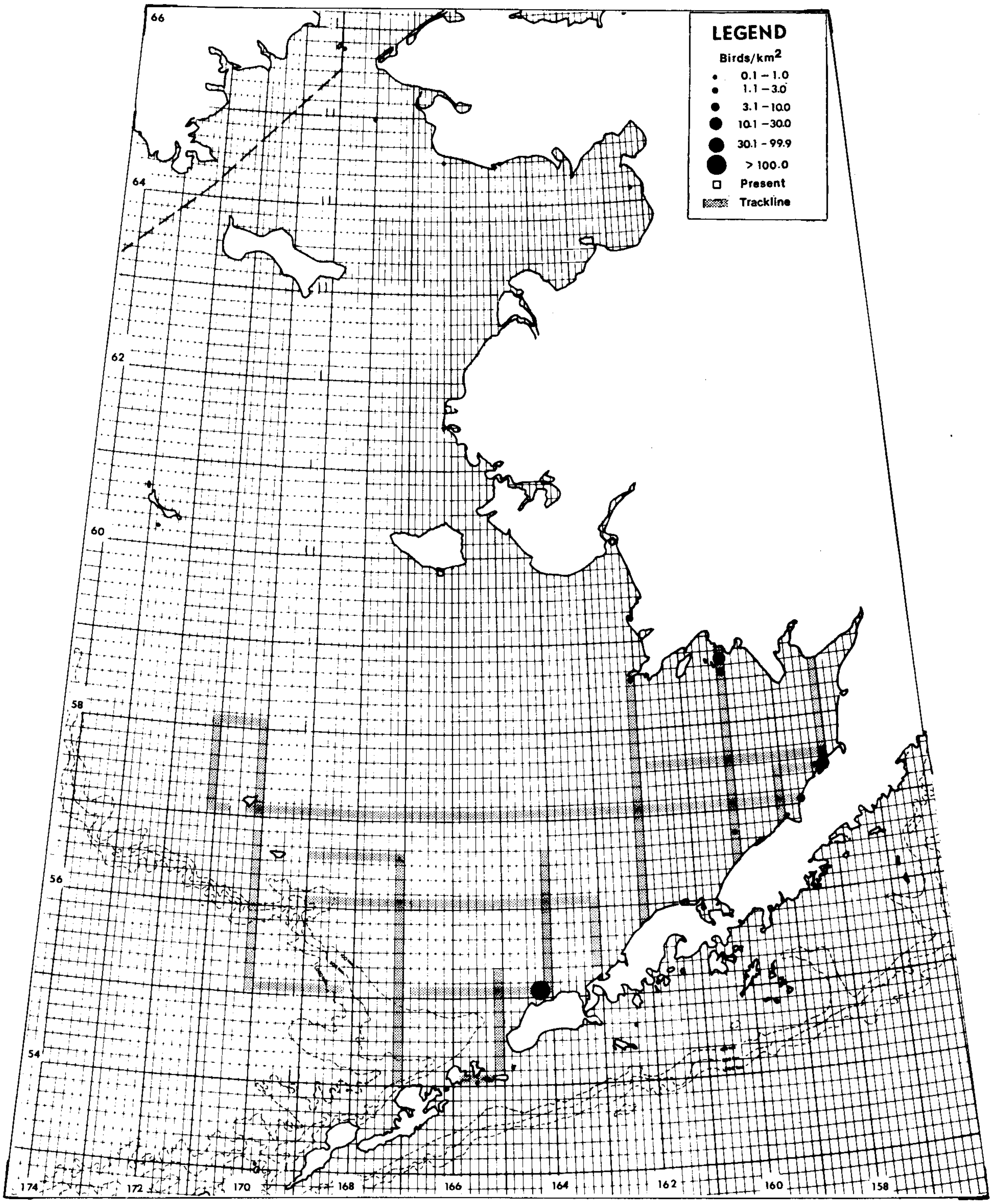

FIGURE 101. DISTRIBUTION AND ABUNDANCE OF SCOTERS IN THE BERING SEA IN JULY.

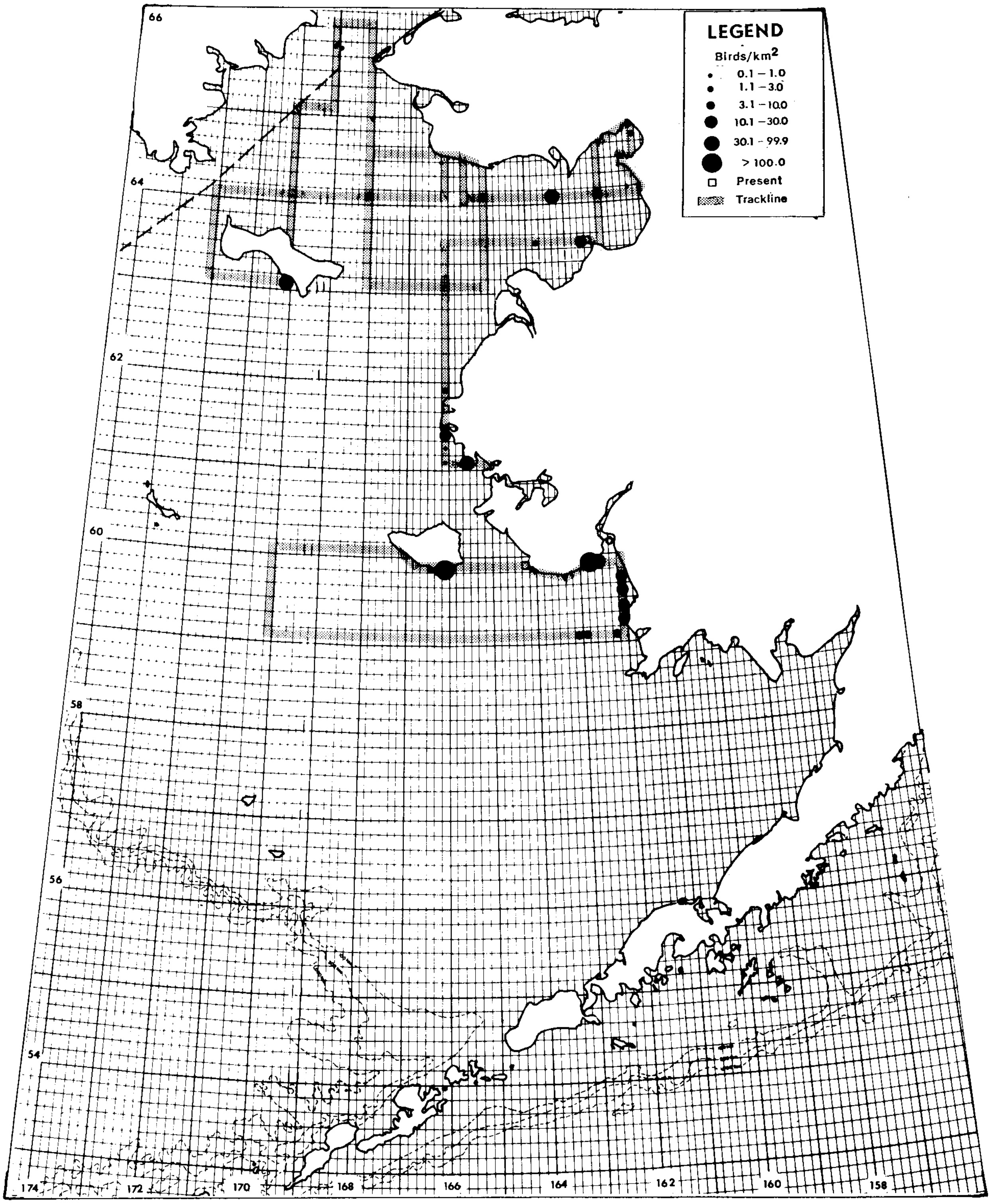

FIGURE 102. DISTRIBUTION AND ABUNDANCE OF SCOTERS IN THE BERING SEA IN AUGUST.

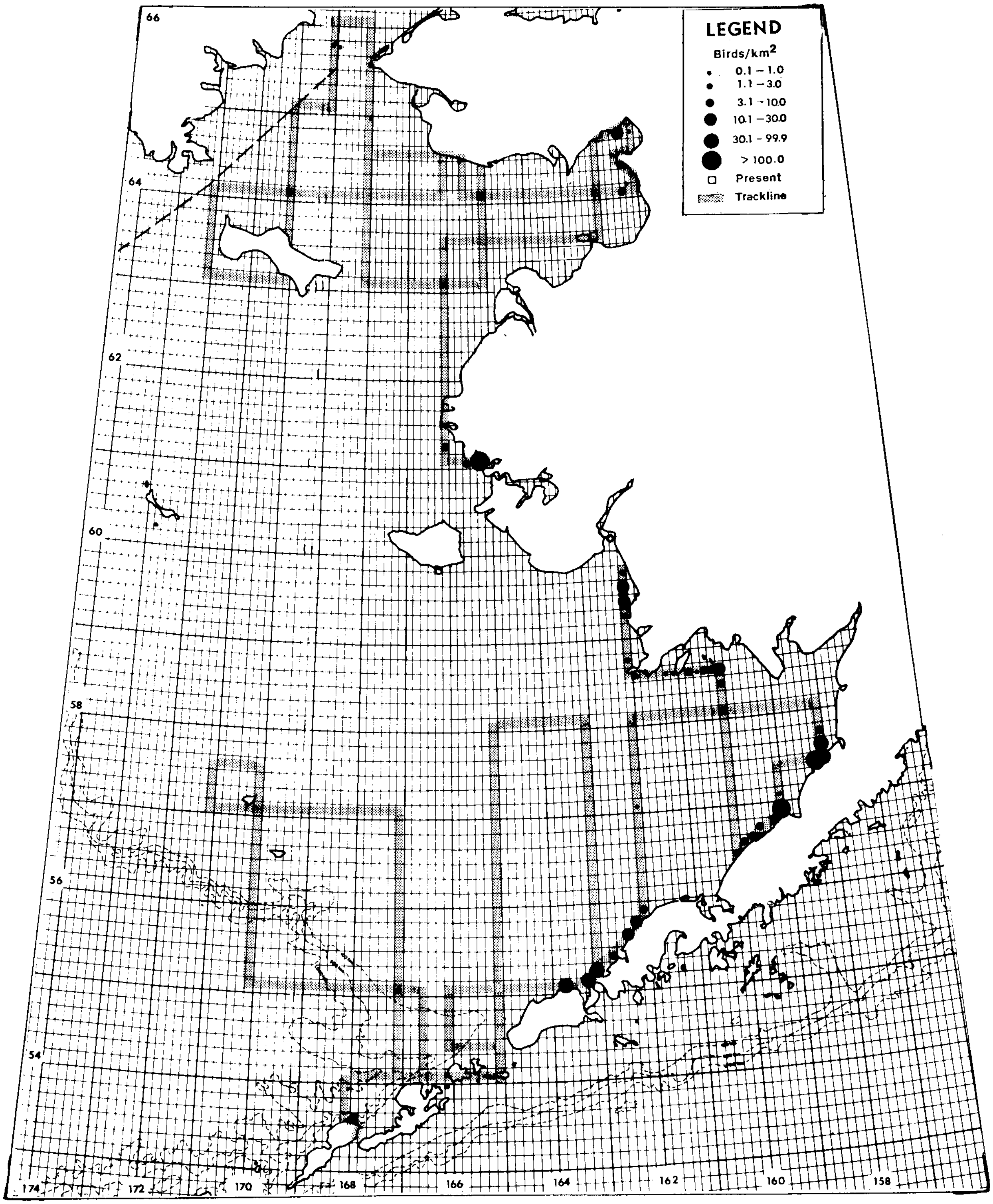

FIGURE 103. DISTRIBUTION AND ABUNDANCE OF SCOTERS IN THE BERING SEA IN OCTOBER.

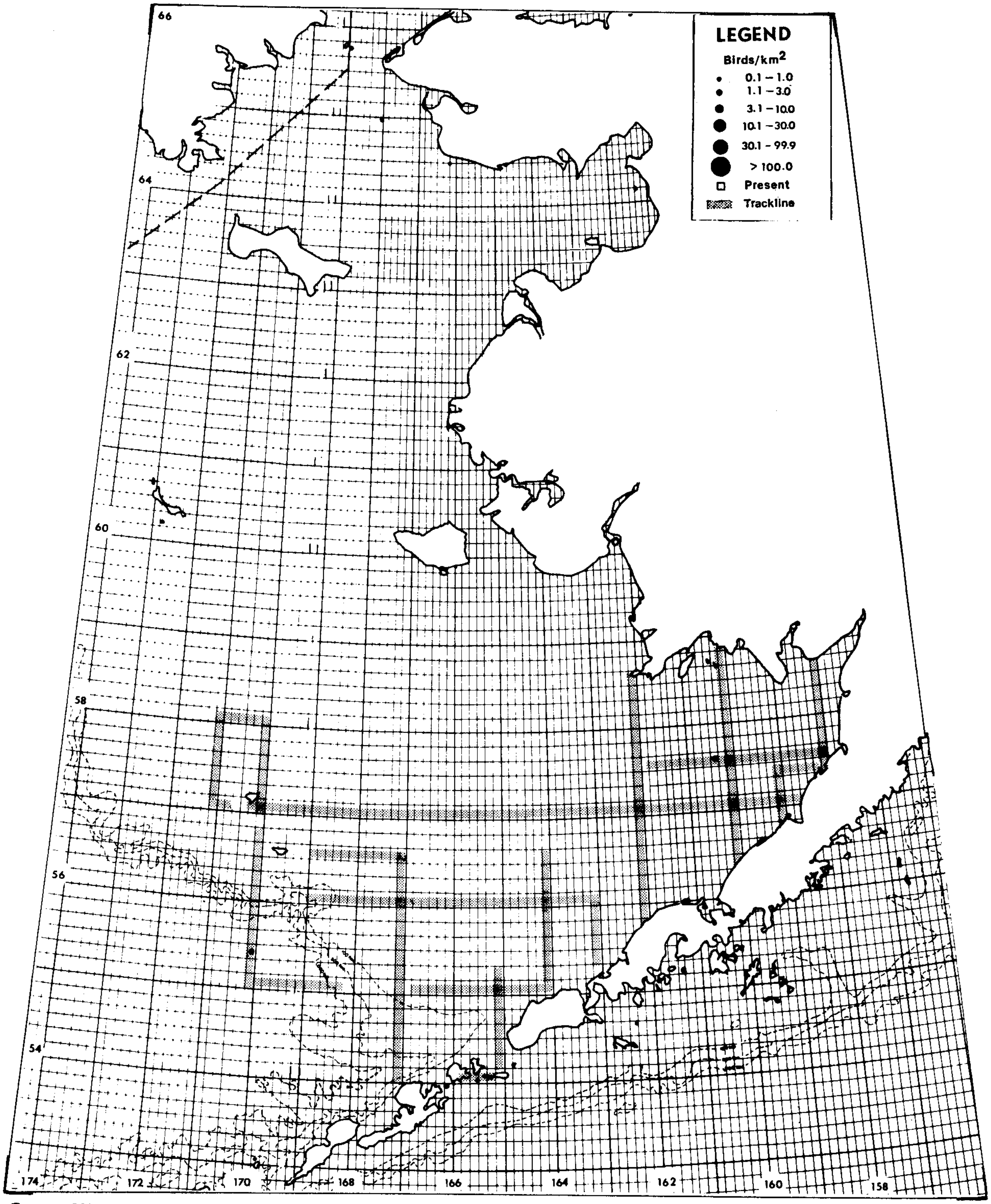

FIGURE 104. DISTRIBUTION AND ABUNDANCE OF PHALAROPES IN THE BERING SEA IN JULY. NO PHALAROPES WERE OBSERVED IN FEBRUARY, MARCH OR JUNE.

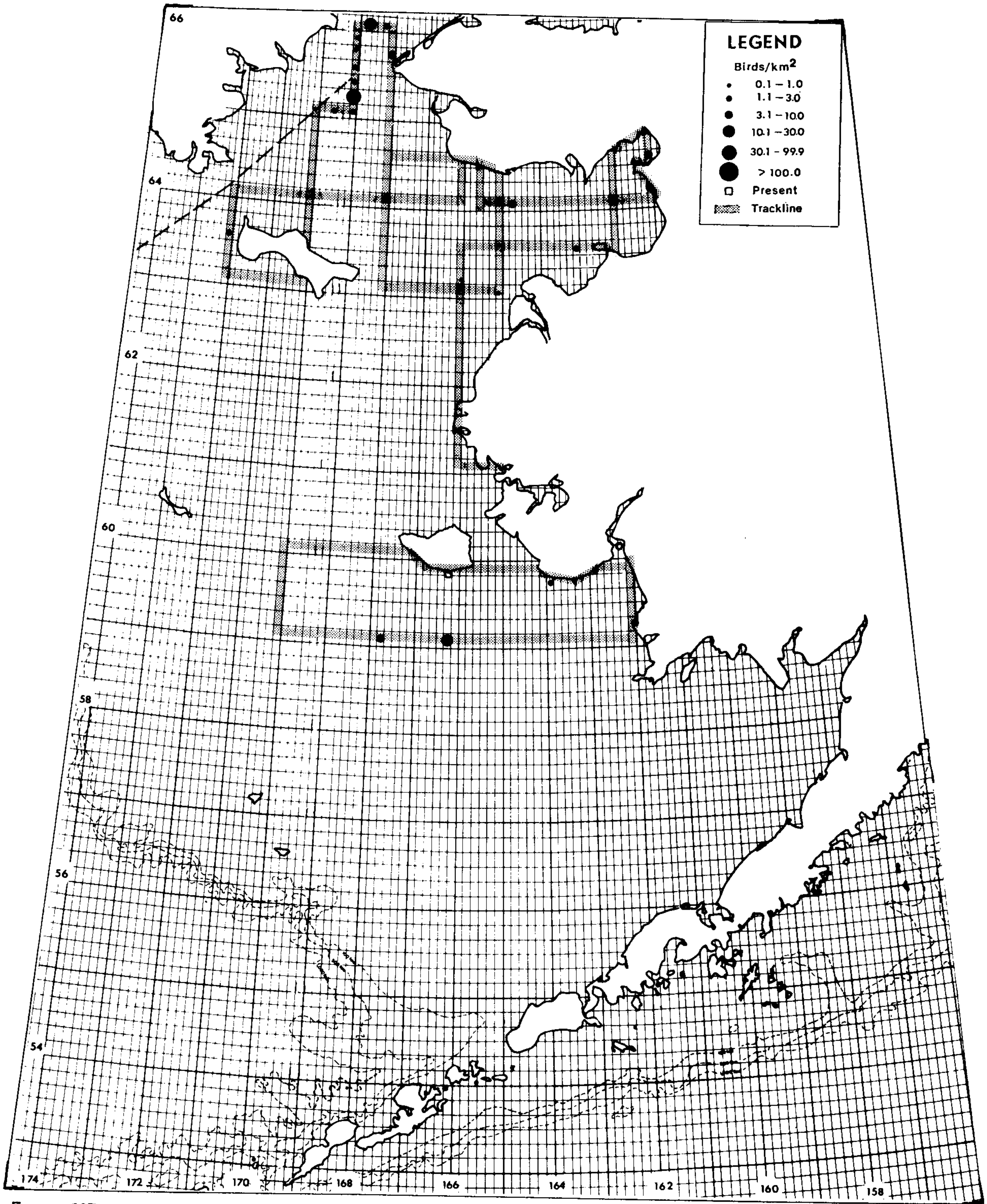

FIGURE 105. DISTRIBUTION AND ABUNDANCE OF PHALAROPES IN THE BERING SEA IN AUGUST.

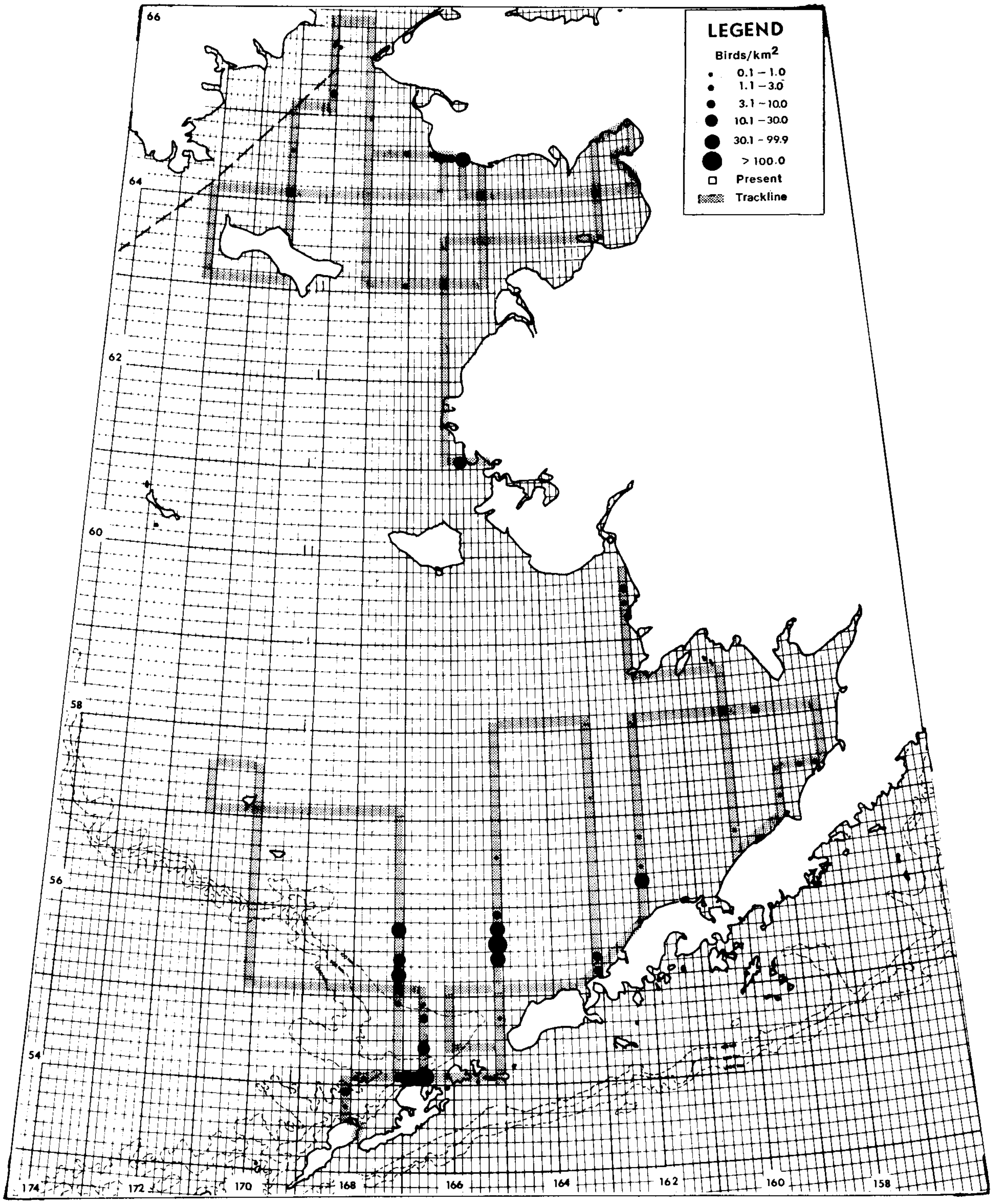

FIGURE 106. DISTRIBUTION AND ABUNDANCE OF PHALAROPES IN THE BERING SEA IN OCTOBER.

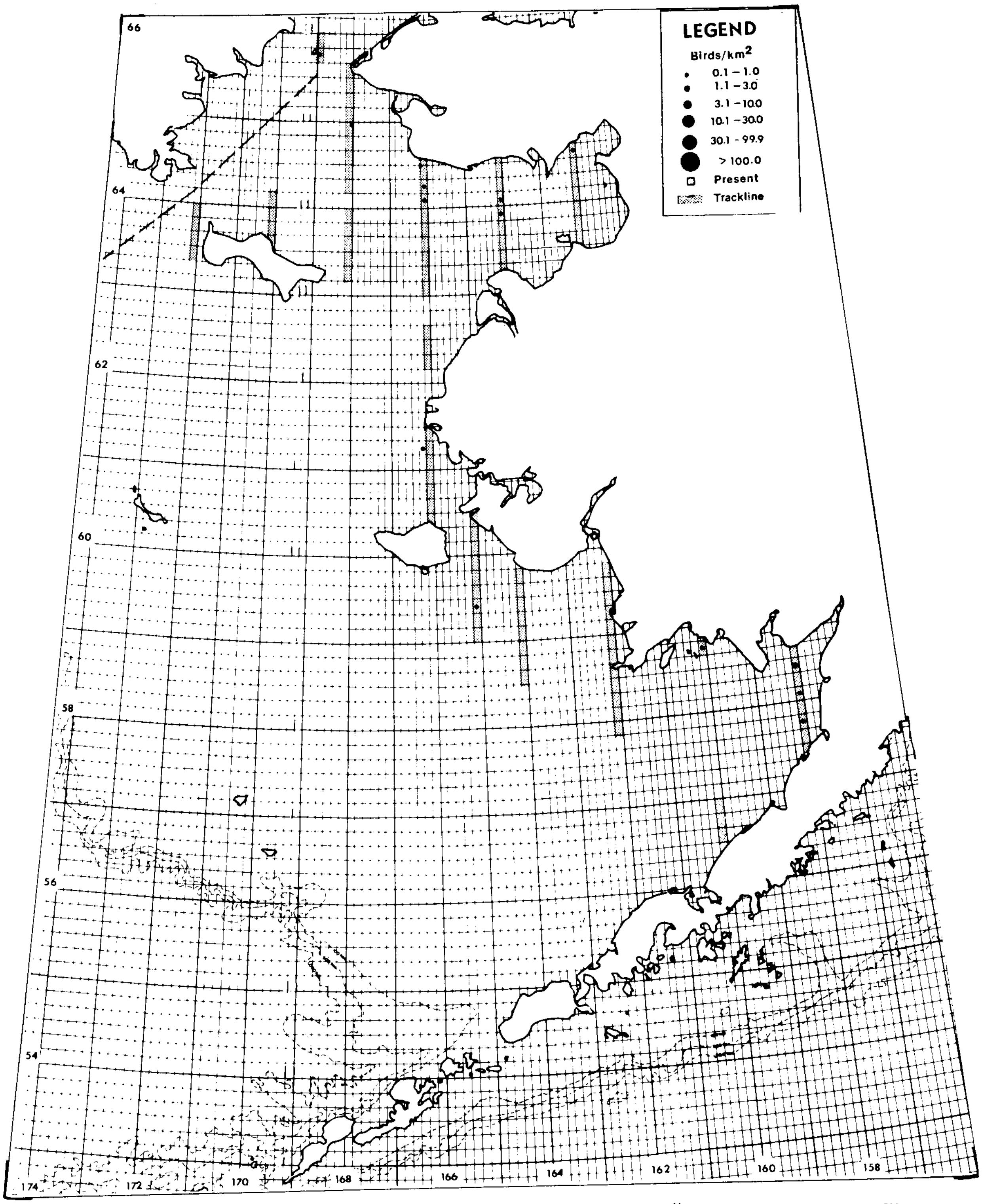

FIGURE 107. DISTRIBUTION AND ABUNDANCE OF JAEGERS IN THE BERING SEA IN JUNE. NO JAEGERS WERE OBSERVED IN FEBRUARY OR MARCH.

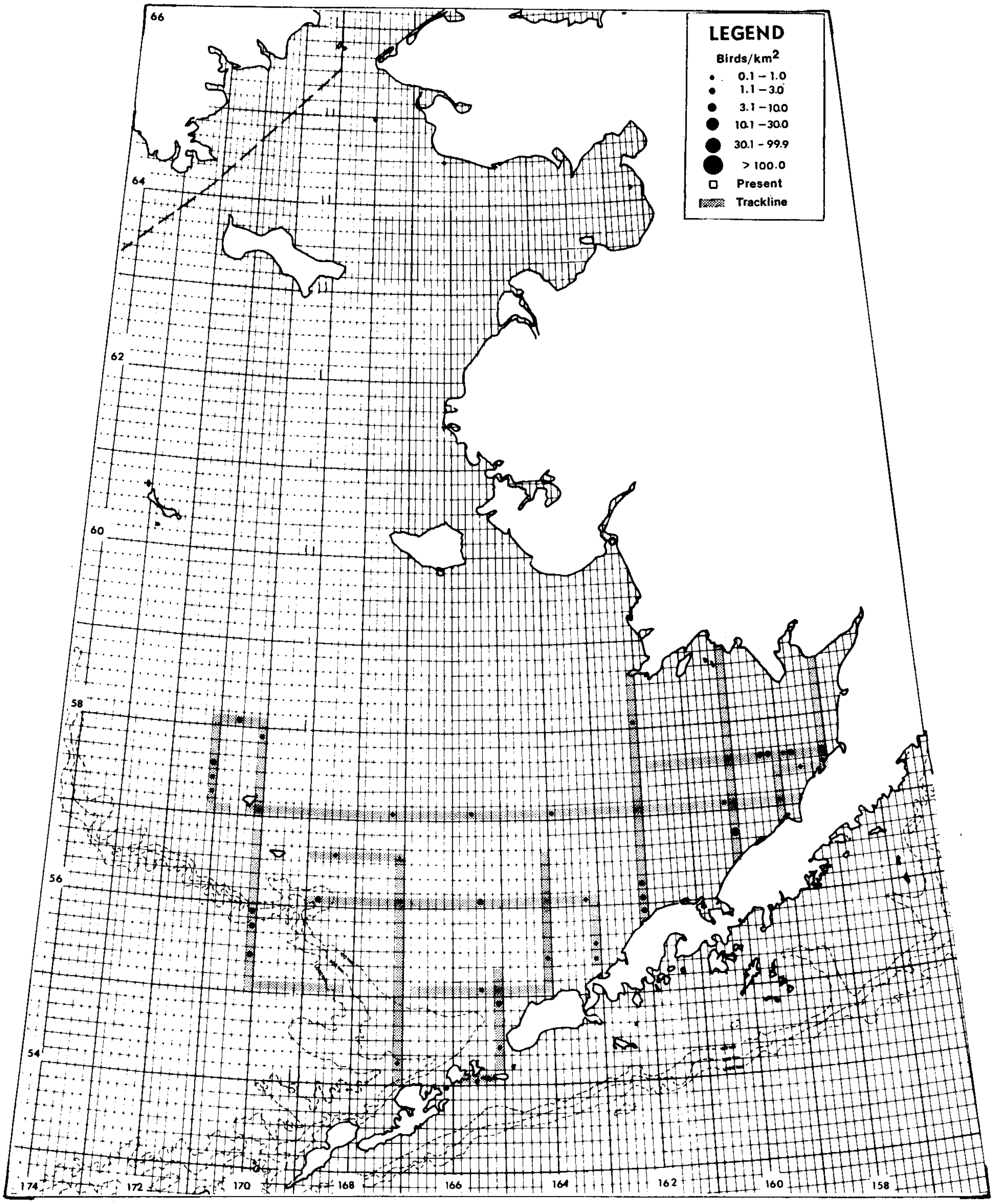

FIGURE 108. DISTRIBUTION AND ABUNDANCE OF JAEGERS IN THE BERING SEA IN JULY.

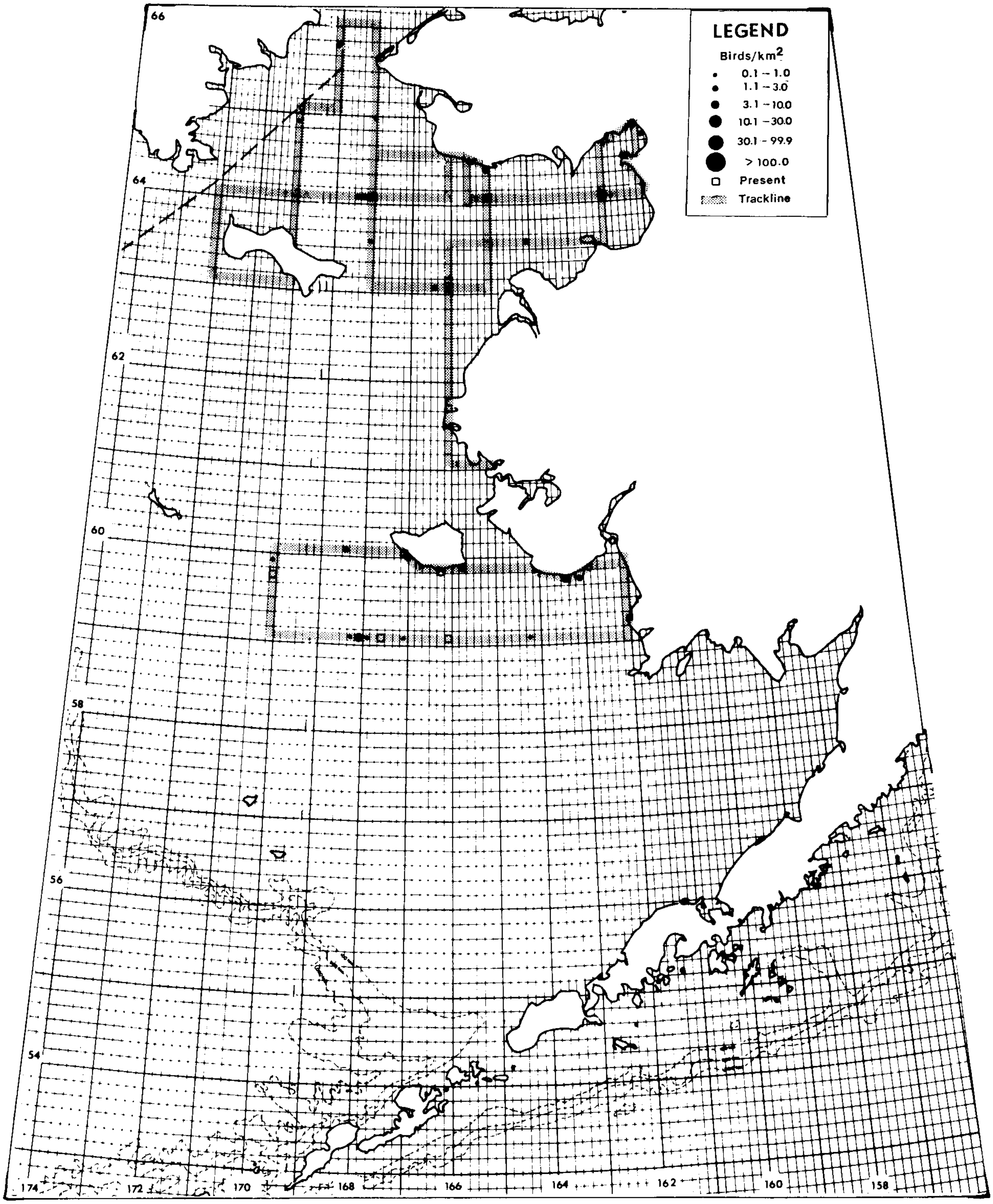

FIGURE 109. DISTRIBUTION AND ABUNDANCE OF JAEGERS IN THE BERING SEA IN AUGUST.

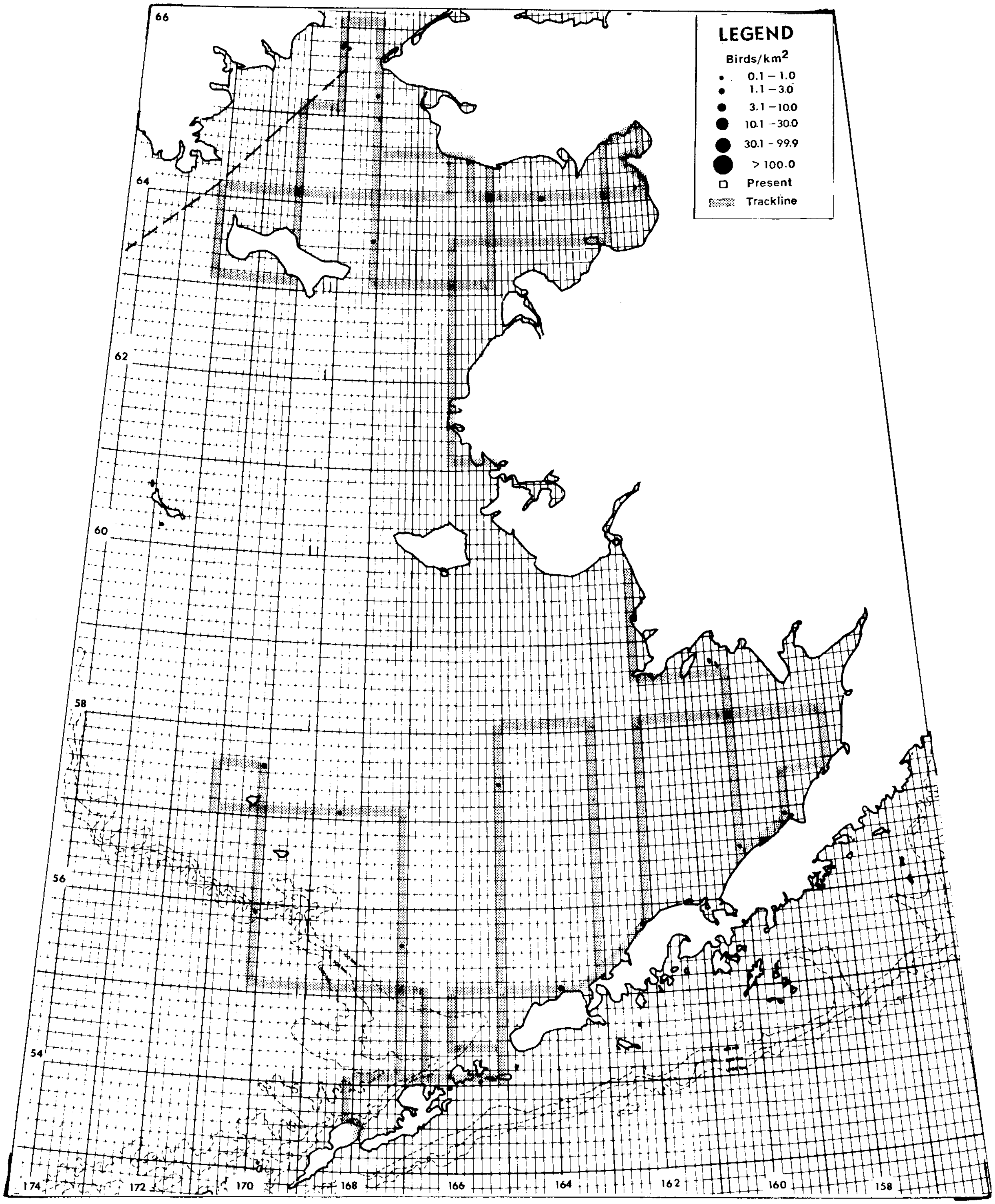

FIGURE 110. DISTRIBUTION AND ABUNDANCE OF JAEGERS IN THE BERING SEA IN OCTOBER.

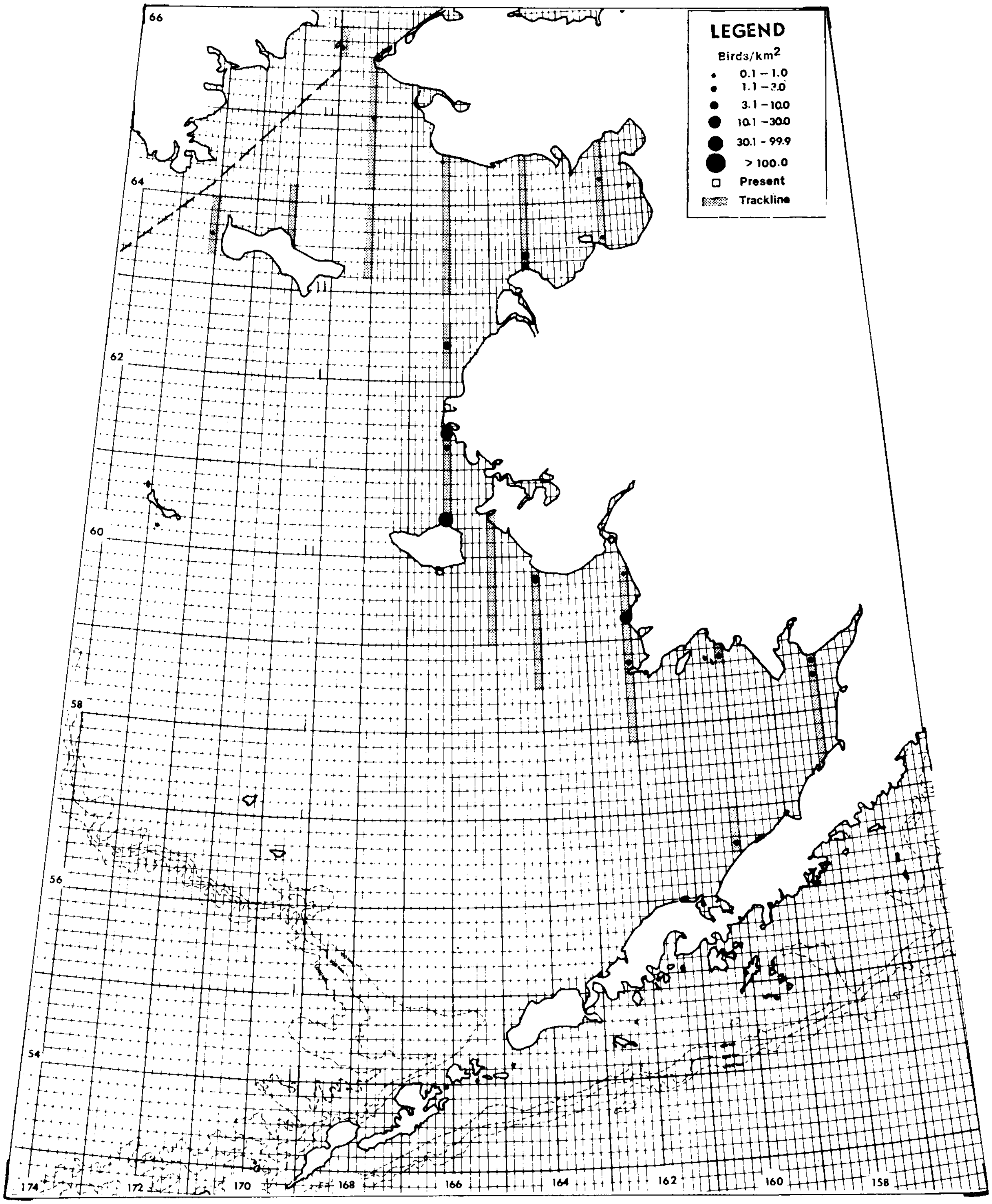

FIGURE 111. DISTRIBUTION AND ABUNDANCE OF GLAUCOUS GULLS IN THE BERING SEA IN JUNE. NO GLAUCOUS GULLS WERE IDENTIFIED IN FEBRUARY OR MARCH.

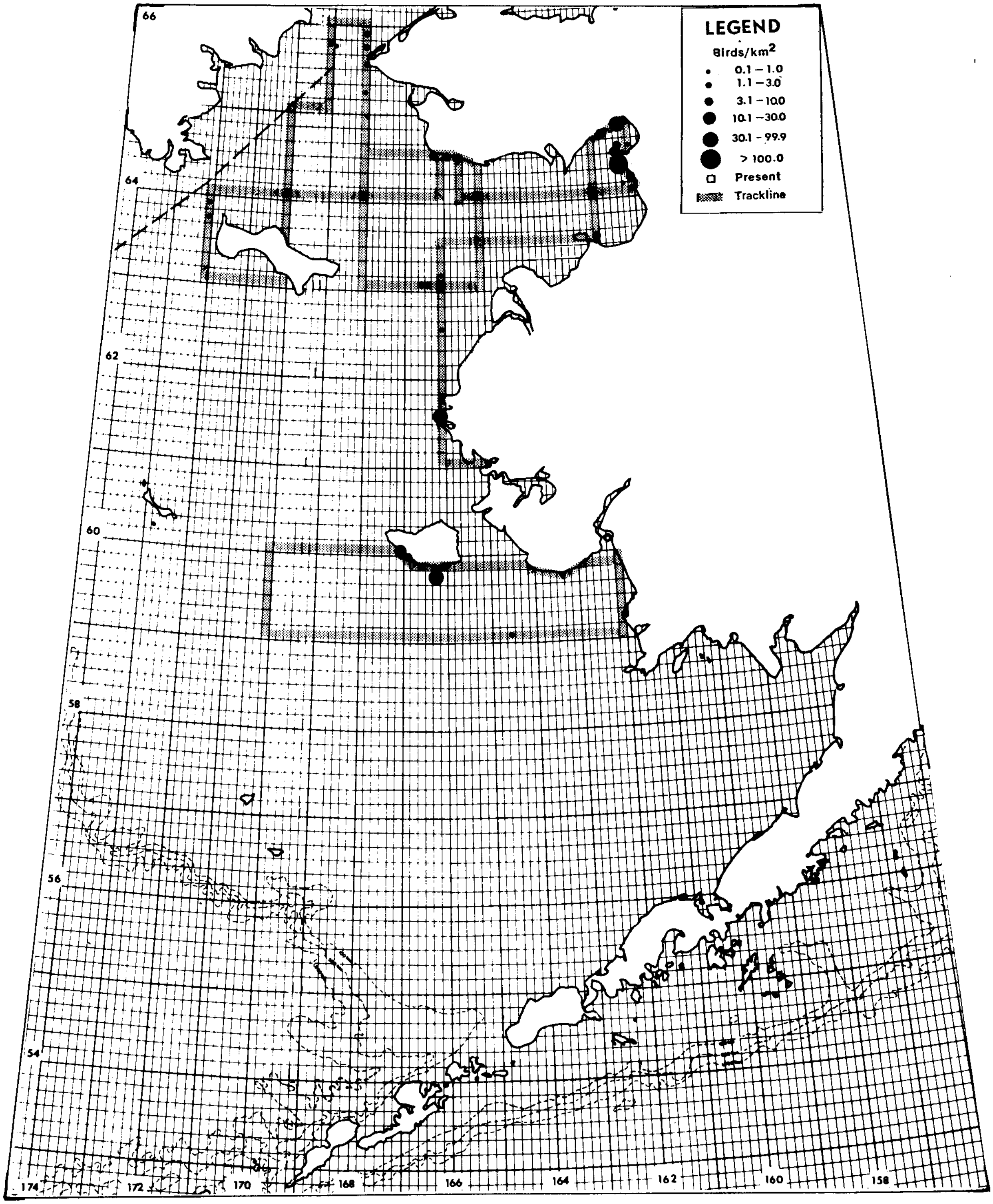

FIGURE 112. DISTRIBUTION AND ABUNDANCE OF GLAUCOUS GULLS IN THE BERING SEA IN AUGUST. NO GLAUCOUS GULLS WERE OBSERVED IN JULY.

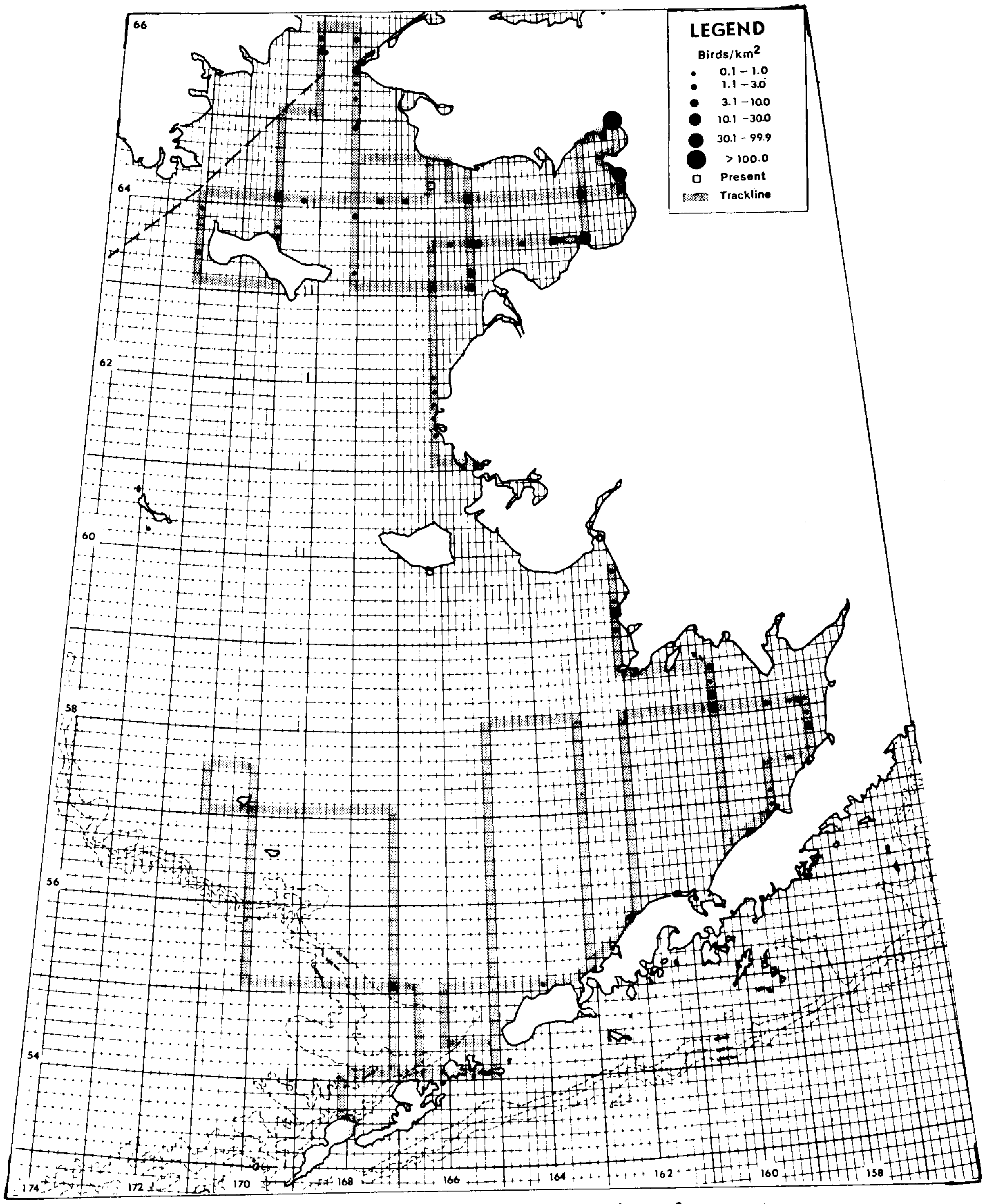

FIGURE 113. DISTRIBUTION AND ABUNDANCE OF GLAUCOUS GULLS IN THE BERING SEA IN OCTOBER. NO GLAUCOUS GULLS WERE OBSERVED IN AUGUST.

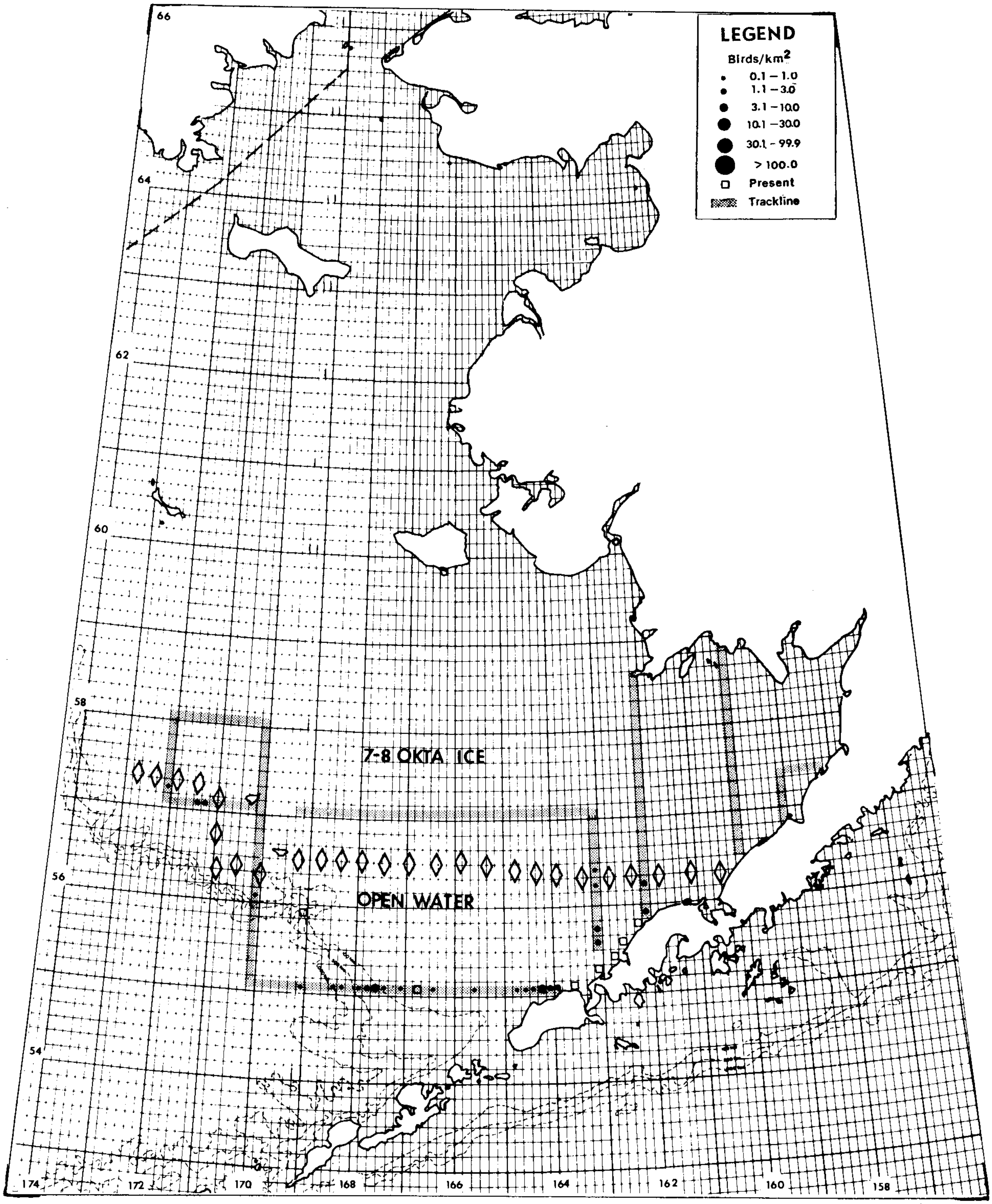

FIGURE 114. DISTRIBUTION AND ABUNDANCE OF GLAUCOUS-WINGED GULLS IN THE BERING SEA IN FEBRUARY.

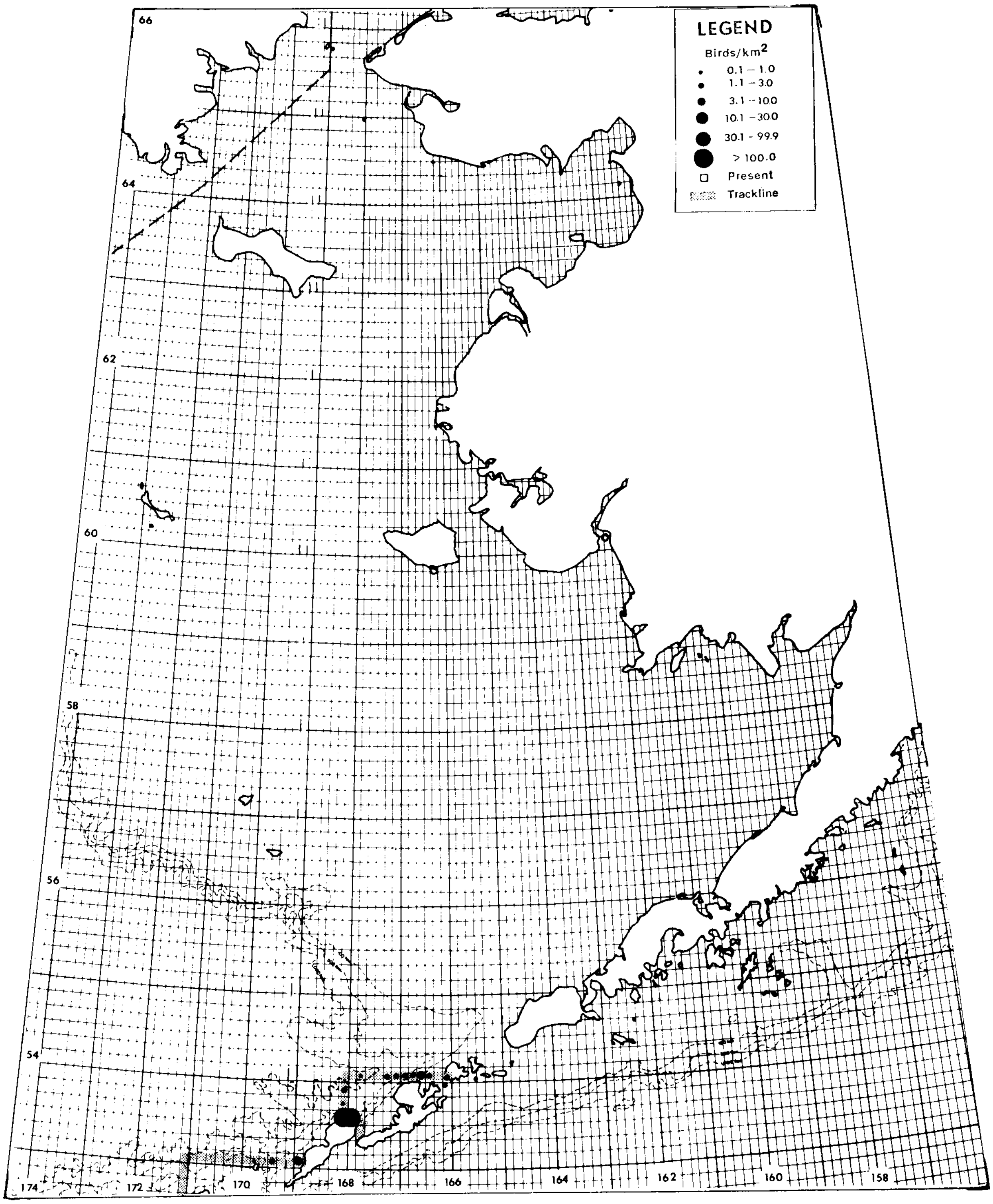

FIGURE 115. DISTRIBUTION AND ABUNDANCE OF GLAUCOUS-WINGED GULLS IN THE BERING SEA IN MARCH.

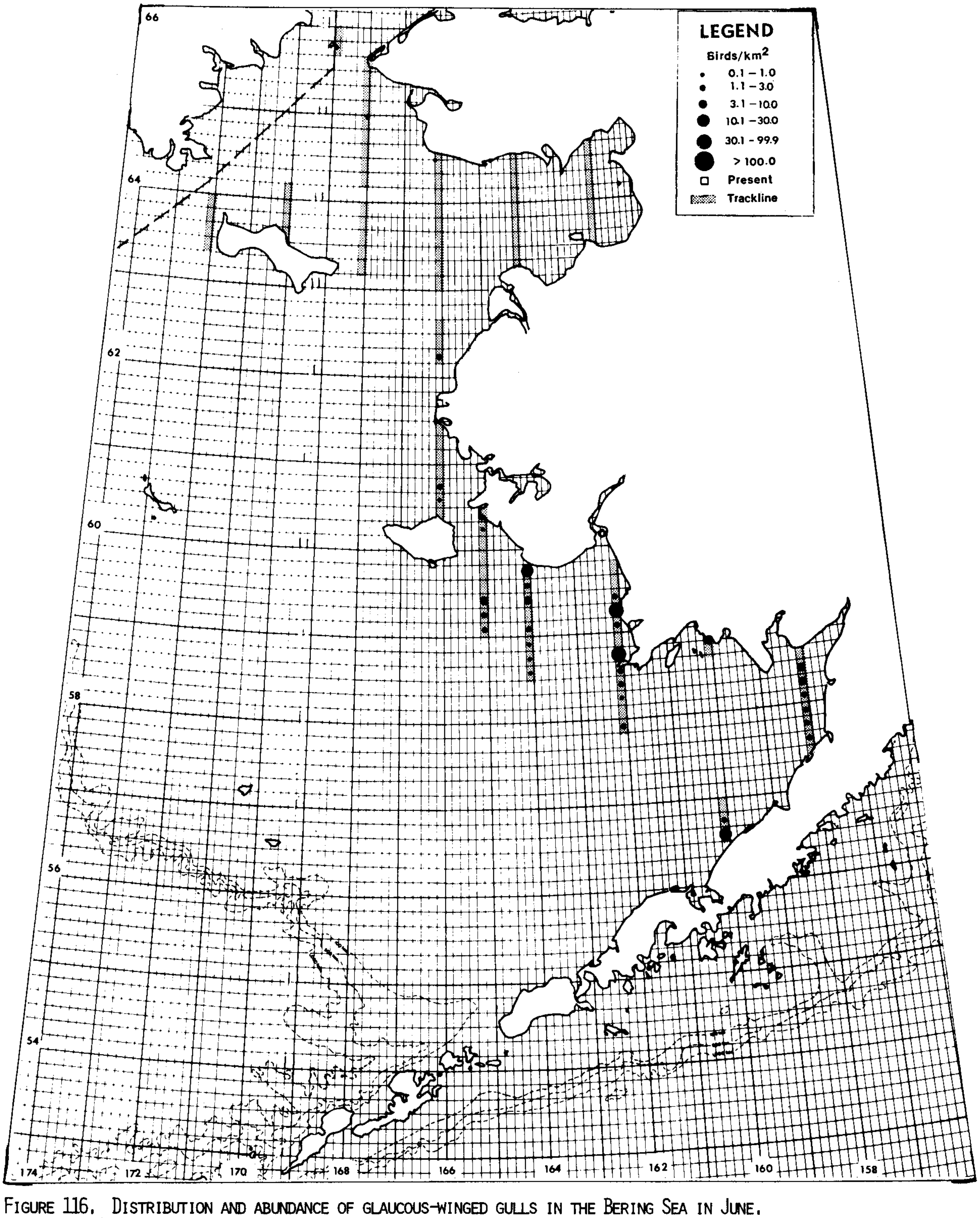

FIGURE 116. DISTRIBUTION AND ABUNDANCE OF GLAUCOUS-WINGED GULLS IN THE BERING SEA IN JUNE.

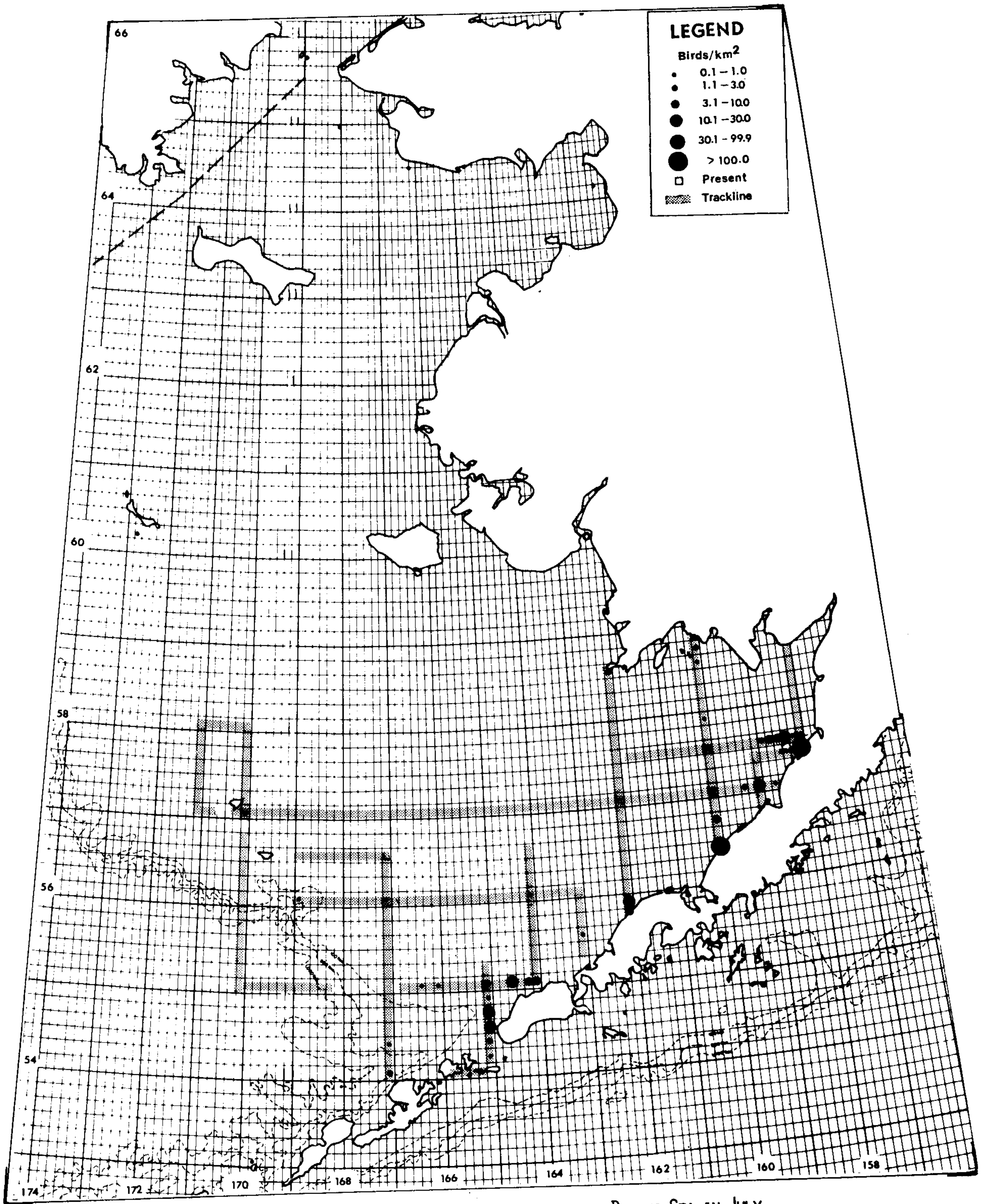

FIGURE 117. DISTRIBUTION AND ABUNDANCE OF GLAUCOUS-WINGED GULLS IN THE BERING SEA IN JULY.

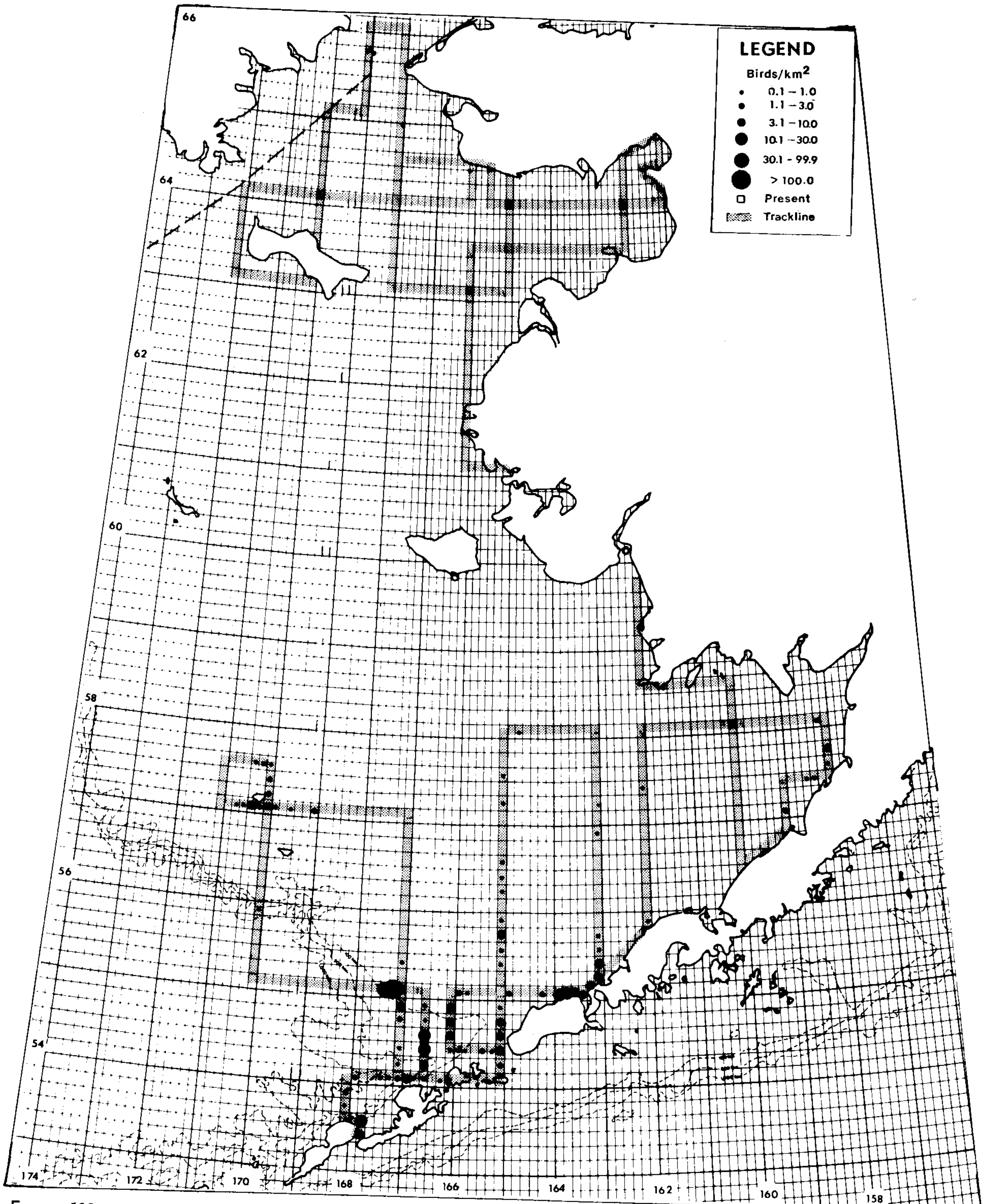

FIGURE 118. DISTRIBUTION AND ABUNDANCE OF GLAUCOUS-WINGED GULLS IN THE BERING SEA IN OCTOBER. NO GLAUCOUS-WINGED GULLS WERE IDENTIFIED IN AUGUST.

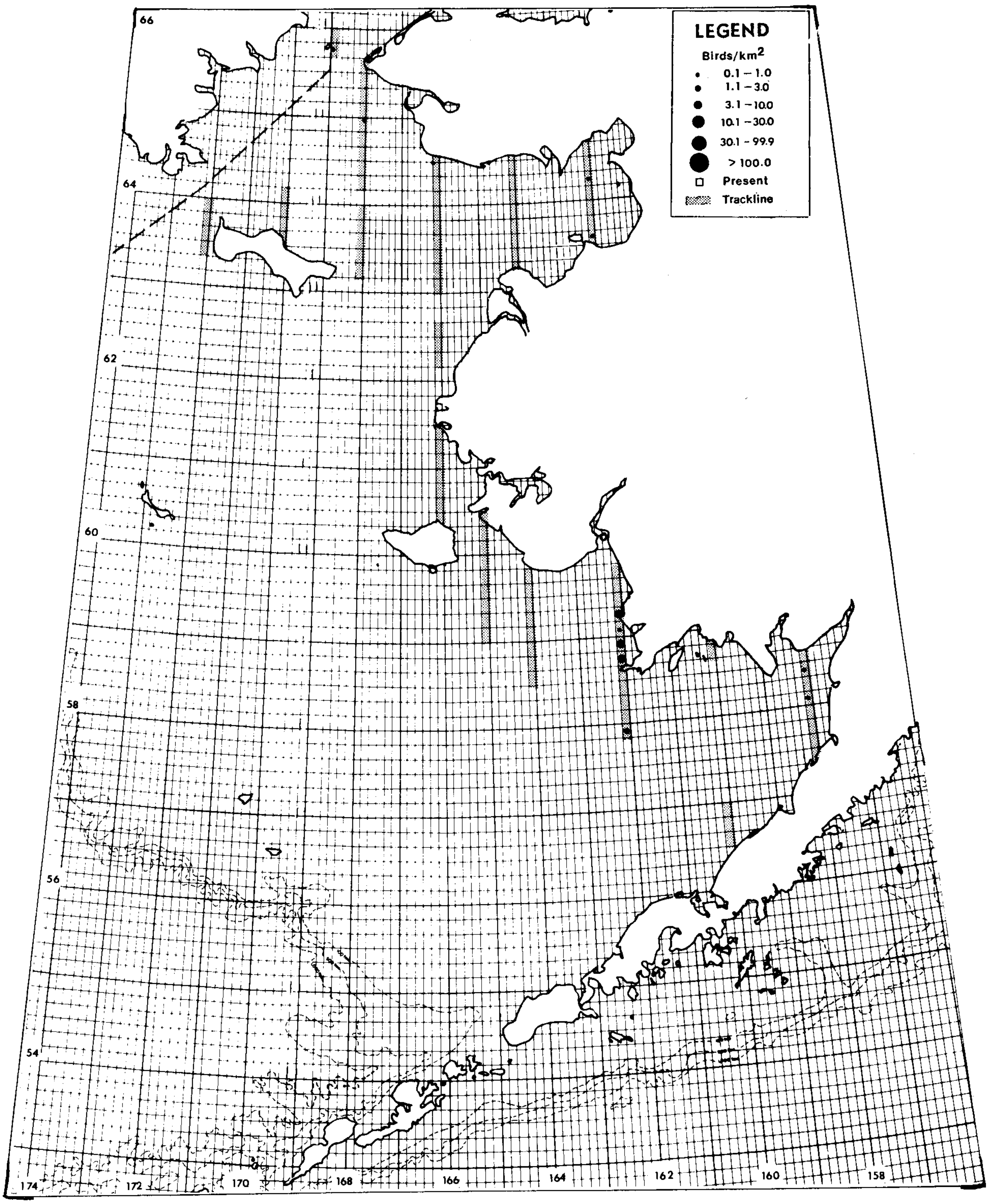

FIGURE 119. DISTRIBUTION AND ABUNDANCE OF HERRING GULLS IN THE BERING SEA IN JUNE. NO HERRING GULLS WERE IDENTIFIED IN FEBRUARY OR MARCH.

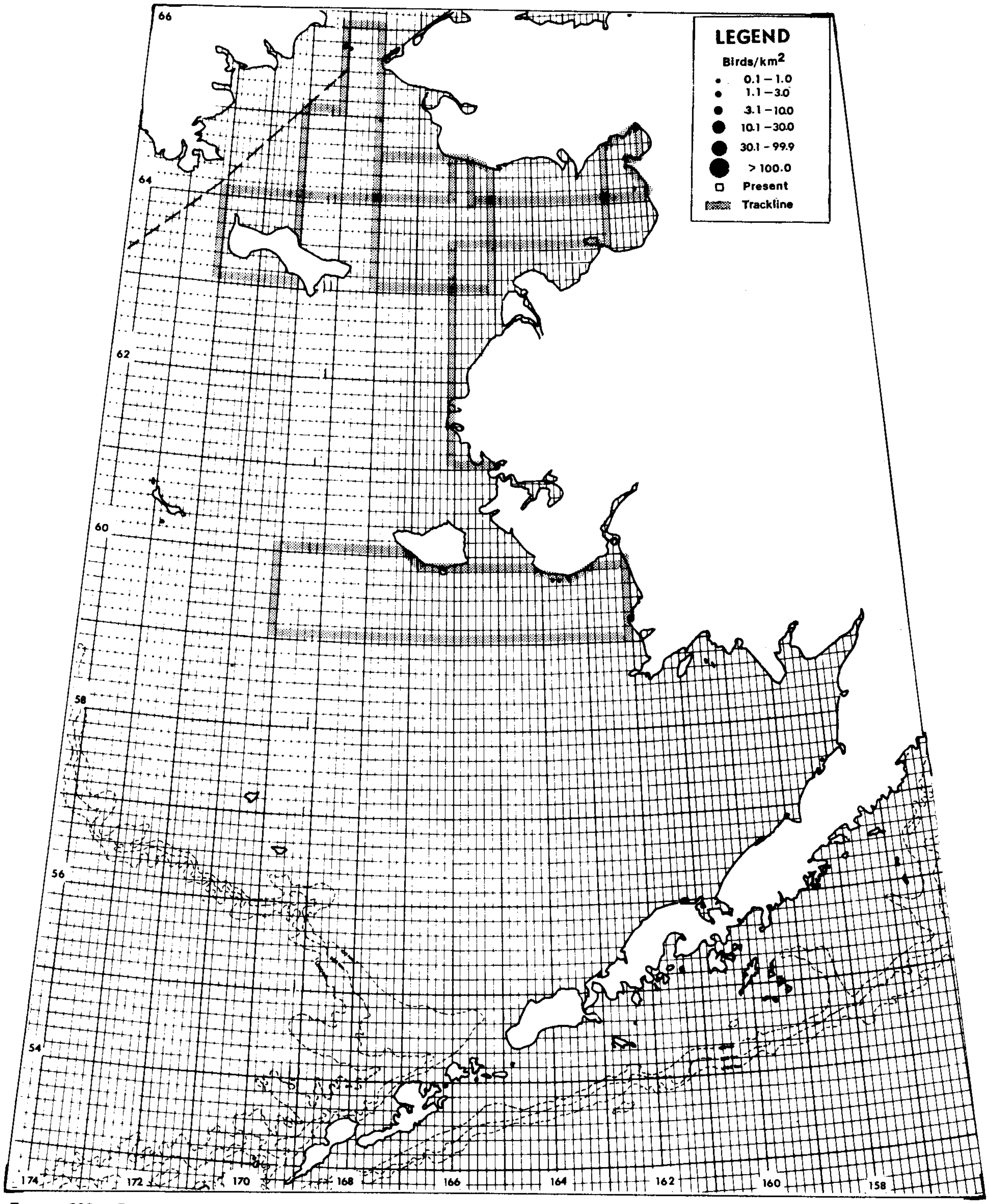

FIGURE 120. DISTRIBUTION AND ABUNDANCE OF HERRING GULLS IN THE BERING SEA IN AUGUST. NO HERRING GULLS WERE IDENTIFIED IN JULY OR OCTOBER.

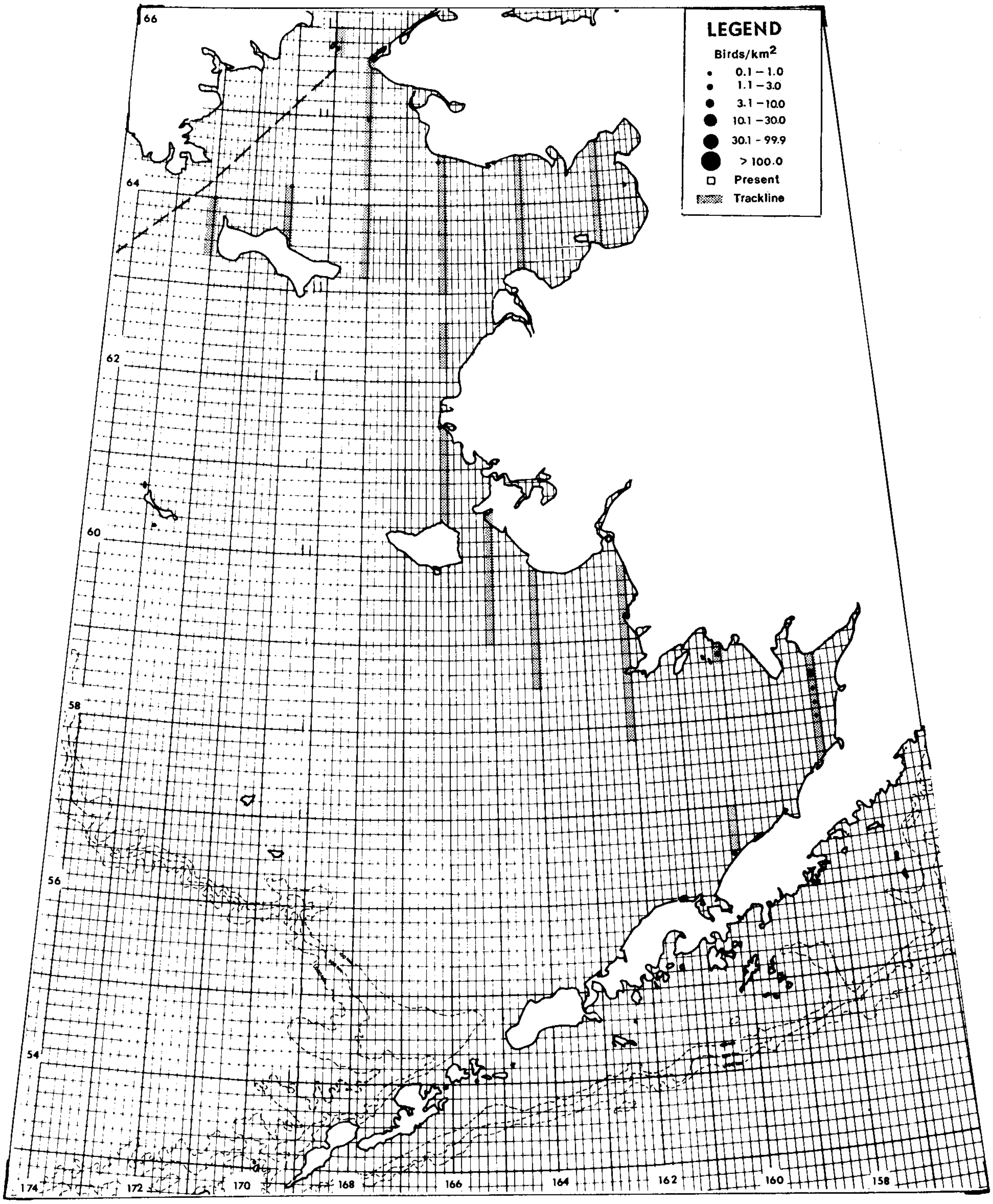

FIGURE 121. DISTRIBUTION AND ABUNDANCE OF MEW GULLS IN THE BERING SEA IN JUNE. NO MEW GULLS WERE OBSERVED IN FEBRUARY OR MARCH.

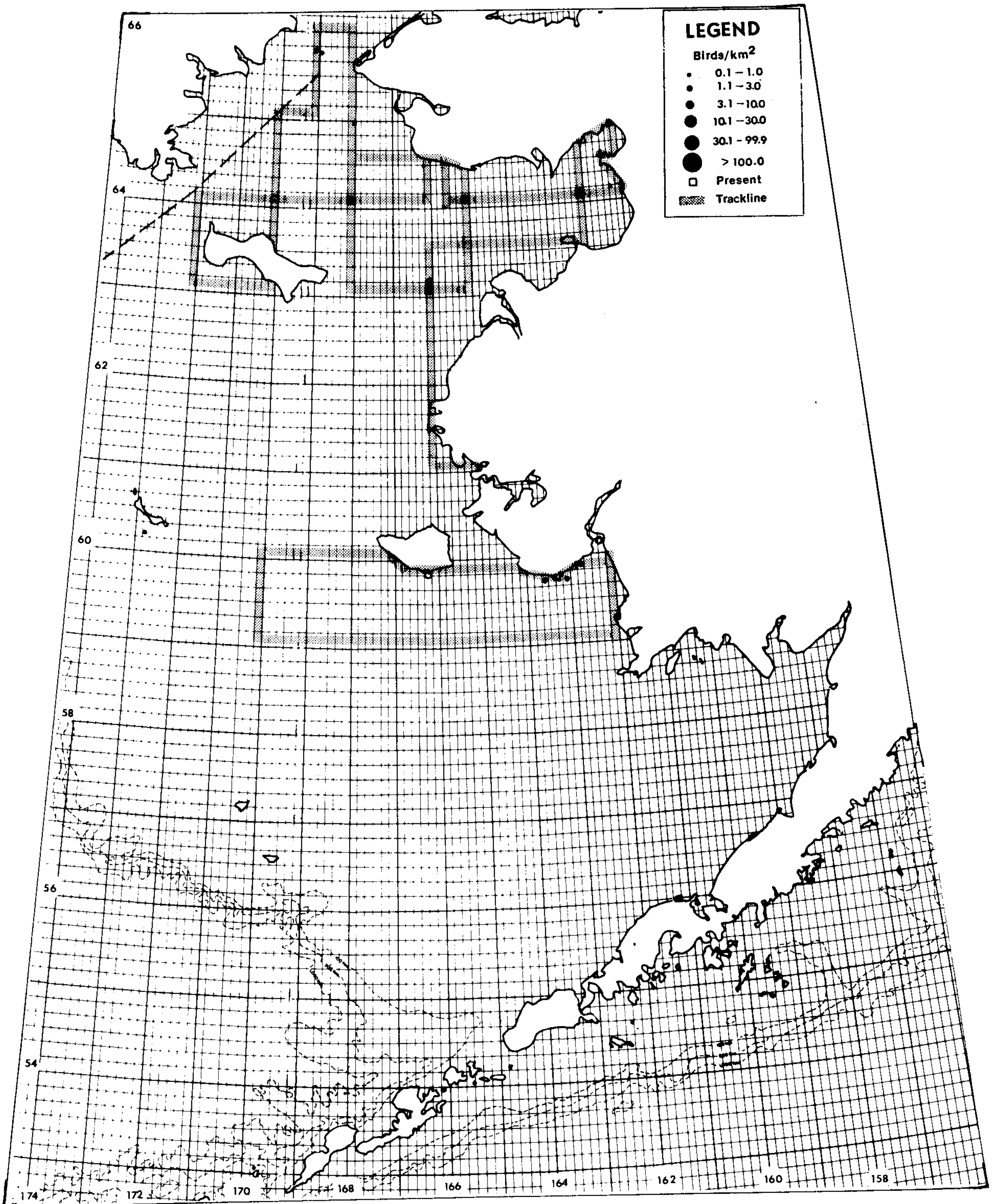

FIGURE 122. DISTRIBUTION AND ABUNDANCE OF MEW GULLS IN THE BERING SEA IN AUGUST. NO MEW GULLS WERE OBSERVED IN JULY OR OCTOBER.

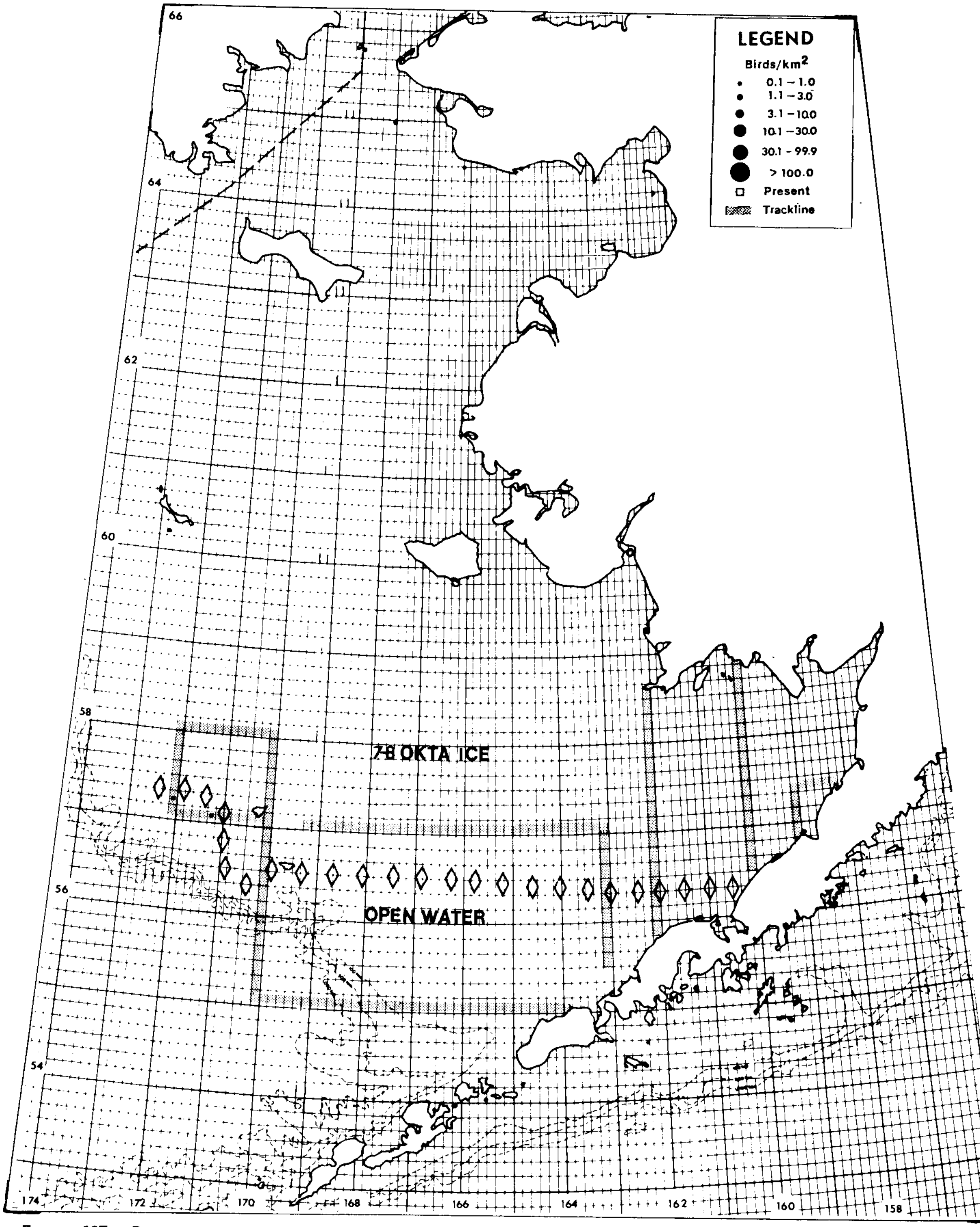

FIGURE 123. DISTRIBUTION AND ABUNDANCE OF IVORY GULLS IN THE BERING SEA IN FEBRUARY. NO IVORY GULLS WERE OBSERVED IN MARCH, JUNE, JULY, AUGUST OR OCTOBER.

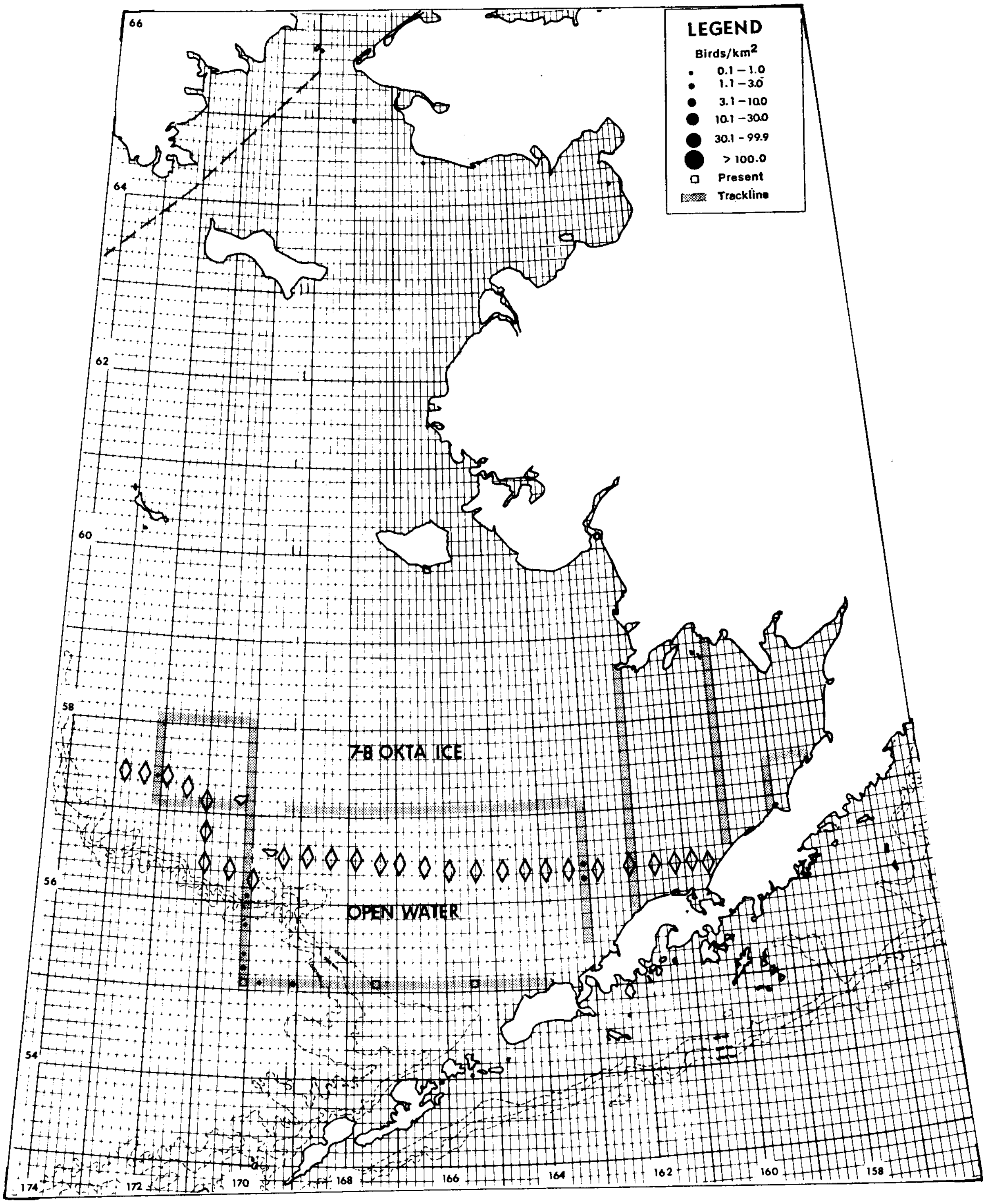

FIGURE 124. DISTRIBUTION AND ABUNDANCE OF BLACK-LEGGED KITTIWAKES IN THE BERING SEA IN FEBRUARY.

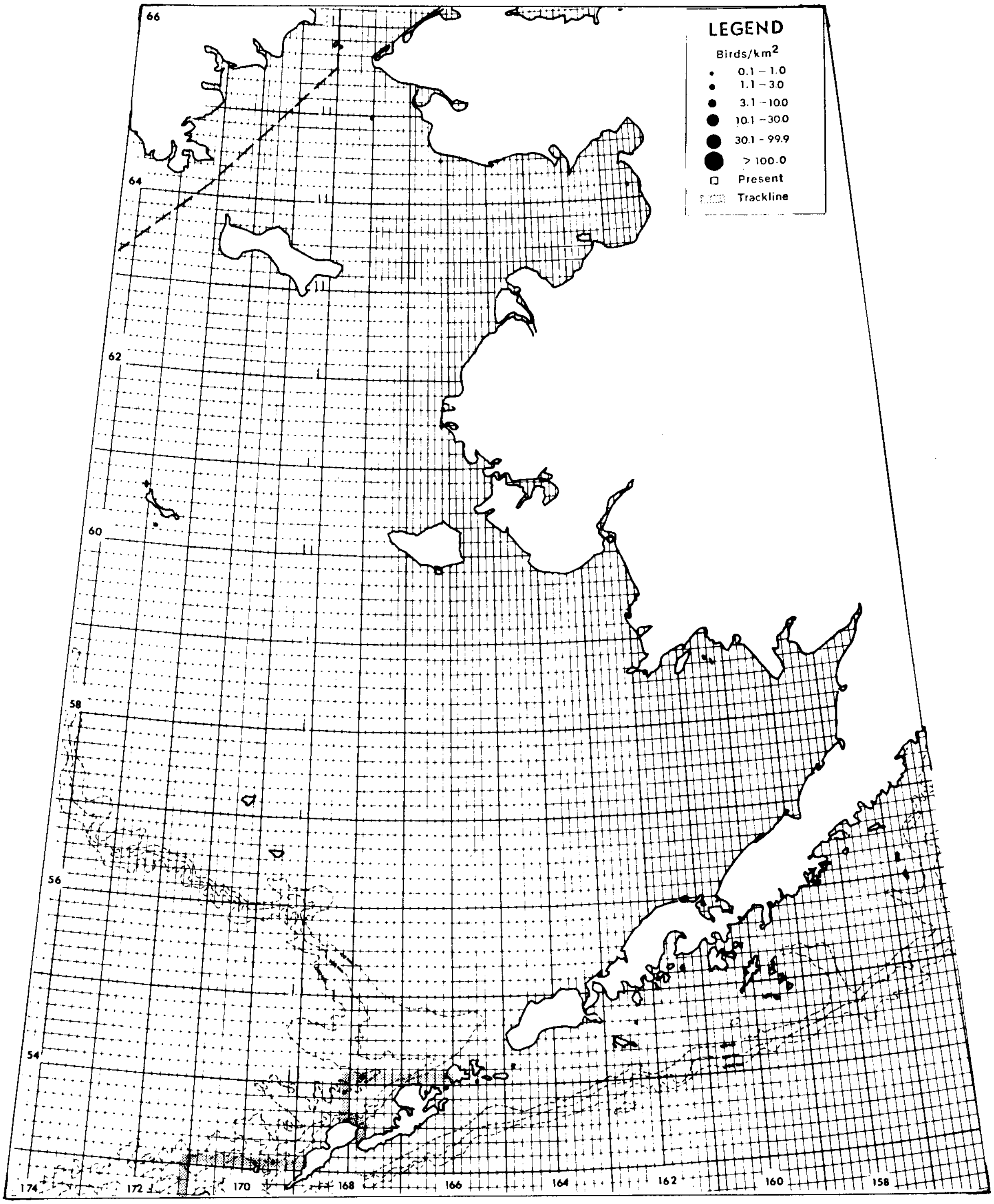

FIGURE 125. DISTRIBUTION AND ABUNDANCE OF BLACK-LEGGED KITTIWAKES IN THE BERING SEA IN MARCH.

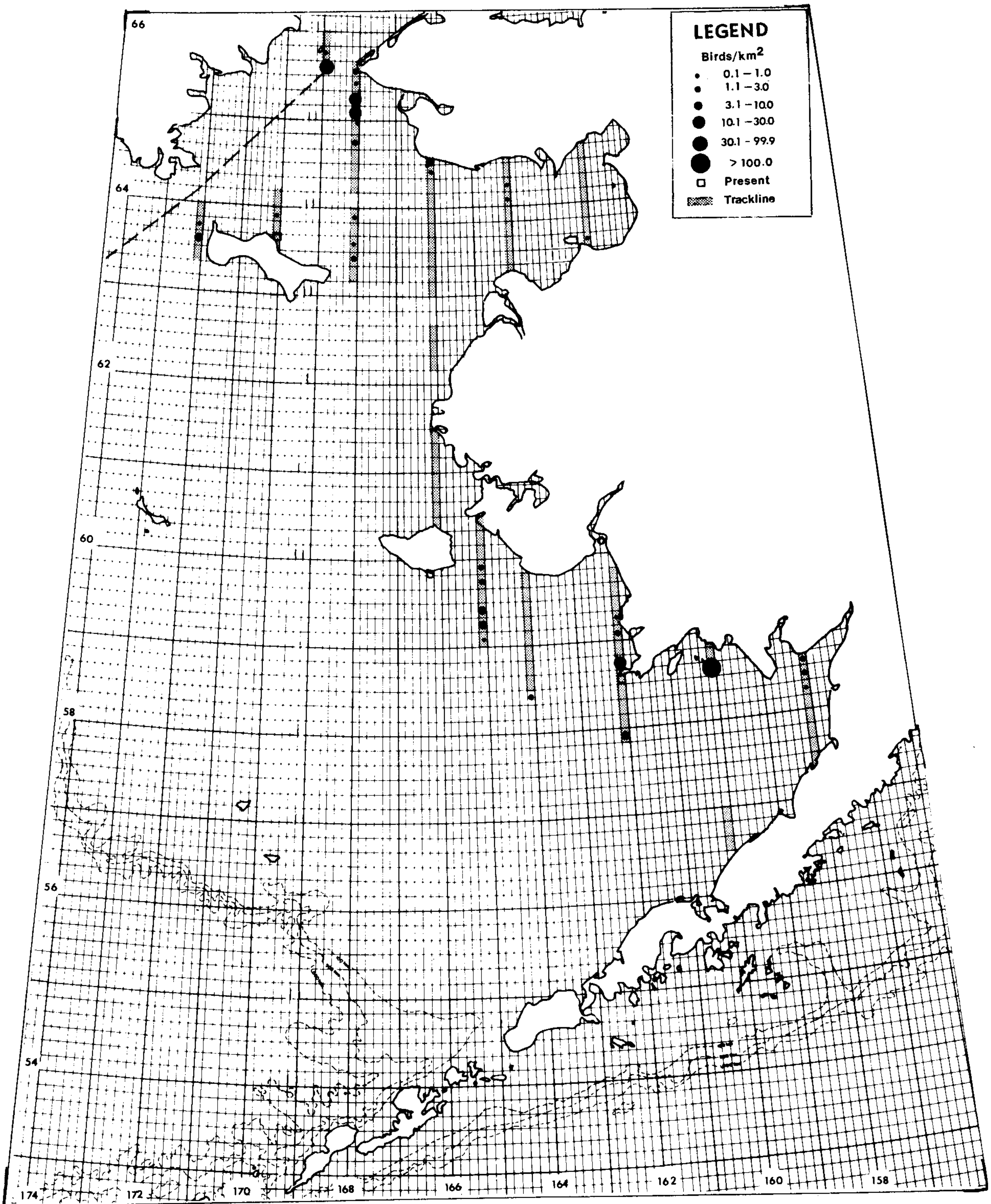

FIGURE 126. DISTRIBUTION AND ABUNDANCE OF BLACK-LEGGED KITTIWAKES IN THE BERING SEA IN JUNE.

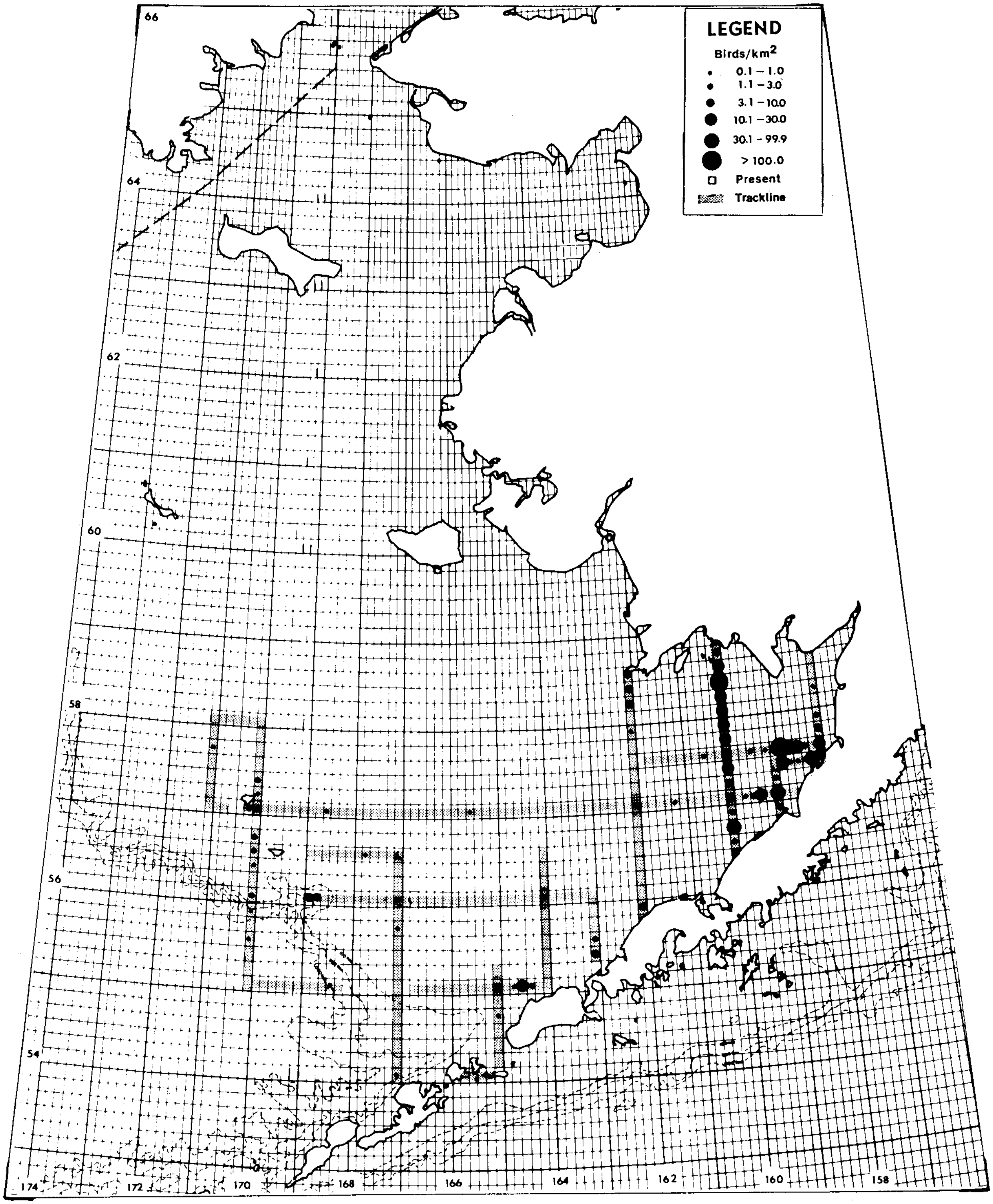

FIGURE 127. DISTRIBUTION AND ABUNDANCE OF BLACK-LEGGED KITTIWAKES IN THE BERING SEA IN JULY.

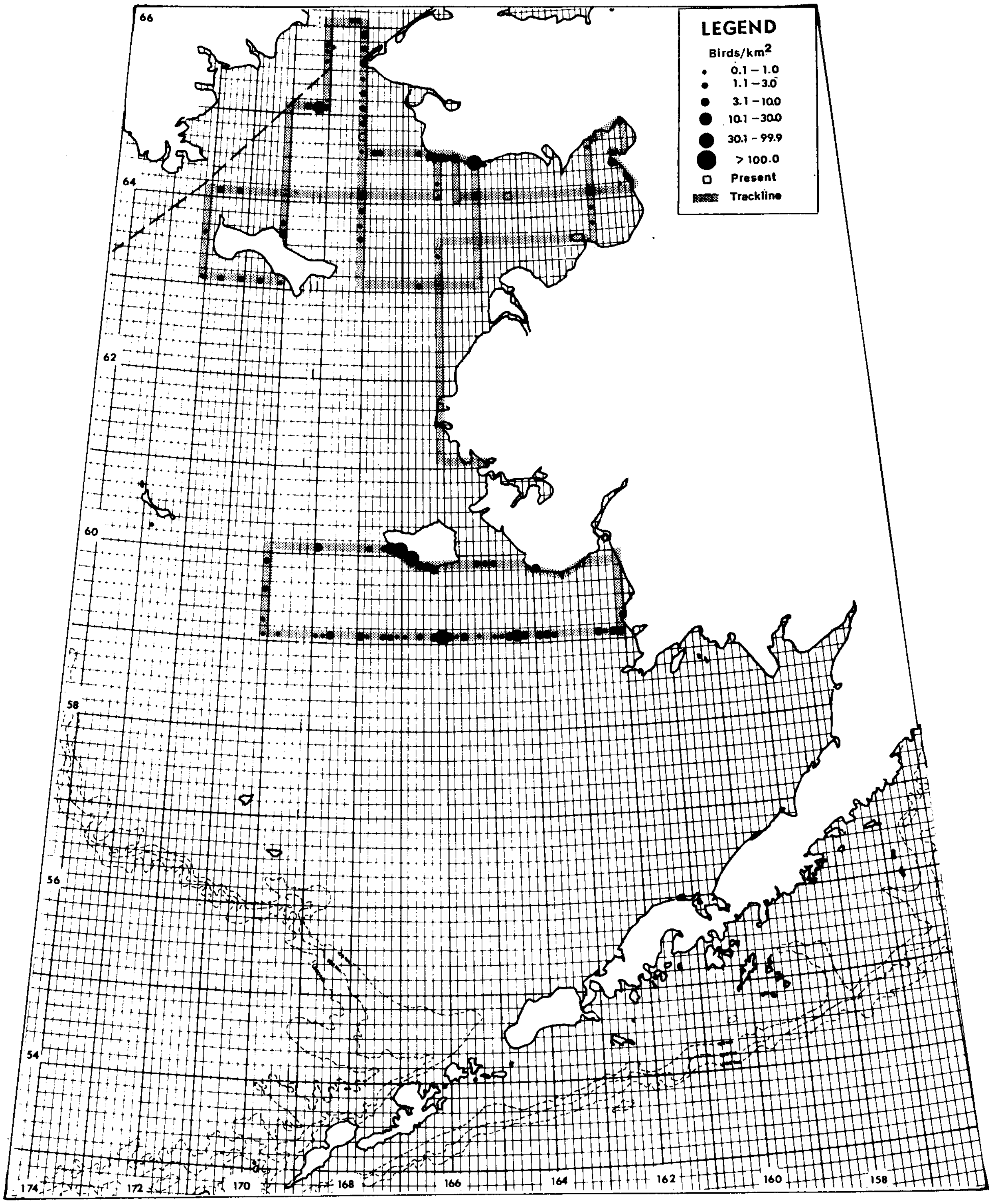

FIGURE 128. DISTRIBUTION AND ABUNDANCE OF BLACK-LEGGED KITTIWAKES IN THE BERING SEA IN AUGUST.

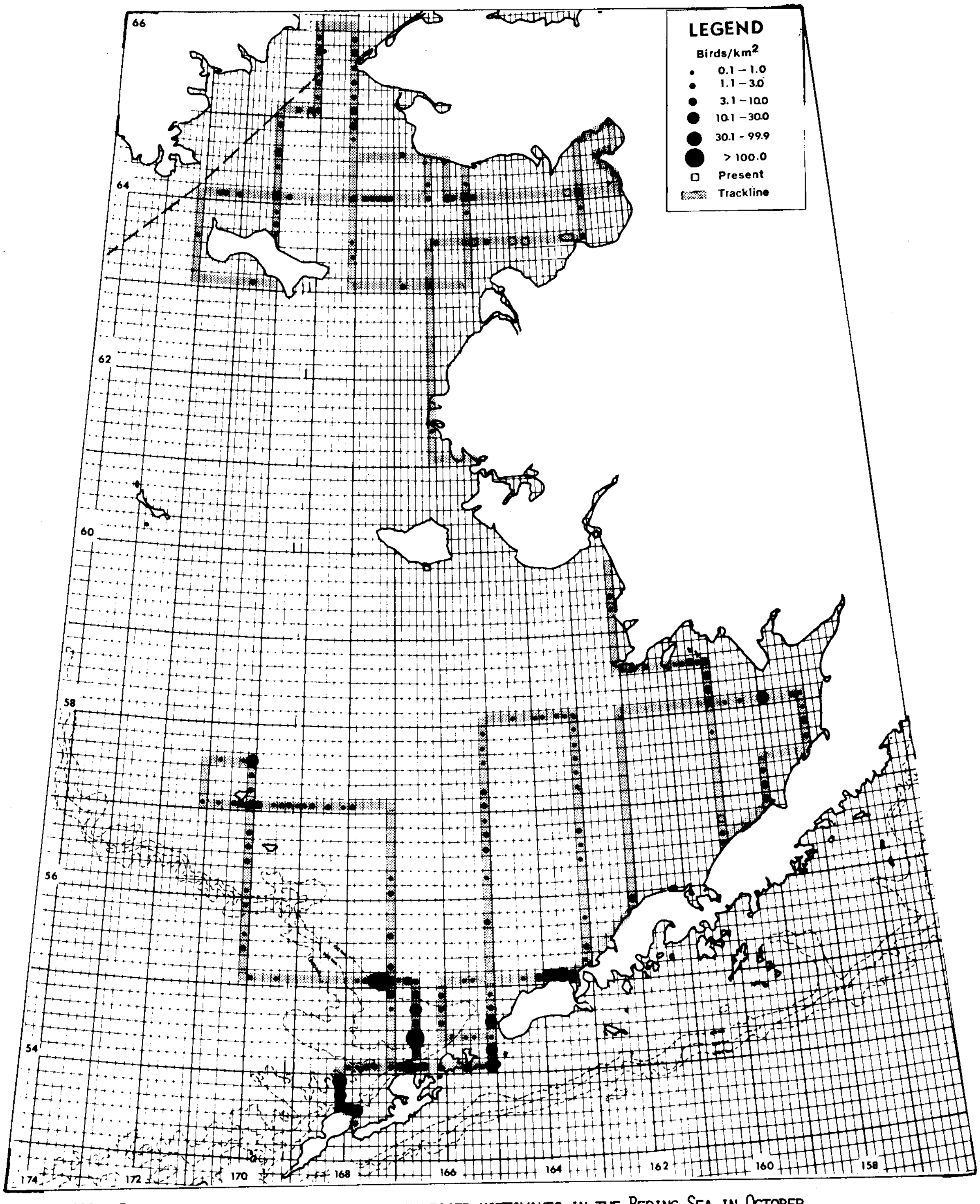

FIGURE 129. DISTRIBUTION AND ABUNDANCE OF BLACK-LEGGED KITTIWAKES IN THE BERING SEA IN OCTOBER.

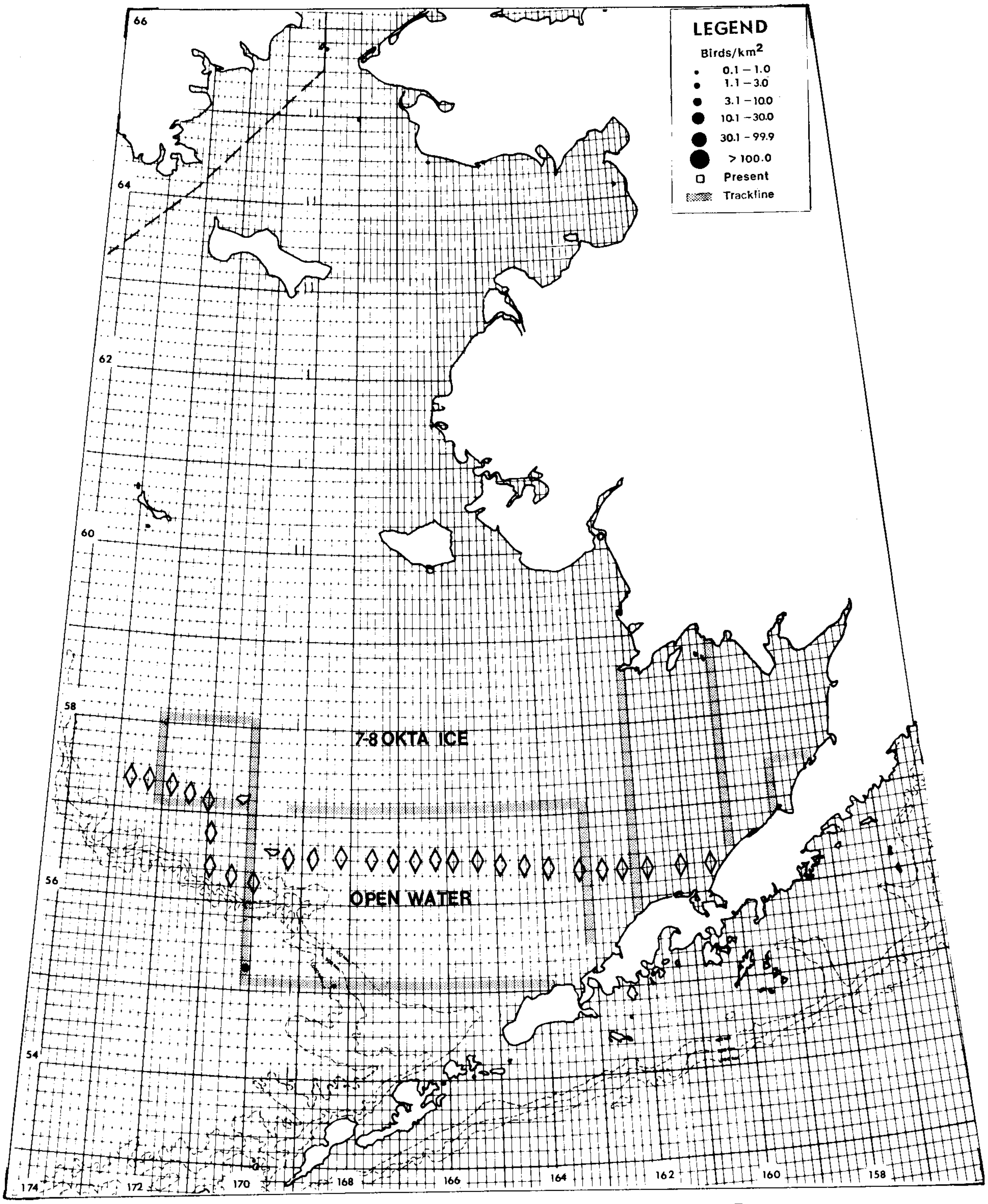

FIGURE 130. DISTRIBUTION AND ABUNDANCE OF RED-LEGGED KITTIWAKES IN THE BERING SEA IN FEBRUARY.

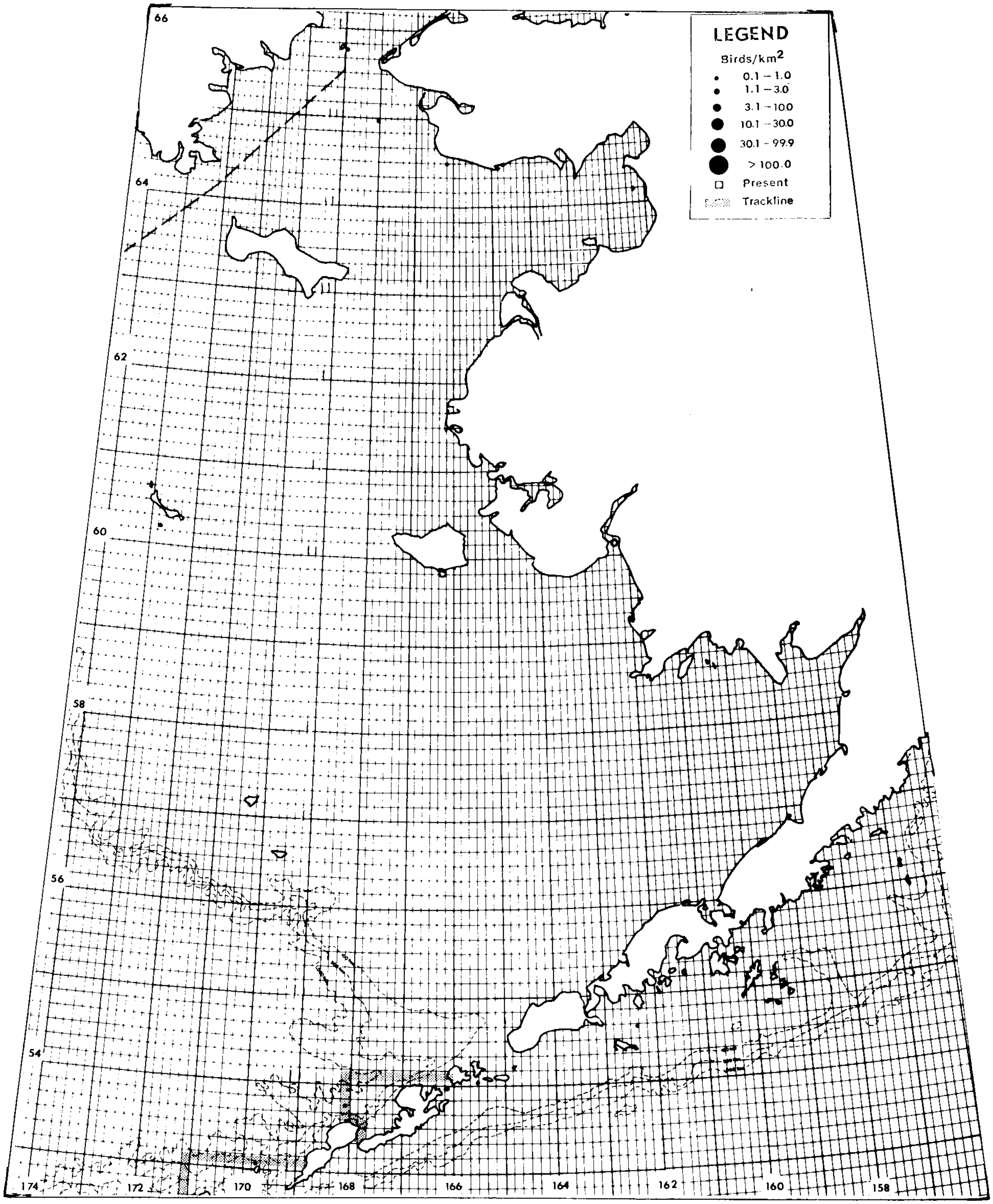

FIGURE 131. DISTRIBUTION AND ABUNDANCE OF RED-LEGGED KITTIWAKES IN THE BERING SEA IN MARCH.

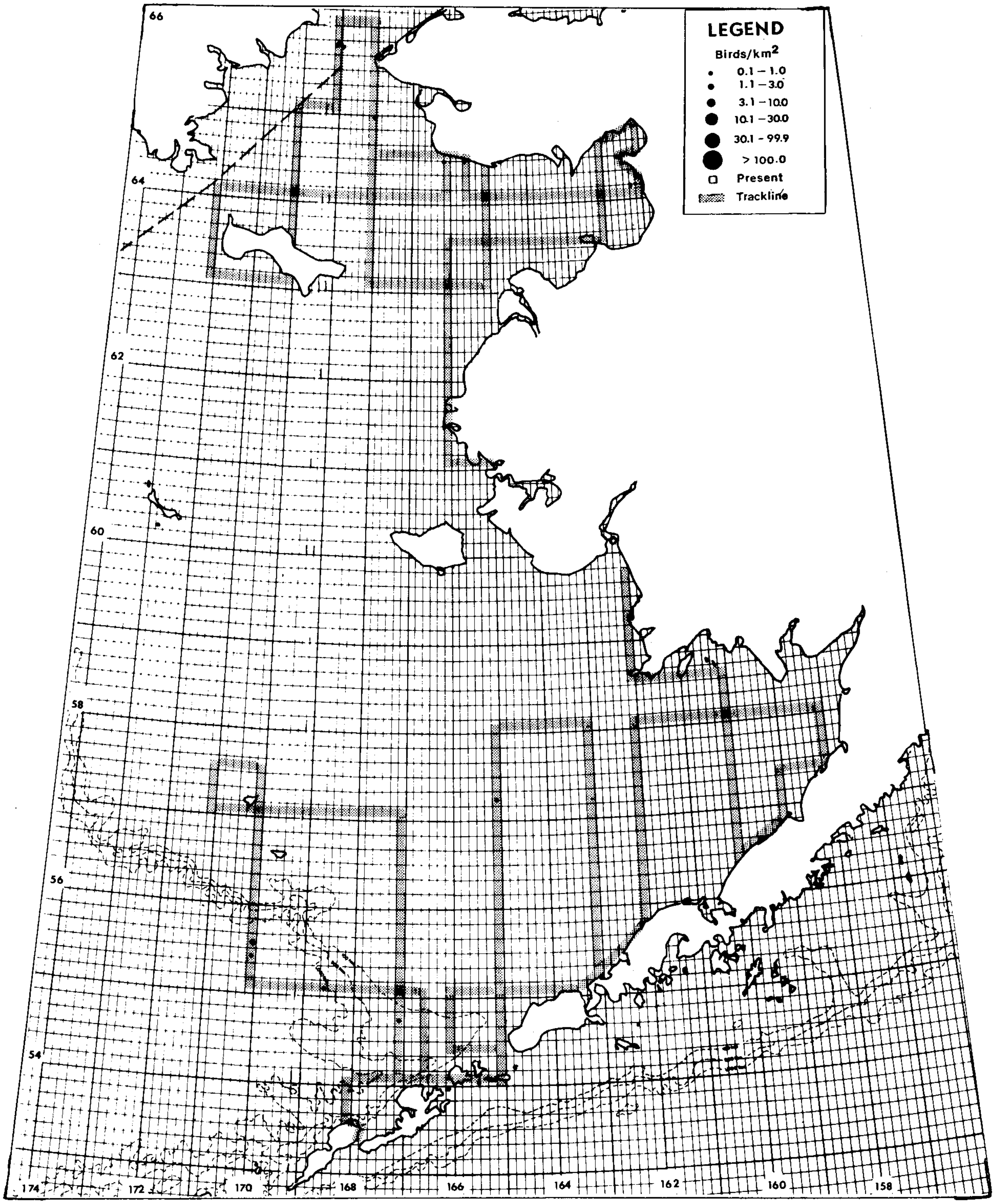

FIGURE 132. DISTRIBUTION AND ABUNDANCE OF RED-LEGGED KITTIWAKES IN THE BERING SEA IN OCTOBER. NO RED-LEGGED KITTIWAKES WERE OBSERVED IN JUNE, JULY OR AUGUST.

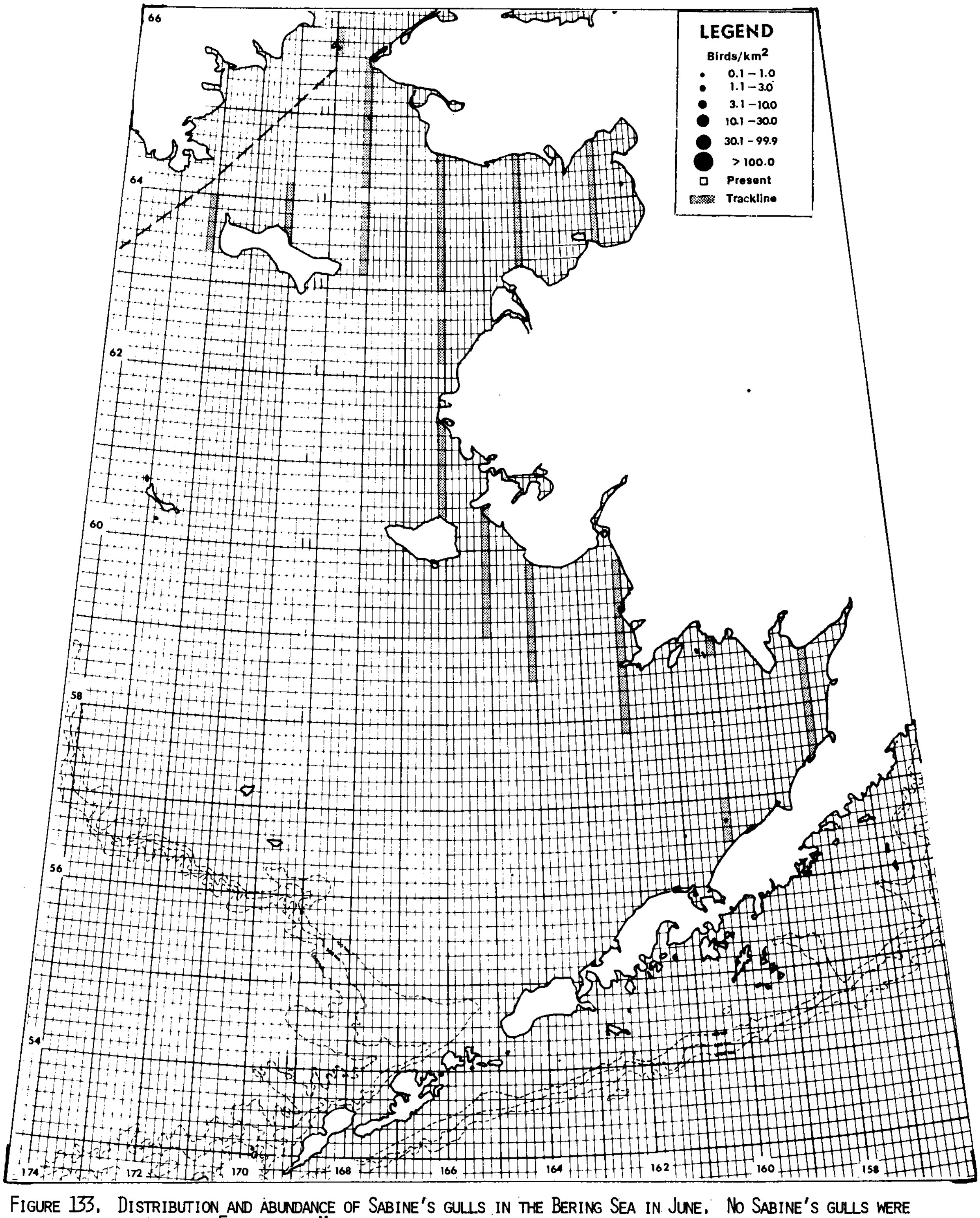

FIGURE 133. DISTRIBUTION AND ABUNDANCE OF SABINE'S GULLS IN THE BERING SEA IN JUNE. NO SABINE'S GULLS WERE OBSERVED IN FEBRUARY OR MARCH.

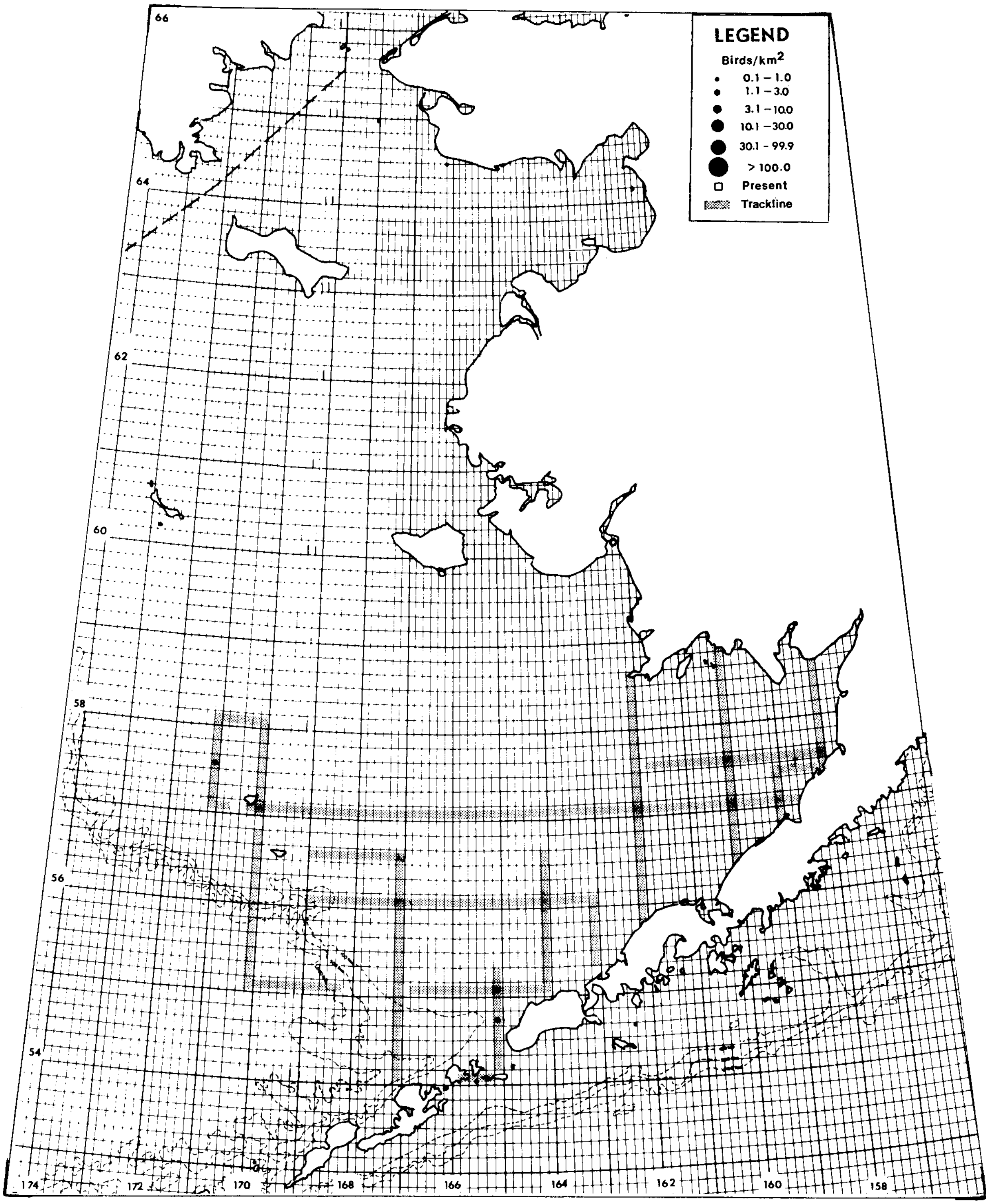

FIGURE 134. DISTRIBUTION AND ABUNDANCE OF SABINE'S GULLS IN THE BERING SEA IN JULY.

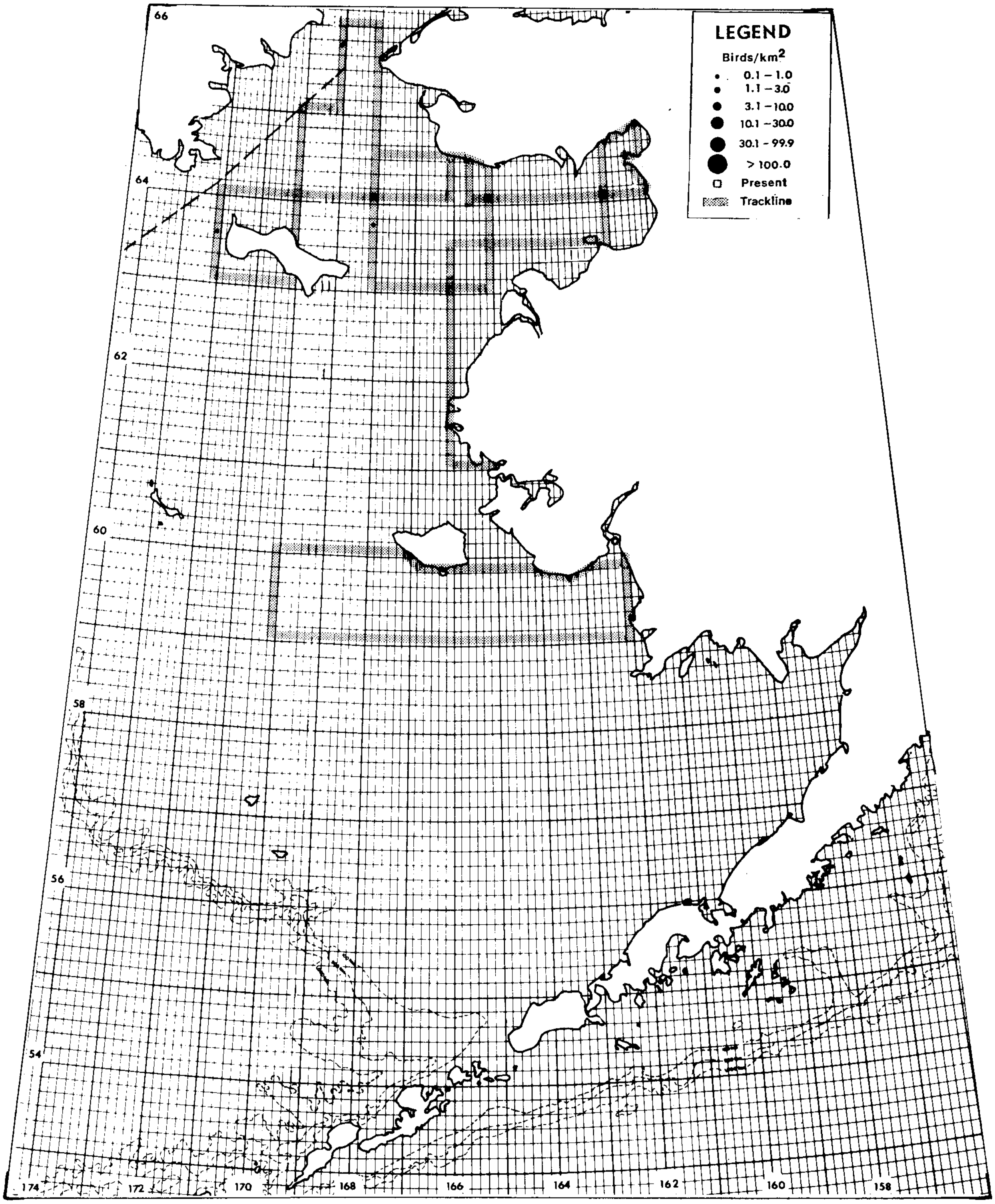

FIGURE 135. DISTRIBUTION AND ABUNDANCE OF SABINE'S GULLS IN THE BERING SEA IN AUGUST.

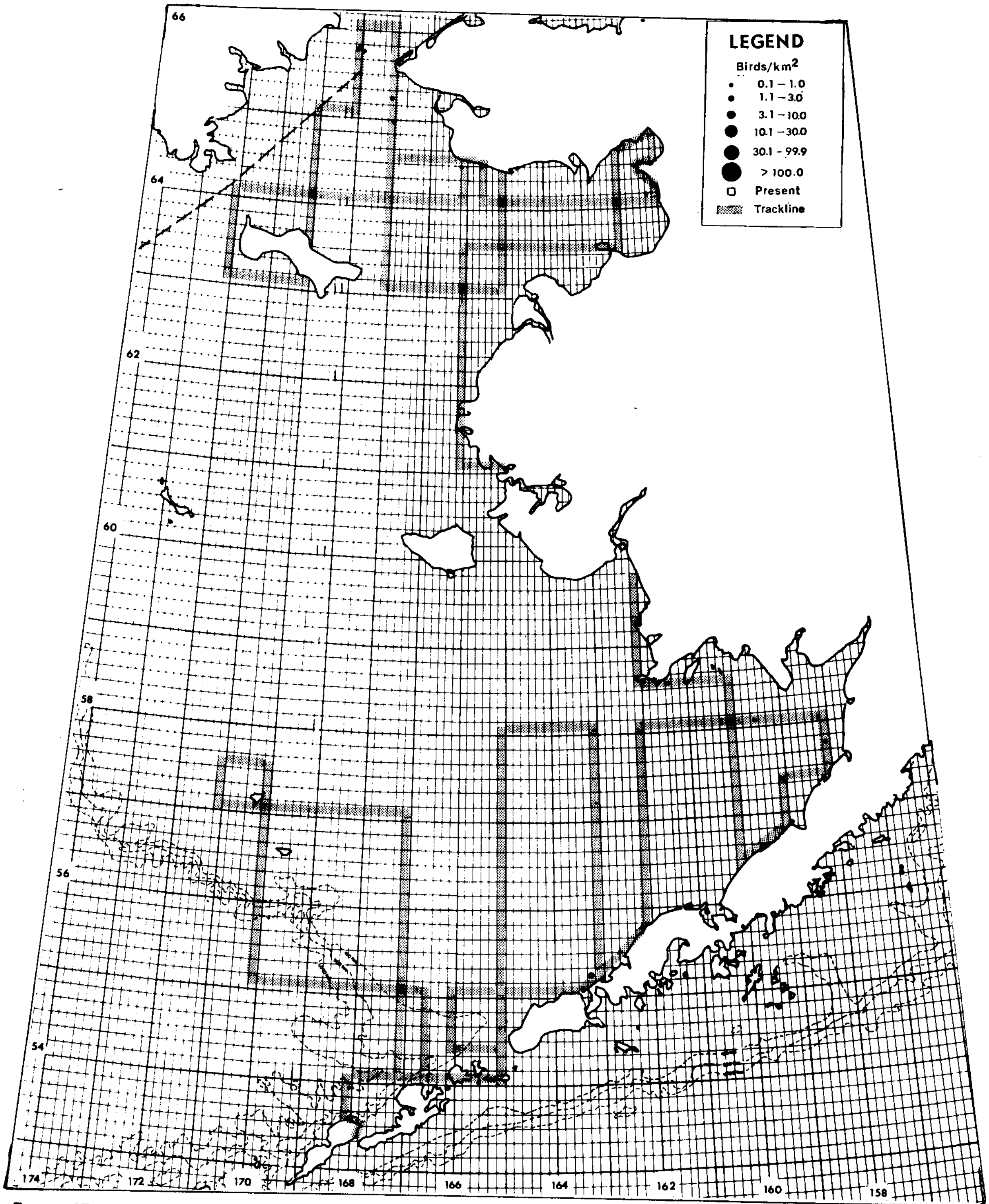

FIGURE 136. DISTRIBUTION AND ABUNDANCE OF SABINE'S GULLS IN THE BERING SEA IN OCTOBER.

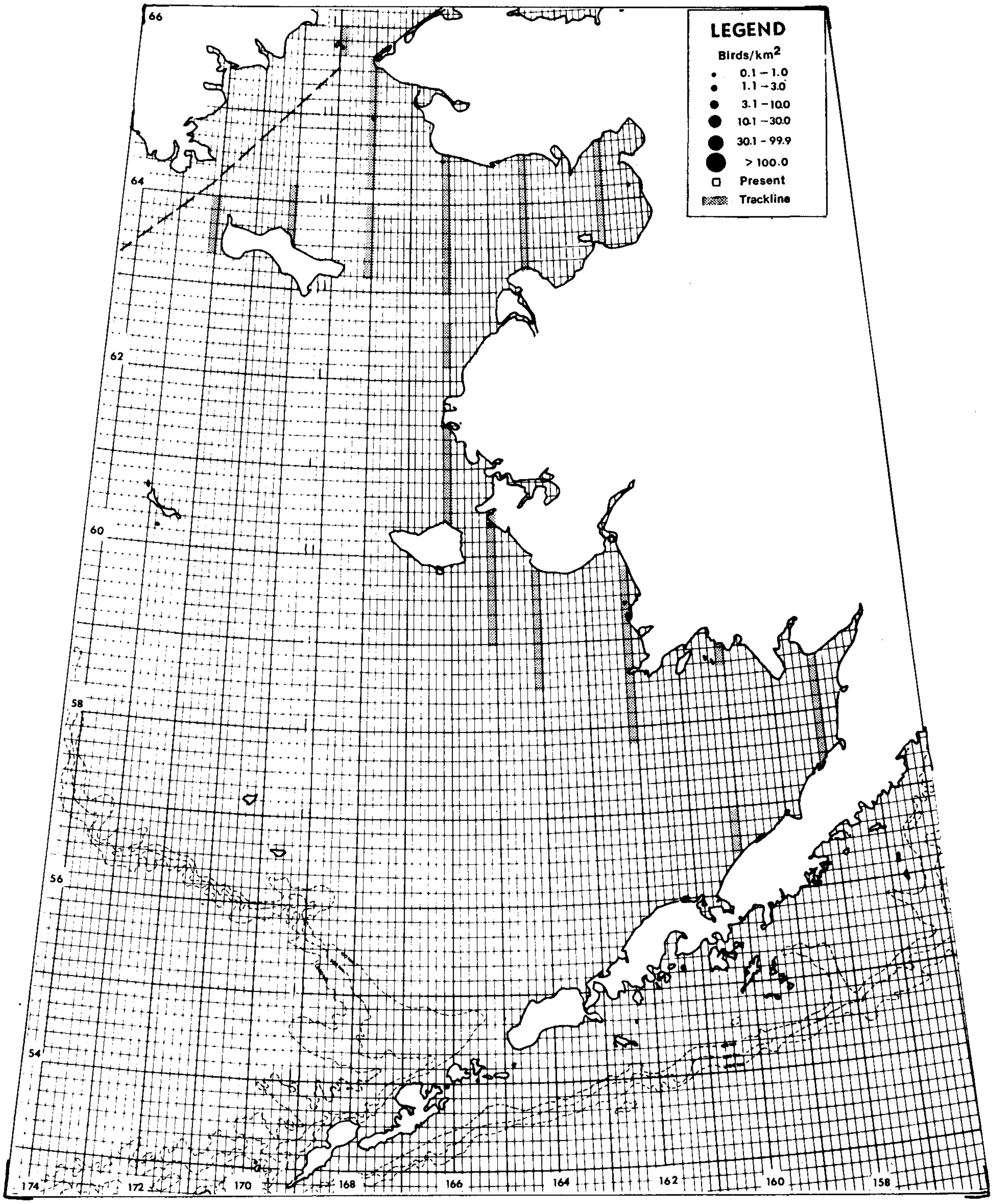

FIGURE 137. DISTRIBUTION AND ABUNDANCE OF ARCTIC TERNS IN THE BERING SEA IN JUNE. NO ARCTIC TERNS WERE OBSERVED IN FEBRUARY OR MARCH.

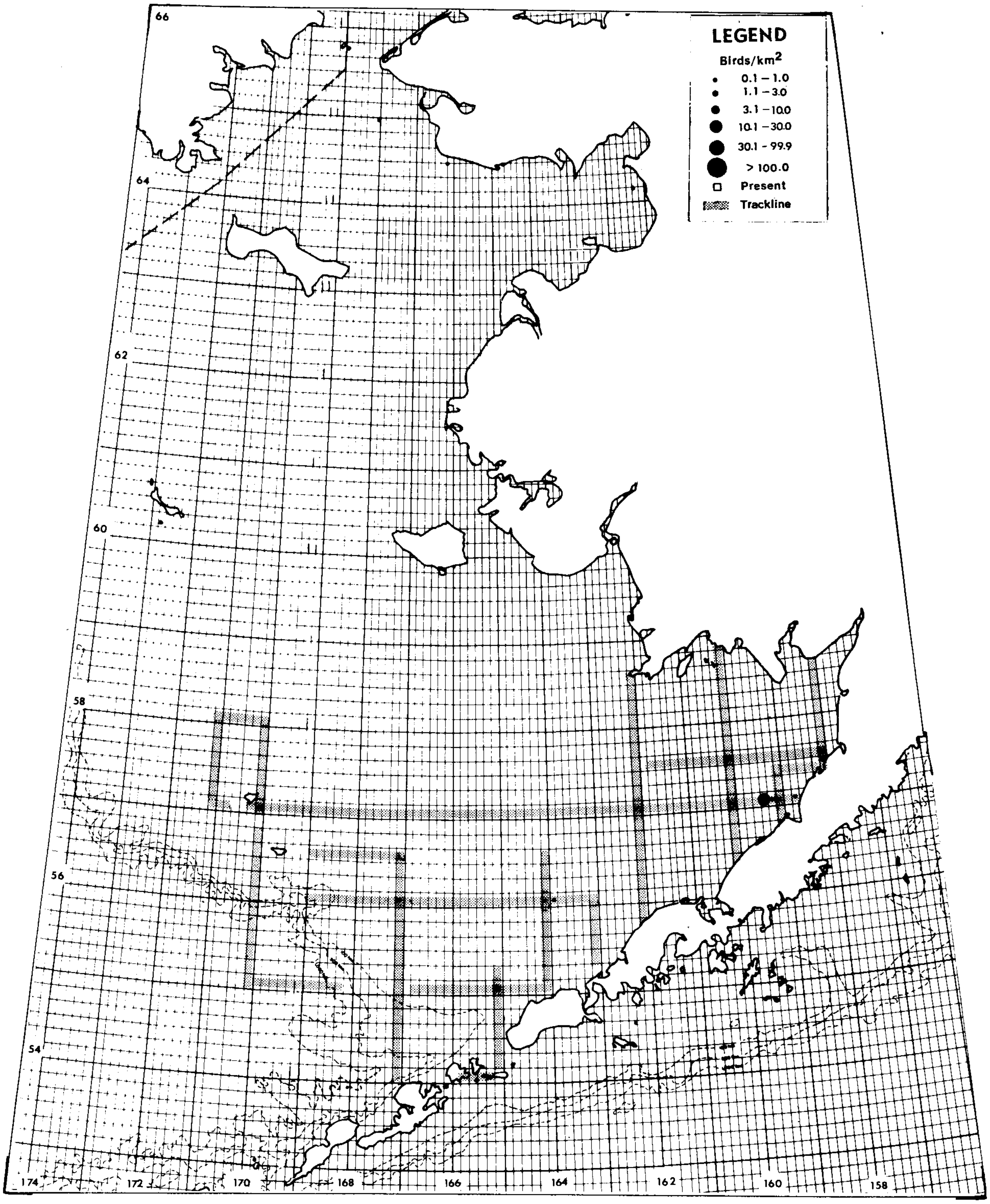

FIGURE 138. DISTRIBUTION AND ABUNDANCE OF ARCTIC TERNS IN THE BERING SEA IN JULY.

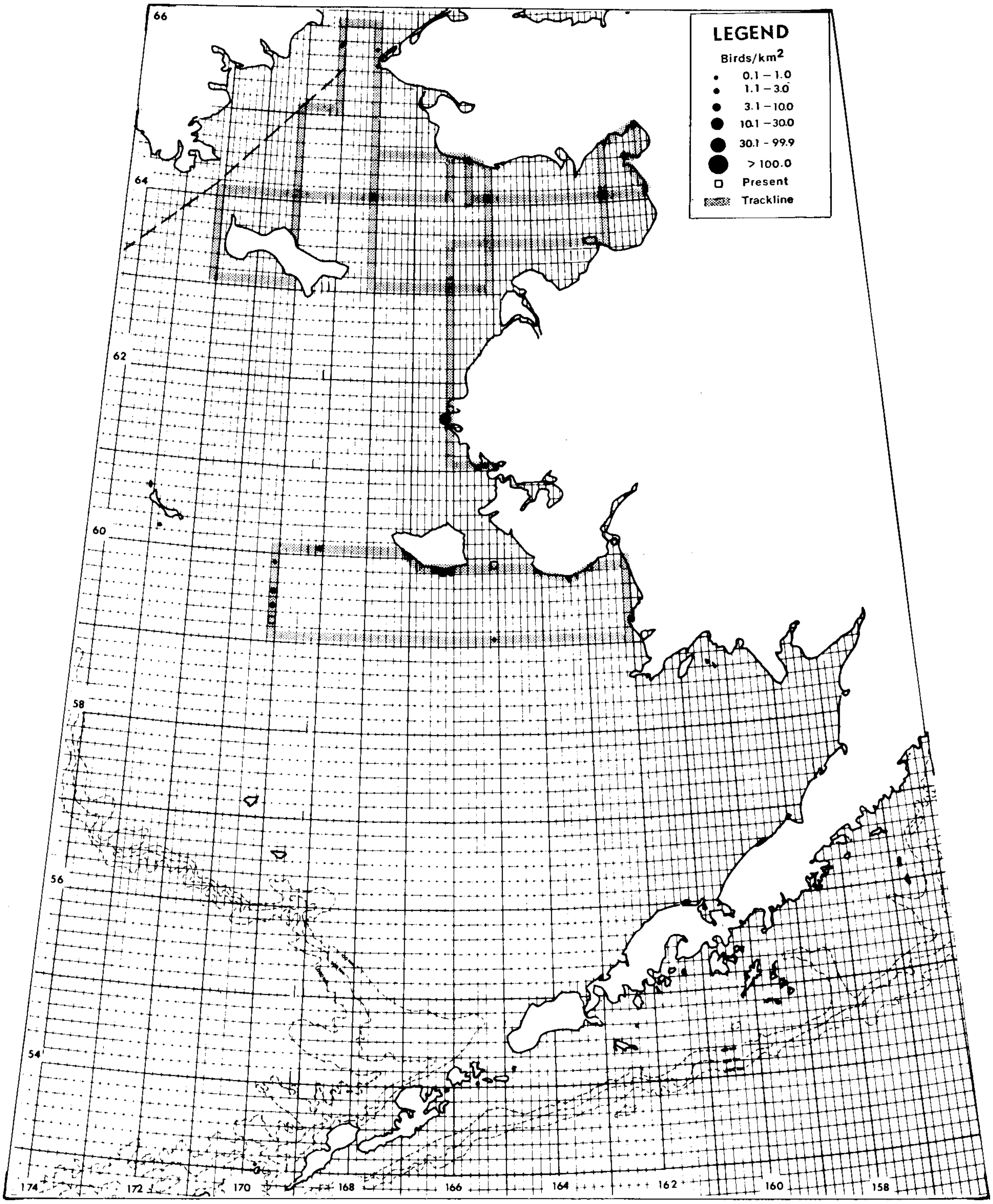

FIGURE 139. DISTRIBUTION AND ABUNDANCE OF ARCTIC TERNS IN THE BERING SEA IN AUGUST. NO ARCTIC TERNS WERE OBSERVED IN OCTOBER.

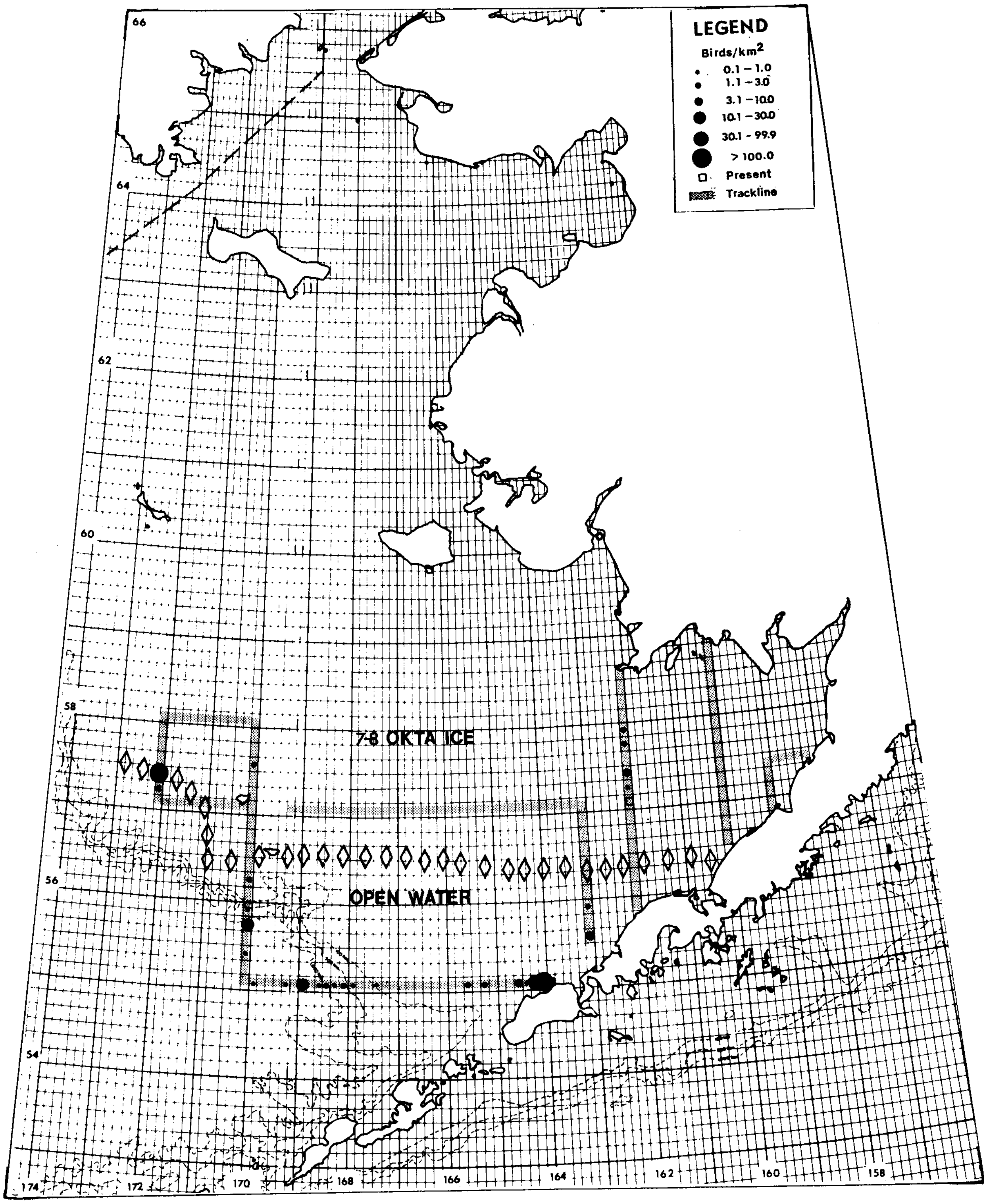

FIGURE 140. DISTRIBUTION AND ABUNDANCE OF SMALL ALCIDS IN THE BERING SEA IN FEBRUARY.

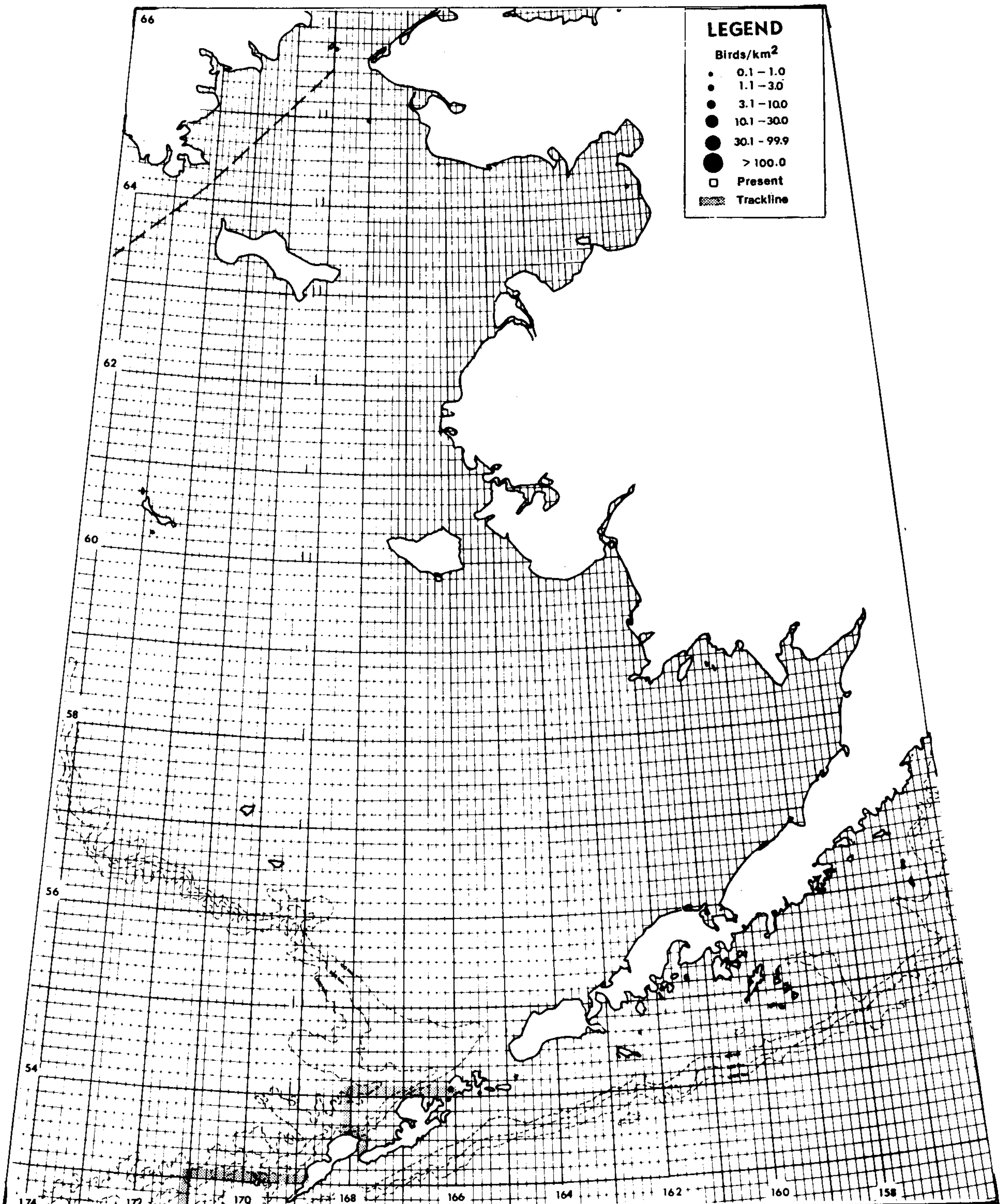

FIGURE 141. DISTRIBUTION AND ABUNDANCE OF SMALL ALCIDS IN THE BERING SEA IN MARCH.

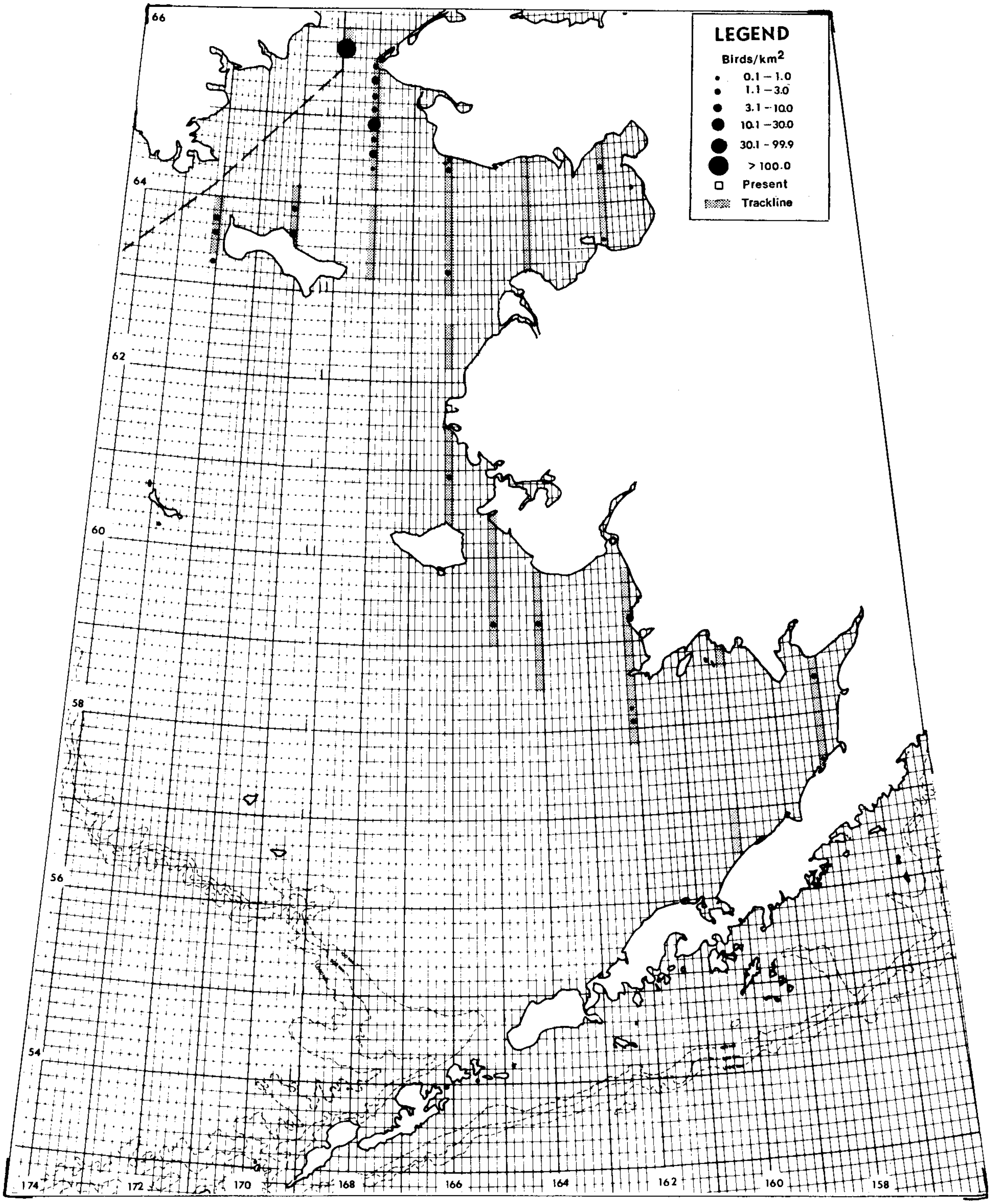

FIGURE 142. DISTRIBUTION AND ABUNDANCE OF SMALL ALCIDS IN THE BERING SEA IN JUNE.

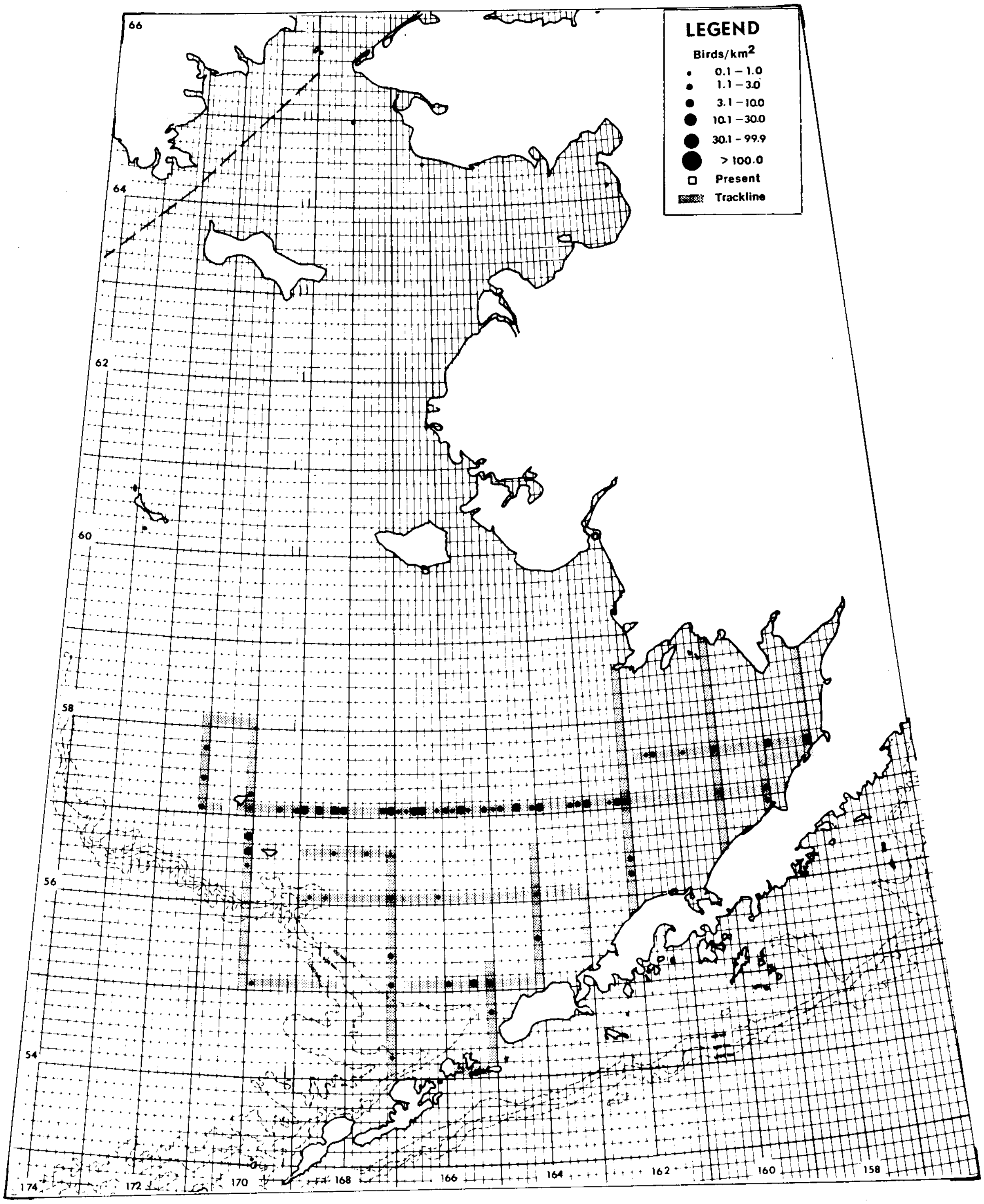

FIGURE 143. DISTRIBUTION AND ABUNDANCE OF SMALL ALCIDS IN THE BERING SEA IN JULY.

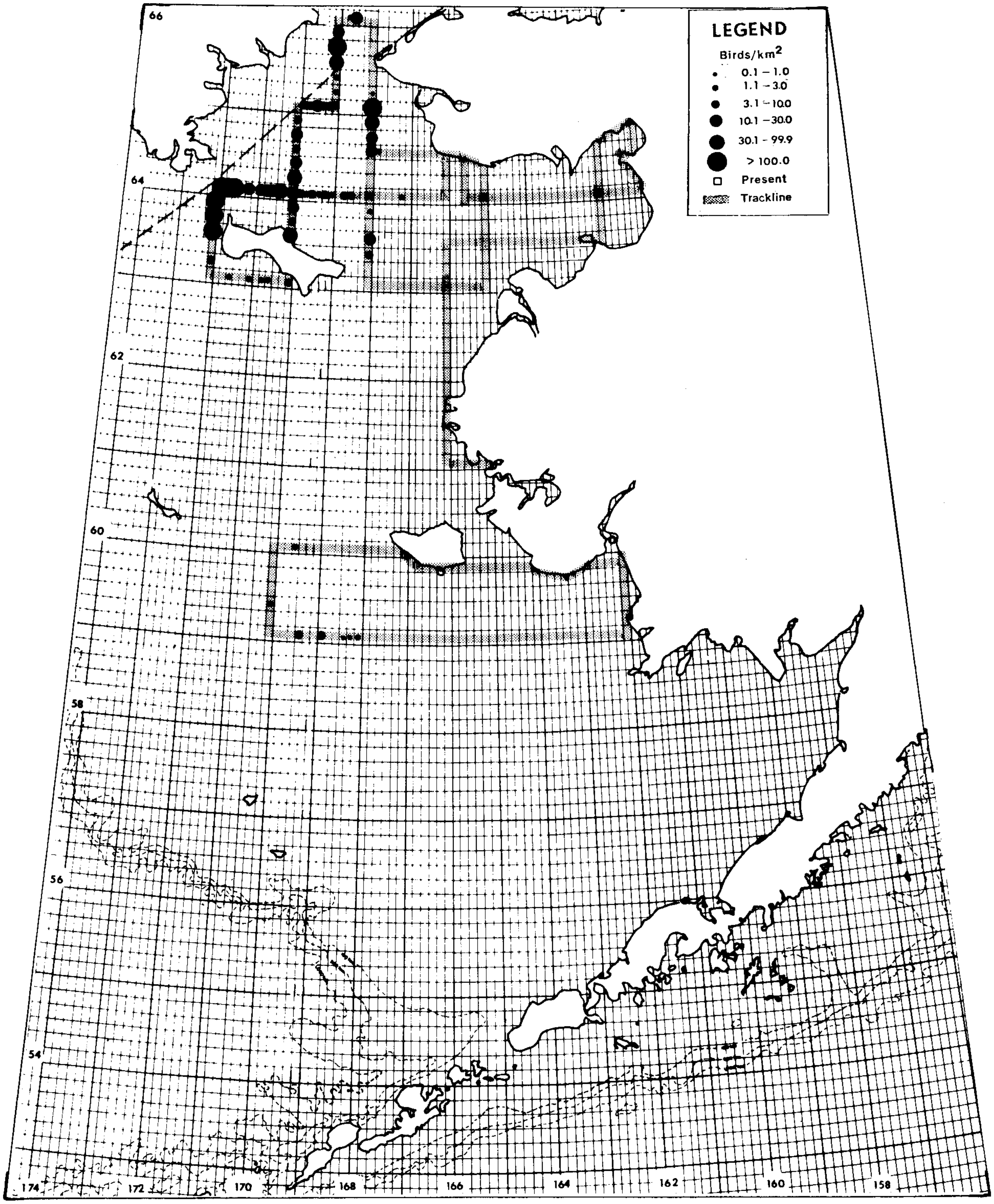

FIGURE 144. DISTRIBUTION AND ABUNDANCE OF SMALL ALCIDS IN THE BERING SEA IN AUGUST.

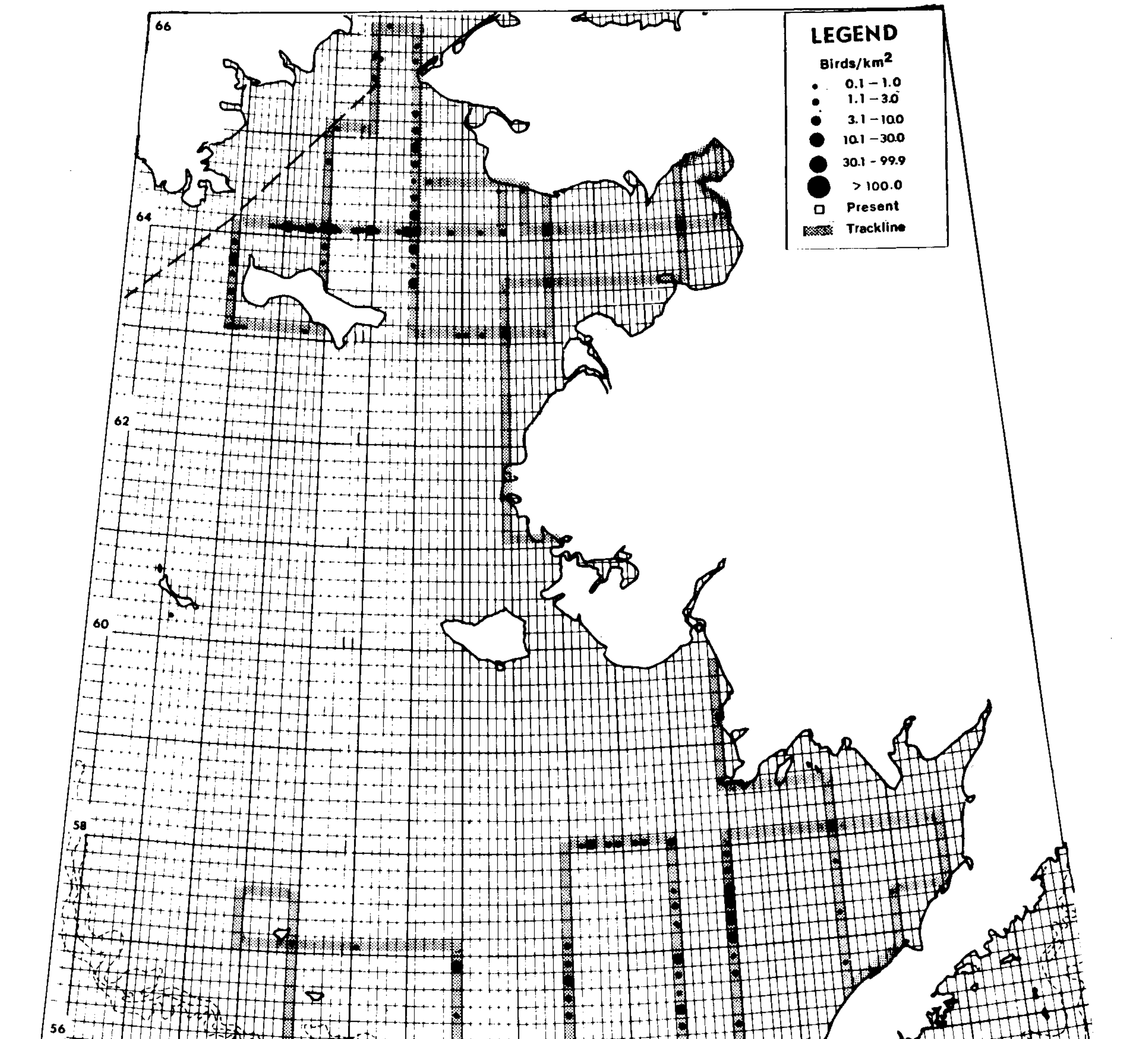

FIGURE 145. DISTRIBUTION AND ABUNDANCE OF SMALL ALCIDS IN THE BERING SEA IN OCTOBER.

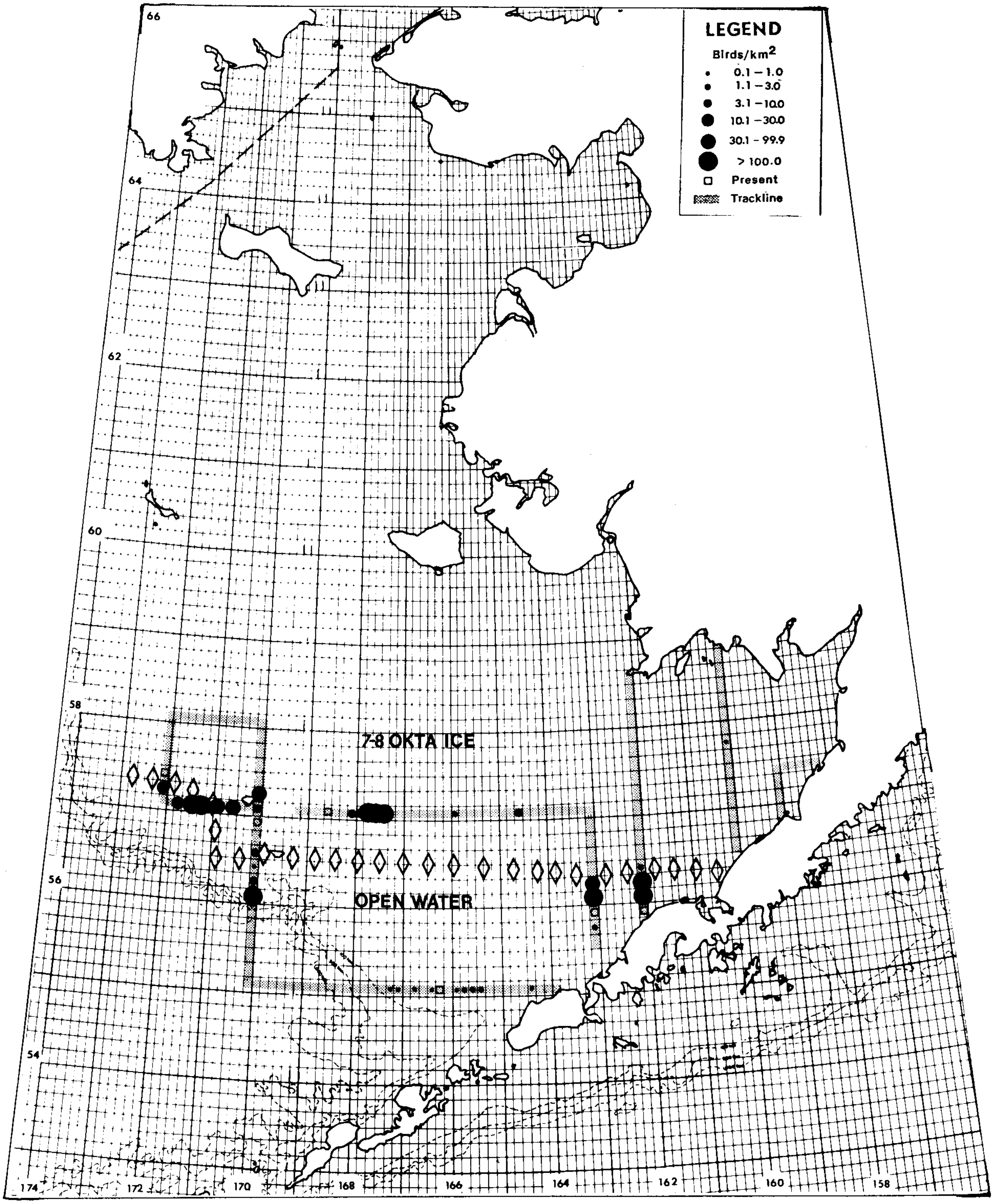

FIGURE 146. DISTRIBUTION AND ABUNDANCE OF MURRES IN THE BERING SEA IN FEBRUARY.

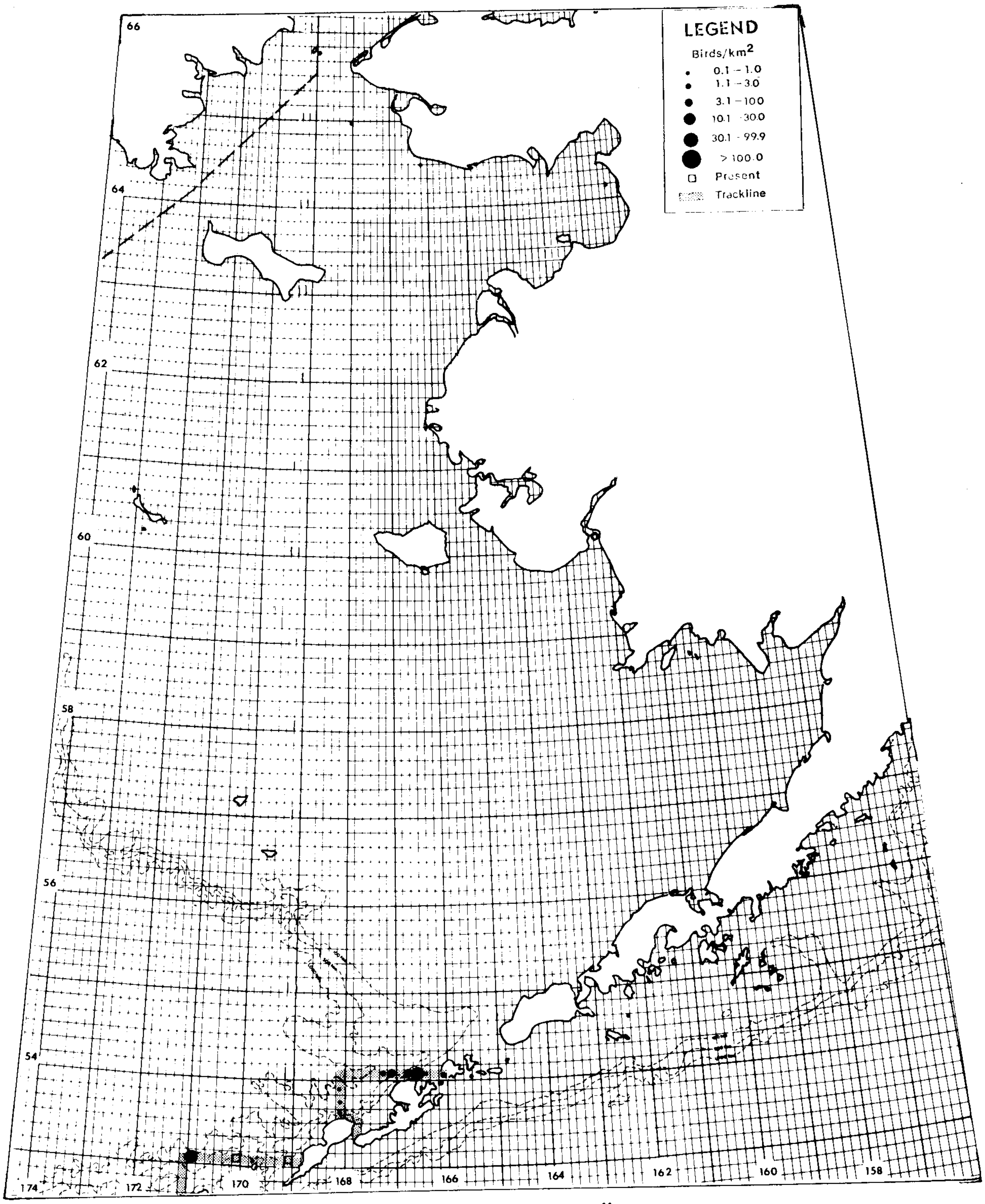

FIGURE 147. DISTRIBUTION AND ABUNDANCE OF MURRES IN THE BERING SEA IN MARCH.

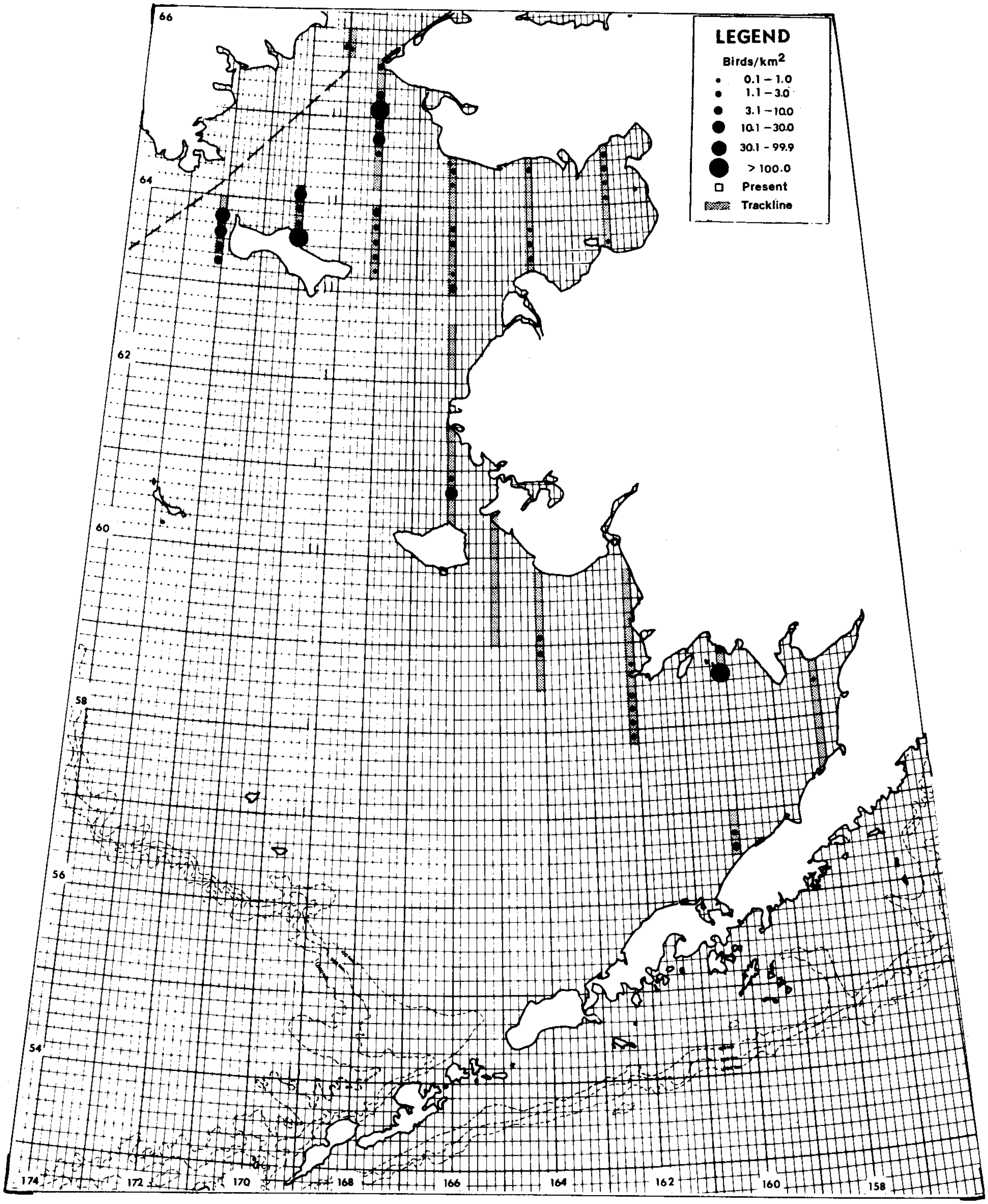

FIGURE 148. DISTRIBUTION AND ABUNDANCE OF MURRES IN THE BERING SEA IN JUNE.

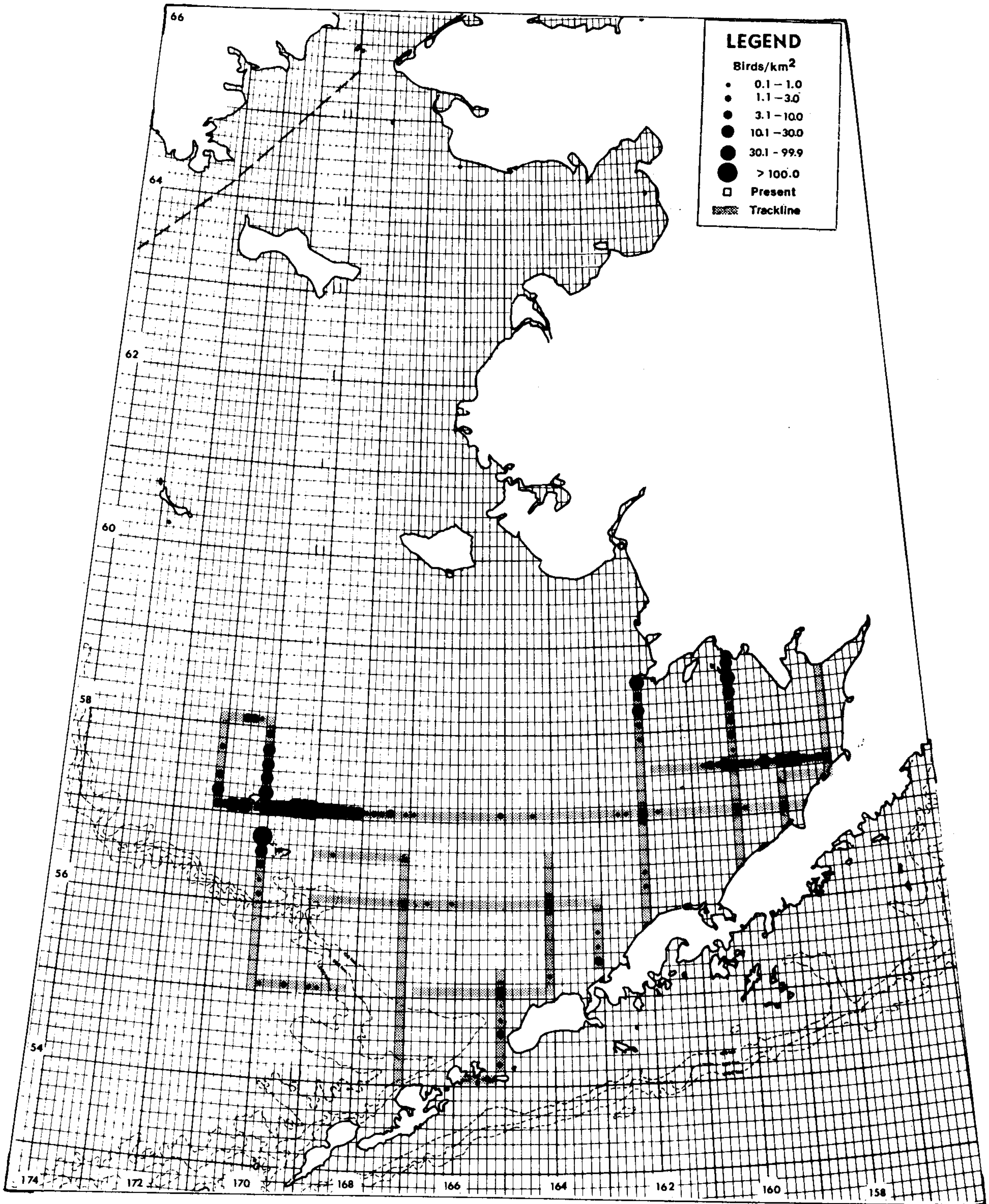

FIGURE 149. DISTRIBUTION AND ABUNDANCE OF MURRES IN THE BERING SEA IN JULY.

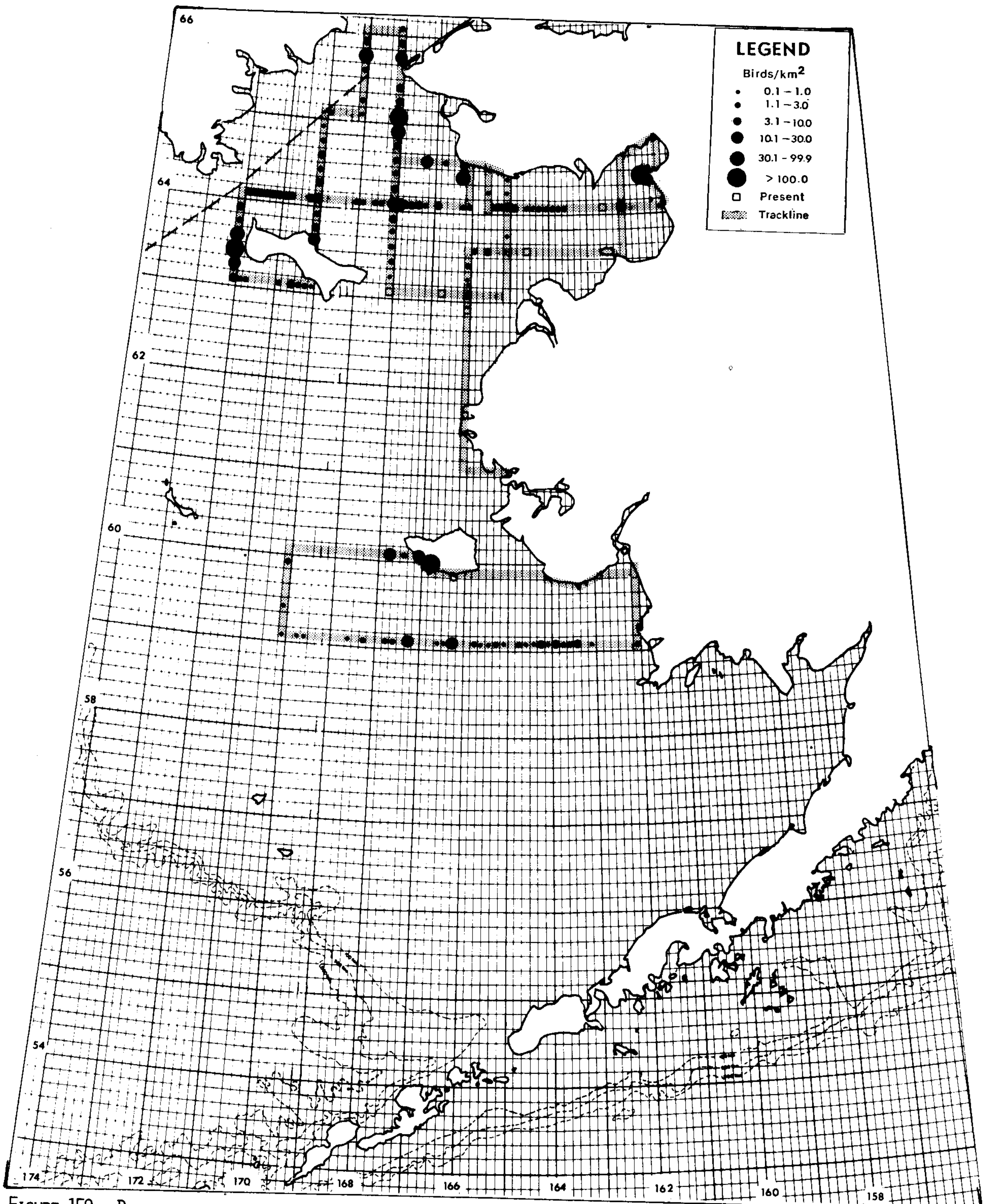

FIGURE 150. DISTRIBUTION AND ABUNDANCE OF MURRES IN THE BERING SEA IN AUGUST.

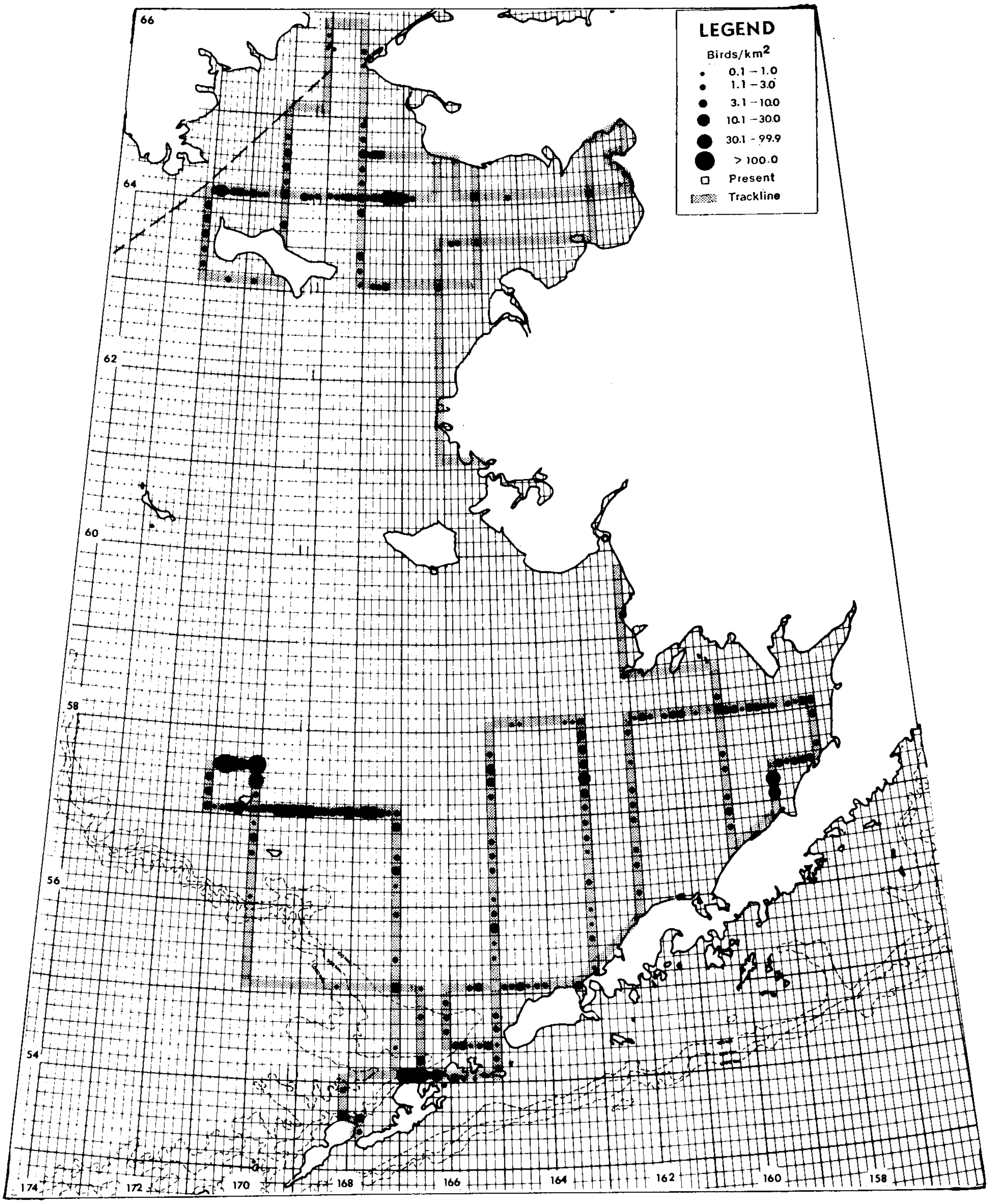

FIGURE 151. DISTRIBUTION AND ABUNDANCE OF MURRES IN THE BERING SEA IN OCTOBER.

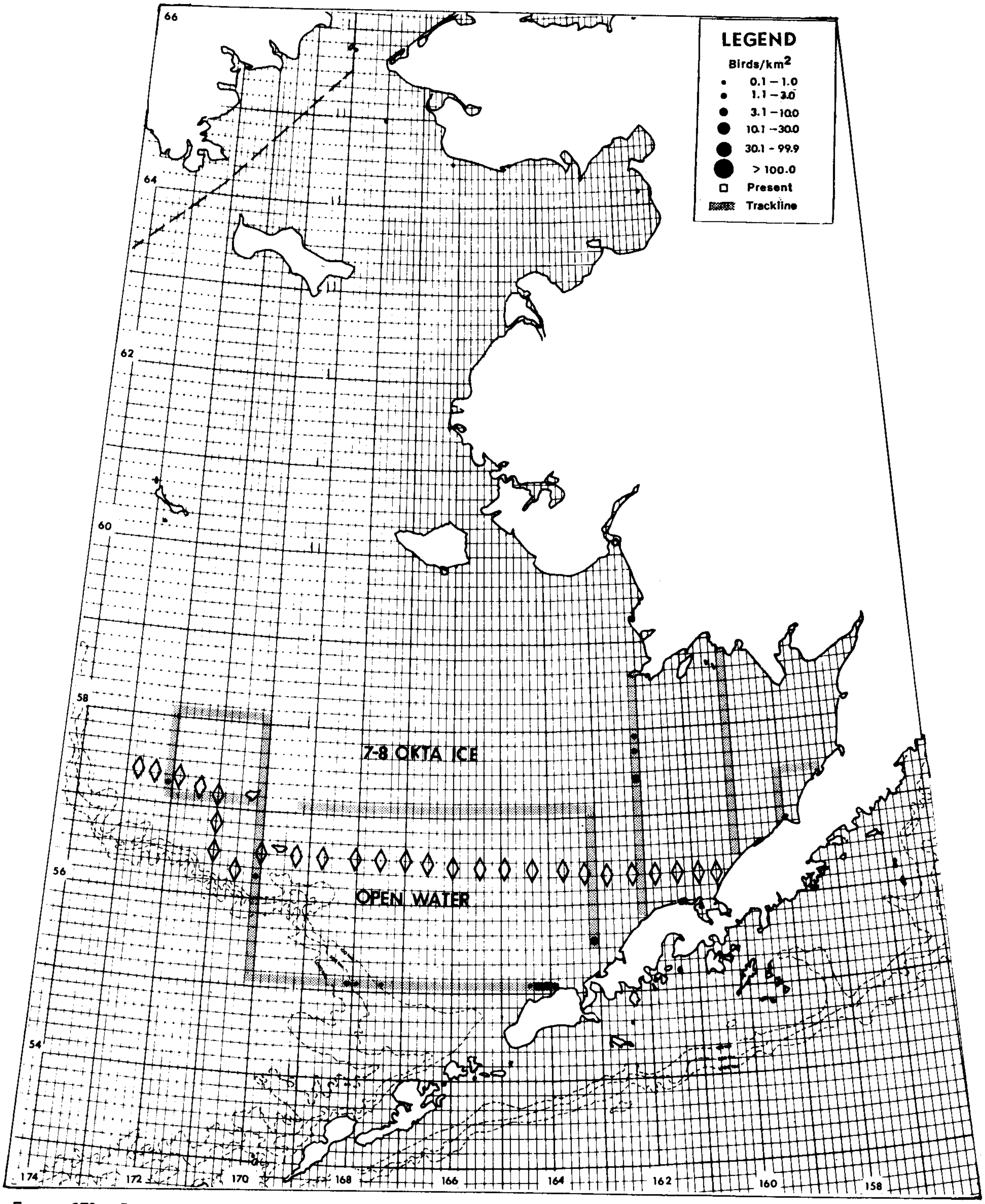

FIGURE 152. DISTRIBUTION AND ABUNDANCE OF PARAKEET AUKLETS IN THE BERING SEA IN FEBRUARY.

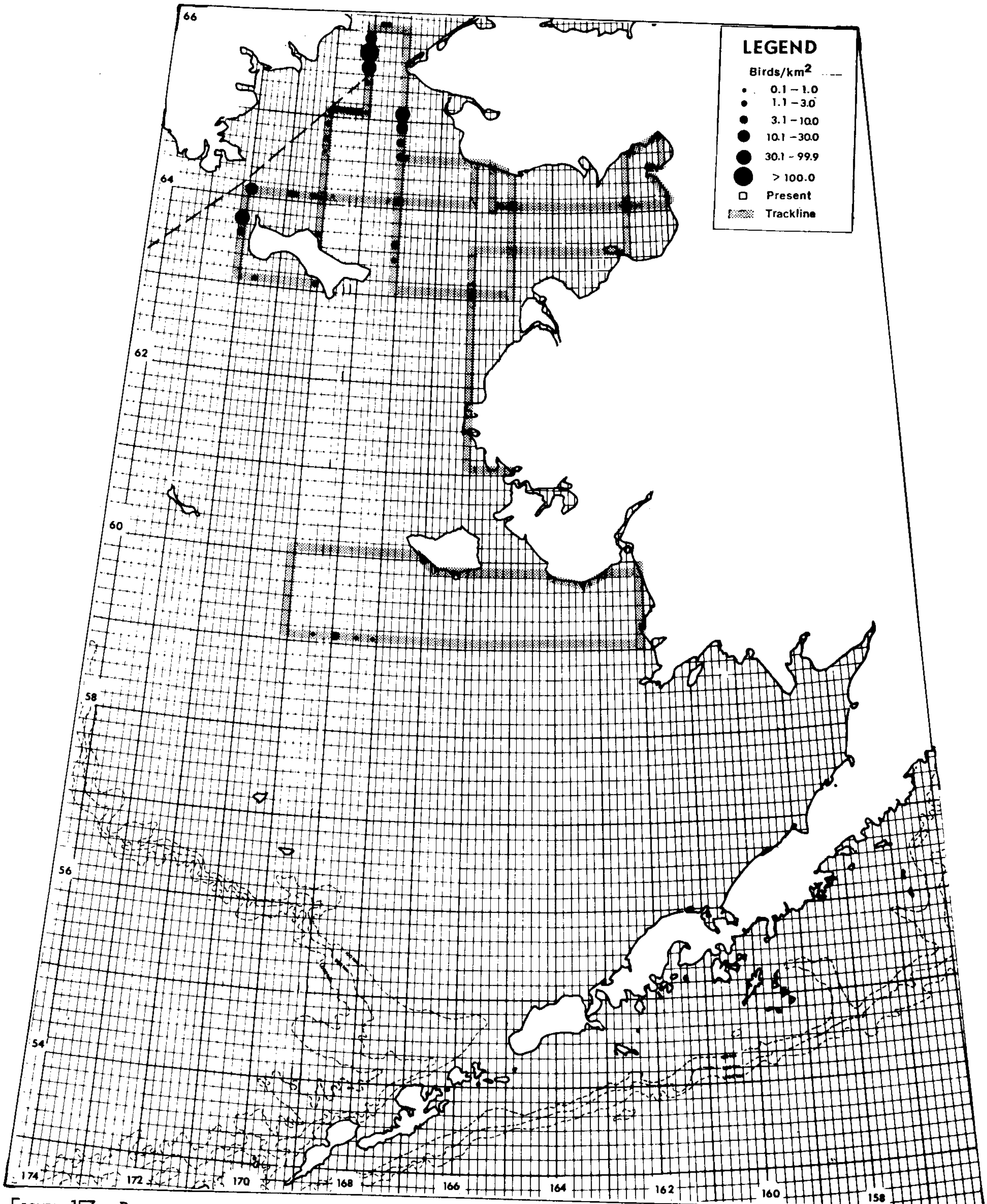

FIGURE 153. DISTRIBUTION AND ABUNDANCE OF PARAKEET AUKLETS IN THE BERING SEA IN AUGUST. NO PARAKEET AUKLETS WERE IDENTIFIED IN MARCH, JUNE OR JULY.

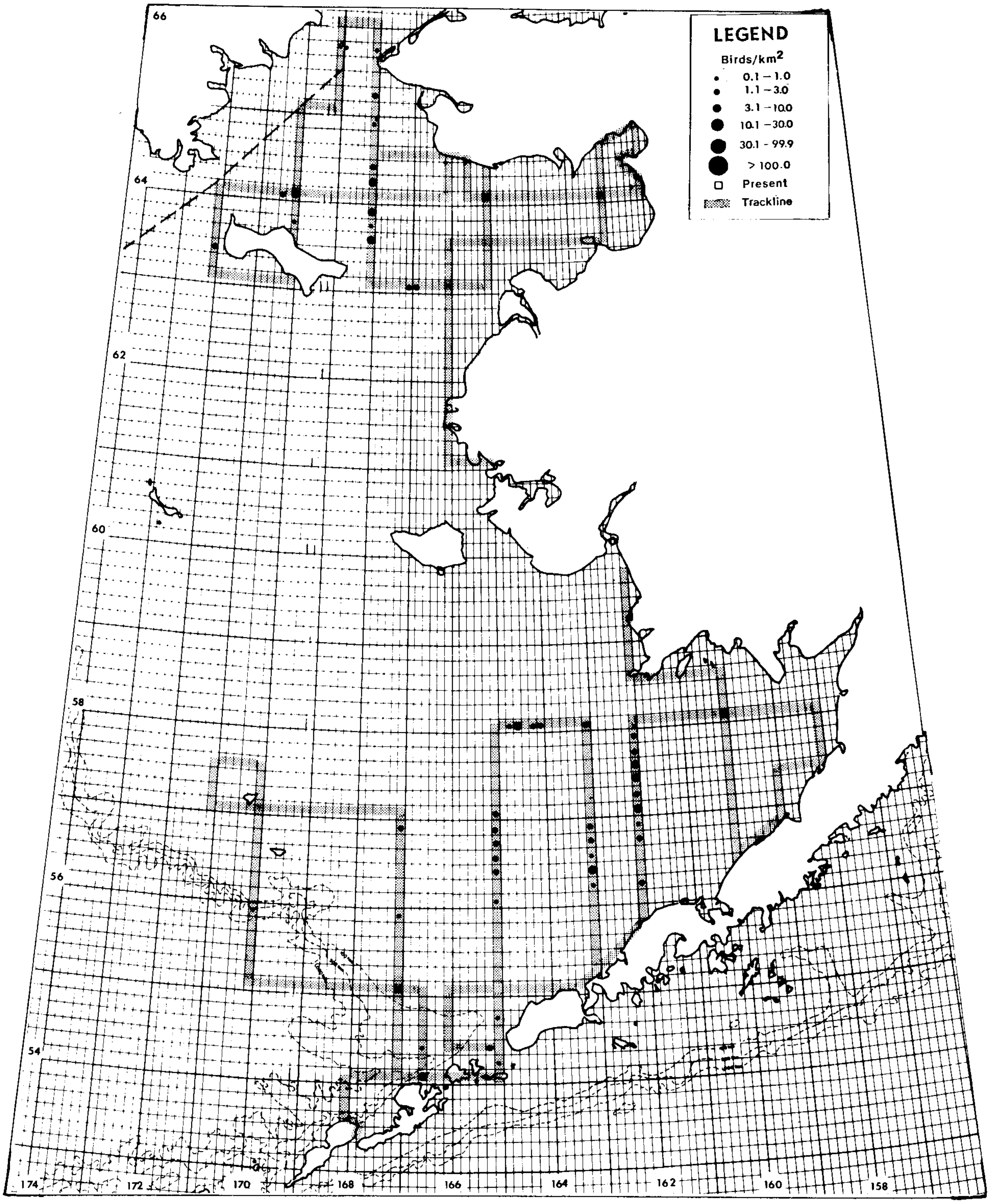

FIGURE 154. DISTRIBUTION AND ABUNDANCE OF PARAKEET AUKLETS IN THE BERING SEA IN OCTOBER.

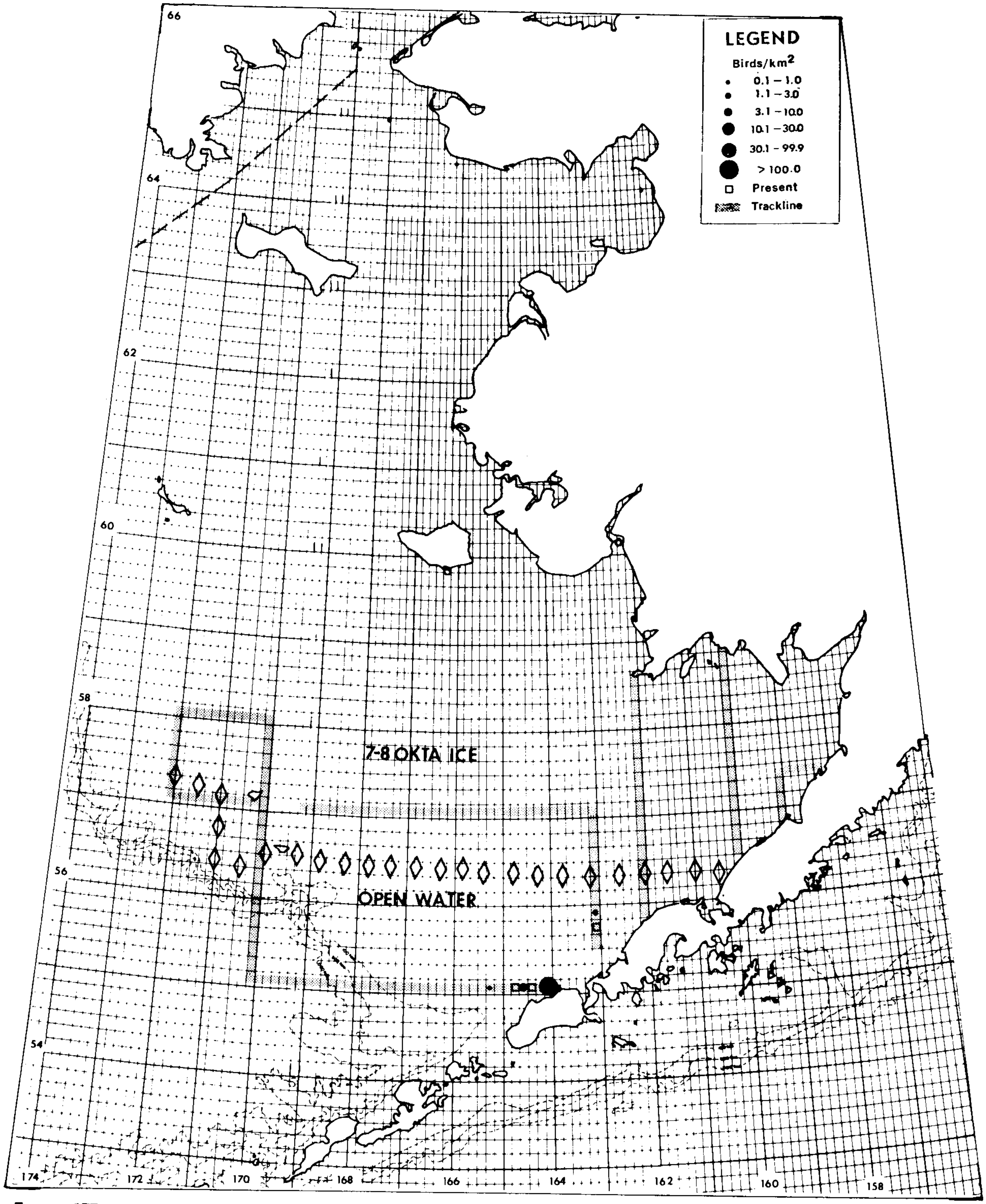

FIGURE 155. DISTRIBUTION AND ABUNDANCE OF CRESTED AUKLETS IN THE BERING SEA IN FEBRUARY.

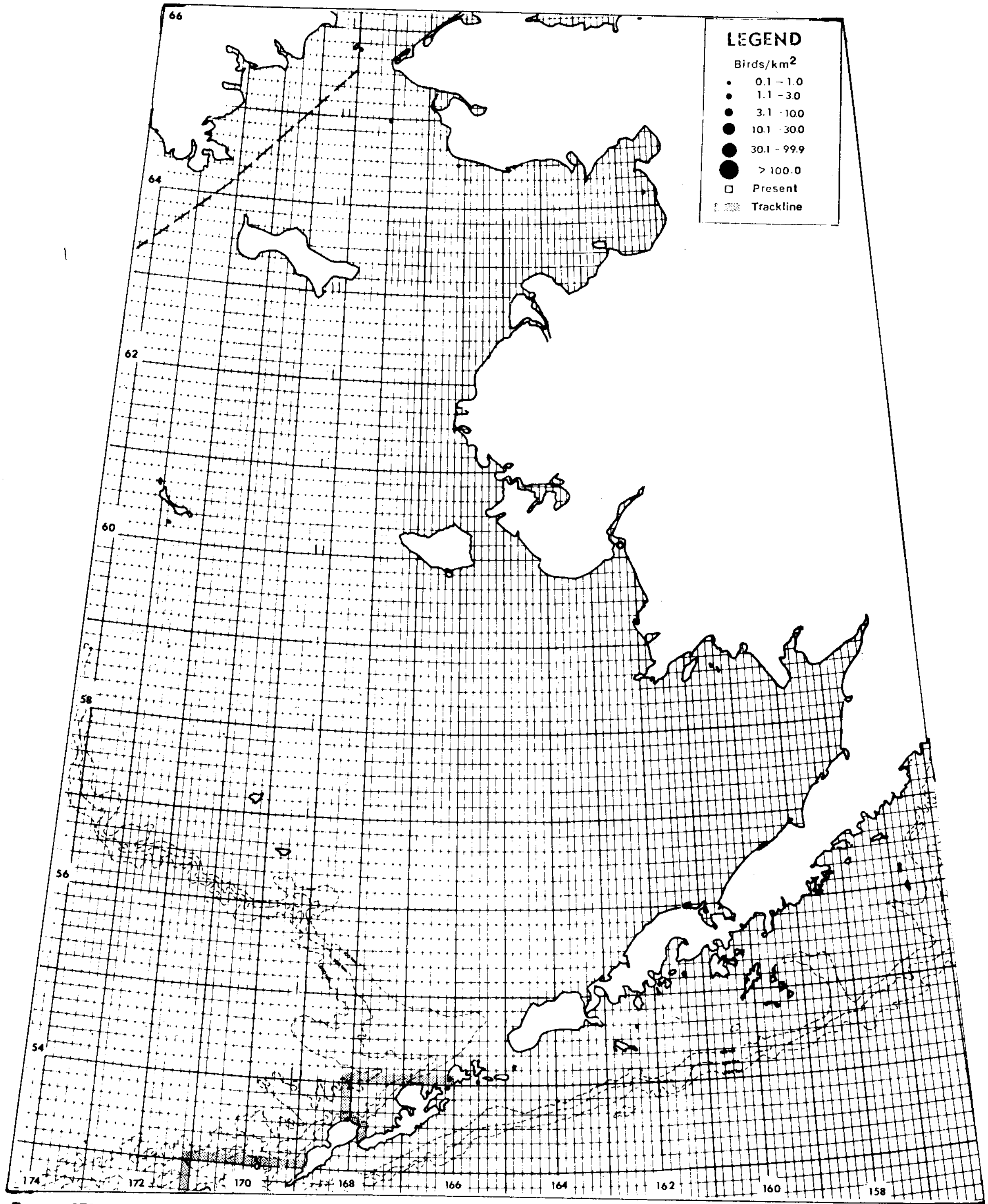

FIGURE 156. DISTRIBUTION AND ABUNDANCE OF CRESTED AUKLETS IN THE BERING SEA IN MARCH.

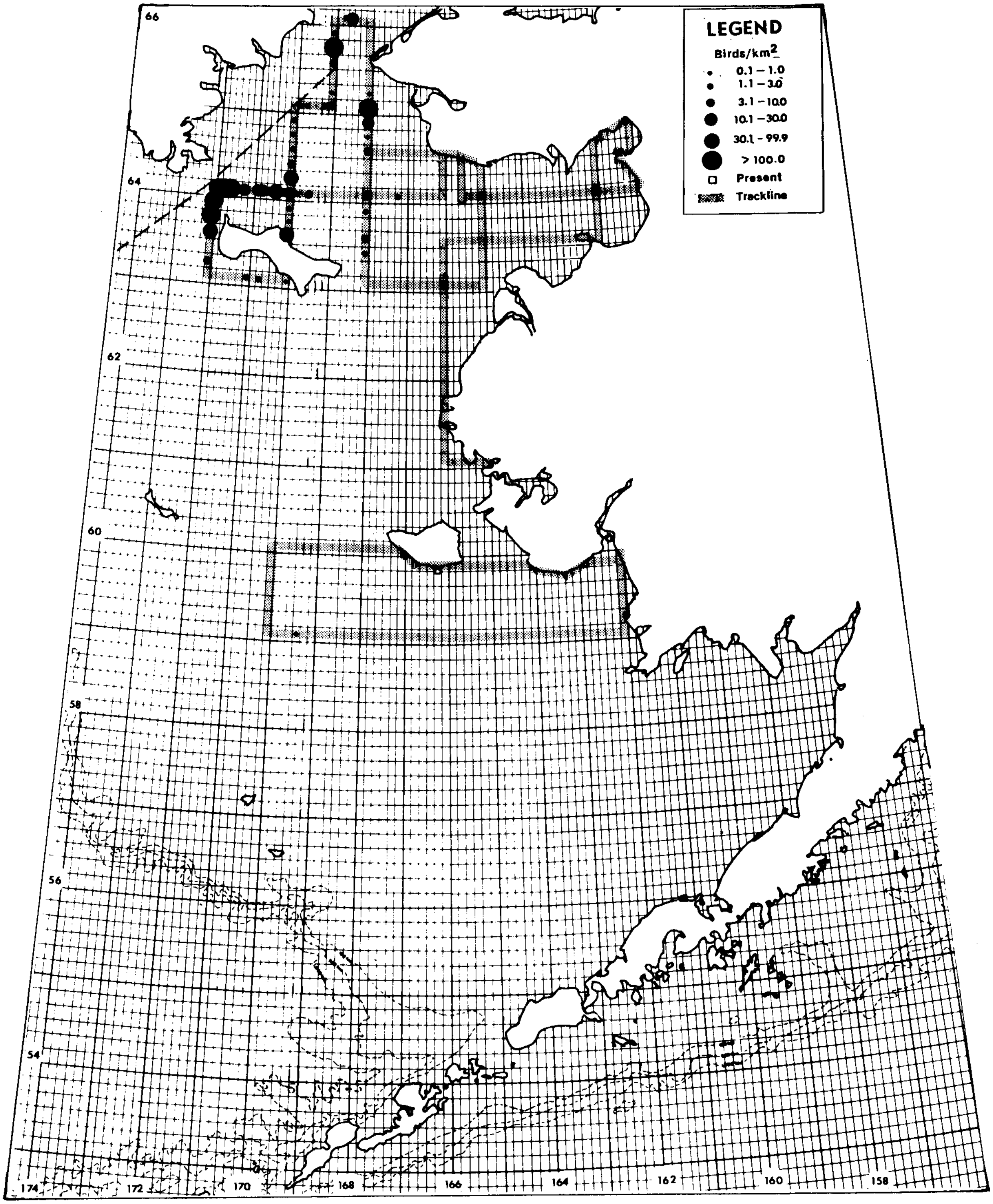

FIGURE 157. DISTRIBUTION AND ABUNDANCE OF CRESTED AUKLETS IN THE BERING SEA IN AUGUST. NO CRESTED AUKLETS WERE IDENTIFIED IN JUNE OR JULY.

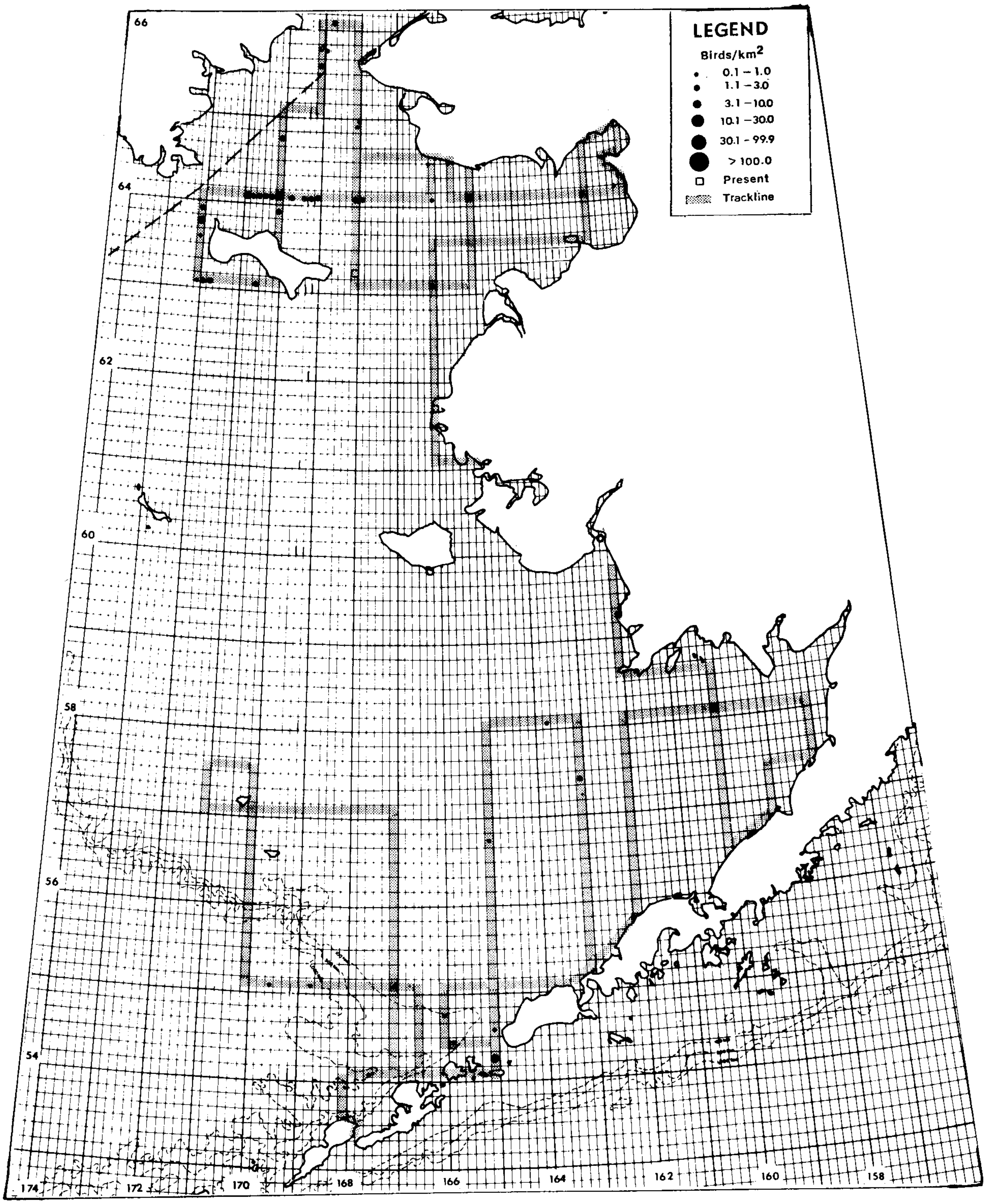

FIGURE 158. DISTRIBUTION AND ABUNDANCE OF CRESTED AUKLETS IN THE BERING SEA IN OCTOBER.

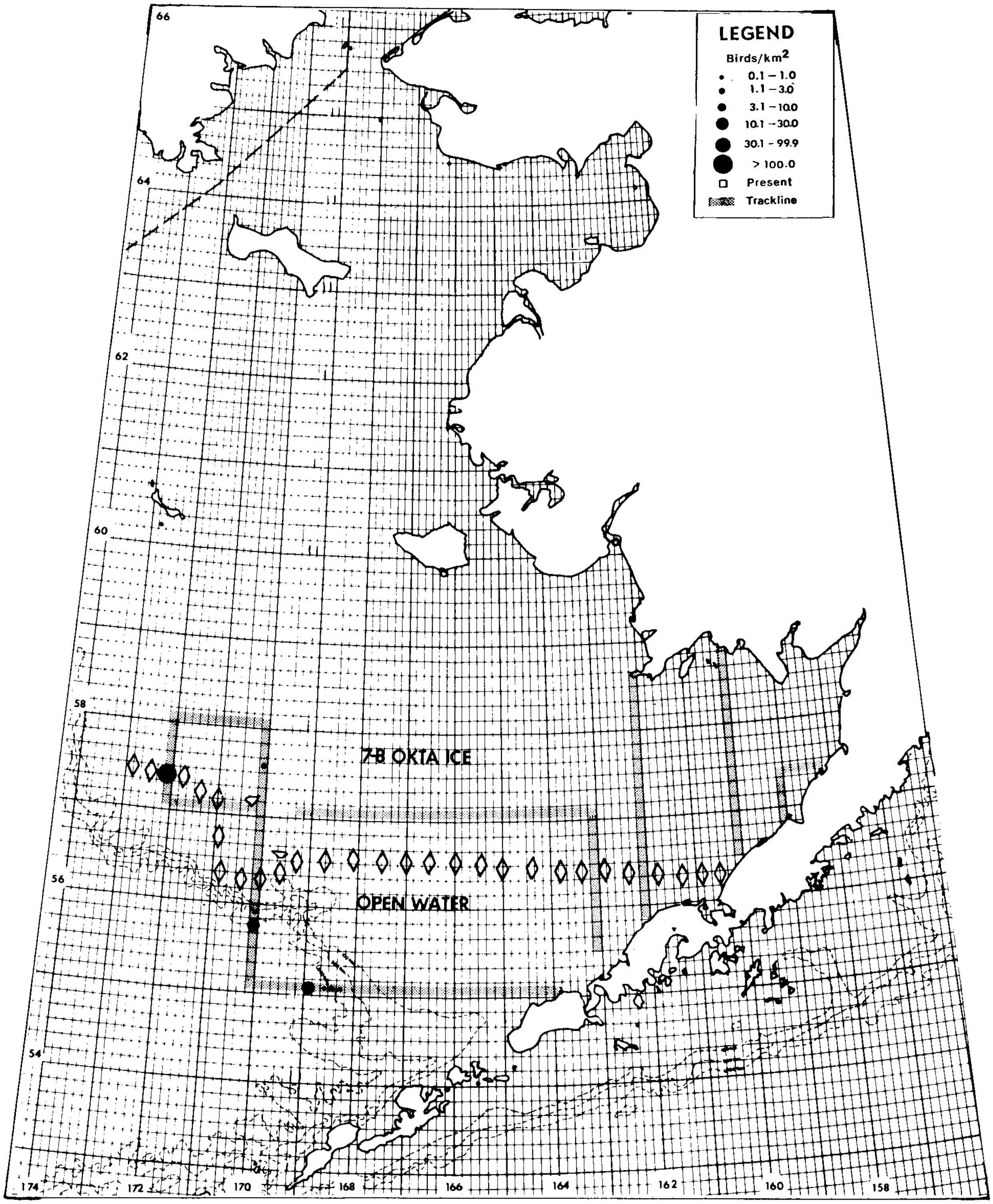

FIGURE 159. DISTRIBUTION AND ABUNDANCE OF LEAST AUKLETS IN THE BERING SEA IN FEBRUARY.

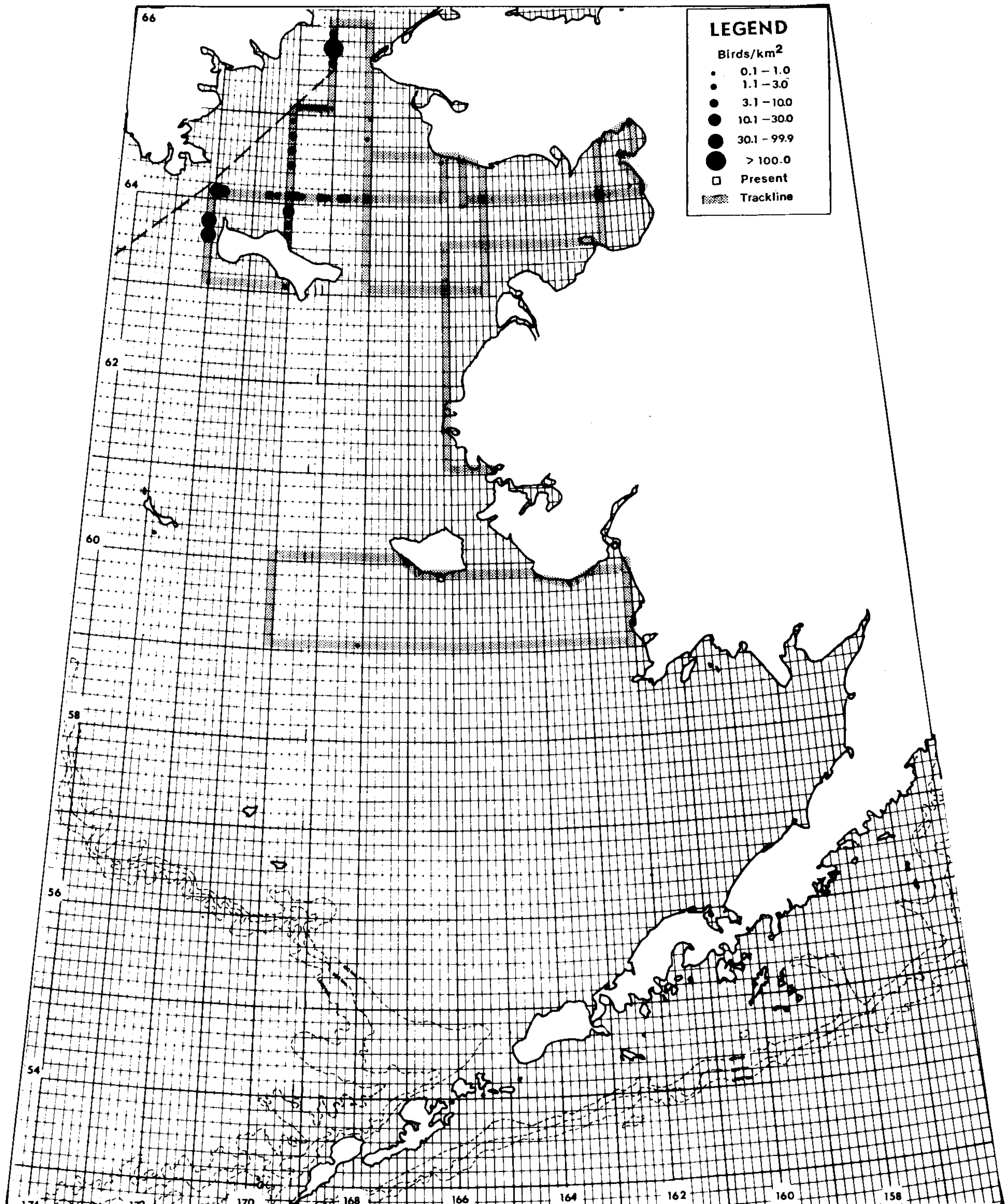

FIGURE 160. DISTRIBUTION AND ABUNDANCE OF LEAST AUKLETS IN THE BERING SEA IN AUGUST. NO LEAST AUKLETS WERE OBSERVED IN MARCH, JUNE OR JULY.

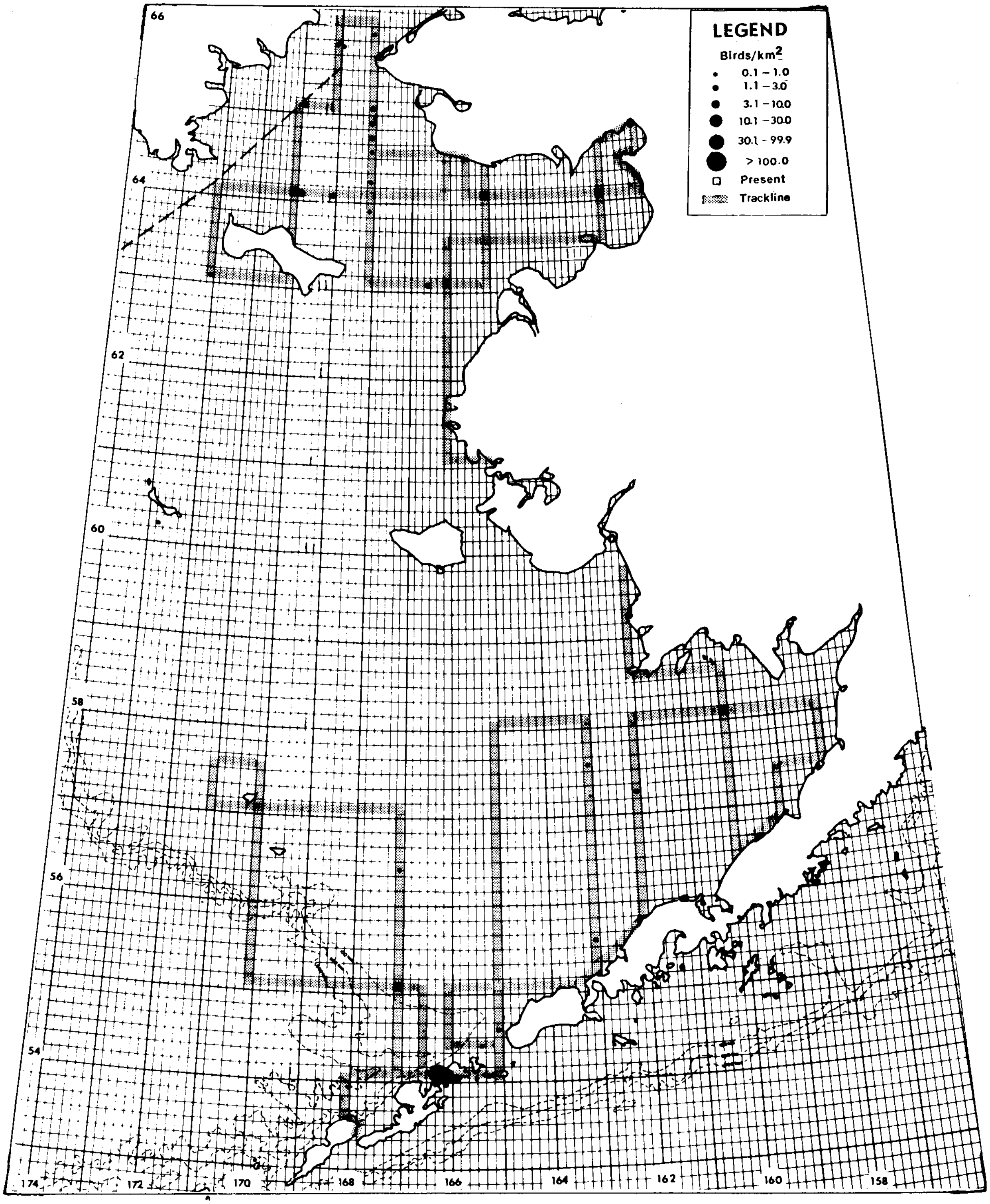

FIGURE 161. DISTRIBUTION AND ABUNDANCE OF LEAST AUKLETS IN THE BERING SEA IN OCTOBER.

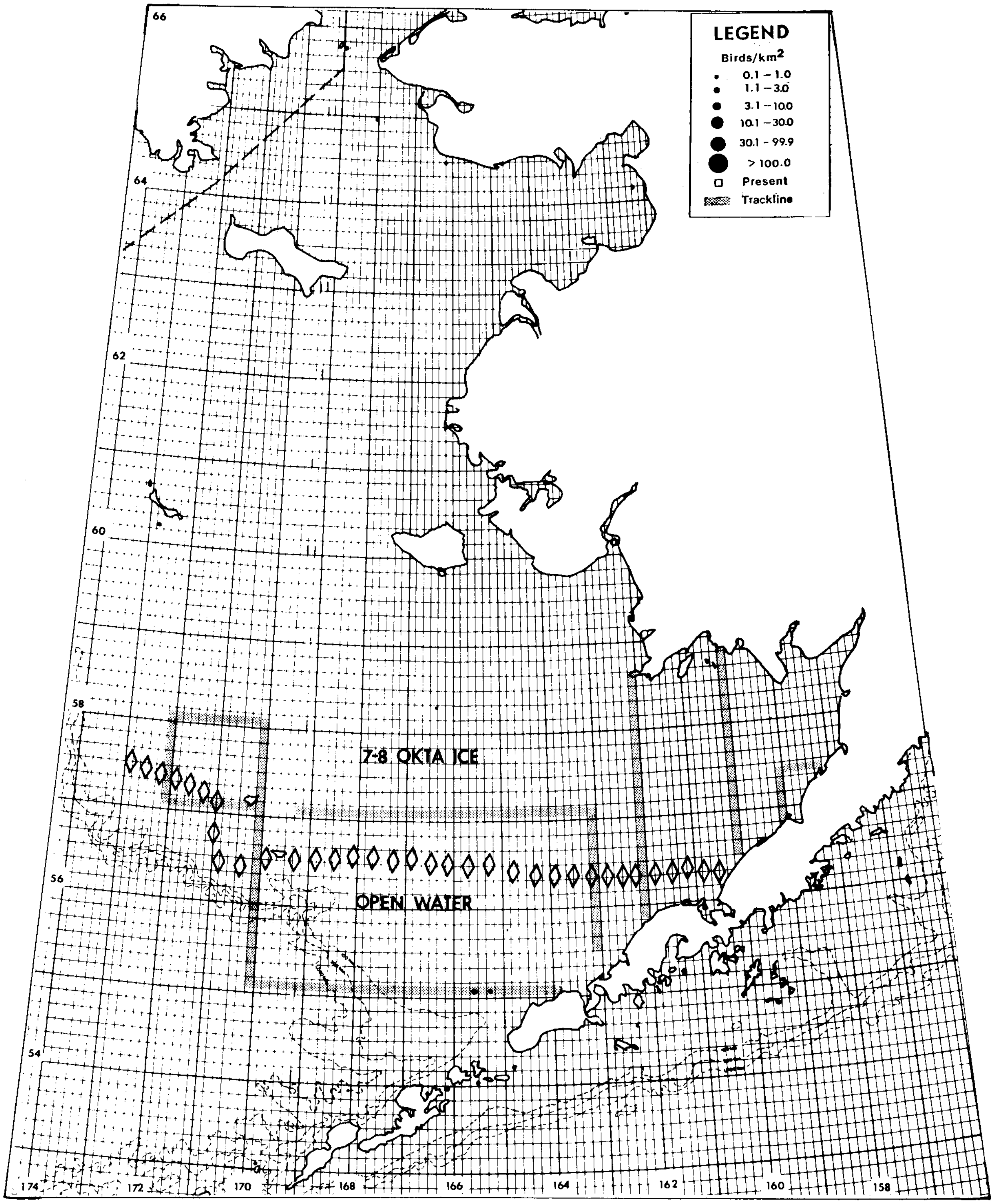

FIGURE 162. DISTRIBUTION AND ABUNDANCE OF KITTLITZ' MURRELET IN THE BERING SEA IN FEBRUARY. NO KITTLITZ' MURRELETS WERE OBSERVED IN MARCH, JUNE, JULY, AUGUST OR OCTOBER.

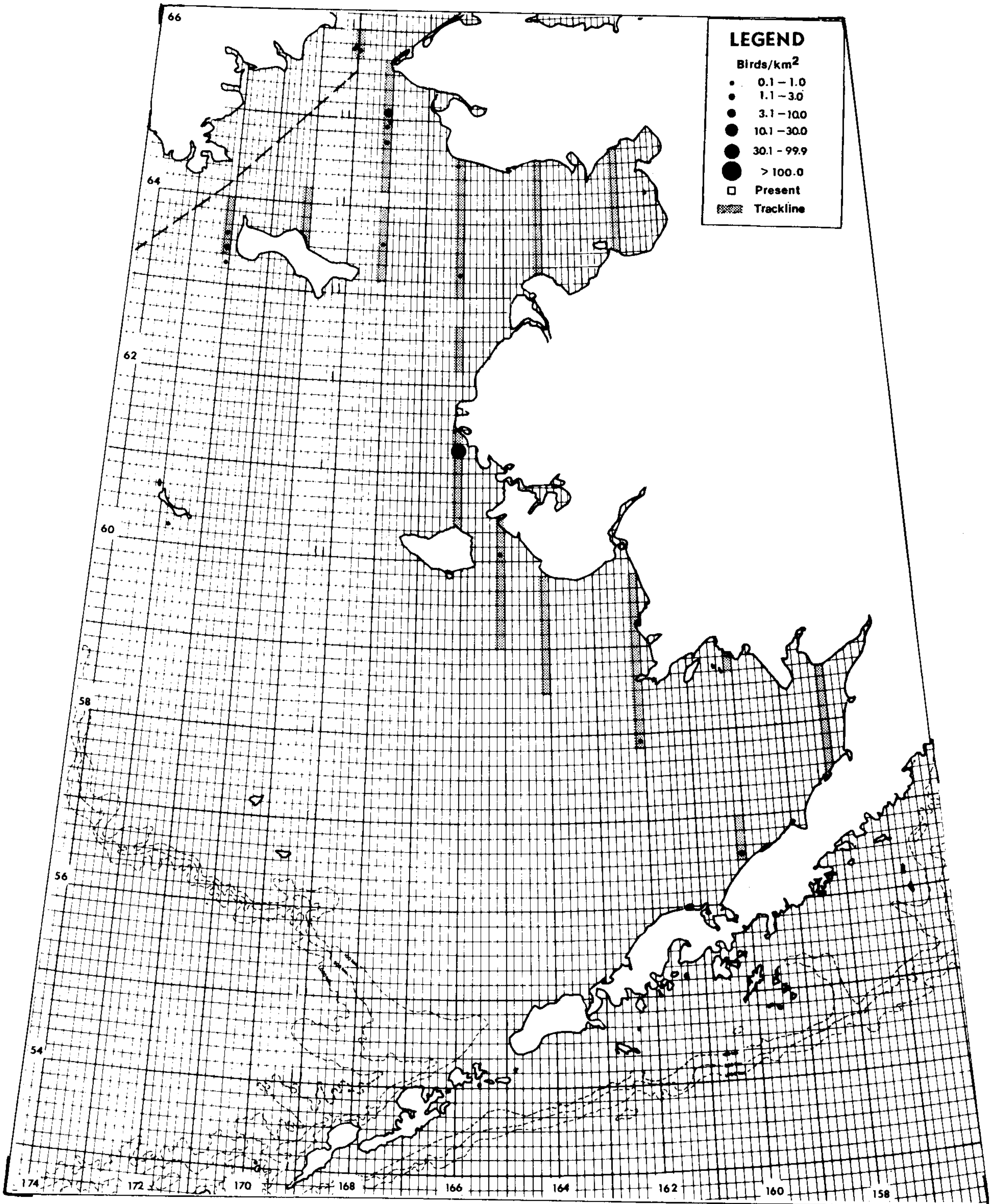

FIGURE 163. DISTRIBUTION AND ABUNDANCE OF TUFTED PUFFINS IN THE BERING SEA IN JUNE. NO TUFTED PUFFINS WERE OBSERVED IN FEBRUARY OR MARCH.

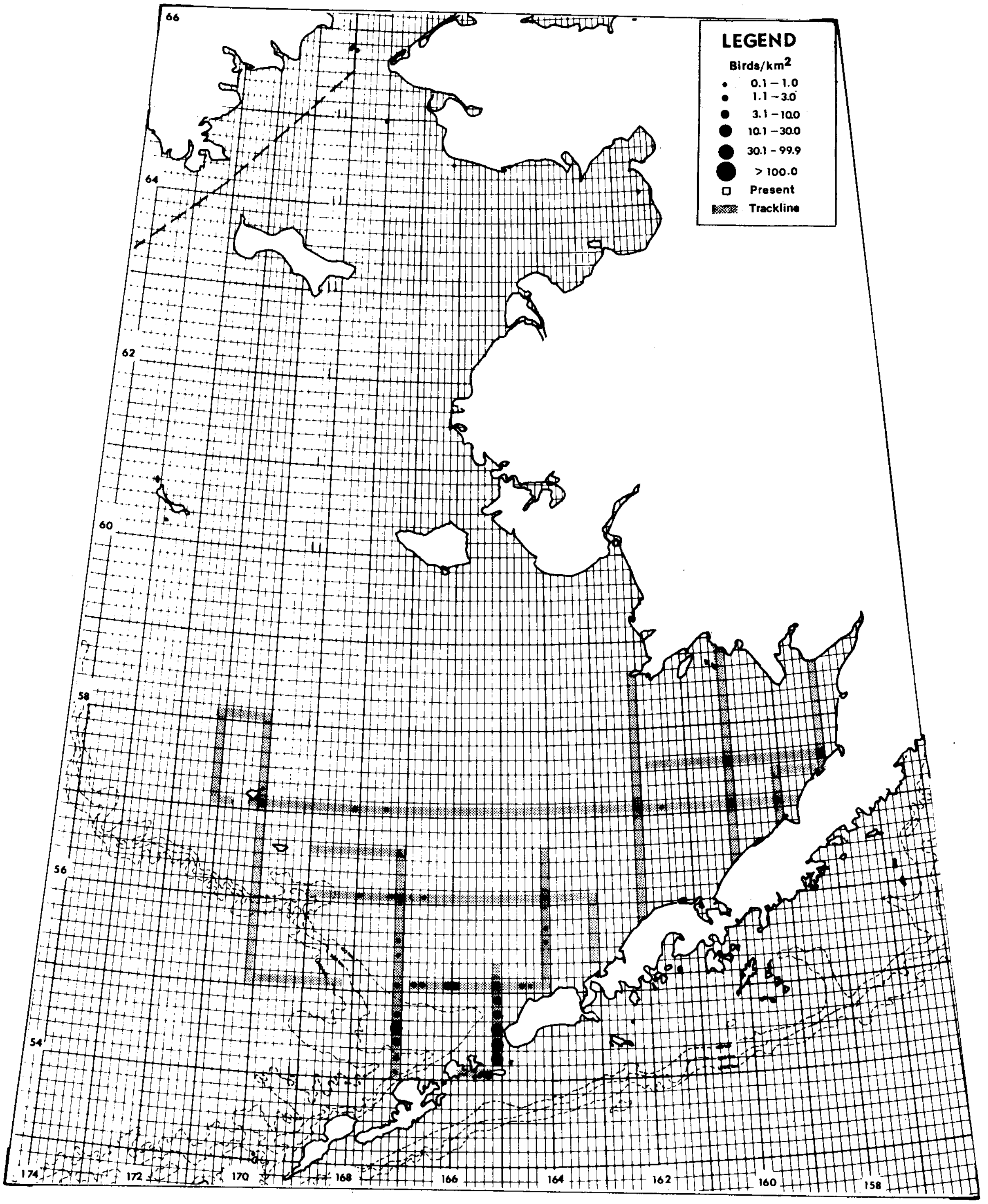

FIGURE 164. DISTRIBUTION AND ABUNDANCE OF TUFTED PUFFINS IN THE BERING SEA IN JULY.

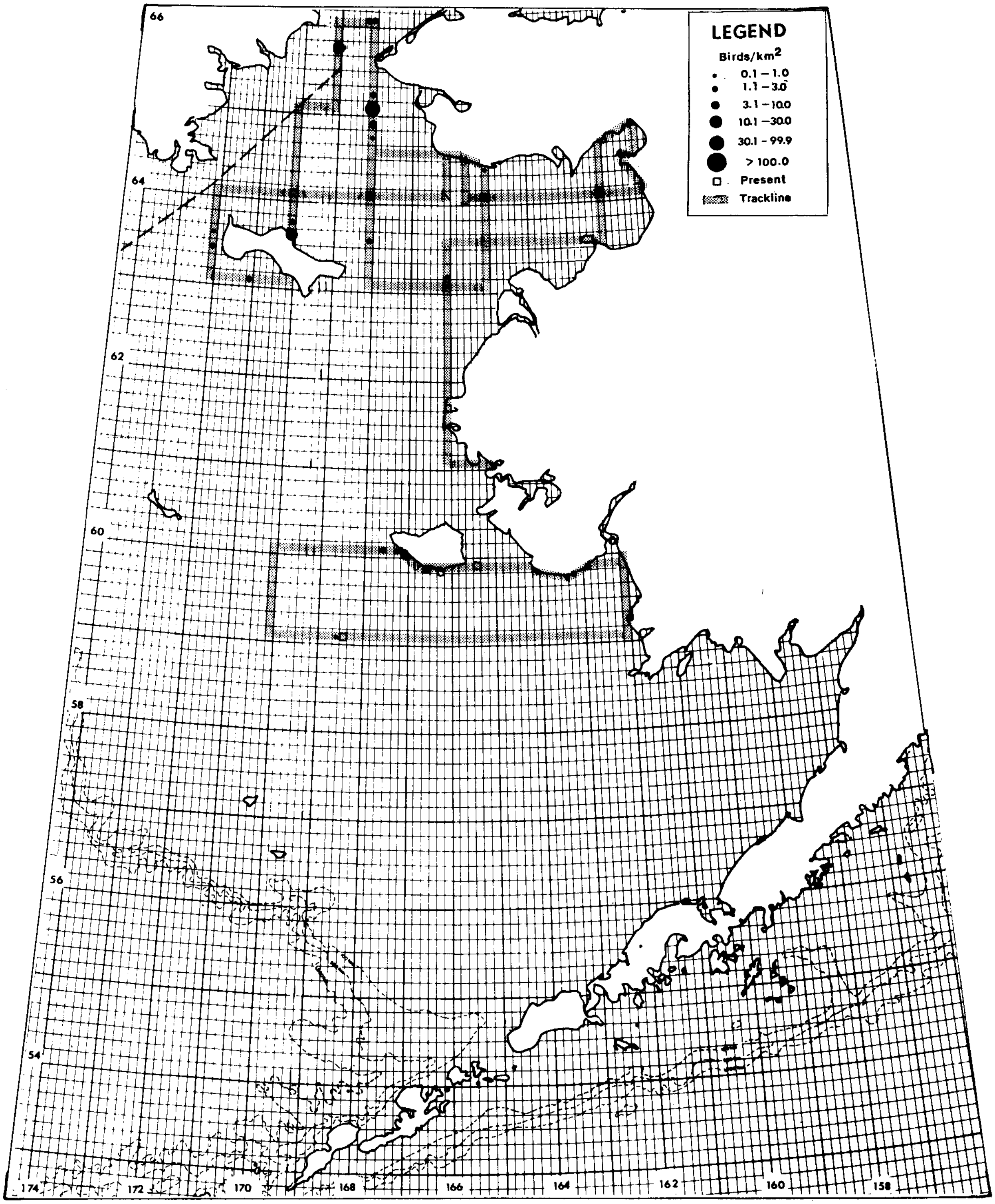

FIGURE 165. DISTRIBUTION AND ABUNDANCE OF TUFTED PUFFINS IN THE BERING SEA IN AUGUST.

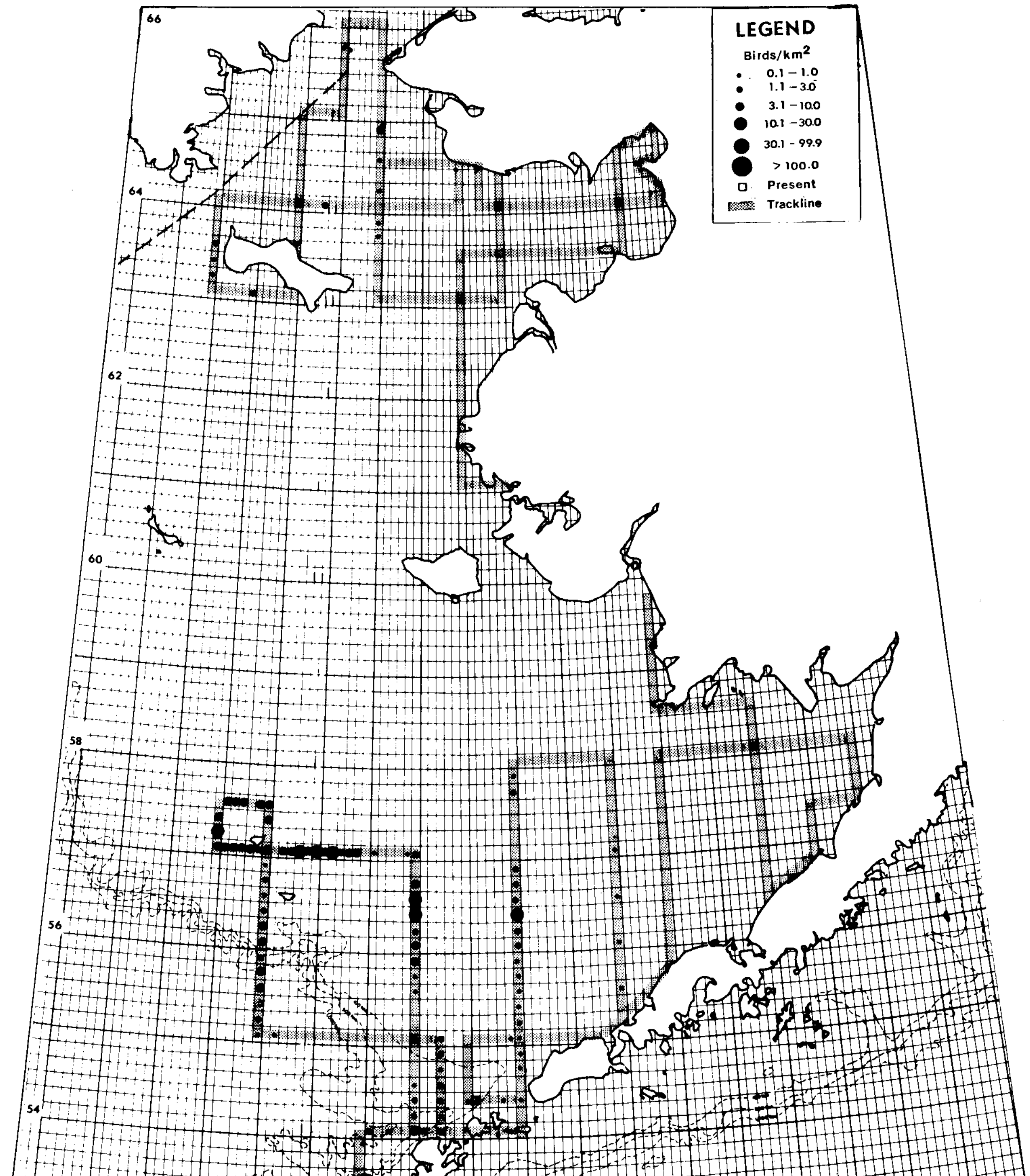

FIGURE 166. DISTRIBUTION AND ABUNDANCE OF TUFTED PUFFINS IN THE BERING SEA IN OCTOBER.

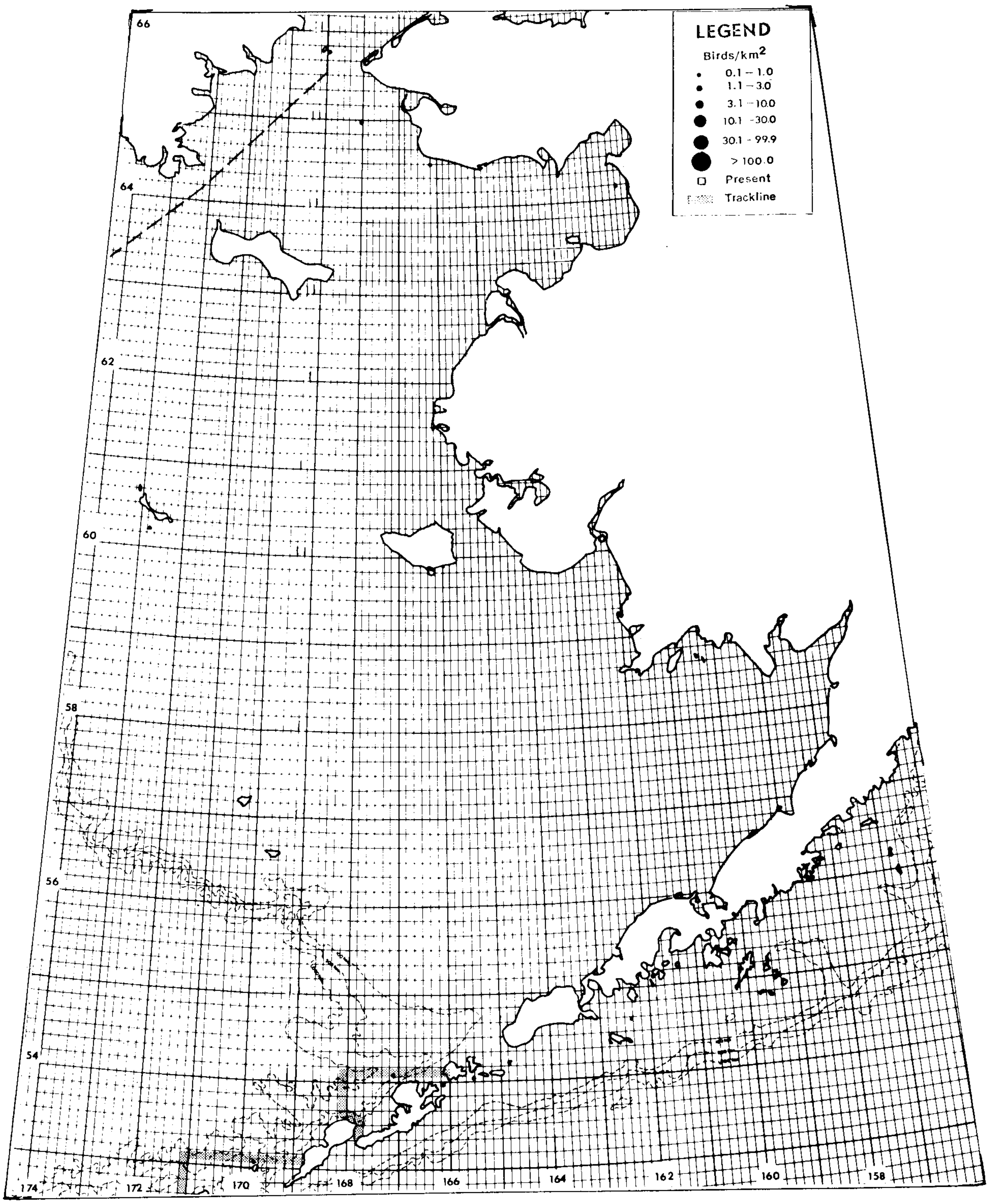

FIGURE 167. DISTRIBUTION AND ABUNDANCE OF HORNED PUFFINS IN THE BERING SEA IN MARCH. NO HORNED PUFFINS WERE OBSERVED IN FEBRUARY.

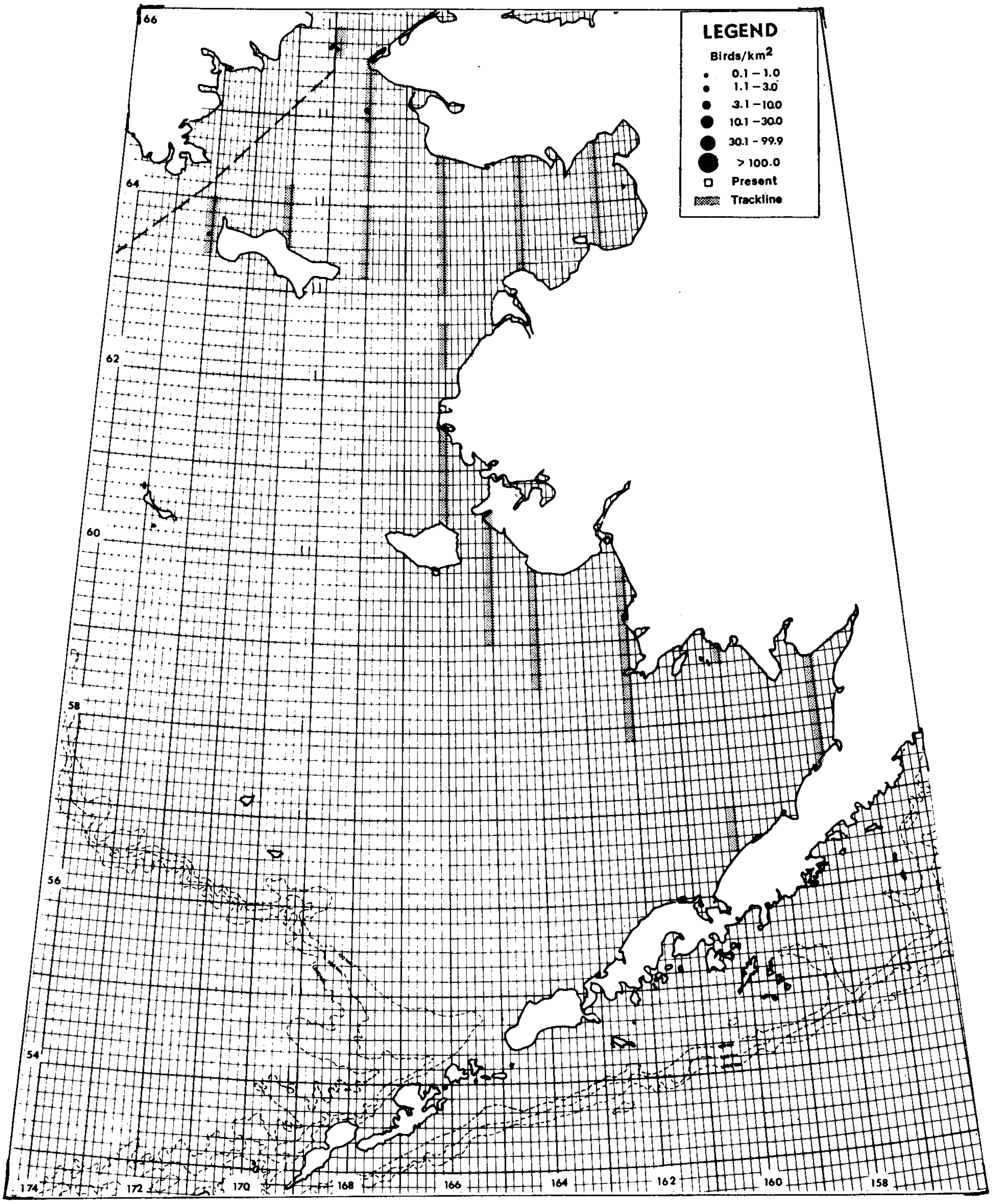

FIGURE 168. DISTRIBUTION AND ABUNDANCE OF HORNED PUFFINS IN THE BERING SEA IN JUNE.

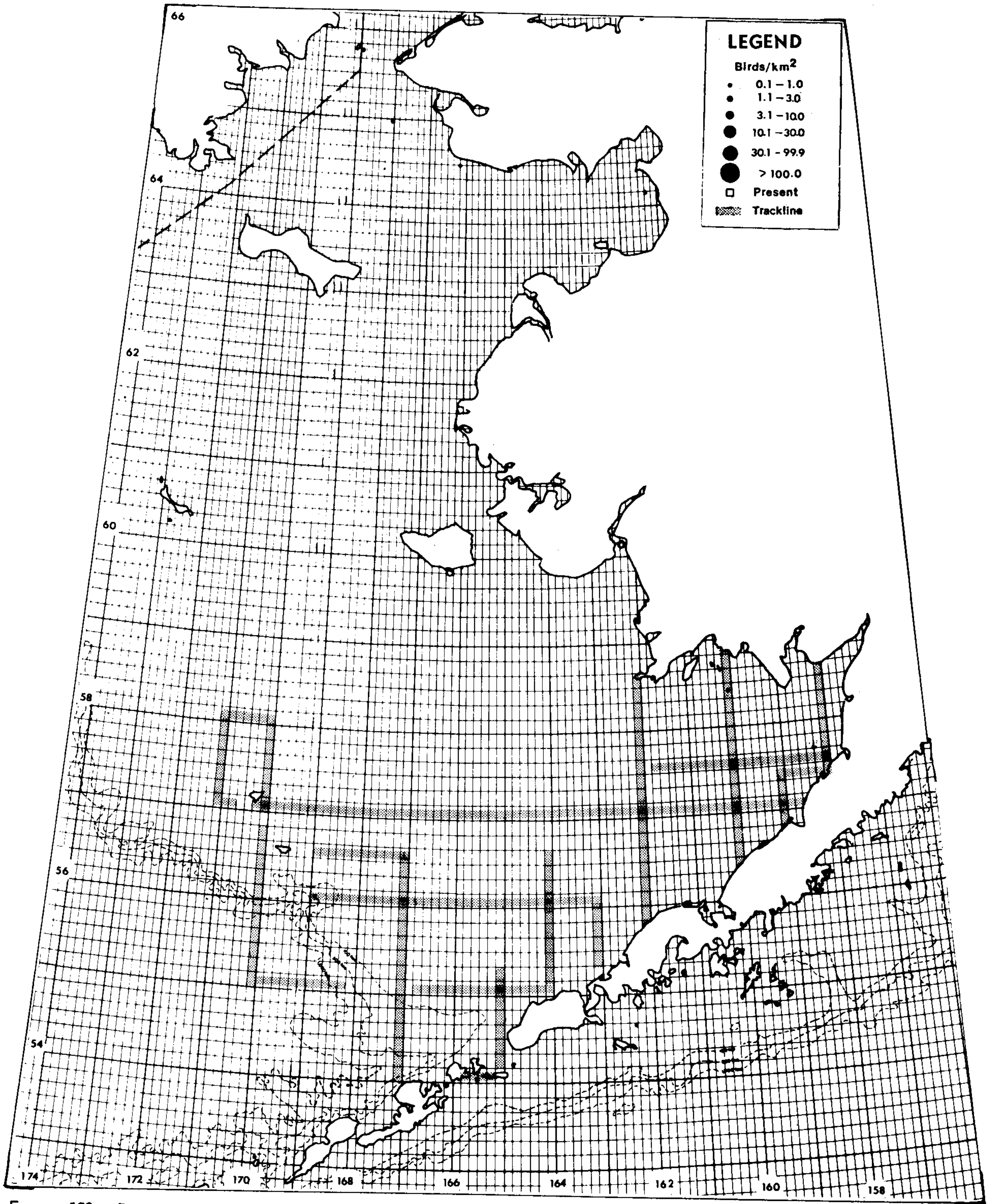

FIGURE 169. DISTRIBUTION AND ABUNDANCE OF HORNED PUFFINS IN THE BERING SEA IN JULY.

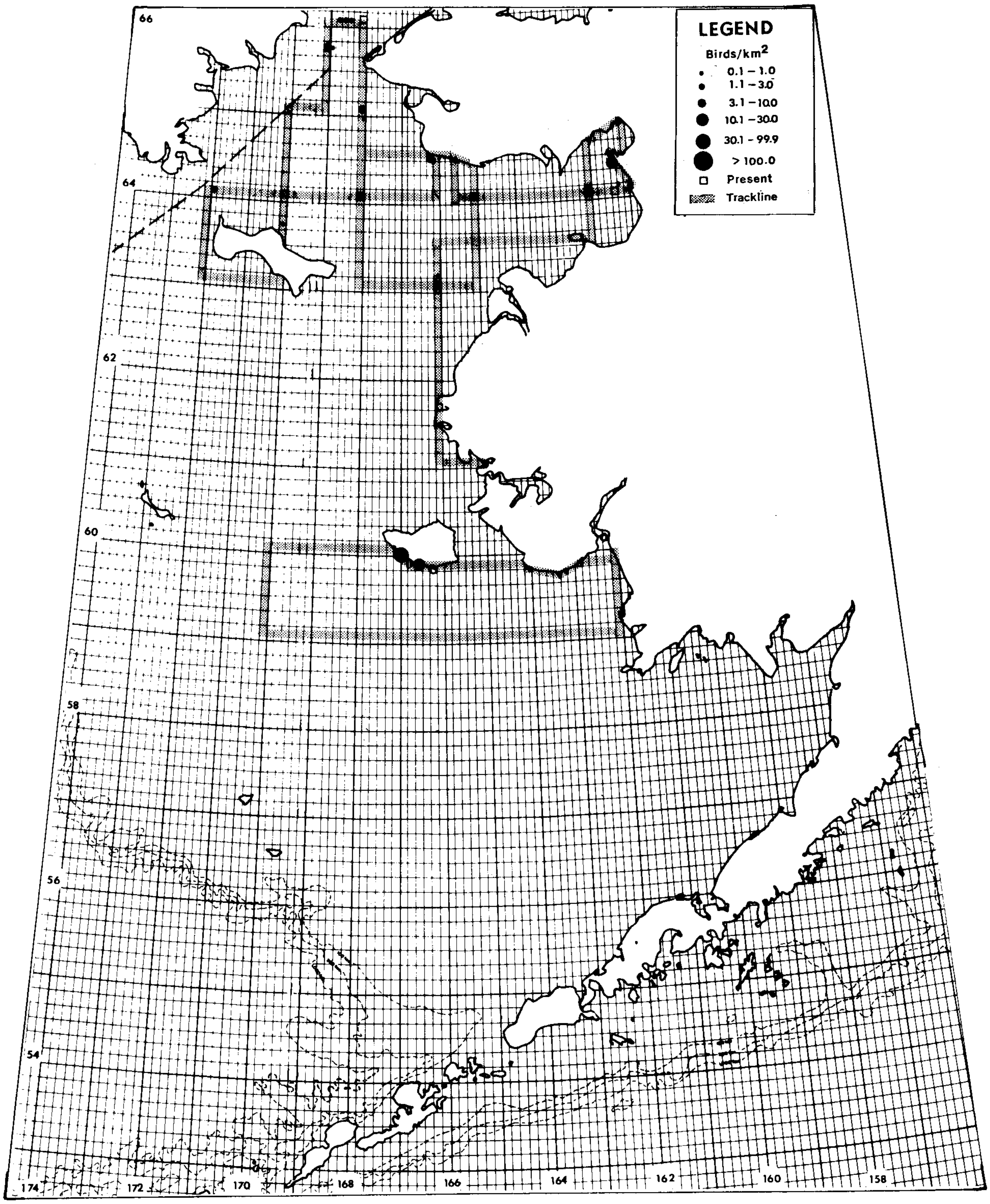

FIGURE 170. DISTRIBUTION AND ABUNDANCE OF HORNED PUFFINS IN THE BERING SEA IN AUGUST.

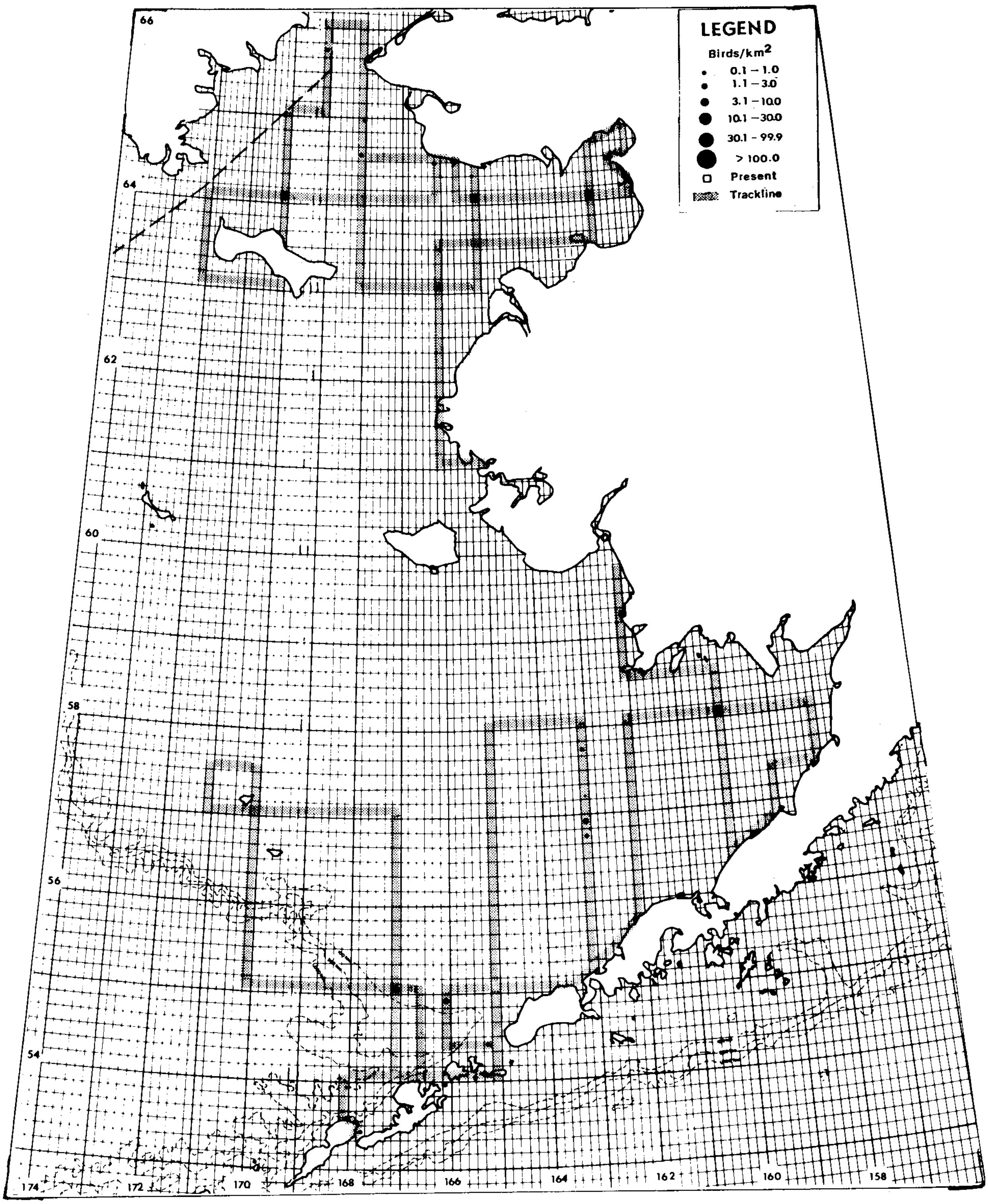

FIGURE 171. DISTRIBUTION AND ABUNDANCE OF HORNED PUFFINS IN THE BERING SEA IN OCTOBER.

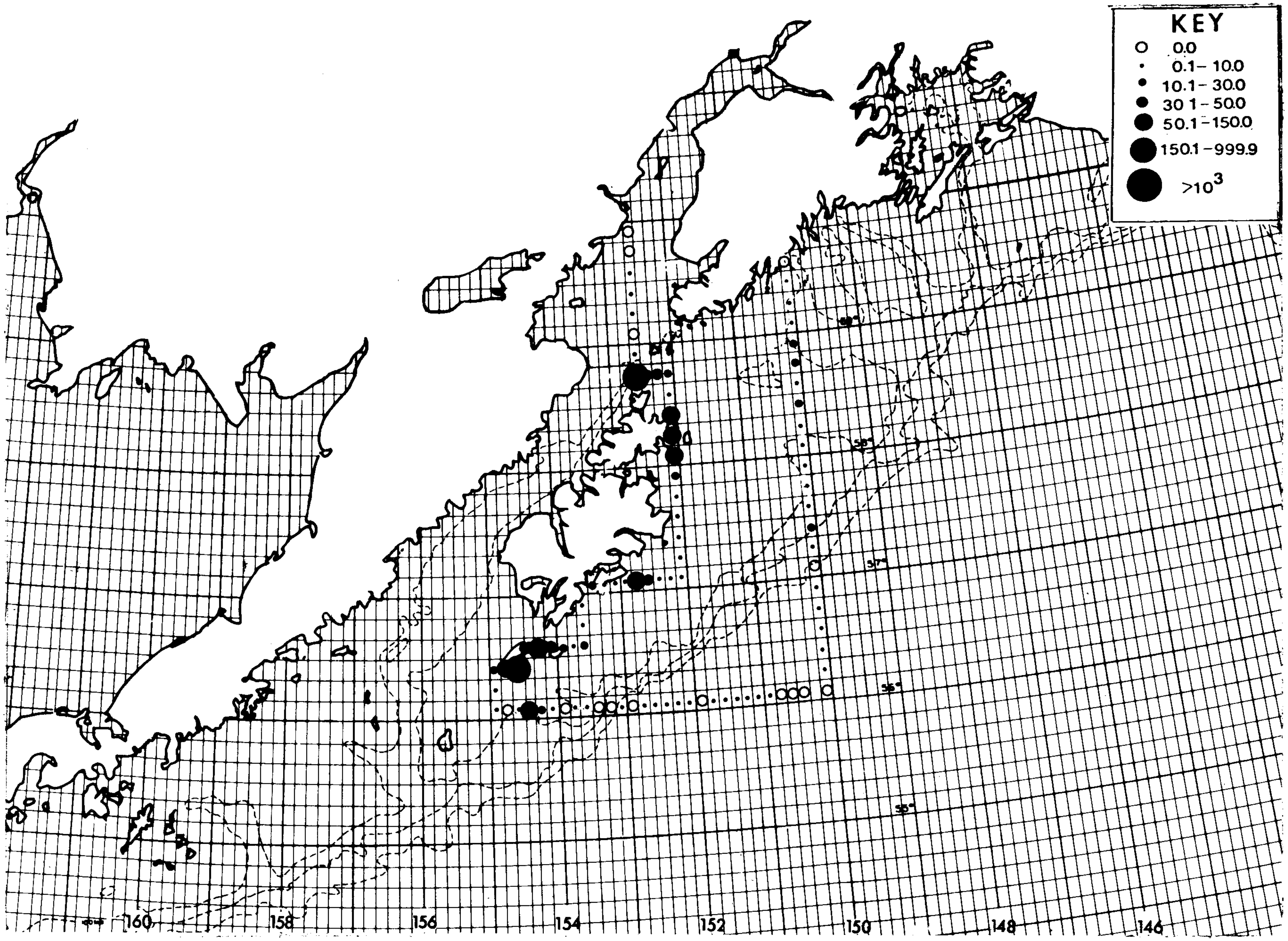

Figure 172. Aerial transects showing density of birds per Km^2 for all areas surveyed in January 1976.

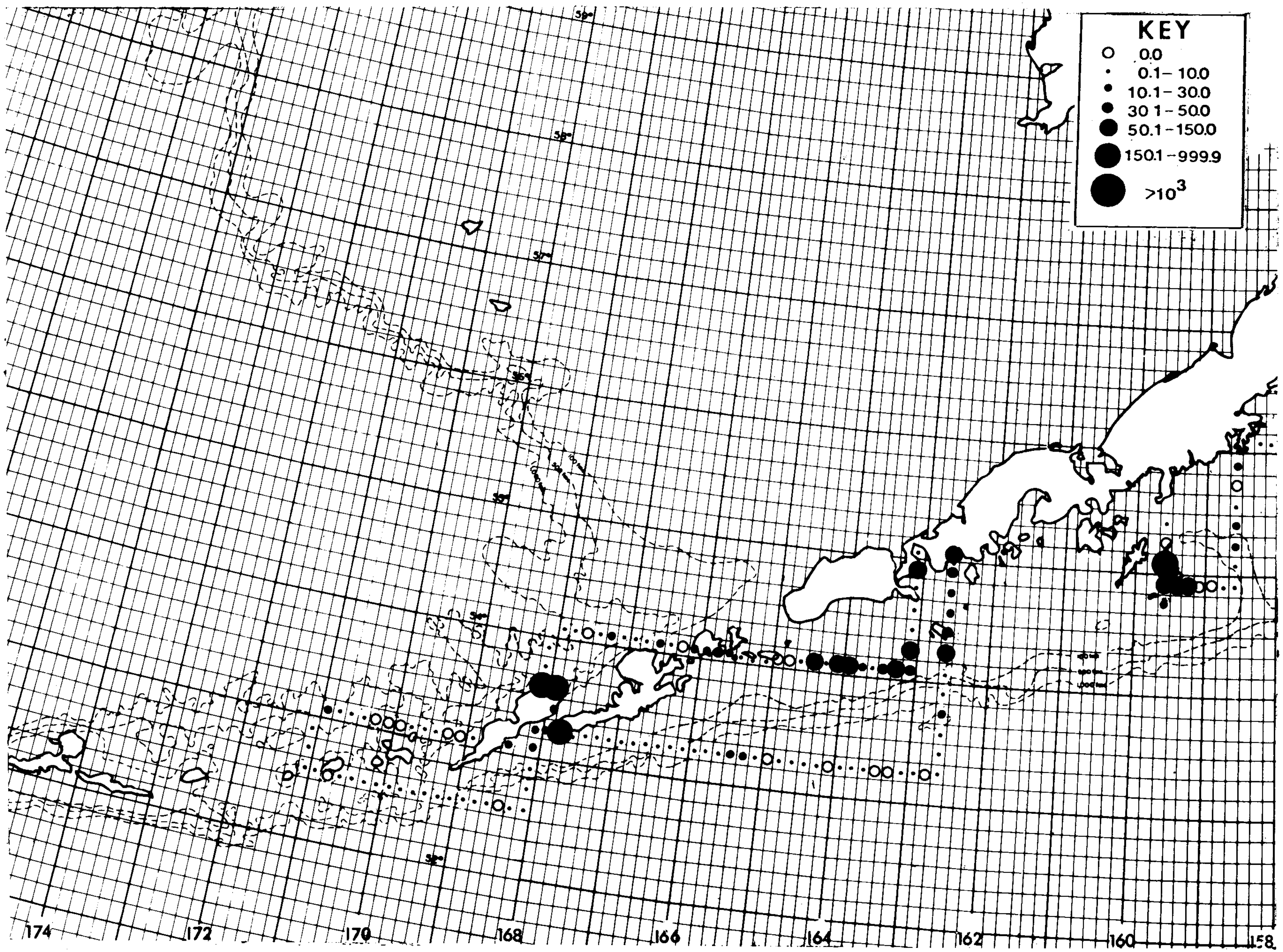

Figure 173a. Aerial transects showing density of birds per Km^2 for all areas surveyed in March 1976.

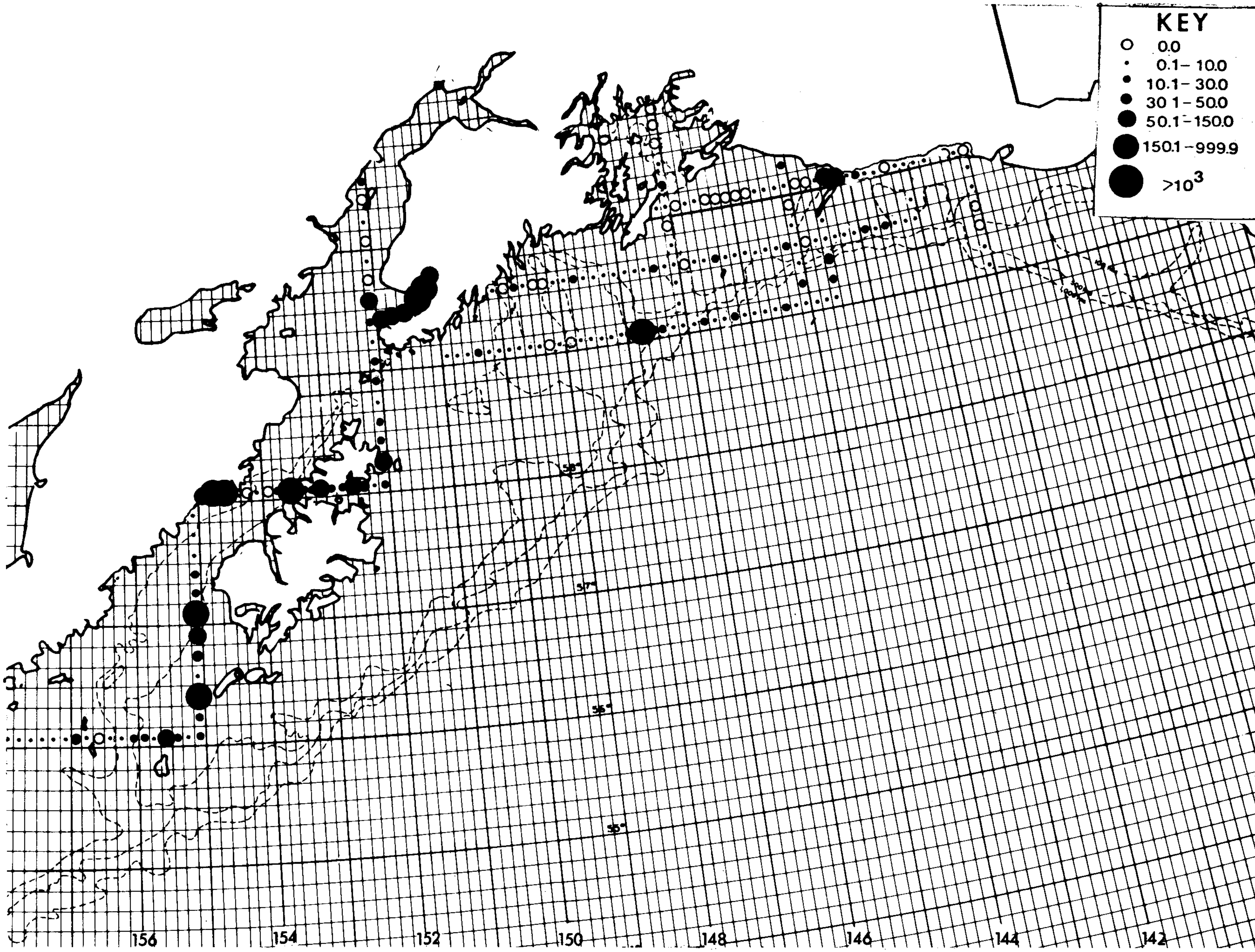

Figure 173b. Aerial transects showing density of birds per Km^2 for all areas surveyed in March 1976.

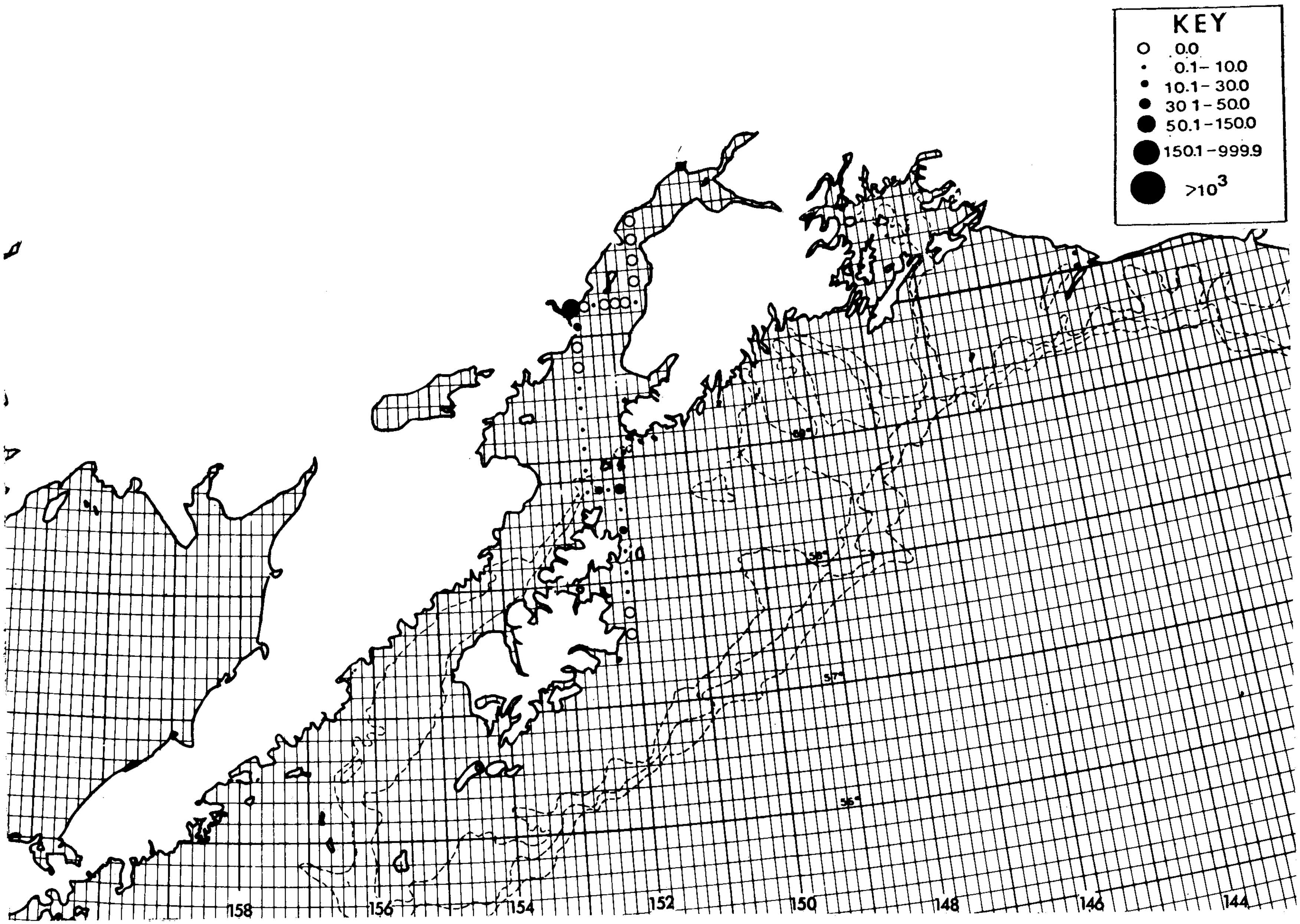

Figure 174. Aerial transects showing density of birds per Km^2 for all areas surveyed in April 1976.

ANNUAL REPORT

NOAA-OCSEAP Contract: 01-022-2538
Research Unit: 338/343
Study Task: A2
Report Period: October 1, 1976 to
March 31, 1977

Catalog of Seabird Colonies

by

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U.S. Fish & Wildlife Service
Office of Biological Services/Coastal Ecosystems
Anchorage, Alaska

March, 1977

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ABSTRACT

This report discusses progress toward completion of a catalog which summarizes status of seabird colonies for the state of Alaska, and provides revisions of map areas 24 Unimak, 49 Blying Sound and 50 Seldovia for which significant new information is available.

Information of varying quality is available for 820 colony areas with populations of more than 19 million birds. A major geographic gap in our data is on colonies in the eastern Aleutians which are adjacent to proposed developments in the Aleutian and St. George Basins.

INTRODUCTION

Seabirds are likely to be most heavily impacted by OCS development when disturbance, pollution, etc., occurs near their colony sites. Colony sites represent areas of major concentration and many species are restricted to within daily commuting distances of the colony during the nesting period.

The objective of this study is to provide the basic information on colony location, composition and size needed to permit identification of vulnerable areas or species.

A preliminary catalog of colonies in the Gulf of Alaska and Bristol Bay was provided for earlier reports. This report provides updates of maps 24 Unimak, 49 Blying Sound and 50 Seldovia. Substantial additional new data has been accumulated and will be summarized in subsequent reports. A catalog summarizing the location and status of colonies for the entire state will be published by December 31, 1977 and will represent the best available data as of that time. In the interim, we have made available to the primary data users (BLM's OCS office, all OCSEAP investigators, ADF&G habitat division, State of Alaska Coastal Zone Management) the open-file of the colony status records, which since our data base is constantly expanding, represent the most comprehensive information source.

Seabird colony sites represent critical habitat that warrants special management consideration by resource planners and developers. While a preliminary catalog, as the name implies, is not definitive, it nonetheless identifies critical habitat, provides a base for which information may be added, upgraded or corrected and identifies deficiencies in the data base.

STATE OF KNOWLEDGE

The coastline of Alaska is over 34,000 miles long. Most of it is remote, poorly charted and frequented by violent storms. These factors along with the previous lack of research effort and the difficulty of censusing colonies have left gaps in the coverage, estimations of numbers and accounting of all species.

A review of information on colonies existing prior to OCSEAP appeared in our Annual Report of April 1976. OCSEAP has provided a large amount of new data, although colony censusing continues to be a side product of site specific studies and generally has not covered large sections of coastline. Large areas exist where we still do not know of all the major colonies. In some areas, data are available only from opportunistic observations from ships or low flying aircraft and do not include ground observations necessary to determine occurrence of many species. Figure 1 shows areas of fairly complete data and Figure 2 shows areas of little or very incomplete coverage. Areas not shaded on either map are of intermediate coverage or are zones where we have yet to receive data from cooperators.

STUDY AREA

While contract requirements stipulate gathering information for those regions being considered for oil and gas leasing, the U.S. Fish and Wildlife Service is cataloging all seabird colonies within Alaska as well as the Atlantic, Gulf and Pacific states. In this report we discuss progress on the Alaskan cataloging effort which will produce a catalog for publication for the entire state by December 31, 1977.

METHODS

Funding for these two research units does not provide for field work. All data is gathered through passive means by:

1) Review of literature (approximately 5% of data).
2) Review of unpublished data and reports (approximately 20%).
3) Opportunistically through RU# 341/342 (approximately 30%).
4) Contributions from cooperators - ADF&G, other OCSEAP studies, amature ornithologists, etc. (approximately 45%).

When possible, summaries done from the literature and unpublished reports are sent to the original investigator for review. Maps are included to delineate colony location and extent. An open file on each colony is retained in our office where information is added, upgraded, or corrected. Photographs and sketches, when available, are included as part of the file.

The basic summarization form and instructions have been modified (figure 3), primarily to facilitate standardization and to emphasize the importance of maps of the colony areas. These forms are filed by a number of which the first three digits designate the U.S. Geological Survey map 1:250,000 (figure 7) in which they occur. Digits 4-6 are sequentially added as new areas are located and digits 7-8 are used if subdividing is required. All forms are copied and filed separately under corresponding map numbers at our office.

Format for the final report (Dec. 1977) has been modified (see maps 24a-50b, and tables 24a-50b). Modifications were necessary to improve map quality, facilitate data additions and interpretations and to meet OCSEAP format requirements. Colony areas and their relative size are shown on reductions of 1:250,000 scale maps and cross-referenced with tabular information on species composition, numbers, source and date of information.

While many people are contributing to information in the colony catalog, particular recognition must be given to the following, for use of their data to update maps 24, 49 and 50. J. Larson, N. Faust, C. Gilbert, and D. Follows (NPS), B. Lehnhausen, and S. Quinlan (U. of Alaska), P. Arneson, D. Kurhajec, and D. Erikson (ADF&G) and G. Watson, V. Byrd, G. Divoky, and E. Bailey (USFWS).

RESULTS

Table 1 gives a summary of colony areas and estimated numbers of seabirds in colonies cataloged in our files at this time. In some areas, primarily in the Gulf of Alaska, these figures represent extensive censusing and probably all major colonies have been identified, with the exception of those of nocturnal birds. For areas outside the Gulf of Alaska, we have just begun to accumulate data and Table 1 probably grossly underestimates the number of colony areas and birds. Our data base for these areas will improve greatly as we acquire data from cooperators. Table 1 is meant as an indication of progress in filing data and not to be used as a base to make regional comparisons.

Updates of maps 024 Unimak, 049 Blying Sound, and 050 Seldovia are included in this report. Quality of data improved dramatically for these regions during the last summer. Updates of other regions are in progress.

Map 024 Unimak, went from 4 colony areas to 13. Population estimates were adjusted upward by 392,000 birds, which included the addition of ten species not included in last year's report. This region still needs extensive censusing, as records obtained to date are primarily from opportunistic observations from ships and do not cover all shorelines. Few land based observations were made and little time was spent deriving accurate estimates of populations.

Map 049 Blying Sound had extensive censusing covering all shoreline east of Cape Resurrection, except for Resurrection Bay north of Callisto Point. Many landings were made and colonies of petrels and Rhinoceros Auklets (nocturnals normally missed) were found in several locations. Generally, population estimates for nocturnal species were not made. This portion of 049 had 21 colony areas added, estimates of numbers adjusted downward by 29,000 birds and 6 species not previously reported here were added. The decrease on the population estimates was due to colony area 003, which Leroy Sowl (1971) estimated 25,000 Black-legged Kittiwakes, 1,000 Horned Puffin and 10,000 Tufted Puffin. Edgar Bailey (1976) found no Black-legged Kittiwakes and estimated only 130 Horned Puffin, 100 Tufted Puffin, 500 Glaucous-winged Gulls, 400 Red-faced and 72 Pelagic Cormorants. Sowl's survey was aerial and he may have interpreted a large feeding flock of kittiwakes as indicating a colony site or perhaps where there has been dramatic changes since 1971. Reproduction of Black-legged Kittiwakes have been reported as failing drastically in some location in 1976 (USFWS unpublished data) and may not have even attempted to nest here this year.

Map 50 Seldovia, had extensive censusing similar to 049. Twenty-nine colony areas were added, population estimates were adjusted upward by 6,000 birds and three species not previously reported were added.

DISCUSSION

The catalog, at present, includes colonies with a total of approximately 19,000,000 birds. Most of the very large colonies have probably been identified, yet we lack reliable estimates of the number of birds on many of them. Populations of large colonies completely overshadow small colonies and are geometrically harded to estimate in the "fast and dirty" surveying that has been necessary to date. Generally, we feel that the estimates tend to be conservative, especially on larger colonies.

Conspicuous by its absence are data on colonies of storm petrels and small alcids. These birds nest in burrows or talus, and their colonies are not apparent to observers passing by in either boats or aircraft. When considering that fewer than eight nests of Kittlitz's murrelets and possibly only two nests of Marbled murrelets have ever been recorded by ornithologists, it is understandable that they do not contribute importantly to the catalog even though qualitatively and quantitatively they represent important elements of the seabird population of Alaska.

Information varies in quality from colony to colony and is usually dependent upon who made the observations and under what circumstances. Accurate counts might be expected where the observer spent several days near a colony during periods when nest attendance was greatest, but counts might be less than that desired when made from an aircraft.

At this state in OCSEAP planning what is of primary importance is knowing where important colonies, i.e., critical habitats are located. It matters little whether the colony contains 100,000 or 200,000 birds. It is critical habitat. Fortunately, cataloging of colonies at this level is relatively easy provided manpower and suitable platforms are available.

CONCLUSIONS

We believe that the catalog will be one of the most useful products of all OCSEAP studies on marine birds, since critical habitats that could be impacted by drifting oil or onshore developments will be identified and mitigating measures may be taken to avoid adverse effects.

We recognize that the data in this catalog vary in quality, precision of estimates, and geographical coverage; but nonetheless it provides a base from which information can be added, upgraded or corrected. Catalog segments provided in prior OCSEAP reports has stimulated many observers to provide new information and we anticipate this pattern will continue.

RECOMMENDATIONS FOR FURTHER STUDY

RU# 338/343 funding has been only for passive data collection. This has proved highly successful and should continue to be most important. As the awareness of our effort spreads and the initial catalog for the state is completed, data flows into our office at an ever increasing rate.

Active colony cataloging should be begun during the 1978 field season to fill in the gaps which by then will be well defined, and to upgrade the poorest data. Careful coordination must be done to maximize the effort and to avoid overlap with opportunistic sources.

During the 1978 field season, emphasis should be placed on the eastern Aleutians where existing data indicate a high importance for seabirds, and southeast Alaska which is poorly known and vulnerable to oil spills from tanker traffic.

SUMMARY OF 3RD QUARTER OPERATIONS

Effort during the 3rd quarter will be devoted to verification of locations, status and composition of colonies within parts of the Gulf of Alaska, in conjunction with field studies conducted as part of Research Unit 341/342.

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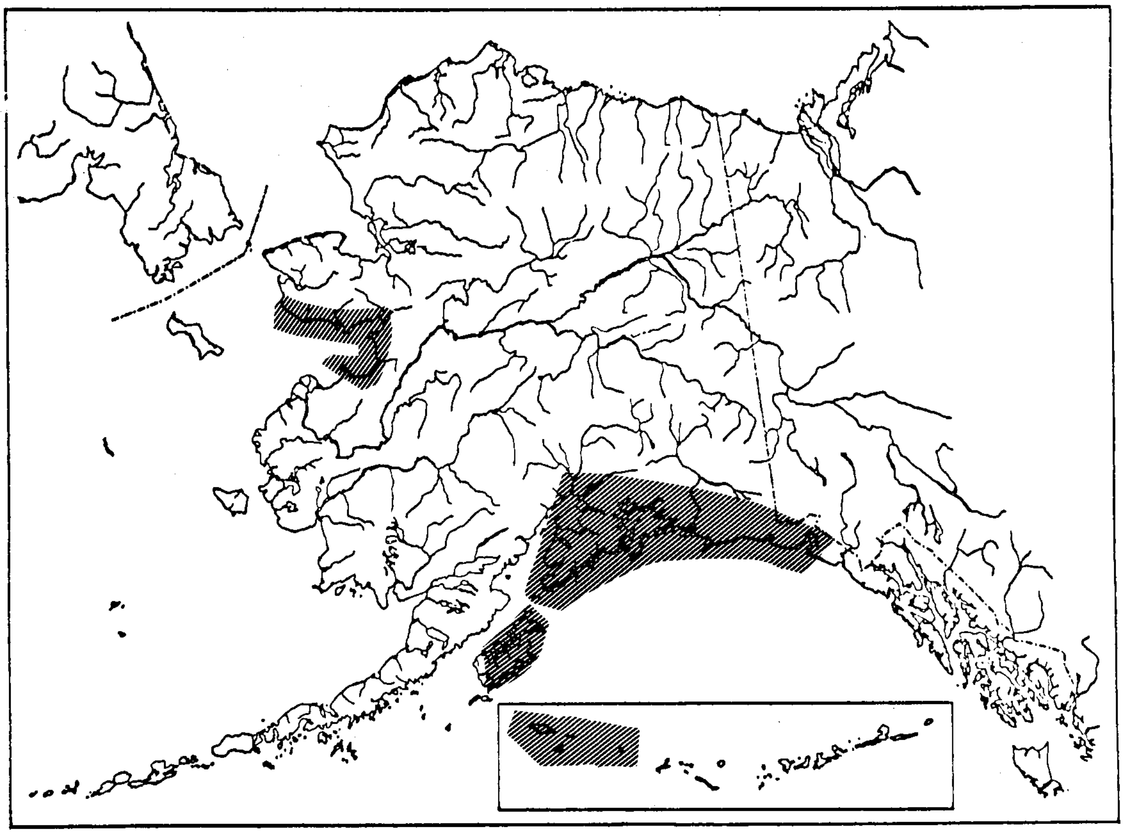

Figure 1. Areas of most complete coverage for seabird colony data.

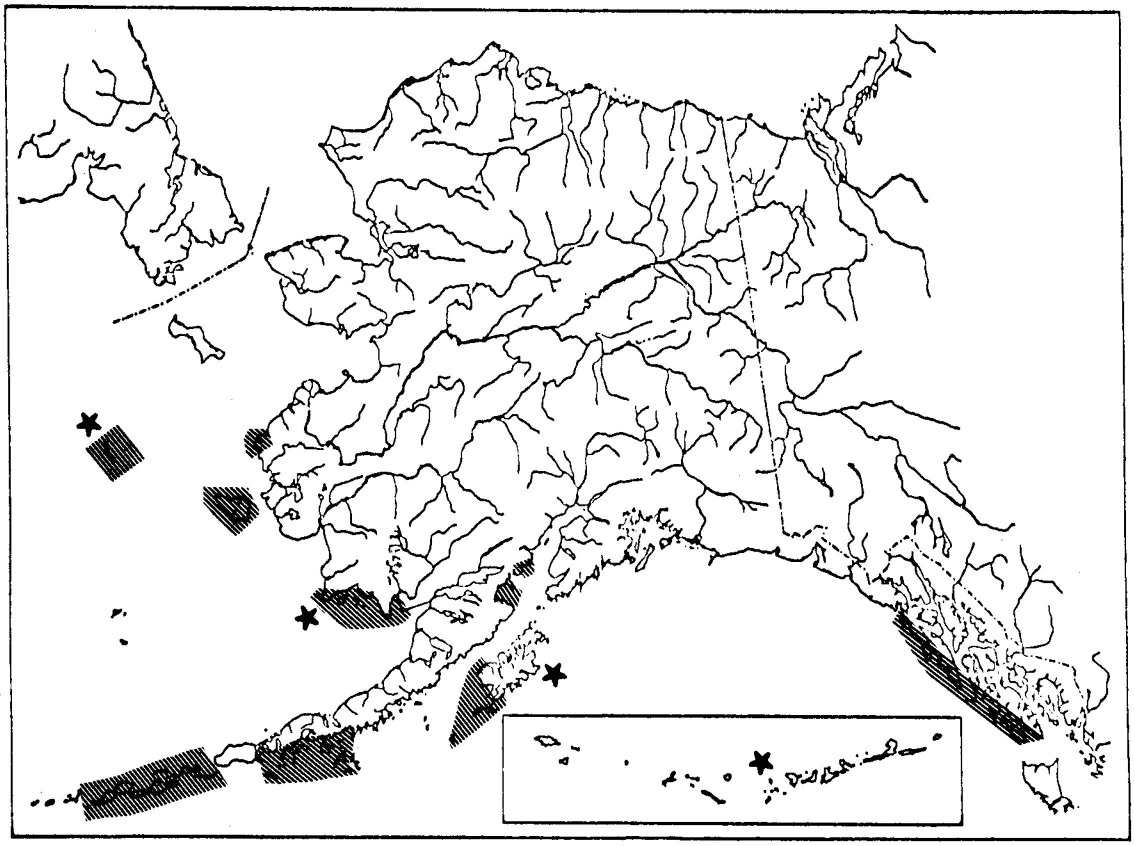

Figure 2. Areas of no or very poor coverage for seabird colony data and locations (✱) where planned 1977 field efforts will greatly improve data. Areas not shaded on this figure or figure 1 are of intermediate coverage or are zones where we have yet to recieve data from cooperators

Colony Status Record

U.S. Fish & Wildlife Service

Area Number 001 002 (to be assigned by office)

Colony Name Forrester Island Field No. ____ Observer(s) DeGange and Possardt

Map Dixon Entrance (D-5) Lat. 54°48' Long. 133°32' Time ____ Date Summer 1976

Species	No. Nests (use codes below[1])	No. Birds	Remarks (estimated minimum & maximum, egg & chick status, etc.)
Northern Fulmar			
Fork-tailed Storm Petrel			
Leach's Storm Petrel			
Cormorant			
Double-crested Cormorant			
Pelagic Cormorant		X	Questionable breeder in sea caves on west side.
Red-faced Cormorant			
Harlequin Duck		E 20nb	
Common Eider			
Bald Eagle	C 1	C 10b	
Black Oystercatcher		E 25bpr.	
Glaucous Gull			
Glaucous-winged Gull			
Mew Gull			
Black-legged Kittiwake		X nb	several immatures seen.
Red-legged Kittiwake			
Arctic Tern			
Aleutian Tern			
Murre			
Common Murre		C 3800b	Questionable as to number paired, few nested.
Thick-billed Murre			
Black Guillemot			
Pigeon Guillemot		E 300b	
Ancient Murrelet		E 30000bpr.	No sampling undertaken.
Cassin's Auklet		E 2200bpr.	Minimum estimate.
Parakeet Auklet			
Crested Auklet			
Least Auklet			
Whiskered Auklet			
Rhinoceros Auklet		E 54000bpr.	Only represents northern half of island.
Horned Puffin		E 375b	
Tufted Puffin		E 35000bpr.	
Peregrine Falcon	1	2bpr.	One pair fledged 2 young. Additional birds probably present on south end of island.
Marbled Murrelet		X	Questionable breeder.

Recommended Classification: Colony Complex ____ Colony X Sub-colony ____ Roost Area ____

[1] Use these abbreviations to decribe numbers. Use C & E whenever possible, avoid P & X.
C = count, E = estimate, P = probably present (state reason under remarks), X = present
pr = pairs, b = breeding, nb = non-breeding

Figure 3. Colony Status Record, front of page. This is the basic summarization form of the colony catalog.

Description of Colony

Access Best access is by small boat, see sketch map for location of landing beaches. Small helicopter can land at Eagle harbor & large one on the north muskeg.

Vegetation & Physiographic Characteristics Steep slopes are the dominant feature with 100m cliffs on the west side. Coniferous forest cover the entire island, except for open muskegs on the north & south ends. Salmonberry, heaths, Devil's Club & elder form unbelievably dense thickets. Fewer areas are park-like. The soil in many areas is deep, affording excellent burrow substrate.

Human Activity Little or none. Fishermen occasionally put ashore.

Mammalian Predators, Livestock, etc. A mouse (Peromyscus sitkensis) and a shrew (Sorex obscurus) are very adundant while a vole (Microtus coronarius) was rarely seen. Thier impact on the birds is probably minimal.

Marine Mammals Steller Sea Lions were frequently seen during the summer while Harbor seals were less regular. A Sea Otter was seen one time.

Census Methods & Data Status A field camp was occupied on Forrester Is. for the summer to study seabirds. Ninety-seven 5m x 5m plots were established to census Rhinoceros Auklets and Thirteen plots were established for Cassin's Auklets. Murres were censused twice from a zodiac raft.

Sample Plots Established As above.

Photo Coverage The east side of Forrester was photographed with B + W. The west side and the habitats on Forrester Island were photographed with color slide film. All photographs are available at USFWS, OBS/CE, Anchorage, Alaska.

Overall Evaluation of Colony Forrester Island is critical nesting habitat for Rhinoceros Auklets and Ancient Murrelets. Much of the Tufted Puffins at the refuge breed on Forrester Island.

Supplemental Material & Data Attached (list) For further information see DeGange and Possardt's in house administrative report. USFWS/OBS-CE, Anchorage, Alaska.

General Colony Sketch

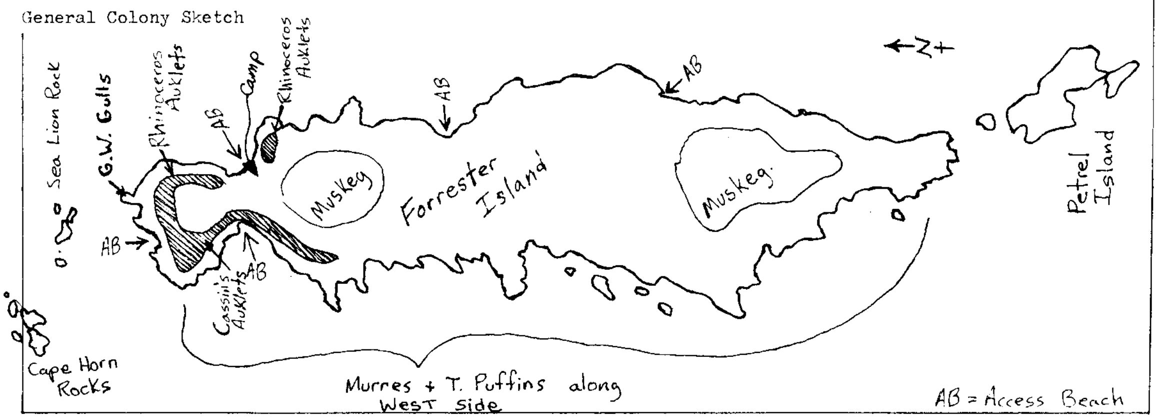

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Figure 4. Colony Status Record, back of page.

Colony Status Record - *Instructions*

U.S. Fish & Wildlife Service

This form is utilized to summarize information on seabird colonies regardless of colony size or composition. Records for the entire coastline of Alaska are being sought in hopes of being able to identify critical habitat, to assess impacts of oil spills and other environmental hazards and to gain insight into the ecology of the North Pacific, Bering Sea and Arctic Ocean.

Fill in this form as described below. Of primary importance are: position, date and an estimate of numbers of each species present. Of course we would like data on any or all other catagories, but realize in many cases it will not be obtained.

It can not be emphasized enough how important your contribution may be, even if only a small part of this form is completed. We are trying to cover over 34,000 miles of coastline, most of it remote and seldom visited. Seabirds have been largely overlooked until recently and the data you submit may be all we have on a particular area for quite some time. As populations change seasonally, or even from day to day, relicate observations are desirable. Please help!

General Instruction

Area Number: All colonies will be assigned a number by our office for cataloging purposes. Do not fill this in unless you know the catalog number.

Colony Name: Name of colony location or nearest location that appears on the USGS quadrangle map.

Field Number: A number you assign for your own convenience as a cross-reference to field notes, maps, etc.

Observer(s): Name(s) of observer(s).

Map: Indicate the U.S. Geological Survey quadrangle map (1:63,360) on which the colony is located. If not available, give U.S. Coast and Geodetic Survey Navigational Chart or smaller scale U.S.G.S. map.

Latitude and Longitude: Geographic coordinates to the nearset minute or, if possible, to the nearest 1/10 of an arc minute.

Time and Date: Give time and date precisely using local time and the 24-hour recording system, e.g., 1:00 pm = 1300 hours. Duration of censusing may be given, e.g., 0800-1015.

Number Nests and Birds: Give the number of nests and birds of each species composing the colony using the abbreviations at the bottom of the form to describe the number. Use total counts and estimates whenever possible. Merely indicating presence gives no idea of size, which an estimate, although perhaps in gross error, will do to at least an order of magnitude. Under "Remarks" state a range within which you feel your estimate lies.

Some species (primarily nocturnals) will be missed in most censuses. For these, negative data will be extremely valuable. When you have specifically looked for these species state so, even if you haven't found anything.

Recommended Classification: Indicate which category you think best describes the data.
- Colony Complex - Data on more than one colony has been combined.
- Colony - A geographically distinct area of breeding birds.
- Sub-Colony - A logical sub-unit of a colony.
- Roost Area - An area where birds roost, but do not breed.

Access: Describe best and alternate means by which the colony may be reached, best landing areas for small boats or aircraft.

Vegetation and Physiographic Characteristics: Provide a brief description including but not limited to the following: 1. Type - cliff, talus, vegetated slope, etc. 2. Exposure 3. Height of cliffs, size of talus, rock type, etc. 4. Vegetation types and species if known.

Human Activity: Note human disturbance, shoreline development, prepence of aircraft and boats, etc.

Mammalian Predators, livestock, etc: Indicate presence of any mammals or sign, and note any impact.

Marine Mammals: Record observations and mark locations of hauling grounds on a map (see figures).

Census Methods and Data Status: Indicate if census was aerial, shipboard and/or on land. Describe the census procedures and quality of data.from which the summary record was made. Provide an estimate, either subjective or statical, for the accuracy of population estimates.

Sample Plots Established: Describe location, size and purpose of sample plots. A sketch map or photo may be helpful in identifying location.

Photo Coverage: Photographs can be of high archival and censusing value. Provide good quality negatives and/or prints and slides whenever possible. Identify all photographs by photographer, date, location

Figure 5. Colony Status Record - Instructions, front of page.

and focal lenght of lens.

In choosing photo sites, consider ease of relocating for future reframing attempts. Describe the location exactly and mark it on a map (see figures).

Overall Evaluation of Colony: Note subjective comments on condition, aesthetic value, importance, potential threats, etc.

Supplemental Material and Data Attached (list): Make reference to any specimens collected (e.g. stomach samples, nests materials, etc.) and any additional data collected (e.g. a list of plant species present).

Maps: Attach a map if at all possible. Sketch maps can be done if no USGS maps are available or to show greater detail and vertical mapping.

Show:

Colony location & extent

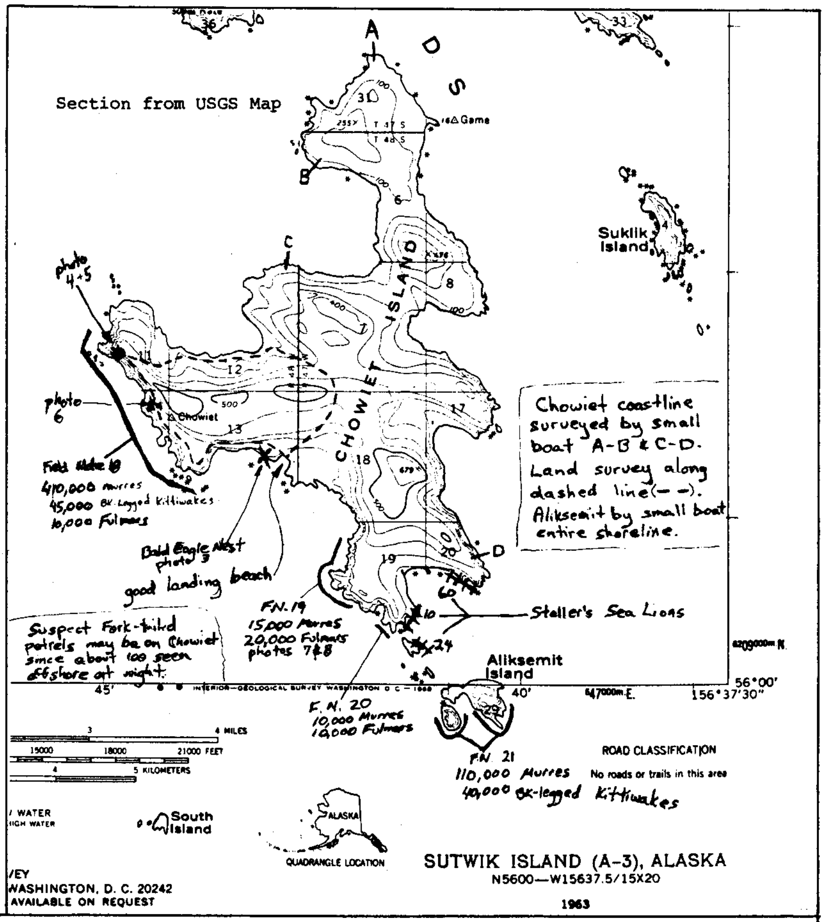
Marine mammal hauling grounds

Extent of survey

Location of eagle nests

Good landing beaches

etc.



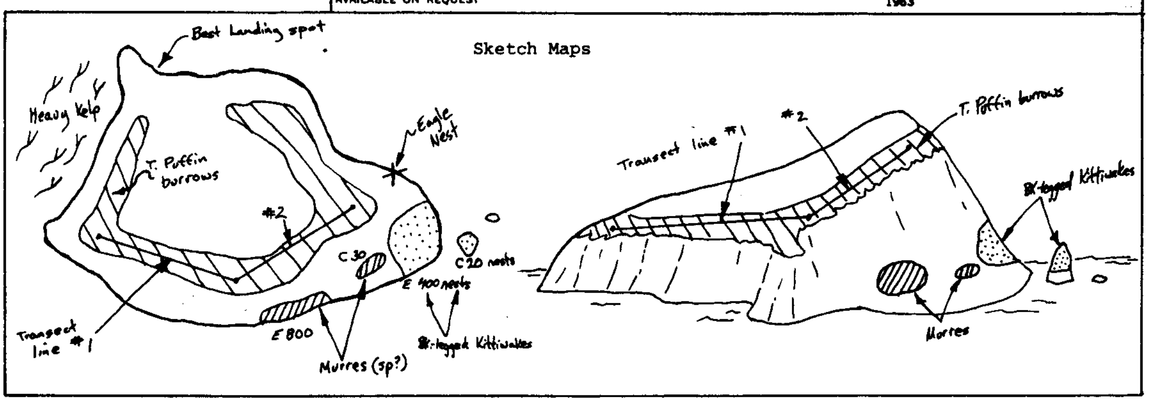


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Figure 6. Colony Status Record - Instructions, back of page.

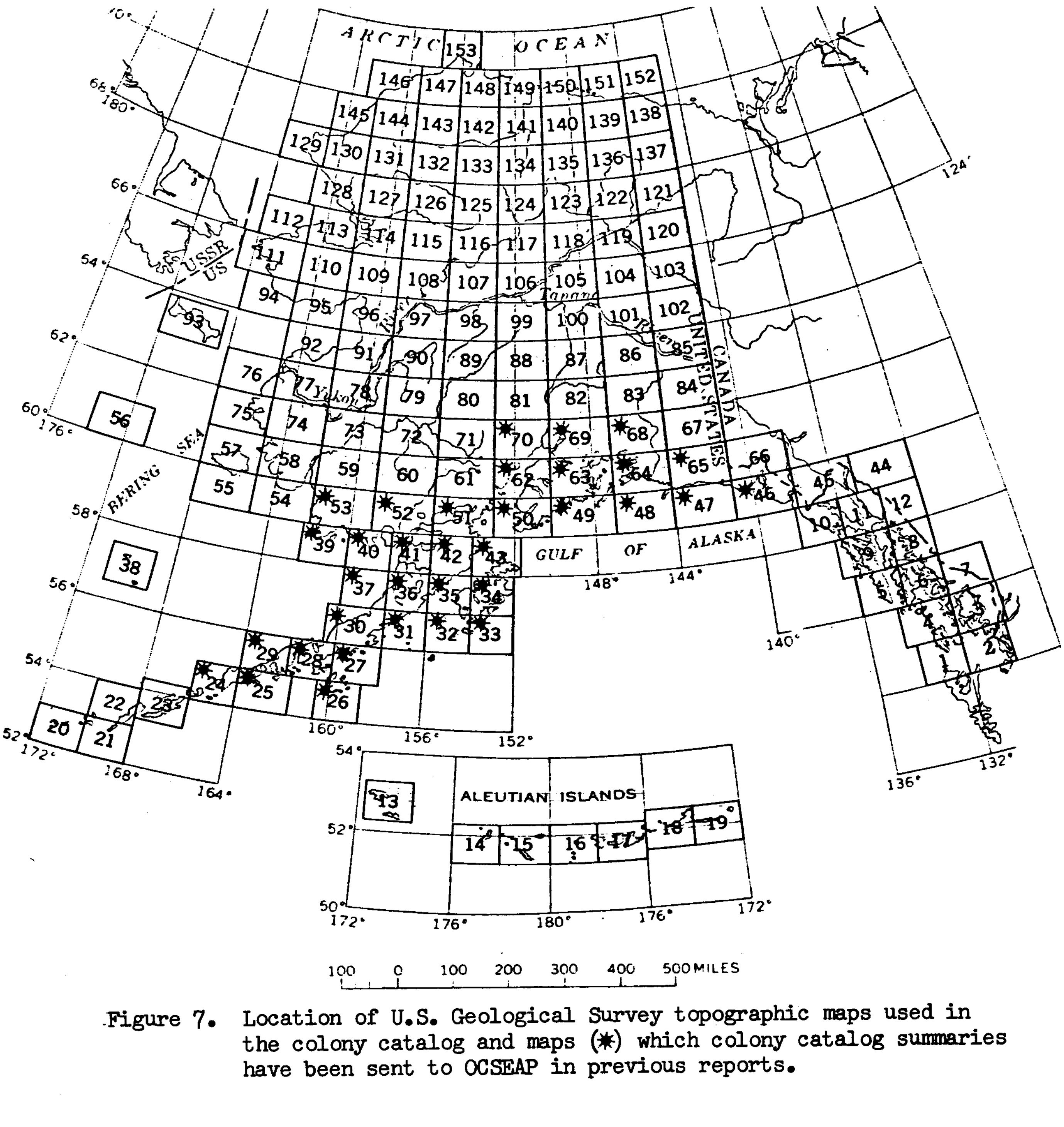


Figure 7. Location of U.S. Geological Survey topographic maps used in the colony catalog and maps (✱) which colony catalog summaries have been sent to OCSEAP in previous reports.

Table 1. Number of known colony areas and estimated numbers of seabirds filed in the colony catalog as of March 1977.

Map No.	Map Name	Colony Areas	No. of Birds
1	Dixon Entrance	5	612,000
2	Prince Rupert	-	-
3	Ketchikan	3	NE
4	Craig	-	-
5	Port Alexander	2	2,000,000
6	Petersburg	-	-
8	Sumdum	-	-
9	Sitka	-	-
10	Mt. Fairweather	6	3,000
11	Juneau	-	-
13	Attu	29	260,000
14	Kiska	3	393,000
15	Rat Islands	15	88,000
16	Gareloi Island	14	247,000
17	Adak	13	31,000
18	Atka	7	134,000
19	Seguam	2	1,000
20	Amukta	4	630,000
21	Samalga	5	288,000
22	Umnak	5	115,000
23	Unalaska	3	101,000
24	Unimak	12	433,000
25	False Pass	25	231,000
26	Simeonof Island	8	139,000
27	Stepovak Bay	34	666,000
28	Port Moller	47	530,000
29	Cold Bay	6	16,000
30	Chignik	6	16,000
31	Sutwik Island	31	2,735,000
32	Trinity Islands	6	8,000
33	Kaguyak	4	7,000
34	Kodiak	69	327,000
35	Karluk	10	535,000
36	Ugashik	6	63,000
37	Bristol Bay	-	-
38	Pribilof Islands	4	2,000,000
39	Hagemeister Island	31	2,195,000
40	Nushagak Bay	13	155,000
41	Naknek	3	> 1,000
42	Mt. Katmai	12	8,000
43	Afognak	114	409,000
45	Skagway	-	-
46	Yakutat	6	5,000
47	Icy Bay	3	1,000
48	Middleton Island	4	185,000

(cont.)

49	Blying Sound	38	101,000
50	Seldovia	37	16,000
51	Iliamna	27	9,000
52	Dillingham	3	1,000
53	Goodnews	-	-
54	Kuskokwin Bay	1	3,000
55	Cape Mendenhall	-	-
56	St. Matthew	3	NE
57	Nunivak Island	2	NE
58	Baird Inlet	-	-
62	Kenai	4	17,000
63	Seward	41	16,000
64	Cordova	21	83,000
65	Bering Glacier	-	-
68	Valdez	4	> 1,000
69	Anchorage	6	18,000
70	Tyonek	-	-
75	Hooper Bay	1	1,000
76	Black	-	-
77	Kwiguk	-	-
91	Unalakleet	6	3,000
92	St. Michael	3	> 1,000
93	St. Lawrence	9	1,710,000
94	Nome	2	5,000
95	Solomon	10	78,000
96	Norton Bay	4	12,000
111	Teller	9	292,000
112	Shishmaref	-	-
113	Kotzebue	6	4,000
114	Selawik	4	2,000
128	Noatak	-	-
129	Point Hope	6	1,001,000
130	De Long Mt.	-	-
138	Demarcation Point	-	-
139	Mt. Michelson	-	-
145	Point Hope	6	1,001,000
146	Wainwright	-	-
147	Meade River	2	>1,000
148	Teshekpuk	-	-
149	Harrison Bay	-	-
150	Beechey Point	-	-
151	Flaxman Island	-	-
152	Barter Island	-	-
153	Barrow	1	>1,000
	Total	820	18,942,000

NE = No estimate

Table 24a. Name, area number, information source and date of known seabird colonies of topographic map 24, Unimak.

AREA NO.	COLONY NUMBER	INVESTIGATOR[1]	DATE
024 001	Rootok Island	Sekora	1972
002	Avatanak Island		
003	Akun Island	Linsink	9-30-57
004	Unimak	Harrison & Hatch	8-15-75
005	Scotch Cap		9- ?-75
006	Sealion Point	Phillips	5- ?-76
007	Cave Point		
008	Cape Mordvinof	Sowls et al.	6- 5-76
009	Derdin Island	Byrd et al.	6-25-73
010	Tigalda Island		
011	Ugamak Island		
012	Kaligagan Island		
013	Cape Lutke		

1/
Byrd = G. Vernon Byrd, USFWS
Harrison = Craig S. Harrison, USFWS
Hatch = Scott A. Hatch, USFWS
Linsink = Calvin J. Lensink, USFWS
Phillips = Mark Phillips, USFWS
Sekora = Palmer Sekora, USFWS
Sowls = Arthur L. Sowls

Table 24b. Summary of data on seabird colonies of map 024, Unimak.

Species	Area Number										
	024 001	024 002	024 003	024 004	024 005	024 006	024 007	024 008	024 009	024 010	024 011
Northern Fulmar											
Fork-tailed Storm Petrel											
Leach's Storm Petrel											
Cormorant								X			
Double-crested Cormorant									1		
Pelagic Cormorant									60		
Red-faced Cormorant				50	200	750	1,000	X	370	120	
Harlequin Duck										X	
Common Eider											
Bald Eagle									2		
Black Oystercatcher									1		
Glaucous Gull											
Glaucous-winged Gull									850		
Mew Gull											
Black-legged Kittiwake			X					P			
Red-legged Kittiwake											
Arctic Tern											
Aleutian Tern											
Murre								P			
Common Murre											10
Thick-billed Murre											
Black Guillemot											
Pigeon Guillemot									5		20
Ancient Murrelet											
Cassin's Auklet											
Parakeet Auklet											
Crested Auklet											
Least Auklet											
Whiskered Auklet											
Rhinoceros Auklet											
Horned Puffin											50
Tufted Puffin	100,000	50,000							2,000		1,500
other										1[b]	
Total	100,000	50,000		50	200	750	1,000	10,000	3,289	121	1,580

X = present, P = probably present, b = Kittlitz's Murrelet

(continued)

Table 24b continued. Summary of data on seabird colonies of map 024, Unimak.

Species	Area Number	
	024 012	024 013
Northern Fulmar		
Fork-tailed Storm Petrel		
Leach's Storm Petrel		
Cormorant		
Double-crested Cormorant		
Pelagic Cormorant		
Red-faced Cormorant	100	60
Harlequin Duck		
Common Eider		
Bald Eagle		
Black Oystercatcher		
Glaucous Gull		
Glaucous-winged Gull		
Mew Gull		
Black-legged Kittiwake		
Red-legged Kittiwake		
Arctic Tern		
Aleutian Tern		
Murre	300	
Common Murre		
Thick-billed Murre		
Black Guillemot		
Pigeon Guillemot	100	
Ancient Murrelet		
Cassin's Auklet		
Parakeet Auklet		
Crested Auklet		
Least Auklet		
Whiskered Auklet		
Rhinoceros Auklet		
Horned Puffin		X
Tufted Puffin	375,000	X
other		
Total	375,500	60

X = present, P = probably present

Table 49a. Name, area number, information source and date of known seabird colonies of topographic map 49, Blying Sound.

AREA NO.	COLONY NUMBER	INVESTIGATOR[1/]	DATE
049 003	Granite Island	Bailey et al.	1976
005	Chat Island		
006	Neck Point	Isleib & Sowl	7-23-72
007	Jeanie Point		
008	Wooded Islands	Lehnhausen & Quinlan	1976
009	Nellie Martin River	Islieb & Sowl	7-23-72
010	Rugged Island	Bailey et al.	1976
011	Callisto Head		
012	Cape Junken	Islieb	5-17-63
013	Cape Fairfield		
014	Cape Puget		7-24-72
015	Pt. Elrington	& Sowl	7-23-72
016	Danger Island	& Divoky	8- ?-73
017	North Twin Bay	& Sowl	7-23-72
018	Caines Head	Shaffer	1969
019	Seal Rocks	Bailey et al.	1976
020	Twin Islands		
021	Lone Rock		
022	Unnamed Chiswell A.		
023	Chiswell Island		
024	Matushka Island		
025	Unnamed Chiswell B.		
026	Beehive Island		
027	Natoa Island		
028	16-21 Island		
029	Harbor Island		
030	Try Triangle		
031	17 Cove		
032	Slate Island		
033	Squab Island		
034	300 Island		
035	Pilot Rock		
036	Cheval Island		
037	East Aialik Pen.		
038	Bear Glacier Pt.		
039	Hive Island		
040	South Renard Is.		
041	Barwell Island		
042	Cape Resurrection		

1/
Bailey = Edgar P. Bailey, USFWS
Isleib = M.E. (Pete) Isleib, USFWS & commercial fisherman
Divoky = George J. Divoky, USFWS
Lehnhausen = William Lehnhausen, U. of Alaska
Quinlan = Susan Quinlan, U. of Alaska
Shaffer = Boyd Shaffer, amature ornithologist
Sowl = Leroy W. Sowl, USFWS

Table 49b. Summary of data on seabird colonies of map 049, Blying Sound.

Species	Area Number										
	049 003	049 005	049 006	049 007	049 008	049 009	049 010	049 011	049 012	049 013	049 014
Northern Fulmar											
Fork-tailed Storm Petrel		X			5,000						
Leach's Storm Petrel					400						
Cormorant			300		250						
Double-crested Cormorant					X						
Pelagic Cormorant	72	28			X		10				
Red-faced Cormorant	400	24			X						
Harlequin Duck											
Common Eider											
Bald Eagle	2	2									
Black Oystercatcher											
Glaucous Gull											
Glaucous-winged Gull	500	40		20	350		100		60	20	
Mew Gull											
Black-legged Kittiwake					1,700						
Red-legged Kittiwake											
Arctic Tern						200					
Aleutian Tern											
Murre											
Common Murre	200	160			80		400				
Thick-billed Murre											
Black Guillemot											
Pigeon Guillemot					100				20	6	
Ancient Murrelet			X		X						
Cassin's Auklet											
Parakeet Auklet					25						
Crested Auklet											
Least Auklet											
Whiskered Auklet											
Rhinoceros Auklet											
Horned Puffin	130	80	10	10	30		260	30			30
Tufted Puffin	100	30	100	100	9,200		10		30	100	
other					X[a]						
Total	1,404	364	410	130	17,135	200	780	30	110	126	30

X = present, P = probably present, a = Marbled Murrelet

(continued)

Table 49b continued. Summary of data on seabird colonies of map 049, Blying Sound.

Species	Area Number										
	049 015	049 016	049 017	049 018	049 019	049 020	049 021	049 022	049 023	049 024	049 025
Northern Fulmar							40				
Fork-tailed Storm Petrel								X	X	X	
Leach's Storm Petrel											
Cormorant	240										
Double-crested Cormorant				X							
Pelagic Cormorant	10		32						40		
Red-faced Cormorant	150				30				80		
Harlequin Duck											
Common Eider											
Bald Eagle								X		2	
Black Oystercatcher		4									
Glaucous Gull											
Glaucous-winged Gull	560	25		X			24		160	70	
Mew Gull											
Black-legged Kittiwake			50					310	2,230		300
Red-legged Kittiwake											
Arctic Tern		30									
Aleutian Tern											
Murre											
Common Murre	170							280	520	3,040	150
Thick-billed Murre											
Black Guillemot											
Pigeon Guillemot	80			X							
Ancient Murrelet											
Cassin's Auklet											
Parakeet Auklet										458	
Crested Auklet											
Least Auklet											
Whiskered Auklet											
Rhinoceros Auklet										1,200	
Horned Puffin	200		10		60	50	40	350	70	1,410	130
Tufted Puffin	1,600		800		800		80	2,560	6,000	2,100	20,000
other											
Total	3,010	59	892	75	890	50	184	3,500	9,100	8,280	20,580

X = present, P = probably present

(continued)

Table 49b continued. Summary of data on seabird colonies of map 049, Blying Sound.

Species	Area Number										
	049 026	049 027	049 028	049 029	049 030	049 031	049 032	049 033	049 034	049 035	049 036
Northern Fulmar											
Fork-tailed Storm Petrel		X		X							
Leach's Storm Petrel											
Cormorant											
Double-crested Cormorant											36
Pelagic Cormorant		18		2							20
Red-faced Cormorant											100
Harlequin Duck											
Common Eider											
Bald Eagle		2					2				
Black Oystercatcher											
Glaucous Gull											
Glaucous-winged Gull	20	596						400	70	20	140
Mew Gull							30				
Black-legged Kittiwake	1,220	70									
Red-legged Kittiwake											
Arctic Tern											
Aleutian Tern											
Murre											
Common Murre	400	1,640	120								
Thick-billed Murre											
Black Guillemot											
Pigeon Guillemot											
Ancient Murrelet											
Cassin's Auklet											
Parakeet Auklet		60	30								
Crested Auklet											
Least Auklet											
Whiskered Auklet											
Rhinoceros Auklet											
Horned Puffin	220	1,330	330	320	10	10	56		60	30	210
Tufted Puffin	11,000	1,920	100	30					500	10	140
other											
Total	12,860	5,636	580	352	10	10	88	400	630	60	646

X = present, P = probably present

(continued)

Table 49b continued. Summary of data on seabird colonies of map 049, Blying Sound.

Species	Area Number										
	049 037	049 038	049 039	049 040	049 041	049 042					
Northern Fulmar											
Fork-tailed Storm Petrel											
Leach's Storm Petrel											
Cormorant											
Double-crested Cormorant			10								
Pelagic Cormorant			20	4	40						
Red-faced Cormorant			40		100						
Harlequin Duck											
Common Eider											
Bald Eagle	4										
Black Oystercatcher											
Glaucous Gull											
Glaucous-winged Gull			100		400	400					
Mew Gull											
Black-legged Kittiwake					2,480	5,840					
Red-legged Kittiwake											
Arctic Tern											
Aleutian Tern											
Murre											
Common Murre			40		17,600	4,300					
Thick-billed Murre											
Black Guillemot											
Pigeon Guillemot											
Ancient Murrelet											
Cassin's Auklet											
Parakeet Auklet											
Crested Auklet											
Least Auklet											
Whiskered Auklet											
Rhinoceros Auklet											
Horned Puffin	150	50	100	50	80	160					
Tufted Puffin			270	20	600	40					
other											
Total	154	50	580	74	21,300	10,740					

X = present, P = probably present

Table 50a. Name, area number, information source and date of known seabird colonies of topographic map 50, Seldovia.

AREA NO.	COLONY NUMBER	INVESTIGATOR[1]	DATE
050 001	Gull Island	Arneson et al.	1976
050 003	East Chugach Island	Bailey et al.	1976
050 006	Gore Point		
050 007	Gull Island (2)	ADF&G	
050 008	Flat Island	Arneson et al.	1976
050 009	Grass Island		
050 010	60 Foot Rock		
050 012	Elizabeth Island	Bailey et al.	1976
050 013	Perl Rock		
050 014	Windy Bay		
050 015	Rocky Bay Island		
050 016	Unnamed Bay		
050 017	Dick 2		
050 018	Taylor Bay		
050 019	10 Section		
050 020	Brown Mountain		
050 021	Westdahl Cove Island		
050 022	SE Nuka Island		
050 023	Middle Nuka Island		
050 024	35 Point		
050 025	Harrington Point		
050 026	Beautiful Island		
050 027	East Arm		
050 028	East Arm North		
050 029	Outer Island		
050 030	Rabbit Island		
050 031	Wildcat Pass		
050 032	Hoof Point		
050 033	28 Section		
050 034	Steep Point		
050 035	Black Bay		
050 036	Nack Triangle		
050 037	Taroka Arm		
050 038	Surok Point		
050 039	Harris Bay Island		
050 040	NW Glacier Island		

[1] Arneson = Paul Arneson, ADF&G
Bailey = Edgar P. Bailey, USFWS

Table 50b. Summary of data on seabird colonies of map 050, Seldovia.

Species	Area Number										
	050 001	050 003	050 006	050 007	050 008	050 009	050 010	050 012	050 013	050 014	050 015
Northern Fulmar											
Fork-tailed Storm Petrel											
Leach's Storm Petrel											
Cormorant								60			
Double-crested Cormorant											
Pelagic Cormorant	222		60					X			46
Red-faced Cormorant	62							X			
Harlequin Duck											
Common Eider	2									6	
Bald Eagle			2							2	2
Black Oystercatcher											
Glaucous Gull											
Glaucous-winged Gull	216	40	50				64			340	20
Mew Gull											
Black-legged Kittiwake	3,194			X		25	68			30	
Red-legged Kittiwake											
Arctic Tern											
Aleutian Tern											
Murre				X							
Common Murre	3,200						350				
Thick-billed Murre											
Black Guillemot											
Pigeon Guillemot	12			X	22						
Ancient Murrelet											
Cassin's Auklet											
Parakeet Auklet											
Crested Auklet											
Least Auklet											
Whiskered Auklet											
Rhinoceros Auklet											
Horned Puffin	10				4						
Tufted Puffin	530	20	100		3,752		52	20	20	80	1,600
other											
Total	7,448	60	212		3,778	25	534	80	20	458	1,668

X = present, P = probably present

(continued)

Table 50b continued. Summary of data on seabird colonies of map 050, Seldovia.

Species	Area Number										
	050 016	050 017	050 018	050 019	050 020	050 021	050 022	050 023	050 024	050 025	050 026
Northern Fulmar											
Fork-tailed Storm Petrel											
Leach's Storm Petrel											
Cormorant				400							
Double-crested Cormorant				X				10			
Pelagic Cormorant		100		X			40			30	16
Red-faced Cormorant				X			50		10		
Harlequin Duck											
Common Eider											
Bald Eagle			X		2			2			2
Black Oystercatcher											
Glaucous Gull											
Glaucous-winged Gull		20			40		50	170	30		6
Mew Gull											
Black-legged Kittiwake	400	800	30								
Red-legged Kittiwake											
Arctic Tern											
Aleutian Tern											
Murre											
Common Murre											
Thick-billed Murre											
Black Guillemot											
Pigeon Guillemot											
Ancient Murrelet											
Cassin's Auklet											
Parakeet Auklet											
Crested Auklet											
Least Auklet											
Whiskered Auklet											
Rhinoceros Auklet											
Horned Puffin						40				10	
Tufted Puffin		60			20			10			
other											
Total	400	980	30	400	62	40	140	192	40	40	24

X = present, P = probably present

(continued)

Table 50b continued. Summary of data on seabird colonies of map 050, Seldovia.

Species	Area Number										
	050 027	050 028	050 029	050 030	050 031	050 032	050 033	050 034	050 035	050 036	050 037
Northern Fulmar											
Fork-tailed Storm Petrel			X								
Leach's Storm Petrel											
Cormorant											
Double-crested Cormorant											
Pelagic Cormorant			120	4	40	172	10	40	14	20	
Red-faced Cormorant			50			100				40	
Harlequin Duck											
Common Eider											
Bald Eagle	2			2							
Black Oystercatcher											
Glaucous Gull											
Glaucous-winged Gull	120	40	940			170		50			
Mew Gull											
Black-legged Kittiwake			1,060								
Red-legged Kittiwake											
Arctic Tern		6									
Aleutian Tern											
Murre											
Common Murre											
Thick-billed Murre											
Black Guillemot											
Pigeon Guillemot											
Ancient Murrelet											
Cassin's Auklet											
Parakeet Auklet											
Crested Auklet											
Least Auklet											
Whiskered Auklet											
Rhinoceros Auklet											
Horned Puffin			900	30	30	1,040			60		80
Tufted Puffin			4,680		30	1,220	150		140		50
other											
Total	122	46	7,750	36	100	2,702	160	90	214	60	130

X = present, P = probably present

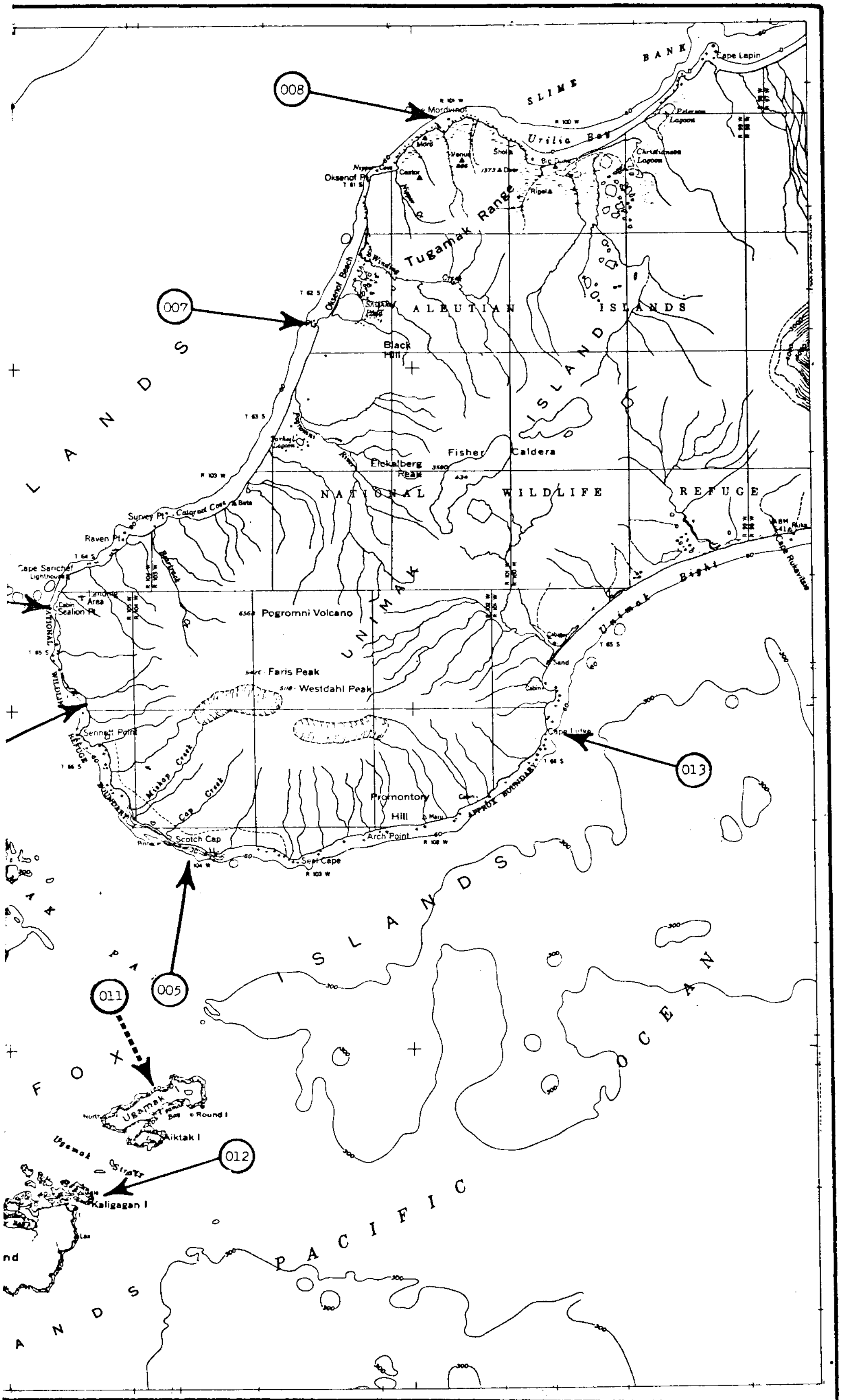
(continued)

Table 50b continued. Summary of data on seabird colonies of map 050, Seldovia.

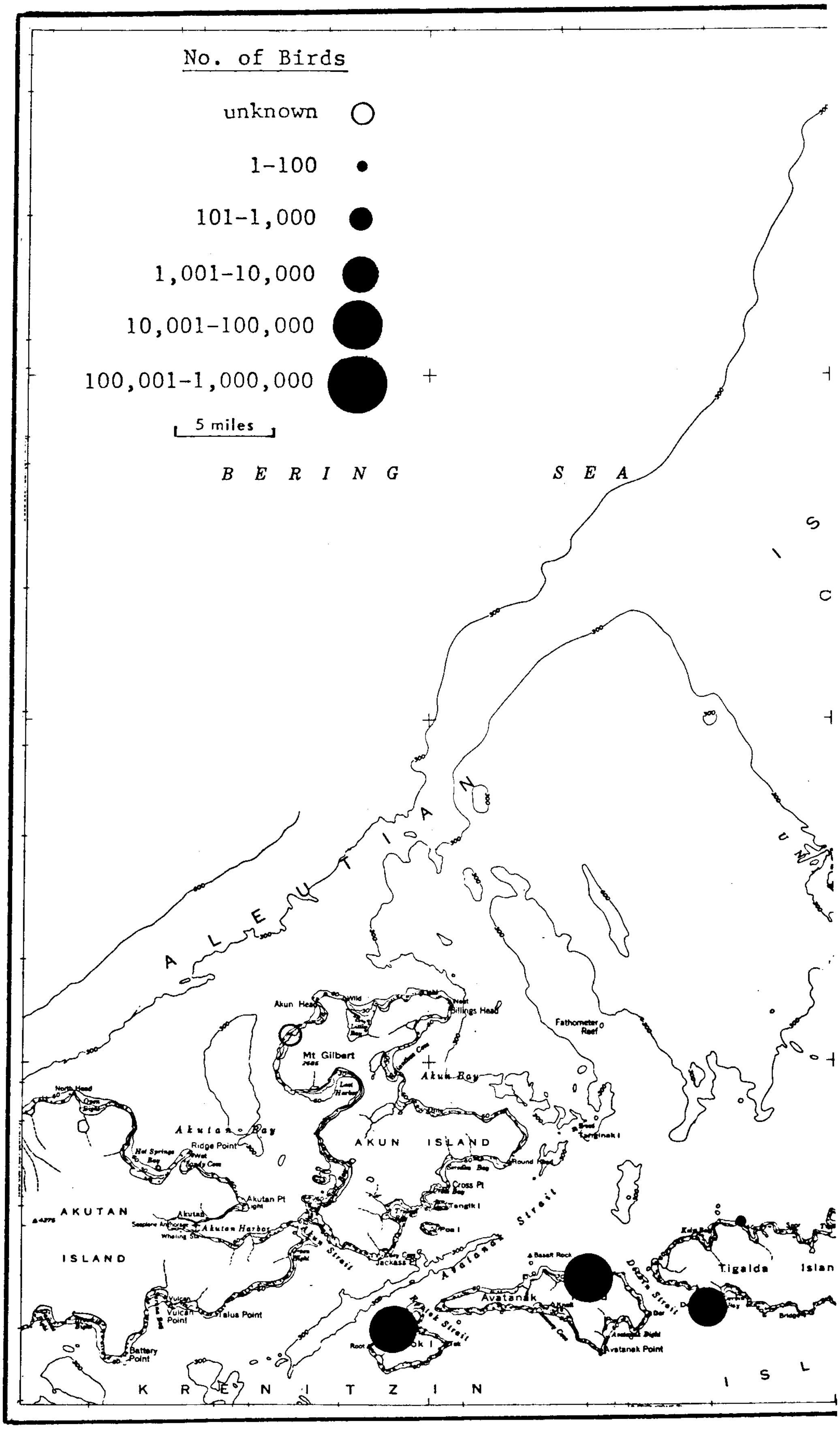
Species	Area Number										
	050 038	050 039	050 040								
Northern Fulmar											
Fork-tailed Storm Petrel											
Leach's Storm Petrel											
Cormorant											
Double-crested Cormorant											
Pelagic Cormorant	140										
Red-faced Cormorant											
Harlequin Duck											
Common Eider											
Bald Eagle											
Black Oystercatcher											
Glaucous Gull											
Glaucous-winged Gull	20	40	16								
Mew Gull		60									
Black-legged Kittiwake											
Red-legged Kittiwake											
Arctic Tern		80									
Aleutian Tern											
Murre											
Common Murre											
Thick-billed Murre											
Black Guillemot											
Pigeon Guillemot											
Ancient Murrelet											
Cassin's Auklet											
Parakeet Auklet											
Crested Auklet											
Least Auklet											
Whiskered Auklet											
Rhinoceros Auklet											
Horned Puffin											
Tufted Puffin											
other											
Total	160	180	16								

X = present, P = probably present

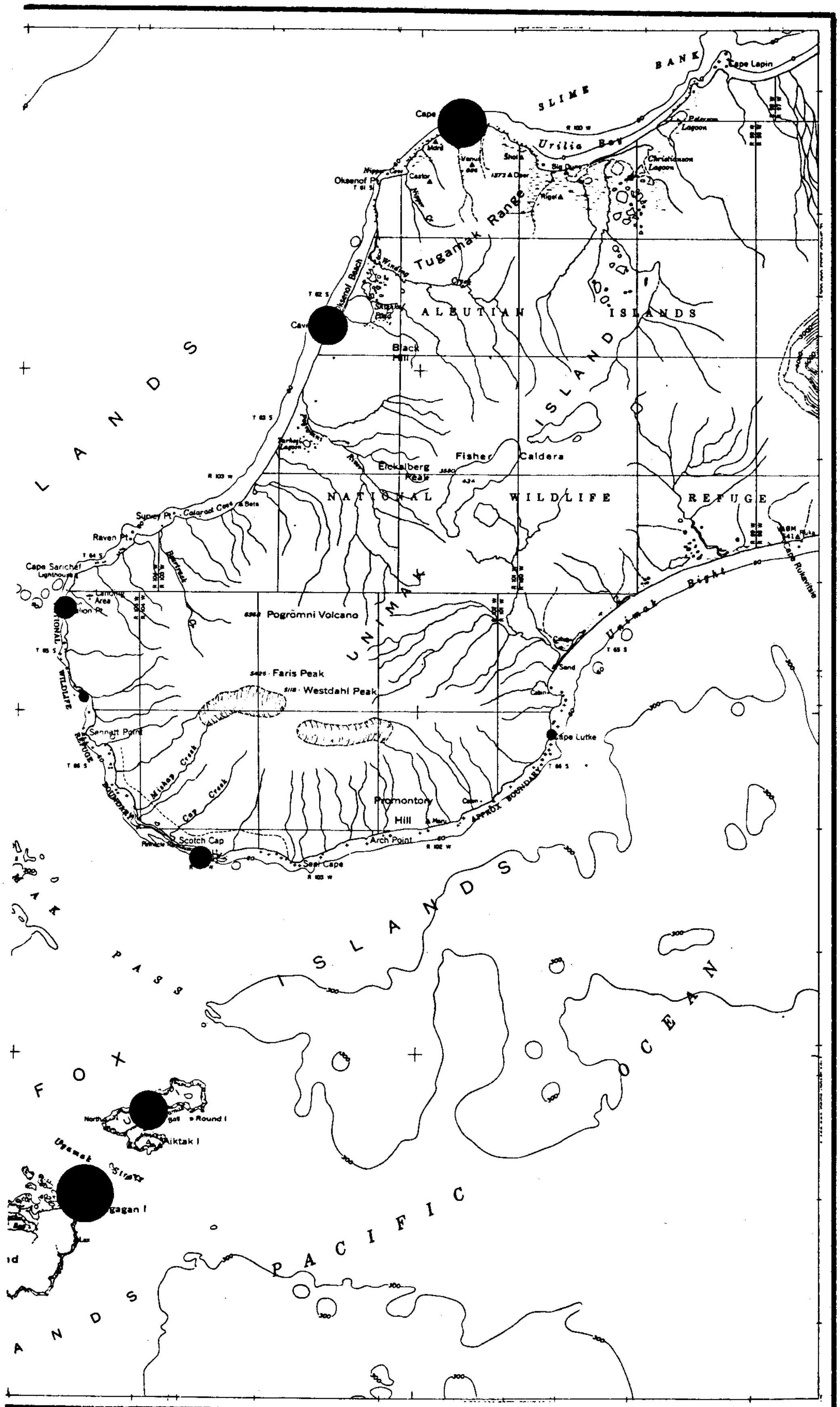
Map 24a. Known seabird colonies in topographic area 024,



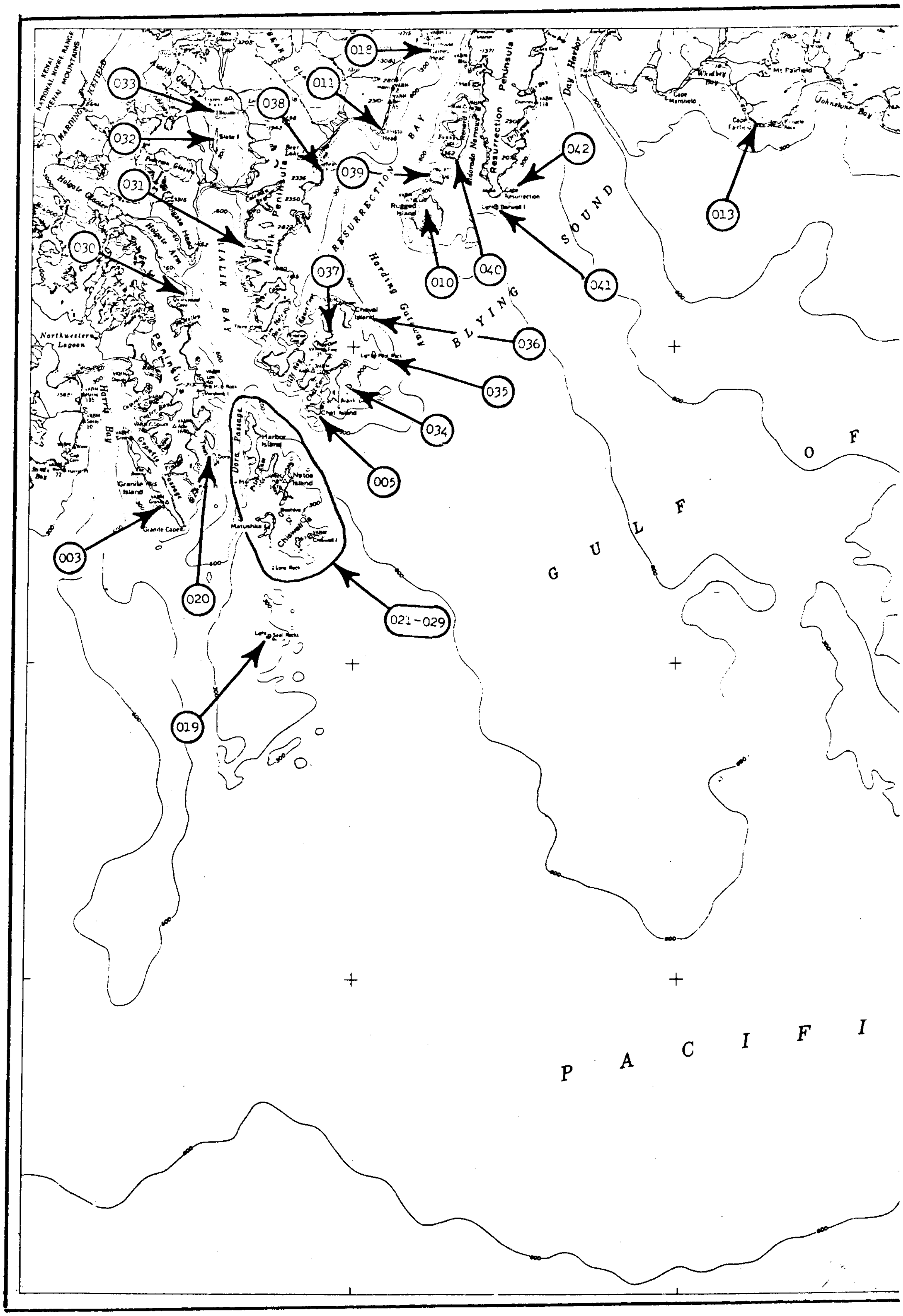
Unimak. Dashed arrows indicate imprecise colony locations.



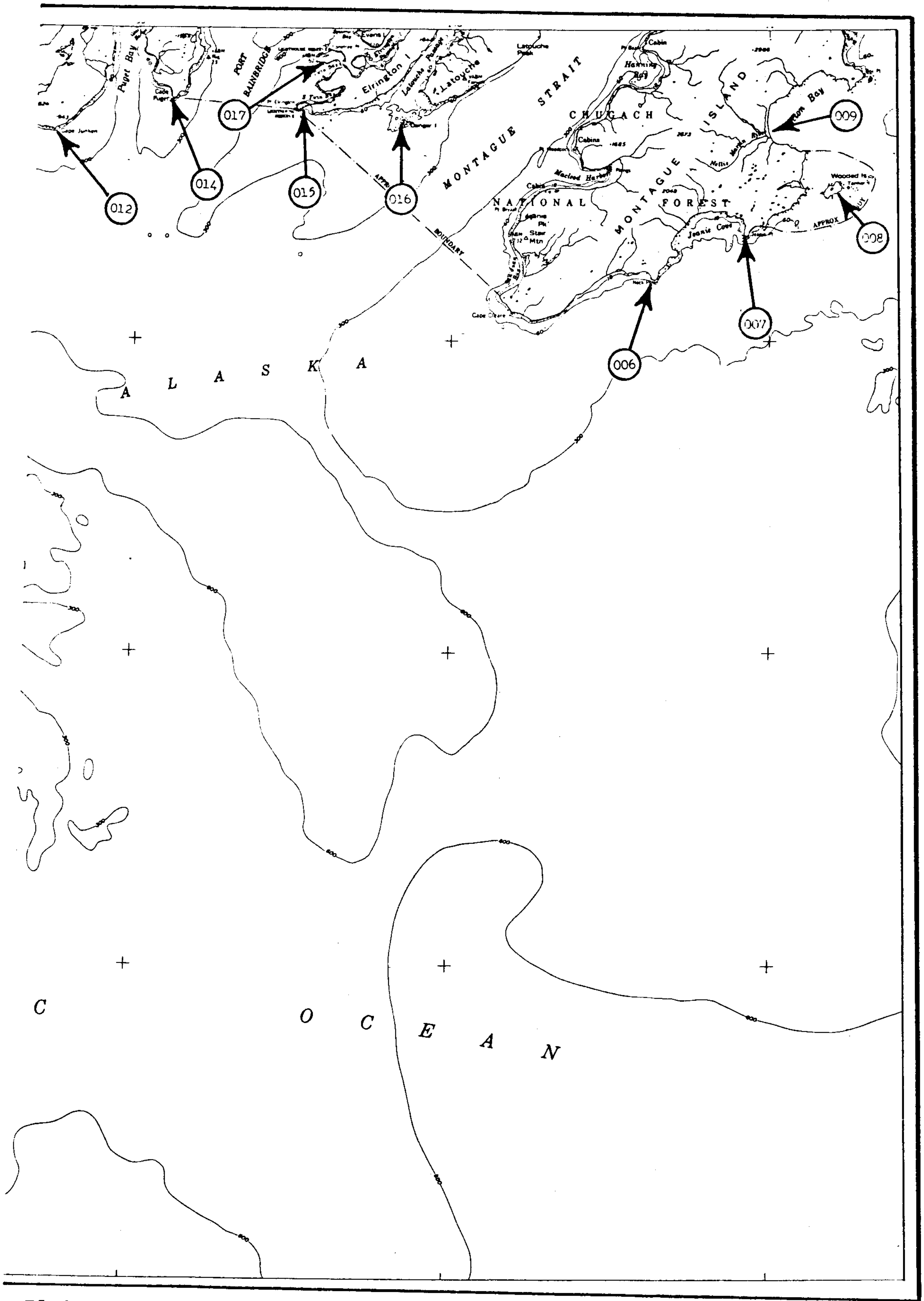
Map 24b. Comparative numbers of seabirds in colonies in



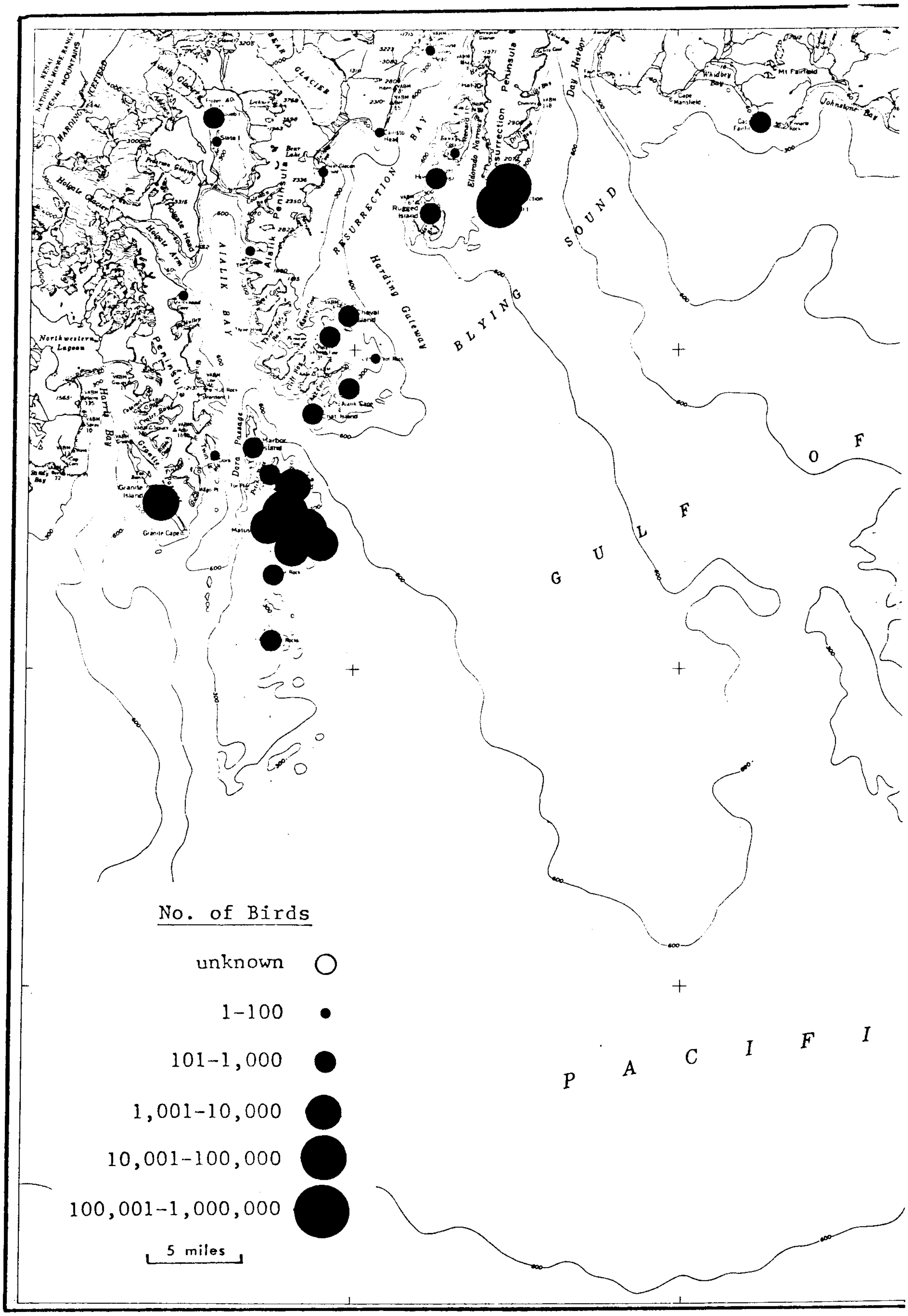
topographic area 024, Unimak.



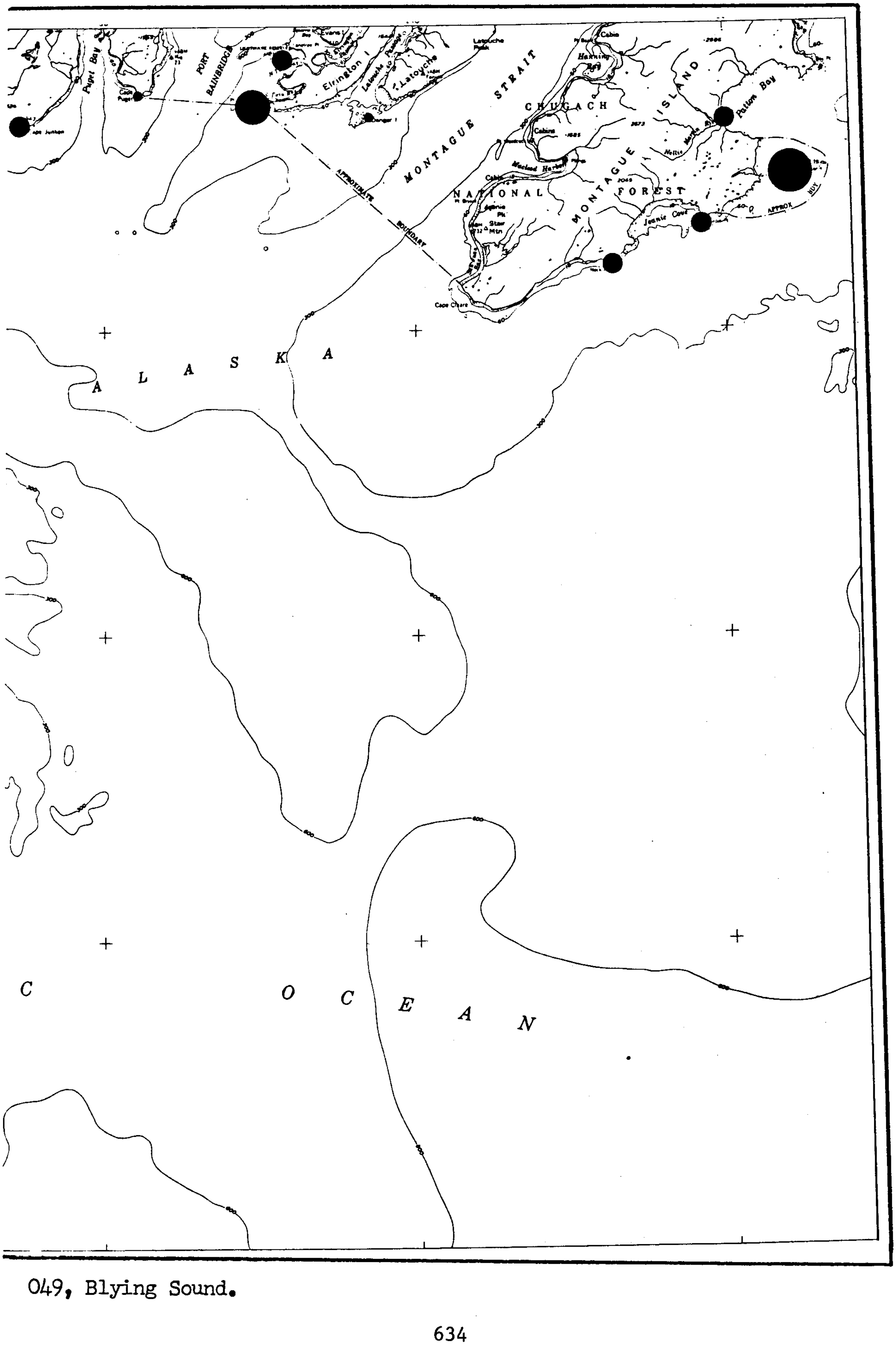
Map 49a. Known seabird colony areas in topographic area 049.



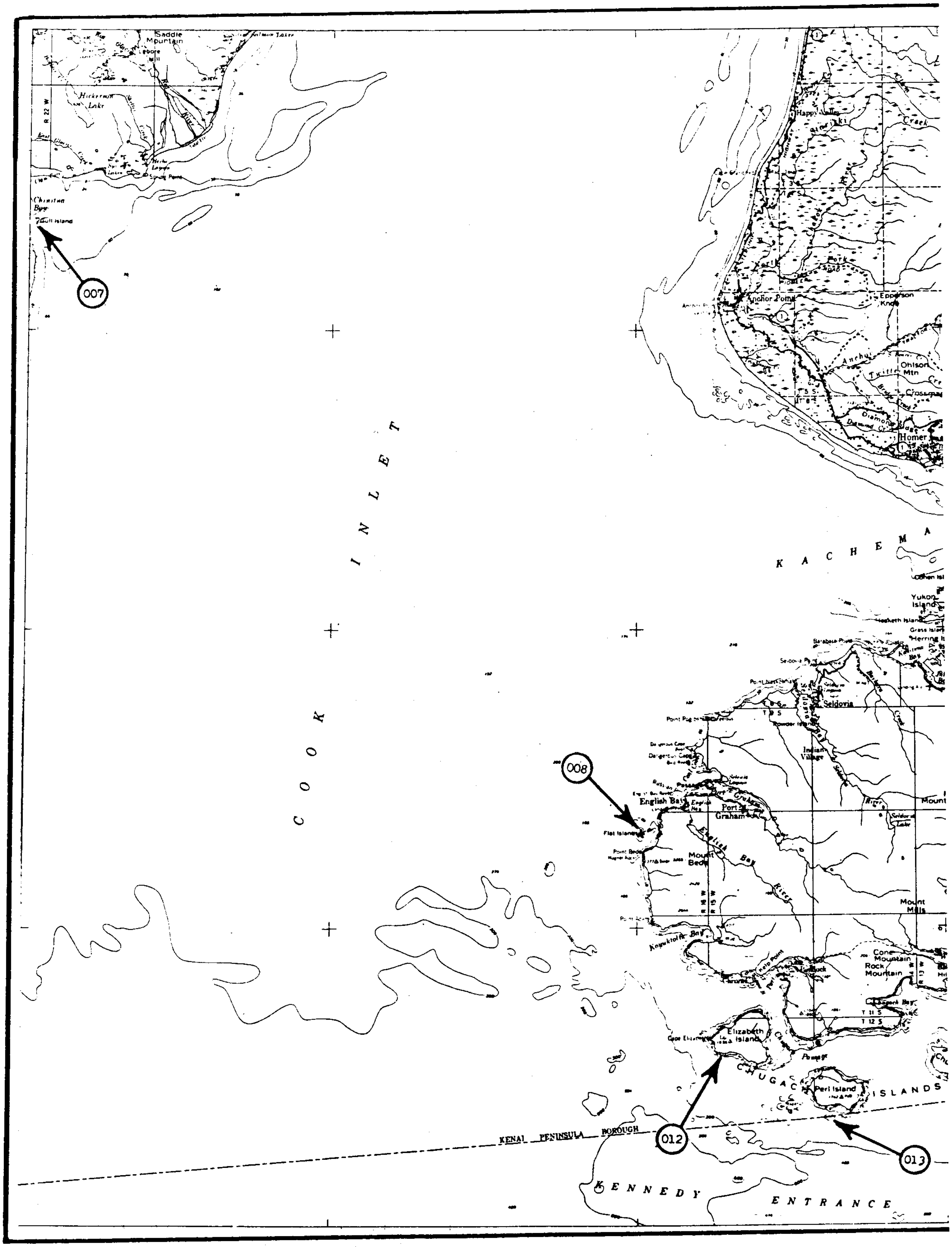
Blying Sound.



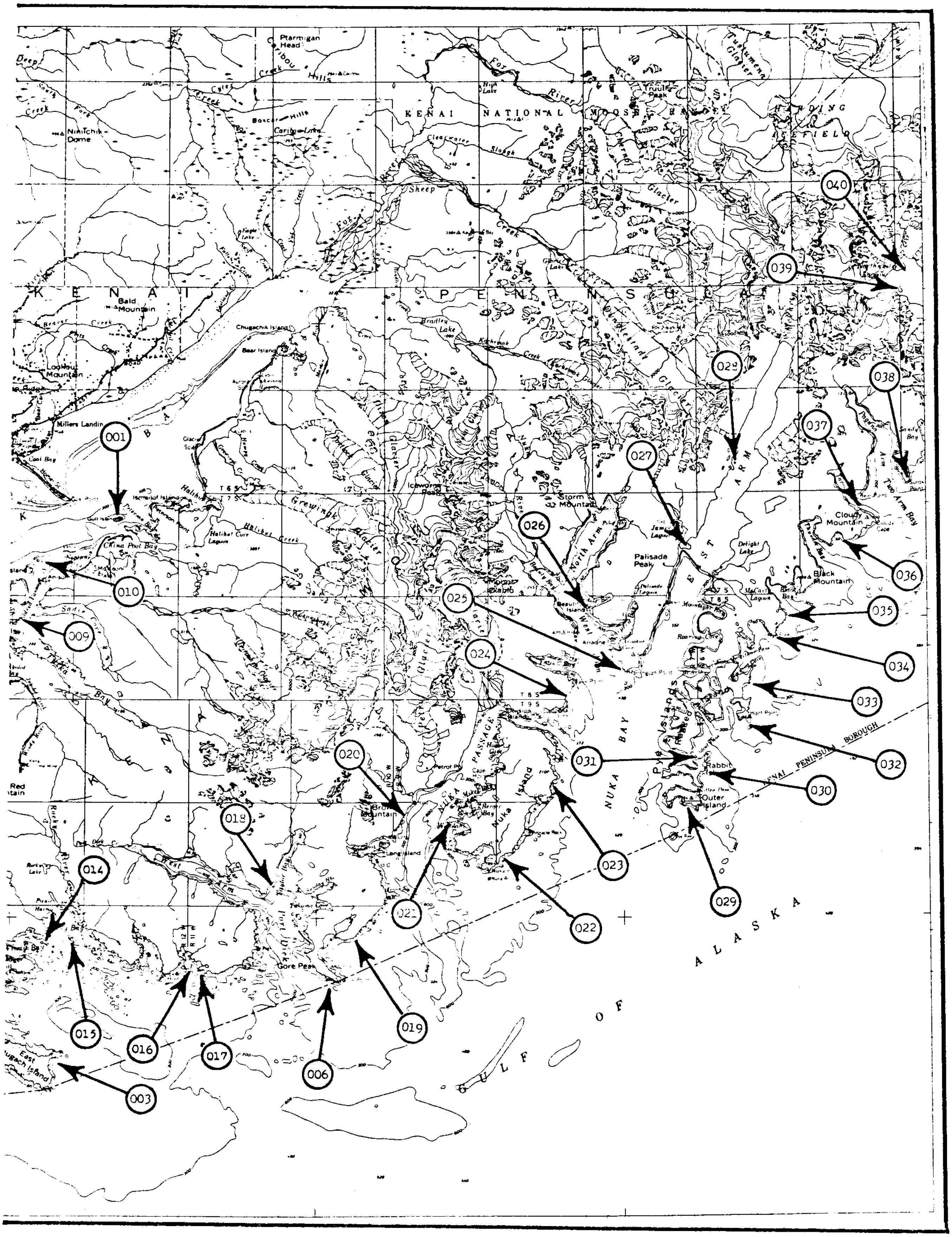
Map 49b. Comparative numbers of seabirds in colonies in topographic area



049, Blying Sound.



Map 50a: Known seabird colony areas in topographic area 050, Seldovia.


KENAI NATIONAL MOOSE RANGE
KENAI PENINSULA
HARDING ICE FIELD
Ptarmigan Head
Caribou Hills
Ninilchik Dome
Bald Mountain
Bradley Lake
Chugachik Island
Bear Island
Loghouse Mountain
Millers Landing
Truuli Peak
Tustumena Glacier
Grewingk Glacier
Halibut Creek
China Poot Bay
Halibut Cove Lagoon
Storm Mountain
Palisade Peak
North Arm
Beauty Island
Delight Lake
Cloudy Mountain
Two Arm Bay
Black Mountain
McCarty Lagoon
NUKA BAY
NUKA PASSAGE
Nuka Island
Pye Islands
Rabbit
Outer Island
Brown Mountain
Petrol Pt
Long Island
West Arm
Port Dick
Gore Peak
East Chugach Island
KENAI PENINSULA BOROUGH
GULF OF ALASKA
001
003
006
009
010
014
015
016
017
018
019
020
021
022
023
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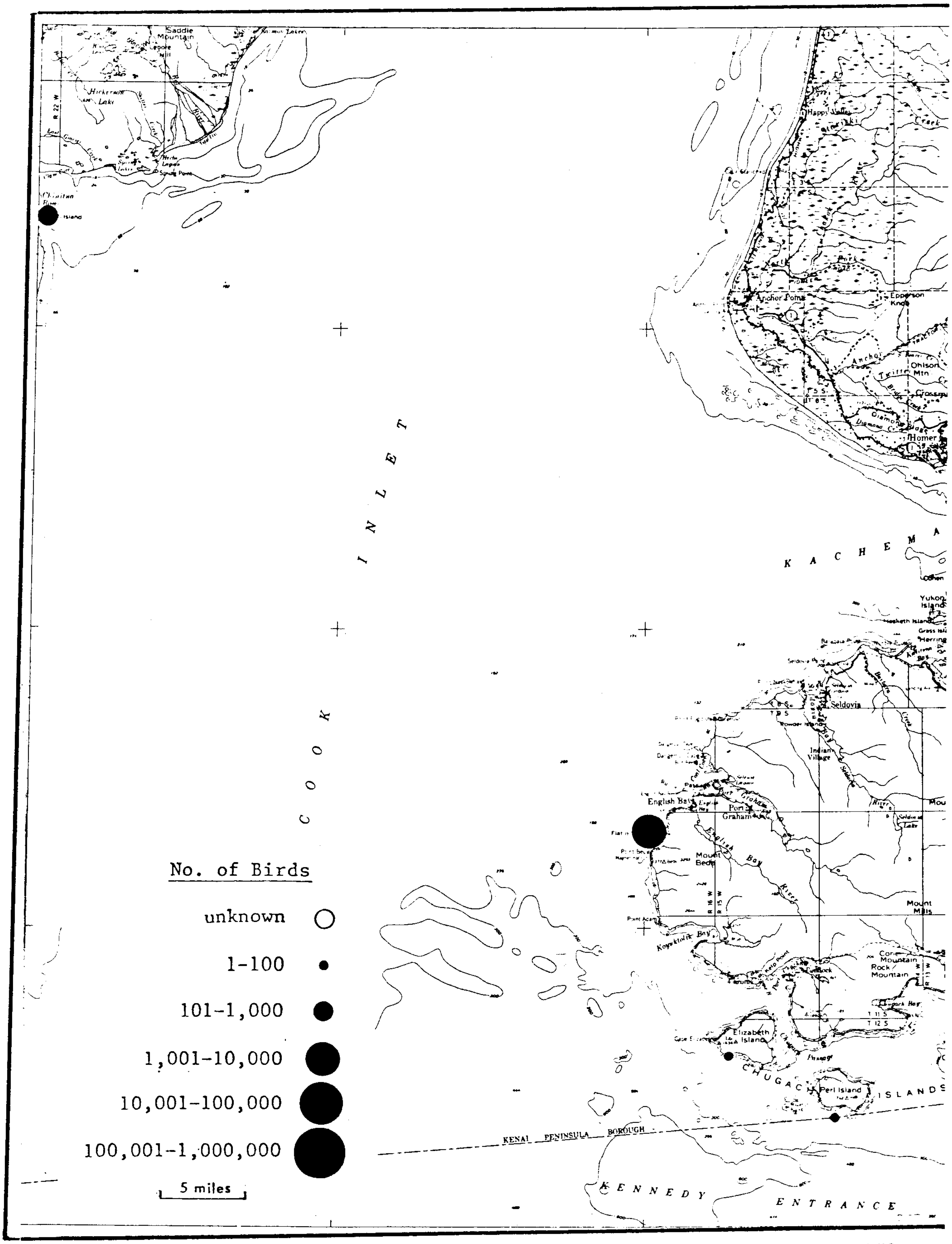
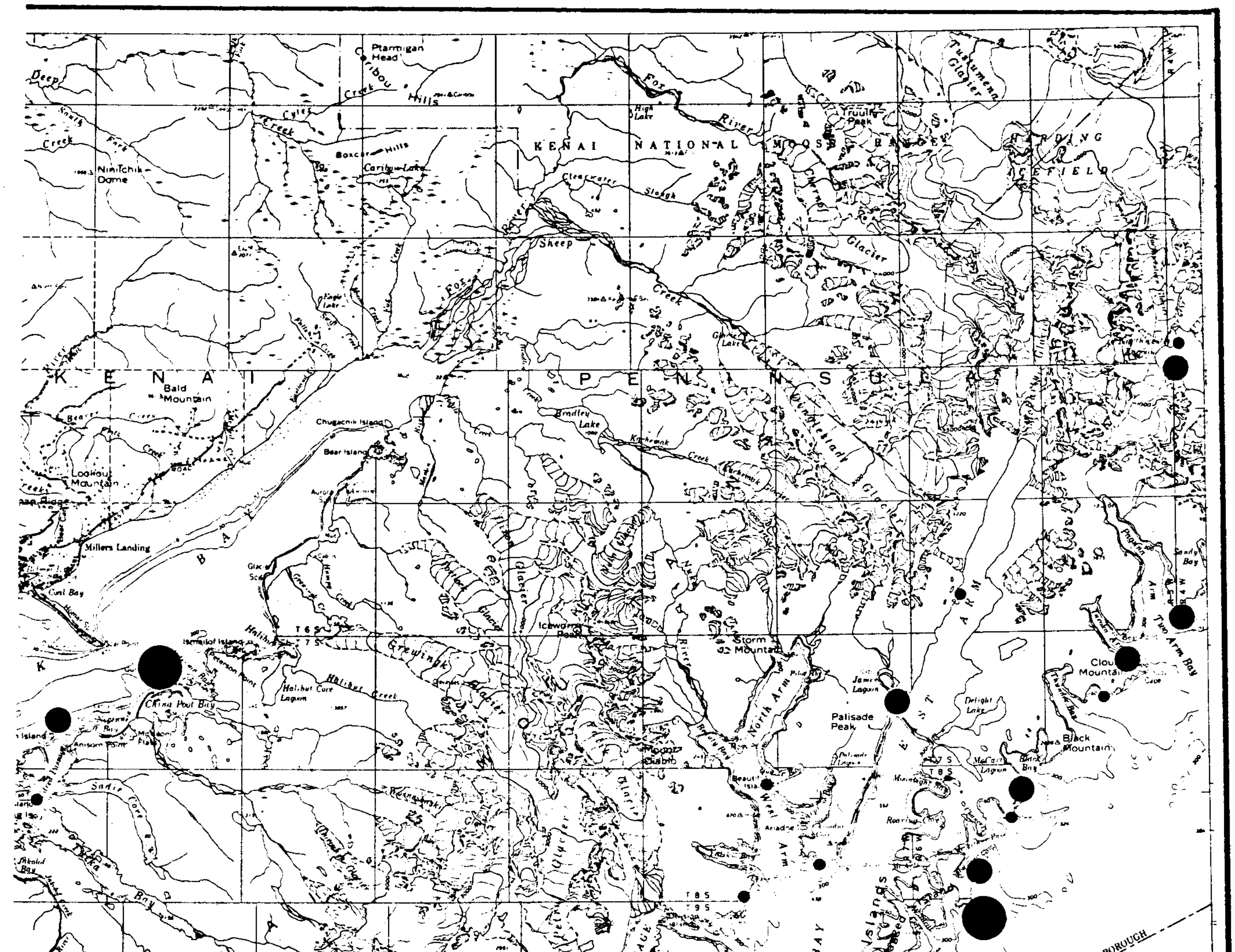
035
036
037
038
039
040



Map 50b: Comparative numbers of seabirds in colonies in topographic area 050,



Seldovia.

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